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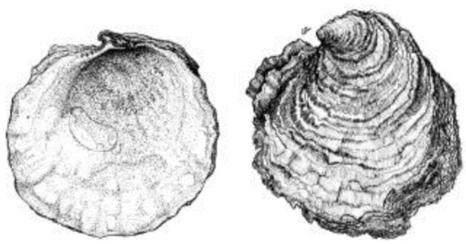
DFPO Mussel, Cockle and Oyster

Public Certification Report



October 2021

Conformity Assessment Body (CAB)	MRAG Americas, Inc.
Assessment team	Julian Addison and Chris Grieve
Fishery client	Danish Fishermen Producer Organisation (DFPO)
Assessment Type	First Reduced Reassessment

Document Control Record

Document Draft	Submitted By	Date	Reviewed By	Date
ACDR	JA, CG	5 July 2020	ASP	6 July 2020
CPRDR	JA, CG	4 May 2021	GP	05 May 2021
PCDR	JA, CG	10 August 2021	MC	16 August 2021
FDR	JA, CG	24 September 2021	CD	08 October 2021
PCR	JA, CG	18 October 2021	MC	20 October 2021

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2 Glossary

Abbreviation	Definition
AMBI	Marine Biotic Index
CA	Consequence Analysis
CAB	Conformity Assessment Body
CAP	Client Action Plan
CHLA	Chlorophyll a
CITES	Convention on International Trade in Endangered Species
CMS	Convention on Migratory Species
DFPO	Danish Fishermen Producer Organisation
DKI	Danish Quality Indicator
EAPO	European Association of Producers Organisations
EC	European Commission
EEZ	Exclusive Economic Zone
ETP	Endangered, Threatened and Protected Species
EU	European Union
FAO	Food and Agriculture Organisation (of the United Nations)
GLMM	Generalised Linear Mixed Models
GPS	Global Positioning System
ICES	International Council for the Exploration of the Sea
IDW	Inner Danish Waters
IUCN	International Union for Conservation of Nature
LRP	Limit Reference Point
LTL	Low Trophic Level
M-AMBI	Multivariate Marine Biotic Index
MCS	Monitoring, Control and Surveillance
MSC	Marine Stewardship Council
MSE	Management Strategy Evaluation

MSFD	Marine Strategy Framework Directive (EC)
PCR	Public Certification Report
PI	Performance Indicator
PSA	Productivity Susceptibility Analysis
RBF	Risk Based Framework
SAC	Special Area of Conservation
SAR	Swept Area Ratios
SPA	Special Protection Area
TAC	Total Allowable Catch
TRP	Target Reference Point
UoA	Unit of Assessment
UoC	Unit of Certification
VME	Vulnerable Marine Ecosystem
VMS	Vessel Monitoring System

3 Executive summary

3.1 Changes since previous assessment

This fishery reassessment covers four UoAs previously assessed and certified under three separate certificates. UoAs 1 and 2 covering mussels and cockles respectively in the Limfjord were previously certified in January 2016 under the DFPO Limfjord Mussel and Cockle Fishery MSC-F-31219 (MRAG-F_0050). UoA 3 covering oysters in the Limfjord was previously certified in May 2017 under the DFPO Limfjord oyster dredge fishery MSC-F-31306 (F-ACO-0066), and UoA 4 covering mussels in Danish inland waters was previously certified in May 2017 under the DFPO Inner Danish Waters blue shell mussel fishery MSC-F-31307 (MRAG-F-0065).

The Client, Danmarks Fiskeriforening Producent Organisation (Danish Fishermen Producer Organisation, DFPO), now wishes to bring all three certificates together under a single fishery certificate.

3.1.1 Principle 1

There have been no significant changes to the harvest strategy and stock status of any of the four fisheries since the previous assessments. The harvest strategy is underpinned by the Mussel and Oyster Policy which is a fisheries management framework covering mussel, cockle and oyster fishing in Natura 2000 areas and also guides the management of shellfish fishing beyond the boundaries of the Natura 2000 sites. The Mussel and Oyster Policy was developed through multi-stakeholder consultation and a revised edition was published in May 2019 (Udenrigsministeriet, 2019). However new information has become available from recent research studies on methods for estimation of stock abundance/biomass of cockles, and in the light of the issues highlighted in the recent studies, a condition has been raised against the cockle fishery in UoA 2.

3.1.2 Principle 2

Whilst there have been no significant changes to the likely impact of the four fisheries on wider ecosystem components since the previous assessments, this reassessment has been carried out under MSC Standard v2.01 for which the requirements for meeting Performance Indicators under the Habitat component have been strengthened, and the fisheries no longer meet the requirements for PIs 2.4.1 and 2.4.3.

3.1.3 Principle 3

There have been no significant changes to the management and governance of the fisheries since the previous assessments. As noted above, a revised edition of the Mussel and Oyster Policy was published in May 2019. A newspaper reported recently that there was evidence of systematic non-compliance in relation to EU engine power rules, including in the Danish fleet. Whilst there is no evidence of such non-compliance within the UoAs, an investigation of the allegations by the Danish authorities has yet to be completed and therefore a condition was raised against PI 3.2.3.

3.2 Reassessment

This Public Certification Report provides the certification decision and information on the reassessment of the DFPO mussel, cockle and oyster fishery against the Marine Stewardship Council (MSC) Fisheries Standard v2.01. The assessment was carried out using MSC Fisheries Certification Process v2.1. For the assessment, the default assessment tree in Annex SA from the MSC Fisheries Standard v2.01, without any changes, was used. The assessment covers four UoAs targeting the Limfjord mussel, cockle and oyster fisheries and the Inner Danish Waters mussel fishery. The Risk Based Framework (RBF) was used to score PI 1.1.1 for UoA 2 (Limfjord cockles), UoA 3 (Limfjord oysters) and UoA 4 (Inner Danish Waters mussels) and to score PI 2.2.1 for starfish as a main secondary species in UoA 2 (Limfjord cockles) and UoA 3 (Limfjord oysters).

Information on the assessment process was made publicly available through www.msc.org at all stages of the assessment. MRAG Americas, Inc. published the assessment announcement along with the Announcement Comment Draft Report and the timeline for the assessment on 9 July 2020 on the MSC website and followed by stakeholder notifications by direct emails. Relevant main stakeholders were interviewed at the remote site visit in August and September 2020. The site visit was held remotely as the MSC Covid-19 Derogation published on 20 March 2020 allowed CABs to conduct assessment site visits as off-site visits for the duration of the 6-month derogation period (27th March 2020 – 27th September 2020). A rigorous assessment of the MSC Principles and Criteria was undertaken by the assessment team and detailed and fully referenced scoring rationales are provided through the assessment tree scoring tables provided in this report. Four conditions against the UoAs were raised and three recommendations were made by the assessment team.

The Eligibility Date for this assessment is expected to be the date of publication of the Public Comment Draft Report (PCDR).

Client strengths:

- Regular stock assessments are conducted to evaluate stock status
- Comprehensive harvest strategies are in place
- There is minimal bycatch in the four fisheries
- The fishery is managed to ensure that marine ecosystem impacts are monitored and minimised, and there are no indications of significant cumulative impacts on the marine environment.
- There is strong governance through the Mussel and Oyster Policy
- Co-management is a strong component of the management and governance, and all vessels must sign up to the Client's Code of Conduct.
- Compliance in all four fisheries is considered to be high by management, enforcement and industry representatives.

Client weaknesses

- Stock abundance/biomass of cockles is not monitored regularly and accurately
- For biogenic reefs, there is not sufficient evidence to demonstrate that the UoAs are highly unlikely to reduce structure and function of the VME to a point where there would be serious or irreversible harm.
- The nature, distribution and vulnerability of biogenic reefs in the UoA areas are not known at a level of detail relevant to the scale and intensity of the UoAs.
- Allegations about systematic non-compliance in relation to EU engine power rules have not been fully investigated.

4 Report details

4.1 Authorship and peer review details

4.1.1 Assessment Team

Julian Addison – Team Leader and Principle 1 and Principle 2 expert

Dr Julian Addison is an independent fisheries consultant with over 30 years' experience of stock assessment and provision of management advice on shellfish fisheries, and a background of scientific research on shellfish biology and population dynamics and inshore fisheries. Until December 2010 he worked at the Centre for Environment, Fisheries and Aquaculture Science (Cefas) in Lowestoft, England where he was Senior Shellfish Advisor to Government policy makers, which involved working closely with marine managers, legislators and stakeholders, Government Statutory Nature Conservation Organisations and environmental NGOs. He has also worked as a visiting scientist at DFO in Halifax, Nova Scotia and at NMFS in Woods Hole, Massachusetts where he experienced shellfish management approaches in North America. For four years he was a member of the Scientific Committee and the UK delegation to the International Whaling Commission providing scientific advice to the UK Commissioner. He has worked extensively with ICES and most recently was Chair of the Working Group on the Biology and Life History of Crabs, a member of the Working Group on Crangon Fisheries and Life History and a member of the Steering Group on Ecosystems Function. He has extensive experience of the MSC certification process primarily as a P1 team member but also as a P2 team member and team leader. He has undertaken over 30 MSC full assessments of crustacean and mollusc fisheries worldwide which use a wide range of stock assessment methodologies and fishing gears. He has also undertaken MSC pre-assessments in Europe, North America and Australia and over 60 annual surveillance audits and technical reviews. He is a member of the MSC Peer Review College and has carried out peer reviews of MSC assessments worldwide of a wide range of fish and shellfish fisheries. Other recent work includes a review of the stock assessment model for blue crabs in Chesapeake Bay, USA, and an assessment of three Alaskan crab fisheries under the FAO-based Responsible Fisheries Management scheme.

MRAG Americas confirms that Dr. Addison meets the competency criteria in Annex PC for team leader as follows:

• He has an appropriate university degree and more than five years' experience in management and research in fisheries;
• He has passed the MSC team leader training;

• He has the required competencies described in Table PC1, section 2;
• He has passed the MSC Traceability training module;
• He meets ISO 19011 training requirements;
• He has undertaken two fishery assessments as a team member in the last five years, and
• He has experience in applying different types of interviewing and facilitation techniques and is able to effectively communicate with clients and other stakeholders.

In addition, he has the appropriate skills and experience required to serve as a Principle 1 and Principle 2 assessor as described in FCP Annex PC table PC3.

MRAG Americas confirms that Dr. Addison has no conflicts of interest in relation to the fishery under assessment.

Chris Grieve – Principle 2 and Principle 3 expert

Chris Grieve has 25+ years' experience in fisheries management and policy-making from local to global levels. First as research assistant to Australian stock assessment scientists, then the manager of complex Australian demersal trawl and dredge fisheries. She moved to the UK in 2000 to lead the Sustainable Fisheries Policy Research Programme for a London-based think tank where the mission was influencing change in the EU's Common Fisheries Policy. In 2002, Chris became International Policy Director for the Marine Stewardship Council (MSC) to lead MSC's work on standards, certification and accreditation, governing bodies and developing world fisheries. Chris's role evolved to become Associate Director between 2005 and 2010 after she established Meridian Prime as a consulting company with a diverse portfolio of work. Chris led and participated in work on the development, evolution and implementation of the MSC standard and certification requirements. She has also led and participated in sustainable fisheries-related projects for client organisations in the UK, across Europe and the USA. Chris has been team member on fishery assessments under the MSC certification scheme; and is an approved independent peer reviewer for MSC's Peer Reviewer College. On a consultancy basis, Chris is Executive Director Standards & Impacts of the EDGE Certified Foundation: a Swiss-based, global certification scheme pursuing gender equality in Fortune 500 companies. Chris served until recently as a Board Director for WOCAN (an international non-profit focusing on gender equality in natural resource management in the global south) and was on the founding Advisory Board of Ocean Outcomes (a US-based non-profit focusing on sustainable fisheries). Chris was a founding Trustee and Vice Chair of the ISEAL Alliance, the global sustainability standards organization; and a statutory-appointed member of two Australian fisheries management public boards.

MRAG Americas confirms that Ms. Grieve meets the competency criteria in Annex PC for team members as follows:

- She has an appropriate university degree and more than five years' experience in management and research in fisheries;
- She has undertaken at least two MSC fishery assessments or surveillance site visits in the last five years;
- She is able to score a fishery using the default assessment tree and describe how conditions are set and monitored.

In addition, she has the appropriate skills and experience required to serve as a Principle 2 and Principle 3 assessor as described in FCP Annex PC table PC3, and MRAG Americas confirms she has no conflicts of interest in relation to the fishery under assessment.

The whole assessment team collectively meets the requirements as described in FCP Annex PC table PC3.

A discussion between team members regarding conflict of interest and biases was held and none were identified.

4.1.2 Peer reviewers

As there was only one peer reviewer in this case, for anonymity, they will not be identified. A summary CV for the peer reviewer shortlist is available in the Assessment downloads section of the fishery's entry on the MSC website.

4.2 RBF Training

Julian Addison has completed the MSC Risk Based Framework (RBF) v2.0 training in the last 3 years.

4.3 Version details

Table 1. Fisheries program documents versions

Document	Version number
MSC Fisheries Certification Process	**Version 2.1**
MSC Fisheries Standard	**Version 2.01**
MSC General Certification Requirements	**Version 2.4.1**
MSC Reporting Template	**Version 2.01**

5 Unit(s) of Assessment and Certification and results overview

5.1 Unit(s) of Assessment and Unit(s) of Certification

5.1.1 Unit(s) of Assessment

MRAG Americas, Inc. confirms that all UoAs within the fishery under assessment are within the scope of the MSC Fisheries Standard (MSC Fisheries Certification Process v2.1, Section 7.4):

- The target species are not amphibians, reptiles, birds or mammals.
- The fishery does not use poisons or explosives.
- The fishery is not conducted under a controversial unilateral exemption to an international agreement.
- The client or client group does not include an entity that has been successfully prosecuted for a forced or child labour violation in the last 2 years.
- The fishery has in place a mechanism for resolving disputes, and disputes do not overwhelm the fishery.
- The fishery is not an introduced species-based fishery as per the MSC FCP 7.4.7. All three target species are native to the waters being assessed and as such do not constitute ISBF fisheries.

In relation to enhanced bivalve fisheries, the cockle (UoA 2) and oyster (UoA 3) fisheries are not enhanced fisheries as per MSC FCP 7.4.6 because these UoAs are not subject to any enhancing activities. However, mussels below commercial size are dredged and then relayed in the Limfjord (UoA 1) and in the Inner Danish Waters (UoA 4) fisheries. The assessment team considered whether such relaying activities should be treated as an enhanced bivalve fishery under MSC FCP v2.1, 7.4.6, Table 1. UoAs 1 and 4 are not conventional enhanced mussel fisheries where seed mussels are dredged and moved, sometimes long distances, on to (often) private mussel plots and then grown on to commercial sizes. In the Limfjord (UoA 1) the Foreningen Muslingeerhvervet's vessel LImfjorden is used to undertake surveys of mussel distribution and abundance to inform the whole fleet, and this is the only vessel that is permitted to harvest mussels for relaying that are under the minimum landing size of 50mm. The purpose of the relaying is to move mussels under the minimum size from areas where oxygen depletion events are common to other areas with better growth conditions within the same basin in order to increase the survival chances of the relayed mussels. Foreningen Muslingeerhvervet and the Client report that 10,000 tonnes of relayed mussels would be re-harvested at a weight of 20,000 tonnes, which is a relatively small increase in size/weight in comparison with conventional enhanced mussel fisheries where relayed seed mussels would be re-harvested at many times their original weight when they reach commercial size. Within the Inner Danish Waters mussel fishery (UoA 4) where two vessels are licensed for relaying mussels, sub-commercial sized mussels are relayed for similar reasons and in a similar manner.

The assessment team explored the scoring implications if the two mussel fishery UoAs were considered as enhanced bivalve fisheries. The key considerations are whether the fishery involves translocations, and if not, whether the fishery negatively impacts on the parent stock. As mussels are moved only within a basin, then it can be concluded that translocation does not occur, and therefore there would be no requirement to score any enhanced fishery under the genetics outcome PI 1.1.3 or under the translocation PIs 2.6.1, 2.6.2 and 2.6.3 as set out in Annex SB of the MSC Fisheries Standard v2.01. As the relaying process in UoAs 1 and 4 is designed to enhance the growth potential of relayed mussels, the assessment team concluded that the relaying process is highly likely to positively, and not negatively, impact the stock. Annex SB 2.1.4 states that if the fishery does not negatively impact the stock, then the assessment team may choose not to score Principle 1. As the main component of the mussel fisheries in UoAs 1 and 4 is the wild fishery, the assessment team considered that it was essential to score Principle 1. Within Natura 2000 sites, the area impact of the fishery includes an evaluation of any mussels harvested for relaying. In conclusion classifying the two UoAs as enhanced bivalve fisheries would not require any additional PIs to be scored and could result in Principle 1 not being scored for some components of the fishery, and therefore the assessment team concluded that using the default assessment tree for UoAs 1 and 4 provides a more comprehensive evaluation of the potential impact of the fisheries on the mussel populations than if the fisheries were designated as enhanced bivalve fisheries.

MRAG Americas, Inc. confirms that the client has completed and submitted the 'Certificate Holder Forced and Child Labour Policies, Practices and Measures' template prior to the start of this assessment.

The proposed Units of Assessment (UoAs) are given in Table 2. The 4 UoAs described below were previously assessed under 3 separate certificates. MRAG Americas, Inc. confirms that there have been no changes to any of the UoAs since the previous assessments.

Table 2. Units of Assessment (UoAs)

UoA 1	Description
Species	Blue mussels, *Mytilus edulis*
Stock	Limfjord, Northern Denmark (Shellfish Production Areas 1 - 42)
Geographical area	Limfjord
Harvest method / gear	Mussel dredge
Client group	All DFPO mussel dredge vessels targeting mussels in the Limfjord who have signed the DFPO Code of Conduct
Other eligible fishers	Vessels that join DFPO in the future.
UoA 2	Description
Species	Cockles, *Cerastoderma edule*
Stock	Limfjord, Northern Denmark
Geographical area	Limfjord
Harvest method / gear	Mussel dredge modified to catch cockles
Client group	All DFPO mussel dredge vessels targeting mussels in the Limfjord who have signed the DFPO Code of Conduct
Other eligible fishers	Vessels that join DFPO in the future
UoA 3	Description
Species	European flat oyster, *Ostrea edulis*
Stock	Limfjord, Northern Denmark

Geographical area	Limfjord
Harvest method / gear	Oyster dredge
Client group	All DFPO oyster dredge vessels targeting oysters in the Limfjord who have signed the DFPO Code of Conduct
Other eligible fishers	Vessels that join DFPO in the future
UoA 4	Description
Species	Blue mussels, *Mytilus edulis*
Stock	*Mytilus edulis* in ICES Division IIIa and Baltic Sea Area 22 (Southern Kattegat and the Baltic Sea are part of ICES Sub-Area IIIa and FAO Statistical Area 27)
Geographical area	Danish inland waters
Harvest method / gear	Mussel dredge
Client group	All DFPO mussel dredge vessels targeting mussels in the Inner Danish Waters that have signed the DFPO Code of Conduct
Other eligible fishers	Vessels that join DFPO in the future

5.1.2 Unit(s) of Certification

Table 3. Units of Certification (UoCs)

UoC 1	Description
Species	Blue mussels, *Mytilus edulis*
Stock	Limfjord, Northern Denmark (Shellfish Production Areas 1 - 42)
Geographical area	Limfjord
Harvest method / gear	Mussel dredge
Client group	All DFPO mussel dredge vessels targeting mussels in the Limfjord who have signed the DFPO Code of Conduct
Other eligible fishers	Vessels that join DFPO in the future.
UoC 2	Description
Species	Cockles, *Cerastoderma edule*
Stock	Limfjord, Northern Denmark
Geographical area	Limfjord

Harvest method / gear	Mussel dredge modified to catch cockles.
Client group	All DFPO mussel dredge vessels targeting mussels in the Limfjord who have signed the DFPO Code of Conduct
Other eligible fishers	Vessels that join DFPO in the future.
UoC 3	Description
Species	European flat oyster, *Ostrea edulis*
Stock	Limfjord, Northern Denmark
Geographical area	Limfjord
Harvest method / gear	Oyster dredge
Client group	DFPO oyster dredge vessels targeting oysters in the Limfjord who have signed the DFPO Code of Conduct
Other eligible fishers	Vessels that join DFPO in the future.
UoC 4	Description
Species	Blue mussels, *Mytilus edulis*
Stock	*Mytilus edulis* in ICES Division IIIa and Baltic Sea Area 22 (Southern Kattegat and the Baltic Sea are part of ICES Sub-Area IIIa and FAO Statistical Area 27)
Geographical area	Danish inland waters
Harvest method / gear	Mussel dredge
Client group	All DFPO mussel dredge vessels targeting mussels in the Limfjord who have signed the DFPO Code of Conduct
Other eligible fishers	Vessels that join DFPO in the future.

5.2 Assessment results overview

5.2.1 Determination, formal conclusion and agreement

As the fishery is in scope for MSC certification and achieves at last a 60 score for each Performance indicator, and at least an 80 score for each Principle, following client, peer, and public review, MRAG Americas has decided to certify it as sustainable according to the MSC Fisheries Standard.

5.2.2 Principle level scores

Table 4 – Principle level scores

Principle	UoA 1	UoA 2	UoA 3	UoA 4
Principle 1 – Target species	85.8	81.2	83.3	87.2
Principle 2 – Ecosystem impacts	86.7	86.7	86.7	86.7
Principle 3 – Management system	92.1	92.1	92.1	92.1

5.2.3 Summary of conditions

Table 5 - Summary of conditions

Condition number	Condition	Performance Indicator (PI)	Related to previous condition?
1	UoA 2 only Stock abundance needs to be regularly monitored at a level of accuracy and coverage consistent with the harvest strategy.	1.2.3	**No**
2	All UoAs For biogenic reefs, evidence is required to demonstrate that the UoAs are highly unlikely to reduce structure and function of the VME to a point where there would be serious or irreversible harm.	2.4.1	**No**
3	All UoAs Evidence is required that the nature, distribution and vulnerability of biogenic reefs in the UoA areas are known at a level of detail relevant to the scale and intensity of the UoAs.	2.4.3	**No**
4	All UoAs Evidence is required that there is no systematic non-compliance in relation to Danish engine power rules.	3.2.3	**No**

5.2.4 Recommendations

The following three recommendations were made by the assessment team:

PI 1.2.4 UoA 1 Limfjord Mussels
The assessment team recommends that the new methodology for assessing mussel stock biomass estimates should undergo peer review.

PI 2.1.3 and PI 2.2.3 All UoAs
The assessment team recommends that up-to-date information on the bycatch of primary and secondary species is collected for all UoAs.

PI 2.5.3 All UoAs
To improve ecological monitoring, particularly of benthic fauna, it is recommended that standardised indicators and a bottom fauna index are developed that are sensitive to localised effects and fishing in coastal waters; and that small reference sites are conserved (from fishing) within the UoAs to provide control areas for comparison with fished areas.

6 Traceability and eligibility

6.1 Eligibility date

The eligibility date for this fishery is the date of the PCDR publication, 18 August 2021. This means that any fish caught by the certified fleet following that date is eligible to enter the chain of custody as certified product when certification is granted. The rationale for this date is that it meets with the client's wishes, for commercial reasons, for the date to be set at the earliest point at which the Certification Requirements allow. As this is a recertification process of previously certified fisheries, traceability and segregation systems are already in place for the mussels, cockles and oysters that they catch.

6.2 Traceability within the fishery

Table 6. Traceability within the fishery

Factor	Description
Will the fishery use gears that are not part of the Unit of Certification (UoC)? If Yes, please describe: - If this may occur on the same trip, on the same vessels, or during the same season; - How any risks are mitigated.	*The fisheries do not use gears that are not part of the respective UoCs. Vessels are permitted to carry only one type of gear on board. Any vessel fishing in the designated production areas needs a fishing license provided by the Ministry, and all vessels holding a fishing license are included in the UoCs. Inspections of landings ensure good compliance with this requirement. The risk is therefore very low.*
Will vessels in the UoC also fish outside the UoC geographic area? If Yes, please describe: - If this may occur on the same trip; - How any risks are mitigated.	*UoC vessels will not fish outside the geographic areas of the respective UoCs. In addition, full compliance is ensured because all vessels targeting mussels, cockles and oysters within the various UoCs are obliged to carry on board the black box, which informs the Danish Fisheries Agency, in real time every 10 seconds, on where the vessels are and if they are deploying the fishing gear or not. Data on position and activity of the fishing vessels are recorded in the Fisheries Agency database. The risk of fishing outside the UoC resulting in non-UoC product entering the supply chain is therefore very low.*
Do the fishery client members ever handle certified and non-certified products during any of the activities covered by the fishery certificate? This refers to both at-sea activities and on-land activities. - Transport - Storage - Processing - Landing - Auction If Yes, please describe how any risks are mitigated.	*Mussels, cockles and oysters can only be landed at authorized landing ports where the auction takes place. Ports and catch are subject to random inspections by enforcement bodies. All shellfish landed at auction sites will come from certified vessels. Catches are transported directly from the quayside to buyers' premises. There is no processing of the catch at sea or before subsequent chain of custody. The fishery client members do not handle certified and non-certified products at any stage in the fishing process from capture through sale following landing. Catches of shellfish by fishing vessels are reported and reconciled with landings records and processor records of purchases and sales. The risk of non-certified shellfish entering the supply chain during storage, transport and handling prior to sale is very low.*
Does transhipment occur within the fishery? If Yes, please describe: - If transhipment takes place at-sea, in port, or both; - If the transhipment vessel may handle product from outside the UoC; - How any risks are mitigated.	*Transhipment does not occur within any of the UoCs.*

Are there any other risks of mixing or substitution between certified and non-certified fish? If Yes, please describe how any risks are mitigated.	*The fishery takes place at designated production areas, all of which require a fishing license which enables vessels to fish and to stay in the area. The UoCs cover all vessels holding fishing licenses; therefore, the risk for vessels from outside the UoCs fishing the same stock is very low. No other fishing vessels are permitted to fish for mussels, cockles or oysters in the respective UoCs. In addition all Danish fishing vessels carry VMS on board, which serves to monitor fishing activities of all Danish fishing vessels. The risk of vessels outside the UoC fishing for this stock is therefore low. The assessment team is not aware of any other risks of mixing or substitution between certified and non-certified shellfish.*

Tracking and tracing systems

The catching and landing of certified mussels, cockles and oysters in the four UoCs is tightly controlled through a robust tracking and tracing system. All DFPO vessels which catch and land certified shellfish must be licensed and must carry a black box system which records position and whether or not the vessel is fishing every 10 seconds. Continuous monitoring of records from the black box system ensure that vessels within the certificate fish only in the areas covered by the UoCs. Vessels must 'hail-in' prior to landing allowing enforcement officers to be present at the landing. Vessels must submit landing records. Following sale at the auction, all shellfish must be labelled with the name of the vessel, and buyers must issue sales notes to each vessel, which are copied to the management authorities. Sales notes are cross-checked with vessel's fishing positions, log book records and landings declarations to ensure that all landings from the UoCs are correctly recorded. No fishing vessels other than DFPO vessels which have signed the DFPO Code of Conduct are permitted to fish for mussels, cockles or oysters in the respective UoCs.

There is a high degree of confidence that all the fishing activity carried out by the vessels under assessment is tracked and recorded by cross-referenced and verifiable mechanisms so that all products entering further Chains of Custody can be directly traced back to the UoCs.

6.3 Eligibility to enter further chains of custody

Eligibility to enter further certified chains of custody

Tracking and traceability information for the fisheries covered by the four UoCs is considered sufficient for product to be eligible to enter further chains of custody, and to be sold as MSC certified.

Parties eligible to use the fishery certificates

The only party eligible to use the fishery certificate is the client (DFPO) and the vessels nominated by DFPO.

Eligible points of landing

Shellfish are only landed by the fleet at the ports described below, where they are subject to random inspections. Vessels have to 'hail in' prior to landing to facilitate inspection and monitoring of catches. Landings are declared and cross-referenced to sales notes. There is therefore a very low risk of MSC and non-MSC product becoming mixed at the point of landing.

Eligible ports of landing for UoCs 1, 2 & 3 in the Limfjord are given below in Table 7 and vessels fishing for mussels in the Inner Danish Waters (UoC 4) land at the following ports - Vejle, Aabenraa, Horsens, Oddesund, Aarhus, Hou, Snaptun, Bogense, Juelsminde, Skaerbaek, Soenderborg, Augustenborg, Faaborg, Assens, Odense, Kerteminde, Ebeltoft, Årøsund, Egernsund, Holbæk and Hundested.

Table 7. Designated landing ports in the Limfjord for UoCs 1, 2 & 3.

Code	Harbour
13015	Rønbjerg Havn
13024	Ålborg Havn
13025	Løgstor Havn
13026	Nibe Havn
13030	Gjøl Havn
14014	Sundstrup Havn
22011	Lemvig Havn
22012	Struer Havn
25001	Jegindø Havn
25010	Øst Vilsund Havn
25012	Sillersley Havn
25014	Nykøbing Havn
25015	Limfjordskompagniet
25016	Fur Havn
25028	Glyngøre Havn
25029	Branden Havn
25034	Skive Havn
25035	Hvalpsund Havn
27019	Oddesund Havn
27028	Agger Havn
27030	Amtoft Havn
27033	Thisted Havn
27034	Vest Vilsund Havn

Point of change of ownership from which Chain of Custody certification is required

The point of change of ownership for product from the fishery will be acceptance of shellfish by customers into their own storage and processing facilities. All merchants and processors wishing to sell MSC certified shellfish that have been purchased from this fishery will therefore require their own Chain of Custody certification.

6.4 Eligibility of Inseparable or Practicably Inseparable (IPI) stock(s) to enter further chains of custody

There are no Inseparable or Practically Inseparable (IPI) stocks in any of the UoAs.

7 Scoring

7.1 Summary of Performance Indicator level scores

Principle	Component	Performance Indicator (PI)		UoA Score			
				1	2	3	4
1	Outcome	1.1.1	Stock status	90	86	85	99
		1.1.2	Stock rebuilding	NA	NA	NA	NA
	Management	1.2.1	Harvest strategy	85	80	85	80
		1.2.2	Harvest control rules & tools	85	80	85	85
		1.2.3	Information & monitoring	80	75	80	80
		1.2.4	Assessment of stock status	85	80	80	80
2	Primary species	2.1.1	Outcome	100	100	100	100
		2.1.2	Management	90	90	90	90
		2.1.3	Information	90	90	90	90
	Secondary species	2.2.1	Outcome	80	80	80	80
		2.2.2	Management	90	90	90	90
		2.2.3	Information	80	80	80	80
	ETP species	2.3.1	Outcome	90	90	90	90
		2.3.2	Management	95	95	95	95
		2.3.3	Information	80	80	80	80
	Habitats	2.4.1	Outcome	75	75	75	75
		2.4.2	Management	95	95	95	95
		2.4.3	Information	75	75	75	75
	Ecosystem	2.5.1	Outcome	90	90	90	90
		2.5.2	Management	85	85	85	85
		2.5.3	Information	85	85	85	85
3	Governance and policy	3.1.1	Legal & customary framework	100			
		3.1.2	Consultation, roles & responsibilities	100			
		3.1.3	Long term objectives	90			
	Fishery specific management system	3.2.1	Fishery specific objectives	90			
		3.2.2	Decision making processes	95			
		3.2.3	Compliance & enforcement	75			
		3.2.4	Monitoring & management performance evaluation	90			

7.2 Fishery overview

This fishery reassessment covers four UoAs previously assessed and certified under three separate certificates. UoAs 1 and 2 covering mussels and cockles respectively in the Limfjord were previously certified in January 2016 under the DFPO Limfjord Mussel and Cockle Fishery MSC-F-31219 (MRAG-F-0050). UoA 3 covering oysters in the Limfjord was previously certified in May 2017 under the DFPO Limfjord oyster dredge fishery MSC-F-31306 (F-ACO-0066), and UoA 4 covering mussels in Danish inland waters was previously certified in May 2017 under the DFPO Inner Danish Waters blue shell mussel fishery MSC-F-31307 (MRAG-F-0065).

The Client, Danmarks Fiskeriforening Producent Organisation (Danish Fishermen Producer Organisation, DFPO), now wishes to bring all three certificates together under a single fishery certificate.

7.2.1 The Client, DFPO

DFPO is the main representative body for all the local fishermen's associations in Denmark. The DFPO was formed in May 2014 when the Danish Fishermen's Association (Danmarks Fiskeriforening) merged with the previous DFPO. The DFPO is based near the town of Fredericia in East Jutland, Denmark. All active Danish vessels are eligible for membership of the DFPO.

DFPO represents its members on a number of committees under the Danish Ministry for Environment and Food and liaises closely with the Danish Fisheries Agency (Fiskeristyrelsen) which is responsible for operational management of fisheries. DFPO is also a member of the EAPO (European Association of Producers Organisations). Unlike some other European Producer Organizations, the DFPO do not play any role in holding vessel quota, monitoring uptake or undertaking quota trading.

DFPO plays a leading role in the MSC certification of a wide range of Danish finfish and shellfish fisheries. Over 80% of all fish caught by Danish fishers today come from MSC certified fisheries. DFPO members are required to comply with the DFPO Code of Conduct and all vessels which sign up for participation in DFPO MSC certificates are required to comply with this code. Vessels that do not comply with the code are subject to sanctions, including removal from the list of vessels on the relevant MSC certificate.

7.2.2 Geographical areas of the fishery

The shellfish fisheries covered by the UoAs in this reassessment cover a wide geographical area within Danish waters (Figure 1). The mussel, cockle and oyster fisheries described by UoAs 1, 2 and 3 respectively are located in the Limfjord on the northwest coast of Jutland, whereas the Inner Danish Waters mussel fishery is located in three main areas, East Jutland, Storebælt and Isefjord (Figure 1).

Shellfish fisheries are defined and delineated by shellfish production areas which have been established for shellfish hygiene purposes. Management authorities will not permit shellfish species to be harvested from a production area until samples of the species are taken and submitted for algal toxin and microbiological analysis and shown to be within prescribed levels. For shellfish production areas to be opened to fishing, fishers must first request the Ministry to open an area, and then the Danish Veterinary and Food Administration will assess the water quality. The two authorities will then liaise, and a license will be issued to fish the area. All landings are attributed to a specific shellfish production area, and management controls are enforced at the level of production area. There are 42 shellfish production areas in the Limfjord (**Figure 2**) and mussels and cockles are found primarily in production areas 6 to 39, whereas the main fishery for oysters is concentrated in production areas 1-4, although oysters are also found in commercial quantities in production areas 6, 7 and 9 and also further east in production areas 35 and 36. For management purposes the Limfjord mussel, cockle and oyster stocks are regarded as single stock units.

In the Inner Danish Waters mussel fishery (UoC 4), mussels have been harvested from shellfish production areas 60-83 and 86 in East Jutland (**Figure 3**) and from production areas 110-120 in Isefjord (**Figure 4**). Some trial mussel fishing has also taken place in production areas 89 and 90 in the Storebælt (**Figure 4**). For management purposes the East Jutland and Isefjord populations are managed separately as the mussel production areas for the two fisheries are geographically isolated.

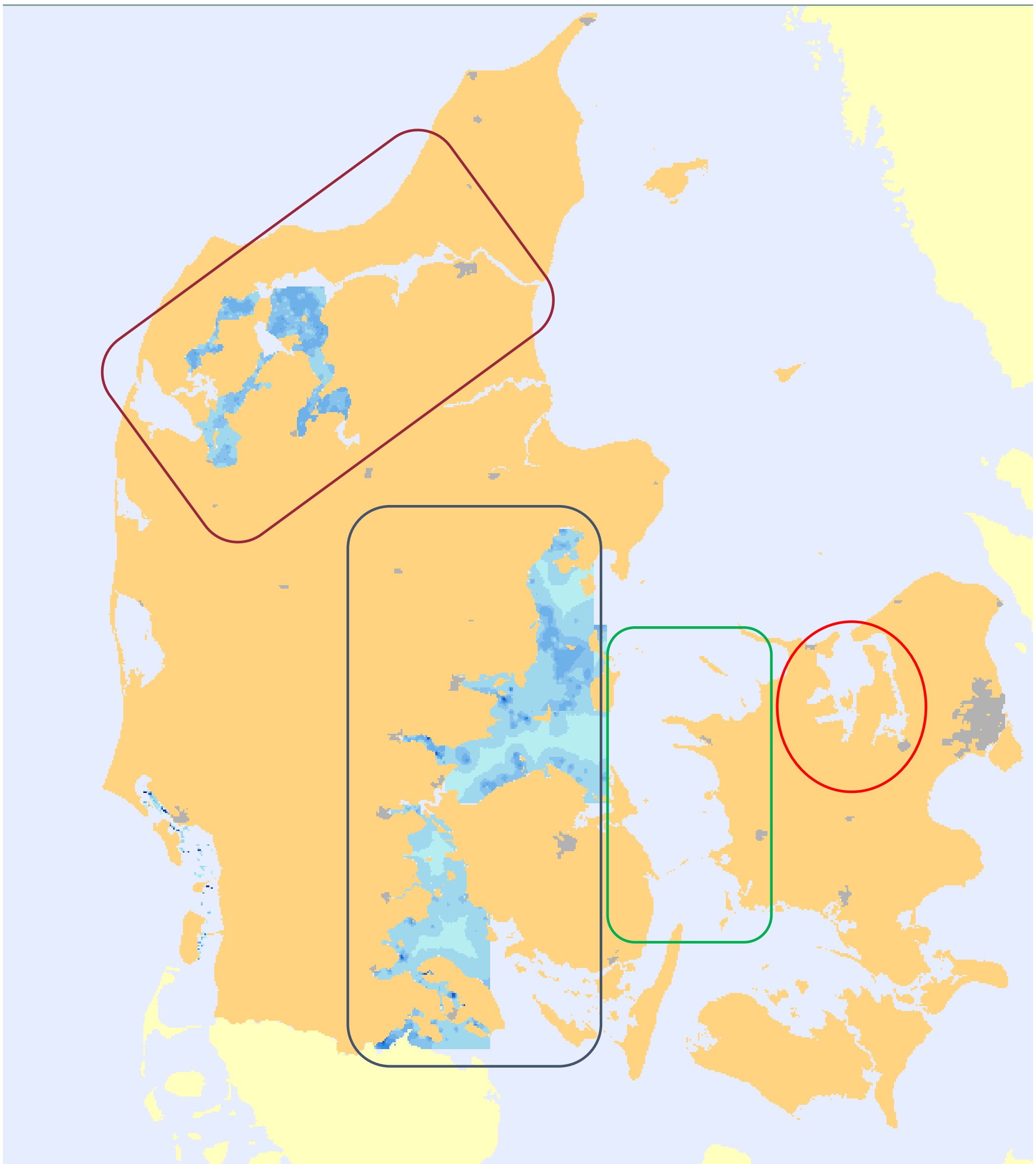


Figure 1. Shellfish fishing areas in Danish waters from top left to right: Limfjord (dark red box); and Inner Danish Waters which comprise: East Jutland (blue box); Storebælt (green box); and Isefjord (red circle). Based on a map showing the distribution and relative abundance of mussel in Danish territorial waters derived from stock surveys between 1996-2004. Darker shades of blue indicate higher mussel abundance during that time period, although note that there were no surveys in the Isefjord during that period. (Source: DTU Aqua, 2011)

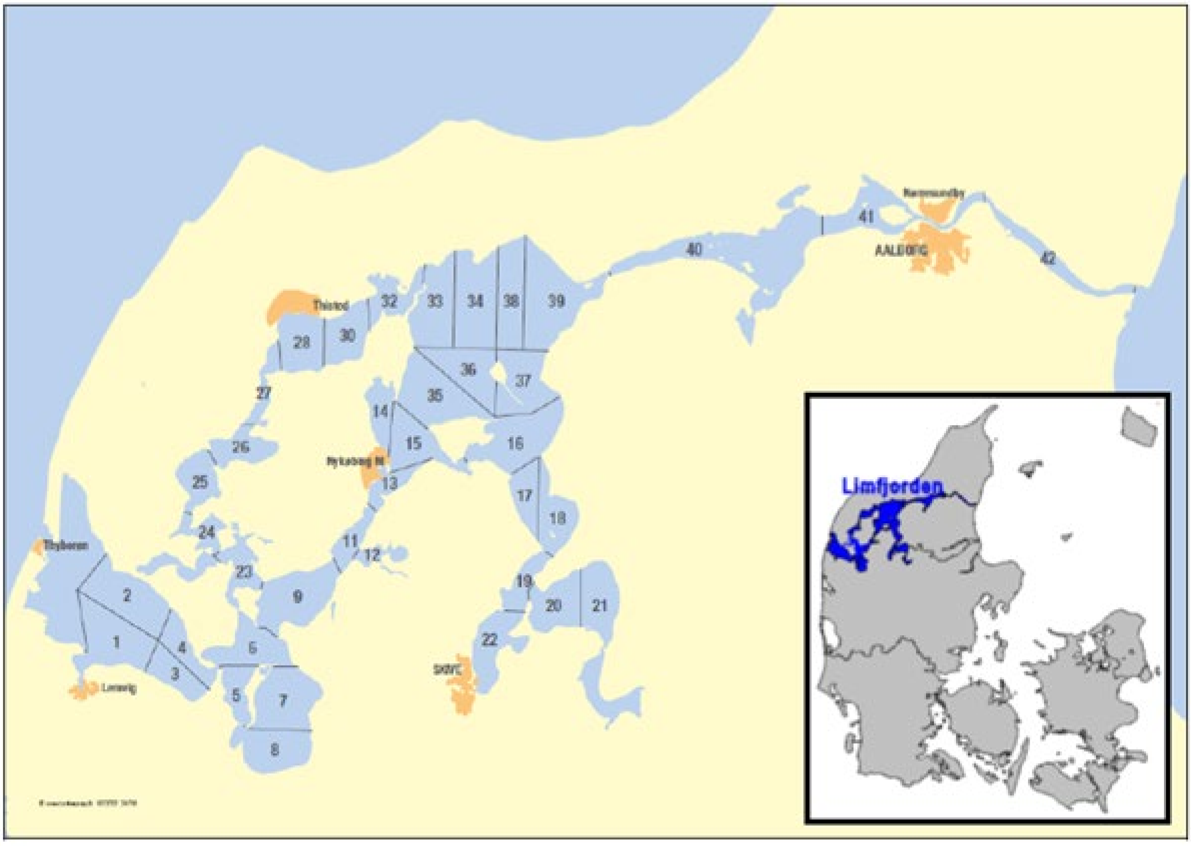


Figure 2. Map of designated shellfish production areas in the Limfjord, northern Denmark. Inset map shows the location of the Limfjord in Denmark.

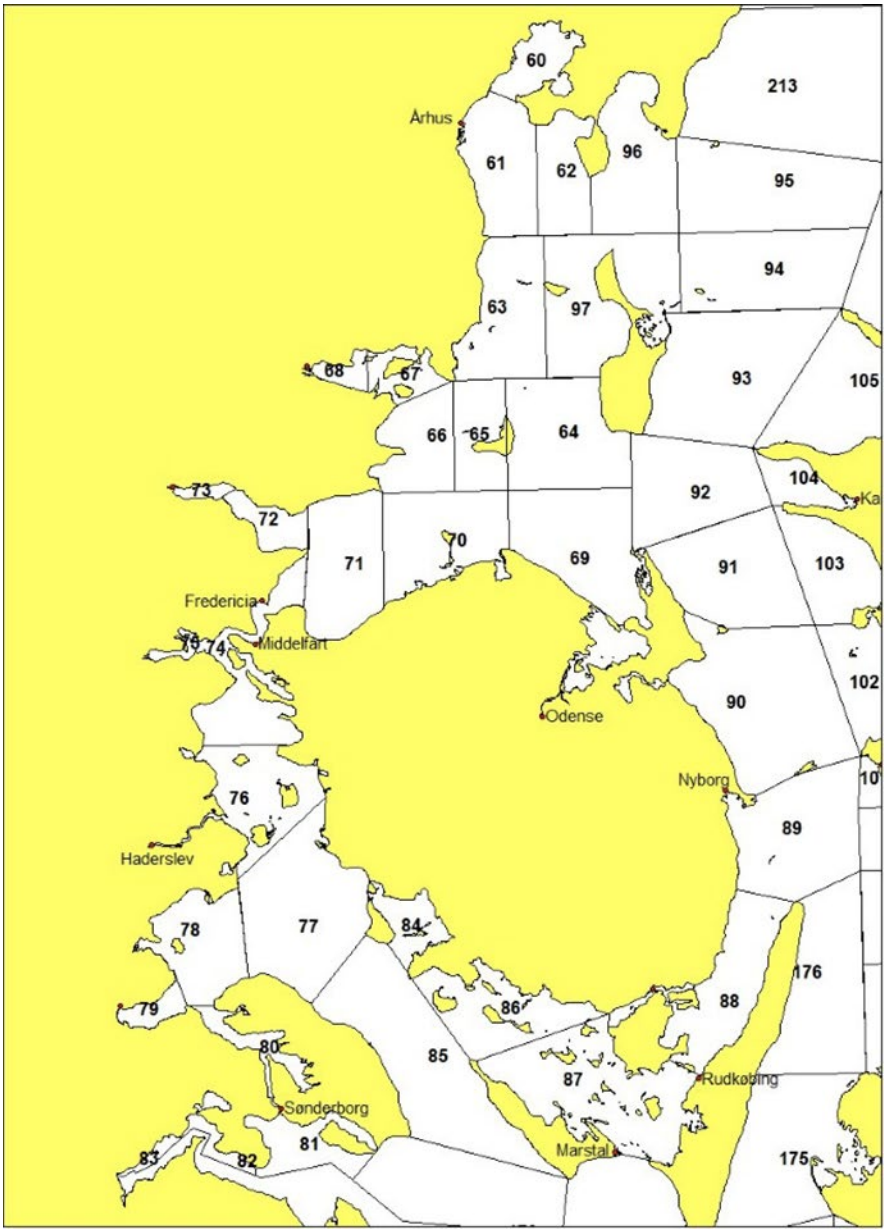


Figure 3. Shellfish production areas in Inner Danish waters, note Natura 2000 areas 67, 68 (Horsens Fjord); 74, 76 (Lillebælt); 89-91 (Storebælt). (Source: https://www.foedevarestyrelsen.dk/Leksikon/Sider/Kort_over_produktionsomraader_i_Danmark.aspx, accessed March 2020.)

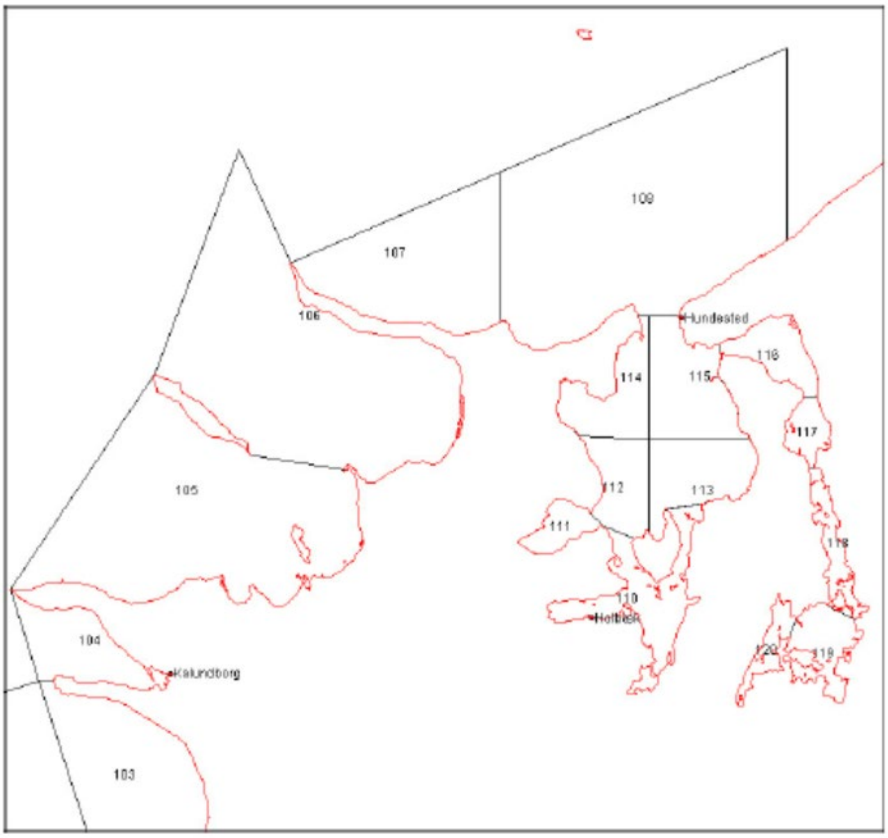


Figure 4. Mussel production areas in North and West Zealand (including Isefjord). (Source: https://www.foedevarestyrelsen.dk/Leksikon/Sider/Kort_over_produktionsomraader_i_Danmark.aspx, accessed March 2020.)

7.2.3 History of the Fishery

Limfjord mussel and cockle fisheries (UoAs 1 and 2)

The blue mussel (*Mytilus edulis*) is an important resource in the Danish fisheries and the most important fishing area for mussels in Denmark is the Limfjord. The mussel fishery in the Limfjord can be dated back to the start of the 20th century. At that time, the mussels were primarily fished for use as bait in long-line fisheries. During the second World War (1939-1945) landings from the mussel fishery increased to 85,000 tonnes for a couple of years as the mussels were exported canned to the German army. After 1945 the landings decreased to <20,000 tonnes per annum during the 1950s and 1960s. Since the late 1970s the annual landings of mussels increased from approximately 20,000 to more than 60-100,000 tonnes in the period 1993-2004. Landings have subsequently been reduced as a more precautionary approach to management has been introduced. Recent landings figures are described in more detail in section 7.3.2.

At certain times mussel dredging vessels will incorporate a smaller mesh net in their dredges to target cockles (*Cerastoderma edule*) in the Limfjord mussel fishery. Catches are highest during the spring and autumn months, when the cockles (which are normally buried in the seabed) may emerge on to the surface of the seabed and become more amenable to capture in mussel dredges. Whilst the mussel dredging vessels are clearly targeting cockles at certain times of the year, the Danish Fisheries Agency does not permit a directed fishery solely for cockles and mussel dredging vessels are only permitted to retain cockles providing that they weigh no more than 49% of the total landings from a vessel per day. Within the Lovns Bredning and Løgstør Bredning Natura 2000 sites, the cockle bycatch is limited to 10% of the total catch. There were no landings of cockles as a bycatch in the Limfjord mussel fishery in 2009 and from 2010 to 2012, landings were very low. However, from 2013 onwards the fishery increased significantly and from 2013 to 2018 annual landings ranged from approximately 5000 to over 8000 tonnes. Recent landings figures for cockles are described in more detail in section 7.3.2.

Limfjord oyster fishery (UoA 3)

The modern commercial fishery for *Ostrea edulis* in the Limfjord commenced around 1850 following the breaching of the Aggertangen isthmus which increased salinity in the Limfjord. The history of the fishery in modern times is one of fluctuating stocks with occasional closures and is described in detail by Overgaard and Nielsen (2003). The main factor driving fluctuations in the oyster population is the large variation in annual recruitment, although historically damage to the seabed and to juvenile oysters by dredging and high levels of exploitation may have caused stock declines. Limfjord is near to the temperature limit for spawning of *Ostrea edulis* and good spatfalls are confined to warm summers (Yonge, 1960). Whilst cultivation using hatchery-reared spat or introduction of spat from other areas has been trialled, this approach to maintaining stocks is no longer possible because of restrictions on introduction of shellfish to the Limfjord. The fishery is therefore based upon careful management of the occasional good recruitment, and restriction on fishing in shallow waters and other areas ensures that some broodstock is always present to provide future recruitment (Nielsen and Petersen, 2019). A management plan is in place which is responsive to annual assessments of stock status and potential environmental impacts of the fishery. Landings from 2005 to 2010 were at the highest level since the modern fishery commenced in the mid-19th century primarily due to warm summers and cold winters which favoured oyster recruitment but have declined since 2011-12. Recent landings figures for oysters are described in more detail in section 7.3.2.

Inner Danish Waters mussel fishery (UoA 4)

This UoA covers Danish dredge boats catching *Mytilus edulis* in the Eastern Inner Danish waters of East Jutland, Isefjord and Storebælt (ICES areas IIIa or Baltic Sea subarea 22). Blue shell mussels are an important resource in the Danish fisheries, and whilst the Limfjord has been the most important fishing area for mussels in Denmark for many years, vessels moved to the East coast when water quality in the Limfjord substantially decreased. However, when new water quality legislation improved water quality in the Limfjord, the itinerant vessels returned to fish in the Limfjord. A relatively small fishery remains on the East coast of Jutland, and in the Isefjord. For management purposes the East Jutland and Isefjord populations are managed separately as the mussel production areas for the two fisheries are geographically isolated. Recruitment patterns are driven primarily by local hydrographical conditions and are likely to differ therefore between East Jutland and Isefjord. Small morphometric differences between mussels for the two areas have been observed, but there are no studies to determine whether there are any genetic differences between the populations in the two areas (Jens Kjerulf Petersen, DTU Aqua, pers. comm.). Although there has recently been a trial fishery in the Storebælt, the area has not been open to commercial fishing in recent years, and as the fishery is in a Natura 2000 site, any future fishing will be subject to an Environmental Impact Assessment before the fishery can be opened. Recent landings figures for mussels in the Inner Danish Waters are described in more detail in section 7.3.2.

7.2.4 Fleet and fishing gear

There is a limit of 50 licences issued in the mussel and cockle fisheries in the Limfjord (UoAs 1 and 2), of which there were 22 active vessels fishing in 2020 (Table 8). All vessels are of a similar size and power (see example in **Figure 5**) and all vessels are required to use the same type of fishing gear. A new lightweight type of dredge was introduced in the fishery in 2010 and is now used throughout the fishery (**Figure 6**). The same dredges are used in both the mussel and cockle fisheries in the Limfjord, but as cockles are smaller than mussels, a smaller mesh net (30 mm mesh) is attached to the dredge when fishing for cockles. This net is attached to the dredge using karabiners. No other modifications are made to the fishing gear when fishing for cockles.

The number of oyster dredging licences is restricted by a statutory licensing scheme in the Limfjord (UoC 3) and there were 34 active vessels in 2020 (**Table 9**), many of which also have licences to mussel fishing. Oyster vessels are restricted to a maximum overall length of 12m, although there are 4 vessels larger than 12m that retain rights to fish for oysters because they were operating in the fishery prior to the introduction of this regulation. The oyster dredges used in the Limfjord are much lighter than the dredges used in the mussel fishery as research has shown that lighter dredges would reduce mortality of smaller oysters and would increase the productivity of the fishery in the long term (Dolmer & Hoffman, 2004). There is a maximum size (100cm width, 20cm height) and weight (35kg) of dredge permitted in the oyster fishery, and there is a maximum of two dredges that can be towed by a vessel. Vessels which hold both mussel and oyster licences may not carry mussel dredges on board whilst fishing for oysters. A typical oyster dredge used in the Limfjord fishery (UoC 3) is shown in **Figure 7**.

The mussel fishery in the Inner Danish waters (UoC 4) is a limited entry fishery. Fishing licenses for the mussel fishery (which are associated with individuals rather than vessels) are issued by the Danish Fisheries Agency (Fiskeristyrelsen). There are currently 8 vessels licensed (**Table 10**) with 6 licenses for operating in East Jutland and 2 licenses for operating in Isefjord. Two licenses were granted for operating a trial of commercial fishing in Storebælt during 2016. However, this trial did not yield commercially viable volumes of mussels, and the Client and the Fisheries Agency reported that there were no further fishing trials in the area in 2019/20. There are two vessels licensed to relay mussel seed in Isefjord waters. Neither the fishing industry nor management bodies have expressed any intention to increase the number of mussel fishing licenses in this UoA in the foreseeable future. Licenses can be aggregated, so that one vessel may have more than one license (entitling it to land more mussels). This restrictive licensing system currently in place was established in the early 1980s in response to increased fishing pressure in the area (apparently due to the Limfjord fleet moving into the area when mussel stock levels in the Limfjord declined owing to poor water quality). Concerns about the potential effect of this increased fishing effort on mussel stocks and the marine environment led to the introduction of local restrictive licensing schemes in all mussel fishing areas. Size, draught, and power of mussel dredges are regulated by legislation in order to control effort and dredging in shallow water depths. A modified version of the lightweight Limfjord dredge is now in use by all vessels fishing in the UoA, having been tested extensively during the last four years against the traditional Dutch mussel dredge for both efficiency and environmental impact. Conditions in the UoA meant that the dredge is slightly heavier than the lightweight Limfjord dredge, however it is lighter than the Dutch mussel dredge which has now fallen completely out of use in the UoA. Dredges are fitted with bars across their mouth to minimize the ingress of boulders. Before deployment of the dredges, DFPO boats may use underwater video equipment and ground discriminating sonar to identify suitable areas for fishing before deploying their dredges. This helps vessels avoid catching undersized mussels, starfish and boulders, increasing their efficiency.

Table 8. List of active vessels in the Limfjord mussel and cockle fishery (UoCs 1 and 2) during 2020. (Source: Client)

Registration	Vessels
A60	Frida
A956	Manta
E63	Sine
HM911	Elias Vendelboe
L154	Tambosund
L253	Laura
L491	Berit
L500	Jens Sund
L54	Mads Vester
L933	Blackie
L935	Sandra Pedersen
L941	Musse II
SK100	Morton Thomas
SK18	Broberg
SK919	Margrethe P
SK920	Nitsen
SK925	Joan Kiss
T121	Balder
T194	Søe Bonde
T229	Liden Kirsten
T300	Betina Kærgaard
T301	Edith Kærgaard

Figure 5. The mussel dredger FV Jenssund which fishes for mussels and cockles in the Limfjord. (Photo credit: Chris Grieve)

Figure 6. Commercial lightweight mussel dredge used in the Limfjord. (Photo credit: Chris Grieve)

Table 9. List of active vessels in the Limfjord oyster fishery (UoC 3) during 2020. (Source: Client)

Registration	Vessels
A36	Gitte II
A5	Anna Holm
A60	Frida
A956	Manta
AS56	Luffe
E63	Sine
HM911	Elias Vendelboe
L102	Tonton
L154	Tambosund
L253	Laura
L34	Vima
L472	Futte
L491	Berit
L500	Jens Sund
L511	Lasse
L54	Mads Vester
L933	Blackie
L935	Sandra Pedersen
SK100	Morton Thomas
SK18	Broberg
SK20	Torben-Ulrik
SK49	Emma
SK919	Margrethe P
SK920	Nitsen
SK925	Joan Kiss
T112	Kirsten II
T121	Balder
T194	Søe Bonde
T229	Liden Kirsten
T300	Betina Kærgaard
T301	Edith Kærgaard
T310	Venus
T58	Marianne
SK21	Ida Marie

Figure 7. Typical oyster dredge used in the Limfjord fishery. (Source: Dolmer & Hoffman, 2004)

Table 10. List of active mussel dredging vessels in the Inner Danish Waters (UoC 4) during 2020. (Source: Client)

Registration	Vessels
HO2	Ydun
HO32	Sif
KA56	Fortuna
L150	Smilla
SK951	Musse III
SK971	Musse IV
HO6	Thyra
HO7	Ronja

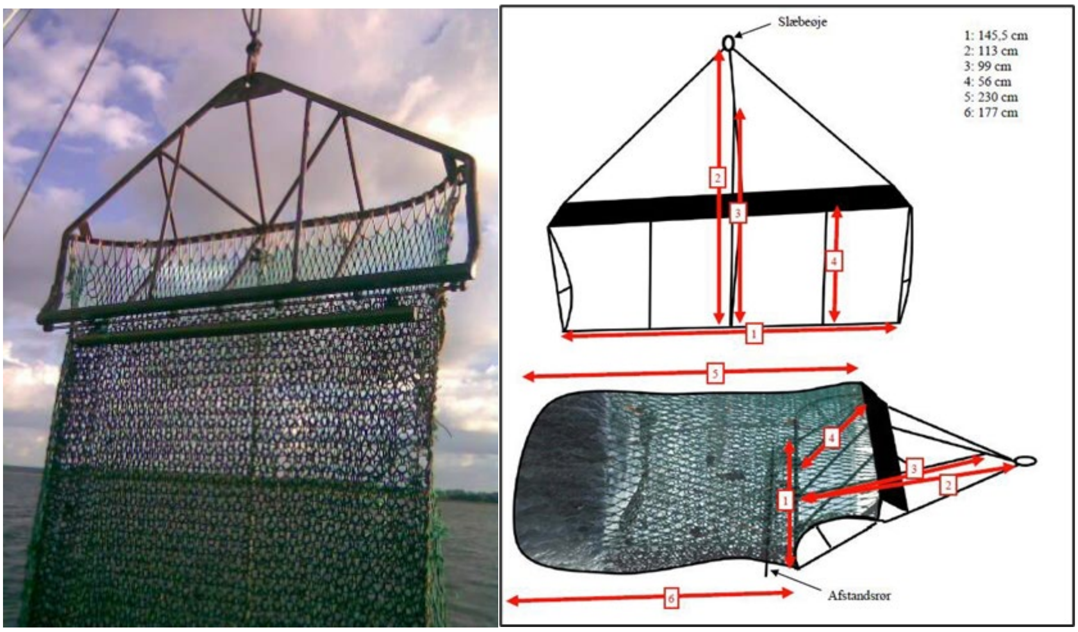


Figure 8. Lightweight dredges used in the Inner Danish Waters mussel fishery (UoC 4) shown on the right, by comparison to the traditional "Dutch" mussel dredge, now phased out of use, shown on the left (Source: 'Dutch' dredge, DFPO; Diagram, Eigaard *et al*., 2011)

7.3 Principle 1

7.3.1 Principle 1 background

<u>Biology, distribution of target species</u>

<u>Mussels</u>

The blue mussel, *Mytilus edulis* (Bivalvia: Mytilidae), has a wide distribution in the North Atlantic from Iceland and Novaya Zemlya to the Atlantic coast of southern France. *Mytilus edulis* is a sessile bivalve attached to the substratum by a byssus. Mussels can withstand wide variation in salinity, desiccation, temperature and oxygen concentration, resulting in the ability to occupy a large variety of microhabitats. Mussels can be found on any substratum providing a secure anchorage such as rocks, stones, gravel, shingle, dead shells, and even mud and sand if these substrates are stable and contain hard surfaces for settlement. In areas where there is a paucity of rocks or other hard surfaces, mussel larvae can settle on live cockle shells (Ramon, 1996). In soft bottom areas like the Limfjord, the mussels form stabilised mussel beds of interconnected mussels and dead shells. Mussel beds are often dominant in terms of biomass and form a key component of many marine communities. These beds support their own diverse communities as the mussel matrix, composed of layers of mussels with accumulated sediments and debris provides numerous microhabitats and an organically enriched environment.

Mytilus edulis is a filter-feeding bivalve feeding primarily on micro-algae and organic detritus but at lower rates also on zooplankton (Maar *et al*., 2008). The tidal range in Limfjorden is low (~0.2 m) and the water circulation is forced by the predominantly eastern-directed wind. This low energy system is eutrophic, receiving nutrients from surrounding farmland areas and the primary production is high, locally exceeding 1000 mg C m^{-2} day^{-1} in summer. In periods with low wind forcing, the mixing of the water column is reduced. First, as no microalgae are transported down to the benthic mussels, the bottom water is depleted of food and the mussels stop filter feeding (Møhlenberg, 1995). Second, the combination of a high algal biomass and a low mixing rate of the water column may induce oxygen depletion and mass mortality of benthic animals, especially in the more enclosed parts of the area.

Mussels follow a reproductive strategy of producing a very large number of gametes and hence planktonic larvae, of which a small proportion survive to settle and establish on the seabed. Mussels can adapt their reproductive strategy depending on environmental conditions, and the reproductive cycle depends on the population's geographical situation. Blue mussels release gametes (approx. 3 million eggs) into the surrounding water where fertilisation takes place. After fertilisation occurs, the fertilised zygotes undergo several larval stages before settling on the seabed.

The duration of planktonic life of *Mytilus edulis* varies with temperature, food supply and availability of suitable settlement substratum, and it can take 10 and more weeks between fertilisation and the settlement of the mussel (Seed, 1976). The maximum settlement period is in June – July, although a cohort of larvae and settlement are often observed in September.

The growth rate of mussels varies greatly and is dependent largely on the availability of food. Suspended mussels are reported to grow from settlement to a marketable size in 10-14 months. The quality of the mussels, measured as the ratio between the cooked weight of the meat and the total weight of the mussel, range from approximately 10 to 30 %. Predators of mussels include starfish, crabs and birds, and there may be episodes of mass mortality of mussels caused by low oxygen concentrations in the water column during the summer months and these natural mortality episodes may be very much higher than any fishing-related mortality (Jens Kjerulf Petersen, DTU Aqua, pers. comm.).

The blue mussel, *Mytilus edulis*, is not considered to be a key low trophic level (LTL) species as it does not meet the criteria for a key LTL as defined by paragraphs SA2.2.8-SA2.2.10 of the MSC Fisheries Standard v2.01 (MSC, 2018).

<u>Cockles</u>

The cockle *Cerastoderma edule* is a common shallow-burrowing bivalve with a wide distribution along the north-eastern coastline of the Atlantic Ocean from the western region of the Barents Sea and the Baltic, and southwards to Senegal on the coast of West Africa and into the Mediterranean (Tebble, 1966). It is common in the intertidal and shallow subtidal, forming aggregated populations in a variety of sediments, notably clean sand, muddy sand, mud and muddy gravels.

Cockles can tolerate salinities down to some 10 ppt, but the normal salinity range is 15 – 35 ppt. Lifespan is typically 2-4 years in most populations, but individuals can live up to 9-10 years or more. The sexes are separate with no external morphological differences, and there is generally a 1:1 sex-ratio in any given population (Boyden, 1971). Spawning normally occurs in the summer, following rapid development of the gonads in April and May. First sexual maturity and spawning occurs at a length of around 15 – 20 mm and an age of about 18 months, but large (>15mm) 1-year-old individuals can also spawn. In the Limfjord *C. edule* undergoes a single spawning event in a short space of time (Ivell, 1981). Fecundity is extremely high (in the range 200,000 - 700,000 per animal, maximum 1.7 million (Honkoop and van der Meer, 1998). Cockle larvae are planktonic, and typically spend around 3-5 weeks in the plankton. Settlement of small cockles, known as spat, normally occurs during the summer, sometimes in densities as high as 10,000m^{-2}. Survival and subsequent recruitment of cockles into the adult population can be influenced by a number of factors including predation, climate, larviphagy and sediment dynamics (e.g. André & Rosenberg, 1991; Bouma *et al*., 2001; Flach, 2003; Beukema & Dekker, 2005). Episodic mass mortality events of unknown cause are a commonly reported feature of cockle populations (Burdon *et al*., 2014).

Cockles are generalist, opportunistic filter feeders; they have very short siphons and generally live within the top 5 cm of the substrate so that they can maintain contact with the overlying water for feeding and respiration. In this position they can be washed out en-masse during storms, but they can also actively move to the surface of the sediment. Emergence behaviour has been linked to the occurrence of digenean parasites in the cockles which makes them more vulnerable to predation and aids the transmission of parasites to the final host. In the Limfjord, seasonal emergence behaviour is very important as it makes cockles more available to capture in mussel dredges. In this fishery, emergence behaviour has been associated with density-dependent processes (crowding), a high frequency of the digenean trematode *Monorchis parvus*, bacterial infections and environmental stressors like oxygen depletion. Current research has identified density-dependent processes as the most likely factor driving emergence patterns (Jens Kjerulf Petersen, DTU Aqua, personal communication). Cockles have many predators at different stages in their life history (Malham *et al*., 2012), including brown shrimp, shore crabs, starfish, gastropods, polychaetes, fish such as flounder and plaice and wading birds, particularly oystercatchers and knot (O'Connor & Brown, 1977).

Although cockles and mussels have differing life habits, abundant populations of cockles and mussels can occur in close proximity, as in the Limfjord. Under these circumstances, competitive interactions can occur between these two filter-feeding bivalves. For example, in areas where there is a paucity of rocks or other hard surfaces, mussel larvae can settle on live cockle shells (Ramon, 1996) and cockle populations can become smothered by developing mussel beds (Meixner, 1979). However there appears to have been little study of the ecology of cockles or cockle-mussel interactions in the Limfjord.

The cockle, *Cerastoderma edule*, is not considered to be a key low trophic level (LTL) species as it does not meet the criteria for a key LTL as defined by paragraphs SA2.2.8-SA2.2.10 of the MSC Fisheries Standard v2.01 (MSC, 2018).

<u>Oysters</u>

The oyster, *Ostrea edulis*, is a bivalve mollusc with a range which extends from latitude 65°N in Norway south to the Atlantic coast of Morocco. It extends into the Mediterranean, primarily along the north coast and penetrates into the Black Sea as far as the Crimea (Alcaraz & Domingues, 1985). Natural populations of native oysters formerly fringed much of this range (Yonge, 1960). Wild oyster populations had become scarce around Europe by the 1940s although some beds remained in various regions, including the Limfjord (Korringa 1952). As a result, the industry became based mainly on aquaculture, though some oysters have continued to be produced by dredging from wild stocks (Kennedy & Roberts, 1999). In many cases, as in the Limfjord, these wild stocks have often been augmented at various times by the re-laying of large numbers of spat brought in from elsewhere. These practices have resulted in genetic homogenization, masking any naturally evolved geographic differentiation (Saavedra *et al*., 1993), although there is still evidence of different physiological races among stocks from different localities in relation to spawning cycles and temperature tolerance (Yonge, 1960). For management purposes, the Limfjord oyster stock is regarded as a single stock unit.

The following description of the life history and biology of Ostrea edulis is taken primarily from the Public Certification Report of the reassessment of the fishery in 2017 (Andrews *et al*., 2017). Oysters can be found intertidally but generally occur offshore from about low water down to some 80 m on firm, comparatively immobile bottoms of mud, rocks, muddy sand, muddy gravel with shells, hard silt or old peat bottoms (Tebble, 1966), but the main concentrations are usually in shallower water, down to around 20 m. Oysters are sessile animals, cementing to hard objects on the seabed, so the substrate must contain suitable, clean, hard surfaces for settlement (known as cultch).

Ostrea edulis is a protandric sequential hermaphrodite: the young oyster first becomes sexually mature as a male, then changes relatively slowly to a functional female, after which it very quickly becomes a male again and so on alternately throughout life (Spärck, 1925; Orton 1937). The age of first sexual maturity varies with temperature but is usually 3-4 years old in Limfjord (Spärck 1925; Orton 1927; Cole 1941). Spawning takes place in the summer months, when the temperature reaches about 15°C. The eggs are forced against the water current through the fine channels in the gills into the inhalant chamber, where they are fertilized by sperm brought in with the inhalant water current. Successful fertilization is enhanced by synchronised spawning between individuals. After 7-15 days, depending on temperature, they have developed into veliger larvae capable of swimming and feeding in the plankton, and are ready for release. Fecundity is high with 1-2 million larvae incubated at one spawning (Walne, 1964), and one individual may spawn more than once a year in warm waters. The planktonic veliger larvae swim and feed for a period of 7-20 days, depending on temperature, before settling on the substrate. Subsequent growth in juvenile and adult oysters depends on various environmental factors such as temperature, food supply and exposure, and on the metabolic demands of spawning. Oysters can grow to 10-12 cm shell length, but very large specimens have been reported up to 20 cm (Orton & Amirthalingam, 1930). These very large oysters can live for over 20 years, although in the Limfjord the maximum age is only about 10-11 years (Jens Kjerulf Petersen, DTU Aqua, pers. comm.).

Mortality of the planktonic larvae and newly settled juveniles is very high (Korringa, 1941). Annual variations in the numbers of eggs released, fertilization success, and larval and spat mortality all contribute to large annual variations in recruitment. In Limfjord good spat settlement is probably confined to warm summers (Yonge, 1960) and historically there have been long periods with no settlement (Overgaard & Nielsen, 2003). Exceptionally hot summers or very severe winters have occasionally caused mass mortalities in shallow-water European populations, and Limfjord, at the northern end of the temperature range for *Ostrea edulis*, is particularly vulnerable.

Oysters are filter feeders, micro-flagellates make up a key part of the diet in the larval stages and after settlement the diet includes organic detritus, bacteria, diatoms, dinoflagellates and a variety of protozoans, together with the smallest planktonic crustaceans and fragments of larger animals (Andrews *et al*., 2017). Predators include the shore crab *Carcinus maenas*, and starfish *Asterias rubens* (Hancock, 1955) and gastropod molluscs, known as oyster drills, which drill through the shell and consume the oyster. There are two important species of drill, the native rough tingle, *Ocenebra erinacea,* and the introduced American whelk tingle, *Urosalpinx cinereraria*, but the common whelk, *Buccinum undatum*, and the dogwhelk, *Nucella lapillus* also occasionally eat oysters (Yonge, 1960). *Ocenebra erinacea* is not found in the Limfjord, but the Japanese oyster drill, *Ocinebrellum inornatus*, a native of the North Pacific that was unintentionally introduced from North America, with shipments of the Pacific oyster *Crassostrea gigas* (Lützen *et al*., 2012) will also feed on *Ostrea edulis* in the Limfjord. Competition from the slipper limpet, *Crepidula fornicate*, is not significant in the Limfjord (Jensen & Knudsen, 2005). Another more important competitor, the Pacific oyster, *Crassostrea gigas*, was introduced into the Limfjord around 1972 (Jensen & Knudsen, 2005) but has only recently become more abundant (Wrange *et al*., 2010), and with its higher growth rate than the native oyster, it may be a future threat to native oyster populations in the Limfjord. The protozoan parasites, *Marteilia refringens* in the 1960s, followed by *Bonamia ostreae* in the 1970s caused major mortalities and loss of production across Europe (McArdle *et al.*, 1991) and resulted in the introduction of *C.gigas* which is not susceptible to bonamiasis (Kennedy & Roberts, 1999). In recent years the Limfjord was considered to be free of both *Martelia* and *Bonamia* (Laing *et al*., 2005), but in autumn 2019, a mass mortality of oysters in Nissum Bredning was attributed to the parasite *Bonamia* and since then DTU Aqua have launched a monitoring program to identify any areas of the Limfjord with high mortality or high levels of infection that could negatively impact both stock and the industry.

The native oyster, *Ostrea edulis*, is not considered to be a key low trophic level (LTL) species as it does not meet the criteria for a key LTL as defined by paragraphs SA2.2.8-SA2.2.10 of the MSC Fisheries Standard v2.01 (MSC, 2018).

Harvest strategy

General

Denmark is a member of the European Union and therefore Danish fisheries management is underpinned by the EU's Common Fisheries Policy (CFP). Key to the management and development of a harvest strategy for the Danish shellfish fisheries is the EU's Habitats Directive (Council Directive 92/43/EEC) as the UoAs operate within Natura 2000 sites – in the Limfjord, Løgstør Bredning and Lovns Bredning for mussel fishing and Nissum Bredning and Løgstør Bredning for oyster fishing, and in the Inner Danish Waters, mussel fishing has historically been permitted in the Lillebælt and Horsens Fjord.

The Danish Fisheries Act underpins fisheries management in Denmark and the overarching framework within which the harvest strategy and management arrangements for the UoAs are defined is the Danish Mussel and Oyster Policy which was adopted in 2013, and a revised edition was published in 2019 (Udenrigsministeriet, 2019). The Mussel and Oyster Policy sets out a management framework which balances commercial shellfish fishing and nature conservation interests with emphasis on the management of mussel and oyster fishing in Natura 2000 areas. Before fishing can commence in a Natura 2000 site, an environmental impact assessment must be undertaken to ensure that the proposed fishery is likely to cause minimum adverse impacts on non-target species including birds, habitat and sensitive ecological features of the Natura 2000 site. Only 15% of the total area of a Natura 2000 site may be fished over a 5-year period. However, the Mussel and Oyster Policy also guides shellfish fishing in areas outside Natura 2000 sites to ensure that such fishing is sustainable and takes account of ecological considerations. An important element of the management framework for shellfish fisheries is co-management of the fishery. The Mussel and Oyster Policy was developed through multi-stakeholder consultation, and the Mussel Advisory Committee was established under the Fisheries Act, 2006 as a multi-stakeholder forum for discussing and developing the management arrangements for all the UoAs covered by this assessment.

The annual management process exemplifies the co-management approach. As representatives of shellfish fishers, DFPO submits fishing plans for mussels and oysters in Natura 2000 sites to the Danish Fisheries Agency. These plans include proposals on quotas, and then the Fisheries Agency commissions DTU Aqua to carry out an environmental assessment of the impact of those proposed quotas. DTU Aqua publishes impact assessment reports which are evaluated by the Mussel Advisory Committee which includes fishing industry representatives, scientists, environmental NGOs, local council representatives, shellfish farming interests and individuals with consumer interests. The Committee then provides recommendations on the next year's management of the fisheries to the Fisheries Director who makes the final decision.

Management of shellfish fisheries are based on shellfish production areas and closures are applied at this scale as well, so these areas therefore serve as the *de facto* management units for the fishery. As indicated earlier in this report, management authorities will not permit shellfish species to be harvested from a production area until samples of the species are taken and submitted for algal toxin and microbiological analysis and shown to be within prescribed levels. For shellfish production areas to be opened to fishing, fishers must first request the Ministry to open an area, and then the Danish Veterinary and Food Administration will assess the water quality. Local fishers' associations manage the fishery by refraining from taking shellfish hygiene samples in areas where there is a high abundance of juvenile mussels, or where mussels have a low meat yield (<14%). Although the associations do not have statutory powers, in the absence of shellfish hygiene samples, these areas effectively become statutorily closed to fishing.

A key element of the harvest strategy for all the UoAs is a restrictive entry licensing system limited with fixed numbers of licences in each UoA. A detailed description of the regulations and elements of the harvest strategy for each UoA are given below. The overall strategy in all UoCs is to limit dredging activity to a relatively small geographical area in comparison with the distribution of the stock area and to secure large reserves of mussels/cockles/oysters as brood stock to safeguard recruitment to the fishery. There are no formally defined reference points for any of the four UoAs. However, the Limfjord mussel fishery (UoA 1) is managed on the basis that removal of mussels equivalent to the annual production of the stock is considered to be sustainable. Studies of the Limfjord mussel stock estimate the production biomass ratio (P/B) to be 40-50%, and the annual stock survey provides an estimate of stock biomass thereby allowing an estimate of annual production. This estimate of annual production provides therefore an implicit reference point for managing the exploitation rate in the fishery through the setting of a precautionary TAC.

There is a rigorous monitoring and enforcement regime in place in all the UoAs. Fishing activity of all vessels is monitored through the 'black box' system, which uses the GPS system to record the vessel's position and activity every 10 seconds, and there is a sensor on the winch which records when fishing is in progress. The system provides real-time fishing activity reports and the recording of activity every 10 seconds (cf. the VMS system on large vessels which may provide reports only every two hours) allows effective compliance monitoring of fine-scale management of closed areas within the fisheries. Catch data must be recorded on electronic logbooks, and vessels must provide advance warning of landing. Landings declarations should include bycatch species and the number of boulders caught in the dredges. Cross referencing of catch declarations in logbooks, landings data and sales records is undertaken to ensure compliance with quota allocations to individual vessels and overall TACs. Catch estimates on logbooks must be within 5% of the recorded landed weight. The Danish Fisheries Agency monitors the fishery and provides enforcement at sea and at the landing points.

Regulations

Limfjord mussel and cockle fisheries (UoAs 1 and 2)

Fishing effort is controlled through a restricted licensing scheme with licences allocated to individuals and therefore licences may be aggregated onto a single vessel. There is also a limit of 15 and 10 vessels permitted to fish in Løgstør Bredning and Lovns Bredning Natura 2000 sites respectively. An annual TAC is set for mussels in the two Natura 2000 sites - Løgstør Bredning and Lovens Bredning – in which mussel fishing occurs. There is a daily mussel quota for each licence of 45 tonnes, but the local fishermen's organisation has voluntarily reduced this to a more precautionary 30 tonnes per day. This action was taken in response to a 2004 report that raised concerns about the long-term sustainability of the fishery and remains in place today. Whilst the catch limits set by the fishers' associations are informal, in conjunction with DFPO the catch limits can be enforced and sanctions applied if the limits are exceeded. Within Natura 2000 sites the main focus of the harvest strategy is to ensure that mussel dredging will not adversely affect nature conservation features (seabed habitats, marine wildlife and wild birds). Management advice is based upon any area of habitat that might be dredged, and also on the possible effect the mussel fishery may have on food available for birds that feed on shellfish.

There is a maximum length of vessel of 12m, and vessel power is limited to 175hp. Dredges must have a maximum length of 1.8m, a maximum width of 1.5m and a maximum weight of 50kg. There is a minimum landing size for mussels of 50mm, although vessels participating in relaying mussels are permitted a smaller minimum size of 45mm.

The mussel and cockle fisheries in the Limfjord are closed in June, July and August, and the industry may also voluntarily close the fishery at other times. Fishing is prohibited in waters shallower than 3m throughout the Limfjord, and this depth limit is increased to 5m in Natura 2000 sites and to 6m where eelgrass beds may be present. There may be other specific closures within Natura 2000 sites to protect eelgrass beds and other habitat features, and overall, more than 50% of the Limfjord is closed to shellfish dredging.

The fishery for cockles in the Limfjord is currently permitted only as a bycatch in the mussel fishery and is managed as such by the Danish management authorities. Management of the cockle fishery is therefore entirely linked to that of the mussel fishery, i.e., through fishing practices, and catches of cockles must not exceed 49% of the total daily catch by weight of mussels and cockles. (Oyster bycatches are also limited to a maximum of 1% of the total catch.) Management of the cockle fishery is therefore not linked to the population dynamics and stock status of cockles.

In this MSC fishery assessment, cockles are considered as a target fishery as mussel vessels use a separate small-meshed trawl when targeting cockles. DTU Aqua has an ongoing research programme which aims to provide the Danish management authorities with advice on sustainable management of the cockle fishery as a directed fishery rather than as a bycatch in the mussel fishery. Although managed only as a bycatch fishery in the Limfjord, in recent years the cockle fishery has been the most valuable bivalve mollusc fishery in Denmark, and indeed Danish cockle landings account for around 30% in value of all cockle landings in Europe (DTU Aqua, 2020a). Until such time as a time series of total cockle population biomass, harvestable biomass and recruitment can be developed from annual surveys, DTU Aqua have recommended an interim precautionary TAC based on the landings data from the most recent years, and that the TAC should be reviewed annually. Landings of cockles over the last 5 fishing seasons have been stable implying stock biomass has been relatively stable, and a stock survey by DTU Aqua in 2018 showed that there were multiple year classes in the population implying regular recruitment episodes.

Limfjord oyster fishery (UoA 3)

Fishing effort is controlled through a restricted licensing scheme with licences allocated to individuals and therefore licences may be aggregated onto a single vessel. This has no effect on overall exploitation rate as the weekly TAC is allocated to each licence. The fishery is managed through an annual quota or total allowable catch (TAC), and vessels are allocated a quota for each two-week period in the season.

Bycatches of mussels may be landed but are limited to 10% of the weight of the oyster catch.

There is a maximum overall length of vessel of 12m, and vessels can only fish one week in each two-week period during the season. Dredges must have a maximum width of 1m, a maximum height of 20cm, and a weight limit of 35 kg, and there is a maximum of two dredges to be fished at any time. The minimum landing size for oysters in the Limfjord stated in the fishing permits is a weight of 80g which corresponds to a shell length of 70-80mm. The fishery is closed from 15 May to 31 August, and fishing is prohibited on Sundays. There are some areas closed to fishing. Oyster dredging is prohibited in areas shallower than 3m depth. Within the Nissum Bredning Natura 2000 site, dredging is not permitted in water shallower than 5m, in three areas where eelgrass is present and areas designated for relaying.

Inner Danish Waters mussel fishery (UoA 4)

The fishery is a limited entry fishery. Licenses specify the gear characteristics, the minimum fishing depth and the allowed fishing areas. TACs are set for the two Natura 2000 sites - Lillebælt and Horsens Fjord – and are determined by estimates of mussel biomass in relation to the feeding requirements of shellfish-eating birds in those Natura 2000 sites. If estimates of stock biomass are not sufficient to support the bird populations and commercial harvests, then the TAC is set to zero. The current individual vessel quota is set at 270 tonnes per week in East Jutland and with no restrictions in Isefjord. However, there is a fishers' agreement to catch no more than 180 tonnes per week in both areas. This action was taken in response to a 2004 report that raised concerns about the long-term sustainability of the fishery and remains in place today. Whilst the catch limits set by the fishers' associations are informal, in conjunction with DFPO the catch limits can be enforced and sanctions applied if the limits are exceeded. Fishers are obliged to report their catch before landing, giving an estimate of the weight caught.

There is a maximum length of vessel of 12m, and vessel power is limited to 175hp. Dredges must have a maximum length of 1.8m, a maximum width of 1.5m and a maximum weight of 50kg.

The mussel fishery is closed in June, July and August, and the industry may also voluntarily close the fishery at other times. Fishing is prohibited in waters shallower than 3m, and there may be other specific closures within Natura 2000 sites to protect eelgrass beds and other habitat features.

Stock assessment

Limfjord mussel and cockle fisheries (UoAs 1 and 2)

The mussel stock in the Limfjord is surveyed regularly, with annual surveys carried out in the two Natura 2000 sites, Lovns Bredning and Løgstør Bredning. The Public Certification Report (PCR) for the original certification described the results from annual stock surveys that encompassed the whole of the Limfjord (MRAG Americas, 2016). The standardised dredging gear used for research surveys is described by Dolmer et al. (1999), which includes a bottom net mesh size of 55 mm, and a top mesh size of 25 mm which therefore samples cockles also (Jens Kjerulf Petersen, DTU Aqua, personal communication). The stock size of mussels is estimated by annual experimental dredging undertaken at stations randomly distributed across the management areas of the Limfjord. At each station, one dredge track of approximately 100 m^2 is collected. The catch is then recalculated to record the exact mussel biomass using a formula based upon a study of efficiency of the mussel dredge as a function of biomass (Dolmer et al. 1999). DTU Aqua stock assessment monitoring does not include areas with water depths less than 3 metres (as these areas are closed to the fishery), but the counties around the Limfjord have estimated that the mussel stocks lying in water depths less than 3 metres represent 325,000 tonnes in total on average from 1998 to 2002) (Data from County of Viborg; DTU Aqua, 2006). The original PCR presented a time series of mussel biomass estimates from 1993-2014 (Figure 9) and a map describing the average distribution and abundance across the Limfjord (

Figure 10). However, DTU Aqua emphasised that a high degree of caution should be exercised in interpreting these trends in biomass because the surveys were not always conducted in the same month each year, and the geographical distribution of stations only occasionally included the Nissum Bredning Natura 2000 site.

There have not been any wide-scale mussel surveys across the whole Limfjord in recent years, but surveys have been undertaken annually in the both the Lovns Bredning and Løgstør Bredning Natura 2000 sites, which provide more accurate time trends in mussel biomass across the Limfjord. Until 2016, the assessments did not include areas with water less than 3 meters in depth and are therefore likely to be precautionary estimates for the entire population. Previous surveys indicate the mussel stock biomass in Limfjord had declined in 2014 and 2015, but the detailed surveys carried out for the Lovns Bredning and Løgstør Bredning Natura 2000 sites within the UoC area provide evidence that the stock has recently shown some signs of recovery (see below).

A new geostatistical assessment model has been developed in conjunction with a European Fisheries Fund (EFF) funded project to develop new methods and models to assess mussels using GPS data. This uses the same input data as previous models, but now estimates the population's spatial structure with associated uncertainties (Petersen *et al.*, 2015). Based on this, the total biomass can be calculated within a finite area to determine stock status.

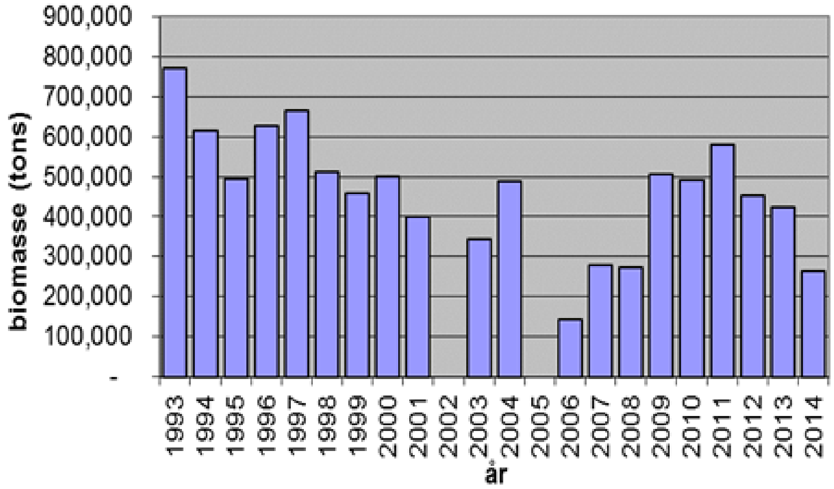


Figure 9. Mussel stock biomass in the Limfjord west of Løgstør in areas deeper than 3 metres, which were open to fishing in 1993-2014. Surveys were not carried out in 2002 and 2005. Note that data gathered between 2000 and 2010 are from late summer surveys. Stocks in Nissum Bredning (areas 1-4) are not included in stock assessments carried out since 1995. [Source: Jens Kjerulf Petersen, DTU-Aqua, pers. comm.]

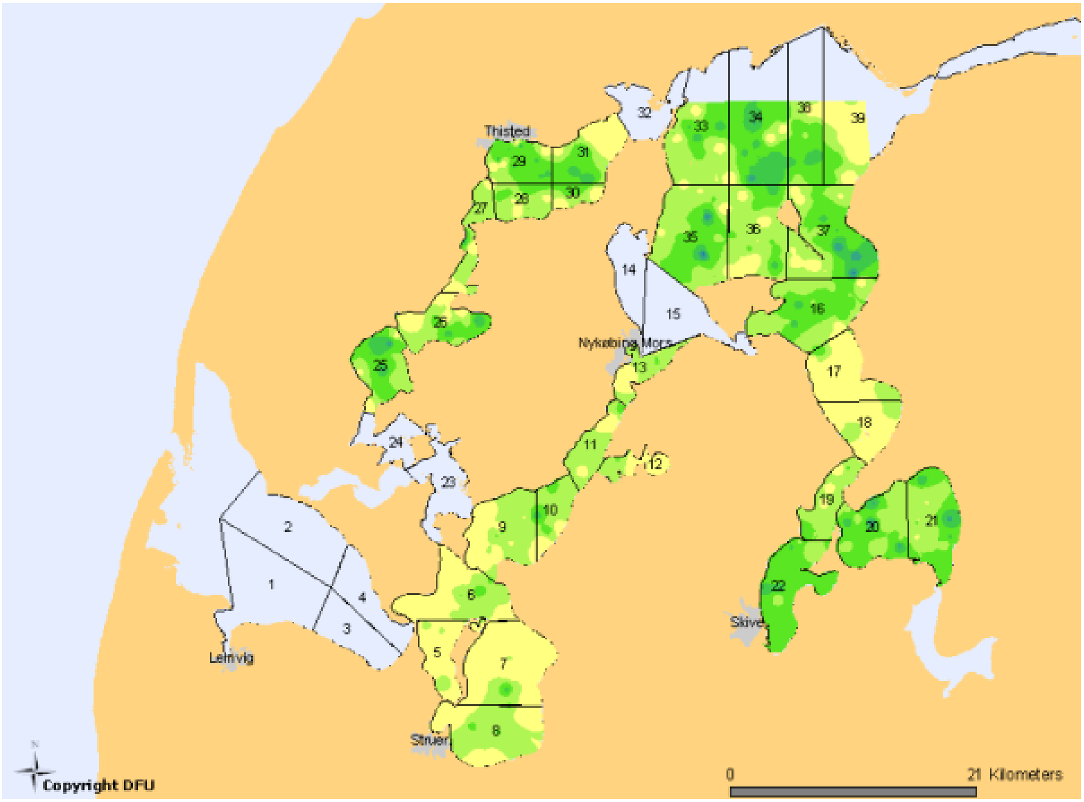


Figure 10. Average distribution and density of mussels (kg/m²) derived from recent mussel surveys in the Limfjord [Source: DFU website GIS viewer: http://gis.dfu.min.dk/website/Limfjord/viewer.htm).

