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DFPO Limfjord Mussel and Cockle Fishery Surveillance Report

Prepared for

Danish Fishermen Producer Organisation (DFPO)

Certificate No: MSC-F-0050 (MSC-F-31219)

MRAG Americas, Inc.
July 2019

Conformity Assessment Body (CAB)	MRAG Americas
Assessment team	Julian Addison, Chris Grieve and Jodi Bostrom
Fishery client	Danish Fishermen Producer Organisation (DFPO)
Assessment Type	Third Surveillance

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2 Glossary

Acronym	Definition
CAB	Conformity Assessment Body
CAP	Client Action Plan
CPUE	Catch per unit effort
DFPO	Danish Fishermen Producer Organisation
DSC	Danish Shellfish Centre
DTU Aqua	Danish Technical University Aquatic Sciences (Danmarks Tekniske Universitet – Aqua)
EMFF	European Maritime and Fisheries Fund
ETP	Endangered, Threatened and Protected (species)
EU	European Union
GPS	Global Positioning System
MCS	Monitoring, Control and Surveillance
MSC	Marine Stewardship Council
PCR	Public Certification Report
PI	Performance Indicator
TAC	Total Allowable Catch
UoA	Unit of Assessment
UoC	Unit of Certification

3 Executive summary

This report contains the findings of the third surveillance cycle in relation to the DFPO Limfjord Mussel and Cockle Fishery. A surveillance audit was carried out remotely on 15 May 2019 when the audit team held conference calls by Skype with DFPO (the Client), the Danish Fisheries Agency and Ministry and the lead scientist from DTU Aqua.

The fishery was originally certified in 2016 with one condition relating to Performance Indicator 3.2.4 (Research Plan) for the Cockle Unit of Assessment (UoA). The Client's responses to the Condition of Certification were set out in the Client Action Plan (CAP), which were appended to the Public Certification Report (PCR). Progress against the single condition was examined as part of this surveillance audit. The surveillance audit team concluded that progress against the condition was on target and the condition remains open.

The audit team reviewed any changes in the management system, relevant regulations and fisheries specific management arrangements, personnel involved in science, management or industry, the scientific base of information including stock assessments, and any developments or changes within the fishery which impact traceability.

The audit team concluded that there was no requirement to changes the scores for any Performance Indicators for the fishery.

MRAG Americas confirms that this fishery continues to meet the MSC Fisheries Standard and shall remain certified.

4 Report details

4.1 Surveillance information

Table 1 – Surveillance information

1	Fishery name	
	DFPO Limfjord Mussel and Cockle Fishery	
2	Surveillance level and type	
	Level 4, offsite	
3	Surveillance number	
	1st Surveillance	
	2nd Surveillance	
	3rd Surveillance	X
	4th Surveillance	
	Other (expedited etc)	
4	Proposed team leader	
	<p>Julian Addison is an independent fisheries consultant specializing in shellfish and inshore fisheries. Until 2010 he served for 28 years at the Centre for Environment, Fisheries and Aquaculture Science (Cefas), which is the UK Government's marine science agency for environment, fisheries and aquatic science, most recently as Senior Shellfish Advisor. Relevant skills and experience include 30 years' experience of stock assessment and provision of management advice on shellfish and inshore fisheries, extensive shellfish research primarily in the field of crustacean population dynamics and assessment, extensive knowledge of the UK shellfish and inshore fisheries industry and liaison with fishers and other stakeholder groups, knowledge of shellfisheries management regimes worldwide, effective oral and written communication skills and winning of contracts under competitive tender. He has conducted MSC full assessments for the Newfoundland and Labrador snow crab fishery, the Ireland and Northern Ireland bottom grown mussel fisheries, both the Estonia and Faroe Islands Barents Sea cold water prawn fisheries, the Nephrops fishery in the Skagerrak and Kattegat, separate assessments for the Swedish, Danish and Norwegian Skagerrak and Norwegian Deep cold water prawn fishery, the Eastern Canada offshore lobster fishery, Limfjord mussel and cockle fisheries and Chile squat lobster fisheries. He has conducted peer reviews of MSC assessments in both Europe and North America of lobster, cold water prawn, razorfish, cockle and scallop fisheries.</p> <p>MRAG Americas confirms that Dr. Addison meets the competency criteria in Annex PC for team leader as follows:</p> <ul style="list-style-type: none"> • 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 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. 	

	<p>In addition, he has the appropriate skills and experience required to serve as a Principle 1 assessor as described in FCP Annex PC table PC3.</p> <p>MRAG Americas confirms that Dr. Addison has no conflicts of interest in relation to the fishery under assessment.</p>
5	<p>Proposed team members <i>[remove if not applicable]</i></p> <p>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.</p> <p>MRAG Americas confirms that Ms. Grieve meets the competency criteria in Annex PC for team members as follows:</p> <ul style="list-style-type: none"> • 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; <p>In addition, she has the appropriate skills and experience required to serve as a 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.</p> <p>The whole assessment team collectively meets the requirements as described in FCP Annex PC table PC3.</p>
6	<p>Audit/review time and location</p> <p>The surveillance audit was conducted remotely via Skype conference calls on 15 May 2019.</p>
7	<p>Assessment and review activities</p> <p>The surveillance audit reviewed changes in science and management and progress in closing out any applicable conditions. See section 7.1 for details.</p>

4.2 Background

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 (Figure 1). All vessels within the Unit of Certification are mussel dredgers, all of a similar size and power, and all of which are required to use the same type of fishing gear. The fishery issues 50 licenses per year, of which there are currently 21 active vessels during 2019 (Table 1). A new lightweight type of fishing gear was introduced in the fishery in 2010 and is now used throughout the fishery. Vessels to continue to fish in the same areas as in previous years. 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 shellfish production areas currently open can be found on the following website:

https://www.foedevarestyrelsen.dk/Kontrol/Muslingeovervaagning/Muslingeovervaagning_Danmark/Sider/11maj2018u dmelding1901fiskeri.aspx

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 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 (Fiskeristyrelsen) 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.

