8950 Martin Luther King Jr. Street N. #202
St. Petersburg, FL 33702 USA
Tel: (727) 563-9070
Fax: (727) 563-0207
Email: mrag.americas@mragamericas.com

President: Andrew A. Rosenberg, Ph.D.

Marine Stewardship Council Fisheries Assessments

Narody Severa - Bolsheretsk Salmon Fisheries

Certificate No: MSC-F-31368 (MRAG-F-0075)

Surveillance Report

August 28, 2019

Conformity Assessment Body	**MRAG Americas, Inc.**
Assessment Team	**A. Stern-Pirlot, R. Beamesderfer & D. Lajus**
Fishery Client	***Co. LLC "Narody Severa"*** **1 Sovetskaya Str., village Oktyabrsky, Ust-Bolsheretsky district, Kamchatsky kray, 684102** ***Co. LLC "Bolsheretsk"*** **16 Suturina Str., village Ust-Bolsheretsk, Ust-Bolsheretsky district, Kamchatsky kray,684100** **Russian Federation**
Assessment Type	**First Surveillance**

Contents

1 Executive summary

This report contains the findings of the 1st surveillance cycle in relation to the Narody Severa - Bolsheretsk Bay Salmon fishery. The audit was conducted on site in Petropavlovsk Kamchatka on July 3-5, 2019. This fishery was first certified on 31 May 2018. The client's responses to the conditions of certification were set out in the Client Action Plan (CAP). Progress associated with the actions set forth in the CAP was examined as a part of this surveillance audit. For each condition, the report sets out progress to date. This progress has been evaluated by MRAG Americas Audit Team (set out below as "Progress on Condition") against the commitments made in the CAP. The certification of the fishery is continued.

2 Report Details

2.1 Surveillance information

1	**Fishery name**	
	Narody Severa Bolsheretsk salmon fisheries Pink Salmon (*Oncorhynchus gorbuscha*) and Chum Salmon (*O. keta*) Coastal Trap nets, beach seines, gill nets	
2	**Surveillance level and type**	
	Level 6 – onsite	
3	**Surveillance number**	
	1st Surveillance	**X**
	2nd Surveillance	
	3rd Surveillance	
	4th Surveillance	
4	**Team leader**	
	Ms. Amanda Stern-Pirlot is an M.Sc graduate of the University of Bremen, Center for Marine Tropical Ecology (ZMT) in marine ecology and fisheries biology. Ms. Stern-Pirlot joined MRAG Americas in mid-June 2014 as MSC Certification Manager (now Director of the Fishery Certification Division) and is currently serving on several different assessment teams as team leader and team member. She has worked together with other scientists, conservationists, fisheries managers and producer groups on international fisheries sustainability issues for over 15 years. With the Institute for Marine Research (IFM-GEOMAR) in Kiel, Germany, she led a work package on simple indicators for sustainable within the EU-funded international cooperation project INCOFISH, followed by five years within the Standards Department at the Marine Stewardship Council (MSC) in London, developing standards, policies and assessment methods informed by best practices in fisheries management around the globe. Most recently she has worked with the Alaska pollock industry as a resources analyst, within the North Pacific Fisheries Management Council process, focusing on bycatch and ecosystem-based management issues, and managing the day-to-day operations of the offshore pollock cooperative. She has co-authored a dozen publications on fisheries sustainability in the developing world and the functioning of the MSC as an instrument for transforming fisheries to a sustainable basis.	

	MRAG Americas confirms that Ms. Stern-Pirlot meets the competency criteria in Annex PC for team leader as follows: ● She has an appropriate university degree and more than five years' experience in management and research in fisheries; ● She has passed the MSC team leader training; ● She has the required competencies described in Table PC1, section 2; ● She has passed the MSC Traceability training module; ● She meets ISO 19011 training requirements; ● She has undertaken two fishery assessments as a team member in the last five years, and ● She has experience in applying different types of interviewing and facilitation techniques and is able to effectively communicate with clients and other stakeholders. MRAG Americas confirms that Ms. Stern-Pirlot has no conflicts of interest in relation to the fishery under assessment.
5	Team members
	Ray Beamesderfer holds a bachelor's degree in Wildlife and Fisheries Biology from the University of California, Davis, and a Master's in Fishery Resources from the University of Idaho. Ray has special expertise in using quantitative analysis, statistics, and computer modelling to solve difficult fisheries-related questions, and in synthesizing and translating scientific analyses. He has completed a wide variety of projects in fishery management, biological assessment, and conservation/recovery planning. He is the author of numerous reports, biological assessments, management plans, and scientific articles on fish population dynamics, fish conservation, fishery and hatchery management, sampling, and species interactions. Ray has served on fishery assessment teams for salmon fisheries in Alaska and Russia. MRAG Americas confirms that Mr. Beamesderfer meets the competency criteria in Annex PC for team members as follows: ● He has an appropriate university degree and more than five years' experience in management and research in fisheries; ● He has undertaken at least two MSC fishery assessments or surveillance site visits in the last five years; ● He is able to score a fishery using the default assessment tree and describe how conditions are set and monitored. In addition, he has the appropriate skills and experience required to serve as a Principle 1 and 3 assessor as described in FCP Annex PC table PC3, and MRAG Americas confirms he has no conflicts of interest in relation to the fishery under assessment. ***Dr. Dmitry Lajus*** is an Associate Professor at the Department of Ichthyology and Hydrobiology at St. Petersburg State University since 2003. In 2006, Dr. Lajus received a Fulbright Fellowship at the University of New Hampshire. Previously, from 1987 to 2003, Dr. Lajus was a Researcher and Senior Researcher at the Zoological Institute, Russian Academy of Sciences. He specializes in population biology of marine fish and invertebrates, population phenogenetics, stress assessment, history of fisheries, historical ecology, and population dynamics. His salmon experience includes conservation implications of salmon genetics, salmon population dynamics, history of salmon fisheries, and salmon ecology. Dr. Lajus has an extensive list of peer-reviewed publications, chapters in books, conference proceedings, participation in

	international conferences, and involvement in international research and educational projects. Dr. Lajus received a M.S. degree from the St. Petersburg State University and a Ph.D. from the Zoological Institute, Russian Academy of Sciences. MRAG Americas confirms that Dr. Lajus meets the competency criteria in Annex PC for team members as follows: ● He has an appropriate university degree and more than five years' experience in management and research in fisheries; ● He has undertaken at least two MSC fishery assessments or surveillance site visits in the last five years; ● He is able to score a fishery using the default assessment tree and describe how conditions are set and monitored. In addition, he has the appropriate skills and experience required to serve as a Principle 1 and 2 assessor as described in FCP Annex PC table PC3, and MRAG Americas confirms he 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.
6	**Audit/review time and location**
	This site visit is part of a combined site visit to Kamchatka for several full assessments and surveillance audits taking place between the period of 24 June and 07 July 2019.
7	**Assessment and review activities**
	The surveillance will review any changes in science and management, and will monitor progress in closing out conditions.

2.2 Background

Changes to Management systems: There were no major changes highlighted for the fishery or management system. Since 2019, KamchatNIRO as well as other regional fishery research institutes (like TINRO, PINRO, etc.) has become a branch of All-Russian Fishery Research Institute (VNIRO).

Changes to Relevant regulations: None identified.

Changes to personnel involved in science, management or industry: There have been no substantive changes to the organisations managing the fishery. Andrey Zdetovetsky replaced Vladimir Galitsyn as a minister of Fishery of Kamchatka Kray. Vladimir Galitsyn became a head of the new founded (8 April 2019) Association of Kamchatka Salmon catchers.

Changes to scientific base of information – including stock assessments: No significant changes in the scientific base of information regarding this fishery were identified beyond information provided to address conditions. Stock assessments are conducted annually with results detailed in Appendix I.

Updates on enhanced fishery's position in relation to scope criteria: Not applicable

Any developments or changes within the fishery which impact traceability or the ability to segregate between fish from the Unit of Certification (UoC) and fish from outside the UoC (non-certified fish): No pertinent developments or changes. None of the clients is using MSC logo in

product labeling or marketing. The only claim by the Client is that the fishery is MSC certified and is a sustainable fishery. No unsupportable claims are made.

2.3 Version Details

Document	Version number
MSC Fisheries Certification Process	Version 2.1
MSC Fisheries Standard	Version 2.01
MSC General Certification Requirements	Version 2.0
MSC Surveillance Reporting Template	Version 2.0

3 Results

3.1 Surveillance Results Overview

3.1.1 Summary of Conditions

Six conditions were identified in the assessment (Table 1). This annual surveillance for found that milestones for all Conditions have been met.

Table 1. Summary of Assessment Conditions

	Condition	Performance Indicator	Status	PI original score	PI revised score
1	Regularly monitor spawning escapement of Pink and Chum Salmon at a level of accuracy and coverage sufficient to ensure effective harvest controls in West Kamchatka rivers.	1.2.3 Information & monitoring	Open & on target	Pink: 65 Chum: 65	--
2	Provide information on the level illegal fishery removals of Pink and Chum Salmon from the Bolshaya River.	1.2.3 Information & monitoring	Open & on target	Pink: 65 Chum: 65	--
3	Estimate stock status of Pink and Chum Salmon in West Kamchatka rivers relative to reference points and demonstrate that survey indicator streams are representative of other populations within the management unit.	1.2.4	Open & on target	Pink: 70 Chum: 70	--
4	Provide quantitative information on escapement of Sockeye and Coho Salmon adequate to assess the impact of the fishery relative to escapement goals.	2.1.3	Open & on target	70	--

5	Demonstrate that information on fishery 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.	3.2.2 Decision-making processes	Open & on target	75	--
6	Demonstrate that a monitoring, control and surveillance system has been implemented in the fishery and associated enhancement activities and has demonstrated an ability to enforce relevant management measures, strategies and/or rules, and that sanctions to deal with non-compliance exist, are consistently applied and thought to provide effective deterrence.	3.2.3	Open & on target	65	--

3.1.2 Catch Data

Recent catches by the Unit of Certification are summarized below. Catches for 2017 include only those by Narody Severa and Bolsheretsk Co. Catches for 2018 include those by the five fishing companies sharing use of the certificate (Narody-Severa Co Ltd, Bolsheretsk Co Ltd, Loyd-Fish Co Ltd, Oktyabsky Rybokombinat Co Ltd., Zyuid Co Ltd).

Table 2. TAC and Catch Data.

	Year	Amount of Salmon (metric tonnes)		
		Pink	Chum	Sockeye
Recommended Catch	**NA[a]**	**NA[a]**	**NA[a]**	**NA[a]**
UoA share of TAC	**NA[a]**	**NA[a]**	**NA[a]**	**NA[a]**
UoC share of UoA	**2018**	**76%[b]**	**44%[b]**	**43%[b]**
Total green weight catch by UoC	**2018**	**60,688**		**1,845**
	2017	**2,220**	**3,312**	**2.033**

[a] *Not applicable: Fishery managed based on realized annual escapements rather than a prescribed total allowable catch.*

[b] *Based on industrial and coastal fisheries in the region of the Kikhchik, the Mukhina, the Bolshaya and the Opala rivers by all companies in 2018.*

3.1.3 Recommendations

Based on the guidelines as set out in CR v2.0, the team has set Surveillance at Level 6. Table 6 indicates that the Year 2 annual surveillance audit should be normal and on site. As part of the annual surveillance process, the fishing companies are expected to provide (or arrange for provision by KamchatNIRO) the following information:

1. Description of any substantive changes in management systems, regulations, fishing sites, personnel involved in science, management or industry, or the scientific base of information.
2. Dates of passing days in the river and sea for the fishery.
3. Harvest in metric tons by each client fishing company of pink salmon, chum salmon, sockeye salmon, coho salmon and Chinook salmon.
4. Annual estimates of aerial survey effort and spawning escapement by species and river.

Table 6. Fishery surveillance program.

Surveillance Level	Year 1	Year 2	Year 3	Year 4
Level 6	On-site surveillance audit	On-site surveillance audit	On-site surveillance audit	On-site surveillance audit

3.2 Conditions

3.2.1 Condition 1

Performance Indicator	1.2.3. Information and monitoring - Relevant information is collected to support the harvest strategy
Score	Pink - 65 Chum – 65
Rationale	The continuing effectiveness of the current harvest strategy will depend on monitoring of spawning escapements. The SG80 standard for regular monitoring is not met because recent reductions in aerial survey intensity have substantially reduced the accuracy and precision of spawning escapement estimates used to guide management decisions. The current survey intensity likely provides sufficient precision to distinguish large and small runs but lack the resolution to avoid estimation bias due to differences in run timing or fish distribution. Historical assessments have generally been sufficient to support the current harvest strategy but current survey frequency may not be sufficient to identify any future changes in productivity or distribution patterns which might confound effective implementation of the harvest control rules.
Condition	Regularly monitor spawning escapement of Pink and Chum Salmon at a level of accuracy and coverage sufficient to ensure effective harvest controls in West Kamchatka rivers.

Milestones	By the first annual surveillance, the client must present evidence that a plan is in place to address this condition. By the second annual surveillance, the client must present evidence that the plan has been implemented. By the third annual surveillance, the client must demonstrate that the condition has been met, at which time the fishery will rescore at least 80. Recommendation: Survey efforts should be sufficient to identify the status of Pink and Chum Salmon in relation to harvest in all areas. Report aerial survey effort including dates, locations and hours flown and annual spawning escapement by species and river system for Pink and Chum Salmon throughout the area of certification.
Client action plan	The Client will provide a plan to improve escapement monitoring sufficient to identify the status of pink and chum salmon in relation to harvest in all areas during the first annual surveillance audit. The plan will include the methodology (e.g. aerial surveys, weir counts, etc.), approximate time period (e.g. mid-August to early September), frequency (e.g. weekly surveys), streams/stream sections for each species, and identify steps to provide sufficient information on wild spawning escapement to support the harvest strategy and demonstrate monitoring of abundance. The plan will be implemented prior to the second surveillance audit. Information on survey effort and distribution and escapement results from the previous season will be provided during each audit.
Consultation on condition	Client will work with ForSea Solutions and KamchatNIRO to develop the plan. The plan presented during the first surveillance will include agreement with KamchatNIRO to provide information.
Progress on Condition (Year 1)	The fishing companies contracted with KamchatNIRO to restore aerial survey effort for estimation of spawning escapement. A total of 50 flight hours were surveyed in 2018 of which 35 were funded by the Bolshaia River fishing association. The fishing companies also contracted with KamchatNIRO to document results and report in comparison with spawning escapement estimates. This report is attached herein as appendix I. Also attached is a letter regarding arrangements for similar surveys in 2019.
Status	Open and ahead on target
Additional information	Bugaev et al. 2019. Analysis of the state of Pacific salmon stocks and fisheries (pink, chum, sockeye, coho salmon) in the basins of some rivers (Bolshaya, Kikhchik, Opala, Mukhina) and in the neighboring offshore waters of Kamchatka west coast area in 2018 (compared to previous years) as part of the scientific support for fishery audit of “Rybolovetskaya artel “Narody Severa”, LLC by standards of the Marine Stewardship Council (MSC). KamchatNiro. Petropavlovsk-Kamchatsky. (see appendix I)

3.2.2 Condition 2

Performance Indicator	1.2.3. Information and monitoring - Relevant information is collected to support the harvest strategy

Score	Pink – 65 Chum – 65
Rationale	While illegal harvest has been substantially reduced from historical levels and current levels are constrained by the remoteness of the area, illegal harvest remains a chronic problem in the Bolshaya River. Therefore, this standard is not met.
Condition	Provide information on the level illegal fishery removals of Pink and Chum Salmon from the Bolshaya River.
Milestones	By the first annual surveillance, the client must present evidence that a plan is in place to address this condition. By the second annual surveillance, the client must present evidence that the plan has been implemented. By the third annual surveillance, the client must demonstrate that the condition has been met, at which time the fishery will rescore at least 80. Recommendation: Provide estimates or inferences of the level illegal harvest by species with a corresponding explanation of the basis for the numbers.
Client action plan	The Client will provide a detailed plan for assessing the magnitude of illegal fishing in the Bolshaya River drainage by the first surveillance audit. In addition, to documenting enforcement activities, and media reports, the plan will include some methodology to quantify the amount of fish illegally harvested. For example, this may include reinstating/modifying KamchatNIRO studies to quantify illegal fishing or incorporating anthropological/sociological studies of local communities to assess the types and scale of different illegal activities. The Client will present evidence that the plan has been implemented during the second surveillance audit. A final report on the magnitude of illegal catches of Pink and Chum salmon from the Bolshaya River and methodology used will be provided during the third surveillance audit.
Consultation on condition	Client will work with ForSea Solutions, KamchatNIRO and/or academic consultants to develop and implement the plan. The Plan provided at the first surveillance will include agreement with relevant agencies or contractors to collect and analyse information.
Progress on Condition (Year 1)	The fishery has developed and is implementing an action plan to address this condition. The fishery has contracted with Dr. Veronika Simonova of the University of St. Petersburg to conduct a social-anthropological assessment of illegal fisheries in Western Kamchatka from 2019 through 2022. This is a continuation of work previous funded by other western Kamchatka fishing companies under assessment. The work plan includes: 1. To define a methodology and research questions of research of illegal fisheries based in a previous results; Mainly, the investigation of illegal fisheries realizes via the tactic as follows: qualitative data allows see the best approach for questionnaire creation and introduction of quantitative techniques; after quantitative analysis is finished, the final step is for a combination of both during the process of fieldwork and analysis. In the

	end, the model of illegal fishery as a social phenomena and the amount of illegally harvested fish will be present. Namely, in the year of 2019 the research will be focused on methodology adjustment and qualitative approach, preliminary report will be presented in April 2020 as well as the plan for the further step of investigation. In 2020 primarily quantitative data will be gathered and the report will be given by April 2021. The final year is a continuation with both set of techniques for establishing an explanation of illegal fisheries as a social phenomena and estimation of a quantity of illegally harvested fish and further recommendation for how illegal fisheries should be decreased. 2. Collaborate on team building with social anthropologists and sociologists from the Centre of Arctic and Siberian Exploration; 3. Work with available media and other literary sources; 4. Do fieldwork in the settlements of interest and business area of LLC 'Narody Severa' et al.. Fieldwork will consist of two expeditions in summer and fall or winter season. Empirical data will be gathered among local populations and experts. 5. Analysis of data gathered: transcribing interviews, working with questionnaire. 6. The first part of social anthropological expertise and sociological monitoring of illegal fisheries will be focused on qualitative research, though quantitative data will be also considered. 7. Discussing the results with colleagues and experts from related disciplines; 8. Writing a report in English and Russian, writing an Academic paper. In addition, the fishing companies have provided a summary of media reports on enforcement activities supported in the area of their fisheries. Significant support is provided by the regional fishery association in the form of funding of enforcement personnel and material support for related activities. Progress on this condition effectively addresses year one milestones.
Status	Open and on target
Additional information	See Appendix III - Reports of Anti-Poaching Activities – July 2018 Examples

3.2.3 Condition 3

Performance Indicator	**1.2.4. Assessment of stock status - There is an adequate assessment of the stock status of the SMU**
Score	75
Rationale	This fishery historically estimated stock status relative to aggregate escapement goals based on annual index area surveys. Escapements were compared to historical values that were shown over time to sustain high returns and fishery harvests. In recent years, the management system has also

	explored development of goals based on population-specific analyses. Recent reductions in aerial survey effort will reduce the accuracy and precision of stock assessments. Management effectiveness will be impaired in the event of changing stock productivity and distribution or fishery patterns. Reduced surveys also provide low resolution on major stock subcomponents and will limit the effective development and application of population-specific reference points. Stock assessment has become increasingly reliant on indicator streams with the reduction in sampling rate but changing distribution patterns over time at different scales of abundance and productivity can confound interpretation of index samples. Reliance on index areas may also not provide representative estimates for a full spectrum of strong and weak stock subcomponents within a system. Peak spawner counts from the most productive habitats may not be representative of the total stock under conditions of low productivity or declining returns. Further, escapement goals are generally based on production functions for aggregate stock and river populations of a species. Curves and goals thus represent an average stock and may be disproportionately driven by large strong stocks in the aggregate. As a result, some populations can be overfished.
Condition	Estimate stock status of Pink and Chum Salmon in West Kamchatka rivers relative to reference points and demonstrate that survey indicator streams are representative of other populations within the management unit.
Milestones	By the first annual surveillance, the client must present evidence that a plan is in place to address this condition. By the second annual surveillance, the client must present evidence that the plan has been implemented. By the third annual surveillance, the client must demonstrate that the condition has been met, at which time the fishery will rescore at least 80. <u>Recommendation: Report annual spawning escapement of Pink and Chum Salmon in West Kamchatka Rivers in relation to escapement goals established for these species. Demonstrate that survey indicator streams are continue to be representative of populations throughout the unit of certification. Consider the potential applicability of target reference points for odd-year pink salmon runs.</u>
Client action plan	The Client will provide an analysis of the relationship between historical escapement monitoring data to actual escapements during the first surveillance audit. For example, are they estimates of total escapement abundance or are they relative indicators of abundance. If they are estimates, the analysis will include a description of how escapements are extrapolated from aerial surveys and why this is appropriate. The Client will also provide a justification for the revised escapement monitoring plan (Condition 1) during the first surveillance audit. For example, if only select “indicator” streams/stream sections are surveyed, the analysis will

	include a rationale for why they are representative of unsurveyed streams in the unit of certification. Starting with the first surveillance audit, the Client will annually provide information comparing annual escapements compared to the relevant escapement targets, by species, and identify steps to assure an estimate of stock status relative to reference points and demonstrate coherence between the status of the indicator streams and the status of the other populations they represent.
Consultation on condition	Client will work with KamchatNIRO to provide the analysis of historical escapement monitoring and graphs of escapement compared to escapement targets. Client will work with ForSea Solutions and KamchatNIRO to provide justification for the revised escapement monitoring plan.
Progress on Condition (Year 1)	KamchatNIRO provided an analysis of the coherence of between the status of the indicator streams and the status of the other populations they represent within the management unit (Shevliakov and Maslov 2011– see Appendix IV). The fishing companies also contracted with KamchatNIRO to document results and report in comparison with spawning escapement estimates. This report is attached herein as appendix I. Progress on this condition effectively addresses year one milestones.
Status	Open and ahead of schedule
Additional information	Appendix I – KamchatNIRO Report Appendix IV –Shevliakov and Maslov 2011

3.2.4 Condition 4

Performance Indicator	**2.1.3. Primary species information - 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**
Score	70
Rationale	The SG80 standard is not met due to reductions in the accuracy and precision of wild abundance estimates for Coho, Sockeye, and Chinook Salmon resulting from recent reductions in aerial survey efforts. Continuing reductions in aerial survey effort, which is the basis for inseason and post season stock assessment, raise concern for the sufficiency of information on spawning escapements for a representative range of component populations in the future. Information is also incomplete on the effects of illegal harvest in road-accessible areas of the Bolshaya River, particularly for Sockeye.
Condition	Provide quantitative information on escapement of Sockeye and Coho Salmon adequate to assess the impact of the fishery relative to escapement goals.
Milestones	By the first annual surveillance, the client must present evidence that a plan is

	in place to address this condition. By the second annual surveillance, the client must present evidence that the plan has been implemented. By the third annual surveillance, the client must demonstrate that the condition has been met, at which time the fishery will rescore at least 80. Recommendation: Report annual spawning escapement of Sockeye and Coho Salmon in West Kamchatka Rivers in relation to escapement goals established for these species. Demonstrate that survey indicator streams continue to be representative of populations throughout the unit of certification. Include assessments for key populations vulnerable to illegal harvest in areas of the Bolshaya River.
Client action plan	Starting with the first surveillance audit, the Client will annually provide graphs comparing annual escapements of coho and sockeye salmon (for at least the previous 15 years) compared to the relevant, escapement targets for the Bolshaya, Opala and Kikhchick Rivers, by species and river. In addition. the Client will work with KamchatNIRO to develop a plan to demonstrate that survey indicator streams are representative of unsurveyed populations including those vulnerable to illegal harvest on the Bolshaya River.
Consultation on condition	Client will work with KamchatNIRO to provide the necessary information.
Progress on Condition (Year 1)	KamchatNIRO provided an analysis of the coherence of between the status of the indicator streams and the status of the other populations they represent within the management unit (Shevliakov and Maslov 2011– see Appendix IV). Additional information related to this question was provided in a report by KamchatNIRO (Appendix I). The KamchatNIRO report contracted by the fishing companies also documents results and comparisons with spawning escapement estimates. Progress on this condition effectively addresses year one milestones.
Status	Open and ahead of schedule
Additional information	Appendix I – KamchatNIRO Report Appendix IV –Shevliakov and Maslov 2011

3.2.5 Condition 5

Performance Indicator	**3.2.2. Decision-making processes - The fishery-specific and associated enhancement 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.**
Score	75
Rationale	Monitoring of decision making for the fishery is limited by the inconsistent

	availability of information outside the local governmental management system. Results of fishing season and effectiveness of management actions undertaken are discussed among management agencies such as AFC, SVTU and FAR, and also at Research Councils of fisheries institutes such as KamchatNIRO, TINRO-Center and VNIRO on a regular basis. Management actions are reported by the Anadromus Fish Commission. However, related information on run size, harvest by time and area, and escapement is not typically reported outside the management system except in rare cases. Occasional publications of related information (e.g. Shevliakov 2013b) provide a historical perspective but are not sufficient to allow tracking action associated with findings and relevant recommendations.
Condition	Demonstrate that information on fishery 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.
Milestones	By the first annual surveillance, the client must present evidence that a plan is in place to address this condition. By the second annual surveillance, the client must present evidence that the plan has been implemented. By the third annual surveillance, the client must demonstrate that the condition has been met, at which time the fishery will rescore at least 80. <u>Recommendation: Provide annual reports document management actions and rationales based on fishery data. Identify initial passing days, modifications to passing days, and season closures. Identify Anadromous Fish Commission protocols for the fishery area. Report annual harvest and escapement by species and river for West Kamchatka rivers included in this assessment.</u>
Client action plan	Beginning with the first surveillance audit, the Client will provide annual reports documenting the rationale behind fishery management actions taken the previous fishing season affecting the unit of certification. In addition to reporting on Anadromous Fish Commission protocols establishing opening dates, initial passing days, modifications to passing days, season closures, etc., the report will provide rationale for the actions. For example, pre-season run forecasts, in-season catch/escapement information may have been used to set or modify passing days based on projected run strength.
Consultation on condition	Client will work with KamchatNIRO to provide the necessary information.
Progress on Condition (Year 1)	A work plan was developed and implemented to address this condition. The fishing companies contracted with KamchatNIRO summarize information on fishery harvests, spawning escapements, and actions taken by Anadromous Fish Catch Monitoring and Controlling Commission in Kamchatka krai (Protocols) in 2018 and justification of actions in certified West Kamchatka fisheries. Progress on this condition effectively addresses year one milestones.