Lovns Bredning

DTU Aqua's most recent annual survey of the mussel stock in Lovns Bredning in spring 2020 estimated stock biomass at 40,056 ± 11,304 tonnes of mussels (Nielsen **et al**., 2020a; **Figure** 11). The population estimates are calculated using a geostatistical model that explicitly takes the spatial structure of the stock into account. The estimate of stock biomass has increased over the last two years continuing a general upward trend in biomass since 2015. Whilst the trend in estimates of stock biomass of mussels in Lovns Bredning since 2006 is very similar to that described in previous assessment reports, absolute estimates of stock biomass are significantly lower since 2018 (Nielsen ***et al***., 2020a) due to a revised estimate of gear efficiency used in the annual surveys. The spatial distribution of the stock in spring 2020 is shown in Figure 12. The average biomass throughout Lovns Bredning during 2020 is estimated at 2.56 kg.m^{-2} (where only stations where biomass is greater than 1 kg.m^{-2} are included).

In addition to the latest estimate of stock biomass, the assessment includes aggregated "black box" data from fishing vessels that shows the exact locations of all fishing activity between September 2019 and June 2020 (**Figure 13**). This illustrates the finite spatial distribution of fishing activities that occur mainly in the south and south west of Lovns Bredning with some fishing in the northern area. The distribution of fishing effort is similar to previous years, except that in 2018 and 2019 there was significant fishing activity along the eastern boundary of the Natura 2000 site (Nielsen *et al*., 2019a). During the fishing season 2019/2020 (September 2019 through June 2020), fishing and transplantation of mussels were carried out in Lovns Bredning in an estimated area of 1.8 km^2, which equates to 2.7% of the total area of Lovns Bredning.

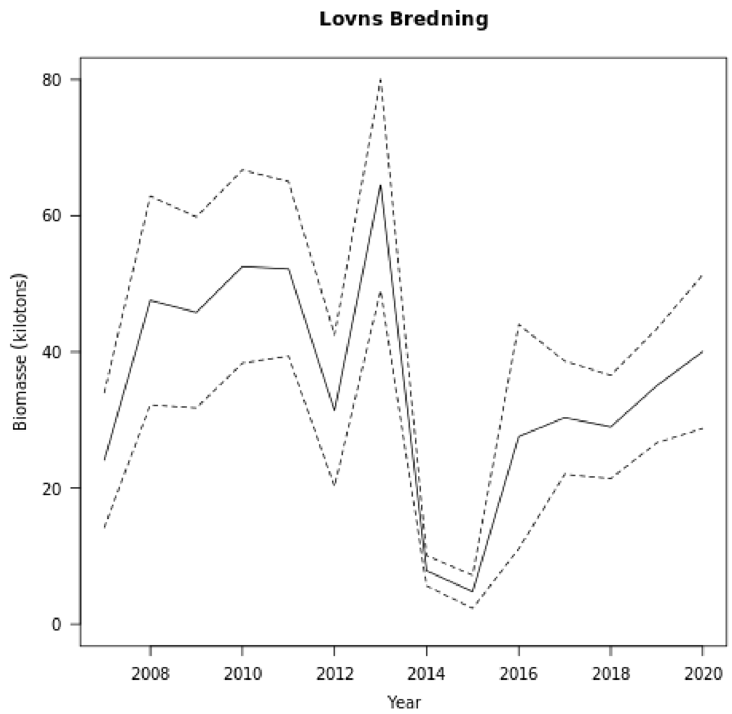


Figure 11. Biomass of mussels in surveys of the Lovns Bredning Natura 2000 site, 2006-2020. Stock biomass estimates (± 95% confidence intervals) are estimated using the geostatistical model and include the whole of Lovns Bredning. (Source: Nielsen *et al*., 2020a).

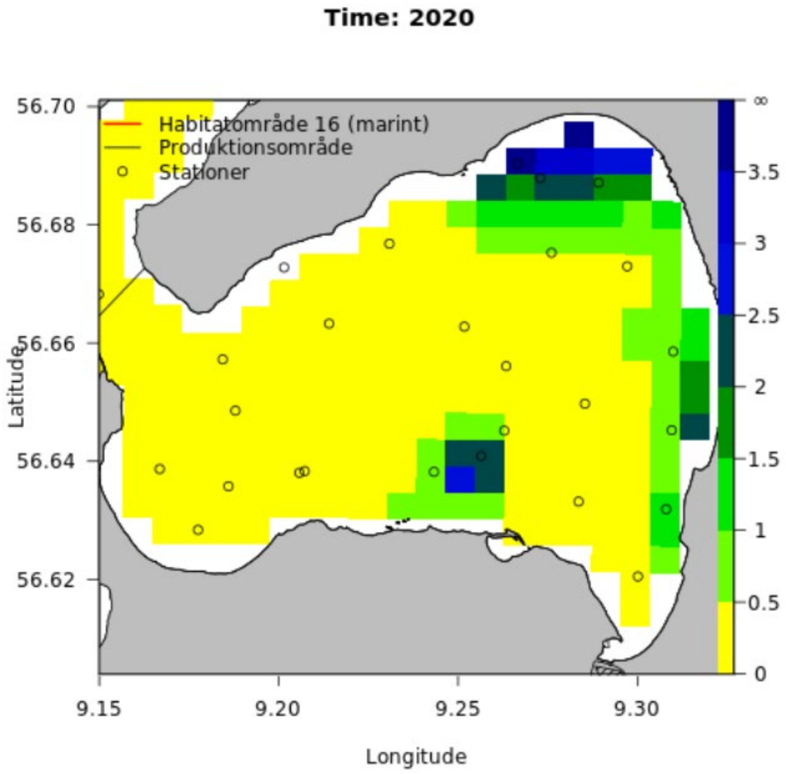


Figure 12. The distribution and abundance of mussel at depths greater than 3m in Lovns Bredning in spring 2020. The density (kg m^{-2}) of mussels is indicated on the right axis. (Source: Nielsen *et al*., 2020a)

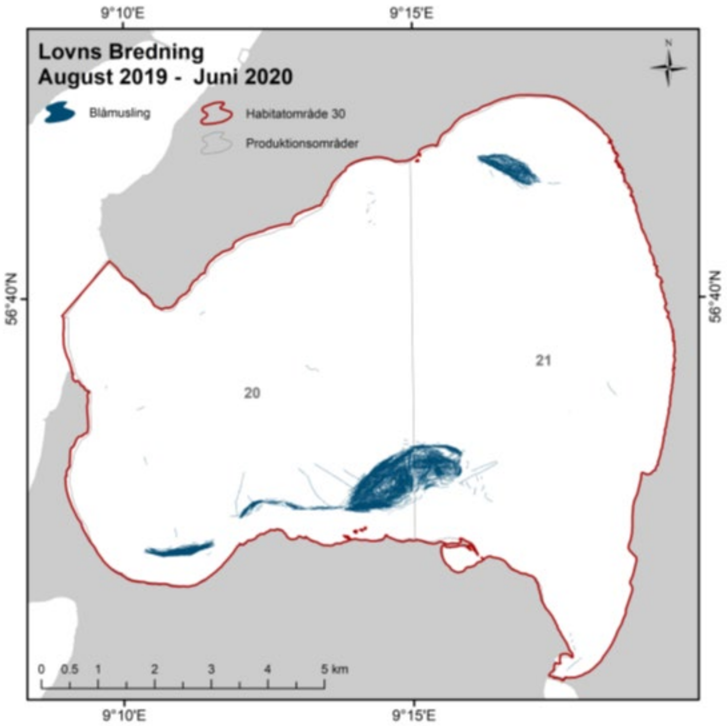


Figure 13. Distribution of mussel fishing activity in the Lovns Bredning Natura 2000 site between September 2019 and June 2020 (Source: Nielsen *et al*., 2020a).

Løgstør Bredning

DTU Aqua's most recent annual survey of the mussel stock in Løgstør Bredning in spring 2020 estimated mussel stock biomass including areas <3m depth at 26,834 ± 5,463 tonnes (Nielsen *et al*., 2020b; **Figure 14**). The population estimates are calculated using a geostatistical model that explicitly takes the spatial structure of the stock into account. The mussel stock had declined from 2017 to 2019 but has increased by approximately 33% between 2019 and 2020 (Nielsen *et al*., 2020b). The spatial distribution of the stock in spring 2020 is shown in Figure **15** and the average density is 1.19 kg.m^{-2}.

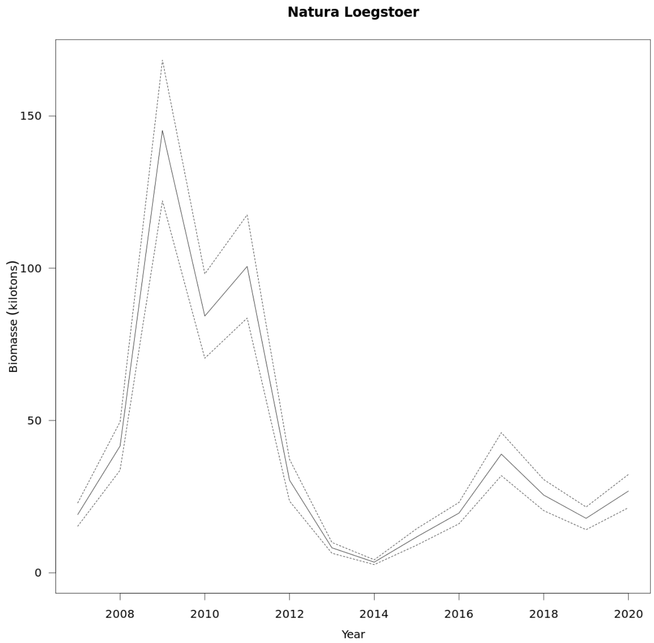


Figure 14. Biomass of mussels in surveys of the Løgstør Bredning Natura 2000 site, 2006-2020. Stock biomass estimates (± 95% confidence intervals) are estimated using the geostatistical model and include the whole of Løgstør Bredning. (Source: Nielsen *et al*., 2020b)

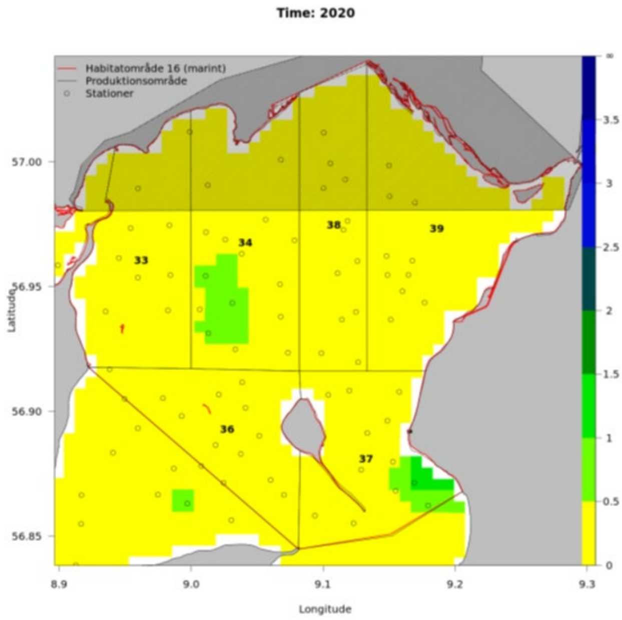


Figure 15. The distribution and abundance of mussels in Løgstør Bredning in spring 2020. Density (kg m^{-2}) of mussels is indicated on the right axis. (Source: Nielsen *et al*., 2020b).

Similar to Lovns Bredning, the most recent assessment shows the spatial distribution of fishing within Løgstør Bredning using "black box" data. This is illustrated for all mussel, oyster and starfish fishing activities between August

2019 and June 2020 (Figure 16). The total affected area was estimated at approximately 2.46 km^2, which accounts for 0.8% of the Natura 2000 area in Løgstør Bredning. The total area of mussel fishing activity remains below the 15% cap set by the Mussel and Oyster Policy.

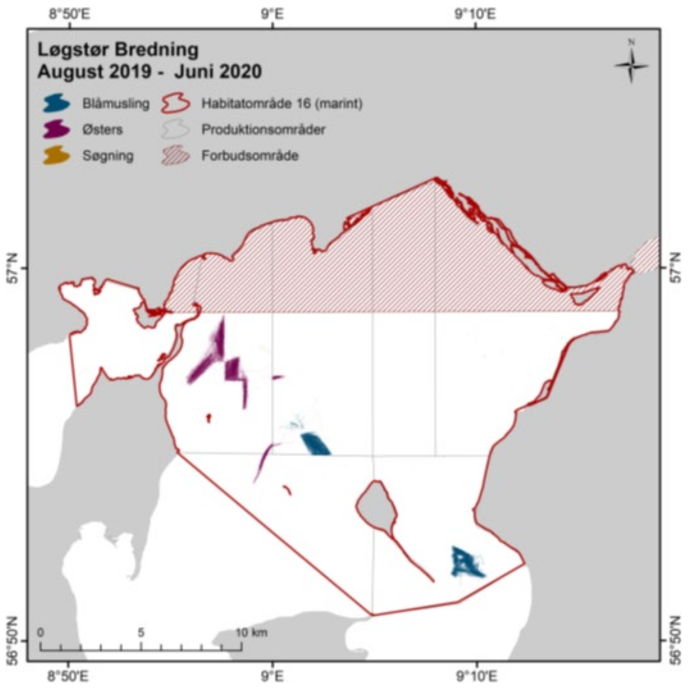


Figure 16. Distribution of mussel (dark blue) and oyster (purple) fishing activity in the Løgstør Bredning Natura 2000 site between August 2019 and June 2020. (Source: Nielsen *et al*., 2020b).

TAC calculations for the mussel fishery

Lovns Bredning

At present, the Fisheries Agency continues to set a weekly TAC of 45 tonnes per fishing licence (voluntarily reduced to 30 tonnes by the fishing industry body) which is well within the implicit reference point of 50% of the stock biomass. In addition, the TAC within Natura 2000 sites must take in to account the food requirements for birds and the total cumulative impact (proportion of total area) for blue mussels, benthic fauna, macroalgae and eelgrass must not exceed 15% as set by the Mussel and Oyster Policy. Generally, TACs are set conservatively to ensure that the 15% threshold is not exceeded. Fishing plans are submitted by DFPO which are then evaluated by DTU Aqua to ensure that the plans are sustainable in relation to stock biomass estimates, food requirements of birds and the 15% threshold.

For the 2020/21 fishing season in Lovns Bredning, DFPO submitted plans for a total quota for catching and transplanting mussels of 10,000 tonnes with fishing for mussels for consumption mussels (shell length> 4.5 cm) in areas that have biomass density greater than 1 kg m^{-2}, while fishing for mussels for transplantation will take place only where the biomass density is greater than 2.5 kg m^{-2}. In addition, mussels will not be fished at lower water depths than 2 m. In addition, DFPO has proposed a quota of 100 tonnes of starfish in Lovns Bredning. With an estimated mussel stock biomass of 40,056 ± 11,304 tonnes, DTU Aqua assesses that a quota of 10,000 tonnes will remove approximately 25% of the total population in 2020, and with the food requirement for birds of 6580 tonnes of mussels (Clausen *et al*., 2009), the fishery should be sustainable in relation to maintaining both the mussel stock and providing sufficient food for birds as long as the maximum number of fishing boats of 10 in one area at a time is not exceeded.

The cumulative distribution of mussel fishing over the last 4 years as described by ‘black box’ data is shown in Figure 17. In the period 2016/17 to 2019/20 the annual area of the Natura 2000 site affected by mussel fishing has ranged from 1.3% to 4.4%, and the proposed catch of 10,000 tonnes of mussels in 2020/21 would affect 8.8% of the Natura 2000 site (Nielsen *et al*., 2020a). The cumulative area impact for blue mussel, macroalgae, bottom fauna and eelgrass as a proportion of the total area of habitat area over the 5-year period between 2016/2017 and 2020/2021 in Lovns Bredning is shown in Table 11. The total cumulative impact for the proposed fishery of 10,000 tonnes of mussels and 100 tonnes of starfish during the fishing season 2020/2021 is estimated at 15.9% for mussels, 13.7% for macroalgae, 15.9% for bottom fauna and 0% for eelgrass (Nielsen *et al*., 2020a). The total cumulative area impact for the ecosystem component mussels and benthic fauna for the fishing season 2020/2021 will therefore exceed the maximum limit of 15% set by the Mussel and Oyster Policy. DTU Aqua therefore recommend that mussel fishing activity is restricted to specific sites equivalent to 7.9% of the total area of the Natura 2000 site to enable the cumulative effect to be constrained within the 15% threshold, and therefore be sustainable at an ecosystem level within Lovns Bredning.

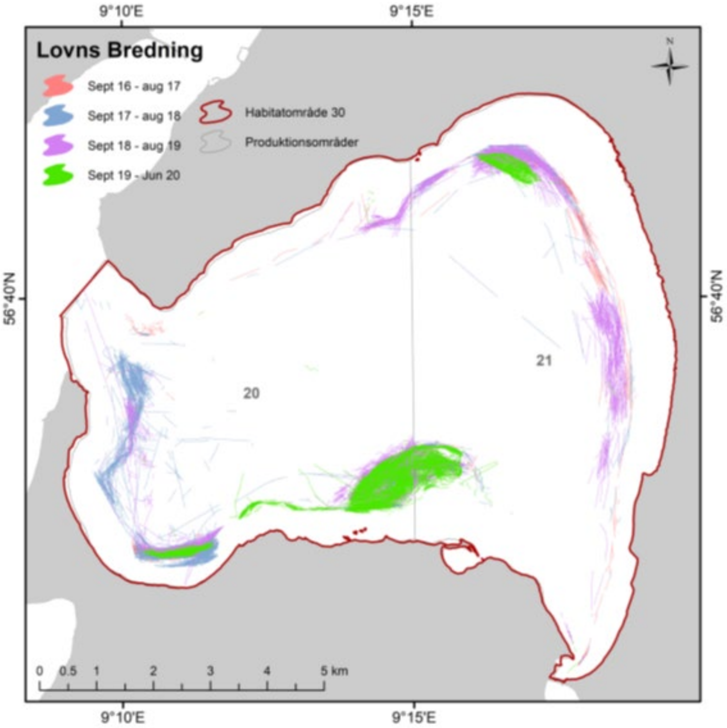


Figure 17. Distribution of mussel fishing for the fishing seasons 2016/17, 2017/18, 2018/19 and 2019/20 in Lovns Bredning. The areas are generated based on 'black box' data. (Source: Nielsen *et al*., 2020a).

Table 11. Cumulative area of impact for blue mussel (blåmusling), macroalgae (makroalger), bottom fauna (bundfauna) and eelgrass (Ålegræs) as a percentage of the total area of habitat in Lovns Bredning based upon a TAC of 10,000 tonnes of mussels. The estimates are based upon recovery times (gendannelsistid) of 3, 5 and 2 years for mussels, macroalgae and bottom fauna respectively. (The estimate for macroalgae includes the impact of a proposed fishery for starfish (søstjerner)). (Source Nielsen *et al*., 2020a).

	Gendan-nelsestid (år)	2016/17 (%)	2017/18 (%)	2018/19 (%)	2019/20 (%)	2020/21 10.000 t blåmuslin-ger (%)	2020/21 100 t søstjer-ner (%)	Kumu-leret (%)
Blåmusling	3			4,4	2,7	8,8	0	15,9
Makroalger	>5	0,4	1,1	1,4	2,1	6,8	2	13,7
Bundfauna	2			4,4	2,7	8,8	0	15,9
Ålegræs*	>20	0	0	0	0	0	0	0

Løgstør Bredning

For the 2020/21 fishing season in Løgstør Bredning, DFPO submitted plans for a total quota for catching and transplanting mussels of 6,500 tonnes with fishing for mussels for consumption mussels (shell length> 4.5 cm) in areas that have biomass density greater than 1 kg m^{-2}, while fishing for mussels for transplantation will take place only where the biomass density is greater than 2.5 kg m^{-2}. Mussels will not be fished at lower water depths than 4 m. In addition, there is a proposal for a fishery of 150 tonnes of oysters and 200 tonnes of starfish. With an estimated mussel stock biomass of 26,834 ± 5,463 tonnes, a quota of 6,500 tonnes will remove approximately 24% of the total population in 2020. DTU Aqua assessed that a fishery of 6,500 tonnes of mussels could potentially lead to significant changes in the occurrence of mussels in habitat area H16, Løgstør Bredning due to the general decline in the stock over a number of years. Coupled with a request for catches of 150 tonnes of oysters and 200 tonnes of starfish, DTU Aqua concluded that a total of 5,500 tonnes of mussels would be sustainable in relation to the mussel stock as long as the maximum number of fishing vessels of 15 in one area at a time is not exceeded. With the food requirement for birds of 2407 tonnes of mussels (Petersen *et al*., 2016), the mussel fishery should provide sufficient food for birds (Nielsen *et al*., 2020b).

The cumulative distribution of mussel fishing over the last 4 years as described by ‘black box’ data is shown in Figure 18. In the period 2016/17 to 2019/20 the annual area of the Natura 2000 site affected by mussel fishing has ranged from 1.1% to 9.4%, and the proposed sustainable catch of 5,500 tonnes of mussels in 2020/21 would affect 2.3% of the Natura 2000 site (Nielsen *et al*., 2020b). The cumulative area impact for blue mussel, macroalgae, bottom fauna and eelgrass as a proportion of the total area of habitat area between 2016/2017 and 2020/2021 in Løgstør Bredning is shown in Table 12. The total cumulative impact for the proposed fishery of 5,500 tonnes of mussels during the fishing season 2020/2021 is estimated at 7.9% for blue mussels, 10.0% for macroalgae, 7.9% for bottom fauna and 0% for eelgrass. For the fishing season 2020/2021 the total cumulative area impact will not therefore exceed the Mussel and Oyster Policy maximum set limit of 15% for each of the ecosystem components. The quota of 5,5000 tonnes for 2020/2021 is estimated to be sustainable at an ecosystem level within Løgstør Bredning.

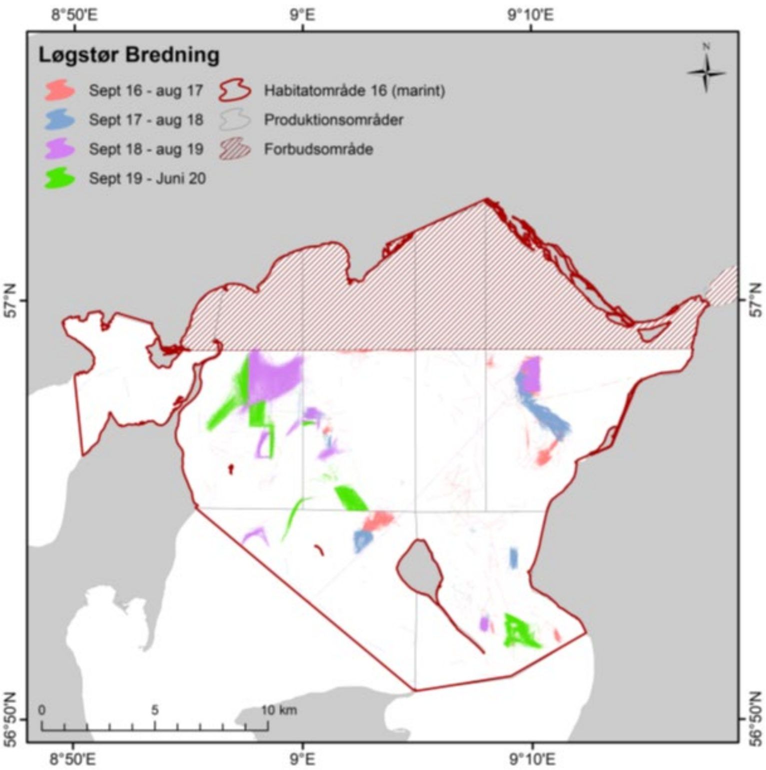


Figure 18. Distribution of mussel fishing for the fishing seasons 2016/17, 2017/18, 2018/19 and 2019/20 in Løgstør Bredning. The areas are generated based on ‘black box’ data. (Source: Nielsen *et al*., 2020b).

Table 12. Cumulative area of impact for blue mussel (blåmusling), macroalgae (makroalger), bottom fauna (bundfauna) and eelgrass (Ålegræs) as a percentage of the total area of habitat in Løgstør Bredning based upon a TAC of 5,500 tonnes of mussels, 150 tonnes of oysters and 200 tonnes of starfish (søstjerner). The estimates are based upon recovery times (gendannelsistid) of 3, >5 and 2-4 years for mussels, macroalgae and bottom fauna respectively. (Source: Nielsen *et al.*, 2020b).

	Gendan-nelsestid (år)	2016/17 (%)	2017/18 (%)	2018/19 (%)	2019/20 (%)	2020/21 5.500 t blåmus-ling (%)	2020/21 150 t flad østers (%)	2020/21 200 t søstjer-ner (%)	2020/21 Kumule-ret (%)
Blåmusling	3			2,6	1,6	2,3	1,4	0	7,9
Makroalger	>5	0,9	1,0	1,9	1,3	1,8	1,1	2	10,0
Bundfauna	3			2,6	1,6	2,3	1,4	0	7,9
Ålegræs	>20	0	0	0	0	0	0	0	0

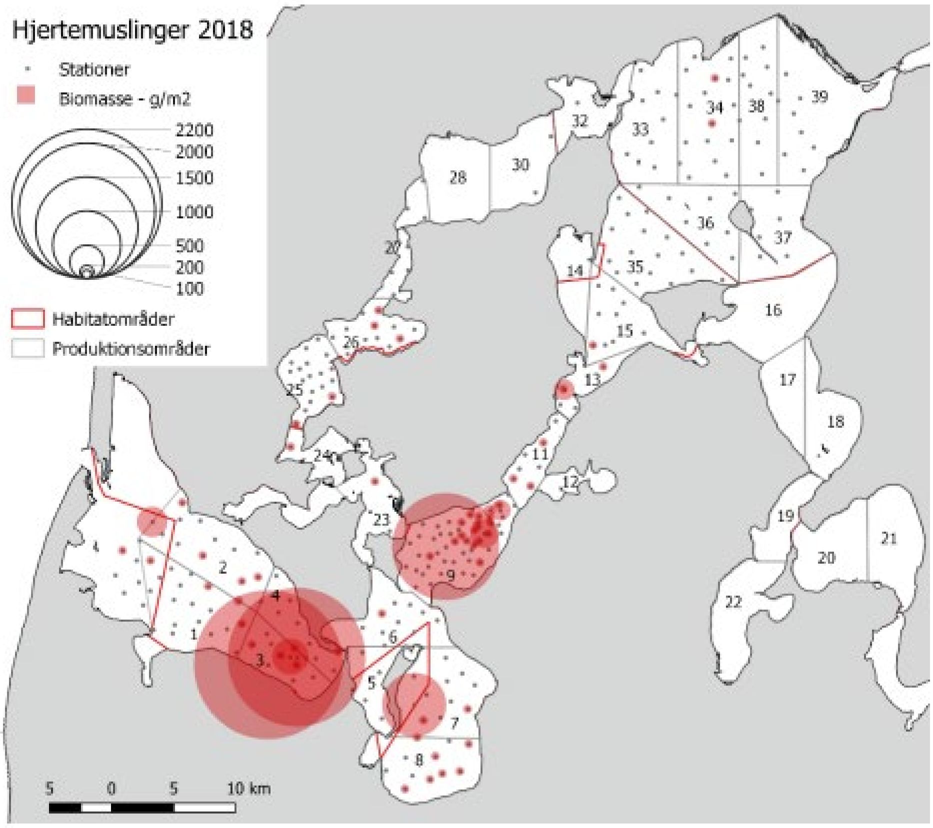
Cockles

There is no available time series of stock biomass estimates for cockles because there have not been regular or annual stock surveys of cockles undertaken in the Limfjord, and therefore there is no formal annual assessment of stock status for the cockle stock. The lack of annual stock surveys is primarily due to difficulties in quantitative sampling of a species which remains in the substrate and is most vulnerable to the fishing gear when it emerges from the substrate. Annual surveys of mussels in Natura 2000 sites use a mussel dredge with a top mesh size of 25 mm which therefore samples cockles also, although DTU Aqua estimated mussel dredge efficiency of only 22% (± 32%) for cockles submerged below the surface (DTU Aqua, 2020a). In 2018 DTU Aqua carried out a detailed survey of cockles in the Limfjord using a cockle suction dredge which is used to harvest cockles in other European fisheries. This detailed stock survey drew important conclusions about the distribution, abundance and size structure of the population of cockles in the Limfjord (DTU Aqua, 2020a). Cockle distribution in the Limfjord was highly clumped with a few stations accounting for most of the cockle abundance (Figure 19). Nearly 80% of the 285 stations sampled had no cockles, and only 5.7% of stations had densities >10 cockles/m^2. These observations on the cockle stock in the Limfjord reflect the nature of most cockle populations in commercial fisheries in Europe which show widespread but often ephemeral patches of cockles. Cockles were most abundant in areas where fishing has recently taken place, although large populations of cockles were observed in two areas of Nissum Bredning where there is no fishing for cockles. The survey detected multiple age cohorts in each basin implying successful recruitment in several recent years, with age classes 2, 3 and 4 dominating the age structure (Table 13). The most recent age cohort (age 1) is not well sampled as these cockles are smaller than the grid size of the suction dredge. An analysis of size-at-age showed that 54% and 94% of age 2 and age 3 cockles respectively were above the industry minimum size of shell width of 16mm (DTU Aqua, 2020a).

Biomass estimates from each station on the stock survey were used to produce an overall estimate of cockle stock biomass of 18,166 tonnes in the Limfjord, with an estimate of biomass in fishable areas (excluding Natura 2000 sites) of 6592 tonnes (DTU Aqua, 2020a). These estimates of total biomass are similar to the annual landings of cockles, which supports DTU Aqua's view that the suction dredge produces significant underestimates of the total stock biomass. The main problem with using such a survey to estimate total stock biomass is that the highly clumped distribution of cockles resulted in significant dense cockle beds being missed by the station grid of the 2018 DTU Aqua stock survey as exemplified by the identification of such high density cockle beds in the DTU Aqua 2018 monitoring of mussels and oyster distributions and by observed fishing patterns for cockles in the 2018/19 fishing season (Figure 20). In addition, as noted above, the suction dredge does not sample the small cockles in the age 1 year class. Figure 20 demonstrates that the patchy distribution of cockles will make it difficult to extrapolate stock survey results across the whole stock distribution in order to estimate total stock biomass, and therefore new methods for estimating cockle stock biomass are being developed under a new research project at DTU Aqua funded through EMFF. Whilst such detailed stock surveys as that undertaken by DTU Aqua in 2018 may provide an index of stock biomass over time, the ephemeral nature of the highly clumped cockle distributions means that absolute estimates of stock biomass require the development of new approaches.

In addition to the problems encountered with using fishery-independent stock surveys to estimate total stock biomass, DTU Aqua noted that it is not possible currently to accurately separate mussel and cockle fishing activity from the black box data and hence it is not possible to calculate an estimate of catch per unit effort (CPUE) for cockles from the annual fishery-dependent data (DTU Aqua, 2020a).

Whilst there is no time series of stock biomass, annual landings data provide information about cockle distribution and abundance for the different production areas, which indicate that cockles can be present in densities that are economically viable for fishing over a large part of the Limfjord but abundant populations are patchily distributed, both spatially and temporally. Landings therefore provide an index of the success of the fishery and hence an indirect index of stock abundance/biomass. Since the early stages of development of the cockle fishery as a permitted bycatch in the mussel dredge fishery in 2010 to 2012, cockle landings have increased significantly to fluctuate between 5000 and 8000 tonnes over the last 10 years. Whilst recent landings data show that cockles have been caught in commercial quantities across mussel production areas 2, 4, 7, 8, 9, 10, 11, 14, 15, 20, 21, 24, 25, 26, 27, 30, 35, 36, 37, and 39, in the last three years 99% of cockle landings are from six production areas only – areas 7, 8, 9, 11, 15 and 25. In particular shellfish production area 9, Kås Bredning, has been the most productive area over the last few years with the proportion of the total landings in the Limfjord that are harvested in Kås Bredning increasing from 38% to 74% (DTU Aqua, 2020a). Other production areas have yielded low levels of landings, but often only for one or two years perhaps reflecting lack of fishing effort in those areas, but more likely the ephemeral nature of cockle beds.



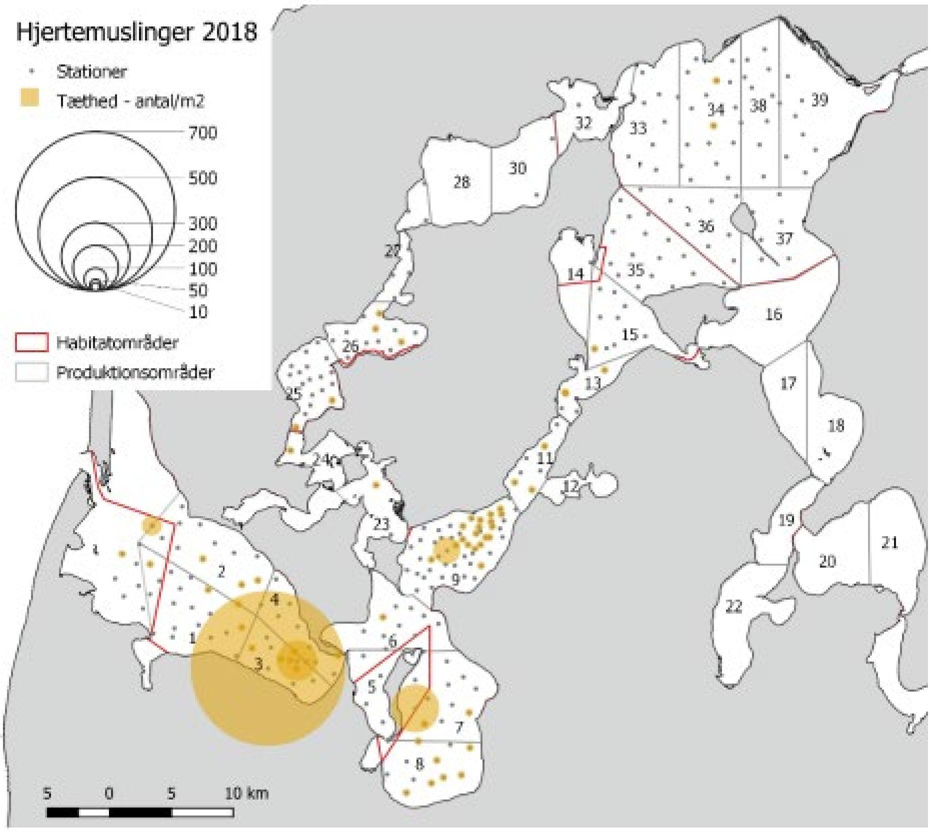


Figure 19. Abundance and distribution of cockles in April 2018 in the Limfjord. Top: biomass in g/m^2, bottom: density in number/m^2. (Source: DTU Aqua, 2020a)

Table 13. Proportion of cockles in each cohort in the Limfjord. (Source: DTU Aqua, 2020a)

Fishing area	Age Cohort / Settlement Year	1 / 2017	2 / 2016	3 / 2015	4 / 2014	5 / 2013	≥ 6 / ≤ 2012	Stations	N	Stock Estimate %
Nissum Bredning (1-4)			1.5	**93.5**	5.1			5	123	60.1
Venø Bugt (7-8)			1.8	**62.8**	**31.7**	3.7	0.02	5	153	21.0
Kås Bredning (9)		6.8	**29.0**	1.8	**40.3**	16.5	5.5	14	563	13.8
Sallingsund (13)			**55.1**	**37.3**	7.5			2	34	3.9
Agerø Sund (23, 24)		**96.4**	3.6					2	50	0.6
Visby Bredning (25, 26)		**100**						2	50	0.6
All Limfjorden		2.7	7.4	**70.2**	15.2	3.4	1.0	30	973	100
Fishing areas (7-9, 13, 25-26)		6.9	**17.9**	**29.9**	**33.2**	9.5	2.7	23	800	39.2
Non-fishing areas (1-4, 23-24)		0.4	1.5	**93.1**	5.1			7	173	60.7

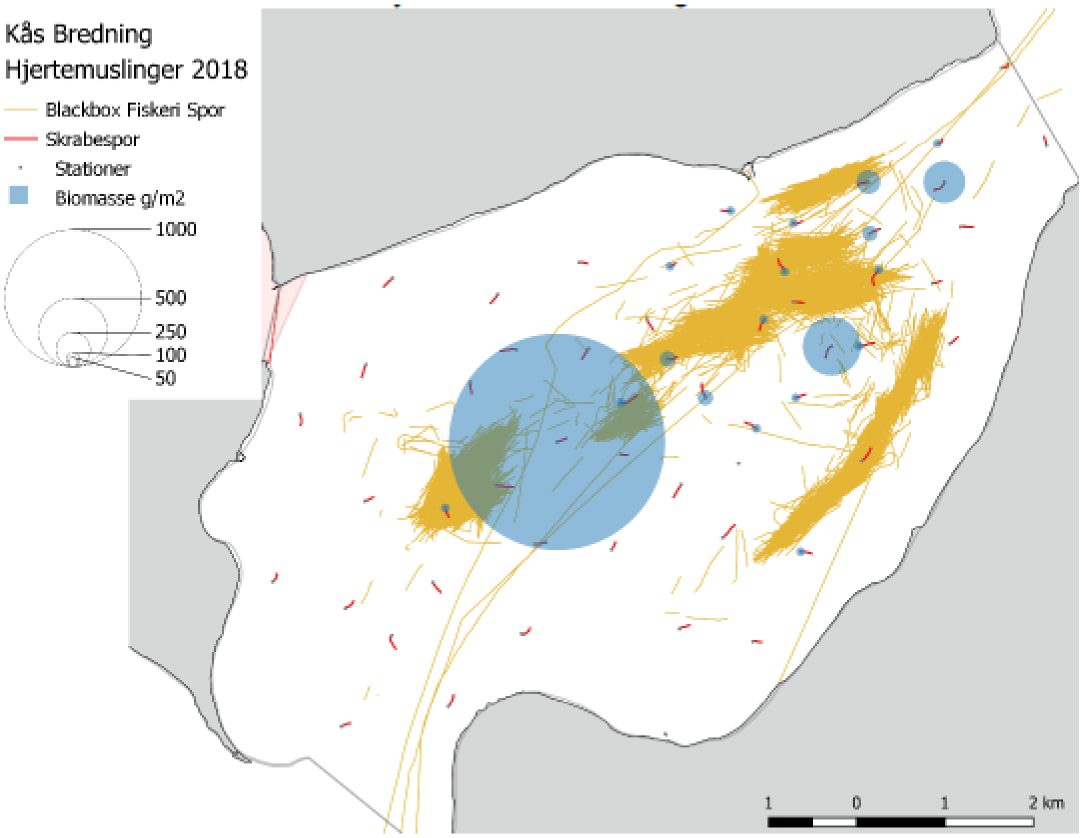


Figure 20. Kås Bredning. Black box fishing positions (yellow lines) for the fishing season 2018/19, cockle biomass as estimated from the 2018 DTU Aqua stock survey (blue circles) and survey dredge tracks (red lines). (Source DTU Aqua, 2020a; Danish Fisheries Agency)

<u>Limfjord oyster fishery (UoA 3)</u>

The oyster stock in the Limfjord is surveyed annually and within Natura 2000 sites a more detailed analysis of stock status is undertaken to ensure that the fishery does not impact the features of the sites. In autumn 2019, a mass mortality of oysters in Nissum Bredning was attributed to the parasite *Bonamia* and since then DTU Aqua have launched a monitoring program to identify any areas of the Limfjord with high mortality or high levels of infection that could negatively impact both the stock and the industry, and therefore throughout this section we describe the results from the two most recent stock surveys in 2019 and 2020. In recent years the main oyster harvesting area has been the Nissum Bredning area denoted by production areas 1-4 at the western end of the Limfjord. Nissum Bredning is designated as a Natura 2000 site and therefore any fishing activities require an assessment under the EU Habitats Directive. In connection with the 2018/2019 fishing season, intensive monitoring of oysters, starfish, eelgrass and macroalgae was carried out, and a detailed impact assessment was conducted on fishing of European oysters and starfish in H28 Habitat in Nissum Bredning (Nielsen *et al*., 2018a), which serves as a baseline for a 3-year impact assessment period valid up to and including the fishing season 2020/2021. The distribution of oysters in the Nissum Bredning in 2019 (Figure 21; Nielsen *et al.*, 2019b) is similar to previous years and the 2019 survey indicates a stock of approximately 1500 tonnes in water depths >3m, similar to that estimated for 2018, but lower than observed in 2017. The latest stock assessment also shows the exact fishing location from black box data (Figure 22). During the 2018/2019 fishing season, fishing for oysters in Nissum Bredning affected an area of approximately 1.7 km^2, which constitutes 1.0% of the area of the Nissum Bredning habitat area, while starfish fishing has affected 0.005 km^2 (Nielsen *et al.*, 2019b). However, it is important to assess the cumulative impact of fishing over many years in the same habitat, and the total area impact for four fishing seasons from 2015 to 2019 is shown in Figure 23. From 2014 to 2019, oyster fishing has affected 1.0-6.3% of the Nissum Bredning Natura 2000 site, and a proposed TAC for 2019/20 of 100 tonnes in Nissum Bredning is estimated to affect 2.1% of the Natura 2000 site, and the cumulative area impact of both the oyster and starfish fisheries on both the macroalgae and bottom fauna is estimated to be below the maximum permitted level of 15% (Nielsen *et al.*, 2019b). Based on the 2019 survey DTU Aqua estimated that fishing of up to 100 tonnes of oysters in Nissum Bredning will not affect the food base of mussel-eating birds (Nielsen *et al*., 2019b). A fishery of up to 100 tonnes of oysters constitutes 7% of the total European oyster stock in Nissum Bredning and 1.8% of the total oyster stock in all production areas surveyed in 2019.

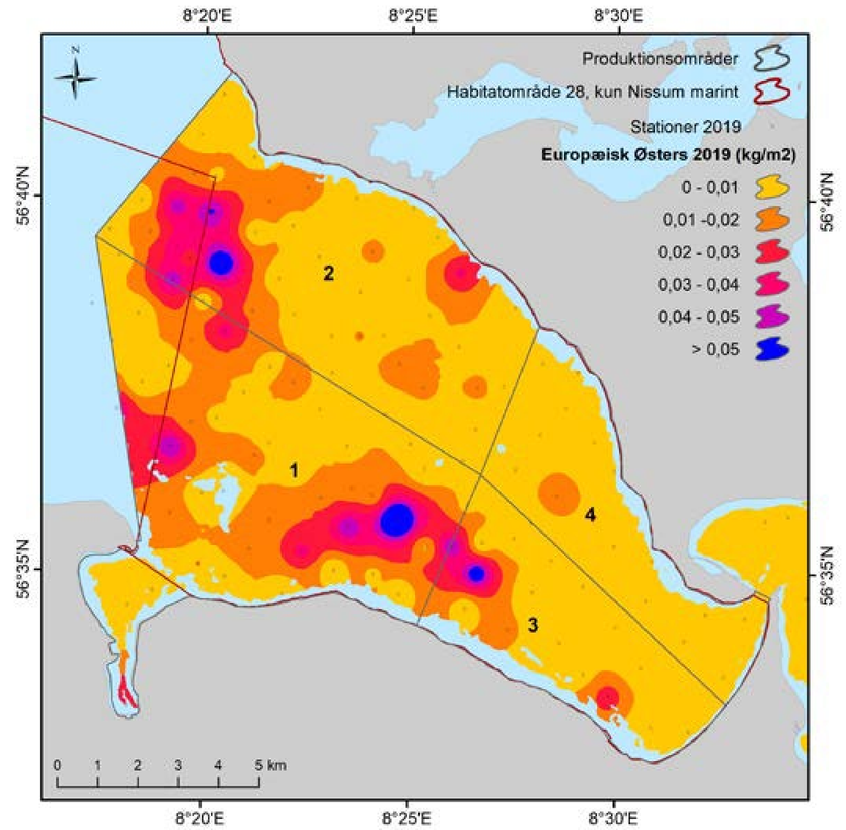


Figure 21 Distribution and abundance (kg m^{-2}) of European oysters in the Nissum Bredning Natura 2000 site from spring 2019 survey data (Source: Nielsen *et al.*, 2019b)

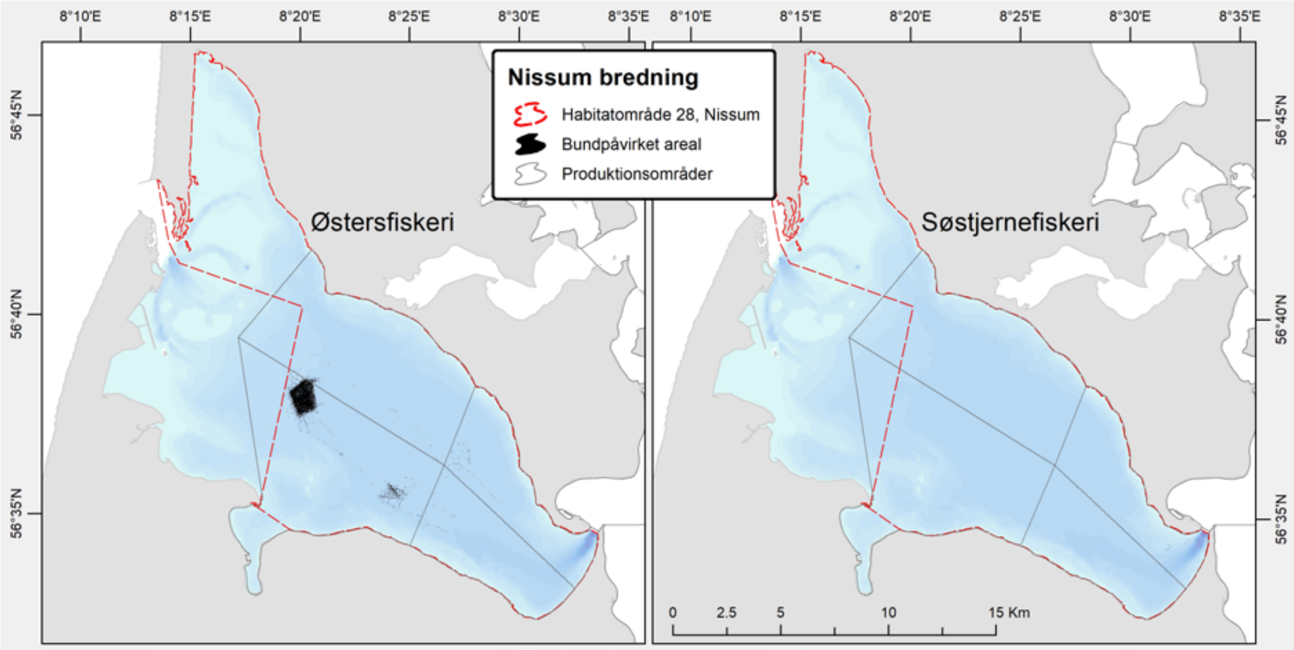


Figure 22. Distribution of fishing activity in the Nissum Bredning Natura 2000 site between September 2018 and August 2019. Left panel shows fishing for oysters, right panel shows fishing activity targeting starfish. (Source: Nielsen *et al.*, 2019b)

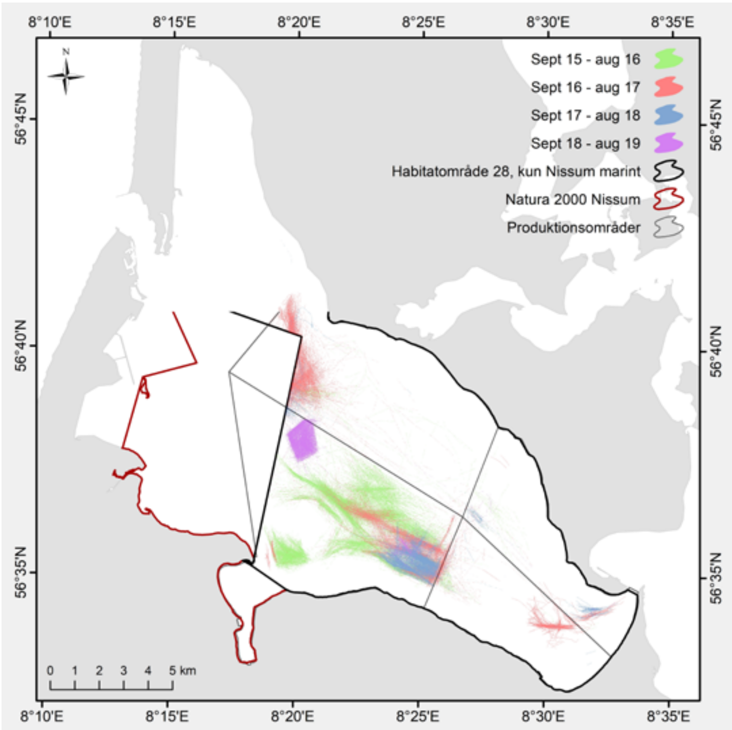


Figure 23. Total area impact for fishing seasons 2015/16, 2016/17, 2017/18 and 2018/19 in Nissum Bredning generated from black box data. (Source: Nielsen *et al.*, 2019b)

The most recent survey in spring 2020 showed a reduced biomass of oysters with a population of approximately 800 tonnes in Nissum Bredning in waters >3m with the highest densities in productions areas 1 and 2 (Figure 24; Nielsen *et al.*, 2020c). The biomass of oysters in Nissum Bredning in 2020 has declined significantly since 2019, and there has been no application for fishing for oysters in Nissum Bredning for fishing season 2020/2021. The 2020 stock assessment also shows the exact fishing location from black box data (Figure 25). During the 2019/2020 fishing season, fishing for flat and Pacific oysters in Nissum Bredning affected an area of approximately 1.6 km^2, which constitutes 0.9% of the area of the Nissum Bredning habitat area while starfish fishing has affected 0.7 km^2 (Nielsen *et al.*, 2020c). Nielsen *et al.* (2020c) note that black box data show that fishing of 89.6 tonnes of flat oysters in the fishing season 2019/2020 took place at approximately twice as high densities than assumed when estimating the area impact in last year's impact assessment for a quota of 100 tonnes (3.6 km^2 and 2.1%). The cumulative total area impact for the last four fishing seasons is shown in Figure 26. From 2016 to 2020, oyster fishing has affected annually 0.9-4.0% of the Nissum Bredning Natura 2000 site, and the cumulative area impact of both the oyster and starfish fisheries on both the macroalgae and bottom fauna was estimated to be below the maximum permitted level of 15% (Nielsen *et al.*, 2020c). There is no requirement for an assessment of the impact of the oyster fishery for 2020/2021 because there has been no application for oyster fishing in Nissum Bredning in 2020/2021.

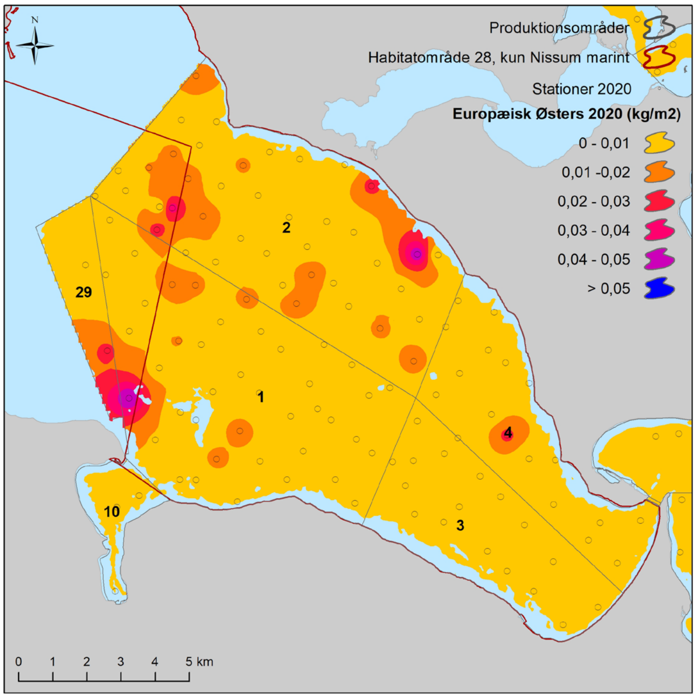


Figure 24. Distribution and abundance (kg m^{-2}) of European oysters in the Nissum Bredning Natura 2000 site from spring 2020 survey data. (Source: Nielsen *et al.*, 2020c)

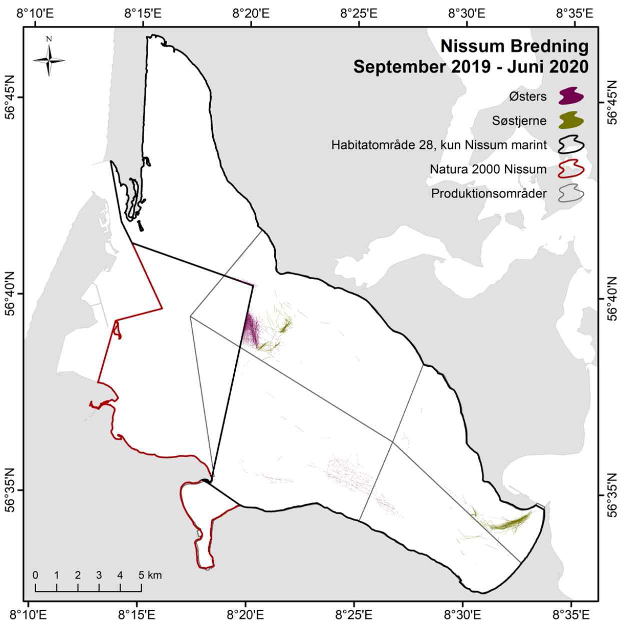


Figure 25. Distribution of fishing activity for flat and Pacific oysters in the Nissum Bredning Natura 2000 site between September 2019 and June 2020. (Source: Nielsen *et al.*, 2020c)

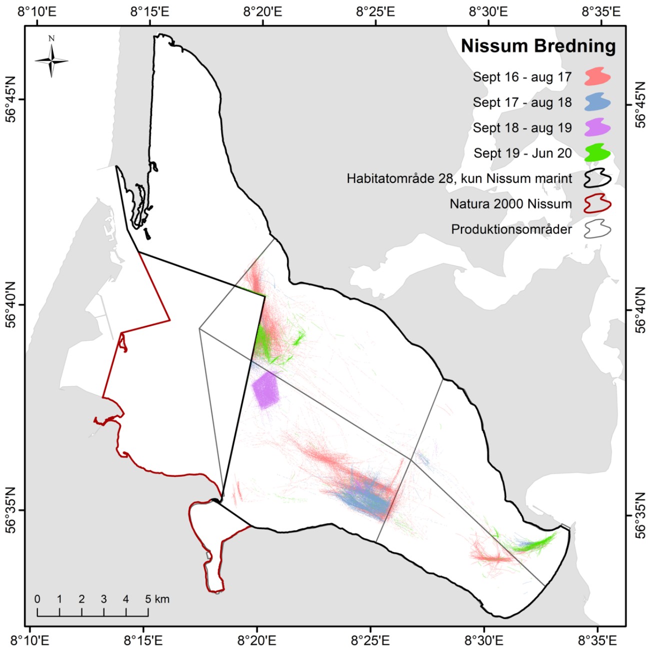


Figure 26. Total area impact for fishing seasons 2016/17, 2017/18, 2018/19 and 201/20 in Nissum Bredning generated from black box data. (Source: Nielsen *et al.*, 2020c)

The oyster stock in the Løgstør Bredning was also surveyed in 2019 and 2020. Prior to 2018 large quantities of oysters had not previously been recorded in Løgstør Bredning and other areas in the eastern Limfjord. In 2019 the distribution and abundance of oysters was similar to that in 2018 (Figure 27). The total estimated biomass of oysters in Løgstør Bredning in 2019 was 2,400 tonnes (Nielsen *et al*., 2019c). The cumulative distribution of mussel and oyster dredging effort from 2015-2019 is shown in Figure 28 . As the Løgstør Bredning is a Natura 2000 site, an appropriate assessment is required to evaluate the impact of fishing in this area. A TAC of 200 tonnes represents approximately 8% of oyster biomass in depths >3m in the area. In 2018/19 the total area of oyster fishing represented 6.2 km^2 corresponding to 2% of the Natura 2000 area. The assessment showed that the oyster fishery taking 200 tonnes in combination with 3,000 tonnes of mussels and 200 tonnes of starfish in 2019/20 would have a cumulative area impact for mussels, bottom fauna and macroalgae that does not exceed 13.8%.

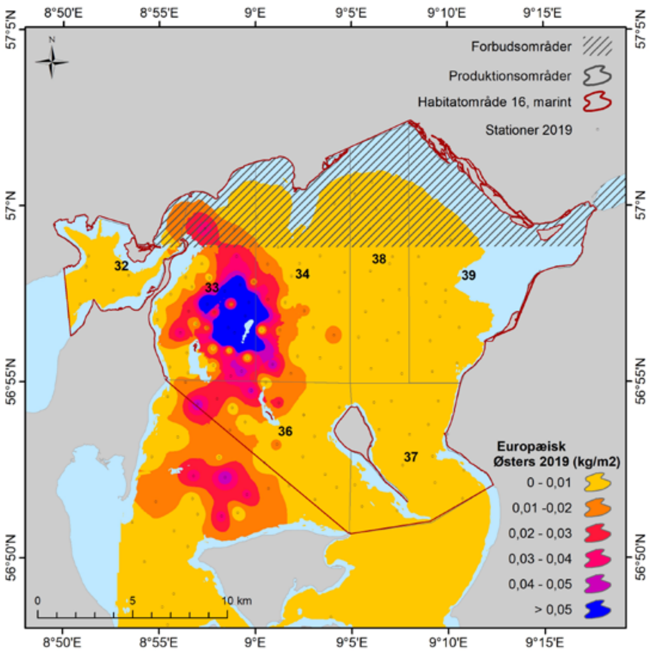


Figure 27. Distribution and abundance (kg m^{-2}) of European oysters in the Løgstør Bredning Natura 2000 site from spring 2019 survey data (Source: Nielsen *et al.*, 2019c)

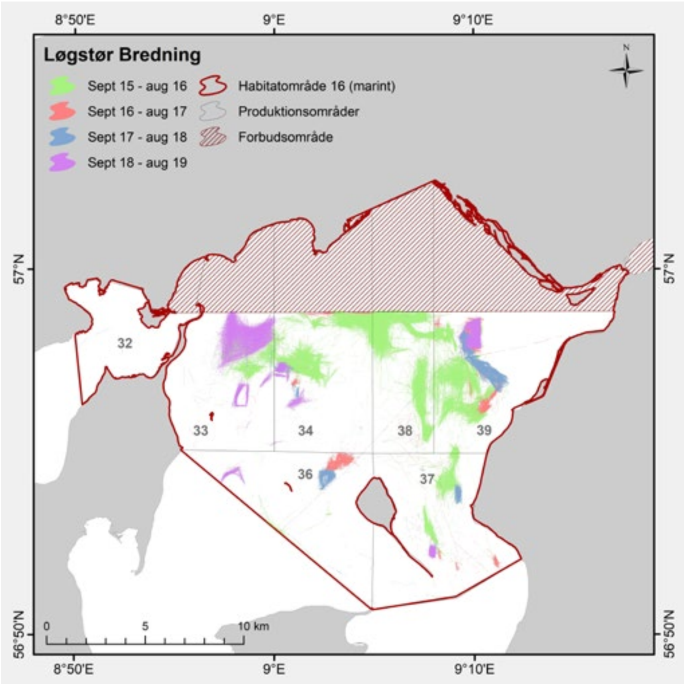


Figure 28. Total area impact for fishing seasons 2015/16, 2016/17, 2017/18 and 2018/19 in Løgstør Bredning generated from black box data. (Source: Nielsen *et al.*, 2019c)

The spring survey in 2020 showed that biomass of oysters in the Løgstør Bredning Natura 2000 area is approximately 2000 tonnes, and the stock is mainly (> 97%) located in areas 33, 34, and 36 (Nielsen *et al.*, 2020b; Figure 29). In 2019/20, oyster fishing impacted 2.73 km^2, which is equivalent to 0.9% of the total area of Løgstør Bredning (Figure 30). The cumulative distribution of mussel and oyster dredging effort from 2016-2020 is shown in Figure 31 .

DFPO's request is for a fishery of 150 tonnes of oysters in Løgstør Bredning for the period September 2020 to July 2021, which represents approximately 7.5% of the oyster stock in Løgstør Bredning and this request is considered by DTU Aqua in conjunction with proposed fisheries for mussels and starfish in Løgstør Bredning. DTU Aqua assesses that a fishery for a total 5,500 tonnes of mussels, 150 tonnes of flat oysters and 200 tonnes of starfish at water depths > 5 m, outside 5 eelgrass boxes and the closed area will not significantly impact the habitat area by affecting one or more of the ecosystem components as defined in the Mussel and Oyster Policy. In 2020, the stock of oysters was estimated at approximately 2,000 tonnes. The area affected by fishing of 150 tonnes of oysters is estimated at 4.5 km^2 corresponding to 1.4% of the total area. The cumulative effects of a fishery of 5,500 tonnes of mussels, 150 tonnes of flat oysters and 200 tonnes of starfish in the 2020/21 fishing season will not exceed the maximum permitted limit of 15% (Nielsen *et al.*, 2020b).

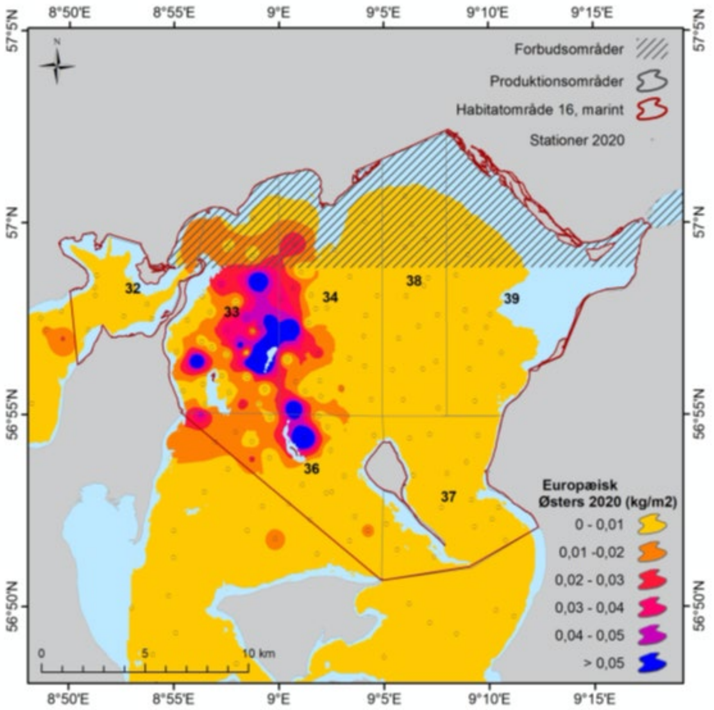


Figure 29. Distribution and abundance (kg m^{-2}) of European oysters in the Løgstør Bredning Natura 2000 site from spring 2020 survey data. (Source: Nielsen *et al*., 2020b)

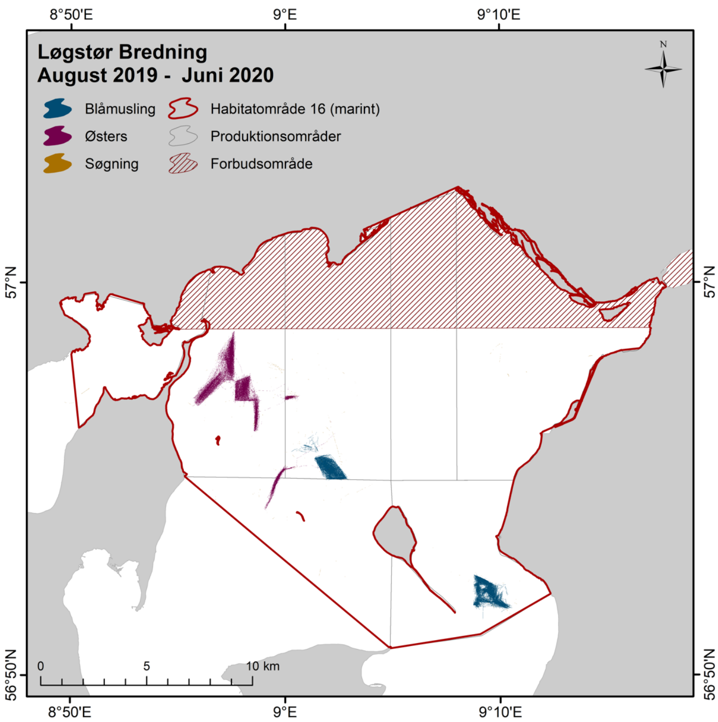


Figure 30. Area impact in the fishing season 2019/20 in Løgstør Bredning when fishing for mussels (dark blue) and oysters (purple) generated from black box data. (Source: Nielsen *et al*., 2020b)

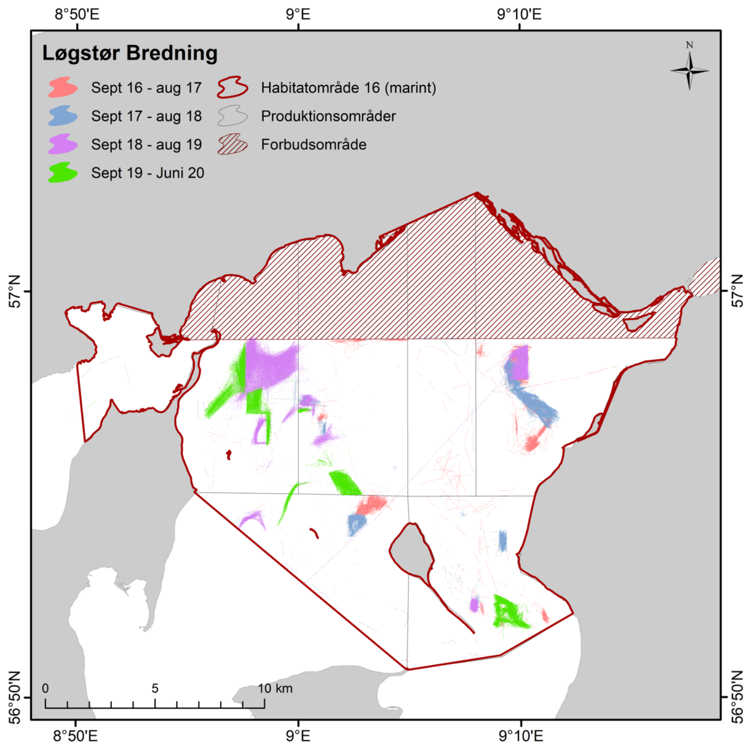


Figure 31. Total area impact of the mussel, oysters and starfish fisheries for fishing seasons 2016/17, 2017/18, 2018/19 and 2019/20 in Løgstør Bredning generated from black box data. (Source: Nielsen *et al*., 2020b)

Oyster stocks outside the Natura 2000 sites are also regularly surveyed. The most recent stock assessment reports of oysters based on the 2019 and 2020 surveys provide a total biomass estimate of 5,500 tonnes in 2019 (Nielsen *et al*., 2019b,c) and the 2020 surveys gave slightly lower biomass estimates of approximately 800 tonnes in Nissum Bredning, 1,400 tonnes in areas 5-9,11-13, 15 and 35 and 2,000 tonnes in the Natura 2000 area in Løgstør Bredning (Nielsen *et al*., 2020b,c; DTU Aqua, 2020b; Figure 32) with a total stock estimate for all surveyed production areas in 2020 of 4,700 tonnes (Figure 33). The largest settlements of oysters in areas outside Natura 2000 areas were found in areas 7, 8 and 28. These estimates of oyster biomass are for waters >3m depth, and there will be oysters in the shallower waters which are closed to dredging. DTU Aqua estimated that in 2015 there were approximately 383 tonnes of oysters in shallow waters in the Nissum Bredning and a further 35 tonnes in the production areas further east (DTU Aqua, 2015). This shallow water survey was conducted prior to the major increase in oyster abundance in the Løgstør Bredning and is therefore likely to be an underestimate of the oyster biomass in shallow waters across the whole Limfjord.

In summary, DFPO, the Central Association for the Limfjord and the Limfjord Fishermen's Oyster Association have submitted a request for a quota in 2020/21 of 150 tonnes of oysters in Løgstør Bredning and 50 tonnes in areas outside the Natura 2000 areas. DTU Aqua's assessment is that fishing at these levels will be sustainable in relation to the total population of oysters as a fishery of up to 200 tonnes represents less than 5% of the total oyster stock in all production areas surveyed in 2020. As noted above, there is no application for a fishery for oysters in Nissum Bredning in 2020/21.

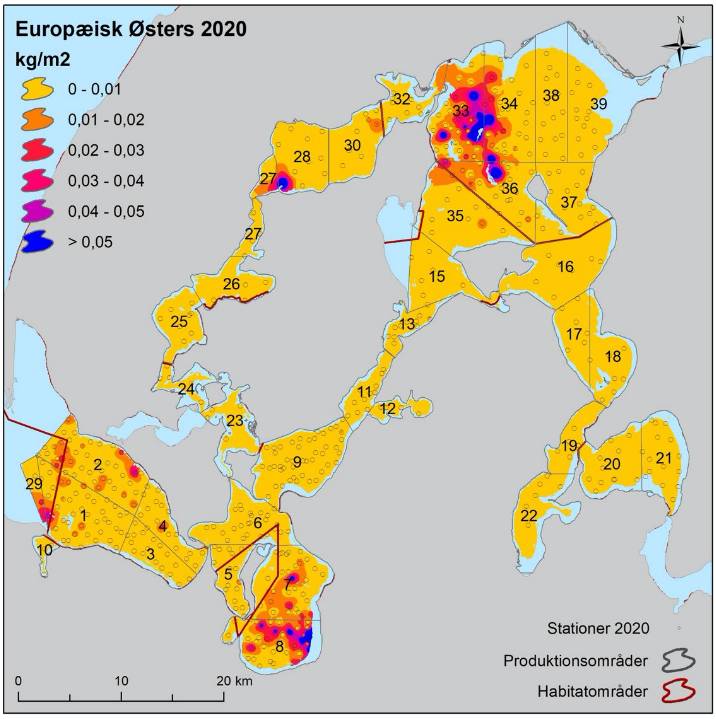


Figure 32. Distribution and abundance (kg m-2) of oysters in the Limfjord based upon the 2020 stock survey. (Source: DTU Aqua, 2020b)

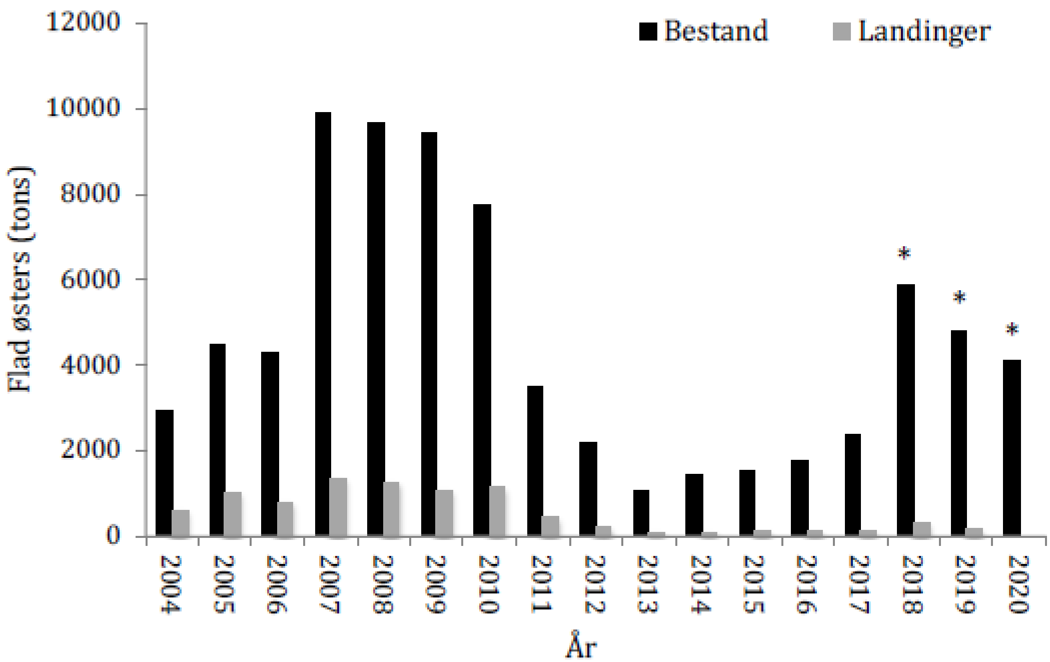


Figure 33. Standing stock (Bestand) and landings (Landinger) in tonnes from the Limfjord oyster fishery from 2004-2020. *Figures for 2018, 2019 and 2020 include biomass estimates from a much wider geographical area than in previous years, primarily related to the large biomass estimates in Løgstør Bredning in production areas 32-39. (Source: Nielsen *et al.*, 2020c)

Monitoring for Bonamia in Limfjord oyster populations

As noted above, a mass mortality event was observed in Nissum Bredning in autumn 2019 and a DTU Aqua analysis of live oysters showed a 38% infection with Bonamia (DTU Aqua, 2020c). In consequence, DTU Aqua launched a detailed monitoring programme for *Bonamia* across seven commercially important fishing areas with high oyster density. Between 2019 and 2020, in Nissum Bredning infection rates of Bonamia increased significantly (although there was only a small sample size in 2019) and oyster density declined significantly (Figure 34; Figure 35). In comparison, very low or zero infection rates were observed in oyster populations in other areas of the Limfjord (Figure 35). Whilst the oyster population in Nissum Bredning had older oysters and a wider range of size classes than the other areas, *Bonamia* infection was found across all size ranges in the oyster populations, suggesting that oyster populations in other areas may be infected by *Bonamia* in future years (DTU Aqua, 2020c). As a result of the outbreak of *Bonamia* and the declining stock estimates, no fishing for oysters has occurred in Nissum Bredning in the 2020/21 season. DTU Aqua warn that a set of preventive and mitigation measures aiming at restricting the movement and transfer of oysters between all areas will need to be implemented to reduce the spread of *Bonamia*.

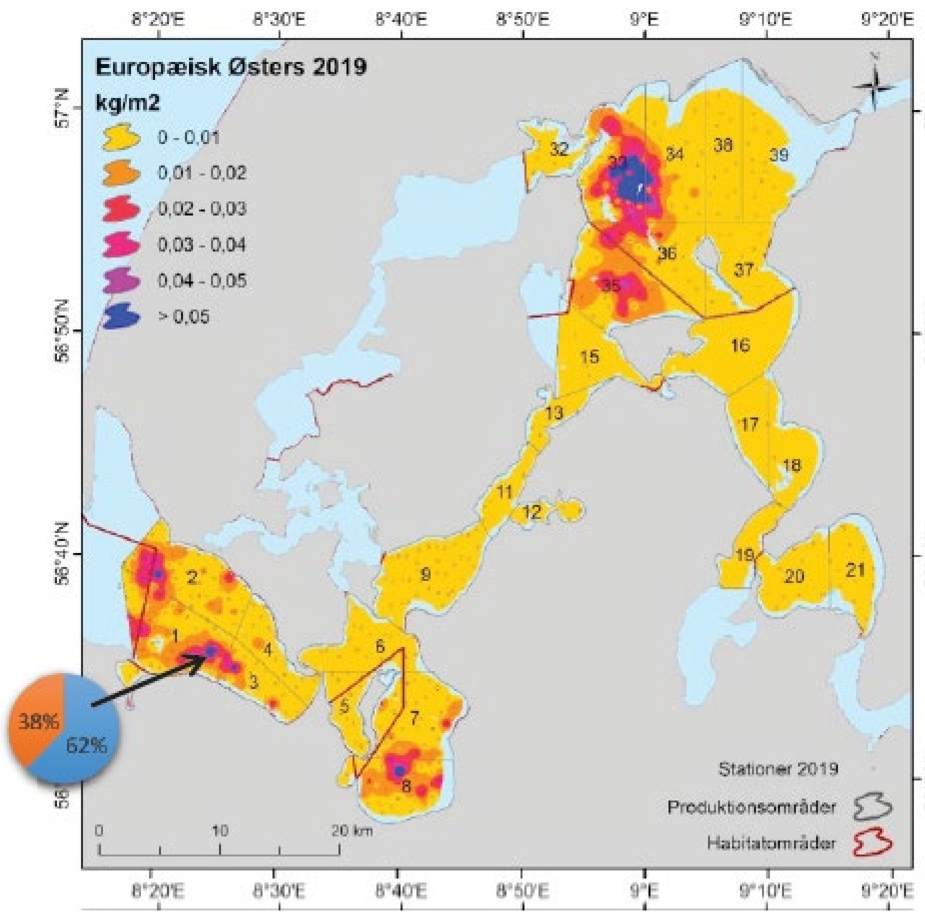


Figure 34. Oyster density in the Limfjord in 2019. *Bonamia* infection rates are plotted as pie charts with orange representing the percentage of oysters contaminated by *Bonamia*, and blue representing *Bonamia*-free oysters. (Source: DTU Aqua, 2020c)

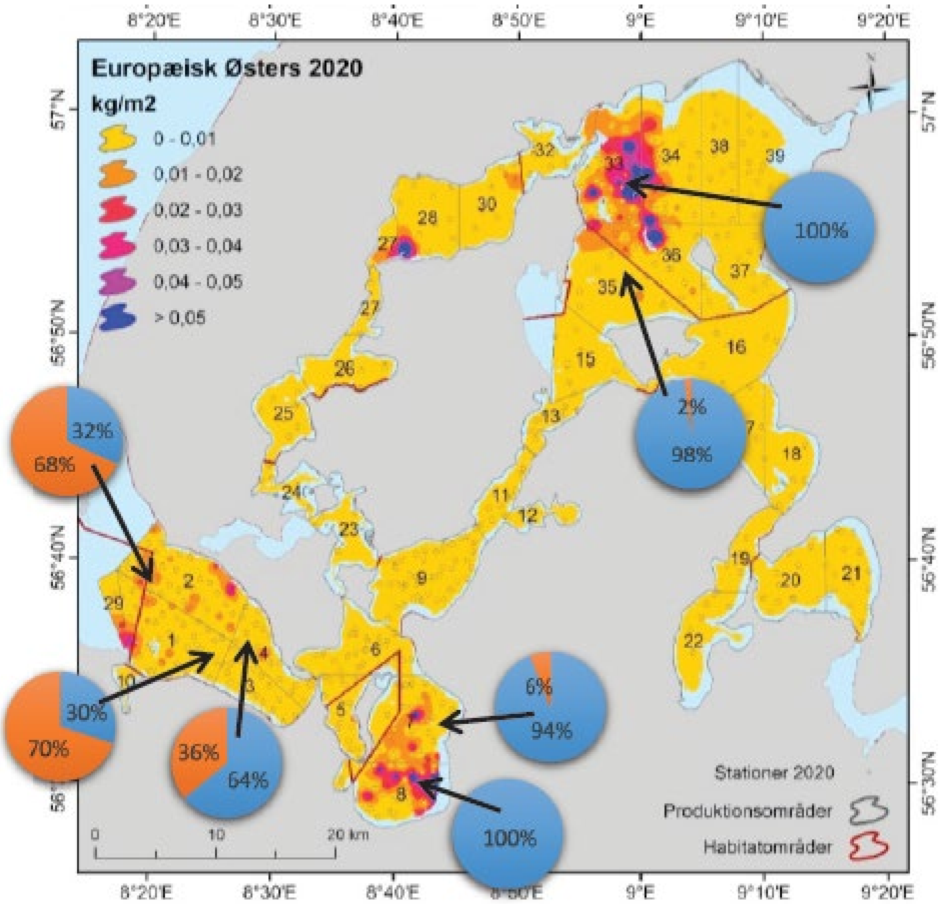


Figure 35. Oyster density in the Limfjord in 2020. *Bonamia* infection rates are plotted as pie charts with orange representing the percentage of oysters contaminated by *Bonamia*, and blue representing *Bonamia*-free oysters. (Source: DTU Aqua, 2020c)

<u>Inner Danish Waters mussel fishery (UoA 4)</u>

In the East Jutland and Isefjord areas there is only limited information available describing the stock status, because monitoring of stock status occurs on a regular basis only within the Natura 2000 sites with monitoring across the whole UoA being undertaken only occasionally. The first surveys of mussels in Danish waters were initiated in the Wadden Sea in 1986, in response to concerns about the potential effect of the fishery on bird populations in this area (DTU-Aqua, 2011). In 1994 DTU Aqua surveyed the mussels in Horsens, Vejle and Kolding fjords. Between 1995 and 1996, most of the Kattegat and Belt were studied from Tunø in the north to Flensburg Fjord in the south. The mussels in the vicinity of Tunø and Kalo Vig were studied by DTU-Aqua in collaboration with Aarhus County up until 2004, which was when the last reported stock assessment covering the whole area was carried out. Figure 1 in section 7.2.2 shows the distribution and relative abundance of mussels in Danish waters based on these early surveys. It is noticeable that there were no surveys at that time of mussels in the Isefjord. During the original certification assessment conducted by Moody Marine in 2011, that assessment team noted that there had been no recent stock surveys of the whole East Jutland and Isefjord. In consequence, the assessment team obtained an informal estimate of total stock abundance from Per Dolmer, a DTU Aqua scientist who is an expert on the mussel fishery (Moody Marine, 2012). Dolmer's stock estimates were as follows:

- East Jutland area – 750,000 tonnes
- Isefjord – 250,000 tonnes

Although there have been no recent surveys of mussel abundance across the entire fishing areas of the UoC, there have been regular monitoring surveys in the Natura 2000 sites. The most recently published survey in the Lillebælt Natura 2000 site was carried out in August 2018. The total population estimate for mussels in areas with water depths between 3-15 m in 2018 is estimated at approximately 35,000 tonnes (Figure 36) of which approximately 11,500 tonnes is made up of large (> 8 cm) mussels (Figure 37; DTU Aqua, 2018). The large mussels are not expected to form part of the food base of the mussel-eating birds in Lillebaelt. The total food requirements of the three mussel-eating bird species in Lillebaelt is estimated at 33,810 tonnes (Figure 36). As can be seen from Figure 36, the estimate of mussel stock biomass from the 2016 survey was not sufficient to allow a commercial fishery from 2016 to 2018, and although the estimate of stock biomass has increased since 2016, the commercial fishery remains closed currently. Black box data from vessels fishing in Lillebaelt in previous years when fishing was permitted showed that dredging in took place primarily in the areas of high mussel density corresponding to between 1% and 2% of the Natura 2000 site. With no sign of any recent recruitment, no further stock surveys have been undertaken in Lillebælt.

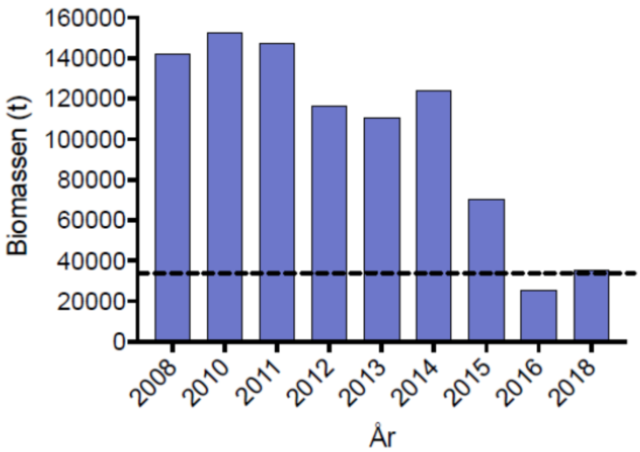


Figure 36. Biomass estimates (tonnes) in the Lillebælt Natura 2000 site from 2008 to 2018. The dotted horizontal line indicates the total food requirement for mussel-eating birds in the Lillebælt. (Source: DTU Aqua)

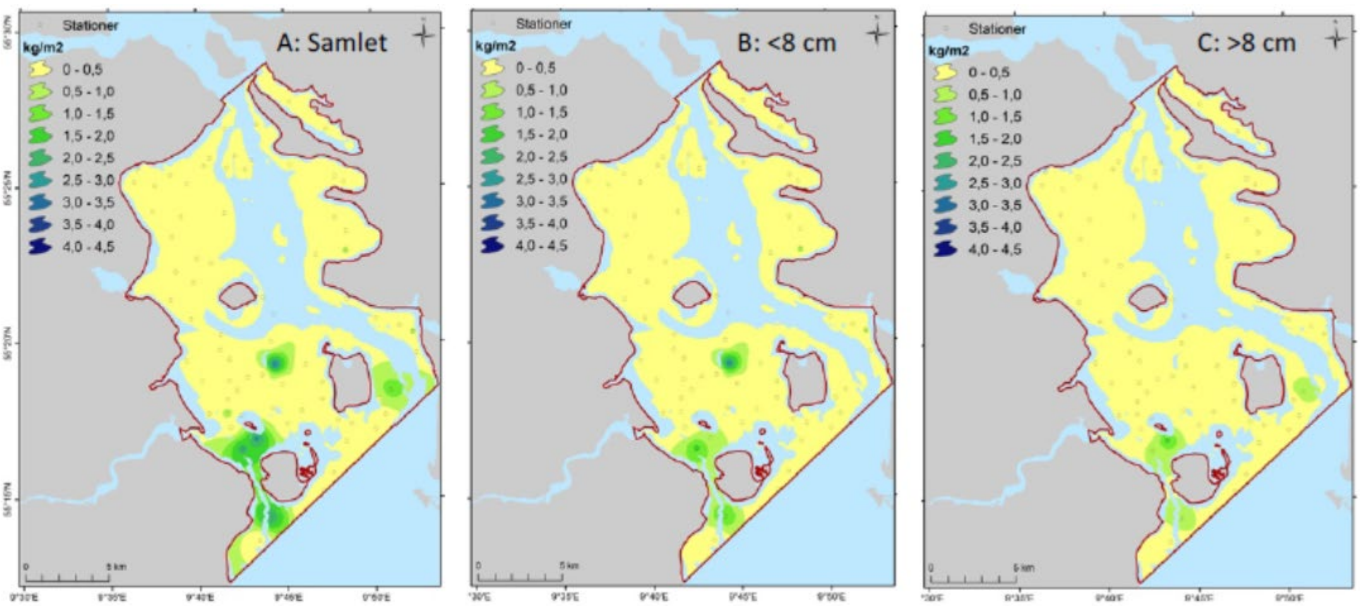


Figure 37. The distribution and densities (kg m-2) of mussels in the Lillebælt Natura 2000 site in 2018. A: Total mussel stock. B: Small (<8 cm) mussels. C: Large (> 8 cm) mussels. (Source: DTU Aqua)

Stock surveys in the Horsens Fjord Natura 2000 site were undertaken in 2016 and 2017. The total biomass of mussels in 2017 in the area at Horsens Fjord at depths greater than 3 m from an interpolation of biomass distribution (Figure 38) was calculated at 58,000 tonnes (Figure 39; Nielsen *et al.,* 2018b). In addition, there is a stock of mussels in shallower (< 3 m) and deeper (> 15 m) water that are not included in this estimate. The average biomass throughout Horsens Fjord during 2017 was estimated at 2.27 kg.m^{-2} (where only stations where biomass is greater than 1 kg.m^{-2} are included). The biomass in 2017 has declined significantly since 2016 (Figure 39), but that biomass estimate was still above the 25,800 tonnes that are required for shellfish-eating birds (Petersen *et al*., 2016) and therefore there was scope for opening the commercial fishery. Aggregated “black box” data from fishing vessels show the exact locations of all fishing activity between March and December 2017 (Figure 40). This illustrates the finite spatial distribution of fishing activities that occur mainly in the northernmost areas of the Natura 2000 site. Fishing for mussels in 2017 was carried out in Horsens Fjord in an estimated area of 3.62 km^2, which equates to 0.8% of the total area of the Natura 2000 site. DTU Aqua assessed that for a fishery of 12,000 tonnes of mussels for the fishing season 2018/2019, the total cumulative area impact would not exceed the Mussel Policy maximum set limit of 15% for each of the ecosystem components of mussels, macroalgae, bottom fauna and eelgrass. The quota of 12,000 tonnes for 2018/2019 was therefore estimated to be sustainable at an ecosystem level within the Horsens Fjord Natura 2000 site (Nielsen *et al*., 2018b). However, the most recent survey in Horsens Fjord in 2018 showed that the estimate of stock biomass had declined below the threshold of 25,800 tonnes that are required for shellfish-eating birds, and therefore the commercial fishery was not opened in 2019/20 and has remained closed since then as there has been no significant settlement of mussels in the Natura 2000 site. The assessment team notes that the 2018 stock survey results have not been formally published by DTU Aqua.

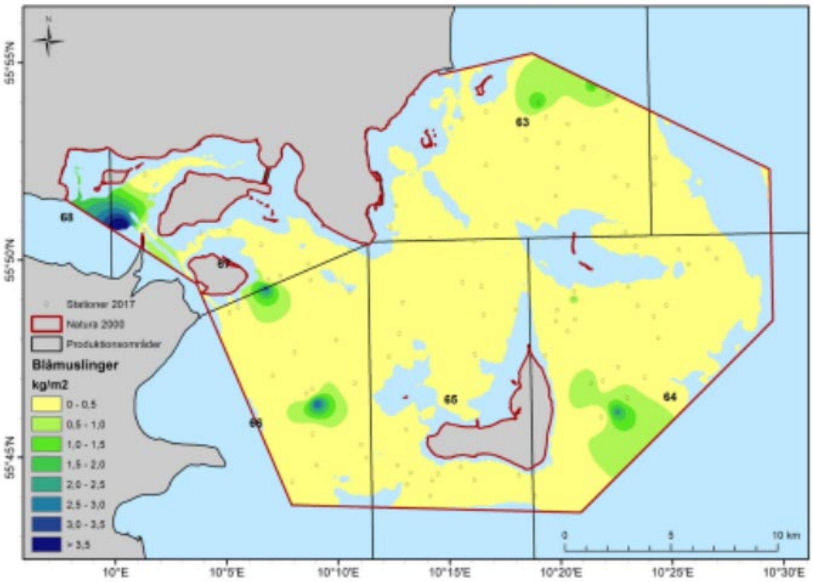


Figure 38. Map showing the distribution and density of mussels in waters greater than 3 m and less than 15 m in the Horsens Fjord Natura 2000 site in autumn 2017. (Source: Nielsen *et al*., 2018b)

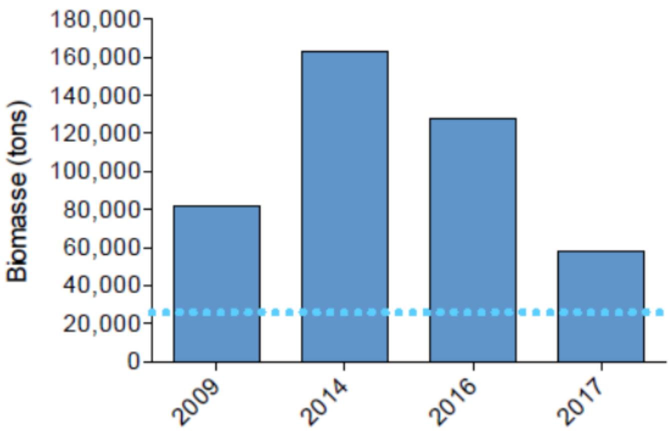


Figure 39. Biomass of mussels in the Horsens Fjord Natura 2000 site in waters between 3-15m depth. Dashed line represents the requirements of shellfish-eating birds (25,800 tonnes). (Source: Nielsen *et al*., 2018b)

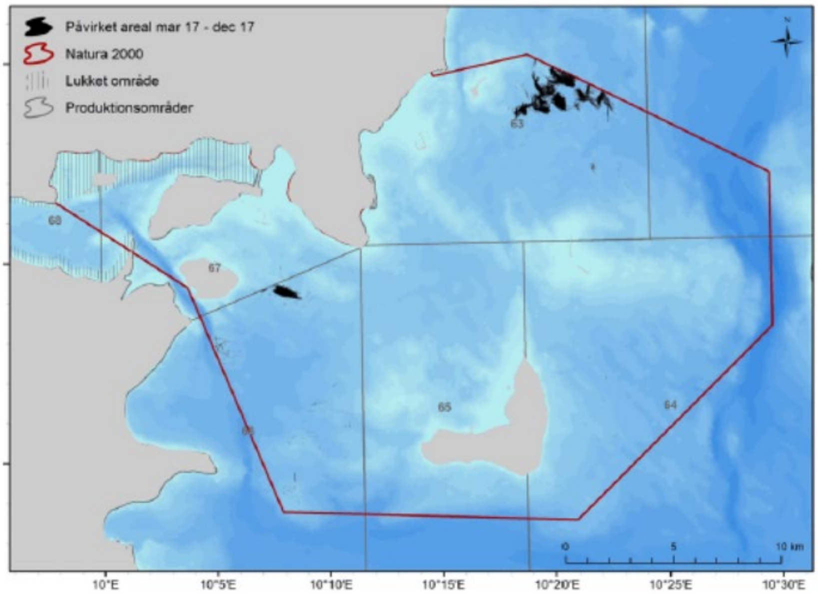


Figure 40. Distribution of mussel fishing activity in the Horsens Fjord Natura 2000 site in 2017. (Source: Nielsen *et al.*, 2018b).