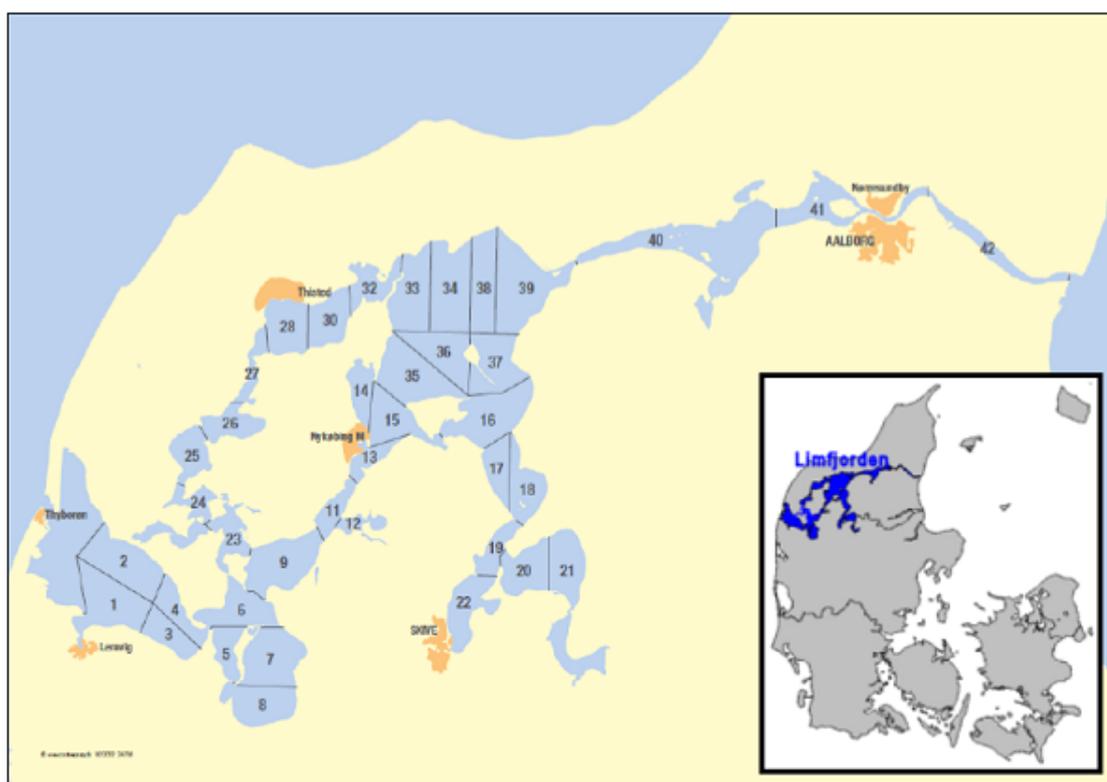


Figure 1: Map of designated shellfish production areas in the Limfjord, northern Denmark. The unit of certification includes all of the production areas 1-42. Inset map shows the location of the Limfjord in Denmark.

Table 1: List of active vessels in the Unit of Certification during 2019. (Note that T 149, Rikke has not fished this year, but is involved in atrial fishery. (Source: Client)

Registration	Vessels
A60	Frida
E63	Sine
HM911	Elias Vendelboe
L154	Tambosund
L158	Heidi Bach
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	Rikke
T229	Liden Kirsten
T301	Edith Kærgaard

4.2.1 Changes in the management system

There have been no major changes in the overarching management system since those reported in last year's Surveillance Report (Addison and Grieve, 2018): the Fisheries Department sits within the Ministry of Foreign Affairs, with fisheries policy-making remaining the responsibility of the Ministry; and monitoring, control and surveillance (MCS) and administration of the European Maritime and Fisheries Fund (EMFF) remaining the responsibility of the Fisheries Agency (Fiskeristyrelsen). The Ministry and the Fisheries Agency continue to work closely, having weekly meetings in which personnel discuss and agree matters relating to the development and implementation of fisheries policy. The reported suggestion in last year's Surveillance Report that the restructure may have engendered more political interaction on a day-to-day basis has not resulted in noticeable differences in the implementation and operation of fisheries policy or day-to-day fisheries management decision-making (A. Gadgård Boye, pers. comm.).

The surveillance team noted that Denmark has a general election on 5 June 2019 and that some initiatives and policy developments have been put on hold until the result is known and any relevant changes within the political landscape unfold. One such example is the development of a directed fishery for cockles within the Limfjord – last year the team was told about increasing interest from politicians in developing a directed cockle fishery. This idea has since been put aside while there is uncertainty about what, if anything, may emerge after the election. For now, cockle fishery management remains the same as it was at the original assessment and in the first two surveillance audits – not managed as a directed fishery.

The Mussel Policy, which sets out the management approach for mussel and other shellfish fishing in Danish waters both inside and outside Natura 2000 waters, was under review at the time of the 2018 Surveillance Audit (Addison and Grieve, 2018). The new version of the Mussel Policy was approved in November 2018 and published by the Foreign Ministry in May 2019 (Udenrigsministeriet, 2019). While the essential objectives of the Mussel Policy remain unchanged from the 2013 policy, changes that were proposed and reported in Addison and Grieve (2018) were included: a specific 'track' relates to developing new shellfish fisheries; specific mention is made to permitting directed fishing for the invasive species Pacific oyster; and biogenic reefs are defined which will enable future management provisions to be enacted. Part of the focus of the policy up to the next evaluation in 2021 will be on creating a management plan for removal and relaying of stones (i.e., habitat modifications), as well as mapping the biogenic reefs.

New Executive Orders were implemented in 2018 and 2019 to update general regulations on trawl fishing, mussel and other shellfish fisheries. In particular, to update for recent fisheries (e.g., Pacific oysters) and on the east coast to close more areas to mussel dredging and to prevent trawling within three nautical miles to protect inshore reefs and coastal eelgrass habitats from fishing gear disturbance. See the References section of this report for an up-to-date list of Executive and Statutory Orders that govern fisheries in general and mussel and shellfish fisheries in particular.

During 2018, the fishery assessment client DFPO tightened its Code of Conduct for all MSC certified fisheries. Each vessel in a certified fishery must carry a Wheelhouse Guide. The guide explains how the Code has been tightened in relation to protected areas and species, and how fishers are to deal with and record coral and sponge encounters. Fishers are required to register all encounters. In the mussel fisheries there have been no reported encounters, which means that fishers are required by the Code of Conduct to submit reports to DFPO only every three months, and may record a general entry stating 'zero encounters'. In other fisheries, reporting is required on a per trip basis. The Code of Conduct also now includes an Annex that sets out sanctions for failures against the Code, particularly in relation to MSC.

4.2.2 Changes in relevant regulations and fisheries specific management arrangements

The government implemented a new Executive Order aimed at preserving the small-scale nature of the Limfjord mussel fishery by ensuring transferable mussel licence shares are spread across the industry, thus preventing consolidation of mussel licence shares into fewer hands (BEK nr 1471 af 11/12/2018). Weekly mussel quotas depend on the number of licence shares held and attached to a vessel. Previous regulations permitted owners to own and attach up to four licence shares per vessel. This has been reduced to a maximum of three, with those who currently own four being required to sell or transfer any surplus licence shares by 2026. The total number of mussel licences available remains at 50.

Changes were implemented to the landing rules in mussel fisheries. Procedures now include the requirement for electronic weighing of catches at landing, with the weighing bill transmitted directly to the Fisheries Agency from the scales themselves. Before implementation the approach was tested by Fisheries Inspectors to ground-truth the data. Along with the new weighing-in rules, sanctions for infringements will be more severe. For example, for operators with a previous infringement recorded, landing shall be delayed until a Fisheries Inspector is present to monitor the landing and weighing-in process. Ministry and Agency personnel reported that the changes were being received positively by fishers – the changes offer transparency, as well as consistent application of the rules, thus levelling the playing field for all fishers.

Infringements detected and sanctions applied during the 2017-18 fishing season involved 28 cases from 16 vessels and mainly involved misreporting of catch weights in logbooks (17 cases where logbook records deviated more than 10% from recorded landed weight, 6 cases of incorrect completion of log books), with a further four cases involving miscellaneous licence infringements, and one case involving undersized mussels. The logbook infringements are said by Ministry and Agency representatives to have sent a clear signal to the Fisheries Agency which, in turn, prompted the action taken during 2018 to implement the above-described new landing rules for electronic weighing-in of landed catch and data transmission directly to the Agency.

The Limfjord fishers association and the fishers themselves are reported as continuing to take greater levels of responsibility and being more innovative in the pursuit of sustainability: the Black Box that monitors and transmits position and fishing operations data to the Agency has an 'Add-on' to the software that provides real-time information to fishers who are using it to analyse their data and set their own, more strict limits on fishing intensity and fishing areas, both in-season and at the end of the fishing year. In this respect, while the quota available for the 2018-19 season was the same as the previous season, Limfjord fishers continue to voluntarily catch less. Ministry and Agency representatives reported feeling positive about the responsibility being demonstrated by Limfjord mussel fishers to the long-term sustainability of their fishery.