Status	Open and on target
Additional information	Appendix I – KamchatNIRO Report

3.2.6 Condition 6

Performance Indicator	**<u>3.2.3. Compliance and Enforcement</u> - Monitoring, control and surveillance mechanisms ensure the management measures in the fishery and associated enhancement activities are enforced and complied with.**
Score	70
Rationale	Effective enforcement is only possible with considerable funding and cooperation among the fishing companies depending on local fish resources. The chronic nature of illegal fishing in some areas indicates that the monitoring, control and surveillance system has not demonstrated a complete ability to enforce relevant rules throughout the system. Enforcement cannot be considered comprehensive because the notable level of illegal fishing is apparently still significant.
Condition	Demonstrate that a monitoring, control and surveillance system has been implemented in the fishery and associated enhancement activities and has demonstrated an ability to enforce relevant management measures, strategies and/or rules, and that sanctions to deal with non-compliance exist, are consistently applied and thought to provide effective deterrence.
Milestones	By the first annual surveillance, the client must present evidence that a plan is in place to address this condition. By the second annual surveillance, the client must present evidence that the plan has been implemented. By the third annual surveillance, the client must demonstrate that the condition has been met, at which time the fishery will rescore at least 80. <u>Recommendation: Provide annual documentation of enforcement efforts and effectiveness by the client companies, fishery association and government.</u>
Client action plan	The Client will provide a detailed plan for assessing the effectiveness of the monitoring, control and surveillance system in the unit of certification by the first surveillance audit. In addition, to documenting enforcement activities undertaken by SVTU, KamchatNIRO and the fishing companies, and media reports, the plan will include some methodology to evaluate the relative effectiveness of enforcement activities. For example, this may include anthropological/sociological studies of local communities to assess the types and scale of different illegal activities, potential trade routes, and strategies for reducing incentives for these activities. The Client will present evidence that the plan has been implemented during

	the second surveillance audit. A final report on the results demonstrating an effective monitoring, control, and surveillance system will be provided during the third surveillance audit.
Consultation on condition	Client will work with ForSea Solutions and academic consultants to develop and implement the plan. The Plan provided at the first surveillance will include agreement with relevant contractors to collect and analyse information.
Progress on Condition (Year 1)	The fishery has developed and is implementing an action plan to address this condition. The fishery has contracted with Dr. Veronika Simonova of the University of St. Petersburg to conduct a social-anthropological assessment of illegal fisheries in Western Kamchatka from 2019 through 2022. This is a continuation of work previous funded by other western Kamchatka fishing companies under assessment. In addition, the fishing companies have provided a summary of media reports on enforcement activities supported in the area of their fisheries. Significant support is provided by the regional fishery association in the form of funding of enforcement personnel and material support for related activities. Progress on this condition effectively addresses year one milestones.
Status	Open and on target
Additional information	Appendix III

3.3 Client Action Plan

No changes

3.4 Re-scoring performance indicators

No changes

4 Evaluation Processes & Techniques

The surveillance audit process as defined in the MSC Fishery Certification Requirements v2.0 was followed in this audit.

Information supplied by the clients and management agencies was reviewed by the assessment team ahead of the on-site meeting, and discussions with the clients and management agencies centered 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 surveillance audit, all stakeholders from the full assessment and previous surveillance audits were informed of the meeting and the opportunity to provide information to the auditors in advance of, or during, the meeting. The notification of the surveillance audit was also published on the MSC website on 23 May 2019.

The surveillance audit was held in Petropavlovsk-Kamchatsky, Russian Federation on July 3 – 5, 2019. The surveillance team consisted of Amanda Stern-Pirlot (team leader) accompanied by Ray

Beamesderfer and Dr. Dmitry Lajus. Mr. Beamesderfer and Dr. Lajus were members of the assessment team. Meetings were conducted in the Company Offices. A meeting with government scientific agency KamchatNIRO was conducted at the agency office. The participants who were in attendance are identified in Table 7.

Discussions covered all issues as laid out in annex CG of the MSC Certification Requirements, including the principal changes occurring to the fishery since the previous surveillance and the outcomes as outlined in the Client Action Plan (CAP) against the conditions set. The assessors drew from referenced material (emails, notices, research submissions, published and draft documents and personal communications) to support the findings in the report.

New documents provided to the surveillance team at this audit are included as appendices to this report.

Table 7. Surveillance meetings in Petropavlovsk-Kamchatka, 2019.

Name	Organization	Title	Location
Alexander Matveyenko	Narody Severa - Bolsheretsk	General Director	NSB Offices
Andrei Morozov	Narody Severa - Bolsheretsk	Deputy Director	NSB Offices
Emil Shaikhov	LoydFish	General Director	NSB Offices
Oksana Sidorova	Loyd Fish	Attorney	NSB Offices
Viktor Leskov	Oktyabrsky rybokombinat	General Director	NSB Offices
Alena Kobets	Oktyabrsky rybokombinat & Zyuid	Attorney	NSB Offices
Natalia Novikova	ForSea Solutions LLC	Founder and Director	All
Randy Ericksen	ForSea Solutions LLC and RP Ericksen Consulting	Fisheries Advisor	All
Amanda Stern-Pirlot	MRAG Americas	Team Leader	All
Ray Beamesderfer	MRAG Americas, Fish Science Solutions	Sr. Fish Scientist and MSC Assessment Team	All
Dmitry Lajus	MRAG Americas, St. Petersburg State University	Independent Consultant and MSC Assessment Team	All
Nina Shpigalskaya	KamchatNIRO (Kamchatka Research Institute of Fisheries and Oceanography)	Director	KamchatNIRO
Alexander Bugaev	KamchatNIRO (Kamchatka Research Institute of Fisheries and Oceanography)	Deputy Director of Research	KamchatNIRO
Olga Zikunova	KamchatNIRO (Kamchatka Research Institute of Fisheries and Oceanography)	Head of the Laboratory of Population Dynamics	KamchatNIRO
Andrey Sdetovetsky	Kamchatka Ministry of Fisheries	Minister	VA Office
Alexandr Khristenko	Federal Fishery Agency (Kamchatka) - SVTU	Head	FAR
Aleksander Savin	Federal Fishery Agency (Kamchatka) - SVTU	Deputy Director	FAR
Vladimir Galitsyn	Kamchatka Salmon Fishermen Association	President	VA Office
Sergey Vakhrin	"Let's Save Salmon Together" Regional Kamchatka Fund	President	“Let’s Save Salmon Together” Museum

1. I. KamchatNIRO Report

ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО РЫБОЛОВСТВУ

ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ НАУЧНОЕ УЧРЕЖДЕНИЕ «ВСЕРОССИЙСКИЙ НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ РЫБНОГО ХОЗЯЙСТВА И ОКЕАНОГРАФИИ»

Камчатский филиал ФГБНУ «ВНИРО» («КамчатНИРО»)

APPROVED
Head of Federal State Budget
Scientific Institution "VNIRO" –
Kamchatka branch (KamchatNIRO)

_____ Shpigalskaya N.

« ____ » _____ 20 19

REPORT ON AGREEMENT № 06/19-NIR signed 06.03.2019

Topic: Analysis of the state of Pacific salmon stocks and fisheries (pink, chum, sockeye, coho salmon) in the basins of some rivers (Bolshaya, Kikhchik, Opala, Mukhina) and in the neighboring offshore waters of Kamchatka west coast area in 2018 (compared to previous years) as part of the scientific support for fishery audit of “Rybolovetskaya artel “Narody Severa”, LLC by standards of the Marine Stewardship Council (MSC)

Executive in charge:
Deputy Director for Science Bugaev A.
Dr, Biological sciences

Petropavlovsk-Kamchatsky, 2019

Executives

Executive in charge, Deputy director, Dr, Biological sciences	**Bugaev A.** General supervision, report processing and editing
Executives:	
Senior research associate	**Artuhina N.** Sections 4, 5
Leading research associate, Ph.D, Biological sciences	**Feldman M.** Section 2
Associate	**Shubkin S.** Sections 1, 3

Contents

Introduction

In frames of salmon fishery audit by standard of Marine Stewardship Council (MSC) for “Rybolovetskaya artel “Narody Severa”, LLC, the required biological information was provided regarding company fisheries during 2018 and during the previous 15 years. The MSC Guidelines for certificate issue states that the certification unit is “Fishery or fish stock (biologically distinguished specimens) in combination with catching method (fishing gear, industrial practice and management infrastructure)”.

Therefore, the definition of the fishery for “Rybolovetskaya artel “Narody Severa”, LLC, in frames of preliminary assessment is as follows: 1) Target fish species: pink salmon Oncorhynchus gorbuscha, chum salmon Oncorhynchus keta, sockeye salmon Oncorhynchus nerka and coho salmon Oncorhynchus kisutch; 2) Geographical area (fishing area): Kamchatka west coast area, the Sea of Okhotsk, and (by administrative zoning system) Kamchatka-Kuril subzone - 61.05.4 (Ust-Bolsheretsky district of Kamchatka region); 3) Fish stocks (fishing units): populations (local stocks) of four species of Pacific salmon (pink, chum, sockeye, and coho salmon) spawning in the basins of the Bolshaya, Kikhchik, Opala and Mukhina rivers.

Taking into account some interrelation of the issues in the request submitted by “Rybolovetskaya artel “Narody Severa”, LLC (letter: incoming number 735 dated 03/04/2019), the specialists of Federal State Budget Scientific Institution "VNIRO" – Kamchatka branch (hereinafter - KamchatNIRO) have to combine sections (questions) 3 and 4, since the information on escapement for the last 15 years a priori includes data for 2018. Therefore, this report covers in total of 5 sections (questions).

KamchatNIRO draws your attention to the fact that the presented target species of Pacific salmon, spawning in the Bolshaya, Kikhchik, Opala and Mukhina rivers, reperesent not only fishing units of “Rybolovetskaya artel “Narody Severa”, LLC, but also of neighboring fishing companies: “Bolsheretsk”, LLC, “Loyd-Fish”, LLC, “Oktyabrsky Rybokombinat”, LLC.

Research objective is to analyze the state of the stocks and fisheries of Pacific salmon (pink, chum, sockeye, coho salmon) in the basins of some rivers (Bolshaya, Kikhchik, Opala, Mukhina) and the neighboring offshore waters of Kamchatka west coast in 2018 (in comparison with the previous years data).

Research tasks:

Improvement plan for escapement monitoring of pink and chum salmon in the rivers and tributaries being a part of Unit of Certification (UoC). This plan will include specific methodology (i.e. aerial surveillance, stanch calculations, etc.), an approximate period of monitoring time (e.g. from mid-August till early September), frequency (i.e. weekly observations), rivers / tributaries / river sections for each species;

Assessment plan for representativeness of revised escapement monitoring plan for all stocks in Management Unit. In particular, the plan should evaluate possible target values for escapement of pink salmon spawners during the odd years. If only “indicator” (benchmark) rivers /

tributaries / river sections are selected for observation, then the analysis will include an explanation of their representativeness for tributaries not under observation;

Graphs for pink, chum, sockeye and coho salmon spawners' escapement, compared to their target values for the last 15 years. Data for each species' escapement in each river in 2018 (for certified rivers and fishing areas)

Catch data on each fishing company for each salmon species and each fishing area in 2018;

An annual report documenting justifications for actions taken in fisheries management adopted during the previous fishing season in 2018, directly affecting certified fisheries (rivers /districts). Opening dates for the fishing season, initial escapement days, changes on escapement days, closing dates for the fishing season are set during the meetings of Commission on anadromous species of fish. In addition to the Minutes of such meetings the report will provide justification for such actions, for example, forecasts of salmon run before early season, information on catch / escapement during the season. The information based on predicted run can be used to establish or change escapement days;

Section 1. Improvement plan for escapement monitoring of pink and chum salmon in the rivers and tributaries being a part of Unit of Certification (UoC). This plan will include specific methodology (i.e. aero visual surveillance, stanch calculations, etc.), an approximate period of monitoring time (e.g. from mid-August till early September), frequency (i.e. weekly observations), rivers / tributaries / river sections for each species

Aerial surveillance procedure developed in the second half of the 20th century by a number of specialists from KamchatNIRO has not undergone significant changes up to the present time (Ostroumov, 1962). A certain upgrading took place in terms of technical support: aircraft types changing, satellite positioning receivers development, uncrewed aerial vehicles (UAVs) development, cartographic programs and geo-information systems development.

Over the previous two decades, with the rapid increase of aircraft freight charges with the lack of funding the need in optimization of aerial surveillance procedures has become critical. As a result, aerial surveillance methodology was supplemented by a part defining the list of rivers based on Pacific salmon spawning within Kamchatka Region (Shevlyakov, Maslov, 2011). Nevertheless, basic organizational approach to the procedure of aerial surveillance remained unchanged.

Flights organization. Aerial surveillance of spawning areas requires considerable preliminary preparation. The general flights schedule and timing should be defined in advance. Before each flight, the observer and the pilot map out the course and agree on details. The observer has to study the maps of the surveyed area and to form an idea about terrain characteristics (orography, hydrographic pattern, etc.) and available landmarks.

Flights schedule. Flights are performed at an altitude of 50–150 m (helicopter) and 150–250 m (airplane) above terrain. Flight altitude should not be too low; otherwise the object escapes the observer's sight line too quickly. The most suitable speed for observation is 100–120 km / h. With higher speeds, the observation is carried out with sufficient difficulties.

Excessive fatigue reduces the accuracy of aero visual surveillance. Therefore, it is not recommended to perform daily observations for more than 5 hours.

Conditions for observation. If surveillance takes place only once during the season, spawning grounds of salmon should be inspected during the period of the most massive spawning or somewhat later. Under these conditions, it is possible to record the maximum number of fish in the spawning grounds, while the number of spawned fish can be counted by the number of nests or by the size of the spawning areas, as well as by the remaining dead fish (spawned out salmon).

It is better to observe the rivers not once, but twice or three times per season: early season, mid season and late season.

The best time for observation is from 8–9 a.m. till 16–17 p.m. In most cases, in August and early September, observations are possible up to 17–18 p.m., as after this time the shadows from the coast and coastal vegetation critically worsen fish visibility.

Favorable weather conditions are: horizontal visibility of at least 10 km, wind speed of no more than 10 m per second, cloudless weather, or 4-5-grade cloudiness. As a rule upper layer cloudiness (cirrus, cirrus strata, etc.) does not interfere with aero visual surveillance. Visual observations effectiveness decreases dramatically when the sky is covered with dense dark ("leaden") clouds of the lower layer (stratocumulus and stratus) with a lower edge of 800–1500 m or less. Under such conditions, fish, especially pink salmon, can be poorly viewed from an airplane. Therefore, when estimating the number of fish, an inexperienced observer may underestimate the quantity 2–3-times the amount of the existing number. This fact should be considered when working in bad light conditions. Salmon visual counting at a height of 50–100 m under the same unfavorable lighting conditions makes it possible to achieve much higher accuracy.

Flights take place over the waters along the coastline and can be carried out both from the headwaters to the lower reaches of the river, and vice versa. Small spawning waters, such as keys and small tributaries, are more widely available for inspection from a helicopter. The main rivers and their tributaries are mainly inspected from the airplane; they are less covered by the coastal tree crowns.

The extent of spawning areas surveillance also depends on the course of the aircraft. As the stream way is usually winding, it is desirable that, to the extent that the aircraft's maneuverability allows, it should follow all the bends of the river. In case the aircraft goes along the central line of the river, crossing the bends, many spawning areas can be left unobserved.

Descending air currents should be taken into consideration, when crossing river valleys, flying in gorges and through mountain ranges, as these currents can be dangerous when flying at low altitude especially when it is significantly windy. In this regard, the chosen course ensures not only the highest efficiency of work (effectiveness and commercial importance), but also maximum safety.

Fish visibility. From an aircraft an observer having no optical device can usually distinguish objects that are larger than 0.002 of flight altitude. In concern with this fact, as well as the fact that salmon have a length of about 0.5 m, the flight altitude above the water surface is admitted as 250 m;

Fish visibility depends not only on weather conditions, flight speed and altitude, but also on the environment, transparency, and color of the waters, the relief of the bottom and its color, on the vegetation along the coastline, on the color of the fish itself, on the river sinuosity, on the time of the day, and on the depth under consideration. Pacific salmon are clearly visible against the background of the river bottom, even when settling, and particularly in motion.

Salmon distinction by species (during river migration and spawning). For the most part on the river migration routes individual species of salmon and their proportions cannot be distinguished and established, while it can be done at the spawning grounds. The distinctive features of each species of salmon are: different sizes, spawning dress coloring (mainly), as well as the reaction to the noise of the engine and the shadow of the aircraft. Distribution of different species in the river basin also contributes to their distinction.

Sockeye salmon. Due to the spawning dress which includes red body color this species is mostly noticeable in water. Spring sockeye salmon usually spawn in rivers or even in the lake basins, coming into tributaries. Summer sockeye salmon spawns in the littoral lake areas apart from the rivers.

Distinction between spring and summer sockeye is facilitated by their spawning at different times. In lakes, sockeye is settled at a greater depth than that at which it spawns for quite a long time. The sound of the aircraft engine and its shadow make salmon move to an even greater depth, where it is inaccessible for observation.

Above lakes with greater depths the flight altitude should not be less than 250 m in altimeter. At such altitude spawning sockeye hardly react to the sound of the engine and the shadow of the aircraft.

Chinook salmon. On spawning grounds, it is distinguished by its larger size and darker body color than that of sockeye salmon.

Typical spawning grounds are located at a small distance from the coast. “Under the coast” fish keep in pairs at a distance of several meters. Spawning grounds stretch in a narrow strip mostly along the coastline.

In the middle of the river steam ways, spawning chinook form clusters of up to 10–20 or more specimens. In these cases, the nests are located in relatively small areas in "spots" at a distance from one to several meters. Chinook go up the rivers and can spawn in areas with fairly great depth and fast current.

Pink salmon and chum salmon. When observed from an airplane, pink salmon look dark brown in spawning dress, while chum salmon look dark grey. One can easily notice the humpiness of spawned out pink salmon , lying on the bottom and along the coastline. This makes it distinguishable from chum salmon, which is larger, more slender, having relatively less tall body. The remaining stripping on the sides of the body is often noticeable with spawned out chum salmon.

At spawning grounds especially in springs and creeks with relatively weak current chum salmon is distinguished from pink salmon not only by color and body size but also by specific circular movement over the spawning hill and constant body bending. Pink salmon behaves differently: it lasts longer with its head against the current, parallel to water flows.

For spawning pink salmon do not usually go up the rivers as high as chum salmon. Most times, pink salmon spawn in the creeks and in the mainstream of the lower and middle currents of most rivers and their main tributaries.

Chum salmon come to the main spawning grounds, which are at the same time visited by sockeye and pink salmon. It also spawns in the creeks.

The most difficult places to distinguish the species are in the lower reaches and migratory areas in the middle currents, where pink, chum, and later coho salmon go together. Pink salmon can be difficult to distinguish from migratory salmon trout, and sometimes from chum, but with enough experience, the number of mistakes is reduced. In the rivers with pink salmon sharp dominance it is difficult to establish the number of species in clear minority.

Coho salmon. When observed from the air, the back part of the body of coho migrating along the river seems to be black making it different from other species. At spawning grounds, they are easily distinguished by their brick-red body color. They differ from sockeye in spawning time, since they come into the rivers and start spawning later. They never spawn in lakes.

Salmon stock taking. Aerial methods for stock record vary depending on the number of fish, its distribution and concentration at spawning grounds.

There are three main cases:

1. a) in the river basin salmon are found in small rare concentrations: 1–25 specimens at the distance of several hundred meters or several kilometers;

b) there are little salmon in the river. They are distributed in small concentrations, but more evenly along the whole stream way than in case “a”.

In both cases, the observer takes into account the number of concentrations, and then counts fish by single specimen.

2. In the river salmon form large, but relatively rare concentrations: from several tens to several thousand specimens at the distance of hundreds of meters or several kilometers. Single specimen calculation cannot be carried out in large concentrations. Therefore, it is necessary to count the fish only partially and determine the total number on the basis of partial calculation.

3. There are a lot of salmon in the water basin. Spawning areas occupied by fish follow one after another almost with no intervals or with small vacant areas. Often fish occupy the whole stream way of spawning grounds for many tens of kilometers. Spawning grounds stretch in wide fields along the coastline (both or one side) with vacant area in the central part of the stream way and vice versa - spawning grounds stretch along the central part of the stream way, and the coastline is vacant. During particularly “fishy” productive seasons salmon use spawning areas of almost the entire lake littoral or entire stream way from coast to coast.

With an abundance of fish at the spawning grounds, it is impossible to make visual single specimen calculation. Different methods are therefore applied.

1) Calculation of fish number per unit of area (for example, 100 m2) or unit of river stream way length (for example, 50 m). The length of the fish itself is favorable scale in this case. Spawned out salmon lying on the bottom and along the coastlines are calculated using the same method.

2) Calculation using any specific number, as initial unit of calculation, for example, one hundred or one thousand fish. In all cases, it is obligatory to use one single unit of calculation.

Aerial photography conditions. Sunny cloudless weather is the most favorable for taking aerial photographs of salmon at the spawning grounds. Aerial photography is also quite possible with cirrus, cirrus strata, cirrocumulus and loose, fairly transparent altocumulus or altostratus clouds.

Solid clouds create difficulties therefore photographing should be avoided. As known, diffused light creates lighting in the shadows and reduces brightness of the objects. As a result, interpretation can be difficult, and in some pictures fish cannot be distinguished at all.

Dense, dark clouds of the lower layer (stratocumulus, stratus) create extreme interference with aerial photography and later interpretation.

With cloudless sky and high sun, flecks on the surface of the water can interfere with surveillance and aerial photography. The fleck area covering and its location in the photographs change depending on the time of the day the flight is performed over the river with meridian or latitudinal direction.

Salmon redds are clearly visible from an airplane. Usually, rivers and lakes at the spawning grounds stand out for shallow depths of about 50–100 cm, and exceptional water transparency. Frequently, the bottom can be viewed to a depth of 5–6 m. Aerial photography is also possible

under such circumstances. In general, salmon can be photographed if they are visually distinguishable, regardless of the depth they are at.

Interpretation. Interpretation of the images should ensure more reliable and complete identification of objects if possible: living salmon, spawned out salmon, redds (spawn nests) for the purpose of their accurate calculation, determination of their occupation density at spawning grounds and their distribution features, and determination of the spawning areas. In addition to these main objectives of interpretation, additional information can be collected such as: currents directions, depths, the nature of the soils at the bottom of the waters and along the coastlines, underwater and coastal vegetation, etc.

Salmon wearing spawning dress, during the spawning period, are easily distinguished in the pictures (see Salmon distinction by species).

When observed from the air, spawned out salmon usually look “white”, i.e. are of a color that, in general, can be called white. Therefore, they are clearly visible in the pictures. Their interpretation and calculation is not difficult, except for the cases with good occupation of spawning grounds by pink salmon, when spawned out salmon occupy holes at the bottom. In such cases they lie in thick layers on shallow spits and shoals that are open after fall of waters.

These circumstances make interpretation complicated and reduce calculation accuracy but even under such circumstances aero visual surveillance enables to calculate spawned out salmon with accuracy inaccessible to ground field research method.

In the photo salmon redds located on non-silted or weakly silted grounds, are visible as spots of somewhat of a darker tone with lighter edges. If the bottom of the spawning basin is thickly silted then redds are distinguished by lighter spots against dark bottom background.

Aviation allows exploring vast territories in short time and repeatedly during the season. Owing to aerial photography by interpretation of twin pictures it is possible to discover the period of spawning, the change of the spawners, the number and location of redds etc.

During pictures examination, distribution of river depths becomes clear: the deeper areas are seen in dark tone, the shallower - in light one. At the same time, silty bottom has a darker tone in the pictures compared to pebble-sandy one.

Salmon calculation at the spawning grounds. Photographing of all spawning grounds would be extremely time-consuming and expensive; therefore, it should be carried out randomly. For each part of the river different in its geographical features in distribution of spawning grounds or salmon occupation typical area should be chosen for photographing. The surveyed areas are marked on the maps as well as the boundaries of the water basins they characterize. Nowadays the procedure does not require much effort since the equipment can be connected to the satellite navigator to link the image to the terrain. With the pictures salmon calculation is carried out distribution is marked and the data can be applied to the entire part of the water basin characterized by the surveyed areas. The required results are obtained for the entire river or entire lake littoral.

The aerial photography method of salmon calculation is free from human errors and even used randomly it gives incomparably more accurate results than the aero visual method. Only continuous counting on fish counting barriers gives more accurate results than aerial photography.

However, this method has several disadvantages. In addition to technical difficulties in performing one of the main problems is time-consuming interpretation with lots of pictures being taken. Therefore, this method is not suitable for immediate assessment of spawning grounds occupation extent. It is practical to carry out aerial photography randomly for accuracy adjustment in spawning areas surveillance. It is also a good method of continuous training for observers when comparing visual surveillance with actual occupation in the selected area.

The period of aerial surveillance procedures. The beginning of aerial surveillance procedures in the audit rivers takes place in the second decade of July — spawning grounds of early sockeye salmon are observed in Nachikinskoye lake and its tributaries (The Bolshaya river water basin) early chum salmon spawning grounds are observed in the Opala river water basin. One helicopter surveying flight lasts for 4 hours.

Next in The Bolshaya and Kikhchik river basins chum salmon are counted in the first or second decade of August, and pink salmon are counted in the second or third decade. Required time is 15 flight hours. Sockeye, chum and coho salmon spawning grounds are surveyed in early September. Required time is 12 flight hours. Coho and late chum salmon are counted in mid October. Required time is 12 flight hours. In total, four species surveillance procedures in audit rivers (pink, chum, sockeye, coho salmon) require 43 flight hours.

During surveillance procedures, terms amendments are frequent, depending on the spawning of the species under observation as well as on the hydrological conditions in the rivers, weather conditions, availability of aviation fuel in the areas of work and other issues. As a rule, the procedures are carried out in such a way that surveillance in the area with minimum of non-functional flights “flows” to another area. The rule is applied to surveillance terms for different species as well.

Taking into account the uncertainties in pink salmon calculations caused by reduced timing of surveys during week years class returns, it is necessary to resume aerial surveillance of river basins with a coverage area corresponding to the level of even years. In this regard, the above flight frequency pattern should be kept in annual aerial surveillance of the audit rivers. In other words, for even and odd years the same number of flight hours should be allocated.

Since 2017 in the Bolshaya river basin a large program of aero visual surveillance has been expanded with aerial photography by UAVs in the area of Nachikinskoye lake and its tributaries. This observation method enables to adjust the number of sockeye spawners spawning in the mentioned waters mainly due to repeated photographing procedures being less costly. On the basis of the data obtained calculation model for sockeye salmon spawning stock was developed and implemented in Nachikinskoye lake. The total number of spawned out salmon spawners was calculated using a simulation model counting daily spawners refill in nests (according to distribution law), their survival rates (inverse logistic model) and change in life expectancy in

nests from the beginning of the run to its end (linear decreasing model). The data obtained using UAVs were used to estimate model properties.

In addition, since 2017 surveillance procedures on Pacific salmon young fish during the seaward run have been expanded. The benchmark point is established in the Kihchik river station. Currently, surveillance procedures are carried out on Pacific salmon young fish during the seaward run in two water basins – The Bolshaya and Kikhchik rivers.

Section 2. Assessment plan for representativeness of revised escapement monitoring plan for all stocks in Management Unit. In particular, the plan should evaluate possible target values for escapement of pink salmon spawners during the odd years. If only "indicator" (benchmark) rivers / tributaries / river sections are selected for observation, then the analysis will include an explanation of their representativeness for tributaries not under observation

Monitoring plan for Pacific salmon stocks spawning in Kamchatka West coast areas is a system including all major commercially important water basins of the region. It includes two main actions:

1) Collection of primary information by means of aero visual surveillance of spawning grounds, escapement assessment by using fish counting barriers or echolocation hydroacoustic systems;

2) Assessment of target spawners escapement to ensure the most sustainable spawning process and salmon catch at regional or local levels.

Since the main focus of Pacific salmon fishing strategy is formed for fishing areas the selection of benchmark waters is based on those areas that provide the main catch of regional stocks. Accordingly, when planning aero visual surveillance procedures benchmark water bodies surveillance is considered in the first place. The Bolshaya, Kikhchik and Opala rivers are audit rivers among four water basins for salmon stock audit of "Rybolovetskaya artel "Narody Severa", LLC. In the first two water basins spawning grounds are surveyed for four species – pink, chum, sockeye and coho salmon. In the Opala river pink and chum salmon are target species under surveillance.

