RUSSIAN FAR EAST CRAB

FISHERY IMPROVEMENT PROJECT

Public Report

Prepared by Russian Crab Cathers Association
www.crab-dv.ru

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Content

1. About Russian Far East Crabs Catchers Association

Russian Far East Crabs Catchers Association (hereinafter –CCA) was established in 2009 and recently celebrated its 10 year anniversary. The primary goal of the CCA is a co-operation with the fishery management authorities and fishery scientific and research institutes towards developing improvement practices for the crab fisheries, and conservation and protection of the crab stocks in the Russian Far East Fishery Basin. Also, the CCA is active in marketing and promotion activities of the Russian Crab and its products at the international markets.

As of end of 2019, the CCA includes 10 crab fishing companies which harvest 7 different crab species within the Russian Far East seas including Red King crab, Opilio crab, Blue King crab, Tanner (Bardi) snow crab, Golden King crab, Red Snow crab, Triangle Tanner crab.

The total catch of CCA member companies of crab species reached 38960 tons in 2019 that equals to 54% of the Far East total catch. However, for the most valuable crab species like Red King, Bluer King, Opilio, Golden King, and Bardi the share of CCA member companies exceeded 62% or 37520 tons landings.

In 2019, the crab fisheries went through substantial changes in terms of quota distribution model. Recent auctions for crab quota have re-shaped the industry, some new companies entered the industry, over 20 new crab catcher vessels are to be built in next several years. New industry players have already expressed their interests in the CCA membership, and joining the CCA sustainability and certification commitments.

2. FIP history, scope and progress

CCA has launched the FIP project for 3 crab species fishery together with the Sustainable Fisheries Partnership in 2011. The initial FIP action plan was developed and completed in 2013. The second stage of the FIP action plan was completed in 2016 that allowed the CCA to commission a MSC pre-assessment of the three crab species fishery in the Sea of Okhotsk. The pre-assessment was completed in 2016, and the summary with the key findings of the MSC pre-assessment is available at the CCA's website. After that, the action plan aimed at closing the gaps by making necessary improvements identified in the pre-assessment in order to get the fishery prepared for the MSC full assessment was developed and launched. It was planned to start full assessment in 2018.

However, in 2018 the government announced a plan to review a quota allocation principle for the crab species. Being one of the most important aspects of the crab fisheries managements that initiative took all resources and capacity from the CCA to work with, so the FIP action plan and MSC certification plans were delayed.

As now the new system of quota allocation has been clarified, the CCA confirms its commitment to continue working on improvement projects in order to obtain MSC certification for 3 crab species fishery in the Sea of Okhotsk at first. In 2020, the CCA will develop and agree a new strategy for the MSC project including action plan and updated timeline of the FIP.

The FIP includes 3 species all harvested off the Kamchatka shelf in the Sea of Okhotsk:

- *Red king crab,*
- *Blue king crab, and*
- *Tanner (Bardi) snow crab.*

For 2018, the total TAC for these 3 species were set at 22,04 thous mt. The total catch was about 21 thous mt. As for the CCA member companies, they harvested 16,3 thous mt corresponding to 77% of the total. For 2019, the total TAC for 3 species was lowered by 15% down to 18,74 thous mt. The reason for that was a close of Tanner (Bairdi) snow crab fishery on Kamchatka shelf. In 2019, CCA member companies harvested 14,3 thous mt that was about 77% of total catch among the 3 fishing zones.

The information on stock status of all 3 species is presented in section 4.

TAC and reported catch of Russian Far East crabs (FIP specific), 2018

Commercial species					*(000 mt)*	
	West Kamchatka subzone (61.05.2)	Kamchatka -Kurils subzone (61.05.4)	Total TAC	Total Catch	Catch of CCA members	
Red king crab	11,022	4,383	15,41	15,29	11,47	75,02%
Blue king crab	3,948		3,95	3,92	3,17	80,92%
Tanner (Bairdi) snow crab		2,683	2,68	1,88	1,68	89,51%
* - FAO Fishing Areas			**22,04**	**21,09**	**16,32**	**77,41%**

TAC and reported catch of Russian Far East crabs (FIP specific), 2019

Commercial species					*(000 mt)*	
	West Kamchatka subzone (61.05.2)	Kamchatka-Kurils subzone (61.05.4)	Total TAC	Total Catch	Catch of CCA members	
Red kinbg crab	11,022	4,383	15,41	15,30	11,67	76,26%
Blue king crab	3,316		3,32	3,28	2,67	81,26%
Tanner (Bairdi) snow crab		0,020	0,02			
* - FAO Fishing Areas			**18,74**	**18,59**	**14,34**	**77,14%**

Inspite of the delay with the MSC certification start, the CCA continued to support the fishery research institutes in their research programs on crab fisheries monitoring by scientific observers and collecting the data required for the stock assessment and forecasting. For this purpose, the CCA traditionally (7 years in a row) provides vessels for observer deployment, as well as financial support of this work. For the period, KamchatNIRO observers have taken part in 20 survey trips off West Kamchatka. During a total of 508 ship-days, 763 fishing series were observered, more than 162 thousand various crab species were analyzed.

Monitoring and research work on commercial fishing vessels with the CCA allow the management institutes to collect data on the crab species, sex, size and weight composition of catches. During such studies, observers gather data on crab catches per trap (unit of fishing effort, CPUE), determine condition of crab shells, and female eggs maturity, and various types of injuries like list limbs are also recorded. Observers also record and register information on by-catch specie like fish, mollusks, echinoderms, etc.

Due to the scientific data regularly obtained directly from the fishery, informational support of the materials for the total allowable catch (TAC) of red king, blue king and bairdi crabs of the Western Kamchatka has been upgraded up to the highest level I, which makes it possible to conduct a comprehensive analytical assessment of the stock status and TAC using structured models of exploited stock.

Along with the results of bottom trawl surveys, CPUE data and size composition of males obtained by scientists during the commercial fishing are the main input indices for setting up a model based on CSA that describes the dynamics of crab functional groups. Over recent years, this model has been successfully used by KamchatNIRO in materials substantiating the total allowable catch of these commercial species of crabs in Western Kamchatka.