4.2.3 Changes to personnel involved in science, management, or industry

There have been some changes to personnel involved in management since the 2018 Surveillance Audit. Ms Anja Gadgård Boye has moved from the Ministry to lead the Control division in the Fisheries Agency. This means she can no longer be Chair of the Mussel Advisory Committee and has stepped down from that role. The Ministry has not yet appointed a replacement, and this is unlikely to occur until after the result of the Danish general election (5 June 2019) is known. Policy functions within the Ministry, previously performed by Anja Gadgård Boye, are now undertaken by Ms Janne Palomino Dalby for mussel and other shellfish fisheries; and Mr Søren Palle Jensen and Ms Iben Astrup at the Fisheries Agency are responsible for monitoring, control and surveillance (MCS) for mussel and shellfish fisheries.

There have been no other recent changes to personnel involved in science or industry.

4.2.4 Changes in scientific base of information, including stock assessments

Mussel stock status

Assessments of mussel stock status in the Limfjord are conducted by DTU Aqua. 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. 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 blue 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.

Previous surveys indicate the mussel stock biomass in Limfjord had declined in 2014, and although the stock had shown some signs of recovery from 2015 to 2017, the stock showed some signs of decline again in 2018 as noted in the detailed surveys carried out for the Løgstør Bredning and Lovns Bredning Natura 2000 sites within the UoC area.

Lovns Bredning

DTU Aqua's annual survey of the mussel stock in spring 2018 estimated stock biomass at $33,151 \pm 10,324$ tonnes of mussels in Lovns Bredning (Nielsen *et al.*, 2018a; Figure 2). The population estimate is calculated using a geostatistical model that explicitly takes the spatial structure of the stock into account. The estimate of stock biomass has declined since the previous survey in April 2017 ($39,419 \pm 12,438$ tonnes). Whilst the trend in estimates of stock biomass of mussel in Lovns Bredning since 2006 is very similar to that described in previous assessment reports (Nielsen *et al.*, 2018b), absolute estimates of stock biomass are significantly lower in this year's report (Nielsen *et al.*, 2018a) due to a revised estimate of gear efficiency used in the annual surveys. The spatial distribution of the stock in spring 2018 is shown in Figure 3. The average biomass throughout Lovns Bredning during 2018 is estimated at 2.06 kg.m^{-2} (where only stations where biomass is greater than 1 kg.m^{-2} are included).

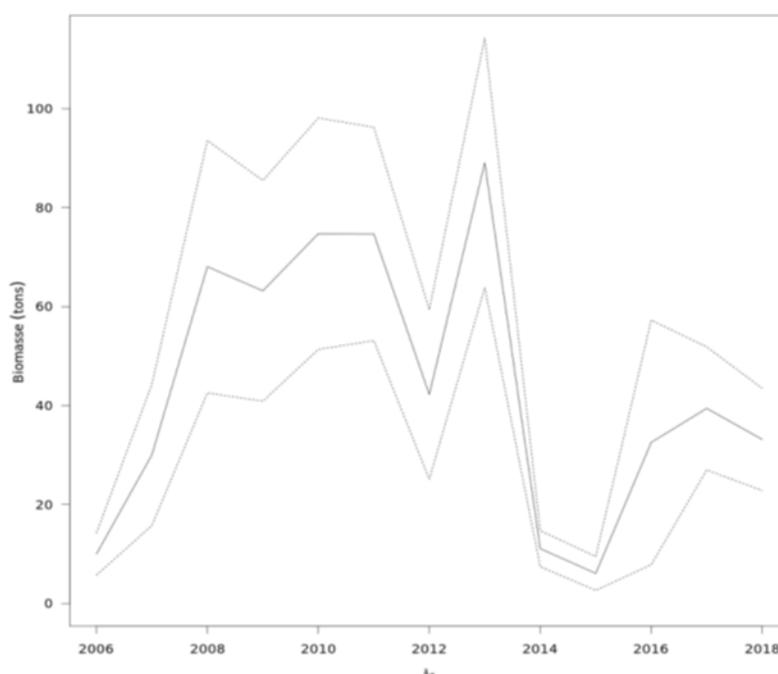


Figure 2: Biomass of mussels in surveys of the Lovns Bredning Natura 2000 site, 2006-2018. Stock biomass estimates ($\pm 95\%$ confidence intervals) are estimated using the geostatistical model and include the whole of Lovns Bredning except for Hjarbæk Fjord. Surveys were not undertaken in 2000, 2002, 2004 and 2005 (Source: Nielsen *et al.*, 2018a).

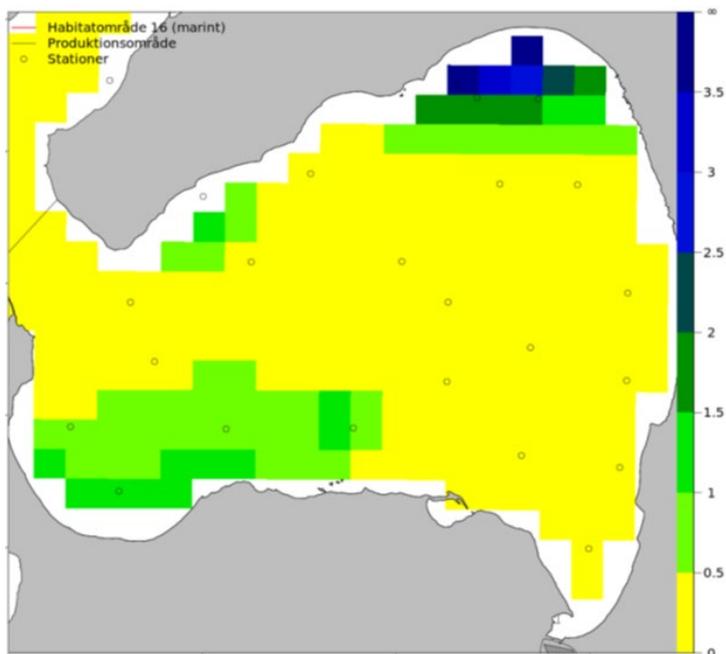


Figure 3: The distribution and abundance of mussel at depths greater than 3m in Lovns Bredning in spring 2018. The density (kg m^{-2}) of mussels is indicated on the right axis. (Source: Nielsen *et al.*, 2018a)

In addition to the latest estimate of stock biomass, the assessment now includes aggregated “black box” data from fishing vessels that shows the exact locations of all fishing activity between September 2017 and May 2018 (Figure 4). 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 and along the eastern boundary. During the fishing season 2017/2018 (Sept. 2017 through May 2018), fishing and transplantation of mussels were carried out in Lovns Bredning in an estimated area of 1.85 km^2 , which equates to 2.7% of the total area of Lovns Bredning.