DTU-Aqua collaborated with Wittrup Seafoods on a stock survey in the Vejle Fjord on the East Jutland coast (mussel production areas 72 & 73) in 2014 to provide a baseline for determining the potential of the area for mussel dredging, seabed cultivation and rope-grown mussel production. The survey was carried out with underwater video equipment over a period of 2 days, so it did not cover the entire area of the fjord and thus it was not possible to produce an estimate of mussel stock biomass. The extent of the mussel beds in the Vejle Fjord and the areas suitable for cultivation are shown in Figure 41. The fjord has produced relatively small quantities of mussels in recent years (1,352 tonnes in 2017/18 but no landings in 2018/19 and 2019/20), and there is interest in using mussel cultivation as a means of improving water quality in this area.

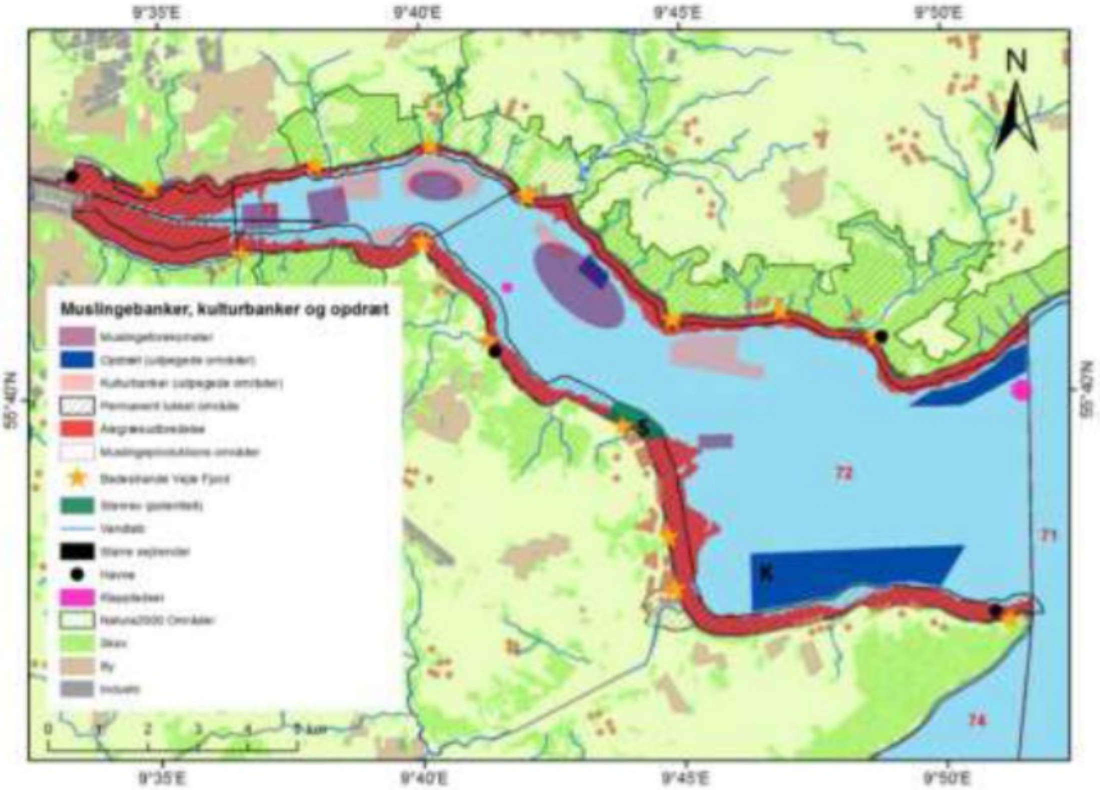


Figure 41. Results of the exploratory survey in Vejle Fjord in 2014 showing areas considered by DTU Aqua to be suitable for dredging (purple), areas suitable for seabed cultivation of mussels (pink), areas suitable for rope-grown mussel cultivation (blue) and areas suitable for the construction of artificial reefs (green). (Source: DTU Aqua Report 295-2015)

Until 2016 there had been no formal assessments of mussel stock status in the Isefjord portion of the UoA in recent years, although the initial certification report in 2012 had presented an informal estimate of 250,000 tonnes of mussels in the Isefjord by Per Dolmer, a former DTU Aqua scientist who is an expert on the mussel fishery (Moody Marine, 2012). However, a full stock survey of the Isefjord area was commissioned in 2016 by the client and undertaken by Orbicon. The 2016 stock survey covered 57 stations across mussel production areas 110-115 in areas deeper than 4 metres (Figure 42). The average density of mussels across all production areas was 0.25kg/m^2. The catch efficiency of mussel dredges from previous studies has been estimated to be between 20-50 %, leading to biomass estimates ranging from 73,272 tonnes to 183,181 tonnes of mussels in the Isefjord (Orbicon, 2016). Mussel length distributions recorded during the survey demonstrated that there were some stations with predominantly large commercial-sized mussels, and other stations where there were predominantly juvenile mussels, which suggests that future recruitment is likely to continue to sustain a fishery in this area. Annual landings from the fishery suggest an exploitation rate of 2.4% to 6.0% of the total biomass. No further mussel stock surveys have been carried out in the Isefjord since the recertification report was published.

At the time of the original recertification report (Addison *et al*., 2017) information from regular stock surveys in both the Lillebælt and Horsens Fjord Natura 2000 sites, a survey in the Vejle Fjord in 2014 and anecdotal information from both the client and fishing industry all suggested that the stock in the East Jutland portion of the UoA was strong at that time with high abundance across a wide area, with landings of mussels in the previous few years from almost all mussel production areas except those closed for fishing. The regular surveys in both the Lillebælt and Horsens Fjord Natura 2000 sites have shown significant declines in stock biomass. During the remote site visit, the assessment team met with Stig Wittrup, a mussel fisher and owner of four mussel dredging vessels in the Inner Danish Waters fishery. Whilst there had been no formal stock surveys of any areas in the Inner Danish Waters mussel fishery in 2019 and 2020, Stig Wittrup reported that despite the closure to mussel fishing of the Lillebælt and Horsens Fjords Natura 2000 sites, there had been good catches of mussels in the Eastern Jutland area, although catches had been declining recently. However, Stig Wittrup considered that such fluctuating abundance of mussels was typical of stock dynamics in the area. He reported good settlement of mussels this summer (2020) which should ensure a successful fishery in two years' time when these recently-settled mussels should have grown to commercial size. Stig Wittrup also reported that whilst catches had been relatively low in the Isefjord, catches had been improving in recent months, and he considered that overall prospects for the mussel fishery in the Inner Danish Waters in future years are good.

A new geostatistical assessment model has been developed in conjunction with a European Fisheries Fund (EFF) funded project to develop new methods and models to assess mussel stocks, which allows the estimation of mean stock biomass and confidence intervals. As noted above, the new methodology has been applied to stock survey data for the Limfjord mussel fishery, but to date there are not sufficient data to apply the methodology to estimating stock biomass in the Horsens Fjord and Lillebælt stock survey data ((Jens Kjerulf Petersen, DTU Aqua, pers. comm.).

Figure 42. Mussel density (kg/m^2) in mussel production areas 110-115 from dredge survey conducted in October 2016. (Source: Orbicon, 2016)

7.3.2 Catch profiles

Mussel landings in UoC 1

Landings from 1993-2012 are shown in Figure 43 with recent landings figures shown below.

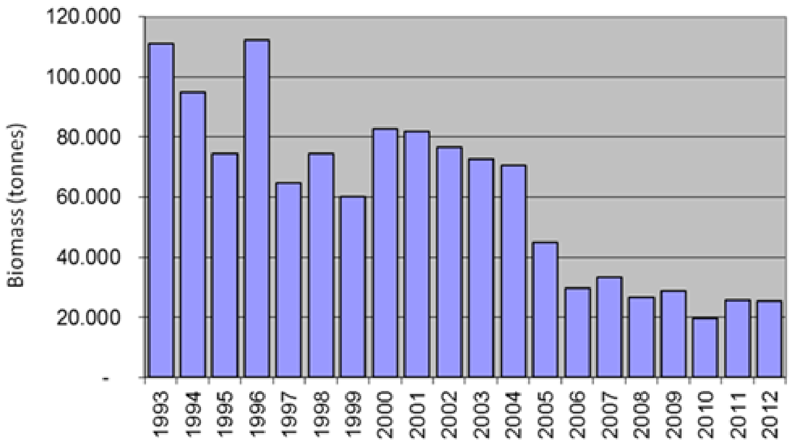


Figure 43. Landings figures for mussels in Limfjord (UoC 1) from 1993-2012. (Source: DTU Aqua)

Recent landings figures of mussels in Limfjord (green weight). Note that after 2016, landings figures are given for the fishing season, i.e., 1 September to 7 July, instead of calendar year. (Source: Danish Fisheries Agency):

2013	22,743 tonnes
2014	22,449 tonnes
2015	21,723 tonnes
2016	17,751 tonnes
2016/2017	20,975 tonnes
2017/2018	32,489 tonnes
2018/2019	22,807 tonnes
2019/2020	27,108 tonnes

Cockle landings in UoC 2

Table 14. Cockle landings in UoC 2 from 2009 to 2019/20. Note that after 2014, landings figures are given for the fishing season, i.e., 1 September to 7 July, instead of calendar year. (Source: Danish Fisheries Agency)

Year	Cockle landings (tonnes)
2009	0
2010	54
2011	441
2012	119
2013	4951
2014	6081
2014/15	5594
2015/16	6173
2016/17	10876
2017/18	11136
2018/19	13454
2019/20	11893

Oyster landings in UoC 3

Table 15. Landings of oysters (tonnes) in the Limfjord from 2010 to 2019/20. Note that after 2015, landings figures are given for the fishing season, i.e., 1 September to 7 July, instead of calendar year. (Source: Danish Fisheries Agency)

Year	Oyster landings (tonnes)
2010	998
2011	795
2012	163
2013	0
2014	46
2015	118
2016/17	44
2017/18	164
2018/19	304
2019/20	228

Mussel landings in UoC 4 (Inner Danish Waters)

Table 16. Landings of mussels from the East Jutland and Isefjord areas from 2007 to 2019/20. Note that after 2016, landings figures are given for the fishing season, i.e., 1 September to 7 July, instead of calendar year. (Source: Danish Fisheries Agency)

Year	Mussel landings (tonnes)
2007	24049
2008	8089
2009	8591
2010	8386
2011	8769
2012	14084
2013	15842
2014	18814
2015	23575
2016	24330
2016/17	20976
2017/18	45393
2018/19	37276
2019/20	24902

7.3.3 Total Allowable Catch (TAC) and catch data

Table 17 Total Allowable Catch (TAC) and catch data – UoC 1 Mussels

TAC	**Year**	**2020 / 2021**	**Amount**	**45 tonnes per licence per week (30 tonnes voluntarily)** **Lovns Bredning: 10,000 tonnes** **Løgstør Bredning: 5,500 tonnes**
UoA share of TAC	**Year**	**2020 / 2021**	**Amount**	**100% of TAC**
UoC share of TAC	**Year**	**2020 / 2021**	**Amount**	**100% of TAC**
Total green weight catch by UoC	**Year (most recent)**	**2019 / 2020**	**Amount**	**13,199 tonnes (net weight)** **27,108 tonnes (green weight)**
	Year (second most recent)	**2018 / 2019**	**Amount**	**13,997 tonnes (net weight)** **22,807 tonnes (green weight)**

Table 18. Total Allowable Catch (TAC) and catch data – UoC 2 Cockles

TAC	**Year**	**2020 / 2021**	**Amount**	**49% of mussel catch** **(10% in Natura 2000 sites)**
UoA share of TAC	**Year**	**2020 / 2021**	**Amount**	**100% of TAC**
UoC share of TAC	**Year**	**2020 / 2021**	**Amount**	**100% of TAC**
Total green weight catch by UoC	**Year (most recent)**	**2019 / 2020**	**Amount**	**6,203 tonnes (net weight)** **11,893 tonnes (green weight)**
	Year (second most recent)	**2018 / 2019**	**Amount**	**7,650 tonnes (net weight)** **13,454 tonnes (green weight)**

Note: The total annual catch of cockles is limited to 49% of the catch aboard a licensed mussel fishing boat on any fishing trip (i.e. a formal limit of 22.05 tonnes per week and a voluntary limit of 14.7 tonnes per week. Within the Lovns Bredning and Løgstør Bredning Natura 2000 sites, the cockle bycatch is limited to 10% of the total catch, i.e. 1000 tonnes and 550 tonnes in Lovns Bredning and Løgstør Bredning respectively for the 2020/2021 fishing season.

Table 19. Total Allowable Catch (TAC) and catch data – UoC 3 Oysters

TAC	**Year**	**2020 / 2021**	**Amount**	**200 tonnes***
UoA share of TAC	**Year**	**2020 / 2021**	**Amount**	**100%**
UoC share of TAC	**Year**	**2020 / 2021**	**Amount**	**100%**
Total green weight catch by UoC	**Year (most recent)**	**2019 / 2020**	**Amount**	**228 tonnes**
	Year (second most recent)	**2018 / 2019**	**Amount**	**304 tonnes**

Note that following a reduction in stock biomass in Nissum Bredning, the fishing industry has not requested a fishery for 2020/2021, and therefore the overall TAC for the Limfjord has been reduced for 2020/2021.

Table 20. Total Allowable Catch (TAC) and catch data – UoC 4 Mussels in Inner Danish Waters

TAC	**Year**	**2020 / 2021**	**Amount**	**270 tonnes per licence per week (180 tonnes voluntarily) Horsens Fjord and Lillebælt: 0 tonnes, closed to fishing**
UoA share of TAC	**Year**	**2020 / 2021**	**Amount**	**100% of TAC**
UoC share of TAC	**Year**	**2020 / 2021**	**Amount**	**100% of TAC**
Total green weight catch by UoC	**Year (most recent)**	**2019 / 2020**	**Amount**	**12,406 tonnes (net weight) 24,902 tonnes (green weight)**
	Year (second most recent)	**2018 / 2019**	**Amount**	**23,004 tonnes (net weight) 37,276 tonnes (green weight)**

7.3.4 Principle 1 Performance Indicator scores and rationales

PI 1.1.1 – Stock status – UoA 1 Mussels in Limfjord

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Scoring Issue		SG 60	SG 80	SG 100
a	Stock status relative to recruitment impairment			
	Guide post	It is **likely** that the stock is above the point where recruitment would be impaired (PRI).	It is **highly likely** that the stock is above the PRI.	There is a **high degree of certainty** that the stock is above the PRI.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

Stock status of mussels in the Limfjord are assessed annually and the fishery has been managed by controlling the exploitation rate through a TAC, but there are no formally defined reference points against which the current status of the stock can be assessed. However, the MSC Fisheries Standard for assessment of PI 1.1.1 anticipates such circumstances and states (GSA 2.2.3):

The wording of PI 1.1.1 requires scoring against the conceptual levels PRI and MSY. Such levels may or may not be used as explicit reference points in a fishery. There may be situations where well-managed stocks do not have target reference points or do not have limit reference points, or their values are not consistent with the conceptual levels of PRI or MSY. The stock will still need to be assessed in terms of the overall outcome objectives, i.e., for SG80 that the stock status is highly likely to be above the point at which there is an appreciable risk that recruitment is impaired and will be at or around a level consistent with BMSY.

All management systems should thus have reference points of some sort, as confirmed in PI 1.2.4 (scoring issue (b)). Where these are not stated explicitly they should be implicit within the decision rules or management procedures, and the fishery should be assessed using these implicit reference points.

The assessment team considers that the mussel fishery can be assessed in relation to this guidance as the stock is clearly well-managed with fishing effort limited through a limited entry licensing system and the use of a TAC. The fishery is managed on the basis that removal of mussels equivalent to the annual production of the stock is considered to be sustainable. Studies of the Limfjord mussel stock estimates the production biomass ratio (P/B) to be 40-50%, and annual stock surveys provide an estimate of stock biomass thereby allowing an estimate of annual production. This estimate of annual production provides therefore an implicit reference point for managing the exploitation rate in the fishery through the setting of a precautionary TAC.

Annual stock surveys show that mussel biomass fluctuates considerably from year to year. The stock survey in 2014 estimated that there were 265,000 tonnes in the areas open to fishing i.e. the waters deeper than 3m. This is the lowest biomass estimate in recent years, and although there have been no more recent wide-ranging stock surveys throughout the whole Limfjord, the annual surveys in Natura 2000 sites show that mussel biomass has increased in the Limfjord since 2014. In addition, the stock of mussels in the waters shallower than 3m which are not covered by the annual survey has been estimated to be around 325,000 tonnes.

Taking the lower end of the production biomass ratio of 40% and the relatively low stock biomass observed in 2014, this would imply that an annual harvest of approximately 106,000 tonnes from the areas opened to fishing would be sustainable and would therefore be consistent with a B_{MSY} approach. If the estimate of the total mussel stock of approximately 600,000 tonnes (including those in waters less than 3m deep) is taken into account, then an annual harvest of approximately 240,000 tonnes would be sustainable. Current management regulations within the Limfjord fishery have limited landings of mussels to between 20,000 and 30,000 tonnes per annum in recent years. This level of landings is therefore well below the estimated current annual production in waters deeper than 3m. Mussel mortalities are common in the Limfjord due to hypoxia events and such mortalities are likely to be higher than fishery removals, but even when such mortalities are taken into account, fishery removals on the scale of the whole fishery would not be expected to affect the mussel stocks.

There are a number of other factors that contribute to the protection of recruitment in the fishery. There are large parts of the Limfjord area that are closed to fishing. All waters less than 3m deep are closed to fishing, and within Natura 2000 sites this depth limit is increased to 5m, and further increased to 6m in areas where eelgrass may be present. Fishing is not permitted in Natura 2000 sites where the effect of mussel fishing has not been considered in an environmental impact assessment, or in areas where the fishing industry has not taken shellfish hygiene samples. These areas closed to fishing represent approximately 50% of the Limfjord, and effectively act as MPAs from which there may be spillover of recruits into the fishing areas. In practice, fishing occurs in much less than 50% of the Limfjord. For example, analysis of data from the black box system mandatory on all vessels shows that mussel fishing activity occurs in less than 5% of the Natura 2000 sites (Søren Palle Jensen, Danish Fisheries Agency, pers. comm.).

A key component of the management plan for the mussel fishery is that mussels below the minimum landing size are dredged from commercial mussel beds and re-laid on high production areas where hypoxia events are rare. Survival of re-laid mussels is high and so this relaying strategy is likely to enhance recruitment.

In addition to the overall management strategy within the mussel fishery, there are aspects of the biology of the species which suggest that recruitment will not be impaired by the fishery. Mussels are a highly fecund species with each female producing approximately 3 million eggs and will quickly establish new populations where suitable substrates are available for settlement. Settlement of seed mussel appears to occur over the whole Limfjord system, so seed mussel is not limited in the area. Dead shells and pebbles are important for settlement of mussels, but there is no evidence in the Natura 2000 sites at least that mussel dredging has impacted such substrates. However, mussel beds are found on a whole range of substrates, so settlement is not confined to particular substrates.

On the basis that (a) the management strategy for the mussel fishery has maintained the stock at a high level and is consistent with maintaining the stock at B_{MSY}, i.e. significantly above the point at which recruitment would be impaired, (b) there are large areas of the mussel distribution in the Limfjord that are closed to fishing, (c) recruitment to the fishery is enhanced by the relaying of small mussels in high production areas, and (d) mussels have a natural high fecundity, the assessment team considers that there is strong evidence that there is a high degree of certainty that the stock is above the point where recruitment would be impaired. The fishery meets the SG60, SG80 and SG100.

b	Stock status in relation to achievement of Maximum Sustainable Yield (MSY)			
	Guide post		The stock is at or fluctuating around a level consistent with MSY.	There is **a high degree of certainty** that the stock has been fluctuating around a level consistent with MSY or has been above this level over recent years.
	Met?		**Yes**	**No**
Rationale				

As noted above, MSC Fisheries Standard v2.01, GSA 2.2.3 acknowledges that there may be circumstances in which a well-managed fishery may have no target reference point. As such the assessment team needs to determine whether or not the stock is at a level that is consistent with B_{MSY}. On the basis that annual stock surveys since 1993 show that the stock has been fluctuating around a relatively high level over 20 years, there is a highly precautionary management regime in which recruitment is safeguarded in both the Natura 2000 sites and the wider fishery, large areas of the Limfjord are closed to fishing, and the mussel has a high natural fecundity, it is reasonable to conclude that the stock is fluctuating around a level that is consistent with a target reference point that is consistent with MSY. The assessment team concluded that the fishery meets the SG80, but in view of the lower stock biomass estimate in 2014, the relatively low biomass estimates in the Løgstør Bredning Natura 2000 site in recent years and the lack of Limfjord-wide stock surveys in recent years, there is not a high degree of certainty that the stock has been fluctuating around a level consistent with MSY and therefore the fishery does not meet the SG100.

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Nielsen, P., Geitner, K., Olsen, J. and Nielsen. M.M. 2019c. Notat vedrørende fiskeri af blåmus-linger, søstjerner, europæisk østers og stillehavsøsters i Løgstør Bredning 2019/2020. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 30pp.

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Nielsen, P., Olsen,J., Geitner, K. And Nielsen, M.M. 2020b. Konsekvensvurdering af fiskeri af blåmuslinger, europæisk østers, stillehavsøsters og søstjerner i Løgstør Bredning 2020/2021. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 77pp.

Stock status relative to reference points			
	Type of reference point	Value of reference point	Current stock status relative to reference point
Reference point used in scoring stock relative to PRI (SIa)	Fishing mortality based on annual assessment of stock biomass and estimates of annual production (estimated from observations of the stock to be 40-50% of stock biomass).	Annual fishing mortality is set at a level less than annual production of the mussel stock (40-50% of stock biomass), indicating that landings of up to 106,000 tonnes per annum from the stock in waters deeper than 3m would be sustainable. (Based on lowest stock biomass estimate in recent years)	Fishery landings are monitored and are consistently less than annual production. In recent years, landings have been around 20,000 to 30,000 tonnes per annum which equates to a maximum of 28% of current annual production of the fishable stock.
Reference point used in scoring stock relative to MSY (SIb)	As above	As above	As above

Draft scoring range and information gap indicator added at Announcement Comment Draft Report

Draft scoring range	**≥80**
Information gap indicator	**More information sought on recent mussel stock surveys outside the Natura 2000 sites**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**90**
Condition number (if relevant)	**NA**

PI 1.1.2 – Stock rebuilding - UoA 1 Mussels in Limfjord

PI 1.1.2		Where the stock is reduced, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue		SG 60	SG 80	SG 100
a	Rebuilding timeframes			
	Guide post	A rebuilding timeframe is specified for the stock that is the **shorter of 20 years or 2 times its generation time**. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.		The shortest practicable rebuilding timeframe is specified which does not exceed **one generation time** for the stock.
	Met?	**N/A**		**N/A**
Rationale				

The mussel stock is not depleted and so this PI is not scored.

b	Rebuilding evaluation			
	Guide post	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within the specified timeframe.	There is **evidence** that the rebuilding strategies are rebuilding stocks, **or it is likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the **specified timeframe**.	There is **strong evidence** that the rebuilding strategies are rebuilding stocks, **or it is highly likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the **specified timeframe**.
	Met?	**N/A**	**N/A**	**N/A**
Rationale				

The mussel stock is not depleted and so this PI is not scored.

References

Draft scoring range	**N/A**
Information gap indicator	**N/A**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**NA**
Condition number (if relevant)	**NA**

PI 1.2.1 – Harvest strategy - UoA 1 Mussels in Limfjord

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Harvest strategy design			
	Guide post	The harvest strategy is **expected** to achieve stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy **work together** towards achieving stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and is **designed** to achieve stock management objectives reflected in PI 1.1.1 SG80.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

Denmark is a member of the European Union and the mussel fishery is therefore managed within the framework of the Common Fisheries Policy (CFP). The long term objectives for the mussel fishery were established by the Danish Government through the setting up in 2005 of the Advisory Committee on Mussel Production following amendments to the Fisheries Act. The Advisory Committee facilitates co-management of the fishery by providing the formal link between the fishery managers, the Danish Fisheries Agency, and the Limfjord fishers' association. All mussel fishing vessels are covered by the DFPO code of conduct. In addition, the Mussel and Oyster Policy document which was published in 2013 (and subsequently revised in 2019) sets out the management strategy based on consultation with WWF and Danish Nature Conservation NGOs – a key component of the harvest strategy.

The overall harvest strategy is to limit mussel dredging to a small proportion of the total distribution of mussels, and to ensure that recruitment to the fishery is safeguarded. In addition, within Natura 2000 sites, the harvest strategy is designed to ensure that mussel dredging does not adversely affect the conservation features. The harvest strategy is composed of a number of elements, including a robust monitoring, control and surveillance policy. The fishery is a limited entry fishery with a maximum of 50 licences, although more than one licence can be aggregated on a single vessel, and in 2020 there were only 22 active vessels in the fishery. There is a minimum landing size of 50 mm, restrictions on the weight and size of dredge, restrictions on vessel size and power, limits on the depth in which fishing is permitted, closed seasons and areas, and no fishing is permitted on Sundays and during the hours of darkness. There is a daily TAC in the general fishery of 45 tonnes per licence, although the fishers' association voluntarily reduces this to 30 tonnes. This action was taken in response to a 2004 report that raised concerns about the long-term sustainability of the fishery and remains in place today. Whilst the catch limits set by the fishers' associations are informal, in conjunction with DFPO the catch limits can be enforced and sanctions applied if the limits are exceeded. The TAC covers total catch of both mussels and cockles, and the landings must contain a minimum of 51% mussels, and 1% bycatch of oysters is permitted. No sorting of the catch is permitted on board the vessel, although stones over 2 kg in weight must be returned to the sea. Within the Natura 2000 sites, there is an annual TAC, and individual landings must contain a minimum of 90% mussels, and there is a limit on vessel numbers allowed in the Natura 2000 sites at any one time. To further safeguard recruitment, there is a relaying strategy for the fishery whereby a communal vessel, "Limfjord", has a licence to dredge mussels below the minimum landing size and relay them in more productive areas.

There is an implicit reference point of the annual production of the mussel stock, estimated as 40-50% of the total biomass, and the harvest strategy is designed to ensure that annual landings are below the annual production of the stock. SG60 is met. Annual stock surveys provide estimates of stock biomass information and TACs and the levels of exploitation are adjusted in relation to estimates of stock biomass. The assessment team concluded that the various elements of the harvest strategy work together to ensure that the harvest strategy is responsive to the state of the stock (SG80 is met) and is designed to achieve stock management objectives and so the SG100 is met.

b	Harvest strategy evaluation

	Guide post	The harvest strategy is **likely** to work based on prior experience or plausible argument.	The harvest strategy may not have been fully **tested** but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been **fully evaluated** and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
	Met?	**Yes**	**Yes**	**No**
Rationale				

The use of TACs adjusted annually in relation to stock biomass estimates, effort limitation, technical conservation measures and robust monitoring and enforcement are a proven method for controlling exploitation rates, ensuring that the reproductive potential of the stock is not impaired by the fishery. Data from the "black box" system on board all vessels provide evidence that there is compliance with all spatial controls in the fishery. Stock surveys and closely monitored landings data over the last 20 years provide evidence that the harvest strategy is achieving its objective of ensuring that fishery removals do not exceed the annual production of the standing stock. There is evidence therefore that the harvest strategy is achieving its objectives and is able to maintain stocks at target levels, and so the SG60 and SG80 are met. There is no evidence that the harvest strategy has been fully evaluated through, for example, a Management Strategy Evaluation (MSE), and therefore the SG100 is not met.

c	Harvest strategy monitoring			
	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	**Yes**		
Rationale				

Landings are closely monitored through logbooks (ERS on larger vessels and paper records on smaller vessels) and through catch declarations on landing. Fishing activity is monitored through the installation on all vessels of a "Black box" system which provides positional information every 10 seconds. In addition, vessels must "hail in" before landing and provide details of fishing area and estimated weight of landings, and there is a strong enforcement presence in harbours and at the processors to ensure compliance with regulations. All these elements of the monitoring programme are capable of showing whether the harvest strategy is working, and cross-checks of the various components of the monitoring programme show no systematic mis-reporting. The SG60 is met.

d	Harvest strategy review			
	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			**No**
Rationale				

Elements of the harvest strategy are regularly reviewed through, for example, the Advisory Committee on Mussel Production, but the assessment team found no evidence that the harvest strategy as a whole is regularly reviewed. The SG100 is not met therefore.

e	Shark finning			
	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**NA**	**NA**	**NA**

Rationale

Sharks are not a target species in this fishery, so this scoring issue is not scored.

	Review of alternative measures			
f	Guide post	There has been a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock, and they are implemented, as appropriate.
	Met?	**Yes**	**Yes**	**No**

Rationale

There is regular review of the minimum landing size and there is a minimum mesh size designed to ensure that catch of small juvenile mussels is minimised. Fishers will often carry out underwater video or ground-truthing observations to avoid areas of high density of small mussels and will not request opening of any production areas which have high densities of small mussels. In addition, mussels under the minimum landing size will be relayed from areas where oxygen depletion events are common to higher production areas in the Limfjord to allow them to 'grow-on' to a commercial size. Alternative measures to minimise mortality of unwanted catch are regularly reviewed, so the SG60 and SG80 are met, but it is not clear that a formal review is conducted every two years so SG100 is not met.

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Nielsen, P., Olsen, J. and Nielsen. M.M. 2019a. Notat vedrørende fiskeri af blåmuslinger og søstjerner i Lovns Bredning 2019/2020. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 23pp.

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Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for muslinge- og østersskrab og øvrig muslinge- og østersproduktion i og udenfor Natura 2000 områder.

Draft scoring range	**≥80**
Information gap indicator	**More information sought on recent reviews of alternative measures to minimise UoA related mortality of unwanted catch.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**85**
Condition number (if relevant)	**NA**

PI 1.2.2 – Harvest control rules and tools - UoA 1 Mussels in Limfjord

PI 1.2.2		There are well defined and effective harvest control rules (HCRs) in place		
Scoring Issue		SG 60	SG 80	SG 100
a	HCRs design and application			
	Guide post	**Generally understood** HCRs are in place **or available** that are **expected** to reduce the exploitation rate as the point of recruitment impairment (PRI) is approached.	**Well defined** HCRs are **in place** that **ensure** that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock **fluctuating around** a target level consistent with (or above) MSY, or for key LTL species a level consistent with ecosystem needs.	The HCRs are expected to keep the stock **fluctuating at or above** a target level consistent with MSY, or another more appropriate level taking into account the ecological role of the stock, **most** of the time.
	Met?	**Yes**	**Yes**	**No**
Rationale				

The key harvest control rule in place is that the exploitation rate is controlled through the setting of a TAC for the Limfjord mussel fishery that is compatible with the annual production of the mussel stock, defined as 40-50% of the stock biomass. Stock biomass is estimated annually through a stock survey so that the weekly TAC allocated to each fishing licence is adjusted to be compatible with stock status allowing a reduction in the TAC if the stock should decline. The weekly TAC was set initially at 85 tonnes when first introduced in the 1990s when the stock biomass was estimated at over 700,000 tonnes but was then reduced to 45 tonnes per week when stock estimates fell in later years. The weekly TAC has remained at 45 tonnes, and although stock surveys have shown fluctuations in stock biomass in recent years, the current TAC is still compatible with the annual production of the mussel stock, and there is therefore no requirement currently to reduce the TAC. It should be noted also that the fishers' association imposes additional voluntary controls on landings. The self-imposed weekly TAC of 30 tonnes is lower than the statutory level set by the management authorities, and the fishers also avoid fishing in areas where there is a high proportion of juvenile mussels or areas that are thought to act as a broodstock for the fishery. An additional harvest control rule requires that a large proportion of the mussel stock should be left unfished in shallow waters and there are other spatial controls which prevent dredging in much of the Limfjord. These harvest control rules are considered to be well-defined and ensure that the exploitation rate is reduced if landings approach the level of annual production of the stock and should ensure that the stock is kept at a level that is consistent with MSY. The fishery therefore meets the SG60 and SG80.

A separate annual TAC is set for the Natura 2000 sites which is responsive to estimates of stock biomass but is set at a lower exploitation rate which takes into account the food requirements of the birds within the Natura 2000 sites, and the potential impact of the mussel fishery on distributions of macroalgae, bottom fauna and eelgrass beds within the Natura 2000 site. The HCR therefore takes into account the ecological role of the stock within the Natura 2000 sites which meets the SG100 requirements in those areas, but outside the Natura 2000 sites it is not clear that the ecological role of the stock is fully taken into account and therefore a score of 80 is appropriate for the whole Limfjord area. The SG100 is not met.
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b	HCRs robustness to uncertainty			
	Guide post		The HCRs are likely to be robust to the main uncertainties.	The HCRs take account of a **wide** range of uncertainties including the ecological role of the stock, and there is **evidence** that the HCRs are robust to the main uncertainties.
	Met?		**Yes**	**No**

Rationale

The main uncertainties for the mussel stock are the variation in and unpredictability of recruitment, and mortality of post-recruits due to predation and hypoxia events. The harvest control rule uses stock biomass estimates from annual stock surveys to ensure that fishery removals do not exceed annual production. These uncertainties are taken into account in the selection of the harvest control rules by using precautionary estimates of stock biomass, i.e. estimates based only on the stock in waters deeper than 3m. The stock of mussels in the shallower waters that is not open to fishing, and which is not included in the estimate of annual production, is estimated to be 325,000 tonnes. In the Natura 2000 sites, a wider range of uncertainties are taken into account in the selection of the harvest control rules. Mussel stocks in waters less than 5m depth are not open to fishing, the ecological role of mussels as food for shellfish-eating birds is included in the setting of the annual TAC, and the potential indirect effects of fishing on marine habitats is also considered by closing potentially vulnerable areas to fishing.

The harvest control rules in place for the whole Limfjord fishery take the main uncertainties into account and therefore the SG80 is met. A wide range of uncertainties including the ecological role of the mussels is taken into account in the Natura 2000 sites, which meets the SG100 requirements in those areas, but a score of 80 is appropriate for the whole Limfjord area, and therefore for the whole area the SG100 is not met.

	HCRs evaluation			
c	Guide post	There is **some evidence** that tools used **or available** to implement HCRs are appropriate and effective in controlling exploitation.	**Available evidence indicates** that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.	**Evidence clearly shows** that the tools in use are effective in achieving the exploitation levels required under the HCRs.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

Evidence from the fishery in terms of the level of fishing effort and the annual landings data show clearly that the input and output controls in the fishery have ensured that the exploitation rate has been maintained at a level much below that required by the harvest strategy. The TACs for the whole Limfjord area and for the individual Natura 2000 sites are never fully utilised. Stock surveys provide an annual estimate of stock biomass from which annual production can be estimated, and then it can be determined whether the exploitation rate is compatible with this annual production. Landings from the fishery in recent years have been no higher than around 25-30% of the fishable stock, and around 10% of the overall mussel stock in the Limfjord. The SG60, SG80 and SG100 are therefore met.

References

Annual landings data

Nielsen, P., Olsen, J. and Nielsen. M.M. 2019a. Notat vedrørende fiskeri af blåmuslinger og søstjerner i Lovns Bredning 2019/2020. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 23pp.

Nielsen, P., Geitner, K., Olsen, J. and Nielsen. M.M. 2019c. Notat vedrørende fiskeri af blåmus-linger, søstjerner, europæisk østers og stillehavsøsters i Løgstør Bredning 2019/2020. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 30pp.

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Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for muslinge- og østersskrab og øvrig muslinge- og østersproduktion i og udenfor Natura 2000 områder.

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**85**
Condition number (if relevant)	**NA**

PI 1.2.3 – Information and monitoring - UoA 1 Mussels in Limfjord

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Range of information			
	Guide post	**Some** relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	**Sufficient** relevant information related to stock structure, stock productivity, fleet composition and other data are available to support the harvest strategy.	A **comprehensive range** of information (on stock structure, stock productivity, fleet composition, stock abundance, UoA removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Annual mussel stock surveys provide detailed information about stock abundance and structure of mussels and provide an estimate of annual production of the stock. Comprehensive information on fleet composition is available, fishery removals are monitored rigorously, and the "black box" system provides detailed records of all fishing activity within the whole Limfjord fishery. There is sufficient information available to support the harvest strategy. The SG60 and SG80 are met. In the Natura 2000 sites, in addition to the mussel surveys, environmental impact assessments are required prior to the commencement of fishing and in these areas. There is a comprehensive range of information available that is well above that is required to support the harvest strategy. For example, there are eelgrass distribution surveys in the Natura 2000 sites.

Although the SG100 requirements are met for those areas of the fishery within Natura 2000 sites, a score of 80 is considered appropriate reflecting the level of information available for the whole Limfjord fishery. The SG100 is not met.

b	Monitoring			
	Guide post	Stock abundance and UoA removals are monitored and **at least one indicator** is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and UoA removals are **regularly monitored at a level of accuracy and coverage consistent with the harvest control rule**, and **one or more indicators** are available and monitored with sufficient frequency to support the harvest control rule.	**All information** required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent **uncertainties** in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Annual stock surveys provide estimates of stock biomass and annual production at a level of accuracy and coverage consistent with the harvest control rule. Within Natura 2000 sites stock status is monitored in greater detail to inform the stricter management requirements of these areas. Fishery removals are rigorously monitored at a high level of accuracy through the "black box" system which monitors fishing vessel position every 10 seconds, fishers' logbooks and landings declarations. Cross-referencing of landings declarations with processor records and fishers' logbooks are supported by inspection activities both on vessels and on shore. The SG60 and SG80 are met.

Whilst all the information required by the harvest control rules is monitored with a high frequency and a high degree of certainty, there is no evidence that the robustness of assessment and management to uncertainty in this information has been investigated. The SG100 is not met.

c	Comprehensiveness of information			
	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		**Yes**	
Rationale				

All fishery removals from the directed mussel fishery are monitored rigorously. The oyster fishery is the only other fishery in the Limfjord that catches mussels. The oyster fishery occurs primarily in the westernmost part of the Limfjord and in Løgstør Bredning. Fishers are permitted to land mussels up to 10% of the total daily catch in the oyster fishery and all mussel landings are recorded on logbooks. There is negligible recreational fishing for mussels in the Limfjord. There is good information on all other fishery removals and SG80 is met.

References

Annual landings data

Nielsen, P., Olsen, J. and Nielsen. M.M. 2019a. Notat vedrørende fiskeri af blåmuslinger og søstjerner i Lovns Bredning 2019/2020. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 23pp.

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Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for muslinge- og østersskrab og øvrig muslinge- og østersproduktion i og udenfor Natura 2000 områder.

Draft scoring range	**≥80**
Information gap indicator	**More information sought on whether recreational fishing for mussels is permitted, and if so, whether there is good information on any such landings.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**80**
Condition number (if relevant)	**NA**

PI 1.2.4 – Assessment of stock status - UoA 1 Mussels in Limfjord

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Appropriateness of assessment to stock under consideration			
	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment takes into account the major features relevant to the biology of the species and the nature of the UoA.
	Met?		**Yes**	**Yes**
Rationale				

The assessment is based on an annual stock survey which provides an estimate of stock biomass, and hence an estimate of annual production of the mussel stock and is therefore appropriate for the harvest control rule. SG80 is met. This assessment takes account of the biology of the species and the nature of the UoA by surveying the fished area using commercial fishing gear, and raw survey data are raised up to stock biomass estimates using dredge efficiency studies. More detailed surveys of the mussel stock are undertaken in the Natura 2000 sites and stock status is evaluated in relation to the feeding requirements of birds and the potential impact of the mussel fishery on the conservation features of the Natura 2000 sites. The SG100 is met.

b	Assessment approach			
	Guide post	The assessment estimates stock status relative to generic reference points appropriate to the species category.	The assessment estimates stock status relative to reference points that are appropriate to the stock and can be estimated.	
	Met?	**Yes**	**Yes**	
Rationale				

The Limfjord mussel fishery is not managed using conventional stock-based reference points but by using information from annual stock surveys about stock biomass and annual stock production. The key reference point for this mussel fishery is the annual stock production which observations indicate is 40-50% of stock biomass. This is an appropriate approach for a mollusc species which experiences major fluctuations in recruitment and therefore MSY-based stock biomass reference points are not appropriate. The SG60 is met. Estimates of annual production can be determined simply from the annual stock surveys of mussel biomass and therefore permit a determination of whether the TAC and exploitation rate is compatible with stock production. The SG80 is met.

c	Uncertainty in the assessment			
	Guide post	The assessment **identifies major sources** of uncertainty.	The assessment **takes uncertainty into account**.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a **probabilistic** way.
	Met?	**Yes**	**Yes**	**No**
Rationale				

The main uncertainties for the mussel stock are the variation in and unpredictability of recruitment, and mortality of post-recruits due to predation and hypoxia events. The assessment takes these uncertainties into account by basing the stock biomass estimate (and hence the annual production estimate) on the stock of mussels only in waters greater than 3m depth. The stock of mussels in the shallower waters that is not open to fishing, and which is not included in the estimate of annual production, is estimated to be 325,000 tonnes. The assessment therefore estimates stock status relative to reference points in a precautionary manner. Within the Natura 2000 sites, there is a more precautionary harvest strategy which takes into account the ecological role of the mussels in providing food for shellfish-eating birds, thereby taking a wider range of uncertainties into account. A new geostatistical assessment model has been developed which allows the estimation of mean stock biomass and confidence intervals. The SG60 and SG80 are met. Whilst the assessment does take uncertainty into account and stock biomass estimates are now presented with confidence intervals, stock status is not yet evaluated in relation to reference points in a probabilistic way, and so SG100 is not met.

d	Evaluation of assessment			
	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
	Met?			**No**
Rationale				

The assessment of the mussel stock appears to be robust, but there is no evidence that alternative hypotheses and assessment approaches have been explored and so the SG100 is not met.

e	Peer review of assessment			
	Guide post		The assessment of stock status is subject to peer review.	The assessment has been **internally and externally** peer reviewed.
	Met?		**Yes**	**No**
Rationale				

The original survey methodology has been published within a peer-reviewed journal (Dolmer *et al*., 1999) and essentially the same survey methodology is used currently for the surveys. Both the survey methodology and the results of the stock surveys are reviewed annually within the Advisory Committee on Mussel Production, and so the SG80 is met. There is no regular external review through for example, the ICES framework, and so the SG100 is not met. The assessment team would recommend that the new methodology for assessing stock biomass estimates should undergo peer review.

References

Dolmer, P., Kristensen, P.S. & Hoffmann, E. 1999. Dredging of blue mussels (*Mytilus edulis* L.) in a Danish sound: stock sizes and fishery-effects on mussel population dynamic. Fisheries Research 40: 73-80.

Nielsen, P., Olsen, J. and Nielsen. M.M. 2019a. Notat vedrørende fiskeri af blåmuslinger og søstjerner i Lovns Bredning 2019/2020. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 23pp.

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Nielsen, P., Olsen,J., Geitner, K. And Nielsen, M.M. 2020b. Konsekvensvurdering af fiskeri af blåmuslinger, europæisk østers, stillehavsøsters og søstjerner i Løgstør Bredning 2020/2021. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 77pp.

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Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**85**
Condition number (if relevant)	**NA**

PI 1.1.1 – Stock status – UoA 2 Cockles in Limfjord

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Scoring Issue		SG 60	SG 80	SG 100
a	Stock status relative to recruitment impairment			
	Guide post	It is **likely** that the stock is above the point where recruitment would be impaired (PRI).	It is **highly likely** that the stock is above the PRI.	There is a **high degree of certainty** that the stock is above the PRI.
	Met?	**NA – RBF used**	**NA – RBF used**	**NA – RBF used**
Rationale				

It is not possible to determine the status of the cockle stock relative to biologically-based limits for sustainability because there are no formally agreed reference points for the cockle stock. The Risk Based Framework was therefore used to assess stock status – see Table 44, Table 49 and Table 53 in section 8.8.

The scores from section 8.8 were:

Consequence Analysis (CA) score = 80
Productivity Susceptibility Analysis (PSA) score = 91
Overall MSC score = 86

b	Stock status in relation to achievement of Maximum Sustainable Yield (MSY)			
	Guide post		The stock is at or fluctuating around a level consistent with MSY.	There is **a high degree of certainty** that the stock has been fluctuating around a level consistent with MSY or has been above this level over recent years.
	Met?		**NA – RBF used**	**NA – RBF used**
Rationale				

NA – RBF used

References

See references in section 8.8.

Stock status relative to reference points			
	Type of reference point	Value of reference point	Current stock status relative to reference point
Reference point used in scoring stock relative to PRI (SIa)	NA – RBF used	NA – RBF used	NA – RBF used
Reference point used in scoring stock relative to MSY (SIb)	NA – RBF used	NA – RBF used	NA – RBF used

Draft scoring range and information gap indicator added at Announcement Comment Draft Report

Draft scoring range	**≥80**
Information gap indicator	**Final score to be determined following consultation with stakeholders.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score from RBF	**86**
Condition number (if relevant)	**NA**

PI 1.1.2 – Stock rebuilding - UoA 2 Cockles in Limfjord

PI 1.1.2		Where the stock is reduced, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue		SG 60	SG 80	SG 100
a	Rebuilding timeframes			
	Guide post	A rebuilding timeframe is specified for the stock that is the **shorter of 20 years or 2 times its generation time**. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.		The shortest practicable rebuilding timeframe is specified which does not exceed **one generation time** for the stock.
	Met?	**N/A**		**N/A**
Rationale				

MSC Guidance to the Fisheries Certification Process v2.1, Paragraph GPF1.1.2 and Table GPF2 define which PIs within the default tree may be scored using RBF methodologies. In relation to PI 1.1.2, Table GPF2 states that "*The RBF is designed for use in cases where direct measures of stock status, such as estimates of biomass, are not available. There is no direct measure to determine whether the stock is actually depleted and would need to consider rebuilding measures under PI 1.1.2*."

MSC Fisheries Certification Process v2.1, Table PF1 states that if the RBF is used to score PI 1.1.1, then this PI is not scored.

b	Rebuilding evaluation			
	Guide post	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within the specified timeframe.	There is **evidence** that the rebuilding strategies are rebuilding stocks, **or it is likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the **specified timeframe**.	There is **strong evidence** that the rebuilding strategies are rebuilding stocks, **or it is highly likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the **specified timeframe**.
	Met?	**N/A**	**N/A**	**N/A**
Rationale				

MSC Fisheries Certification Process v2.1, Table PF1 states that if the RBF is used to score PI 1.1.1, then this PI is not scored.

References

MSC Fisheries Certification Process v2.1

Overall Performance Indicator score	**NA**
Condition number (if relevant)	**NA**

PI 1.2.1 – Harvest strategy - UoA 2 Cockles in Limfjord

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Harvest strategy design			
	Guide post	The harvest strategy is **expected** to achieve stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy **work together** towards achieving stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and is **designed** to achieve stock management objectives reflected in PI 1.1.1 SG80.
	Met?	**Yes**	**Yes**	**No**
Rationale				

It is not possible to determine the status of the cockle stock relative to biologically-based limits for sustainability (reference points) and the RBF was therefore used to score PI 1.1.1. Under these circumstances, the MSC Fisheries Standard v2.01, GSA2.4 states that -

“Assessment of data-deficient fisheries against this indicator (PI 1.2.1) should consider how elements of the harvest strategy combine to manage impact, such that susceptibility is maintained at or below acceptable levels given the productivity of the species."

It is appropriate therefore to consider how the harvest strategy manages the fishery to ensure that the susceptibility scores (for areal overlap, vertical overlap, selectivity and post capture mortality) are maintained at acceptable levels. The harvest strategy is composed of a number of elements, including a robust monitoring, control and surveillance policy. The fishery is a limited entry fishery with a maximum of 50 licences, although two licences can be aggregated on a single vessel, and in 2020 there were only 22 active vessels in the fishery. There are restrictions on the weight and size of dredge, restrictions on vessel size and power, limits on the depth in which fishing is permitted, and closed seasons and areas. There is a daily TAC in the general fishery of 45 tonnes per licence, although the fishers’ association voluntarily reduces this to 30 tonnes. The TAC covers total catch of both mussels and cockles, and the landings must contain a maximum of 49% cockles. Within Natura 2000 sites, the landings must contain a maximum of only 10% cockles. No sorting of the catch is permitted on board the vessel, although stones over 2 kg in weight must be returned to the sea.

These management controls combine to maintain the susceptibility of cockles to the dredge fishery at or below acceptable levels. In particular depth restrictions in the fishery, restrictions on fishing activity in Natura 2000 sites, and areas of high cockle abundance which are not fished ensure that the areal overlap of the fishery with the distribution of the stock is maintained at a low level. Selectivity of the dredge and the industry minimum landing size of 16mm ensures that the catch is composed of primarily large cockles which have already reproduced, and any cockles below the industry minimum landing size that are not retained are expected to have a high survival rate. Whilst the encounterability attribute of susceptibility within the RBF must be scored at high risk because cockles are the target species, the light dredge used in the fishery is capable of catching primarily emergent cockles that are on the surface of the seabed. Buried cockles are not vulnerable to the dredge, and so most of the cockles in the Limfjord are not susceptible to capture in this fishery such that the vertical overlap between the target species and the fishing gear is low. The harvest strategy is designed therefore to ensure that the susceptibility of cockles to the fishery is maintained at a level of risk that achieves stock management objectives. The SG60 and SG80 are met.

The management authorities currently permit the fishery for cockles only as a bycatch in the mussel fishery, although DTU Aqua are currently reviewing methods for assessing cockle stock status with the goal of providing science-based advice and information and recommending fishing practices adapted to cockle biology and population dynamics which will support long-term sustainable management of a targeted cockle fishery. Until this approach is fully developed, it cannot be concluded that the harvest strategy is designed to achieve stock management objectives in PI 1.1.1 SG80. The SG100 is therefore not met.

	Harvest strategy evaluation			
b	Guide post	The harvest strategy is **likely** to work based on prior experience or plausible argument.	The harvest strategy may not have been fully **tested** but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been **fully evaluated** and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
	Met?	**Yes**	**Yes**	**No**
Rationale				

A limited entry licensing scheme, limitations on the quantity of cockles that can be removed from the fishery (TACs for vessels), spatial and temporal closures of the fishery and robust monitoring and enforcement are a proven method for controlling exploitation rates, thereby limiting the susceptibility of the target species to fishing. Data from the “black box” system on board all vessels and catch reporting and monitoring of landings provide evidence that catch limitations and all spatial controls in the fishery are being complied with. In addition, the light dredge used in the fishery is only capable of catching emergent cockles that are on the surface of the seabed. Buried cockles are not vulnerable to the dredge, and so most of the cockles in the Limfjord are not susceptible to capture in this fishery confirming that the vertical overlap between the target species and the fishing gear is low.

There is evidence therefore that the harvest strategy is achieving its objective of limiting the susceptibility of the target species to fishing. SG60 and SG80 are met. There is no evidence that the harvest strategy has been fully evaluated through, for example, a Management Strategy Evaluation (MSE), and therefore the SG100 is not met.

	Harvest strategy monitoring			
c	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	**Yes**		
Rationale				

Landings are closely monitored through logbooks (ERS on larger vessels and paper records on smaller vessels) and through catch declarations on landing. Fishing activity is monitored through the installation on all vessels of a “Black box” system which provides positional information every 10 seconds. In addition, vessels must “hail in” before landing and provide details of fishing area and estimated weight of landings, and there is a strong enforcement presence in harbours and at the processors to ensure compliance with regulations. All these elements of the monitoring programme are capable of showing whether the harvest strategy is working, and cross-checks of the various components of the monitoring programme show no systematic mis-reporting. The SG60 is met.

	Harvest strategy review			
d	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			**No**
Rationale				

Elements of the harvest strategy are regularly reviewed through, for example, the Advisory Committee on Mussel Production which considers cockles as well as mussels, but the assessment team found no evidence that the harvest strategy for the cockle fishery as a whole is regularly reviewed. The SG100 is therefore not met.

e	Shark finning			
	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**NA**	**NA**	**NA**
Rationale				

Sharks are not a target species in this fishery, so this scoring issue is not scored.

f	Review of alternative measures			
	Guide post	There has been a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock, and they are implemented, as appropriate.
	Met?	**Yes**	**Yes**	**No**
Rationale				

The nature of the fishing operations in the mussel and cockle fishery is continually evaluated and a key element of the harvest strategy is minimising the UoA-related mortality of unwanted catch of cockles through setting appropriate mesh sizes, returning small individuals to the sea, which are expected to have a high survival rate, and avoiding areas with high densities of small animals. There is an industry minimum landing size above the size at maturity and the selectivity of the dredge is such that the catch is composed primarily of large cockles that have already reproduced. In designing the current harvest strategy, the potential effectiveness and practicality of alternative measures to minimise mortality of unwanted catch have been reviewed regularly. SG60 and SG80 are met. Whilst there are regular reviews of alternative measures, it is not clear that these are biennial reviews. SG100 is not met.

References

MSC Fisheries Standard v2.01.

Beukema, J.J. and Dekker, R. 2005. Decline of recruitment success in cockles and other bivalves in the Wadden Sea: possible role of climate change, predation on postlarvae and fisheries. *Marine Ecology Progress Series,* 287, 149-167.

DTU Aqua. 2020a. Notat from DTU Aqua to the Minister for Fisheries in the Ministry of Environment and Food, 9 September, 2020. Hjertemuslingefiskeri i Limfjorden: Anbefalinger om bæredygtig kvote (Recommendations for catch limits of cockle fishing in the Limfjorden). 16pp.

Malham, S. K., Hutchinson, T. H. and Longshaw M. 2012. A review of the biology of European cockles (*Cerastoderma* spp.). *Journal of the Marine Biological Association of the United Kingdom*, 92: 1563-1577.

Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for muslinge- og østersskrab og øvrig muslinge- og østersproduktion i og udenfor Natura 2000 områder.

Draft scoring range	**60-79**
Information gap indicator	**More information sought on reviews of alternative measures to minimise UoA-related mortality of unwanted catches of cockles.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**80**
Condition number (if relevant)	**NA**

PI 1.2.2 – Harvest control rules and tools - UoA 2 Cockles in Limfjord

PI 1.2.2		**There are well defined and effective harvest control rules (HCRs) in place**		
Scoring Issue		SG 60	SG 80	SG 100
a	HCRs design and application			
	Guide post	**Generally understood** HCRs are in place **or available** that are **expected** to reduce the exploitation rate as the point of recruitment impairment (PRI) is approached.	**Well defined** HCRs are **in place** that **ensure** that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock **fluctuating around** a target level consistent with (or above) MSY, or for key LTL species a level consistent with ecosystem needs.	The HCRs are expected to keep the stock **fluctuating at or above** a target level consistent with MSY, or another more appropriate level taking into account the ecological role of the stock, **most** of the time.
	Met?	**Yes**	**Yes**	**No**
Rationale				

It is not possible to determine the status of the cockle stock relative to biologically-based limits for sustainability (reference points) and the RBF was therefore used to score PI 1.1.1. It is appropriate therefore to consider how the harvest control rules manage the fishery to ensure that the susceptibility scores (for areal overlap, vertical overlap, selectivity and post capture mortality) remain acceptable. When the RBF is used it is not necessary for exploitation rates to be reduced as reference points are approached.

MSC Fisheries standard v2.01, GSA2.5 states that:

"HCRs are often applied on a frequent basis, such as with the annual setting of TACs or effort restrictions. Such HCRs respond dynamically to the monitoring data from the fishery with regular adjustments to input/output type management measures. In data-poor fisheries which are managed without such input/output controls, management may comprise only technical measures such as size limits, gear restrictions, closed seasons and closed areas. In these cases, the specific terms of the technical measures are usually set and fixed for a relatively long period of time (several years), based on occasional strategic stock assessments, that are shown to deliver defined target and/or limit reference points. Such an arrangement may be regarded as equivalent to a dynamic HCR operating over a longer time scale in cases where some indicators are monitored to confirm that the HCRs are delivering the intended targets for the stock."

The main harvest control rule for the cockle fishery that maintains the susceptibility level at acceptable levels is a consequence of the harvest strategy for the fishery. The harvest controls for the cockle fishery are based upon restrictions on the number of vessels permitted to operate in the fishery and a restriction on the quantity of cockles that can be landed per vessel per week which limit the exploitation rate, a relatively large mesh size in relation to the size at maturity, and there are also spatial controls in place that prevent dredging for cockles in much of the Limfjord which thereby limits the areal overlap.

As noted in PI 1.2.1 above, the statutory licence conditions permit only light mussel dredges to be used in this fishery. These dredges are designed to minimise interactions with the seabed, and do not penetrate the substrate. Only emergent cockles are caught in these dredges, and buried cockles are not susceptible to capture. Thus the "vertical overlap" between the gear and the target species is limited.

The effect of these controls is to ensure that only a small proportion of the cockle stock is susceptible to fishing. The majority of the cockles in the Limfjord cannot be caught because of the gear restrictions and spatial controls; thus the harvest control rule is an emergent property of the harvest strategy.

These control rules are in place and ensure that the susceptibility of the target stock to fishing is limited. The SG60 and SG80 are therefore met. It is not clear that the ecological role of the stock is taken into account, and so SG100 is not met.

b	HCRs robustness to uncertainty

	Guide post		The HCRs are likely to be robust to the main uncertainties.	The HCRs take account of a **wide** range of uncertainties including the ecological role of the stock, and there is **evidence** that the HCRs are robust to the main uncertainties.
	Met?		**Yes**	**No**

Rationale

The main uncertainties underlying the cockle stock in the Limfjord are the stock biomass and size composition, and variation in recruitment and natural mortality. The harvest control rules take into account these uncertainties by restricting the number of vessels that can enter the fishery and restricting the quantity of cockles that can be harvested from the fishery, thereby limiting the impact of the fishery on the stock and safeguarding recruitment to the fishery. In addition, there are extensive areas of the Limfjord within the distribution and depth range for cockles which are closed to fishing, and fishing is permitted using only light dredges ensuring that only emergent cockles on the surface of the seabed are susceptible to the gear, with a large stock of buried cockles left invulnerable to the dredge.

These harvest control rules take account of the main uncertainties and so the SG80 is met. However, there is no evidence that the harvest control rules have been designed to take into account a wide range of uncertainties and so the SG100 is not met.

c	HCRs evaluation			
	Guide post	There is **some evidence** that tools used **or available** to implement HCRs are appropriate and effective in controlling exploitation.	**Available evidence indicates** that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.	**Evidence clearly shows** that the tools in use are effective in achieving the exploitation levels required under the HCRs.
	Met?	**Yes**	**Yes**	**No**

Rationale

The available evidence from the fishery shows that there is good compliance with the harvest controls in place, and that the TAC limits for vessels are respected. The desired exploitation rates are therefore being achieved and the SG60 and SG80 are met. As there is no annual assessment of cockle stock status, there is not sufficiently clear evidence to meet the SG100.

References

MSC Fisheries Standard v2.01.

DTU Aqua. 2020a. Notat from DTU Aqua to the Minister for Fisheries in the Ministry of Environment and Food, 9 September, 2020. Hjertemuslingefiskeri i Limfjorden: Anbefalinger om bæredygtig kvote (Recommendations for catch limits of cockle fishing in the Limfjorden). 16pp.

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Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for muslinge- og østersskrab og øvrig muslinge- og østersproduktion i og udenfor Natura 2000 områder.

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**80**
Condition number (if relevant)	**NA**

PI 1.2.3 – Information and monitoring - UoA 2 Cockles in Limfjord

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Range of information			
	Guide post	**Some** relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	**Sufficient** relevant information related to stock structure, stock productivity, fleet composition and other data are available to support the harvest strategy.	A **comprehensive range** of information (on stock structure, stock productivity, fleet composition, stock abundance, UoA removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Annual surveys of mussels in Natura 2000 sites use a mussel dredge with a top mesh size of 25 mm which therefore samples cockles and so there is information available on the distribution of the cockle stock. There is no annual estimate of cockle stock biomass although annual landings data provide information about cockle distribution and abundance for the different production areas, which indicate that cockles can be present in densities that are economically viable for fishing over a large part of the Limfjord but abundant populations are patchily distributed, both spatially and temporally. Landings therefore provide an index of the success of the fishery and hence an indirect index of stock abundance/biomass. A detailed stock survey undertaken in 2018 across the whole Limfjord, including those areas where there is no cockle fishing, provided information on stock structure and stock productivity. The survey detected multiple age cohorts in each basin implying successful recruitment in several recent years, with age classes 2, 3 and 4 dominating the age structure. There is very good information available from the fishery concerning all cockle fishing activities, in particular the distribution of fishing activity in relation to the distribution of the stock. The fishery is limited entry and detailed information is available on the composition of the fleet. The “Black box” system records all fishing vessel movements every 10 seconds, and all fishery removals are recorded in logbooks and landings declarations.

The key objective of the harvest strategy is to ensure that the susceptibility of the target species to the fishery is maintained at an acceptable level, and the information available supports the harvest strategy, which aims to limit the exploitation rate through a restrictive licensing scheme and catch limits, and to limit the temporal and spatial extent of fishing activity. The available information meets the SG60 and SG80 requirements. Whilst there is some information on the factors that influence emergence behaviour of cockles and the subsequent vulnerability of cockles to the fishing gear, and there is detailed environmental and habitat information for the Natura 2000 sites in the Limfjord, there is not sufficient information about the cockle stock and fishery to conclude that it is comprehensive. The SG100 is not met.

b	Monitoring			
	Guide post	Stock abundance and UoA removals are monitored and **at least one indicator** is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and UoA removals are **regularly monitored at a level of accuracy and coverage consistent with the harvest control rule**, and **one or more indicators** are available and monitored with sufficient frequency to support the harvest control rule.	**All information** required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent **uncertainties** in the information [data] and the robustness of assessment and management to this uncertainty.

	Met?	**Yes**	**No**	**No**
Rationale				

Whilst there is no annual estimate of stock abundance/biomass, annual landings data provide information about cockle distribution and abundance for the different production areas, which indicate that cockles can be present in densities that are economically viable for fishing over a large part of the Limfjord but abundant populations are patchily distributed, both spatially and temporally. Landings therefore provide an index of the success of the fishery and hence an indirect index of stock abundance/biomass. Fishing activity of the fleet is monitored with a very high degree of accuracy through the "black box" system, and all fishery removals of more than 50 kg are recorded. Information from logbooks, landings declarations and processor records are cross-referenced, and are supported by inspections of vessel catches and landings both at sea and on shore. The SG60 is met. A detailed stock survey undertaken in 2018 across the whole Limfjord, including those areas where there is no cockle fishing, provided an index of stock biomass, but it was apparent from an analysis of the survey results in comparison with landings data that the patchy distribution of cockles will make it difficult to extrapolate stock survey results across the whole stock distribution in order to estimate total stock biomass, and therefore new methods for estimating cockle stock biomass are being developed by DTU Aqua. In addition to the problems encountered with using fishery-independent stock surveys to estimate total stock biomass, DTU Aqua noted that it is not possible currently to accurately separate mussel and cockle fishing activity from the black box data and hence it is not possible to calculate an estimate of catch per unit effort (CPUE) for cockles from the annual fishery-dependent data. Stock abundance is not therefore regularly monitored at a level of accuracy and coverage consistent with the harvest strategy. SG80 is not met. No evidence has been presented of the uncertainties in the data and the robustness of management to this uncertainty and so the SG100 is not met.

c	Comprehensiveness of information			
	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		**Yes**	
Rationale				

All commercial fishery removals from the stock are fully monitored and recorded. There is negligible recreational fishing for cockles in the Limfjord. There is good information on all other fishery removals and SG80 is met.

References

MSC Fisheries Standard v2.01.

DTU Aqua. 2020a. Notat from DTU Aqua to the Minister for Fisheries in the Ministry of Environment and Food, 9 September, 2020. Hjertemuslingefiskeri i Limfjorden: Anbefalinger om bæredygtig kvote (Recommendations for catch limits of cockle fishing in the Limfjorden). 16pp.

Malham, S. K., Hutchinson, T. H. and Longshaw M. 2012. A review of the biology of European cockles (*Cerastoderma* spp.). *Journal of the Marine Biological Association of the United Kingdom*, 92: 1563-1577.

Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for muslinge- og østersskrab og øvrig muslinge- og østersproduktion i og udenfor Natura 2000 områder.

Draft scoring range	**≥80**
Information gap indicator	**More information sought on results from recent research projects on the cockle fishery and on whether recreational fishing for cockles is permitted, and if so, whether there is good information on any such landings.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**75**
Condition number (if relevant)	**1**

PI 1.2.4 – Assessment of stock status - UoA 2 Cockles in Limfjord

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Appropriateness of assessment to stock under consideration			
	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment takes into account the major features relevant to the biology of the species and the nature of the UoA.
	Met?		**NA**	**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

b	Assessment approach			
	Guide post	The assessment estimates stock status relative to generic reference points appropriate to the species category.	The assessment estimates stock status relative to reference points that are appropriate to the stock and can be estimated.	
	Met?	**NA**	**NA**	
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

c	Uncertainty in the assessment			
	Guide post	The assessment **identifies major sources** of uncertainty.	The assessment **takes uncertainty into account**.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a **probabilistic** way.
	Met?	**NA**	**NA**	**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

d	Evaluation of assessment			
	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.

	Met?			**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

e	Peer review of assessment			
	Guide post		The assessment of stock status is subject to peer review.	The assessment has been **internally and externally** peer reviewed.
	Met?		**NA**	**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

References

MSC Fisheries Certification Process v2.1.

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**80**
Condition number (if relevant)	**NA**

PI 1.1.1 – Stock status – UoA 3 Oysters in Limfjord

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Scoring Issue		SG 60	SG 80	SG 100
a		Stock status relative to recruitment impairment		
	Guide post	It is **likely** that the stock is above the point where recruitment would be impaired (PRI).	It is **highly likely** that the stock is above the PRI.	There is a **high degree of certainty** that the stock is above the PRI.
	Met?	**NA – RBF used**	**NA – RBF used**	**NA – RBF used**
Rationale				

It is not possible to determine the status of the oyster stock relative to biologically-based limits for sustainability because there are no formally agreed reference points for the oyster stock. The Risk Based Framework will therefore be used to assess stock status – see Table 45, Table 50 and Table 54 in section 8.8.

The scores from section 8.8 were:

Consequence Analysis (CA) score = 80
Productivity Susceptibility Analysis (PSA) score = 89
Overall MSC score = 85

b		Stock status in relation to achievement of Maximum Sustainable Yield (MSY)		
	Guide post		The stock is at or fluctuating around a level consistent with MSY.	There is **a high degree of certainty** that the stock has been fluctuating around a level consistent with MSY or has been above this level over recent years.
	Met?		**NA – RBF used**	**NA – RBF used**
Rationale				

NA – RBF used

References

See references in section 8.8.

Stock status relative to reference points			
	Type of reference point	Value of reference point	Current stock status relative to reference point
Reference point used in scoring stock relative to PRI (SIa)	**NA – RBF used**	**NA – RBF used**	**NA – RBF used**
Reference point used in scoring stock relative to MSY (SIb)	**NA – RBF used**	**NA – RBF used**	**NA – RBF used**

Draft scoring range and information gap indicator added at Announcement Comment Draft Report

Draft scoring range	**≥80**
Information gap indicator	**Final score to be determined following consultation with stakeholders.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**85**
Condition number (if relevant)	**NA**

PI 1.1.2 – Stock rebuilding - UoA 3 Oysters in Limfjord

PI 1.1.2		Where the stock is reduced, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue		SG 60	SG 80	SG 100
a	Rebuilding timeframes			
	Guide post	A rebuilding timeframe is specified for the stock that is the **shorter of 20 years or 2 times its generation time**. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.		The shortest practicable rebuilding timeframe is specified which does not exceed **one generation time** for the stock.
	Met?	**N/A**		**N/A**
Rationale				

If the RBF is used to score PI 1.1.1, then this PI is not scored (MSC Fisheries Certification Process v2.1, Table PF1).

b	Rebuilding evaluation			
	Guide post	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within the specified timeframe.	There is **evidence** that the rebuilding strategies are rebuilding stocks, **or it is likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the **specified timeframe**.	There is **strong evidence** that the rebuilding strategies are rebuilding stocks, **or it is highly likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the **specified timeframe**.
	Met?	**N/A**	**N/A**	**N/A**
Rationale				

If the RBF is used to score PI 1.1.1, then this PI is not scored (MSC Fisheries Certification Process v2.1, Table PF1).

References

MSC Fisheries Certification Process v2.1

Draft scoring range	**N/A**
Information gap indicator	**N/A**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**NA**
Condition number (if relevant)	**NA**

PI 1.2.1 – Harvest strategy - UoA 3 Oysters in Limfjord

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Harvest strategy design			
	Guide post	The harvest strategy is **expected** to achieve stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy **work together** towards achieving stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and is **designed** to achieve stock management objectives reflected in PI 1.1.1 SG80.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The RBF has been used to score PI 1.1.1 because there are no reference points in place for the oyster fishery. Under these circumstances, the MSC Fisheries Standard v2.01, GSA2.4 states that -

"Assessment of data-deficient fisheries against this indicator (PI 1.2.1) should consider how elements of the harvest strategy combine to manage impact, such that susceptibility is maintained at or below acceptable levels given the productivity of the species."

The harvest strategy for the oyster fishery at the national level is set out in Danish legislation which aims to "…to promote sustainable economic development of fishing and farming of mussels, oysters and other molluscs, including establishing rules on fishing and farming …" (Fisheries Act at s6a).

At the local level, the harvest strategy is based upon a restrictive licence scheme that limits the number of vessels that can operate in the fishery, with a quota allocation to individual vessels (which can now be aggregated). For the largest oyster fishing areas in the Nissum Bredning and Løgstør Bredning Natura 2000 sites, this quota allocation is determined after an assessment of stock status carried out by DTU-Aqua. There is also an oyster minimum size limit of 80g in the Limfjord, equivalent to a size of 70-80mm, which is larger than the national minimum size. The size limit is also larger than the size at maturity for oysters, which serves to protect the stock, promoting sustainable exploitation. The TAC set for the fishery serves to limit its areal extent, and the minimum landing size for oysters ensures that selectivity of the fishery is maintained.

The temporal scale of the fishery is limited by the licensing scheme, such that oyster dredging is only possible between 1st September of one year and 14th May of the following year. The spatial scale of the fishery is limited by the extent of the shellfish production areas, and the area where fishing is permitted to take place, limiting the areal overlap of the fishery. The encounterability of the fishery is limited by the depth restrictions on fishing activity, which mean that the population of oysters in water shallower than 5m depth is protected from all fishing activities.

Selectivity is managed by the restrictions on the type of oyster dredge that is used in the fishery and ensures that small oysters can escape from the dredges.

Taken together, the harvest strategy has resulted in the creation of a management regime that imposes constraints on all aspects of the fishery that would alter the susceptibility of the target species to oyster fishing activity. This strategy meets the SG60, SG80 and SG100 requirements.

b	Harvest strategy evaluation

	Guide post	The harvest strategy is **likely** to work based on prior experience or plausible argument.	The harvest strategy may not have been fully **tested** but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been **fully evaluated** and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Evidence that the harvest strategy is achieving its objective of limiting the susceptibility of oysters to dredging is provided from several sources. Recent surveys show that the distribution of the oyster stock has expanded from its original centre in the Nissum Bredning Natura 2000 site, and oysters are now found in significant densities further east. Black box data on the areal extent of fishing activity shows that only a limited area of the oyster stock is fished annually. These data also provide evidence that the constraints on the depth at which fishing can take place are being observed. Evidence from the size composition of oysters caught using commercial fishing gear during stock surveys demonstrates that the constraints imposed on gear design serve to maintain the selectivity of the gear.

The harvest appears to be working and is achieving its objectives, and so the SG60 and SG80 are met. There is no evidence that the harvest strategy has been fully evaluated through, for example, a Management Strategy Evaluation (MSE), and therefore the SG100 is not met.

c	Harvest strategy monitoring			
	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	**Yes**		
Rationale				

Landings are closely monitored through logbooks (ERS on larger vessels and paper records on smaller vessels) and through catch declarations on landing. Fishing activity is monitored through the installation on all vessels of a “Black box” system which provides positional information every 10 seconds. In addition, vessels must “hail in” before landing and provide details of fishing area and estimated weight of landings, and there is a strong enforcement presence in harbours and at the processors to ensure compliance with regulations. All these elements of the monitoring programme are capable of showing whether the harvest strategy is working, and cross-checks of the various components of the monitoring programme show no systematic mis-reporting. The SG60 is met.

d	Harvest strategy review			
	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			**No**
Rationale				

Elements of the harvest strategy are regularly reviewed through, for example, the Advisory Committee on Mussel Production, but the assessment team found no evidence that the harvest strategy as a whole is regularly reviewed. The SG100 is therefore not met.

e	Shark finning

	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**NA**	**NA**	**NA**

Rationale

Sharks are not a target species in this fishery, so this scoring issue is not scored.

f	Review of alternative measures			
	Guide post	There has been a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock, and they are implemented, as appropriate.
	Met?	**Yes**	**Yes**	**No**

Rationale

There is regular review of the minimum landing size and regulations around dredge construction and dimensions to ensure that catch of small juvenile oysters is minimised. The nature of the fishing operations in the oyster fishery is continually evaluated and the harvest strategy is based upon minimising the impact of fishing on the local stocks through returning small individuals to the sea and avoiding areas with high densities of small animals. Following the outbreak of *Bonamia* in Nissum Bredning in 2019, the fishing industry has not requested any catch of oysters from this area, ensuring that fishing activities do not increase the likelihood of spreading *Bonamia* and its associated mortality rates to other areas of the Limfjord. The SG60 and SG80 are met but it is not clear that alternative measures are reviewed on a biennial basis. The SG100 is not met.

References

DTU Aqua. 2020b. Rådgivning vedr. østersfiskeri i Limfjorden i områder udenfor Natura 2000, 3pp.

DTU Aqua. 2020c. Notat from DTU Aqua to the Minister for Fisheries in the Ministry of Environment and Food, 11 November, 2020. Forekomst af *Bonamia* og dødelighed af europæisk østers i Limfjorden. (Occurrence of Bonamia and mortality of European oysters in the Limfjord) 5pp.

Nielsen P, Geitner K, Olsen J, Nielsen MM. 2018a. Konsekvensvurdering af fiskeri af flad østers, stillehavsøsters og søstjerner i Nissum Bredning 2018/2019. DTU Aqua-rapport nr. 333-2018. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 52 pp. + bilag.

Nielsen, P., Geitner, K., Olsen, J. and Nielsen. M.M. 2019c. Notat vedrørende fiskeri af blåmus-linger, søstjerner, europæisk østers og stillehavsøsters i Løgstør Bred-ning 2019/2020. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 30pp.

Nielsen, P., Nielsen, M.M. and Geitner, K. 2019b. Notat vedrørende fiskeri af euro- pæisk østers og søstjerner i Nissum Bredning 2019/2020. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 23 pp.

Nielsen, P., Nielsen, M.M. and Geitner, K. 2020c. Notat vedrørende fiskeri af søstjerner og stillehavsøstersi Nissum Bredning 2020/2021, 21pp.

Nielsen, P., Olsen, J., Geitner, K. and Nielsen. M.M. 2020b. Konsekvensvurdering af fiskeri af blåmuslinger, europæisk østers, stillehavsøsters og søstjerner i Løgstør Bredning 2020/2021, 77pp.

Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for muslinge- og østersskrab og øvrig muslinge- og østersproduktion i og udenfor Natura 2000 områder.

Draft scoring range	**60-79**
Information gap indicator	**More information sought on reviews of alternative measures to minimise UoA-related mortality of unwanted catches of oysters.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**85**
Condition number (if relevant)	**NA**

PI 1.2.2 – Harvest control rules and tools - UoA 3 Oysters in Limfjord

PI 1.2.2		There are well defined and effective harvest control rules (HCRs) in place		
Scoring Issue		SG 60	SG 80	SG 100
a	HCRs design and application			
	Guide post	**Generally understood** HCRs are in place **or available** that are **expected** to reduce the exploitation rate as the point of recruitment impairment (PRI) is approached.	**Well defined** HCRs are **in place** that **ensure** that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock **fluctuating around** a target level consistent with (or above) MSY, or for key LTL species a level consistent with ecosystem needs.	The HCRs are expected to keep the stock **fluctuating at or above** a target level consistent with MSY, or another more appropriate level taking into account the ecological role of the stock, **most** of the time.
	Met?	**Yes**	**Yes**	**No**
Rationale				

As noted under the scoring of PI1.2.1, there are no reference points for the target stock, so it is appropriate to consider how the harvest control rules & tools manage the “susceptibility” attributes of the fishery used in the PSA assessment (areal overlap, vertical overlap, selectivity and post capture mortality) to ensure that it does not adversely affect the target species stock. When the RBF is used it is not necessary for exploitation rates to be reduced as reference points are approached.

MSC Fisheries Standard v2.01, GSA2.5 states that:

“HCRs are often applied on a frequent basis, such as with the annual setting of TACs or effort restrictions. Such HCRs respond dynamically to the monitoring data from the fishery with regular adjustments to input/output type management measures. In data-poor fisheries which are managed without such input/output controls, management may comprise only technical measures such as size limits, gear restrictions, closed seasons and closed areas. In these cases, the specific terms of the technical measures are usually set and fixed for a relatively long period of time (several years), based on occasional strategic stock assessments, that are shown to deliver defined target and/or limit reference points. Such an arrangement may be regarded as equivalent to a dynamic HCR operating over a longer time scale in cases where some indicators are monitored to confirm that the HCRs are delivering the intended targets for the stock.”

The harvest strategy for the oyster fishery is delivered through several harvest control rules and tools: -

- Total Allowable Catch – this is set annually in response to surveys of stock biomass and extent and serves to limit both the biomass removed from the stock and the areal extent of fishing.
- Depth restrictions – a depth limit of 5m applies in the main oyster fishing area, and 3m elsewhere. This constrains the encounterability attribute, ensuring that the overlap between the fishery and the stock is limited and that a significant quantity of adult and juvenile oysters never encounter oyster dredging.
- Gear restrictions – the specification of the oyster dredges is stipulated in legislation, which was based on gear trials, and which has subsequently been found to limit impacts on small oysters. This ensures that the susceptibility attribute of the fishery does not change.
- Minimum Landing Size – the MLS for oysters is set at 80g, equivalent to a shell length of around 70-80mm. Any oysters smaller than this size must be returned to the sea. The size at maturity for oysters is around 50mm. The MLS further serves to ensure that the selectivity of the fishery is maintained at an appropriate level.

These harvest control rules and tools serve to limit the susceptibility of the oyster stock to fishery removals. The variation of the TAC in response to changing stock status shows that the harvest control rules and tools are responsive. The SG60 and 80 requirements are therefore met. It is not clear that the ecological role of the stock is taken into account, and so SG100 is not met.

	HCRs robustness to uncertainty			
b	Guide post		The HCRs are likely to be robust to the main uncertainties.	The HCRs take account of a **wide** range of uncertainties including the ecological role of the stock, and there is **evidence** that the HCRs are robust to the main uncertainties.
	Met?		**Yes**	**No**

Rationale

The main uncertainty for the oyster fishery is recruitment. The harvest control rules and tools respond to this uncertainty by ensuring that a significant proportion of the stock remains unfished year after year, optimising the chance of there being a large broodstock present when climatic conditions are favourable for recruitment. Throughout the fished area of the stock, the harvest control rules, and tools have responded to uncertainty by setting a MLS for oysters that is larger than the size at maturity; ensuring that the gear used in the fishery is selective in terms of the retained catch and minimises damage to juveniles; and adjusting the TAC (and thus area fished) annually in response to changes in stock status.

The precautionary nature of the harvest control rules and tools with respect to protecting both a broodstock and juvenile oysters meets the SG80 requirements. In the Natura 2000 sites, a wider range of uncertainties are taken into account in the selection of the harvest control rules. The ecological role of oysters as food for shellfish-eating birds is taken into account, and the potential indirect effects of fishing on marine habitats is also considered by closing potentially vulnerable areas to fishing.

The harvest control rules in place for the whole Limfjord fishery take the main uncertainties into account and therefore the SG80 is met. A wide range of uncertainties including the ecological role of the oysters is taken into account in the Natura 2000 sites, which meets the SG100 requirements in those areas, but a score of 80 is appropriate for the whole Limfjord area. The SG100 is not met.

	HCRs evaluation			
c	Guide post	There is **some evidence** that tools used **or available** to implement HCRs are appropriate and effective in controlling exploitation.	**Available evidence indicates** that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.	**Evidence clearly shows** that the tools in use are effective in achieving the exploitation levels required under the HCRs.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

There is very good evidence from the fishery that the harvest control tools in place are achieving the fishing and exploitation levels required by the harvest control rules. Oyster biomass is increasing and the distribution of oysters in the Limfjord has expanded from the traditional grounds in the Nissum Bredning Natura 2000 site, and oysters are now found in significant densities further east. Evidence of compliance with the TAC for the fishery is provided by the catch and landings data monitored by the Danish Fisheries Agency. Compliance with area controls is provided in near real-time by the black box equipment that monitors all fishing activity. Compliance with technical measures and the oyster minimum landing size is monitored and is reported to be good.

The evidence available clearly shows that the set of harvest control tools in use for this fishery are successfully constraining the susceptibility of the oyster stock to fishing activity in all respects. The SG60, 80 and 100 requirements are therefore met.

References

Dolmer, P. and Hoffmann, E., 2004. Østersfiskeri i Limfjorden -sammenligning af redskaber. Danmarks Fiskeriundersøgelser, 40 pp.

Nielsen P, Geitner K, Olsen J, Nielsen MM. 2018a. Konsekvensvurdering af fiskeri af flad østers, stillehavsøsters og søstjerner i Nissum Bredning 2018/2019. DTU Aqua-rapport nr. 333-2018. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 52 pp. + bilag.

Nielsen, P., Geitner, K., Olsen, J. and Nielsen. M.M. 2019c. Notat vedrørende fiskeri af blåmus-linger, søstjerner, europæisk østers og stillehavsøsters i Løgstør Bredning 2019/2020. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 30pp.

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Nielsen, P., Nielsen, M.M. and Geitner, K. 2020c. Notat vedrørende fiskeri af søstjerner og stillehavsøstersi Nissum Bredning 2020/2021, 21pp.

Nielsen, P., Olsen, J., Geitner, K. and Nielsen. M.M. 2020b. Konsekvensvurdering af fiskeri af blåmuslinger, europæisk østers, stillehavsøsters og søstjerner i Løgstør Bredning 2020/2021, 77pp.

Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for muslinge- og østersskrab og øvrig muslinge- og østersproduktion i og udenfor Natura 2000 områder.

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**85**
Condition number (if relevant)	**NA**

PI 1.2.3 – Information and monitoring - UoA 3 Oysters in Limfjord

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Range of information			
	Guide post	**Some** relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	**Sufficient** relevant information related to stock structure, stock productivity, fleet composition and other data are available to support the harvest strategy.	A **comprehensive range** of information (on stock structure, stock productivity, fleet composition, stock abundance, UoA removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
	Met?	**Yes**	**Yes**	**No**
Rationale				

In scoring this Performance Indicator, the team has taken regard of the fact that the RBF has been used to score PI 1.1.1 because there is limited information about the state of the stock relative to any analytically or empirically determined reference points. Oyster surveys are undertaken regularly both within and outside Natura 2000 sites providing information on stock abundance, stock structure and productivity. Very good information is available about the composition of the fleet prosecuting the oyster stock. "Black box" recorders have been fitted to all oyster fishing vessels, so that the spatial extent of all oyster dredging activity can be monitored. The range of information available about oyster abundance, stock composition and distribution, detailed monitoring of fishing activity, information about impact on marine habitats and non-target species, levels of infection of *Bonamia* and evidence that all fishery removals are detected is sufficient to support the harvest strategy for the fishery, meeting the SG60 and SG80 requirements. In the Natura 2000 sites, in addition to the oyster surveys, environmental impact assessments are required and there is a comprehensive range of information available that is well above that required to support the harvest strategy. Although the SG100 requirements are met for those areas of the fishery within Natura 2000 sites, a score of 80 is considered appropriate reflecting the level of information available for the whole Limfjord fishery. The SG100 is not met.

b	Monitoring			
	Guide post	Stock abundance and UoA removals are monitored and **at least one indicator** is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and UoA removals are **regularly monitored at a level of accuracy and coverage consistent with the harvest control rule**, and **one or more indicators** are available and monitored with sufficient frequency to support the harvest control rule.	**All information** required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent **uncertainties** in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	**Yes**	**Yes**	**No**
Rationale				

DTU-Aqua has presented evidence of ongoing annual surveys of the entire oyster stock in the western Limfjord and Løgstør Bredning. It is clear, therefore, that there is a good understanding of the abundance and distribution of oysters in the Limfjord. Further to this, all fishing activity is recorded and monitored, and all fishery removals from the oyster stock are recorded in official landings data. The SG60 and 80 requirements are fully met. Whilst there is a good understanding of the uncertainties underlying the information, there is no evidence that the robustness of assessment and management to uncertainty in this information has been investigated. The SG100 is not met.

c	Comprehensiveness of information			
	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		**Yes**	
Rationale				

The only targeted fishery removals are taken by the oyster dredge fishery. There will also be a small catch by mussel dredgers, but this catch is permissible under the bycatch regulations for the mussel fishery and is recorded in the landings database. There is negligible recreational fishing for oysters in the Limfjord. There is good information on all other fishery removals and SG80 is met.

References

Dolmer, P. and Hoffmann, E., 2004. Østersfiskeri i Limfjorden -sammenligning af redskaber. Danmarks Fiskeriundersøgelser, 40 pp.

Nielsen P, Geitner K, Olsen J, Nielsen MM. 2018a. Konsekvensvurdering af fiskeri af flad østers, stillehavsøsters og søstjerner i Nissum Bredning 2018/2019. DTU Aqua-rapport nr. 333-2018. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 52 pp. + bilag.

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Nielsen, P., Olsen, J., Geitner, K. and Nielsen. M.M. 2020b. Konsekvensvurdering af fiskeri af blåmuslinger, europæisk østers, stillehavsøsters og søstjerner i Løgstør Bredning 2020/2021, 77pp.

Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for muslinge- og østersskrab og øvrig muslinge- og østersproduktion i og udenfor Natura 2000 områder.

Draft scoring range	**≥80**
Information gap indicator	**More information sought on whether recreational fishing for mussels is permitted, and if so, whether there is good information on any such landings.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**80**
Condition number (if relevant)	**NA**

PI 1.2.4 – Assessment of stock status - UoA 3 Oysters in Limfjord

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Appropriateness of assessment to stock under consideration			
	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment takes into account the major features relevant to the biology of the species and the nature of the UoA.
	Met?		**NA**	**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

b	Assessment approach			
	Guide post	The assessment estimates stock status relative to generic reference points appropriate to the species category.	The assessment estimates stock status relative to reference points that are appropriate to the stock and can be estimated.	
	Met?	**NA**	**NA**	
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

c	Uncertainty in the assessment			
	Guide post	The assessment **identifies major sources** of uncertainty.	The assessment **takes uncertainty into account**.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a **probabilistic** way.
	Met?	**NA**	**NA**	**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

d	Evaluation of assessment			
	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.

	Met?			**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

e	Peer review of assessment			
	Guide post		The assessment of stock status is subject to peer review.	The assessment has been **internally and externally** peer reviewed.
	Met?		**NA**	**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

References

MSC Fisheries Certification Process v2.1

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**80**
Condition number (if relevant)	**NA**

PI 1.1.1 – Stock status – UoA 4 Mussels in Inner Danish Waters

PI 1.1.1		The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing		
Scoring Issue		SG 60	SG 80	SG 100
a	Stock status relative to recruitment impairment			
	Guide post	It is **likely** that the stock is above the point where recruitment would be impaired (PRI).	It is **highly likely** that the stock is above the PRI.	There is a **high degree of certainty** that the stock is above the PRI.
	Met?	**NA – RBF used**	**NA – RBF used**	**NA – RBF used**
Rationale				

It is not possible to determine the status of the mussel stock in the Inner Danish Waters relative to biologically-based limits for sustainability because there are no formally agreed reference points for the mussel stock. The Risk Based Framework will therefore be used to assess stock status. – see Table 46, Table 51 and Table 55 in section 8.8.

The scores from section 8.8 were:

Consequence Analysis (CA) score = 100
Productivity Susceptibility Analysis (PSA) score = 97
Overall MSC score = 99

b	Stock status in relation to achievement of Maximum Sustainable Yield (MSY)			
	Guide post		The stock is at or fluctuating around a level consistent with MSY.	There is **a high degree of certainty** that the stock has been fluctuating around a level consistent with MSY or has been above this level over recent years.
	Met?		**NA – RBF used**	**NA – RBF used**
Rationale				

NA – RBF used

References

MSC. 2018. MSC Fisheries Standard Version 2.01.

See references in section 8.8.

Stock status relative to reference points			
	Type of reference point	Value of reference point	Current stock status relative to reference point
Reference point used in scoring stock relative to PRI (SIa)	**NA – RBF used**	**NA – RBF used**	**NA – RBF used**
Reference point used in scoring	**NA – RBF used**	**NA – RBF used**	**NA – RBF used**

stock relative to MSY (SIb)			

Draft scoring range and information gap indicator added at Announcement Comment Draft Report

Draft scoring range	**≥80**
Information gap indicator	**More information sought on recent mussel stock surveys outside the Natura 2000 sites**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**99**
Condition number (if relevant)	**NA**

PI 1.1.2 – Stock rebuilding - UoA 4 Mussels in Inner Danish Waters

PI 1.1.2		Where the stock is reduced, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue		SG 60	SG 80	SG 100
a	Rebuilding timeframes			
	Guide post	A rebuilding timeframe is specified for the stock that is the **shorter of 20 years or 2 times its generation time**. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.		The shortest practicable rebuilding timeframe is specified which does not exceed **one generation time** for the stock.
	Met?	**N/A**		**N/A**
Rationale				

If the RBF is used to score PI 1.1.1, then this PI is not scored (MSC Fisheries Certification Process v2.1, Table PF1).

b	Rebuilding evaluation			
	Guide post	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within the specified timeframe.	There is **evidence** that the rebuilding strategies are rebuilding stocks, **or it is likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the **specified timeframe**.	There is **strong evidence** that the rebuilding strategies are rebuilding stocks, **or it is highly likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the **specified timeframe**.
	Met?	**N/A**	**N/A**	**N/A**
Rationale				

If the RBF is used to score PI 1.1.1, then this PI is not scored (MSC Fisheries Certification Process v2.1, Table PF1).

