NPAFC
Doc. 1903
Rev.

Russian Bibliography Publications Linked to the NPAFC Science Plan in 2019

by

N.V. Klovach[1], O.S. Temnykh[2], V.A. Shevlyakov[2], S.V.Naydenko[2], A.V. Bugaev[3], V.Yu. Zharikova[4], A.V. Yamborko[5], V.I. Ostrovsky[6], and E.V. Golub[7]

[1]Russian Federal Research Institute of Fisheries and Oceanography (VNIRO)
17, V. Krasnoselskaya St., Moscow, 107140, Russia

[2]Pacific Branch of VNIRO (TINRO)
4 Shevchenko Alley, Vladivostok, 690091, Russia

[3]Kamchatka Branch of VNIRO (KamchatNIRO)
18, Naberezhnaya St., Petropavlovsk-Kamchatsky, 683602, Russia

[4]Sakhalin Branch of VNIRO (SakhNIRO)
196, Komsomolskaya Str., Yuzhno-Sakhalinsk, 693023, Russia

[5]Magadan Branch of VNIRO (MagadanNIRO)
36/10, Portovaya St., Magadan, 685000, Russia

[6]Khabarovsk Branch of VNIRO (KhabarovskNIRO)
13A, Amur Blvd., Khabarovsk, 680028, Russia

[7]Pacific Branch of VNIRO (TINRO)
56, Otke St., Anadyr, Chukotka Autonomous District, 689000, Russia

Submitted to the

NORTH PACIFIC ANADROMOUS FISH COMMISSION

by

Russia

April 2020

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:
Klovach, N.V., O.S. Temnykh, V.A. Shevlyakov, S.V. Naydenko, A.V. Bugaev, V.Yu. Zharikova, A.V. Yamborko, V.I. Ostrovsky, and E.V. Golub. 2020. Russian bibliography publications linked to the NPAFC Science Plan in 2019. NPAFC Doc. 1903. 24 pp. Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), Pacific Branch of VNIRO (TINRO), Kamchatka Branch of VNIRO (KamchatNIRO), Magadan Branch of VNIRO (MagadanNIRO), Sakhalin Branch of VNIRO (SakhNIRO), and Khabarovsk Branch of VNIRO (KhabarovskNIRO) (Available at https://npafc.org).

Russian Bibliography Publications Linked to the Current NPAFC Science Plan in 2019

ABSTRACT

The current bibliography lists original papers published in 2018 by Russian scientists and their collaborators relevant to the 2016–2020 NPAFC Science Plan as well as other salmon studies. The bibliography lists 61 papers, corresponding mainly to the 3 key research components of the NPAFC Science Plan: 1) Status of Pacific Salmon and Steelhead Trout; 2) Pacific Salmon and Steelhead Trout in a Changing North Pacific Ocean; 3) New Technologies; 4) Management Systems. Each publication is listed under one research component, although some of them are relevant to several components. The references are given with abstracts if papers included abstracts in English.

BIBLIOGRAPHY

Theme 1: Status of Pacific Salmon and Steelhead Trout

Alekseyev S.S., Pichugin M.Y., Gordeeva N.V., Samusenok V.P., Yur'ev A.L., Khlystov V.S., Matveev A.N. 2019. Reproductive strategies and the origin of parapatric and sympatric forms of arctic charr *Salvelinus alpinus* (*Salmonidae*) in the system of Lakes Bol'shoe Leprindo and Maloe Leprindo (Northern Transbaikalia). J. of Ichthyology 59 (4): 527–544. (In English). In the system of lakes Bol'shoe Leprindo and Maloe Leprindo (Lena basin, Transbaikalia), spawning of two isolated populations of the dwarf form of Arctic charr *Salvelinus alpinus* was studied. The results supplemented with the data about the exterminated large form from these lakes, demonstrate a unique combination of sympatric and parapatric charr forms with autumn (large form), summer (dwarf form, Bol'shoe Leprindo) and first recorded in Russia winter-spring (dwarf form, Maloe Leprindo) spawning peaks. In both lakes, the dwarf form spawns in the profounder zone at silty bottom at the depth 25–58 m: in Bol'shoe Leprindo, from late June to October with peak in July-August when water temperature is 5–6°C, in Maloe Leprindo from January to July, with peak in January–March when temperature is 2.5–3.0°C. Eggs laid in July–August in Bol'shoe Leprindo develop for 3.0–3.5 months, eggs laid in January–March in Maloe Leprindo, for about 4.0–4.5 month; in both lakes they are actively consumed by burbot Lota lota. Due to smaller egg size the dwarf form has twice as high individual relative fecundity as the large form, which compensates for high egg mortality. It is supposed that the differences in spawning strategies were formed as the result of outcompeting of the dwarf form by the large form from the littoral to the profundal zone, where perennial low temperature favoured the prolongation and displacement of their spawning time. These differences determined reproductive isolation and genetic divergence between three charr populations.

Antonov A.A., Nikitin V.D., Kim Khe Yun, Kostyuchenko K.M. 2019. Assessment of numbers of the spawning areas for Pacific salmon in the basins of Langry and Bolshaya rivers (northwestern Sakhalin). Water life biology, resources status and condition of inhabitation in Sakhalin-Kuril region and adjoining water areas: Transactions of the "SakhNIRO" 15: 38–60. (In Russia with English abstract). The objects of researches were chum and pink salmon spawning grounds in rivers of the north-western Sakhalin. The aim of researches was a preliminary estimation of quantitative characteristics of the spawning areas in basins of Langry and Bolshaya rivers. The following methods were used: aerovisual investigation of the subterranean waters during the winter mean water; field studies on the perspective river sites; on-foot observations to assess sizes of spawning grounds; sampling and biological analysis of salmon spawners; estimation of ichthyofauna state. There was done a preliminary estimation of sizes of the spawning areas in basins of Langry and

Bolshaya rivers (northwestern Sakhalin). The run of the autumn chum salmon continued during researches. Spawning of coho, char and malma occurs simultaneously with the chum salmon. Spawning grounds of Pacific salmon (predominantly pink salmon) are located both in the main riverbeds and their tributaries. A peculiar feature of chum salmon in the mentioned area is their spawning in small tributaries. Salmon spawning grounds are attached to zones of the crumbling banks.

Atamanova I.A. 2019. Habitat conditions and forage resources for juvenile salmon in the coastal area of Aniva Bay Water life biology, resources status and condition of inhabitation in Sakhalin-Kuril region and adjoining water areas: Transactions of the "SakhNIRO" 15: 70–86. (In Russia with English abstract). This paper presents the results of hydrobiological surveys conducted in May–July 2016 in the coastal area of Aniva Bay near the mouth of the Taranai River during the period of fry salmon downstream migration. The data on temperature and salinity were obtained up to the 30-m isobath. Species composition, structure and dynamics of abundance and biomass of zooplankton were determined. The food part of zooplankton was distinguished and its total seasonal production for Aniva Bay was calculated. The comfortable temperature habitat conditions for juveniles in the coastal area have been observed between the first and third decades of June, and in the critical conditions, caused their spatial redistribution, between the first and second decades of July. Biological processes in planktonic community begin to activate by the first decade of June that leads to the increase in biomass, abundance and species diversity. From the second to the third decade of June, a peak of zooplankton biomass has been observed caused by the euphausids reproduction. Zooplankton biomass decreases a little by the first decade of July and zooplankton takes features of the summer stable community with the dominance of copepod plankton.

Barabanshchikov E.I., Lysenko A.V. 2019. Results of salmon fishing season 2019 in Primorsky region. Bulletin of Pacific salmon studies in the Far East 14: 86–92. (In Russian). Downstream migration of Pink, Chum, Cherry salmon and Char in Primosky region is estimated. This data is used to predict and establish allowable catches. Besides, return rates of the above-mentioned species to Primorsky region in 2019 in accordance with biological and environmental information are also presented.

Bragina I.Yu. 2019. Characteristics of zooplankton as forage resources for juvenile salmon in the northwestern part of Aniva Bay in May–June 2014. Water life biology, resources status and condition of inhabitation in Sakhalin-Kuril region and adjoining water areas: Transactions of the "SakhNIRO" 2019. 15: 280–295. (In Russia with English abstract). Species composition and size-weight characteristics of food objects for wild and hatchery-reared juvenile pink and chum salmon were determined from zooplankton samples totally collected in May–June 2014 in the estuaries of Taranai and Mariyka rivers and adjacent area of the northwestern Aniva Bay (Sea of Okhotsk) using a big Juday net. The analysis showed that taking into account species composition, total biomass, abundance, and size characteristics, the estuary of Taranai River and adjacent northwestern part of Aniva Bay should be estimated as the area fit for a successful adaptation of downstream fry migrants to changes in feeding during their sea life period.

Bugaev V.F., Bazarkin G.V. 2019. Formation of the "false annual rings" on scale of juvenile coho salmon *Oncorhynchus kisutch* in the upper tributaries, floodplain old river bodies and lakes of the middle and lower parts of Kamchatka river). Izv. TINRO 199: 64–82. (In Russian with English abstract). Scale structure of yearling coho salmon from several feeding sites in the basin of Kamchatka river (from Puschino Village — 685 km from the mouth — to Nerpichye lake — Kamchatka river outlet) was examined. On emerging from the nests the major part of underyearling coho salmon stock starts quick emigration from the spawning grounds and spreading in Kamchatka River to occupy individual territories. Rest part of the stock stays feeding and

wintering in the area of the spawning grounds (in vicinity Puschino village — Milkovo village). A number of juvenile individuals stays for the feeding and wintering in convenient sites in the tributaries of Kamchatka River. During spring-summer flooding (mid-May–July) underyearling coho salmon migrants with and without scale appear in the old river bodies of the upper and middle part of Kamchatka river (in vicinity of Milkovo village, upper Dolinovka village, upper Taezhnoe settlement, "Dedova Yurta", "Kulpik lake") and in the floodplain and lagoon-estuarine lakes (Kurazhechnoye, Kursin and so on). Local coho salmon never spawn in the lakes and old bodies mentioned, but juvenile coho salmon can be observed round the year. Resumption of the seasonal growth and growing the zones of dense sclerites — the annual rings — on scale of yearling and older juvenile coho salmon (overwintered in the floodplain lakes and old bodies) can be observed in early May and in the end of the second decade of May (in early June in a part of the stock). Scaled coho salmon individuals due to changing the feeding environment in some lakes can have additional zones of dense sclerites of the 1st type on scale. Juvenile coho salmon of the age group 1+ from the old bodies upper Dolinovka village, upper Taezhnnoe settlement, Dedova Yurta", "Kulpik lake" and in the channel Azabachya (in vicinity of Dyakonov brook) can have additional zone of the 2nd type after the annual ring well recognized in late July — August. That effect coincides with the seasonal changes in the character of juvenile feeding. Similar additional zones of the 2nd type were earlier discovered in yearling coho salmon in the lakes Kurazhechnoye, Kursin and Azabachye.