It should be noted that adjustments in aero visual surveillance planning does not take place annually. As a rule, it is caused by financial issues, particularly, flight time reduction due to rising costs of aircrafts service. Other reasons may include decrease or instead sharp increase in spawning stocks of any water basin. This can be caused both by human impact and by natural reasons. However, in 2018 this case was not observed in river basins of Kamchatka West region. Therefore, there is no point in talking about fundamental changes in plans for collecting primary information on regional spawning stocks of Pacific salmon.

However, target estimates for spawners escapement of different species may change. This is mainly caused by survival conditions variability during marine and oceanic periods of salmon

life, when their production characteristics are formed (The Ocean ecology of salmon and trout, 2018). The latter circumstance influences their natural fluctuations in number. Escapement to the Bolshaya, Kikhchik, Opala and Mukhina rivers target estimates are shown below for spawners of four Pacific salmon species.

In the second decade of the twentieth century the number of ***pink salmon*** in Kamchatka West coast area is rising compared to available data during the whole observation period. However, two isolated lines corresponding to even and odd years make adjustments to the overall picture. In 2018, in accordance with the new data, targets for pink salmon in Kamchatka West coast area have been revised. A new general stratified model of dependence (refill on escapement) (Fig. 2.1) was used as a basis for new benchmarks.

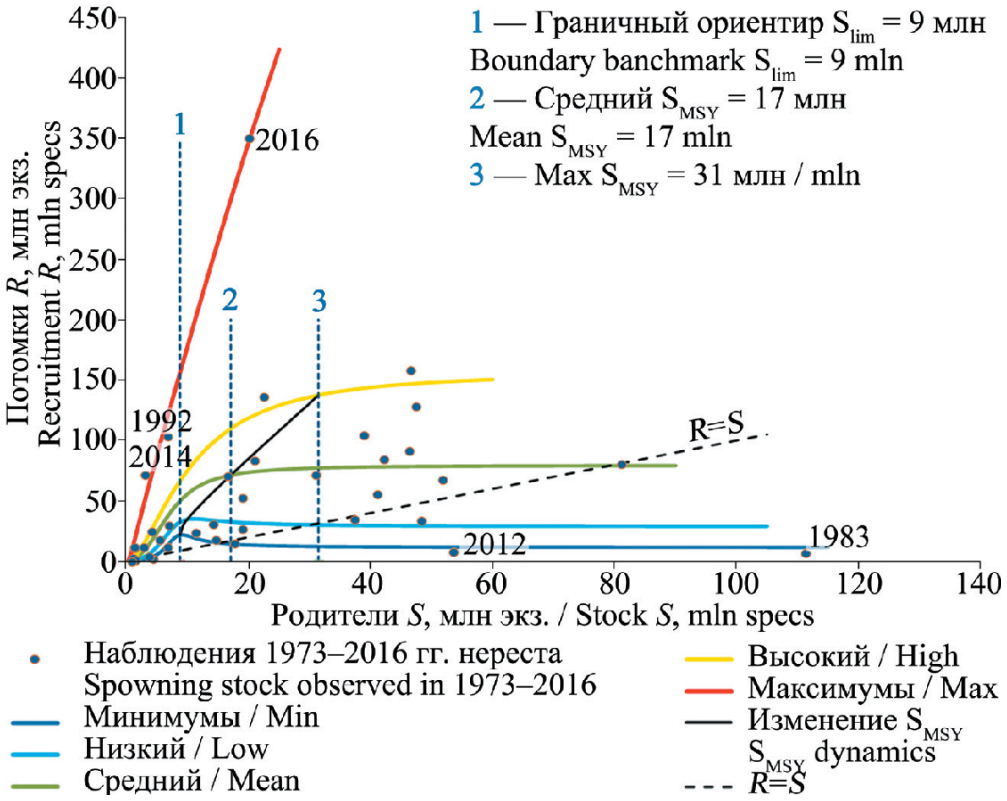

Figure2.1 — A stratified model «stock–refill» for pink salmon of Kamchatka West coast. Surveillance 1973–2016.

The new model has five strata in contrast to the previous one where only three levels of reproduction were considered. This is caused mainly by recent years data, in particular, 2016/2018 period (350 million recruitments per 20 million stock), which showed higher stratum, describing observations with maximum reproduction rates. Justification of this model was carried out using likelihood ratio test (Table 2.1). Only four strata model can be competitive to the five strata model since it combines observations of the low and minimum levels of the latter. However, since the null hypothesis is significant above $\alpha = 0.05$ level, the five level strata was considered the best one.

Table 2.1 — Assessing significance of five strata model compared to shorter models

Number of strata	Likelihood maximum	Likelihood ratio	p-level
5 strata	-141,5	-	-
4 strata	-144,3	5,688	0,017
3 strata	-387,9	492,82	0,000
2 strata	-709,3	1135,59	0,000

In the new model, the MSY benchmarks have significantly increased (Table 2.2). Boundary and target benchmarks of pink salmon spawners escapement are defined in such a way that for each of the strata the target benchmark of one stratum is at the same time the benchmark for the upper level stratum, and the precautionary target benchmark of the lower level stratum is the target for the higher one.

Table 2.2 — Revision of management benchmarks for strong and weak year class of pink salmon

NEW	Weak year			Strong year		
	S_{lim}	S_{MSY}	S^*_{MSY}	S_{lim}	S_{MSY}	S^*_{MSY}
Kikhchik-Mukhina	0,85	0,97	1,67	0,97	1,67	3,07
Bolshaya pool	1,68	1,91	3,29	1,91	3,29	6,06
Opala pool	1,11	1,26	2,18	1,26	2,18	4,01
OLD	S_{lim}	S_{MSY}	S^*_{MSY}	S_{lim}	S_{MSY}	S^*_{MSY}
Kikhchik-Mukhina	0,32	0,37	1,12	0,37	1,12	1,74
Bolshaya pool	0,68	0,80	2,40	0,80	2,40	3,74
Opala pool	0,45	0,53	1,58	0,53	1,58	2,47

For a maximum stratum a precautionary target benchmark is 25% larger than the target one. In our opinion, such an approach should be aimed at maximum population growth, which is one of the objectives of the modern fish management strategy. For example for pink salmon weak year class is inevitable (Feldman, Shevlyakov, 2015), but as seen by simulation modeling (Feldman et al., 2018) following fishing management strategies weak year class of pink salmon can be reduced in the future and numbers can level up. In other words, when forecasting weak year class odds (two lower strata) the task is to bring the stock to a more productive level in the next generation (mean stratum), and in the future to the maximum productive level. Accordingly, the number of fish between the target benchmark and its precautionary assessment (but no less than the existing boundary benchmark) should escape to the spawning grounds in case of weak year class. Naturally, the efficiency of fishing management directly depends on the quality of forecasting.

Methodological changes in assessing escapement target benchmarks mainly affected sockeye salmon in the Bolshaya river where their main stocks are concentrated. Firstly, it is associated with the stock in Nachikinskoye lake and its tributaries, where the program of aerial visual surveillance has been expanded since 2017 by aerial photography of UAVs. This method ensures adjustments in the number of sockeye salmon spawners, mainly due to repeated photography procedures being financially costly for frequent calculations during the long fish run. Based on the data obtained a model for estimating the spawning sockeye salmon stock in Nachikinskoye lake was developed and implemented. The estimation of the total number of spawned out salmon was carried out using a simulation model similar to the model estimates of the "area under the curve" from Hilborn (1999), Sparkman (2010).

A model for sockeye salmon survival in nests is represented by an inverse logistic l curve:

$$F_t = 1 - \frac{t^s}{S_t^s + t^s}$$

Where F_t is the proportion of living specimens per day, s is the slope parameter of the survival curve; St is the average life expectancy for sockeye in nests for fish that came up on day t.

Since the fish that came up later are more mature as a rule they have less time for spawning. Therefore, it can be assumed that fish lifespan in the spawning area is daily reduced by a certain amount Δ:

$$S_t+1 = S_t - \Delta,$$

Then $S_t = S_0 - t\Delta$, where S_0 – is the average lifespan of sockeye spawners in nests on the first day of spawning. The proportion of living specimens from any daily stock on any given day t will be equal to:

$$F_t = 1 - \frac{t^s}{(S_0 - t\Delta)^s + t^s}$$

For population of several sub-isolates (or sub-populations) with different numbers, places, and periods of spawning the spawning run will be extended in time, presumably according to distribution law, and then its parameters (mid run and its standard deviation) will determine the main trend of spawners refill in nests.

The number of spawners refill in the nests per day t, runs normally distributed over time taken into account, will be equal to:

$$R_t = a \cdot Z_t \cdot P_p(M, \sigma)$$

Where a is total return of sockeye in Nachikinskoye lake, excluding fishing and other mortality factors;

Zt is the parameter of total (natural and fishing) mortality

Pt (M, σ) is probability of spawning run normal distribution, M, σ is mean and standard deviations of spawning run normal distribution over the time.

The number of spawners on any day *t*, will be equal to the sum of the spawners in all daily refill stocks, mortality taken into account:

$$N_t = \sum_{t=0}^{n} R_t \cdot F_t ,$$

where F_t is the proportion of living specimens.

The total number of spawners *(N*) is equal to the sum of all daily spawning grounds refills:

$$N = \sum_{t=0}^{n} R_t$$

The objective - it is necessary to estimate the total number of sockeye spawners in Nachikinskoye lake, at the start of spawning - N, having estimates of spawners numbers (in nests) on certain days. Data obtained by using UAVs were used to estimate model parameters.

With objective function minimization (sum of squares of known spawners deviations in number on counting days from corresponding model values), the following parameters were estimated:

s is the survival curve slope parameter (standard deviation from the average life expectancy, days),

Δ is life expectancy change (days),

a is the total return number of Nachikinskoye sockeye, excluding fishing and other mortality factors (thousand specimens),

M, σ is mean and standard deviation of normal spawning time distribution

Parameter S0 is the average sockeye spawners lifespan in nests on the first day of spawning (set as 23 days).

The obtained simulation model with probabilistic values clearly reflects spawners number observed (Fig. 2.2).

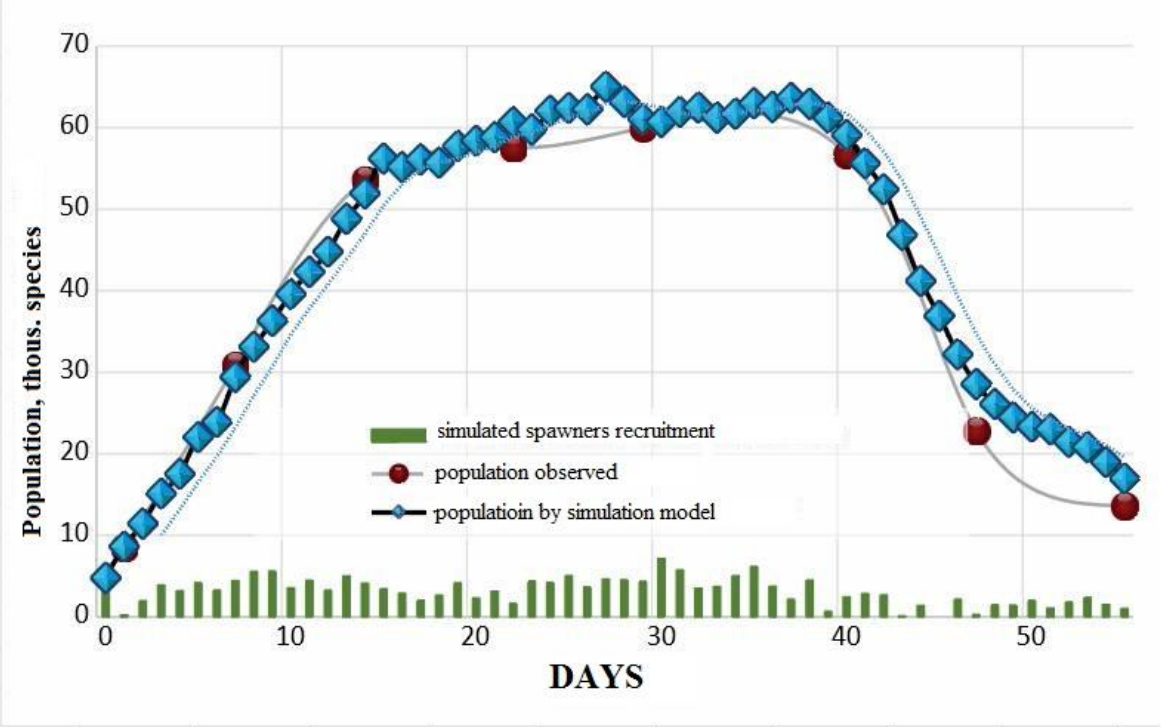

Figure 2.2 — One of the implementation cases of a simulation model on sockeye spawners number at spawning grounds with a starting life span of S_0 ≈ 23–24 days

Based on the obtained estimates of all parameters (including Zt), 1000 samples were generated. They give probabilistic estimate of all Nachikinskoye sockeye spawners number, which amounted to 140 thousand specimens, with a standard deviation of 6.5 thousand specimens. Consequently, the total estimate of the spawners number is in the range of 127–153 thousand specimens (α = 0.05). Clarification data on the number of sockeye salmon spawners in the basin of the Bolshaya river will clarify escapement target benchmarks in the future.

However, in general, escapement benchmarks in the rivers under consideration have not been changed (Table 2.3). Therefore, estimated optimal average escapement values for sustainable sockeye reproduction (S_{MSY}, thousand specimens) remain at the same level: the Kikhchik river - 8.7, the Mukhina river - 0.2, the Bolshaya river - 35.7, the Opala-Golygina - 31.2.

Table 2.3 — Sockeye escapement benchmarks in the rivers under consideration

Rivers	Sockeye salmon, thousand specimens		
	S_{lim}	S_{MSY}	S^*_{MSY}
Kikhchik	4	8,7	18,8
Mukhina	0,1	0,2	0,5
Bolshaya	16	35,7	77
Opala-Golygina	14	31,2	67,3

No changes were also made in the assessment of escapement benchmarks for chum and coho salmon in 2018 (Table 2.3). As seen from the presented data, optimal average escapement values for sustainable reproduction of these species (S_{MSY}, thousand specimens) correspond to: chum salmon - the Kikhchik river - 42.4, the Mukhina river - 2.9, the Bolshaya river - 67.7, the Opala-Golygina - 75.9; coho salmon - the Kikhchik river - 31.4, the Mukhina river - 1.9, the Bolshaya river - 38.6, the Opala-Golygina river - 57.7.

Table 2.3 — Escapement target benchmarks for chum and coho salmon

Rivers	Chum salmon, thousand specimens			Coho salmon, thousand specimens		
	S_{lim}	S_{MSY}	S^*_{MSY}	S_{lim}	S_{MSY}	S^*_{MSY}
Kikhchik	24,3	42,4	52,7	14,8	31,4	39,2
Mukhina	1,7	2,9	3,6	0,9	1,9	2,3
Bolshaya	38,7	67,7	84,1	14,5	30,9	38,6
Opala-Golygina	43,5	75,9	94,4	21,7	46,1	57,7

Section 3. Graphs for pink, chum, sockeye and coho salmon spawners escapement, compared to their target values for the last 15 years. Data for each species escapement in each river in 2018 (for certified rivers and fishing areas)

Pink salmon. Over the past 15 years, the total amount of pink salmon escapement to the Kihchik, Bolshaya, Opala and Khomutina rivers varied from 0.028 million specimens to 18.5 million specimens, averaging 4 million. The spawning stock of pink salmon during lean allied years is estimated at an average of 0.7 million specimens, ranging from 0.028 million to 2.770 million. Maximum escapement number was recorded in 2003 (1.682 million species) and 2005 (2.77 million species), subsequently, until 2015, the escapement level did not exceed 0.11 million specimens. In 2017 there was a trend in escalation of pink salmon number amounting to almost 0.8 million specimens.

Among the rivers under consideration the most productive is the Kikhchik river where escapement amount averaged about 0.5 million specimens. In the Bolshaya and Opala rivers the accounted number of spawners at the spawning grounds is relatively equivalent and is estimated at an average of 0.24 and 0.23 million specimens, respectively (Fig. 3.1).

The ratio of spawning population with target escapement benchmarks indicates depression in pink salmon population of an odd germ line. During the considered period, the number of spawners at the spawning grounds never reached the boundary escapement benchmark (Slim) defined for a cluster of rivers with 3.6 million specimens. It should be noted that the statistical value taken into account when defining target escapement benchmarks covers a greater number of rivers than those under certification. Accordingly, the actual optimum for the audit rivers is lower. In addition, estimation of pink salmon population during lean years was not as a rule carried out in full taking into consideration funding shortenings. Nevertheless, it is undeniable fact that there is a shortage of spawners in this line of reproduction in the

mentioned rivers, which optimal number should fall within the limits of the target escapement number from 4.1 million with SMSY up to 7.1 million specimens for S*MSY.

In the adjacent reproduction cycles of productive population the average escapement value amounted to not more than 8 million specimens of pink salmon within the range from 0.426 million to 18.7 million specimens. Total target escapement benchmarks calculated for productive population fall within the limits of 7.1 million specimens (SMSY) to 13.1 million specimens (S*MSY).

The maximum is registered in the Kikhchik river - 4 million specimens which corresponds to the top stratum of the target escapement value. In the Bolshaya and the Opala rivers the numbers are in relatively equal proportions of 2.8 million specimens and 2 million specimens respectively and are estimated as suboptimal values (Fig. 3.2).

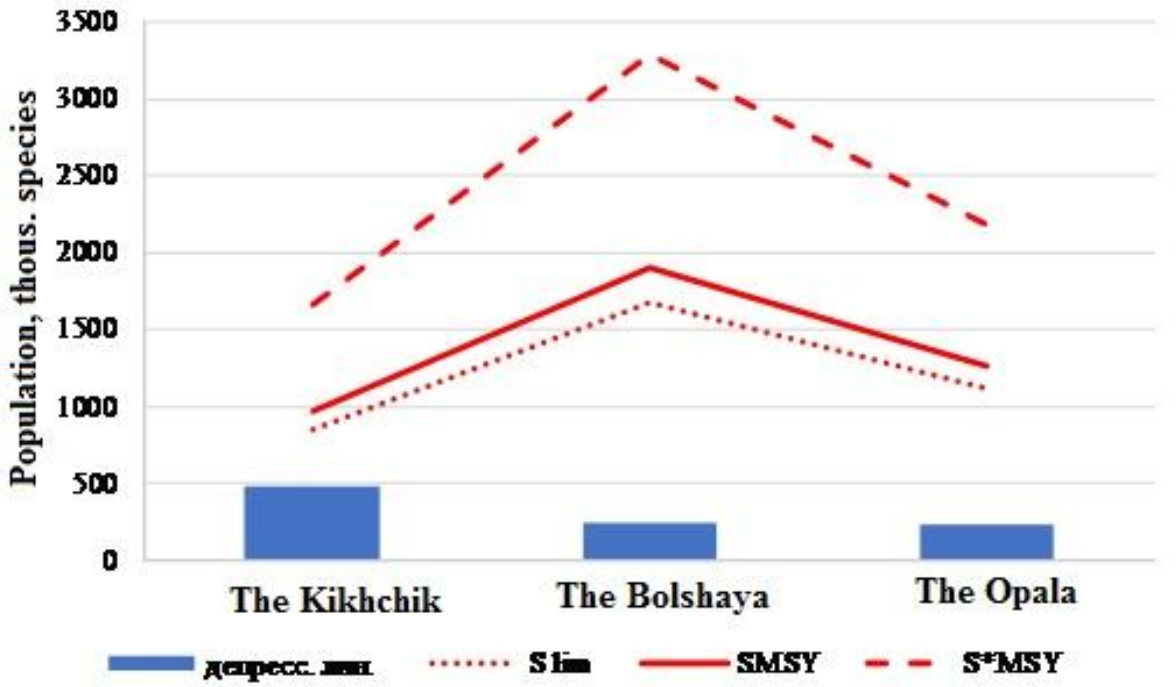

Figure 3.1 — The average spawners escapement value during allied years for an odd line in audit rivers during 2003–2017 and escapement targets calculated for them

Pink salmon population in 2016, returning in 2018, is considered to be superproductive. Pink salmon spawners escapement in Kamchatka west coast area took place at an extremely high level of 112 million specimens exceeding the value of 1983 when 111 million spawners were registered which subsequently led to a change in dominant pink salmon lines. In latitudinal direction, pink salmon run to the coast formed the maximum core in the river systems from the Kikhchik river to the Vorovskaya river. This area was the concentration of fishing power as well. To the south and north of the mentioned zone within the boundaries beginning from the Bolshaya river to the Icha river run intensity decreased dramatically. To the south of the

Bolshaya river the number of pink salmon in the rivers did not exceed 0.4 million specimens (Fig. 3.3).

The total escapement value in the audit rivers located in the laydown area which is well illustrated by figures 3.2 and 3.3 amounted to 28.5 million specimens. The maximum load for the spawning grounds is registered in the Kikhchik river, where the number of registered spawners amounted to about 22 million specimens. In the Bolshaya river the escapement took place in the amount of 6 million specimens, which corresponds to the escapement level for productive population. In the Opala river pink salmon number is estimated at the level of 0.352 thousand specimens.

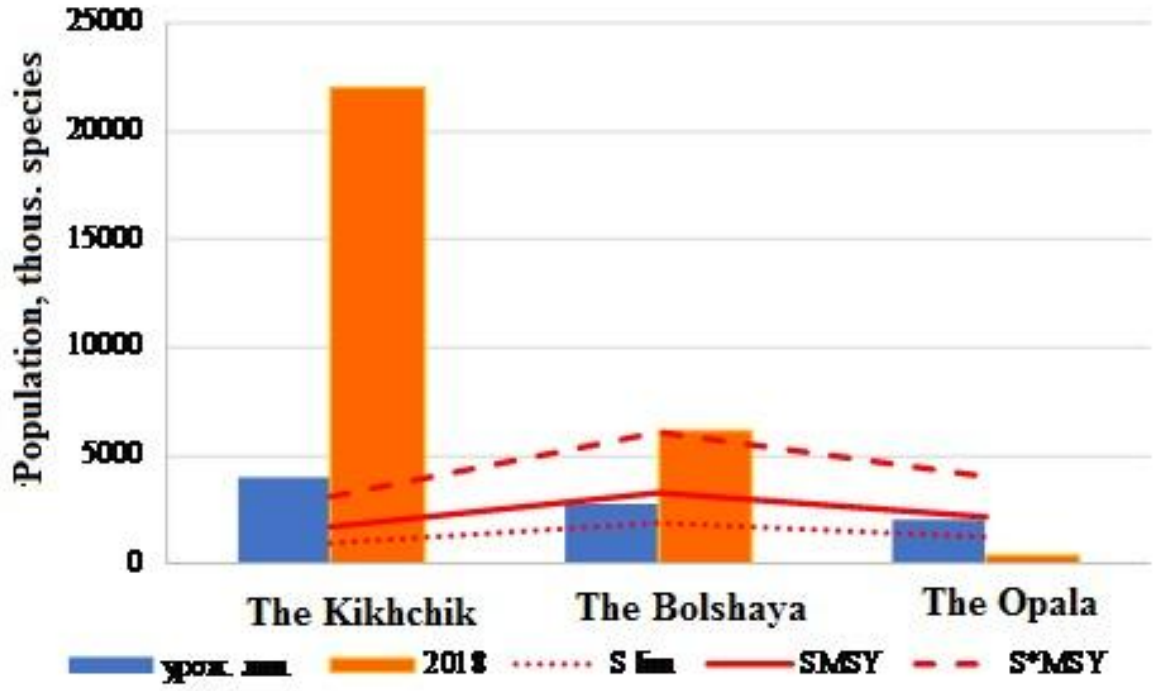

Figure 3.2 — The average spawners escapement value during allied years for strong year population in the audit rivers in 2003–2017, the actual pink salmon spawners escapement in 2018, and escapement targets calculated for them

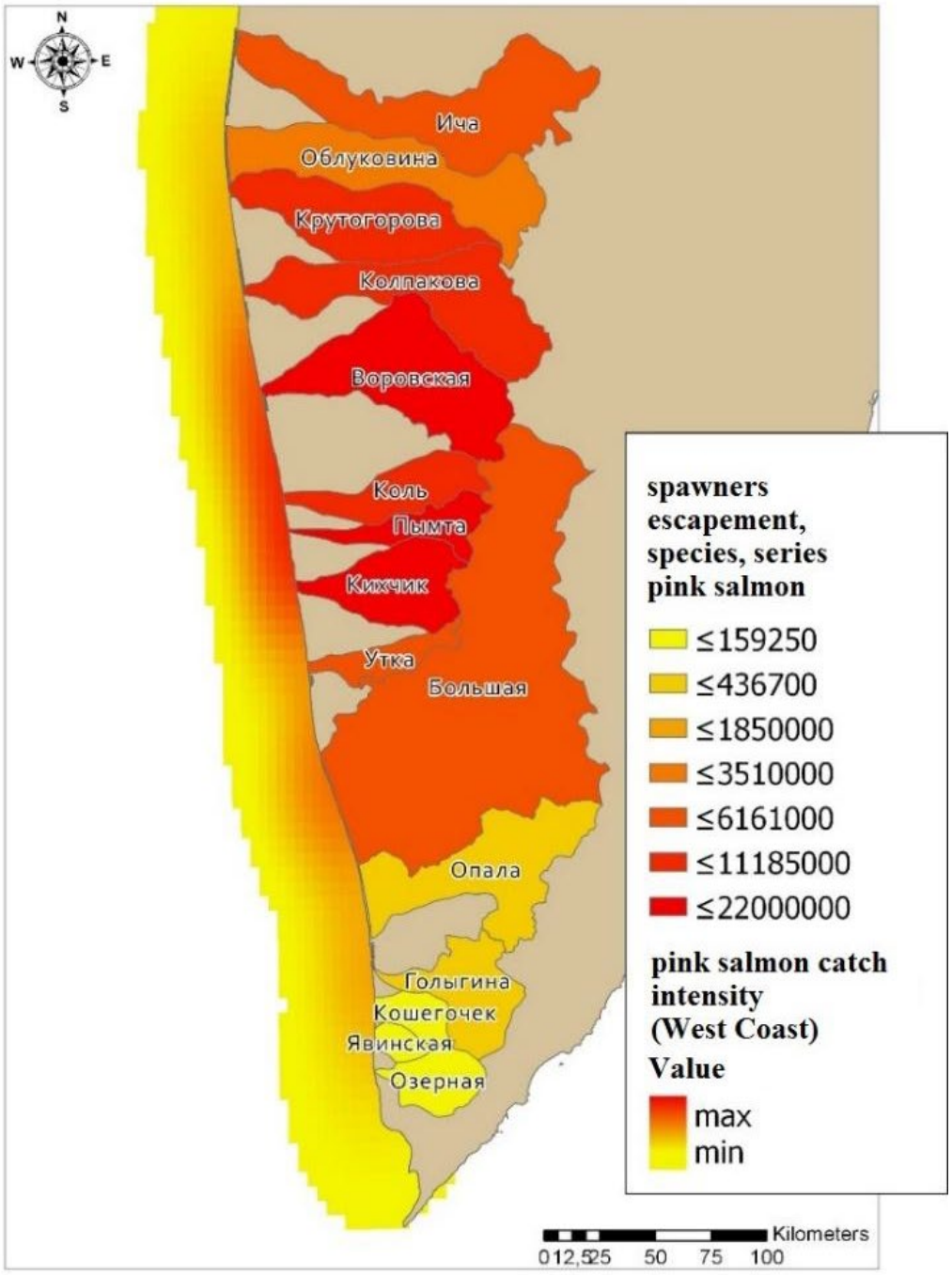

Figure 3.3 — Distribution of pink salmon spawners in the rivers of Kamchatka west coast areas and pink salmon fishing intensity in 2018

Chum salmon. The spawning population of chum salmon in the audit rivers varied from 27 thousand specimens to 270 thousand specimens. The average escapement value was registered as 154 thousand specimens. High chum spawners escapement values were recorded in 2005–2007 averaging 249 thousand specimens. Later, the number of chum salmon at the spawning grounds consistently decreased and in 2011 the minimum number of spawners was registered (27 thousand specimens). In 2012 and 2013 the run increased to an average of 133 thousand

specimens. During the period from 2014 to 2016, the chum spawners assessment took place fragmentarily and objectively does not reflect the actual chum escapement value. In 2017 chum salmon stock was estimated by two water basins – the Bolshaya and the Opala rivers totaling 114 thousand speciments.