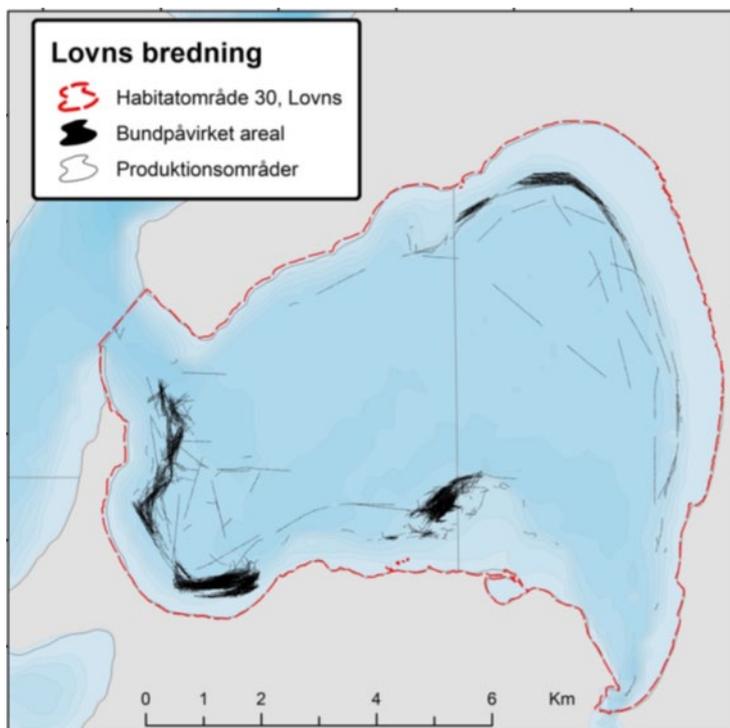


Figure 4: Distribution of mussel fishing activity in the Lovns Bredning Natura 2000 site between September 2017 and May 2018 (Source: Nielsen *et al.*, 2018a).

Løgstør Bredning

DTU Aqua's annual survey of the mussel stock in Løgstør Bredning in spring 2018 estimated stock biomass at $21,127 \pm 4,644$ tonnes (Nielsen *et al.*, 2018c; Figure 5). The mussel stock has declined significantly since 2017. The spatial distribution of the stock in spring 2018 is shown in Figure 6, and the average mussel density is 0.07 kg.m^{-2} .

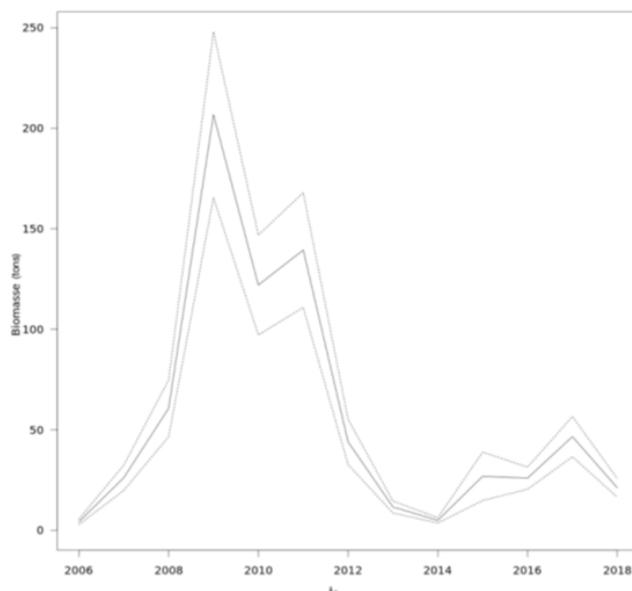


Figure 5. Biomass of mussels in surveys of the Løgstør Bredning Natura 2000 site, 2006-2018. Stock biomass estimates ($\pm 95\%$ confidence intervals) are estimated using the geostatistical model and include the whole of Løgstør Bredning. Surveys were not undertaken in 2001 and 2005. [Source: Nielsen *et al.*, 2018c]

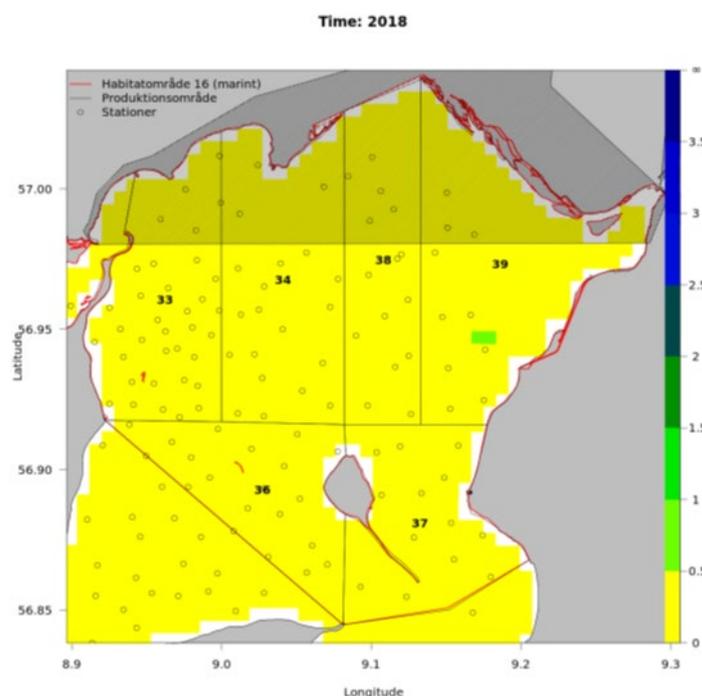


Figure 6. The distribution and abundance of mussels in Løgstør Bredning in spring 2018 The density (kg m^{-2}) of mussels is indicated on the right axis. (Source: Nielsen *et al.*, 2018c).

Similar to Lovns Bredning, the assessment shows the cumulative spatial distribution of fishing within Løgstør Bredning using “black box” data. This is illustrated for all mussel and starfish fishing activities between September 2017 and May 2017 (Figure 7). The total affected area was estimated at approximately 3.7 km^2 , which accounts for 1.2% of the Natura 2000 area in Løgstør Bredning. The total area of mussel fishing activity remains below the 15% cap set by the Mussel Policy.

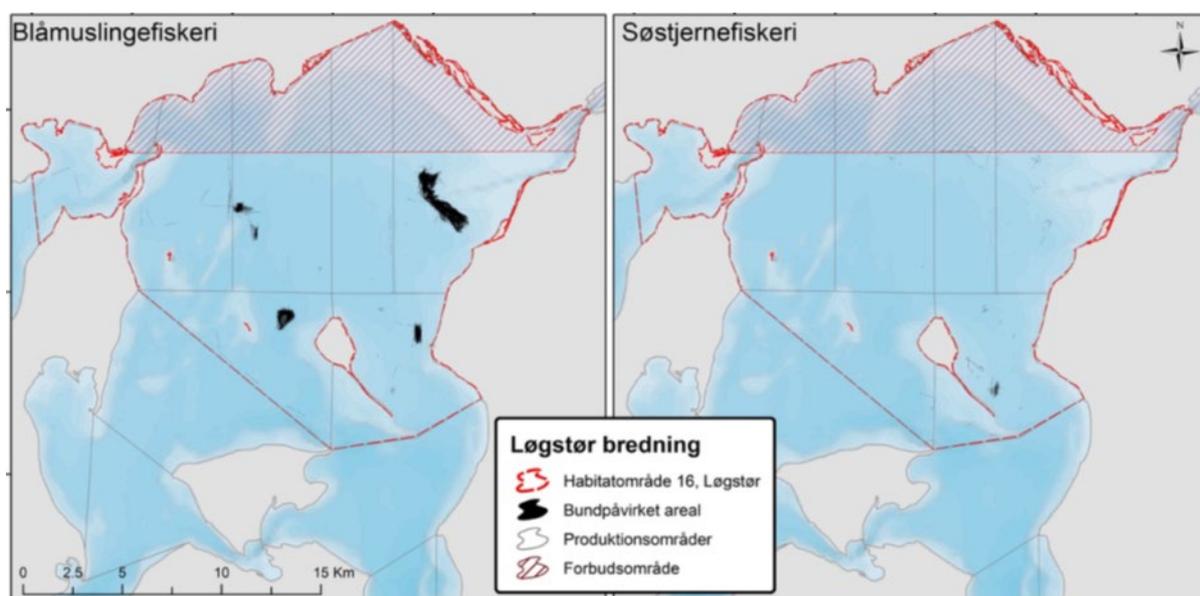


Figure 7. Distribution of mussel (left) and starfish (right) fishing activity in the Løgstør Bredning Natura 2000 site between September 2017 and May 2018. (Source: Nielsen *et al.*, 2018c).

