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BERING-ALEUTIAN SALMON INTERNATIONAL SURVEY (BASIS): POPULATION-BIOLOGICAL RESEARCHES IN THE WESTERN PART OF BERING SEA (RUSSIAN ECONOMIC ZONE). PART 3 - CHINOOK SALMON *ONCORHYNCHUS TSCHAWYSCHA*

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ABSTRACT

This work has represented results of identification of regional complexes of local stocks of immature chinook salmon on the data of trawl surveys of the R/V «TINRO» in the Bering–Aleutian Salmon International Surveys (BASIS) in the Western Bering Sea in summer-fall periods in 2002-2004. The system of districts of the Bering Sea part of the EEZ of RF, accepted in TINRO-Center for making biocenological researches, was used in this work. Scale structure was used as a criterion for differentiation. Scale structure was used as an instrument of the differentiation. In the whole the ages of fishes in mixed marine samples were estimated for the total sample size of 756 chinook salmon individuals, including 480 fishes which ages were identified in particular. In the analysis there were used the age groups 1.1 + 1.2, taking in the total more than 90% of immature chinook salmon in the trawl catches. The basis scale lines of 2004-2005 consisted of 3196 chinook salmon individuals from the age groups 1.2 + 1.3 + 1.4.

The result of the identification indicated predominance of the stocks of Alaska in the occurrence in the trawl catches in the Western Bering Sea in 2002-2004. The part of fishes of this complex varied in range 50.2-71.2%. The peak occurrence was in 2004. Moreover, that year a high density of fishes in the boundary area of the Bering Sea part of the EEZ of RF was displayed on the trawl catches of chinook salmon distribution. The other part of immature Chinook salmon was represented by one stock of the Kamchatka River (East Kamchatka).

INTRODUCTION

Chinook salmon is not abundant species of Pacific Salmon in the Far East, what makes providing of the population-biological researches of this species difficult, as sampling adequate mixed marine or baseline data pools is problematic. The collision gets maximally critical in the case when the research has built on the scale structure analysis.

Some preliminary data on the identification of chinook salmon stocks in the trawl catches from the cruises of RV TINRO in 2002-2003 on the program BASIS were released earlier (Bugaev 2004, 2005). In the current research we used the baselines of 2004 and 2005. The use had to provide minimization of the baseline/mixed sample difference in the years of emergence of chinook salmon.

In the rivers of Kamchatka and Alaska the principle ages (more than 90% of individuals) of chinook salmon spawners revealed were 1.2, 1.3 and 1.4 (Healey 1991). The baselines in this work are built on the base of scale criteria combination among all dominant ages of spawners into a separate baselines in each of watersheds. Hence, the averaged age of the scale standards used is approximately 1.3. With that the immature individuals in the trawl samples were from the age groups 1.1 (up to 80%) and 1.2. Therefore the difference of 2 years between the baselines and mixed samples was to provide making maximally adequate comparison in a respect to the year of emergence in the course of identification. The term was not satisfied only in 2004, because the assessments were obtained from the baseline of 2005, therefore the data also can be reckoned as preliminary. Indeed, the approach mentioned was forced, as sampling the scales was limited on the deficiency of chinook salmon individuals. Thus, the factor of the year-to-year variations was taken into account, and the assessments already obtained were defined more precisely.

The purpose of this work was to make identification and assessment of potential stock abundance of regional complexes of chinook salmon local stocks on the data of trawl catches by RV TINRO in the Western Bering Sea in summer-fall 2002-2004.

Material and methods

The material included scale samples and biological measuring data collected by scientists of TINRO-Centre in the trawl catches by RV TINRO in the Western Bering Sea in summer-fall 2002-2004. Sampling was accomplished according the standard scheme adopted in the BASIS Program. The system of the statistical districts worked out for the purposes of the biocenological researches within the Economical Zone of RF in the Far East (Shuntov 1986; Volvenko 2003) was used.

As known the scales can be lost often in the course of trawling, therefore the scale sampling is a challenge not always satisfying the terms of the standard method of sampling. The problem gets harder due to the total deficiency of chinook salmon individuals to make appropriate sample. In these terms the accurate sampling of scale scales, as it were for the mass Pacific Salmon species, cannot be provided. This is why the analysis should include almost all scale material from the ages mentioned. All the circumstances bring specific inaccuracy into the results. It should be added nevertheless, that if all mixed samples were covered maximally, their size in general would never answer statistical requirements to provide the data obtained as representative. In the total the sample size of the mixed samples was: 756 fishes aged and 480 fishes identified (Table 1).

All assessments of Pacific Salmon abundance/biomass in the Western Bering Sea and in the adjacent waters of the north-west part of the Pacific Ocean were provided by the scientists of TINRO-Centre and applied to NPAFC (NPAFC 2003, 2004, 2005).

In this research we used the scale baselines only from the most important watersheds contributing to the commercial abundance of chinook salmon spawners. Such watersheds in the Asian part of chinook salmon areal are Kamchatka and Bolshaya Rivers (Table 2, Fig. 1). In the case of Kamchatka River the samples can characterize scales of East Kamchatkan chinook salmon, and in the case of Bolshaya River – of West Kamchatkan fishes. The catch of chinook salmon in these two rivers makes up to 90% of the total catch of the species in Asia. Kamchatka River supplies up to 80% in the catch (according to the official statistics data), therefore, on our view, the pool of the baselines can answer the requirements of the Asian stocks identification. Nevertheless, real catch of chinook salmon, especially on the west coast of Kamchatka, where a number of spawning grounds is situated, stays uncertain.

North American chinook salmon is represented by three most abundant stocks of Alaska from the rivers Nushagak, Kuskokwim and Yukon. There stocks characterize central and north-west regions of Alaska and make up to 50% of the total harvest in this area. The factor of the geographical distribution of chinook salmon from Alaska in the Bering Sea is also playing role. Earlier researches of scale structure and parasite species composition carried out on the base of the data of tagging indicate that the fishes of the stocks mentioned are chinook salmon distributed maximally in the west part of the Bering Sea (Major et al. 1978; Myers at al. 1987; Urava at al. 1998; Klovatch et al. 2002). Thus, we have suggested the pool of the baselines from Alaska also should be quite demonstrative for this research. In the whole the scale baselines were made up of 3196 chinook salmon individuals.

The scheme of the scale criteria used for the identification of the regional complexes of chinook salmon local stocks is demonstrated in the Fig. 2. The analysis on the criteria and the mathematic analysis have provided according to the international standards accepted in NPAFC. We have provided the description of the methodical aspects in the details in Part 1 of the work "Bering-Aleutian salmon international survey (BASIS): population-biological researches in the western part of Bering Sea (Russian Economic Zone)" and other publications (Bugaev 2004, 2005; Bugaev et al. 2004).

RESULTS AND DISCUSSION

Characterization of trawl samples

Distribution and abundance

Just a brief review of the biological component of the research is provided in this part. The details of the biological assessments of chinook salmon in the Western Bering Sea on the data of BASIS are demonstrated by I.I. Glebov (2007).

The spatial distribution of chinook salmon figured out on the data of the trawl surveys by RV TINRO in the summer-fall seasons 2002-2004 is shown in the Figures 3-5. In most cases chinook salmon was not found in the catches or was met as 1-50 individuals per a square kilometer. That is normal nowadays when chinook salmon has reckoned as the least in the abundance among Pacific Salmon species in Asia. Moreover, the assessment mentioned above is not too low relatively to the official statistics data on the abundance of the mass species of Pacific Salmon. During the period of the observations the highest catches of chinook salmon were observed in the "northern" districts 1-8. This species was maximum frequent in summer of 2003, when epipelagic averaged assessments were in the range 251-500 fishes/km^2. These assessments are comparable to the assessments of the mass salmon species, including sockeye salmon. But in general the occurrence of chinook salmon in the Western Bering Sea was relatively low, what predetermined the lack of the material in the course of scale sampling.

On the base of the size-weight characteristics of chinook salmon and of the state of gonads the experts of TINRO-Centre identified the juvenile individuals as immature or postcatadromous. Mature fish were not observed in the catches. Mainly the immature part of the stocks was analyzed. The assessments of the abundance and biomass by the biostatistical districts were made by the experts on the data of the distribution of the catches of immature chinook salmon (Table 3, Fig. 6). For the period in the whole the maximum abundance/biomass of chinook salmon was in the district 8 (3.22-30.11 million fishes/4.73-36.35 thousand t). Next playing an important role district was the district 12. The abundance/biomass of immature chinook salmon varied there as 1.54-2.58 million fishes/3.44-4.54 thousand t.