Target escapement benchmarks fall within the limits from 108 thousand specimens corresponding to the boundary limit (Slim) to 235 thousand specimens corresponding to the upper stratum based on the precautionary approach (S*MSY). In this case the average long-term spawning population value for the period from 2003 to 2017 corresponds to suboptimal escapement values.

Among rivers under consideration the most productive is the Opala river basin where the average number of spawners was estimated at 87 thousand specimens which corresponds to the fishing strategy based on the precautionary approach for the Opal-Golygin cluster.

The average escapement value in the Bolshaya and the Kikhchik rivers is estimated at 42 thousand and 26 thousand specimens respectively characterizing boundary limit escapement (Slim).

In 2018 high number chum run was registered in the Opala and the Kikhchik rivers. In the Bolshaya river spawners run took place at the level of average values (Fig. 3.4).

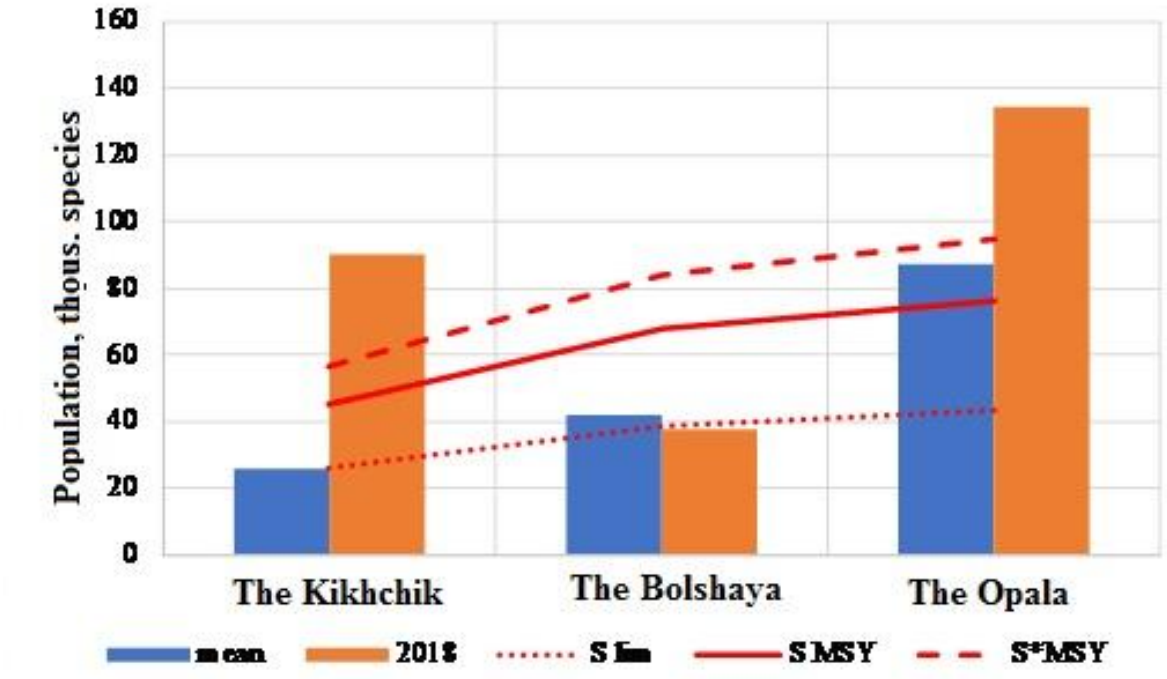

Figure 3.4 — The average spawners escapement value in the audit rivers during 2003-2017 and escapement targets calculated for them

Sockeye salmon. The total number of sockeye salmon spawners in 2003-2017 varied from 26 thousand to 189 thousand specimens averaging 84 thousand specimens. The maximum escapement values were registered in 2003, 2004, 2012 and 2017. During these years on

average 136 thousand specimens were spawning, approaching the number S*MSY defined as 163 thousand specimens. During other years the number of sockeye salmon at the spawning grounds corresponded on average to 61 thousand specimens, being slightly lower than the calculated optimum (75 thousand specimens).

When assessing sockeye salmon escapement value in a separate manner a certain spawners shortage was registered for the Opala river. However considering the fact that aerial surveillance is mainly focused on chum salmon (both types) and pink salmon populations the defined average number of sockeye at the level of the boundary limit Slim can actually indicate a higher spawning stock and entirely fit into the concept of Pacific salmon stocks management strategy based on providing the necessary value of spawners escapement.

The target benchmarks are calculated for the Opala-Golygin cluster of rivers, and estimating sockeye population in the Opala river a certain population value is enough to assess spawning grounds population in the river at the level of at least suboptimal values (Fig. 3.5).

Relatively high salmon spawning stock in the Bolshaya and the Kihchik rivers is assured. In both rivers spawners escapement value falls on average within the limits of two upper strata S_{MSY} and S^*_{MSY} (Fig. 3.5).

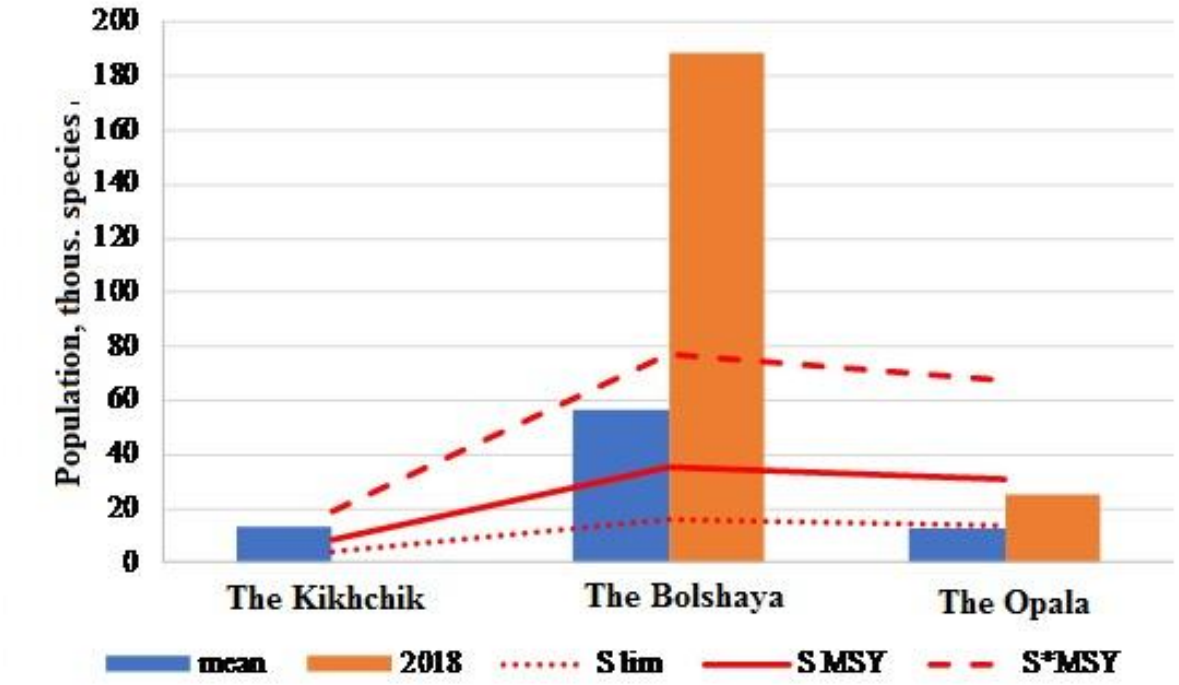

Figure 3.5 — The average spawners escapement value in the audit rivers during 2003-2017 and escapement targets calculated for them

In 2018 in the Bolshaya river sockeye salmon run is characterized as high-numbered averaging almost 190 thousand specimens, while the population basis was formed by limnophilic type of sockeye salmon in the Nachikinsky lake. In the Opala river sockeye salmon population is

estimated at 25 thousand specimens. Sockeye salmon population in the Kikhchik river could not be estimated due to extra high pink salmon run rate.

Coho salmon. Coho salmon spawning migrations are later than other Pacific salmon species. In addition, coho spawning course is greatly extended in time and can last until early winter. Coho salmon season types are also distinguished which is specific for most Pacific salmon species. All these factors can lead to certain difficulties in estimating the spawning part of species population. In addition, beginning with the second half of September it is the period of active cyclonic activity in Kamchatka Region influencing aerial surveillance work organization dramatically.

Effective accounting for salmon population can be carried out until snow falls - the first or second decade of October. After this period distinguishing fish in the water becomes extremely difficult which is caused by snow high reflective properties in contrast to which the river stream way seems dark and is not visible. Considering the above mentioned factors surveillance in the best case is only possible for estimating the escapement of the young spawners.

From 2003 to 2017 the total number of fish in the audit rivers averaged 69 thousand specimens. The minimum escapement value was recorded in 2013 when 13 thousand specimens were accounted, the maximum escapement value was recorded in 2014 (239 thousand specimens).

Target escapement benchmarks for the river basins under consideration are calculated ranging from 52 thousand specimens for the lower strata (Slim) and up to 139 thousand specimens for the maximum strata (S*MSY).

Spawners escapement value in the specified period for individual water basins is characterized at the level of boundary limits (Slim), but taking into consideration assessment uncertainties for the reasons mentioned above we believe that the population rate at the spawning grounds may easily reach the rate comparable to the level above the average stratum (SMSY) (Fig. 3.6).

In 2018 coho spawners dates of run to the rivers of the west coast area were shifted by two weeks. Mass course was not observed during the surveillance of the spawning grounds. Most likely, the spawning migration took place at a steady pace without clearly expressed mass migration period. However surveillance was finished on weather conditions in the second decade of October. Obviously, there was an underestimation of coho spawners population due to objective reasons.

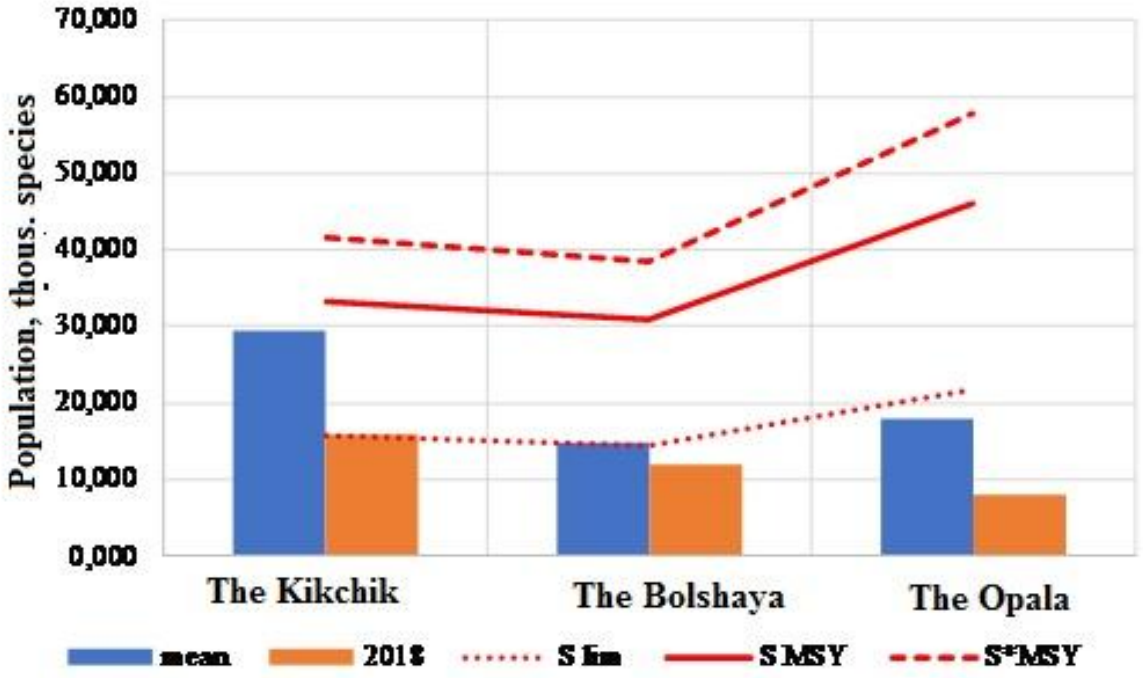

Figure 3.6 — The average spawners escapement value in the audit rivers during 2003-2017 and escapement targets calculated for them

Section 4. Catch data on each fishing company for each salmon species and each fishing area in 2018

This section contains information on Pacific salmon catch based on official fishing statistics data provided by the Northeast Territorial Administration (SVTU) of the Russian Fishery Agency for 2018.

In 2018 like previous years in the area of the Kikhchik, Mukhina, Bolshaya, and Opala rivers the main fishery was industrial and coastal. In 2018 its part was more than 98% of the total catch of Pacific salmon in these water basins.

Four species of Pacific salmon are caught by industrial and coastal fisheries: pink salmon, chum salmon, sockeye salmon, coho salmon (Table 4.1). In 2018 the main object of fishing was pink salmon both on river and sea fishing grounds.

Table 4.1 —Pacific salmon catch by industrial and coastal fisheries in the region of the Kikhchik, the Mukhina, the Bolshaya and the Opala rivers by all companies in 2018

Fishing company	Fishing ground №	Fishing ground	Catch, tons			
			Pink salmon	Chum salmon	Sockeye salmon	Coho salmon

"Bolsheretsk", LLC	102	The Sea of Okhotsk	2 456,33	53,29	0,36	0,00
	104	The Sea of Okhotsk	2 859,87	43,82	0,76	0,25
	105	The Sea of Okhotsk	2 939,59	31,21	0,31	0,00
	106	The Sea of Okhotsk	3 401,42	36,18	0,22	1,00
	107	The Sea of Okhotsk	2 399,66	34,58	0,18	0,12
	702	The Kikhchik river	747,87	13,64	0,00	0,00
	703	The Kikhchik river	772,06	35,98	0,00	1,87
	727	The Bolshaya river	2 013,61	125,68	358,49	86,00
JC "Fish canner "Komandor"	103	The Sea of Okhotsk	2 762,71	19,36	0,82	0,00
	110	The Sea of Okhotsk	2 508,16	12,71	0,40	0,00
	112	The Sea of Okhotsk	1 901,13	8,29	0,40	0,00
	152	The Sea of Okhotsk	1 514,84	34,01	5,40	0,00
	157	The Sea of Okhotsk	2 034,87	64,77	10,20	3,95
	164	The Sea of Okhotsk	1 521,43	84,09	16,29	6,00
	711	The Bolshaya river	1 774,71	261,82	63,12	39,36
	716	The Bolshaya river, Churikova island	963,76	71,28	31,21	44,65
	723	The Bolshaya river	436,69	26,98	12,51	31,65
"Loyd-Fish", LLC	108	The Sea of Okhotsk	3 320,46	38,49	26,13	0,00
	150	The Sea of Okhotsk	4 640,74	86,78	96,29	17,00
	160	The Sea of Okhotsk	3 550,62	132,89	91,84	26,14
	713	The Bolshaya river	2 005,85	104,65	44,40	119,14
Artel “Narody Severa”, LLC	109	The Sea of Okhotsk	2 655,45	27,80	0,47	0,00
	111	The Sea of Okhotsk	2 539,26	18,03	0,05	0,00
	156	The Sea of Okhotsk	2 140,00	144,74	0,00	0,00
	159	The Sea of Okhotsk	2 421,34	145,57	0,00	0,00
	162	The Sea of Okhotsk	2 008,72	138,55	0,00	0,00
	704	The Kikhchik river	532,37	8,29	0,47	0,00
	718	The Bolshaya river	976,19	114,07	204,02	42,99
	719	The Bolshaya river	976,73	83,64	203,30	42,91
	734	The Tolmachevo lake	0,00	0,00	1,00	0,00
"Zapadnoyie-M", LLC	1075	The Sea of Okhotsk	766,20	198,80	70,25	67,15
Zyuid Co. Ltd	151	The Sea of Okhotsk	1 757,56	65,99	37,88	0,00
	710	The Bolshaya river	4 649,09	327,74	179,34	151,75
	1084	The Bolshaya river	996,52	71,38	40,21	27,34
Collective fishery "Brig", LLC	154	The Sea of Okhotsk	563,80	69,70	62,15	39,07
"Dary Kamchatki", LLC	155	The Sea of Okhotsk	1 059,53	191,81	65,74	126,80

“Oktyabrsky rybokombinat” LLC	163	The Sea of Okhotsk	855,04	64,63	40,98	0,00
	712	The Bolshaya river	1 598,35	120,85	61,96	88,46
	717	The Bolshaya river, fishing ground «Zuikovskiy uval»	480,15	50,98	13,66	15,99
	1080	The Sea of Okhotsk	198,82	50,00	31,32	20,00
Fishing company "SKOP", LLC	724	The Bolshaya river	1 537,45	123,85	29,99	109,97
	732	The Bolshaya river, fishing ground «Shestaya»	736,73	87,66	29,90	62,39
"ORK-2", LLC	720	The Bolshaya river	517,96	66,35	34,74	73,29
"Rybkholkam", LLC	165	The Sea of Okhotsk	118,85	12,15	0,40	1,60
	166	The Sea of Okhotsk	192,40	3,98	0,55	7,15
	167	The Sea of Okhotsk	446,60	81,60	87,50	0,00
	168	The Sea of Okhotsk	7,00	3,00	1,00	0,00
	169	The Sea of Okhotsk	405,30	70,00	66,30	16,00
“Oktyabrsky rybokombinat” LLC	170	The Sea of Okhotsk	698,20	58,03	41,44	0,00
	171	The Sea of Okhotsk	778,62	54,10	64,80	0,00
Fishing company "KamNORiS", LLC	172	The Sea of Okhotsk	1 455,39	84,00	110,25	0,00
"Bolsheretsk", LLC	173	The Sea of Okhotsk	962,00	69,72	0,00	0,00
	182	The Sea of Okhotsk	1 062,00	193,67	0,00	0,00
	738	The Opala river	1 731,23	103,13	0,00	82,82
"Loyd-Fish", LLC	174	The Sea of Okhotsk	1 462,17	95,86	179,28	0,00
	183	The Sea of Okhotsk	1 098,63	270,58	193,31	2,00
	186	The Sea of Okhotsk	1 202,81	347,54	395,72	15,28
	739	The Opala river	630,20	228,90	6,25	61,60
Fishing company "Kolkhoz Krasniy truzhenik"	175	The Sea of Okhotsk	543,14	28,23	32,07	0,00
Artel “Narody Severa”, LLC	176	The Sea of Okhotsk	1 071,00	36,27	0,00	0,00
	185	The Sea of Okhotsk	863,49	181,72	0,00	0,00
"Delta", LLC	177	The Sea of Okhotsk	1 087,45	68,00	48,42	0,00
	178	The Sea of Okhotsk	1 077,11	103,73	58,92	0,00
	179	The Sea of Okhotsk	1 068,27	103,61	62,71	0,00
	180	The Sea of Okhotsk	887,25	67,74	47,07	0,00
	181	The Sea of Okhotsk	892,95	69,00	68,52	0,00
	184	The Sea of Okhotsk	125,00	3,00	25,00	0,00

	740	The Opala river	499,59	98,93	28,26	0,00
JC "Ozernovskiy RKZ № 55"	187	The Sea of Okhotsk	442,92	25,94	124,20	0,00
	188	The Sea of Okhotsk	475,22	30,74	110,67	0,00
"Zyuid", LLC	1081	The Sea of Okhotsk	36,74	3,12	5,98	0,00
	1083	The Opala river	442,98	231,92	17,34	42,25

In 2018 like previous years Pacific salmon was caught in this area by four fishery types: industrial - fishing companies; traditional - communities, clans and representatives of Small Indigenous Peoples of the North, Siberia, and the Far East (KMNS); sport and amateur - individuals in licensed areas; fish rearing - salmon fish farms (LRZ).

Sport and amateur fishing. Table 4.2 presents data on Pacific salmon catch by this type of fishery.

Table 4.2 — Pacific salmon catch by sport and amateur fishing, tons

Basins	Pink salmon	Chum salmon	Sockeye salmon	Coho salmon	Chinook salmon	Masu salmon
The Kikhchik river basin (river areas)					1,50	
The Bolshaya river basin (river areas)	80,99	10,88	8,20	23,20	7,91	1,18
The Opala river basin (river areas)	3,05	4,98	2,00	5,92	2,09	
The Sea of Okhotsk (sea areas)	9,22	8,11	1,61	5,01		

From basins under consideration this type of fishery is mostly developed in the basin and estuary area of the Bolshaya river.

Traditional fishing. From basins under consideration this type of fishery was carried out only in the Bolshaya river (Table. 4.3).

Table 4.3 — Pacific salmon catch by representatives of Small Indigenous Peoples of the North (KMNS), tons

Basins	Pink salmon	Chun salmon	Sockeye salmon	Coho salmon
The Bolshaya river basin (river areas)	202,09	22,18	15,76	36,47
The Sea of Okhotsk (sea areas)	1331,12	128,78	89,17	180,08

Fish rearing. This type of fishery is carried out only in the basin of the Bolshaya river where there are 2 salmon fish farms (LRZ) - "Malkinskiy" and "Ozerki". The catch of sockeye salmon, chum salmon and chinook salmon is carried out annually as part of the state program for fish rearing and with the purpose of Pacific salmon stock preservation in the basin of the Bolshaya river (tributaries of the Plotnikova, the Bystraya and the Klyuchevka rivers). 31.8 tons of sockeye salmon, 5.1 tons of chum salmon, and 3.3 tons of chinook were caught in 2018.

Industrial fishing. This is the main type of fishery in the Kikhchik, Bolshaya, and Opala rivers. Figure 4.1 indicates that the main part of the catch (46.4%) falls on the sea and river areas belonging to the Bolshaya river. The Kikhchik river part averages 29.4%, the Opala river part averages 24.2%.

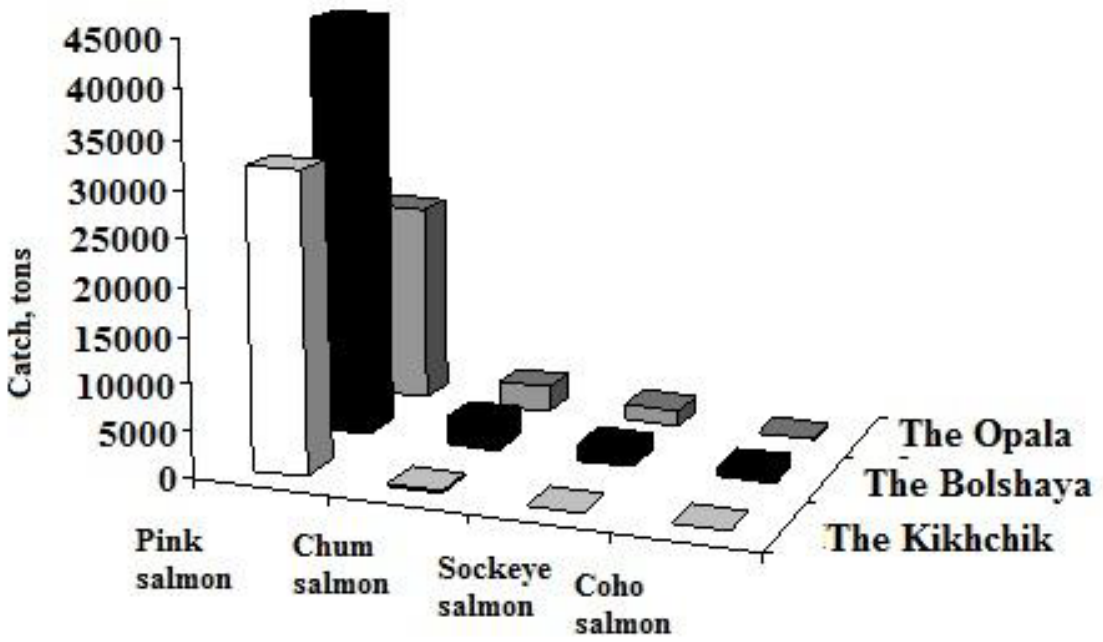

Figure 4.1 — Pacific salmon industrial and coastal catch on river and sea areas of the Kihchik, the Bolshaya, and the Opala rivers in 2018

In 2018 the part of pink salmon averaged 89.7% of the total Pacific salmon catch in this region, chum salmon part averaged 5.7%, sockeye salmon part averaged 3.3% and coho salmon part averaged 1.3%.

Most part of Pacific salmon (72.8%) was caught at sea fishing grounds (Figure 4.2). Only coho salmon was caught 3 times the amount in river areas than at sea fishing grounds.

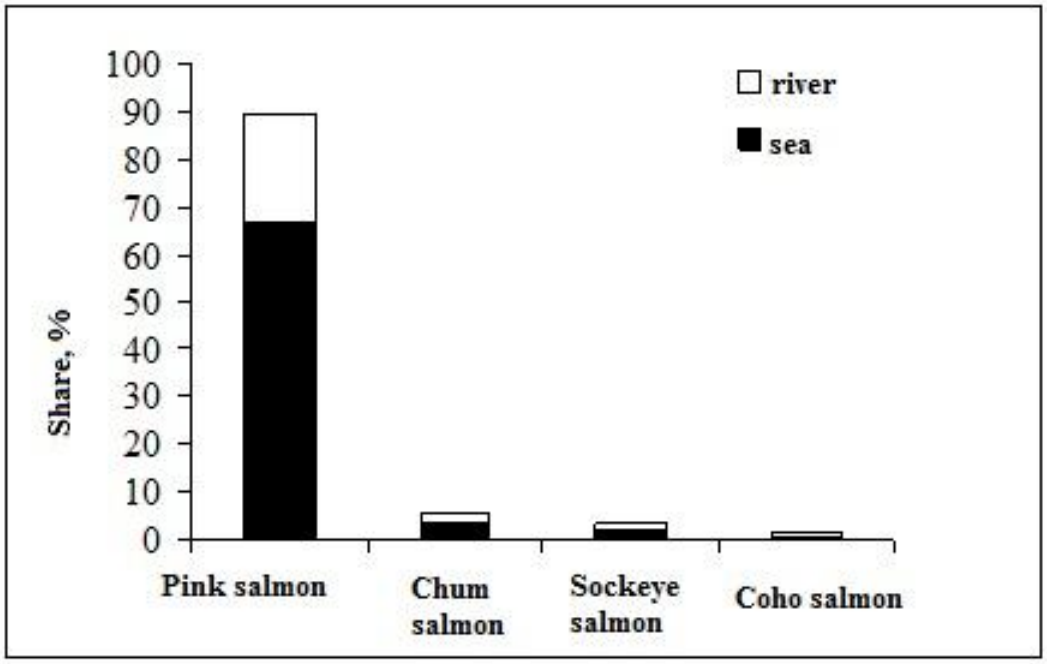

Figure 4.2 — The part of Pacific salmon catch at sea and river fishing grounds in the region of the Kikhchik, the Bolshaya, and the Opala rivers in 2018

Section 5. An annual report documenting justifications for actions taken in fisheries management adopted during the previous fishing season in 2018, directly affecting certified fisheries (rivers /areas). Opening dates for the fishing season, initial migration days, changes on migration days, closing dates for the fishing season are set during the meetings of Commission on anadromous species of fish. In addition to the Minutes of such meetings the report will provide justification for such actions, for example, forecasts of salmon run before early season, information on catch / escapement during the season. The information based on predicted run can be used to establish or change escapement days

The target species of salmon fishing in Kamchatka west coast area are pink salmon of even reproduction line, chum salmon, late sockeye salmon, and during recent years coho salmon. Chinook salmon is caught in limited amount in frames of sport and amateur and research fishing. There is a ban kept for the catch of young Bolsheretskaya sockeye salmon. In most cases sockeye salmon (late type, in particular) form significant stock in riverine areas. Sockeye fishing is associated with such areas and neighboring coastal areas and spawners escapement is monitored locally at the spawning grounds - in lakes Kurilskoye, Nachikinskoe, Palanskoe. Among significant target species, only chum and coho salmon are abundant along coastal rivers, gradually being reduced in number to the north direction.