Bugaev V.F., Rastyagaeva N.A., Travina T.N. 2019. About the water temperature effects in the seasonal growth of yearling coho salmon *Oncorhynchus kisutch* in the lower part of the Bolshaya River in 2007–2018. Izv. TINRO 199: 49–63. (In Russian with English abstract). Water temperature effects in the lower part of the Bolshaya River on the body length and number of sclerites after the annual ring in the edge part of scale (in the "plus" part) in yearling coho salmon in case of the "cold" or "warm" year are not very significant. During the growth period the water temperature effects were different depending on criteria of a "cold" or "warm" year. The results obtained can be explained by rather low average water temperatures in the river in spring-summer-autumn period (in May — 6.44° C; in June — 8.80° C; in July — 11.83° C; in August — 12.25° C; in September — 10.10° C; in October — 6.33°C), almost at the lower limit of the optimum for juvenile coho salmon in the range, believing to some researches 11.5–16.8° C. Analysis of the correlation between the date of the catch and the body length of the yearling coho salmon individuals (in terms of July in a "cold" or "warm" year) from the lower part of the Bolshaya river on the data for 2007–2018 has indicated, that during 20–90 days (from the start point May 15) of "warm" year juvenile coho salmon was just slightly bigger (the difference in the mean length on the same dates of the catch was 2–5 mm), comparing in a "cold" year, and the number of sclerites in the "plus' part in yearling coho salmon individuals in different dates of sampling (from May 15) for the period 20–120 days was always higher, than in "cold" years. On the date of sampling "20 days" the increment followed the annual ring on scale was 0.77 sclerites averaged in the "warm" and 0.51 sclerites in the "cold" years, and on the date of sampling "120" — 10.39 sclerites in the "warm" and 10.13 sclerites in the "cold" years. In the "warm" and "cold" years one sclerite for the period 20–120 days has been formed for 10.40 days averaged. Analysis of the correlation between the date of the catch and the body length of the yearling coho salmon individuals (in September of a "cold" or "warm" year) on the data for 2007–2018 for the period from mid-May (0 days) to the end of August (100 days) has demonstrated rather extensive similarity in the body length of the individuals, and the number of the sclerites in the "warm" years in the "plus" part in yearning coho salmon was not always higher, comparing to the number in the "cold" years. The differences revealed in yearling coho salmon in the body length and in the number of sclerites (independently of the criteria for the "warm" or "cold" year) were at the level of statistical errors for the mean values of the body length and the number of sclerites, obtained in the course of processing the data sampled. This is why it is recommended for

the future to carry out analysis of the interannual indices of juvenile coho salmon in the Bolshaya River on a united data pool, without any division into feeding in “warm” and “cold” years.

Bugaev V.F., Bazarkin G.V., Pogorelova D.P. 2019. Formation of the “false annual rings” on scale of juvenile coho salmon *Oncorhynchus kisutch* in the lake Kurazhechnoye (Kamakovskaya lowland in the basin of Kamchatka river). Izv. TINRO 198: 77–92. (In Russian with English abstract). During spring-summer flood (from mid-May to early July) transit underyearling coho salmon with and without scale migrate in the lake Kurazhechnoye (the lower part of Kamchatka river), where local coho salmon never spawns. Scaled individuals, due to their change of the feeding environment, possibly can have additional zones of dense sclerites of the 1st type formed on their scales. Resumption of the seasonal growth and formation of the annual zones of dense sclerites (the annual rings) on scales of yearling and older coho salmon, wintered in the lake Kurazhechnoye, can be observed from early May to the end of the second decade of May (in a part of the juvenile stock it can be in early June). Results of scale structure analysis for the juvenile coho salmon (the age groups 1+ and 2+) in the lake Kurazhechnoye indicate, that after the last annual ring recognized well as late July or August the fish can have additional zones of dense sclerites of the 2nd type. Analysis of the sclerite formation rate in juvenile coho salmon of the age group 1+ samples in the lake Kurazhechnoye in 2001 has indicated, that for the period 13.06-05.07 one sclerite appeared in 9.18 days, for 05-23.07 - in 7.86 days (in 8.52 days averaged).

Bugaev V.F., Pogorelova D.P. 2019. Formation of the “false annual rings” on scale of juvenile coho salmon *Oncorhynchus kisutch* in the lake Kursin (the lower part of Kamchatka river). Izv. TINRO 198: 61–76. (In Russian with English abstract). During spring-summer floods (June–July) transit coho salmon under yearlings with and without scale migrate in the lake Kursin (the low part of Kamchatka river), where local coho salmon never spawns. In view of changing the water body the migrants can have additional zones of dense sclerites (DSZ) of the 1st type. Resumption of the seasonal growth and formation of the annual zones of dense sclerites (the annual rings) on scales of yearlings and older juvenile coho salmon individuals wintered in the lake has been observed in mid-May and early June. Despite the conclusion of G.V. Bazarkin [2003], that in spring-autumn period coho salmon yearlings don’t obtain additional zones of dense sclerites (“false annual rings”) in the lake Kursin on scales, after later analysis of the same data samples we realized that additional structures can occur. Analysis of the scale structure of yearling coho salmon in the lake Kursin has demonstrated that after the first annual ring well recognized in the end of July or August there can be an additional zone of dense sclerites of the 2nd type. Possible explanation of previous underestimation of the additional zones can be due to immediate reading and measuring the fish scales at a high resolution (113-fold), instead preliminary reading at less resolutions (35-50-fold), when the edges of both certain or uncertain zones can be recognized better. Revised research of the sclerite formation rate in juvenile coho salmon of the age group 1+ in the lake Kursin from the samples of 2001 has demonstrated that for the period 09.06-01.07 one sclerite appeared in 15.60 days; for 01-21.07 - in 7.52 days and in 21.07-30.08 - in 7.94 days (in 10.35 days averaged). The rate revised is higher comparing to results published earlier.

Bugaev A.V., Shpigalskaya N.Yu., Zikunova O.V., Artukhiha N.B. Feldman M.G., Shubkin S.V., Kovalenko M.N. 2019. Analytic review of the results of salmon fishery campaign 2019 (Kamchatka territory). Bulletin of Pacific salmon studies in the Far East 14: 23–52. (In Russian). Analysis of the results of salmon fishery campaign is provided for 2019.

Busarova O.Yu., Koval M.V., Esin E.V., Markevich G.N. 2019. Trophic segregation in multispecies community of *Salmonids* in the Penzhina river lower course (Kamchatsky krai, Russia). Nature Conservation Research 4 (2): 83–94. (In Russian with English abstract). Trophic relationships are presented for the juveniles of *Coregonus sardinella*, *C. subautumnalis*, *C.*

pidschian, *Prosopium cylindraceum*, and *Thymallus arcticus mertensii* jointly inhabiting the Penzhina River lower reaches in summer. This community has no analogues in the North-Okhotsk region in terms of freshwater salmonid diversity. We analyzed the stomachs content, indicative parasites infestation and stable isotopes ratio in the muscles. We demonstrated the similarity of food niches for the following pairs of species *P. cylindraceum - T. a. mertensii* and *C. sardinella - C. subautumnalis*. The summer diet of the species pair *P. cylindraceum - T. a. mertensii* mainly consisted of chironomid larvae. At the same time, mysids dominated in the diet of the species pair *C. sardinella - C. subautumnalis*. *Coregonus pidschian* mainly fed on gammarids. The following parasites have been found in juvenile fishes: *Chloromyxum tuberculatum*, *Myxobolus spp*., *Proteocephalus longicollis*, *Triaenophorus nodulosus, Diplostomum sp., Metecercaria spp., Pronoprymna petrowi, Cystidicola farionis, Salmonema ephemeridarum, Raphidascaris acus, Pseudocapillaria salvelini, Echinorhynchus cotti, and Salmincola extensus*; herewith, the intensity of invasion was low for all parasites. Only *T. a. mertensii* has been infested by *C. tuberculatum, T. nodulosus*, and *C. farionis*. Only *C. pidschian* was infested by *P. longicollis*. Only *C. sardinella* and *C. subautumnalis* have been infested by *P. petrowi*, while *Salmincola extensus* has infested only *P. cylindraceum* in the studied ecosystem. *Thymallus arcticus mertensii* and *C. pidschian* are significantly different from other fish species in term of infestation by the helminths *E. cotti* and *P. salvelini*. In the δ 13C-15N isotopes space, the fish juveniles formed three groups: 1) with high 15N level (*C. sardinella - C. subautumnalis*), 2) with low 13C level (*C. pidschian*), and 3) with low 15N - high 13C level (*P. cylindraceum - T. a. mertensii*). The complexity of trophic relationships of juvenile salmonids in the River Penzhina and an increased feeding competition in the species pairs threaten the functioning of the unique River Penzhina *salmonid* community under the conditions of extreme fishing pressure in the Northern Far East.

Glubokovsky M.K., Marchenko S.L. 2019. On the issue of life strategy formation in Pacific salmon of the genus *Oncorhynchus* (*Salmonidae*). J. of Ichthyology 59 (4): 516–526. (In English). Data on life strategies of Pacific salmon of the genus *Oncorhynchus* are reviewed, and possible mechanisms of their realization in the ontogeny are discussed. Reproductive success and maintenance of intraspecific diversity are provided due to synchronization of maturity dates in the individuals with different life strategies. The following hypothesis is proposed. A complex of factors determining the ontogenetic vector of the individuals is not restricted by temperature, food availability, or accessibility of rearing areas. The key factors for realization of a certain life strategy are the presence of essential carotenoid pigment astaxanthin in rearing areas and physiological ability of the fish for its assimilation and accumulation. Relations between the life strategies in different species and populations of Pacific salmon and sex composition of individuals with different life strategies are mainly determined by astaxanthin availability.

Golub' E. V., Golub' A. P. 2019. The research and harvest of the Pacific salmon in Chukotka in 2019. Bulletin of Pacific salmon studies in the Far East 14: 80–85. (In Russian). The results and problems of salmon fishing in 2019 in Chukotka Autonomus Region are presented.

Golub' E.V., Golub' A.P. 2019. Traumatization by lampreys of sockeye salmon *Oncorhynchus nerka* (Walbaum, 1792) of Meynypil'gyn lake-river system (Koryak coast of Chukotka). Izv. TINRO 198: 3–18. (In Russian with English abstract). Data on traumatization of sockeye salmon *Oncorhynchus nerka* spawners in the Meynypil'gyn lake-river system by lampreys are presented on results of observations in 1998–2018. Features and localization of injuries are described comparing the injuries of males and females and biological parameters of fish with and without the injuries. In the Meynypil'gyn lake-river system, relative to other areas of Russian Far East, the portion of fish with injuries from lampreys is medium for sockeye salmon, and low for pink salmon *Oncorhynchus gorbuscha* and charr *Salvelinus malma.* Judging by size of the wounds, the injuries were caused mostly by arctic lamprey *Entosphenus tridentatus.* Generally, about 68 % of

sockeye spawners were attacked by lampreys during their pre-spawning migrations just before entering the fresh waters, but the percentage (P) depends on length (L) of fish: P = 1.2026L + 1.2192 (R^2 = 0.879). So, the portion of injured fish increased from 2.7 % for the sockeye producers with length < 500 mm to 31.2 % for those with length 671–680 mm. Mean size and weight of the male and female sockeye spawners with traces of lampreys were statistically significantly higher than these parameters for the fish without injuries. The males injured by lampreys were larger than the males without injuries in 18 mm and 295 g, the females – in 5 mm and 80 g, on average. Sockeye females had weaker and less numerous damages, so their portion among the fish with 1 injury was 45.4 %, among the fish with 2 injuries – 42.9 %, among the fish with 3 or more injuries – 37.0 %. Besides, mean size of the injured sockeye increased with a number of injures and for the groups with 1, 2, and 3 or more injures it was for females: 604, 608, and 613 mm, for males: 655, 667, and 674 mm, respectively. Such dependencies of alive fish traumatization on their size are caused by higher mortality of small fish after lampreys attacks. There is concluded that arctic lamprey affects significantly on sexual and size composition of sockeye spawners in the Meynypil'gyn lake-river system providing selection of fish with larger size and weight, in particular males.