Table – Summarized data of monitoring activities performed by KamchatNIRO scientific observers on the CCA's fishing vessels in all fishing areas of the Russian Far East in 2013-2019

Year/Vessel	Area	Operations	Bioanalysis	Vessel-days
2013				
Seawind	West Kamchatka	40	8225	28
Dezhnevo	West Kamchatka, Kamchatka-Kuril	45	8335	36
Total		**85**	**16560**	**64**
2014				
Odyssey-1	West Kamchatka	53	9687	27
Shantar-1	Karaginakaya, West Bering Sea	92	7523	37
Gefest	West Kamchatka	49	5081	41
Odyssey-1	West Kamchatka, Kamchatka-Kuril	56	10212	38
Andrey Smirnov	West Bering Sea	68	4189	43
Total		**318**	**36692**	**186**
2015				
Seawind	West Kamchatka	128	34090	60
Solid	West Bering Sea	4	885	
Tamango	West Bering Sea	8	1568	
Andrei Smirnov	West Bering Sea	68	9345	65
Shantar-1	West Bering Sea	8	1773	
	Karaginskaya	51	5158	
Svyatogor	West Kamchatka	42	9773	25
Total		**309**	**62592**	**150**
2016				
Rashkov	West Kamchatka	51	13331	
Svyatogor	West Kamchatka	17	4206	43
Alaid	West Kamchatka	5	471	9
Seawind	Kamchatka-Kuril	52	11220	36
Potapovo	Karaginakaya, West Bering Sea	200	4745	37
Total		**125**	**29228**	**125**
2017				

Real	Kamchatka-Kuril	28	5633	36
Olafsson	West Bering Sea	7	825	13
Asacha	West Kamchatka	21	4643	8
Real	Kamchatka-Kuril	6	1206	8
Rashkov	West Kamchatka	31	4050	45
Total		**93**	**16357**	**110**
2018				
Seawind	Kamchatka-Kuril	39	6427	24
Uzon	West Kamchatka	48	10176	39
Seawind	West Kamchatka, Kamchatka-Kuril	38	7872	24
Total		**125**	**24475**	**87**
2019				
Uzon	West Kamchatka	30	4133	15
Andrey Smirnov	West Kamchatka	26	4069	16
Solid-1	Petropavlovsk-Kommandorsky	19	2288	8
Florin		18	2097	7
Asacha	West Kamchatka	15	4165	3
Arka-35	West Kamchatka	37	8654	24
Total		**93**	**12587**	**73**
GRAND TOTAL		**1400**	**216055**	**795**

Maintaining high levels of Kamchatka and blue crabs in Western Kamchatka in recent years is largely the result of the work of scientists on fishing vessels. Monitoring data on the bairdi crab fishery in the Western Kamchatka confirmed the results of census studies that showed changes in the population of this species, and made it possible to develop appropriate fishery control measures in time.

It should be noted that in recent years the assessment of the stock status of the population of blue king crab in the Shelikhov Bay has been carried out exclusively by conducting registration trap surveys from commercial fishing vessels, and their value can hardly be overestimated.

Monitoring studies red king crab fishery off West Kamchatka are carried out annually, during the period allowed for the fishing of this species (September – December). Regular work in the blue crab fishery in the West Kamchatka subzone and bairdi crab in the Kamchatka-Kuril subzone is carried out mainly in the first half of the year.

To obtain adequate information about the state of crab stocks harvested off the coast of Kamchatka, first of all, regular research is necessary. Work in the monitoring mode of fishing should be carried out annually, and for Kamchatka crab, in both fishing subzones. The frequency of registration trapping surveys for blue crab can be at least once every two years, but work in the monitoring mode of fishing of this species should also be carried out annually.

3. Recent changes in the crab fisheries management

As it is mentioned above, there is a historical change in the crab fisheries legislation and quota allocation system approved and came into force in 2019. In May 2019 addendums to the Federal law "On fisheries…" were accepted. The new regulations state that 50% of crab quota limits are now allocated among the companies through auction system. The remaining 50% of quota is allocated based on the historical principle as it was for 2008-2018. The first auctions were held in October

2019. In respect to the Far East fishing zones, 30 lots with crab quotas were sold out to the Russian companies. It resulted in pre-allocation of the quotas among the companies, as well as several new players entered into the industry. All quotas now have been distributed among the companies for 15 year period.

FFA's orders for crab quota allocations for companies for 2020 are available at the FFA website:

1) 2020 crab quota allocation (historical principle)
2) 2020 crab quota allocation (auctions).

As for the operational fishery management system, it remains generally unchanged. Policy and regulations development are conducted by Ministry of Argriculture and Federal Agency for Fisheries (FFA). General management on the fishery is executed through FFA territorial departments. The fishery enforcement and control is executed by the FSB Coast Guard.

The only change in the management system that has come into force in 2019 refers to fishery science system. Since 2019, TINRO and KamchatNIRO as well as other regional fishery research institutes across the country has changed its legal status and become branches of All-Russian Fishery Research Institute (VNIRO) based in Moscow. Despite this change of legal status, KamchatNIRO and TINRO has kept their role as leading research institutes for crab fisheries in the Russian Far East.

In May 2019, updated Fishing Rules for the Far East Fishery Basin officially came into force. The Fishing Rules define catch limits, seasons, gears specifications, areas for fishing, rules and procedures for fishing plots (parcels) allocation, catch recording and reporting. The Fishing Rules includes standard fishery regulations describing the responsibilities of the fishing company or user, list of documents must-have on-board, prohibited areas and seasons, species prohibited for fishing, fishing gear regulations, minimal commercial size of fish and other harvestable species, and by-catch regulations. There are requirements to submit a daily vessel report, maintain VMS on vessels[1], and follow rules restricting by-catch, prohibited areas and seasons, prohibited species, fishing gear regulations, minimal catch size, and other operational rules. The Fishing Rules set out general management measures for the Crab fisheries.

Latest version of Fishing Rules for the Far East Fishery Basin approved by MoA decree N267 of 23.05.2019.

4. Stock status and scientific advice on FIP crab species[2]

4.1. Red King Crab, West Kamchatka (WK) and Kamchatka-Kuril (KK) Subzones

The forecasts on king crab stock condition and potential yield in 2018 are based on data of the trawling survey performed by the *TINRO* research vessel in June – July 2016 (102 stations in WK subzone and 112 stations in KK subzone). This survey was performed using a 27-meter bottom trawl with a horizontal spread of 16 m and average trawling speed of 3 knots. Trawl catchability index was assumed at 0.75.