Chum salmon and coho salmon escapement is considered to be a criterion for rational fishing and in accordance with the available spawning grounds should be provided at the level of about

1.0–1.2 million species for chum salmon and about 300–350 thousand species for coho salmon. Such escapement value provides extended reproduction and contributes to minimization of risks concerning population decrease caused by random factors (forecast materials for 2018). Meanwhile, against the historical background with stocks escalation of these species during recent years the escapement value is reduced both in relative (part of the total run) and in absolute values which is undoubtedly associated with todays fishery efficiency and raw processing. Despite continuous funding reduction in aerial surveillance data on benchmark water basins is still relevant for objective assessment of spawning capacity not only directly in these basins but also in reproduction areas in general.

In circumstances of existing continuous anthropopression on salmon stocks in the sea coast there is highly rarefied run to river estuaries that (taking into account frequency and duration of migration days in the rivers) cannot even provide minimal occupation of spawning grounds. Under the conditions of limiting salmon spawning by the area of spawning grounds the basis for rational salmon fishery is to ensure sufficient spawners escapement to the spawning grounds and to take the remaining amount by fishing. Moreover, occupation of spawning grounds cannot take place during one run stage but should be carried out in the course of the whole run ensuring that all epigenetic groups of spawners constituting their intraspecific diversity escape to the spawning grounds. As salmon move toward spawning grounds they successively run through sea coastal areas, river estuaries, and only after that they reach the destination. Therefore escapement should be ensured by successive fixed restrictions on fishing first in the sea coastal areas and then on river fishing grounds. Such a tool is migration days – periods of escapement for spawners of anadromous fish species in water basins or their parts set for performance of stated types of fishery.

These days from all local spawning areas (specific basins or groups of water bodies) there can be distinguished two types of spawning areas: 1) conditionally favorable (satisfactory) considering spawners occupation in spawning grounds and reproduction levels and 2) others experiencing increased fishing effects and requiring additional measures on spawners escapement as well as enhanced fishing control. Contrasted with in general satisfactory population level in most Kamchatka West rivers the latter type can be attributed to the Bolshaya river. It is recommended to introduce additional measures increasing the number of migration days for fishing efficiency.

If river fishing ground (part of the river occupied by fishing grounds, as a rule, the lower part of the river including the estuary) is stretched and fish cannot run it within one day this fishing area should be divided into two parts. Therefore the length of the estuarine (up to 25–30 km) and partly neighboring zone of fresh water (~ 5–10 km) of the Bolshaya river where most industrial fishing areas are concentrated determined the need for introducing original management techniques aimed at ensuring spawners escapement. Step-by-step system provides introduction of 3 migration days a week for the lower part of the stated ground (from the estuary to the fishing ground No. 721) and 3 successive migration days a week for the upper part of the fishing ground (the fishing ground No 723 and upstream). Furthermore, the second migration day of the first ground and the first day of the second ground clash resulting in spawners spatial “support” as they move through the most “dangerous” parts of the river.

Fishing management in relation to anticipated salmon run rates in 2018

The forecast of recommended catch volumes of Pacific salmon in Kamchatka West fishing areas for 2018 is presented in Table 5.1. The concept for regional level fishing management was based on these data.

Table 5.1 — Forecast of recommended Pacific salmon catch volumes in Kamchatka West fishing areas for 2018

Fishing area	Total	Species					
		Pink salmon	Chum salmon	Sockeye salmon	Coho salmon	Masu salmon	Chinook salmon
West Kamchatka	**188 058**	**152 500**	**11 051**	**21 099**	**3 367**	**8**	**33**
Kamchatka Western subzone	85 237	76 250	5 330	1 624	2 020	3	10
Kamchatka Kurilskaya subzone	102 821	76 250	5 721	19 475	1 347	5	23

On Kamchatka west coast historically high pink salmon run rates were expected during 2018 fishing season. Accordingly, fishing management was carried out by the “pink” type considering this species high population. It was expected that the focus in fishery would be directed to installation of the largest number of stationary nets as well as engaging the largest amount of raw ship processing. Stocks of other salmon species synchronic in fishery (late sockeye salmon, chum salmon) recorded the same level. Experience has shown that with pink salmon high run rates synchronic species are far less affected by fishing pression compared to the years with pink salmon weak year class run. It can be explained by the fact that catching and to a greater extent processing capacities during the spawning period of pink salmon strong year class (depending on its transience) are able to take and process up to 50–100 million species equal to 50% of total run rate. Accordingly, synchronic species being distributed in pink salmon aggregations will be caught at the same rate unlike during pink salmon weak years when the focus of the fishery is shifted to them and catch intensity reaches and exceeds 70%.

In general, taking into account the ratio of fishing capacity it was assumed that Pacific salmon spawners escapement rate to the rivers of Kamchatka west coast during pink salmon run period would be objectively higher than long-term annual average. When it comes to pink salmon spawners considering anticipated run rates – it is inevitably, speaking about river sockeye and

chum salmon – it is due to synchronic fishing with the pink salmon. Keeping escapement rates of pink salmon spawners within the boundaries of 100 million species has become a strategic task aimed at maintaining high level of fishing during even years. Consequently, it was considered unpractical to interrupt fishing process with aims of salmon spawners escapement during the period of pink salmon mass run to the coast. Before and after pink salmon run period migration regulations for chum salmon, sockeye salmon and coho salmon escapement was planned to be carried out by association with previous years.

As specific practical measures for establishment and cancellation of migration days in the Bolshaya, Opala and Kikhchik rivers we provide key dates and actions taken by Commission for strategic catch management on anadromous fish species in Kamchatka Region in 2018 (Table 5.1).

Table 5.1 — Actions taken by Commission for strategic catch management on anadromous fish species in Kamchatka Region in 2018 fishing season

Minutes № and date	**Actions**	**The Bolshaya river**	**The Opala river**	**The Kikhchik river**
05/25/2018 №5	Establish migration days			
	Rivers	— aquatic area of the Bolshaya river from its estuary to the fishing ground № 721 (included) – Establish migration days **Monday, Tuesday, Wednesday** weekly; — aquatic area of the Bolshaya river from the fishing ground №723 (included) and upstream including tributaries, Establish migration days – **Tuesday, Wednesday, Thursday** weekly	From catch commencement till July, 25 and since September, 3 Establish migration days — **Monday, Tuesday** weekly	From catch commencement till July, 25 and since September, 3 Establish migration days— **Monday, Tuesday** weekly
	Offshore	From catch	From catch	From catch

		commencement till July, 25 and since September, 3 Establish migration days — **Monday, Tuesday** weekly	commencement till July, 25 and since September, 3 Establish migration days — **Monday, Tuesday** weekly	commencement till July, 25 and since September, 3 Establish migration days— **Monday, Tuesday** weekly
06/25/2018 №8	Establish commencement time frames for industrial, coastal, sport and amateur, and traditional fisheries with netting and seine gears for Pacific salmon and trout:			
	Rivers	Since July, 11	Since July, 11	Since July, 11
	Offshore	Since July, 11	Since July, 11	Since July, 11
	Introduce an additional migration day in order to ensure the most favorable schedule for spawners escapement of young chum salmon to the basin of the Opala river.		Offshore fishing grounds №№ 165-188— July, 18.	
07.08/30/2018 №18	Cancel previously established migration days in rivers and lakes of Ust-Bolsheretskiy area			
08/09/2018 №22	Establish 2 migration days to the Opala river		August, 11, 12	
08/22/2018 №25	Establish migration days for the period since August, 27		Monday, Tuesday weekly	
		— aquatic area of the Bolshaya river from its estuary to the fishing ground № 721 (included)		

		Establish migration days – **Monday, Tuesday** weekly; — aquatic area of the Bolshaya river from the fishing ground №723 (included) and upstream including tributaries Establish migration days – **Tuesday, Wednesday** weekly		
09/03/2018 №27	Cancel previously established migration days in offshore fishing grounds of Kamchatka-Kurilskaya subzone from 5 p.m. September, 3	September, 3 and 4	September, 3,4	September, 3,4
09/06/2018 №28	Establish migration days in the Opala river		From midnight September, 12 till midnight September, 15	
09/11/2018 №29	Cancel previously established migration days in the Opala river		From midnight September, 12 till midnight September, 15	
09/21/2016 № 31	Establish prohibition time frames for industrial, coastal and traditional	From midnight September, 24	From midnight September, 24	From midnight, October, 08

	fisheries (communities and individuals) towards Pacific salmon and trout			

Conclusion

Resulting out of work completed analysis has been carried out on stocks state and Pacific salmon fishing management (pink, chum, sockeye, coho salmon) in the basins of some rivers (the Bolshaya, Kikhchik, Opala, Mukhina rivers) and neighboring offshore of Kamchatka West Coast in 2018. The research has been performed as part of the scientific support for fishery audit of "Rybolovetskaya artel "Narody Severa", LLC by standards of the Marine Stewardship Council (MSC)

It is seen that spawners escapement of Pacific salmon mass species (pink, chum, sockeye salmon) in water basins being used for industrial fishing purposes by "Rybolovetskaya artel "Narody Severa", LLC for the last 15 years is showing a considerable stocks growth. In most cases escapement rates are close to or exceed the average targets. In general, the above mentioned fact has a positive effect on Pacific salmon regional stocks. For coho salmon escapement issue remains uncertain since regular aerial surveillance is not carried out.

We can say that the set of measures applied for fishing management of "Rybolovetskaya artel "Narody Severa", LLC indicates clear balance between fishing and spawners escapement. However, a deeper monitoring is needed for some salmon stocks species in the observed the water basins.

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2. II. Agreements regarding 2019 Aerial Surveys

Translated to English from the original letter in Russian

April 2, 2019

From: KamchatNIRO
To: G.V. Polukarov, General Director, LLC Co Narody Severa
Re: On the Planning of Aerosurveying Research of Pacific Salmon Spawning Grounds

Dear Grigory Vasilievich!

In connection with the planning of the Kamchatka branch of the FSUE “VNIRO” (“KamchatNIRO”) (hereinafter - KamchatNIRO) for conducting aerial survey work on the spawning grounds of Pacific salmon in the most commercial basins of the Kamchatka Krai) we are offering to the companies, participating in MSC certification to apply for the implementation of these works in 2019 for individual units of stocks within the boundaries of the water bodies under such certification. Work will be carried out both for the general assessment of the spawning stock status of Pacific salmon in the Kamchatka Krai, and as part of the scientific support of the fishery certification units.

Applications are necessary for their subsequent inclusion in the Aerial Monitoring Program of Water Basins of the Kamchatka Krai in 2019 (hereinafter referred to as the Program). Considering the systemic lack of funding for aerial surveys, only reference water bodies can be included in the Program for 2019, according to the developed methodology of KamchatNIRO. Taking into account the significant number of fisheries that are certification units, the absence of applications from enterprises in the Program can lead to a lack of information on Pacific salmon stocks in selected water basins, where companies are undergoing annual MSC auditing.

Acting head of the branch A.I. Warkentin

Bugaev Alexander Viktorovich
Deputy Director for Research, Dr. Sc.
8- 914-993-96-78
bugaev.a.v@kamniro.ru

«Рыболовецкая артель «Народы Севера»

Общество с ограниченной ответственностью

Юридический адрес: 684102, Россия, Камчатский край, Усть-Большерецкий район, п. Октябрьский, ул. Советская, 1
Почтовый адрес: 683024, Россия, г. Петропавловск-Камчатский, проспект Рыбаков, 4, 1-й этаж
тел.: (4152) 26-67-79, факс: (415-2) 26-88-11 E-mail: narsevera@yandex.ru
ОГРН 1074141001901 ИНН 4108006887, КПП 410801001
р/сч. 40702810007050000037 в ФОАО «Дальневосточный банк» «Сахалинский», г. Южно-Сахалинск,
БИК 046401745 к/сч. 30101810900000000745

Исх. №
От «08» апреля 2019 г.

ВРИО Директора Камчатский филиал ФГБНУ «ВНИРО» («КамчатНИРО»)
Варкентину А.И.

Уважаемый Александр Иванович!

ООО Артель «Народы Севера» задействовано в программе сертификации промысла по стандартам Морского попечительского совета (MSC).

На основании Вашего письма № 01-03/854 от 02 апреля 2019 года, просим включить в программу авиамониторнига водных объектов Камчатского края в 2019 году следующие бассейны рек: Большая, Кихчик, Опала, Мухина по видам горбуша, кета, нерка, кижуч.

Artel LLC “Peoples of the North” is involved in the certification program for fishing according to the standards of the Marine Stewardship Council (MSC).

Based on your letter No. 01-03 / 854 dated April 2, 2019, please include the following river basins in the program for air monitoring of water objects in the Kamchatka Territory in 2019: Bolshaya, Kikhchik, Opala, Mukhina by types of pink salmon, chum salmon, sockeye salmon, coho salmon.

С Уважением,

Генеральный директор
ООО Артель «Народы Севера» **А.В. Матвеенко**

Исполнитель: Андрей Морозов
тел.: 8-909-835-1210, (4152) 266-827
e-mail: kamfish41@yandex.ru

3. III. Reports of Anti-Poaching Activities – July 2018 Examples[1]

Post
A group of poachers was detained at the mouth of the Bolshoi A joint group of SVTU FAR and inspectors of the Bolshoi River Association detained poachers who hunted Pacific salmon long before the official start of Putin at the mouth of the Bolshoi River. Lovers of illicit profit caught fish from the shore with a float net. Before the approach of the inspection team, they managed to catch 18 individuals of sockeye salmon, 5 - chinook salmon and 19 - char. Fish and nets were seized and transferred for safekeeping. An administrative violation protocol has been drawn up, the materials will be handed over to the police to resolve the issue of initiating a criminal case. In just a week, 138 raids, 606 hours on water, 132 inspections were carried out by joint teams of SVTU FAR and inspectors of the Bolshaya River Association. Compiled 6 protocols on administrative offenses. 5 nets, 3 boats and 80 kilograms of fish were seized from violators.
More than a kilometer of poaching networks seized in the west of Kamchatka Employees of the Yelizovsky department of the Border Directorate of the FSB of Russia for the eastern Arctic region, together with public inspectors of the Association "River Bolshaya" carried out a raid along the west coast of the Sea of Okhotsk in the estuary zone of the Bolshoi River. During the raid, inspection teams removed more than 1 kilometer of the networks exposed by poachers. Salmon caught in the net are released into the natural habitat, fishing gear transferred for safekeeping. Administrative proceedings are ongoing.
Salmon began to enter rivers in the west of Kamchatka Pacific salmon began to enter rivers in the Ust-Bolsheretsky region in western Kamchatka. In addition to chinook salmon, chum salmon, pink salmon and summer sockeye salmon appear in the rivers of the Bolshoi basin. However, there are no significant approaches yet. Poachers are not particularly active either - they save energy and wait for the fish to go into the spawning massively. Since early July, joint inspector teams of the Federal Higher Fisheries Agency of the Federal Agency for Fishery and the Bolshoi River Association carried out 205 raids, 850 hours on the water. 228 inspections were carried out, 4 protocols on administrative offenses were compiled. 4 nets, 1 boat and 30 kg of fish were seized.
Almost a centner of caviar was detained in western Kamchatka while trying to export from the fishing area A joint group of police officers and inspectors from SVTU FAR and the Bolshaya Reka Association detained nearly a centner of salmon caviar while trying to export from fishing areas. A car moving towards Petropavlovsk-Kamchatsky was stopped for inspection in the area of the village of Sokoch in the Elizo district. In the car, an inspection team found cubotainers with

[1] Publicized in online, print and radio media.

salted salmon caviar weighing more than 75 kilograms. The driver could not provide documents for the right to produce and transport expensive delicacy.

Caviar seized and transferred to custody. Administrative proceedings are ongoing.

Three poachers detained on the Bystroi river

Two groups of poachers were detained by the joint groups of the North-West Federal Agency for Fishery and the Bolshaya River Association on the Bystroy River over the weekend.

Both poaching vessels were found in the area of the village of Kavalersky. In the first case, before the inspectors arrived, a local resident managed to illegally obtain 5 individuals of salmon: chinook salmon, sockeye salmon and sim. A day later, in the same area, when inspecting a boat with two fishermen, the inspectors found an illegally caught sockeye salmon and chinook salmon.

Another poacher was detained on the Plotnikova River near the village of Apache. In the car, a man was transporting illegal fishing gear and 5 copies of Pacific salmon without permission for the right to prey and transport.

The boats Obyanka, Kazanka, motor, nets and illegal catch were seized and transferred for safekeeping. Administrative protocols were drawn up for four violators under Part 2 of Article 8.37 of the Code of Administrative Offenses (Violation of the rules governing fishing).

Passing Days do not stop poachers from fishing for salmon

Joint groups of the North-West Federal Agency for Fisheries and the Bolshaya River Association on the Bystroi River on the “passing day” detained another lover to profit from illegal fishing.

A citizen salmon traded in the tributary of Starushka using the Ob boat with a Yamaha motor and a vein network. The boat and fishing gear were seized and transferred for safekeeping. Administrative proceedings are ongoing.

Recall that two days earlier, three poachers, hunting for sockeye salmon, chinook salmon and sim, were detained on the Bystroi river. Illegal fishermen lost two boats, nets and illegal fishing.

More than half a kilometer of poaching networks seized in the west of Kamchatka

Employees of the Yelizovsky department of the Border Directorate of the FSB of Russia for the eastern Arctic region, together with public inspectors of the Bolshaya River Association, conducted raids on the Sea of Okhotsk adjacent to the western coast of Kamchatka. For three days, inspection teams removed more than 600 meters of networks exposed by poachers. Salmon caught in the net were released into their natural habitat, fishing gear and three boats taken from illegal fishermen were transferred for safekeeping.

5 violators of environmental legislation were detained. Compiled 5 protocols. Administrative proceedings are ongoing.

Branch science notes good filling of river spawning grounds in western Kamchatka

Specialists of KamchatNIRO (Kamchatka Scientific Institute of Fisheries) note the good filling of the spawning grounds of the Opala River Basin in western Kamchatka by producers of Pacific salmon.

Aerovisual surveys were carried out by employees of the laboratory for the dynamics of salmon abundance. The funding of the flight time was taken over by the Bolshaya River Association.

Spawning grounds of the main tributaries were examined: the Sawan, Left Sawan, Right Sawan rivers and the Opala River itself. During spawning, scientists counted 25 thousand specimens of sockeye salmon, 125.3 thousand specimens of the early form of chum salmon, 250 specimens of pink salmon and 2.5 thousand specimens of chinook salmon during spawning.

“These are very good values. The total pass of sockeye salmon, chum salmon, chinook salmon, we assess as high. Especially taking into account the fact that even late forms of Pacific salmon will enter the rivers, ”said Nina Shpigalskaya, Director of KamchatNIRO.

The mass course of pink salmon began in rivers in the west of Kamchatka

On the rivers of western Kamchatka, the so-called “runic” course of pink salmon began.

The long-awaited fish, having felt the warmth, began to massively enter spawning. The fish approaches justify the forecast of the TINRO Center, which previously announced a record population of pink salmon heading for spawning this year.

Along with the fish, poachers became more active. In this regard, the Bolshaya River Association exposes in addition to the existing posts 7 posts on the Bolshaya River, three in the upper reaches of the Opala and Kikhchik rivers.

In just a week, 214 raids, 959 hours on the water, 209 inspections were carried out by joint groups of employees of SVTU FAR and public inspectors of the Association "Bolshaya River". 22 protocols have been drawn up for violators of environmental legislation. 18 nets, 10 boats, 5 motors and about 1.2 tons of fish were seized.

In the west of Kamchatka, a ton of fish was detained, which they tried to export according to "linden" documents

Employees of the Border Directorate of the Federal Security Service of the Russian Federation for the eastern Arctic region, together with public inspectors of the Bolshaya River Association, detained a car in the Ust-Bolsheretsky region, the driver of which tried to remove almost a ton of illegally caught salmon fish from the fishing area.

During the search for the Toyota SUV, bags were found carrying 646 kg of pink salmon, 78 kg of sockeye salmon and 199 kg of chum salmon. Transportation of fish was carried out according to fake documents.

Car and illegal catch seized. The materials were handed over to the police to resolve the issue of instituting criminal proceedings.

4. IV. Shevlyakov & Maslov 2011

Известия ТИНРО

2011 **Том 164**

УДК

Е.А. Шевляков, А.В. Маслов*

Камчатский научно-исследовательский институт рыбного хозяйства и океанографии, 683000, г. Петропавловск-Камчатский, ул. Набережная, 18

РЕКИ, ОПРЕДЕЛЯЮЩИЕ ВОСПРОИЗВОДСТВО ТИХООКЕАНСКИХ ЛОСОСЕЙ НА КАМЧАТКЕ, КАК РЕПЕРЫ ДЛЯ ОЦЕНКИ ЗАПОЛНЕНИЯ НЕРЕСТОВОГО ФОНДА

Рассмотрена динамика заполнения нерестилищ производителями тихоокеанских лососей всех значимых нерестовых рек Камчатки. Проанализирована сопряженность флюктуаций заходов производителей на нерест в реки в рамках промысловых районов. Выделены основные нерестовые реки, оценен их вклад в общее воспроизводство разных видов тихоокеанских лососей. Показана принципиальная возможность ограниченного учета производителей на реперных реках с последующей экстраполяцией на районы воспроизводства. Оценена минимальная потребность в полетном времени для учета 5 видов тихоокеанских лососей в реках Камчатки. Предложен системный подход для организации авиаучетных работ в условиях ограниченного финансирования.

Ключевые слова: западное побережье, восточное побережье, горбуша, нерка, кета, кижуч, чавыча, учет численности на нерестилищах, основные реки.

Shevlyakov E.A., Maslov A.V. The rivers determining reproduction of pacific salmons in Kamchatka as indicators of spawning grounds filling // Izv. TINRO. — 2011. — Vol. 164. — P. 114–139.

Dynamics of spawning grounds filling by pacific salmons is investigated for the main rivers of Kamchatka. Contribution of each river to production of salmons is estimated. Principles of extrapolation of the spawners assessments made on some typical rivers to other ones are discussed. The minimal flight time necessary for assessment of 5 species of pacific salmons is estimated. A systematic approach to organize air observations under limited funding is proposed.

Key words: Kamchatka, pink salmon, sockeye salmon, chum salmon, coho salmon, chinook salmon, spawning grounds, river.

Введение

Дальневосточные лососи являются одним из основных промысловых объектов на Камчатке, при этом ценнейшим. Организация их рационального промысла во многом определяется возможностью надежного прогнозирования численности подходов к побережьям и соответственно уловов. Разработка промысловых прогнозов невозможна без адекватных и регулярных сведений о численности заходящих на нерест производителей. Эти данные позволяют классифицировать нерес-

* *Шевляков Евгений Александрович, заместитель директора по науке, кандидат биологических наук, e-mail: shevlyakov.e.a@kamniro.ru; Маслов Алексей Викторович, ведущий инженер, e-mail: mazlov@mail.ru.*

тилища, определять сроки хода, нереста и распределение на них лососей, в том числе и темпорально изолированных рас на одних и тех же нерестовых площадях, а также оценивать вероятный ущерб от воздействия на окружающую среду.

Одним из основных способов получения достоверных данных о распределении и численности лососей в нерестовых водоемах является аэровизуальный. Авиаобследования нерестовых водоемов Камчатской области (края) и Корякском автономном округе проводятся ежегодно начиная с 1950 г. Учетами охватываются все основные речные и озерные системы Камчатки. Аэровизуально обследуется около 200 речных систем с общей протяженностью водотоков более 80 000 км. С учетом уже накопленных рядов заполнения нерестилищ камчатских рек производителями, начатых с 50-х гг. прошлого века, очевидна исключительная важность продолжения авиаучетных работ в полном объеме. Аналогов такой полномасштабной оценки степени использования нерестового фонда разными видами лососей нет ни в отечественной практике, ни в мировой. Ежегодный объем полетного времени для полного учета производителей в реках составляет около 600 ч.

При уменьшении объема полетного времени, как правило, теряется важная информация о численности лососей на нерестовых площадях в результате ежегодного смещения сроков захода производителей на нерестилища и их недоучета на не охваченных учетами водотоках. Это в конечном счете сказывается на качестве разрабатываемых прогнозов. До 2003 г. на учетные работы традиционно, за редким исключением, выделялось до 650 ч полетного времени, при этом в достаточно полном объеме обследовались практически все нерестовые водоемы Камчатского региона. С 2003 г. началось снижение объемов финансирования авиаучетных работ до 300 ч в 2006 г. и даже 150 ч в 2009 г. Понятно, что детальную информацию по конкретным популяциям может дать только полный учет производителей. В связи с этим возникает проблема использования неполных данных по учетам производителей на нерестилищах тех или иных рек. С особой остротой она возникает в годы кардинальных перестроек в системе отраслевой рыбохозяйственной науки, что, как правило связано с либо изменением источников, либо просто катастрофическим оскудением финансирования, в первую очередь сказывающимся на объемах авиаучетов.

Для проведения авиучетов на Камчатке используется вертолет МИ-8. Он показал свою надежность, маневренность, а с учетом установки дополнительных топливных баков и значительную длительность проведения работ. Как известно, полетное время на указанном вертолете обходится весьма дорого, в 2010 г. цена полетного часа на Камчатке составляла порядка 105 тыс. руб. Несложные расчеты показывают, что авиаучет тихоокеанских лососей в полном объеме должен стоить около 63 млн руб. Понятно, что в настоящее время в условиях ограниченного финансирования рассчитывать на обеспечение работ даже в половинном объеме представляется маловероятным. В связи с этим возникает необходимость максимально эффективного использования полетного времени для охвата наиболее значимых для воспроизводства лососей водоемов и экстраполяции полученных данных на не охваченный учетами остальной нерестовый фонд лососей.

Материалы и методы

В работе использованы архивные данные КамчатНИРО по авиаучетам производителей тихоокеанских лососей (за исключением симы) на нерестовых водоемах Камчатского региона (Остроумов, 1961а, б, 1962, 1964–1982, 1984, 1989, 1991, 1992, 1994–1996, 1998, 1999; Остроумов, Непомнящий, 1983, 1985–1994; Остроумов, Упрямов, 1996; Маслов, Полынцев, 1997; Полынцев, 1997; Маслов, 1998–2009). Работы по оценке численности производителей горбуши, кеты и нерки на нерестилищах были начаты в 1957 г., чавычи — в 1962 г., кижуча — в 1972 г. В отдельных случаях длину рядов ограничивали пробелы в учетах на конкретных водоемах.