References

MSC Fisheries Certification Process v2.1

Draft scoring range	**NA**
Information gap indicator	**NA**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**NA**
Condition number (if relevant)	**NA**

PI 1.2.1 – Harvest strategy - UoA 4 Mussels in Inner Danish Waters

PI 1.2.1		There is a robust and precautionary harvest strategy in place		
Scoring Issue		SG 60	SG 80	SG 100
a	Harvest strategy design			
	Guide post	The harvest strategy is **expected** to achieve stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy **work together** towards achieving stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and is **designed** to achieve stock management objectives reflected in PI 1.1.1 SG80.
	Met?	**Yes**	**Yes**	**No**
Rationale				

As Denmark is a member of the European Union, the mussel fishery must be managed within the framework of the EU's Common Fisheries Policy (CFP). The long-term objectives for the mussel fishery were established by the Danish Government through the setting up of the Advisory Committee on Mussel Production in 2005 following amendments to the Fisheries Act. The terms of reference of the Committee are "..*to promote sustainable economic development of fishing and farming of mussels……including establishing rules on fishing and farming….*". The Advisory Committee facilitates co-management of the fishery by providing the formal link between the fishery managers, the Danish Fisheries Agency, the fishing industry and environmental NGOs. A key component of the harvest strategy is the Mussel and Oyster Policy document which was published in 2013 (and revised in 2019) following consultation between the Government and WWF and Danish Nature Conservation NGOs. The Mussel and Oyster Policy is a fisheries management framework for fishing in the Natura 2000 areas but also guides the management of the fishery outside the Natura 2000 sites. In addition, all mussel fishing vessels are covered by the code of conduct developed by the Client (DFPO).

Although there are no formally agreed target and limit reference points for the mussel fishery, the overall harvest strategy is to limit mussel dredging to a small proportion of the total distribution of mussels, and to ensure that recruitment to the mussel stock is safeguarded. In addition, within Natura 2000 sites, the harvest strategy is designed to ensure that mussel dredging does not adversely affect the conservation features.

The harvest strategy is composed of a number of elements, including a robust monitoring, control and surveillance policy. The fishery is a limited entry fishery with a maximum of 8 licences (6 in East Jutland, 2 in Isefjord) in 2020, although two licences can be aggregated on a single vessel. There is a minimum landing size of 50 mm, restrictions on the weight and size of dredge, restrictions on vessel size and power, limits on the depth in which fishing is permitted, closed seasons and areas, and no fishing is permitted on Sundays and during the hours of darkness. There is a weekly TAC in East Jutland of 270 tonnes per licence, although the fishing industry voluntarily reduces this to 180 tonnes. In the Isefjord, there is no official weekly catch quota, but the fishing industry has voluntarily introduced a limit of 180 tonnes. This action was taken in response to a 2004 report that raised concerns about the long-term sustainability of the fishery and remains in place today. Whilst the catch limits set by the fishers' associations are informal, in conjunction with DFPO the catch limits can be enforced and sanctions applied if the limits are exceeded. No sorting of the catch is permitted on board the vessel. Within the Natura 2000 sites, there is an annual TAC, and there is a limit on vessel numbers allowed in the Natura 2000 sites at any one time. The TAC in Natura 2000 sites is based on the status of the stock as estimated from stock surveys. A full Environmental Impact Assessment (EIA) must be undertaken before fishing is permitted, and if mussel biomass estimates suggest that the stock cannot support both the needs of shellfish-eating birds and the fishery, then the fishery will not be permitted. To further safeguard recruitment, mussel relaying is permitted in a small area of the Isefjord, which cannot be fished unless it is opened by the Fisheries Agency.

The harvest strategy is designed therefore to limit mussel dredging activity to a relatively small geographical area in comparison with the distribution of the mussel stock area and to secure large reserves of mussels as brood stock to safeguard recruitment to the fishery. Within the Natura 2000 sites, the TAC is set in response to the status of the stock as demonstrated by stock surveys, and in some years (and currently) this strategy has resulted in the closure of the fishery within specific Natura 2000 sites. Whilst there are no regular surveys of the mussel stock outside the

Natura 2000 sites (although a full stock survey was conducted in the Isefjord in 2016), and there are no biologically-based reference points, the limited entry fishery with individual vessel quotas ensures that current fishery removals are generally less than natural mortalities and thus the fishery is unlikely to have any significant impact on stock levels. The assessment team concludes that both inside and outside the Natura 2000 sites the harvest strategy is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving stock management objectives reflected in PI 1.1.1 SG80. The SG60 and SG80 are met. Within the Natura 2000 sites, the harvest strategy which includes regular surveys and TACs is sufficient to meet the SG100, but outside the Natura 2000 sites the lack of regular surveys, overall TACs and Environmental Impact Assessments means that overall the mussel fishery does not meet the SG100.

b	Harvest strategy evaluation			
	Guide post	The harvest strategy is **likely** to work based on prior experience or plausible argument.	The harvest strategy may not have been fully **tested** but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been **fully evaluated** and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Restricted entry to the fishery, TACs, technical conservation measures and robust monitoring and enforcement are proven methods for controlling exploitation rates, ensuring that the reproductive potential of the stock is not impaired by the mussel fishery. The SG60 is met. Data from the “black box” system on board all vessels provides evidence of compliance with all spatial controls in the fishery. Regular stock surveys in the Natura 2000 sites and occasional surveys in areas outside the Natura 2000 sites, in conjunction with robust monitoring of landings data, provide evidence that the harvest strategy is achieving its objective of ensuring that mussel stocks are not adversely impacted by the fishery, that recruitment has not been impaired, and that the fishery does not impact on the conservation features within the Natura 2000 sites. There is evidence therefore that the harvest strategy is achieving its objectives and is able to maintain stocks at target levels, and so the SG80 is clearly met. However, there is no evidence that the harvest strategy has been fully evaluated through, for example, a Management Strategy Evaluation (MSE), and therefore the SG100 is not met.

c	Harvest strategy monitoring			
	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	**Yes**		
Rationale				

Landings are closely monitored through electronic logbooks and through catch declarations on landing. Vessels must “hail in” before landing and provide details of fishing area and estimated weight of landings, and there is a strong enforcement presence both at sea and in harbours and at the processors to ensure compliance with regulations. Fishing activity is monitored through the installation on all vessels of a “Black box” system which provides positional information every 10 seconds, which ensures compliance with all spatial management controls. All these elements of the monitoring programme are capable of showing whether the harvest strategy is working, and cross-checks by the Danish Fisheries Agency of the various components of the monitoring programme show no systematic mis-reporting. The SG60 is met.

d	Harvest strategy review			
	Guide post			The harvest strategy is periodically reviewed and improved as necessary.

	Met?			**No**
Rationale				

The Advisory Committee on Mussel Production regularly reviews elements of the harvest strategy and makes improvements where appropriate, but the assessment team found no evidence that the harvest strategy as a whole is regularly reviewed. The SG100 is therefore not met.

e	Shark finning			
	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**NA**	**NA**	**NA**
Rationale				

Sharks are not a target species in this fishery, so this scoring issue is not scored.

f	Review of alternative measures			
	Guide post	There has been a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock, and they are implemented, as appropriate.
	Met?	**Yes**	**Yes**	**No**
Rationale				

There is regular review of the minimum landing size and there is a minimum mesh size designed to ensure that catch of small juvenile mussels is minimised. Fishers will often carry out underwater video or ground-truthing observations to avoid areas of high density of small mussels and will not request opening of any production areas which have high densities of small mussels. In addition, mussels under the minimum landing size will be relayed from areas where oxygen depletion events are common to higher production areas to allow them to 'grow-on' to a commercial size. Alternative measures to minimise mortality of unwanted catch are regularly reviewed, so the SG60 and SG80 are met, but it is not clear that a formal review is conducted every two years so SG100 is not met.

References

DFPO Code of Conduct

DTU-Aqua, 2011. Blue mussel surveys in Danish waters. Available from: http://www.aqua.dtu.dk/Om_DTU_Aqua/Afdelinger/Faglige_stottefunktioner/GIS/Bl%C3%A5muslinger.aspx?lg=print

Nielsen, P., Geitner, K., Olsen, J. and Møller Nielsen, M. 2018b. Notat vedrørende konsekvensvurdering af fiskeri af blåmuslinger ved og øst for Horsens Fjord samt Endelave 2018/2019. DTU Aqua.

Orbicon. 2016. Bestandsundersøgelse af blåmus-ling i Isefjorden. Report for Danmarks Fiskeriforening, 21pp.

Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for muslinge- og østersskrab og øvrig muslinge- og østersproduktion i og udenfor Natura 2000 områder.

Draft scoring range	**≥80**
Information gap indicator	**More information sought on recent reviews of alternative measures to minimise UoA related mortality of unwanted catch.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**80**
Condition number (if relevant)	**NA**

PI 1.2.2 – Harvest control rules and tools - UoA 4 Mussels in Inner Danish Waters

PI 1.2.2		**There are well defined and effective harvest control rules (HCRs) in place**		
Scoring Issue		SG 60	SG 80	SG 100
a	HCRs design and application			
	Guide post	**Generally understood** HCRs are in place **or available** that are **expected** to reduce the exploitation rate as the point of recruitment impairment (PRI) is approached.	**Well defined** HCRs are **in place** that **ensure** that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock **fluctuating around** a target level consistent with (or above) MSY, or for key LTL species a level consistent with ecosystem needs.	The HCRs are expected to keep the stock **fluctuating at or above** a target level consistent with MSY, or another more appropriate level taking into account the ecological role of the stock, **most** of the time.
	Met?	**Yes**	**Yes**	**No**
Rationale				

In the absence of limit and target reference points, there should be management tools and measures in place that are consistent with ensuring that the susceptibility of the target species to removal is within an acceptable risk range, and that the measures could be spatial, temporal or changes to gear overlap.

MSC Fisheries Standard v2.01, GSA2.5 states that:

"HCRs are often applied on a frequent basis, such as with the annual setting of TACs or effort restrictions. Such HCRs respond dynamically to the monitoring data from the fishery with regular adjustments to input/output type management measures. In data-poor fisheries which are managed without such input/output controls, management may comprise only technical measures such as size limits, gear restrictions, closed seasons and closed areas. In these cases, the specific terms of the technical measures are usually set and fixed for a relatively long period of time (several years), based on occasional strategic stock assessments, that are shown to deliver defined target and/or limit reference points. Such an arrangement may be regarded as equivalent to a dynamic HCR operating over a longer time scale in cases where some indicators are monitored to confirm that the HCRs are delivering the intended targets for the stock."

Within the Natura 2000 sites, the key harvest control rule is that fishing is only permitted if the TAC can be accommodated within the likely annual growth of the stock within the Natura 2000 site. Fishing will only be permitted if the estimate of stock biomass is above the quantity of mussels required by shellfish-eating birds. In essence, there is a form of limit reference point, as the fishery will remain closed if the estimate of stock biomass from the stock survey drops below a specific level.

Both within and outside the Natura 2000 sites, there are a range of management measures which limit the susceptibility of the stock to fishery removals. Depth restrictions ensure that a large proportion of the mussel stock should be left unfished in shallow waters and there are other spatial controls which prevent dredging in much of the UoC. There are seasonal closures of the fishery and fishers also avoid fishing in areas where there is a high proportion of juvenile mussels or areas that are thought to act as a broodstock for the fishery. In addition to these spatial and temporal measures which limit the encounterability and overlap of the fishery with the mussel stock, the susceptibility of the mussel stock to fishery removals is constrained by a limit on the number of participating vessels, weekly TACs which limit the biomass of mussels removed and the geographical extent of the fishery, gear restrictions which limit the impact on smaller mussels and a minimum landing size above the size at maturity.

These harvest control rules and tools serve to limit the susceptibility of the mussel stock to fishery removals. Within the Natura 2000 sites the TAC varies in response to changing stock status demonstrating that the harvest control rules and tools are responsive. The SG60 and SG80 are therefore met. It is not clear that the ecological role of the stock is taken into account, and so SG100 is not met.

b	HCRs robustness to uncertainty

	Guide post		The HCRs are likely to be robust to the main uncertainties.	The HCRs take account of a **wide** range of uncertainties including the ecological role of the stock, and there is **evidence** that the HCRs are robust to the main uncertainties.
	Met?		**Yes**	**No**

Rationale

The main uncertainties for the mussel stock are the variation in and unpredictability of recruitment and regular high levels of mortality in the summer months of post-recruits due to predation and hypoxia events. Within the Natura 2000 sites, the TAC takes into account a wide range of uncertainties including variations in the food requirements of shellfish-eating birds and the potential indirect effects of fishing on marine habitats is also considered by closing potentially vulnerable areas to fishing. Within the Natura 2000 sites, the harvest control rule uses stock biomass estimates from stock surveys to ensure that fishing is only permitted when the estimate of stock biomass is above the quantity of mussels required by shellfish-eating birds. Uncertainties are taken into account in the selection of the harvest control rules by using precautionary estimates of stock biomass, which do not take into account the stock of mussels in the shallower waters.

Both within and outside the Natura 2000 sites, the management rules and tools respond to the uncertainty in recruitment by ensuring that a significant proportion of the stock remains invulnerable to fishing, through limiting the geographical area of the fishery, closing the fishery when natural mortalities due to anoxic conditions are most likely to occur, limiting the exploitation rate through limiting the number of licences and setting weekly quotas, setting a minimum landing size above the size at maturity and requiring the use of gear that is selective in terms of the retained catch and that minimises damage to juvenile mussels.

The harvest control rules in place for the mussel fishery take the main uncertainties into account and therefore the SG80 is met. In the Natura 2000 sites, a wide range of uncertainties including the ecological role of the mussels is taken into account, and therefore the requirements of the SG100 are met in those areas. However, within the whole Inner Danish Waters fishery a score of 80 is appropriate and the SG100 is not met.

c	HCRs evaluation			
	Guide post	There is **some evidence** that tools used **or available** to implement HCRs are appropriate and effective in controlling exploitation.	**Available evidence indicates** that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.	**Evidence clearly shows** that the tools in use are effective in achieving the exploitation levels required under the HCRs.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

There is good evidence from the fishery in terms of the level of fishing effort and the annual landings data that the input and output controls in the fishery have ensured that the exploitation rate has been maintained at a level that has little impact on the stock. TACs have been strictly adhered to, and the industry has implemented its own more restrictive TACs. Black box data shows that the geographical extent of the fishery is highly restricted in relation to the whole mussel stock, and that there is full compliance with all spatial management measures. Compliance with technical measures and the MLS is monitored by the Fisheries Agency and is reported to be good. Closure of the Lillebaelt and Horsens Fjord Natura 2000 sites to fishing because the stock surveys showed that there were not sufficient mussels to support both shellfish-eating birds and a fishery provides evidence that the harvest control rules which are used to set the TAC within the Natura 2000 sites are effective.

The evidence available shows clearly that the management measures and harvest control tools in use for the mussel fishery are successfully ensuring that the susceptibility of the mussel stock to fishing activity does not increase. The SG60, SG80 and SG100 are therefore met.

References

DFPO Code of Conduct

DTU-Aqua, 2011. Blue mussel surveys in Danish waters. Available from: http://www.aqua.dtu.dk/Om_DTU_Aqua/Afdelinger/Faglige_stottefunktioner/GIS/Bl%C3%A5muslinger.aspx?lg=print

Nielsen, P., Geitner, K., Olsen, J. and Møller Nielsen, M. 2018b. Notat vedrørende konsekvensvurdering af fiskeri af blåmuslinger ved og øst for Horsens Fjord samt Endelave 2018/2019. DTU Aqua.

Orbicon. 2016. Bestandsundersøgelse af blåmus-ling i Isefjorden. Report for Danmarks Fiskeriforening, 21pp.

Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for muslinge- og østersskrab og øvrig muslinge- og østersproduktion i og udenfor Natura 2000 områder.

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**85**
Condition number (if relevant)	**NA**

PI 1.2.3 – Information and monitoring - UoA 4 Mussels in Inner Danish Waters

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Range of information			
	Guide post	**Some** relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	**Sufficient** relevant information related to stock structure, stock productivity, fleet composition and other data are available to support the harvest strategy.	A **comprehensive range** of information (on stock structure, stock productivity, fleet composition, stock abundance, UoA removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
	Met?	**Yes**	**Yes**	**No**
Rationale				

In the Natura 2000 sites, regular mussel stock surveys provide detailed information about stock abundance and stock structure of mussels and provide an estimate of annual production of the stock. Outside the Natura 2000 sites in Isefjord, a full mussel survey was undertaken in November 2016 which provided up-to-date information on stock abundance, stock structure and productivity. Outside the Natura 2000 sites In the East Jutland area of the fishery, only irregular stock surveys have been conducted, so stock abundance and stock structure are less well understood in those areas. Comprehensive information on fleet composition is available from the Danish Fisheries Agency through their licensing scheme, and fishery removals are monitored rigorously through the vessels' electronic logbooks, recording of landings at the ports and inspection at processors' plants. The "black box" system provides highly detailed records of all fishing activity, particularly on the spatial extent of the fishing activity in relation to the distribution of the whole stock within the Inner Danish waters fishery. The SG60 and SG80 are therefore met. In addition to the mussel surveys in the Natura 2000 sites, Environmental Impact Assessments are required prior to the commencement of fishing and in these areas, there is a comprehensive range of information available that is well above that required to support the harvest strategy. For example, there are eelgrass distribution surveys in the Natura 2000 sites.

Although the SG100 requirements are met for those areas of the fishery within Natura 2000 sites, an overall score of 80 is considered appropriate reflecting the level of information available for the whole Inner Danish Waters fishery. The SG100 is not met.

b	Monitoring			
	Guide post	Stock abundance and UoA removals are monitored and **at least one indicator** is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and UoA removals are **regularly monitored at a level of accuracy and coverage consistent with the harvest control rule**, and **one or more indicators** are available and monitored with sufficient frequency to support the harvest control rule.	**All information** required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent **uncertainties** in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Within the Natura 2000 sites regular stock surveys provide estimates of stock biomass and annual production at a level of accuracy and coverage consistent with the harvest control rule. Stock status is monitored within Natura 2000 sites in greater detail to inform the stricter management requirements of these areas. Outside the Natura 2000 sites in Isefjord, a full mussel survey was undertaken in November 2016 which provided up-to-date information on stock abundance, stock structure and productivity. Outside the Natura 2000 sites In the East Jutland area of the fishery, only irregular stock surveys have been conducted, so stock abundance is less well understood in those areas. However, as the RBF has been used to score Performance Indicator 1.1.1, the assessment team considered that, bearing in mind the highly restricted spatial extent of the fishery in East Jutland, the monitoring of stock abundance within the East Jutland area as a whole is at a sufficient level to ensure that any increase in the susceptibility of the mussel stock to fishery removals could be identified.

Fishery removals are rigorously monitored at a high level of accuracy through the “black box” system which monitors fishing vessel position every 10 seconds, fishers’ logbooks and landings declarations. Cross-referencing of landings declarations with processor records and fishers’ logbooks are supported by inspection activities both on vessels and on shore. SG60 and SG80 are therefore met.

Whilst all the information required by the harvest control rules is monitored with a high frequency and a high degree of certainty, there is no evidence that the robustness of assessment and management to uncertainty in this information has been investigated. The SG100 is therefore not met.

c	Comprehensiveness of information			
	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		**Yes**	
Rationale				

All fishery removals from the directed mussel fishery are monitored rigorously. There is no recreational fishery for mussels, and any catches of mussels in other fisheries is considered to be very small in comparison with directed fishery. The SG80 is met.

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Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**80**
Condition number (if relevant)	**NA**

PI 1.2.4 – Assessment of stock status - UoA 4 Mussels in Inner Danish Waters

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Appropriateness of assessment to stock under consideration			
	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment takes into account the major features relevant to the biology of the species and the nature of the UoA.
	Met?		**NA**	**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

b	Assessment approach			
	Guide post	The assessment estimates stock status relative to generic reference points appropriate to the species category.	The assessment estimates stock status relative to reference points that are appropriate to the stock and can be estimated.	
	Met?	**NA**	**NA**	
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

c	Uncertainty in the assessment			
	Guide post	The assessment **identifies major sources** of uncertainty.	The assessment **takes uncertainty into account**.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a **probabilistic** way.
	Met?	**NA**	**NA**	**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

d	Evaluation of assessment			
	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.

	Met?			**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

e	Peer review of assessment			
	Guide post		The assessment of stock status is subject to peer review.	The assessment has been **internally and externally** peer reviewed.
	Met?		**NA**	**NA**
Rationale				

If RBF is used to score PI 1.1.1, a default score of 80 shall be awarded to this PI (MSC Fisheries Certification Process v2.1, Table PF1).

References

MSC Fisheries Certification Process v2.1

Draft scoring range	**≥80**
Information gap indicator	**NA**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**80**
Condition number (if relevant)	**NA**

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7.4 Principle 2

7.4.1 Principle 2 background

7.4.1.1 Primary, Secondary and ETP species

The impact of the UoAs on non-target species is evaluated differently depending on whether the species is considered to be a Primary, Secondary or Endangered, Threatened or Protected (ETP) species. The MSC Fisheries Standard v2.01 defines the three categories of non-target species as follows:

Primary species are species where management tools and measures are in place, intended to achieve stock management objectives reflected in either limit (LRP) or target reference points (TRP). Primary species can therefore also be referred to as 'managed species'. Primary species are species not covered by Principle 1 because they are not part of the UoA and are species within scope of the MSC programme.

Secondary species are species that are not managed in accordance with limit or target reference points. Species that are out of scope of the MSC programme, but where the definition of ETP species is not applicable (see below). Where out of scope species are in the catch profile, they are considered to be 'main'.

In addition to designating non-target species as primary or secondary species, the impact of the UoAs on the non-target species considers whether the species are 'main' or 'minor' primary or secondary species.

Primary and Secondary species are defined as 'main' if they meet the following criteria:

- The catch comprises 5 % or more by weight of the total catch of all species by the UoA;
- The species is classified as 'less resilient' and comprises 2 % or more by weight of the total catch of all species by the UoC. Less resilient is defined here as having low to medium productivity, or species for which resilience has been lowered due to anthropogenic or natural changes to its life-history;
- The species is out of scope but is not considered an ETP species (Secondary species only);

ETP species are defined as follows:

- Species that are recognised by national ETP legislation
- Species listed in binding international agreements including Appendix 1 of the Convention on International Trade in Endangered Species (CITES) and the Convention on Migratory Species (CMS);
- Species classified as 'out-of-scope' (amphibians, reptiles, birds and mammals) that are listed in the IUCN Redlist as vulnerable (VU), endangered (EN) or critically endangered (CE).

UoAs 1 & 2 – Mussel and cockle fishery in the Limfjord

There is little or no discarding of non-target species in the Limfjord mussel and cockle fishery. A single dedicated licensed vessel will locate suitable mussel beds using underwater video cameras and sonar equipment which allows dredging to concentrate on areas where the mussel or cockle density is high, the shellfish are larger than the MLS and where the catch of non-target species is low. The fishing and sorting process is summarised below.

When the dredges are hauled to the surface after each tow the fishers will typically "wash" the dredges by dipping them repeatedly up and down at the surface of the water, which dislodges some smaller shell, stones, sand and some undersized mussels. At this stage the catch may be rejected (for instance if there are too many undersized mussels in the catch or if it contains a lot of starfish), and everything therefore released back to the seabed. Due to the regular surveying activities using sonar and video equipment this rejection of the whole catch is very unusual.

Once deposited in the boat's hold, very little of the catch may be returned to the seabed, with the exception of any large stones, fish or oysters lying on the surface of the catch in the hold. To minimise the impact of the fishery on the habitat, stones greater than 2kg in weight must be returned to the seabed and since mussel prices are adjusted according to the proportion of good quality mussels in the landed catch there is clearly an incentive for fishers to return large stones to the seabed. The weight of stones landed must be recorded and logged.

As part of licence conditions, fishers are required to report any landings of non-target species making up 50 kg or more of the catch. The quantity of retained species in the catch is monitored during processing at the factories. Interviews with fishers and factory operators during the site visit for the original certification (Wakeford *et al.*, 2016) reported that the main bycatch species were:

- Starfish, *Asterias rubens* – these are occasionally very abundant, and are avoided by dredgers. Any starfish caught form a small (<5%) part of the catch and are landed with the catch. They are removed from the mussels and cockles during processing (for disposal with empty shells to farmland).
- Crabs, *Carcinus maenas* – these are also caught and landed, and separated from the target catch (cockles and mussels) during processing for disposal ashore. Again, abundance was considered to be far less than 5% by weight of the catch.
- Flatfish – between 10 - 30 flatfish (mostly flounder, *Platichthys flesus*) were reported by fishers to be caught per day, and those that can be reached in the vessel hold by the fishers are thrown back in the sea.

Stakeholders consulted during the remote site visit for this reassessment confirmed that the main bycatch species remain as reported in 2015.

There is no formal observer programme in the Limfjord mussel and cockle fishery but independent information on the catch of non-target species is available from the annual mussel surveys that are conducted throughout the Limfjord. These surveys are carried out using commercial fishing vessels and mussel dredges, with DTU-Aqua scientists aboard. The gear used in the surveys is a downscaled version of the ‘old’ dredge (the so-called Dutch dredge). It has remained unchanged since the 1990’s and includes a 25 mm mesh on the upper side of the dredge. DTU-Aqua scientists record the quantity of mussels and other species in each 100 m dredge tow.

The annual mussel survey data therefore provides quantitative information about the total catch of target and non-target species obtained when using a shellfish dredge when fishing for mussels, because a commercial mussel dredge is used to carry out the survey. The survey also provides qualitative and some quantitative information about the catch that is likely to be obtained when fishing for cockles, since the design of the survey dredge includes a 25mm mesh which is smaller than the 30mm mesh used when targeting cockles in the commercial fishery.

Wakeford *et al*. (2016) present the results of an analysis of catch composition from the Limfjord shellfish stock survey in 2014. The catch composition was obtained by sub-sampling the stock survey results to show the catch associated with mussels or with cockles. Of the 235 stations sampled, mussels were only caught at 79 stations. At most of the stations where mussels were caught, the mussel catch was very low (an average of 14.1 kg per 100 m tow). DTU-Aqua estimated that the minimum economic catch rate for mussels is 1 kg per m² dredged (which is equivalent to around 2.1 kg/m² owing to the catch efficiency of the gear). The gear used in the stock survey is the standard dredge (1.45 m wide) that is towed for 100 m to produce a sample (i.e. an area of 145 m²). On this basis, only dredge hauls in the sample data of over 145 kg of blue mussels would be economically viable. None of the samples in the stock survey contained this quantity with more than 100 kg of mussels caught at only one station (Table 21). The data shown in Table 21 include the mean weight of the catch components from all 235 sample stations, from the sample stations where more than 10 kg of mussels were caught (this is less than 1/10 of the economically viable catch limit) and for the sample station where a catch of over 100 kg was taken, which is more typical of commercial activity. The data from all of the samples provides an indication of the high abundance of starfish in the Limfjord at the time of the survey in 2014, as they make up around 22% of the total weight sampled. It is also evident that even in areas where the mussel catch rate is much less than the minimum commercial limit, the abundance of non-target species is very low, with the most abundant non-target species (starfish) making up 3% of the catch. In the single sample where more than 100 kg of mussels was caught, starfish made up 0.5% of the catch.

Of the 235 stations sampled, cockles were only caught at 7 stations. At the 7 stations where cockles were caught, the catch was also quite low (an average of 18.5 kg per tow) (Table 22). It should be noted that the first two rows of the DTU Aqua table reproduced as Table 22 relating to catches of mussels and cockles have been transposed in error, i.e. row 1 should be labelled ‘cockles’ and row 2 should be labelled ‘mussels’. Although cockles command a higher price than mussels, the peak catch recorded in the survey results was just 64 kg for a single 100 m (145 m²) tow. DTU-Aqua has not estimated the economically viable catch rate for a cockle tow. The catch composition data indicate that starfish make up the greatest non-target catch component when cockles are caught at around 9% of the catch (Table **22**). All of the other catch components are caught in much lower quantities. Shore crabs represent around 1% of the catch, and the main catch component in the survey data were unidentified material (reported to be mostly old shells). The cockle catch analysis (**Table 22**) suggests that starfish could make up around 8% of the cockle proportion of the catch, whereas they make up around 0.5% of the catch in areas where mussels are most abundant. In reality, a catch of cockles containing 8% starfish is unlikely to be acceptable to processors, and fishers would avoid areas with such a high starfish density. Nevertheless, the rules on catch composition (49% cockles: 51% mussels) would result in the catch of starfish being less than 5% of total catch even in the “worst case scenario” of the cockle catch containing up to 9% starfish (arithmetically, (49% x 9%) + (0.5% x 51%) = 4.6%).

With respect to discarding from the fishery, the only species that has been reported as a discard are flounder (*Platichthys flesus*) which fishers report are thrown back to the sea, alive, immediately after capture. Fishers report a catch rate of between 10 - 30 flounder per day of fishing. The DTU-Aqua survey in 2014 indicated an average catch rate of flounder across all stations of 0.0003 kg in comparison with 4.7 kg of mussels. Assuming typical landings of around 25,000 tonnes of mussels per year, this equates to less than 2 tonnes of flounder discarded annually in the mussel fishery.

It should be stressed that there is no formal observer programme for the mussel and cockle fisheries and therefore no direct observation of the total catch composition for these fisheries. The data presented in Table 21 and Table **22** provide only an indirect estimate of the percentage of total catch for each bycatch species for a single annual stock survey conducted in 2014. Whilst the raw data on catch composition are available for more recent annual surveys of the mussel and cockle stocks, DTU Aqua have not analysed these data to provide similar catch composition data as presented in Table 21 and Table 22.

Table 21. Mussel catch analysis derived from the catch composition of shellfish survey samples taken during the 2014 stock survey in the Limfjord. The catch composition for the single sample with over 100kg of mussels is likely to be typical of commercial catches, which require a catch rate of 1 kg per m² dredged. Catches of more than 10 kg of mussels per sample station (a catch rate of less than 0.1 kg/m²) are shown, as well as the catch composition from all sample stations. (Source: DTU Aqua; Wakeford *et al*., 2016)

	All samples		**Samples with >10kg mussels**		**Samples with >100kg mussels**	
Number of samples	**235**		**28**		**1**	
Item	**Mean Weight (kg)**	**Proportion of catch (%)**	**Mean Weight (kg)**	**Proportion of catch (%)**	**Mean Weight (kg)**	**Proportion of catch (%)**
Mussels *Mytilus edulis*	4.7	66.6	37.5	96.5	123.9	99.5
Cockles *Cerastoderma edule*	0.55	7.7	0	0	0	0
Starfish *Asterias rubens*	1.6	22.5	1.16	3.0	0.6	0.5
Shore crabs *Carcinus maenas*	0.1	1.5	0.16	0.4	0	0
Oysters *Ostrea edulis*	0.04	0.6	0.02	0.06	0	0
Fish						
Flounder *Platichthys flesus*	0.0003	0.01	0	0	0	0
Hake *Merluccius merluccius*	0.02	0.3	0	0	0	0
Sand gobies *Pomatoschistus minutus*	0.00004	0.001	0	0	0	0
Scorpion fish / Sculpin *Myoxocephalus scorpius*	0.0007	0.01	0	0	0	0
Other fish	0.003	0.05				
Other invertebrates						
Leathery sea-squirts *Styela clava*	0.001	0.02	0	0	0	0
Queen scallops *Aequipecten opercularis*	0.0002	0.003	0	0	0	0
Seaweed	0.036	0.5	0	0	0	0
Other material						
Stone and wood	0.63		0.3		0	
Metal	0.001		0		0	
Plastic	0.0007		0		0	
Unidentified (mostly empty shells)	37.3		41.3		26.6	

Table 22. Cockle catch analysis derived from the catch composition of shellfish survey samples in the Limfjord. Catch composition is shown for all samples and subsets of samples where more than 1 kg and more than 10 kg of cockles were present in the catch. Commercial tows are likely to contain more than 10 kg per 100 m tow distance. (Source: DTU Aqua; Wakeford *et al*., 2016.) N.B. This table was produced originally by DTU Aqua and the first two rows have been transposed in error - i.e., row 1 should be labelled 'cockles' and row 2 should be labelled 'mussels'.

	All samples		Samples with >1kg cockles		Samples with >10kg cockles	
Number of samples	235		6		3	
Item	Mean Weight (kg)	Proportion of mean catch (%)	Mean Weight (kg)	Proportion of mean catch (%)	Mean Weight (kg)	Proportion of mean catch (%)
Mussels *Mytilus edulis*	0.55	7.7	21.50	88	38.1	91.3
Cockles *Cerastoderma edule*	4.7	66.6	0.82	3.3	0.003	0.01
Starfish *Asterias rubens*	1.6	22.5	1.84	7.5	3.24	7.8
Shore crabs *Carcinus maenas*	0.1	1.5	0.19	0.8	0.213	0.51
Oysters *Ostrea edulis*	0.04	0.63	0.07	0.3	0.13	0.32
Fish						
Flounder *Platichthys flesus*	0.0003	0.01	0	0	0	0
Hake *Merluccius merluccius*	0.02	0.34	0	0	0	0
Sand gobies *Pomatoschistus minutus*	0.00004	0.001	0.001	0.01	0.003	0.01
Scorpion fish / Sculpin *Myoxocephalus scorpius*	0.0007	0.01	0	0	0	0
Other fish	0.003	0.5	0.0185	0.08	0.04	0.09
Other invertebrates						
Leathery sea-squirts *Styela clava*	0.001	0.02	0	0	0	0
Queen scallops *Aequipecten opercularis*	0.0002	0.03	0	0	0	0
Seaweed	0.036	0.5	0	0	0	0
Other material						
Stone and wood	0.63		0.19		0	
Metal	0.001		0		0	
Plastic	0.0007		0		0	
Unidentified (mostly empty shells)	37.3		5.9		4.33	

Designation of non-target species in the Limfjord mussel (UoA 1) and cockle (UoA 2) fishery.

Based upon the information above, the only species caught in any significant quantity in commercial tows in the mussel fishery are cockles, oysters, starfish, shore crabs and flounder. Cockles, oysters, starfish and shore crabs are not 'managed' species and therefore should be classified as secondary species in UoA 1. Although cockles are assessed as a target (P1) species in this fishery in UoA 2, MSC Fisheries Standard v2.01, SA3.1.4 states that "The team shall assign secondary species in P2 as species in the catch that are within scope of the MSC program but are not covered under P1 because they are not included in the Unit of Assessment", and as cockles are not included in UoA 1, they have been considered under P2 as a secondary species. As the catch rates of cockles, oysters, starfish, shore crabs are less than 5% of the total catch in the mussel fishery, all these species can therefore be designated as minor secondary species. For the North Sea and Skagerrak flounder stocks ICES report that the exploitation rate is below the F_{MSY} proxy, but no stock biomass reference points are determined (ICES, 2021). ICES provides advice on maximum catches based upon stock assessments and so flounder can be considered as a minor primary species.

In commercial tows where cockles are the main targeted species, the information presented above suggests that only mussels, starfish, shore crabs, oysters and flounder are caught in significant numbers. Mussels and flounder are designated as primary species in UoA 2. Although mussels are assessed as a target (P1) species in this fishery in UoA 1, MSC Fisheries Standard v2.01, SA 3.1.3.1 states that primary species include “species in the catch that are not covered under P1 because they are not included in the UoA”, and as mussels are not included in UoA 2, they have been considered under P2 as a primary species. As mussels are caught in relatively small numbers (<5%) of the total catch in cockle-directed tows, they should be considered as a minor primary species. As for UoA 1, flounder are designated as a minor primary species and shore crabs and oysters are designated as minor secondary species for UoA 2. There is potential for starfish to constitute more than 5% of the total catch in UoA 2 and therefore must be considered main secondary species.

It should be emphasised that these designations of (main and minor) primary and secondary species are based upon the DTU Aqua 2014 Limfjord stock survey. No analysis of more recent DTU Aqua survey data is available, and there is no formal observer programme from which catch composition from dredge tows in the commercial fisheries is available.

UoA 3 Oyster fishery in the Limfjord

The fishing and sorting process in the oyster fishery is similar to that described above for the mussel and cockle fishery. After towing the oyster dredges along the seabed, they are hauled to the surface after each tow. The fishermen will typically “wash” the dredges by dipping them repeatedly up and down at the surface of the water before recovering the dredges back to the vessel, which dislodges some smaller shell, stones, sand and some undersized oysters (on occasion, removing the majority of the haul). At this stage the catch may be rejected, and everything therefore released back to the seabed. Due to the regular prospecting activities that are carried out the rejection of the whole catch is unusual. After “washing” the catch, the dredges are emptied onto a sorting table on deck where the catch is sorted. Undersized oysters and non-target species are returned to the sea (discarded).

Oyster dredging vessels are permitted to retain mussels during an oyster fishing trip, providing that the quantity of mussels retained is no more than 10% (by weight) of the oyster catch aboard the vessel. The quantity of mussels landed by oyster dredging vessels is recorded in catch and landings declarations. These data are aggregated for all vessels for each fishing area and for each month, so it is not possible to extract the quantity and proportion of mussels and cockles that are retained and landed by the oyster fishermen per year as a separate statistic from the official database. During the site visit for the previous assessment of the oyster fishery, Andrews *et al*. (2017) consulted a wide range of stakeholders who all confirmed that a very small quantity of mussels are landed by dredgers when they are targeting oysters. These anecdotal reports were supported by analysis of catch composition data on the official database from production areas 1-4 (where only oyster dredges can be used). Annual landings over the period 2010-2016 for these areas were 311 tonnes per year of oysters, and the associated mussel catch was just over 9 tonnes (3% of the total catch), and cockle catches averaged just over 950kg per year over the same period (0.3% of the total catch) (Andrews *et al*., 2017).

The only formal observer trips in the oyster dredge fishery were undertaken by DTU-Aqua on 12 fishing trips during the 2013-14 fishing season (Gommesen & Fomsgaard, 2014). The key findings of this work were that dead material (mostly old oyster shells) form the bulk of the catch (~65%) (Figure 44). Oysters make up less than 10% of the total catch; undersized oysters make up less than 1% of the total catch; and around 24% of the catch is made up of non-target animal species, mostly other invertebrate species. The only species that comprised more than 2.5% of the catch were starfish, which made up 15% of the catch in oyster dredges (Gommesen & Fomsgaard, 2014). No further observer trips have been undertaken in the oyster fishery since the 2014 study.

Designation of non-target species in the Limfjord oyster (UoA 3) fishery.

Based on the information above, the only species caught in significant numbers in the oyster dredge fishery are mussels, cockles and starfish. Mussels are managed species, but comprise less than 5% of the total landings, so can be considered as a minor primary species, cockles are a minor secondary species, and starfish should be considered to be a main secondary species as they can constitute more than 5% of the total catch in the oyster fishery. The other species recorded in small numbers by Gommesen and Fomsgaard can all be classified as minor secondary species.

These are non-target species and are all returned directly to the sea after capture. They are robust species, and individuals are likely to survive being caught in oyster dredges. Each of these non-target species is widespread and locally abundant. It should be noted that there is a fishery for starfish in the Limfjord. This is prosecuted independently from the fishery for oysters, although some vessels may participate in both fisheries. The starfish fishery is licensed and is subject to assessment within Natura 2000 sites to ensure that its impacts are acceptable. The starfish caught in the starfish fishery are landed and processed for use in animal and aquaculture feed. Starfish are not retained in the targeted oyster fishery.

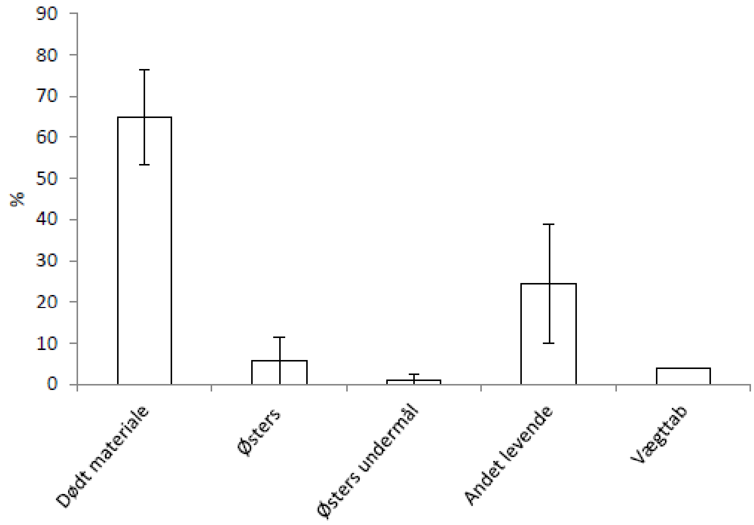


Figure 44. Catch composition in oyster dredges in the Limfjord. (Dødt material = dead material, mostly old oyster shells; Østers = oysters; Østers undermål = undersized oysters; Andet levende = other living organisms; Vægttab = plant material). [Source: Gommesen & Fomsgaard, 2014]

<u>UoA 4 – Mussel fishery in the Inner Danish Waters</u>

There is little or no discarding of non-target species in the Inner Danish Waters mussel fishery. Test dredging is undertaken by a single dedicated licensed vessel to locate suitable mussel beds using underwater video cameras and sonar equipment, and so dredging concentrates on areas where the mussel density is high. When the dredges are hauled to the surface, the fisher will typically “wash” the dredges by dipping them repeatedly up and down at the surface of the water. This dislodges some smaller shell, stones, sand and undersized mussels. Once deposited in the boat’s hold, nothing may be returned to the seabed, with the exception of larger stones.

In this UoA, bycatch over 50 kg per species has to be recorded in the logbook. Based on logbook data from the Danish Fisheries Agency, a maximum of 10% undersized mussels are allowed as bycatch in each landing in East Jutland. Local inspectors randomly take samples from the landings to monitor whether there are too many undersized mussels and will record any other bycatch species. Starfish may be retained along with mussels. As with the Limfjord mussel fishery there is no formal observer programme, although the assessment team assumed that starfish, shore crabs and flounder may occasionally be caught. Surveys are undertaken regularly in the Natura 2000 sites within the UoA, and although similar data to that presented for the Limfjord mussel fishery must be available for the Inner Danish Waters fishery, no analysis of the raw survey data to provide total catch composition has been undertaken.

Designation of non-target species in the Inner Danish Waters mussel (UoC 4) fishery.

Starfish and shore crabs are both secondary species as they are not managed in relation to formal limit or target reference points. In the eastern Danish waters (ICES Divisions 3A.21 and 3a.22), ICES assessments of flounder show that fishing pressure is below the F_{MSY} proxy, but there are no stock biomass reference points, and no TAC is set for this species (ICES, 2019), so it can be concluded that the flounder stock is not managed, and therefore flounder is a secondary species. Based on the likely catch composition in the commercial tows, starfish, shore crabs and flounder can be designated as minor secondary species.

Starfish, *Asterias rubens*

Within the Limfjord, DTU Aqua surveys show that starfish, *Asterias rubens*, are found widely across the Løgstør Bredning, Lovn Bredning and Nissum Bredning Natura 2000 sites, and there are large populations within the Limfjord outside the Natura 2000 sites. There is no information on stock structure of starfish in the Limfjord and the surrounding region. Starfish have a high fecundity, a pelagic larvae stage of more than 80 days, the ability to settle on a wide variety of substrates, a highly mobile adult stage and throughout their geographical range are widely distributed from the intertidal up to 600m depth (Budd, 2008). It seems reasonable to assume therefore that there is a single stock in the Limfjord, although the stock may have a wider distribution than the Limfjord itself.

Starfish are key predators in many coastal ecosystems and their prey are primarily benthic invertebrates, particularly bivalve molluscs such as mussels, polychaetes, small crustaceans and other echinoderms. Starfish are known to occur in areas of large concentrations of mussels and may exhibit increased foraging activity when they crowd together in dense clusters (Agüera *et al*. 2012). With their documented predation on banks of mussels (Gallagher *et al*. 2008; Agüera *et al*. 2012) starfish can thus potentially be a threat to biogenic reefs (Nielsen *et al*., 2020b). Although some bird and fish species are predators of starfish, their distribution is primarily governed by environmental and food conditions with high temperatures and low oxygen concentrations being unfavourable conditions for starfish (Holtegaard *et al*. 2008).

During their annual mussel surveys, DTU Aqua have estimated population biomass of starfish since 2013 in Løgstør Bredning, Lovn Bredning and Nissum Bredning Natura 2000 sites (Nielsen *et al*., 2019b, 2020a,b), but the methodology is not fully validated and thus there is some uncertainty around the annual estimates of starfish biomass. For both the cockle dredge (UoA 2) and oyster dredge (UoA 3) fisheries, starfish are not retained and discarded back to the sea following capture. Post-capture survival is expected to be high as starfish are resilient to disturbance and are capable of regrowing arms even if damaged by fishing gear (autotomy). As starfish are discarded in both UoAs and in the absence of an observer programme, there is no estimate of catch of starfish available for either UoA. However, in recent years there has been a directed fishery for starfish in the Limfjord (Table 23). The fishery uses a starfish seine net which is designed so that there is minimal impact of the gear on the seabed. There is limited information on total catch composition within the directed starfish fishery, but one scientific survey in 2013 showed that over 90% of the catch was starfish.

Table 23. Landings of starfish, *Asterias rubens*, in the Limfjord in recent years. (Source: Danish Fisheries Agency)

Year	Starfish landings (tonnes)
2016/17	1692
2017/18	0
2018/19	749
2019/20	452

Directed fisheries for starfish are incorporated within DTU Aqua's assessment of the overall impact of all fisheries on the Natura 2000 sites in the Limfjord. Based on the 2020 DTU Aqua stock surveys, the fishing industry has requested catches of 100 tonnes in Lovns Bredning, 200 tonnes in Løgstør Bredning and 500 tonnes in Nissum Bredning, and 5000 tonnes outside the Natura 2000 sites in fishing season 2020/2021. Assuming that fishing will take place at the highest densities of starfish, the proposed catch in both Lovns Bredning and Løgstør Bredning is estimated to affect less than 2% of the area of the Natura 2000 site, whereas in Nissum Bredning the proposed fishery is expected to be restricted to 4% of the total area of the Natura 2000 site (Nielsen *et al*., 2019b, 2020a, b). DTU Aqua consider that the proposed fishery is sustainable in relation to the starfish stock in the Limfjord which was estimated to be 26,400 tonnes across the whole of the Limfjord in spring 2020.

Endangered Threatened & Protected (ETP) species in the UoAs

As noted above, the MSC define Endangered Threatened & Protected (ETP) species (SA3.1.5) as follows:

- Species that are recognised by national ETP legislation
- Species listed in the following binding international agreements: Appendix 1 of the Convention on International Trade in Endangered Species (CITES) and the Convention on Migratory Species (CMS);

- Species classified as 'out-of-scope' (amphibians, reptiles, birds and mammals) that are listed in the IUCN Redlist as vulnerable (VU), endangered (EN) or critically endangered (CE).

Species are not considered as ETP under the MSC Standard if they only appear in non-binding lists; are only the subject of intergovernmental recognition; are not included in national legislation; are not subject to binding international agreement.

Danish national legislation is transcribed from the current EU legislation for the protection of ETP species which is set out in two Directives: the "Habitats Directive" (92/43/EC) and the "Wild Birds Directive" (2009/147/EC). The species protected in these Directives are assigned varying levels of protection, dependent on the conservation status of each species. Under the Habitats Directive, sturgeon (*Acipenser sturio*) is currently protected but has not been recorded as captured in the UoAs. The potential impact of the mussel, cockle and oyster fisheries in the Limfjord and Inner Danish Waters on wild birds is assessed every year for the Natura 2000 sites that are vital for the protection of these species, using the most up to date information about the species, mussel, cockle and oyster stocks and the shellfish fisheries.

In addition, each year the EU publishes a Council Regulation fixing the fishing opportunities for various fish stocks in EU waters and includes a list of prohibited species. For 2021, Article 20 of Council Regulation (EU) 2021/92 lists the following species which must not be harmed, and which must be released back to the sea immediately if caught in fishing gear:

(a) starry ray (*Raja radiata*) in Union waters of ICES divisions 2a, 3a and 7d and ICES subarea 4;
(b) splendid alfonsino (*Beryx splendens*) in NAFO subarea 6;
(c) leafscale gulper shark (*Centrophorus squamosus*) in Union waters of ICES division 2a and ICES subarea 4 and in Union and international waters of ICES subareas 1 and 14;
(d) Portuguese dogfish (*Centroscymnus coelolepis*) in Union waters of ICES division 2a and ICES subarea 4 and in Union and international waters of ICES subareas 1 and 14;
(e) kitefin shark (*Dalatias licha*) in Union waters of ICES division 2a and ICES subarea 4 and in Union and international waters of ICES subareas 1 and 14;
(f) birdbeak dogfish (*Deania calcea*) in Union waters of ICES division 2a and ICES subarea 4 and in Union and international waters of ICES subareas 1 and 14;
(g) common skate (*Dipturus batis*) complex (*Dipturus* cf. *flossada* and *Dipturus* cf. *intermedia*) in Union waters of ICES division 2a and ICES subareas 3, 4, 6, 7, 8, 9 and 10;
(h) great lanternshark (*Etmopterus princeps*) in Union waters of ICES division 2a and ICES subarea 4 and in Union and international waters of ICES subareas 1 and 14;
(i) tope shark (*Galeorhinus galeus*) when taken with longlines in Union waters of ICES division 2a and ICES subarea 4 and in Union and international waters of ICES subareas 1, 5, 6, 7, 8, 12 and 14;
(j) porbeagle (*Lamna nasus*) in all waters;
(k) thornback ray (*Raja clavata*) in Union waters of ICES division 3a;
(l) undulate ray (*Raja undulata*) in Union waters of ICES subareas 6 and 10;
(m) whale shark (*Rhincodon typus*) in all waters; (n) common guitarfish (*Rhinobatos rhinobatos*) in the Mediterranean;
(o) picked dogfish (*Squalus acanthias*) in Union waters of ICES subareas 2, 3, 4, 5, 6, 7, 8, 9 and 10, with the exception of avoidance programmes as set out in Annex IA.

Appendix 1 of CITES has been accessed at the CITES website. There are no species listed in this Appendix that are affected by the Limfjord mussel, cockle and oyster fisheries under assessment. However, there are two species present in the Inner Danish Waters fishing area that are listed in Appendix 1:

White-tailed eagle (*Haliaeetus albicilla*) – There are potential breeding and nesting sites in the Lillebælt Natura 2000 site. However, only 2-3 eagles were seen in the area from 2004 to 2012 (Miljøministeriet, 2013a). DTU Aqua believes that the food base for this species will not be affected by the UoAs since the fishing takes place with limited vessels over a limited area and time (Nielsen *et al*., 2015a).

Otter (*Lutra lutra*) – The otter population is spread throughout Denmark. While the total stock size is unknown, it is known that the population has increased since the 1980s to become a viable stock. It is believed that otters enter the Horsens Natura 2000 site during migration, but it is unknown whether this is a proper breeding stock or just stray individuals. Overall, limited evidence of otter presence has been found at the monitoring stations within Horsens (Miljøministeriet, 2013b). Otters are sensitive to disturbance, particularly during breeding season. The UoAs operate year-round but typically are a good distance from the shore where otters breed and hideout. There is no registered bycatch of otters in the UoAs, most likely because otters are nocturnal and the UoAs only operate from sunrise to sunset. Further, given that otters have a diverse diet (e.g., fish, frogs, small mammals, birds, crustaceans), otters are likely to adapt well to the removal of mussels. DTU Aqua believes that this along with the limited vessels and spatial and temporal coverage of the UoAs means that the UoAs will have a minimal impact on otters (Nielsen *et al*., 2016).

In relation to binding agreements made under the Convention on the Conservation of Migratory Species (CMS), the only agreement that is relevant to the UoAs in this fishery is the Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS) which includes a limit of anthropogenic interaction with harbour porpoise. No interactions with harbour porpoise have been recorded in the dredge fisheries in the UoAs. In a previous assessment of a Danish mussel fishery, concerns were raised about the possible disturbance of cetaceans by mussel dredgers. In 2016, ICES provided advice to the EU stating a need to mitigate and investigate the effects of static nets on harbour porpoise in the Kattegat and Belt Seas (ICES Area IIIa and Subdivisions 21-23). ICES has not identified mussel dredging as a fishing activity with the potential to adversely affect ETP species (ICES, 2016). In addition, the ICES Working Group on Bycatch of Protected Species (WGBYC) carried out an assessment of the risk factor by gear type on various species/species groups (ICES, 2018). The analysis concluded that dredges were a low risk factor for lampreys, sturgeon, roundfish, diving, bottom and surface feeding birds, seals and harbour porpoise.

The assessment team has reviewed the IUCN Redlist of endangered species online (IUCN, 2021) and the HELCOM Red List of Baltic Sea species in danger of becoming extinct, also compiled using IUCN criteria as its basis (HELCOM, 2013). There have been no records of the UoAs interacting with any of the out-of-scope species on these lists.

The Limfjord mussel, cockle and oyster dredge fisheries and the Inner Danish waters mussel dredge fishery have the potential to interact with ETP species either by direct capture or through indirect “ecosystem” effects through, for example, impacts on habitats or depletion of prey items for birds or other species groups.

There have been no observed direct impacts of the four UoAs, i.e. no ETP species have been directly captured in the fishery. Shellfish dredge fisheries are only permitted in Natura 2000 sites if it is considered to be unlikely to impact the ETP bird species (through depletion of food) and the habitats that support these birds. Interactions with bird species are addressed through the management measures in place for the Natura 2000 sites (under the EU Birds Directive [Directive 2009/147/EC] and transposing legislation) in the areas that protect these species. The assessments carried out for the Natura 2000 sites take account of changes in fishing practice and the current status of ETP species and their supporting habitats. These assessments provide an annual review of whether these sites are achieving their management objectives. Specifically, the potential impact on bird species is assessed annually for the mussel and cockle fishery in Lovns Bredning and Løgstør Bredning Natura 2000 sites in the Limfjord, for the oyster fishery in Nissum Bredning and Løgstør Bredning Natura 2000 sites, and for the Inner Danish Waters mussel fishery for the Horsens Fjord and Lillebælt Natura 2000 sites. Shellfish fishing will only be permitted if there are sufficient stocks of shellfish to meet the food requirements of the bird populations.

For each of the Natura 2000 sites, DTU Aqua assesses the food requirements of birds based upon bird counts in each area. Current assessments are based upon a study by Aarhus University which provided target numbers for the following diving bird species in six bird protection areas, including those potentially fished within the UoAs (Petersen *et al*., 2016):

- Tufted duck, *Aythya fuligula* (Danish name – Troldand)
- Common pochard, *Aythya farina* (Danish name – Taffeland)
- Greater scaup, *Aythya marila* (Danish name – Bjergand)
- Common goldeneye, *Bucephala clangula* (Danish name – Hvinand)
- Long-tailed duck, *Clangula hyemalis* (Danish name – Havlit)
- Common eider duck, *Somateria mollissima* (Danish name – Ederfugl)
- Common scoter, *Melanitta nigra* (Danish name – Sortand)
- Velvet scoter, *Melanitta fusca* (Danish name – Fløjlsand)

Bird counts are obtained from the nationwide midwinter censuses of waterfowl carried out primarily as counts from aircraft, occasionally supplemented by land counts. In the three Natura 2000 sites in the Limfjord, Løgstør Bredning, Lovns Bredning and Nissum Bredning, and in parts of the Horsens Fjord Bird Protection Area the counts are total counts, whereas in the Lillebælt and the majority of the Horsens Fjord bird counts are based upon line transects. Data from the nationwide waterfowl censuses date back to 1987 and since 2000 have been part of the NOVANA program. Midwinter waterfowl counts are made annually, but data from spring, autumn and summer are available from a number of years. Under the NOVANA program, nationwide counts of waterfowl are made every third winter and every sixth summer. For the calculation of target figures for diving ducks, only data from midwinter counts have been used. Calculation of target figures is made in time intervals of six years with the count being the maximum number of registered / estimated individuals within each six-year period, and then the target number of birds is the average maximum count across the six-year periods (Petersen *et al*., 2016). In addition to the target number of birds, the time utilisation of an area for the individual species is calculated by multiplying the number of individuals by the number of days they are present in the area. This information is used to calculate the food requirements of birds in each of the Natura 2000 sites.

In Løgstør Bredning, the common goldeneye, *Bucephala clangula*, is the only mussel-eating diving duck that is included in the designation basis for the Bird Protection Area based upon a population of 12,000 birds in 1970 and because Løgstør Bredning is an important area that contributes to maintaining the species' distribution area in Denmark. Counts of common goldeneye in the area fluctuated from 303 individuals in 1988 to 2,663 individuals in 2013, with an average maximum number of 1,372 birds. Common goldeneye accounted for over 90% of all diving ducks observed in the area over the census period with common eider, *Somateria mollissima* and long-tailed duck, *Clangula hyemalis*, being the only other species with significant average counts of 47 and 35 birds respectively. Based upon the observed seasonal variation in birds in the Limfjord by Madsen *et al*. (1992), the average number of bird days for common goldeneye in the Løgstør Bredning is 231,000 days. With the target figure of 1,732 common goldeneye in Løgstør Bredning, the requirement for feeding the birds is estimated to be 2,407 tonnes of mussels annually. With an estimated mussel stock biomass of 26,834 ± 5,463 tonnes in 2020 (Nielsen *et al*., 2020a), a food requirement for birds of 2407 tonnes of mussels represents approximately 9% of the mussel stock, and coupled with a quota of 5,500 tonnes of mussels for the fishery representing approximately 20% of the stock, there is scope for a sustainable mussel fishery which does not impact on the feeding requirements of the designated bird species.

In Lovns Bredning the common goldeneye, *Bucephala clangula*, is the only mussel-eating diving duck that is included in the designation basis for the Bird Protection Area following an audit in 2005 and on the basis of the results from the nationwide censuses in the 1980s where Laursen *et al*. (1997) noted the area as being internationally significant for the species. Lovns Bredning has been monitored annually from aircraft at midwinter since 1987 with the exception of 1990 and 2001-2003. The number of goldeneyes counted in the area has been declining since the 1980s and today is only in the order of 25% of what it was in the mid-1980s and early 1990s, although within Denmark as a whole, the population is stable. Counts of common goldeneye in the area have been declining continually since 1992-1997 when 4735 birds were observed to less than 1000 birds in recent censuses, Tufted duck, *Aythya fuligula*, common pochard, *Aythya farina* and Greater scaup, *Aythya marila*, are also occasionally observed in relatively small numbers, but none of these species are part of the designation for the Natura 2000 site. As the population of common goldeneye in Lovns Bredning has been declining, the target number for common goldeneye is not based upon the average counts over each six-year census period but is based upon the maximum count of 4,735 birds observed in January 1989. Based upon the observed seasonal variation in birds in the Limfjord by Madsen *et al*. (1992), the average number of bird days for common goldeneye in the Lovns Bredning is 614,000 days. With the target figure of 4,735 common goldeneye in Lovns Bredning, the requirement for feeding the birds is estimated to be 6580 tonnes of mussels annually (Clausen *et al*., 2009). With an estimated mussel stock biomass of 40,056 ± 11,304 tonnes in 2020 (Nielsen *et al*., 2020b), a food requirement for birds of 6580 tonnes of mussels represents approximately 16% of the mussel stock coupled with a quota of 10,000 tonnes representing approximately 25% of the total population in 2020, there is scope for a sustainable mussel fishery which does not impact on the feeding requirements of the designated bird species.

As with Løgstør Bredning and Lovns Bredning, in Nissum Bredning, the common goldeneye, *Bucephala clangula*, is the only mussel-eating diving duck that is included in the designation basis for the Bird Protection Area based upon the area's special significance for resting diving ducks in ice winters (Petersen *et al*., 2016). Common goldeneye and other diving duck species are counted in connection with nationwide counts of waterfowl and carried out as total counts. Over the period 1986 to 2014, counts of common goldeneye in the area fluctuated from 194 to 666 individuals with an average maximum number of 387 birds. Based upon the observed seasonal variation in birds in the Limfjord by Madsen *et al*. (1992), the average number of bird days for common goldeneye in the Nissum Bredning is 50,000 days. Common eider duck, *Somateria mollissima* is the most common diving duck species in the area. With the target figure of 387 common goldeneye in Nissum Bredning which have a food requirement of 538 tonnes of mussels, it is highly unlikely that the UoAs will impact on the feeding requirements of the common goldeneye. From 2016 to 2020 there has been no fishing for mussels within the Nissum Bredning (Iben Astrup, Fisheries Agency, pers. comm.) and oyster fishing has affected annually only 0.9-4.0% of the Nissum Bredning Natura 2000 site (Nielsen *et al*., 2020c). There is no requirement for an assessment of the impact of the oyster fishery on the features of the Natura 2000 site for 2020/2021 because there has been no application for oyster fishing in Nissum Bredning in 2020/2021.

In Horsens Fjord and Endelave, four mussel-eating diving duck species are included in the designation basis for the Bird Protection Area - Greater scaup, *Aythya marila*, common goldeneye, *Bucephala clangula*, common eider duck, *Somateria mollissima* and velvet scoter, *Melanitta fusca*. Eider ducks and velvet scoter were included in the original designation basis (Fredningsstyrelsen 1983), and other two species were included in the revision in 2005 based on the results from the nationwide counts in the 1980s where Laursen *et al*. (1997) noted the area as being internationally significant for greater scaup and common goldeneye (Petersen *et al*., 2016). Annual bird counts are based upon nationwide counts of waterfowl and carried out as total counts in midwinter from 1987 to 2013 but also from spring

1988 and 1989 and summer and autumn 1987 and 1988. Eider is the most common diving duck species in the area. Eiders occur most frequently in the area during winter but are present throughout the year. The eiders shed during the summer period, when the birds are particularly vulnerable to disturbance in that they are unable to fly during their feathering. The target number for each designated bird species is the average maximum count across the six-year periods from 1986-1991 to 2010-2014. For eider ducks the target figure is 22,527 birds, for greater scaup 5,283 birds, velvet scoter 27 birds and common goldeneye 1,107 birds. Based on observations of seasonal variations in presence of the various species within the Natura 2000 site, the average number of bird days for eider, greater scaup, velvet scoter and common goldeneye is 3.4 million, 357,000, 2450 and 96,000 respectively (Petersen *et al*., 2016). DTU Aqua estimate that the food requirement for eider, greater scaup, velvet scoter and common goldeneye is 25,800 tonnes of mussels. The population of mussels in Horsens Fjord was estimated at 163,000 tonnes in 2014, and although the stock declined to 58,000 tonnes in 2017, this was still sufficient to sustain a fishery of 12,000 tonnes of mussels for 2018/2019 and meet the food requirements of the four diving duck species (Nielsen *et al*., 2018d). However, the most recent survey in Horsens Fjord in 2018 showed that the estimate of mussel stock biomass had declined below the threshold of 25,800 tonnes that are required for shellfish-eating birds, and therefore the commercial fishery was not opened in 2019/20 and has remained closed since then as there has been no significant settlement of mussels in the Natura 2000 site.

In Lillebælt, three mussel-eating diving ducks are included in the designation basis for the Bird Protection Area - Greater scaup, Aythya *marila*, common eider duck, *Somateria mollissima* and common goldeneye*, Bucephala clangula.* Annual bird counts are based upon nationwide counts of waterfowl and carried out as total counts in midwinter from 1987 to 2013. Eider is the most common diving duck species in the area. The target number for each designated bird species is the average maximum count across the six-year periods from 1986-1991 to 2010-2014. For greater scaup the target figure is 6,423 birds, for eider ducks 32,038 birds and for common goldeneye 1,057 birds. Based on observations of seasonal variations in presence of the various species within the Natura 2000 site, the average number of bird days for greater scaup, eider and common goldeneye is 434,000, 4.8 million and 91,500 respectively (Petersen *et al*., 2016). The total food requirements of the three mussel-eating bird species in Lillebaelt has been estimated by DTU Aqua at 33,810 tonnes, but the most recent estimate of mussel stock biomass from the 2016 survey was not sufficient to allow a commercial fishery from 2016 to 2018 (DTU Aqua, 2018), and although the estimate of stock biomass has increased since 2016, the commercial fishery remains closed currently. With no sign of any recent recruitment of mussels, no further stock surveys have been undertaken in Lillebælt, and there remains no impact of the commercial mussel fishery on the three designated diving duck species.

7.4.1.2 Habitats

Marine habitats in Denmark are subject to protection within Natura 2000 sites, which are designated under the EC Habitats Directive (92/43/EC), and also under the Birds Directive (79/409/EEC, consolidated in Directive 2009/147/EC). In addition to designated Natura 2000 sites, there are also listed Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites, all of which give varying levels of protection under Danish law to salt marshes, wetlands, inshore and offshore sites for species (e.g., birds) or habitats, and many of which have been integrated into the Natura 2000 site network in Denmark. These instruments sit beside, or perhaps under the policy umbrella provided by the EC Marine Strategy Framework Directive which seeks to achieve 'good environmental status' of marine ecosystems using an ecosystem-based approach to the management of human activities and sustainable use of marine goods and services (2008/56/EC). At a national level, the Mussel and Oyster Policy sets a clear and comprehensive management strategy for managing directed fishing on shellfish in all Danish territorial waters, with particular emphasis on establishing objectives and procedures for monitoring, assessing, managing and mitigating the impacts of shellfish fishing on habitats, including cumulative impacts, especially in designated Natura 2000 sites (Udenrigsministeriet, 2019).

In the Limfjord, mussel and cockle fishing are historically concentrated within the Løgstør Bredning and Lovns Bredning Natura 2000 sites, while oyster fishing is historically concentrated within the Nissum Bredning Natura 2000 site but has recently also been taking place more widely in the Limfjord including in Løgstør Bredning. Almost all shellfish landed from the UoAs are caught in these areas, while relatively small amounts are taken outside Natura 2000 sites.

In the Inner Danish Waters of East Jutland, Storebælt and Isefjord, mussel fishing occurs mainly outside Natura 2000 sites. East Jutland has 14 Natura 2000 sites (encompassing 12 SACs and seven SPAs, totaling almost 3,800 km^2). Isefjord has seven Natura 2000 sites (encompassing six SACs and three SPAs, totaling around 365 km^2). Storebælt has 18 Natura 2000 sites (11 SACs and seven SPAs, totaling more than 2,400 km^2). The majority of these SACs have been designated as Natura 2000 areas based on the nature conservation features "large shallow inlets and bays" and "reefs". There are also three Ramsar sites in East Jutland and one in Storebælt. In 2019-2021 all the Natura 2000 sites in Inner Danish Waters were closed to fishing. In the past mussel fishing has occurred from time to time in the Lillebælt and Horsens Fjord Natura 2000 sites, subject to the requirements outlined below.

Danish and European legislation require that any fishing activity that takes place within a protected site, particularly Natura 2000 sites, must be first subject to an appropriate environmental impact assessment (i.e. an assessment that meets the requirement of Article 6 of the Habitats Directive). Shellfish fishing licences specify that any fishing in Natura 2000 sites is prohibited unless such an impact assessment, that indicates favourable outcomes, has been completed by DTU Aqua, the agency that provides independent scientific advice to the Danish Fisheries Agency. Impact assessments consider the cumulative impact of shellfish fishing on habitats, taking account of extensive data and information from monitoring and management, including the historical extent of shellfish fishing and recovery rates of identified marine habitats.

Black box monitoring results in very high temporal and spatial resolution of fishing effort data: logging vessel position, speed and winch activity every 10s. Fishing intensity in all UoAs is therefore well understood and estimated as 'swept area ratio' (SAR). SAR in Danish waters is calculated as five-year frequencies for gear impact on the seabed in squares of 100 x 100 m by dividing the period's total gear impact in each square (the cumulative footprint measured in m^2) with the area of the square (10,000 m^2). The SAR values can therefore be interpreted as an expression of how many times the seabed in the individual squares has been directly affected by fishing in the period from 2014-2018 (Figure 45). SAR values for all the UoAs under this assessment are in the very low to medium range (Figure 46), with fishing for other species with other bottom-contacting gears outside the UoAs showing much higher values (Eigaard *et al*, 2020; Petersen, 2021).

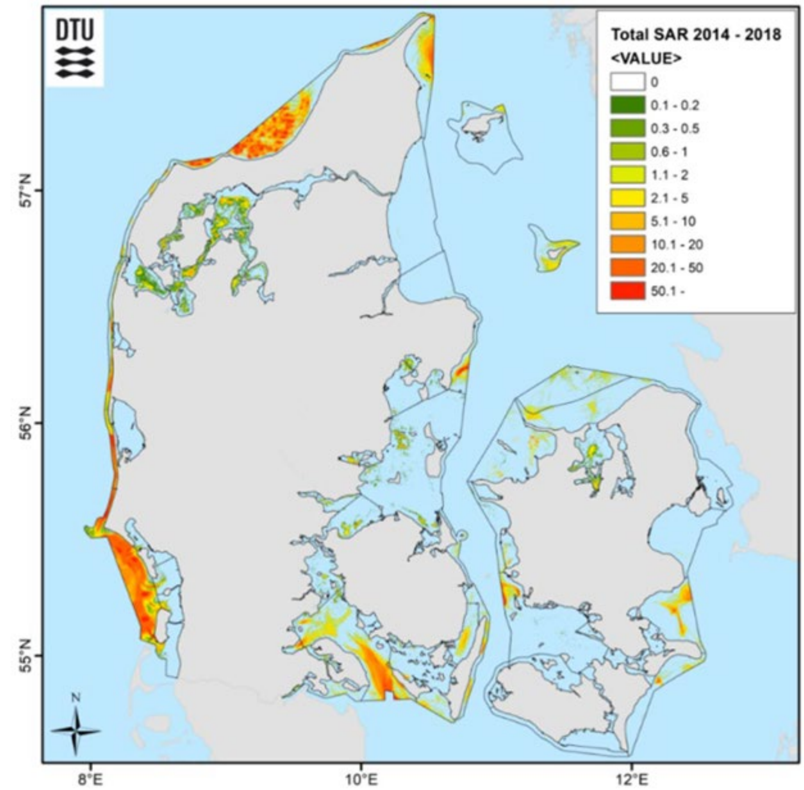


Figure 45. Cumulative footprint of bottom-contacting fishing gear – calculated as swept area ratios – for all Danish waters over the five-year period 2014-2018. (Source: Petersen, 2021)

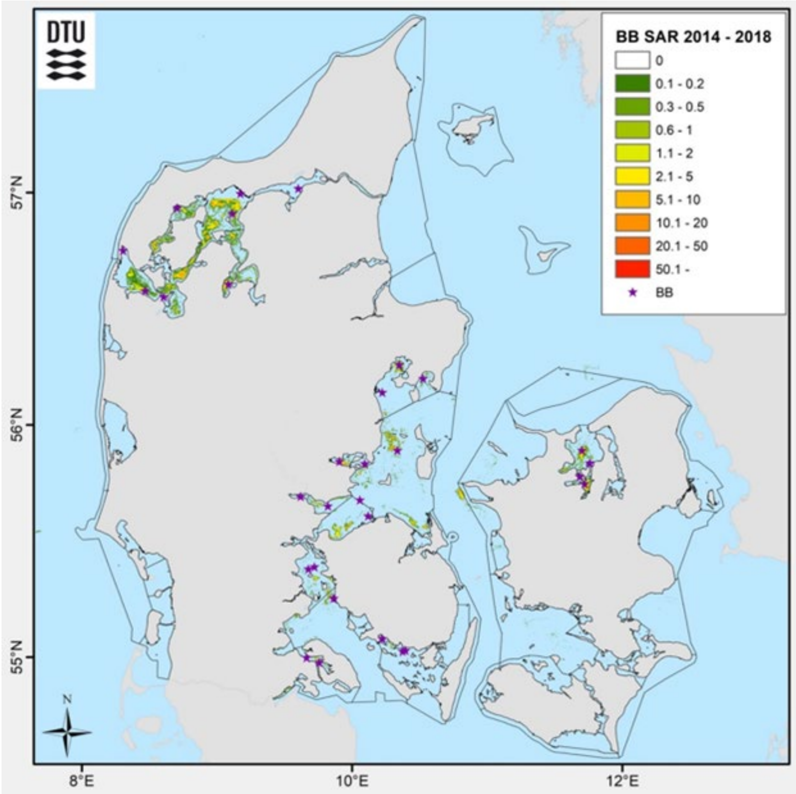


Figure 46. Fishing intensity by shellfish dredging in all UoAs (2014-2018) calculated as an annual frequency for gear impact on the seabed in squares of 100 x 100m in the areas where black box-monitored fishing takes place. (Source: Eigaard *et al.*, 2020).

Substrates, geomorphology and biota in Limfjord and Danish inland waters

In an MSC assessment benthic habitats are assessed in relation to recognised categories with the following habitat characteristics:

a. *Substratum – sediment type*
b. *Geomorphology – seafloor topography*
c. *Biota – characteristic floral and/or faunal groups*

In general, the majority of the benthic habitat fished by shellfish operators in Limfjord and Danish inland waters can be characterised as Fine (mud, sand), Flat (simple surface structure) to Low Relief (some irregular topography, with till/diamicton, i.e., glacigenic deposits consisting of a heterogenous mixture of clay, sand, gravel and boulders varying in size), with Small erect/encrusting/ burrowing biota (consolidated bivalve beds and mixed low small/low encrusting invertebrate communities) and other Biota (eelgrass and macroalgae species). There are some known outcropping 'mussel' or 'shellfish' biogenic reefs, i.e., those formed by shellfish binding the shells of dead and living shellfish and 'possible' biogenic reefs identified within Natura 2000 sites (e.g., see Nielsen *et al*, 2018b).

Thus, the mussel, oyster and cockle habitats in Danish territorial waters include intertidal and subtidal sandbanks, mudflats and gravel/stony beds, and the location and extent of these are well known. They have been extensively mapped and used to identify Natura 2000 sites (see Figure 47 through to Figure 57). Information about the type and extent of marine habitats from survey work means the beds of eelgrass *Zostera* spp and macroalgae (e.g., seaweeds and other visible marine 'plants') are also very well-known and mapped in considerable detail throughout the Limfjord and in Inner Danish waters (see Figure 47 through to Figure 57). Comprehensive monitoring of marine habitats, consistent with Denmark's obligations under the EU's Marine Strategy Framework, is conducted in accordance with a monitoring program published by the Danish Environment Protection Agency, the latest of which sets out monitoring plans for the years 2021-2026 (Miljøstyrelsen, 2020a).

The rocky, boulder reefs and biogenic reefs, where these are known and mapped, are included in prohibited areas for shellfish fishing (Udenrigsministeriet, 2019). It is known that boulder reefs were deliberately exploited for building materials for centuries, but there is no quantitative information on this. The importance of structural complexity of seabed habitats (which is increased by the presence of shell, stones and boulders) for shellfish settlement and survival, as well as for other benthos, is well understood (see Dolmer and Frandsen, 2002).

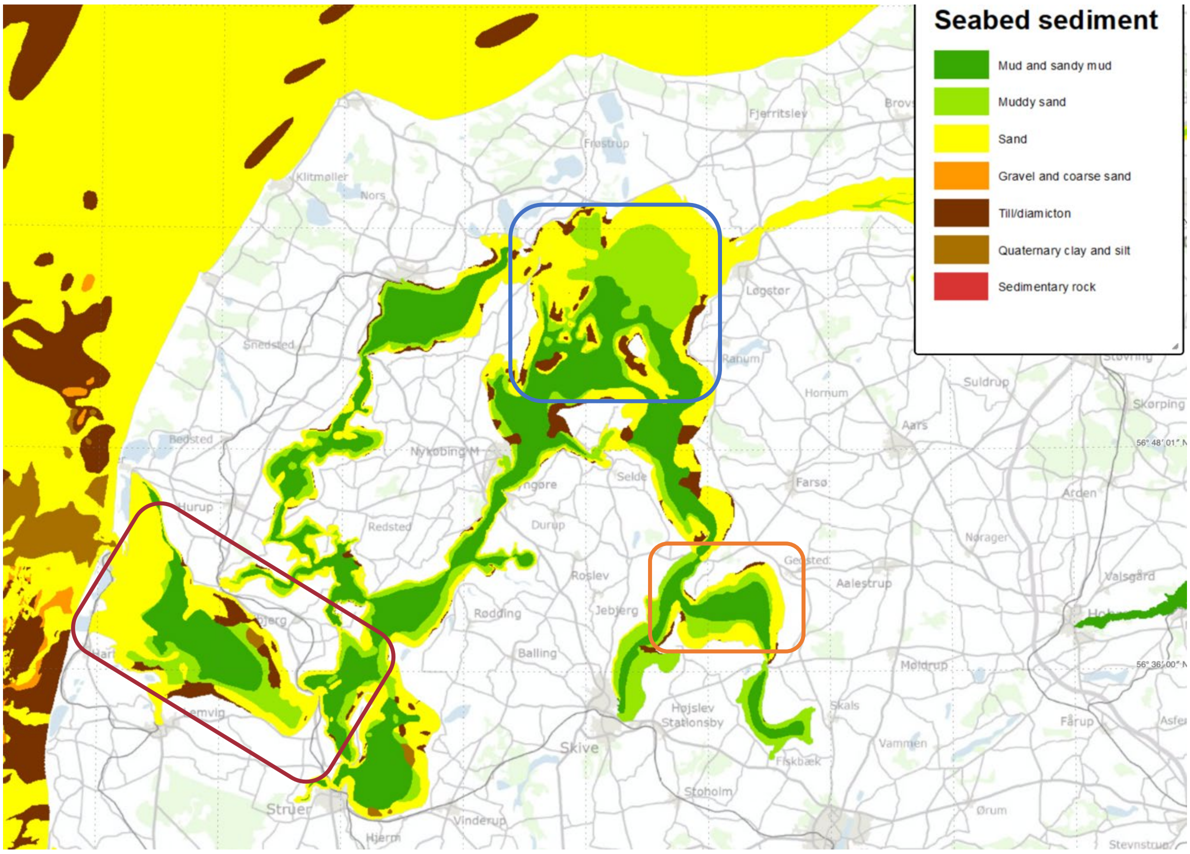


Figure 47. Seabed sediment types in Limfjord's Nissum Bredning (dark red box), Løgstør Bredning (blue box) and Lovns Bredning (orange box) (relevant to UoA1, UoA2 and UoA3). (Source: Geological Survey of Denmark and Greenland: https://data.geus.dk/geusmap/ Accessed 26 April 2020)

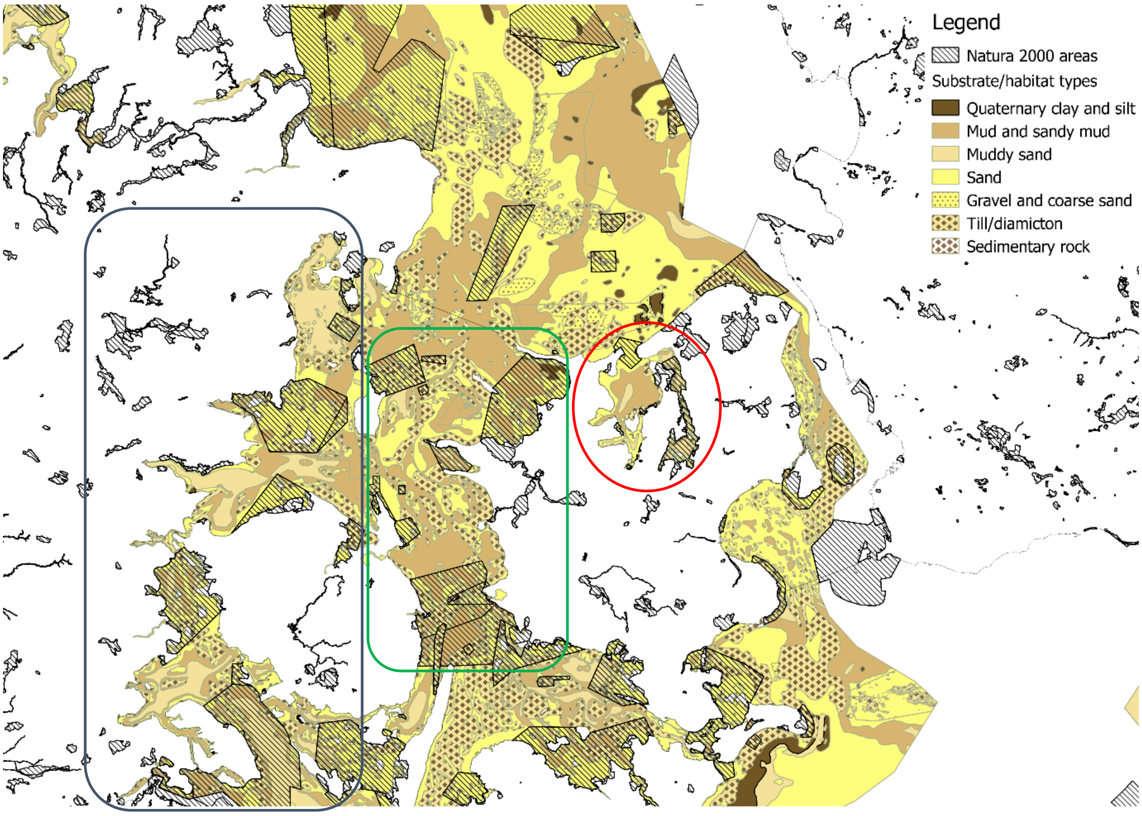
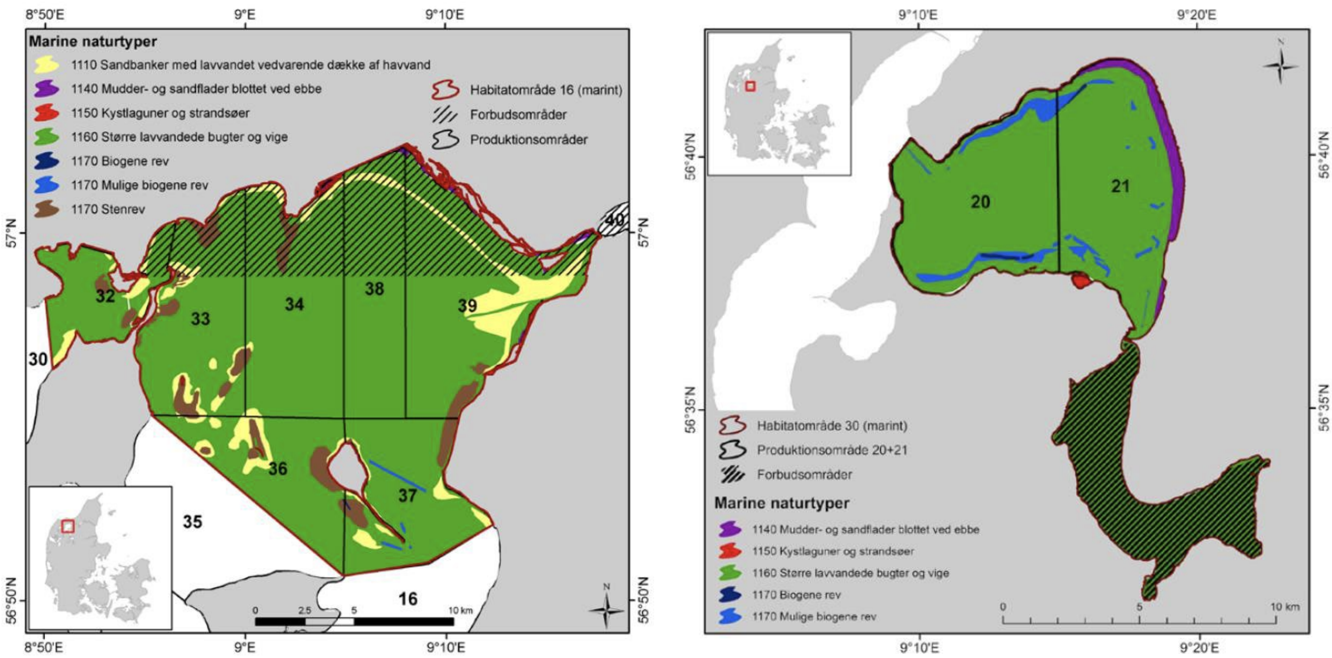


Figure 48. Habitat map for East Jutland (blue box), Storebælt (green box), and Isefjord (red circle) (relevant to UoA4) (Source: Geological Survey of Denmark and Greenland, 2016)

a. b.

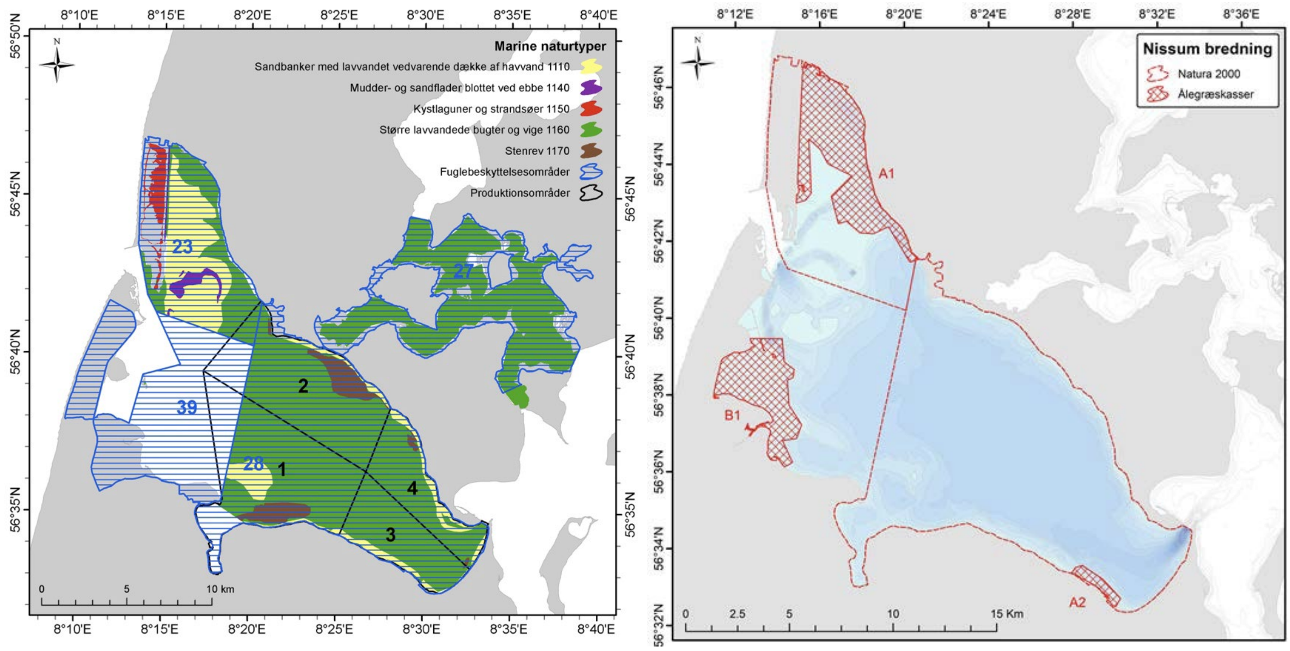


Key to habitat types

1110 (yellow)	Sandbanks that are slightly covered by seawater at all times.
1140 (purple)	Mudflats and sandflats not covered by seawater at low tide.
1150 (red)	Coastal lagoons and lagoons.
1160 (green)	Large shallow inlets and bays.
1170 (blue/brown)	Biogenic reefs

Figure 49. Distribution of marine habitats within Limfjord's (a) Løgstør Bredning; and (b) Lovn Bredning Natura 2000 sites (relevant to UoA1 and UoA2). (Source: Nielsen *et al*., 2014; Canal-Vergés *et al*., 2014)

c. d.



Key to habitat types

1110 (yellow) Sandbanks that are slightly covered by seawater at all times.
1140 (purple) Mudflats and sandflats not covered by seawater at low tide.
1150 (red) Coastal lagoons and lagoons.
1160 (green) Large shallow inlets and bays.
1170 (blue/brown) Biogenic reefs

Figure 50. Distribution of marine habitats within Limfjord's Nissum Bredning (c); and Natura 2000 sites and eelgrass beds (d) (relevant to UoA3) (Source: Nielsen *et al.*, 2018a)

e. f.

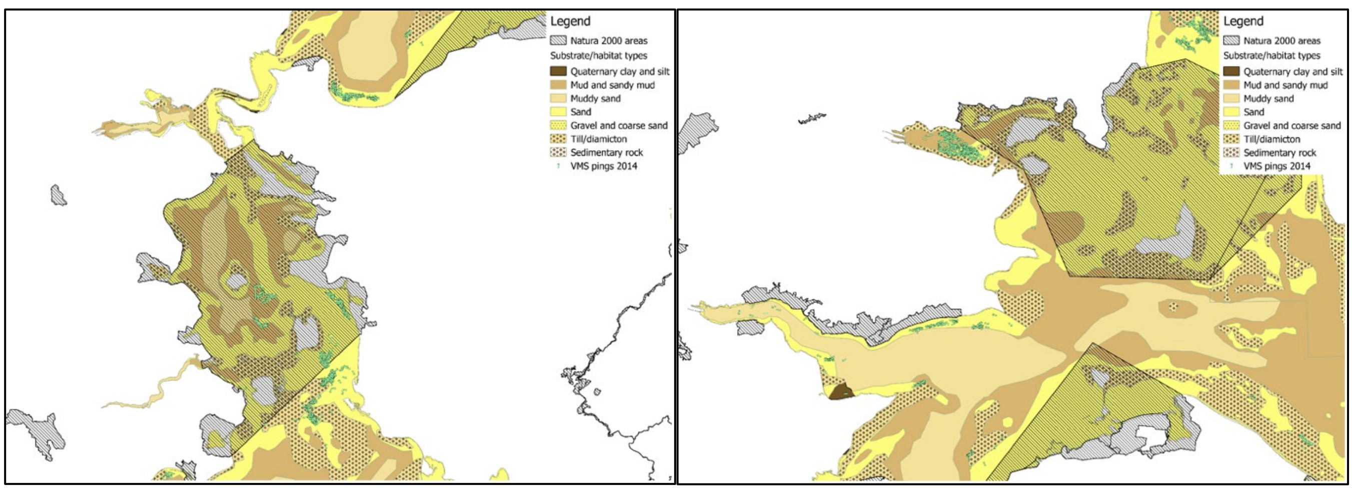


Figure 51. Detailed habitat map for the Lillebælt (e); and Horsens Fjord (f) Natura 2000 sites in East Jutland (relevant to UoA4) (Source: Geological Survey of Denmark and Greenland, 2016)

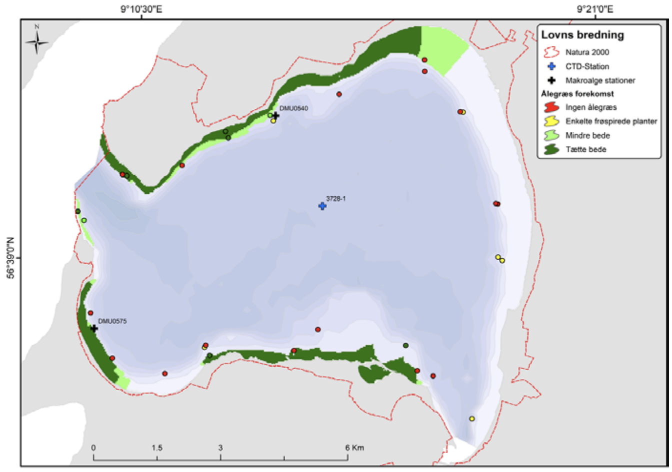
Commonly encountered, VMEs and minor habitats

As described above, the benthic habitats in all the UoAs are well known and have been extensively studied, resulting in detailed habitat maps and detailed understanding of the cumulative impacts of fishing (e.g., Naturstyrelsen, 2014). This forms the knowledge base for managing and reducing the impacts of fishing on key habitat features. Commonly encountered habitats across all the UoAs can be considered the mudbanks, sandflats and till/diamicton beds with various amounts of stones. VMEs across all UoAs can be divided into three scoring elements: eelgrass (*Zostera* spp) beds, macroalgae beds, and biogenic reefs. These habitats across Danish waters, including those that occur within designated Natura 2000 sites, are afforded very high levels of protection including depth, spatial and temporal restrictions, effort limitation, and high levels of monitoring and impact assessment, which in combination results in a precautionary and conservative approach to managing and mitigating cumulative impacts upon habitats across all the UoAs.