Gordeev I.I., Klovach N.V. 2019. Free salmon: the difficulty of forecasting the catch of pacific salmons. Priroda 3: 22–27. (In Russian). Pacific salmons are one of the main target species of fishery in the Far East of Russia. In 2018, the historic maximum of their catch was reached; it was amounted of more than 677 thousand tons. Despite close attention and the availability of modern methods of census the abundance and biomass of future salmon generations, scientists are unable to develop an accurate forecast of salmon catch. This is especially true for pink salmon. Every year the number of pink salmon that will take part in spawning is a surprise for us. Unlike other commercially valuable salmons (chum salmon, sockeye salmon, coho salmon, cherry salmon, and chinook salmon), pink salmon mostly depends on environmental conditions due to the characteristics of its biology. The cause of the record catch of 2018, in our opinion, is the quintessence of favorable environmental factors that led to increased survival of salmons at all stages of the life cycle (especially in the marine period of life), good technological equipment of fishery companies, and environmentally conscious bioresource management.

Gorin S.L., Popryadukhin A.A., Koval M.V. 2019. Hydrological processes in a lagoon–channel estuary in the warm season: case study of the mouth of the Bol'shaya R., Western Kamchatka. Water Resources 46 (1): 1–10. (In Russian with English abstract). The results of long-term field studies are used to consider in detail the issues of hydrological regime formation in a lagoon–channel estuary of the Bol'shaya R. in Kamchatka krai, one of the most remote and poorly know Russian regions. A vast factual data set is given to characterize the estuary and the processes taking place in it, as well as the natural conditions under which it exists.

Gorokhov M.N., Volobuev V.V., Golovanov I.S., Zhukov V.G., Kikeev I.V., Korshukova A.M., Makarov D.V., Ostrinsky M.O., Yamborko A.V. 2019. Results of 2019 salmon fishing in the Magadan region. Bulletin of Pacific salmon studies in the Far East 14: 76–79. (In Russian). Salmon fishing in the Magadan region in 2019 lasted for three months - from June 20 to September 22. In 2019, MagadanNIRO recommended the catch of 9,385 tons of salmon. In the course of scientific support for fishing, in accordance with the power of approaches, prepared 4 additional justifications for increasing the possible catch of salmon. The total, additionally justified volume of salmon amounted to 4,215 tons.

Gorokhov M.N., Golovanov I.S., Korshukova A.M., Volobuev V.V. 2019. Biological characteristics, stock status and fishery of pink salmon *Oncorhynchus gorbuscha* (Walbaum) in the Magadan region in the beginning of the XXI century. Studies on aquatic biological resources of Kamchatka and North-west part of The Pacific Ocean 53: 57–66. (In Russian with

English abstract). Results of measuring the major biological indices of pink salmon in two districts of fishing by the lines of even and odd years are demonstrated. Data on pink salmon spawning run dynamics in Shelikhov Gulf and Tauiskaya Bay by the even and odd lines are provided. Shifting of the level of pink salmon spawning runs in Shelikhov Gulf along simultaneous decreasing of the runs in the Tauiskaya Bay is shown. Data on the dynamics of commercial fishing indices in two major areas of fishery are presented. Decreasing role of Tauiskaya Bay as the main area of pink salmon fishery is demonstrated.

Dulenin A. A., Kozlova T. V. 2019. Species of fam. *Salmonidae* in the Botchi River: Current state of the resources and possible fishery. Bulletin of Pacific salmon studies in the Far East 14: 155–166. (In Russian). At the present, a major river in Prymorskiy region within the boundaries of Khabarovsk krai is the Botchi River. Illegal fishing here is supposed to be at low level due to fact that the area is remote and considered as the state guarded natural reserve named "Botchinskiy". Thus, development of the special fishing is favorable at the river. Consequently, sustainable catch of salmon and char could be reached up to half and 26.6 % of their stock respectively.

Elnikov A. N., Lepskaya V. A., Varaksin I. A. 2019. Chum salmon forecasting in the South Kuril Islands. Trudy VNIRO 177: 17–27. (In Russian with English abstract). In this paper, the results of our own research conducted at hatcheries of Iturup Island during spawning approaches of chum salmon in 2014-2018 and results of the analysis of literary data on reproduction and fishery of chum salmon *Oncorhynchus keta* near the South Kuril Islands are given. Despite the existence of modern methods for assessment of abundance and biomass of future generations, the forecasts of Pacific salmon catch are often incorrect. Now the main problem of forecasting system is associated with critically insufficient volume of data. The forecast errors are largely related to inadequacy of methods for determination of a share of fish released from different hatcheries. In our work, to forecast catch of hatchery- rearing chum salmon in 2019 and 2020, the method of calculation of return abundance for various age groups is used (by coefficient of return from released juveniles with further splitting on annual classes by the rate of maturing). The proposed method of calculation is compared to the methods developed by other specialists of fishery science. The analysis of information collected for assessment of chum salmon stock allows to suppose that quality control of biofishery statistics will increase the forecast accuracy.

Esin E.V., Markevich G.N. 2019. Parallel late ontogeny transformations in contrasting landlocked phenotypes of *Salvelinus malma* (*Salmonidae*) from small volcanic lakes. Ecology of Freshwater Fish 28(4): 624–638. (In English). A rapid phenotype deviation is a common population response to atypical environmental conditions in aquatic animals. However, the implications for adaptive specialization, stochastic segregation and ancestral traits fixation in the stress-induced phenotype transformation are not clear. Here we cross-analyze the populations of commonly fluvial Dolly Varden charr *Salvelinus malma* multiply locked in small lakes (< 1 sq. km) throughout Kamchatkan volcanic range to assess the ratio of (non)parallel outcomes of phenotype specialization under stress conditions. The growth rate and definitive size parameters show a twofold difference in six populations inhabiting the same resource-poor lakes. An inter-population comparison revealed a weakly pronounced morphological similarity - no directional vector towards lacustrine lifestyle is detected in body and skull shape. Local morphotypes experiencing random segregation and ancestral fixation processes inherit the unique morphometric, meristic and cranial characteristics. The most ancient populations are characterized by the most paedomorphic exterior and archaic anatomical peculiarities. Parallelism in population structure manifests itself in growth acceleration of some mature or maturing individuals resulting in two distinct size groups with different allometric body proportions. Small fish (50–260 g, average age 6–7 years) feed on invertebrates throughout their life, while the biggest ones (290–780 g, average age 8 years) switch to

cannibalism. This transformation does not lead to any inherited sympatric polymorphism. Thus, we did not reveal any common vector of the stress-induced specialization; adaptive phonotypes are strongly influenced by the resource dynamics.

Esin E.V., Mel'nik N. O., Zlenko D.V., Shkil' F.N., Markevich G.N. 2019. Sympatric diversification of Dolly Varden *Salvelinus malma* (Salmonidae) in an extremely small ecosystem. J. of Ichthyology 59(6): 958–961. (In English). A planktivorous form of *Salvelinus malma* characterized by lacustrine winter spawning was discovered for the first time in north-east Asia in an isolated water system with an area of 0.23 km². This form dwells in sympatry with the benthivorous form of the same species, which reproduces in autumn in the lake tributary. Given the size of the ecosystem, a single isolation event, and the absence of other fish species, this example of ecological diversification can be recognized as the simplest known in the world. The data on the growth rate, morphology, and feeding of two sympatric forms are presented.

Feldman M.G., Shevlyakov E.A., Artukhina N.B. 2019. Evaluation of Pacific salmon *Oncorhynchus* spawning escapement landmarks for the river basins of West Kamchatka. The researches of the aquatic biological resources of Kamchatka and of the north-west part of the Pacific Ocean 52: 50–78. (In Russian with English abstract). The article is the third and the last part in the series of articles, devoted to evaluation of the Pacific salmon spawning escapement for the rivers of Kamchatka region. In the first article we analyzed rivers of the Petropavlovsk-Commander fisheries subzone in the south-eastern part of Kamchatka peninsula (Feldman et al., 2016). In the second – we proposed landmarks for Pacific salmon spawning escapement for the rivers of North-Eastern Kamchatka (Feldman et al., 2018b). In this article we demonstrate the landmarks for Pacific salmon spawning escapement into the rivers of West Kamchatka, separated into the southern Kamchatka-Kurile and northern West-Kamchatka subzones.

Izergin L.I. 2019. Juvenile chum salmon distribution characteristics in the mixogalin Ola lagoon (the Taui bay, the Sea of Okhotsk). Vestnik KGTU 50: 89–97. (In Russia) The study results of Pacific salmon juveniles distribution in the estuary zone of the Ola River in summer 2004 are discussed. The material for the study was based on the data of a Pacific salmon juveniles quantitative distribution survey and on the data of hydrological and hydrochemical studies. The collection of ichthyological material was carried out by means of a fry Seine. Abiotic characteristics such as temperature, salinity, electrical conductivity and turbidity were determined on 20 sites of the Olsky lagoon. During comparative study of changes in environmental factors and quantitative accounting of fish the regularities of juvenile chum salmon distribution in the estuary zone of the Ola river were revealed. It is noted that the juvenile chum salmon distribution depends on the influence of abiotic factors, and for fish at different stages of stratification, different abiotic indicators are decisive. At the stage of presmolts chum salmon juveniles are quite sensitive to salinity, later – to temperature, causing a decrease in the amount of dissolved oxygen. Stratified juveniles prefer sea salinity and are no longer found at 25‰ and below.

Lepskaya E.V., Koval M.V., Tepnin O.B., Bugaev V.F., Bonk T.V., Shaburov A. Yu. 2019. Kokanee salmon (*Oncorhynchus nerka* Walbaum) of commercial size in the Tolmachev water reservoir and in the water objects of the cascade of the Tolmachev HPW (biology, distribution, specifics of fishing, prospects of commercial importance resumption) Salmon. Bulletin of Pacific salmon studies in the Far East 14: 204–210. (In Russian). The Tolmachev water reservoir is a plot of commercial fishing exploited by the artel "Peoples of the North" and estimated by the used as promising in view of development of sport and amateur fishing. The object can be reached by land transport only, what makes it more attractive for legal tour companies. In this connection the information whether the object has or not an attractive sport fishing species, what biological characteristics and distribution it may have in the local waters, is highly required. On the

other hand the Tolmachev water reservoir is the vital part for the cascade of the Tolmachev hydropower stations, currently having in the local water bodies a stock of kokanee salmon with impressive body length for populations of such type – over 20 cm (conventional commercial size/ a trophy scale). In this paper we demonstrate current distribution of kokanee salmon in the waters of the reservoir and the cascade of small HPSs and biological characteristics of kokanee salmon of conventional commercial body length. It has been shown, that for the period 2011-2019 the kokanee salmon "trophy scaled" individuals and the population in the whole don't have helminths and parasites dangerous for human health (neither in the body cavity nor in the internal organs or muscles). The filets of the Tolmachev kokanee salmon stock is a full source of irreplaceable fatty acids, and the level of the organochlorine pesticides (OCP) and polychlorinated bipheniles (PCBs) in the fish is same as background everywhere in freshwater bodies of the world. These three factors altogether make the Tolmachev kokanee salmon stock highly attractive object for sport and amateur fishing, dietary kitchen or making gourmet meals.