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[1] All fishing vessels and other vessels with engine power more than 55 kWt and more than 80 mt DWT engaged in fishery operations must be equiped with VMS.

[2] Stock status information in section 4 has been summarized from the officially published stock assessment annual report "Condition of fishing resources. Forecast of total catch of hydrobionts in the Far East Fishery Basin for 2018" (TINRO, 2018).

The total area covered by this survey was approx. 48,000 km^2. The forecasts also used materials obtained in the king crab fishery in October – November 2016 by the *STR Rashkov* refrigerating seiner/trawler and *STR Svyatogor* refrigerating seiner/trawler in WK subzone and by the *SRTM Orlan* medium refrigerator trawler in KK subzone. An additional source of information was data of count surveys performed by the *Engineer Martynov* research vessel in August – September within the territorial waters off the southern tip of Kamchatka Peninsula and on the Sea of Okhotsk side of Paramushir and Shumshu islands not covered by surveys earlier (37 series).

For retrospective analysis of the stock condition and for CSA-based (Collie, Sissenwine, 1938; Collie, Kruse, 1998) model tuning, multi-year data (1996–2016) of bottom trawling and trap count surveys as well as materials, collected on board fishing vessels in a king crab monitoring or fishing mode, were used.

Both direct count methods and methods based on fishing statistics have been used for king crab stock assessments since 2015.

One of key methods for assessment of invertebrate and king crab commercial resources is trawling survey. Such surveys have been performed off West Kamchatka coast almost every year since 1950s.

At the present time, results obtained by direct count methods are used less frequently for stock assessment and TAC forecasting. Priority tools in addressing these tasks are mathematic modeling methods, with survey results normally used for tuning of input parameters of the model. As a result, the whole available data set becomes involved in estimations – varying from fishing statistics to direct count-based independent assessments.

Information support to this forecast allows for a comprehensive analytical assessment of the stock condition and TAC using structured models of the exploited stock ("cohort models").

Proceeding from the structure and volume of information about king crab of the West Kamchatka shelf accumulated to date, it seems most reasonable to use CSA-based models describing the dynamics of functional groups (juveniles, pre-recruits of I and II orders, commercial-size males, females). Use of such models is appropriate when it is not possible to specify the age of the object of study but possible to specify its affiliation to a particular functional group by its linear size.

In the West Kamchatka shelf of the Sea of Okhotsk, the king crab population is distributed unevenly and grouped in more or less isolated aggregations with their names given due to geographical considerations: Khairyuzovskaya – north of 57°00′ N, Northern No-Entry Zone grouping – 56°20′–57°00′ N, Ichinskaya – 55°00′–56°20′ N, Kolpakovskaya – 54°00′–55°00′ N, Kikhchikskaya – 53°00′–54°00′ N, and Ozernovskaya – 51°00′–53°00′ N.

The northern part of the West Kamchatka shelf is its breeding center from where king crab's semi-independent northern (Khairyuzovskaya) and sourthern (Ichinskaya and Kolpakovskaya) and dependent (Kikhchikskaya and Ozernovskaya) sub-populations are replenished. It is clear that the processes taking place in the Northern No-Entry Zone and Khairyuzovskaya zone are of special importance: it is they that ensure existence of this species as an independent unit of biota.

Excessive exposure of the population to human-induced impacts in late 1990s–early 2000s has resulted in a significant decrease of the abundance of commercial-size males and pre-recruits of the West Kamchatka king crab population. It was found through studies that the key reason for reduced king crab numbers in WK subzone is large-scale overfishing of large-size males and pre-recruit males.

To prevent adverse changes in the WK king crab population due to intensive fishing, a ban was imposed on its commercial fishing during 2005–2012 (excluding 2007) till its abundance recovery. The results of 2013 surveys showed that its commercial stock abundance exceeded that of the early period after ban imposition (2005) and that of an earlier period (2000) when crab fishing was quite active. The outcome of 2013 surveys was a justification study for resuming king crab commercial fishing already in 2013 with TAC volumes to be adjusted, and on November 22 commercial fishing in WK subzone was restarted after several years of ban.

The rate of king crab stock utilization was high after resumption of its commercial fishing.

According to data obtained in the course of king crab fishery monitoring activities during the fishing season of 2014–2016, mean catch of commercial-size males per trap per day remained at rather high stable level with an emerging overall upward trend. At the same time, a clear trend to reduced catches of male pre-recruits of both orders was observed in WK subzone and variability of this parameter was observed in KK subzone.

According to results of trawling count surveys performed in 2016, 83.7% of the population’s commercial stock was concentrated in the central and southern parts of the West Kamchatka shelf.

Maximum crab numbers are concentrated within Kolpakovskaya and Ichinskaya areas: commercial-size males – 48.3%, male pre-recruits – 69.5%, small-size males – 69.1%, females – 47%. Females are a dominant functional group in two northern areas of the West Kamchatka shelf. Its southern areas continue playing an insignificant role in stock breeding processes.

The materials obtained through count surveys were used for assessing king crab abundance in each migration area of the West Kamchatka shelf. It was found that the maximum abundance of individuals of all size and functional groups, including females, was registered in Ichinskaya area of West Kamchatka shelf.

King crab total abundance in WK subzone in 2016 was as follows: commercial-size males – 29.467 million individuals, pre-recruits – 21.995 million individuals, small-size males – 9.471 million individuals, females – 22.794 million individuals. King crab total abundance in KK subzone was as follows: commercial-size males – 18.084 million individuals, pre-recruits – 4.118 million individuals, small-size males – 0.629 million individuals, females – 3.763 million individuals.

King crab commercial stock in KK subzone in 2016 was estimated at 18.084 million individuals or 43.402 kilotons (at commercial-size male’s mean weight of 2.40 kg). The Northern No-Entry Area and Khairyuzovskaya area are currently closed for crab fishing. Given that, currently available commercial stock in WK subzone (Kolpakovskaya and Ichinskaya areas) was estimated at 22.928 million individuals or 49.066 kt (at commercial-size male’s mean weight of 2.14 kg) and, taken together for all WK areas where fishing is permitted, 41.012 million individuals or 92.468 kt.

In summary, the size of overall commercial stock in the whole WK shelf has decreased by 6% compared with assessments based on the preceding year’s estimations, i.e. it has undergone virtually no change. At the same time, a downward trend in the abundance of its nearest recruitment and females, observed by results of 2015 surveys, continued. The number of male pre-recruits and females decreased by 33% and 28%, respectively, compared with a year ago.