In general the quantitative assessments of the spatial distribution of chinook salmon demonstrated in the Western Bering Sea were relatively high, even when comparing them to the World stock of this species. Judging on the current data of the distribution of the coastal and river catches of chinook salmon spawners for the last 10-15 years in Asia and North America, it can be said that 80-85% of the Bering Sea stock have originated in Alaska (Fig. 7). In average the annual runs of chinook salmon spawners (the catch + the escapement) to the coasts of Kamchatka and Alaska take averagely 1.0 million fishes. That is under the term that commercial fisheries remove about 70% of the runs. The abundance of Russian chinook salmon according to the statistics by KamchatNIRO is 0.15 million fishes approximately. The assessment might be two times higher if poaching removal were taken into account, since chinook salmon has got one of the most valuable commercial species of Pacific Salmon. We do not concentrate attention on the stock abundance of chinook salmon of Canada and Washington State (US) intentionally because their geographical distant situation prevents the possibility of any significant influence of these stocks on formation of chinook salmon abundance in the Economic Zone of Russia. Nevertheless we have it noted that the summary contribution of these stocks to the total abundance of the species is similar to the contribution of the stocks from Alaska (the coastal and river catches 0.8-0.9 million fishes).

Thus, the assessments of immature chinook salmon from the trawl surveys by RV TINRO exceed (6-40 times) the stock abundance assessment for Kamchatka and Alaska. Over that, the area of chinook salmon feeding in the ocean was not been covered by the research completely. The factor of the abundance increase of Pacific Salmon hardly can be the only explanation of the phenomenon. A methodical error in making the assessment of the abundance by the method of squares, what appears maximal in the researches of poor abundant species, can take place.

The age structure

The age structure of immature chinook salmon pool from the catches in the Western Bering Sea is demonstrated in the Table 4. The data summarized for all biostatistical districts of the Bering Sea part of the EZ of Russia are shown for this species. The age group 1.1 (the contribution 75.53-87.93%) dominates. The percent of fishes from the age group 1.2 is visibly lower and in the range 8.63-18.80%. The other age groups are not abundant. In general, the percent of the available age groups (AAG - 1.1+1.2) in all cases exceeds the level 90%, the exceeding is highly informative parameter for identification on scale criteria. Otherwise the total relatively small volume of chinook salmon scale sample can strongly compensate this parameter.

The baselines

The discriminate analysis

The discriminating analysis has demonstrated a rather wide range of the centroid average meanings used in the baselines 2004 and 2005 relatively the first and the second canonic meanings (Fig. 8). In 2004 the difference between the Asian and American baselines is quite clear. One can differentiate the stock complexes, as next: East (Kamchatka River) and West (Bolshaya River) Kamchatka, North-west Alaska (the rivers Yukon and Kuskokwim) and Central Alaska (Bristol Bay) (Nushagak River). In 2005 a similarity between the baselines from the Yukon R. and the Kamchatka R. gets visible from the canonic meanings. In principle, there might be a casual grasping of a part of the mixed sample by one of the baselines, determined underestimation and overestimation of the percent of the East Kamchatkan or Alaskan stocks in the mixed samples in 2003. The baselines of Bolshaya R. (West Kamchatka) and Nushagak R. (Central Alaska) could be identified well on the data of the discriminating analysis.

Pair bi-selective t-test for the average meanings

The level of the difference between the marked components of the baseline simulations was estimated by the pair t-test for the averages (Table 5). The results of testing have demonstrated that the scale baselines suggested can provide authentic difference in 90-100%. Such level is very high indeed. In real it is overestimated to some extent because the difference up to the 10% threshold of the reliability was included. In principle, such level can be satisfactory for this research, because the expected error of the scale criteria mean accuracy for Pacific Salmon is approximately 10-15% in average (Bugaev 2003a,b; Bugaev et al. 2004).

Nevertheless, from the mathematical point of view the authentic level of the difference is reached when the 5%-threshold of the reliability has exceeded, hence, saying strictly the comparison how different the components of the baselines used are demonstrates the variations of the level of the reliable identification in the range 60-80%.

Among the critical moments it is remarkable that the difference between the scale baselines of Bolshaya R. and Nushagak R. was inauthentic in 2005. The effect might influence the results of the identification. However, as the largest Asian stock of chinook salmon from Kamchatka R. is authentically different in all cases the possible error can be neglected.

The simulation

The results of simulation of chinook salmon baselines (the pool of the ages 1.2+1.3+1.4) are demonstrated in Tables 6 and 7. The computations demonstrate that the resolution ability of the simulations used is rather high – 86.15% in 2004 and 88.80% in 2005. Hence, the error of the method can be less than 15% what agrees to the assessment reliability level selected.

The identification of the regional complexes of local stocks

Distribution of the stock complexes

The results of the identification of the principle complexes of immature chinook salmon local stocks in the age groups 1.1 and 1.2 on the data of the trawl catches by RV TINRO in 2002-2004 are demonstrated in Table 8 and Figures 9-11. It should be noted, that only the samples of 2003 were the most representative. In 2002 and 2004 the sample size analyzed was less than 100 individuals, therefore the results cannot be reckoned as none discussable. Nevertheless, the relationships revealed in the composition of the complexes identified for the whole period of observations allow to think that the assessments obtained are not of the fortuity.

It can be seen from the data demonstrated, that Alaskan complex of stocks dominated in frequency in the trawl catches in 2002-2004 in the western part of the Bering Sea. The percent of this complex varied in the range 50.2-71.2%. The maximal frequency was in 2004, and in this year the scheme of the distribution of chinook salmon trawl catches has revealed significant concentration of fishes at the edge of the Bering Sea part of the EZ of the RF. This fact might indicate about an increase of the potential presence of American chinook salmon in this region. The other part of immature chinook salmon actually consisted of single stock from Kamchatka River (East Kamchatka). In principle, this view of the distribution is not contrary to the concept of the distribution of the complexes of stocks in the Bering Sea.

Our preliminary data in 2002-2003 also have demonstrated predominance of two these complexes in the trawl catches by R/V TINRO (Bugaev 2004, 2005). However according to more precise data for 2002 a visible increase (of 30% approximately) of the part of Alaskan stocks takes place, and in 2003 the increase of 20% is observed in September-October. Preliminary and more precise meanings on the summer data 2003 were almost same (taking about 50%). This fact is rather interesting in the view that the maximally high abundance of immature chinook salmon in summer 2003 was 41.01 million fishes.

Let's note, that earlier we had obtained the data of the distribution of immature chinook salmon stocks of the age groups 1.2 and 1.3 on the drift net catches in the West Bering Sea zone in July-August 2003 (Bugaev et al., 2004). The part of American chinook salmon on these data was 74%. It is clear, that in each case the results were influenced by inevitable error of the method and by the scale quality itself. It would be probably more correct to interpret the result as a limit. In the essence it can be said that the part of American chinook salmon in July-August 2003 was 50-70% approximately.

In general the results obtained provide the evidence of the extensive distribution of immature chinook salmon from Alaska in the Western Bering Sea (Fig. 12) as in summer, as in fall. Even minimal assessments (50% or so) of American chinook salmon frequency in the trawl catches by R/V TINRO can indicate of that. As we already have admitted it cannot be excluded as well that the ecosystem conditions in the Western Bering Sea determined that in the period from the end of XX century and beginning if XXI century (Shuntov and Sviridov 2005). The data for recent years also mean that. Perhaps there can be quite stable migration system of abundant American and scare Asian chinook salmons already.

The estimates of the abundance and biomass of the stock complexes

The estimates of the abundance and the biomass of the identified Asian and American immature chinook salmon on the data of the trawl surveys carried out by R/V TINRO are demonstrated in the Table 9. The results show that in autumn of 2002 the abundance/biomass of Russian stocks in the Western Bering Sea (districts 1-12) was 5.97 million fishes/8.20 thousand tons, and of American – 6.01 million fishes/ 8.26 thousand t.

In 2003 the abundance/biomass of chinook salmon was maximal for the whole observation period. In summer the abundance/biomass of Russian stocks was 19.92 million fishes/24.56 thousand t, and of American – 21.37 million fishes/26.71 thousand tons. In autumn the abundance/biomass was visibly lover as for Russian (5.96 million fishes/10.28 thousand t), as for American (8.40 million fishes/14.48 thousand t) stocks.

In autumn of 2004 chinook salmon abundance/biomass was minimal for the observation period in the whole: 1.83 million fishes/2.76 thousand tons for Russian stocks and 4.53 million fishes/6.83 thousand tons - for American stocks.