Kaev A.M., Romasenko L.D., Kaev D.A. 2019. Characteristics of pink salmon growth rate at the first year of life from their returns to the southeastern coast of Sakhalin Island and Iturup Island in 2017. Bulletin of Pacific salmon studies in the Far East 14: 226–229. (In Russian). There were studied scale patterns (numbers of circuli on scales and circulus spacing) from 187 and 194 fishes collected in 2017 respectively on southeastern Sakhalin and Iturup Island (3 patterns from 100 fishes in each area). The average number of circuli in the first year zone (FYZ) was reliably smaller ($F = 17.0$; $p < 0.001$) in fish from Iturup Island, although differences by this character in fish from different samples were statistically significant. Nevertheless, the profile of all FYZ circuli was similar within each of the areas (Sakhalin: ($F = 2.1$; $p > 0.05$; Iturup ($F = 1.4$; $p > 0.05$), but differed greatly in fish from different areas ($F = 18.6$; $p < 0.001$). At the same time, the intra-areal variability of the circulus formation points once again that when revealing growth peculiarities of fish from different spawning areas we should use patterns of scales collected during the same years, since the changing conditions of fish feeding may affect significantly the scale structure.

Kaev A.M. 2019. Critical remarks to publications on reproduction of Pacific salmons in the rivers of northern Sakhalin Island. Izv. TINRO 198: 19–32 (In Russian with English abstract). Results of long-term studies of pink salmon reproduction (spawners run to the rivers, fry downstream migration and adults returns, their survival during the freshwater and marine periods) are widely presented for southern Sakhalin and southern Kuril Islands but were not published until nowadays for northern Sakhalin because of many uncertainties in the data. New series of scientific articles published by A.A. Zhivoglyadov with co-authors pretends to fill this gap, but they content a lot of errors and inaccuracies, so both presented data and conclusions should be considered very carefully.

Kaev A.M. 2019. Some results from studies on number dynamics of pink *Oncorhynchus gorbuscha* and chum *O.keta* salmons on the northwest coast of Sakhalin Island. J. of Ichthyology 59 (5): 743–753. (In English). The data characterizing the number of separate generations of pink salmon *Oncorhynchus gorbuscha* and chum salmon *O. keta* on the northwest coast of Sakhalin Island (harvest volumes, entries of spawners into rivers and the subsequent downstream migration of the juvenile fish) are analyzed. According to the dynamics of harvests and biological indicators of fish, it has been shown that fishing is based on the approaches to the shore of different groups of these fish species. If the presence of groupings for chum salmon is associated with the migration of fish of different races (summer and autumn) and of different origin (from the Amur River and small rivers of the northwestern coast of Sakhalin and the adjacent mainland coast), then it is mainly due to the approach of fish of local origin but of different temporal forms for pink salmon.

Kaev A.M. 2019. Some results from studies on number dynamics of pink salmon *Oncorhynchus gorbuscha* on the northeast coast of Sakhalin Island. J. of Ichthyology 59 (6): 672–680. (In English). Data characterizing the number of individual generations of pink salmon *Oncorhynchus gorbuscha* (the volume of harvest, entry of spawners into the rivers, and subsequent downstream migration of fry) in the northern and southern regions of the northeast coast of Sakhalin Island are analyzed. The analysis of the ratio of the number of spawners on spawning grounds to juvenile salmon migrating downstream suggests that the efficiency of reproduction in the mountain pink salmon-type rivers of the southern part of the coast is higher than in the relatively large plain rivers of the northern part. It has been shown that the growth in the number of pink salmon observed in recent years was mainly due to an increase in the survival of generations during the marine period of life.

Kaev A.M. 2019. Some population dynamics issues on pink salmon *Oncorhynchus gorbuscha* temporal forms on Sakhalin and the southern Kuril Islands. J. of Ichthyology 59 (4): Pp. 583–590 (In English). Population dynamics of early and late temporal forms of pink salmon *Oncorhynchus gorbuscha* on the Iturup and Kunashir islands (southern Kuril Islands) and on the southeastern coast of Sakhalin in 1991–2017 is considered. The periods of the increase and decrease in the abundance of pink salmon in odd and even years occurred simultaneously. However, the duration of periods with high abundance of the early form was shorter. The sharp decrease in the abundance of each of the temporal forms was often due to the effect of extreme environmental factors (flash floods in rivers that wash out the soil on spawning grounds or storms in the coastal zone during the feeding period of juveniles that had recently migrated downstream from the rivers); however, the causes remained unclear in some cases. The abundance of the early form tends to decrease more intensively or one to two generations earlier than the reduction of the more numerous late form; therefore, the emergence of depression signs in the early form may indicate the coming general depression of pink salmon stocks in the area under study.

Khristoforova N.K., Litvinenko A.V., Tsygankov V.Yu., Kovalchuk M.V., Erofeeva N.I. 2019. The trace-element content in the pink salmon *Oncorhynchus gorbuscha* (Walbaum, 1792) from the Sakhalin-Kuril region. Russian Journal of Marine Biology 45(3): 221–227. (In English). The contents of the trace elements Hg, Cu, Pb, Cd, Zn, and As were measured in the pink salmon *Oncorhynchus gorbuscha* (Walbaum, 1792), a common Pacific salmon species, which was kept in the net-pens of the Reidovy (Iturup Island) and Firsovka (Sakhalin Island) fish hatcheries in October 2016. The levels of the toxic elements Cd, Pb, As, and Hg in the pink salmon from the Sakhalin–Kuril region were found to meet the official health standard norms for seafood in the Russian Federation. At the same time, they were a few times higher than that in the pink salmon from ocean waters off the Kuril Islands during its anadromous migration and dozens of times higher than in the fish from the Sea of Japan that were caught off the Primorsky Krai coast during the pre-spawn period in different years. The greatest differences were recorded for lead, whose concentration in the muscles, liver, and eggs of the fish from the rivers of Iturup and Sakhalin was, respectively, 50, 40, and 60 times higher than that in the pink salmon from the Sea of Japan. The only trace element whose level in the pink salmon from the Sea of Japan exceeded that in the fish from Sakhalin and the Kuril Islands was zinc.

Kirillova E.A. 2019. Results of quantitative assessment of seaward migrating fry of Pacific salmon in the Malaya Khusi River (north-east of Sakhalin). Bulletin of Pacific salmon studies in the Far East 14: 211–215. (In Russian). Following the results of quantitative assessment in the Malaya Khusi river, total number of seaward migrating pink salmon *Oncorhynchus gorbuscha* fry was 6.5 mln and 0.006 mln of chum salmon *O. keta*. Seaward migration of pink salmon had started not earlier than the II ten-day period of May and terminated in the I ten-day period of July. Maximum of the migration was registered in June 14^{th}–15^{th}. Increase of migration intensity was

caused by strong rainfall flood. Over 50% of pink salmon fry had migrated from the river by this date. At stable hydrological conditions intensity of migration varied due to water temperature fluctuations. Seaward migration of pink salmon was nocturnal. Daylight migration had occurred if transparency of water decreased to a great extent. Mean body length and weight of pink salmon fry were, accordingly, 31.4±1.04 mm and 0.181±0.029 g. These traits didn't undergo significant changes during the period of migration. In general, 18 % of pink salmon fry had remnants of yolk sac. Massive seaward migration of chum salmon in the Malaya Khuzi River was discovered at the first time throughout 6 years of observations. The fact of survivance and seaward migration of chum salmon fry in untypical river for this species proves the possibility of effective reproduction of chum salmon in small rivers of southern part oa North-Eastern coast of Sakhalin. Colonization of small rivers by chum salmon occurred due to unprecedented high number of breeders in 2018. Seaward migration of chum salmon begone in the III ten-day period of June and was over by the end of July. Maximal diurnal number of fry was registered in July, 7th. Increase of migration intensity was associated with warming-up of water and lowering of water level. The migration took place at nighttime and was passive, but it is highly probable that some part of chum salmon fry migrated actively at the day time or avoided the trap at night. That is the species-specific pattern of chum salmon seaward migration. Body length and weight of chum salmon fry varied in a wide range. It's mean length and weight were, accordingly, 33.5±3.38 mm and 0.297±0.166 g. The registered number of pink salmon fry coherent with the data on the number of breeders on the spawning grounds in Malaya Khuzi in 2018 and obtained earlier results of revision of spawning area in this river. Location and description of spawning grounds of chum salmon is a high-priority task to survey.

Kolpakov N.V., Kotsyuk D.V., Podorozhnyuk E.V., Ostrovskiy V.I. 2019. Results of salmon fishing season in Khabarovsk krai in 2019. Bulletin of Pacific salmon studies in the Far East 14: 53–64. (In Russian). Preliminary forecast of salmon and char stocks in Khabarovsk krai in 2019 should be admitted satisfyingly (it worked out 77.5 %), except the forecast of summer chum salmon (16.8 %) and pink salmon abundance in the Amur River (35.8 %) respectively. Initial value of the predicted salmon catch (taking into consideration that the commercial catch of summer salmon forms in the Amur River was banned) was made up to 72.9 %. Fishing effort on salmon and char in Northern Okhotsk sea zone achieved high level (especially in Okhotsk sea zone), which may require to impose additional restrictions to provide an optimal level of salmon escapement. Abundance of summer chum salmon, after being increased in 2008–2018, dropped to interannual level. Meanwhile, abundance of autumn chum salmon was also decreasing, but with lower rate. Unfavourable hydro meteorological conditions led to significant under exploitation of the quota allocated for the autumn chum salmon form, but at the same time it provided the salmon escapement required for effective salmon production at the spawning grounds. In summary, the introduced fishery restrictions were successful in improving this situation.

Koval M.V., Gorin S.L. 2019. The Role of environmental conditions in various types of estuaries for the productivity of Pacific salmon populations of Kamchatka. NPAFC Technical Rep 15: 90–93. The analysis of information about the main area of reproduction and fishing of Pacific salmon in the Kamchatka region and our data suggests that the survival of Kamchatkan Pacific salmon during the early marine period of their life cycle is directly related to the specific hydrology-morphological conditions they are exposed to in the various types of estuaries. These conditions also could determine the distribution, biological particularities, and reproduction level of Pacific salmon populations which would specifically affect salmon fisheries in the different areas of Kamchatka peninsula.

Klovach, N.V., O.S. Temnykh, V.A. Shevlyakov, A.V. Lysenko, E.V. Golub, O.V. Burlak, A.V. Bugaev, A.M. Kaev, I.S. Golovanov, V.I. Ostrovsky. 2019. Biostatistical

information on salmon catches, escapement and enhancement production in Russia in 2019. NPAFC Doc. 1836 (Rev. 1). 4 pp. (Available at https://npafc.org). Biostatistical Information on Salmon Catch, Escapement and Enhancement Production in Russia in 2019 is given.

Klovach N.V., Leman V.N., Gordeev I.I. 2019. Salmon Iturup Island: history of fishing and artificial reproduction. Bulletin of Pacific salmon studies in the Far East 14: 174–184. (In Russian). Iturup Island is one of the significant reproduction areas for Pacific salmon and the largest center for the artificial reproduction of chum salmon in the Russian Far East. Catches of chum salmon on the Iturup Island are comparable with the catches at the large areas of reproduction, such as Kamchatka Peninsula, Sakhalin Island, Amur River and the mainland coast of the Sea of Okhotsk. At the same time, at the present stage, almost all of the chum salmon on Iturup is the product of salmon hatcheries. The stocks and catches of pink salmon, on the contrary, practically do not depend on the production of juveniles, and follow weather, as in all other regions of the Far East. In this thesis work we analyze our own data and literary sources, which make it possible to explain the phenomenon of the exceptional success of the artificial breeding of chum salmon on Iturup and the reasons for the sustainable natural reproduction of pink salmon.