A clear trend to growth of the commercial stock percentage in KK subzone has been observed during last 4 years of studies. 38% of all king crab commercial-size males of WK shelf were concentrated here in 2016. With consideration for the above said downward trend in recruitment numbers in the northern migration areas, further growth of the commercial stock percentage in KK subzone can be expected.

Another specific feature of the last 4 years is a steadily decreasing percentage of females in total king crab abundance off West Kamchatka (from 41% to 24% since 2012), which gives rise to certain anxiety against the background of declining in absolute numbers of females during last three years.

According to model-based assessments, an upward trend in growth of the king crab stock still continued as of the beginning of 2016. This circumstance has been attributed to a large recruitment in 2012–2015. Total abundance and biomass of commercial-size males as of early 2016 was estimated at 65.3 million individuals and 148.9 kt respectively. These estimations are well consistent with trawling survey data and catch per trap data.

The size/frequency distribution histograms for WK subzone in 2012–2015 based on trap catch data have an appearance close to a bimodal pattern. This was indicative of rather high percentage of undersized males. Size distribution data based on trawling survey results also confirm available potential for recruitment. In 2016, recruitment is less marked on size distribution diagrams built both by trap catch data and by bottom trawling survey data.

In KK subzone, the structure of male size distribution was different and essentially differed from that of WK subzone. The percentage of recruitment is extremely low here. This is clearly seen both for trap catches and trawl catches.

Due to a relatively steady high percentage of undersized males – male pre-recruits and small-size individuals – in 2014 and 2015, both by trap catch data and trawl catch data for WK subzone, we could state that recruitment of the king crab commercial stock in these years occurred regularly and at the rate sufficient for supporting it at a comparatively high level. This was also confirmed by analysis of the male size distribution in KK subzone: a steady volume of recruitment in northern migration areas supported a sufficiently high percentage of large-size crabs in the commercial part of the king crab stock in southern areas of the WK shelf.

In the meantime, data of male size distribution analysis in 2016 demonstrate that their size is growing virtually in the entire WK shelf compared with 2015 data. Overall, mean size of fishable males according to trawling survey data increased by 2.5 mm in KK subzone and by 0.4 mm in WK subzone. Mean size of females increased even more during the year (3.8 and 4.2 mm respectively) demonstrating growth for a second consecutive year. These facts may be indicative of the lack of strong year classes, both males and females, and are consistent with the trend, noted on trawling survey data, to reducing recruitment abundance, particularly females, in last 2 years. Given these trends, we can expect that mean size of males and females may grow in the coming 2 years.

The biological reference points for zonal HCR management determined in 2015 did not change and were used in this justification paper: limit reference point for male fishing biomass Blim = 36.6 kt, target reference point Btr is 92.56 kt, fishing mortality target reference point Ftr = 0.202 1/year.

In line with mid-term forecasting methods under "precautionary approach" to commercial stock management, HCRs for WK king crab were developed and their aim was to bring the stock to a high productivity level and further exploit it at this level with a fishing intensity rate of Ftr.

The same values of instantaneous natural mortality and selectivity rates as in retrospect were used to forecast stock condition, and fishing mortality rate in 2017 (F = 0.09 1/year) was adopted equal to TAC – 11.85 kt.

A mean value of II order pre-recruit abundance for last 10 years equal to 22.8 million individuals was adopted as recruitment for the projected period.

Stock biomass in 2018 was assessed using a cohort approach-based procedure. Commercial-size male abundance will be 60.05 million individuals and their biomass will be 136.9 kt. The lower limit of 90% confidence interval for this estimation (51.5 million individuals or 117.5 kt) exceeds the above target reference point for biomass. Therefore, a peak of king crab abundance was passed in 2017. Model-based assessments demonstrate a stock reduction in 2018.

The value of fishing biomass obtained through running a model of the dynamic of functional groups corresponds to the exploitation area of recovered stock. In relation to above said reference points, the stock condition forecast is more than optimistic and allows for yield intensity at the level of its target reference point. According to HCR, recommended fishing mortality for commercial-size king crab males in the West Kamchatka shelf in 2018 will be 0.202/year and theoretical yield is estimated at 19.539 kt.

An important step of management strategy testing is assessment of the probability that in long-term prospect (10 years forward) the West Kamchatka king crab stock biomass will not decline below its limit reference point Blim at a prescribed constant exploitation rate. This probability was evaluated using the Monte Carlo statistic imitation modeling method. At fishing intensity at a level of target reference point Ftr during 10 years, the risk of overfishing in terms of recruitment will not exceed the recommended level α = 0.1–0.2 (Babayan, 2000). Therefore, such management strategy can be accepted.

Another argument in favor of the chosen fishing strategy may be results of stock modeling over a long period of time (10 years) at the recruitment volume averaged over last 10 years and at yield intensity recommended according to HCR. With consideration for the assumed recruitment and yield values in accordance with the established HCR, the king crab fishing stock with 95% probability will not reach beyond biologically safe limits and be at a high productivity level. Based on imitation modeling results, it was concluded that the management strategy may be recognized effective.

Based on review of king crab TAC forecast materials at a session of the inter-institute ad hoc group on national fishing priority objects, extended meeting of the VNIRO Academic Council, Industry-level Council on Fishery Forecasting held on March 20, 2017, it was decided to set the king crab TAC collectively for WK and KK subzones in 2018 at 30% of the 2017 TAC (11.850 kt) or, namely, at 15.405 kt.

In line with bottom trawling survey data for traditional king crab fishing areas in WK shelf, averaged over last 5 years, fishing stock biomass was distributed as follows: 71.55% – WK subzone, 28.45% – KK subzone.

Thus, the red king crab TAC for 2018 will be 11.022 kt in WK subzone and 4.383 kt in KK subzone.

4.2. Blue King Crab, West Kamchatka (WK) Subzone

The blue king crab stock and potential yield assessment for 2018 was based on materials obtained in the blue king crab fishery in Shelikhov Bay in November 2016 by the *RS Alaid* fishing vessel (owned by OJSC Fenix) in the area with coordinates 58°37′–58°44′ N, 155°10′–155°44′ E at depth contours of 133–207 m, and by the *SRTM Orlan* medium refrigerator trawler (Piligrim LLC, JSC ORKZ No. 55) in the same period in Shelikhov Bay with coordinates 58°47′–58°53′ N, 157°00′–158°17′ E at depth contours of 94–134 m, with a total of 17 series processed.