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Appendix figures and Tables

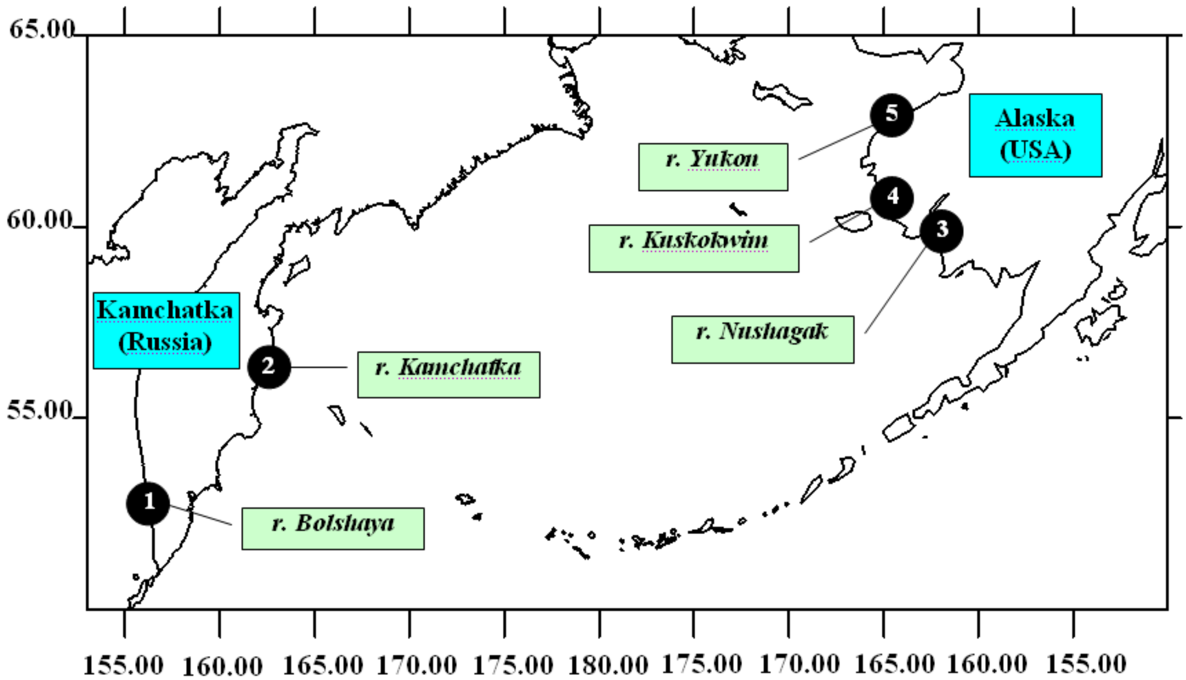


Fig. 1. Areas collected scale samples of chinook salmon used for baselines in 2004-2005

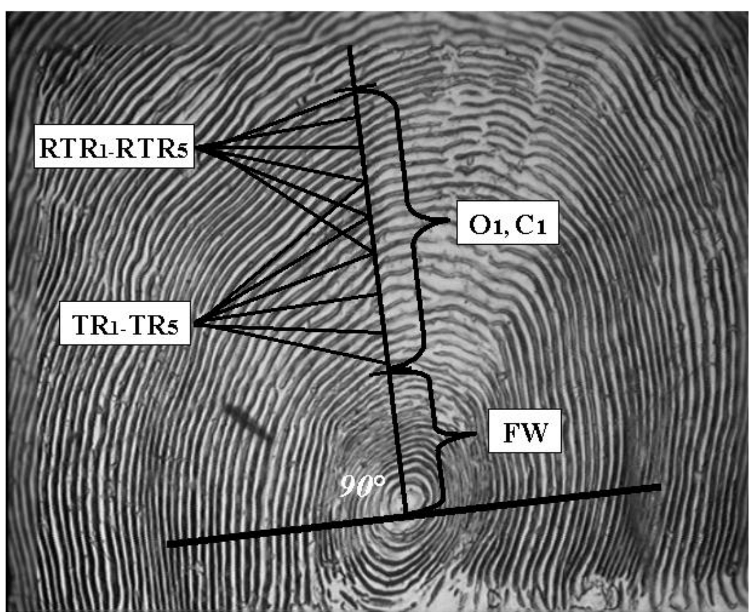


Fig. 2. Scheme of scale image used for identification local stocks of chinook salmon: FW – the total radius of freshwater zone; O_1 – total distance in the first annual ocean growth zone; C1 – number sclerites in the first annual ocean growth zone; TR_1-TR_5 – triplets circulus distance from first circuli in the first annual ocean growth zone (five triplets); RTR_1-RTR_5 – reverse-triplets circulus distance from last circuli in the first annual ocean growth zone (five reverse-triplet)

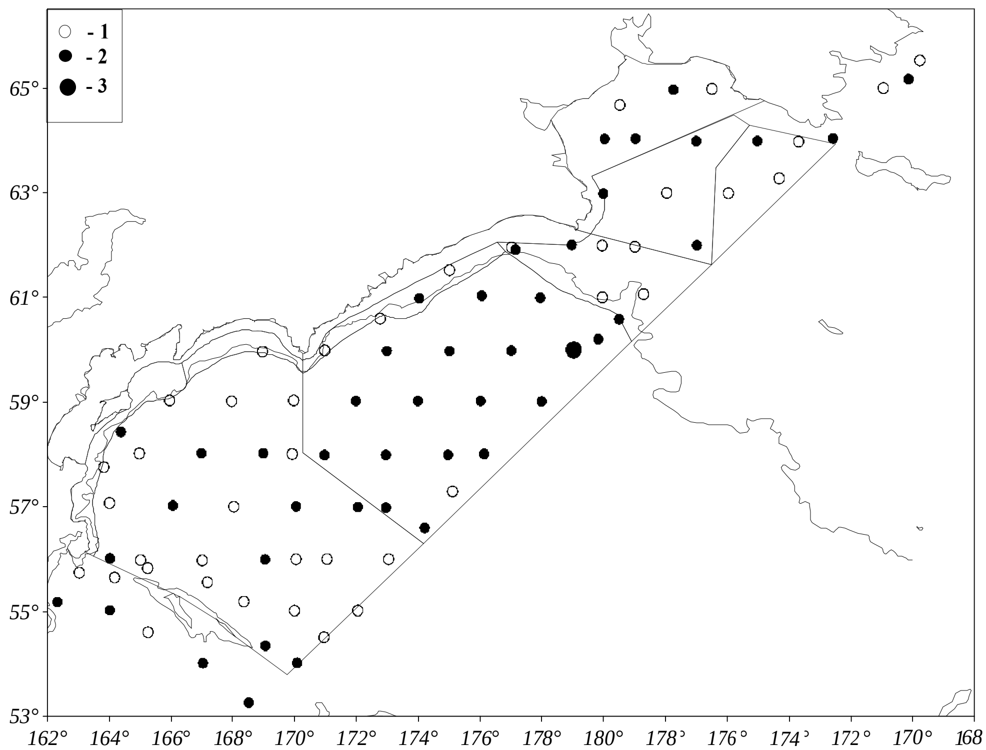


Fig. 3. The spatial distribution of the relative abundance of chinook salmon relative abundance (ind./km^2) in the Western Bering Sea in September-October of 2002. The designations: 1 – no catches; 2 – 1-10; 3 – 11-100