Cockle stock status

No formal stock assessment for the cockle stock was presented at this audit. Information about cockle distribution and abundance in the Limfjord can be inferred from the landings data 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. Preliminary research by DTU Aqua suggests 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.

Changes in ecosystem issues

Native oysters (*Ostrea edulis*) continue to be caught as bycatch in the mussel fishery as they have become more widely distributed in recent years. In particular there are large numbers of native oysters in Løgstør Bredning. There has also been a significant increase in Pacific oysters (*Crassostrea gigas*) recorded in surveys, although they are not recorded in log books unless they are landed. The mussel fishery also has a bycatch of starfish. The starfish are landed to ensure their removal from mussel beds as starfish are major predators of mussels, although the impact of starfish predation on mussel population dynamics has not been quantified. There is also a separate fishery for starfish using a specially designed purse seine, and there is ongoing research within DTU Aqua on starfish population modelling to establish sustainable harvest rates.

In addition to monitoring of mussel stocks, DTU Aqua's surveys undertake video monitoring of eelgrass in both Lovns Bredning and Løgstør Bredning and following the surveys, eelgrass beds continued to be closed to fishing with an associated 300 m buffer zone around the closed area. The surveys in the two Natura 2000 sites also map and monitor macroalgae and the distribution of biogenic reefs and estimate the population biomass of starfish, native oysters (*Ostrea edulis*) and Pacific oysters (*Crassostrea gigas*) in relation to proposed fisheries for these species.

All mussel fishermen have signed the DFPO Code of Conduct, and a DFPO wheelhouse guide to all MSC ETP species and sensitive habitats including birds, mammals, corals and sponges has been placed on all vessels. Reports on any interactions must be returned every three months, and failure to make such returns may result in removal of the vessel by DFPO from the MSC certificate.

4.2.5 Updates on enhanced fishery's position in relation to scope criteria

The fishery is not an enhanced fishery.

4.2.6 Developments or changes within the fishery which impact traceability

There have been no changes in the fishery since the last surveillance audit that could impact traceability.

4.2.7 TAC Calculation

Mussel fishery

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 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.

Lovns Bredning

For the 2018/19 fishing season, DFPO submitted plans for a total quota for catching and transplanting mussels of 7,000 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. With an estimated mussel stock biomass of 33,151 ± 10,324 tonnes, a quota of 7000 tonnes will remove approximately 21% of the total population in 2018, 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.

The cumulative distribution of mussel fishing over the last 4 years as described by 'black box' data is shown in Figure 8. The cumulative area impact for blue mussel, macroalgae, bottom fauna and eelgrass as a proportion of the total area of habitat area between 2014/2015 and 2018/2019 in Lovns Bredning is shown in Table 2. The total cumulative impact for the proposed fishery of 7000 tonnes of mussels during the fishing season 2018/2019 is estimated at 11.4% for blue mussels, 9.2% for macroalgae, 10.3% for bottom fauna and 0% for eelgrass. For the fishing season 2018/2019 the total cumulative area impact will not therefore exceed the Mussel Policy maximum set limit of 15% for each of the ecosystem components. The quota of 7000 tonnes for 2018/2019 is estimated to be sustainable at an ecosystem level within Lovns Bredning.

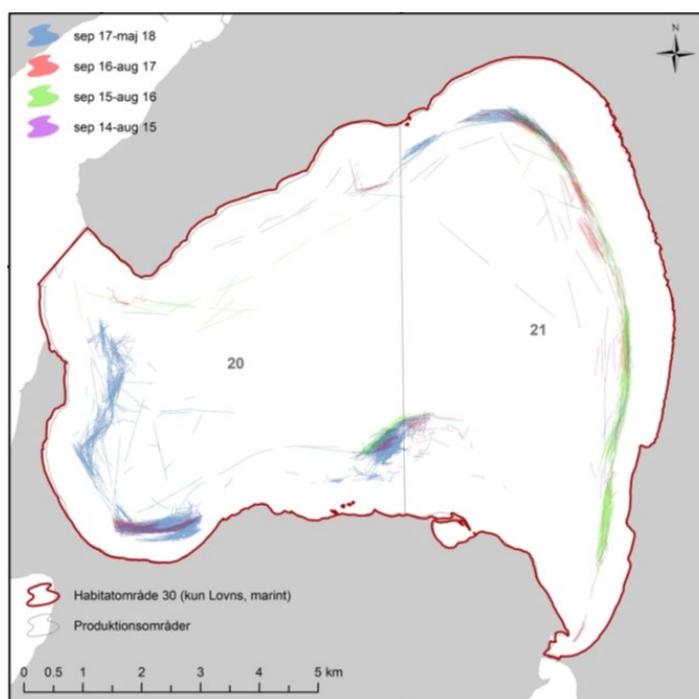


Figure 8. Distribution of mussel fishing for the fishing seasons 2014/15, 2015/16, 2016/17 and 2017/18 in Lovns Bredning. The areas are generated based on 'black box' data. (Source: Nielsen *et al.*, 2018a).

Table 2: 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 7000 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.*, 2018a).

	Gendan- nelsestid (år)	2014/15 (%)	2015/16 (%)	2016/17 (%)	2017/18 (%)	Estimat for 2018/19 (%)	Søstjer- ner (%)	Kumu- leret (%)
Blåmusling	3			1,0	2,7	7,6	0	11,4
Makroalger	>5	0,1	0,6	0,3	0,8	2,4	Max 5	9,2
Bundfauna	2				2,7	7,6	0	10,3
Ålegræs	>20	0	0	0	0	0	0	0

Løgstør Bredning

For the 2018/19 fishing season, DFPO submitted plans for a total quota for catching and transplanting mussels of 4,000 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 4 m. With an estimated mussel stock biomass of 21,127 ± 4,644 tonnes, a quota of 4000 tonnes will remove approximately 19% of the total population in 2018, and with the food requirement for birds of 2407 tonnes of mussels (Petersen *et al.*, 2016), the fishery should be sustainable in relation to maintaining both the mussel stock and providing sufficient food for birds.

The cumulative distribution of mussel fishing over the last 4 years as described by 'black box' data is shown in Figure 9. The cumulative area impact for blue mussel, macroalgae, bottom fauna and eelgrass as a proportion of the total area of habitat area between 2014/2015 and 2018/2019 in Løgstør Bredning is shown in Table 3. The total cumulative impact for the proposed fishery of 4000 tonnes of mussels during the fishing season 2018/2019 is estimated at 4.2% for blue mussels, 14.8% for macroalgae, 12.3% for bottom fauna and 0% for eelgrass. For the fishing season 2018/2019 the total cumulative area impact will not therefore exceed the Mussel Policy maximum set limit of 15% for each of the ecosystem components. The quota of 4000 tonnes for 2018/2019 is estimated to be sustainable at an ecosystem level within Løgstør Bredning. However it should be noted that DTU Aqua's overall assessment regarding proposed fishing of mussels, starfish and European oysters in 2018 was that it is not possible to carry out fishing of 4000 tonnes of mussels, 400 tonnes of European oysters and 2000 tonnes of starfish without the total cumulative area effect exceeding 15%.