Kolpakov N.V., Kotsyuk D.V. 2019. Crisis of fishery in the Amur River basin. Quantitative analysis of fishing sites. Bulletin of Pacific salmon studies in the Far East 14: 93–105. (In Russian). Fishery effort on the Amur River basin exceeded acceptable level while total number of fishing sites was 315–320, including commercial ones – 165–170. In 2018 total number of fishing sites was 365 in the Amur River basin, including commercial ones – 200. Therefore, it is necessary to decrease number of fishing sites by 20–25 % (to reach 280–300 in total and 150-160 commercial sites respectively). Partially, it can be done by declining fishing sites which contract terms were almost over. Besides, dialog is required between business entities and Federal Fishery agency. Additionally, a decrease of fishing sites participated in fishery 2019 is necessary to implement and can be negotiated through the decision of the fishery anadromous commission. Thus, it is only required to provide mechanism of choosing these fishing sites. Accordance of the fishing sites to the new fishery rules can be completed only after publishing the last ones. In case of appeared problems on the sites – they can be removed from fishery by commission decision through the disapproval the places for setting fishing gear or refusing salmon fishing quotas.

Kornev S.I. 2019. Larga seal (*Phoca largha*) and it`s influence on Pacific salmon resources in the mouth of Ozernaya river (the Okhotsk sea coast of Kamchatka) in 2017-2018. The researches of the aquatic biological resources of Kamchatka and of the north-west part of the Pacific Ocean. 54: 58–73. (In Russian with English abstract). The effects of largha seal in the estuary zone of the Ozernaya river was evaluated. Data on traumatizing of salmon by different predators were analyzed, consumption of salmon by largha seals in the estuary zone was evaluated. A review on the literature data is provided concerning the problem of protecting the catches from marine mammals; it is suggested to work out a method of protecting the catches from largha seal predation, appropriate for conditions in Russian Far Eastern seas.

Korshukova A.M., Ostrinski M.O., Smirnov A.A. 2019. Anadromous form of bulltrout *Salvelinus malma* of the Magadan Region: ecology, current stocks state, and trade prospects. J. Rybnoe khozyajstvo 2: 39–43. (In Russian with English abstract). Some features of biology, the current stock state and trade prospects for the anadromous bull trout of the Sea of Okhotsk coast of the Magadan Region are considered based on materials collected in 2009–2018. A brief biological characteristic of its age and size-weight indicators is given.

Kuzishchin K.V., Gruzdeva M.A., Pichugin M.Y., Pavlov D.S. 2019. Features of the changes in external morphology and axial skeleton in juvenile *Salmonid* fishes (*Salmonidae*) associated with smoltification. J. of Ichthyology59 (5): 664–679. (In English). Changes in

external morphological characters and relative lengths of vertebral centra from different regions of the vertebral column are analyzed during smoltification in wild juveniles of five salmonid fish species: Atlantic salmon *Salmo salar*, brown trout *S. trutta*, mikizha *Parasalmo mykiss*, coho salmon *Oncorhynchus kisutch*, and northern Dolly Varden *Salvelinus malma*. The changes in the body proportions and external morphology are similar in different salmonid species, but the patterns of differentiation of the vertebral column's postanal part are different. In Atlantic salmon, all vertebral centra of the postanal part are subject to elongation; in mikizha and brown trout, a small number of the centra are elongated only in the anterior region of the postanal part; in coho salmon, the centra are elongated in the posterior region of the postanal part; in Dolly Varden, the centra are elongated in the middle region of the postanal part. Thus, despite observed universal changes in external morphology associated with smoltification in the family *Salmonidae*, the development of future marine migrants' phenotypes is species-specific due to different growth of various groups of vertebral centra in the vertebral column's postanal part. The possible reasons for the species diversity in the growth of various groups of vertebral centra are discussed.

Lepskaya E.V., Bonk T.V., Sushkevich A.S., Kurbanova L.V., Koval M.V., Lozovoy A.P., Kozhevnikov A.V., Kolomeytsev V.V. 2019. Plankton in the off-shore of benchmark basins of pink salmon *Oncorhynchus gorbuscha* reproduction on west Kamchatka. The researches of the aquatic biological resources of Kamchatka and of the north-west part of the Pacific Ocean 53: 22–33. (In Russian with English abstract). The hydrological and hydrobiological survey carried out in early June of 2018 on the west coast of Kamchatka at a banhmark plot with the depth less than 20 m has it indicated, that oxygene and temperature conditions and the start point density of "forage" zooplankton of 313 mg/m³ provided favorable environment for juvenile pink salmon feeding in early marine period of life history. Three districts of high production were revealed in the course of the survey, including the southern, formed on the plot affected by the waters from the Bolshaya River, and two northern within cold marine water masses. The emphasis is made on the need to find methods, aside of the hydrological and hydrobiological monitoring, for assessment of the number of juvenile Western Kamchatka pink salmon and on competitors for the forage objects in the period of early marine feeding.

Litvinenko A.V., Khristoforova N.K., Grinberg E.V. 2019. Traditional and modern approaches to artificial reproduction of Kuril region Pacific salmon. J. Rybnoe khozyajstvo 6: 72–77. (In Russian with English abstract). The salmon fishery factories of Iturup as the biggest island of Kuril ridge are examined. A comparative analysis is performed to compare methods and conditions of salmon's artificial reproduction in old "traditional" factories and ones being built in the last decade. It is established, that in both cases a traditional biotechnology of artificial reproduction is in use, but the way of breeding and output differs, as well as the technology of facilities watering. All of the studied fish farming facilities work with traditional objects - humpback salmon and Siberian salmon, but one of them, "Ozero", reproduces a lake ecotype of Siberian salmon. Being under optimal natural conditions and using the same biotechnology all of the studied facilities are characterized with high efficiency, which can be accessed via number of returned producers.

Lozovoy A.P., Smorodina L.N. 2019. An assessment of the juvenile sockeye salmon stock and a joint fish community in the coastal waters of Western Kamchatka in July–August of 2019. Bulletin of Pacific salmon studies in the Far East 14: 230–236. (In Russian). General results of the research of juvenile sockeye salmon and the other Pacific salmon species, accomplished by Kamchatka branch of "VNIRO" ("KamchatNIRO") on the R/V MRTK-316 in the coastal waters of Western Kamchatka in July-August of 2019 are demonstrated. The main purpose of the research was an assessment of the number of juvenile Pacific salmon (first of all juvenile sockeye salmon of the Ozernaya River) and analysis of the composition of the fish community, including the number distribution of the mass fish species.

Makoedov A.A., Nikitin V.D., Ignatyev Yu.I., Antonov A.A., Kovtun M.V. 2019. Some results of pink and chum salmon fishery in the Sakhalin-Kuril region in 2019. Bulletin of Pacific salmon studies in the Far East. 14: 65–75. (In Russian). Traditionally, pink salmon takes the first place in the Sakhalin-Kuril salmon fishery. However, in 2019, its catch, for the first time, appeared to be significantly smaller than chum salmon – the second-numbered species. At the forecasted pink salmon catch of 41,960 t, the actual catch was 28224 t (67.2 %). The pink salmon catch was lower than that of forecasted one in all of the basic fishery areas. The chum salmon catches in the Sakhalin-Kuril region were presented mainly by the hatchery-reared fish. In 2019, 0.02 to 41.52 million ind. (709.07 million ind. in total) were released into 62 water bodies. Even if taking into account a catch of the transient chum salmon along the northwestern Sakhalin and Kuril Islands, about 80% of fish in the total catch were provided by the activity of the local hatcheries. At the forecast of 39,951 t, the chum salmon catch was 46,384 t (116.0 %) that is close to the historical maximum (47.4 thousand tons). The leaders in chum salmon catches were the Iturup Island (26,175 t) and southeastern Sakhalin (8,005 t).

Makoedov A.A., Antonov A.A., Ignatyev Yu.I., Dzen G.N., Frolova S.E., Zakharov A.V., Anisimov D.S., Safronov A.S., Chesnakova S.V., Akhmadeeva E.S. 2019. Some results of quantitative count of fry pink salmon in the rivers of Sakhalin-Kuril region in 2019. Bulletin of Pacific salmon studies in the Far East 14: 106–115. (In Russian). The counting works on juvenile Pacific salmon in the Sakhalin-Kuril region are focused mainly on the pink salmon count assessment. They were conducted in 5 rivers located within the distribution areas for different territorial groupings of this species. The downstream migration index (relationship between spawners and fry migrants) was determined. The results of the count assessment were extrapolated on other rivers with distribution of these groupings. The total number of migrants in the Sakhalin-Kuril region in 2019 was 866.4 million pink salmon. In the cyclic 2017, this index was 864.9 million. Hence, the number of pink salmon migrants from the odd-year generations is approximately at the same level in the Sakhalin-Kuril region and the expected pink salmon return in 2021 will be determined by the conditions in places of feeding.

Milovankin P.G., Starovoitov A.N., Sheibak A.Yu., Ponomarev S.S. 2019. Species structure of the nekton and macroplankton communities during pre-anadromous salmon migrations to the North-western Pacific in 2014–2019. Bulletin of Pacific salmon studies in the Far East 14: 237–245. (In Russian). The presented information is based on data given from research vessel “Professor Kaganovskiy” and “TINRO” during complex trawl survey of upper epipelagic layer in the Northwestern Pacific. In total, 517 trawl catches were made from May to July in 2014-2019 on the survey area which square was estimated at around 1 million km². There were 82 taxons of nekton and macroplankton noted, forming 1314 taxon pairs. Number of the taxons ordinarily varied from 1 to 20, in average 9 taxons in each trawl catch. Every taxon occurred with at least three or maximum – with 70 other ones, in average – with 33 taxons. The top of the most frequent taxon pairs were: *Ph. camtschatica – Ch. melanaster* (45.2 %), *O. keta – O. gorbuscha* (42.5 %), *Ch. melanaster – Aequorea* sp. (41.7 %), *Ph. camtschatica – Aequorea* sp. (41.6 %), *Ph. camtschatica – O. keta* (41.4 %), *O. keta – Aequorea* sp. (40.6 %), *Ph. camtschatica – O. gorbuscha* (40.4 %), *O. keta – Ch. melanaster* (40.0 %), *O. gorbuscha – Ch. melanaster* (39.7 %) and *O. gorbuscha – Aequorea* sp. (39.3 %). However, the most frequent species were: *Ph. camtschatica* (63.4 %), *Ch. melanaster* (54.5 %), *Aequorea* sp. (52.3 %), *O. keta* (51.8 %) и *O. gorbuscha* (48.6 %). In summary, species structure was divided into four species complexes related to the following zones: Kamchatka-Commander basin, Subarctic front zone, inshore and offshore Kuril waters.

Mironova T.N. 2019. Commercial catch of pink salmon in the Sakhalin gulf in 2019. Bulletin of Pacific salmon studies in the Far East 14: 272–275 (In Russian). Less abundant

migrations of pink salmon in the western part of Sakhalin gulf was marked in 2019 in comparison to typical odd years. However, the near optimal escapement to the spawning grounds was revealed, with long-term average number of commercial gear used in the area.