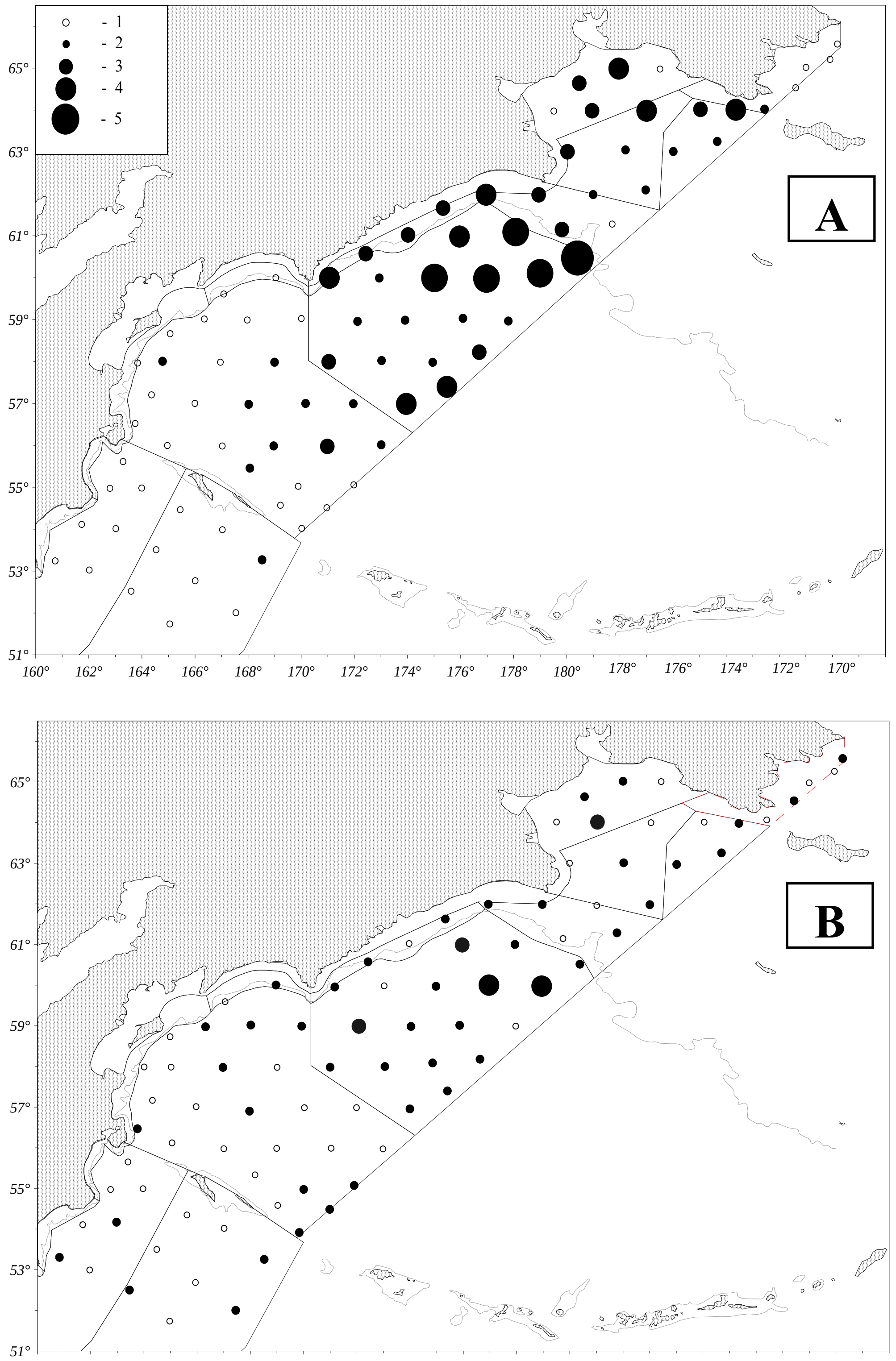


Fig. 4. The spatial distribution of the relative abundance of chinook salmon (ind./km^2) in the Western Bering Sea in July–August (A) and in September–October (B) of 2003. The designations: 1 – no catches; 2 – 1-50; 3 – 51-100; 4 – 101-250; 5 – 251-500

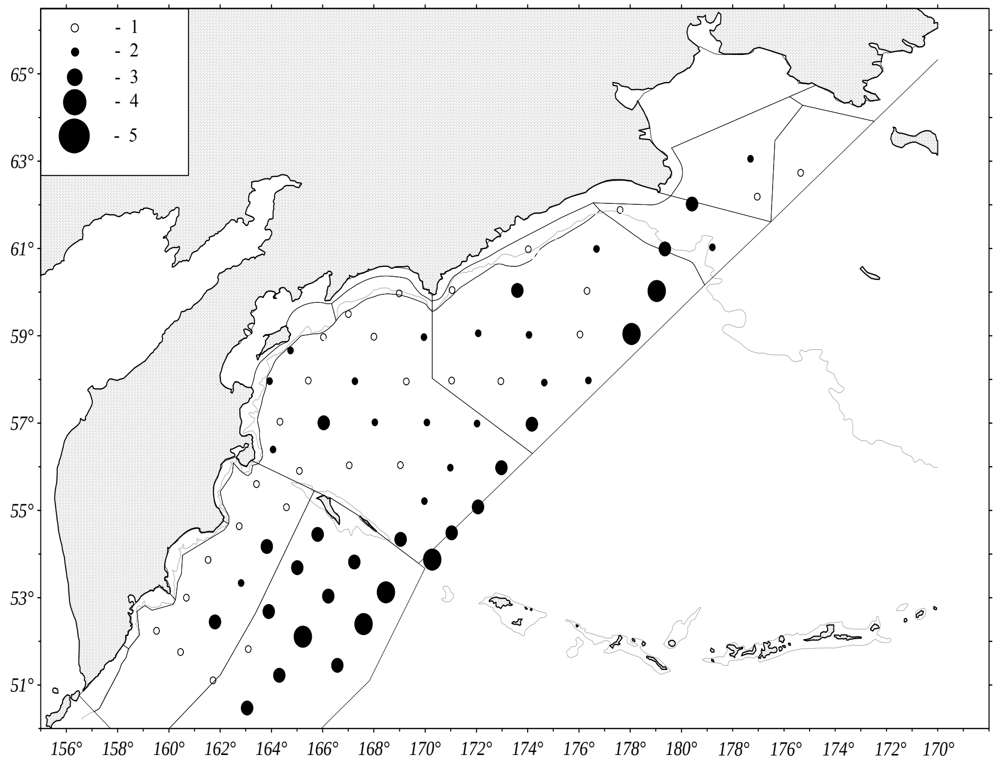


Fig. 5. The spatial distributions of the relative abundance of chinook salmon (ind./km^2) in the Western Bering Sea in September-October of 2004. The designations: 1 – no catches; 2 – <10; 3 – 11-50; 4 – 51-100; 5 - >100

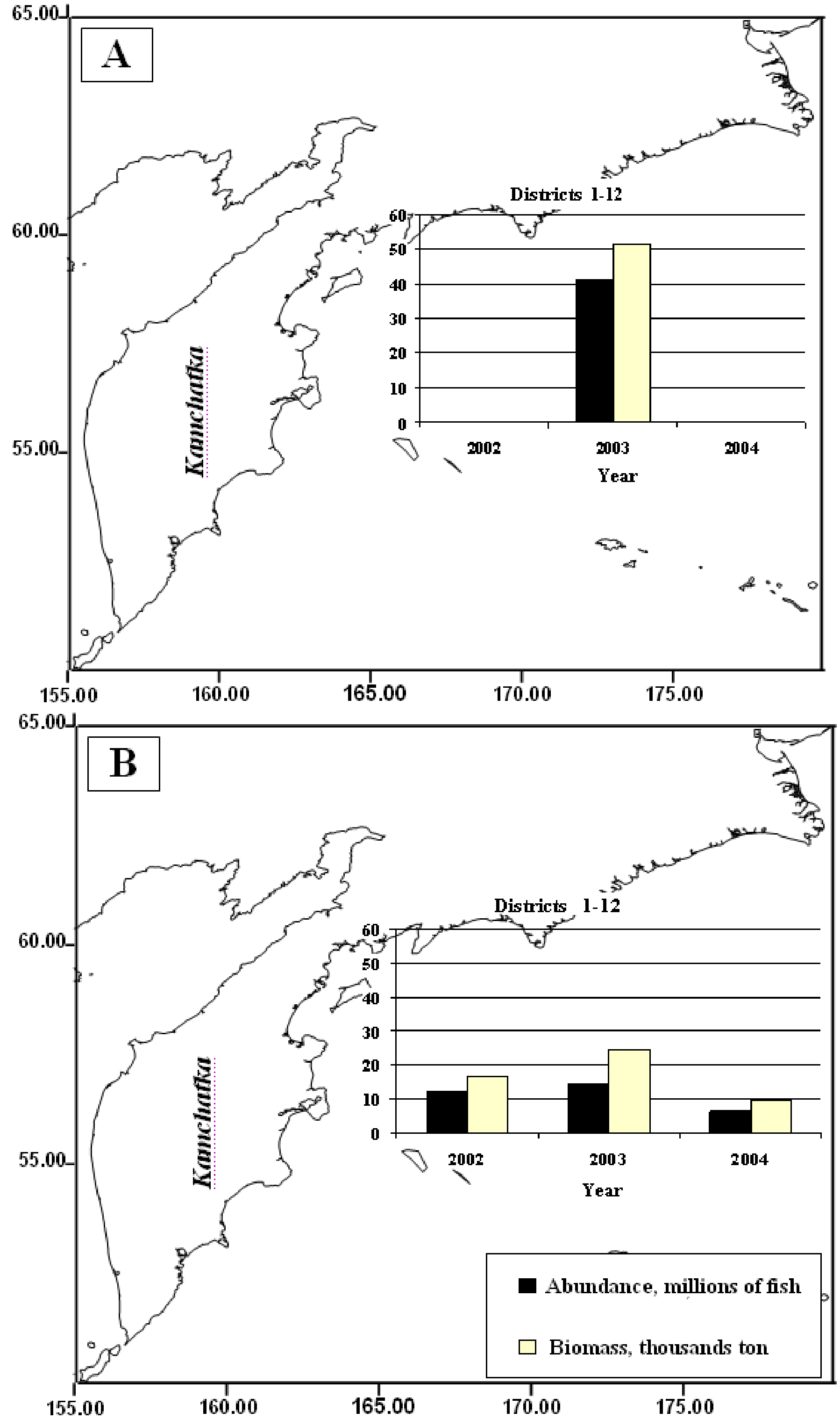


Fig. 6. The distribution of the abundance and the biomass of immature chinook salmon in the Western Bering Sea (the districts 1-12) in July-August (A) and in September-October (B) 2002-2004