Список рек, определяющих основной вклад в воспроизводство вида в конкретном рыбопромысловом районе, определялся методом пошагового исключения из общего перечня. При этом надо понимать, что в итоговый список входили не только реки, в которых динамика захода производителей осуществлялась синхронно, но и те, которые вносили максимальные отклонения от общего уровня (направленности) и, следовательно, были ценными для максимально точного описания общего захода производителей.

Результаты и их обсуждение

Горбуша

Западное побережье

Четная линия воспроизводства. На западном побережье Камчатки основной вклад в общий пропуск производителей горбуши в четном поколении вносят 11 рек: Ича, Колпакова, Брюмка, Воровская, Коль, Пымта, Кихчик, Большая, Опала, Голыгина и Кошегочек — до 75 % всего захода в реки (рис. 1) на западном побережье и в сумме определяют более 99 % общей вариации. Следует отметить, что динамика заходов горбуши в реки Опала, а в большей степени Голыгина и Кошегочек, не синхронна по отношению к оставшимся выделенным рекам и вносит определенный "шум" в общую вариацию, поскольку заходы здесь нестабильны, а в отдельные годы очень высокочисленны. Исключение этих рек из анализа приводит к резкому ухудшению качества описания зависимости. Экстраполяция на остальной нерестовый фонд с использованием приведенной на рис. 1 зависимости позволяет рассчитать гипотетический общий заход горбуши с вполне приемлемым уровнем точности (рис. 2). При этом фактическая численность обозначена крупными кружками без заливки, а расчетная численность (тонированные кружки) должна стремиться вписаться в этот круг наподобие попадания в мишень. Анализ отклонений "расчет—факт" (рис. 3) показал, что основные отклонения наблюдались в период от начала авиаучетов до 1970 г. включительно, после чего отклонения от наблюденных значений не превышали 16 %. Все существенные отклонения лежали в области минимальных значений заходов горбуши на нерест (экстремум по минимуму) и свидетельствовали об увеличении ошибки определений (учетов) на минимуме численности популяций (рис. 4).

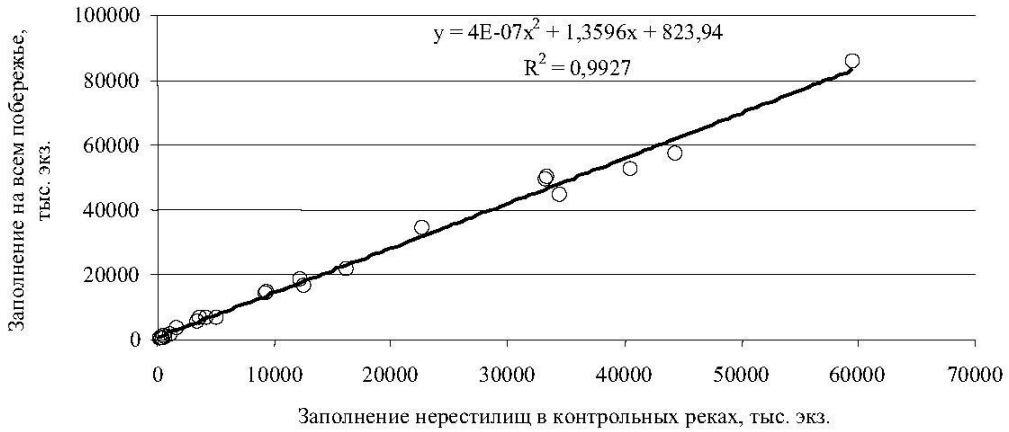


Рис. 1. Соотношение общей численности пропусков горбуши четной линии воспроизводства на западном побережье Камчатки и заходов на нерест в контрольные реки

Fig. 1. Ratio between total abundance of pink salmon on the west coast of Kamchatka in even runs and number of spawning pink in control rivers

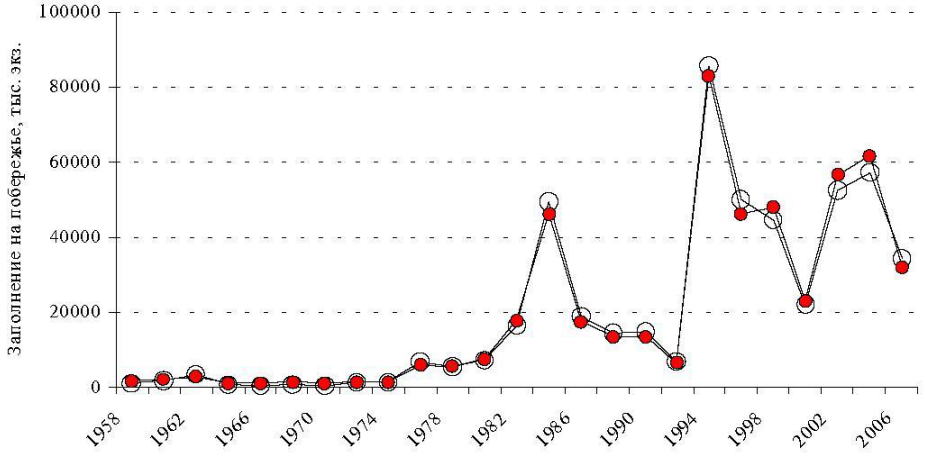


Рис. 2. Расчетная и фактическая численность производителей горбуши четной линии воспроизводства на западном побережье Камчатки. Условные обозначения в тексте

Fig. 2. Observed and calculated abundance of pink salmon spawners on the west coast of Kamchatka in even runs. Graphical symbols are explained in the text

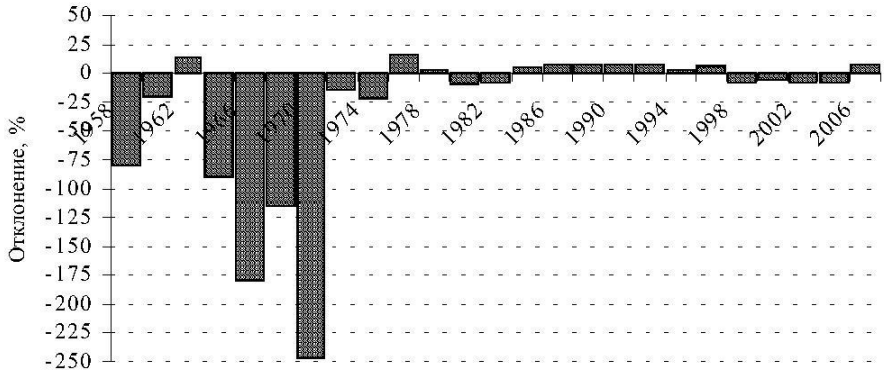


Рис. 3. Отклонение расчетных от фактических величин захода производителей горбуши четного поколения на нерест в реки западного побережья Камчатки за весь период наблюдений

Fig. 3. Deviations of calculated numbers of pink salmon spawners from their observed numbers in the rivers of the west coast of Kamchatka in even years

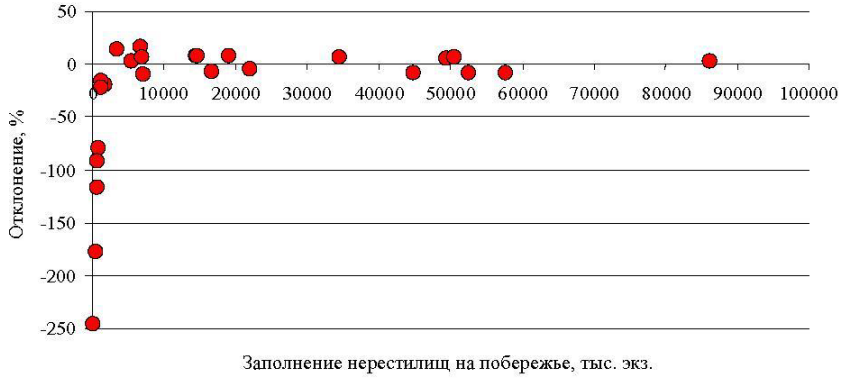


Рис. 4. Зависимость ошибки расчетных значений от численности учтенных производителей

Fig. 4. Dependence of the error of assessment on the accounted number of pink spawners on the east coast of Kamchatka

Нечетная линия воспроизводства. В нечетном поколении горбуши рек западного побережья Камчатки были отобраны те же реки, что и в четном: Ича, Колпакова, Брюмка, Воровская, Коль, Пымта, Кихчик, Большая, Опала, Голыгина и Кошегочек. Анализ показал, что, как и в первом случае, вклад этих рек в общую вариацию значителен (рис. 5). Указанная линия воспроизводства была многочисленной до 1985 г., т.е. до времени последней смены фаз доминирования поколений горбуши в этом регионе. В настоящее время численность горбуши этой линии невелика, в отдельные годы вылов составлял до 100 т на всем побережье. В последние годы в двух случаях была отмечена весьма значительная численность горбуши, "грозящая" вывести нечетную линию воспроизводства на уровень урожайных поколений (возвраты 11,4 млн экз. в 2003 г. и 24 млн экз. в 2005 г.). Однако в последние два цикла численность линии существенно снизилась, до 8,7 млн в 2007 г. и 3,2 млн экз. в 2009 г., пропуск производителей на нерест при этом составлял соответственно 3,20 и 0,12 млн экз. Судя по всему, в ближайшее время ожидать от горбуши нечетной линии воспроизводства заметного наращивания численности и выхода на промысловый уровень не приходится.

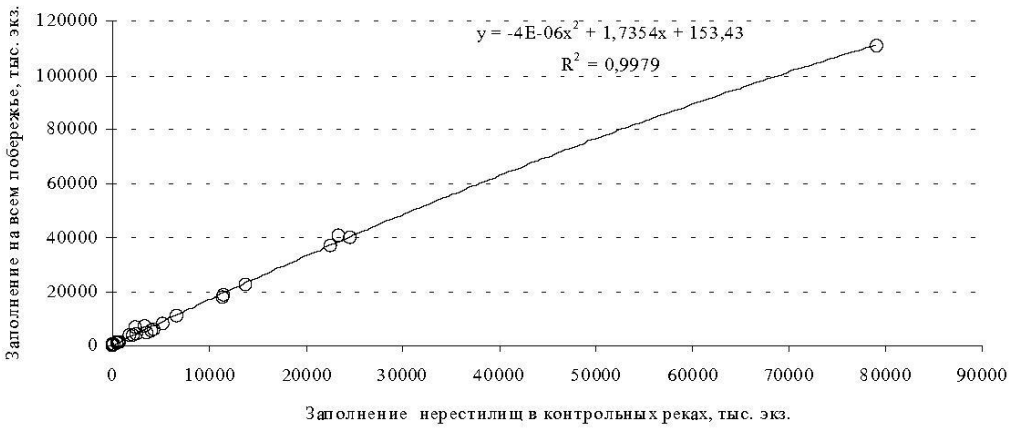


Рис. 5. Соотношение общей численности пропусков горбуши нечетной линии воспроизводства на западном побережье Камчатки и заходов на нерест в контрольные реки

Fig. 5. Ratio between total abundance of pink salmon on the west coast of Kamchatka in odd runs and number of spawning pink in control rivers

Так же как и в первом случае, рассчитали численность заходов горбуши по приведенной на рис. 5 зависимости (рис. 6). Визуально соответствие расчетных значений фактическим можно оценить как очень высокое, но дальнейший анализ показывает, что отклонения здесь могут достигать больших величин (рис. 7).

Отклонение 2001 г. можно объяснить аномально северным распределением производителей по рекам (из 1,225 млн экз. 0,750 млн экз. на протяжении рек Пустой — Сопочной). В целом же расчетные величины в 8 случаях из 26 отличались от фактических на уровне, превышающем допустимый для подобных оценок (20 %). Так же как в предыдущем случае, максимальные отклонения приходились на период, соответствующий низкому уровню численности производителей в линии воспроизводства (рис. 8). Порог численности, ниже которого оценки характеризуются значительными отклонениями, можно определить в 7,7 млн экз.

Из вышесказанного следует, что для достоверных учетов на минимуме численности необходим тотальный учет производителей во всех реках побережья. В противном случае приходиться довольствоваться оценками с большими допусками в значениях. Надо акцентировать, что на минимуме численности и значительные отклонения представляют собой весьма малые числа. Нам представляется, что для целей мониторинга вполне достаточен и этот уровень оценок, поскольку

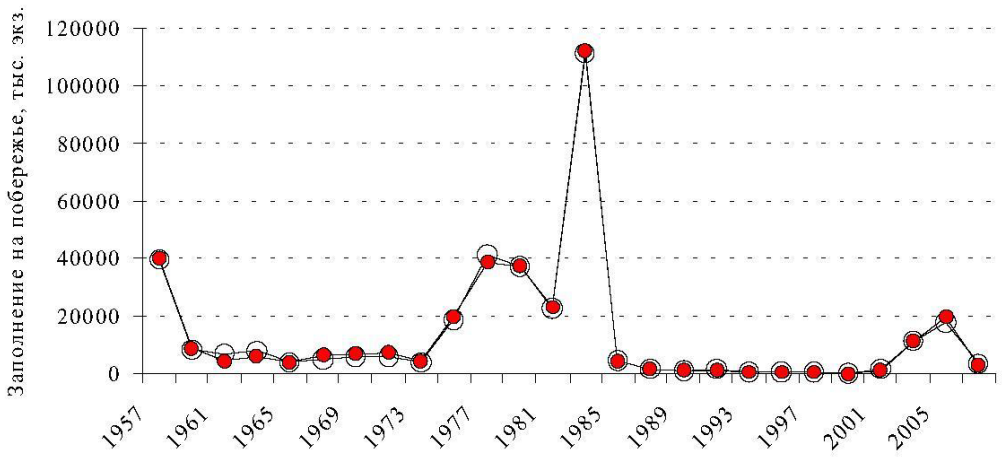


Рис. 6. Расчетная и фактическая численность производителей горбуши нечетной линии воспроизводства на западном побережье Камчатки

Fig. 6. Observed and calculated abundance of pink salmon spawners on the west coast of Kamchatka in odd runs

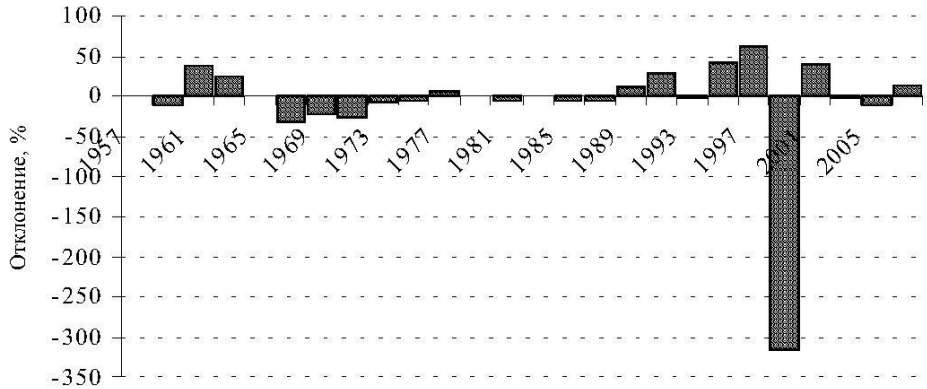
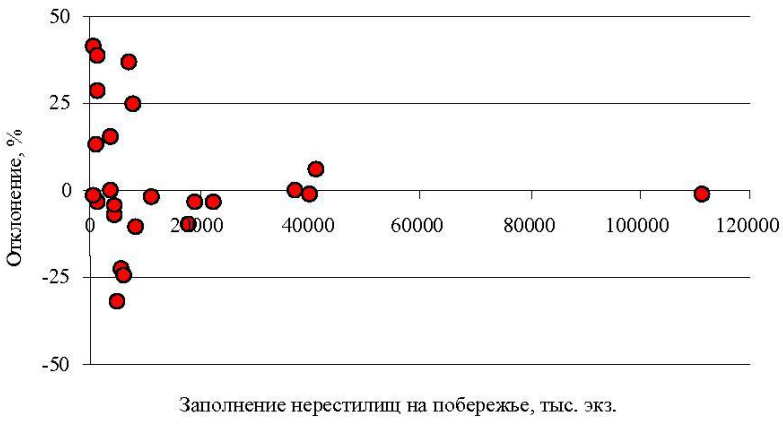


Рис. 7. Отклонение расчетных от фактических величин захода производителей горбуши нечетного поколения на нерест в реки западного побережья Камчатки за весь период наблюдений

Fig. 7. Deviations of calculated numbers of pink salmon spawners from their observed numbers in the rivers of the west coast of Kamchatka in odd years

Рис. 8. Зависимость ошибки расчетных значений от численности учтенных производителей западнокамчатской горбуши

Fig. 8. Dependence of the error of assessment on the accounted number of pink spawners on the west coast of Kamchatka



надежное прогнозирование возможно только при промысловом уровне численности, в малоурожайные годы промысел лососей ориентируется на нерку, кету, кижуча, а вылов горбуши осуществляется по факту прилова к сопутствующим видам.

Восточное побережье

Детальный подсчет производителей горбуши в реках Карагинского и Олюторского районов начали проводить начиная с 1970 г. За весь период наблюдений сохранялся строгий порядок численного доминирования горбуши нечетной линии воспроизводства. Естественно, что авиаучетные приоритеты в условиях лимитирования полетного времени в межгодовом аспекте складываются следующим образом: в четные годы — западное, в нечетные — северо-восточное побережье полуострова. В связи с этим, как правило, лучше оказываются обследованы популяции горбуши урожайных линий. Может быть, это, наряду с высказанными ранее предположениями относительно оценок на нижнем экстремуме, является одной из причин недостаточного качества учетных оценок малоурожайных поколений. Учитывая короткие ряды в одном случае, а также то, что смен доминирования смежных линий на исследуемом отрезке времени в Карагинской рыбопромысловой подзоне не происходило, в дальнейшем мы не проводили анализ соответствия отклонений уровням численности горбуши.

Четная линия воспроизводства. В четной линии горбуши на северо-восточном побережье учетные работы в удовлетворительном объеме начаты в 1984 г. Здесь в линии горбуши четного поколения наибольший вклад в оценки вносят 11 рек: Хайлюля, Кануриваям, Ивашка, Большой Кинмаваям, Макаровка, Гыткаткинваям, Карага, Тымлат, Паклаваям, Анапка, Вывенка. В сумме численность горбуши на этих реках объясняет более 99 % общей вариации (рис. 9). Расчеты в целом удовлетворяют предъявляемым требованиям (рис. 10, 11), только в одном случае (1986 г.) отклонение расчета от факта превышало 20 %-ный уровень. Кстати, в 1986 г. малоурожайная линия, вслед за горбушей четной линии воспроизводства западного побережья, по данным промысловых уловов обнаружила тенденцию к выходу на промысловый уровень, однако в отличие от западнокамчатских популяций вернулась в исходное положение.

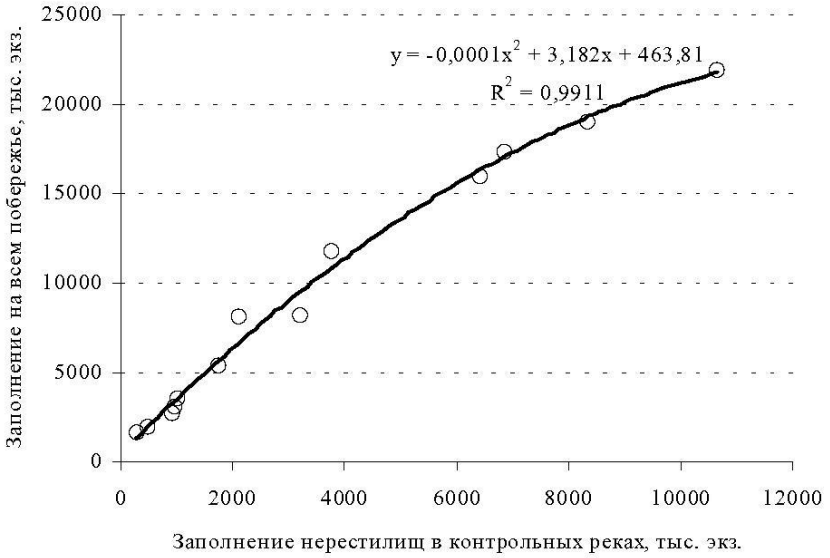


Рис. 9. Соотношение общей численности пропусков горбуши четной линии воспроизводства на восточном побережье Камчатки и заходов на нерест в контрольные реки

Fig. 9. Ratio between total abundance of pink salmon on the east coast of Kamchatka in even runs and number of spawning pink in control rivers

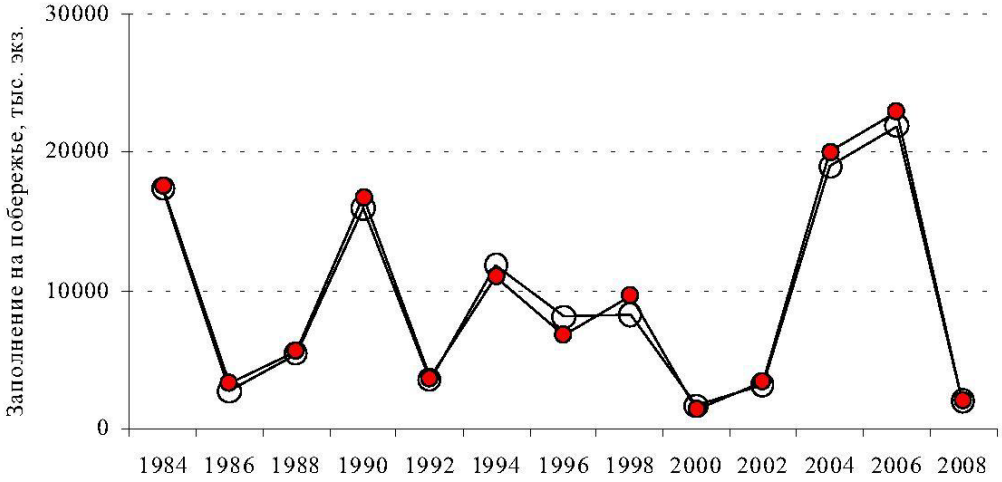


Рис. 10. Расчетная и фактическая численность производителей горбуши четной линии воспроизводства на восточном побережье Камчатки

Fig. 10. Observed and calculated abundance of pink salmon spawners on the east coast of Kamchatka in even runs

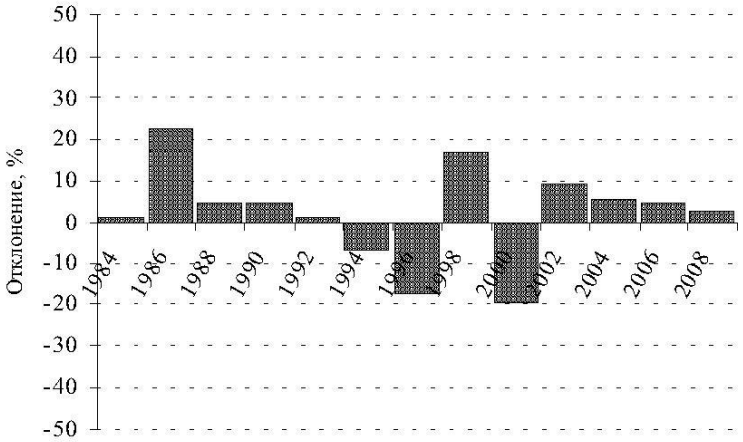


Рис. 11. Отклонение расчетных от фактических величин захода производителей горбуши четного поколения на нерест в реки восточного побережья Камчатки за весь период наблюдений

Fig. 11. Deviations of calculated numbers of pink salmon spawners from their observed numbers in the rivers of the east coast of Kamchatka in even years

Нечетная линия воспроизводства. В нечетной линии горбуши авиаучеты налажены с 1971 г. Список рек по отношению к четной линии воспроизводства отличается, для достижения удовлетворительного уровня экстраполяций общее их число увеличено до 14: Хайлюля, Ивашка, Дранка, Большой Кинмаваям, Гыткаткинваям, Вытвироваям, Карага, Тымлат, Кичига-Белая, Игунаваям, Игнаваям, Вывенка, Култучная, Аллюваям. В сумме они определяют 96 % вариации (рис. 12). Отклонения хотя и выглядят значительными (рис. 13), в действительности, за исключением трех случаев, соответствуют допустимому уровню — 25 % (рис. 14). Их вполне можно отнести к недостаточной детализации учетов, отсутствию регулярных и планомерных тотальных учетов. Рассматриваемый район является очень сложным с позиции организации учетных работ в силу удаленности, протяженности, сложной метеообстановки и отсутствия баз горюче-смазочных материалов для вертолетной техники.

Нерка

Как известно, основные запасы азиатской нерки сконцентрированы в двух основных реках — Камчатка и Озерная. Кроме этого, на северо-западе Камчатки

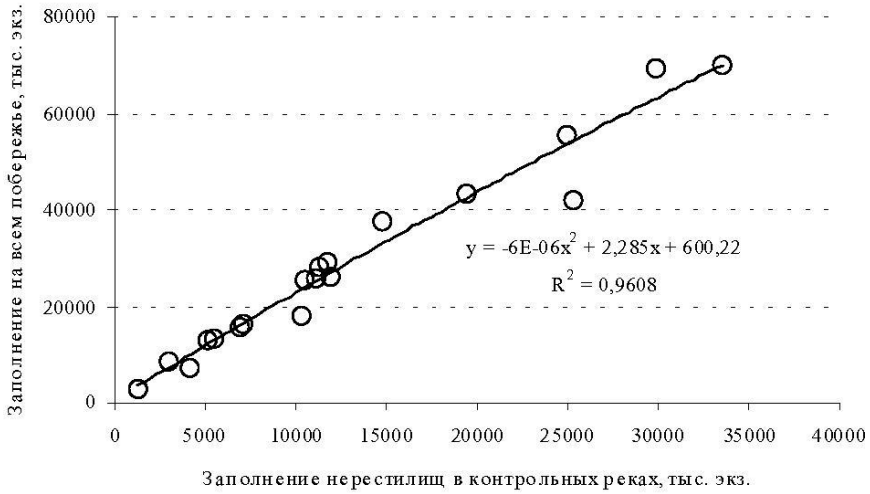


Рис. 12. Соотношение общей численности пропусков горбуши нечетной линии воспроизводства на восточном побережье Камчатки и заходов на нерест в контрольные реки

Fig. 12. Ratio between total abundance of pink salmon on the east coast of Kamchatka in odd runs and number of spawning pink in control rivers

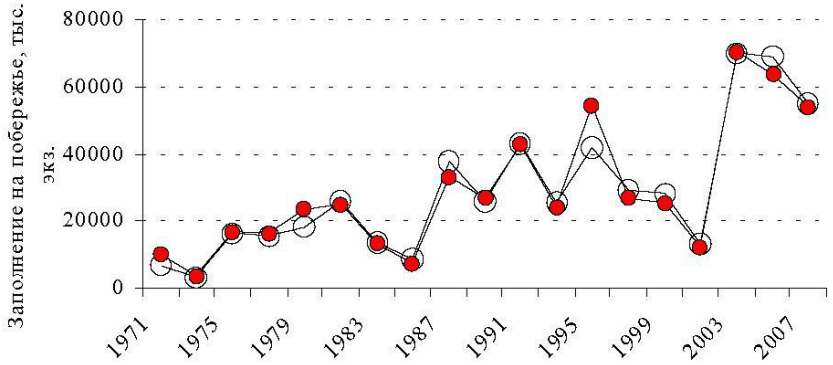


Рис. 13. Расчетная и фактическая численность производителей горбуши нечетной линии воспроизводства на восточном побережье Камчатки

Fig. 13. Observed and calculated abundance of pink salmon spawners on the east coast of Kamchatka in odd runs

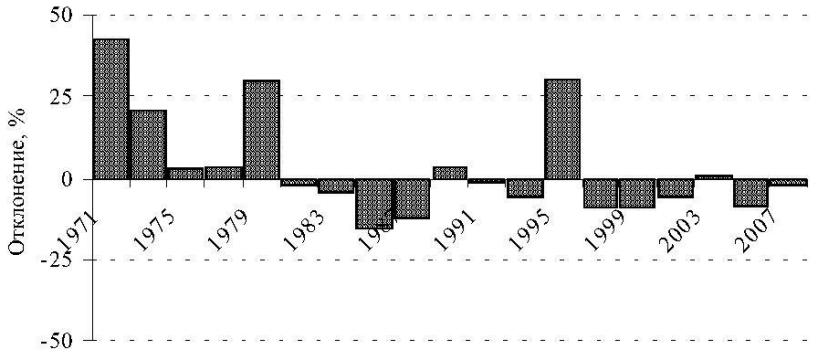


Рис. 14. Отклонение расчетных от фактических величин захода производителей горбуши нечетного поколения на нерест в реки восточного побережья Камчатки за весь период наблюдений

Fig. 14. Deviations of calculated numbers of pink salmon spawners from their observed numbers in the rivers of the east coast of Kamchatka in odd years

довольно высокой численности достигает популяция нерки оз. Паланского. Поскольку динамика численности в крупных озерно-речных системах отличается от таковой в малых речных системах, то названные водоемы мы вынесли за рамки нашего текущего исследования, полагая, что в крупных озерах мониторинг обязателен в полном объеме ежегодно.

