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Revision of data on pink salmon abundance in East Sakhalin and Kuril Islands

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Abstract

Pink salmon reproduction parameters vary substantially in different regions of East Sakhalin coast, North and South Kuril Islands. Trends in population dynamics differ as well. On this evidence we carry out a revision of data on pink salmon abundance (catches) in East Sakhalin coast and Kuril Islands. The data were represented separately on northwest coast, north and south parts of east coast of Sakhalin Island, as well as on north and south Kuril Islands.

Introduction

Pink salmon catches in the Sakhalin-Kuril region amount to a half of pink salmon catches in the Far East of Russia. The largest catches were in the east coast of Sakhalin (70.4 % on the average) and the South Kuril Islands (26.8 % on the average). The rest of catches (2.8 %) of pink salmon fell to the west coast of Sakhalin and the North Kuril Islands (there is no fishery in the middle part of Kuril Islands ridge). Until recently there was no salmon fishery in the north Kuril Islands. That is why in statistical reports not "the South Kuriles" but "the Kuriles" were written being only the South Kuril Islands – Iturup and Kunashir. Subsequently "the Kuriles" were written although salmon catch in the North Kuriles rose gradually. The northwest coast of Sakhalin Island was included in the East Sakhalin (Sakhalin coast) because as the East coast itself it is washed by the Sea of Okhotsk. However different groups of pink salmon run to these extremely lengthy areas. It should be noted also that abundance calculation of pink salmon caught was carried out by division of the catch biomass by the mean individual mass. The latest was determined monthly at the best, but more often the mean individual mass per season was used. At the same time different seasonal (temporal) forms of pink salmon (early and late) run to the coast. At that spawners of the late form are usually larger than early pink salmon individuals (Kaev 2012a).

Thus depending on the ratio of individuals of different seasonal forms in overall sample per fishing season the mean mass calculated and consequently the run abundance calculated could be both over- and underestimated.

Use of the mean value of fish density in spawning sites caused essential uncertainties in the calculation of pink salmon run abundance in rivers because the list of rivers investigated vary substantially in different years. Meanwhile the rivers had different reproduction significance. That is why in 2000-th we attempted to unify calculation methods of pink salmon abundance and biological features of fishes of different generations. For this purpose the source data covering last 20–25 years were analyzed. First of all the unification of the data was conducted for south part of East Sakhalin (Kaev et al. 2004), Kunashir Island (Kaev Romasenko 2003), and Iturup Island (Kaev et al. 2006). In this paper supplemented data on pink salmon abundance in this regions are represented as well as data from other pink salmon reproduction regions in East Sakhalin and the Kuril Islands (Fig. 1).

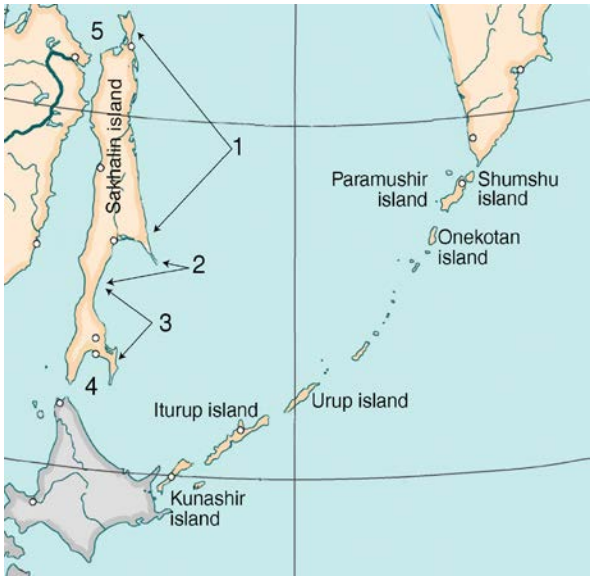

Fig.1. Sakhalin and Kuril islands:
1– North-eastern Sakhalin, 2– Terpeniya Bay,
3– South-eastern Sakhalin, 4– Aniva Bay,
5– North-western Sakhalin

Materials and methods

Biomass of pink salmon catch over five-day periods in different areas was assessed on the base of statistical data of Pacific salmon catch controlling organizations. By the results of biological analysis of fishes from commercial pound net catches in seashore and research throw nets catches in estuaries the mean mass of fishes in collected samples was determined. In the North Kuril Islands samples from commercial drift nets catches in coast seawaters were used for the mean mass determination. As the periodicity of sample collection was unequal the mean mass of fishes in the middle of each five-day period was calculated using moving average method (Fig. 2). Number of pink salmon caught over five-day periods was estimated by the division of the catch biomass by the mean sample mass.

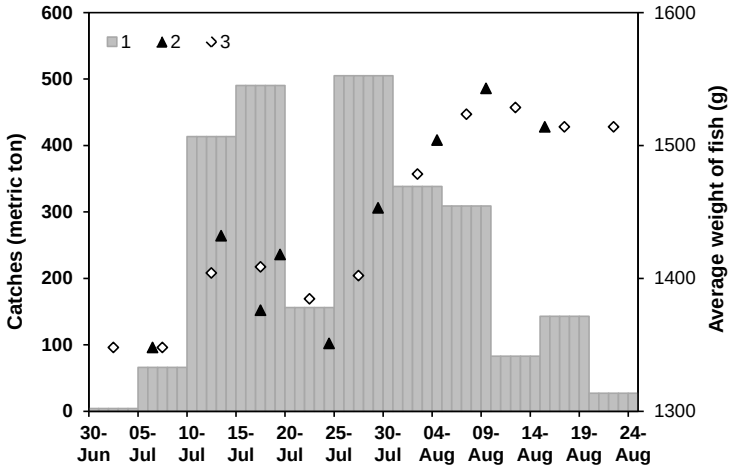

Fig. 2. Average daily catches (1), actual (2) and estimated (3) values of mean mass of pink salmon near the north coast of Terpeniya Bay in 2011.