In 2013–2014, count surveys were performed by the *SKYaM Sivind* and *Odyssey-1* medium refrigerator longliner crab fishing vessels (OJSC Fenix) and in 2015 by the *SKYaM Sivind* medium refrigerator longliner crab fishing vessel and *STRM Sparta* medium refrigerator trawler (Antei LLC). These surveys were performed in an area with coordinates 57°45′–59°15′ N, 155°00′–157°20′ E at depth contours of 90–430 m (50 stations) and covered approx. 15,605 km^2. Furthermore, information was collected as part of scientific activities in the course of crab commercial fishing (96 stations). Data of the "Rybolovstvo" Industry-level Monitoring System were also used.

Direct count survey methods and methods based on fishing statistics (since 2015) are used for blue king crab stock assessments.

The key direct survey method for this crab species in this area relies on traps because the seabed north of 57° N is extremely snaggy and not suitable for normal trawl surveys.

In recent years, models of the dynamic of functional groups gain more importance in stock assessment and TAC forecasting studies. Count survey results are normally used for tuning of input parameters of the model. As a result, the whole available data set becomes involved in estimations – varying from fishing statistics to direct count-based independent assessments. Such approach is used in this justification paper as well, and use of modern models, resistant to input data errors, improves the accuracy of obtained results.

Proceeding from the structure and volume of accumulated information about blue king crab of the West Kamchatka shelf, it seems most reasonable to use CSA-based models describing the dynamics of functional groups (juveniles, pre-recruits, commercial-size males, females).

Blue king crab is currently one of key species in the crab fishery in the Far Eastern region. Its largest population lives in the northeastern part of the Sea of Okhotsk and in Shelikhov Bay and its commercial fishing is performed in this area.

In 2005–2006 (except 2009–2010), the rate of blue king crab utilization was high according to data of the "Rybolovstvo" Industry-level Monitoring System (89.4–98.6% of TAC). The imposition of blue king crab fishing restrictions in 2009–2010 significantly affected this species' total yield which was at its lowest in the last decade (38.6–55.2% of TAC).

Total blue king crab yield was 3.449 kt or 98.3% of TAC in 2016, 3.497 kt or 98.4% (TAC = 3.555 kt) in 2015, 4.238 kt or 98.6% (4.3 kt) in 2014, 4.343 kt or 96.5% (4.5 kt) in 2013.

Mean daily catch from January till a temporary ban on its commercial fishing imposed due to its molting season (July 15 – October 15) in 2016 was 7.126 t in 2016 which is in line with results of two preceding years: 7.379 t in 2015 and 7.475 t in 2014. In October 2016, an all-time record-high mean daily catch of blue king crab for this area was registered – it was 5.6 times more than in same period of 2015, 1.7 times more than in 2014 and 1.3 times more than in 2013.

After blue king crab commercial fishing was prohibited in this subzone south of 57°40′ N, the area limited by latitudes 57°00′–57°40′ N was excluded from its abundance assessments. Since 2008, surveys have been performed in the area north of latitude 57°40′.

In 2013–2015, count surveys were performed across a single network of stations which allowed for a rigorous comparative study of the most essential biological and fishing parameters of the actively exploited stock. It was found that the largest aggregations of blue king crab commercial-size males were concentrated east of the deep-water trough of Shelikhov Bay, with their density reaching 2,600 individuals per square kilometer at depth contours of 120–130 m. Daily catch per trap varied in the range of 3–22 individuals and averaged at 12 individuals.

In 2016, commercial-size crab catches east of the canyon varied in the range of 1.7 to 16.2 ind./trap and averaged at 9.6 individuals. These figures were somewhat lower west of the canyon, varying within 4.5–8.7 ind./trap and averaging at 6.9 ind./trap.

Given that these data were obtained at the concluding stage of the fishing season when TAC had been utilized at about 97%, it can be stated that the blue king crab stock in the northeastern part of the Sea of Okhotsk is in a satisfactory condition.

According to surveys performed during fishing operations in 2016, size distribution of the crab commercial stock included same size groups as in 2013–2015. A relatively steady proportion between separate size and functional groups in the total mass of crab males was observed in last 3 years. The bulk of catches are commercial-size males followed in a descending order by pre-recruits of I and II orders and small-size males. Therefore, key biological and fishing parameters of blue king crab show that its stock is in a satisfactory condition.

According to model-based assessments, commercial-size male abundance and biomass as of early 2016 was estimated at 17.8 million individuals and 30.3 kt respectively. A reduction of commercial stock is expected in the coming 2 years.

The biological management reference points for zonal HCR were determined in 2015, have not changed and been used in this justification paper: limit reference point for male fishing biomass Blim = 14.17 kt, biomass target reference point Btr = 19.25 kt, fishing mortality target reference point Ftr = 0.181 1/year.

In line with mid-term forecasting methods under "precautionary approach" to commercial fish stock management, blue king crab HCRs were justified and their aim was to bring the stock to a high productivity level Btr and further exploit it at this level with a fishing intensity rate of Ftr.

The same values of instantaneous natural mortality and selectivity rates as in retrospect were used to forecast stock condition, and fishing mortality rate of commercial-size males in 2017 (≈0.154 1/year) was adopted appropriately with TAC equal to 3.850 kt. Mean multi-year pre-recruit abundance was adopted as recruitment value for the projected period.

Stock biomass was assessed for 2 years forward using a cohort approach-based procedure. As of early 2018, an estimated median value of commercial-size blue king crab male abundance will be 15.4 million individuals and their biomass will be 26.23 kt.

The obtained value of fishing biomass corresponds to the exploitation area of recovered stock. According to HCR, recommended fishing mortality rate in 2018 will be 0.181 1/year and yield will be 3.948 kt.

An important step of management strategy testing is assessment of the probability that in long-term prospect (10 years forward) the West Kamchatka blue king crab fishing stock biomass will not decline below its limit reference point Blim at a prescribed constant exploitation rate. This probability was evaluated using the Monte Carlo statistic imitation modeling method. At fishing intensity at a level of target reference point Ftr during 10 years, the risk of overfishing in terms of recruitment does not exceed the recommended level α = 0.1–0.2. Therefore, such management strategy is acceptable.