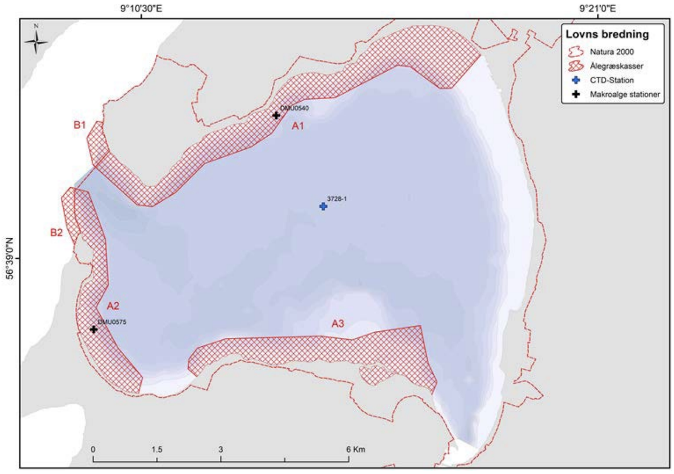
Eelgrass (*Zostera* spp) and macroalgae

The distribution of eelgrass and macroalgae within Danish territorial waters is well known (see Figure 47 to Figure 51 above and Figure 52 to Figure 57 below). Dredging is prohibited in all waters shallower than 3m for mussels and cockles and 5m for oysters, therefore mussel, oyster and cockle fishing does not presently impact directly on eelgrass areas. In some management areas, macroalgae are distributed in similar depths, thus depth restrictions also largely protect these species from the impacts of shellfish fishing. However, macroalgae have been observed growing to depths of up to 10-12m (Nielsen *et al.*, 2019a), therefore the cumulative impact of shellfish fishing on macroalgae is also directly considered in environmental impact assessments conducted on Natura 2000 sites prior to annual fishing plans being approved with prohibited fishing areas set out in updated regulations and before fishing licenses are issued.

a.



b.

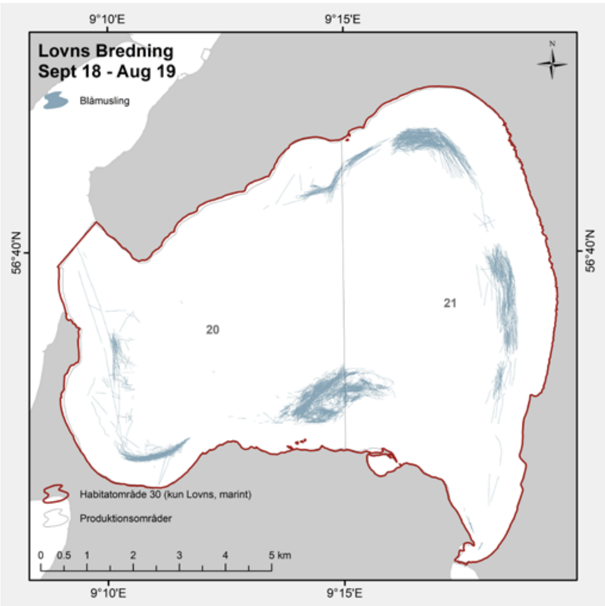


Key

Red	No eelgrass (only shown as points)
Yellow	Single seeded plants (only shown as points)
Dark green	Dense continuous eelgrass beds
Light green	Less densely concentrated eelgrass beds

Figure 52 (a) Eelgrass beds in Lovns Bredning (Limfjord): observations from 2018 shown as points and from 2016 as green blocks of colour. (b) Three eelgrass boxes where fishing bans were proposed by scientists for the 2019-20 season. Representative example of results from impact assessments of key sites in all UoAs and subsequent management advice (Source: Nielsen *et al.*, 2019c)

c.



d.

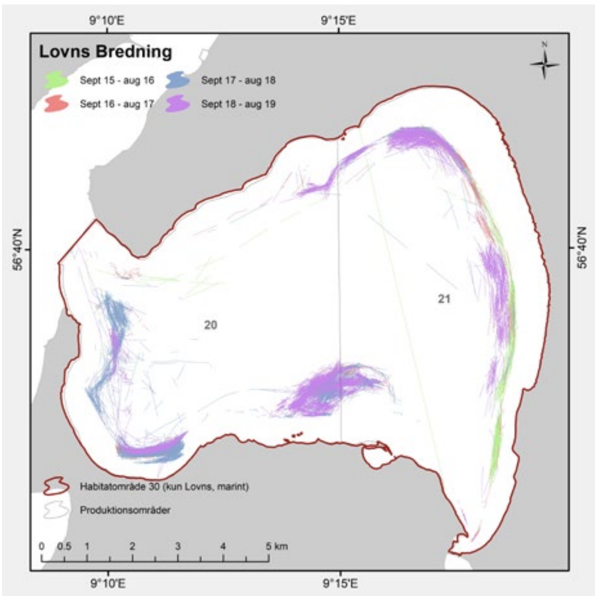


Figure 53 (a) Fished areas in Lovns Bredning in 2018-19: data from “black boxes” mandatory on all shellfish vessels. (b) “Black box data showing all fishing from 2015-16 – 2018-19 fishing seasons. Representative example of results from impact assessments to determine cumulative impact across key sites in all UoAs and subsequent management advice (Source: Nielsen *et al*., 2019c)

It has been noted in the Limfjord that twenty years without fishing in certain areas where eelgrass beds have been mapped annually has not resulted in any extension of eelgrass into deeper waters (Hansen and Høgslund, 2021). Modelling has suggested that at present turbidity levels there is no likelihood of extension of eelgrass beds into areas where it would overlap with mussel or oyster dredging. Depth restrictions introduced for oyster and mussel dredging are based upon water turbidity and the maximum depth at which eelgrass can grow.

Tests have suggested that mussel dredging does not have any significant influence of turbidity on nearby eelgrass beds, thought to be the most sensitive receptor to turbidity. Modelling has also shown that high density mussel beds have a limited ability to filter particles due to a relatively low rate of transport of particles to the seabed, i.e. a lower density of mussels would have the same filtration capacity. Thus, removal of mussels would have a limited ability to reduce the overall filtration capacity of the community (Dolmer, 2000).

Mapping the extent of eelgrass and macroalgae beds in the Lillebælt and Horsens Fjord areas (i.e., Natura 2000 sites) of the Inner Danish Waters (UoA 4) was expanded in 2016-2017 through the use of video transects from a vessel, diving studies, and an experimental drone project (Nielsen *et al*., 2019a). In both Natura 2000 sites, results indicated good conditions for macroalgae, with high occurrences of macroalgae discovered at depths up to 10 and 12 metres in Horsens Fjord and Lillebælt, respectively. Diver surveys also revealed a high diversity of macroalgae in both areas (see Table 24 and Table 25 below). For eelgrass, the results for both areas showed scattered deposits, covering a total of 10% and 14% of the total area of Horsens Fjord and Lillebælt, respectively (ibid). Representative examples of the mapping results for eelgrass in Horsens Fjord and macroalgae in Lillebaelt are shown at Figure 54 and Figure 55 respectively. In 2019 and 2020, both Horsens Fjord and Lillebælt were closed to mussel fishing, therefore affording complete protection for eelgrass and macroalgae habitats in those Natura 2000 sites. Indeed, in 2019-2020 none of the 39 designated Natura 2000 sites in Inner Danish Waters (UoA 4) were open to fishing (Janne Palomino Dalby, Ministry of Environment and Food, pers. comm.).

Table 24. Red, green and brown macroalgae species found at 15 selected stations (Incidence = % of stations) in Lillebælt during a diving survey. (Source: Nielsen *et al.*, 2019a)

	Latinsk navn	Dansk navn	Forekomst (% af stationer)
Rødalger	*Aglaothamnion bipinnatum*	Tosidet havpryd	27
	Ahnfeltia plicata	Horntang	53
	Bonnemaisonia hamifera	Rødtot	53
	Brongniartella byssoides	Juletræesalge	47
	Callithamnion corymbosum	Tæt rødsky	53
	Ceramium nudulosum	Alm. Klotang	87
	Ceramium sp.	Klotang arter	73
	Chondrus crispus	Carragen tang	33
	Coccotylus	Rødblad	87
	Corralina officinalis	Koralalge	0
	Cystoclonium purpureum	Grisehaletang	80
	Dasya baillouviana	Dusktang	27
	Delesseria sanguinea	Blodrød ribbeblad	93
	Furcellaria lumbricalis	Gaffeltang	47
	Membranoptera alata	Vinget ribbeblad	7
	Nemalion multifidum	Ormetang	7
	Polysiphonia elongata	Langstrakt ledtang	33
	Polysiphonia fucoides	Alm. Ledtang	100
	Polysiphonia fibrillosa	Violet ledtang	40
	Phycodrys rubens	Bugtet ribbeblad	87
	Rhodomela confervoides	Ulvehaletang	60
	Spermothamnion repens	Pudderkvastalge	73
		Røde skorpealger	100
		Lyserøde kalkskorper	7
Grønalger	*Bryopsis sp.*	Grønfjer	20
	Chladophora sp.	Vandhår	60
Brunalger	*Chorda filum*	Strengetang	80
	Dictyosiphon chordaria	Gylden skægtang	7
	Dictyosiphon foeniculaceus	Alm. Skægtang	7
	Dumontia contorta	Dumontalge	13
	Ectocarpus siliculosus	Vatalge	87
	Elachista fucicula	Knold og tot alge	53
	Fucus serratus	Savtang	53
	Fucus vesiculosus	Blæretang	13
	Saccharina latissima	Sukkertang	87
	Sphacelaria cirrosa	Brun totalge	93
	Sphacelaria plumosa	Fjer-totalge	7
	Sphaerotrichia divaricata	Blød vinkeltang	40
		Brune skorpealger	73

Table 25. Red, green and brown macroalgae species found at 18 selected stations (Incidence = % of stations) in Horsens Fjord during a diving survey. (Source: Nielsen *et al.*, 2019a)

	Latinsk navn	Dansk navn	Forekomst (% af stationer)
Rødalger	*Aglaothamnion bipinnatum*	Tosidet havpryd	11
	Ahnfeltia plicata	Horntang	11
	Bonnemaisonia hamifera	Rødtot	61
	Brongniartella byssoides	Juletræsalge	61
	Callithamnion corymbosum	Tæt rødsky	28
	Ceramium nodulosum	Almindelig klotang	67
	Ceramium sp.	Fin klotang - art	39
	Chondrus crispus	Carrageentang	11
	Coccotylus truncatus	Kile-rødblad	78
	Corralina officinalis	Koralalge	11
	Cystoclonium purpureum	Grisehaletang	44
	Dasya baillouviana	Dusktang	6
	Delesseria sanquinea	Blodrød ribbeblad	44
	Furcellaria lumbricalis	Gaffeltang	28
	Gracilaria vermiculophylla	Brunlig gracilariatang	11
	Membranoptera alata	Vinget ribbeblad	6
	Phycodrys rubens	Bugtet ribbeblad	67
	Polyides rutundus	Rødkløft	6
	Phyllophora sp.	rødblad-art	61
	Phyllophora pseudoceranoides	Fliget rødblad	39
	Polysiphonia elongata	Langstrakt ledtang	44
	Polysiphonia fibrillosa	Violet ledtang	56
	Polysiphonia fucoides	Almindelig ledtang	78
	Polysiphonia stricta	Fin ledtang	6
	Rhodomela confervoides	Ulvehaletang	67
	Spermothamnion repens	Pudderkvastalge	6
		Røde skorpealger	94
Grønalger	*Bryopsis sp.*	Grønfjer	11
	Chaetomorpha melagonium	Mørkegrøn børstetråd	6
	Cladophora sericea	Silke-vandhår	28
	Cladophora rupestris	Klippe-vandhår	6
	Ulva sp.	søsalat-art	6
Brunalger	*Chorda filum*	Strengetang	61
	Dictyosiphon foeniculaceus	Almindelig skægtang	22
	Dumontia contorta	Dumont-alge	17
	Ectocarpus siliculosus	Almindelig vatalge	78
	Elachista fucicola	Knold-og-tot-alge	44
	Fucus serratus	Savtang	39
	Fucus vesiculosus	Blæretang	11
	Halidrys siliquosa	Skulpetang	22
	Laminaria digitata	Fingertang	28
	Punctaria tenuissima	Bølget priktunge	6
	Saccharina latissima	Sukkertang	50
	Sphacelaria cirrosa	Brun totalge	83
	Sphaerotrichia divaricata	Blød vinkeltang	17
		Brune skorpealger	94

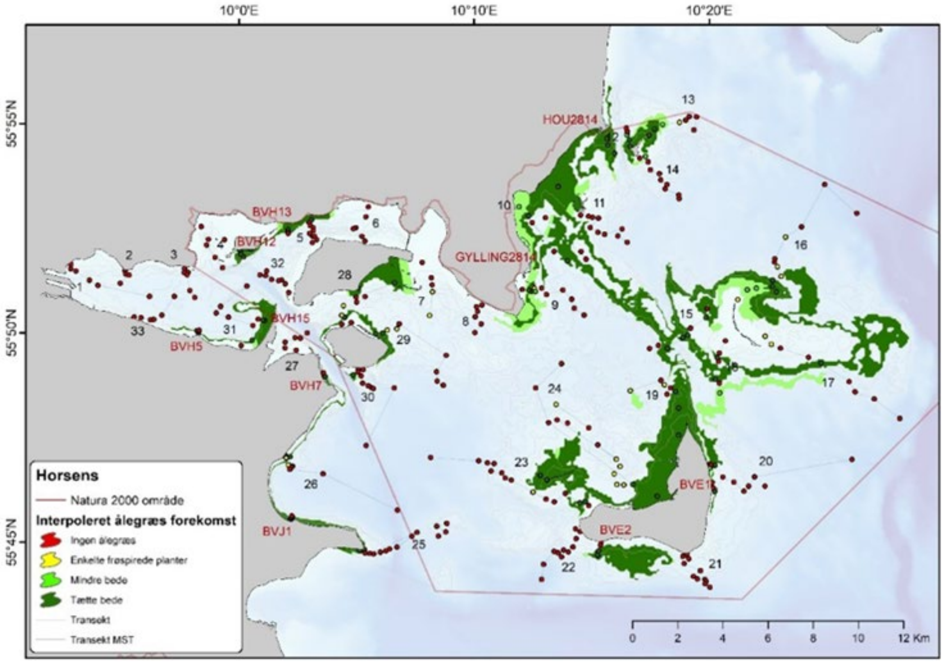


Figure 54. Occurrence of eelgrass on DTU Aqua's 33 transects and 10 of the Danish Environmental Protection Agency's transects in the Natura 2000 area by Horsens Fjord in 2016. No eelgrass (red dot), some seedling plants (yellow dot), smaller beds (light green) and dense beds (dark green). (Source: Nielsen *et al*, 2019a)

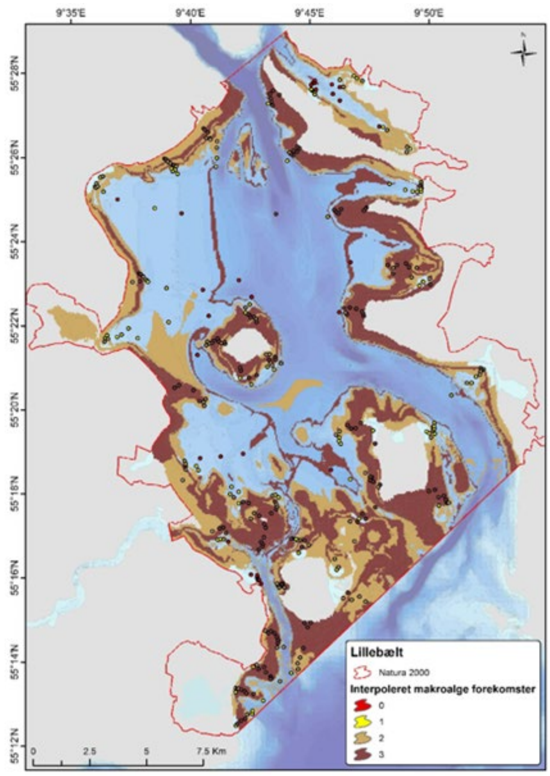


Figure 55. Distribution of macroalgae at 349 stations in Lillebælt in 2017. No occurrences (red), small occurrences (yellow), medium-sized deposits (light brown), dense deposits (dark brown). (Source: Nielsen *et al,* 2019a)

Both eelgrass and macroalgae have been extensively studied, sampled and assessed across all Danish waters under the National Program for Monitoring the Aquatic Environment and Nature (NOVANA), the fourth generation of nationwide monitoring programs conducted since 1988 (see Figure 56 and Figure 57 below). In 2021, the NOVANA Marine Areas report, published by DCE-National Center for Environment and Energy at Aarhus University, describes the relative status of marine ecosystem components (including eelgrass and macroalgae) in coastal waters, inner fjords, outer fjords, the Limfjord and on rocky/stone reefs, i.e., at a regional level (Hansen & Høgslund, 2021). As has already been reported, detailed environmental impact assessments within Natura 2000 sites where fishing is proposed take account of the specific cumulative impact any shellfish fishing may have on both eelgrass and macroalgae at a local scale within individual Natura 2000 sites.

The recently published NOVANA report suggests that in the thirty years from 1990 to 2019 the overall trend in cumulative coverage of macroalgae has increased by 48% in coastal waters, 51% in the outer fjords, 93% in the inner fjords and 74% on rocky/stone reefs, but decreased by 56% in Limfjord, although they were unable to attribute the reason to any particular natural or anthropogenic source, including fishing. Between 2010 and 2019, there was significant growth in cumulative macroalgae coverage in coastal waters (22%), while coverage in outer and inner fjords, the Limfjord and on rocky/stone reefs generally remained unchanged (Hansen and Høgslund, 2021). In relation to eelgrass, the report concludes that the generally positive growth in eelgrass coverage in the beginning of the last decade has not continued relative to both depth distribution and coverage (Hansen and Høgslund, 2021).

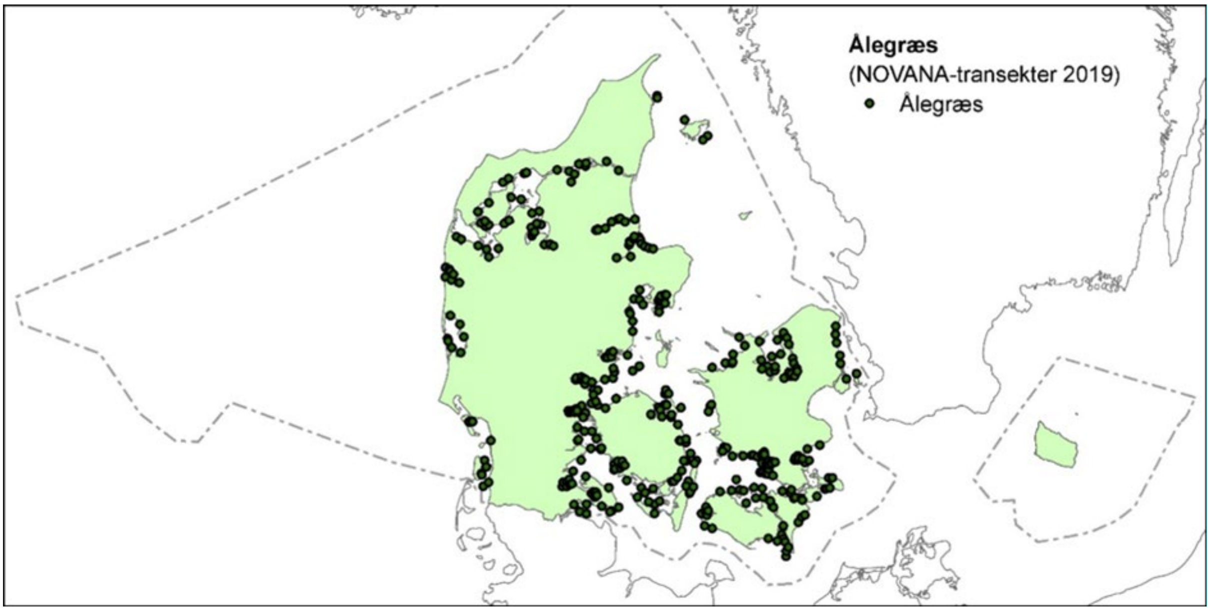


Figure 56. Sampling stations in all Danish waters for the study of eelgrass visited in 2019. Eelgrass is monitored once a year in the period June-September. (Source: Hansen & Høgslund, 2021)

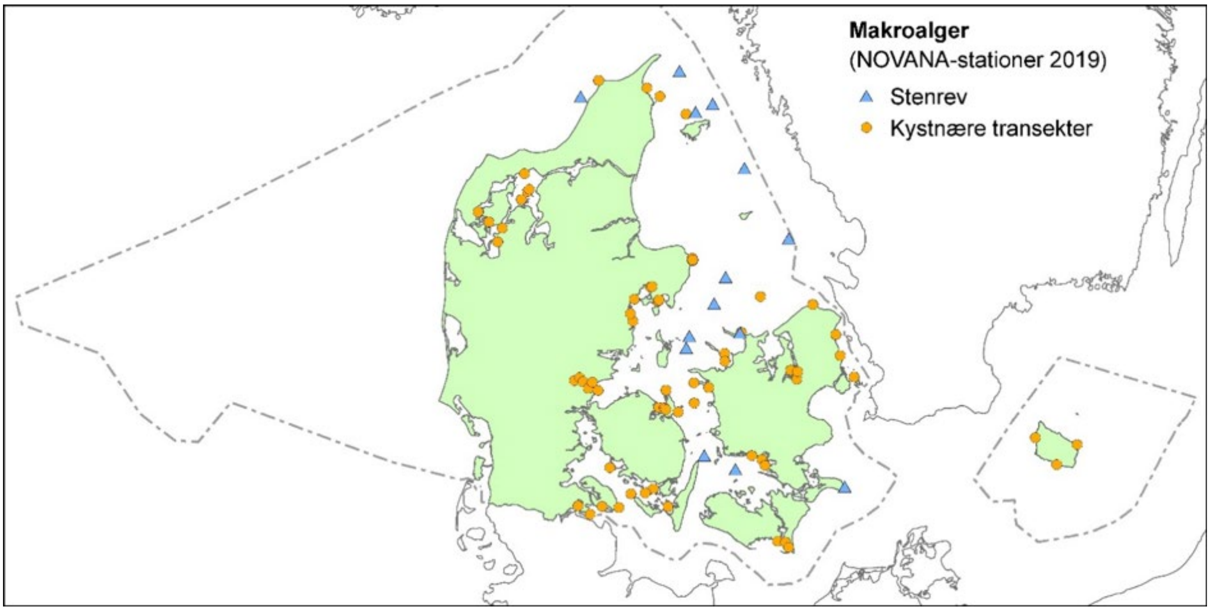


Figure 57. Sampling stations in all Danish waters for the study of macroalgae near the coast and on rocky reefs visited in 2019. Macroalgae monitored once a year in the period June-August. Delimitation of Danish water areas is indicated by the dotted line. (Source: Hansen & Høgslund, 2021)

Given the depth restrictions and the high temporal and spatial resolution of fishing effort monitoring, impact assessments by DTU Aqua routinely conclude that there is no impact, and therefore zero cumulative impact by shellfish fishing on eelgrass beds (Nielsen *et al*., 2018a,b,c; 2019a,b,c). In the case of macroalgae, extensive impact assessments each year have considered the cumulative impact of shellfish fishing on the spread and growth of macroalgae. Much of the distribution of macroalgae is protected by the depth restrictions imposed to protect eelgrass beds and the requirement to re-deposit larger stones and rocks and shells to the area from where they were fished serves to reduce the risk of permanent removal of substrate features. The cumulative proportion of macroalgae habitat within Natura 2000 sites that is affected by shellfish fishing has consistently been calculated to be less than the limit of 15% over the five years imposed by the Mussel and Oyster Policy (see Nielsen *et al.*, 2018a,b,c; 2019a,b,c; 2020a,b), and when proposed plans are assessed by DTU Aqua to pose a risk of exceeding the limits, approved plans are adjusted to ensure cumulative impact limits will not be exceeded prior to the formulation of the following year's fishing regulations.

Biogenic reefs

Executive orders regulating the fishing of oysters and mussels, derived from the Mussel and Oyster Policy, across all UoAs include the objective that irreversible damage to rocky reefs and biogenic reefs must be avoided. And where known within Natura 2000 areas, these are included in protected areas and fishing is prohibited.

Metric-driven definitions for designating biogenic reefs formed by blue mussels (*Mytilus edulis*), horse mussels (*Modiolus modiolus*), and combined horse mussel and rocky reefs were published by the Danish Environment Protection Agency in 2018 (Dahl & Petersen (Eds.) 2018). Referencing the EC's Habitats, Birds and Marine Strategy Framework Directives, as well as the OSPAR and HELCOM conventions and the approaches taken by UK, Germany and Sweden, the Danish definition sets out criteria that take account of the specific ecological characteristics and dynamics of Danish waters and the ecological and biological characteristics of various shellfish species, as well as practical considerations in terms of regulatory, mapping and data-monitoring perspectives. A key objective of the criteria is to delimit stable biogenic reefs from temporary mussel or other shellfish banks.

The following four criteria establish the basis for designating mussel-related biogenic reefs:

1. Area – a mussel bank is defined as a biogenic reef when it is over a certain size.
2. Coverage – a mussel bank must have a certain density of mussels before it can be classified as a biogenic reef.
3. Stability – a mussel bank can be classified as a biogenic reef when it is stable and permanent enough for a community of hard-bottom species to be established and can be found in the same area over a number of years. Metrics depend on the species biology, e.g., the number of cohorts that are present, or for longer-lived species a certain proportion of the resident population reaching a minimum size.
4. Associated species community – the reef has become habitat for a number of species associated with hard-bottom habitat that would not otherwise exist on the surrounding seafloor.

For blue mussel (*Mytilus edulis*) the above criteria lead to the following definition:

- Biogenic reefs of blue mussels are contiguous areas of at least 50 x 50 metres, i.e., 2500m^2, with an average coverage of mussels of at least 30% and the presence of at least three cohorts of mussels. The associated community will often be gammarids (amphipods or shrimp-like crustaceans), polychaete worms, other mussel species, barnacles, snails, crabs, triangular worms and smaller red algae.

For horse mussel (*Modiolus modiolus*) the following definition applies:

- Biogenic reefs of horse mussels are areas of at least 10 x 10 metres, i.e., 100m^2, that achieve a central coverage of 20% mussels and shells, of which 10% are live mussels and shells and mainly consists of mussels that are over 4cm long. Reefs will typically be breeding grounds for species such as red algae, polychaete worms and brittle stars.

For combined horse mussel (*Modiolus modiolus*) and rocky reefs:

- An area defined as a combined reef of mussels and rocks of a minimum area of 500m^2, has a central coverage of rocks, live mussel and shell of 25% of which a minimum of 5% are live mussels. The outer boundary is determined where the total coverage of rocks and mussels falls below 10%. Mussels on the reef must be mainly over 4cm long. Associated species are typically red algae, polychaetes, hyrdroids and brittle stars.

Native oysters were excluded from the definition because European oysters (*Ostrea edulis*) do not occur in sufficient densities nor with sufficient stability to form discernible biogenic reefs in Danish waters. Pacific oysters are also excluded from formal (i.e., policy/management) consideration as biogenic reefs because they are invasive species that pose a serious threat to native mussel and oyster species in Danish waters, despite being biogenic reef-forming species (Dahl and Petersen, 2018).

Stakeholders expressed concern about the definition for blue mussel biogenic reefs being too restrictive (i.e., not conservative enough); suggested that the size and cohort criteria excludes virtually all blue mussel banks from being defined as biogenic reefs; and pointed to other countries' definitions (e.g., Germany) as relevant to the assessment. In the absence of supporting evidence provided by the stakeholders, the assessment team investigated and concluded that the coverage rate is consistent with the only metric criteria laid out by OSPAR (i.e., 30%), and while the team did not find a published national definition for Germany, the state of Schleswig-Holstein has defined criteria that involve significantly smaller area and coverage for biogenic reefs formed by blue mussels in the Wadden Sea. Examination of the scientific basis for the difference between the definitions leads us to conclude that there are substantial justifiable differences between the dynamics and ecology of the intertidal and subtidal regions of the Wadden Sea and the UoAs in Danish waters, and indeed substantial differences between the species composition (e.g., blue mussel and Pacific oyster), the persistence of the mussel beds, and the variability of mussel biomass on the potential Wadden Sea reefs and those found in Danish waters (see Collinson *et al.*, 2016; Folmer *et al.*, 2017; and Vorberg *et al.*, 2017). Dahl and Petersen (2018) describe and document the transience and movement of mussel banks, or mussel substrate, in unfished areas that are clearly too unstable and unpredictable to form reef structures that are big enough and long-standing enough to enable more complex communities to develop. The team is satisfied that the basis for defining blue mussel biogenic reefs in Danish waters is valid from a scientific perspective. However, we do acknowledge that the definition has not been verified by direct examination so all anyone can do is speculate about how many will or will not meet the criteria for protection.

The next steps, having established definitions and criteria, are to use the Danish Environmental Protection Agency's mapping projects (e.g., NOVANA) on rocky reefs and in Natura 2000 areas to identify potential biogenic reefs and further study already mapped 'reefs' to verify them against the area, coverage, stability and associated species community criteria; with a view to designating and protecting them under the relevant fishing and nature protection regulations (Dahl and Petersen, 2018; and Janne Palomino Dalby, Ministry of Environment and Food, pers. comm.).

In the meantime, rocky reefs with *M. modolius* and/or *M. edulis* have been noted at Schultz's Grund, Storebælt, Lillebælt and the Sound (Dahl and Petersen, 2018). In the Natura 2000 sites of Lovns Bredning, Løgstør Bredning, Lillebælt and Horsens Fjord, 'blue mussel' or other 'shellfish' (e.g., *Modiolus modiolus* or cockles) biogenic reefs and possible biogenic reefs have been mapped and identified and potential impacts have been routinely considered as part of the environmental impact assessment process performed each year prior to establishing annual shellfish fishing regulations (for example see Nielsen *et al*., 2018b, 2018c, 2020a).

Horse mussel (*Modiolus modiolus)* biogenic reefs have been mapped in Løgstør Bredning at depths of 4-5m, but as the extent of the reefs have not been verified against the Danish definition for biogenic reefs (Dahl and Petersen, 2018), scientists conclude in the 2020 environmental impact assessment that it is not possible to determine how large a part of the biogenic reefs may be impacted by the 2020-21 proposed fishery. The impact assessment does conclude, however, that shellfish fishing at depths greater than 5m is unlikely to affect the mapped biogenic reefs (Nielsen *et al*, 2020a). In Løgstør Bredning a so-called 'cockle' biogenic reef has also been mapped in waters shallower than 5m, thus is also afforded full protection by the depth restrictions designed to protect eelgrass and macroalgae (Nielsen *et al.*, 2018c).

The Danish Environmental Protection Agency (Miljøstyrelsen) notes in its analysis for the Lovns Bredning and Hjarbæk Fjord Natura 2000 Plan for 2022-2027, that 50% of known and possible blue mussel biogenic reefs in the marine Atlantic region are found in these two areas (Miljøstyrelsen, 2020b). Two known blue mussel biogenic reefs in Lovns Bredning are found within the eelgrass beds and are therefore subject to protection by virtue of the eelgrass boxes (see Figure 52 above), while the majority of the so-called 'possible' biogenic reefs are also found within the eelgrass protection areas, leading DTU Aqua to conclude in its impact assessments that shellfish fishing will not significantly impact upon biogenic reefs in the Natura 2000 site (Nielsen *et al*., 2018b, 2020b).

Until the known and possible biogenic reefs are mapped and verified against the adopted criteria, and fishing impacts and risks assessed to a greater degree of certainty than currently exists, it is not possible to conclude that the UoAs individually or collectively are highly unlikely to reduce the structure and function of such biogenic reef habitat features to the point where there is a risk of serious or irreversible harm.

Impacts on other habitat features

Concerns were raised about the effect of the removal of stones from the seabed by the mussel dredging fishery. To address concerns about habitat degradation, in 2008 a requirement was introduced for all mussel dredgers operating within Natura 2000 sites to return all rocks weighing more than 2 kg to the sea immediately. The quantity of rocks and boulders retained by the fishery are recorded by processing factories and reported to the Fisheries Agency. Records indicate that 1.2t of stones were removed from the Løgstør Bredning Natura 2000 site during 2013-14 (range is between 0 and 1.2t). No stones were reported to be removed from the Lovns Bredning site during 2013-14 (the historical range for this site is between 0 and 2.3t) (Wakeford *et al*., 2016).

Since Danish mussel fisheries were first certified in 2010 the dredges used throughout the mussel and cockle UoAs have changed. Lighter and narrower dredges, weighing around 50kg (compared to 200kg) and measuring 1.45m (compared to 2m), were adopted following gear trials by DTU Aqua (Frandsen *et al.*, 2014). The trials found that the lighter dredges scraped up much less mud than the heavier, wider dredges, and that vessel fuel consumption fell per kg of mussel caught, indicating that the light dredge had less impact on the seabed. The light dredges have a much less robust construction than the heavier dredges and cannot be used near to any boulder or outcropping biogenic reef areas without sustaining damage.

Cumulative effects on habitats, including VMEs

The cumulative effect of the shellfish fishing in all UoAs on the marine habitats within Natura 2000 sites is closely monitored and evaluated in the annual impact assessments for these sites. Cumulative effects are assessed by taking account of the maximum possible extent of dredging over previous seasons (the period being based upon the habitat recovery time) as well as the fishing anticipated for the coming season. Fishing is only permitted if the cumulative impact on a habitat (in terms of the total proportion of a habitat that has been fished within the habitat recovery time) is less than 15%.

Summaries of results of cumulative effect from 2019-20 and 2020-21 Natura 2000 impact assessment reports are shown in Table 26 to Table 28 below. The proposed scenarios for shellfish and starfish TACs indicate the potential cumulative impact on ecosystem components, including habitats, of the proposed fishing plans by fishers (via DFPO). Where proposals are likely to result in higher than the permitted 15% cumulative impact over five years against the given ecosystem components, the proposal is either amended to reduce the cumulative impact to less than 15% based on recommendations from the independent scientists (e.g., see Nielsen *et al*., 2020b), or it is rejected, and the relevant area is not opened for fishing in the given year.

Table 26. Cumulative area impact calculations for Løgstør Bredning for blue mussels, macroalgae, benthic fauna and eelgrass in 2020-21. For the calculations, recovery times are 3, 5 and 3 years, respectively. The cumulative effect is calculated for previous years according to recovery time + impact on the recommended fishery (5,500 tonnes of mussels, 150 tonnes of European oysters, 200 tonnes of starfish). (Source: Nielsen *et al.*, 2020a)

	Gendannelsestid (år)	2016/17 (%)	2017/18 (%)	2018/19 (%)	2019/20 (%)	2020/21 5.500 t blåmusling (%)	2020/21 150 t flad østers (%)	2020/21 200 t søstjerner (%)	2020/21 Kumuleret (%)
Blåmusling	3			2,6	1,6	2,3	1,4	0	7,9
Makroalger	>5	0,9	1,0	1,9	1,3	1,8	1,1	2	10,0
Bundfauna	3			2,6	1,6	2,3	1,4	0	7,9
Ålegræs	>20	0	0	0	0	0	0	0	0

Table 27. Cumulative impact calculations for fishing proposals in Lovns Bredning for blue mussels, macroalgae, benthic fauna and eelgrass in 2020-21. Note: scientists recommended a reduction of the cumulative impact to the blue mussel and benthic fauna components to 7.9% respectively in order to reduce cumulative impact to within acceptable limits. The approved TAC would therefore be lower. (Source: Nielsen *et al.*, 2020b)

	Gendan-nelsestid (år)	2016/17 (%)	2017/18 (%)	2018/19 (%)	2019/20 (%)	2020/21 10.000 t blåmuslin-ger (%)	2020/21 100 t søstjer-ner (%)	Kumu-leret (%)
Blåmusling	3			4,4	2,7	8,8	0	15,9
Makroalger	>5	0,4	1,1	1,4	2,1	6,8	2	13,7
Bundfauna	3			4,4	2,7	8,8	0	15,9
Ålegræs*	>20	0	0	0	0	0	0	0

Table 28. Cumulative impact calculations for fishing proposals in Nissum Bredning 2019-20. (Source: Nielsen *et al.*, 2019b)

Fiskerisæson	**Mængde**	**Arealpåvirkning**	
	ton	**km²**	**%**
2014/2015	100	4,3	2,5
2015/2016	144	10,8	6,3
2016/2017 – europæisk østers / søstjerner	129	6,9 / 0,9	4,0 / 0,5
2017/2018 – europæisk østers / søstjerner	115,6 / 55,4	3,0 / 0,2	1,7 / 0,1
2018/2019 – europæisk østers / søstjerner	46,7/	1,7 / 0,005	1,0 /0,003
2019/2020 – europæisk østers	100	3,6	2,1
2019/2020 - søstjerner	500	5,2	Max 3

7.4.1.3 Ecosystems

The ecosystem, both fished and unfished, within which the UoAs are found is well monitored and carefully studied (e.g., recently published work by Eigaard *et al.*, 2020; Hansen and Høgslund, 2021; McLaverty *et al.*, 2020; Nielsen *et al.*, 2018a,b,c; 2019a,b,c; 2020a,b; Petersen *et al.*, 2020; and Petersen, 2021). Dredging for shellfish has the potential to affect marine ecosystems in a number of ways, including:

- Removal of prey – shellfish including mussels and oysters are important food items for certain species of wildlife, for example birds such as goldeneye (*Bucephala clangula*) feed on mussels.
- Removal of hard substrate and/or habitat – shellfish beds create habitats that are colonized by a range of other animals including invertebrates and small fish. Dredges can bring up boulders and cobbles from the seabed and their removal can change its physical character.
- Impacting benthic fauna communities in complex ways – species assemblages make up diverse communities of organisms, and the density of some species may increase while overall species richness may decrease or remain unchanged between fished and unfished areas.
- Resuspension and disturbance of seabed sediments which may affect water quality, sediment biogeochemistry and nutrient cycles.
- Facilitation of the spread of non-native species.

Potential direct and indirect ecosystem impacts, including the cumulative impact on benthic fauna, of shellfish dredging are identified and assessed in considerable detail in the formal impact assessments carried out annually by DTU Aqua in the Natura 2000 sites where fishing is proposed:

- In Limfjord – Lovns Bredning (Nielsen *et al.*, 2018c, 2019c and 2020b) and Løgstør Bredning (Nielsen *et al*., 2018b, 2019a and 2020a) in relation to UoA1 and UoA2; Nissum Bredning in relation to UoA3 (Nielsen *et al.*, 2018a and 2019b).
- In Inner Danish Waters – Lillebælt and Horsens Fjord (Nielsen *et al*., 2019a) in relation to UoA4.

Between 2018 and 2021, a suite of papers was published under a Danish Environmental Protection Agency project "*Effects on the quality elements defined by the EU Water Framework Directive (WFD) of other pressure factors than excess nutrient load and climate change*", summarised in Petersen (2021). The potential direct and indirect effects of mobile bottom-contacting fisheries (e.g., shellfish dredging and bottom trawling) on Danish Quality Indicators (DKI) in 16 water bodies were modelled using data assembled from a range of sources (e.g., black box data; NOVANA data sets (see Hansen and Høgslund, 2021), and FlexSem (a biogeochemical process model described in Larsen *et al*, 2017)), and reported in Petersen *et al.*, 2020a (on benthic fauna and phytoplankton) and 2020b (on eelgrass). Modelling for benthic fauna could not detect a significant effect of fisheries on DKI values; only depth, abundance of species and abundance of individuals appeared to have a significant effect on water quality values. Petersen *et al.* (2020a) suggest that the lack of fisheries effect may be explained because DKI were designed to detect effects of eutrophication and thus give weight to species number; and that effects of fishing may be masked, but comparatively small, in areas already heavily disturbed by eutrophication. In relation to phytoplankton, the model was run with five realistic mussel fishing scenarios, including no fishing. Results suggested that fishing may produce a relatively small increase in Chlorophyll *a*. (CHLA) – an indicator of phytoplankton biomass (e.g., blooms) that can in turn indicate a decrease in water quality – but the overall effect will depend on the spatial distribution and composition of mussel beds and the intensity of fishing. Furthermore, a relatively large change (e.g., increase) in fishing intensity would be required before any cascade effects would be visible in phytoplankton biomass and nutrient concentrations (Petersen *et al.*, 2020a).

Related to the above project, two more targeted projects were undertaken to analyse the effects of mussel and oyster fisheries specifically on benthic fauna. Eigaard *et al.*, (2020) aimed to improve the scientific basis for mussel and oyster fisheries management in Natura 2000 sites in relation to benthic fauna by developing a method to detect the potential effects of shellfish dredging on benthic fauna, and to link observed effects with a more accurate estimation of the actual area (footprint) impacted by the fishery, within and across Natura 2000 sites. While McLaverty *et al.* (2020) set out to investigate the effects of dredging on benthic communities on fishing grounds that experience high levels of eutrophication and natural variability.

In the Eigaard *et al.* (2020) study, benthic fauna communities in Nissum Bredning, Løgstør Bredning and Lovns Bredning in Limfjorden, as well as Horsens Fjord and Lillebaelt in Inner Danish Waters were sampled directly from 196 stations to ensure different habitats and varying fishing pressures were included in the study, including both fished and unfished areas. By combining samples with the 2014-2018 data from the NOVANA program (Hansen and Høgslund, 2021), a dataset from 271 sample sites across the five areas was analysed, producing an overview of the spatial distribution of individual benthic communities in the study areas; the key species within each community cluster; and calculations for the longevity composition of the community. Recovery times were calculated to be in the range of 2.0-3.7 years depending on the area. Multivariate modelling was used to estimate the effect of mussel and oyster dredging on benthic fauna composition, and generalised linear mixed models (GLMM) were used to analyse the effects on three univariate benthic fauna indicators: number of individual animals, species numbers and total biomass.

At a regional level, GLMM results indicated no significant effect of fishing on the three benthic fauna indicators. Other factors suggested greater effects: the amount of shell fragments showed a significant positive effect on all three indicators; the amount of organic matter present showed a significant negative effect on individual and species numbers; O_2 concentration showed a significant positive effect on biomass; and depth showed a significant positive effect on species number. The results were partly confirmed in area-specific analysis, where neither individual nor species number appeared to be significantly correlated to fishing intensity, whereas both indicators were significantly correlated to either O_2 concentration or organic load in most areas. However, the area-specific analysis also showed that fishing was correlated with a statistically significant negative effect on the total biomass indicator in two of the Natura 2000 sites (ibid).

Multivariate analysis of the full combined dataset showed that environmental factors such as depth, longitude, O_2 concentration, organic matter and shell fragments in the sediment explained a higher degree of variance in the benthic data than fishing intensity. These results were largely replicated in the models of the individual Natura 2000 data sets, where results show that the composition of the benthic fauna in the Natura 2000 areas is more influenced by the other pressure factors than fishing, but also that some benthic fauna components and indicators (biomass) remain sensitive to fishery impacts despite high levels of other disturbances. Another important result is that the significant effects of fishing and environmental variables on the indicators varied significantly across the three Limfjorden areas, even though these are located within a range of only about 0-15km. The authors suggest that this result highlights the need for differentiation between a local and regional scale when it comes to monitoring and assessing cumulative impacts on benthic fauna in relation to fishing proposal impact assessments in Natura 2000 sites (ibid).

Using GLMM, the sensitivity of five bottom fauna indicators (species number, individual number, AMBI (Marine Biotic Index), M-AMBI (Multivariate-AMBI) and DKI to mussel and oyster dredging in 16 Danish water bodies (defined according to the EC Water Framework Directive) was analysed. The data set included 1669 bottom fauna samples (as also reported in Petersen *et al.*, 2020a), collected in 2014-2018 under the NOVANA program, which were individually coupled to fishing intensity at each sampling position using black box data. The results showed that fishing did not have a significant effect on benthic fauna according to each of the five indicators. Eigaard *et al.* (2020) draw the same conclusions as Petersen *et al.* (2020) above: that the indicators are designed for water quality analysis (e.g, DKI). But the authors go a step further by recommending that current standard indicators for monitoring the ecological status of benthic fauna in the marine environment should be changed in order to monitor localized fisheries effects, and that resources are allocated to further development of a bottom fauna index that is sensitive to the impact of fishing in coastal waters (Eigaard *et al.*, 2020).

The McLaverty *et al.* (2020) study, also related to the Eigaard *et al.* (2020) and Petersen *et al.* (2020a,b) work described above, used some of the same datasets (e.g. black box fishing effort/SAR analysis), but also collected macrofaunal data from 34 locations across four main bivalve basins: Horsens Fjord, Løgstor Bredning, Lovns Bredning and Nissum Bredning. The study examined the effects of dredging on taxonomic and functional (biological trait) characteristics, with the analysis accounting for environmental differences between fishing grounds as well as sediment characteristics and hydrodynamic properties.

Results suggested that while dredging appeared to reduce benthic community biomass and impact species composition across the study area, these relationships varied significantly between regional and local scales (e.g., two basins showed decreases in community biomass, one showed little relationship and one showed an increase in community biomass), leading the authors to conclude that the results cannot be generalised across spatial scales.

Several benthic metrics (e.g., community composition; community density; functional richness) did not show a response to dredging which the authors suggest may be because eutrophication and natural variability partly mask the effects of dredging on benthic communities. The study was similarly unable to detect any functional impacts on benthic communities between unfished and fished areas, suggesting that shallow water communities are often naturally disturbed and can exhibit traits associated with high functional resilience and recoverability.

The authors concluded that it is difficult to separate out fisheries effects in areas heavily modified by high nutrient enrichment and variable environmental conditions because benthic communities may become stress-adapted irrespective of fishing effort. However, the authors noted that having suitable reference conditions (e.g., unfished areas in areas where oxygen conditions are stable) and high-resolution fishing effort data undoubtedly benefited their analysis and recommended that conserving small reference sites could provide ‘control’ areas that could help improve future ecological monitoring. (McLaverty *et al.*, 2020)

In relation to biogeochemical processes, mussel dredging was shown to release phosphorous (P) bound to iron particles from the sediment during a field study in Limfjord (Holmer *et al.*, 2003). However, these particles are not directly available and were shown to eventually sink and resettle on the bottom. During hypoxia in summertime, iron bound-P can be transformed to PO_4 and potentially fuel microorganisms. However, the overall release of phosphorous during dredging was much less in August due to lower pools of sedimentary iron-bound phosphorous that were already depleted by hypoxia due to eutrophication. Sediment pools and fluxes of dissolved phosphorous were not affected by dredging in this study (Holmer *et al.*, 2003). Other studies showed that dissolved nutrient concentrations increased in the water column immediately after dredging (Riemann and Hoffmann, 1991; Dyekjær *et al.*, 1995), but this corresponded to less than 1% of the nutrient loads from land and atmosphere (Dyekjær *et al.*, 1995). Oxygen consumption increased less than 4 days after dredging and can contribute to promote hypoxia (Riemann and Hoffmann, 1991; Holmer *et al.*, 2003). The effects of dredging on water quality are potentially highest during the warm summer months with little wind, where oxygen consumption is highest, and nutrients are depleted. However, summer closures for mussel fishing, the strictly limited number of boats in any given UoA area, and the mandatory use of lighter mussel dredging gear in the last five years contribute to reducing and minimising these impacts.

Other indirect impacts such as resuspension of seabed sediments or the spread of non-native species are considered insignificant: in relation to UoA3 (Limfjord oyster) sediment resuspension is considered unlikely to restrict the range of marine macrophytes in the Limfjord; and oyster dredging is no longer considered likely to encourage the spread of non-native species (Nielsen *et al.*, 2015b). New regulations imposed in 2019-20 now prohibit dredging for mussels and oysters within 300m of the boundary of any Natura 2000 site that is closed to fishing, thereby adding a buffer zone to prevent resuspension from affecting protected sites (see BEK nr 1258 af 27/11/2019).

Stakeholders suggested that the effects of bottom trawling on nitrogen cycles should be considered in the assessment. A recently published experimental study (Ferguson *et al.*, 2020) in the shallow waters (approx. 4m) of a sub-tropical bay off the coast of Queensland, Australia examined the potential effect of bottom trawling on benthic biogeochemical processes (ecosystem function), with particular focus on the process of benthic denitrification – where bioavailable nitrogen is removed from N-limited coastal marine waters in a microbially mediated biogeochemical process, thus helping to buffer against or offset stress caused by eutrophication. The effect of bottom trawling on these processes is a little studied phenomenon but it is thought that changes in sediment structure and infauna species loss may be detrimental. Therefore, to test the hypothesis that bottom trawling reduces benthic denitrification, a before-after control-effect experimental study was conducted on three sites with control, pre-trawl and post-trawl observations at three 3-monthly intervals.

Results showed detectable acute effects on all measured sediment-water fluxes except NO_3, but in most cases there was variation in the direction of effect (increase or decrease) and/or the sites and/or times where an impact was detected. Trawling appeared to decrease net N_2 fluxes (denitrification) over time, with the first occasion producing a non-significant decrease and increasingly significant decreases over the last two trawling occasions. The texture of surface sediments appeared to be homogenized due to the removal of burrow structures and the redistribution of sediment particles – a commonly observed disturbance in trawled coastal sediments. However, no statistically significant chronic effect of trawling was detected for any measured parameter at any site or time, which the authors hypothesised may be because the return frequency of trawling to the experimental sites was insufficient to incur detectable chronic effects, and the heterogeneous sediment structures had recovered within weeks of one-off disturbances. The authors suggest that although net denitrification returned to control rates following disturbance, the effect of trawling appeared to increase over subsequent trawling events, but they acknowledge this may be due to seasonal variation. Alternatively, disturbance that effected the complex three-dimensional redox structures in surface sediments that maximize denitrification potential, resulting in up to a 50% reduction in net denitrification, could suggest a declining resilience to repeated trawling over time. Counterintuitively for the authors, macrofaunal species richness appeared to increase after trawling which introduced further uncertainty into the results. Finally, the authors suggest that further work at high trawl intensities, over larger spatial and temporal scales would be needed to see if there is in fact a chronic effect on benthic denitrification. Similarly, impacts in other areas will depend on the sediment type, natural disturbance regime (e.g., high or low energy environments), sensitivity of key macrofaunal species for maintaining ecosystem complexity at microbial levels, and ultimately fishing disturbance of sediment structures and fishing intensity over time (Ferguson *et al.*, 2020).

The study poses and attempts to answer important questions about the effect bottom-contacting mobile fishing gears may have on the global nitrogen cycle. However, while the results point to some short-term conclusions about the shallow, soft-sediment environment of a subtropical bay in Australia, it is more difficult to generalise those results to the specifics of the ecosystems under assessment for all four UoAs, although the authors do suggest that their results could be applied globally (Ferguson *et al.*, 2020). It offers fertile territory for researchers to explore to determine whether the same short-term effects occur in significantly different environments, and whether any chronic long-term effects happen.

The question for the assessment team is whether the results can reasonably lead us to conclude that there is a high likelihood that the UoAs themselves pose a risk of serious or irreversible harm to the structure and function of the ecosystems within which they operate. Even if we grant the notion that there may be denitrification effects caused by changes in sediment structures and nitrogen cycles, the extent and contribution of these to the overall structure and function of the Limfjorden and Inner Danish waters is necessarily limited by the extensive spatial, temporal and fishing effort controls imposed upon the UoAs. There are vast areas within these water bodies that are simply closed permanently to all dredging activity; there are closures over the summer months and at the end of each calendar year; there are strict vessel number controls on specific areas within the UoAs; and the actual dredged areas are limited in spatial extent due to the distribution of shellfish of sufficient density and quality that make fishing commercially viable. Taken together, these limit the areas of fishing to very specific locations which are not widely distributed across the areal extent of the UoAs, indeed impact assessments for each of the Natura 2000 sites where fishing is permitted (e.g., Løgstør, Lovns & Nissum) routinely conclude that year on year less than 10% (frequently less than 5%) of those areas are impacted by dredging, and that over the wider ecosystem in any given year less than 2% by area of all the UoAs is affected annually by shellfish dredging (see Nielsen *et al*, 2014; 2018a,b,c;2019a,b,c;2020a,b). Given these factors, the team concludes that the UoAs are highly unlikely to pose a risk of serious or irreversible harm to the structure and function of the ecosystems within which the UoAs operate.

Similarly, in relation to the effects on benthic fauna, the abundance of data and information collected and analysed in recent years directly from the UoAs in fished and unfished areas, as well as in areas that were fished but are now closed to fishing, has contributed significantly to the knowledge base. The studies described above do demonstrate that while there may be localised, but variable, impacts of fishing to benthic fauna, there is also evidence pointing to the presence of a diversity of benthic species and community complexes in the unfished, protected and closed areas, including species of concern to some stakeholders. For example, while *Arctica islandica* or *Modiolus modiolus* are not recorded in fishers' logbooks as bycatch during routine shellfish fishing operations in the UoAs, *A. islandica* are recorded in unfished areas by McLavety *et al.* (p.27, 2020) in Limfjord; and Hansen and Høgslund encountered high densities and high biomass in the northern Belt off Horsens Fjord (p.91, 2021); and both *A. islandica* and *M. modiolus* are mapped in an analysis of the existing network of protected areas by Olesen *et al.* (pp. 50-52, 2020) using NOVANA data and are demonstrably present in multiple sites in the Belt Sea (i.e., the largest area of the Inner Danish Waters UoA). This is strongly suggestive that unfished, closed and protected areas are providing significant refugia for some of the larger benthic taxa found in the ecosystem of the UoAs.

All of which leads the assessment team to conclude, again because of the strict spatial and temporal limitations, control of fishing effort/vessel numbers by area, gear restrictions, output controls, high spatial and temporal coverage of black box monitoring, and the cumulative impact controls within Natura 2000 sites, that the UoAs are highly unlikely to pose a risk of serious or irreversible harm to the structure and function of the ecosystem and that there is evidence to support this conclusion. The state of knowledge about the localised effects of dredging on certain ecosystem components has continued to evolve and scientists have made a number of recommendations that could further improve and refine future monitoring and assessment of ecological factors in relation to the effects of shellfish fishing in Danish waters.

Table 29 – Scoring elements

Scoring elements						
Component	Scoring elements	UoA1	UoA2	UoA3	UoA4	Data-deficient
e.g. P1, Primary, Secondary, ETP, Habitats, Ecosystems	e.g. species or stock (SA 3.1.1.1)	Main or Minor				
Target species	Mussels	NA	-	-	-	No
Target species	Cockles	-	NA	-	-	Yes
Target species	Oysters	-	-	NA	-	Yes
Target species	Mussels	-	-	-	NA	Yes
Primary	Flounder	Minor	Minor	-	-	No
Primary	Mussels	-	Minor	Minor	-	No
Secondary	Starfish	Minor	Main	Main	Minor	Yes
Secondary	Cockles	Minor	-	Minor	-	Yes
Secondary	Oysters	Minor	Minor	-	-	Yes
Secondary	Shore crabs	Minor	Minor	-	Minor	Yes
Secondary	Flounder	-	-	-	Minor	Yes
ETP	Greater scaup, *Aythya marila*	NA	NA	NA	NA	No
ETP	Common goldeneye, *Bucephala clangula*	NA	NA	NA	NA	No
ETP	Common eider duck, *Somateria mollissima*	NA	NA	NA	NA	No
ETP	Velvet scoter, *Melanitta fusca*	NA	NA	NA	NA	No
ETP	White-tailed eagle	NA	NA	NA	NA	Yes
ETP	Otter	NA	NA	NA	NA	Yes
Habitats	'Commonly encountered' 'VMEs'	NA				No
Ecosystems	No further designations in ecosystem component	NA				No

7.4.2 Principle 2 Performance Indicator scores and rationales

PI 2.1.1 – Primary species outcome

PI 2.1.1		The UoA aims to maintain primary species above the point where recruitment would be impaired (PRI) and does not hinder recovery of primary species if they are below the PRI		
Scoring Issue		SG 60	SG 80	SG 100
a	Main primary species stock status			
	Guide post	Main primary species are **likely** to be above the PRI. OR If the species is below the PRI, the UoA has measures in place that are **expected** to ensure that the UoA does not hinder recovery and rebuilding.	Main primary species are **highly likely** to be above the PRI. OR If the species is below the PRI, there is either **evidence of recovery** or a demonstrably effective strategy in place **between all MSC UoAs which categorise this species as main**, to ensure that they collectively do not hinder recovery and rebuilding.	There is a **high degree of certainty** that main primary species are above the PRI **and are** fluctuating around a level consistent with MSY.
	Met?	**UoA 1 NA** **UoA 2 NA** **UoA 3 NA** **UoA 4 Yes**	**UoA 1 NA** **UoA 2 NA** **UoA 3 NA** **UoA 4 Yes**	**UoA 1 NA** **UoA 2 NA** **UoA 3 NA** **UoA 4 Yes**
Rationale				

UoAs 1, 2 & 3. There are no main primary species in UoAs 1, 2 & 3, and therefore this scoring issue is not scored.

UoA 4. There are no primary species (main or minor) caught in UoA 4, so MSC FCRv2.1 states that this UoA should score 100 for the outcome PI 2.1.1.

b	Minor primary species stock status			
	Guide post			Minor primary species are highly likely to be above the PRI. OR If below the PRI, there is evidence that the UoA does not hinder the recovery and rebuilding of minor primary species.
	Met?			**UoA 1 Flounder Yes** **UoA 2 Flounder Yes** **Mussel Yes** **UoA 3 Mussel Yes** **UoA 4 Yes**
Rationale				

UoA 1. Flounder is the only minor primary species caught in UoA 1. The most recent ICES advice shows that current fishing pressure is below the F_{MSY} proxy. Stock size indicator (in relative biomass) from the North Sea International

Bottom Trawl Survey Q1 shows a slight decline over the last 2-3 years, but there are currently no reference points defined for stock size for this stock and flounder is considered to be highly likely to be above the PRI. SG100 is met.

UoA 2. Flounder and mussels are the only main primary species in the cockle fishery. For flounder the most recent ICES advice shows that current fishing pressure is below the F_{MSY} proxy. Stock size indicator (in relative biomass) from the North Sea International Bottom Trawl Survey Q1 shows a slight decline over the last 2-3 years, but there are currently no reference points defined for stock size for this stock and flounder is considered to be highly likely to be above the PRI. SG100 is met. When scoring mussel as the target species in UoA 1, the assessment team concluded that there was a high degree of certainty that the stock is above the PRI and fluctuating around a level consistent with MSY. The SG100 is met.

UoA 3. Mussel is the only minor primary species in this UoA. As described above, the stock is highly likely to be above the PRI. SG100 is met.

UoA 4. There are no primary species (main or minor) caught in UoA 4, so MSC FCRv2.2 states that this UoA should score 100 for the outcome PI 2.1.1.

References

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Draft scoring range	**UoA 1 ≥80** **UoA 2 ≥80** **UoA 3 ≥80** **UoA 4 ≥80**
Information gap indicator	**More information sought on recent catch compositions from all UoAs**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score Scoring elements UoA 1 Flounder 100 UoA 2 Flounder 100 Mussel 100 UoA 3 Mussel 100 UoA 4 NA	**UoA 1 100** **UoA 2 100** **UoA 3 100** **UoA 4 100**
Condition number (if relevant)	**NA**

PI 2.1.2 – Primary species management strategy

PI 2.1.2		There is a strategy in place that is designed to maintain or to not hinder rebuilding of primary species, and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place for the UoA, if necessary, that are expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are likely to be above the PRI.	There is a **partial strategy** in place for the UoA, if necessary, that is expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are highly likely to be above the PRI.	There is a **strategy** in place for the UoA for managing main and minor primary species.
	Met?	**UoA 1 Yes** **UoA 2 Yes** **UoA 3 Yes** **UoA 4 Yes**	**UoA 1 Yes** **UoA 2 Yes** **UoA 3 Yes** **UoA 4 Yes**	**UoA 1 Yes** **UoA 2 Yes** **UoA 3 Yes** **UoA 4 Yes**
Rationale				

<u>UoAs 1 and 2</u>. There are no main primary species in UoAs 1 and 2, and so SG60 and SG80 are met by default. There is a general strategy in place in the mussel and cockle fishery to ensure that the catch of all non-target species is minimised. Specific actions are undertaken by the fleet to avoid high density areas of non-target species, including primary species. Incentives to avoid high catches of non-target species are created because vessels have no facility to sort the catch and they are required to land all catches. The catch is then sorted at the processor and all non-target species discarded. Measures are also undertaken by the fishery to reduce the likelihood of retaining high catches of non-target species. Underwater video cameras and sonar equipment are used with test dredging by a dedicated vessel within the fleet to identify areas of high mussel abundance and quality or high cockle abundance (and low non-target species). This information is relayed back to the rest of the fleet to facilitate specific targeted areas. There are also a number of statutory management measures that prevent dredging activities in much of the Limfjord region, including depth restrictions and compliance with spatial controls is monitored through vessel 'black box' recorders (vessel monitoring system) fitted to all shellfish vessels. Any flounder caught in the dredge are returned to the sea so that mortality is minimised. There is therefore a strategy in place for managing primary species in UoA 1 and UoA 2. SG100 is met.

<u>UoA 3</u>. There are no main primary species in UoA 3, and so SG60 and SG80 are met by default. In the oyster fishery, landings of non-target species are kept at a low level by the practice of sorting the catch aboard vessels before landing, and discarding everything apart from oysters. In addition to this, catches of non-target species are kept low by measures adopted by the fleet to avoid areas where non-target species are abundant. There are also a number of statutory management measures that prevent dredging activities in much of the Limfjord region, including depth restrictions and compliance with spatial controls is monitored through vessel 'black box' recorders (vessel monitoring system) fitted to all shellfish vessels. The only minor primary species caught in the oyster fishery is mussels and there is a management strategy in place in the mussel fishery to ensure that the dredge fishery does not impact on the mussel stock. The SG100 is met.

<u>UoA 4</u>. There are no primary species (main or minor) caught in UoA 4, and so SG60 and SG80 are met by default. However as described for UoA 1 above, there is a similar strategy in place in the Inner Danish Waters fishery for managing primary species. The SG100 is met.

b	Management strategy evaluation			
	Guide post	The measures are considered **likely** to work, based on plausible argument (e.g., general experience, theory or	There is some **objective basis for confidence** that the measures/partial strategy will work, based on some information directly about the	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on information directly

		comparison with similar fisheries/species).	fishery and/or species involved.	about the fishery and/or species involved.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**

Rationale

All UoAs. Evidence from DTU-Aqua surveys in all UoAs, official landings data and anecdotal evidence from fishers and processing companies show that there is a very small quantity of primary species caught in the UoAs providing confidence that the strategy is working in all UoAs. Mussels are a minor primary species in the cockle and oyster fisheries in the Limfjord, and evidence from DTU Aqua surveys shows that the strategy is working. SG60 and SG80 are met for all UoAs. It is not clear that formal testing of the strategy has been undertaken in the UoAs, and therefore the SG100 is not met for all UoAs.

c	Management strategy implementation			
	Guide post		There is **some evidence** that the measures/partial strategy is being **implemented successfully**.	There is **clear evidence** that the partial strategy/strategy is being **implemented successfully and is achieving its overall objective as set out in scoring issue (a).**
	Met?		**All UoAs Yes**	**All UoAs Yes**

Rationale

All UoAs. Information obtained from DTU-Aqua research surveys coupled with reports from industry sources, landings data (and for the oyster fishery independent observations of catch composition) helps to demonstrate that bycatch of primary species is very low in all UoAs. This coupled with sorting of the catch and retaining only the target species (except for mussels in UoAs 2 & 3) shows that the strategy is being implemented successfully. All vessels are equipped with "black box" recorders that verify compliance with controls in place to protect target and non-target species, as well as marine habitats in both the Limfjord and Inner Danish Waters providing further evidence that the strategy is achieving its objectives. The SG80 and SG100 are met for all UoAs.

d	Shark finning			
	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**All UoAs NA**	**All UoAs NA**	**All UoAs NA**

Rationale

There is no evidence that sharks are captured in this fishery. This scoring issue is not relevant and has not been scored.

e	Review of alternative measures			
	Guide post	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of all primary species, and they are implemented, as appropriate.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**

Rationale

All UoAs. Apart from mussels in UoAs 2 & 3, all primary species caught in the UoAs are unwanted catch. All possible measures to ensure that these unwanted catches are minimised are constantly under review in the UoAs. Fishing and discarding practices including video and sonar surveys, gear rigging, and statutory measures implemented to minimise impact on non-target species and sensitive habitats are constantly under review to ensure that unwanted catches are minimised. The assessment team considered that there are regular reviews, so SG60 and SG80 are met for all UoAs, but there is no evidence that alternative measures are formally reviewed every two years, so SG100 is not met.

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Draft scoring range	**UoA 1 ≥80** **UoA 2 ≥80** **UoA 3 ≥80** **UoA 4 ≥80**
Information gap indicator	**More information sought on recent catch compositions from all UoAs**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**UoA 1 90** **UoA 2 90** **UoA 3 90** **UoA 4 90**
Condition number (if relevant)	**NA**

PI 2.1.3 – Primary species information

PI 2.1.3		Information on the nature and extent of primary species is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage primary species		
Scoring Issue		SG 60	SG 80	SG 100
a		Information adequacy for assessment of impact on main primary species		
	Guide post	Qualitative information is **adequate to estimate** the impact of the UoA on the main primary species with respect to status. **OR** **If RBF is used to score PI 2.1.1 for the UoA:** Qualitative information is adequate to estimate productivity and susceptibility attributes for main primary species.	Some quantitative information is available and is **adequate to assess** the impact of the UoA on the main primary species with respect to status. **OR** **If RBF is used to score PI 2.1.1 for the UoA:** Some quantitative information is adequate to assess productivity and susceptibility attributes for main primary species.	Quantitative information is available and is **adequate to assess with a high degree of certainty** the impact of the UoA on main primary species with respect to status.
	Met?	**UoA 1 NA UoA 2 NA UoA 3 NA UoA 4 NA**	**UoA 1 NA UoA 2 NA UoA 3 NA UoA 4 NA**	**UoA 1 NA UoA 2 NA UoA 3 NA UoA 4 NA**
Rationale				

UoAs 1, 2, 3 & 4. There are no main primary species in UoAs 1, 2, 3 and 4, and therefore this scoring issue is not scored.

b		Information adequacy for assessment of impact on minor primary species		
	Guide post			Some quantitative information is adequate to estimate the impact of the UoA on minor primary species with respect to status.
	Met?			**UoA 1 Flounder Yes UoA 2 Flounder Yes Mussels Yes UoA 3 Mussels Yes UoA 4 Yes**
Rationale				

UoA 1. The only minor primary species in UoA 1 is flounder. There is some quantitative information from fishers on the daily catches of flounder in the UoA and there is information from the DTU Aqua surveys in the Limfjord of the catches of flounder in tows similar to those undertaken in the commercial fishery. All evidence suggests that the catches of flounder are negligible in relation to the precautionary TAC of 1650 tonnes advised by ICES for the flounder stock in the North Sea and Skagerrak. The SG 100 is met.

UoA 2. The only minor primary species in UoA 2 are flounder and mussels. As for UoA 1, flounder meets the SG100. When scoring mussel as the target species in UoA 1, the assessment team reviewed the quantitative information on the impact of the mussel and cockle fishery on the status of mussels in the Limfjord. The assessment concluded that there was a high degree of certainty that the mussel stock is above the PRI and fluctuating around a level consistent with MSY, inferring that the fishery is not impacting stock status. There is also good quantitative information from the DTU Aqua stock surveys on the catch of mussels in areas where cockles are targeted. The SG100 is met.

UoA 3. Mussels are the only minor primary species in the oyster fishery. There is good information on bycatch of mussels in the oyster fishery and on stock status of mussels in the Limfjord which allows an estimate of the impact of the UoA on the mussel stock. The SG100 is met.

UoA 4. There are no primary species caught in UoA4, but the methods for collection of information on catches of all non-target species is adequate to estimate the impact of the UoA on any primary species that might be caught in the future. SG100 is met.

c	Information adequacy for management strategy			
	Guide post	Information is adequate to support **measures** to manage **main** primary species.	Information is adequate to support a **partial strategy** to manage **main** primary species.	Information is adequate to support a **strategy** to manage **all** primary species and evaluate with a **high degree of certainty** whether the strategy is achieving its objective.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**
Rationale				

All UoAs. There are no main primary species in all UoAs, so the SG60 and SG80 are met by default. There is some information available in all these UoAs to support the strategy for managing primary species including flounder in UoAs 1 & 2 and mussels in UoA 2. However, there is no formal observer programme in any of the UoAs, and analysis of DTU Aqua survey data in UoAs 1 & 2 and bycatch data from UoA 3 have not been updated for many years. The SG 100 is not met. The assessment team recommends that up-to-date information on the bycatch of primary species is collected for all UoAs.

References

ICES. 2021. ICES advice - Flounder (*Platichthys flesus*) in Subarea 4 and Division 3.a (North Sea, Skagerrak and Kattegat). https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2021/2021/fle.27.3a4.pdf

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Draft scoring range	**UoA 1 ≥80** **UoA 2 ≥80** **UoA 3 ≥80** **UoA 4 ≥80**

Information gap indicator	**More information sought on recent catch compositions from all UoAs**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score Scoring elements UoA 1 Flounder 90 UoA 2 Flounder 90 Mussel 90 UoA 3 Mussel 90 UoA 4 NA	**UoA 1 90** **UoA 2 90** **UoA 3 90** **UoA 4 90**
Condition number (if relevant)	**NA**

PI 2.2.1 – Secondary species outcome

PI 2.2.1		The UoA aims to maintain secondary species above a biologically based limit and does not hinder recovery of secondary species if they are below a biological based limit		
Scoring Issue		SG 60	SG 80	SG 100
a	Main secondary species stock status			
	Guide post	Main secondary species are **likely** to be above biologically based limits. OR If below biologically based limits, there are **measures** in place expected to ensure that the UoA does not hinder recovery and rebuilding.	Main secondary species are **highly likely** to be above biologically based limits. OR If below biologically based limits, there is either **evidence of recovery** or a **demonstrably effective partial strategy** in place such that the UoA does not hinder recovery and rebuilding. AND Where catches of a main secondary species outside of biological limits are **considerable**, there is either **evidence of recovery** or a, **demonstrably effective strategy in place between those MSC UoAs that have considerable catches of the species**, to ensure that they collectively do not hinder recovery and rebuilding.	There is a **high degree of certainty** that main secondary species are above biologically based limits.
	Met?	**UoA 1 NA UoA 2 Scored using RBF UoA 3 Scored using RBF UoA 4 NA**	**UoA 1 NA UoA 2 Scored using RBF UoA 3 Scored using RBF UoA 4 NA**	**UoA 1 NA UoA 2 Scored using RBF UoA 3 Scored using RBF UoA 4 NA**
Rationale				

UoAs 1 & 4. There are no main secondary species in the fishery in UoCs 1 & 4, so this scoring issue is not scored.

UoAs 2 & 3. Information on bycatches show that starfish, *Asteria rubens*, are likely to constitute more than 5% of the total catch in both the cockle fishery (UoA 2) and the oyster fishery (UoA 3), and that as main secondary species, starfish should be scored using the RBF for UoAs 2 & 3 for this PI.

The score using the RBF for this PI was 98 for both UoAs (see Table 52 and Table 56).

b	Minor secondary species stock status			
	Guide post			Minor secondary species are highly likely to be above biologically based limits. OR If below biologically based limits', there is evidence that the UoA does not hinder the

				recovery and rebuilding of secondary species
	Met?			**All UoAs NA as RBF used to score this PI and score capped at 80**
Rationale				

All UoAs. There are minor secondary species caught in all UoAs – cockles, oysters, starfish and shore crabs in UoA 1, oysters and shore crabs in UoA 2, cockles in UoA 3 and starfish, shore crabs and flounder in UoA 4. All these minor secondary species should be considered as data-deficient as there are no stock status reference points available (MSC FCPv2.1, 7.7.3, Table 3) for those species in either the Limfjord or the Inner Danish Waters regions. Paragraph 7.7.6.5 requires that the Risk-Based Framework (RBF) should be used to evaluate scoring elements that are data-deficient. The secondary species identified for all the UoAs should therefore be scored using the RBF. However, MSC FCP PF4.1.4 states that "*The team may elect to conduct a PSA on "main" species only when evaluating PI 2.1.1 or 2.2.1*", and this is the approach taken in this assessment as all secondary species caught in all UoCs were designated as minor secondary species. MSC FCP PF 5.3.2 is therefore applied and the scores for this Performance Indicator are capped at 80.

References

Gommesen, M., & Fomsgaard, C. 2014. Bifangst ved skrab af østers. DTU-Aqua, Dansk Skaldyrcenter. 4pp.

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Draft scoring range	**All UoAs ≥80**
Information gap indicator	**More information sought from Stakeholder consultations on the RBF for starfish**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**All UoAs 80**
Condition number (if relevant)	**NA**

PI 2.2.2 – Secondary species management strategy

PI 2.2.2		There is a strategy in place for managing secondary species that is designed to maintain or to not hinder rebuilding of secondary species and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place, if necessary, which are expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be above biologically based limits or to ensure that the UoA does not hinder their recovery.	There is a **partial strategy** in place, if necessary, for the UoA that is expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be above biologically based limits or to ensure that the UoA does not hinder their recovery.	There is a **strategy** in place for the UoA for managing main and minor secondary species.
	Met?	**UoA 1 Yes** **UoA 2 Yes** **UoA 3 Yes** **UoA 4 Yes**	**UoA 1 Yes** **UoA 2 Yes** **UoA 3 Yes** **UoA 4 Yes**	**UoA 1 Yes** **UoA 2 Yes** **UoA 3 Yes** **UoA 4 Yes**
Rationale				

UoA 1. There are no main secondary species in the Limfjord mussel fishery and therefore SG60 and SG80 are met by default. There is a general strategy in place in the Limfjord mussel and cockle fishery to ensure that the catch of all non-target species is minimised. Specific actions are undertaken by the fleet to avoid high density areas of non-target species, including secondary species. Incentives to avoid high catches of non-target species are created because vessels have no facility to sort the catch and they are required to land all catches. The catch is then sorted at the processor and all non-target species discarded. Measures are also undertaken by the fishery to reduce the likelihood of retaining high catches of non-target species. Underwater video cameras and sonar equipment are used with test dredging by a dedicated vessel within the fleet to identify areas of high mussel abundance and quality (and low non-target species). This information is relayed back to the rest of the fleet to facilitate specific targeted areas. There are also a number of statutory management measures that prevent dredging activities in much of the Limfjord region, including depth restrictions and compliance with spatial controls is monitored through vessel 'black box' recorders (vessel monitoring system) fitted to all shellfish vessels. There are four minor secondary species in UoA 1 – cockles, oysters, starfish and shore crabs. Cockles and oysters may be landed but these landings are controlled through bycatch limits and any such landings are fully taken into account in the management strategy for the cockle and oyster fisheries. Starfish and shore crabs are discarded. There is a strategy in place for managing main and minor secondary species. SG100 is met.

UoA 2. Starfish are the only main secondary species in the cockle fishery. Starfish caught in the cockle fishery are discarded and post-capture survival is expected to be high as starfish are resilient to disturbance and are capable of regrowing arms even if damaged by fishing gear (autotomy). Avoidance where possible of areas of high densities of starfish and discarding of all starfish constitutes a partial strategy. There are no biological based limits for starfish populations but scoring of starfish under PI 2.2.1 using the RBF resulted in a high PSA score, and with starfish found throughout the Limfjord in high numbers, it can be concluded that any mortality of starfish caused by the cockle fishery will have negligible impact on the starfish population. SG 60 and SG 80 are met. As for UoA 1, there is a general strategy in place in the Limfjord cockle fishery to ensure that the catch of all non-target species is minimised. Specific actions are undertaken by the fleet to avoid high density areas of non-target species, including secondary species. Incentives to avoid high catches of non-target species are created because vessels have no facility to sort the catch and they are required to land all catches. The catch is then sorted at the processor and all non-target species discarded. Measures are also undertaken by the fishery to reduce the likelihood of retaining high catches of non-target species. Underwater video cameras and sonar equipment are used with test dredging by a dedicated vessel within the fleet to identify areas of high cockle abundance (and low non-target species). This information is relayed back to the rest of the fleet to facilitate specific targeted areas. There are also a number of statutory management measures that prevent dredging activities in much of the Limfjord region, including depth restrictions and compliance with spatial controls is monitored through vessel 'black box' recorders (vessel monitoring system) fitted to all shellfish vessels. Any flounder caught in the dredge are returned to the sea so that mortality is minimised. There are two minor secondary species in UoA 2 – oysters and shore crabs. Oysters may be landed but these landings are controlled through bycatch limits and any such landings are fully taken into account in the management strategy for the oyster fishery. Shore crabs are discarded. There is a strategy in place for managing main and minor secondary species. SG100 is met.

UoA 3. Starfish are the only main secondary species in the oyster fishery. Starfish caught in the oyster fishery are discarded and post-capture survival is expected to be high as starfish are resilient to disturbance and are capable of regrowing arms even if damaged by fishing gear (autotomy). Avoidance where possible of areas of high densities of starfish and discarding of all starfish constitutes a partial strategy. There are no biological based limits for starfish populations but scoring of starfish under PI 2.2.1 using the RBF resulted in a high PSA score, and with starfish found throughout the Limfjord in high numbers, it can be concluded that any mortality of starfish caused by the oyster fishery will have negligible impact on the starfish population. SG 60 and SG 80 are met. In the oyster fishery, landings of non-target species are kept at a low level by the practice of sorting the catch aboard vessels before landing and discarding everything apart from oysters. In addition to this, catches of all secondary species are kept low by measures adopted by the fleet to avoid areas where non-target species are abundant. There are also a number of statutory management measures that prevent dredging activities in much of the Limfjord region, including depth restrictions and compliance with spatial controls is monitored through vessel 'black box' recorders (vessel monitoring system) fitted to all shellfish vessels. There is therefore a strategy in place for managing secondary species in the UoA. SG100 is met.

UoA 4. There are no main secondary species in the Inner Danish Waters mussel fishery and therefore SG60 and SG80 are met by default. As with the Limfjord mussel fishery (UoA 1), there is a general strategy in place in the fishery to ensure that the catch of all non-target species is minimised. Specific actions are undertaken by the fleet to avoid high density areas of non-target species, including secondary species. Incentives to avoid high catches of non-target species are created because vessels have no facility to sort the catch and they are required to land all catches. The catch is then sorted at the processor and all non-target species discarded. Measures are also undertaken by the fishery to reduce the likelihood of retaining high catches of non-target species. Underwater video cameras and sonar equipment are used with test dredging by a dedicated vessel within the fleet to identify areas of high mussel abundance and quality (and low non-target species). This information is relayed back to the rest of the fleet to facilitate specific targeted areas. There are also a number of statutory management measures that prevent dredging activities in Natura 2000 sites in the Inner Danish Waters region including depth restrictions. There are three minor secondary species in UoA 4 – Starfish, shore crabs and flounder. Any flounder caught in the dredge are returned to the sea so that mortality is minimised. Starfish and shore crabs are discarded and both species are expected to have a high post-capture survival rate. There is therefore a strategy in place for managing secondary species in the UoA. SG100 is met.

b	Management strategy evaluation			
	Guide post	The measures are considered **likely** to work, based on plausible argument (e.g. general experience, theory or comparison with similar UoAs/species).	There is **some objective basis for confidence** that the measures/partial strategy will work, based on some information directly about the UoA and/or species involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on information directly about the UoA and/or species involved.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**
Rationale				

All UoAs. Evidence from DTU-Aqua surveys in all UoAs, official landings data and anecdotal evidence from fishers and processing companies show that there is a very small quantity of secondary species caught in the UoAs providing confidence that the strategy is working in all UoAs. In both the cockle (UoA 2) and oyster (UoA 3) fisheries there may be significant numbers of starfish (the only main secondary species) caught in the dredge, but these are discarded, and post-capture mortality is expected to be very high. In addition, DTU Aqua surveys show that any catches of starfish are negligible in relation to the overall stock biomass of starfish in the Limfjord. SG60 and SG80 are met for all UoAs. It is not clear that formal testing of the strategy has been undertaken in the UoAs, and therefore the SG100 is not met for all UoAs.

c	Management strategy implementation			
	Guide post		There is **some evidence** that the measures/partial strategy	There is **clear evidence** that the partial strategy/strategy is

			is being **implemented successfully**.	being **implemented successfully and is achieving its objective as set out in scoring issue (a).**
	Met?		**All UoAs Yes**	**All UoAs Yes**
Rationale				

All UoAs. Information obtained from DTU-Aqua research surveys coupled with reports from industry sources, landings data (and for the oyster fishery independent observations of catch composition) helps to demonstrate that bycatch of secondary species is very low in all UoAs. (In the oyster fishery (UoA 3) there are significant numbers of starfish caught in the dredge, but DTU Aqua surveys show that these catches are negligible in relation to the overall stock biomass of starfish in the Limfjord.) This coupled with sorting of the catch and retaining only the target species shows that the strategy is being implemented successfully. All vessels are equipped with "black box" recorders that verify compliance with controls in place to protect target and non-target species, as well as marine habitats in both the Limfjord and Inner Danish Waters providing further evidence that the strategy is achieving its objectives. The SG80 and SG100 are met for all UoAs.

d	Shark finning			
	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**All UoAs NA**	**All UoAs NA**	**All UoAs NA**
Rationale				

All UoAs. There is no evidence that sharks are captured in this fishery. This scoring issue is not relevant and has not been scored.

e	Review of alternative measures to minimise mortality of unwanted catch			
	Guide post	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of main secondary species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of main secondary species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of all secondary species, and they are implemented, as appropriate.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**
Rationale				

All UoAs. All secondary species caught in the UoAs except for cockles and oysters are unwanted catch. (Whilst there are targeted fisheries for starfish, bycatch of starfish in the mussel, cockle and oyster fisheries are not landed.) All possible measures to ensure that these unwanted catches are minimised are constantly under review in the UoAs. Fishing and discarding practices including video and sonar surveys, gear rigging, and statutory measures implemented to minimise impact on non-target species and sensitive habitats are constantly under review to ensure that unwanted catches are minimised. The assessment team considered that there are regular reviews, so SG60 and SG80 are met for all UoAs, but there is no evidence that alternative measures are formally reviewed every two years, so SG100 is not met.

References

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Nielsen, M.M., Linden-Vørnle, M. and Petersen, J.K. 2019a. Forvaltningsgrundlag for fiskeri af muslinger i Natura 2000-områderne Horsens Fjord og Lillebælt. DTU Aqua-rapport nr. 343-2019. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 28 pp. + bilag (Management basis for fishing for mussels in Natura 2000 sites Horsens Fjord and Lillebælt – mapping extent of eelgrass and macroalgae)

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Draft scoring range	**UoA 1 ≥80** **UoA 2 ≥80** **UoA 3 ≥80** **UoA 4 ≥80**
Information gap indicator	**More information sought from recent DTU-Aqua surveys and from stakeholder consultations on the RBF for starfish.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**UoA 1 90** **UoA 2 90** **UoA 3 90** **UoA 4 90**
Condition number (if relevant)	**NA**

PI 2.2.3 – Secondary species information

PI 2.2.3		Information on the nature and amount of secondary species taken is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage secondary species		
Scoring Issue		SG 60	SG 80	SG 100
a	Information adequacy for assessment of impacts on main secondary species			
	Guide post	Qualitative information is **adequate to estimate** the impact of the UoA on the main secondary species with respect to status. OR **If RBF is used to score PI 2.2.1 for the UoA:** Qualitative information is adequate to estimate productivity and susceptibility attributes for main secondary species.	Some quantitative information is available and **adequate to assess** the impact of the UoA on main secondary species with respect to status. OR **If RBF is used to score PI 2.2.1 for the UoA:** Some quantitative information is adequate to assess productivity and susceptibility attributes for main secondary species.	Quantitative information is available and **adequate to assess with a high degree of certainty** the impact of the UoA on main secondary species with respect to status.
	Met?	**UoA 1 NA** **UoA 2 Yes** **UoA 3 Yes** **UoA 4 NA**	**UoA 1 NA** **UoA 2 Yes** **UoA 3 Yes** **UoA 4 NA**	**UoA 1 NA** **UoA 2 NA** **UoA 3 NA** **UoA 4 NA**
Rationale				

UoAs 1 & 4. There are no main secondary species in UoAs 1 & 4, so this scoring issue is not scored.

UoAs 2 & 3. Starfish are main secondary species in UoAs 2 & 3, and the RBF has been used to score PI 2.2.1 for both these UoAs. Sufficient quantitative information on starfish populations was available to assess productivity and susceptibility attributes for starfish in the two UoAs, and starfish achieved a score of 98 in the PSA. The SG60 and SG80 are met.

b	Information adequacy for assessment of impacts on minor secondary species			
	Guide post			Some quantitative information is adequate to estimate the impact of the UoA on minor secondary species with respect to status.
	Met?			**All UoAs No**
Rationale				

All UoAs. Whilst there is quantitative information available on the level of bycatches of minor secondary species in all UoAs, there is no information on the status of most of the minor secondary species caught in the four UoAs, and therefore it is not possible to estimate the impact of the UoAs on the minor secondary species. SG100 is not met.

c	Information adequacy for management strategy			
	Guide post	Information is adequate to support **measures** to manage **main** secondary species.	Information is adequate to support a **partial strategy** to manage **main** secondary species.	Information is adequate to support a **strategy** to manage **all** secondary species and **evaluate** with a **high degree**

				of certainty whether the strategy is **achieving its objective**.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**

Rationale

UoAs 1 & 4. There are no main secondary species for the fishery in UoAs 1 & 4, so the SG60 and SG80 are met by default for these UoAs. For the minor secondary species, there is not sufficient information to evaluate with a high degree of certainty whether the strategy is achieving its objective. SG100 is not met.

UoAs 2 & 3. Starfish are main secondary species in UoAs 2 & 3 and there is quantitative information available to support a strategy to manage starfish. The SG60 and SG80 are met. There is not sufficient information for all secondary species to evaluate with a high degree of certainty whether the strategy is achieving its objective. SG100 is not met.

There is no formal observer programme in any of the UoAs, and analysis of DTU Aqua survey data in UoAs 1 & 2 and bycatch data from UoA 3 have not been updated for many years. The assessment team recommends that up-to-date information on the bycatch of secondary species is collected for all UoAs.

References

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Nielsen, P., Nielsen, M.M. and Geitner, K. 2019b. Notat vedrørende fiskeri af euro- pæisk østers og søstjerner i Nissum Bredning 2019/2020. DTU-Aqua notat. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 23pp. (Advisory note on fishing of European oysters and starfish in Nissum Bredning)

Nielsen, P., Olsen,J., Geitner, K. and Nielsen, M.M. 2020a. Konsekvensvurdering af fiskeri af blåmuslinger, europæisk østers, stillehavsøsters og søstjerner i Løgstør Bredning 2020/2021. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 77pp.

Draft scoring range	**All UoAs ≥80**
Information gap indicator	**More information sought from recent DTU-Aqua surveys and from stakeholder consultations on the RBF for starfish.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**All UoAs 80**
Condition number (if relevant)	**NA**

PI 2.3.1 – ETP species outcome

PI 2.3.1		The UoA meets national and international requirements for the protection of ETP species The UoA does not hinder recovery of ETP species		
Scoring Issue		SG 60	SG 80	SG 100
a	Effects of the UoA on population/stock within national or international limits, where applicable			
	Guide post	Where national and/or international requirements set limits for ETP species, the **effects of the UoA** on the population/ stock are known and **likely** to be within these limits.	Where national and/or international requirements set limits for ETP species, the **combined effects of the MSC UoAs** on the population /stock are known and **highly likely** to be within these limits.	Where national and/or international requirements set limits for ETP species, there is a **high degree of certainty** that the **combined effects of the MSC UoAs** are within these limits.
	Met?	**All UoAs NA**	**All UoAs NA**	**All UoAs NA**
Rationale				

<u>All UoAs</u>. There are no national or international limits set for any of the ETP species that might be captured in the four UoAs, and therefore this scoring issue is not scored.

b	Direct effects			
	Guide post	Known direct effects of the UoA are likely to not **hinder recovery** of ETP species.	Direct effects of the UoA are **highly likely** to not **hinder recovery** of ETP species.	There is a **high degree of confidence** that there are no **significant detrimental direct effects** of the UoA on ETP species.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**
Rationale				

<u>All UoAs</u>

The MSC define Endangered Threatened & Protected (ETP) species (SA3.1.5) as follows:

- Species that are recognised by national ETP legislation
- Species listed in the following binding international agreements: Appendix 1 of the Convention on International Trade in Endangered Species (CITES) and the Convention on Migratory Species (CMS);
- Species classified as ‘out-of-scope’ (amphibians, reptiles, birds and mammals) that are listed in the IUCN Redlist as vulnerable (VU), endangered (EN) or critically endangered (CE).

Danish national legislation is transcribed from the current EU legislation for the protection of ETP species which is set out in two Directives: the “Habitats Directive” (92/43/EC) and the “Wild Birds Directive” (2009/147/EC). The potential impact of the mussel, cockle and oyster fisheries in the Limfjord and Inner Danish Waters on wild birds is assessed every year for the Natura 2000 sites that are vital for the protection of these species, using the most up to date information about the species, mussel, cockle and oyster stocks and the shellfish fisheries. There are no accounts of any of these species being directly captured by the UoAs.

Article 20 of Council Regulation (EU) 2021/92 provides a list of prohibited species which must not be harmed, and which must be released back to the sea immediately if caught in fishing gear. There are no accounts of any of the species included in the list of prohibited species being captured by the UoAs in recent years.

Under the Convention on the Conservation of Migratory Species (CMS), the only agreement that is relevant to the UoAs in this fishery is the Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS) which includes a limit of anthropogenic interaction with harbour porpoise. No interactions with harbour porpoise have been recorded in the dredge fisheries in the UoAs. ICES has not identified mussel dredging as a fishing activity with the potential to adversely affect ETP species. In addition, the ICES Working

Group on Bycatch of Protected Species (WGBYC) carried out an assessment of the risk factor by gear type on various species/species groups. The analysis concluded that dredges were a low risk factor for lampreys, sturgeon, roundfish, diving, bottom and surface feeding birds, seals and harbour porpoise.

The assessment team has reviewed the IUCN Redlist of endangered species online (IUCN, 2021) and the HELCOM Red List of Baltic Sea species in danger of becoming extinct, also compiled using IUCN criteria as its basis (HELCOM, 2013). There have been no records of the UoAs interacting with any of the out-of-scope species on these lists.

There are no species listed in CITES Appendix 1 that are affected by the Limfjord mussel, cockle and oyster fisheries under assessment. However, there are two species present in the Inner Danish Waters fishing area that are listed in Appendix 1 - White-tailed eagle (*Haliaeetus albicilla*) and Otter (*Lutra lutra*). Neither white-tailed eagles nor otters have been recorded as being captured in the Inner Danish Waters mussel fishery.

In summary, there have been no observed direct impacts on ETP species of the four UoAs, i.e. no ETP species have been directly captured in the fishery. The SG60, SG80 and SG100 are met.

c	Indirect effects			
	Guide post		Indirect effects have been considered for the UoA and are thought to be **highly likely** to not create unacceptable impacts.	There is a **high degree of confidence** that there are no **significant detrimental indirect effects** of the UoA on ETP species.
	Met?		**All UoAs Yes**	**All UoAs No**
Rationale				

Indirect effects are most likely to occur in relation to bird species. Shellfish dredge fisheries are only permitted in Natura 2000 sites if it is considered to be unlikely to impact the ETP bird species through depletion of food and the habitats that support these birds. Interactions with bird species are addressed through the management measures in place for the Natura 2000 sites (under the EU Birds Directive [Directive 2009/147/EC] and transposing legislation) in the areas that protect these species. The assessments carried out for the Natura 2000 sites take account of changes in fishing practice and the current status of ETP species and their supporting habitats. These assessments provide an annual review of whether these sites are achieving their management objectives. Specifically, the potential impact on bird species is assessed annually for the mussel and cockle fishery in Lovns Bredning and Løgstør Bredning Natura 2000 sites in the Limfjord, for the oyster fishery in Nissum Bredning and Løgstør Bredning Natura 2000 sites, and for the Inner Danish Waters mussel fishery for the Horsens Fjord and Lillebælt Natura 2000 sites. Shellfish fishing will only be permitted if there are sufficient stocks of shellfish to meet the food requirements of the bird populations.