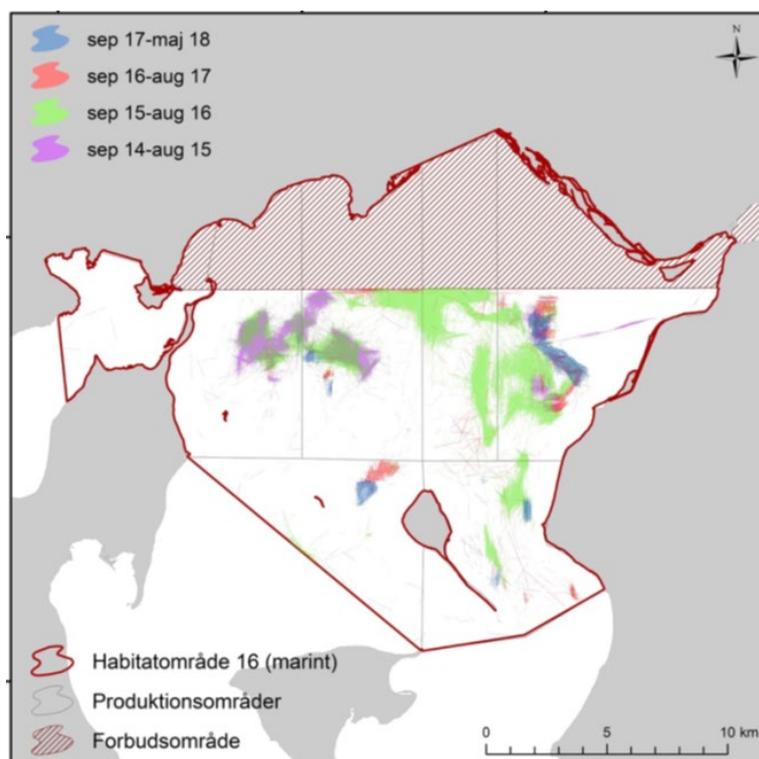


Figure 9. Distribution of mussel fishing for the fishing seasons 2014/15, 2015/16, 2016/17 and 2017/18 in Løgstør Bredning. The areas are generated based on ‘black box’ data. (Source: Nielsen *et al.*, 2018c).

Table 3: 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 4000 tonnes of mussels and 2000 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.*, 2018c).

	Gendan- nelsestid (år)	2014/15 (%)	2015/16 (%)	2016/17 (%)	2017/18 (%)	2018/19 Estimeret 4.000 t (%)	2018/19 Søstjerner 2.000 t (%)	Kumuleret inkl sø- stjerner (%)
Blåmusling	3			1,0	1,2	2,0	0	4,2
Makroalger	>5	2,4	6,1	0,9*	0,9*	1,5	Max 3	14,8
Bundfauna	2-4		8,1	1,0	1,2	2,0	0	12,3
Ålegræs	>20	0	0	0	0	0	0	0

4.3 Version details

Table 4 outlines the MSC Process and Standard versions used in the surveillance of this fishery.

Document	Version number
MSC Fisheries Certification Process	Version 2.01
MSC Fisheries Standard	Version 1.3

MSC General Certification Requirements	Version 2.3
MSC Surveillance Reporting Template	Version 2.01

5 Results

5.1 Surveillance results overview

5.1.1 Summary of conditions

Table 5 – Summary of conditions

Condition number	Condition	Performance Indicator (PI)	Status	PI original score	PI revised score
1	A research plan provides the management system with a strategic approach to research and reliable and timely information sufficient to achieve the objectives consistent with MSC's Principles 1 and 2.	3.2.4	On target	70	70 Not revised

5.1.2 Total Allowable Catch (TAC) and catch data

The most recently available TAC and catch data for the Limfjord mussel and cockle fisheries are set out in Tables 6 & 7 below. It is noted that the fishing season runs from September – June. As such the last available total catch data at the time of the surveillance audit are for 2017/2018 fishing season.

Table 6. TAC and catch data for the Limfjord mussel fishery (Source: Fiskeristyrelsens database).

TAC	Year	2018 / 2019	Amount	45 tonnes per licence per week (30 tonnes voluntarily) Lovns Bredning: 7,000 tonnes Løgstør Bredning: 4,000 tonnes
UoA share of TAC	Year	2018 / 2019	Amount	100% of TAC
UoC share of TAC	Year	2018 / 2019	Amount	100% of TAC
Total green weight catch by UoC	Year (most recent)	2017 / 2018	Amount	19,500 tonnes
	Year (second most recent)	2016 / 2017	Amount	16,083 tonnes

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) (Table 7). Within the Lovns Bredning and Løgstør Bredning Natura 2000 sites, the cockle bycatch is limited to 10% of the total catch, i.e. 700 tonnes and 400 tonnes in Lovns Bredning and Løgstør Bredning respectively for the 2018/2019 fishing season.

Table 7. TAC and catch data for the Limfjord cockle fishery (Source: Fiskeristyrelsens database).

TAC	Year	2018 / 2019	Amount	49% of mussel catch (10% in Natura 2000 sites)
UoA share of TAC	Year	2018 / 2019	Amount	100% of TAC
UoC share of TAC	Year	2018 / 2019	Amount	100% of TAC
Total green weight catch by UoC	Year (most recent)	2017 / 2018	Amount	8,500 tonnes
	Year (second most recent)	2016 / 2017	Amount	8,119 tonnes

5.1.3 Recommendations

There were no recommendations from the original full assessment.

5.2 Conditions

Table 8 – Condition 1

Performance Indicator	PI 3.2.4
Score	70
Justification	<p>Referencing p.197, original Assessment Report (MRAG Americas, 2016): Research in the fishery is directed at shellfish, however the priority species is mussel. The research into the status of shellfish, their management and development is being carried out by DTU-Aqua under a European Fisheries Fund project that provides a strategic approach to research work and sets a timetable for action. Priority areas within the planned project are the impacts of dredge fisheries on seabed habitats, particularly eelgrass and benthic infauna.</p> <p>In addition to this work, DTU-Aqua also conducts ad-hoc research into issues as they arise. An example of this is research into the “surfacing” of cockles on the seabed: i.e., emergence behaviours; as well as stock-related distribution and density studies.</p> <p>Research into cockles is undertaken that is consistent with that required to achieve the objectives of MSC’s Principles 1 and 2. However, there is no evidence of a research plan for cockles that would provide the management system with a strategic approach to research or reliable and timely information sufficient to achieve the objectives consistent with MSC’s Principles 1 and 2.</p>
Condition	A research plan should be prepared for the Limfjord cockle fishery that is designed to provide the management system with reliable and timely information about the effects of the fishery on the cockle stock and the components of the marine environment.
Milestones	<p>Year 1 – a draft research plan should be prepared in collaboration with relevant organisations and institutions. Resulting score: 70</p> <p>Year 2 – the research plan should be agreed and implemented. Resulting score: 70</p> <p>Years 3-4 – evidence of implementation of the research plan and initial research results should be provided. Resulting score: 80</p>