Западное побережье

Список рек, определяющих воспроизводство нерки на западном побережье, включает Тигиль, Ича, Облуковина, Крутогорова, Колпакова, Воровская, Коль, Кихчик, Большая. Качество описания — 97 % вариации (рис. 15). Надо отметить, что связь, за исключением двух точек (1996, 2006 гг.), очень плотная. Сейчас сложно судить, но, по всей видимости, здесь имел место недоучет производителей на реках, которые мы в работе считаем контрольными. Экстраполяция на весь нерестовый фонд показала хорошую сходимость оценок (рис. 16). Отклонения расчетных значений от наблюденных (рис. 17) в двух случаях превышают порог в 25 % и в основном приемлемы. Отклонение 2007 г. объясняется отсутствием в этом году авиаучетов в бассейне р. Крутогорова и экстремально большим заходом нерки в р. Голыгина. Эти в общем разнонаправленные процессы и определили уровень отклонения от фактических значений.

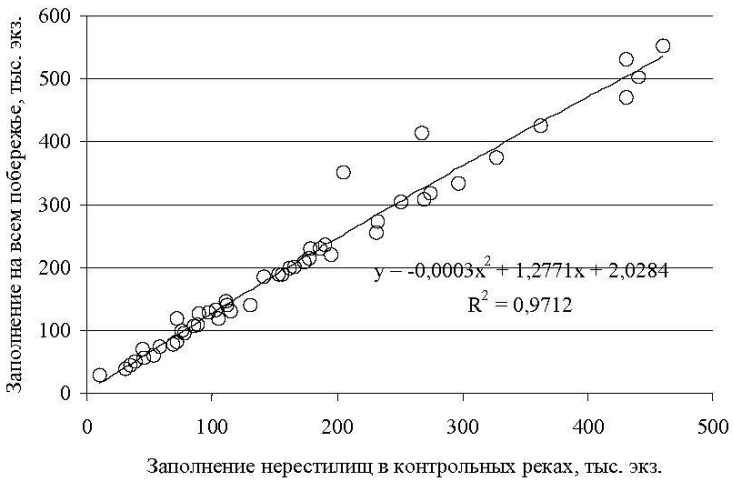


Рис. 15. Соотношение общей численности подходов нерки на западном побережье Камчатки и заходов на нерест в контрольные реки (за исключением рек Палана, Озерная) в 1961–2007 гг.

Fig. 15. Ratio between total abundance of sockeye salmon runs on the west coast of Kamchatka and number of spawning sockeye in control rivers (excluding the Palana and Ozernaya) in 1961–2007

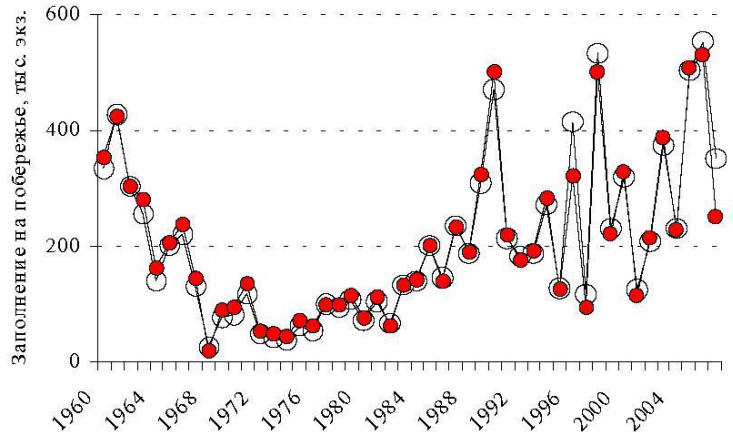


Рис. 16. Динамика расчетных и фактических значений захода производителей нерки на нерест в реки западного побережья Камчатки (за исключением рек Палана, Озерная) в 1961–2007 гг.

Fig. 16. Dynamics of observed and calculated numbers of sockeye salmon spawners in the rivers of the west coast of Kamchatka (excluding the Palana and Ozernaya) in 1961–2007

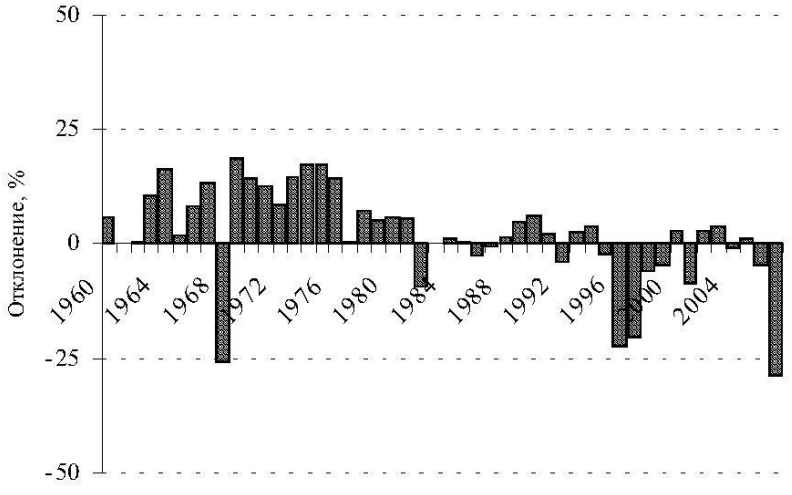


Рис. 17. Отклонение расчетных от фактических величин захода производителей нерки на нерест в реки западного побережья за весь период наблюдений (за исключением рек Палана, Озерная) в 1961–2007 гг.

Fig. 17. Deviations of calculated numbers of sockeye salmon spawners from their observed numbers in the rivers of the west coast of Kamchatka (excluding the Palana and Ozernaya) in 1961–2007

В целом, с учетом уровень погрешностей при учете производителей на местах нереста, связанных с ежегодными изменениями в сроках миграций, волнообразным характером подходов на нерестилища, недоучетом по разным причинам, в том числе и по метеорологическим, и т.д., нам представляется, что достигнутый уровень экстраполяций серьезно превышает экспертный и может быть принят на вооружение в дальнейшем при малобюджетном финансировании учетных работ.

Восточное побережье

На восточном побережье основной кластер значимых водоемов составили реки Озерная (восточная), Хайлюля, Тымлат, Кичига-Белая, Вывенка, Култучная, Пахача, Апука, лагуна Анана. Разброс точек вокруг кривой достаточно высок, а качество описания составляет только 88 % (рис. 18). Тем не менее, как оказывается при дальнейших расчетах (рис. 19, 20), тенденции в динамике заходов на нерест определяются в подавляющем большинстве случаев верно, уровень для района вполне удовлетворительный и превосходит предварительно ожидаемый.

Кета

Западное побережье

Все промысловые реки западного побережья в той или иной степени используются производителями кеты для воспроизводства. До недавнего времени вылов кеты в бассейне р. Большой и в примыкающей морской акватории превышал 25 % от улова на всем западном побережье. В настоящее время более массовыми подходы кеты наблюдаются в более северных реках, исключение составляет р. Опала, где запасы этого вида весьма значительны, а также нерестится крупная популяция кеты ранней формы.

В ранговом списке 9 рек, определяющих воспроизводство вида на побережье: Ича, Колпакова, Брюмка, Воровская, Коль, Пымта, Кихчик, Большая, Опала — объясняют около 97 % дисперсии (рис. 21). Как видно на рис. 22, 23 соответствие расчетных значений фактическим вполне приемлемо. Примечательно, что исключение из списка северных рек — Тигиль и Хайрюзова — сильно снижает качество описания — в 10 случаях из 46 (21,7 %) отклонения выходили за пределы 25 %-ного уровня.

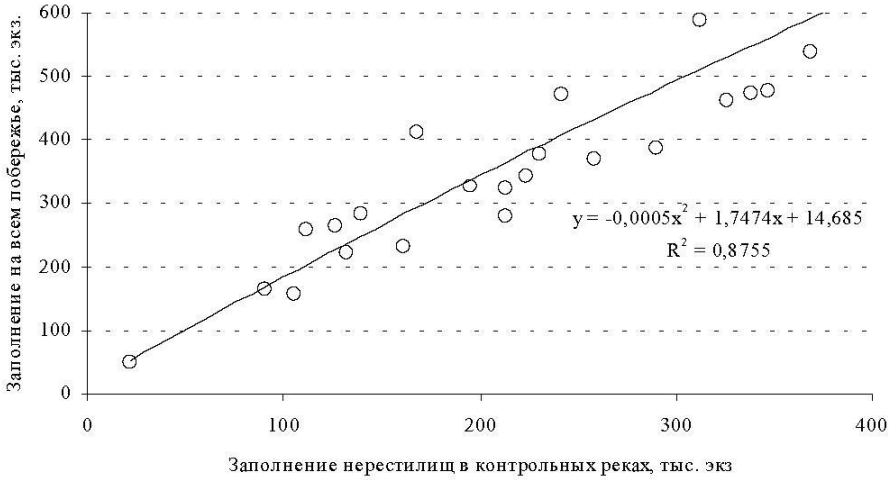


Рис. 18. Соотношение общей численности подходов нерки на восточном побережье Камчатки и заходов на нерест в контрольные реки (за исключением р. Камчатка) в 1982–2007 гг.

Fig. 18. Ratio between total abundance of sockeye salmon runs on the east coast of Kamchatka and number of spawning sockeye in control rivers (excluding the Kamchatka) in 1982–2007

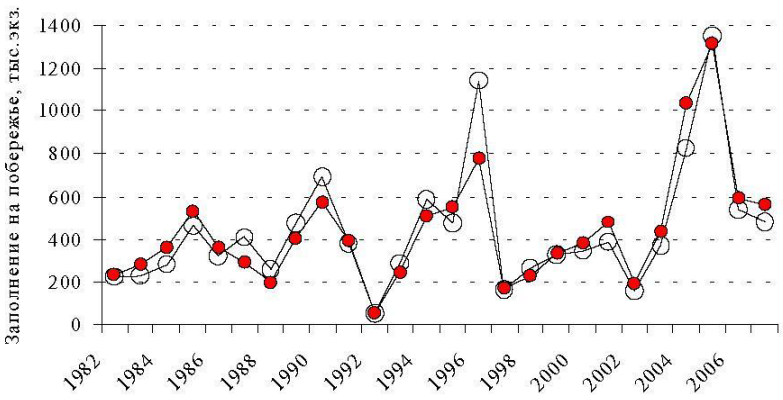


Рис. 19. Динамика расчетных и фактических значений захода производителей нерки на нерест в реки восточного побережья Камчатки (за исключением р. Камчатка) в 1982–2007 гг.

Fig. 19. Dynamics of observed and calculated numbers of sockeye salmon spawners in the rivers of the east coast of Kamchatka (excluding the Kamchatka) in 1982–2007

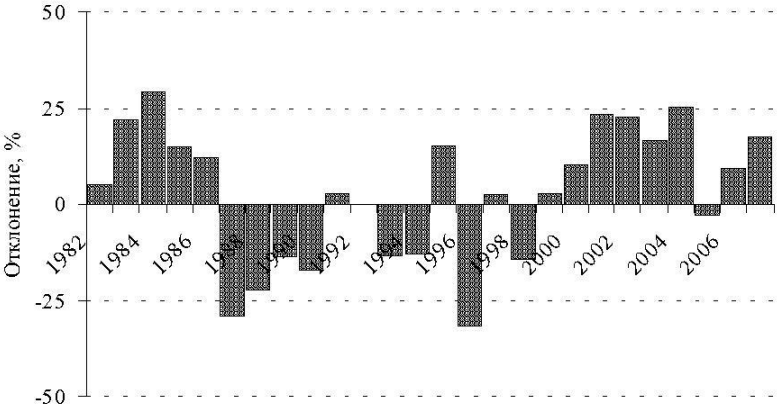


Рис. 20. Отклонение расчетных от фактических величин захода производителей нерки на нерест в реки восточного побережья за весь период наблюдений (за исключением р. Камчатка) в 1982–2007 гг.

Fig. 20. Deviations of calculated numbers of sockeye salmon spawners from their observed numbers in the rivers of the east coast of Kamchatka (excluding the Kamchatka) in 1982–2007

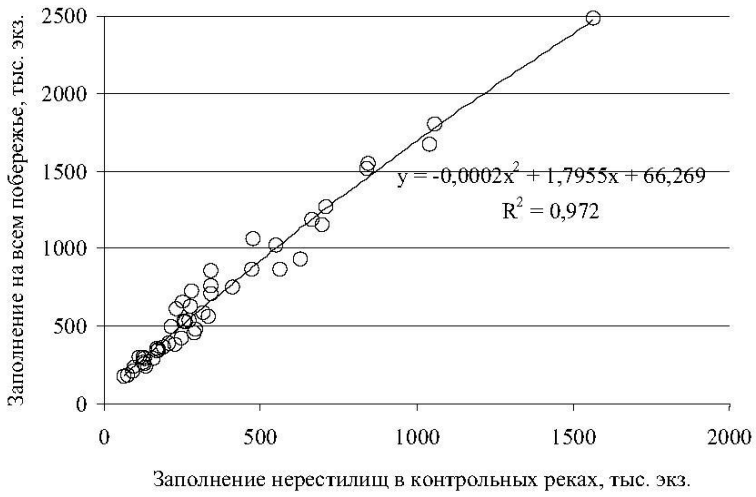


Рис. 21. Соотношение общей численности подходов кеты на западном побережье Камчатки и заходов на нерест в контрольные реки за весь период наблюдений

Fig. 21. Ratio between total abundance of chum salmon runs on the west coast of Kamchatka and number of spawning chum in control rivers in the whole period of observations

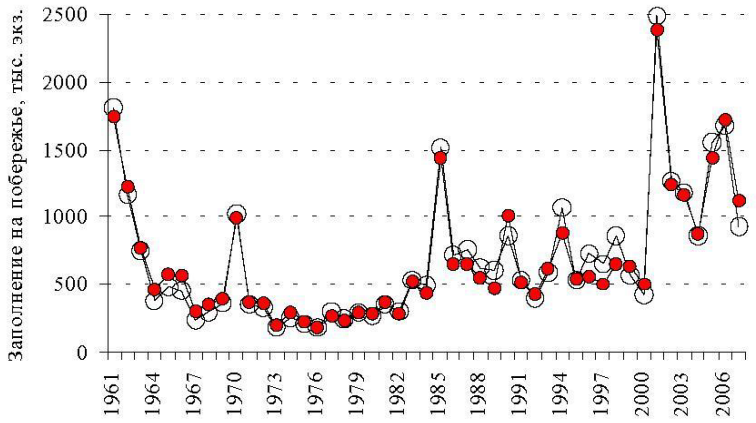


Рис. 22. Динамика расчетных и фактических значений захода производителей кеты на нерест в реки западного побережья Камчатки за весь период наблюдений

Fig. 22. Dynamics of observed and calculated numbers of chum salmon spawners in the rivers of the west coast of Kamchatka in the whole period of observations

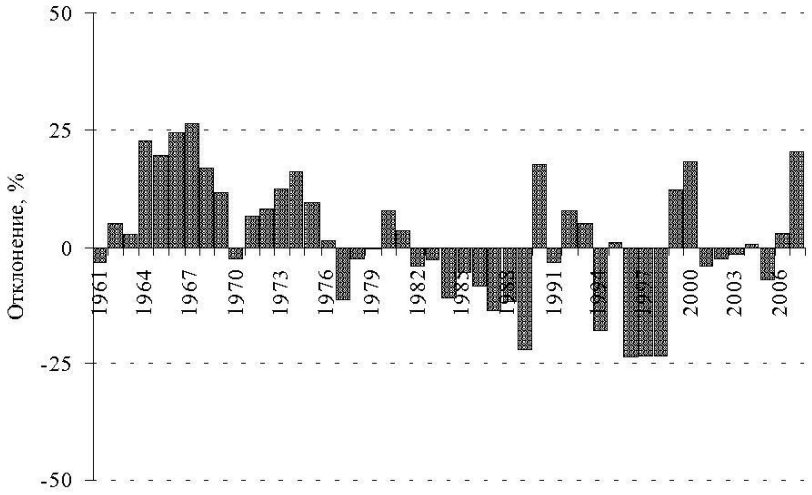


Рис. 23. Отклонение расчетных от фактических величин захода производителей кеты на нерест в реки западного побережья за весь период наблюдений

Fig. 23. Deviations of calculated numbers of chum salmon spawners from their observed numbers in the rivers of the west coast of Kamchatka in the whole period of observations

Восточное побережье

Основными единицами запаса кеты на восточном побережье Камчатки являются р. Камчатка и реки Карагинской подзоны, которые в сумме определяют около 95 % всего улова. В дополнение к этому можно отметить, что на юго-востоке побережья (реки Авачинской бухты) расположены три рыборазводных завода, ориентированных на выпуск молоди кеты, которые вносят некоторый вклад в оставшиеся 5 %. Бассейн р. Камчатка, как и в случае с неркой, подлежит отдельному регулярному обследованию нерестилищ кеты. Поэтому далее рассматривались реки Карагинской рыбопромысловой подзоны от р. Озерной (восточной) до р. Опуха. Реки, вошедшие в итоговый список — Хайлюля, Карага, Сигаэктап, Кичига-Белая, Анапка, Вывенка, Авьяваям. В целом перечисленные 7 рек определяют около 94 % общей вариации (рис. 24). Дальнейший анализ (рис. 25, 26) с учетом ранее высказанных соображений относительно сложности работы в районе в целом подтверждает их пригодность для оценки заполнения всего нерестового фонда кеты Карагинской подзоны.

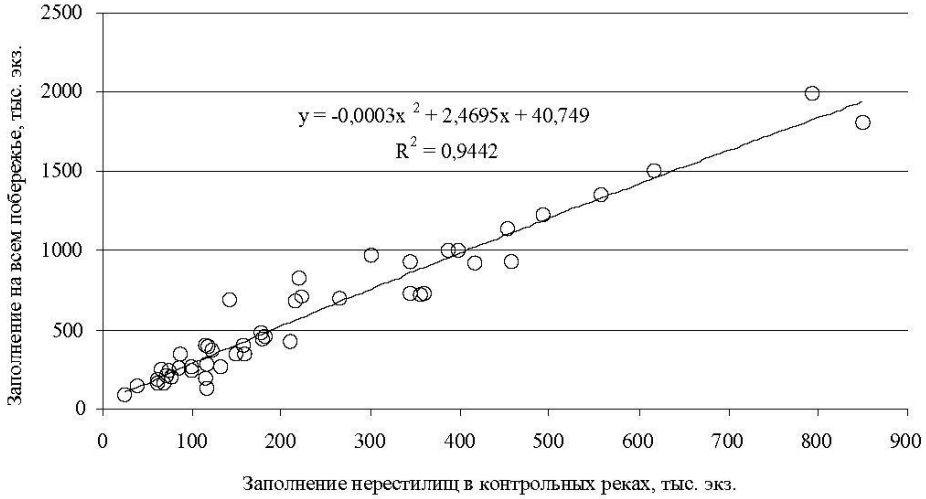


Рис. 24. Соотношение общей численности подходов кеты на северо-восточном побережье Камчатки и заходов на нерест в контрольные реки за весь период наблюдений

Fig. 24. Ratio between total abundance of chum salmon runs on the north-east coast of Kamchatka and number of spawning chum in control rivers in the whole period of observations

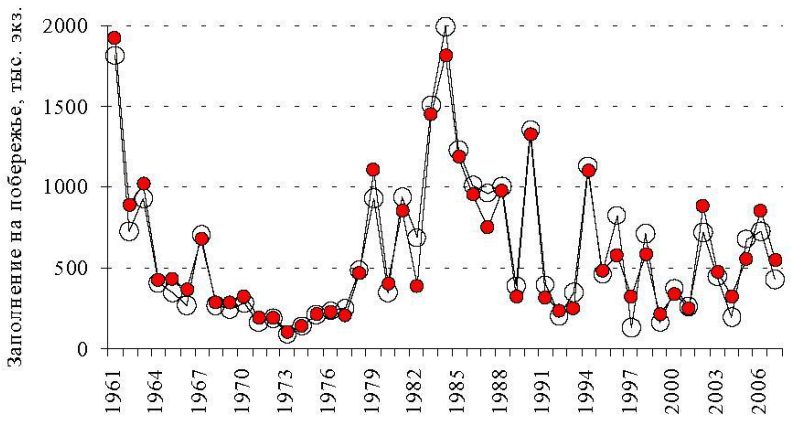


Рис. 25. Динамика расчетных и фактических значений захода производителей кеты на нерест в реки северо-восточного побережья Камчатки за весь период наблюдений

Fig. 25. Dynamics of observed and calculated numbers of chum salmon spawners in the rivers of the north-east coast of Kamchatka in the whole period of observations

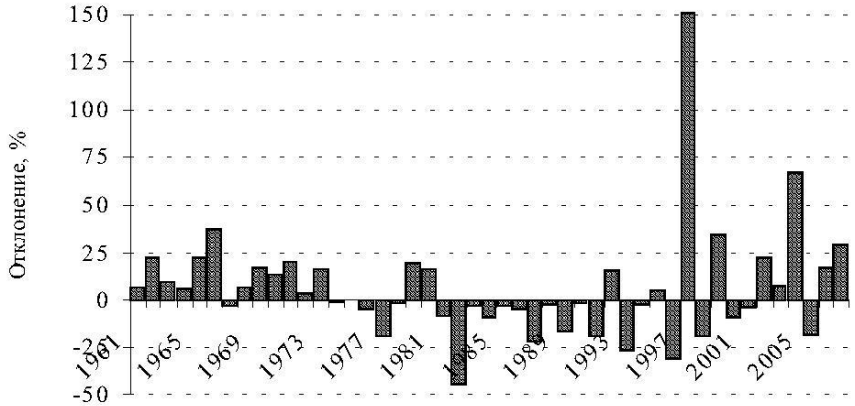


Рис. 26. Отклонение расчетных от фактических величин захода производителей кеты на нерест в реки северо-восточного побережья Камчатки за весь период наблюдений

Fig. 26. Deviations of calculated numbers of chum salmon spawners from their observed numbers in the rivers of the north-east coast of Kamchatka in the whole period of observations

Кижуч

Западное побережье

Воспроизводство кижуча на западном побережье полуострова определяют реки Тигиль, Морошечная, Ича, Облуковина, Колпакова, Воровская, Коль, Пымта, Кихчик, Большая. Описательное качество подобранной зависимости составляет около 94 %, при этом разброс точек относительно прямой характерен для высоких численностей заходов кижуча на нерест (рис. 27). Подобное обстоятельство, однако, не искажает картины соответствия расчетных данных фактически наблюденным: 25 %-ный порог отклонений превышен только в 1 случае из 29 (рис. 28, 29).