For each of the Natura 2000 sites, DTU Aqua assesses the food requirements of birds based upon bird counts in each area. Current assessments are based upon a study by Aarhus University which provided target numbers for the following diving bird species: Tufted duck, *Aythya fuligula*, common pochard, *Aythya farina*, Greater scaup, Aythya *marila*, common goldeneye, *Bucephala clangula*, Long-tailed duck, *Clangula hyemalis*, common eider duck, *Somateria mollissima*, common scoter, *Melanitta nigra* and velvet scoter, *Melanitta fusca*.

<u>UoAs 1, 2 & 3</u>.
In Løgstør Bredning, the common goldeneye, *Bucephala clangula*, is the only mussel-eating diving duck that is included in the designation basis for the Bird Protection Area as Løgstør Bredning is an important area that contributes to maintaining the species' distribution area in Denmark. Counts of common goldeneye in the area fluctuated from 303 individuals in 1988 to 2,663 individuals in 2013, with an average maximum number of 1,372 birds. With the target figure of 1,732 common goldeneye in Løgstør Bredning, the requirement for feeding the birds is estimated to be 2,407 tonnes of mussels annually. With an estimated mussel stock biomass of 26,834 ± 5,463 tonnes in 2020, a food requirement for birds of 2407 tonnes of mussels represents approximately 9% of the mussel stock and coupled with a quota of 5,500 tonnes of mussels for the fishery representing approximately 20% of the stock, there is scope for a sustainable mussel fishery which does not impact on the feeding requirements of the designated bird species.

In Lovns Bredning the common goldeneye, *Bucephala clangula*, is the only mussel-eating diving duck that is included in the designation basis for the Bird Protection Area as the area is internationally significant for the species. Counts of common goldeneye in the area have been declining continually since 1992-1997 when 4,735 birds were observed to less than 1,000 birds in recent censuses. With the target figure of 4,735 common goldeneye in Lovns Bredning, the requirement for feeding the birds is estimated to be 6580 tonnes of mussels annually. With an estimated mussel stock biomass of 40,056 ± 11,304 tonnes in 2020, a food requirement for birds of 6580 tonnes of mussels represents approximately 16% of the mussel stock and coupled with a quota of 10,000 tonnes for the fishery representing approximately 25% of the total population in 2020, there is scope for a sustainable mussel fishery which does not impact on the feeding requirements of the designated bird species.

In Nissum Bredning, the common goldeneye, *Bucephala clangula*, is also the only mussel-eating diving duck that is included in the designation basis for the Bird Protection Area based upon the area's special significance for resting diving ducks in ice winters. Over the period 1986 to 2014, counts of common goldeneye in the area fluctuated from 194 to 666 individuals with an average maximum number of 387 birds. With the target figure of 387 common goldeneye in Nissum Bredning which have a food requirement of 538 tonnes of mussels, it is highly unlikely that the UoAs will impact on the feeding requirements of the common goldeneye. From 2016 to 2020 there has been no fishing for mussels within Nissum Bredning and oyster fishing has affected annually only 0.9-4.0% of the Natura 2000 site, and currently there is no oyster fishing in Nissum Bredning.

There are no known indirect impacts of the UoAs on any of the prohibited species in Article 20 of Council Regulation (EU) 2021/92 or on harbour porpoises, there have been no records of the UoAs interacting with out-of-scope species on the IUCN Redlist and there are no species listed in CITES Appendix 1 that are affected by the UoAs.

In summary, indirect effects have been considered for the UoA and are thought to be highly likely to not create unacceptable impacts. The SG80 is met. The information from bird counts that is used to evaluate the potential indirect impact of the UoAs on the designated bird species is in need of updating, so there is not a high degree of confidence that there are no significant detrimental indirect effects of the UoA on ETP species. The SG100 is not met.

UoA 4.

In Horsens Fjord and Endelave, four mussel-eating diving duck species are included in the designation basis for the Bird Protection Area - Greater scaup, *Aythya marila*, common goldeneye, *Bucephala clangula*, common eider duck, *Somateria mollissima* and velvet scoter, *Melanitta fusca*. Eider is the most common diving duck species in the area. Eiders occur most frequently in the area during winter but are present throughout the year. The eiders shed during the summer period, when the birds are particularly vulnerable to disturbance in that they are unable to fly during their feathering. The target number for each designated bird species is eider 22,527 birds, greater scaup 5,283 birds, velvet scoter 27 birds and common goldeneye 1,107 birds. DTU Aqua estimate that the food requirement for eider, greater scaup, velvet scoter and common goldeneye is 25,800 tonnes of mussels annually. The population of mussels in Horsens Fjord was estimated at 163,000 tonnes in 2014, and although the stock declined to 58,000 tonnes in 2017, this were still sufficient mussels to sustain a fishery of 12,000 tonnes of mussels for 2018/2019 and meet the food requirements of the four diving duck species. However, the most recent survey in Horsens Fjord in 2018 showed that the estimate of mussel stock biomass had declined below the threshold required for shellfish-eating birds, and therefore the commercial fishery was not opened in 2019/20 and has remained closed since then as there has been no significant settlement of mussels in the Natura 2000 site.

In Lillebælt, three mussel-eating diving ducks are included in the designation basis for the Bird Protection Area - Greater scaup, *Aythya marila*, common eider duck, *Somateria mollissima* and common goldeneye, *Bucephala clangula*. The target number for each designated bird species is greater scaup 6,423 birds, eider ducks 32,038 birds and common goldeneye 1,057 birds. The total food requirements of the three mussel-eating bird species in Lillebaelt has been estimated by DTU Aqua at 33,810 tonnes, but the most recent estimate of mussel stock biomass from the 2016 survey was not sufficient to allow a commercial fishery from 2016 to 2018 (DTU Aqua, 2018), and although the estimate of stock biomass has increased since 2016, the commercial fishery remains closed currently. With no sign of any recent recruitment of mussels, no further stock surveys have been undertaken in Lillebælt, and there remains no impact of the commercial mussel fishery on the three designated diving duck species.

There are no known indirect impacts of the UoAs on any of the prohibited species in Article 20 of Council Regulation (EU) 2021/92 or on harbour porpoises and there have been no records of the UoAs interacting with any of the out-of-scope species on the IUCN Redlist or HELCOM Red List of Baltic Sea species.

There are two species present in the Inner Danish Waters that are listed in CITES Appendix 1 – white-tailed eagles and otters. There are potential breeding and nesting sites for white-tailed eagle in the Lillebælt Natura 2000 site. However, only 2-3 eagles have been seen in the area from 2004 to 2012. DTU Aqua believes that the food base for this species will not be affected by the UoA since the fishing takes place with limited vessels over a limited area and time. It is believed that otters enter the Horsens Natura 2000 site during migration, but it is unknown whether this is a proper breeding stock or just stray individuals. Overall, limited evidence of otter presence has been found at the monitoring stations within Horsens. Otters are sensitive to disturbance, particularly during breeding season. The UoA operates year round but typically are a good distance from the shore where otters breed and hideout. There is no registered bycatch of otters in the UoA, most likely because otters are nocturnal and the UoA only operates from sunrise to sunset. Further, given that otters have a diverse diet (e.g., fish, frogs, small mammals, birds, crustacean), otters are likely to adapt well to the removal of mussels. DTU Aqua believes that this along with the limited vessels and spatial and temporal coverage of the UoA means that the UoA will have a minimal impact on otters.

In summary, indirect effects have been considered for the UoA and are thought to be highly likely to not create unacceptable impacts. The SG80 is met. The information from bird counts that is used to evaluate the potential indirect impact of the UoAs on the designated bird species is in need of updating, so there is not a high degree of confidence that there are no significant detrimental indirect effects of the UoA on ETP species. The SG100 is not met.

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Nielsen, M.M., Linden-Vørnle, M. and Petersen, J.K. 2019a. Forvaltningsgrundlag for fiskeri af muslinger i Natura 2000-områderne Horsens Fjord og Lillebælt. DTU Aqua-rapport nr. 343-2019. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 28 pp. + bilag (Management basis for fishing for mussels in Natura 2000 sites Horsens Fjord and Lillebælt – mapping extent of eelgrass and macroalgae)

Nielsen, P., Nielsen, M.M. and Geitner, K. 2019b. Notat vedrørende fiskeri af euro- pæisk østers og søstjerner i Nissum Bredning 2019/2020. DTU-Aqua notat. Institut for Akvatiske Ressourcer, Dan-marks Tekniske Universitet. 23pp. (Advisory note on fishing of European oysters and starfish in Nissum Bredning)

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Draft scoring range	**UoA 1 ≥80** **UoA 2 ≥80** **UoA 3 ≥80** **UoA 4 ≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**UoA 1 90** **UoA 2 90** **UoA 3 90** **UoA 4 90**
Condition number (if relevant)	**NA**

PI 2.3.2 – ETP species management strategy

PI 2.3.2		The UoA has in place precautionary management strategies designed to: - meet national and international requirements; - ensure the UoA does not hinder recovery of ETP species. Also, the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of ETP species		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place (national and international requirements)			
	Guide post	There are **measures** in place that minimise the UoA-related mortality of ETP species and are expected to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **strategy** in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **comprehensive strategy** in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to **achieve above** national and international requirements for the protection of ETP species.
	Met?	**All UoAs, all elements Yes**	**All UoAs, all elements Yes**	**All UoAs, all elements No**
Rationale				

Within Europe, the EU has established a network of sites to protect key habitats and species under the Natura 2000 program. This has been transposed into Danish legislation and implemented throughout Denmark as a series of Natura 2000 sites, several of which occur in the UoA fishing areas. Interactions with bird species are addressed through the management measures in place for the Natura 2000 sites (under the EU Birds Directive and transposing legislation) in the area that protects these species. The impact of the UoAs on ETP species is tightly controlled through management of Natura 2000 sites to minimize the impact of the UoAs on these species.

UoAs 1, 2 and 3. Specifically within the Løgstør Bredning, Lovns Bredning and Nissum Bredning Natura 2000 sites, the food requirements of the designated bird species have been estimated based upon bird counts and there are annual mussel stock surveys to determine the biomass of mussels in each Natura 2000 site. If the mussel stock biomass is not above the threshold of biomass to meet the food requirements of the designated bird species, then no fisheries are permitted. If the stock biomass is above the threshold of bird feeding requirements, then mussel fisheries will be permitted but only at a level that will not impact on the habitat features of the Natura 2000, ensuring that only 15% of the total area of a Natura 2000 site may be fished over a 5-year period achieved through a restrictive entry licensing system limited, daily quotas, gear restrictions, depth restrictions and closed areas, In summary the fisheries are tightly controlled to ensure that both the food requirements of the designated bird species are not compromised, and that the overall habitat features of the Natura 2000 sites, including those features that are important for designated bird species, are not adversely impacted. The management strategy for the fisheries within the UoAs is rigorously monitored and enforced through the black box system which ensures that fishing is not carried out in closed areas or at levels above which the habitat features might be impacted, and electronic logbooks and landings declarations must record all bycatch species. It can be concluded that there is a strategy in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to be highly likely to achieve national and international requirements for the protection of ETP species. The SG60 and SG80 are met for all ETP species in UoAs 1, 2 and 3. Whilst the Natura 2000 program and associated national sites within Denmark have been designed to be a comprehensive strategy to manage ETP species and ensure that the shellfish dredge fisheries do not hinder the recovery of these species, it is not clear that the strategy has been designed to achieve above national and international requirements. SG100 is not met.

UoA 4. Specifically, within the Horsens Fjord and Lillebælt Natura 2000 sites, the food requirements of the designated bird species has been estimated based upon bird counts and there are regular mussel stock surveys to determine the biomass of mussels in each Natura 2000 site. If the mussel stock biomass is not above the threshold of biomass to meet the food requirements of the designated bird species, then no fisheries are permitted. If the stock biomass is above the threshold of bird feeding requirements, then mussel fisheries will be permitted but only at a level that will not impact on the habitat features of the Natura 2000 as described above for the Limfjord. In summary the fisheries are tightly controlled to ensure that both the food requirements of the designated bird species are not compromised, and that the overall habitat features of the Natura 2000 sites are not adversely impacted. Under this strategy, the Horsens Fjord and Lillebælt Natura 2000 sites are currently closed to mussel fishing. The management strategy for the fisheries within UoA 4 is rigorously monitored and enforced through the black box system, electronic logbooks and landings declarations. It can be concluded that there is a strategy in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to be highly likely to achieve national and international requirements for the protection of ETP species. The SG60 and SG80 are met for all ETP species in the UoA. As with the Limfjord UoAs, it is not clear that the strategy has been designed to achieve above national and international requirements. Whilst the strategy in place in Natura 2000 sites is sufficient to ensure that mortality of white-tailed eagle and otter is minimised and therefore highly likely to achieve national and international requirements, it is not clear that a comprehensive strategy is in place for these species. The SG100 is not met.

b	Management strategy in place (alternative)			
	Guide post	There are **measures** in place that are expected to ensure the UoA does not hinder the recovery of ETP species.	There is a **strategy** in place that is expected to ensure the UoA does not hinder the recovery of ETP species.	There is a **comprehensive strategy** in place for managing ETP species, to ensure the UoA does not hinder the recovery of ETP species.
	Met?	**All UoAs NA**	**All UoAs NA**	**All UoAs NA**
Rationale				

All UoAs. As scoring issue a was scored, this scoring issue is not scored.

c	Management strategy evaluation			
	Guide post	The measures are **considered likely** to work, based on **plausible argument** (e.g., general experience, theory or comparison with similar fisheries/species).	There is an **objective basis for confidence** that the measures/strategy will work, based on **information** directly about the fishery and/or the species involved.	The strategy/comprehensive strategy is mainly based on information directly about the fishery and/or species involved, and a **quantitative analysis** supports **high confidence** that the strategy will work.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**
Rationale				

UoAs 1, 2 & 3. An impact assessment is carried out each year within Natura 2000 sites by DTU Aqua and includes an analysis of the direct and indirect impacts of the shellfish fishery on ETP bird species within the Limfjord. The management strategy is based on information directly about the fishery and ETP species affected and is based on the precautionary approach. Quantitative analysis within the impact assessments has been used to determine that the shellfish fisheries should not take place within certain Natura 2000 sites if there is not sufficient stock to meet the requirements of fish-eating birds. This quantitative analysis supports a high confidence that the strategy will work, meeting the requirements for SG60, SG80 and SG100.

UoA 4. As for UoAs 1, 2 & 3, the SG60, SG80 and SG100 are met for designated bird species in the Natura 2000 sites. There is also quantitative information on white-tailed eagles and otters that supports high confidence that the strategy will work. The SG60, SG80 and SG100 are met for these species.

d	Management strategy implementation			
	Guide post		There is some **evidence** that the measures/strategy is being implemented successfully.	There is **clear evidence** that the strategy/comprehensive strategy is being implemented successfully and **is achieving its objective as set out in scoring issue (a) or (b).**

	Met?		**All UoAs Yes**	**All UoAs Yes**
Rationale				

All UoAs. There is clear evidence from the results of the annual impact assessments conducted within the Natura 2000 sites by DTU Aqua that the management strategy is being implemented successfully and is meeting its objective. This is exemplified by the current closure of the Horsens Fjord and Lillebælt Natura 2000 sites to mussel fishing because there is not sufficient mussel biomass to support both the food requirements of the designated bird species and a commercial mussel fishery. The SG80 and SG100 are met.

e	Review of alternative measures to minimize mortality of ETP species			
	Guide post	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality ETP species, and they are implemented, as appropriate.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**
Rationale				

All UoAs. There are no ETP species directly caught in the UoAs and rigging of the dredges and the pattern of fishing are reviewed regularly to ensure that captures do not occur. There is an annual assessment of the potential impact (both direct and indirect) of the UoAs on ETP species in the Natura 2000 sites. Shellfish fishing is not permitted if there is any possibility of fishing impacting on the designated bird species within the Natura 2000 sites. The assessment team concluded that the fisheries were managed to ensure that there was no UoA-related mortality of ETP species and that all measures were reviewed on an annual basis. The SG60, SG80 and SG100 are met.

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Draft scoring range	**UoA 1 ≥80** **UoA 2 ≥80** **UoA 3 ≥80** **UoA 4 ≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**UoA 1 95** **UoA 2 95** **UoA 3 95** **UoA 4 95**
Condition number (if relevant)	**NA**

PI 2.3.3 – ETP species information

PI 2.3.3		Relevant information is collected to support the management of UoA impacts on ETP species, including: - Information for the development of the management strategy; - Information to assess the effectiveness of the management strategy; and - Information to determine the outcome status of ETP species		
Scoring Issue		SG 60	SG 80	SG 100
a	Information adequacy for assessment of impacts			
	Guide post	Qualitative information is **adequate to estimate** the UoA related mortality on ETP species. **OR** **If RBF is used to score PI 2.3.1 for the UoA:** Qualitative information is **adequate to estimate productivity and susceptibility** attributes for ETP species.	Some quantitative information is **adequate to assess** the UoA related mortality and impact and to determine whether the UoA may be a threat to protection and recovery of the ETP species. **OR** **If RBF is used to score PI 2.3.1 for the UoA:** Some quantitative information is **adequate to assess productivity and susceptibility attributes** for ETP species.	Quantitative information is available to assess with a high degree of certainty the **magnitude of UoA-related impacts, mortalities and injuries and the consequences for the status** of ETP species.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**
Rationale				

All UoAs. The potential impacts of the mussel, cockle and oyster fisheries on ETP species within Natura 2000 sites are monitored regularly through annual impact assessments. Electronic logbook records and landings declarations provide quantitative evidence that there has been no direct mortality of any ETP species in any of the UoAs in recent years. In relation to indirect effects, the annual impact assessments include quantitative information on numbers of designated bird species and their food requirements within each Natura 2000, and annual stock surveys of mussels are undertaken within each Natura 2000 site. This information allows an evaluation of whether the mussel stock biomass is sufficient to support the food requirements of the designated bird species and a commercial mussel fishery. If the stock biomass estimate is below the threshold of food requirements for the designated bird species, then no mussel fishery is permitted. Under this strategy, the mussel fisheries in the Horsens Fjord and Lillebælt Natura 2000 sites are currently closed. In UoA 4 the white-tailed eagle and otter are also considered to be ETP species, but sightings of either species are very rare within the UoA, and the nature of the fishery is such that it is highly unlikely that the fishery would interact in any way with either species. The assessment team concluded that there was sufficient quantitative information to assess UoA-related mortality and impact and to determine whether the UoAs may be a threat to the protection and recovery of the ETP species. SG60 and SG80 are met for all UoAs. The information from bird counts of designated species and sightings of both white-tailed eagles and otters is not considered sufficiently comprehensive to assess with a high degree of certainty the magnitude of impacts, mortalities and injuries and consequences for the status of the ETP species. The SG100 is not met for all UoAs.

b	Information adequacy for management strategy			
	Guide post	Information is adequate to support **measures** to manage the impacts on ETP species.	Information is adequate to measure trends and support a **strategy** to manage impacts on ETP species.	Information is adequate to support a **comprehensive strategy** to manage impacts, minimize mortality and injury of ETP species, and evaluate with a **high degree of certainty** whether a strategy is achieving its objectives.

	Met?	All UoAs Yes	All UoAs Yes	All UoAs No

Rationale

All UoAs. To measure trends and support a strategy to manage the potential impacts of the UoAs on ETP species, information is required on capture of ETP species and potential indirect effects of the UoAs on the ETP species. In relation to direct capture of ETP species, electronic logbook records and landings declarations and scientific observations aboard vessels provide quantitative information that there have been no direct captures of ETP species in the UoAs in recent years. To assess potential indirect impacts on ETP species within the Natura 2000 sites, quantitative information is required on counts of the designated bird species and their food requirements in the Natura 2000 sites, and assessments of mussel stock biomass within the sites. Bird counts have been undertaken every midwinter and sometimes in other seasons in all of the Natura 2000 sites since the 1980s and therefore there are time trends of abundance of the designated bird species in each Natura 2000 site. This allows calculation of the food requirements of those birds and along with annual estimates of mussel stock biomass permit an assessment of whether there is sufficient biomass to support both the food requirements of the designated bird species and a commercial fishery. If the stock biomass of mussels is below the threshold for the food requirements of the designated bird species, then no fishery is permitted. In addition to depletion of food resources, within the Natura 2000 sites, an annual assessment is undertaken to ensure that the habitat features of the Natura 2000 site are not compromised by the fishery, and the management regulations through which this is achieved is rigorously monitored through electronic logbooks, landings declarations and a black box system which records all fishing activity. It can be concluded that the current monitoring programme provides sufficient information to measure trends and support a strategy to manage the impacts of the UoAs on ETP species. The SG60 and SG80 are met. The counts of designated birds used in the annual impact assessments are due for an update based on data from the NOVANA programme, and along with little information on white-tailed eagles and otters in UoA 4 due to their irregular presence in the area means that it is not possible to evaluate with a high degree of certainty whether the strategy is achieving its objectives. The SG100 is not met.

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Draft scoring range	**UoA 1 ≥80 UoA 2 ≥80 UoA 3 ≥80 UoA 4 ≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**UoA 1 80 UoA 2 80 UoA 3 80 UoA 4 80**
Condition number (if relevant)	**NA**

PI 2.4.1 – Habitats outcome – all UoAs

PI 2.4.1		The UoA does not cause serious or irreversible harm to habitat structure and function, considered on the basis of the area covered by the governance body(s) responsible for fisheries management in the area(s) where the UoA operates		
Scoring Issue		SG 60	SG 80	SG 100
a	Commonly encountered habitat status			
	Guide post	The UoA is **unlikely** to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.	The UoA is **highly unlikely** to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**UoA 1 Yes** **UoA 2 Yes** **UoA 3 Yes** **UoA 4 No**
Rationale:				

One scoring element: sandbanks, mudflats, gravel beds with stones, rocks various sizes (till/diamictom)

There were concerns in the Limfjord and elsewhere in Denmark that the use of shellfish dredges may adversely affect seabed habitats. The principal concern was that the use of dredges in an area over time would result in disturbance and removal of cobbles and boulders from the seabed; and that in areas where there may be a paucity of rocky benthic substrata for marine species to colonise, the loss of cobble and boulder habitat areas could result in changes to seabed habitat structure.

These concerns formed the basis of a complaint to the European Union in 2009 by Danmarks Naturfrednings-forening (the Danish Society for Nature Conservation, DN) about mussel dredging in the Limfjord. DN considered that dredging for mussels within Natura 2000 sites is inappropriate because of the effect that it will have on seabed habitats, and were also concerned about other forms of dredging, such as oyster dredging. These concerns were scrutinised at the EU level, and it was concluded in 2014 that the current approach to shellfish dredging impacts within Natura 2000 sites in Denmark is acceptable, following changes that were made since the complaint was submitted. Lighter mussel dredges are used; cumulative impacts of shellfish fishing in given areas is limited to 15% over a five year period; fishing is prohibited in eelgrass areas; oyster fishing in waters shallower than 5m is prohibited, while mussel/cockle fishing is prohibited in waters shallower than 3m in order to protect both eelgrass and macroalgae habitats; TACs are imposed on oysters and mussels by area; vessel numbers are limited by area; and seasonal and temporal measures also limit fishing times throughout the year in each of the UoAs.

Marine habitats are well studied and documented throughout Danish waters, and the cumulative fishing footprint of bottom-contacting gear is monitored and reported as swept area ratios (e.g., Petersen, 2021). Extensive independent impact assessment work performed regularly in all the UoAs provides evidence that the Limfjord mussel and oyster UoAs are highly unlikely to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm (see Nielsen *et al.*, 2018a-2020b). Potential cumulative impacts on seabed habitats from shellfish dredging (by both oyster and mussel dredges) are independently calculated based on known recovery times of each habitat or ecosystem component and the proportion of the habitats that have been fished in recent years – as these cumulative impacts are calculated to determine the status of habitats at very local levels and are limited to no more than 15% over a five year period for each type of habitat, any impacts are considered to be correspondingly much less significant at the regional or bioregional scale at which these habitat features are found (ibid). Therefore, for the Limfjord mussel (UoA1), cockle (UoA2) and oyster (UoA3) fisheries SG60, SG80 and SG100 are met.

This level of evidence is not documented to the same extent for the commonly encountered habitats in the IDW mussel UoA4, particularly for mussel fishing outside the Natura 2000 sites. However, the management strategy in place in the UoA, the limited extent of mussel fishing relative to the total area of commonly encountered habitats, the very small number of licences (i.e., vessels) able to fish in IDW UoA, the relatively low indicated cumulative footprint (Petersen, 2021) and general information about impacts of fisheries on commonly encountered habitats lead to a conclusion that the UoA is highly unlikely to reduce structure and function of commonly encountered habitats to a point where there would be serious or irreversible harm. Therefore, the IDW UoA (UoA 4) meets SG60 and SG80 on this scoring issue, but the SG100 is not met.

b	VME habitat status			
	Guide post	The UoA is **unlikely** to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.	The UoA is **highly unlikely** to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.
	Met?	**All UoAs** **Yes for all eelgrass, macroalgae and biogenic reefs**	**All UoAs** **Yes for eelgrass and macroalgae** **No for biogenic reefs**	**All UoAs** **Yes for eelgrass and macroalgae** **No for biogenic reefs**

Rationale:

The Danish government has identified habitat types in Danish inland and inner waters (i.e., across all UoAs) which occur within and outside designated Natura 2000 sites, these include, eelgrass (*Zostera* spp) and macroalgae beds. Biogenic reefs are indicated as requiring protection from irreversible harm and where known, fishing on such habitat features is prohibited. Thus, the assessment team has considered three scoring elements under this scoring issue.

Both eelgrass and macroalgae have been extensively studied, sampled and assessed across all Danish waters under the National Program for Monitoring the Aquatic Environment and Nature (NOVANA), the fourth generation of nationwide monitoring programs conducted since 1988 (see Figure 56 and Figure 57). In 2021, the NOVANA Marine Areas report, published by DCE-National Center for Environment and Energy at Aarhus University, describes the relative status of marine ecosystem components (including eelgrass and macroalgae) in coastal waters, inner fjords, outer fjords, the Limfjord and on rocky/stone reefs (Hansen & Høgslund, 2021).

The NOVANA report suggests that the overall trend from 1990 to 2019 demonstrates an increase in cumulative coverage of macroalgae by 48% in coastal waters, 51% in the outer fjords, 93% in the inner fjords and 74% on rocky/stone reefs, while coverage has reduced by 56% in the Limfjord. Between 2010 and 2019, there was significant growth in cumulative macroalgae coverage in coastal waters (22%), while coverage in outer and inner fjords, the Limfjord and on rocky/stone reefs generally remained unchanged (Hansen & Høgslund, 2021). In relation to eelgrass, the report concludes that the generally positive growth in eelgrass coverage in the beginning of the last decade has stagnated relative to both depth distribution and coverage (Hansen & Høgslund, 2021).

Impact assessments by DTU-Aqua routinely conclude that there is no impact, and therefore zero cumulative impact by shellfish fishing on eelgrass beds (Nielsen et al., 2018a,b,c; 2019a,b,c; 2020a,b). In the case of macroalgae, extensive impact assessments each year have considered the cumulative impact of shellfish fishing on the spread and growth of macroalgae. Much of the distribution of macroalgae is protected by the depth restrictions imposed to protect eelgrass beds and the requirement to re-deposit larger stones and rocks and shells to the area from where they were fished serves to reduce the risk of permanent removal of substrate features. The cumulative proportion of macroalgae habitat within Natura 2000 sites that is affected by shellfish fishing has consistently been calculated to be less than the limit of 15% imposed by the Mussel and Oyster Policy (see Nielsen *et al.*, 2018a,b,c; 2019a,b,c; 2020a,b), and when proposed plans are assessed by DTU-Aqua pose a risk of exceeding the limits, approved plans are adjusted to ensure cumulative limits will not be exceeded.

Fishing is only permissible if the cumulative impact (by area) is 15% or less over a five-year period for habitats within a Natura 2000 site. For each of the habitats in the Natura 2000 sites, the benthic impacts of mussel and oyster dredging and the cumulative impacts of shellfish fishing on eelgrass and macroalgae habitats has been studied in a great deal of detail. Within the Natura 2000 sites of Løgstør Bredning, Lovns Bredning, Nissum Bredning, Lillebælt and Horsens Fjord regular impact assessments reveal strong and compelling evidence that the UoAs are highly unlikely to reduce structure and function of eelgrass and macroalgae habitats to a point where there would be serious or irreversible harm, and management arrangements including spatial, temporal, effort, fishing gear and total catch restrictions have been imposed year on year to ensure the cumulative impact does not exceed 15%. Indeed, for eelgrass, the cumulative impact is reported as zero as eelgrass is afforded maximum protection. Whereas for macroalgae the percentage impact varies according to area but has not in the last decade exceeded 15%. Therefore, the eelgrass and macroalgae scoring elements both meet the requirements of SG60, SG80 and SG100.

For biogenic reefs, which includes biogenic reefs formed by blue mussel (*M. edulis*), horse mussel (*Modiolus modiolus*) and combined horse mussel and rocky reefs, the evidence is less clear. There is some evidence that in certain Natura 2000 sites biogenic reefs are known and protected, particularly those that are in waters shallower than 3-5m where fishing is prohibited. However, given the scientific advice states that in the absence of verification against the Danish definition of biogenic reefs (Dahl and Petersen, 2018), there is some uncertainty about the total impact on such habitat features. Recent environmental impact assessments conclude that the UoAs are unlikely to affect so-called identified and possible biogenic reefs as they are located either entirely in depths where fishing is prohibited or large parts of them are located in prohibited areas (Neilsen *et al*., 2018a, 2018c, 2020a, 2020b). On balance, given the significant restrictions on vessel numbers by area, time, area, effort, gear and total catch of target species, the UoAs are unlikely to reduce structure and function of the biogenic reef habitats to a point where there would be serious or irreversible harm. Therefore, for this scoring element SG60 is met. However, given that the MSC Fisheries Standard v2.01 (Table SA9) requires that the SG80 probability requirement for 'highly unlikely' is greater than (>) the 30th percentile, it is less certain that the UoAs are *highly* unlikely to reduce structure and function of the VME to a point where there would be serious or irreversible harm, therefore the assessment team cannot justify that SG80 has been met for the scoring element 'Biogenic reefs'.

Scoring element	SG60	SG80	SG100
Eelgrass beds	Y	Y	Y
Macroalgae	Y	Y	Y
Biogenic reefs	Y	N	N

c	Minor habitat status			
	Guide post			There is **evidence** that the UoA is highly unlikely to reduce structure and function of the minor habitats to a point where there would be serious or irreversible harm.
	Met?			**All UoAs No**

Rationale:

Minor habitats (i.e., not commonly encountered habitats or VME) have not been identified for the combined shellfish UoAs and so the SG100 has not been met.

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Petersen, J.K. 2021. Andre presfaktorer end næringsstoffer og klimaforandrin-ger – sammenfatning. DTU Aqua-rapport nr. 381-2021. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 32pp. (Pressure factors other than nutrients and climate change – summary)

Riemann, B. and Hoffmann, E. (1991) Ecological consequences of dredging and bottom trawling in the Limfjord, Denmark. *Ecology Progress Series*, 69: 171-178.

Draft scoring range	**60-79**
Information gap indicator	**More information sought – 2019-20 updates to references and information**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score

Scoring element	UoA 1	UoA 2	UoA 3	UoA 4
Commonly-encountered	100	100	100	80
Eelgrass	100	100	100	100
Macroalage	100	100	100	100
Biogenic reefs	60	60	60	60
Minor	80	80	80	80

UoA 1 75
UoA 2 75
UoA 3 75
UoA 4 75

Condition number (if relevant)	**2**

PI 2.4.2 – Habitats management strategy – all UoAs

PI 2.4.2		There is a strategy in place that is designed to ensure the UoA does not pose a risk of serious or irreversible harm to the habitats		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place, if necessary, that are expected to achieve the Habitat Outcome 80 level of performance.	There is a **partial strategy** in place, if necessary, that is expected to achieve the Habitat Outcome 80 level of performance or above.	There is a **strategy** in place for managing the impact of all MSC UoAs/non-MSC fisheries on habitats.
	Met?	**All UoAs and all scoring elements - Yes**	**All UoAs and all scoring elements - Yes**	**All UoAs and all scoring elements - Yes**

Rationale:

There is a clear strategy in place for managing the impact of the fishery on habitat types, as set out in EC legislation under the Marine Strategy Framework, Habitats and Birds Directives. These Directives create the Natura 2000 programme which is transposed into Danish legislation through the established network of Natura 2000 sites. The management strategy is based upon information about the natural habitats in the area, and its implementation takes account of the potential effect of fishing activity by all UoAs on those habitats, including those considered to be VMEs or potential VMEs. The commitment of the Danish government, the Danish Fisheries Agency and the Mussel Advisory Committee to implement this strategy is explained in the Mussel and Oyster Policy (Udenrigsministeriet, 2019) which sets out the rules for impact assessments, and obligates fisheries managers to ensure that the cumulative impact on Natura 2000 habitats is limited to 15% over a five year period, that biogenic reefs are identified in accordance with the Danish Environmental Protection Agency definition (Dahl and Petersen (Eds), 2018) and protected from the impacts of fishing, and that all shellfish fishing by the UoAs is based on scientific advice and monitored using “black box” recorders which provide high levels of precision in relation to fishing location and activity.

Under the strategy each year, precautionary statutory management measures are applied to shellfish fishing activity in protected Natura 2000 sites throughout Danish territorial waters to protect sensitive marine plant (eelgrass and macroalgal) and reef habitats (e.g., Executive Order: BEK nr 1258, 27/11/2019). These precautionary measures are designed to control localised fishing areas and closures, specify areas where bottom-gear is prohibited, permitted fishing depths, and the type and weight of dredges that may be used. Outside Natura 2000 sites, potentially sensitive marine plant (eelgrass and macroalgal) and other habitats are also protected from fishing activities with statutory controls on vessel numbers (particularly in UoA4 – Inner Danish Waters), localised fishing areas, closures and prohibitions, depth restrictions and fishing gear type. Finally, dredges are designed to prevent the capture of rocks and boulders larger than 25cm, and fishers are required to return any stones or rocks to the seabed which measure 20cm or more in diameter.

MSC Fisheries Standard v2.01, SA3.14.2.2 requires that at the SG80 level, the “partial strategy” for a UoA that encounters VMEs shall include, at least, the following points: a. Requirements to comply with management measures to protect VMEs (e.g., designation of closed areas); b. Implementation by the UoA of precautionary measures to avoid encounters with VMEs, such as scientifically based, gear-and habitat-specific move-on rules or local area closures to avoid potential serious or irreversible harm on VMEs. Within the four UoAs, VMEs are protected through the designation of highly localised closed areas, gear and depth restrictions which are designed to avoid potential serious or irreversible harm to the VME elements, and all fishing activity is monitored through the black box system which provides fishing position in real time every 10 seconds at a very fine level of spatial detail, thereby ensuring rigorous enforcement of those closed areas. The SG80 is met.

Comprehensive impact assessments conducted by DTU Aqua within Natura 2000 sites that may be subject to fishing from year to year form an integral part of the strategy for managing the impact of all the shellfish fishing in the UoAs to ensure that fishing does not pose a risk of serious or irreversible harm to habitats (Nielsen *et al.*, 2018a,b,c; 2019a,b,c; 2020a,b) There are no additional MSC UoAs or non-MSC fisheries that fish the same areas and therefore habitats as the UoAs in this assessment.

The strategy in place meets the requirements of SG100.

Assessment team note – The UoAs have not been assessed in relation to SG60 in line with the MSC derogation of 5 November 2020 which stated that:

2.1 When scoring PI 2.4.2 the CAB shall assess the UoA at the SG80 level for scoring issue a first.

2.1.1. If SG80 for scoring issue a is met, including complying with requirements under SA3.14.2.2 and associated guidance GSA3.14.2.2, the CAB shall not assess the UoA at the SG60 level for scoring issue a.

Full details of the derogation can be found at: https://mscportal.force.com/interpret/s/article/Move-On-Rules-derogation-November-2020

b	Management strategy evaluation			
	Guide post	The measures are **considered likely** to work, based on plausible argument (e.g. general experience, theory or comparison with similar UoAs/habitats).	There is some **objective basis for confidence** that the measures/partial strategy will work, based on **information directly about the UoA and/or habitats** involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on **information directly about the UoA and/or habitats** involved.
	Met?	**All UoAs and all scoring elements - Yes**	**All UoAs and all scoring elements - Yes**	**<u>All UoAs</u>** **Commonly-encountered Yes** **Eelgrass – Yes** **Macroalgae – Yes** **Biogenic reefs – No**

Rationale:

Annual impact assessments conducted in Natura 2000 sites comprehensively document the impacts of fishing activities on commonly encountered and potentially vulnerable habitats within all UoAs. The management controls that have been imposed and strengthened to protect sensitive habitats both within and outside Natura 2000 sites across all UoAs gives an objective basis that the strategy will work. Quantitative information is obtained on the spatial location, speed of operation, and timing of fishing for every vessel in all UoAs through the “black boxes” to confirm that vessels are avoiding sensitive habitats during fishing operations throughout the UoAs.

Testing of the strategy, through monitoring of habitat impacts associated with mussel and oyster fishing and changes in the extent of sensitive habitats within Natura 2000 sites, provides a high level of confidence that the strategy is working for all UoAs for commonly encountered, eelgrass and macroalgae habitat scoring elements. (Nielsen *et al.*, 2018a,b,c; 2019a,b,c; 2020a,b). Therefore, the requirements for SG60, SG80 and SG100 have been fully met by all UoAs for the commonly encountered and VME habitat scoring elements of eelgrass and macroalgae.

For the scoring element ‘biogenic reefs’ the requirements for SG60 are met. There is also some objective basis for confidence that the strategy will work based on the current state of knowledge of biogenic reefs within the UoAs, given that those that have been identified are protected by virtue of closed area and depth restrictions implemented for eelgrass and macroalgae. The team has high confidence that when further mapping is conducted to more directly identify and verify the presence of biogenic reefs, that the strategy to delineate and protect them from the impact of shellfish fishing will be implemented by management authorities. Therefore, the SG80 requirements for this scoring element are fully met, but until assessments can test that the strategy is working the SG100 is not met for this scoring element.

c	Management strategy implementation			
	Guide post		There is **some quantitative evidence** that the measures/partial strategy is being implemented successfully.	There is **clear quantitative evidence** that the partial strategy/strategy is being implemented successfully and is achieving its objective, as outlined in scoring issue (a).
	Met?		**All UoAs and all scoring elements - Yes**	**All UoAs and all scoring elements - Yes**

Rationale:
There is clear evidence from the impact assessments carried out by DTU Aqua that both EC and Danish nature conservation legislation is being implemented successfully. All shellfish dredging activities by the UoA fleets are carefully monitored and controlled to ensure that any habitat impacts are within acceptable limits set by national and international legislation. (Nielsen *et al.*, 2018a,b,c; 2019a.b.c ; 2020a,b) There is also clear evidence from Danish Fisheries Agency enforcement officers that all UoAs are in good compliance with the control measures imposed to protect natural habitats (i.e. annual TAC, temporal restrictions (fishing seasons), gear restrictions, spatial and depth restrictions on fishing activity to protect sensitive habitats). Furthermore, temporal, spatial and depth restrictions in all UoAs are also monitored by the “black box” recording equipment on all fishing vessels in each UoA. (Annual reports on fisheries control 2012-2019) The requirements of SG80 and SG100 are fully met.

d	Compliance with management requirements and other MSC UoAs’/non-MSC fisheries’ measures to protect VMEs			
	Guide post	There is **qualitative evidence** that the UoA complies with its management requirements to protect VMEs.	There is **some quantitative evidence** that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant.	There is **clear quantitative evidence** that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant.
	Met?	**All UoAs and all scoring elements - Yes**	**All UoAs and all scoring elements - Yes**	**All UoAs and all scoring elements - Yes**

Rationale:
Natura 2000 sites, with the extensive network in Danish waters, are by definition VME or potential VMEs. There is clear quantitative evidence that fishing inside and outside Natura 2000 sites by vessels in all UoAs complies with both the management requirements and precautionary protection measures afforded to VMEs – through the cumulative impact limit of 15% over a five year period, the vessel number restrictions, gear restrictions, spatial and depth restrictions that are designed as precautionary protections for the VMEs, and temporal (seasonal) restrictions, as monitored with high levels of precision through the “black box” recording system on all vessels and enforcement and surveillance activity implemented across all UoAs (Ref: Annual reports on fisheries control 2012-2019). This combined shellfish assessment covers all MSC UoAs fishing for oysters, mussels and cockles in the Limfjord and Danish Inner Waters, therefore by definition there are no “other MSC UoAs” for shellfish. There are no other MSC UoAs or non-MSC fisheries that fish the same areas and therefore habitats as the UoAs in this assessment. The SG60, SG80 and SG100 are met for all UoAs and all scoring elements.

References

BEK nr 1258 af 27/11/2019 Bekendtgørelse om regulering af fiskeri efter muslinger og østers. Miljø- og Fødevareministeriet. 36pp. Available from: https://www.retsinformation.dk/Forms/R0710.aspx?id=211261 (Executive Order on fishing for mussels and oysters) Accessed on 18 April 2020.

Nielsen, P., Geitner, K., Olsen, J., and Nielsen. M.M. 2018a. Konsekvensvurdering af fiskeri af flad østers, stillehavsøsters og søstjerner i Nissum Bredning 2018/2019. DTU Aqua-rapport nr. 333-2018. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 52 pp. + bilag. (Impact assessment of fishing for flat oysters, Pacific oysters and starfish in Nissum Bredning)

Nielsen, P., Nielsen, M.M., Geitner, K. and Petersen, J.K. 2018b. Konsekvensvurdering af fiskeri af blåmuslinger og søstjerner i Løgstør Bredning 2017/2018. DTU Aqua-rapport nr. 330-2019. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 58 pp. + bilag. (Impact assessment of fishing for mussels and starfish in Løgstør Bredning)

Nielsen, P., Nielsen, M.M., Geitner, K., and Petersen, J.K. 2018c. Konsekvensvurdering af fiskeri af blåmuslinger og sø-stjerner i Lovns Bredning 2017/2018. DTU Aqua-rapport nr. 329-2018. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 59 pp. + bilag. (Impact assessment of fishing for mussels and starfish in Lovns Bredning)
Nielsen, M.M., Linden-Vørnle, M. and Petersen, J.K. 2019a. Forvaltningsgrundlag for fiskeri af muslinger i Natura 2000-områderne Horsens Fjord og Lillebælt. DTU Aqua-rapport nr. 343-2019. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 28 pp. + bilag (Impact assessment of fishing for mussels in Natura 2000 sites Horsens Fjord and Lillebælt)

Nielsen, P., Nielsen, M.M., and Geitner, K. 2019b. Notat vedrørende fiskeri af europæisk østers og søstjerner i Nissum Bredning 2019/2020. DTU-Aqua notat. Institut for Akvatiske Ressourcer, Dan-marks Tekniske Universitet. 23pp. (Advisory note on fishing of European oysters and starfish in Nissum Bredning)

Nielsen, P., Olsen, J., and Nielsen, M.M. 2019c. Notat vedrørende fiskeri af blåmuslinger og søstjerner i Lovns Bredning 2019/2020. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 23pp. (Advisory note on fishing for mussels and starfish in Lovns Bredning)

Nielsen, P., Olsen,J., Geitner, K. And Nielsen, M.M. 2020a. Konsekvensvurdering af fiskeri af blåmuslinger, europæisk østers, stillehavsøsters og søstjerner i Løgstør Bredning 2020/2021. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 77pp.

Nielsen, P., Olsen J. and Nielsen, M.M. 2020b. Konsekvensvurdering af fiskeri af blåmuslinger og søstjerner i Lovns Bredning 2020/2021. Danmarks Tekniske Universitet Institut for Akvatiske Ressourcer, 68pp.

Petersen, J.K. 2021. Andre presfaktorer end næringsstoffer og klimaforandrin-ger – sammenfatning. DTU Aqua-rapport nr. 381-2021. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 32pp. (Pressure factors other than nutrients and climate change – summary)

Udenrigsministeriet (2019) Målsætninger og forvaltningsprincipper for mudslinger- og østersskrab og øvrig muslinge- og østers production I og udenfor Natura 2000 områder (Objectives and management principles for mussel and oyster dredging and other mussel and oyster production in and outside Natura 2000 areas.”). 17pp. (The Mussel and Oyster Policy) Available from: https://fiskeristyrelsen.dk/media/10650/muslinge-og-oesterspolitik.pdf Accessed on 29 March 2020.

Draft scoring range	**≥80**
Information gap indicator	**More information sought – updates and references for 2019-20 and information related to Scoring Issue d**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**UoA 1 95** **UoA 2 95** **UoA 3 95** **UoA 4 95**
Condition number (if relevant)	**NA**

PI 2.4.3 – Habitats information – all UoAs

PI 2.4.3		Information is adequate to determine the risk posed to the habitat by the UoA and the effectiveness of the strategy to manage impacts on the habitat		
Scoring Issue		SG 60	SG 80	SG 100
a	Information quality			
	Guide post	The types and distribution of the main habitats are **broadly understood**.	The nature, distribution and **vulnerability** of the main habitats in the UoA area are known at a level of detail relevant to the scale and intensity of the UoA.	The distribution of all habitats is known over their range, with particular attention to the occurrence of vulnerable habitats.
	Met?	**All UoAs and all scoring elements - Yes**	**All UoAs** **Commonly-encountered Yes** **Eelgrass Yes** **Macroalgae beds Yes** **Biogenic reefs No**	**All UoAs and all scoring elements - No**
Rationale:				

The distribution of habitats within the Limfjord and Inner Danish Waters is known and mapped (e.g., Naturstyrelsen, 2014), and the distribution of vulnerable biotopes is known at the EU (bioregional) level. Particular attention is paid to the distribution of all vulnerable habitats (such as eelgrass and macroalgal beds), and the extent of habitats within Natura 2000 sites which have been designated to protect particularly vulnerable and/or natural habitat types.

As indicated under the rationale for PI 2.4.1b (VME Habitats), for biogenic reefs, which includes biogenic reefs formed by blue mussel (*M. edulis*), horse mussel (*Modiolus modiolus*) and combined horse mussel and rocky reefs, the evidence base for their distribution is less clear, i.e., verification against the Danish definition for biogenic reefs. There is some evidence that in certain Natura 2000 sites biogenic reefs are known, particularly those that are in waters shallower than 3-5m where fishing is prohibited. However, the scientific advice indicates that because the distribution of biogenic reefs has not been verified against the Danish definition of such reefs, their vulnerability to impacts by fishing is uncertain and cannot be quantified (Dahl and Petersen, 2018). Recent environmental impact assessments conclude that the UoAs are unlikely to affect so-called identified and possible biogenic reefs as they are located either entirely in depths where fishing is prohibited or large parts of them are located in prohibited areas (Neilsen *et al*., 2018a, 2018c, 2020a, 2020b). On balance however, while the types and distribution of some biogenic reefs are partially understood, there remains some uncertainty about their nature, distribution and vulnerability at a level of detail relevant to the scale of the UoAs in the reassessment (Hansen and Høgslund, 2021; Frandsen *et al*., 2014; Dyekjær *et al*., 1995; Miljøstyrelsen, 2020b; Nielsen *et al.*, 2018a,b,c; 2019a,b,c; 2020a,b).

The combination of knowledge of habitat distributions at bioregional and local levels fully meets the requirements of SG60, SG80 and SG100 for eelgrass and macroalgae habitats, while for biogenic reefs the information meets the requirements of SG60.

b	Information adequacy for assessment of impacts			
	Guide post	Information is adequate to broadly understand the nature of the main impacts of gear use on the main habitats, including spatial overlap of habitat with fishing gear.	Information is adequate to allow for identification of the main impacts of the UoA on the main habitats, and there is reliable information on the spatial extent of interaction and on the timing and location of use of the fishing gear.	The physical impacts of the gear on all habitats have been quantified fully.

	Met?	All UoAs and all scoring elements - Yes	All UoAs and all scoring elements - Yes	All UoAs and all scoring elements - No

Rationale:

There is good information available about potential impacts of shellfish dredges on habitats and the location of these habitats, e.g., from the annual research surveys conducted across Danish territorial waters in each of the UoAs. The cumulative fishing gear footprint (for bottom-contacting fishing gear) across all Danish waters, calculated as swept area ratios, is well understood and documented (Eigaard *et al,* 2020; Petersen, 2021). This information is used to inform a precautionary management approach which limits the maximum permissible cumulative impact on habitat area to 0% in the case of eelgrass beds and to 15% over a five-year period for other vulnerable or protected habitats. This management approach uses highly reliable information provided by the on-board "black box" recorders fitted to all UoA vessels about the location and timing of fishing activities, and thus also the spatial extent of habitat interaction through the use of shellfish fishing gear in all UoAs (Nielsen *et al.*, 2018a,b,c; 2019a,b,c; 2020a,b). The requirements of SG60 and SG80 are fully met for all UoAs for all scoring elements.

Although fishing gear used in the mussel, cockle and oyster dredge fisheries in all UoAs has been comprehensively studied, the gear's impacts on all habitat types have not been fully quantified. Therefore, the requirements of SG100 have not been met.

c	Monitoring			
	Guide post		Adequate information continues to be collected to detect any increase in risk to the main habitats.	Changes in all habitat distributions over time are measured.
	Met?		**All UoAs and all scoring elements - Yes**	**All UoAs** **Commonly encountered Yes** **Eelgrass – Yes** **Macroalgae – Yes** **Biogenic reefs – No**

Rationale:

"Black box" recorders fitted to all fishing vessels in the UoAs provide GPS information about their movements and activities, including where and when each vessel deploys and recovers its dredges (Annual reports). This enables the spatial extent and cumulative impact of fishing to be monitored continuously. Such monitoring enables any increase or risks in habitat impacts to be identified throughout each UoA. Cumulative fishing gear footprint (swept area ratios) can be calculated based on the information and data collected (Eigaard *et al,* 2020; Petersen, 2021).

Changes in the extent of commonly encountered, vulnerable or other habitats are measured, with eelgrass beds and macroalgae distribution being monitored in fished and unfished areas across all UoAs (see Nielsen *et al*, 2018a,b,c; 2019a,b,c; 2020a,b; Eigaard *et al*, 2020). Regular impact assessments within Natura 2000 sites and the NOVANA monitoring program contribute information that is adequate to detect changes in risk factors for the main habitats. The extent and distribution of biogenic reefs is still to be verified and documented. A comprehensive monitoring program for 2021-2026, in relation to Denmark's obligations under the Marine Strategy Framework Directive and published by the Danish Environmental Protection Agency (Miljøstyrelsen, 2020a), indicates that biogenic reefs and other habitats in Danish waters will be monitored during the life of the plan.

In combination, these measures mean that the requirements of SG60, SG80 and SG100 are fully met for commonly-encountered, eelgrass and macroalgae habitats, but the SG100 is not met for biogenic reefs.

References

Annual reports for fisheries control going back to 2012 published on Danish Fisheries Agency website: https://fiskeristyrelsen.dk/erhvervsfiskeri/kontrol/aarsrapport/ Accessed on 25 November 2020.

BEK nr 1258 af 27/11/2019 Bekendtgørelse om regulering af fiskeri efter muslinger og østers. Miljø- og Fødevareministeriet. 36pp. Available from: https://www.retsinformation.dk/Forms/R0710.aspx?id=211261 (Executive Order on fishing for mussels and oysters) Accessed on 18 April 2020.

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Miljøstyrelsen. 2020a. Danmarks Havstrategi II, Anden del, Overvågningsprogrammet. Juli 2020. 67pp. (Denmark's Marine Strategy II, Part Two, Monitoring Program)

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Nielsen, P., Nielsen, M.M., Geitner, K. and Petersen, J.K. 2018b. Konsekvensvurdering af fiskeri af blåmuslinger og søstjerner i Løgstør Bredning 2017/2018. DTU Aqua-rapport nr. 330-2019. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 58 pp. + bilag. (Impact assessment of fishing for mussels and starfish in Løgstør Bredning)

Nielsen, P., Nielsen, M.M., Geitner, K., and Petersen, J.K. 2018c. Konsekvensvurdering af fiskeri af blåmuslinger og søstjerner i Lovns Bredning 2017/2018. DTU Aqua-rapport nr. 329-2018. Institut for Akvatiske Ressourcer, Dan-marks Tekniske Universitet. 59 pp. + bilag. (Impact assessment of fishing for mussels and starfish in Lovns Bredning)

Nielsen, M.M., Linden-Vørnle, M. and Petersen, J.K. 2019a. Forvaltningsgrundlag for fiskeri af muslinger i Natura 2000-områderne Horsens Fjord og Lillebælt. DTU Aqua-rapport nr. 343-2019. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 28 pp. + bilag (Impact assessment of fishing for mussels in Natura 2000 sites Horsens Fjord and Lillebælt)

Nielsen, P., Nielsen, M.M., and Geitner, K. 2019b. Notat vedrørende fiskeri af euro- pæisk østers og søstjerner i Nissum Bredning 2019/2020. DTU-Aqua notat. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 23pp. (Advisory note on fishing of European oysters and starfish in Nissum Bredning)

Nielsen, P., Olsen, J., and Nielsen, M.M. 2019c. Notat vedrørende fiskeri af blåmuslinger og søstjerner i Lovns Bredning 2019/2020. Institut for Akvatiske Ressourcer, Dan-marks Tekniske Universitet. 23pp. (Advisory note on fishing for mussels and starfish in Lovns Bredning)

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Draft scoring range	**60-79, possibly ≥80**
Information gap indicator	**More information sought – updates and references for 2019-20; harmonise score for IDW (UoA4) or more information required**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score					**UoA 1 75** **UoA 2 75** **UoA 3 75** **UoA 4 75**
Scoring element	**UoA 1**	**UoA 2**	**UoA 3**	**UoA 4**	

Commonly-encountered	85	85	85	85
Eelgrass	85	85	85	85
Macroalage	85	85	85	85
Biogenic reefs	75	75	75	75

Condition number (if relevant)	**3**

PI 2.5.1 – Ecosystem outcome – all UoAs

PI 2.5.1		The UoA does not cause serious or irreversible harm to the key elements of ecosystem structure and function		
Scoring Issue		SG 60	SG 80	SG 100
a	Ecosystem status			
	Guide post	The UoA is **unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	The UoA is **highly unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.
	Met?	**All UoAs Yes**	**Al UoAs Yes**	**All UoAs Partial**

Rationale:

Fishing activity across all the UoAs is only concentrated in areas where mussels, oysters and cockles are abundant. Only a very small proportion (less than 2% by area) of the areal extent of the UoAs is affected annually by shellfish dredging for mussels, oysters and cockles. In Limfjorden this is concentrated in the central Limfjord in three main basins. In Inner Danish Waters, mussel fishing is also limited to very specific locations, is not widely distributed across the whole UoA, and undertaken by six vessels total or four or fewer vessels in any given area. Key habitat areas (notably eelgrass beds, reefs and a significant proportion of macroalgae) are protected from dredging activity by depth, area, season and a suite of other restrictions (see Habitats PIs), and other potentially sensitive areas are closed to dredging altogether. Along with strict spatial and fishing effort controls, there are temporal controls that prevent fishing during the summer months and at the end of the calendar year; gear restrictions; output controls; high spatial and temporal coverage of black box monitoring, and cumulative impact controls within Natura 2000 sites. Thus, over the long term, dredging will not affect the entire area covered by all UoAs (e.g., Limfjord, East Jutland, Isefjord, and Storebælt).

Short-term impacts of oyster fishing, such as increased presence of scavengers, are known to be reversible. There is evidence that there is a low risk of harm from the removal of stones by the lightweight dredges used to catch oysters and mussels. Empty mussel shells taken during fishing operations are sorted during processing and redeposited on the seabed; and DTU-Aqua has presented evidence that, in general, oyster and mussel dredging does not affect the abundance of empty shells, which can be micro-habitats for colonisation by mussels, oysters and other epibenthos.

Management and modelling of mussel fishing in Natura 2000 sites ensures there is a surplus of mussels in these areas to meet the energy requirements of shellfish-eating birds. Regular impact assessments show evidence of research survey data and simulation modelling for eelgrass (*Zostera* spp.) and counts of bird numbers demonstrate that shellfish fishing in all UoAs is highly unlikely to disrupt these key elements underlying the ecosystem's structure and function.

Evidence suggests there are variable impacts of shellfish fishing in highly localised areas on benthic fauna biomass within the UoAs, while several benthic, including functional, metrics did not show responses to fishing intensity. However, researchers suggest that natural variability and eutrophication may partly mask the effects of dredging on benthic communities and conclude that it is difficult to separate out fisheries effects in areas modified by high nutrient enrichment and variable environmental conditions because benthic communities may become stress-adapted irrespective of fishing effort. Recent research studies also provide evidence that unfished, closed and protected areas are providing significant refugia for some larger benthic taxa found in the UoAs' ecosystems (eg., *Arctica islandica* and *Modiolus modiolus*).

The effect of shellfish dredging on nutrient remobilisation has been studied in Limfjord (for mussel fishing). There is evidence that a temporary and localised increase in nutrient concentrations in the water after dredging, but these effects are very small (less than 1% of the nutrient loading to the Limfjord from land and atmospheric sources). Other indirect impacts such as resuspension of seabed sediments, potential denitrification, or the spread of non-native species are considered insignificant.

There is therefore some evidence, although this is not comprehensive, that the UoAs are highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be serious or irreversible harm. The requirements of SG60 and 80 are fully met, and the availability of evidence indicates that the requirements of SG100 are partially met.

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Nielsen, P., Nielsen, M.M., Geitner, K. and Petersen, J.K. 2018b. Konsekvensvurdering af fiskeri af blåmuslinger og søstjerner i Løgstør Bredning 2017/2018. DTU Aqua-rapport nr. 330-2019. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 58 pp. + bilag. (Impact assessment of fishing for mussels and starfish in Løgstør Bredning)

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Draft scoring range	**≥80**
Information gap indicator	**More information sought – updates to information and references for 2019-20**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**UoA 1 90** **UoA 2 90** **UoA 3 90** **UoA 4 90**
Condition number (if relevant)	**NA**

PI 2.5.2 – Ecosystem management strategy – all UoAs

PI 2.5.2		There are measures in place to ensure the UoA does not pose a risk of serious or irreversible harm to ecosystem structure and function		
Scoring Issue		SG 60	SG 80	SG 100
a		Management strategy in place		
	Guide post	There are **measures** in place, if necessary which take into account the **potential impacts** of the UoA on key elements of the ecosystem.	There is a **partial strategy** in place, if necessary, which takes into account **available information and is expected to restrain impacts** of the UoA on the ecosystem so as to achieve the Ecosystem Outcome 80 level of performance.	There is a **strategy** that consists of a **plan**, in place which contains measures to **address all main impacts of the UoA** on the ecosystem, and at least some of these measures are in place.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**

Rationale:

The combined legal and policy framework, including the Marine Strategy Framework, Water Framework, Habitats and Birds Directives as implemented under Danish fisheries and nature conservation laws and the Mussel and Oyster Policy mean a strategy is in place to protect the key ecosystem features of the UoAs in the form of the network of Natura 2000 sites, and the management measures that restrict or prohibit dredging activity inside Natura 2000 sites in order to protect key habitats and birds.

On a broader scale, outside Natura 2000 sites, management measures aim to restrain impacts on the ecosystem of all UoAs through a number of statutory controls to protect eelgrass beds and reefs, and restrictions that seek to minimise the capture of boulders and stones in dredges.

For the Natura 2000 sites that form parts of each of the UoAs, there are clearly comprehensive plans in place to manage ecosystem impacts. Outside the Natura 2000 sites, the approach can be characterised as a partial strategy in the form of statutory restrictions on the spatial extent of dredging activity, the number of vessels permitted in each UoA, TAC limits imposed on vessels, and constraints on fishing gear specification. In combination, these measures are intended to address all the main impacts of the UoAs on the ecosystem, thus ensuring the fishery does not pose a risk of irreversible harm to ecosystem structure and function. However, these cannot be considered a plan (or plans) for each of the UoAs for the purposes of this Scoring Issue. Thus, the UoAs fully meet the requirements of SG 60 and 80, but do not meet the SG100.

b		Management strategy evaluation		
	Guide post	The **measures** are considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar UoAs/ ecosystems).	There is **some objective basis for confidence** that the measures/ partial strategy will work, based on some information directly about the UoA and/or the ecosystem involved.	**Testing** supports **high confidence** that the partial strategy/ strategy will work, based on information directly about the UoA and/or ecosystem involved.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**

Rationale:

There is direct evidence, spanning nearly a decade, from testing and assessment of fishing impacts and ecosystem monitoring within Natura 2000 sites across all the UoAs which confirm that testing supports high confidence that the partial strategy will work within the Natura 2000 sites.

There is some monitoring outside Natura 2000 sites (e.g., NOVANA program; Petersen *et al.*, 2021) that contributes to the knowledge base about the effects of shellfish fishing on the UoAs and ecosystem involved. Recent work on the effects of shellfish fishing on benthic fauna both inside and outside Natura 2000 sites have concluded that the effects detected are highly variable and hard to distinguish from natural variability and other anthropogenic impacts, therefore recommendations have been made that could improve testing and by extension confidence: changing standardised indicators to monitor localised fisheries effects; developing a bottom fauna index that is more sensitive to the impact of fishing in coastal waters; and setting aside small reference sites to provide 'control' areas to improve future ecological monitoring.

Despite the extent of habitat and ecosystem impacts being monitored less intensively in the wider UoA areas, the limited extent of shellfish fishing across the entire area of all the UoAs (less than 2%) and the similarity of ecosystem components both lend weight to suggesting that evidence from Natura 2000 site-related testing and assessment within Limfjord and eastern Inner Danish Waters give an objective basis for confidence that the partial strategy will work across the wider area of the UoAs. However, given that the level of testing and assessment is significantly lower than that performed in Natura 2000 sites, the level of confidence cannot be rated as 'high' outside Natura 2000 sites. The requirements of SG60 and SG80 are fully met for all areas of the UoAs, but met at SG100 only for Natura 2000 sites and therefore overall the UoAs do not meet the SG100.

c	Management strategy implementation			
	Guide post		There is **some evidence** that the measures/partial strategy is being **implemented successfully**.	There is **clear evidence** that the partial strategy/strategy is being **implemented successfully and is achieving its objective as set out in scoring issue (a).**
	Met?		**All UoAs Yes**	**All UoAs Yes**

Rationale:

There is clear evidence from the monitoring of fishing activities by the fleets in all UoAs using "black box" recorders that there are high levels of compliance with the management rules contained in the partial strategy and that these are serving to protect marine ecosystem components. The adoption some years ago of the lighter design dredges by both mussel and oyster fishers across all UoAs and the subsequent integration into statutory licence conditions demonstrates successful implementation of measures within the strategy. Detailed monitoring of Natura 2000 sites also provides clear and supporting evidence that the partial strategy in place across all UoAs is working successfully. The requirements for SG80 and 100 are likely to be met.

There is clear evidence from the monitoring and surveillance of fishing activities by the fleets in all UoAs using "black box" recorders that there are high levels of compliance with the management rules contained in the partial strategy and that these are serving to protect marine ecosystem components (see Annual Reports). The adoption some years ago of the lighter design dredges by both mussel and oyster fishers across all UoAs and the subsequent integration into statutory licence conditions demonstrates successful implementation of measures within the strategy. Detailed monitoring and impact assessments of Natura 2000 sites also provides clear and supporting evidence that the partial strategy/strategy in place across all UoAs is being implemented successfully and is achieving its objective to restrain and/or address the main impacts of the UoAs on the underlying structure and function of the ecosystem such that there would be serious or irreversible harm (Nielsen *et al*, 2018a,b,c; 2019a,b,c; 2020a,b). The requirements for SG80 and SG100 are fully met.

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Draft scoring range	**≥80**
Information gap indicator	**More information sought – updates to information and references for 2019-20**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**UoA 1 85** **UoA 2 85** **UoA 3 85** **UoA 4 85**
Condition number (if relevant)	**NA**

PI 2.5.3 – Ecosystem information

PI 2.5.3		There is adequate knowledge of the impacts of the UoA on the ecosystem		
Scoring Issue		SG 60	SG 80	SG 100
a	Information quality			
	Guide post	Information is adequate to **identify** the key elements of the ecosystem.	Information is adequate to **broadly understand** the key elements of the ecosystem.	
	Met?	**All UoAs Yes**	**All UoAs Yes**	
Rationale:				
The key elements of the ecosystem have all been identified, for example, the character and extent of seabed habitats and benthic communities vulnerable to dredge impacts. There is information available to enable the key elements of the ecosystem and potential interactions with the UoAs' fishing activities to be understood, such as the cumulative impact of shellfish dredging on seabed habitats. The requirements of SG60 and SG80 are fully met.				
b	Investigation of UoA impacts			
	Guide post	Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, but **have not been investigated** in detail.	Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, and **some have been investigated in detail**.	Main interactions between the UoA and these ecosystem elements can be inferred from existing information, and **have been investigated in detail**.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**
Rationale:				
There is evidence of detailed investigation on the UoAs and their respective ecosystems and the main interactions between those UoAs and ecosystem elements can be inferred or directly understood from existing information. There is information across all UoAs about potential impacts on ecosystem elements such as marine habitats, ETP species and non-target species and the main interactions may be inferred. Detailed investigations into the interaction between shellfish fishing and benthic fauna communities have recently been published revealing variable results. Researchers have recommended improved ecological monitoring and understanding may result from changing standardised indicators to monitor localised fisheries effects; developing a bottom fauna index that is more sensitive to the impact of fishing in coastal waters; and setting aside small reference sites to provide 'control' areas to investigate in detail the effects of shellfish fishing on benthic fauna communities. The requirements of SG60 and SG80 are fully met, while the requirements of SG100 are not fully met. The assessment team recommends that to improve ecological monitoring, particularly of benthic fauna, standardised indicators and a bottom fauna index are developed that are sensitive to localised effects and fishing in coastal waters; and that small reference sites are conserved (from fishing) within the UoAs to provide control areas for comparison with fished areas.				
c	Understanding of component functions			
	Guide post		The main functions of the components (i.e., P1 target species, primary, secondary and ETP species and Habitats) in the ecosystem are **known**.	The impacts of the UoA on P1 target species, primary, secondary and ETP species and Habitats are identified and the main functions of these components in the ecosystem are **understood**.
	Met?		**All UoAs Yes**	**All UoAs No**

Rationale:

The impacts of the UoAs on target, non-target, and ETP species and habitats are broadly understood and are subject to ongoing and continuous monitoring. The main functions of all of these components in the ecosystem are known, and some (such as the interaction between birds and shellfish) have been modelled and are understood. The SG80 requirements are fully met.

Recent studies into the shellfish fishing effects in the UoAs, e.g., Eigaard *et al.* (2020); McLaverty *et al.* (2020); Petersen *et al.* (2020a, 2020b) reveal that some of the observed impacts to certain ecosystem components cannot be generalised across all UoAs, that at local scales (i.e., basin scale) results can be highly variable, confounded by other anthropogenic effects and/or natural variability. The recent studies suggest that the impacts and main functions of the MSC components in the ecosystem are not fully understood but should be monitored and assessed at more localised scales. Therefore, SG100 is not met.

d	Information relevance			
	Guide post		Adequate information is available on the impacts of the UoA on these components to allow some of the main consequences for the ecosystem to be inferred.	Adequate information is available on the impacts of the UoA on the components **and elements** to allow the main consequences for the ecosystem to be inferred.
	Met?		**All UoAs Yes**	**All UoAs No**

Rationale:

There is adequate information available on the components and some of the elements of the ecosystem to allow the main consequences to the ecosystem to be inferred. All of the available information, particularly from impact assessments, suggests that under the current management regime the UoAs have very little impact on ecosystem components, elements, and function.

The available information on the impacts of UoAs on ecosystem components is satisfactory to meet the SG80 requirements because some of the main consequences for the ecosystem can be inferred. However, the information available is not adequate enough to meet the SG100 requirements as the available information is not detailed or comprehensive enough on the impacts of UoAs on components *and all* elements.

e	Monitoring			
	Guide post		Adequate data continue to be collected to detect any increase in risk level.	Information is adequate to support the development of strategies to manage ecosystem impacts.
	Met?		**All UoAs Yes**	**All UoAs Yes**

Rationale:

Information about UoAs and their effects on the ecosystem components and elements is assessed annually in the key Natura 2000 sites where fishing is planned. All fishing activity in the UoAs is continuously monitored using the “black box” recorders fitted to every vessel. This information is capable of detecting any change in risk level and has also been used (and is thus adequate) to support the development of strategies to manage ecosystem impacts (for instance, through the depth restrictions in place to protect eelgrass beds and macroalgae). The requirements of SG80 and SG100 are met.

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McLaverty, C., Eigaard, O.R., Dinesen, G.E., Gislason, H., Kokkalis, A., Erichsen, A.C. and Petersen, J.K. 2020. High-resolution fisheries data reveal effects of bivalve dredging on benthic communities in stressed coastal systems. *Marine Ecology Progress Series*, 642: 21-38.

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Nielsen, P., Nielsen, M.M., Geitner, K. and Petersen, J.K. 2018b. Konsekvensvurdering af fiskeri af blåmuslinger og søstjerner i Løgstør Bredning 2017/2018. DTU Aqua-rapport nr. 330-2019. Institut for Akvatiske Ressourcer, Danmarks Tekniske Universitet. 58 pp. + bilag. (Impact assessment of fishing for mussels and starfish in Løgstør Bredning)

Nielsen, P., Nielsen, M.M., Geitner, K., and Petersen, J.K. 2018c. Konsekvensvurdering af fiskeri af blåmuslinger og søstjerner i Lovns Bredning 2017/2018. DTU Aqua-rapport nr. 329-2018. Institut for Akvatiske Ressourcer, Dan-marks Tekniske Universitet. 59 pp. + bilag. (Impact assessment of fishing for mussels and starfish in Lovns Bredning)

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Draft scoring range	**≥80**
Information gap indicator	**More information sought – updates and references from 2019-20**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**UoA 1 85** **UoA 2 85** **UoA 3 85** **UoA 4 85**
Condition number (if relevant)	**NA**

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7.5 Principle 3

7.5.1 Principle 3 Background

The fishery under assessment encompasses the combined shellfish (mollusc) UoAs for mussels, cockles and oysters in the brackish territorial waters of Limfjord and for mussels in the inner territorial waters of the east coast of Denmark (Figure 1). There are no straddling stocks and the species are not migratory, therefore the fishery is categorised as a single jurisdiction fishery with the Danish government solely responsible for its management. The fishery is, however, managed within a broader legal and policy context: as Denmark is a member of the European Union, the Danish government must ensure that the management of all Denmark's fisheries resources is consistent with the objectives of the European Union's Common Fisheries Policy (the CFP), Regulation (EU) No 1380/2013.

The Danish government department responsible for the overall management of shellfish fishing is the Ministry of Environment and Food (Miljø- og Fødevareministeriet) (Figure 58). Fisheries policy-making is the responsibility of the Minister for Fisheries, Equal Opportunities and Nordic Cooperation.

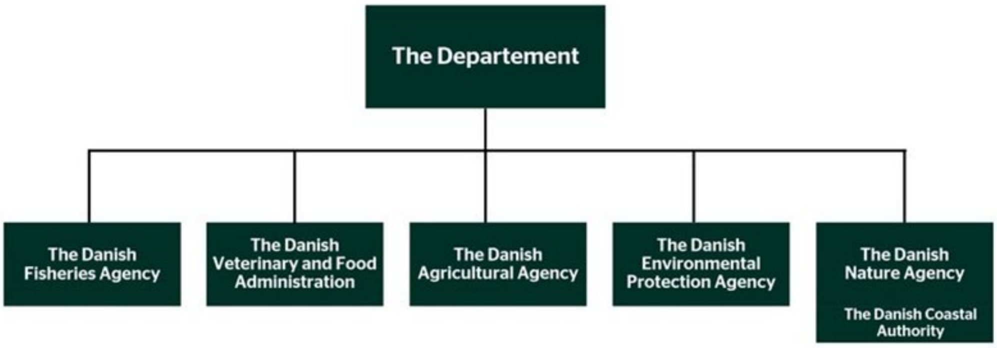

Figure 58. Ministry for Environment and Food structure in 2020 (Source: https://en.mfvm.dk/the-ministry/)

The Danish Fisheries Agency (Fiskeristyrelsen) is responsible for operational management of fisheries including Monitoring, Control and Surveillance, as well as the administration of the European Maritime and Fisheries Fund (EMFF). Other agencies that sit within the Ministry that play a role in the management of Denmark's shellfish fisheries include: the Danish Veterinary and Food Administration (Fødevarestyrelsen) which has jurisdiction for ruling upon water quality issues in relation to opening shellfish fishing grounds, particularly in relation to algal toxins; the Danish Nature Agency (Naturstyrelsen) and the Danish Environmental Protection Agency (Miljøstyrelsen) which are responsible for implementing government policies concerning nature and the environment. Of particular interest and responsibility are the establishment of environmental benchmarks for water quality (which influence shellfish hygiene), and the conservation and/or protection of habitats and non-fish species, as well as the administration of Natura 2000 sites in Denmark's seas, inlets and waterways. Within the Limfjord, this includes the Natura 2000 sites Løgstør Bredning and Lovns Bredning (for mussel fishing) and Nissum Bredning (for oyster fishing). In the eastern inner waters of East Jutland, Isefjord and Storebælt, Natura 2000 sites include Lillebælt and Horsens Fjord in East Jutland, and the Storebælt.

While the Fisheries Director has the regulatory power to make fishery management decisions, the Director's decisions are based on the recommendations of the statutory Advisory Committee on Mussel Production – in English sometimes referred to as the Mussel Advisory Committee, despite it also being responsible for making recommendations on the management of other shellfish species, including oysters and cockles. The Mussel Advisory Committee was established under Denmark's Fisheries Act, 2006 as the ongoing multi-stakeholder forum for discussing and developing the management arrangements for all the UoAs covered by this assessment.

There are a number of groups with recognised interests in the management of the fishery which are represented in the Mussel Advisory Committee and/or actively engaged in the management process. Both the Limfjord fishers' association Centralforeningen for Limfjorden (CF) and the Danmarks Fiskeriforening Producent Organisation (DFPO) represent the shellfish fishers' interests, as do other local fishers associations which are members of DFPO. Danmarks Tekniske Universitat – Aqua (DTU Aqua) represents science interests, conducts scientific monitoring and research, and provides technical advice for the management process. The nature conservation groups WWF Danmark and the Danmarks Naturfredningsforening (Danish Society for Nature Conservation) have represented environmental interests during policy development and ongoing management consultations. Fishing processing interests, local councils and consumer interests are involved in the Advisory Committee, as are shellfish farming interests.

Annual management arrangements are informed by the previously cited overarching Mussel and Oyster Policy – a fisheries management framework for shellfish fishing in the Natura 2000 areas that was developed through multi-stakeholder consultation, a revised edition of which was published in May 2019 (Udenrigsministeriet, 2019). The framework also guides the management of shellfish fishing beyond the boundaries of the Natura 2000 sites.

Each year DFPO, on behalf of shellfish fishers, submits to the Danish Fisheries Agency fishing plans for mussels and oysters in key Natura 2000 sites, including proposed quotas for each species. The Agency commissions an environmental impact assessment of proposals from DTU Aqua. Scientists from DTU Aqua seek input and data from the Nature Agency to supplement their own research and survey findings. The stock assessment and scientific advice are compiled into impact assessment reports which are in turn considered by the Mussel Advisory Committee, whose recommendations and opinions are forwarded to the Fisheries Director. After considering the scientific advice, the various recommendations and opinions, the Director decides the following year's fisheries management arrangements and license conditions. Stakeholders are advised directly about the decisions, including the reasoning. Decisions are also publicised on the Agency's website, as are the minutes showing the Mussel Advisory Committee deliberations and discussions.

There is a good level of co-management with the well-established local fishers' associations who work in partnership with DFPO and with Government to aid informal management of the timing, location and intensity of shellfish fishing activities. Anecdotal reports from fishers and government representatives, interviewed separately during previous site visits by MRAG Americas assessment teams, agree that the fishers have in the past consistently proposed more precautionary, i.e., lower TACs and other more conservative arrangements for mussels, than the science suggests could be sustainable.

Overview of objectives

The overarching fisheries legal and policy framework, as well as the fishery-specific management decisions guiding mussel, cockle and oyster fishing are influenced by a nested suite of objectives that begin with the CFP and end with the relevant local fishers' associations. The fisheries' objectives can be characterised as a combination of statutory laws and policies that seek to maximise stock health and minimise adverse impacts on non-target species, habitat and sensitive ecological features, and to secure the livelihoods of the mussel, cockle and oyster fishers.

At a European level, Article 2, paragraphs 1-4, of the CFP establish a range of objectives for managing fisheries in the EU, including: long-term environmental sustainability; being consistent with achieving economic, social and employment benefits; using a precautionary approach and restoring resources above levels that will produce MSY; implementing an ecosystem approach; and contributing to the collection of scientific data (Regulation (EU) No. 1380/2013). Also influencing the management of the shellfish fishery are the EU's Habitats Directive (Council Directive 92/43/EEC), Birds Directive (Directive 2009/147/EC), the Water Framework Directive (Directive 2000/60/EC), and the Marine Strategy Framework Directive (Directive 2008/56/EC). The objectives and purposes of these Directives combine to guide the Danish government about the application of an ecosystem-based approach to managing human activities, maintenance and/or restoration of favourable conservation status to habitats and species, particularly within the system of protected sites that make up the Europe-wide Natura 2000 network, or to set water quality objectives that seek to ensure 'good ecological status and good chemical status' in Europe's surface and coastal waters.

Denmark's fisheries are governed by the Fisheries Act 2006, as amended in 2019, the overarching objectives of which are to ensure: the protection and restoration of living marine and freshwater resources; the protection of other animals and plants; and manage sustainable commercial fishing and related industries, and recreational fishing. The Act also sets out the purpose of the Mussel Advisory Committee:

> "…*to provide advice to the Minister on initiatives to promote the sustainable and commercial development of fishing and farming of mussels, oysters and other molluscs, including establishing rules on fishing and farming...".*

Both the Nature Protection Act, 1992, as amended in 2019-20, and the Planning Act, 2007, as amended in 2020, contain objectives that seek to preserve and protect nature, habitats and wildlife in coastal waters and ensure that the public may participate in relevant governing processes as much as possible.

The previously mentioned Mussel and Oyster Policy states that one of the government's key desires is to set clear objectives and the basis for a 'green conversion' of shellfish fishing in Natura 2000 areas, which both ensures a balance between the development of the fishing industry through sustainable resource use and the achievement of nature protection and water quality objectives established by the EU Directives cited above (Udenrigsministeriet, 2019).

Finally, the local fishers themselves, within the context of their local fishers' associations, have agreed upon informal sets of objectives that seek not only to maintain shellfish stocks in the UoAs and minimise the impact of dredging upon sensitive or protected elements of the environment, but are also precautionary in practice (CFF, pers. comm.).

Overview of fleet, rights and licensing

The UoAs are limited entry fisheries, with fixed numbers of licences in each UoA, resulting in a restricted number of vessels within each UoA (see Table 30). Licences are regranted annually to eligible fishers and are associated with named individuals rather than vessels. Eligibility requirements relating to licensing in each UoA are set out in relevant Executive Orders, but generally relate to prior track record of fish landings over a specified annual value over a specified time period (e.g., see Andrews *et al*., 2017). Vessels in each UoA are permitted to carry multiple licences and thus aggregate weekly quota (or TAC) shares onto a single vessel. Until late 2018, up to four licences were permitted per mussel vessel in Limfjord. In order to prevent consolidation of mussel licences into fewer hands and to preserve the small-scale nature of the Limfjord mussel fishery, regulations were amended to reduce this to a maximum of three per vessel, with those who own four being required to sell or transfer surplus licences by 2026 (BEK nr 1471 af 11/12/2018). In the Limfjord oyster and Inner Danish Waters mussel UoAs, there are no such restrictions on consolidation. One vessel in the Limfjord oyster fishery was reported as having 16 licences associated with it, however this has no impact on fishing effort as the weekly TAC is allocated to each licence and the number of licences are fixed (Andrews *et al*., 2017).

Licences in all UoAs specify gear type, permitted fishing areas, closed areas and weekly TACs. Licences require fishers to report their catch while at sea, declaring an estimated weight of shellfish they intend to land.

Rules agreed in 2018 and implemented in the December 2019 Executive Order (BEK nr 1258) promote the active use of vessels and shellfish quota. Oyster and mussel vessels in all Danish waters with relevant licenses and quota must fish and land volumes that correspond to at least 25% of the total annual quota attached to each license. Failure to comply will result in reductions in the following season's quota allocation on a sliding scale, calculated on the percentage landed below the fishing license's total allocated quota for a given season. (Addison and Grieve, 2020)

Table 30. Number of licences and vessels in each UoA, 2020. (Source: Client)

UoA	Number of Licences (2020)	Number of Active Vessels (2020)
UoA 1 – Limfjord mussel	50	22
UoA 2 – Limfjord cockle	50	22
UoA 3 – Limfjord oyster	103	34
UoA 4 – Inner Danish Waters mussel	8	6 (East Jutland); 2 (Isefjord)

Summary of management measures (harvest controls)

The following is based on sources including the Mussel and Oyster Policy, fishing licence regulations for each UoA, Limfjord oyster public certification and surveillance reports (Andrews *et al*., 2017 and Andrews & Maar, 2019), Limfjord mussel and cockle public certification and surveillance reports (Wakeford *et al*., 2016; Addison *et al*., 2019a) and Inner Danish Waters mussel public certification and surveillance reports (Addison *et al*., 2017 and 2019b), and information provided during the 2020 site visit (conducted remotely due to Covid-19) by DFPO and local fishing association representatives, and representatives of DTU-Aqua, the Danish Fisheries Agency and the Ministry. Each year management measures are regulated through Executive Orders which lay out the rules for the following year in the mussel, cockle and oyster fisheries, e.g., for the 2019-20 fishing season in all UoAs was BEK nr 1258 af 27/11/2019.

Output controls:
UoA1 and UoA2 – Limfjord mussel and cockle
The Danish Fisheries Agency allocates a weekly and daily mussel TAC/quota share per licence: currently 45 tonnes per licence per week gross landings of any species, including non-target species such as cockles, per licence per day. In addition:

- The government also sets an annual mussel TAC for each of the two Natura 2000 sites: currently 5,500t for Løgstør Bredning and 10,000t for Lovns Bredning for the 2020/2021 fishing season.
- Minimum size – 50mm, with no more than 10% of the total catch on a given day permitted to be smaller than this.

For vessels involved in mussel relaying activities, a minimum size of 45mm is permitted, and no more than 30% of the catch may be smaller than this.

- A bycatch of up to 1% by weight of oysters is permissible.
- Cockles are not considered a 'directed fishery' rather they are considered and managed by the Danish Fisheries Agency as bycatch.
- Cockles must be no more than 49% of the total landed catch (the remaining 51% must be composed of mussels). Vessels are required to start fishing trips with empty holds in order to ensure any cockle catches are taken as bycatch on mussel trips rather than by directed cockle fishing.

UoA3 – Limfjord oyster
An annual TAC is set by the Danish Fisheries Agency (200 tonnes in 2020/2021 fishing season) which is divided into weekly TAC/quota shares per licence. In addition:

- Minimum landing size – oysters must be larger than 80g.
- Oysters must be landed on the day of capture, with any catch in excess of quota allocations required to be returned to the sea at the point where they were caught.
- Retained bycatch of mussels may be landed, providing the weight landed is no more than 10% of the weight of oysters.

UoA4 – Inner Danish Waters mussel
Again, TACs are set by the Danish Fisheries Agency and allocated as weekly TACs/quota shares amounting to 270 tonnes per fishing licence for vessels operating throughout the UoA, including East Jutland and Isefjord. In recent years, however, this has been reduced voluntarily by the fishing industry body to 180t per week (Addison *et al*., 2019b). In addition:

- Annual TACs are calculated for each Natura 2000 site (Lillebælt and Horsens Fjord), considering food requirements for birds and total cumulative impact on habitats (proportion of total area) and on blue mussels, benthic fauna, macroalgae and eelgrass, and decisions about whether stock biomasses in these areas may support commercial fisheries are taken after considering the impact assessments. For example, Lillebælt stock biomass was not sufficient to support commercial fishing in 2018-2019, thus the TAC was zero; similarly, in Horsens Fjord stock biomass estimates did not support commercial fishing in 2019 also resulting in a zero TAC for that Natura 2000 site (Addison *et al*., 2019b).

Rules agreed in 2018 and implemented in the December 2019 Executive Order promote the active use of vessels and shellfish quota. Oyster and mussel vessels in all Danish waters with relevant licenses and quota must fish and land volumes that correspond to at least 25% of the total annual quota attached to each license. Failure to comply will result in reductions in the following season's quota allocation on a sliding scale, calculated on the percentage landed below the fishing license's total allocated quota for the given season.

Spatial measures, including depth restrictions
As noted earlier, Danish waters are divided into designated (numbered) shellfish production areas. Within production areas, smaller areas may be designated. Fishing in all the UoAs is prohibited in or near any Natura 2000 site unless an environmental impact assessment has been conducted. Vessels are required to observe area closures, such as those in place for habitats in Natura 2000 sites and to protect eelgrass beds. In addition:

- Fishing for shellfish in depths shallower than 3m is prohibited in all UoAs.
- Fishing for oysters in Nissum Bredning Natura 2000 sites in depths shallower than 5m is prohibited.
- Exclusion zones prohibit dredging within 300 metres of the boundaries of all Natura 2000 sites that are closed to fishing to create buffer zones to prevent potential negative effects from resuspension and redistribution of sediments and/or nutrient loading from land runoff that may be the consequence of physical disturbance by shellfish dredging.
- The Danish Fisheries Agency may adjust area boundaries within season if eelgrass depths change.

Additional habitat-specific measures
In 2018, the Danish Environmental Protection Agency published a document (Miljøstyrelsen, 2018) which reviewed available information and offered a definition of 'biogenic reefs' with reference to the provisions of the EU's Habitats Directive and Danish marine strategy. Biogenic reefs have since been defined on the basis of minimum size (sqm); coverage and stability i.e., the density of shellfish forming the reef and the number of cohorts of shellfish present; and species composition, i.e., the associated species community. The definition relates only to blue mussel and horse mussel reefs and by 2019-20 was increasingly worked into environmental impact assessments for Natura 2000 sites and where known, i.e., mapped, whether inside or outside Natura 2000 sites, reefs are identified in the regulations, closed to fishing, with all fishing activity monitored through the Black Box system.

Cumulative effects
Embedded into the management measures, including into the setting of shellfish quotas and other spatial or temporal controls, is the concept of cumulative effects on habitats. The limit for cumulative effects on Natura 2000 sites has

been set at 15% of the total area over a five-year period and is calculated based on regeneration times for key ecosystem species such as the target stocks, eelgrass (0% impact is permitted on eelgrass), macroalgae species and benthic fauna. All fishing activity with bottom-contacting gear, including fishing for non-shellfish species, is factored into the calculation. Supplementary criteria are also considered in the development of management measures for all UoAs: cumulative effects of past seasons (areas affected), rocks and stones brought ashore, number of vessels per area, any other fishing activities in the area and oxygen depletion.

Effort limitation
In UoA 1 and 2, within the fishing areas in the Løgstør Bredning and Lovns Bredning Natura 2000 sites, there is a limit on the total number of vessels that can fish in each Natura 2000 production area (15 and 10 vessels per production area, respectively).

While in UoA 3, oyster vessels may fish every other week during the oyster season: vessels with odd letters and numbers fish in weeks with odd numbers; and vessels with just letters and even numbers fish in even numbered weeks of the year.

Vessel size and gear restrictions
- *Vessel size – UoA 1, 2 and 4* – the maximum length, power and draft of mussel vessel is limited. Boats are limited to 175hp and maximum length of 12m, with the exception of four larger boats for historical reasons.
- *Vessel size – UoA 3* – oyster vessels may be no more than 15m in length, and if replaced by a new vessel, no more than 12m in length except in special circumstances.

- *Dredges – UoA 1, 2 and 4* – light dredges must be used (these must weigh no more than 50kg and be no more than 1.8m long and 1.5m wide).
- *Dredges – UoA 3* – oyster dredges must not be more than 1m wide, 22cm high and framework (including bridle) must not weigh more than 11.5kg; the bag must not weigh more than 12kg; the wet weight must not be more than 24kg.
- *Prohibition on carrying mussel dredges – UoA 3* – while fishing for oysters, vessels must not carry mussel dredges.

- *Sorting gear – UoA 1, 2 and 4* – mussel vessels are not allowed to install gear that sorts the catch on board the vessel.

- *Hand rakes – UoA 3* – fishing for oysters using a hand rake from vessels smaller than 8m is permitted. This is a traditional local fishing method that would otherwise be illegal. However, the depth restrictions now imposed upon the oyster UoA mean that is no longer practical to use this fishing method.

Relaying
- *UoA 1 and 2 – Limfjord mussel and cockle* – a part of the management plan is that small mussels may be dredged from commercial mussel beds and re-laid on high production areas where hypoxia events are rare.

- *UoA 3 – Limfjord oyster* – any small oysters in the catch from the Nissum Bredning Natura 2000 site must be returned to the sea within a specified area in the centre of Nissum Bredning.

Seasonal and temporal measures
There is a range of formal and customary daily, weekly and monthly closures employed. Regulations prohibit fishing between the hours of sunset and sunrise and on Sundays. In addition:

UoA 1, 2 and 4 – Limfjord mussel and cockle and Danish Inner Waters mussel:
- Elevated temperatures in the summer months cause oxygen depletion and transport issues affecting mussel health and quality. The fishery is therefore closed during June, July and August.
- Self-management by mussel fishers usually means the fishery is also closed between Christmas and the end of February.

UoA 3 – Limfjord oyster
- Fishing for oysters is prohibited between 15th May and 31st August each year.

Public health measures
For shellfish production areas to be opened to fishing, fishers must first request the Danish Fisheries Agency to open an area, and then the Danish Veterinary and Food Administration will assess water quality (for algal toxins or threats to public health). The two agencies will liaise, and a licence will be issued to permit fishing in the specified area. All shellfish production areas open for fishing are publicised on the following website:

https://www.foedevarestyrelsen.dk/Kontrol/Muslingeovervaagning/Muslingeovervaagning_Danmark/Sider/Danmark_muslingovervaagning.aspx

Monitoring
At sea – all vessels are required to carry a “black box” recorder which monitors the position of the vessel, its speed and course and whether or not it has deployed its fishing gear via sensors on the dredge winch. Data is logged in the black box every 10 seconds. When navigating in areas where fishing is not permitted, vessels are required to maintain a minimum speed of at least 5 knots (i.e. too fast to allow fishing to take place). Vessels may not leave port if the equipment is not functioning correctly, and skippers are required to report any malfunction of the black box system to the Danish Fisheries Agency, stop fishing and return to port immediately.
Data transfer – all licence holders must ensure the data are sent electronically to the Danish Fisheries Agency servers once per day.
Discarding of oysters – any discarding of oysters by mussel fishers (UoAs 1,2 and 4) must be recorded in the vessel’s logbook.
Landings – all skippers must inform the Danish Fisheries Agency of any landings at least one hour in advance of the vessel landing their catch. Catch data must be reported in electronic logbooks and catch estimates must be within specified tolerances of actual landed weight (see below under Inspections), which is later reported by onshore processing facilities.