Myakishev M.S., Ivanova V.A., M.S., Kiselev M.A., Zelennikov O.V. 2019. Experimental analysis of modern state of reproduction for cherry salmon *Oncorhynchus masou* at the fish farms of Sakhalin region. Izv. TINRO 198: 195–208. (In Russian with English abstract). Growing of cherry salmon juveniles under two different temperature regimes at the salmon farms Anivsky and Okhotsky in the fish-rearing cycle of 2016-2017 is analyzed. Data on cherry salmon growing for other fish farms of Sakhalin region collected in 1995-2017 are considered, as well. The periods of fish feeding and dynamics of their growth varied significantly in dependence on temperature conditions. The feeding started in April-May at the cold-water fish farms (Anivsky, Lesnoy, Sokolovsky, Urozhainiy) where the water temperature lowered in winter to 0.2-0.3 ¸° C, but in February at Reidovo fish farm where the water temperature were not lower than 2 ¸° C and in January at the most warm-water Okhotsky fish farm with the temperature never lower than 6.5 ¸° C. In accordance with growing conditions, the growth rate of juveniles was high in winter month at the warm-water fish farms, where the ground water was used for rearing, but increased since May-June at the cold-water fish farms using natural heating of the river water. However, several cases were noted when the fish that accumulated less than 500-700 degree-days released from cold-water fish farms in June-July were larger than those from warm-water fish farms. Thus, cherry salmon is the only species among pacific salmons whose juveniles can be successfully grown at any temperature regime and consequently at any fish farm. This ability is reasoned by earlier spawning (along with pink salmon) and long period of development in rivers. At cold-water fish farms, the best results for cherry salmon growing could be achieved with the eggs planting in late August-September, whereas the time of eggs planting is not significant for warm-water fish farms.

Myakishev M.S., Ivanova M.A., Zelennikov O.V. 2019. Marking of salmon juveniles and efficiency of fish farming. Russian Journal of Marine Biology 45 (5): 363–369. (In English). This study deals with the distribution of pink salmon spawners, which were tagged during embryogenesis at the Anivsky salmon farm, in the water area of the Sakhalin region. A majority of the tagged salmon were caught in the Bystraya River near the salmon farm. As well, the pink salmon spawners with the fish farm tag in the otoliths were found all over the water area of southern Sakhalin and Iturup Island. Here, the number of farm-reared salmon that were caught in the common migration routes or settled in the different water courses exceeded the number of fish that returned to the basic river of the Anivsky salmon farm by several times.

Naydenko S.V., Temnykh O.S. 2019. Modern state of salmon stocks in the Far East. Sphere: Fish 22: 48–52. (In Russian). Retrospective information on the status of Pacific salmon stocks in the Russian Far East is shown for several time periods. Pink salmon producers' approaches to the main regional fishing areas over a 37-year period are illustrated and described. The contribution of each fishing regions to the overall salmon catch is reflected. On the example of 2018 fishery season, some results and steps made by fisheries science to achieve high and sustainable management are represented.

Ostrovsky V.I. 2019. Assessment of regulation measures efficiency on the Amur River chum fisheries in 2019. Bulletin of Pacific salmon studies in the Far East 14: 216–220. (In Russian). The Amur River chum fisheries was different from previous years because of strict regulation measures launched to increase fish escapement to spawning grounds. Such strict measures are result of overwhelming commercial pressure on species in 2017, which led to not sufficient spawners number on spawning grounds. Based on stock decrease of summer chum commercial catch was banned in 2019. Escapement days (non-fishery days) for all fisheries types launched for 30 days

of most active autumn chum spawning migration period. On average, 14 non-fishery days were marked for each fisheries site (enterprise). Commercial pressure on chum salmon decreased in a half in comparison to previous years as a result of launched measures: non-fishery days number and early fishery close date. We assess such regulation measures as redundant ones. We have estimated spawner escapement number as 4.5 mln, that is a close to optimal one.

Pogodin V.P., Borzov S.I., Myakishev M.S., Varaksin I.A., Zelennikov O.V. 2019. Experience of two-year rearing of cherry salmon *Oncorhynchus masou* juveniles at fish farm on Iturup Islanḍ. Izv. TINRO 196: 182–192. (In Russian with English abstract). Results of cherry salmon juveniles rearing at Reidovo fish farm on Iturup Island during two annual cycles of cultivation are analyzed. Different variants of the breeders selection, feeding, preventive treatment, and release were tested. The breeders were caught in the river mouth and near the fish farm. Mass mortality of young fish in the first and second years was avoided by decreasing of their density and other preventive measures. Minced fish was used as a food for them that is less expensive in compare with a combined fodder. The best diet for the second year of rearing was the minced pink salmon with the daily ration of 2 % of the juveniles body weight; it provided a significant decrease of mortality and enhanced their growth. After 2-year rearing, percentage of females, anadromous males, and dwarf males was 42.1, 36.3, and 21.6 %, respectively. Their weights were similar, though a group of fast-growing males was found among the dwarfs. The mass of ovaries varied from 13 to 46 mg in close dependence on females' body weight ($r = 0.81$). Before the release, the ovaries of all females contained oocytes of similar size (varied in 2-4 times) at the final stage of previtellogenesis. Number of the oocytes per transverse section varied from 4.7 to 32.3, on average for 5 cuts and their diameter varied from 164.3 to 279.2 mm and did not correlate with the females body weight. The mass of dwarf males' testes varied from 14 to 488 mg in dependence on their body weight ($r = 0.78$). The elder oocytes of females would mature in a year, and majority of dwarf males would reach the maturity in autumn of the current year.

Shevlyakov E.A., Shubkin S.V. 2019. Observations of Pacific Salmon spawning areas in the basins of some water bodies of Chukotka in 2019. Bulletin of Pacific salmon studies in the Far East 14: 199–203. (In Russian). The results of aerial accountings of spawning grounds for Pacific salmon in the Anadyr river basin and the Mainypilgyn lake system are presented. The main concentrations of pink and chum salmon in the main tributaries of the Anadyr river basin are localized. The total number of chum salmon in Velikaya River and Anadyr river basin is estimated. The main sockeye salmon spawners aggregations in Mainypilgyn lake-river system were identified. The spawn timing since the last similar work in this region has been clarified. The results of the accounting work of pink salmon, chum salmon and sockeye salmon in this basin are presented. Aerial accountings on other salmon (Pink, Chum) within Mainypilgyn lake-river system are also represented.

Shubin A. O., Tshay Zh.R., Koynov A.A. 2019. Duration of feeding period for juvenile pink *Oncorhynchus gorbuscha* and chum *Oncorhynchus keta* salmon along northeastern Sakhalin Islanḍ. Water life biology, resources status and condition of inhabitation in Sakhalin-Kuril region and adjoining water areas: Transactions of the "SakhNIRO" 15: 61–69. (In Russian with English abstract). A seasonal SST variability over the northeastern Sakhalin shelf area is evaluated based on the SakhNIRO Tera Scan data. This area appeared to have no favorable conditions for juvenile pink and chum salmon feeding in the summer season. The instrumental oceanological survey carried out aboard the R/V "Dmitry Peskov" in 2002–2003 proves this situation. During the trawl surveys of 1986 and 2002–2003, no juvenile pink and chum salmon of the local origin have been found in July – early August on the shelf area of northeastern Sakhalin out of the coastal line. The absence of juveniles on the shelf area was hypothetically related with their long delay in the narrow coastal zone up to 30 m depth. The trap net observations in the mouth of the

Langeri River in late August 2010 proved this hypothesis. In this relation, to prevent negative impact on juvenile pink and chum salmon because of seismic prospecting on the northeastern Sakhalin shelf area, it is reasonable to impose restrictions for such activities in the coastal zone during the summer season.

Shuntov V.P. 2019. About international year of salmon (nonstandard notes). Bulletin of Pacific salmon studies in the Far East 14: 221–225. (In Russian). Author suggested the direction according to the cooperation related to "International Year of Salmon-2019". There was historical focus presented international collaboration related to NPAFC, under whose auspices the cooperative research marine expeditions were conducted. In this period of the co-research, the understanding of long-term trends in the dynamics of salmon abundance and other nekton species as well as the composition and forage base of nekton communities in the survey area was improved. Hopefully, the further close cooperation will continue not only on the Pacific salmon study through the local national programs and organizations such as PICES or NPAFC, but also on more global international level for exchanging data and developing ideas related to other issues as well.

Sogrina A.V., Kulemeeva I.O., Yakusheva G.D. 2019. Gelminthoses of Pacific salmon in Kamchatka peninsula. Perm agrarian bulletin 2 (26):143–151. (In Russian). Anizakis and diffillibitrium infestations in Pacific salmon had been revealing during many years in Kamchatka territory. The purpose of this research was to examine the distribution of *Anisakis sp*. Saidov, 1956 and *Diphyllobothrium sp*. Cobbold, 1858 in Pacific salmon of Kamchatka, to evaluate the indices of the extensity (EI), the average intensity of the invasions (II) and the abundance index (AI). During 2018 there were collected 225 individuals of mature Pacific salmon from the major spawning sites of Kamchatka territory, including the rivers Bolshaya, Kluchevka, Plotnikova, Avacha and the lakes Azabachye, Kurilskoya and Bolshoy Viluy. Sampling was also provided in the coastal area of Petropavlovsk-Kamchatsky. Muscle tissues of the fish sampled were examined with the method of parallel cutting and compressing. It was revealed *Anisakis sp* larval invasion of *Oncorhynchus nerka*, where the EI was 93.3-100. %, the II and AI were 28.0-46.7. The infestation indices for *Oncorhynchus keta* were as next: the EI – 86.6-100.0 %, the II – 17.5-41.3, the AI – 14.2-41.3. *Oncorhynchus gorbuscha* demonstrated the EI 46.6-65.5 %, the II - 3.4-5.5 and the AI – 1.6-3.6. *Oncorhynchus kisutch* was less infested by larval nematodes: the EI was 30-46.6 %, the II – 3.7-7.3. the AI – 1.7-2.2. Larval *Anisakis sp*. were found in all Pacific salmon individuals in all water bodies examined. The plerocercoids *Diphyllobothrium sp*. were generally observed in *O. keta* from the rivers Bolshaya, Paratunka and Avacha, where the EI was 53.3-60.0 %, the II – 4.8-9.8, the AI – 2.5-5.9. The *Diphyllobothrium sp*. invasion was observed in pink salmon, caught in the Bolshaya river estuary. The EI was 34.5 %, the II – 2.4, the AI – 0.8. *O. kisutch* was infested by *Diphyllobothrium sp*. as next: the EI- 10.0-20.0 %, the II – 2.7-3.3, the AI – 0.3-0.6. The muscles of *O. nerka* from the Bolshaya were infested by the plerocercoids *Diphyllobothrium sp.*, and the EI was 13.3%, the II – 2.0 and the AI – 0.3. As the examination revealed dangerous parasites in Pacific salmon it is necessary to strictly follow the veterinary and sanitary standards for processing and consumption of the fish raw materials.