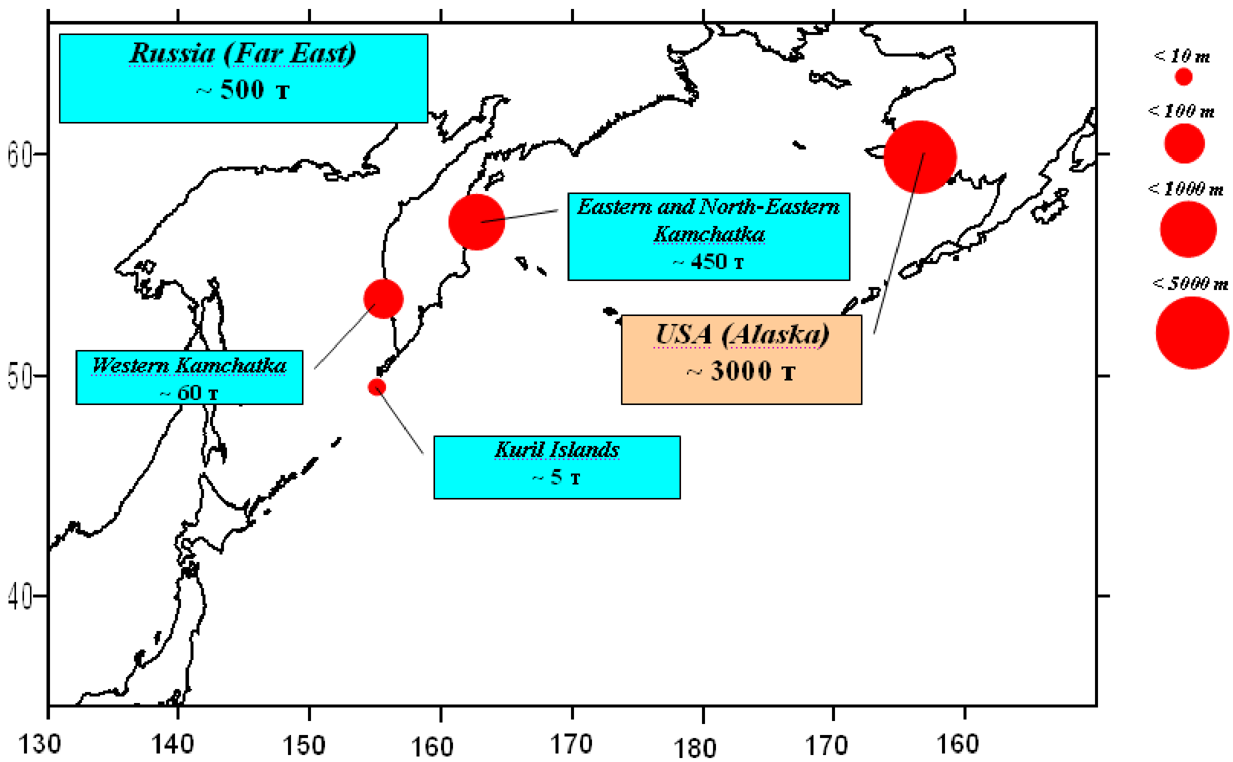


Fig. 7. The distribution of the coastal and river catches of chinook salmon in Asia and North America on the data for 1996-2005 (from Eggers et al. 2003; Karpenko and Rassadnikov 2004 and archival commercial fisheries statistic of KamchatNIRO)

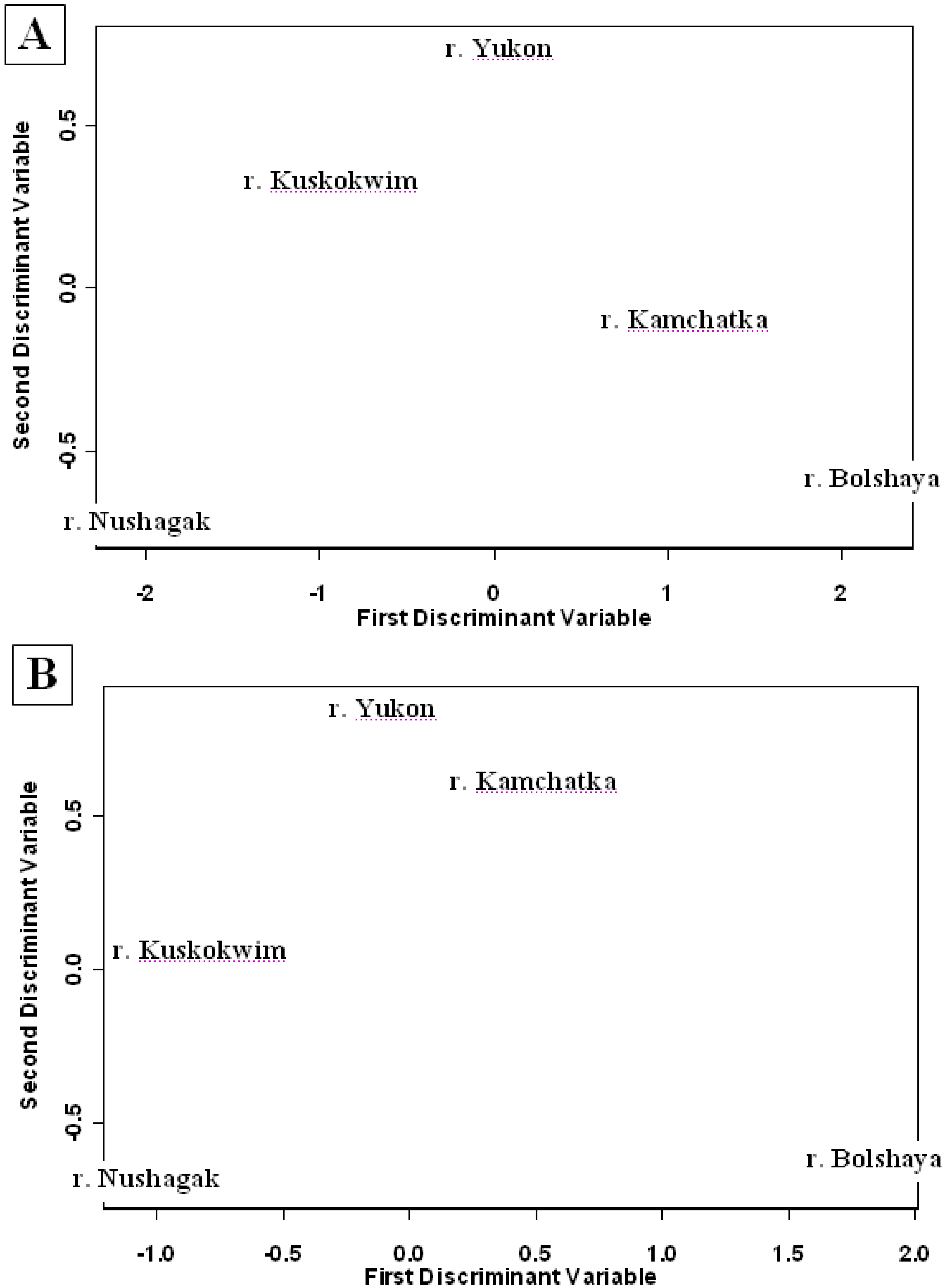


Fig. 8. The multivariate stock centroids of chinook salmon scale criteria by age groups 1.2 + 1.3 + 1.4 relatively to the first and second canonical discriminate variables on the data of 2004 (A) and 2005 (B)