<p>Consultation on condition</p>	<p>The DFPO's Action Plan required verification that DTU Aqua would collaborate and that funding would be available.</p> <p>Action Plan stated that DFPO will ensure that a research plan for the cockle fishery is developed and implemented. Work plan included:</p> <p>Year 1: A draft research plan will be produced in collaboration with DTU Aqua. (Draft sighted at Surveillance Audit No.1 and collaboration verified through stakeholder consultation directly with DTU Aqua)</p> <p>Year 1 or Year 2: The research plan will be agreed and implemented. (Planned collaborative research project was agreed between DTU Aqua and DFPO, and verified at Surveillance Audit No.2 through stakeholder consultation directly with DTU Aqua and the Fisheries Agency, as well as surveillance team sighting of a formal letter to DFPO from the EMFF confirming receipt of grant application for the planned cockle research)</p> <p>Year 2 to Year 4: Evidence of implementation will be provided, as well as results of research carried out as according to the plan. (Direct consultation with DTU Aqua and the Fisheries Agency at Surveillance No.3 verified progress verbally. DFPO provided written evidence sighted by the surveillance team that also verified funding had been received from EMFF. Details are given in the next sections of the table, below.</p>
<p>Progress on Condition (Year 1)</p>	<p>At the time of the site visit there had been progress with this condition. The client worked with DTU Aqua to develop and draft a plan for research in the cockle fishery and submitted this to the surveillance team.</p> <p>The document begins with contextual background that explains some of the marine environment, biological and behavioural factors that confound understanding of the impact of the cockle fishery on cockle biomass. As burrowing animals, cockles are only available to dredge (i.e., vulnerable to fishing pressure) when they are exposed on the sea bed. Thus, the plan is to first study the proportion of the cockle population that is exposed to fishing pressure. The outcome of such a study will give the client, scientists and management stakeholders an idea of the magnitude of the issues in relation to fishery/cockle dynamics, and this will help them determine together which research options to pursue next. If, for example, a large proportion of the stock is vulnerable to fishing pressure, then understanding the biological mechanisms and their influence on cockle behaviour would become a priority for study under the plan. If, on the other hand, only a very small proportion is ever vulnerable to fishing pressure, conclusions may be drawn about the effect of fishing on cockle biomass, which in turn may influence decisions about the value of pursuing further research.</p> <p>The draft plan states the intention for DFPO and the Danish Shellfish Centre (DSC) to apply together to the government for research funds for the initial scoping study.</p> <p>With increasing interest in the cockle fishery and its management by a range of stakeholders, AgriFish staff interviewed for this audit confirmed that there is also increasing interest from a management perspective in understanding cockle/fishery dynamics and therefore in principle support for funding research into cockles that is relevant to the combined interests of fishers, managers, scientists and other stakeholders.</p> <p>Conclusion</p> <p>Progress with this condition is on target.</p>
<p>Progress on Condition (Year 2)</p>	<p>At the time of the surveillance audit, the client had made more progress on this condition. The research plan included DFPO and DTU Aqua collaborating on a grant proposal for funding for a comprehensive cockle research project. The Ministry representative confirmed, as did both client and DTU Aqua representatives, that the proposal had been submitted for funding from EMFF. The client provided written confirmation from the Danish Fisheries Agency that the proposal was received in December 2017.</p> <p>There has been a delay in formal decisions about funding from the EMFF. A funding decision is expected by September 2018. Despite this, DTU Aqua and fishers started the study in 2018 at their own financial risk. The surveillance team noted that this demonstrates commendable commitment by the client and DTU Aqua. The surveillance team considers the commencement of the study consistent with implementation of the previously agreed research plan, and therefore the year 2 milestone has been met. However, the DTU Aqua representative reported to the team that it is unlikely DTU Aqua would continue the project unfinanced. The surveillance team concluded that this is a key reason to rule that the condition should remain open and subject to continued surveillance.</p>

	<p>The two-year project (2018-2019) aims to establish the scientific basis for sustainable exploitation of cockle resources in the Limfjord. Specifically, the purpose is to estimate the size of cockle stocks, estimate the proportion of cockles on the surface of sediment, and describe the reasons for their presence on the surface rather than being naturally submerged. Work packages over the two years will examine: 1) Mapping of fishing and hence areas cockles have emerged from the seabed. 2) Cockle stock status in the Limfjord. 3) The proportion of cockles on the surface of the seabed. 4) Attempt to describe surfacing/resurfacing [emergence] behaviour of cockles. 5) Screening for diseases and parasites. 6) Summary and design of recommendations for management and project management. Work Package 1 (WP1) will inform the activities in WP2, which will in turn inform WP3. The outcomes of WP6 will depend on the results of WP1-5.</p> <p>Conclusion</p> <p>Progress with this condition is on target.</p>
<p>Progress on Condition (Year 3)</p>	<p>The grant application to EMFF for the cockle research project was successful, as evidenced by letter to DTU Aqua, and provided to the team by DFPO. The research that began in 2018, before funding was confirmed, has continued. The DTU Aqua representative confirmed that survey work and on-the-water research has been conducted. Researchers have used the standard fishing method used when conducting surveys for mussel stock assessment purposes: the modified dredge; as well as supplementing their efforts with a suction dredge (because cockles sit deeper in the seabed than mussels). The challenge for analysis and creating a reliable stock assessment will be around calibrating results between the two methods.</p> <p>Early results also appear to confirm what fishers have previously reported and scientists understood – that cockles are patchily distributed in localised areas. Therefore another challenge will be translating distribution results into stock estimates. It seems likely that density dependence may be the most likely driver of emergence (understanding of which is another objective of the research plan). Fisher targeting behaviour is highly influenced by cockle density, with high density patches being detected using scanners and test fishing giving fishers an indication of size before they commit to fishing a patch of cockles.</p> <p>There are no published initial results or reports available to the surveillance team yet. The first planned report to the Mussel Advisory Committee is scheduled for August 2019.</p> <p>The Condition requires that the Limfjord cockle research plan is designed to provide reliable and timely information about the effects of the fishery on the cockle stock and the components of the marine environment. The milestones for Years 3-4 require both evidence of implementation of the research plan and that initial results are provided. Given that the research is only part-way through and in the absence of evidence of initial results (which would likely indicate that reliable and timely information has been produced), the condition cannot yet be closed.</p>
<p>Status</p>	<p>On target. Score not revised, remains at 70.</p>
<p>Additional information</p>	<p>N/A</p>

5.3 Client Action Plan

There have been no changes to the Client Action Plan.

5.4 Re-scoring Performance Indicators

The condition on PI 3.2.4 (Research Plan) remains open with a score of 70, and therefore there is no requirement to rescore PI 3.2.4. There were no other PIs that have been re-scored following the surveillance audit.

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- BEK nr 1270 30/10/2018 Bekendtgørelse om regulering af fiskeriet (Executive Order on Fisheries Regulation) <https://www.retsinformation.dk/Forms/R0710.aspx?id=203641> Accessed on 25 May 2019
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7 Appendices

7.1 Evaluation processes and techniques

7.1.1 Site visits

The surveillance audit process as defined in the MSC Fishery Certification Process version 2.1 was followed in this audit.

Information supplied by the client, management agencies and scientists was reviewed by the surveillance audit team ahead of the off-site meeting, and discussions with the client, management agencies and scientists 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 assessment team and subsequently supplied during, or shortly after the meeting.