Somov A.A., Khleborodov A.S., Slabinsky A.M., Hunt B., Pakhomov E.A. 2019. Feeding habits of Pacific salmon in the gulf of Alaska in February–March 2019. Bulletin of Pacific salmon studies in the Far East 14: 185–199. (In Russian). Feeding habits of Pacific salmon in the Gulf of Alaska in 2019 during the winter-spring season are presented. A comparative analysis of salmon diet data obtained during earlier similar studies is given. The composition and spatial distribution of diet components within study are described.

Somov A.A. 2019. Preliminary cruise plan of the research vessel professor Kaganovsky to study the ocean ecology of pacific salmon in the north-western Pacific Ocean in winter 2019.

NPAFC Doc. 1808: 3 pp. (Available at https://npafc.org). The document summarizes trawl survey plan for Pacific salmon marine winter life period studies in the western Subarctic front zone of North Pacific in 2019 by Russia (TINRO-Centre). The outline of materials, methods, surveys timing and theoretical background is provided. According to NPAFC Doc. 1807, R/V "Professor Kaganovsky" is scheduled to conduct the first comprehensive survey of Pacific salmon in the Gulf of Alaska (GoA) in February–March 2019. To make winter monitoring program more comprehensive, it is decided to conduct epipelagic survey in the western Subarctic front zone of North Pacific out of Russia's EEZ in January 2019. The main objectives of the expedition are to identify the stock specific rearing areas for all species of salmon, their abundances, spatial distribution and their condition. Scientific group consists of 7 specialists from Russia. After the survey is finished, the vessel is heading to Vancouver, BC to take on board scientists from other NPAFC-member countries. Then the vessel is heading to the GoA.

Starovoytov A.N., Sheibak A.Yu., Chulchekov D.N. 2019. The composition of nekton communities during pacific salmon pre-anadromous migrations and the results of trawl survey for estimation of abundance of pink salmon (*Oncorhynchus gorbuscha*) in the north-western Pacific Ocean in May–July 2019. Bulletin of Pacific salmon studies in the Far East 14: 140–145. (In Russian). As a result of a trawl survey performed in the Pacific waters of the Kuril Islands within the EEZ of the Russian Federation and outside the external border of the EEZ of the Russian Federation, the abundance and biomass of all representatives of nekton and macroplankton were determined. Peculiarities of the spatial distribution of massive representatives of pelagic nekton and jellyfish were revealed. According to the summer survey of the upper epipelagic layer of the Pacific waters, the abundance and biomass of Pacific salmon during their pre-anadromous migrations to the rivers of the Okhotsk Sea basin were taken into account and the main concentrations of mature pink salmon were outlined. During the survey, data on the biological state of salmon in mixed clusters were obtained and preliminary spatial differentiation of the early and late pink salmon stock belonging to different regions of the Okhotsk Sea was performed.

Starovoytov A.N., Sheibak A.Yu., Dudkov S.P., Gritsay E.V., Shevlyakov V.A., Dederer N.A. 2019. New data on nekton and macroplankton species composition and results of trawl survey on pink salmon juveniles (*Oncorhynchus gorbuscha*) in Bering and Okhotsk seas in autumn 2019. Bulletin of Pacific salmon studies in the Far East 14: 146–154. (In Russian). Biomass and abundance of nekton and makroplankton species obtained during the routine 2019 survey on juvenile salmon in Bering and Okhotsk seas are estimated. Some features of pelagic nekton and jellyfish spatial distribution are also evaluated. Juveniles of Pink salmon were of particular interest: spatial distribution as well as quality and quantity aspects. For Okhotsk sea comparative analysis of 22-year time series on Pink salmon CPUE and average weight is presented.

Temnykh O.S., Shevlyakov E.A., Kanzeparova A.N. 2019. Results of salmon fishery season in the Russian Far Eastern in 2019. Bulletin of Pacific salmon studies in Far East 14: 3–22. (In Russian). The current state of Pacific salmon stocks in the Russian Far East remains at a high level. Pink salmon continues to hold a leading position in the total salmon catch in the Russian Far East. The other species (except of Chinook salmon and Masu salmon) also stay at the high level of abundance, which is typical for the recent decades. In 2019, Sakhalin-Kuril chum salmon stocks for the first time shared the highest proportion of total Chum salmon catch in Russian Far East.

Tsygankov V.Yu., Lukyanova O.N., Boyarova M.D., Gumovskiy A.N., Donets M.M., Lyakh V.A., Korchagin V.P., Prikhodko Yu.V. 2019. Organochlorine pesticides in commercial pacific salmon in the Russian far eastern seas: food safety and human health risk assessment. Marine pollution bulletin 140: 503–508. (In English). Concentration of organochlorine pesticides (OCPs) (α-, β-, γ-hexachlorocyclohexane (HCH), dichlorodiphenyltrichloroethane (DDT),

dichlorodiphenyldichloroethane (DDD), dichlorodiphenyldichloroethylene (DDE)) in four species of Pacific salmon (pink, chum, chinook, and sockeye) are presented. OCPs in salmon organs increased in the following order: muscle < liver < eggs < male gonads. Concentrations of the OCP in salmon organs increased in following order: DDE < γ-HCH < α-HCH. The level of pollutants in salmon is compared with the sanitary and epidemiological norms of Russia and other countries. Cancer and noncancer hazard ratios through consumption of salmon in Russian Far East for both men and women also were summarized. Noncancer and cancer hazard ratio values were far below threshold values (<1.0).

Uglova T.Yu. 2019. Ways of approach of pink salmon of different seasonal forms to the coast of Iturup Island (South Kuril Islands). Trudy VNIRO 177: 5–16. (In Russian with English abstract). Results are provided of a study of the pre-spawning routes of pink salmon *Oncorhynchus gorbuscha* to the Okhotsk Sea coast of Iturup Island (South Kuril Islands). The South Kuril pink salmon has two seasonal forms: early (summer) and late (autumn). The results obtained showed that pink salmon of different seasonal forms comes to the island in two ways, the early form (summer) preferably chooses the Strait of Catherine and goes north along the Okhotsk Sea coast to the Kuril Bay, and only 3 weeks later, a massive coming of pink salmon is noted through the Freez Strait and the northern part of the island to the south to the Prostor Bay. Reliable differences in the size and weight parameters of the early (summer) and late (autumn) forms are presented. From 2008 to 2011 there were two waves in the approaches of pink salmon producers. According to the change in the sex ratio during the spawning period, a change in the approach of one form of another was judged. The main catch since 2012 is the late form, the approaches of the summer pink salmon are extremely small. The status of the seasonal forms of pink salmon is discussed.

Vershinina O. V., Hodger D. S. 2019. Current state of the summer chum salmon stocks and their biological characteristics in the Amur river. Bulletin of Pacific salmon studies in the Far East 14: 167–173. (In Russian). High-yielding generation of the summer chum salmon, which formed in 2006–2016 in the Amur River, provided its annual catch of 4.6–16.1 thousand tons during 2009–2016. The chum salmon stock decreased to an interannual level of its abundance throughout the period 2014-2019. Biological characteristics of summer chum salmon of the Amur River reached their minimum value during the research period. Abundance fall of summer chum salmon since 2014 could be explained by prolonged shortage of spawners number at the spawning area, which was caused by increased fishing effort and decreased production level due to unfavourable environmental conditions.

Volobuev V.V., Grushinets V.A. 2019. Biological structure of the chum salmon *Oncorhynchus keta* at the continental coast of the Okhotsk sea. Vestnik SVNC DVO RAN 48: 104–116. (In Russia) The biological structure of chum salmon adults, both in the mixed samples and separately for two ecological forms (early and late) in the rivers of the continental coast of the Sea of Okhotsk is considered. Data on their age, size-weight structure, sex ratio, fatness, degree of maturity of sexual products are presented. Influence of some biocenotic factors on the chum salmon biological structure is considered.

Volobuev V.V., Gorokhov M.N., Golovanov I.S., Khovanskaya L.L., Yamborko A.V. 2019. Sockeye salmon *Oncorhynchus nerka* (Walbaum) from the north-eastern continental coast of the Okhotsk sea. Vestnik KGTU 48: 49–58. (In Russia). In this paper, we summarized previously published and newly obtained data on the least abundant Pacific salmon species, *Oncorhynchus nerka*, which is distributed on the northern continental coast of the Okhotsk Sea. The data on its biological characteristics, population structure, natural reproduction and economic use are presented. It was stated that sockeye salmon from Magadanskaya oblast is characterized by a relatively small size (58–60 cm in length) and body weight (2.5–2.8 kg). Under the conditions of

reproduction, it is divided into limnophilic and rheophilic ecotypes, which breed in the lakes and river mouths. The dominant ecotype is limnophilic one. It was found that in the studied populations along with the migratory species, there are neotenic landlocked individuals of sockeye salmon, the entire life cycle of which takes place in native lakes. 86-94% of the landlocked sockeye salmon are male individuals. The reproductive ecology peculiarity of limnophilic sockeye salmon is that during breeding season dwarf landlocked individuals together with migratory fish form a single spawning pool.

Zhivoglyadov A.A., Zhivoglyadova L.A. 2019. Reproduction of pacific salmon (*Oncorhynchus*) in rivers flowing into Terpeniya bay (Sakhalin Island). J. of Ichthyology 59 (2): 205–215. (In English). The conditions for the reproduction of Pacific salmon of the *Oncorhynchus* genus in rivers flowing into Terpeniya Bay were assessed. The differences between the rivers of the northern and western parts of the study area were described according to the channel morphology, the faunistic composition of the aquatic biota, and the predominant species of salmon. In the rivers of the northern section (the basin of the Poronai River and Lake Nevskoe), which have both mountain-foothill and plain types of channels, the reproduction of *O. gorbusha* pink salmon is at a low level. In the rivers of the western section having a pronounced mountain character and a relatively poor ichthyofauna, reproduction of pink salmon is concentrated in Terpeniya Bay. The data on the dynamics of the number of migrants and spawners are given. The size of the pass of pink salmon spawners in the rivers of Terpeniya Bay required for sustainable reproduction is estimated at 3.63–10.42 million individuals.

Zolotukhin S.F. 2019. Intra-species groupings of chum salmon *Oncorhynchus keta* (*Salmonidae*) of the Amur River and their distribution within the basin. Izv. TINRO 197: 21–34. (In Russian with English abstract). Chum salmon in the Amur River basin are represented by two races: summer and fall ones. For the summer race, one population with specific type of spawning grounds is known, but the fall race includes three populations with different types of spawning grounds. In total, four eco-geographical groupings of the species are separated in their reproduction by geographical boundaries of geomorphological zones, as well as temporally and ecologically. Chum salmon do not spawn in the Chinese part of the Amur basin in more than 50 years. In the Russian part, the summer chum salmon spawn completely in the hyporheic waters in late July - August, the major grouping of fall chum (77.1 %) spawns in the spring waters in September-November, other two groupings spawn in the hyporheic waters of the lower Amur in September (20.4 %) and in the spring waters of the lakes near the Amur mouth in October-November (2.5 %).

Zelennikov O.V. 2019. Gamethogenesis of pacific salmons. 1. Development of gonad in young chum salmon *Oncorhynchus keta* Walbaum under various temperature regimes. Izv. TINRO 193: 88–98. (In Russian with English abstract). Early stages of gametogenesis in young chum salmon are investigated under various temperature regimes at three fish farms of Sakhalin region and in laboratory conditions. In all cases, sex differentiation started after the mass hatching, the age of differentiation varied from 65 to 213 days, but the sum of accumulated degree-days was rather stable - from 620.6 to 669.1. The period from the beginning of sex differentiation to the beginning of previtellogenesis lasted 27-144 days depending on conditions, even for fish in the same fish farm. The lower was the water temperature after the beginning of sex differentiation, the smaller sum of degree-days was accumulated by fish before the beginning of previtellogenic growth of oocytes and the shorter was the period of oocyte growth before the fish release from the farm. The period of previtellogenesis in chum salmon always began before the end of larval period, when weight of the yolk sac was from 1.8 to 18.2 % of the total body weight.