Another argument in favor of the chosen fishing strategy may be results of stock dynamic modeling over a long period of time (10 years) at the recruitment volume averaged over last 10 years and at yield intensity recommended according to HCR. With consideration for the assumed recruitment and yield values in accordance with the established HCR, the blue king crab fishing stock with 95% probability will not reach beyond biologically safe limits and be at a high productivity level. Based on imitation modeling results, it was concluded that the management strategy may be recognized effective.

Therefore, TAC for blue king crab in the WK subzone in 2018 is recommended at 3.948 kt (2.322 million individuals).

4.3. Tanner Crab (Bairdi Crab), Kamchatka-Kuril (KK) Subzone

Tanner crab stock condition and potential yield assessments for 2018 used data of trawling count surveys performed by the *TINRO* research vessel in June – July 2016 (112 stations, 14,520 km^2). A DT 27.1/24.4 m bottom trawl was used. Mean trawling speed was 3 knots, horizontal trawl spread was 16 m, and trawl catchability index was adopted at 0.6. An additional source of information was data obtained in March – April 2016 by the *SKYaM Sivind* medium refrigerator longliner crab fishing vessel (OJSC Fenix). Biological and fishing data were gathered in the course of commercial fishing operations in an area with coordinates 51°58′–52°28′ N, 155°46′–155°37′ E at water depth contours of 52–104 m.

The key method for direct count surveys of the fishing stock of invertebrates and, in particular, tanner crab is bottom trawling survey. Such works have been performed off West Kamchatka almost every year since 1950s. Any model-based stock assessment methods are not suitable for this species as yet because of insufficiency of available biological and fishing information. In view of the above said, perspective stock condition assessments and TAC estimations, same as in previous years, continue being performed using so-called bio-statistical method.

During last decade, tanner crab catches and utilization rate varied, respectively, from 0.781 to 3.577 kt and 75.8% to 98.5% averaging at 93.8%. In 2015, tanner crab catch and TAC utilization rate were 1.920 kt and 96.8% respectively. The catch in 2016 was 3.577 kt (98.1% of TAC).

According to survey data gathered during fishery, catches were absolutely dominated by commercial-size males (92% on average). Maximum density of aggregations was observed in coordinates 52°00′ N, 155°43′ E in a water depth of 104 m and amounted to 15.8 individuals per trap per day. Daily catch in the rest area varied in the range of 4.2–14.2 ind./trap and averaged at 8.7 ind./trap.

It was found by results of trawling count surveys that the largest tanner crab aggregations off Southwest Kamchatka tend to stay in the southernmost areas of this subzone (south of 52°30′ N), exposed to maximum effects of warm Pacific waters inflowing through the straits of the Kuril Archipelago, and input of this subzone's northern areas to the total tanner crab stock is insignificant. Count survey results in the subzone's southern part in 2016 were as follows: commercial-size males – 87.1%, pre-recruits – 64%, small-size males – 90.2%, females – 90.3%.

Studies of the tanner crab male size distribution in trawl catches showed that it was rather dynamic and subject to significant variations. Several periods of abrupt changes in male size distribution have been observed during the last decade. The strong year-class of males found in 2008–2009, which joined the fishable part of stock in 2011, contributed to a noticeable reduction of the mean size of commercial-size males. A marked trend to growth of this parameter was observed in the following years. In 2016, individuals with sizes 85–94 mm were representative, compared with 2013–2015, which will join the fishable part of the stock in the next few years.

In 2016, total abundance and biomass of commercial-size males was 28.5 million individuals and 25.7 kt respectively. Both abundance and biomass reduced 1.5 times compared to the preceding year. A possible explanation of this fact may be specific features of that year's tanner crab distribution (highly dense aggregations in the southern part of the work area not covered by surveys) and resulting underestimation of the stock size. In this connection, it would be correct to take maximum values, obtained through bootstrap analysis performed using "CardMaster v.4.1" software, as initial values of the abundance of commercial-size males and pre-recruits of I order for perspective stock condition assessment and TAC estimation.

Tanner crab biological reference points for zonal HCR in KK subzone were determined in 2015 and did not change in this justification paper: limit reference point for fishing stock abundance Nlim = Nloss = 10.4 million individuals, target reference point for fishing stock abundance Ntr = 23.1 million individuals, target reference point for exploitation rate Ctr = 15.6%, exploitation rate for scientific research works C0 = 1.0%.

In line with mid-term forecasting methods under "precautionary approach" to commercial stock management, an HCR for this stock was developed and its aim was to bring the stock to a high productivity level and further exploit it at this level.

The forecast of fishing stock volume in 2017–2018 was performed using bio-statistical method, with the abundance of commercial-size males and pre-recruits of I order, estimated by results of bottom trawling surveys in 2016, taken as initial data.

The estimation of fishing stock volume as of early 2017 was based on commercial-size male abundance data according to 2016 count surveys with account for natural loss (0.2), pre-recruits of I order joining the fishing stock with account for natural mortality (0.6) and take. Stock estimations as of early 2018 are similar to the above described procedure, with commercial-size male abundance as of early 2017 and forecasted joining number for pre-recruits of I order, assumed at a mean multi-year level (2012–2016) equal to 8.744 million individuals, taken as initial values. It was supposed that fishing mortality in 2017 was equivalent to TAC (4.394 kt or 4.882 million individuals).

It is forecasted that as of early 2018 fishing stock volume will decrease on 2016 and amount to some 21.558 million individuals or 19.402 kt. The obtained volume of fishing stock corresponds to stock recovery area. In accordance with HCR, recommended commercial exploitation rate in 2018 will be 13.8%.

Therefore, tanner crab TAC in KK subzone in 2018 will be 2.683 kt (2.975 million individuals).

5. Enforcement activities and IUU progress

According to the information from the FSB Coast Guard department which is responsible for the fisheries enforcement and control, the Coast Guard conducted 2620 inspections of crab fishing vessels and crab transshipments at-sea in 2018. Coast Guard detected 7 cases of non-compliance with the Fishing Rules and regulations. 3 vessels under convenient flag were restrained.

In 2019, enforcement activities remain at the same level – 2642 at-sea inspections. The Coast Guard detected 2 cases of non-compliance by the Russian flagged vessels. No convenient flag vessel was identified.