Overview of monitoring, control and enforcement (all UoAs)

All fishing activity is closely scrutinised by the Danish Fisheries Agency at sea, at points of landing and at processing facilities. Catch declarations, landings data and sales records are cross-referenced and monitored electronically to ensure compliance with TAC allocations to individual vessels, as well as the overall TAC. Sources of information include previous PCDRs and Surveillance Reports for each of the UoAs, to be supplemented with more recent information during the site visit for the reassessment in 2020.

The Danish Fisheries Agency employs around 175 fishery officers, who are based at seven staffed fishery offices throughout Denmark. They patrol and inspect fisheries on land, at points of landing, and also at sea. The Agency has two large offshore Fisheries Patrol Vessels for work in the North Sea and Baltic, and one smaller (20m) inshore patrol vessel. Nineteen smaller craft (inflatable, aluminium and fibreglass vessels) are also used for inshore fishery inspections.

Electronic Logbooks
Electronic logbooks are compulsory for all boats under EU and Danish regulation. Compulsory information provided from the logbooks includes estimated gross landings by area and time. Logbook information is submitted to the Danish Fisheries Agency. The exact GPS position of fishing is required within the Food safety regulations and in the two Natura 2000 areas GPS positions must be recorded every half hour to comply with the fishing plans for these areas.

Electronic monitoring
In April 2012, the Fisheries Agency introduced a new approach to vessel monitoring at sea. All shellfish dredging vessels working in all UoAs now use the “black box” recorder. This recording unit uses GPS technology and the GSM network to provide accurate tracks of all vessel movements during every day that they spend fishing. Other data, such as the use of the vessel’s net winches, is also recorded by the system. The vessel’s position is recorded every few seconds to create the vessel track, and this information is transmitted automatically to the Danish Fisheries Agency every evening. The information can then be interrogated to see where the vessel has been fishing relative to production areas, Natura 2000 sites, biogenic reefs, and any other closed areas or exclusion zones.

Inspections
The vessels have to inform the fishery inspectors of their intention to land mussels no later than 1 hour before landings to allow for ad hoc inspections of catch. Inspectors allow a margin of error of up to 5% between declared and actual landings (owing to the difficulty of estimating weights from volumes of shellfish in the hold, particularly as shellfish condition changes over the year), and will also tolerate up to 10% undersized mussels in landings (or up to 30% if the mussels are due to be relayed in other parts of the Limfjord).

Landings and related data
Since 2018, catches are weighed electronically at landing, and the weighing bill is transmitted directly to the Fisheries Agency from the scales themselves. Operators with a previous infringement (logbook discrepancy) are required to delay landing until a Fisheries Inspector is present to monitor the landing and weighing-in process. Ministry and

Agency personnel reported in 2019 that fishers appeared to be reacting positively to the new rules as they offer transparency, and consistent application of the rules, thus levelling the playing field for all fishers.

For mussels, data are also recorded with regard to meat yield of mussels and the amounts of undersized mussels that are relaid. Bycatch quantities in the catch are also recorded in landings data, as is the amount of substratum e.g., boulders, rocks are recorded by weight (kilograms).

Infringements
Since the introduction of the black box, compliance by fishers with management measures in all UoAs has been considered to be high. No significant infringements are recorded in each of the UoAs and there is no wholesale or systematic pattern of non-compliance. Data provided by the Danish Fisheries Agency for the Limfjord demonstrated that of 1,655 fishing trips in 2018-19 there were 17 recorded infringements, i.e., around 1% of trips, (6 logbook infringements, 2 for illegal bycatch, 4 for hygiene infringements and 5 miscellaneous licence-related infringements, e.g., closed area violation, lack of active licence or failure to start with an empty load). In 2019-20, from 1957 fishing trips, this reduced to only 10 recorded infringements, i.e., around 0.5% of trips (1 logbook, 2 declarations of landing, 2 notifications of landing and 5 miscellaneous licence infringements). Logbook infringements, mainly misreporting of catch weights, led the Danish Fisheries Agency in 2018 to implement the new landing and electronic weighing-in rules described above and in turn, making sanctions for infringements more severe than before. Similarly, bycatch infringements for cockles resulted in the Agency amending rules to ensure Limfjord vessels start every fishing trip with an empty load (i.e., an empty hold) to deter operators from conducting solo trips targeting cockles (i.e., directed fishing for cockles) but claiming the catch as bycatch from an earlier mussel fishing trip.

Engine power
Stakeholders submitted allegations made by a journalist in a Danish weekend newspaper article in November 2020 which suggested there is systematic non-compliance in relation to EU and Danish engine power restrictions for fishing vessels, specifically Limfjord mussel and oyster dredging vessels (Hansen, 2020). The article referenced interviews, investigations conducted by the journalist into the public vessel registers, and a report published by the European Commission in 2019 (RDA, 2019). The Danish Fisheries Agency was asked about the allegations and responded in writing on 29 January 2021 to the assessment team's questions stating that the Agency is carrying out a dedicated control campaign of engine power encompassing almost all vessels in the Limfjord in the first half of 2021 and that so far, the allegations have not been verified.

Principle 3 Performance Indicator scores

PI 3.1.1 – Legal and/or customary framework – All UoAs

PI 3.1.1	The management system exists within an appropriate legal and/or customary framework which ensures that it: - Is capable of delivering sustainability in the UoA(s); - Observes the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood; and - Incorporates an appropriate dispute resolution framework			
Scoring Issue		SG 60	SG 80	SG 100
a	Compatibility of laws or standards with effective management			
	Guide post	There is an effective national legal system **and a framework for cooperation** with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2	There is an effective national legal system and **organised and effective cooperation** with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2.	There is an effective national legal system and **binding procedures governing cooperation with other parties** which delivers management outcomes consistent with MSC Principles 1 and 2.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**

Rationale:

As the area of fishery is entirely within Denmark's territorial waters, the Limfjord mussel and cockle fishery is managed under a single jurisdiction: Danish national law. There is therefore no need for cooperation with other Coastal States or internationally recognised parties.

As a member of the European Union, Denmark is bound by the requirements set out in the EU's Common Fisheries Policy (CFP). The CFP creates binding legal requirements on EU member states for the pursuit and achievement of sustainable fisheries consistent with MSC's Principles 1 and 2. Denmark also adheres to the EU's Habitats, Birds and Water Framework Directives which complement fisheries management in relation to Natura 2000 nature conservation sites and other ecosystem components of importance to the fishery.

Denmark manages fisheries through its Fisheries Act, 2005 as amended in 2019, which creates binding procedures via the Advisory Committee for Mussel Production, governing cooperation with shellfish stakeholder organisations to deliver management outcomes.

The Danish Nature Protection Act, 1992 and Planning Act, 2007, national fisheries management legislation and the overarching CFP and EU Habitats, Water Framework and Birds Directives combine to create an effective national system and binding procedures governing cooperation with other parties which deliver management outcomes consistent with MSC Principles 1 and 2. The UoAs therefore meet the requirements of SG60, SG80 and SG100.

b	Resolution of disputes			
	Guide post	The management system incorporates or is subject by law to a **mechanism** for the resolution of legal disputes arising within the system.	The management system incorporates or is subject by law to a **transparent mechanism** for the resolution of legal disputes which is **considered to be effective** in dealing with most issues and that is appropriate to the context of the UoA.	The management system incorporates or is subject by law to a **transparent mechanism** for the resolution of legal disputes that is appropriate to the context of the fishery and has been **tested and proven to be effective**.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**

Rationale:

The creation of the Advisory Committee for Mussel Production by the government provides a proactive system for avoiding disputes, and as noted the committee's remit covers all shellfish fishing including mussels, cockles and oysters. Even so, Section 19 of the Fisheries Act, as amended in 2019, also incorporates transparent mechanisms for resolution of appeals and complaints (i.e., disputes) about fisheries management decisions made by delegated authorities and/or the Fisheries Minister.

The EU also has transparent dispute mechanisms relevant to this fishery, as evidenced by the Danish Nature Conservation Society lodging a compliant about the potential habitat impacts of mussel dredging in Natura 2000 sites to the European Parliament Committee on Petitions. The Committee referred the complaint to the European Commission for assessment. Following consideration and a review of Denmark's impact assessment and management procedures, the complaint was resolved and closed by the European Commission in 2014.

The management system incorporates and is subject by law to a transparent mechanism for the resolution of legal disputes that is appropriate to the context of the fishery and has been tested and proven to be effective. The UoAs therefore meet the requirements of SG60, SG80 and SG100.

	Respect for rights			
c	Guide post	The management system has a mechanism to **generally respect** the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to **observe** the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to **formally commit** to the legal rights created explicitly or established by custom of people dependent on fishing for food and livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**

Rationale:

Commercial fishers depend on this fishery for their livelihoods. The management system has mechanisms to allocate a limited number of licenses to eligible fishers with a history of shellfish fishing in the Limfjord, or east coast waters. Overarching and site-specific quota allocations for mussels and oysters are shared among relevant license holders within each of the UoAs. Additional spatial and temporal controls for shellfish species across Danish waters are also self-managed equitably by fishers.

The management system clearly demonstrates that it has mechanisms to formally commit to the legal rights created explicitly or established by custom of people dependent on fishing for their livelihoods in a manner that is consistent with the objectives of MSC Principles 1 and 2. The UoAs therefore meet the requirements of SG60, SG80 and SG100.

References

BEK nr 1258 af 27/11/2019 *Bekendtgørelse om regulering af fiskeri efter muslinger og østers* (Executive Order on Mussel and Oyster Fishing)

BEK nr 1300 af 02/12/2019 *Bekendtgørelse om muslinger m.m* (Executive Order on Mussels – Testing Water Quality)

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. *Official Journal of the European Communities,* L206/7-L206/50, 22.7.92. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01992L0043-20070101&from=EN

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Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds. *Official Journal of the European Union,* L20/7-L20/24, 26.1.2010. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0147&from=EN

The Mussel and Oyster Policy:
Udenrigsministeriet, May 2019. Målsætninger og forvaltningsprincipper for mudslinger- og østersskrab og øvrig muslinge- og østers production I og udenfor Natura 200 områder (Objectives and management principles for mussel and oyster dredging and other mussel and oyster production in and outside Natura 2000 areas.”). 17pp. Available from: https://fiskeristyrelsen.dk/media/10650/muslinge-og-oesterspolitik.pdf Accessed on 29 March 2020.

Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC. *Official Journal of the European Union,* L354/22-L354/61, 28.12.2013. Available from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:354:0022:0061:EN:PDF

Draft scoring range	**All UoAs ≥80**
Information gap indicator	**More information sought – updates and references for 2019-20**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**All UoAs 100**
Condition number (if relevant)	**NA**

PI 3.1.2 – Consultation, roles and responsibilities

PI 3.1.2		The management system has effective consultation processes that are open to interested and affected parties The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties		
Scoring Issue		SG 60	SG 80	SG 100
a	Roles and responsibilities			
	Guide post	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **generally understood**.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **explicitly defined and well understood for key areas** of responsibility and interaction.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **explicitly defined and well understood for all areas** of responsibility and interaction.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**

Rationale:

Management processes for the cockle and mussel fishery are straightforward and explicitly defined in the Fisheries Act, 2006.

Danish shellfish management rests under the competence of the Ministry for Environment and Food (Miljø og Fødevareministeriet) and, within this, the Danish Fisheries Agency (Fiskeristyrelsen) is responsible for operational fisheries management. Fisheries management decisions are made by the Fisheries Director after formal environmental impact assessment and stock status advice is sought, and after consideration of that advice, as well as relevant recommendations and opinions from the legislatively mandated consultative body.

The Danish Technical University Aquatic Sciences department (Danmarks Tekniske Universitet – Aqua, abbreviated to DTU Aqua) provides environmental impact assessment and scientific advice about stock status.

The key consultative body for Danish shellfisheries is the Advisory Committee on Mussel Production (the Mussel Advisory Committee). This Committee was established by the Fisheries Act 2006 with the aim of promoting the sustainable management of the mussel fisheries in Denmark. Members are drawn from the fishing and shellfish processing industries, the government agencies, DTU Aqua, key environmental groups, local government and consumer groups. Fishers' associations are actively represented on the Mussel Advisory Committee, through DFPO which counts a comprehensive network of local fisher associations as members that represent each of the UoAs.

All the organisations and individuals involved in the management process have therefore been identified. Their functions, roles and responsibilities are explicitly defined and well understood for all areas of responsibility and interaction, and therefore all UoAs meet the requirements of SG60, SG80 and SG100.

b	Consultation processes			
	Guide post	The management system includes consultation processes that **obtain relevant information** from the main affected parties, including local knowledge, to inform the management system.	The management system includes consultation processes that **regularly seek and accept** relevant information, including local knowledge. The management system demonstrates consideration of the information obtained.	The management system includes consultation processes that **regularly seek and accept** relevant information, including local knowledge. The management system demonstrates consideration of the information and **explains how it is used or not used**.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**

Rationale:
An integral component of the management system for all the UoAs is the Mussel Advisory Committee, whose remit includes mussel, oyster, cockle and clam fisheries. The Committee provides a mechanism for wide stakeholder consultation and involvement in the management of the Danish shellfisheries and ensures that all relevant information, including local knowledge from fisheries representatives and other stakeholders, informs management of the fishery. Committee minutes provide evidence that the Committee regularly seeks and accepts relevant information which has been actively considered. Following decisions by the Fisheries Director, the Mussel Advisory Committee and the fishers' associations, e.g., DFPO and the Central Limfjord fishers' association, are provided with written advice explaining the reasons (or not) for decisions. For the Natura 2000 sites within the UoAs there is a further level of consultation about management, with the industry being invited to propose the level of fishing activity, and this then being subject to impact assessment before a management decision is taken, which further demonstrates how local knowledge and assessment recommendations have been considered. The management system therefore includes consultation processes that regularly seek and accept relevant information, including local knowledge. Further, the management system demonstrates consideration of the information and explains how it is used or not used. The UoAs therefore meet the requirements for SG60, SG80 and SG100.

	Participation			
c	Guide post		The consultation process **provides opportunity** for all interested and affected parties to be involved.	The consultation process provides **opportunity and encouragement** for all interested and affected parties to be involved, and **facilitates** their effective engagement.
	Met?		**All UoAs Yes**	**All UoAs Yes**

Rationale:

As has already been demonstrated, the consultation process, via the legally mandated Mussel Advisory Committee, provides opportunity and encouragement for all interested and affected parties to be involved, and facilitates their effective engagement. The UoAs therefore meet the requirements of SG80 and SG100.

References

Minutes of Mussel Advisory Committee meetings from 2005-2020 available from: https://fiskeristyrelsen.dk/raad-og-udvalg/muslingeudvalget/moedereferater/ Accessed 25 November 2020.

The Mussel and Oyster Policy:
Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for mudslinger- og østersskrab og øvrig muslinge- og østers production I og udenfor Natura 2000 områder (Objectives and management principles for mussel and oyster dredging and other mussel and oyster production in and outside Natura 2000 areas."). 17pp. Available from: https://fiskeristyrelsen.dk/media/10650/muslinge-og-oesterspolitik.pdf Accessed on 29 March 2020.

Structure and stakeholder representation on the Mussel Advisory Committee: https://fiskeristyrelsen.dk/raad-og-udvalg/muslingeudvalget/ Accessed 25 November 2020.

Draft scoring range	**≥80**
Information gap indicator	**More information sought – updates and references from 2019-20**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**All UoAs 100**
Condition number (if relevant)	**NA**

PI 3.1.3 – Long term objectives

PI 3.1.3		The management policy has clear long-term objectives to guide decision-making that are consistent with MSC Fisheries Standard, and incorporates the precautionary approach		
Scoring Issue		SG 60	SG 80	SG 100
a	Objectives			
	Guide post	Long-term objectives to guide decision-making, consistent with the MSC Fisheries Standard and the precautionary approach, are **implicit** within management policy.	**Clear** long-term objectives that guide decision-making, consistent with MSC Fisheries Standard and the precautionary approach are **explicit** within management policy.	**Clear** long-term objectives that guide decision-making, consistent with MSC Fisheries Standard and the precautionary approach, are **explicit** within **and required by** management policy.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Partial**

Rationale:

As a member of the European Union, the Danish government is required to ensure that the management of all fisheries resources is consistent with the requirements of the Common Fisheries Policy (CFP). The objectives of the CFP are described in Section 7.4.1 of this report and are demonstrably consistent with MSC Principles and Criteria, as well as the precautionary approach.

Long-term objectives for managing Danish fisheries are set out in Section s6a of the Fisheries Act, 2006, and are established in the context of the clear and explicit terms of reference for the Mussel Advisory Committee (described in detail in Section 7.4.1 of this report).

Complementing these objectives are the requirements laid out in national legislation under Denmark's Nature Protection Act, 1992 and the Planning Act, 2007 which create the legal framework for implementing the EU's Habitats, Birds, Water Framework Directive and, if not covered by the Water Framework Directive, the Marine Strategy Framework Directive, for achieving 'good ecological status' and 'good chemical status'.

The Mussel and Oyster Policy itself sets out to engender a 'green conversion' of shellfish fishing in Danish waters, while balancing both the desire to enable the development of the fishing industry through sustainable resource use and the intention of achieving the nature protection and water quality objectives established by the EU Directives cited above. Explicit within the policy is the intention, or target, to ensure that the impact of fishing by the UoAs is lower than the present day. The effect of this policy is evidenced by the active consideration of cumulative effects both within and outside Natura 2000 sites when considering management measures and the increasing protections, particularly in relation to habitat and ecosystem protection, that have been enacted year on year (e.g., exclusion zones buffering Natura 2000 sites; biogenic reef definition, mapping and protection).

The combination of EU-level and national legislation set out clear and explicit long-term objectives that guide decision-making that are consistent with MSC Principles and Criteria. While the CFP is explicit about the precautionary approach, and the Mussel and Oyster Policy and subsequent evidence of implementation imply a precautionary management approach, there is no direct evidence that the national management policy requires such explicit consideration of the precautionary approach in its objectives for shellfish fisheries management. Therefore, the requirements of SG60 and SG80 are fully met, and partially met for SG100.

References

BEK nr 1258 af 27/11/2019 *Bekendtgørelse om regulering af fiskeri efter muslinger og østers* (Executive Order on Mussel and Oyster Fishing)

Miljøstyrelsen. 2018. Dahl, K. and Petersen, J.K. (Editors) *Definition af biogene rev.* Miljøprojekt nr. 1992, Marts 2018. 26pp.

The Mussel and Oyster Policy:

Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for mudslinger- og østersskrab og øvrig muslinge- og østers production I og udenfor Natura 2000 områder (Objectives and management principles for mussel and oyster dredging and other mussel and oyster production in and outside Natura 2000 areas.”). 17pp. Available from: https://fiskeristyrelsen.dk/media/10650/muslinge-og-oesterspolitik.pdf Accessed on 29 March 2020.

Draft scoring range	**All UoAs ≥80**
Information gap indicator	**More information sought – updates and references from 2019-20**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**All UoAs 90**
Condition number (if relevant)	**NA**

PI 3.2.1 – Fishery-specific objectives

PI 3.2.1		The fishery-specific management system has clear, specific objectives designed to achieve the outcomes expressed by MSC's Principles 1 and 2		
Scoring Issue		SG 60	SG 80	SG 100
a	Objectives			
	Guide post	**Objectives**, which are broadly consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **implicit** within the fishery-specific management system.	**Short and long-term objectives**, which are consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **explicit** within the fishery-specific management system.	**Well defined and measurable short and long-term objectives**, which are demonstrably consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **explicit** within the fishery-specific management system.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Partial**

Rationale:

The long-term objectives set out by the EU's CFP and the Danish Fisheries Act for mussel fisheries nationally are applicable at the local level to all UoAs. Similarly, so are the objectives of the Nature Protection and Planning Acts that serve to protect aquatic, wildlife and water quality within the Natura 2000 sites (thereby giving effect to the EU Habitats, Birds and Water Framework Directives and, if not covered by the Water Framework Directive, the Marine Strategy Framework Directive).

The Mussel and Oyster Policy (covering mussels, oysters and cockles), as amended in 2019, translates those objectives further to more fishery-specific objectives and evidence of their local application can be seen in the suite of harvest controls that have been established in the UoAs to deliver sustainable development of mussels, oysters and cockles, the protection of specific Natura 2000 sites within each of the UoAs, and the protection of habitats and ecosystems both inside and outside Natura 2000 sites.

Long and short-term objectives are consistent with achieving the outcomes expressed by MSC's Principles 1 and 2 and are explicit within the fishery-specific management system. The requirements of SG60 and SG80 are therefore fully met.

The requirements of SG100 are partially met. For Principle 2, there are well defined, measurable short and long-term objectives in place to manage impacts of the UoAs on marine habitats within Natura 2000 sites and for habitat and ecosystem features outside Natura 2000 sites (e.g., biogenic reefs, macroalgae and eelgrass beds). However, objectives relevant to Principle 1 do not fully meet the SG100 requirements for all UoAs because of the absence of well-defined and measurable, i.e., explicit, short-term objectives for fishing in areas outside Natura 2000 sites.

References

BEK nr 1258 af 27/11/2019 *Bekendtgørelse om regulering af fiskeri efter muslinger og østers* (Executive Order on Mussel and Oyster Fishing)

Miljøstyrelsen. 2018. Dahl, K. and Petersen, J.K. (Editors) *Definition af biogene rev.* Miljøprojekt nr. 1992, Marts 2018. 26pp.

The Mussel and Oyster Policy:
Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for mudslinger- og østersskrab og øvrig muslinge- og østers production I og udenfor Natura 2000 områder (Objectives and management principles for mussel and oyster dredging and other mussel and oyster production in and outside Natura 2000 areas."). 17pp. Available from: https://fiskeristyrelsen.dk/media/10650/muslinge-og-oesterspolitik.pdf Accessed on 29 March 2020.

Draft scoring range	**All UoAs ≥80**
Information gap indicator	**More information sought – updates and references from 2019-20**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**All UoAs 90**
Condition number (if relevant)	**NA**

PI 3.2.2 – Decision-making processes

PI 3.2.2		The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives, and has an appropriate approach to actual disputes in the fishery		
Scoring Issue		SG 60	SG 80	SG 100
a	Decision-making processes			
	Guide post	There are **some** decision-making processes in place that result in measures and strategies to achieve the fishery-specific objectives.	There are **established** decision-making processes that result in measures and strategies to achieve the fishery-specific objectives.	
	Met?	**All UoAs Yes**	**All UoAs Yes**	
Rationale:				
The key decision-making processes that demonstrably result in measures and strategies to achieve the fishery-specific objectives in the UoAs are those established by the Fisheries Act, 2006 that set out the remit of the Mussel Advisory Committee, whose remit extends to all bivalve fisheries including mussels, oysters and cockles, and the delegated decision-making powers of the Danish Fisheries Agency and the relevant Minister. In all UoAs decision-making processes therefore meet the requirements of SG60 and SG80.				
b	Responsiveness of decision-making processes			
	Guide post	Decision-making processes respond to **serious issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take some account of the wider implications of decisions.	Decision-making processes respond to **serious and other important issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.	Decision-making processes respond to **all issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**
Rationale:				
Explanations of the recommendations of the Mussel Advisory Committee are published as minutes on the Danish Fisheries Agency website, along with supporting information that was considered when decisions were made. Subsequent Executive Orders provide evidence that final decision-making by the Ministry responds to the serious and other important issues that are identified, discussed and decided upon in Committee. The minutes demonstrate that the Committee is able to respond to serious and other important issues identified in relevant research, monitoring, evaluation and consultation in a transparent, timely and adaptive manner, and takes account of the wider implications of decisions. The SG60 and SG80 are therefore met, but it is not clear from reading a selection of minutes from several Committee meetings that decision-making processes respond to *all* issues, so the SG100 is not met.				
c	**Use of precautionary approach**			
	Guide post		Decision-making processes use the precautionary approach and are based on best available information.	
	Met?		**All UoAs Yes**	

Rationale:
The management system within all UoAs is precautionary; dredging for shellfish is not permitted within waters shallower than 3m in Danish territorial waters, leaving significant stocks of mussels, oysters and cockles unfished. Within Natura 2000 sites there is a highly precautionary approach to decision-making (based on Article 6 of the Habitats Directive) that ensures that the supply of prey for shellfish eating birds and the cumulative impacts of shellfish fishing on marine habitats do not exceed 15%. Decisions on all aspects of the fishery, from the determination of closed areas to the setting of TACs and specification of fishing gear use the best available information supplied by DTU Aqua. The requirements of SG80 are met for all UoAs.

d	Accountability and transparency of management system and decision-making process			
	Guide post	Some information on the fishery's performance and management action is generally available on request to stakeholders.	**Information on the fishery's performance and management action is available on request**, and explanations are provided for any actions or lack of action associated with findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.	Formal reporting to all interested stakeholders **provides comprehensive information on the fishery's performance and management actions** and describes how the management system responded to findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**

Rationale:
Information about fishery performance and landings of shellfish for each production area are publicly available on the Danish Fisheries Agency website for all fishing years since 2001, including the current fishing year. TAC allocations for relevant defined fishing areas are published through regulation and are publicly available prior to every fishing season. Reports and audits relevant to subsidies and grants in Danish fisheries are available publicly. Summaries of fishing activity in the UoAs are provided in relevant published impact assessment reports for each of the Natura 2000 sites where fishing is proposed or takes place and are publicly available from the DTU Aqua website – these contain the management recommendations, some generated by the fishers themselves, and are based on monitoring of shellfish and natural habitats in these areas. Meetings of the Mussel Advisory Committee are provided with comprehensive reports of fishery performance, progress with research, management of fishing and its impacts in Natura 2000 sites, and updates on other issues including compliance and enforcement, that are relevant to the management of mussels, oysters and other shellfish in the UoAs. The minutes of Committee meetings are published in the public domain and provide a formal and comprehensive record for interested stakeholders about how the management system has responded to findings and relevant recommendations emerging from research, monitoring, evaluation and review activity. The level of reporting and accessibility of information for all UoAs meets the requirements of SG60, SG80 and SG100 and clearly demonstrates the extent to which transparency and accountability are embedded within the management system.

e	Approach to disputes			
	Guide post	Although the management authority or fishery may be subject to continuing court challenges, it is not indicating a disrespect or defiance of the law by repeatedly violating the same law or regulation necessary for the sustainability for the fishery.	The management system or fishery is attempting to comply in a timely fashion with judicial decisions arising from any legal challenges.	The management system or fishery acts proactively to avoid legal disputes or rapidly implements judicial decisions arising from legal challenges.

	Met?	All UoAs Yes	All UoAs Yes	All UoAs Yes

Rationale:

There is no evidence that the management authority or fishery has shown disrespect or defiance of the law, nor repeatedly violated the same law or regulation necessary for the sustainability of the fishery. In 2020, there is also no evidence of any current or recent legal challenges through the courts, nor any judicial action.

The complaint brought in 2009 by the Danish Society for Nature Conservation (Danmarks Naturfredningsforening) to the European Parliament about the management of the fishery within Natura 2000 sites resulted in timely and significant improvements to impact assessment processes, and therefore the management system, that addressed concerns raised by the European Commission in their review of the complaint. The Commission closed the complaint in 2014. Proactive action by Danish authorities, in collaboration with stakeholders resulted in the Mussel and Oyster Policy, and subsequently updated with additional ecosystem-related management features in Udenrigsministeriet, 2019. This is said to have resolved the complaint and avoided a legal dispute between the government and other parties over the matter. The matter is now closed.

The information available demonstrates that the shellfish fisheries and the management system meet the requirements of SG60, SG80 and SG100.

References

Minutes of Mussel Advisory Committee meetings from 2005-2020 available from: https://fiskeristyrelsen.dk/raad-og-udvalg/muslingeudvalget/moedereferater/ Accessed 25 November 2020.

Udenrigsministeriet, May 2019. Målsætninger og forvaltningsprincipper for mudslinger- og østersskrab og øvrig muslinge- og østers production I og udenfor Natura 200 områder (Objectives and management principles for mussel and oyster dredging and other mussel and oyster production in and outside Natura 2000 areas.”). 17pp. Available from: https://fiskeristyrelsen.dk/media/10650/muslinge-og-oesterspolitik.pdf Accessed on 29 March 2020.

Draft scoring range	**All UoAs ≥80**
Information gap indicator	**More information sought – updates and references from 2019-20**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**All UoAs 95**
Condition number (if relevant)	**NA**

PI 3.2.3 – Compliance and enforcement

PI 3.2.3		Monitoring, control and surveillance mechanisms ensure the management measures in the fishery are enforced and complied with		
Scoring Issue		SG 60	SG 80	SG 100
a	MCS implementation			
	Guide post	Monitoring, control and surveillance **mechanisms** exist, and are implemented in the fishery and there is a reasonable expectation that they are effective.	A monitoring, control and surveillance **system** has been implemented in the fishery and has demonstrated an ability to enforce relevant management measures, strategies and/or rules.	A **comprehensive** monitoring, control and surveillance system has been implemented in the fishery and has demonstrated a consistent ability to enforce relevant management measures, strategies and/or rules.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**

Rationale:

The Danish Fisheries Agency implements a comprehensive monitoring, control and surveillance system.

This system requires that all fishing vessels report their catch and landings, which are cross-referenced to processor records. The movements and activities of all fishing vessels are monitored using electronic “black box” recorders that use GPS data and sensors attached to vessel winch gear to determine the vessel location, speed, and whether or not its fishing gear is deployed.

Electronic weighing of landed catch is required, and the data is simultaneously transmitted to the Fisheries Agency.
Danish Fisheries Agency officers are locally based around Limfjord and other territorial waters and carry out patrols on land and at sea to verify the accuracy of catch and landings records, inspect processing facilities, and inspect fishing gear and vessels. This information is collected and analysed by the Fisheries Agency to determine that every fishing trip and dredge tow carried out by every fishing vessel is recorded and checked for compliance with regulations.

A control campaign relating to compliance with relevant engine power regulations has been initiated in the first half of 2021 and will encompass almost all vessels in the Limfjord.

The level of monitoring of fishing activity in all UoAs using electronic equipment, coupled with verification of remote surveillance by on-site fishery officers demonstrates a consistent ability to enforce relevant management measures, strategies and rules.

The requirements of SG60, SG80 and SG100 are fully met for all UoAs.

b	Sanctions			
	Guide post	Sanctions to deal with non-compliance exist and there is some evidence that they are applied.	Sanctions to deal with non-compliance exist, **are consistently applied** and thought to provide effective deterrence.	Sanctions to deal with non-compliance exist, are consistently applied and **demonstrably** provide effective deterrence.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**

Rationale:

In cases of non-compliance, the authorities can apply a range of penalties, including heavy economic sanctions and even the loss of a fishing licence, as well as the reduction of quota in subsequent fishing years. Sanctions have been consistently applied and in the past severe infractions were tried in the courts.

There is currently reported to be a very high level of compliance with regulations across all UoAs and fishers consistently report that the level of monitoring and control, combined with the management requirements, demonstrably provide effective deterrence by “levelling the playing field” for all fishers.

The combination of sanctions and their consistent application can be said to demonstrably provide effective deterrence. The requirements of SG60, SG80 and SG100 are fully met for all UoAs.

c	Compliance			
	Guide post	Fishers are **generally thought** to comply with the management system for the fishery under assessment, including, when required, providing information of importance to the effective management of the fishery.	**Some evidence exists** to demonstrate fishers comply with the management system under assessment, including, when required, providing information of importance to the effective management of the fishery.	There is a **high degree of confidence** that fishers comply with the management system under assessment, including, providing information of importance to the effective management of the fishery.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**

Rationale:

Compliance with fisheries regulations is reported at the national level by the Danish Fisheries Agency on an annual basis. Annual reports indicate that the UoAs comply well with all regulations, with no systematic issues of non-compliance. Local enforcement staff also consistently report that the compliance with regulations is generally good. The monitoring of all fishing trips by all fishing vessel using the Fisheries Agency’s “black box” electronic equipment provides a high degree of confidence that the management system offers both a deterrent to non-compliance and mechanisms for detecting any transgressions with respect to spatial and temporal controls, which are key aspects of the shellfish fishery management system throughout all Danish territorial waters, including the waters of each of the UoAs. The advance reporting of landing times to enable targeted on-site inspection, plus the requirements for electronic weighing of catch and simultaneous transmission of landing data to the authorities adds to the high degree of confidence expressed by enforcement officers and fishers alike that logbooks are accurate and true weights are being recorded and that quotas and catch limits are being complied with.

The fishing industry provides information to the Danish Fisheries Agency about the abundance and character of mussels, oysters and other species in different shellfish production areas as the fishing season progresses and provide samples of shellfish for hygiene analysis before the production areas are opened.

The SG60 and SG80 are met for all UoAs. While there is a high degree of confidence in the level of compliance with specific mussel, oyster and cockle fishing rules and regulations in each of the UoAs and that fishers provide information which is important for the effective management of each of the UoAs in the fishery under assessment, there are the outstanding allegations being investigated in relation to the more general engine power rules for Danish fishing vessels that are the subject of a dedicated control campaign in 2020-21, particularly in Limfjord. The SG100 is not met therefore for all UoAs.

d	Systematic non-compliance			
	Guide post		There is no evidence of systematic non-compliance.	
	Met?		**All UoAs No**	

Rationale:

Compliance with fisheries regulations is reported at the national level by the Danish Fisheries Agency on an annual basis, including the number of infringements detected in each fishery. The annual report indicates that the shellfish dredge fisheries comply well with all regulations related to fisheries-specific management rules, with no systematic issues of non-compliance identified. Similarly, local enforcement staff also consistently report that the compliance with relevant regulations is generally very good, and Agency enforcement staff also confirmed that there is no evidence of systematic non-compliance in relation the regulations emerging from the Mussel and Oyster Policy in any of the UoAs.

However, a control campaign was initiated in 2020-21 to investigate allegations about non-compliance with the more general engine power rules that apply across Danish fisheries that emerge from the EU's Common Fisheries Policy rather than fishery-specific management rules in the UoAs undergoing reassessment. As the allegations were levelled at mussel and oyster vessels, the control campaign has a particular focus so far in Limfjord. While Danish Fishery Agency enforcement staff informally reported to the assessment team that by early 2021 no systematic non-compliance had been discovered and that the allegations so far appeared unfounded, the investigation was incomplete at the time of the reassessment. The intent of this scoring guidepost, according to the MSC, is that there is "*simultaneously adequate evidence to assess the compliance of the fishery and no evidence of infringements that occur regularly*". On that basis and as the investigation is, at the time of writing, incomplete in regard to the question of engine power, the requirements for this scoring guidepost (SG80) have not been met and a condition has been raised in relation to completing the engine power control campaign and publishing the findings.

References

Annual reports for fisheries control going back to 2012 published on Danish Fisheries Agency website: https://fiskeristyrelsen.dk/erhvervsfiskeri/kontrol/aarsrapport/ Accessed on 25 November 2020

Fiskeristyrelsen (2019) *Fiskerikontrol 2018*. 16pp. Available from: https://fiskeristyrelsen.dk/media/11535/aarsrapport-fiskerikontrol-2018.pdf Accessed on 25 November 2020

RDA. 2019. Study on engine power verification by Member States. Written by Roos Diesel Analysis B.V. June 2019. Published by DG-Maritime Affairs and Fisheries, European Commission. 120pp.

Draft scoring range	**All UoAs ≥80**
Information gap indicator	**More information sought – updates and references from 2019-20**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**All UoAs 75**
Condition number (if relevant)	**4**

PI 3.2.4 – Monitoring and management performance evaluation

PI 3.2.4		There is a system of monitoring and evaluating the performance of the fishery-specific management system against its objectives There is effective and timely review of the fishery-specific management system		
Scoring Issue		SG 60	SG 80	SG 100
a	Evaluation coverage			
	Guide post	There are mechanisms in place to evaluate **some** parts of the fishery-specific management system.	There are mechanisms in place to evaluate **key** parts of the fishery-specific management system.	There are mechanisms in place to evaluate **all** parts of the fishery-specific management system.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs Yes**

Rationale:

An independent committee was appointed by the government in 2004 to formally review all parts of the management system for shellfish fisheries in Denmark. This led to a major revision of the fisheries legislation including the creation of the statutory stakeholder body the Mussel Advisory Committee with a remit for all shellfish management. This committee conducts regular (annual) evaluations of the fishery-specific management system for the UoAs.

In 2018, the Danish government via the Ministry undertook a review of the Mussel and Oyster Policy itself, publishing an updated version in May 2019. Changes included: a new policy 'track' on developing and managing new shellfish fisheries (e.g., Pacific oysters); and defining biogenic reefs to enable future management. The next evaluation of the Mussel and Oyster Policy is planned for 2021 and officials have declared the intention to integrate a management plan governing habitat modification such as the removal and relaying of stones, as well as further mapping of biogenic reefs.

At a European level, there are a number of mechanisms in place to review the overarching CFP legislation and supporting mechanisms. The European Commission reviews the CFP every ten years. The most recent outcomes, implemented in 2014, of a revised EU regulation are stronger ecosystem-based management principles, reduction of discarding, and greater stakeholder engagement in fisheries management.

The ongoing level of scrutiny of the UoAs, specifically and in the wider context, demonstrates that there are mechanisms in place to evaluate all parts of the fishery-specific management system. The requirements for SG60, SG80 and SG100 are met for all UoAs.

b	Internal and/or external review			
	Guide post	The fishery-specific management system is subject to **occasional internal** review.	The fishery-specific management system is subject to **regular internal** and **occasional external** review.	The fishery-specific management system is subject to **regular internal and external** review.
	Met?	**All UoAs Yes**	**All UoAs Yes**	**All UoAs No**

Rationale:

The fishery-specific management system is subject to regular internal review by the Mussel Advisory Committee that involves the wide range of interested stakeholder representatives described earlier in this report and in relation to the evaluation of the fishery for PI 3.1.2.

In 2018, the Danish government via the Ministry undertook an internal review of the Mussel and Oyster Policy itself, publishing an updated version in May 2019. Changes included: a new policy 'track' on developing and managing new shellfish fisheries (e.g., Pacific oysters); and defining biogenic reefs to enable future management. The next evaluation and therefore review of the Mussel and Oyster Policy are planned for 2021 and as noted above, officials have declared the intention to integrate a management plan governing habitat modification such as the removal and relaying of stones, as well as further mapping of biogenic reefs

The fishery-specific management system is also subject to occasional external review, as evidenced by the 2004 independent legislative review commissioned by the government that made specific shellfish fishery-related recommendations that were implemented in the subsequent new legislation that became the Fisheries Act, 2006 and the updated Mussel and Oyster Policy, but since then there has been no external review.

Whilst the fishery-specific management system is subject to regular internal and occasional external review and therefore the requirements for SG60 and SG80 are met, there is no evidence that there is regular external review and therefore the SG100 is not met.

References

Danish Fisheries Act, 2006:
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The Mussel and Oyster Policy:
Udenrigsministeriet. 2019. Målsætninger og forvaltningsprincipper for mudslinger- og østersskrab og øvrig muslinge- og østers production I og udenfor Natura 2000 områder (Objectives and management principles for mussel and oyster dredging and other mussel and oyster production in and outside Natura 2000 areas."). 17pp. Available from: https://fiskeristyrelsen.dk/media/10650/muslinge-og-oesterspolitik.pdf Accessed on 29 March 2020.

Draft scoring range	**All UoAs ≥80**
Information gap indicator	**More information sought – updates and references from 2019-20**

Overall Performance Indicator scores added from Client and Peer Review Draft Report

Overall Performance Indicator score	**All UoAs 90**
Condition number (if relevant)	**NA**

Principle 3 References

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Danish Fisheries Act, 2006:
Bekendtgørelse af fiskerilov. LBK nr 372 af 26/04/2006, Fødevareministeriet . Updated by *Bekendtgørelse af fiskerilov* LBK nr 261 af 21/03/2019 https://www.retsinformation.dk/Forms/R0710.aspx?id=208281 Accessed on 29 March 2020.

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8 Appendices

8.1 Assessment information

8.1.1 Previous assessments

This fishery reassessment covers four UoAs previously assessed and certified under three separate certificates. UoAs 1 and 2 covering mussels and cockles respectively in the Limfjord were previously certified in January 2016 under the DFPO Limfjord Mussel and Cockle Fishery MSC-F-31219 (MRAG-F_0050). UoA 3 covering oysters in the Limfjord was previously certified in May 2017 under the DFPO Limfjord oyster dredge fishery MSC-F-31306 (F-ACO-0066), and UoA 4 covering mussels in Danish inland waters was previously certified in May 2017 under the DFPO Inner Danish Waters blue shell mussel fishery MSC-F-31307 (MRAG-F-0065).

At the previous assessment of the DFPO Limfjord mussel and cockle fishery, there was one condition raised in relation to Performance Indicator 3.2.4 (Research Plan) for the Cockle Unit of Assessment. This condition remained open at the third surveillance audit in 2019 but was closed at the fourth surveillance audit that was undertaken in conjunction with the site visit for the reassessment. A variation request to the MSC was accepted to allow this reassessment to be undertaken as a reduced reassessment despite all conditions not being closed at the third annual surveillance audit on the basis that there was evidence available to close the outstanding condition during the 4th surveillance (see link below).

https://fisheries.msc.org/en/fisheries/dfpo-limfjord-mussel-and-cockle-fishery/@@assessments

For the DFPO Limfjord oyster dredge fishery and the DFPO Inner Danish Waters blue shell mussel fishery, there were no conditions raised at the previous assessment.

Table 31. Summary of previous assessment conditions

Condition	PI(s)	Year closed	Justification
Limfjord cockle fishery Condition 1	PI 3.2.4 Research Plan	Closed in 2020 at 4th surveillance audit	A research plan for the cockle fishery had been drawn up and implemented through EMFF funding, the results of the major EMFF-funded research project had been disseminated to all stakeholders at the Mussel Advisory Committee, and a further collaborative research project had been agreed.

8.1.2 Small-scale fisheries

Table 32. Small-scale fisheries

Unit of Assessment (UoA)	Percentage of vessels with length <15m	Percentage of fishing activity completed within 12 nautical miles of shore
UoA 1 Limfjord mussels	80% (maximum length 12m, but four larger boats have historical rights)	100%
UoA 2 Limfjord cockles	80% (maximum length 12m, but four larger boats have historical rights)	100%
UoA 3 Limfjord oysters	100% (Maximum length 15m)	100%
UoA 4 Inner Danish Waters mussels	80% (maximum length 12m, but four larger boats have historical rights)	100%

8.2 Evaluation processes and techniques

8.2.1 Site visits

The reassessment process as defined in the MSC Fishery Certification Process version 2.1 was followed in this fishery reassessment.

Information supplied by the client, management agencies, scientists and environmental NGOs was reviewed by the surveillance audit team ahead of the off-site meeting, and discussions with the client, management agencies, scientists, fishers' representatives and eNGOs centred on the content within the provided documentation. In cases where relevant documentation was not provided in advance of the meeting, it was requested by the audit team and subsequently supplied during, or shortly after the meeting.

Thirty days prior to the audit site visit, all stakeholders were informed of the visit and given the opportunity to provide information to the auditors in advance of, or during, the site visit. WWF and Danmarks Naturfredningsforening (The Danish Society for Nature Conservation) made a written submission and the audit team met with WWF as part of the audit. No other written submissions were received from stakeholders, and there were no requests from other stakeholders to meet with the surveillance audit team.

The site visit was held remotely by Skype and Zoom with the Client, DFPO, the Danish Fisheries Agency and Ministry of Environment and Food, the lead scientist from DTU Aqua, fishers' representatives and WWF on 13, 14 and 21 August and 3 September 2020. The MSC Covid-19 Pandemic Derogation allowed CABs to conduct the site visit remotely for the duration of the derogation period (27th March 2020 – 27th September 2020). The site visit was held in conjunction with the annual surveillance audits for the DFPO Limfjord Mussel and Cockle Fishery MSC-F-31219 (MRAG-F_0050), the DFPO Limfjord oyster dredge fishery MSC-F-31306 (F-ACO-0066), and the DFPO Inner Danish Waters blue shell mussel fishery MSC-F-31307 (MRAG-F-0065). Table 33 list the participants who were in attendance during part, or all of the meetings held during the site visit, and Table 34 summarizes the agenda for the Skype and Zoom meetings held on 13, 14 and 21 August and 3 September 2020.

Table 33. Site visit participants.

Name	Affiliation
Julian Addison	Independent Fisheries Consultant, MRAG Americas assessment team
Chris Grieve	Meridian Prime, MRAG Americas assessment team
Sofie Smedegaard Mathiesen	DFPO, client
Henrik Lund	DFPO
Anja Gadgård Boye	Danish Fisheries Agency, Policy
Iben Astrup	Danish Fisheries Agency, Control Unit
Janne Palomino Dalby	Fisheries Department, Ministry of Environment and Food
Jens K. Petersen	DTU Aqua
Bo Husted	Centralforening for Limfjorden
Henrik Nielsen	Chairman, Foreningen Muslingeerhvervet
Stig Wittrup	Mussel fisher and vessel owner
Henrike Semmler Le	WWF, Denmark
Philipp Kanstinger	WWF, Germany

Table 34. Site visit agenda

Date	Time	Item	Participants	Supporting documents
13 August 2020	0900	Meeting with Client	Julian Addison Chris Grieve	Previous full assessment reports (MRAG, 2016; Andrews *et al.*,

			Sofie Smedegaard Mathiesen Henrik Lund	2017; Addison *et al*., 2017) and surveillance audit reports. List of vessels participating in the fishery. Client submission.
13 August 2020	1000	Meeting with DTU Aqua	Julian Addison Chris Grieve Jens K. Petersen Sofie Smedegaard Mathiesen	Impact assessments of fishing for mussels, oysters and starfish in Limfjord and for mussels in the Inner Danish Waters Methods for estimating mussel biomass. Recent research on cockle population dynamics and stock abundance in Limfjord. Recent research on developing methods to detect potential effects of bivalve dredging on benthic fauna at local and regional scales. Previous full assessment reports (MRAG, 2016; Andrews *et al*., 2017; Addison *et al*., 2017) and surveillance audit reports.
13 August 2020	1400	Meeting with Fisheries Agency and Fisheries Department, Ministry of Environment and Food	Julian Addison Chris Grieve Anja Gadgård Boye Janne Palomino Dalby Iben Astrup Sofie Smedegaard Mathiesen	Previous full assessment reports (MRAG, 2016; Andrews *et al*., 2017; Addison *et al*., 2017) and surveillance audit reports. Updated Executive Order regulating mussel and oyster fisheries, and other changes in regulations. Data on TACs and landings for Limfjord mussel, cockle and oyster fisheries and Inner Danish Waters mussel fishery. Information on infringements in the Limfjord mussel, cockle and oyster fisheries and Inner Danish Waters mussel fishery.
14 August 2020	0900	Meeting with Limfjord mussel, cockle and oyster fishers' representatives	Julian Addison Chris Grieve Bo Husted Henrik Nielsen Sofie Smedegaard Mathiesen	Previous full assessment reports (MRAG, 2016; Andrews *et al*., 2017) and surveillance audit reports. Updated Executive Order regulating mussel and oyster fisheries, and other changes in regulations. Data on TACs and landings for Limfjord mussel and cockle fisheries.
14 August 2020	1000	Meeting with Inner Danish Waters mussel fisher and vessel owner	Julian Addison Chris Grieve Stig Wittrup	Previous full assessment report (Addison *et al*., 2017) and surveillance audit reports.

			Sofie Smedegaard Mathiesen	Updated Executive Order regulating mussel and oyster fisheries, and other changes in regulations. Data on TACs and landings for Inner Danish Waters mussel fisheries.
21 August 2020	0900	Meeting with WWF	Henrike Semmler Le Philipp Kanstinger	Previous full assessment reports (MRAG, 2016; Andrews *et al*., 2017; Addison *et al*., 2017) and surveillance audit reports. Recent research on developing methods to detect potential effects of bivalve dredging on benthic fauna at local and regional scales.
3 September 2020	1500	Closing meeting with Client	Julian Addison Chris Grieve Sofie Smedegaard Mathiesen	Previous full assessment reports (MRAG, 2016; Andrews *et al*., 2017; Addison *et al*., 2017) and surveillance audit reports. Information on infringements in the Limfjord mussel and cockle fisheries.

8.2.2 Stakeholder participation

The Client, DFPO, the Danish Fisheries Agency, the Fisheries Department, Ministry of Environment and Food, DTU Aqua, mussel, cockle and oyster fishers' representatives and WWF participated in the site visit. All other stakeholders were contacted prior to the audit meetings and given an opportunity to provide written submissions or to meet with the assessment team. Other than WWF, no such opportunities were taken up.

8.2.3 Evaluation techniques

The Announcement Comment Draft Report was based on a desk-top study with information received from the client including the client document checklist and on information available in the original certification reports and subsequent surveillance audit reports. Based on this information, the RBF was triggered for PI 1.1.1 for UoA 2 (Limfjord cockles), UoA 3 (Limfjord oysters) and UoA 4 (Inner Danish Waters mussels) and PI 2.2.1 for starfish as a main secondary species in UoA 2 (Limfjord cockles) and UoA 3 (Limfjord oysters). The default assessment tree from Annex SA of the MSC Fisheries Standard v2.01, without any modifications, was used for this assessment.

Information on the assessment process was made publicly available through www.msc.org at all stages of the assessment. MRAG Americas, Inc. published the assessment announcement along with the Announcement Comment Draft Report and the timeline for the assessment on 9 July 2020 on the MSC website and followed by stakeholder notifications by direct emails. In addition, all relevant stakeholders identified at the beginning of the assessment were reached through direct e-mails and given a possibility to provide feedback to the assessment team.

Relevant main stakeholders were interviewed at the remote site visit in August and September 2020 as described in section 8.2.1 above. The site visit was held remotely as the MSC Covid-19 Derogation published on 20 March 2020 allowed CABs to conduct assessment site visits as off-site visits for the duration of the 6-month derogation period (27th March 2020 – 27th September 2020). Stakeholders provided additional information during those meetings and in follow-up e-mails. Information gathered during those meetings is presented in this report. In addition, WWF presented information in two subsequent e-mails to the assessment team, and that information and the assessment team's response is included in section 8.4 below.

Information was reviewed by the assessment team at scoring meetings held on 16 September 2020, 17 November 2020, 10 February 2021 and 9 April 2021 and through e-mail correspondence. The team discussed evidence together, weighed up the balance of evidence and used their judgement to agree on a final score following MSC FCRv2.1 processes and based on consensus.

Scores for individual Performance Indicators are assigned in increments of five points. Any divisions of less than five points are justified. Overall scores for each of the three Principles are reported to the nearest one decimal point. In Principles 1 and 2 the scoring may include PIs with multiple scoring elements. Scoring is then applied to the individual scoring elements and the overall score for the PI is determined based on the score of the different scoring elements.

In order to fulfil the requirements for certification the following minimum scores are required:

- The fishery must obtain a score of 80 or more for each of the three MSC Principles, based on the weighted aggregate scores for all Performance Indicators under each Principle.

- The fishery must obtain a score of 60 or more for each individual scoring issue under each Performance Indicator in each Principle.

Conditions are set where the fishery fails to achieve a score of 80 to any Performance Indicators. Conditions with milestones are set to result in improved performance to at least the 80 level within a period set by the assessment team. The client is required to provide a Client Action Plan to be accepted by the assessment team.

The Risk Based Framework (RBF) was used to score PI 1.1.1 for UoA 2 (Limfjord cockles), UoA 3 (Limfjord oysters) and UoA 4 (Inner Danish Waters mussels) because for these three stocks there are no reference points available, derived either from analytical stock assessments or using empirical approaches.

The RBF was also used to score PI 2.2.1 for starfish as a main secondary species in UoA 2 (Limfjord cockles) and UoA 3 (Limfjord oysters) because there are no biologically based limits for starfish, derived either from analytical stock assessments or using empirical approaches.

The justification for using the RBF for these PIs was announced on 9 July 2020 on the MSC website, and all registered stakeholders were notified of the proposal to use the RBF. As part of the Fishery Announcement on the MSC website, in line with MSC Fisheries Certification Process v2.1, PF2.3.2, it was announced that “A key purpose of the site visit is to collect information and speak to stakeholders with an interest in the fishery. For those parts of the assessment involving the MSC’s Risk-Based Framework (RBF, see msc.org), we will be using a stakeholder-driven, qualitative and semi-quantitative analysis during the site visit. To achieve a robust outcome from this consultative approach, we rely heavily on participation of a broad range of stakeholders with a balance of knowledge of the fishery. We encourage any stakeholders with experience or knowledge of the fishery to participate in these meetings.”

RBF stakeholder consultation was carried out during the site visit, but as all meetings were held remotely, it was not possible to hold a single RBF workshop with all stakeholders, and so consultation on RBF scoring was included in each individual stakeholder meeting. For PI 1.1.1 for UoA 2 (Limfjord cockles), UoA 3 (Limfjord oysters) and UoA 4 (Inner Danish Waters mussels), the RBF had been used in the original MSC assessments, and therefore these scores were used as a starting point for the discussions with each stakeholder on current RBF scores for the three UoAs. The focus was therefore on likely changes to the risk of the fishery to the relevant species. For PI 2.2.1 for starfish in UoA 2 (Limfjord cockles) and UoA 3 (Limfjord oysters), information for the scoring of Consequence Analysis (CA) and Productivity Susceptibility Analysis (PSA) was obtained from the various stakeholder meetings.

The verbal input from stakeholders is incorporated in the rationales given in the scoring tables for both the Consequence Analysis (CA) and Productivity Susceptibility Analysis (PSA). As part of their written stakeholder input, WWF included some comments on scoring of the RBF for PI 1.1.1, and these comments and the assessment team’s responses are included in section 8.4.

8.3 Peer Review reports

Peer Reviewer General Comments

Fishery	Assess-ment Start Year	Peer Reviewer (A/B/C)	Question	Yes/No	Peer Reviewer Justification (as given at initial Peer Review stage). Peer Reviewers should provide brief explanations for their 'Yes' or 'No' answers in this table, summarising the detailed comments made in the PI and RBF tables.	CAB Response to Peer Reviewer's comments (as included in the Public Comment Draft Report - PCDR)
DFPO mussel, cockle and oyster	2020	PR A	Is the scoring of the fishery consistent with the MSC standard, and clearly based on the evidence presented in the assessment report?	No	Answer should be Yes and No. This is a thorough, well written report. The CAB and assessment team are clearly experienced with this fishery which is reflected in the great amount of detail presented. In most cases, this level of detail was also present in the scoring rationales - this is with the exception of the ETP species performance indicators which I believe need more evidence to support the scores. Additionally, based on the information presented, I do not agree with the condition that was raised against 1.2.1f (cockle UoA) and believe a condition would be appropriate against 3.2.3d (all UoAs). Overall however, I applaud the team for putting a lot of effort into this reduced reassessment.	Thank you for your positive comments on the report generally. More detail has been added to both the background information on ETP species and to the scoring rationales for the relevant Performance Indicators. The comment that there was not sufficient justification for raising a condition against PI 1.2.1f for cockles (UoA 2) is accepted. The rationale was more appropriate under SIa for which the score was reduced from 100 to 80. The score for SIf was increased from 60 to 80 and the condition removed. A new condition has been raised against PI 3.2.3d.
DFPO mussel, cockle and oyster	2020	PR A	Are the condition(s) raised appropriately written to achieve the SG80 outcome within the specified timeframe? [Reference: FCP v2.2, 7.18.1 and sub-clauses]	Yes	Although I do not agree with the condition against 1.2.1f (cockle UoA) all conditions and milestones are appropriately drafted and will ensure the fishery achieves the SG80 score within the recertification period.	The condition on PI 1.2.1f for cockles (UoA 2) has been removed.

DFPO mussel, cockle and oyster	2020	PR A	Is the client action plan clear and sufficient to close the conditions raised? [Reference FCR v2.0, 7.11.2-7.11.3 and sub-clauses]	NA	Note: Include this row for assessments completed against FCR v1.3 and v2.0, but not for FCP v2.1/v2.2 (in which the client action plan is only prepared at the same time as the peer review). Delete this text from the cell for FCR v1.3/v2.0 reviews or delete the whole row if FCP v2.1/v2.2.	No response required.
DFPO mussel, cockle and oyster	2020	PR A	Enhanced fisheries only: Does the report clearly evaluate any additional impacts that might arise from enhancement activities?	No	The assessed fishery is not enhanced; however throughout the report several references are made to relaying and transplanting activities which would make it an enhanced fishery. E.g. Page 28: *There are two vessels licensed to relay mussel seed in Isefjord waters.* P 73: *To further safeguard recruitment, there is a relaying strategy for the fishery whereby a communal vessel, "Limfjord", has a licence to dredge seed mussel and relay it in more productive areas.* P 75: *In addition, small non-commercial mussels will be relayed in the Limfjord to allow them to 'grow-on' to a commercial size.* P. 40*: During the fishing season 2019/2020 (September 2019 through June 2020), fishing and transplantation of mussels were carried out in Lovns Bredning in an estimated area of 1.8 km2, which equates to 2.7% of the total area of Lovns Bredning.* P. 45*: For the 2020/21 fishing season in Løgstør Bredning, DFPO submitted plans for a total quota for catching and transplanting mussels of 6,500 tonnes.* Etc! The report should explain to what extent these activities are covered by the assessment. If they are not, then this would need to be considered in the traceabilty section as well.	The peer reviewer raises a very important question as to why the mussel fisheries in UoAs 1 and 4 were not considered as enhanced bivalve fisheries, and the assessment team accepts that the report should have provided some explanation. As the peer reviewer correctly notes, mussels below commercial size are relayed in the Limfjord and in the Inner Danish Waters fisheries. However, these are not conventional enhanced mussel fisheries where seed mussels are dredged and moved, sometimes long distances, on to (often) private mussel plots and then grown on to commercial sizes. In the Limfjord (UoA 1) the Foreningen Muslingeerhvervet's vessel Limfjorden is used to undertake surveys of mussel distribution and abundance to inform the whole fleet, and this is the only vessel that is permitted to harvest mussels for relaying that are under the minimum landing size of 50mm. The purpose of the relaying is to move mussels under the minimum size from areas where oxygen depletion events are common to other areas with better growth conditions within the same basin in order to increase the survival chances of the relayed mussels. Foreningen Muslingeerhvervet and the Client report that 10,000 tonnes of relayed mussels would be re-harvested at a weight of 20,000 tonnes, which is a relatively small increase in size/weight in comparison with conventional enhanced mussel fisheries where relayed seed mussels would be re-harvested at many times their

							original weight when they reach commercial size. Within the Inner Danish Waters mussel fishery (UoA 4) where two vessels are licensed for relaying mussels, sub-commercial sized mussels are relayed for similar reasons and in a similar manner. The assessment team considered whether such relaying activities should be treated as an enhanced bivalve fishery under MSC FCP v2.1, 7.4.6, Table 1, and explored any subsequent scoring implications. The key considerations are whether the fishery involves translocations, and if not, whether the fishery negatively impacts on the parent stock. As mussels are moved only within a basin, then it can be concluded that translocation does not occur, and therefore there would no requirement to score any enhanced fishery under the genetics outcome PI 1.1.3 or under the translocation PIs 2.6.1, 2.6.2 and 2.6.3 as set out in Annex SB of the MSC Fisheries Standard v2.01. As the relaying process in UoAs 1 and 4 is designed to enhance the growth potential of relayed mussels, the assessment team concluded that the relaying process is highly likely to positively, and not negatively, impact the stock. Annex SB 2.1.4 states that if the fishery does not negatively impact the stock, then the assessment team may choose not to score Principle 1. As the main component of the mussel fisheries in UoAs 1 and 4 is the wild fishery, the assessment team considered that it was essential to score Principle 1. Within Natura 2000 sites, the area impact of the fishery includes an evaluation of any mussels harvested for relaying. In conclusion, classifying the two UoAs as enhanced bivalve fisheries would not require any additional PIs to be scored and could result in Principle 1 not being scored for some components of the

						fishery, and therefore the assessment team concluded that using the default assessment tree for UoAs 1 and 4 provides a more comprehensive evaluation of the potential impact of the fisheries on the mussel populations than if the fisheries were designated as enhanced bivalve fisheries. Explanatory text has been added to section 5.1.1 justifying the approach taken by the assessment team.
DFPO mussel, cockle and oyster	2020	PR A	Optional: General Comments on the Peer Review Draft Report (including comments on the adequacy of the background information if necessary). Add extra rows if needed below, including the codes in Columns A-C.	NA	Page 27-28: caption issues: Section 7.2.3: History of the Fishery has multiple "section 0".	The correct cross-references to section 7.3.2 have now been added.

DFPO mussel, cockle and oyster	2020	PR A	Optional: General Comments on the Peer Review Draft Report (including comments on the adequacy of the background information if necessary). Add extra rows if needed below, including the codes in Columns A-C.	NA	Page 42: caption isssue - figure 15 appears to be embedded in the cross-reference.	The error has been corrected.

Peer Reviewer PI Comments

Fishery	Year	UoA stock	UoA gear	PR (A/B/C)	PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification (as given at initial Peer Review stage)	CAB Response to Peer Reviewer's comments (as included in the Public Comment Draft Report - PCDR)	CAB Res-ponse Code
DFPO mussel, cockle and oyster	2020	Blue mussel - Limfjord	Mussel dredge	PR A	1.1.1	Yes	Yes	NA	I probably would have been tempted to apply the RBF to score this stock (in accordance with Table 3 of the FCP2.1) however I agree we may be in a bit of grey area of the standard and I doubt it would have influenced the overall scoring. In fact, applying the default tree in this case might very well have led to more precautionary scoring.	The peer reviewer's comment about being tempted to apply the RBF to UoA 1 is noted. The assessment team reviewed whether or not the RBF should be used to score PI 1.1.1 for UoA 1. The RBF was not used to score this UoA in the original assessment or	NA (No response needed)

										for an overlapping fishery at the time of the original certification, and as nothing had changed since the original certification, the assessment team decided to maintain the same approach during the reassessment. The assessment team also considered that using the default tree might produce a lower score for this PI than applying the RBF, and decided that the more precautionary approach should be adopted.	
DFPO mussel, cockle and oyster	2020	Blue mussel - Limfjord	Mussel dredge	PR A	1.1.2	NA (PI not scored)	NA (PI not scored)	NA	The stock is not depleted so this PI is not scored.	NA	NA (No response needed)
DFPO mussel, cockle	2020	Blue mussel - Limfjord	Mussel dredge	PR A	1.2.1	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)

and oyster											
DFPO mussel, cockle and oyster	2020	Blue mussel - Limfjord	Mussel dredge	PR A	1.2.2	No (change to rationale expected, not to scoring)	Yes	NA	It would be good to better understand the mechanism for voluntary agreements made by the fishers (e.g. the reduced TAC of 30 tonnes). Is there some sort of code of conduct that applies to all participants in this fishery, which is then enforced by the fishers' association? However regardless of this voluntary agreement, I think the general scoring given is appropriate.	The local fishers' associations, Centralforening for Limfjorden (CF) and Foreningen Muslingeerhvervet (FME), have agreed upon informal sets of objectives that seek to maintain shellfish stocks in the UoAs. Since 2005, CF has applied a voluntary quota to the fishery of 30 tonnes per day compared to the statutory government quota of 45 tonnes. This action was taken in response to a 2004 report that raised concerns about the long-term sustainability of the fishery and remains in place today. CF also manages the fishery by refraining from	Accepted (no score change, change to rationale)

										taking shellfish hygiene samples in areas where there is a high abundance of juvenile mussels, or where mussels have a low meat yield. Although CF does not have statutory powers, in the absence of shellfish hygiene samples, these areas effectively become statutorily closed to fishing. DFPO works alongside the local fishers' associations, and whilst the catch limits set by the fishers' associations are informal, the Client Group for the certificate covers all DFPO mussel dredge vessels targeting mussels in the Limfjord who have signed the DFPO Code of Conduct. As part of that code, all vessels in the certificate must give power of	

										attorney to DFPO to access and make use of the information about the vessel's activities existing at the Fisheries Agency and DTU Aqua at any time. This includes the vessel's logbook reports and landings data. The DFPO Code of Conduct also list the sanctions that will be applied if members break that code, and so in conjunction with the local fishers' associations, DFPO can enforce the catch limits and apply sanctions if the limits are exceeded. Additional information has been incorporated in the background information and the scoring rationale, although the	

										assessment team notes that the peer reviewer considers the scoring for this SI to be appropriate.	
DFPO mussel, cockle and oyster	2020	Blue mussel - Limfjord	Mussel dredge	PR A	1.2.2	Yes	No (non-material score reduction expected)	NA	Scoring issue a, SG100: would it not make sense to apply the same reasoning as for scoring issue b here? I.e. the 100 scoring is appropriate for the N2000 areas but it's not clear from the rationale whether it applies to the whole of the Limfjord. An overall SI score of 80 may be more appropriate.	Accepted. The score for SIa has been reduced from 100 to 80 and the overall score for PI 1.2.2 has been reduced from 95 to 85.	Accepted (non-material score reduction)
DFPO mussel, cockle and oyster	2020	Blue mussel - Limfjord	Mussel dredge	PR A	1.2.3	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Blue mussel - Limfjord	Mussel dredge	PR A	1.2.4	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Cockles - Limfjord	Mussel dredge modified to catch cockles	PR A	1.1.1	Yes	Yes	NA	See RBF tab; scoring agreed.	NA	NA (No response needed)

DFPO mussel, cockle and oyster	2020	Cockles - Limfjord	Mussel dredge modified to catch cockles	PR A	1.1.2	NA (PI not scored)	NA (PI not scored)	NA	Not scored if the RBF is used.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Cockles - Limfjord	Mussel dredge modified to catch cockles	PR A	1.2.1	Yes	No (score increase expected)	No	Scoring issue f: I struggle with the rationale provided here. This scoring issue should address unwanted catch of cockles in the UoA (i.e. discards) and the rationale explains that the selectivity of the dredge is such that the catch is composed primarily of large cockles that have already reproduced (which presumably means they are above the minimum landing size). Therefore, logically, it would seem that discards are currently not an issue in the UoA which uses the light mussel dredge, in which case this scoring issue does not need to be scored. The following statement: "*DTU Aqua are currently reviewing methods for assessing cockle stock status with the goal of providing science-based advice and information and recommending fishing practices adapted to cockle biology and population dynamics which will support long-term sustainable management of a targeted cockle fishery*" seems more of an argument for scoring issue a (SG100) not to be met. I.e., the harvest strategy is <u>not</u> designed to achieve stock management objectives reflected in PI 1.1.1 SG80. It implies there is an intent to move towards a more targeted cockle fishery (presumably with other gear?) but from what I've seen in the report this doesn't yet exist. So why raise a condition against something that might happen in the future and that arguably is not within the UoA? Overall, I do not believe that the current rationale and condition match the scoring guideposts for	The peer reviewer's overall conclusion that the current rationale and condition for SIf do not match the scoring guideposts is accepted. The assessment team agree that much of the rationale does not directly address unwanted catch of cockles in the UoA and that the rationale is more appropriate to SIa. The rationale for SIa has therefore been revised and the score for SIa reduced from 100 to 80. Although there are relatively low numbers of small cockles discarded currently in the fishery, a range	Accepted (score increased)

									SIf. Either the scoring would need to change and the condition removed, or the rationale clarified.	of measures for minimising catches of unwanted cockles have been evaluated, and therefore the assessment team considers that it is appropriate to score this SI. The score for SIf has been increased from 60 to 80, and the condition removed.	
DFPO mussel, cockle and oyster	2020	Cockles - Limfjord	Mussel dredge modified to catch cockles	PR A	1.2.2	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)

DFPO mussel, cockle and oyster	2020	Cockles - Limfjord	Mussel dredge modified to catch cockles	PR A	1.2.3	Yes	Yes	Yes	I agree with the rationale and with the condition against scoring issue b.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Cockles - Limfjord	Mussel dredge modified to catch cockles	PR A	1.2.4	Yes	Yes	NA	Default score of 80 when RBF is used.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Native oyster - Limfjord	Oyster dredge	PR A	1.1.1	Yes	Yes	NA	See RBF tab; scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Native oyster - Limfjord	Oyster dredge	PR A	1.1.2	NA (PI not scored)	NA (PI not scored)	NA	Not scored if the RBF is used.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Native oyster - Limfjord	Oyster dredge	PR A	1.2.1	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Native oyster - Limfjord	Oyster dredge	PR A	1.2.2	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle	2020	Native oyster - Limfjord	Oyster dredge	PR A	1.2.3	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)

and oyster											
DFPO mussel, cockle and oyster	2020	Native oyster - Limfjord	Oyster dredge	PR A	1.2.4	Yes	Yes	NA	Default score of 80 when RBF is used.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Blue mussel - Inner Danish waters	Mussel dredge	PR A	1.1.1	Yes	Yes	NA	See RBF tab; scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Blue mussel - Inner Danish waters	Mussel dredge	PR A	1.1.2	NA (PI not scored)	NA (PI not scored)	NA	Not scored if the RBF is used.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Blue mussel - Inner Danish waters	Mussel dredge	PR A	1.2.1	Yes	No (non-material score reduction expected)	NA	Scoring issue a: a score of 80 may be more appropriate as it is not clear to what extent the harvest strategy is responsive to the state of the stock and is designed to achieve stock management objectives reflected in PI 1.1.1 SG80 outside the N2000 areas (where there are no regular stock surveys, no TAC etc)	Accepted. The score for SIa has been reduced from 100 to 80 and the overall score for PI 1.2.1 has been reduced from 85 to 80.	Accepted (non-material score reduction)

DFPO mussel, cockle and oyster	2020	Blue mussel - Limfjord	Mussel dredge	PR A	1.2.1	No (change to rationale expected, not to scoring)	Yes	NA	Scoring issue a: given the importance of voluntary agreements in the harvest strategy, it would be good to have a better understanding of how those agreements are made (are they formalised in any way) and enforced.	The local fishers' associations, Bælternes Fiskeriforening (for East Jutland) and Isefjorden Fiskeriforening (for Isefjord), have agreed upon informal sets of objectives that seek to maintain shellfish stocks in the UoAs. Since 2005, the associations have applied a voluntary quota to the fishery of 30 tonnes per day. This action was taken in response to a 2004 report that raised concerns about the long-term sustainability of the fishery. The associations also manage the fishery by refraining from taking shellfish hygiene samples in areas where there is a high abundance of juvenile mussels, or where	Accepted (no score change, change to rationale)

										mussels have a low meat yield. Although the associations do not have statutory powers, in the absence of shellfish hygiene samples, these areas effectively become statutorily closed to fishing. DFPO works alongside the local fishers' associations, and whilst the catch limits set by the fishers' associations are informal, the Client Group for the certificate covers all DFPO mussel dredge vessels targeting mussels in the Inner Danish Waters who have signed the DFPO Code of Conduct. As part of that code, all vessels in the certificate must give power of attorney to DFPO to access and make use of the information about the	

										vessel's activities existing at the Fisheries Agency and DTU Aqua at any time. This includes the vessel's logbook reports and landings data. The DFPO Code of Conduct also list the sanctions that will be applied if members break that code, and so in conjunction with the local fishers' associations, DFPO can enforce the catch limits and apply sanctions if the limits are exceeded. Additional information has been incorporated in the background information and the scoring rationale, although the assessment team notes that the peer reviewer considers the	

										scoring for this SI to be appropriate.	
DFPO mussel, cockle	2020	Blue mussel - Inner Danish waters	Mussel dredge	PR A	1.2.2	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)

and oyster											
DFPO mussel , cockle and oyster	202 0	Blue mussel - Inner Danish waters	Mussel dredge	PR A	1.2. 3	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel , cockle and oyster	202 0	Blue mussel - Inner Danish waters	Mussel dredge	PR A	1.2. 4	Yes	Yes	NA	Default score of 80 when RBF is used.	NA	NA (No response needed)
DFPO mussel , cockle and oyster	202 0	Blue mussel and cockle - Limfjor d (UoA 1, 2)	Mussel dredge and modifie d mussel dredge	PR A	2.1. 1	No (change to rationale expected, not to scoring)	Yes	NA	Sib: flounder - the ICES advice cited is out of date but I agree with the scoring.	The ICES advice for flounder in the North Sea, Skagerrak and Kattegat has been updated.	Accepted (no score change, change to rationale)
DFPO mussel , cockle and oyster	202 0	Oyster Limfjor d and Blue mussel inner Danish waters (UoA 3, 4)	Oyster dredge and mussel dredge	PR A	2.1. 1	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel , cockle and oyster	202 0	All UoAs	All UoAs	PR A	2.1. 2	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)

DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.1.3	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Blue mussel - Limfjord and Inner Danish waters	Mussel dredge	PR A	2.2.1	Yes	Yes	NA	Scoring agreed and correctly capped at 80.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Cockles and oysters - Limfjord	Oyster dredge and modified mussel dredge	PR A	2.2.1	Yes	Yes	NA	See RBF tab; scoring agreed and correctly capped at 80.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.2.2	Yes	Yes	NA	Scoring agreed. Note, in some cases the rationale does not refer to all scoring guideposts being met (e.g. SG60) which is a procedural requirement. It might make sense to have a check of this throughout the report as I encountered this in other PIs as well. But clearly this doesn't affect scoring in any way. I commend the team for the detailed rationales and thorough impact assessment.	The peer reviewer is thanked for the advice that the rationale does not always refer to all scoring guideposts being met both for this PI and also for other PIs throughout the report. The rationale for all PIs has now been reviewed and revised if necessary to ensure that reference is	Accepted (no score change, change to rationale)

										made to all scoring guideposts being met.	
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.2.3	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.3.1	No (scoring implications unknown)	No (scoring implications unknown)	NA	I would expect to see some more detail here in relation to ETP birds. The rationale refers to the appropriate assessments carried out in the context of the N2000 areas but doesn't explain how the conclusion of no impact was reached for wild birds. There is also no mention of the actual species involved and to what extent they rely on mussels/cockles/oysters as a food source. Furthermore, impact through depletion of food is an indirect impact so should be considered under scoring issue b, not a. Little detail is presented on this in the background section of the report - i.e. the studies cited in relation to the food availability models all seem relatively out of date and I would expect to see detail on how the conclusions drawn are still appropriate to support an SG100 score.	The peer reviewer's conclusion that that there is a lack of detail in relation to ETP birds is accepted. Greater detail has now been added to both the background section of the report (7.4.1.1) and the scoring rationales in relation to the species of birds that are part of the designations for the Bird Protection Areas within the Natura 2000 sites, how bird counts are undertaken, the	Accepted (non-material score reduction)

										estimate of food requirements and how DTU Aqua assesses whether the fisheries are likely to have an impact on the various bird species. Direct effects are now considered under SIb, and the detail of indirect impacts in relation to food requirements is now considered under SIc. The assessment team also acknowledges that the assessment of bird numbers and their food requirements needs to be updated, and so the score for SIc has been reduced from 100 to 80.	

DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.3.2	No (scoring implications unknown)	No (scoring implications unknown)	NA	SIa: I believe detail is lacking here as well. E.g. "I*nteractions with bird species are addressed through the management measures in place for the Natura 2000 sites (under the EU Birds Directive and transposing legislation) in the area that protects these species. The impact of the UoAs on ETP species is tightly controlled through management of Natura 2000 sites to minimize the impact of the UoAs on these species. The SG60 and SG80 are met.* " What are these management measures exactly? Is it mainly through ensuring food availability? All this should be outlined more clearly.	Accepted. Additional information has been provided in the rationales on specific management measures for protecting designated bird species within the UoAs.	Accepted (no score change, additional evidence presented)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.3.3	No (scoring implications unknown)	No (scoring implications unknown)	NA	Again, I believe referring to the N2000 appropriate assessments alone is not sufficient to support the score. Because the main impacts on ETP birds are likely indirect (through food depletion), I would expect to see some detail on bird population monitoring and the food availability models to support the 80 score. Note that most of the references cited are in Danish which is not all that helpful. If they contribute to the scoring, the studies should be referred to and explained in the rationale.	Accepted. Greater detail has now been added to the background section of the report (7.4.1.1) in relation to the species of birds that are part of the designations for the Bird Protection Areas within the Natura 2000 sites, how bird counts are undertaken, the estimate of food requirements and how DTU Aqua assesses whether the fisheries are likely to have an impact on the various bird	Accepted (no score change, additional evidence presented)

										species. The rationales have also been expanded to provide more specific information.	
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.4.1	Yes	Yes	Yes	The rationale is well reasoned and precautionary. I agree with the scoring and the condition.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.4.2	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.4.3	No (change to rationale expected, not to scoring)	Yes	Yes	The rationale is a bit sparse for Sia (biogenic reefs), especially as is leads to a condition, but I suppose it is sufficiently detailed under 2.4.1 (perhaps add a cross-reference?) but I agree with the overall score given and with the condition.	Agreed. Additional sentences have been added in order to clarify and strengthen the rationale, along with a cross-reference to the related rationale under PI 2.4.1.	Accepted (no score change, additional evidence presented)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.5.1	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)

DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.5.2	No (change to rationale expected, not to scoring)	Yes	NA	Overall, I agree with the scoring, but I would expect the marine strategy framework directive to be mentioned in the context of ecosystem management. This is lacking from the rationale.	Agreed. Reference to the Marine Strategy Framework Directive has been added to the rationale, along with other relevant legal and policy instruments.	Accepted (no score change, additional evidence presented)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	2.5.3	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	3.1.1	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	3.1.2	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	3.1.3	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	3.2.1	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)

DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	3.2.2	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	3.2.3	Yes	No (material score reduction expected to <80)	NA	Sid: Given that outstanding allegations are being investigated (in relation to the engine power rules for Danish fishing vessels referred to under Sic and by Hansen, 2020 - see page 217), I would argue that SG80 should not be met. (MSC Interpretation: T*he intent behind the phrase no evidence of systematic non-compliance is that there is simultaneously adequate evidence to assess the compliance of the fishery and no evidence of infringements that occur regularly.* https://mscportal.force.com/interpret/s/article/3-2-3-Scoring-Issue-d-Systematic-non-compliance-SA4-9-1527262005731). Therefore, with the allegations of systematic non-compliance made, and the investigation still ongoing, I believe this 'adequate evidence' is lacking. SG80 should not be met until the investigation has been formally concluded and no systematic non-compliance is found.	Agreed. Thank you for the clarification about the MSC intent. The scoring table has been changed to reflect that SId has not been met. The recommendation that was listed in relation to SIc has been moved, amended and strengthened to a condition in relation to SId, along with supporting rationale. The rationale now acknowledges that while the allegations appear to be unfounded with no infringements being found so far in 2021 (at the time of reassessment), the current investigation is incomplete and it	Accepted (material score reduction to <80)

										is therefore not possible to demonstrate that "there is simultaneously adequate evidence to assess the compliance of the fishery and no evidence of infringements that occur regularly". The score for PI 3.2.3 has been downgraded to 75 and a condition has been raised that requires the completion of the investigation, publishing of the findings and if no evidence of systematic non-compliance, then a score of 80 may be awarded.	
DFPO mussel, cockle and oyster	2020	All UoAs	All UoAs	PR A	3.2.4	Yes	Yes	NA	Scoring agreed.	NA	NA (No response needed)

Peer Reviewer RBF Comments

Fishery	Year	UoA stock	UoA gear	PR (A/B/C)	PI	RBF Scoring	RBF Information	Peer Reviewer Justification (as given at initial Peer Review stage)	CAB Response to Peer Reviewer's comments (as included in the Public Comment Draft Report - PCDR)	CAB Res-ponse Code
DFPO mussel, cockle and oyster	2020	Cockles - Limfjord	Mussel dredge modified to catch cockles	PR A	1.1.1 (RBF)	Yes	Yes	The rationale provided for the CA and PSA is detailed, well-reasoned and precautionary. I agree with the scoring.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Native oyster - Limfjord	Oyster dredge	PR A	1.1.1 (RBF)	Yes	Yes	The rationale provided for the CA and PSA is detailed, well-reasoned and precautionary. I agree with the scoring.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Blue mussel - Inner Danish waters	Mussel dredge	PR A	1.1.1 (RBF)	Yes	Yes	The rationale provided for the CA and PSA is detailed, well-reasoned and precautionary. I agree with the scoring.	NA	NA (No response needed)
DFPO mussel, cockle and oyster	2020	Cockles and oysters - Limfjord	Oyster dredge and modified mussel dredge	PR A	2.2.1 (RBF)	Yes	Yes	The conclusions are thoroughly detailed and precautionary. I agree with the scoring.	NA	NA (No response needed)

8.4 Stakeholder input

To be completed at Public Certification Report

Six separate stakeholder meetings were held remotely using Skype and Zoom providing verbal submissions from the following groups:
(1) the Client, DFPO,
(2) Danish Fisheries Agency and Fisheries Department, Ministry of Environment and Food,
(3) DTU Aqua,
(4) Bo Husted and Henrik Nielsen, mussel, cockle and oyster fishers' representatives,
(5) Stig Wittrup, vessel owner and mussel fisher in the Inner Danish Waters fishery, and
(6) WWF.

A summary of each of these verbal submissions is given below. Other information received at those meetings was included in the main sections of the report.

A written submission was received from WWF and Danmarks Naturfredningsforening, in response to the publication of the Announcement Comment Draft Report. In addition, following agreement with the assessment team, WWF provided a second written submission after the site visit and also some time after the site visit WWF provided a third written submission following publication in the Press about concerns expressed about the shellfish fisheries in the Limfjord. The WWF written submissions and the responses from the assessment team are presented below.

Verbal submissions:

DFPO (Client)

The audit team spoke with Sofie Smedegaard Mathiesen on two occasions: at an initial meeting with the Client which also included Henrik Lund from DFPO, and at a closing meeting after the assessment team had met with other stakeholders.

The main purpose of the meetings was to discuss any changes in the mussel, cockle and oyster fisheries since the original certifications and following recent surveillance audits and to re-affirm information provided by DTU Aqua and the Fisheries Agency / Ministry during the site visit. In addition to a verbal submission, the client also submitted updated information relating to the 2019/20 fishing season, and an updated list of vessels in the various UoAs. The assessment team received input from the client on scoring of the RBF for PI 1.1.1 for the Limfjord cockle and oyster fisheries, for Inner Danish Waters mussel fishery and for starfish as a main secondary species in the Limfjord cockle and oyster fisheries.

Danish Shellfish Centre, DTU Aqua

The audit team spoke with Jens K. Petersen of DTU Aqua.

In summary, discussion focussed on the current status of the mussel and oyster populations in the Limfjord and the mussel populations in the Inner Danish Waters both within and outside Natura 2000 sites. Use of the "black box" vessel monitoring system over the past five years has now enabled new geostatistical models to be developed for the assessment of mussel populations, which includes estimates of uncertainty. Results of the most recent stock surveys, impact assessments of the mussel and oyster fisheries on habitat features of the Natura 2000 sites and consequent fishing opportunities were presented. Discussions also covered bycatch composition in the mussel fishery and bycatches of native and Pacific oyster and starfish in mussel dredges, and recent research on developing methods to detect potential effects of bivalve dredging on benthic fauna at local and regional scales. An update on recent output from research projects on cockle population dynamics was also provided by DTU Aqua. The assessment team received input on scoring of the RBF for PI 1.1.1 for the Limfjord cockle and oyster fisheries, for Inner Danish Waters mussel fishery and for starfish as a main secondary species in the Limfjord cockle and oyster fisheries.

Fiskeristyrelsens (Fisheries Agency) and Fisheries Department, Ministry of Environment and Food

The audit team spoke with Anja Gadgård Boye, Janne Palomino Dalby and Iben Astrup.

In summary, discussion focused on changes following the updating of the New Executive Order that was implemented in 2019 to update regulations in the mussel and oyster fisheries, any changes in management arrangements in the mussel and oyster fisheries in the last year including the prohibition of fishing in a 300m buffer zone around Natura 2000 sites in which fishing is prohibited and rules intended to reduce the number of inactive fishing vessels, infringements in the fishery in 2018 and 2019, and issues to be discussed at the upcoming Mussel Advisory Committee. The assessment team received input on scoring of the RBF for PI 1.1.1 for the Limfjord cockle and oyster fisheries, for Inner Danish Waters mussel fishery and for starfish as a main secondary species in the Limfjord cockle and oyster fisheries.

Bo Husted and Henrik Nielsen, mussel fishers' representatives

Discussion focussed on the current status of mussel and oyster stocks and recent recruitments in the Limfjord, the use of the black box system in the fishery, compliance with the DFPO Code of Conduct and the input of the views of mussel and oyster fishers in the Limfjord to the Mussel Advisory Committee. The assessment team received input on scoring of the RBF for PI 1.1.1 for the Limfjord cockle and oyster fisheries and for starfish as a main secondary species in the Limfjord cockle and oyster fisheries.

Stig Wittrup, mussel fisher and vessel owner

Discussion focussed on the current status of mussel stocks and recent recruitments in Eastern Jutland and the Isefjord, the use of the black box system in the fishery and the input of the views of mussel fishers in the Inner Danish waters to the Mussel Advisory Committee. The assessment team received input on scoring of the RBF for PI 1.1.1 for Inner Danish Waters mussel fishery.

WWF

The audit team spoke with Henrike Semmler Le and Philipp Kanstinger.

Discussion centred around WWF comments on the Announcement Comment Draft Report for the reassessment of the combined fishery, which was undertaken in conjunction with this surveillance audit. WWF alerted the assessment team to recent research on developing methods to detect potential effects of bivalve dredging on benthic fauna at local and regional scales, and this research is discussed in section 7.2.4. WWF did not provide any input to the RBF scoring as they had not yet had an opportunity to review the information provided to them ahead of the site visit.

Written submissions from WWF:

(1) In response to the publication of the ACDR and prior to the site visit, WWF and Danmarks Naturfredningsforening submitted comments to the assessment team on the MSC Template for Stakeholder Input into Fishery Assessments'. These comments and the assessment team's responses are reproduced below

Performance Indicator (PI) input

Performance Indicator (PI)	Input summary	Input detail	Evidence or references	Suggested score change	CAB response to stakeholder input	CAB response code
Performance Indicator - please copy and insert rows to raise more than one input against a Performance Indicator	Summary sentence	Detail of stakeholder input	Objective evidence or references should be provided in support of any claims or claimed errors of fact.	If suitable, please provide a suggested score change based on your input and evidence - Optional	The CAB shall respond in this column. CAB responses should include details of where different changes have been made in the report (which section #, table etc).	The CAB shall assign a response code to each row completed by the stakeholder.
Principle 1 - Sustainable fish stocks						
1.1.1 - Stock status	UoA 3: cockle stock status score needs to be lower	We really have difficulties to see how the stock status can score >80, if there has not been done a stock assessment. The Risk Based Framework will be performed at the site visit. Referring to the previous assessment, where it was stated, that all stakeholders at the site visit agreed that the outcome of the original RBF is still valid. At the time, we cannot comment further as we have not seen the RBF, and considering that we probably will not be able to attend the site-visit, it makes it difficult to comment on it.			PI 1.1.1 for cockles was scored using the RBF at the site visit and input was received from the various stakeholders at the site visit. While there is no time series of stock biomass estimates for cockles because there have not been regular or annual stock assessments, the results from annual stock surveys of mussels in the Limfjord also record catches of cockles and the time series of annual landings of cockles from each production area provide an indication of the sustainability of the fishery and indirect measures of stock abundance. Also available are the results from a major stock survey of cockles throughout the Limfjord undertaken in 2018, which showed that multiple age cohorts of cockles were present in each	Not accepted (no score change)

					basin, implying successful recruitment in several recent years. The assessment team did meet with WWF at the site visit, but WWF did not provide any input to the RBF scoring as they had not yet had an opportunity to review the information provided to them ahead of the site visit.	
1.1.2 - Stock rebuilding						
1.2.1 - Harvest strategy						
1.2.2 - Harvest control rules and tools						
1.2.3 - Information and monitoring						
1.2.4 - Assessment of stock status						
Principle 2 - Minimising environmental impacts						

2.1.1 - Primary species outcome						
2.1.2 - Primary species management						
2.1.3 - Primary species information						
2.2.1 - Secondary species outcome						
2.2.2 - Secondary species management						
2.2.3 - Secondary species information						
2.3.1 - ETP species outcome						

2.3.2 - ETP species management						
2.3.3 - ETP species information						
2.4.1 - Habitats outcome	our comment covers entire 2.4. Habitat	We disagree that a strategy is given that ensures that the UoA does not pose a risk of serios or irreversible harm to the habitats. We mean that only through the establishment of zero-fisheries-impact reference areas an evaluation of the environmental impact of a fishery is possible, and that scoring the impact of the fisheries correct will otherwise not be possible, based on the following reasoning: Normally it is difficult to differentiate the impact of fishing in sites that are impacted strongly from several human activities (e.g. eutrophication) and variable environmental conditions. So, in the areas e.g. Nissum and Lovns impacts of fisheries are hard to proof. However, in Løgstør, despite the presence of nutrient enrichment and natural disturbance, a clear negative effect of dredging on macrofaunal communities could be observed . It was possible due to the presence of a longstanding fisheries closure in the north of the basin, where oxygen conditions are stable. The communities found in the closed area were comparatively less disturbed by other pressures, and as a result provided unfished reference conditions relative to the rest of the basin. Therefore, we mean that the strategy and measures to achieve a habitat outcome with no irreversible harm is not given as long as there are no permanent fisheries closures in oxygen stable areas established in the different sites (in addition to established closed areas for protection of biogenetic reefs or eel grass). So, these closed areas should be a prerequisite in the management strategy of this fisheries, to be able to answer P2.4.2, but also to determine the risk to the habitat and the effectiveness of the strategy (P2.4.3.).	McLaverty et al. 2020. High-resolution fisheries data reveal effects of bivalve dredging on benthic communities in stressed coastal systems. Marine Ecology Progress Series 642: 21–38.		The issues raised by the stakeholder, including the recent paper by McLaverty et al., have been considered in the CPRDR and the scores for PIs 2.4.1 and 2.4.3 no longer meet the SG80 and conditions have been raised in relation to these PIs.	Accepted (material score reduction to <80)

2.4.2 - Habitats management strategy	our comment covers entire 2.4. Habitat					
2.4.3 - Habitats information	our comment covers entire 2.4. Habitat					
2.5.1 - Ecosystem outcome	our comment covers entire 2.5. Ecosystem	We disagree that this fishery does not cause serios or irreversible harm to the ecosystem. As shown in a recent study, dredging reduced community biomass and impacted species composition . The results showed that dredging intensity correlated with shifts in species composition and reduced community biomass. It has to be highlighted that the relationships varied significantly between regional and local scales, and therefore it is important to look at a local scale when assessing the impacts of this fisheries. We mean that this fishery, mainly taking place in Natura 2000 sites, is incompatible with the Habitats Directive and that the applied gear is causing significant negative ecosystem changes, as well as severe destructive habitat impacts, as also could be shown in the recent study . In certain areas, where human impacts and variable environmental conditions are present, the impact of fishing was difficult to differentiate, as it potentially is the situation in the sites in Nissum and Lovns. The reason for this may be found in the fact that benthic communities may become stress-adapted irrespective of fishing effort .	McLaverty et al. 2020. High-resolution fisheries data reveal effects of bivalve dredging on benthic communities in stressed coastal systems. Marine Ecology Progress Series 642: 21–38.		The issues raised by the stakeholder have been taken into account by the assessment team during preparation of the CPRDR. Whilst the assessment team considers that scores for the ecosystem PIs are justified, a recommendation was made in relation to PI 2.5.3. Two conditions are also raised in relation to VME habitats under Habitats PIs 2.4.1 (Outcomes) and 2.4.3 (Information).	Accepted (no score change)
2.5.2 - Ecosystem management strategy	our comment covers entire 2.5. Ecosystem					

2.5.3 - Ecosystem information	our comment covers entire 2.5. Ecosystem					
Principle 3 - Effective management						
3.1.1 - Legal and/or customary framework						
3.1.2 - Consultation, roles and responsibilities						
3.1.3 - Long term objectives						
3.2.1 - Fishery-specific objectives						
3.2.2 - Decision-making processes						

3.2.3 - Compliance and enforcement						
3.2.4 - Monitoring and management performance evaluation						

No general comments were submitted on the worksheet.