Zolotukhin S.F. 2019. Basis for selection of rivers for monitoring on the stocks of chum and pink salmon in the Amur river. Izv. TINRO 199: 19–34. (In Russian with English abstract). The monitoring of chum and pink salmon escapement to spawning grounds in the Amur River basin was stopped in 2009. To start it again, a proved choice of the rivers is necessary for adequate controlling of these species number, by the spawning habitats of their population groups within the basin. For this purpose, results of the monitoring in 1949-2000 and the data on human settlements in the medieval times are analyzed. The lower reaches of the Amur were anciently inhabited by the paleoasiatic Nivkh people and the upper reaches where the fall chum spawned in spring waters were inhabited by the people of Pokrovskaya archeological culture - their burial grounds coincided with the spawning area of fall chum salmon. To reach these spawning grounds, fall chum salmon migrated up to the distance of 3427 km from the Amur mouth, but since the 20th century they occur rarely in the upper reaches of the Amur, in particular within Chinese territory where they are not observed in more than 50 years; recently they spawn in spring waters at the distance 500-1200 km from the Amur mouth, mainly in its right tributaries. The reproduction centers of other two populations of chum salmon, as the summer chum and fall chum breeding in hyporheic waters, are located in the Amgun River basin (the lower left tributary of the Amur). The fourth population is the lake chum salmon breeding in spring waters of Lake Chlya located on the left bank in the lower reaches of the Amur River. Centers of reproduction for both pink salmon populations, differentiated by even and odd years of spawning, are located in the Amgun River. Several test rivers are selected within all mentioned centers of reproduction, they are: Kerbi, Duki, Im, Somnya, Aksha, Khilka, Beshenaya, Gur, Anui, Khor, Kur, and Bira. This list is similar to the list of the rivers where chum and pink salmons were monitored in the 20th century.

Theme 2: Pacific Salmon and Steelhead Trout in a Changing North Pacific Ocean

Krovnin A.S., Klovach N. V., Kivva K. K. 2019. Unprecedented Far East Salmon Catches in 2018: What Should We Expect in Future?, North Pacific Anadromous Fish Commission (NPAFC) Technical Report 15: 7–12. (In English).

Theme 3: New Technologies

Akinicheva E., Volobuev V., Myakishev M., Yamborko A. Marked salmon production by the hatcheries of Russia in 2018. 2019. NPAFC Doc. 1832: 4 pp. (Available at www.npafc.org). As in the preceding years, the main aim of the hatcheries salmon marking in Russia is to evaluate numbers of hatchery-reared salmon returns. In recent years the basic part of juvenile salmon have been reared and marked at Sakhalin. Two methods were used for hatcheries marking: thermal (Munk et al., 1993) and "dry" (Safronenkov et al., 1999). In 2018, the percentage of marked salmon juveniles in Sakhalin region was 73.49 % of the total Russian release of marked juveniles. This is caused by the location of hatcheries, a large number of which (38) are located at Sakhalin and only 19 hatcheries in other regions of the Russian Far East.

Akinicheva E., Volobuev V., Myakishev M. 2019. Proposed otolith marks for brood Year 2019 Salmon in Russia. NPAFC Doc. 1833: 2 pp. (Available at https://npafc.org). Otolith marking of salmon of 2019 brood year will be conducted in five regions of the Far East: Kamchatka, Magadan, Sakhalin, Khabarovsk, Kuril and Primorsky regions. Marking will be carried out using two methods (thermal and "dry"). Their application will be determined by the possibilities and specificity of the water supply of incubated embryos at hatcheries of the Far East. The dominating method of marking will be a "dry" one – it will be used on the 75% of salmon hatcheries. Salmon will be marked at 28hatcheries. Totally 32 otolith marks will be used.

Khrustaleva A.M., Klovach N.V. 2019. Morphological and genetic heterogeneity of sockeye salmon *Oncohynchus nerka* (*Salmonidae*) in large lake-river systems of eastern and western Kamchatka. J. of Ichthyology 59 (6): 640–650. (In English). The morphological and genetic heterogeneity of sockeye salmon *Oncorhynchus nerka* samples was studied both mixed and collected at different periods of its mass move from the mouths of the Western (Ozernaya, Bolshaya, Palana) and Eastern Kamchatka rivers (Kamchatka River), in the basins (tributaries and lakes) of which its largest herds in Asia are reproducing. According to the estimates of biological indicators and allele frequencies of 45 loci of single nucleotide DNA polymorphism, the periodicity during the mass run of sockeye salmon in the rivers of the western coast of Kamchatka was not detected. The analysis of mixed samples of sockeye salmon from the mouths of the Western Kamchatka rivers allowed us to identify a large group of individuals, which we supposedly assigned to the lake form. In samples from the Ozernaya and Palana rivers, phenotypic and genetic heterogeneity were not noted. The revealed heterogeneity of the sampling from the mouth of the Kamchatka River reflects the complex spatial and genetic structure of sockeye salmon in the basin of this lake-river system, and the differences between the samples, collected during the mass run in the main channel, indicate a consistent approach of spawning groups, reproducing in different parts of the river, to the mouth.

Khrustaleva A.M. and Klovach N. V. 2019. Morphological and genetic subdivision of sockeye salmon samples, *Oncorhynchus nerka*, collected within the period of spawning migration in outfalls of Kamchatka Riverş. North Pacific Anadromous Fish Commission (NPAFC) Technical Report 15: 54–58.

Pavlenko A.A., Radchenko V.I., Kantakov G.A., Likhograev A.Yu., Likhoshapko A.A. 2019. Live fish box for pelagic trawl and problems of its use to catch salmon. Bulletin of Pacific salmon studies in the Far East 14: 133–139. (In Russian). The live fish trap is a pelagic trawl device that allows holding and lifting on board a research vessel of live, undamaged fish from the trawl catch for further study and or tagging. For the international Gulf of Alaska expedition, the live fish trap was constructed at aluminium workshop in Murmansk, Russia under supervision of PINRO scientists, who have substantially modified the FISH-LIFT device (Holst and McDonald 1999) for local operating conditions. The net part of device ensures its connection with the trawl bag and the direction of fish caught and held by the trawl directly into the trap hull. Size and cutting shape of the net part of the live fish trap were made in accordance with the shape and size of the used trawl, in our case – Russian pelagic trawl of 80/396 m. Four trawl hauls with the live fish trap were conducted in 48º35 – 48º43 N 128º34–136º11 W on March 14-19, 2019. The live fish trap was towed at speed of 3.9-4.8 knots during 20 to 30 min with upper trawl panel kept on the surface. Many mesopelagic fish, jellyfish, macrozooplankton and two coho salmon specimens were sampled alive by the live fish trap in night-time. Coho salmon were tagged by disk tags and released. However, both coho had significant scale loss above recommended 10% while osmotic problems will cause fish with too high scale loss to die. Technical approaches to reduce a scale loss by salmon are discussed.

Pilganchuk O.A., Shpigalskaya N.Yu., Denisenko A.D., Savenkov V.V. 2019. Genetic differentiation of sockeye salmon *Oncorhynchus nerka* (Walbaum, 1792) in the basin of Kamchatka river. The researches of the aquatic biological resources of Kamchatka and of the north-west part of the Pacific Ocean 53: 41–56. (In Russian with English abstract). Allelic variability of ten microsatellite loci of sockeye salmon (*Ots*107, *Oki*1a, *Oki*1b, *One*104, *One*109, *Ots*G68, *Omm*1037, *Oki*6, *Ots*100, *Ots*2) in the basin of Kamchatka River was examined. The samples analyzed have demonstrated several genetic-distinct groups: of “Azabachye Lake” (early and late), of “the upper part of Kamchatka River”, of “the middle part of Kamchatka River”. The part of the intergroup component of the molecular diversity was 1.83% that exceeds the dispersion between the samples in the groups (0.56%).

Theme 4: Management Systems

Fadeev E.S., Shevlyakov E.A., Feldman M.G. 2019. Complex monitoring of salmon spawners escapement to the Kamchatka River in real time regime. Izv. TINRO 197: 3–20. (In Russian with English abstract). Complex method of quick quantitative evaluation of the spawners escapement to the Kamchatka River is developed for pacific salmons on the base of analysis of their passing dynamics through certain parts of the river (main stream, tributaries, spawning grounds). The runs of different temporal forms of anadromous salmons were separated taking into account their biological parameters using the data of biological analysis of commercial catches in Ust-Kamchatsky district. The spawners abundance was evaluated from CPUE value for the main stream where control catches of spawners were made in the periods predetermined for escapement, and directly using two duplicate hydroacoustic complexes for the tributary important for salmon reproduction or visually from ashore, boats, or flying vehicles for other tributaries. These data were coupled with general assessments of the escapement values in the river basin from helicopters. Numeral model was developed to evaluate the salmon escapement to the spawning grounds. The escapement dynamics was simulated retrospectively for sockeye, chum and coho salmon in 2016 and 2017. The method was successfully used for fishery management in the fishery campaign of 2018. Efficiency of the fishery regime was estimated using this approach. The value of sockeye salmon escapement was determined as enough for medium reproduction, and the values of chum and coho salmons escapement — as enough for medium or high reproduction. For Chinook salmon, the model was not tested, but the method of control catches was developed and applied as a part of integrated methodology for quantitative operational assessment of escapement.

Shevlyakov E.A., Feldman M.G., Ostrovsky V.I., Volobuev V.V., Kaev A.M., Golub E.V., Barabanshchikov E.I., Golovanov I.S. 2019. Limits and operational evaluation of the spawners escapement to the spawning grounds as tools for prospective and short-term management of the pacific salmon stocks in the rivers of the far-eastern fisheries basin. Izv. TINRO 196: 23–62. (In Russian with English abstract). The major aspects of density regulation of the pacific salmons spawning are analyzed. Uncertainty of the ecological parameters considered traditionally as indicators of the salmon reproduction efficiency is discussed. If the method of the efficient spawning density is applied to the whole area of spawning grounds, without examination of conditions for spawning, false conclusions on optimum abundance of the spawners could be made. Clear criteria of the spawning grounds environments suitable for spawning are necessary for correct evaluation of the density factor for regulation the population abundance. Efficient escapement to the spawning grounds could be determined adequately by analysis of the reproduction curve. Critical analysis of tools for short- and long-term management of the salmon fishery is presented. Variants of compromise decisions for the multispecies fishery are discussed. The optimal escapement to the spawning grounds in not an absolute norm, but is a statistical parameter used for reaching the maximum production. Conflict between the strategies of saving the reproduction basis of salmon populations and the landing increase by fishing companies is demonstrated. Criteria and algorithm of short-term corrections of the salmon catches during the fishery campaign are provided. Major local units of the pacific salmon stocks in the Far East of Russia are outlined; biological parameters necessary for management of their exploitation are defined. Numbers of the spawners necessary for local and general support of spawning stocks for 5 commercial species of pacific salmons are evaluated to provide the most effective and sustainable natural reproduction of the stocks in the Russian part of the North Pacific.