In recent years, Russian fisheries management authorities have made great efforts in fighting with the IUU crab fishing in the Russian EEZ. As we earlier reported, the situation dramatically improved in 2015, after signed international agreements with several countries (Republic of Korea, Japan, China) aimed at illuminating the IUU practices started to be implemented in 2014.

Besides intergovernmental agreements, for the purposes of implementation of the International plan to prevent, deter and liquidate IUU fisheries approved by the Committee on Fisheries (FAO) in 2001, the Russian Government approved a National plan to prevent, deter and liquidate IUU fisheries of aquatic bioresources (Order of the Russian Government dated December 25, 2013 No. 2534-r).

The following actions are planned in accordance with the plan:

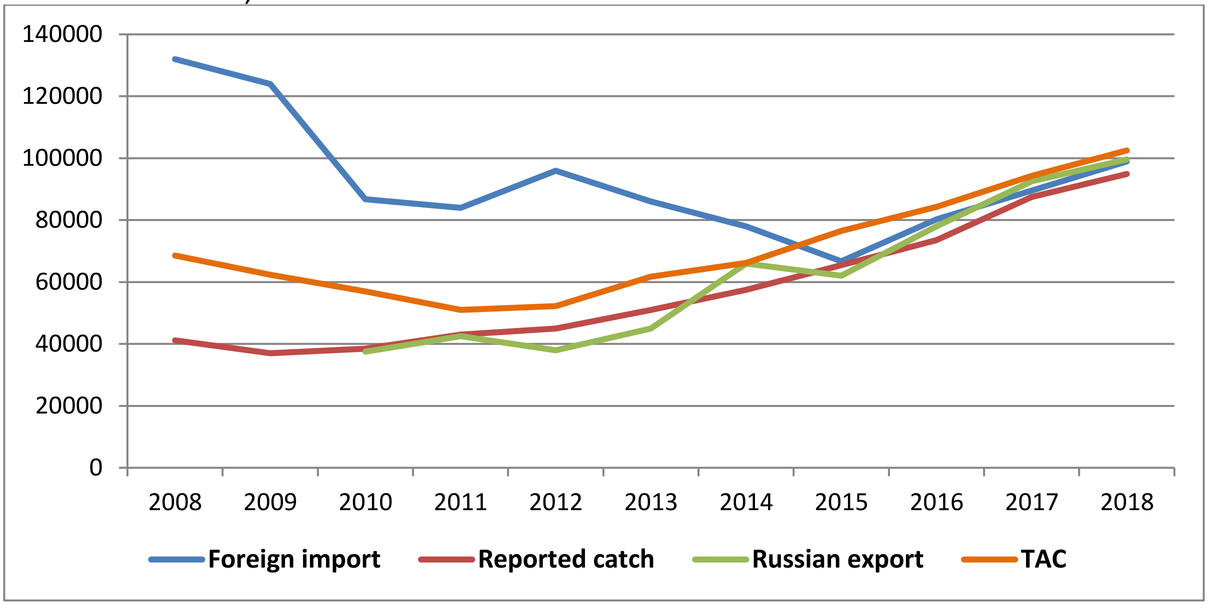
• improvement of specific legislation of the RF concerning regulation of the activities connected with acceptance, transshipment, transportation, storage and unloading of catches, procedure for chartering of the fishery vessels, marking of the fishery vessels and fishing gear as well as inspection of the vessels flying the flag of the foreign country in the Russian sea port;

• strengthening of control over circulation of ABR catches, establishment of catch origin monitoring system during all stages of their displacement. There are the plans to introduce electronic log books and electronic signature for the masters of fishing vessels;

• taking measures to prevent RF citizens from participation in IUU fisheries, including relevant regular raids, strengthening of administrative and criminal sanctions against persons violating legislation concerning fisheries and aquatic bioresources conservation.

Certain steps and measures for implementation of the National plan to combat IUU fisheries to be taken by Rosrybolovstvo and MoA were developed and approved by the Government (order N2661-p of 24.12.2015).

Fig.1 – Comparison of reported catch and official export and import trade flows of the Russian Crab, 000 mt



Source: CCA calculation based on official catch and trade statistics

CCA makes an annual assessment and comparison of trading flows to verify the amount of supply of the Russian crab to the international markets with the amount of officially reported catch and registered export. The calculation is based on the official statistics of crab imports from the key importing countries (Japan – Ministry of finance; US – NOAA trade data; Republic of Korea – data from Korean international trade association; Canada – official statistics from the government of Canada; EU – Eurostat source; China – International trade center customs statistics online). The Russian catch and export statistics come from the Federal Fisheries Agency official reports on the catches, and Russian Customs online trade base.

In 2008-2012, import from Russia exceeded the official export and catch by 3 times, the chart below clearly shows that it does not happen anymore, official export, import and catch figures are at the same point. There is no IUU crab coming from Russia to the market. See fig. 1.

6. Russian Far East Crabs TAC and Catch information

6.1. Total TAC of all crab species in the Far East seas in 2012-2018, 000 mt

Area	2012	2013	2014	2015	2016	2017	2018
West Bering Sea zone	4,145	3,126	4,934	4,755	4,703	5,769	6,082
Karaginskiy subzone	0,334	0,457	0,436	0,434	0,731	0,814	0,695
Petropavlovsk-Kommandorsky subzone	0,208	0,208	0,330	0,336	0,329	0,329	0,456
North Kuril zone	0,529	0,620	0,690	0,8	0,801	0,902	0,732
South Kuril zone	0,294	0,332	0,252	0,381	0,381	0,383	0,283
Central part of the Sea of Okhotsk	-	-	-	-	0,03	0,28	0,28
Northern Sea of Okhotsk subzone	16,849	16,832	16,643	16,05	19,403	21,694	24,451
West Kamchatka subzone	2,863	8,493	7,943	9,206	10,698	13,027	15,473
East Sakhalin subzone	5,243	5,742	4,817	9,008	8,628	8,281	9,827
Kamchatka-Kuril subzone	1,391	4,067	3,263	4,083	6,226	7,721	7,117
Primorye subzone	14,517	15,490	15,980	15,347	15,039	15,169	16,419
West Sakhalin subzone	0,303	0,303	0,303	0,303	0,303	0,879	0,879
TOTAL	**46,676**	**55,670**	**55,591**	**60,703**	**67,272**	**75,248**	**82,694**