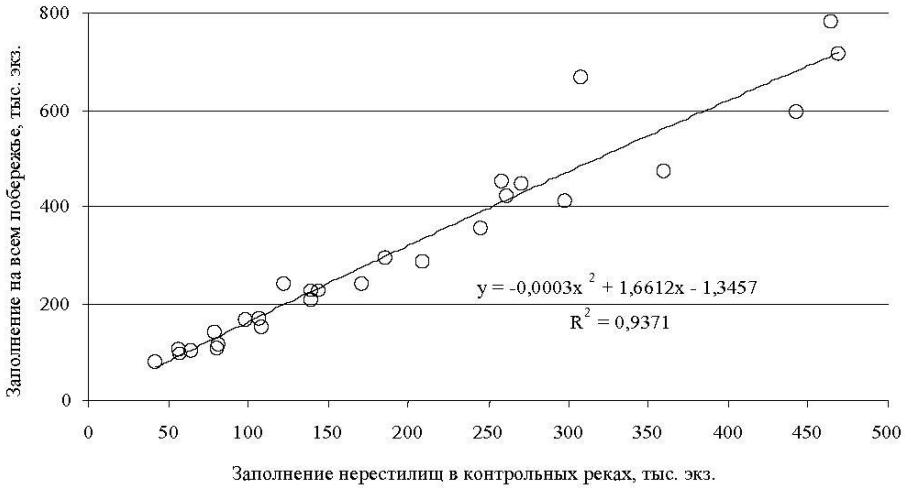


Рис. 27. Соотношение общей численности подходов кижуча на западном побережье Камчатки и заходов на нерест в контрольные реки за весь период наблюдений

Fig. 27. Ratio between total abundance of coho salmon runs on the west coast of Kamchatka and number of spawning coho in control rivers in the whole period of observations

Восточное побережье

Как уже отмечалось выше, нерестилища р. Камчатка должны обследоваться регулярно с необходимой степенью детализации. На северо-восточном побережье

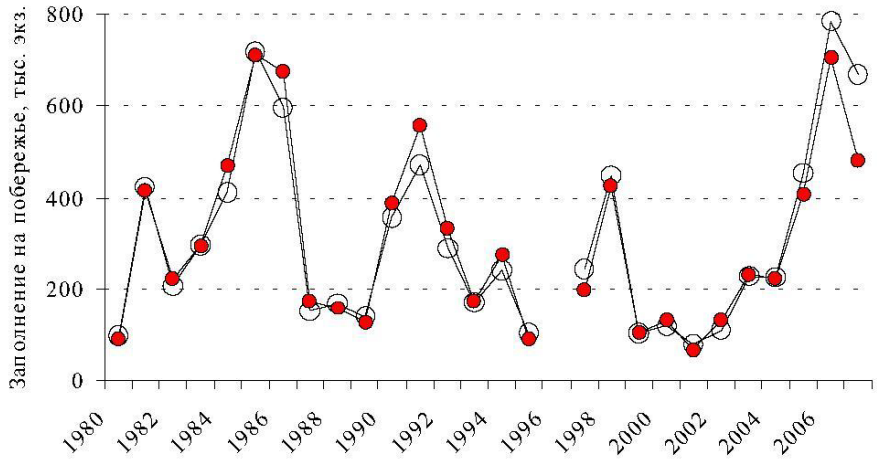


Рис. 28. Динамика расчетных и фактических значений захода производителей кижуча на нерест в реки западного побережья Камчатки за весь период наблюдений

Fig. 28. Dynamics of observed and calculated numbers of coho salmon spawners in the rivers of the west coast of Kamchatka in the whole period of observations

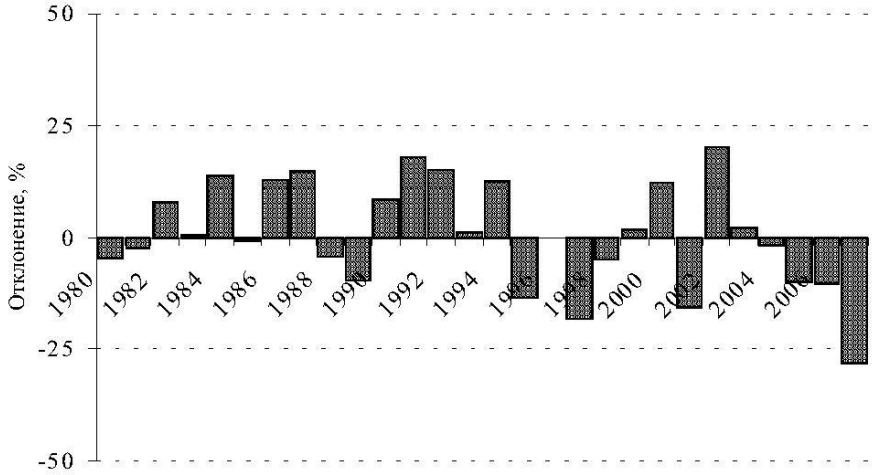


Рис. 29. Отклонение расчетных от фактических величин захода производителей кижуча на нерест в реки западного побережья Камчатки за весь период наблюдений

Fig. 29. Deviations of calculated numbers of coho salmon spawners from their observed numbers in the rivers of the west coast of Kamchatka in the whole period of observations

Камчатки кижуч присутствует в уловах в реках южной части региона. Следует обратить внимание, что популяция кижуча северо-востока Камчатки ранее считалась малочисленной. В основном такое мнение сформировалось по ряду причин. Промысел в 1970–1980-е гг. прекращался с началом осенних штормов, часто в последней декаде августа либо в первых числах сентября. Население заготавливало рыбу для личных нужд, браконьерства как такового, не существовало, поскольку не было рынка сбыта, а авиаучеты не проводились. Поэтому об истинном состоянии запасов было трудно судить. При хорошем состоянии запасов, которое наблюдается в настоящее время, кижуч в Карагинской подзоне начинает подходить к берегу уже в первой декаде августа, и его нерестовый ход совпадает с ходом кеты, поздней нерки и частично с нерестовым ходом горбуши и длится до середины октября (Зорбиди, 2010; Лососи—2006, 2006). В 2005 г. авиаучетами было охвачено большинство водоемов Карагинской подзоны. Численность производителей кижуча на нерестилищах этого региона составила 181,3 тыс. экз.,

или 40 % общего их числа на восточном побережье. В 2009 г. учтено около 80 тыс. экз., при этом по данным официальной статистики более 300 т освоено промыслом. Слабая отчетность по вылову кижуча представителями общин коренных малочисленных народов Севера позволяет предполагать его изъятие в Карагинской подзоне в целом на уровне 400–500 т. Авиаучетные данные до сих пор продолжают оставаться фрагментарными, на полные учеты его нерестилищ в рассматриваемом районе в конце путины традиционно не хватает средств. Анализ наиболее полных учетов, проведенных в 1998 и 1999 гг., показал, что, по всей видимости, авиаучет кижуча в этом районе следует сосредоточить на реках Озерная, Ука, Хайлюля, Ивашка, Дранка, Карага, Кичига-Белая, Анапка, Вывенка, Култучная, Кавача, Камчиммоваям.

Чавыча

Западное побережье

Несмотря на очень существенный пресс промысла, в том числе и незаконного, на запасы чавычи р. Большой, в бассейне которой находится до 60–70 % ее нерестилищ на западном побережье Камчатки, река продолжает оставаться весьма востребованной с точки зрения использования ресурсов чавычи. В последнее время в связи с развитием спортивного рыболовства, а также запретом промысла ранней нерки, которая заходит в реки в одни сроки с чавычей, весомая часть квот чавычи отводится под этот вид промысла. При снижении запасов чавычи в р. Большой, значительный удельный вес в воспроизводстве набирают более северные, сравнительно некрупные реки. Список значимых рек включает реки Тигиль, Облуковина, Крутогорова, Колпакова, Воровская, Коль, Пымта, Кихчик. Качество описания соответствия фактических значений расчетным довольно высокое, но высока и дисперсия (рис. 30–32), а это является основным для решения поставленных в данной работе задач. За весь период отклонения достигали и превышали 50 %-ный уровень дважды, а 25 %-ный — в 7 случаях из 39. Примечательно, что добавление в анализ материалов по р. Большой весьма значительно нивелировало различия между расчетными и фактическими рядами. При этом отмечено лишь одно отклонение, превышающее 20 %-ный уровень — 31 % в 2004 г.

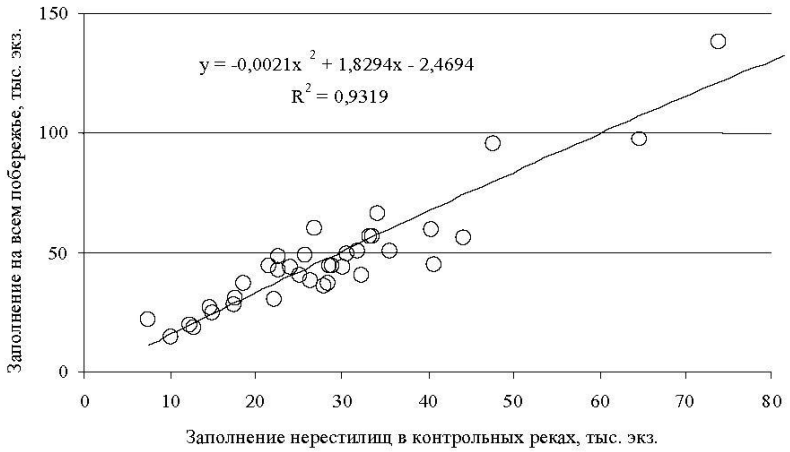


Рис. 30. Соотношение общей численности подходов чавычи на западном побережье Камчатки (за исключением р. Большой) и заходов на нерест в контрольные реки за весь период наблюдений

Fig. 30. Ratio between total abundance of chinook salmon runs on the west coast of Kamchatka (excluding the Bolshaya) and number of spawning chinook in control rivers in the whole period of observations

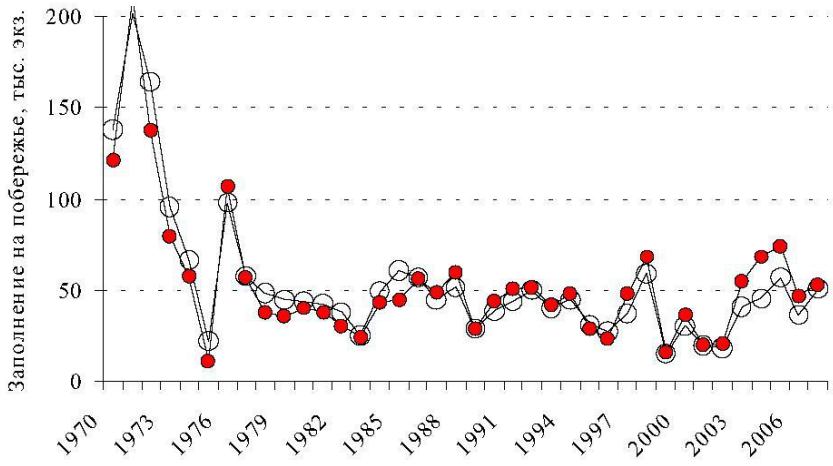


Рис. 31. Динамика расчетных и фактических значений захода производителей чавычи на нерест в реки западного побережья Камчатки (за исключением р. Большой) за весь период наблюдений

Fig. 31. Dynamics of observed and calculated numbers of chinook salmon spawners in the rivers of the west coast of Kamchatka (excluding the Bolshaya) in the whole period of observations

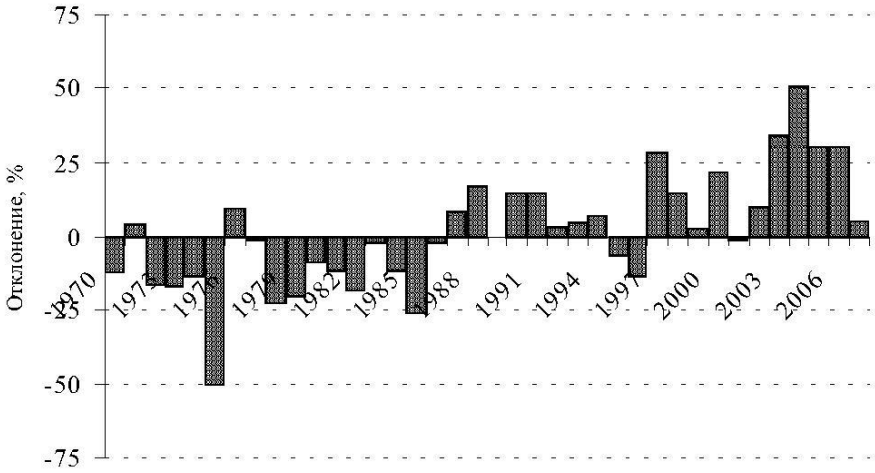


Рис. 32. Отклонение расчетных от фактических величин захода производителей чавычи на нерест в реки западного побережья Камчатки (за исключением р. Большой) за весь период наблюдений

Fig. 32. Deviations of calculated numbers of chinook salmon spawners from their observed numbers in the rivers of the west coast of Kamchatka (excluding the Bolshaya) in the whole period of observations

Восточное побережье

На восточном побережье 80–90 % нерестового фонда чавычи сосредоточено в бассейне р. Камчатка. Здесь ее подходы за время исследований достигали 300 тыс. экз., а уловы — 2,0–2,5 тыс. т. Совершенно очевидно, что нерестилища чавычи на р. Камчатка должны контролироваться ежегодно. Среди второстепенных для воспроизводства чавычи (в сравнении с р. Камчатка) наиболее важными являются реки Озерная (восточная), Тымлат, Кичига-Белая, Вывенка, Авьяваям, Пахача, Апука. Учитывая, что основное воспроизводство чавычи на востоке сконцентрировано в этих реках, качество описания очень высокое (рис. 33, 34). Отклонения за весь период не превышали значения 15,5 % (рис. 35).

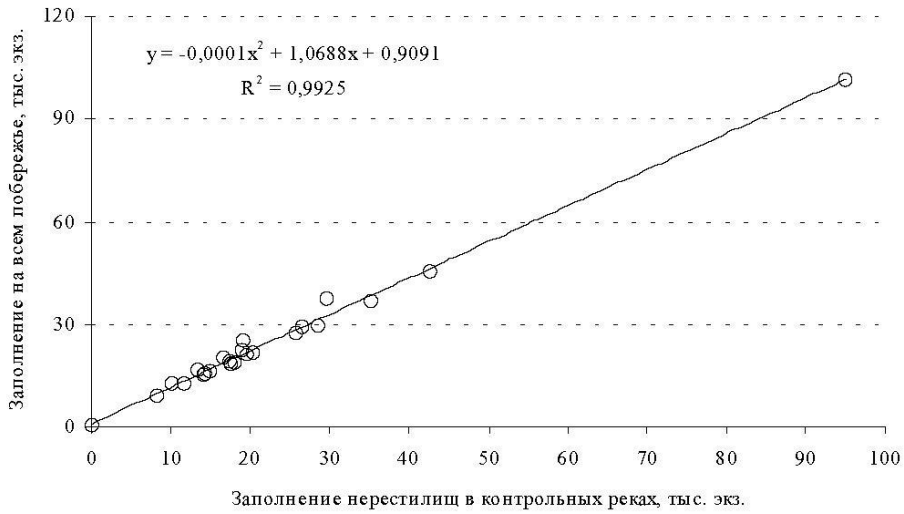


Рис. 33. Соотношение общей численности подходов чавычи на северо-восточном побережье Камчатки и заходов на нерест в контрольные реки за весь период наблюдений

Fig. 33. Ratio between total abundance of chinook salmon runs on the north-east coast of Kamchatka and number of spawning chinook in control rivers in the whole period of observations

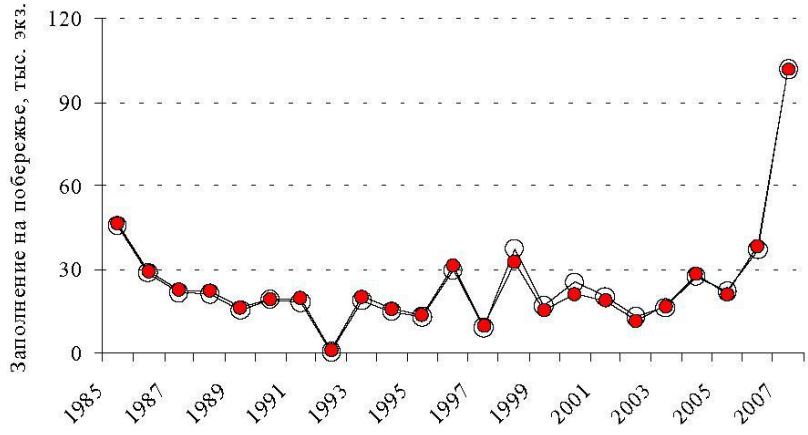


Рис. 34. Динамика расчетных и фактических значений захода производителей чавычи на нерест в реки северо-восточного побережья Камчатки за весь период наблюдений

Fig. 34. Dynamics of observed and calculated numbers of chinook salmon spawners in the rivers of the north-east coast of Kamchatka in the whole period of observations

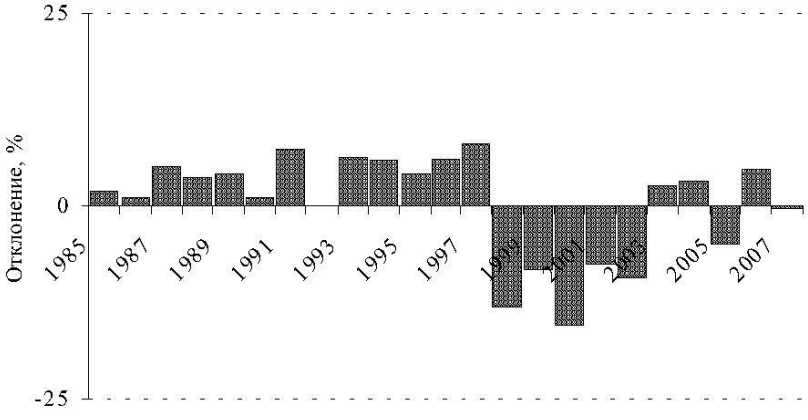


Рис. 35. Отклонение расчетных от фактических величин захода производителей чавычи на нерест в реки северо-восточного побережья Камчатки за весь период наблюдений

Fig. 35. Deviations of calculated numbers of chinook salmon spawners from their observed numbers in the rivers of the north-east coast of Kamchatka in the whole period of observations

Заключение

Проведенный анализ, на наш взгляд, показал принципиальную возможность довольно адекватных оценок численности при проведении сокращенного авиаучета производителей тихоокеанских лососей в Камчатском регионе. Отдельно отметим, что даже в условиях жесткого лимитирования объема полетного времени необходимо обследовать в полном объеме бассейны рек Камчатка, Большая, Палана и Озерная (западная), как определяющих воспроизводство чавычи, кижуча и нерки в Камчатском крае. Рассмотрение второстепенных в воспроизводстве рек в отрыве от них может приводить к существенным ошибкам при экстраполяциях численности на более обширные районы. Однако для анализа "в чистом виде" крупные реки и были выделены из общего списка. Крупные, определяющие водотоки рассматривали отдельно от комплекса остальных рек, поскольку на фоне большого удельного веса, вносимого в общую вариацию крупными реками, нивелируются или вовсе теряются отклонения часто меньшего масштаба. Есть уверенность, что в дальнейшем, суммируя расчетные оценки с фактическими учетами на таких реках, как Камчатка и Большая, а для западнокамчатской нерки — Озерная и Палана — реально получить вполне корректные для прогнозных расчетов учетные данные производителей на нерестилищах.

Тихоокеанские лососи заходят в реки Камчатки с начала мая и до ноября (рис. 36). Первой в реки заходит чавыча, на одну — две декады позже следует нерка, в начале — середине июля заходит горбуша, далее с небольшим отставанием следует кета, в начале — середине августа начинает заходить кижуч. Кроме этого чавыча, нерка, кета и кижуч в ряде районов образуют темпоральные формы — расы, иногда до трех в одном водоеме (Берг, 1948; Hanamura et al., 1966, Foerster, 1968; Groot & Margolis, 1991; Глубоковский, 1995; Шунтов, Темных, 2008). Сроки хода разных видов тихоокеанских лососей, в том числе и в результате наличия у последних сезонных рас, в значительной мере перекрываются. В большинстве случаев вследствие малой численности и соответственно малой значимости для решения поставленных задач сезонные расы можно не учитывать. Однако в ряде случаев сезонные расы у лососей достигают довольно высокой численности и представляют собой самостоятельные единицы запаса, примером здесь могут служить ранняя и поздняя расы нерки р. Камчатка и р. Озерная (западная). Тогда для адекватной оценки численности производителей всех значимых внутривидовых форм необходимо выделение дополнительного полетного времени, если только сроки учета одной из форм не накладываются на учет следующего (смежного) вида лососей в бассейне и эти формы занимают сходные со смежным видом нерестовые биотопы.

Следующий этап нашего исследования заключался в обсчете полученных результатов (определение протяженности транссект и требуемого полетного времени) с учетом возможных наложений сроков нереста видов и внутривидовых значимых темпоральных форм.

Расчеты были произведены исходя из наличия заправок авиатехники во всех аэропортах (г. Елизово, поселки Эссо, Палана, Оссора, Тиличики, Пахачи), и идеальных метеоусловий. Стандартный «самолетовылет» МИ-8: заправка 4400 л (с учетом дополнительных баков), продолжительность полета 5 ч, протяженность маршрута приблизительно 750 км, средняя скорость при проведении авиучетов составляет около 150 км/ч (рабочая скорость — 100–120 км/ч, на перегонах — 190–210 км/ч, средняя скорость за сезон по данным GPS — в пределах 145–155 км/ч).

Наложение сроков нереста *ранней нерки* и *чавычи* позволяет производить единовременный учет этих видов практически повсеместно в рамках Камчатского региона.

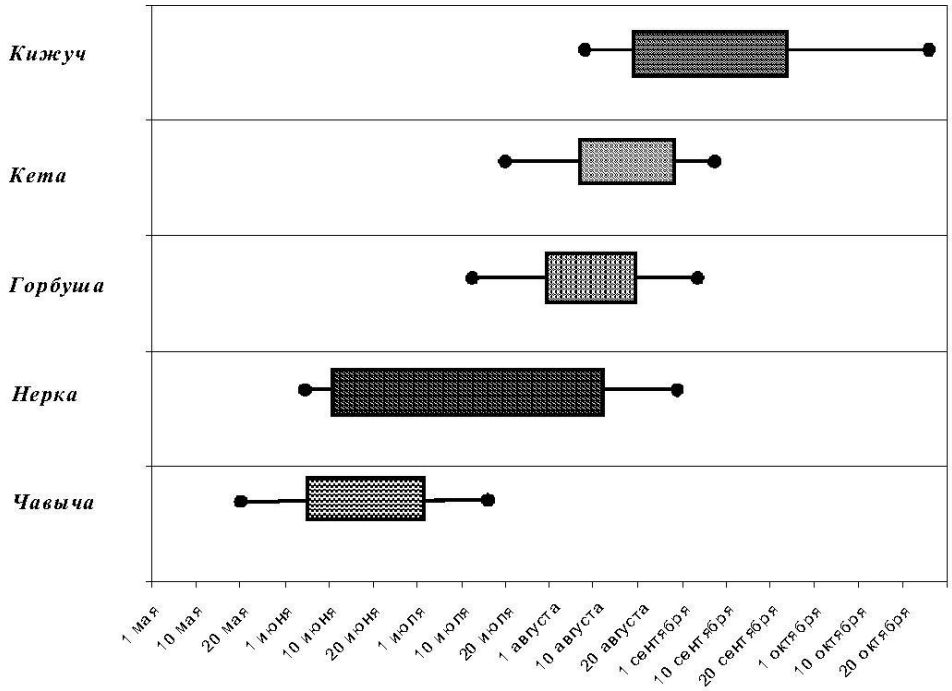


Рис. 36. Генерализированная схема сроков начала (*линии*) и массового хода (*штриховка*) чавычи, нерки, горбуши, кеты и кижуча на Камчатке

Fig. 36. Generalized scheme of the beginning (*lines*) and the mass run (*hatching*) of chinook, sockeye, pink, chum, and coho salmons in Kamchatka

Бассейн р. Камчатка. Как уже говорилось, учеты ранней чавычи и нерки совпадают по времени, их целесообразно производить во второй половине июля, обычно после 15-го и по 25 июля, при этом минимальная потребность составляет 20 полетных часов, в том числе: 5 ч — оз. Двухюрточное, р. Еловка, 5 ч — реки Хапица, Радуга, озера Азабачье, Белое, а также реки Крерук, Крюки и пр., 5 ч — правые притоки р. Камчатка (реки Щапина, Николка) и верхнее течение реки. На обследование левых притоков — рек Кимитина, Кирганик, Андриановка — и собственно основного русла р. Камчатка в районе пос. Мильково и выше по течению потребуется еще 5 полетных часов. В самом начале августа в верхнем течении р. Камчатка наблюдается промежуточный ход нерки, совпадающий по времени с появлением поздней (ильинской) чавычи, который также потребует 5 часов полетных часов. Обследование нерестилищ поздней формы нерки производятся в конце августа — начале сентября. Маршрут и продолжительность учета те же, что в начале сезона, при этом учитывается основная часть кеты — всего 20 ч. Кижуч и поздняя кета на нерестилищах фиксируются в конце сентября — середине октября, потребность полетного времени на их учет составляет около 25 ч. Итого для обследования всех видов тихоокеанских лососей в бассейне р. Камчатка требуется 70 полетных часов.

Бассейн р. Большой. Ранняя нерка и чавыча учитываются одновременно во второй половине июля. Продолжительность одного вертолетного вылета для их учета составит 5 ч. Горбуша и кета учитываются в третьей декаде августа, потребность в полетном времени — 5 ч. В начале сентября обследуются нерестилища нерки, кеты и кижуча, требуемая продолжительность — 5 полетных часов. В середине октября на нерестилищах фиксируется нерест кижуча и поздней кеты, для чего необходимо использовать еще 5 полетных часов. Итого для обследования всех видов тихоокеанских лососей в бассейне р. Большой требуется 20 полетных часов.

Кроме этого, весьма желательно в конце июня — начале июля обследовать нерестилища ранней нерки озер Начикинского, Голыгинского, Курильского, Камбального, ранней кеты и чавычи рек Опала, Голыгина, общая протяженность транссекты составляет 600 км, потребность — 4 полетных часа. Также желательно провести обследование нерестилищ ранней чавычи средней части западного побережья (реки Воровская, Колпакова и др.) в те же сроки — еще 5 полетных часов (протяженность транссекты — 750 км).

Западное побережье (исключая бассейн р. Большой). Вне зависимости от «горбушевого» или «негорбушевого» сезонов осматриваются практически одни и те же водоемы. Во второй половине июля одновременно учитываются чавыча, нерка. Требуется как минимум два рейса с авиаплощадки г. Елизово на реки Кихчик — Колпакова с общим полетным временем 10 ч. Далее один рейс из пос. Эссо на реки Облуковина — Ича потребует 6 полетных часов. Также одновременно и по такой же схеме в августе учитываются горбуша и кета, в эти же сроки производится и учет поздней чавычи, что требует еще 16 полетных часов. Проведенный анализ показывает, что детально учитывать необходимо только горбушу урожайных линий воспроизводства. В годы подходов неурожайных поколений лимиты горбуши выделяются в качестве прилова к ценным видам лососей, при этом пропуск производителей на нерест минимален и его учеты обладают слишком большой ошибкой (см. выше), чтобы можно было использовать данные в расчетах. В этих условиях, на наш взгляд, для мониторинга динамики заходов горбуши малочисленных поколений на нерестилища достаточно осуществлять ее учет совместно с сопутствующими видами. Во второй половине сентября на нерестилищах учитывается кижуч, поздние нерка и кета. Схема учетов сохраняется, потребность та же — 16 ч. Нерка рек Тигиль, Палана приступает к нересту в конце августа — начале сентября, с учетом дозаправки вертолета в пос. Палана на учет потребуется 7 ч, при этом учитываются еще и горбуша, кета и частично кижуч. В конце сентября — октябре желательно осмотреть нерестилища кижуча в реках Опала, Голыгина — 4 полетных часа.

Восточное побережье (исключая басс. р. Камчатка). В конце августа необходимо обследовать нерестилища лососей в бассейне р. Озерной (восточной), при этом вертолет базируется в пос. Эссо. Учитываются все виды тихоокеанских лососей, кроме кижуча. Далее учеты осуществляются в направлении рек Хайлюля — Ивашка и до пгт Оссора, общий расход полетного времени составит около 7 ч. До недавнего времени в связи с организационными и другими сложностями проведения работ в Карагинском и Олюторском районах (расположение заправочных баз, наличие авиа-горюче-смазочных материалов, сложная метеообстановка и т.д.), в реках, расположенных севернее р. Ивашка, традиционно все виды тихоокеанских лососей учитывались за один разрез. Маловероятно, что эта схема в ближайшем будущем существенно изменится. На обследование обозначенных выше рек в анализе необходимо не менее 30 ч. В дополнение к этому на обследование бассейна р. Вывенка (при базировании в пос. Тиличики) требуются полные 5 полетных часов. Обследование озер Корякского нагорья Илир Гытхын, Потат Гытхын, лагуны Анана, бассейнов рек Пахача, Апука займет не менее 7 ч с учетом дозаправки в пос. Пахачи. В конце сентября — октябре весьма желательно еще раз обследовать нерестилища кижуча в бассейне р. Озерной (восточной), для чего потребуются дополнительные 5 полетных часов.

Бассейны рек Авача, Паратунка, как правило, обследуются по пути следования, но в целом это занимает около 6 ч.

Таким образом, общий необходимый объем полетного времени для обследования нерестилищ тихоокеанских лососей в нерестовых водоемах Камчатки по сокращенной схеме составит около 220 полетных часов (см. таблицу).

По всей видимости, дополнительно около 50 ч необходимо планировать на всякие форс-мажорные обстоятельства, возникающие, кстати, с завидным посто-

Распределение полетных нагрузок по районам Камчатки
Air monitoring efforts (flight frequency) by districts of Kamchatka

Реки	Требуемое полетное время, ч
Западного побережья	88
В том числе р. Камчатка	29
Восточного побережья	130
В том числе р. Большая	70
Всего	**218**

янством. По мере проведения работ неизбежны корректировки сроков осуществления работ, зависящие от характера нерестового хода каждого из отслеживаемого вида лососей, а также от гидрологических условий в реках, метеообстановки, наличия авиа-горюче-смазочных материалов в районах проведения работ и массы других организационных причин. В целом, как правило, работа строится таким образом, чтобы учеты в одном районе с минимальным объемом не функциональных перелетов "перетекали" в работу в другом районе, то же касается и сроков учетов по различным видам.

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