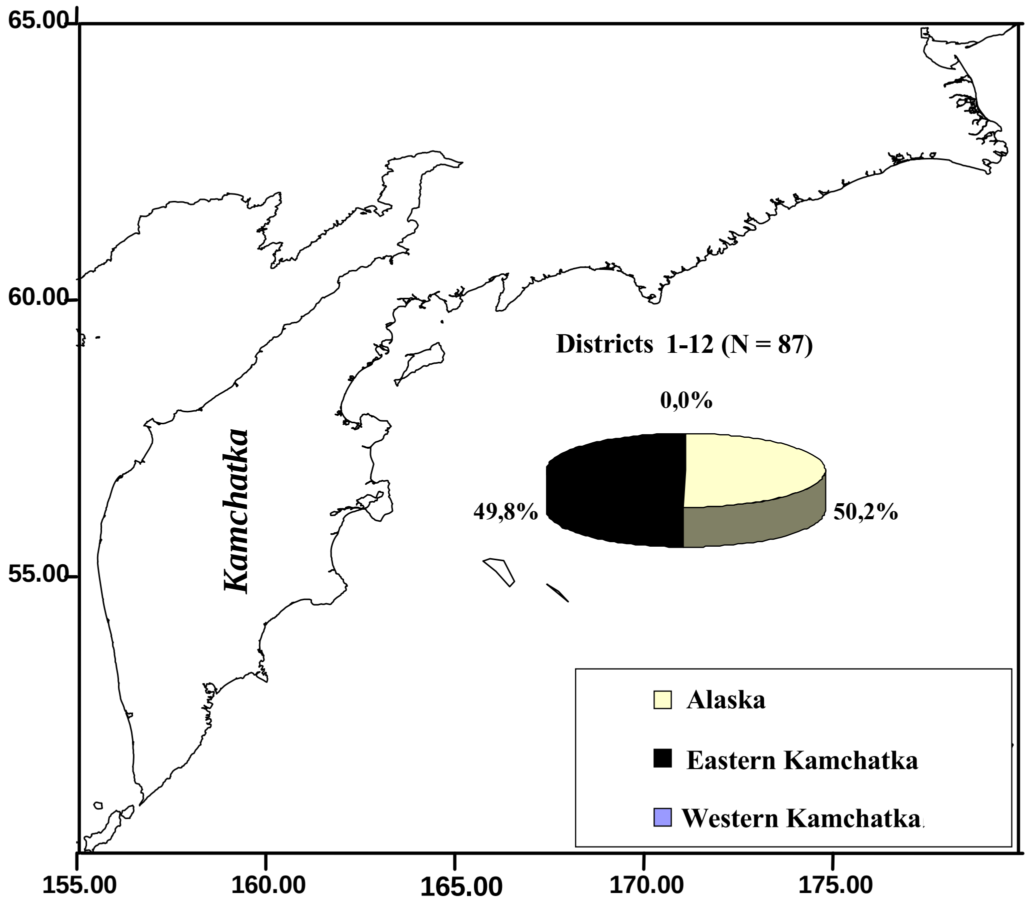


Fig. 9. The distribution of the complexes of immature chinook salmon stocks (the age 1.1 + 1.2) on the data of the trawl catches of the R/V«TINRO» in the Western Bering Sea in September-October of 2002

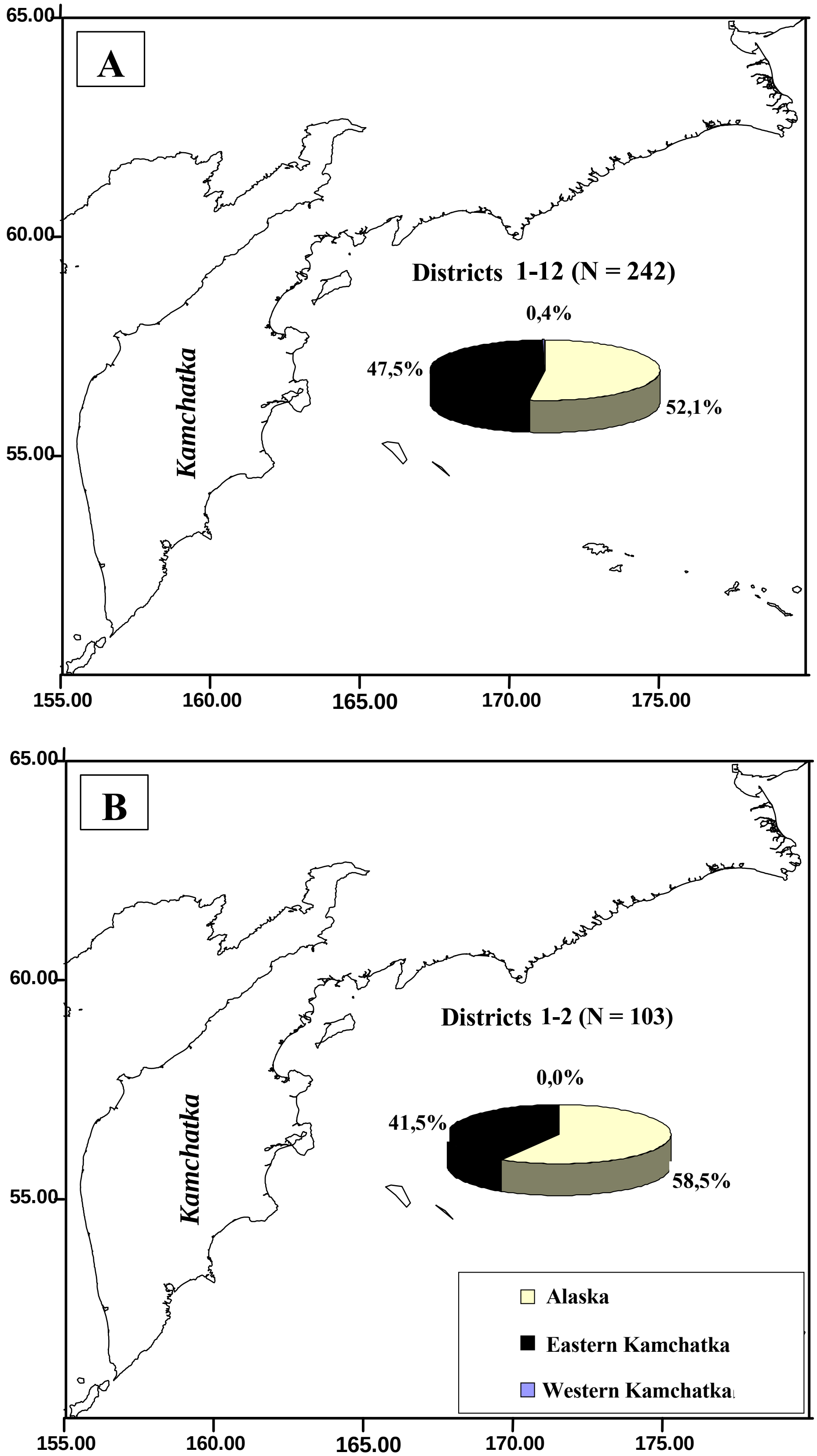

A
Districts 1-12 (N = 242)
0,4%
47,5%
52,1%
Kamchatka
65.00
60.00
55.00
155.00
160.00
165.00
170.00
175.00
B
Districts 1-2 (N = 103)
0,0%
41,5%
58,5%
Kamchatka
Alaska
Eastern Kamchatka
Western Kamchatka
65.00
60.00
55.00
155.00
160.00
165.00
170.00
175.00

Fig. 10. The distribution of the complexes of immature chinook salmon stocks (the age 1.1 + 1.2) on the data of the trawl catches of the R/V«TINRO» in the Western Bering Sea in July-August (A) and in September-October of 2003