Thirty days prior to the audit site visit, all stakeholders from the full assessment were informed of the visit and given the opportunity to provide information to the auditors in advance of, or during, the site visit. No written submissions were received from stakeholders, and there were no requests from stakeholders to meet with the surveillance audit team.

The surveillance audit was held remotely by Skype with the Client, DFPO, the Danish Fisheries Agency and Ministry and the lead scientist from DTU Aqua on 15 May 2019.

The following participants were in attendance:

Name	Affiliation
Julian Addison	Independent Fisheries Consultant, MRAG Americas assessment team
Chris Grieve	Meridian Prime, MRAG Americas assessment team
Sofie Smedegaard Mathiesen	DFPO, client
Anja Gadgård Boye	Danish Fisheries Agency, Policy
Janne Palomino Dalby	Fisheries Department, Ministry of Foreign Affairs
Iben Astrup	Fisheries Department, Ministry of Foreign Affairs
Jens K. Petersen	DTU Aqua

The table below summarizes the agenda for the Skype meetings held on 15 May 2019.

Time	Item	Participants	Supporting documents
1100	Meeting with Client	Julian Addison Chris Grieve Sofie Smedegaard Mathiesen	Previous full assessment report (MRAG, 2016) and Years 1 & 2 surveillance audit reports. List of vessels participating in the fishery. Client submission.
1130	Meeting with DTU Aqua	Julian Addison Chris Grieve Jens K. Petersen	Impact assessments of fishing for blue mussels and starfish in Lovns Bredning and Løgstør Bredning in 2018/2019. Previous full assessment report (MRAG, 2016) and Years 1 & 2 surveillance audit reports.

			EMFF research proposal on cockles
1500	Meeting with Fisheries Agency and Fisheries Department, Ministry of Foreign Affairs	<p>Julian Addison Chris Grieve Anja Gadgård Boye Janne Palomino Dalby Iben Astrup</p>	<p>Previous full assessment report (MRAG, 2016) and Years 1 & 2 surveillance audit reports.</p> <p>Updated Mussel Policy 2019, and updated Executive Orders on fisheries (see section 6 for full references)</p> <p>Data on TACs and landings for Limfjord mussels and cockle fisheries.</p> <p>Information on infringements in the Limfjord fisheries.</p>
1630	Closing meeting with Client	<p>Julian Addison Chris Grieve Sofie Smedegaard Mathiesen</p>	<p>Previous full assessment report (MRAG, 2016) and Years 1 & 2 surveillance audit reports.</p>

7.1.2 Stakeholder participation

The Client, DFPO, the Danish Fisheries Agency, the Fisheries Department, Ministry of Foreign Affairs and DTU Aqua participated in the surveillance audit. All other stakeholders were contacted prior to the surveillance audit meetings and given an opportunity to provide written submissions or to meet with the surveillance audit team. No such opportunities were taken up.

7.2 Stakeholder input

No written submissions were received from stakeholders. Separate stakeholder meetings were held by Skype with representatives from (1) the Client, DFPO, (2) Danish Fisheries Agency and Fisheries Department, Ministry of Foreign Affairs and (3) DTU Aqua at which verbal submissions were received. A summary of each of those meetings is given below and details of the outcome of those meetings is given in the main sections of the report.

DFPO

The audit team spoke with Sofie Smedegaard Mathiesen on two occasions – at an initial meeting with the Client, and at a closing meeting after other stakeholders had been met.

The main purpose of the meetings was to discuss progress on the Client Action Plan in relation to Condition 1 on the development of a Research Plan for the cockle fishery and to re-affirm information provided by DTU Aqua and the Fisheries Agency / Ministry during the surveillance audit. In addition to a verbal submission, the client also submitted updated information relating to the 2018/19 fishing season, an updated list of vessels in the fishery, a link to the website describing all currently open shellfish production areas and a revised DFPO Code of Conduct for MSC certified fisheries.

Fiskeristyrelsens (Fisheries Agency) and Fisheries Department, Ministry of Foreign Affairs

The audit team spoke with Anya Gadgård Boye, Janne Palomino Dalby and Iben Astrup.

In summary, discussion focused on changes following the updating of the Mussel Policy in 2018, changes in licensing arrangements, New Executive Orders that were implemented in 2018 and 2019 to update general regulations on trawl fishing, mussel and other shellfish fisheries, the requirement for electronic weighing of catches at landing with the weighing bill transmitted directly to the Fisheries Agency from the scales themselves, infringements in the fishery in 2017 and 2018, any changes in management arrangements in the mussel fishery in the last year, and voluntary real-time management by fishers of their fishing activity through the black box data.

Danish Shellfish Centre, DTU Aqua

The audit team spoke with Jens K. Petersen of DTU Aqua.

In summary, discussion focussed on the newly-funded EMFF project on cockles and preliminary results emanating from the project and current status of the mussel and cockle populations within Limfjord. In particular, this included the results of the impact assessments for each fishing plan submitted for operations within Lovns Bredning and Løgstør Bredning Natura 2000 sites (Nielsen *et al.*, 2018a; Nielsen *et al.*, 2018c). 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 the mussel population, which includes estimates of uncertainty. Discussions also covered bycatches of native and Pacific oyster and starfish in mussel dredges, and the recently-commenced fishery for starfish using an adapted purse seine.

7.3 Revised surveillance program

There were no revisions of the surveillance program. The Year 4 surveillance audit will be on-site in 2020 in conjunction with the re-assessment site visit.

7.4 Harmonised fishery assessments

An identical Unit of Assessment and Unit of Certification to this DFPO Limfjord Mussel and Cockle Fishery was re-certified in 2015 for Vilsund Blue A/S by Acoura Marine. During the 2016 full assessment by MRAG Americas for DFPO, new information became available that resulted in two of the original three conditions identified under the Vilsund Blue assessment being no longer valid. It is noted that the 2015 annual surveillance audit report for Vilsund Blue repeals these two conditions so that both fisheries were fully harmonized. However, the Vilsund Blue dredge fishery withdrew from the MSC assessment from 28th February 2017, and officially joined the DFPO client group since their activity was covered under this UoA.

The Inner Danish Waters mussel fishery has also been recently certified by the same CAB (MRAG Americas) as the DFPO Limfjord Mussel and Cockle Fishery using two members of the original assessment team. The Inner Danish Waters fishery is in the Isefjord and eastern areas of Denmark and therefore does not cover the same stock as the Limfjord fishery and is in a different geographical area, so there was no requirement to harmonise scores for P1 and P2 between the two fisheries. However, the management framework for the two fisheries is very similar and during the assessment process for the Inner Danish Waters fishery the assessment team reviewed the P3 scores for the two fisheries. There were no significant differences between the two fisheries for P3 scores (Table 8) at the time of the original assessments and there have been no changes to P3 scores for either fishery since the original certifications, and so the audit team considered that the scoring of the two fisheries had been harmonised.

Table 9. Principle 3 scores for the Limfjord and Inner Danish waters mussel fisheries.

	PI	Component	Limfjord	Inner Danish Waters
Principle Three	3.1.1	Legal & customary framework	100	100
	3.1.2	Consultation, roles & responsibilities	100	100
	3.1.3	Long term objectives	90	90
	3.1.4	Incentives for sustainable fishing	90	90
	3.2.1	Fishery specific objectives	90	90
	3.2.2	Decision making processes	90	95
	3.2.3	Compliance & enforcement	100	100
	3.2.4	Research plan	80	80
	3.2.5	Management performance evaluation	90	90