Source: FFA and MoA orders

6.2. Total Available Catch (TAC) of Russian Far East crabs, 2018 *(000 mt)*

Ministry of Agriculture Order № 533 of 27.10.2017

Commercial species	West Bering Sea zone (61.01)*	East Kamchatka zone (61.02)		North Kurils zone (61.03)	South Kurils subzozn (61.04)	Sea of Okhotsk zone (61.05)					Sea of Japan zone (61.06)	
		Karaginsky subzone (61.02.1)	Petropavlovsk-Komandor subzone (61.02.2)			North Okhotsk Sea subzone (61.05.1)	North Okhotsk Sea (Peanut Hole enclave) (61.52)	West Kamchatka subzone (61.05.2)	Kamchatka-Kurils subzone (61.05.4)	East Sakhalin subzone (61.05.3)	subzone Primorye (61.06.1)	West Sakhalin subzone (61.06.2)
Red kinbg crab			0,0020	0,001	0,002	0,590		11,022	4,383	0,001	0,502	0,001
Blue king crab	3,897	0,001				0,520		3,948		0,160	0,871	
Spiny king crab		0,010			0,130			0,001		0,350	0,400	
Mitten crab												
Golden king crab				0,730	0,150	2,289	0,270	0,300		0,006		
Scarlet king crab												
Queen (opilio) snaw crab	2,876	0,397	0,001			18,100	0,005	0,200		1,600	6,390	0,498
Red snow crab											9,360	0,300
Tanner (Bairdi) snow crab	0,206	0,287	0,580	0,001					2,683			
Triangle tanner snow crab						2,520	0,005	0,002	0,001	7,630		
Grooved tanner crab												
Horsehair crab				0,000 1	0,001				0,050	0,080	0,620	0,080

* - FAO Fishing Areas

6.3. Total Catch of Russian Far East crabs, 2018 *(000 mt)*

Commercial species	West Bering Sea zone (61.01)*	East Kamchatka zone (61.02)		North Kurils zone (61.03)	South Kurils subzozn (61.04)	Sea of Okhotsk zone (61.05)					Sea of Japan zone (61.06)	
		Karaginsky subzone (61.02.1)	Petropavlovsk-Komandor subzone (61.02.2)			North Okhotsk Sea subzone (61.05.1)	North Okhotsk Sea (Peanut Hole enclave) (61.52)	West Kamchatka subzone (61.05.2)	Kamchatka-Kurils subzone (61.05.4)	East Sakhalin subzone (61.05.3)	subzone Primorye (61.06.1)	West Sakhalin subzone (61.06.2)
Red kinbg crab						0,574		10,953	4,340		0,241	
Blue king crab	3,871					0,518		3,916		0,149	0,580	
Spiny king crab					0,070					0,208	0,393	
Mitten crab												
Golden king crab				0,624	0,145	2,156	0,270	0,290				
Scarlet king crab												
Queen (opilio) snaw crab	2,766	0,384				17,982	0,005	0,144		1,572	5,794	0,452
Red snow crab											6,691	0,137
Tanner (Bairdi) snow crab	0,201	0,283	0,496						1,878			
Triangle tanner snow crab						1,695	0,005			5,018		
Grooved tanner crab												
Horsehair crab											0,512	

* - FAO Fishing Areas

6.4. Total Available Catch (TAC) of Russian Far East crabs, 2019 *(000 mt)*

Ministry of Agriculture Order № 516 of 09.11.2018

Commercial species	West Bering Sea zone (61.01)*	East Kamchatka zone (61.02)		North Kurils zone (61.03)	South Kurils subzozn (61.04)	Sea of Okhotsk zone (61.05)					Sea of Japan zone (61.06)	
		Karaginsky subzone (61.02.1)	Petropavlovsk-Komandor subzone (61.02.2)			North Okhotsk Sea subzone (61.05.1)	North Okhotsk Sea (Peanut Hole enclave) (61.52)	West Kamchatka subzone (61.05.2)	Kamchatka-Kurils subzone (61.05.4)	East Sakhalin subzone (61.05.3)	subzone Primorye (61.06.1)	West Sakhalin subzone (61.06.2)
Red kinbg crab			0,0020	0,001	0,001	0,767		11,022	4,383	0,001	0,351	0,001
Blue king crab	3,997	0,001				0,603		3,316		0,154	0,967	
Spiny king crab		0,010			0,260			0,001		0,350	0,400	
Mitten crab												
Golden king crab				0,773	0,214	1,943	0,270	0,300		0,006		
Scarlet king crab												
Queen (opilio) snaw crab	1,668	0,540	0,001			21,000	0,005	0,200		1,600	5,710	0,500
Red snow crab											7,900	0,300
Tanner (Bairdi) snow crab	0,247	0,230	0,797	0,001					0,020			
Triangle tanner snow crab						2,520	0,005	0,002	0,002	7,194		
Grooved tanner crab												
Horsehair crab				0,000 1	0,001				0,050		0,570	0,080

* - FAO Fishing Areas

6.5. Total Reported Catch of Russian Far East crabs, 2019 *(000 mt)*

Commercial species	West Bering Sea zone (61.01)*	East Kamchatka zone (61.02)		North Kurils zone (61.03)	South Kurils subzozn (61.04)	Sea of Okhotsk zone (61.05)					Sea of Japan zone (61.06)	
		Karaginsky subzone (61.02.1)	Petropavlovsk-Komandor subzone (61.02.2)			North Okhotsk Sea subzone (61.05.1)	North Okhotsk Sea (Peanut Hole enclave) (61.52)	West Kamchatka subzone (61.05.2)	Kamchatka-Kurils subzone (61.05.4)	East Sakhalin subzone (61.05.3)	subzone Primorye (61.06.1)	West Sakhalin subzone (61.06.2)
Red kinbg crab						0,743		10,953	4,350		0,170	
Blue king crab	3,866					0,594		3,282		0,151	0,568	
Spiny king crab					0,223					0,211	0,146	
Mitten crab												
Golden king crab				0,772	0,213	1,896	0,266	0,291				
Scarlet king crab												
Queen (opilio) snaw crab	1,636	0,534				20,865		0,195		1,591	5,508	0,440
Red snow crab											5,360	0,155
Tanner (Bairdi) snow crab	0,237	0,224	0,788									
Triangle tanner snow crab						0,537				4,368		
Grooved tanner crab												
Horsehair crab									0,042		0,465	

* - FAO Fishing Areas