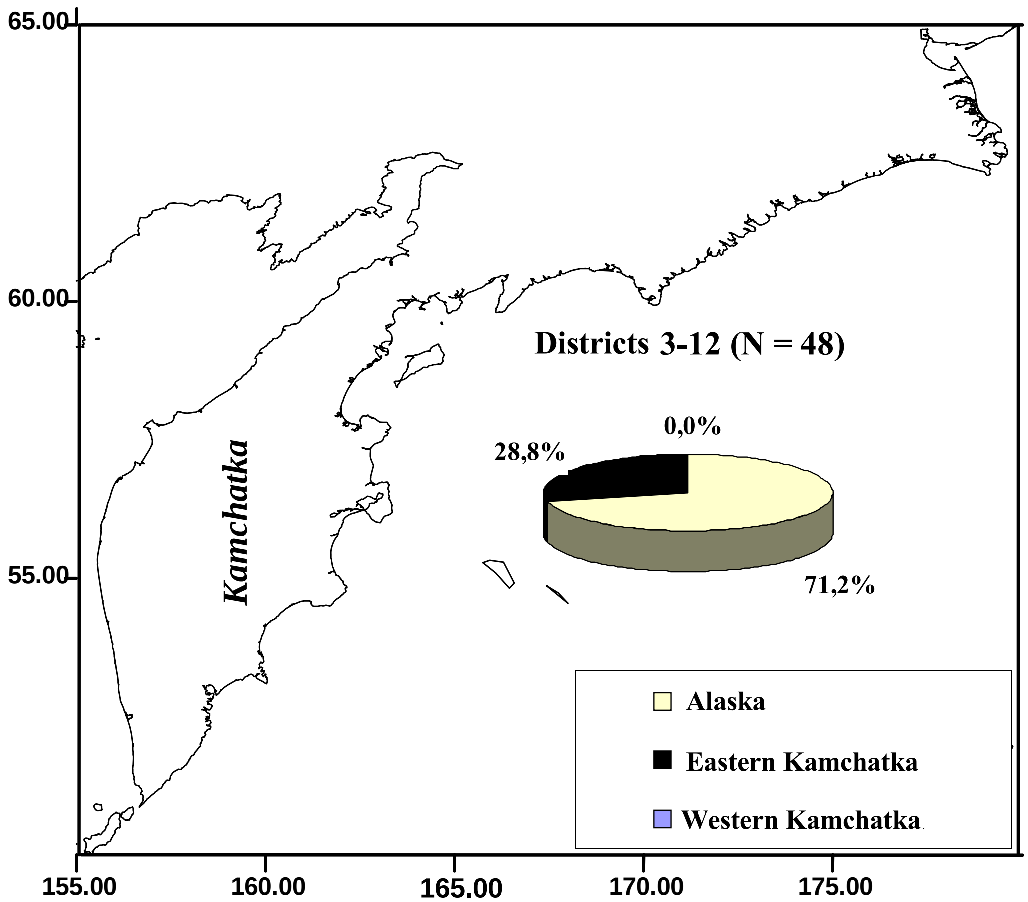
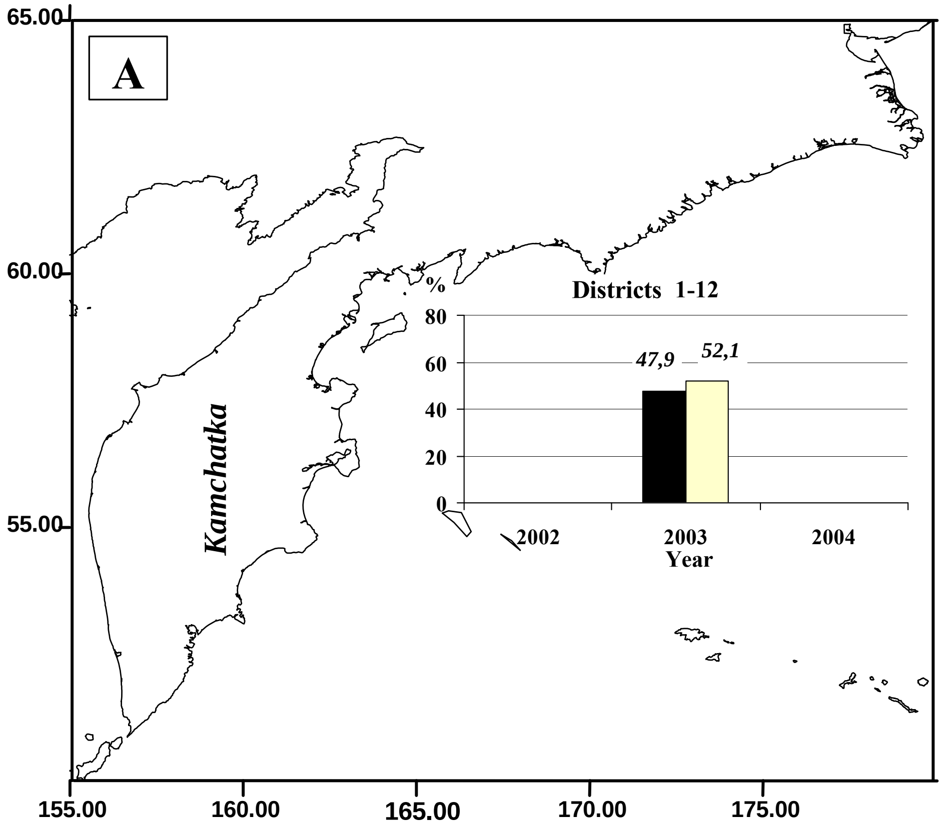


Fig. 11. The distribution of the complexes of immature chinook salmon stocks (the age 1.1 + 1.2) on the data of the trawl catches of the R/V«TINRO» in the Western Bering Sea in September-October of 2004



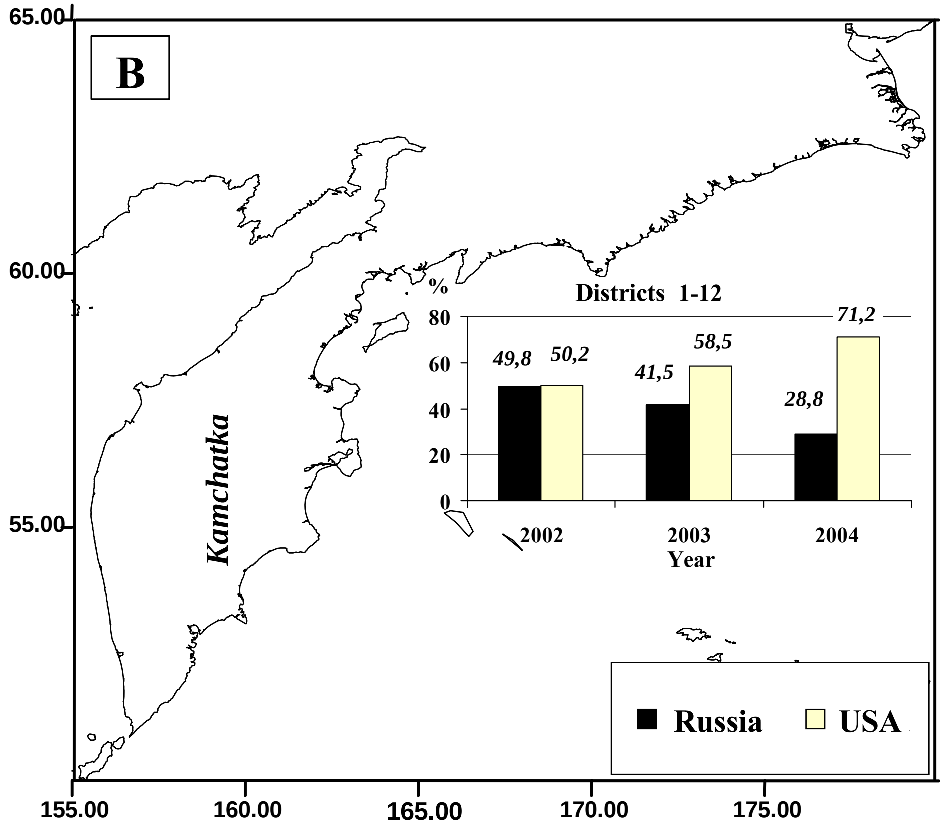


Fig. 12. The distribution of Asian and North American stocks of immature chinook salmon on the data of trawl catches of the R/V «TINRO» in the Western Bering Sea in simmer and in the fall in 2002-2004

Table 1. The total size of the mixed samples of chinook salmon used in the work, ind.

Year	Season	Biostatistical districts	Period	Coordinates	Determine age	Identification
2002	Autumn	8 (+ 1-7)	13.09-30.09	56°36' - 61°01' N 170°58' - 179°49' E	133	87
		12 (+ 9)	03.09-14.10	53°28' - 59°57' N 164°00' - 175°04' E		
2003	Summer	8 (+ 1-7)	02.08-23.08	56°59' - 64°59' N 169°07' - 179°32' E	421	242
		12 (+ 9)	17.07-05.08	54°01' - 60°00' N 163°45' - 171°59' E		
	Autumn	8 (+ 3-7)	05.10-22.10	56°57' - 63°15' N 171°00' - 179°37' E	144	103
		12 (+ 9)	23.09-05.10	53°55' - 58°59' N 163°45' - 172°59' E		
2004	Autumn	8 (+ 3-7)	05.10-23.10	56°59' - 63°03' N 171°02' - 179°35' E	58	48
		12	26.09-11.10	53°52' - 59°58' N 163°56' - 172°59' E		
TOTAL					756	480

Table 2. The size of the scale baselines of chinook salmon used in the work, ind.

Region	Stock/river	Age							
		2004				2005			
		1.2	1.3	1.4	Total	1.2	1.3	1.4	Total
RUSSIA									
Western Kamchatka	r. Bolshaya	59	36	16	111	50	50	21	121
Eastern Kamchatka	r. Kamchatka	58	147	36	241	50	50	50	150
USA									
Alaska	r. Nushagak	50	50	50	150	50	50	50	150
	r. Kuskokwim*	95	100	44	239	50	50	50	150
	r. Yukon*	-	86	100	186	-	50	50	100
TOTAL		262	419	246	927	200	250	221	671

Note. * - used scale samples from 2003 for scale baselines 2004.