(2) Following a meeting with the assessment team at the site visit, and in agreement with the assessment team, WWF submitted further comments by e-mail on 14 September 2020. The comments and the assessment team's responses are reproduced below:

E-mail from Henrike Semmler henrike.semmler@wwf.dk

Re: Danish Shellfish Assessment Stakeholder Meeting

Date: Mon 14/09/2020 21:23

Dear Julian,

please find below our comments to the different points we already discussed in the call on the 21st Aug – related to the different principles and performance indicators.

Chris also asked for the reference to the publication on the negative impact of bottom trawling on the denitrifications process (also mentioned below under 2.5.1):
Ferguson et al 2020: Bottom trawling reduces benthic denitrification and has the potential to influence the global nitrogen cycle. Limnology and Oceanography Letters 5 (3)
https://aslopubs.onlinelibrary.wiley.com/doi/full/10.1002/lol2.10150

And, thanks again for forwarding us DTU Aqua's definition on "biogenic reef", that you will refer to in the assessment. The Danish requirements for blue mussel reefs to be called "biogenic reef" are very restrictive: a metric-driven definition for "blue mussels biogenic reefs of a 30% coverage rate and a stability requirement of min. 3 cohorts in a minimum area of 2500 m2" excludes virtually all mussel banks from being defined as "biogenic reefs". Looking at other countries definitions (e.g. Germany) shows clearly the challenges with this definition and therefore it is relevant the MSC report clearly outlines issues with this definition in the light of the Danish mussel policy, and also shows which areas, if any at all, fall under this definition.

Assessment team response. The assessment team investigated and concluded that the coverage rate is consistent with the metric established by OSPAR (i.e., 30%), and while the team did not find a published national definition for Germany, the state of Schleswig-Holstein has defined criteria that involve significantly smaller area and coverage for biogenic reefs formed by blue mussels in the Wadden Sea. Examination of the scientific basis for the difference between the definitions leads us to conclude that there are substantial justifiable differences between the dynamics and ecology of the intertidal and subtidal regions of the Wadden Sea and the UoAs in Danish waters, and indeed substantial differences between the species composition (e.g., blue mussel and Pacific oyster), the persistence of the mussel beds, and the variability of mussel biomass on the potential Wadden Sea reefs and those found in Danish waters (see Collinson *et al*, 2016; Folmer *et al*, 2017; and Vorberg *et al*, 2017). Dahl and Petersen (2018) describe and document the transience and movement of mussel banks, or mussel substrate, in areas that have been unfished for decades that are clearly too unstable and unpredictable to form reef structures that are big enough and long-standing enough to enable more complex communities to develop. The assessment team is satisfied that the basis for defining blue mussel biogenic reefs in Danish waters is valid from a scientific perspective. However, we do acknowledge that the definition has not been verified by direct examination. It is therefore presently uncertain how many will or will not meet the criteria for protection.

Having established definitions and criteria, the next steps, are to use the Danish Environmental Protection Agency's mapping projects (e.g., NOVANA) on rocky reefs and in Natura 2000 areas to identify potential biogenic reefs and further study already mapped 'reefs' to verify them against the area, coverage, stability and associated species community criteria; with a view to designating and protecting them under the relevant fishing and nature protection regulations (Dahl and Petersen, 2018; and J.P. Dalby pers comm.).

There are some so-called biogenic reefs identified already and these are set out in the background to P2 Habitats in the main body of the report. But until the known and potential biogenic reefs are mapped and verified against the adopted criteria, and fishing impacts and risks assessed to a greater degree of certainty than currently exists, it is not possible to conclude that the UoAs individually or collectively are highly unlikely to reduce the structure and function of such biogenic reef habitat features to the point where there is a risk of serious or irreversible harm. Scoring of the 'Biogenic Reefs' element under Habitats Outcome and Habitats Information reflects this and relevant conditions have been applied.

1.1.1. European oyster assessment using RBF: Due to changes in MSC requirements regarding the use of RBF / PSA, the outcome for European oyster will be significant lower compared to the previous assessment (for example encounterability will be now 3 by default setting). From our PSA calculations a condition for European oyster seems likely and in the end the setting of a condition will depend on the availability score (>10% overlap).

Assessment team response. Following stakeholder input at the site visit, the RBF for the oyster fishery returned a PSA score of 2.32 which translates into an MSC score of 89 for the PSA. Combined with a score of 80 for the CA, gives an overall score (rounded) of 85 for PI 1.1.1. Stakeholders including the DTU Aqua scientist who undertakes the stock surveys and the environmental impact assessments were all in agreement that the spatial overlap of the oyster fishery with the stock distribution (availability) was less than 10%. However the assessment team notes that even with a higher overlap of 10-30%, the overall PSA score of 2.62 would still be equivalent to an MSC score of >80.

1.1.1. UoA 4 Mussels in Inner Danish waters - DTU Aqua's definition on "biogenic reef"on page 14 stated that in habitat area H96 Lillebælt, in recent years there has been a decrease in total biomass.

Assessment team response. As described in the assessment report, there has indeed been a decrease in total biomass of mussels in the Lillebælt Natura 2000 site in recent years, and with no recent signs of recruitment, the area has been closed to mussel fishing since 2016.

2.4.1, 2.4.2, 2.4.3. Is the quality of the different habitats considered? e.g. are oxygen depletion zones subtracted from total habitat areas (Table 10).

Assessment team response. In general, water quality is studied and reported on under the Water Framework Directive Quality Status Reports (e.g., under the NOVANA program). Oxygen depletion, including seasonal and interannual variations, in the UoAs is well-studied, and the effects are documented in annual impact assessments, e.g., in the eelgrass and macroalgae sections of the annual reports that consider cumulative impact on habitats and ecosystem components. But oxygen depletion zones are not subtracted per se from total habitat areas either for management purposes or when considering the likelihood of serious or irreversible harm by the UoAs on the structure and function of habitats, rather the total combined effects of the UoA on habitats are considered.

2.4.1, 2.4.2, 2.4.3. Are Overlapping UoA non MSC fishery (e.g. plaice, shrimps?) relevant for the areas ?

Assessment team response. There are no overlapping MSC UoAs, nor any non-MSC fisheries that overlap. Plaice and shrimp fishing take place in waters outside the UoAs.

2.4.1, 2.4.2, 2.4.3 concerning cumulative area of impact for blue mussel, macroalgae, bottom fauna and eelgrass – the report mentions 200 t starfish in Nissrum N2000 site, but DK catch statistic in Limfjorden show in 2017 catches of 1500t, in 2018 of 1000t and in 2019 almost 900t. So impact of starfish fisheries to UoA is bigger then the one mentioned for the N2000 site alone.?

Assessment team response. DTU Aqua surveys show that starfish are found widely across the Løgstør Bredning, Lovn Bredning and Nissum Bredning Natura 2000 sites, and there are large populations within the Limfjord outside the Natura 2000 sites. Directed fishing for starfish within the Limfjord is permitted both within and outside Natura 2000 sites. For each Natura 2000 site, DTU Aqua ensures that the potential cumulative effects of fisheries for mussels, oysters and starfish will not significantly impact the habitat area by affecting one or more of the ecosystem components as defined in the Mussel and Oyster Policy.

2.4.2 VME strategy need to include a move on rule (and bycatch analysis) e.g.for VME types macroalgae, biogenic reefs

Assessment team response. On 5 November 2020 the MSC issued the following:

> *"The MSC has issued a derogation for scoring PI 2.4.2.a scoring issue a – habitats management strategy.*
>
> *The derogation came into effect on 5 November 2020 and applies to any assessment against v2.0 and v2.01 of the MSC Fisheries Standard. The derogation only relates to PI 2.4.2 scoring issue a of the MSC Fisheries Standard and only applies to UoAs that encounter VMEs or potential VMEs. It will remain in effect until fisheries are assessed against a newer version of the standard.*
>
> *The derogation for PI 2.4.2 scoring issue a instructs CABs to assess the fishery against SG80 for PI 2.4.2 scoring issue a first. If the fishery meets SG80 i.e. it has a partial management strategy in place that protects and avoids vulnerable marine ecosystems (VMEs), then the CAB does not have to assess the fishery against SG60 and the fishery does not have to implement commonly accepted move-on rules."*

The assessment team has taken the above approach to scoring PI 2.4.2.

2.4.2 Macrophyte communities (species composition & function) differ greatly with depth. Protection of only areas <3m not sufficient to maintain structure and function of the habitat

Assessment team response. The MSC scoring guideposts require the assessment team to consider the likelihood of the UoAs reducing the structure and function of habitats to a point where there would be serious or irreversible harm. The assessment team considered Macroalgae (i.e., macrophyte communities) as VME habitats, examined the available evidence and concluded that existing protections, combined with the actual footprint of the fishery across the UoAs mean the UoAs are highly unlikely to reduce the structure and function of these habitats to a point where there would be serious or irreversible harm.

2.4.2 Modiulus reefs are relevant in the area and should be assessed as VME (see OSPAR)

Assessment team response. *Modiolus modiolus* (horse mussel) are considered under the Biogenic Reef scoring element (i.e., VME) under the Habitats PIs. *M. modiolus* are included in the Danish definition for biogenic reefs. And the Mussel and Oyster Policy requires biogenic reefs to be identified, mapped, verified and protected under law. Two conditions have been raised in relation to biogenic reefs: one for the Habitats Outcome PI and one for the Habitats Information PI.

2.4.1 common habitat score is 100. This seems unjustified eg. Arctica islandica (sand, muddy sand) can experience high mortality rates due to trawling (up to ~20% per trawl pass) (Bergman & Van Santbrink 2000). This species also exhibits late maturity and slow recoverability, and is often absent from heavily fished areas (see McLaverty et al. paper)

Assessment team response. Benthic fauna communities, including large taxa like *Arctica islandica* and *M. modiolus*, are considered in the Ecosystems section and under the Ecosystems PIs. McLaverty *et al*, 2020, Eigaard *et al*, 2020, Petersen *et al*, 2020, and Hansen and Høgslund, 2021 all record the presence of a diversity of benthic species and community complexes in the unfished, protected and closed areas of the UoAs, including the species of concern here. For example, while *Arctica islandica* or *Modiolus modiolus* are not recorded in fishers' logbooks as bycatch during routine shellfish fishing operations in the UoAs, *A. islandica* are recorded in unfished areas by McLavety *et al* (2020) in Limfjord; and Hansen and Høgslund encountered high densities and high biomass in the northern Belt off Horsens Fjord (2021); and both *A. islandica* and *M. modiolus* are mapped in an analysis of the existing network of protected areas by Olesen *et al* (2020) using NOVANA data and are demonstrably present in multiple sites in the Belt Sea (i.e., the largest area of the Inner Danish waters UoA). This strongly indicates that unfished, closed and protected areas are providing significant refugia for some of the larger benthic taxa found in the ecosystem of the UoAs, including *A. islandica*.

2.4.3 Representative Unfished Reference areas are needed to justify a score of 80 (see McLaverty et al. 2020)

Assessment team response. This was considered in relation to PI 2.5.3 and a recommendation was made regarding improved monitoring and study of benthic fauna, including developing standardized indicators and a bottom fauna index that are sensitive to localized effects and fishing in coastal waters; and that small reference sites within the UoAs are protected (from the impacts of fishing) to provide control areas for comparison with fished areas.

2.5.3 ecosystem
Information for areas outside Limfjorden is quite scarce and a lower score seems justified

Assessment team response. Research showed a plethora of information across all the UoAs, including waters outside Limfjord, in papers published in 2020 and 2021. This information has been integrated into the consideration of all PIs in the assessment, including PI 2.5.3.

2.5.1 Bottom trawling effects nutrient cycles what is not yet addressed in the assessment (see e.g. Ferguson et al. 2020)

Assessment team response. The effects of bottom trawling on nutrient cycles are now considered in the assessment under PI 2.5.1. The Ferguson et al. (2020) study poses and attempts to answer important questions about the effect bottom-contacting mobile fishing gears may have on the global nitrogen cycle. However, while the results point to some short-term conclusions about the shallow, soft-sediment environment of a subtropical bay in Australia, it is more difficult to generalise those results to the specifics of the ecosystems under assessment for all four UoAs, although the authors do suggest that their results could be applied globally. It offers fertile territory for researchers to explore to determine whether the same short-term effects occur in significantly different environments, and whether any chronic long-term effects happen.

Results from Ferguson et al., (2020) showed detectable acute effects on all measured sediment-water fluxes except NO_3, but in most cases there was variation in the direction of effect (increase or decrease) and/or the sites and/or times where an impact was detected. Trawling appeared to decrease net N_2 fluxes (denitrification) over time, with the first occasion producing a non-significant decrease and increasingly significant decreases over the last two trawling occasions. The texture of surface sediments appeared to be homogenized due to the removal of burrow structures and the redistribution of sediment particles – a commonly observed disturbance in trawled coastal sediments. However, no statistically significant chronic effect of trawling was detected for any measured parameter at any site or time, which the authors hypothesised may be because the return frequency of trawling to the experimental sites was insufficient to cause detectable chronic effects, and the heterogeneous sediment structures had recovered within weeks of one-off disturbances. The authors suggest that although net denitrification returned to control rates following disturbance, the effect of trawling appeared to increase over subsequent trawling events, but they acknowledge this may be due to seasonal variation. Alternatively, disturbance that affected the complex three-dimensional redox structures in surface sediments that maximize denitrification potential, resulting in up to a 50% reduction in net denitrification, could suggest a declining resilience to repeated trawling over time. Counter-intuitively for the authors, macrofaunal species richness appeared to increase after trawling which introduced further uncertainty into the results. Finally, the authors suggest that further work at high trawl intensities, over larger spatial and temporal scales would be needed to see if there is in fact a chronic effect on benthic denitrification. Similarly, impacts in other areas will depend on the sediment type, natural disturbance regime (e.g., high or low energy environments), sensitivity of key macrofaunal species for maintaining ecosystem complexity at microbial levels, and ultimately fishing disturbance of sediment structures and fishing intensity over time (Ferguson *et al*, 2020).

The question for the assessment team is whether the results can reasonably lead us to conclude that there is a high likelihood that the UoAs themselves pose a risk of serious or irreversible harm to the structure and function of the ecosystems within which they operate. Even if we accept that there may be denitrification effects caused by changes in sediment structures and nitrogen cycles, the extent and contribution of these to the overall structure and function of the Limfjorden and Inner Danish waters is necessarily limited by the extensive spatial, temporal and fishing effort controls imposed upon the UoAs. There are vast areas within these water bodies that are closed permanently to all dredging activity; there are other temporal closures over the summer months and at the end of each calendar year; there are strict vessel number limits on specific areas within the UoAs; and the actual dredged areas are limited in spatial extent due to the distribution of shellfish of sufficient density and quality that make fishing commercially viable. Taken together, these factors limit the areas of fishing to very specific locations which are not widely distributed across the UoAs. Impact assessments for each of the Natura 2000 sites where fishing is permitted (e.g., Løgstør, Lovns & Nissum Bredning Natura 2000 sites) routinely conclude that year on year less than 10% (frequently less than 5%) of those areas are impacted by dredging, and that over the wider ecosystem in any given year less than 2% by area of all the UoAs is affected annually by shellfish dredging (see Nielsen *et al*, 2014; 2018a-2020b). Given these factors, the team concludes that the UoAs are highly unlikely to pose a risk of serious or irreversible harm to the structure and function of the ecosystems within which the UoAs operate.

2.3 - ETP Ocean quahog – Arctica islandica - is included in the OSPAR List of threatened and/or declining species and habitats and should be treated as ETP species (OSPAR Agreement 2008-6).
- ETP Horsemussel - Modiolus modiolus - is included in the OSPAR List of threatened and/or declining species and habitats and should be treated as ETP species (OSPAR other agreement 2008-6).
- ETP European oysters – Ostrea edulis – is included in the OSPAR List of threatened and/or declining species and habitats (OSPAR agreement 2008-6).
Some of the Macrophyte species in the area could/should be assessed as ETP species e.g. Fucus vesiculosus included in the Helcom Redlist
https://www.helcom.fi/wp-content/uploads/2019/08/HELCOM-RedList-All-SIS_Macrophytes.pdf

Assessment team response. MSC Standard v2.01 defines ETP species (SA3.1.5) as follows:

- Species that are recognised by national ETP legislation;
- Species listed in the following binding international agreements: Appendix 1 of the Convention on International Trade in Endangered Species (CITES) and the Convention on Migratory Species (CMS);
- Species classified as 'out-of-scope' (amphibians, reptiles, birds and mammals) that are listed in the IUCN Redlist as vulnerable (VU), endangered (EN) or critically endangered (CE).

OSPAR is not included within MSC's list of binding international agreements, and so *Arctica islandica*, *Modiolus modiolus* and *Ostrea edulis* are not considered as ETP species in this report. However all three species are considered elsewhere in the assessment report. *A. islandica* could be captured within the shellfish dredges and would therefore be considered under secondary species. However, there are no reports of *A. islandica* being caught in the dredges and DTU Aqua report that this species has not been seen in recent years in the stock surveys in the various UoAs, and therefore there is no requirement to consider *A. islandica* as part of the scoring for secondary species. However the assessment team does consider *A. islandica* in relation to possible effects on the ecosystem under Ecosystem 2.5. –*M. modiolus* is considered under Habitat 2.4 as a potential VME species. *O. edulis* is considered as either target or secondary species within the UoAs.

The HELCOM red list was compiled using IUCN criteria as its basis, but macrophytes are out-of-scope species and are therefore not considered as ETP species for this assessment. However the assessment team considered Macroalgae (i.e., macrophyte communities) as VME habitats under Habitat 2.4.

We are looking forward to hear from you.

With kind regards,

Henrike

(3) On 4 December 2020, WWF submitted a further e-mail raising three separate concerns about the UoAs covered by this reassessment. Their comments and the assessment team's responses are reproduced below.

E-mail from Henrike Semmler henrike.semmler@wwf.dk

New information on DFPO Danish Shellfish Assessment

Date: Fri 04/12/2020 15:06

Dear Julian

I just want to inform you about three news concerning the Limfjord cockle and Limfjord oysters fisheries, that are probably relevant for the ongoing MSC Danish Shellfish reassessment.

1. DTU Aqua registered a high level of *Bonamia* infection in the oyster populations in Limfjorden, that has impacts on the mortality of the oysters. While in 2017 the Bonamia incidence was low (3%) it increased to 36-70% and is associated with the mass mortality of flat oysters in 2020. The Nissum population is collapsing. Although the populations in the other broads are younger, there is a risk of further population collapse as the disease is expected to continue to spread (the attached DTU Aqua report contains an English summary).

   Assessment team response. The assessment team has reviewed the recent report by DTU Aqua on the incidence of *Bonamia* infection in oysters in the Limfjord, and has incorporated the information in the CPRDR. It was noted that in Nissum Bredning infection rates of *Bonamia* increased significantly while oyster density declined significantly. In comparison, very low or zero infection rates were observed in oyster populations in other areas of the Limfjord. As a result of the outbreak of *Bonamia* and the declining stock estimates, no fishing for oysters has occurred in Nissum Bredning in the 2020/21 season, and all future requests for the oyster fishery will need to take into account potential infection rates of *Bonamia*. DTU Aqua warn that a set of preventive and mitigation measures aimed at restricting the movement and transfer of oysters between all areas will need to be implemented to reduce the spread of *Bonamia*.

2. The cockle fisheries cannot be considered a bycatch fishery but a direct fishery. The legal regulation states that cockles may only be caught as a by-catch in the blue mussel fishery in Limfjorden, and landings must contain a maximum of 49% of the catch. But the cockles do not get caught in the same place as blue mussels, the regulation just requires that they are caught on the same fishing trip. So actually fishers sleep on the boat and sail somewhere else to catch cockles (see attached news article).

   Assessment team response. In this MSC reassessment, the cockle fishery is considered as a target species in a directed fishery in UoA 2, even though the Danish authorities have implemented a regulation that prevents active targeting of cockles. The assessment team is aware that there may have been previous bycatch infringements related to the proportion of cockles in the overall catch. The Danish Fisheries Agency has now amended the regulations to ensure Limfjord vessels start every fishing trip with an empty load (i.e., an empty hold) to deter operators from conducting solo trips targeting cockles (i.e., directed fishing for cockles) but claiming the catch as bycatch from an earlier mussel fishing trip.

3. The limit for engine power of 130 kW in the Limfjord-area is not always complied (see attachment "motorkraftmysteriet"). To what extent the noncompliance is occurring, still needs to be assessed, but is does not seems insignificant. Denmark still has not implemented a sampling plan for controlling the engine power even though this plan was already developed in 2012. Well, the reason I mention this here is that noncompliance will lead to greater environmental impacts, in particular in an already vulnerable area such as Limfjord.

Assessment team response. WWF submitted allegations made by a journalist in a Danish weekend newspaper article in November 2020 which suggested there is systematic non-compliance in relation to EU and Danish engine power restrictions for fishing vessels, specifically Limfjord mussel and oyster dredging vessels. The newspaper article referenced interviews and investigations conducted by the journalist into the public vessel registers, and a report published by the European Commission in 2019. The Danish Fisheries Agency was asked by the assessment team about the allegations and they responded in writing on 29 January 2021 to the assessment team's questions stating that the Agency is carrying out a dedicated control campaign of engine power encompassing almost all vessels in the Limfjord in the first half of 2021 and that so far, the allegations have not been verified. Even so, the MSC's stated intent of the scoring issue relating to there being "no evidence of systematic non-compliance" (PI 3.2.3d) means there must be supporting evidence there is no systematic non-compliance and no regular infringements. As such, the assessment team considered that the scoring issue is not met and therefore a condition has been raised.

These news have implications to all three principles.
With kind regards,
Henrike

Comments were received from MSC Technical Oversight on the Public Comment Draft Report. The comments and Team's responses are below.

SubID	PageReference	Grade	RequirementVersion	OversightDescription	Pi	CABComment
31083	p.20	Minor	FCP-7.9.1 v2.2	As per FCP 7.9.1 and Section 6.2 of the MSC Reporting Template v1.2, the CAB shall shall determine whether the fishery has sufficient systems of tracking, tracing and segregation and how these systems will allow any products sold as MSC certified to be traced back to the UoC(s). While the CAB did document the risk factors and their management, it is unclear what systems and records to enable traceability back to an appropriate UoC.		Additional text has been included in section 6.2 of the text under Table 2 as follows: "The catching and landing of certified mussels, cockles and oysters in the four UoCs is tightly controlled through a robust tracking and tracing system. All DFPO vessels which catch and land certified shellfish must be licensed and must carry a black box system which records position and whether or not the vessel is fishing every 10 seconds. Continuous monitoring of records from the black box system ensure that vessels within the certificate fish only in the areas covered by the UoCs. Vessels must 'hail-in' prior to landing allowing enforcement officers to be present at the landing. Vessels must submit landing records. Following sale at the auction, all shellfish must be labelled with the name of the vessel, and buyers must issue sales notes to each vessel, which are copied to the management authorities. Sales notes are cross-checked with vessel's fishing positions, log book records and landings declarations to ensure that all landings from the UoCs are correctly

						recorded. No fishing vessels other than DFPO vessels which have signed the DFPO Code of Conduct are permitted to fish for mussels, cockles or oysters in the respective UoCs. There is a high degree of confidence that all the fishing activity carried out by the vessels under assessment is tracked and recorded by cross-referenced and verifiable mechanisms so that all products entering further Chains of Custody can be directly traced back to the UoCs."

31084	17	Guidance	FCP-7.9.1.5.a v2.2	The CAB shall identify and document the UoC. For UoCs 2 & 3, Cockles and Oysters are targeted, however the Team wrote mussels as target species for UoCs 2 & 3.		The Technical Oversight highlights inconsistencies in Table 3 on pages 17 & 18 for UoCs 2 and 3 between the target species and the respective Client groups. The Client group for UoC 3 for oysters has indeed been incorrectly designated by the assessment team. The Client group should read "All DFPO oyster dredge vessels targeting oysters in the Limfjord who have signed the DFPO Code of Conduct". The text has now been corrected. For UoC 2 cockles, under Danish Fisheries Agency regulations, vessels are not permitted to directly target cockles in the Limfjord as a cockle-only fishery, but mussel dredge vessels may modify their gear during mussel fishing trips to catch and land cockles. Only DFPO mussel dredge vessels targeting mussels in the Limfjord are therefore licensed and permitted to fish for cockles which must comprise a maximum of 49% of the total catch during any single mussel fishing trip. Table 3 therefore correctly states that the Client group for UoC 2 is "All DFPO mussel dredge vessels targeting mussels in the Limfjord who have signed the DFPO Code of Conduct".

A selection of MRAG reports were included in a Principle 3 Cross-Cutting Analysis performed by Assurance Services International (ASI). The PCDR for this fishery was included in the analysis. With the permission of ASI we are publishing the findings as they pertain to the report and identifying any changes made as a result of the findings.

ASI finding	MRAG's response
PI 3.2.2 SA4.8.5 At the SG60 level, at least a general summary of information on subsidies, allocation, compliance and fisheries management decisions should be available to stakeholders on request. SA4.8.7 At the SG100 level, the information listed in the SG60 and SG80 levels should be comprehensive and available openly, publicly and regularly to all stakeholders. Note MSC-MSCi vocabulary v1.2: "Should: Denotes a requirement that shall be followed unless there are reasons not to. If the requirement is not followed, the justification shall be recorded." -DFPO Mussel, Cockle and Oyster PCDR (Aug 2021)- The rationale in SI d does not indicate whether the information listed in SA4.8.5 is available either as a summary (SG60) or publicly available (SG100)	Language in the rationale for PI 3.2.2.d has been changed to include those items listed from SA4.8.5-4.8.7 that are relevant to the Danish shellfish fishery assessment.

8.5 Conditions

There was only one outstanding condition across the three previously assessed fisheries. For the DFPO Limfjord mussel and cockle fishery, there was one condition raised in relation to Performance Indicator 3.2.4 (Research Plan) for the Cockle Unit of Assessment. This condition was closed at the fourth surveillance audit and therefore is not carried over into the reassessment. For the DFPO Limfjord oyster dredge fishery and the DFPO Inner Danish Waters blue shell mussel fishery, there were no conditions raised at the previous assessment. Four conditions were raised during the reassessment of the combined fisheries – they are all new conditions which do not relate to any conditions raised in previous assessments.

Table 35. Condition 1 – UoA 2 only

Performance Indicator	PI 1.2.3. Relevant information is collected to support the harvest strategy. SIb. Stock abundance and UoA removals are regularly monitored at a level of accuracy and coverage consistent with the harvest control rule, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.
Score	75
Justification	A detailed stock survey undertaken in 2018 across the whole Limfjord, including those areas where there is no cockle fishing, provided an index of stock biomass, but it was apparent from an analysis of the survey results in comparison with landings data that the patchy distribution of cockles will make it difficult to extrapolate stock survey results across the whole stock distribution in order to estimate total stock biomass, and therefore new methods for estimating cockle stock biomass are being developed by DTU Aqua. In addition to the problems encountered with using fishery-independent stock surveys to estimate total stock biomass, DTU Aqua noted that it is not possible currently to accurately separate mussel and cockle fishing activity from the black box data and hence it is not possible to calculate an estimate of catch per unit effort (CPUE) for cockles from the annual fishery-dependent data. Stock abundance is not therefore regularly monitored at a level of accuracy and coverage consistent with the harvest strategy. SG80 is not met. (This is a new condition which does not relate to any conditions raised in previous assessments.)
Condition	By the 4th surveillance audit in 2025, the Client shall provide evidence that stock abundance of cockles is regularly monitored at a level of accuracy and coverage consistent with the harvest strategy.
Milestones	Year 1, 2022: Provide written evidence of progress made by DTU Aqua in developing a methodology for estimating cockle stock abundance/biomass in the Limfjord. Resulting score = 75. Year 2, 2023: Provide written evidence of continuing progress made by DTU Aqua in developing a methodology for estimating cockle stock abundance/biomass in the Limfjord. Resulting score = 75. Year 3, 2024: Provide written evidence that DTU Aqua has provided an accurate estimate of cockle stock abundance/biomass in the Limfjord. Resulting score = 75. Year 4, 2025:

	Demonstrate that the SG80 requirements of SIb are met, such that stock abundance / biomass of cockles is regularly monitored at a level of accuracy and coverage consistent with the harvest strategy. Resulting score = 80.
Consultation on condition	The Client will need to liaise with DTU Aqua to ensure that this condition is met.

Table 36. Condition 2 – all UoAs

Performance Indicator	2.4.1. The UoA does not cause serious or irreversible harm to habitat structure and function, considered on the basis of the area covered by the governance body(s) responsible for fisheries management in the area(s) where the UoA operates. SIb. The UoA is highly unlikely to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm. (Biogenic reefs scoring element only.)
Score	75
Justification	Biogenic reefs are formed by blue mussel (*M. edulis*), horse mussel (*Modiolus modiolus*) and combined horse mussel and rocky reefs. There is some evidence that in certain Natura 2000 sites biogenic reefs are known and protected, particularly those that are in waters shallower than 3-5m where fishing is prohibited. However, given the scientific advice states that in the absence of verification against the Danish definition of biogenic reefs (Dahl and Petersen, 2018), there is some uncertainty about the total impact on such habitat features. Recent environmental impact assessments conclude that the UoAs are unlikely to affect so-called identified and possible biogenic reefs as they are located either entirely in depths where fishing is prohibited or large parts of them are located in prohibited areas (Neilsen et al 2018a, 2018c, 2020a, 2020b). On balance, given the significant restrictions on vessel numbers by area, time, area, effort, gear and total catch of target species, the UoAs are unlikely to reduce structure and function of the biogenic reef habitats to a point where there would be serious or irreversible harm. Therefore, for this scoring element SG60 is met. However, it is less certain that the UoAs are *highly* unlikely to reduce structure and function of the VME to a point where there would be serious or irreversible harm, therefore the assessment team cannot justify that SG80 has been met for the scoring element 'Biogenic reefs'. (This is a new condition which does not relate to any conditions raised in previous assessments.)
Condition	By the 4th surveillance audit in 2025, the Client shall provide evidence that the UoAs are highly unlikely to reduce structure and function of biogenic reefs to a point where there would be serious or irreversible harm.
Milestones	Year 1, 2022: Provide written evidence of progress made by relevant agencies (e.g., Naturstyrelsen, Miljøstyrelsen, Fiskeristyrelsen and/or DTU Aqua) in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters. Resulting score = 75. Year 2, 2023: Provide written evidence of continuing progress made by relevant agencies in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters. Resulting score = 75.

	Year 3, 2024: Provide written evidence of continuing progress made by relevant agencies in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters and assessing their vulnerability. Resulting score = 75. Year 4, 2025: Demonstrate that the SG80 requirements of SIb are met, such that evidence is provided that the UoAs are highly unlikely to reduce structure and function of biogenic reefs to a point where there would be serious or irreversible harm. Resulting score = 80.
Consultation on condition	The Client will need to liaise with relevant agencies to ensure that this condition is met.

Table 37. Condition 3 - all UoAs

Performance Indicator	PI 2.4.3. Information is adequate to determine the risk posed to the habitat by the UoA and the effectiveness of the strategy to manage impacts on the habitat. SIa. The nature, distribution and vulnerability of the main habitats in the UoA area are known at a level of detail relevant to the scale and intensity of the UoA. (Biogenic reefs scoring element only.)
Score	75
Justification	The distribution of habitats within the Limfjord and Inner Danish Waters is known and mapped, and the distribution of vulnerable biotopes is known at the EU (bioregional) level. Particular attention is paid to the distribution of all vulnerable habitats (such as eelgrass and macroalgal beds), and the extent of habitats within Natura 2000 sites which have been designated to protect particularly vulnerable and/or natural habitat types. However, while the types and distribution of some biogenic reefs are partially understood, there remains some uncertainty about their nature, distribution and vulnerability. For biogenic reefs the information meets the requirements of SG60 but not for SG80. (This is a new condition which does not relate to any conditions raised in previous assessments.)
Condition	By the 4th surveillance audit in 2025, the Client shall provide evidence that the nature, distribution and vulnerability of the biogenic reefs in the UoA areas are known at a level of detail relevant to the scale and intensity of the UoAs.
Milestones	Year 1, 2022: Provide written evidence of progress made by relevant agencies (e.g., Naturstyrelsen, Miljøstyrelsen, Fiskeristyrelsen and/or DTU Aqua) in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters. Resulting score = 75. Year 2, 2023: Provide written evidence of continuing progress made by relevant agencies in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters.

	Resulting score = 75. Year 3, 2024: Provide written evidence of continuing progress made by relevant agencies in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters and assessing their vulnerability. Resulting score = 75. Year 4, 2025: Demonstrate that the SG80 requirements of SIb are met, such that evidence is provided that the nature, distribution and vulnerability of the biogenic reefs in the UoA areas are known at a level of detail relevant to the scale and intensity of the UoAs. Resulting score = 80.
Consultation on condition	The Client will need to liaise with relevant agencies to ensure that this condition is met.

Table 38. Condition 4 - all UoAs

Performance Indicator	PI 3.2.3. Monitoring, control and surveillance mechanisms ensure the management measures in the fishery are enforced and complied with. SId. There is no evidence of systematic non-compliance.
Score	75
Justification	A control campaign was initiated in 2020-21 to investigate allegations in relation to the possibility that general engine power rules that apply across Danish fisheries, with particular focus so far in Limfjord, are systematically broken. While enforcement staff informally reported to the assessment team that by early 2021 no systematic non-compliance had been discovered in Limfjord and that the allegations so far appeared unfounded, the investigation was incomplete at the time of the reassessment. The intent of this scoring guidepost, according to the MSC, is that there is "*simultaneously adequate evidence to assess the compliance of the fishery and no evidence of infringements that occur regularly*". (This is a new condition which does not relate to any conditions raised in previous assessments.)
Condition	By the 1st surveillance audit in 2022, the Client shall provide evidence that confirms that there is no evidence, in relation to engine power rules, of systematic non-compliance in relation to all UoAs.
Milestones	Year 1, 2022: Provide written (published) evidence from the Fisheries Agency following the completion of the engine power control campaign that there is no systematic non-compliance in relation to engine power in the UoAs. Resulting score = 80.
Consultation on condition	The Client will need to liaise with the Control division of the Fisheries Agency to ensure that this condition is met.

8.6 Client Action Plan

Condition 1 UoA 2 only

Performance Indicator	PI 1.2.3. Relevant information is collected to support the harvest strategy. SIb. Stock abundance and UoA removals are regularly monitored at a level of accuracy and coverage consistent with the harvest control rule, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.
Condition	By the 4th surveillance audit in 2025, the Client shall provide evidence that stock abundance of cockles is regularly monitored at a level of accuracy and coverage consistent with the harvest strategy.
Milestones	Year 1, 2022: Provide written evidence of progress made by DTU Aqua in developing a methodology for estimating cockle stock abundance/biomass in the Limfjord. Year 2, 2023: Provide written evidence of continuing progress made by DTU Aqua in developing a methodology for estimating cockle stock abundance/biomass in the Limfjord. Year 3, 2024: Provide written evidence that DTU Aqua has provided an accurate estimate of cockle stock abundance/biomass in the Limfjord. Year 4, 2025: Demonstrate that the SG80 requirements of SIb are met, such that stock abundance / biomass of cockles is regularly monitored at a level of accuracy and coverage consistent with the harvest strategy.
Client Action Plan	Another set up for management of the fishery for cockles in the Limfjord has been reviewed the last years, and DFPO and DTU Aqua continue to be involved in this work. This includes both changes to licenses and specific advice for a sustainable cockle harvest on a yearly basis. In regard to stock estimates, the former project by DTU Aqua identified problems with estimating biomass using a suction dredge, for example, very small cockles are not caught in the suction dredge. It further highlighted other issues in relation to assessing stock status of a species which exhibits burrowing behaviour, and which appears to be distributed patchily. On this basis a new project has been set up focusing on new methods for stock assessment in selected areas where either the fishery is concentrated or where there is no fishery. The outcome of the research project will inform sustainable management of the cockle fishery and will address Condition 1, as the aim is to get a scientific assessment of the catches requested by the fishermen in the same manner as for blue mussels and oysters at present as a specific licence for cockle fishing would be needed. Additionally, the latest advice by DTU Aqua states that the fisheries for blue mussels and cockles do not take place in the same area and time (DTU Aqua, 2020a). To address milestones for Condition 1: Year 1-3: DFPO will provide evidence of the progress made by DTU Aqua in developing a methodology for estimating cockle stock abundance/biomass in the Limfjord in the project referred to above, and report if or how this is used to inform managers' decision on catches allowed by the fishery. Even if no biomass estimates are achievable the first years, DTU Aqua will, in the transition period, advise managers on sustainable catches from their expert view. Additionally, updates on management regulation for the fishery to ensure long-term sustainable management of the stock will be given and discussions in the "Muslingeudvalg" will be presented, so it should be evident that DTU Aqua recommendations for the fishery are adapted where necessary.

	Year 4: DFPO will provide evidence that the stock abundance/biomass of cockles is regularly monitored at a level of accuracy and coverage consistent with the harvest strategy.
Consultation on condition	DFPO will maintain its ongoing liaison with DTU Aqua to ensure that the condition is met.

Condition 2 all UoAs

Performance Indicator	2.4.1. The UoA does not cause serious or irreversible harm to habitat structure and function, considered on the basis of the area covered by the governance body(s) responsible for fisheries management in the area(s) where the UoA operates. SIb. The UoA is highly unlikely to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm. (Biogenic reefs scoring element only.)
Condition	By the 4th surveillance audit in 2025, the Client shall provide evidence that the UoAs are highly unlikely to reduce structure and function of biogenic reefs to a point where there would be serious or irreversible harm.
Milestones	Year 1, 2022: Provide written evidence of progress made by relevant agencies (e.g., Naturstyrelsen, Miljøstyrelsen, Fiskeristyrelsen and/or DTU Aqua) in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters. Year 2, 2023: Provide written evidence of continuing progress made by relevant agencies in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters. Year 3, 2024: Provide written evidence of continuing progress made by relevant agencies in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters and assessing their vulnerability. Year 4, 2025: Demonstrate that the SG80 requirements of SIb are met, such that evidence is provided that the UoAs are highly unlikely to reduce structure and function of biogenic reefs to a point where there would be serious or irreversible harm.
Client Action Plan	In the areas where the fishery of the UoA take place, some verified and possible biogenic reefs have been identified by the Environmental Agency in 2012, however these generally lack verification in relation to whether they meet the Danish definition of biogenic reefs from 2018. A lot of the potential biogenic reefs are placed in areas with eelgrass, where the fishery is not allowed. However, the effects of the fishery on biogenic reefs are considered by managers when requesting DTU Aqua to assess the impact of the fisheries on a yearly basis. Hence, the verification of and the fisheries impact on biogenic reefs will continue to be addressed and considered a focus point in future impact assessments by DTU Aqua. To address milestones for Condition 2: Year 1: DFPO will provide evidence that work on verification of biogenic reefs in the UoA areas has moved forward, and that the impact assessment addresses the impact of the fishery on the verified biogenic reefs. If an impact on biogenic reefs is a concern, DFPO will ask for an

	assessment on whether this impact is likely to reduce structure and function of the biogenic reef to a point where there would be serious or irreversible harm. This can inform whether the fishery should avoid fishing activities in certain areas for the following fishing year. Further to this, any other mapping and/or verification of possible biogenic reefs by managers will be reported. Years 2-3: DFPO will provide evidence that work on verification of biogenic reefs in the UoA areas has moved forward, and that the impact assessment addresses the impact of the fishery on the verified biogenic reefs. This will be done through the request from the fishery on fishing opportunities to the managers. If an impact on biogenic reefs is a concern, DFPO will ask for an assessment on whether this impact is likely to reduce structure and function of the biogenic reef to a point where there would be serious or irreversible harm. This can inform whether the fishery should avoid fishing activities in certain areas for the following fishing year. Further to this, any other mapping and/or verification of possible biogenic reefs by managers will be reported. Year 4: DFPO will provide evidence that the UoAs are highly unlikely to reduce structure and function of biogenic reefs to a point where there would be serious or irreversible harm.
Consultation on condition	DFPO will maintain its ongoing liaison with DTU Aqua and other relevant agencies to ensure that the condition is met.

Condition 3 all UoAs

Performance Indicator	PI 2.4.3. Information is adequate to determine the risk posed to the habitat by the UoA and the effectiveness of the strategy to manage impacts on the habitat. SIa. The nature, distribution and vulnerability of the main habitats in the UoA area are known at a level of detail relevant to the scale and intensity of the UoA. (Biogenic reefs scoring element only.)
Condition	By the 4th surveillance audit in 2025, the Client shall provide evidence that the nature, distribution and vulnerability of the biogenic reefs in the UoA areas are known at a level of detail relevant to the scale and intensity of the UoAs.
Milestones	Year 1, 2022: Provide written evidence of progress made by relevant agencies (e.g., Naturstyrelsen, Miljøstyrelsen, Fiskeristyrelsen and/or DTU Aqua) in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters. Year 2, 2023: Provide written evidence of continuing progress made by relevant agencies in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters. Year 3, 2024: Provide written evidence of continuing progress made by relevant agencies in mapping the distribution and nature of biogenic reefs within the Limfjord and Inner Danish Waters and assessing their vulnerability. Year 4, 2025: Demonstrate that the SG80 requirements of SIb are met, such that evidence is provided that the nature, distribution and vulnerability of the biogenic reefs in the UoA areas are known at a level of detail relevant to the scale and intensity of the UoAs.

Client Action Plan	In the areas where the fishery of the UoA take place, some verified and possible biogenic reefs have been identified by the Environmental Agency in 2012, however these generally lack verification in relation to whether they meet the Danish definition of biogenic reefs from 2018. A lot of the potential biogenic reefs are placed in areas with eelgrass, where the fishery is not allowed. However, the effects of the fishery on biogenic reefs are considered by managers when requesting DTU Aqua to assess the impact of the fisheries on a yearly basis. Hence, the verification of and the fisheries impact on biogenic reefs will continue to be addressed and considered a focus point in future impact assessments by DTU Aqua. <u>To address milestones for Condition 3:</u> <u>Year 1:</u> DFPO will provide evidence that work on verification of biogenic reefs in the UoA areas have moved forward, and that the impact assessment addresses the impact of the fishery on the verified biogenic reefs. If an impact on biogenic reefs is a concern, DFPO will ask for an assessment on whether this impact is likely to reduce structure and function of the biogenic reef to a point where there would be serious or irreversible harm. This can inform whether the fishery should avoid fishing activities in certain areas for the following fishing year. Further to this, any other mapping and/or verification of possible biogenic reefs by managers will be reported. <u>Years 2-3:</u> DFPO will provide evidence that work on verification of biogenic reefs in the UoA areas has moved forward, and that the impact assessment addresses the impact of the fishery on the verified biogenic reefs. This will be done through the request from the fishery on fishing opportunities to the managers. If an impact on biogenic reefs is a concern, DFPO will ask for an assessment on whether this impact is likely to reduce structure and function of the biogenic reef to a point where there would be serious or irreversible harm. This can inform whether the fishery should avoid fishing activities in certain areas for the following fishing year. Further to this, any other mapping and/or verification of possible biogenic reefs by managers will be reported. <u>Year 4:</u> DFPO will provide evidence that the nature, distribution and vulnerability of the biogenic reefs in the UoA areas are known at a level of detail relevant to the scale and intensity of the UoAs.
Consultation on condition	DFPO will maintain its ongoing liaison with DTU Aqua and other relevant agencies to ensure that the condition is met.

Condition 4 all UoAs

Performance Indicator	PI 3.2.3. Monitoring, control and surveillance mechanisms ensure the management measures in the fishery are enforced and complied with. SId. There is no evidence of systematic non-compliance.
Condition	By the 1st surveillance audit in 2022, the Client shall provide evidence that confirms that there is no evidence, in relation to engine power rules, of systematic non-compliance in relation to all UoAs.
Milestones	<u>Year 1, 2022</u>: Provide written (published) evidence from the Fisheries Agency following the completion of the engine power control campaign that there is no systematic non-compliance in relation to engine power in the UoAs.

Client Action Plan	DFPO will provide written evidence from the results of the engine power control campaign carried out by the Danish Fishery Agency in 2021.
Consultation on condition	DFPO will liaise with the Control Division of the Fisheries Agency to ensure that the condition is met.

8.7 Surveillance

Table 39. Fishery surveillance program

Surveillance level	Year 1	Year 2	Year 3	Year 4
Level 5	On-site surveillance audit	Off-site surveillance audit	On-site surveillance audit	On-site surveillance audit & re-certification site visit.

Table 40. Timing of surveillance audit

Year	Anniversary date of certificate	Proposed date of surveillance audit	Rationale
1	October 2022	October 2022	The predicted certification date for this fishery will be October 2021.
2	October 2023	October 2023	
3	October 2024	October 2024	
4	October 2025	October 2025	

Table 41. Surveillance level rationale

Year	Surveillance activity	Number of auditors	Rationale
1, 3 & 4	On-site audit	2 auditors on-site	While information needed to verify progress of the conditions can be provided remotely, this reassessment has combined three separate originally certified fisheries, and the complexity of the UoAs requires on-site surveillance audits in most years.
2	Off-site audit	2 auditors off-site	

8.8 Risk-Based Framework outputs

The Risk-Based Framework (RBF) was used to score PI 1.1.1 for UoA 2 (Limfjord cockles), UoA 3 (Limfjord oysters) and UoA 4 (Inner Danish Waters mussels) and the Consequence Analysis (CA) and Productivity Susceptibility Analysis (PSA) scores for these UoAs are presented below in sections 8.8.1 and 8.8.2 respectively. In addition, the RBF was used to score PI 2.2.1 for starfish as a main secondary species in UoA 2 (Limfjord cockles) and UoA 3 (Limfjord oysters), and the PSA scores for these two UoAs are presented in section 8.8.2 below.

8.8.1 Consequence Analysis (CA)

For Limfjord cockles (UoA 2), Limfjord oysters (UoA 3) and Inner Danish Waters mussels (UoA 4), the assessment team considered available information and stakeholder input to assign a score for the consequence of the fishing activity on the subcomponent (population size, reproductive capacity, age/size/sex structure or geographic range) on which the fishery was considered to be having the most impact (MSC Fisheries Certification Process v2.1, PF3.3.2). The consequence scores were assigned based on Table 43 below.

Table 42. Scores for the consequence of fishing activity of the various sub-components on which the fishery is having the most impact – MSC Fisheries Certification Process v2.1, Table PF3.

	Consequence category			
Subcomponent	**100**	**80**	**60**	**Fail**
Population size	Insignificant change to population size/growth rate (r). Change is unlikely to be detectable against natural variability for this population.	Possible detectable change in size/growth rate (r) but minimal impact on population size and none on dynamics.	Full exploitation rate but long-term recruitment dynamics not adversely damaged.	Consequence is higher-risk than 60 level.
Reproductive capacity	Insignificant change in reproductive capacity. Unlikely to be detectable against natural variability for this population	Possible detectable change in reproductive capacity but minimal impact on population dynamics.	Detectable change in reproductive capacity. Impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely affected.	
Age/size/sex structure	Insignificant change in age/size/sex structure. Unlikely to be detectable against natural variability for this population.	Possible detectable change in age/size/sex structure but minimal impact on population dynamics.	Detectable change in age/size/sex structure. Impact on population dynamics at maximum sustainable level, long-term recruitment dynamics not adversely affected.	
Geographic range	Insignificant change in geographic range. Unlikely to be detectable against natural variability for this population.	Possible detectable change in geographic range but minimal impact on population distribution and none on dynamics.	Detectable change in geographic range up to 10% of original distribution due to fishing activities.	

The various terms in the Table 43 should be interpreted as follows:

a. “Insignificant change” shall mean that changes in the subcomponents are undetectable or if detectable, these are of such a low magnitude that the impact of the fishing activity cannot be differentiated from the natural variability for this population.
b. “Possible detectable change” shall mean that changes are detected and can be reasonably attributable to the fishing activity, but these are of such a low magnitude that the impact of the fishery is considered to be minimal on the population size and dynamics.
c. “Detectable change” shall mean that changes to the subcomponent can be attributed to the fishing activity and changes are of such magnitude that cannot be considered as minimal.

(MSC Fisheries Certification Process v2.1, PF3.3.3)

Table 43. CA scoring for PI 1.1.1 for UoA 2 Limfjord cockles

	Scoring element	Consequence subcomponents	Consequence score
Principle 1: Stock status outcome	Cockles	Population size	80
		Reproductive capacity	
		Age/size/sex structure	
		Geographic range	
Rationale for most vulnerable subcomponent	Cockles are widely distributed in the Limfjord and throughout north-western Europe. The fishery is limited in its spatial extent to a small part of the Limfjord and a limited depth range for just a short period of time when the cockles are amenable to capture. Cockles are fast maturing and highly fecund, and generally mature in their second year (or even in their first year in warmer parts of Europe). The dredges used in the Limfjord fishery have a mesh size of 30mm ensuring the retention of only larger individuals that have already reproduced. The fishery is therefore considered highly unlikely to affect the geographic range of the cockle population, the age / size / sex structure, or the reproductive capacity of the cockle stock. All stakeholders and the assessment team concluded that population size was the most vulnerable sub-component to assess the risk that the fishery poses to the productivity of the cockle population.		
Rationale for consequence score	The view of stakeholders during the first certification cycle and during this reassessment was that the scale of fishery removals and the spatial scale of the fishery were small relative to the Limfjord cockle stock. Cockles are widely distributed in the Limfjord, from the intertidal zone into the shallow sublittoral. Cockles can occur in densities that are economically viable for fishing over a large part of the Limfjord but abundant populations are patchily distributed, both spatially and temporally. Whilst there is no time series of stock biomass, annual landings data provide information about cockle distribution and abundance for the different production areas, which indicate that cockles can be present in densities that are economically viable for fishing over a large part of the Limfjord but abundant populations are patchily distributed, both spatially and temporally. Landings therefore provide an index of the success of the fishery and hence an indirect index of stock abundance/biomass. Landings have fluctuated between 5,000 and 8,000 tonnes over the last decade implying stable stock dynamics. In addition, a recent DTU Aqua stock survey showed that multiple age cohorts were present in each basin implying successful recruitment in several recent years, with 2, 3 and 4 age classes dominating the age structure. Whilst cockles have been harvested from 22 production areas over the last few years, in the last three years 99% of cockle landings were from six production areas only. The fishery is limited to waters at least 3m deep, which means that most of the species’ range in the Limfjord cannot be fished. Throughout the Limfjord, dredging is not permitted in any waters shallower than 3m (and this restriction is increased to 5m throughout Natura 2000 sites, and 6m in parts of these sites).		

	Dredging is only permitted in the western Limfjord, and is not permitted in the vicinity of harbours or close to bathing beaches. Overall, more than 50% of the Limfjord area is closed to cockle or mussel dredging. There are legal and practical constraints on fishing activity that limit the number of days per year when cockles can be caught. Dredging in the Limfjord is only permissible on weekdays, and cockle fishing can only take place in the spring and autumn due to the pattern of emergence of cockles from the seabed when they are more amenable to capture in dredges. Stakeholders considered that environmental variations (and in particular low oxygen levels) in the Limfjord have a far greater effect on settlement and recruitment of benthic marine infauna such as cockles. Stakeholders also considered that natural mortality may be high in comparison with fishing mortality. Some stakeholders considered that changes in population size were likely to be insignificant, and undetectable against background variability of the Limfjord cockle population. and that a consequence score of 100 was appropriate. However the assessment team concluded that local effects of fishing activity on the population might be detected, and with uncertainties underlying accurate stimates of stock biomass, increasing reliance of the fishery on one production area (Kås Bredning), and the potential negative impact of dredging on settlement of cockles that has been observed in other fisheries (Piersma *et al*., 2001), it would be precautionary to conclude that changes are detected and can be reasonably attributable to the fishing activity, but these are of such a low magnitude that the impact of the fishery is considered to be minimal on the population size and dynamics. A consequence score of 80 was therefore assigned to the cockle fishery.

Table 44. CA scoring for PI 1.1.1 for UoA 3 Limfjord oysters.

	Scoring element	Consequence subcomponents	Consequence score
Principle 1: Stock status outcome	Oysters	Population size	80
		Reproductive capacity	
		Age/size/sex structure	
		Geographic range	
Rationale for most vulnerable subcomponent	All stakeholders and the assessment team agreed that population size was the most vulnerable sub-component to assess the risk that the fishery poses to the productivity of the oyster population. Whilst populations of oysters have declined across Europe historically, and in the Limfjord the oyster population has previously been concentrated in the Nissum Bredning and recruitment has been sporadic, in recent years the oyster population has increased in its geographic distribution with recruitment events and increased populations observed in Løgstør Bredning, in areas to the east of Nissum Bredning and other areas outside Natura 2000 sites, in particular areas 27 and 28. The fishery does not appear to have had any recent impact on geographic range or reproductive capacity of the oyster population. Recent surveys within both Løgstør Bredning and outside Natura 2000 sites show that there are several year classes present in the population. Minimum landing size for oysters is now specified as 80 g in fishing permits which corresponds to a shell height of 70-80 mm well above the size at maturity, and any oysters below minimum size caught in the dredges are immediately returned to the sea and are expected to have a high survival rate. All observations from the fishery therefore provide evidence that the fishery has not had any recent impact on age/size/sex distribution of the population or on its reproductive capacity.		
Rationale for consequence score	The annual stock survey information and monitoring of the fleet through the black box system show that the fishery is very limited in its extent. Within the Natura 2000 sites all fishing activities (i.e. including, but not solely, the oyster fishery) are limited to a maximum of 15% of the total area over a five year period, which means within the		

	Natura 2000 sites, the annual areal overlap of the oyster with the distribution of the stock is very low. In addition, there is a limit to the number of days that vessels can fish for oysters. The most recent (2020) estimate of oyster stock biomass in the whole Limfjord is 4,700 tonnes, and the fishing industry has requested catches of 150 tonnes in Løgstør Bredning, 50 tonnes outside Natura 2000 sites, but no fishery in Nissum Bredning. The requested fishery in 2021 represents less than 5% of the stock, and landings from the fishery in recent years have been approximately 5-10% of the stock. Exploitation rates are considered overestimates as they do not take into account oysters in shallow waters less than 3m in depth which are not available to the fishery. All stakeholders noted that natural mortality may be high in oyster populations in comparison with fishing mortality, in particular due to a recent outbreak of Bonamia in Nissum Bredning and therefore the impact of the low exploitation rates in the fishery on the oyster population is limited in comparison with natural mortality rates. In addition, Nielsen and Petersen (2019) showed that summer water temperature is an important factor causing fluctuations in the oyster population, thought to be due to its influence on recruitment success. Some stakeholders considered that changes in population size due to fishing were likely to be insignificant and undetectable against background variability of the Limfjord oyster population and that a consequence score of 100 was appropriate. However, the assessment team concluded that in the light of the recent mortality event in the Nissum Bredning, and the potential for Bonamia to cause high mortalities across other parts of the Limfjord, a more precautionary score of 80 was appropriate.

Table 45. CA scoring for PI 1.1.1 for UoA 4 Inner Danish Waters mussels.

	Scoring element	Consequence subcomponents	Consequence score
Principle 1: Stock status outcome	Mussels	Population size	100
		Reproductive capacity	
		Age/size/sex structure	
		Geographic range	
Rationale for most vulnerable subcomponent	The history of Danish mussel fisheries suggests that if there is excessive fishing pressure, population size will be adversely affected, and so all stakeholders agreed that the most vulnerable sub-component of the fishery was population size. The limited spatial extent of the fishery in comparison with the widespread distribution of mussel populations in the region and the low exploitation rate in the Inner Danish Waters fishery suggest that the fishery is highly unlikely to affect the geographic range of the mussel population, the age / size / sex structure, or the reproductive capacity of the mussel populations in the region.		
Rationale for consequence score	In the last two fishing seasons, total landings from East Jutland and Isefjord have averaged 31,000 tonnes annually. A precautionary estimate of stock biomass in East Jutland and Isefjord is around 850,000 tonnes, so the current level of landings observed is equivalent to approximately 3.6% of the stock. The mussel stocks outside the Natura 2000 sites in East Jutland and Isefjord are not surveyed regularly. The most recent full-scale survey in the Isefjord provided biomass estimates ranging from 73,272 tonnes to 183,181 tonnes dependent on assumptions about catch efficiency of the mussel dredge. With average annual landings of 4,363 tonnes over the last two fishing seasons, this represents an exploitation rate of 2.4% to 6.0% of the total biomass in the Isefjord. Recruitment to the stock is good and DTU Aqua estimate that recruitment will be around 50% of stock biomass. Natural mortality through predation and major die-offs due to anoxic conditions in the summer months are considered to be much higher than fishery-related mortalities (Jens Kjerulf Petersen, DTU Aqua, pers. comm.), and so relative to natural mortality and recruitment, the effect of current fishery removals on the mussel stocks in the East Jutland and Isefjord areas are at levels which are highly unlikely to be detectable (at the stock level) against background variability. A consequence score of 100 is appropriate.		

8.8.2 Productivity Susceptibility Analysis (PSA)

For PI 1.1.1 the assessment team scored each productivity and susceptibility attribute as set out in Table 47 and Table 48 respectively for Limfjord cockles (UoA 2), Limfjord oysters (UoA 3) and Inner Danish Waters mussels (UoA 4). In addition, PSA was used to score PI 2.2.1 for starfish as a main secondary species in UoA 2 (Limfjord cockles) and UoA 3 (Limfjord oysters). Stakeholder input assisted in the scoring of the susceptibility attributes.

Table 46. PSA Productivity attributes and scores - MSC Fisheries Certification Process v2.1, Table PF4.

Productivity attribute	High productivity (Low risk, score = 1)	Medium productivity (medium risk, score = 2)	Low productivity (high risk, score = 3)
Average age at maturity	<5 years	5-15 years	>15 years
Average maximum age	<10 years	10-25 years	>25 years
Fecundity	>20,000 eggs per year	100-20,000 eggs per year	<100 eggs per year
Average maximum size (not to be used when scoring invertebrate species)	<100 cm	100-300 cm	>300 cm
Average size at maturity (not to be used when scoring invertebrate species)	<40 cm	40-200 cm	>200 cm
Reproductive strategy	Broadcast spawner	Demersal egg layer	Live bearer
Trophic Level	<2.75	2.75-3.25	>3.25
Density dependence (to be used when scoring invertebrate species only)	Compensatory dynamics at low population size demonstrated or likely.	No depensatory or compensatory dynamics demonstrated or likely.	Depensatory dynamics at low population sizes (Allee effects) demonstrated or likely.

Table 47. PSA Susceptibility attributes and scores - MSC Fisheries Certification Process v2.1, Table PF5.

Susceptibility attribute	Low susceptibility (Low risk, score = 1)	Medium susceptibility (medium risk, score = 2)	High susceptibility (high risk, score = 3)
Areal overlap (availability) Overlap of the fishing effort with a species concentration of the stock	<10% overlap	10-30% overlap	>30% overlap
Encounterability - The position of the stock/species within the water column relative to the fishing	Low overlap with fishing gear (low encounterability).	Medium overlap with fishing gear.	High overlap with fishing gear (high encounterability).

gear, and the position of the stock/species within the habitat relative to the position of the gear					Default score for target species (Principle 1).	
Selectivity of gear type Potential of the gear to retain species	a	Individuals < size at maturity are rarely caught.	a	Individuals < size at maturity are regularly caught.	a	Individuals < size at maturity are frequently caught
	b	Individuals < size at maturity can escape or avoid gear.	b	Individuals < half the size at maturity can escape or avoid gear.	b	Individuals < half the size at maturity are retained by gear.
Post-capture mortality (PCM) The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Evidence of majority released post-capture and survival.		Evidence of some released post-capture and survival.		Retained species or majority dead when released. Default score for retained species (Principle 1 or Principle 2).	

Table 48. PSA Productivity attributes and scores for UoA 2 Limfjord cockles.

Performance Indicator	PI 1.1.1	
Productivity		
Scoring element (species)	Cockles	
Attribute	Rationale	Score
Average age at maturity	Between 1 and 2 years (Dare *et al*., 2004; Malham *et al*., 2012; www.marlin.co.uk) but can be less than 12 months in areas with high growth rates.	**1**
Average maximum age	Dare *et al*. (2004) state that longevity is 5-8 years in The Wash, UK, www.marlin.ac.uk gives an average lifespan of 2-4 years, but states that cockles may live for 9 years or more. Dabouineau & Ponsero (2009) state that cockles generally live for 2-5 years on average, but they can exceptionally reach 10 years old. All evidence suggests that the average maximum age is < 10 years.	**1**
Fecundity	Egg production is usually in the range 200,000 to 700,000 per annum but a maximum of 1.7 million has been reported (Honkoop and van der Meer, 1998). Dare *et al*. (2004) state that large individuals produce more than 1 million eggs in The Wash, UK.	**1**
Average maximum size Not scored for invertebrates	NA	**NA**
Average size at maturity Not scored for invertebrates	NA	**NA**
Reproductive strategy	Broadcast spawner	**1**
Trophic level	Suspension feeder, phytoplankton and detritus are main food sources (Dare *et al*., 2004; SeaLifeBase). Trophic level less than 2.75.	**1**

Density dependence Invertebrates only	Little is known about depensatory mechanisms in cockle, but cockle populations are known to be highly variable over time and may disappear from areas, but then reappear again when environmental conditions are favourable for settlement and/or recruitment. Depensatory dynamics at low population sizes (Allee effects) are unlikely.	**2**
Susceptibility		
Fishery Only where the scoring element is scored cumulatively	The only source of fishing-related mortality for sublittoral cockles in the Limfjord is the dredge fishery. There is no demersal trawling for finned fish in the Limfjord, nor any other use of mobile fishing gear that could impact on the cockle stock. Although cockles can only be caught by mussel dredgers as a bycatch species making up no more than 49% of the catch on any given day, the capture of cockles is deliberate and directed through the addition of a small-meshed dredge. Cockles could potentially be caught whilst vessels are targeting mussels. However, the distribution of mussels and cockles are not considered to overlap significantly and information on bycatch of cockles from both the directed mussel fishery and from stations on the annual survey where mussels were caught in commercial quantities show that the impact of the directed mussel fishery on the cockle population is negligible. The assessment team concluded that only the cockle fishery needs to be considered when evaluating susceptibility attributes.	
Attribute	Rationale	Score
Areal Overlap	Cockles are an intertidal species that extend into the subtidal. In Limfjord, there is little tide, so the intertidal area is small and most cockle populations are subtidal. Cockles are widespread throughout Limfjord but patchy and cannot live in oxygen depleted areas. Although a bycatch of the mussel fishery, cockles have different life habits and the main cockle beds are adjacent to mussel beds, not on them. Throughout the Limfjord, dredging is not permitted in any waters shallower than 3m (and this restriction is increased to 5m throughout Natura 2000 sites, and 6m in parts of these sites). Dredging is only permitted in the western Limfjord and is not permitted in the vicinity of harbours or close to bathing beaches. Overall, more than 50% of the Limfjord area is closed to dredging. Within the Natura 2000 sites all fishing activities are limited to a maximum of 15% of the total area over a five year period, which means within the Natura 2000 sites, the areal overlap with the distribution of the stock is *de facto* <10%. The exact degree of overlap of the dredge fishery with cockle species distribution is not known primarily due to the difficulties with quantitative sampling of cockle distribution and abundance. Whilst cockles have been harvested from 22 production areas over the last few years, in the last three years 99% of cockle landings were from six production areas only. A recent survey by DTU Aqua showed that there were two areas of high cockle abundance in Nissum Bredning where there is currently no fishery. DTU Aqua provided some quantitative data on the areal overlap of the fishery with the distribution of the stock within shellfish production area 9, Kås Bredning, which over the last few years has contributed 74% of the total landings in the Limfjord. Kås Bredning has approximately 44 km^2 of fishable area, but the total area fished from 2013 to 2019 constituted 13.4 km^2 or 30.5% of the total fishable area. However, on average in any single year, the total area fished was estimated at 3.9 ±1.1 km^2, equivalent to 8.9% of the total fishable area. In conclusion, even in the most highly productive areas, the fishery overlaps on an annual basis with less	**2**

	than 10% of the distribution of the cockle stock. Whilst all stakeholders considered that the areal overlap is likely to be small (<10%), in view of the uncertainties concerning the overall distribution of the cockle stock, as a precautionary measure the assessment team has used a higher estimate of areal overlap of 10-30%. (As noted above, the only source of fishing-related mortality for sublittoral cockles in the Limfjord is the dredge fishery.)	
Encounterability	Cockles are a benthic species and although they exhibit burrowing behaviour, the dredge fishery takes advantage of the period when the cockles emerge from the seabed. The assessment team considered that there was a high encounterability between cockles and the dredge and as the target species, there is a default score of 3 for this attribute. (As noted above, the only source of fishing-related mortality for sublittoral cockles in the Limfjord is the dredge fishery.)	**3**
Selectivity of gear type	The average size at maturity for cockles is 15-20mm (although this may vary regionally), and the industry minimum landing size in the Limfjord is 16mm. However, the cockle fishery uses a dredge with a mesh size of 30mm, so stakeholders considered that the dredge retains primarily larger individuals that have already reproduced. The assessment team concluded that the dredge may still capture individuals under the size at maturity on a regular basis, i.e., in more than 5% of gear deployments, giving a score for category ‘a’ for this attribute of 2. For category ‘b’, individuals less than half the size at maturity, i.e. 7.5 to 10 cm, are not captured in the dredge, and therefore the score for category ‘b’ of this attribute is also 2.	**2**
Post capture mortality	Retained species, so default score of 3	**3**

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Table 49. PSA productivity attributes and scores for UoA 3 Limfjord oysters.

Performance Indicator	PI 1.1.1	
Productivity		
Scoring element (species)	Oysters	
Attribute	Rationale	Score
Average age at maturity	The age of first sexual maturity varies with temperature but is usually 3-4 years old in the UK and in Limfjord (Spärck 1925; Orton 1927; Cole 1941).	**1**
Average maximum age	Although oysters are known to live for up to 20 years, Richardson *et al*. (1993) recorded oysters living up to 14 years in the UK and the maximum age observed in the Limfjord is 10 years.	**2**
Fecundity	More than 20,000 eggs per year (Yonge,1960)	**1**
Average maximum size Not scored for invertebrates	NA	**NA**
Average size at maturity Not scored for invertebrates	NA	**NA**
Reproductive strategy	Following fertilisation of the eggs, oysters of the genus Ostrea release larvae into the water and these larvae undergo a pelagic stage before settling on the seabed. Oysters might therefore be generally considered as broadcast spawners. However following fertilisation of the eggs by spermatozoa in the mantle cavity, the adults incubate their larvae for 7-15 days (Yonge, 1960), a phase described as internal brooding, prior to release of the larvae into the wild, a process described as swarming (Colsoul *et al*., 2021). During the initial certification, the assessment team concluded that the reproductive strategy of oysters was such that the females could be considered as live bearers and therefore this attribute was scored at 3. From a precautionary perspective, the assessment team for this recertification has kept the high risk score.	**3**
Trophic level	Oysters are filter feeders, with a diet of phytoplankton and suspended organic particles (Yonge, 1960). The trophic level is therefore less than 2.75.	**1**
Density dependence Invertebrates only	Oyster populations are known to be highly variable both spatially and temporally and are dependent upon successful settlement and recruitment. At low population densities, it is possible that depensatory (Allee) effects may be observed.	**3**
Susceptibility		
Fishery Only where the scoring element is scored cumulatively	The primary source of fishing-related mortality for oysters in the Limfjord is the targeted oyster dredge fishery. In addition, oysters may occasionally be caught in the directed mussel fishery where a maximum 1% bycatch of oysters is permitted.	
Attribute	Rationale	Score
Areal Overlap	The extent of fishing activity is known from the black box monitoring of areas fished and is tightly controlled in Natura 2000 sites where all fishing activities are limited to a maximum of 15% of the total area over a five year period. In the 2019/2020 fishing season, fishing for European (*Ostrea edulis*) and Pacific (*Crassostrea gigas*) oysters in	**1**

	Nissum Bredning affected an area of approximately 1.6 km^2, while starfish fishing affected 0.7 km^2 which constitutes a total for all fisheries of 1.3% of the area of the Nissum Bredning habitat area. From 2016 to 2020, oyster fishing has affected annually 0.9-4.0% of the Nissum Bredning Natura 2000 site, and the cumulative area impact of both the oyster and starfish fisheries on both the macroalgae and bottom fauna was estimated to be below the maximum permitted level of 15% over the 5 year period. The fishing industry has not requested any oyster catches in Nissum Bredning in 2021, so the areal overlap in this Natura 2000 site will be zero. In Løgstør Bredning in 2019/20, oyster fishing impacted 2.73 km^2, which is equivalent to 0.9% of the total area. The fishing industry's request is for a fishery of 150 tonnes of oysters in Løgstør Bredning for the period September 2020 to July 2021, and the area affected by that level of fishing is estimated at 4.5 km^2 corresponding to 1.4% of the total area. The potential impact of the oyster fishery must be considered in conjunction with proposed fisheries for mussels and starfish in Løgstør Bredning. The cumulative effects of a fishery of 5,500 tonnes of mussels, 150 tonnes of oysters and 200 tonnes of starfish in the 2020/21 fishing season will not exceed the maximum permitted limit of 15% over a 5 year period. Outside Natura 2000 sites, the published stock assessments do not provide information on black box data, but for the 2020/21 season, the fishing industry has requested catches of only 50 tonnes from a population of approximately 1500 tonnes, and therefore the percentage area impacted by the fishery is likely to be of similar magnitude to that observed in the Natura 2000 sites. In conclusion all the data provide evidence that the areal overlap between the oyster fishery and the stock (including those areas where there is also a mussel fishery which may have a small bycatch of oysters) is less than 10%, justifying a susceptibility score of 1.	
Encounterability	Oysters are a benthic species which essentially sit on the seabed and the oyster dredge is designed to run across the seabed. Whilst dredging is only permitted in water deeper than 5m in the Natura 2000 sites and 3m elsewhere, and most of the UoC area is very shallow (<8m), such that these depth restrictions cover a significant proportion of the species' range, there is a high encounterability between oysters and the dredge and as the target species, there is a default score of 3 for this attribute. The mussel fishery, which may have a small bycatch of oysters, also uses a dredge which has a high encounterability with oysters and therefore the mussel fishery also scores 3 for this attribute.	**3**
Selectivity of gear type	*Ostrea edulis* reach maturity at a size of approximately 50mm. The minimum landing size for oysters in the Limfjord stated in the fishing permits is a weight of 80g which corresponds to a shell length of 70-80mm (DTU Aqua, 2020b). The sizes of oysters caught in commercial fishing gear throughout the UoC during stock assessments were reported for the period 2002-2005 (Kristensen & Hoffmman, 2006). This report showed that out of 11,301 individuals sampled, only 18 (0.2%) had a shell length of 25mm or less. Individuals smaller than 50mm made up 24.7% of the catch by number. The information about the frequency of capture of different sizes of oysters from this study indicates that oysters smaller than the size at	**Oyster dredge 2 Mussel dredge 3**

	maturity are frequently caught (i.e. in more than 50% of gear deployments). It is noted that all of these are individuals are subsequently returned to the sea alive. This would indicate a susceptibility score of 3 under the criteria listed in FCR Table PF5 as the Selectivity "a" attribute. The information available from the fishery suggests that a different score may be appropriate under the Selectivity "b" attribute. The catch size distribution provides evidence that there is negligible capture of individuals less than half of the size at maturity, and that oysters smaller than 50mm can escape the fishing gear, which is designed to retain oysters larger than 70mm. This would indicate a susceptibility score of 1. The FCR indicates that where the (a) and (b) elements indicate different risk scores, the team shall assign a score that is the average of the two. A susceptibility score of 2 is therefore appropriate for the oyster dredge fishery. No information is available on the selectivity of mussel dredges, which are outside the UoC but which may catch a very small quantity of oysters. In the absence of information, a susceptibility score of 3 is appropriate on a precautionary basis.	
Post capture mortality	Retained species, so default score of 3	**3**
Catch (weight) Only where the scoring element is scored cumulatively	Total landings of oysters in 2018/19 and 2019/20 have been 304 and 228 tonnes respectively. Landings data are not broken down into those from the targeted oyster fishery and those recorded as bycatch in the mussel fishery, but black box data for 2019/20 for Løgstør Bredning which is the only area where there are both mussel and oyster fisheries shows negligible overlap between the two fisheries. In addition, there is negligible overlap between mussel fishing activity as described by the black box data and observed oyster distributions from the stock survey, and therefore we assume that there is negligible bycatch of oysters in the mussel fishery. We have used the average catch weight over the last two years of 266 tonnes in the targeted fishery, and 10 tonnes bycatch in the mussel fishery.	**Oyster fishery 266 tonnes** **Mussel fishery 10 tonnes**

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Table 50. PSA Productivity attributes and scores for UoA 4 Inner Danish Waters mussels

Performance Indicator	PI 1.1.1	
Productivity		
Scoring element (species)	Mussels	
Attribute	Rationale	Score
Average age at maturity	Average age at maturity is 1-2 years	**1**
Average maximum age	Average maximum age is less than 10 years	**1**
Fecundity	*Mytilus edulis* females can produce millions of eggs.	**1**
Average maximum size Not scored for invertebrates	NA	**NA**
Average size at maturity Not scored for invertebrates	NA	**NA**
Reproductive strategy	Broadcast spawner	**1**
Trophic level	*Mytilus edulis* is a suspension filter feeder with a diet of phytoplankton, dinoflagellates, diatoms etc., and so has a trophic level < 2.75.	**1**
Density dependence Invertebrates only	Mussel population dynamics are strongly density dependent with lower growth rate and higher mortality rates of juvenile mussels observed at high adult densities. Compensatory dynamics are in evidence at low densities, but in contrast settlement of spat is enhanced by high adult densities. Mussels are common over a wide geographical area and are widespread across a range of substrates and so depensatory dynamics at low population sizes through reduced likelihood of fertilisation (Allee effects) are highly unlikely. In view of contrasting density-dependent effects, a precautionary score of 2 was allocated to this attribute.	**2**
Susceptibility		
Fishery Only where the scoring element is scored cumulatively	The only source of fishing-related mortality for mussels in the Inner Danish Waters is the dredge fishery. The assessment team concluded that only the mussel fishery needs to be considered when evaluating susceptibility attributes.	

Attribute	Rationale	Score
Areal Overlap	As there have been no regular surveys of the mussel stock outside the Natura 2000 sites in East Jutland, there is no accurate estimate of the spatial distribution of the stock, so it is necessary to estimate the spatial scale of fishing activity in relation to the stock from data on the likely biomass of the stock and landings from the fishery. On the assumption that mussel dredgers operate only in areas where the mussel density is at least 1.5 kg/m^2 (DTU Aqua, pers. comm.), and that mussel dredges are only 50% efficient, then the average annual landings of mussels from East Jutland in the last two years (26,725 tonnes) would be achieved from fishing an area of approximately 36km^2. A conservative estimate of the area of the mussel beds in the East Jutland area can be calculated by using the same parameters. Assuming that mussel beds have a density of 1.5kg/m², the biomass estimate of 750,000 tonnes for the East Jutland area corresponds to an area of 500 km^2 as a conservative estimate of the distribution of the mussel stock. The recent annual landings would therefore have been harvested from approximately 7% of the spatial extent of the mussel stock. In the Isefjord the recent annual landings of mussels were 4363 tonnes, which is equivalent to fishing an area of 5.8km^2. The 2016 stock survey estimated stock biomass in the Isefjord to be 73,272 tonnes assuming a dredge efficiency of 50%. Using the method described above for East Jutland, this corresponds to an area of 49 km^2 as a conservative estimate of the distribution of the mussel stock. The recent landings would therefore have been harvested from approximately 12% of the spatial extent of the mussel stock. The above estimates of spatial scale of fishing activity are highly precautionary, as they assume that the stock is distributed only in areas where the density is at least 1.5 kg/m^2, and there are obviously large areas of mussels where the density is below that threshold. For example, the recent Isefjord survey estimated overall density to be 0.25 kg/m^2. In addition, there are mussels in shallower waters where fishing is not permitted. Additional information suggests that these estimates of the proportion of the geographical extent of the stock in which fishing activity occurs are significant over-estimates. The Lillebælt and Horsens Fjord Natura 2000 sites are currently closed to mussel fishing, and even when these Natura 2000 sites are open to fishing, black box data show that annual mussel fishing activity occurs in only around 1-2% of the Natura 2000 sites, and the recent survey of the Isefjord area provided estimates of exploitation rate ranging from 2.4% to 6.0% depending on the assumptions regarding gear efficiency (Orbicon, 2016). Although neither of these above figures are equivalent to the proportion of the total mussel stock within which fishing occurs, they do suggest a very restricted spatial extent of the fishery. The assessment team concluded therefore that there is a high degree of certainty that mussel dredging activity is restricted to less than 10% of the geographical extent of the stock equivalent to a score of 1. All stakeholders concurred with this evaluation. (As noted above, the only source of fishing-related mortality for mussels in the Inner Danish Waters is the dredge fishery.)	**1**
Encounterability	The mussel dredge is designed to run across the mussel beds on the seabed. The assessment team considered that there was a high	**3**

	encounterability between mussels and the dredge and as the target species, there is a default score of 3 for this attribute. (As noted above, the only source of fishing-related mortality for mussels in the Inner Danish Waters is the dredge fishery.)	
Selectivity of gear type	There is a minimum landing size of 50mm in the Inner Danish Waters Fishery, which is well above the size at maturity, which may range from 10 to 30mm dependent on density of mussel beds. However, the regulations allow 10% of the landings to be under the minimum landing size. The assessment team concluded that individuals less than the size at maturity may be regularly caught (i.e. in 5% to 50% of gear deployments) and so there is medium susceptibility (score=2). Whilst the mussel dredge catches a wide range of sizes of mussels, it was concluded that individuals less than half of the size at maturity can escape or avoid gear (i.e. they are not caught in the mussel dredges) and so again there is medium susceptibility (score=2).	**2**
Post capture mortality	Mussels are the target species, so post-capture mortality has a default score of 3.	**3**

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Table 51. PSA Productivity attributes and scores for UoA 2 Limfjord cockles and UoA 3 Limfjord oysters

Performance Indicator	PI 2.2.1	
Productivity		
Scoring element (species)	Starfish – *Asterias rubens*	
Attribute	Rationale	Score

Average age at maturity	Approximately 1 to 2 years.	**1**
Average maximum age	Lifespan of *Asterias rubens* is 7-8 years.	**1**
Fecundity	*Asterias rubens* can produce 2.5 million eggs.	**1**
Average maximum size Not scored for invertebrates	NA	**NA**
Average size at maturity Not scored for invertebrates	NA	**NA**
Reproductive strategy	Broadcast spawner	**1**
Trophic level	Starfish are predators which eat primarily benthic invertebrates, particularly bivalve molluscs such as mussels, polychaetes, small crustaceans and other echinoderms. Trophic level is approximately 3.	**2**
Density dependence Invertebrates only	Adult starfish are highly mobile and are widespread across a range of substrates and so depensatory dynamics at low population sizes through reduced likelihood of fertilisation (Allee effects) are highly unlikely. Little is known about compensatory density dependence in starfish populations in the Limfjord, so a precautionary score of 2 is given.	**2**
Susceptibility		
Fishery Only where the scoring element is scored cumulatively	The two UoAs, for which starfish is potentially a main secondary species – the cockle dredge fishery (UoA 2) and the oyster dredge fishery (UoA 3) are considered together. MSC FCPv.2.1, PF4.4.3c states that “When scoring PI 2.2.1, if the UoA has main species with catches at 10% or more of the total catch by weight of the UoA, all MSC UoAs having a catch of the same species that is 10% or more of the total catch of the UoAs shall be identified and listed separately.” Estimates of bycatch of starfish in the cockle fishery (UoA 2) and the oyster fishery (UoA 3) are approximately 15% and 7% respectively, but there is considerable uncertainty surrounding these estimates. The assessment team has therefore taken a precautionary approach and assumed that both UoAs have bycatch of starfish of over 10% of the total catch. In addition, starfish are discarded in both UoAs and in the absence of an observer programme for the two UoAs, there is no estimate of catches of starfish in the two UoAs, and therefore the assessment team has allocated a score for each attribute in line with the highest susceptibility score for the two UoAs, i.e., the two gear types (FCP v2.1, PF4.4.5a). Within the Limfjord, there is also a targeted starfish fishery using seine nets, but this fishery is not MSC-certified and is not therefore considered in the PSA.	
Attribute	Rationale	Score
Areal Overlap	There is no information on stock structure of *Asterias rubens* in the Limfjord and the surrounding region. Starfish have a high fecundity, a pelagic larvae stage of more than 80 days, the ability to settle on a wide variety of substrates, a highly mobile adult stage and throughout their geographical range are widely distributed from the intertidal up to 600m depth. The assessment team therefore assumed that there is a single stock in the Limfjord, although the stock may have a wider distribution than the Limfjord itself. DTU Aqua surveys show that starfish are found widely across the Løgstør Bredning, Lovn Bredning and Nissum Bredning Natura 2000 sites, and there are large populations within the Limfjord outside the Natura 2000 sites.	**1**

	For the cockle dredge fishery (UoA 2), throughout the Limfjord, dredging is not permitted in any waters shallower than 3m (and this restriction is increased to 5m throughout Natura 2000 sites, and 6m in parts of these sites). Dredging is only permitted in the western Limfjord and is not permitted in the vicinity of harbours or close to bathing beaches. Overall, more than 50% of the Limfjord area is closed to dredging. The extent of fishing activity is known from the black box monitoring of areas fished and is tightly controlled in Natura 2000 sites where all fishing activities are limited to a maximum of 15% of the total area over a five year period which means within the Natura 2000 sites, the areal overlap with the distribution of the starfish populations is highly likely to be <10%. All stakeholders agreed that the overlap of the cockle fishery with starfish distribution is less than 10%. For the oyster dredge fishery (UoA 3) in the 2019/2020 fishing season, fishing for *Ostrea edulis* affected 1.3% of the area of the Nissum Bredning habitat area. The fishing industry has not requested any oyster catches in Nissum Bredning in 2021, so the areal overlap in this Natura 2000 site will be zero. The equivalent figure for 2019/20 in Løgstør Bredning is 0.9%, and the fishing industry's catch limit request for 2021 will be expected to impact 1.4% of the total area. Outside Natura 2000 sites, the published stock assessments do not provide information on black box data, but for the 2020/21 season, the fishing industry catch limit request for the oyster fishery is expected to impact percentage areas of similar magnitude to that observed in the Natura 2000 sites. All the evidence suggests that the oyster fishery will overlap with a very small (<10%) of the overall distribution of the starfish population, and this conclusion was confirmed by all stakeholders at the site visit.	
Encounterability	Starfish are benthic invertebrates and both cockle (UoA 2) and oyster (UoA 3) dredges are designed to run across the seabed. The assessment team considered that there was a high encounterability between starfish and the cockle and oyster dredges.	**3**
Selectivity of gear type	No information is available on the selectivity of the cockle and oyster dredges in relation to size at maturity. A precautionary score of 3 is therefore allocated to this attribute.	**3**
Post capture mortality	For both the cockle dredge (UoA 2) and oyster dredge (UoA 3) fisheries, starfish are not retained and discarded back to the sea following capture. Post-capture survival is expected to be high as starfish are resilient to disturbance and are capable of regrowing arms even if damaged by fishing gear (autotomy).	**1**
Catch (weight) Only where the scoring element is scored cumulatively	Starfish are discarded in both UoAs and in the absence of an observer programme, there is no estimate of catch of starfish available for either UoA.	

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Table 52. UoA 2 cockles in the Limfjord – calculation of RBF scores

The scores awarded in Table 44 and Table 49 above are used to determine an MSC score for Performance Indicator 1.1.1 using a spreadsheet provided by the MSC. This spreadsheet uses an algorithm that has been developed by the MSC to determine a “Productivity” and a “Susceptibility” score for the fishery, and then to allocate a corresponding MSC score. A copy of the spreadsheet that is used to perform this calculation is shown in below.

Productivity Scores [1-3]									Susceptibility Scores [1-3]										
Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level	Density Dependance	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	PSA Score	**MSC PSA-derived score**	Risk Category Name	MSC scoring guidepost	**Consequence Score (CA)**	**Final MSC score (per scoring element)**
1	1	1			1	1	2	1.17	2	3	2	3	1.88	2.21	91	Low	≥80	80	86

Table 53. UoA 3 oysters in the Limfjord – calculation of RBF scores

The scores awarded in Table 45 and Table 50 above are used to determine an MSC score for Performance Indicator 1.1.1 using a spreadsheet provided by the MSC. This spreadsheet uses an algorithm that has been developed by the MSC to determine a “Productivity” and a “Susceptibility” score for the fishery, and then to allocate a corresponding MSC score. A copy of the spreadsheet that is used to perform this calculation is shown in below.

N.B. Row 1 is for the oyster dredge, Row 2 is for the mussel dredge.

Productivity Scores [1-3]									Susceptibility Scores [1-3]						Cumulative only								
Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level	Density Dependance	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	PSA Score	Catch (tons)	Weighting	Weighted Total	Weighted PSA Score	**MSC PSA-derived score**	Risk Category Name	MSC scoring guidepost	**Consequence Score (CA)**	**Final MSC score (per scoring element)**
1	2	1			3	1	3	1.83	1	3	2	3	1.43	2.32	266	1.00	2.32	2.32	89	Low	≥80	80	85
1	2	1			3	1	3	1.83	1	3	3	3	1.65	2.47	10							80	

Table 54. UoA 4 mussels in Inner Danish waters – calculation of RBF scores.

The scores awarded in Table 46 and Table 51 above are used to determine an MSC score for Performance Indicator 1.1.1 using a spreadsheet provided by the MSC. This spreadsheet uses an algorithm that has been developed by the MSC to determine a "Productivity" and a "Susceptibility" score for the fishery, and then to allocate a corresponding MSC score. A copy of the spreadsheet that is used to perform this calculation is shown in below.

Productivity Scores [1-3]									Susceptibility Scores [1-3]						Cumulative only								
Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level	Density Dependance	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	PSA Score	Catch (tons)	Weighting	Weighted Total	Weighted PSA Score	**MSC PSA-derived score**	Risk Category Name	MSC scoring guidepost	**Consequence Score (CA)**	**Final MSC score (per scoring element)**
1	1	1			1	1	2	1.17	1	3	2	3	1.43	1.84					97	Low	≥80	100	99

Table 55. Starfish in UoA 2 Limfjord cockles and Limfjord oysters – calculation of RBF scores.

The scores awarded in Table 52 above are used to determine an MSC score for Performance Indicator 1.1.1 using a spreadsheet provided by the MSC. This spreadsheet uses an algorithm that has been developed by the MSC to determine a "Productivity" and a "Susceptibility" score for the fishery, and then to allocate a corresponding MSC score. A copy of the spreadsheet that is used to perform this calculation is shown in below.

Productivity Scores [1-3]									Susceptibility Scores [1-3]						Cumulative only								
Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level	Density Dependance	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	PSA Score	Catch (tons)	Weighting	Weighted Total	Weighted PSA Score	**MSC PSA-derived score**	Risk Category Name	MSC scoring guidepost	**Consequence Score (CA)**	**Final MSC score (per scoring element)**
1	1	1			1	2	2	1.33	1	3	3	1	1.20	1.79					98	Low	≥80		98

8.9 Harmonised fishery assessments

This reassessment covers four UoAs previously assessed and certified under three separate certificates. UoAs 1 and 2 covering mussels and cockles respectively in the Limfjord were previously certified in January 2016 under the DFPO Limfjord Mussel and Cockle Fishery MSC-F-31219 (MRAG-F_0050). UoA 3 covering oysters in the Limfjord was previously certified in May 2017 under the DFPO Limfjord oyster dredge fishery MSC-F-31306 (F-ACO-0066), and UoA 4 covering mussels in Danish inland waters was previously certified in May 2017 under the DFPO Inner Danish Waters blue shell mussel fishery MSC-F-31307 (MRAG-F-0065). In previous assessments, there was a need to consider harmonisation across these various fisheries, but now that the four fisheries have been amalgamated into one reassessment, harmonisation occurs automatically across the four fisheries.

The only other certified fishery in the Limfjord is the Limfjord blue shell mussel (rope-grown) fishery. This is an enhanced fishery for which there is no requirement to score Principle 1, and there are essentially no bycatch species caught in the fishery as the mussels are rope-grown rather than being harvested by a dredge, so there is no need to harmonise P1 and most of P2. In addition, the rope grown fishery was certified under MSC CRv1.3, and therefore harmonising across the habitat component is not required as there are different versions of the standard for this component. Therefore, it is necessary to harmonise only P3 scores between the rope grown fishery and the new reassessed joint fishery. Originally there were three certified mussel fisheries in eastern Denmark - the Isefjord and East Jutland Danish blue shell mussel fishery, the Vilsund Blue East Jutland blue shell mussel dredge fishery and the Seafood Romo East Jutland and Isefjord blue shell mussel dredge fishery – but these three fisheries were all combined in 2017 within the DFPO Inner Danish Waters blue shell mussel fishery, and so there is no longer any other Danish mussel fishery with which it is necessary to harmonise. There are a number of mussel, cockle and oyster fisheries certified in Germany and the Netherlands but none appear to overlap with the UoAs in this reassessment.

For the two certified molluscan fisheries in Denmark, the DFPO mussel, cockle and oyster fishery (this fishery) and the Limfjord rope-grown mussel fishery, there is a requirement to harmonise only the Governance and Policy PIs of Principle 3, i.e., PIs 3.1.1, 3.1.2 and 3.1.3. In addition, the assessment team has undertaken harmonisation for this fishery with other Danish fisheries certified under MSC Standard v2.01 (Table 57). All Danish fisheries for which DFPO is the client have now been combined into a single fishery certificate entitled “Joint demersal fisheries in the North Sea and adjacent waters”, and so the assessment team has ensured harmonisation of the DFPO mussel, cockle and oyster fishery with this combined Joint Demersal fishery.

Table 56 - Overlapping fisheries

Fishery name	Certification status and date	Performance Indicators to harmonise
Limfjord blue shell mussel (rope grown)	Certified in 2012	PIs 3.1.1, 3.1.2, 3.1.3
Joint demersal fisheries in the North Sea and adjacent waters	Certified in 2019	PIs 3.1.1, 3.1.2, 3.1.3

Table 57. Overlapping fisheries

Supporting information	
Harmonisation of the DFPO mussel, cockle and oyster fishery was carried out mainly as a desktop review of relevant fishery reports and agreed scoring process with the fisheries listed above in Table 57. The differences in scores were minor and therefore the assessment team considered that it was not necessary to convene harmonisation meetings with the CABs for the overlapping fisheries.	
Was either FCP v2.1 Annex PB1.3.3.4 or PB1.3.4.5 applied when harmonising?	**No**
Date of harmonisation meeting	**NA**
If applicable, describe the meeting outcome	
NA	

Table 58. Scoring differences

Performance Indicators (PIs)	DFPO mussel, cockle and oyster fishery	Limfjord rope-grown mussel fishery	Joint Demersal fisheries
PI 3.1.1	**100**	**100**	**95**
PI 3.1.2	**100**	**95**	**100**
PI 3.1.3	**90**	**90**	**100**

Table 59. Rationale for scoring differences

There was only a single difference in scores between the DFPO mussel, cockle and oyster fishery and those from the Limfjord rope-grown mussel fishery. The difference in overall score for PI 3.1.2 arises because of a different interpretation between assessment teams of one component of the SG100 requirements for a single scoring issue within PI 3.1.2, and therefore cannot be considered to be a material difference between the two fisheries.

Comparison of the scores for the DFPO mussel, cockle and oyster fishery with those for the Joint Demersal fishery shows that the scores were very similar, but the two sets of scores are not fully comparable because the Joint Demersal fishery also considers Swedish, Dutch and German management systems in addition to the management system in Denmark.

8.10 Objection Procedure

No objections were received.

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Dear MRAG Americas,

Danish Fishermen PO, as the client of DFPO mussel, cockle and oyster, accepts the Public Certification Report (PCR) for this fishery and assessments and certification determination. We appreciate the efforts of MRAG Americas and the assessment team to produce these final certification reports.

Thank you.

Sincerely,

Kenn Skau Fischer

CEO Danish Fishermen PO