Table 3. The abundance and the biomass of immature chinook salmon in the epipelagic zone of the Western Bering Sea in 2002-2004

Year	Season	Biostatistical districts												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
Abundance, millions of fish														
2002	Autumn	0.06	0.47	0.47	0.08	0.26	-	0.05	8.87	-	-	-	1.72	11.98
2003	Summer	0.02	1.63	2.08	1.43	2.18	-	1.20	30.11	-	-	-	2.36	41.01
	Autumn	0.07	0.53	0.23	0.50	0.49	-	0.10	10.83	0.07	-	-	1.54	14.36
2004	Autumn	-	-	0.08	-	0.48	-	-	3.22	-	-	-	2.58	6.36
Biomass, thousands ton														
2002	Autumn	0.38	2.39	0.81	0.05	1.08	-	0.11	9.87	-	-	-	4.54	19.23
2003	Summer	0.13	2.33	2.19	1.27	3.43	-	1.56	36.35	-	-	-	4.01	51.27
	Autumn	0.48	1.59	0.50	1.83	1.13	-	0.10	15.60	0.09	-	-	3.44	24.76
2004	Autumn	-	-	0.10	-	0.80	-	-	4.73	-	-	-	3.96	9.59

Note. Coefficient of trawl catch – 0.3.

Table 4. The age structure of immature chinook salmon in the trawl catches of the R/V «TINRO» in the Western Bering Sea

Year	Season	Biostatistical districts	N	AGE, %									AAG, %
				0.1	0.2	0.3	1.1	1.2	1.3	1.4	2.1	2.2	
2002	Autumn	1-12	133	-	0.75	-	75.95	18.80	3.00	-	1.50	-	94.75
2003	Summer	1-12	421	1.66	1.19	0.24	75.53	18.29	2.37	0.24	0.24	0.24	93.82
	Autumn	1-12	144	0.69	0.69	0.69	80.56	11.81	4.87	-	-	0.69	92.37
2004	Autumn	3-12	58	1.72	-	-	87.93	8.63	-	-	1.72	-	96.56

Note. AAG - available age groups for identification by scale pattern analysis.

Table 5. The pair t-test for the averages of cluster complexes of chinook salmon stocks identified on the basis scale lines of 2004-2005

Year	Stock/river	N	By average means (M)		By coefficients of variation	
			t-test	p-level	t-test	p-level
2004	r. Bolshaya r. Kamchatka	111 241	2.26	< 0.05	3.34	< 0.01
	r. Bolshaya r. Nushagak	111 150	1.36	0.199	5.30	< 0.001
	r. Bolshaya r. Yukon	111 186	2.71	< 0.05	4.25	< 0.01
	r. Bolshaya r. Kuskokwim	111 239	1.91	0.079	1.15	0.272
	r. Kamchatka r. Nushagak	241 150	0.94	0.363	12.16	< 0.001
	r. Kamchatka r. Yukon	241 186	1.97	0.072	8.54	< 0.001
	r. Kamchatka r. Kuskokwim	241 239	1.58	0.139	4.89	< 0.001
	r. Nushagak r. Yukon	150 186	0.13	0.899	3.34	< 0.01
	r. Nushagak r. Kuskokwim	150 239	0.22	0.829	4.07	< 0.01
	r. Yukon r. Kuskokwim	186 239	0.05	0.961	1.87	0.086
2005	r. Bolshaya r. Kamchatka	121 150	2.43	< 0.05	1.15	0.273
	r. Bolshaya r. Nushagak	121 150	0.78	0.453	0.95	0.360
	r. Bolshaya r. Yukon	121 100	2.71	< 0.05	1.86	0.087
	r. Bolshaya r. Kuskokwim	121 150	1.90	0.082	0.54	0.600
	r. Kamchatka r. Nushagak	150 150	0.67	0.516	3.96	< 0.01
	r. Kamchatka r. Yukon	150 100	2.39	< 0.05	3.12	< 0.01
	r. Kamchatka r. Kuskokwim	150 150	1.15	0.274	2.28	< 0.05
	r. Nushagak r. Yukon	150 100	1.85	0.089	0.95	0.359
	r. Nushagak r. Kuskokwim	150 150	2.03	0.065	0.89	0.389
	r. Yukon r. Kuskokwim	100 150	0.75	0.467	2.37	< 0.05

Note. Underlined meanings t-test with statistical probability ($p < 0.05$, $p < 0.01$, $p < 0.001$) or ($0.05 < p < 0.10$).

Table 6. The dependent simulation of the basis scale line of chinook salmon of the age group 1.2 + 1.3 + 1.4 on the data 2004, MLE/SD

Stock/river	N	1.	2.	3.	4.	5.
1. r. Bolshaya	111	0.9881 0.0216	0.0787 0.0560	0.0003 0.0019	0.0044 0.0080	0.0013 0.0056
2. r. Kamchatka	241	0.0063 0.0192	0.8011 0.0914	0.0000 0.0003	0.0067 0.0232	0.0136 0.0240
3. r. Nushagak	150	0.0000 0.0000	0.0000 0.0000	0.9677 0.0458	0.0023 0.0073	0.1439 0.0657
4. r. Yukon	186	0.0048 0.0107	0.1190 0.0727	0.0003 0.0025	0.9477 0.0509	0.2382 0.0967
5. r. Kuskokwim	239	0.0008 0.0038	0.0012 0.0057	0.0317 0.0459	0.0389 0.0439	0.6030 0.1125
Mean accuracy, %						86.15

Table 7. The dependent simulation of the basis scale line of chinook salmon of the age group 1.2 + 1.3 + 1.4 on the data 2005, MLE/SD

Stock/river	N	1.	2.	3.	4.	5.
1. r. Bolshaya	121	0.9781 0.0260	0.0080 0.0148	0.0029 0.0068	0.0090 0.0165	0.0386 0.0268
2. r. Kamchatka	150	0.0074 0.0196	0.8462 0.0951	0.0026 0.0105	0.0571 0.0768	0.0069 0.0178
3. r. Nushagak	150	0.0009 0.0039	0.0012 0.0074	0.9244 0.0737	0.0305 0.0315	0.0606 0.0735
4. r. Yukon	100	0.0126 0.0171	0.1322 0.0935	0.0003 0.0029	0.8481 0.1070	0.0509 0.0602
5. r. Kuskokwim	150	0.0010 0.0049	0.0124 0.0281	0.0698 0.0728	0.0553 0.0688	0.8430 0.0973
Mean accuracy, %						88.80

Table 8. The estimates of the maximal likelihood (ML), the standard deviation (SD) and the confidential intervals (CI – 95%) obtained in the identification of immature chinook salmon local stocks in the trawl catches of the R/V «TINRO» in the Western Bering Sea in 2002-2004

Year	Season	Biostatistical districts	Age	N	Stock/river	MLE	SD	CI - 95%
2002	Autumn	1-12	1.1 + 1.2	87	r. Bolshaya	-	-	-
					r. Kamchatka	0.4981	0.0853	0.2941-0.6489
					r. Nushagak	0.0320	0.0323	0.0000-0.1132
					r. Yukon	0.0004	0.0020	0.0000-0.2466
					r. Kuskokwim	0.4695	0.0916	0.2019-0.6266
2003	Summer	1-12	1.1 + 1.2	242	r. Bolshaya	0.0036	0.0124	0.0000-0.0390
					r. Kamchatka	0.4756	0.0496	0.3341-0.5980
					r. Nushagak	0.5208	0.0478	0.3947-0.6539
					r. Yukon	-	-	-
					r. Kuskokwim	-	-	-
	Autumn	1-12	1.1 + 1.2	103	r. Bolshaya	-	-	-
					r. Kamchatka	0.4148	0.0704	0.2272-0.5812
					r. Nushagak	0.5852	0.0704	0.4123-0.7507
					r. Yukon	-	-	-
					r. Kuskokwim	-	-	-
2004	Autumn	3-12	1.1 + 1.2	48	r. Bolshaya	-	-	-
					r. Kamchatka	0.2882	0.0919	0.0998-0.4640
					r. Nushagak	0.7105	0.0883	0.5077-0.8600
					r. Yukon	0.0013	0.0439	0.0000-0.1389
					r. Kuskokwim	-	-	-

Table 9. The estimates of the abundance and biomass of identified Asian and American complexes of immature chinook salmon local stocks in the Western Bering Sea on the data of trawl surveys of the R/V «TINRO» in 2002-2004

Year	Season	Biostatistical districts	Total abundance and biomass		Complex stocks					
					Russia			USA		
			Millions of fish	Thousands ton	%	Millions of fish	Thousands ton	%	Millions of fish	Thousands ton
2002	Autumn	1-12	11.98	16.46	*49.8*	5.97	8.20	*50.2*	6.01	8.26
2003	Summer	1-12	41.01	51.27	*47.9*	19.64	24.56	*52.1*	21.37	26.71
	Autumn	1-12	14.36	24.76	*41.5*	5.96	10.28	*58.5*	8.40	14.48
2004	Autumn	3-12	6.36	9.59	*28.8*	1.83	2.76	*71.2*	4.53	6.83