Number of spawners in spawning sites was determined visually by foot rounds of the rivers in maximal pink salmon concentration period. At that all the rivers were divided into three groups. First group is the rivers inspected regularly, second group is the rivers inspected occasionally, and third group is the rivers where examinations weren't conducted. Calculated density of fish concentration (ratio of counted number of fishes in a river to spawning sites area) was accepted as actual in the first group rivers. For the rivers from second group density of fish concentration was calculated as the mean value between the value observed in the river and the value determined for the first group rivers. Afterwards sum results of observations in the rivers of the first and the second groups were extrapolated on the rivers from the third group.

In northwest Sakhalin rivers spawning sites area prospected is 1244 thousands of m^2. In 2007–2013 regular inspections were conducted only in Langry River (242 thousands of m^2 of spawning sites), episodic inspections were conducted in 5 rivers more (in different years from 346 to 357 thousands of m^2 in average 200 thousands of m^2 of spawning sites including years without episodic inspections).

In northeast Sakhalin rivers spawning sites area prospected is 6022 thousands of m^2. In 1985–2013 regular inspections were conducted in Dagi River, Bogataya River, and Melkaya River (790 thousands of m^2 of spawning sites). The list of episodic inspected rivers consists of 29 designations (from 1 to 21 rivers in different years) resulting in data on pink salmon runs in the rivers with the sum area of spawning sites from 129 to 3306 thousands of m^2, 1531 thousands of m^2 in average.

In the rivers of Terpeniya Bay spawning sites area prospected was 7532 thousands of m^2. In 2003-2013 regular inspections were conducted in Pugachevka River, Nituy River, Lesnaya River, Lasovaya River, Makarova River, and in tributaries of the biggest river in Sakhalin – Poronay River: Kholodny Spring, Beresovy Spring, Yuzhnaya Khandasa River, Zhytnica River, Orlovka River, and Elnya River (1860 thousands of m^2 of spawning sites). The list of episodic inspected rivers consists of 18 designations. In different years from 2 to 14 rivers were examined with the sum area of spawning sites from 74 to 2737 thousands of m^2, 1353 thousands of m^2 in average.

In the rivers of southeast Sakhalin coast spawning sites area prospected was 1494 thousands of m^2. In 1985–2013 regular inspections were conducted in Dudinka River, Firsovka River, Bahura River, and Zhukovka River (262 thousands of m^2 of spawning sites). The list of episodic inspected rivers consists of 11 designations (from 4 to 11 rivers in different years) with the sum area of spawning sites from 113 to 807 thousands of m^2, 515 thousands of m^2 in average.

In the rivers of Aniva Bay spawning sites area prospected is 1671 thousands of m^2. In 1985–2013 regular inspections were conducted in Naycha River, Kura River, Ulyanovka River, Tambovka River, Uryum River, Taranay River, Bystraya River (a tributary of Lutoga River), Ostrovka River, and Igrivaya River (850 thousands of m^2 of spawning sites). The list of episodic inspected rivers consists of 12 designations (from 1 to 13 rivers in different years) with the sum area of spawning sites from 13 to 95 thousands of m^2, 29 thousands of m^2 in average.

In the rivers of Kunashir Island spawning sites area prospected is 266 thousands of m^2. In 1990–2013 regular inspections were conducted only in Ilyushina River (21 thousands of m^2 of spawning sites). The list of episodic inspected rivers consists of 20 designations (from 1 to 12 rivers in different years) with the sum area of spawning sites from 27 to 121 thousands of m^2, 77 thousands of m^2 in average (including years without episodic inspections). Pink salmon run into the rivers of the Island in 1985–1989 was assessed on the base of expert assessment on the assumption of catch and run correlation in subsequent years($r = 0.90$, $n = 22$).

Commercial pink salmon stock in Iturup Island is provided by pink salmon reproduction in the rivers of the Sea of Okhotsk coast. The spawning sites area prospected was 600 thousands of m^2. For calculation of the total run in the rivers data of annual spawners count in Kuybyshevka River, Rybatskaya River, Kurilka River, Olya River, Reidovaya River, Skal'niy River, Chistaya River, and Slavnaya River (503 thousands of m^2 of spawning sites) were used. As a rule (with the exception of the last several years) Saratovka River and Osennyaya River (21 thousands of m^2 of spawning sites) were examined.

Urup Island allocated northeast of Iturup Island is explored insufficiently. The spawning sites area prospected was 241 thousands of m^2. Spawning density in Urup Island water bodies varies in wide range from 0.1 to 3 specimen/m^2 (Water biol. resources… 2000). But regular fishery in Urup Island is absent. Only twice in 2000 and 2001 experimental fishery by pound nets was conducted in the Sea of Okhotsk site of the island.

In Paramushir Island (the North Kuril Islands) intensive pink salmon reproduction occurs in 42 Rivers. Part of the rivers falls into the Sea of Okhotsk, the other part – into the Pacific Ocean. Regular inspections of spawning sites were conducted in fore rivers of the Sea of Okhotsk coast – Shelekhovka River, Kohmayuri River, Chayka River, and Savushkina River (35,5 thousands of m^2 of spawning sites). The area of rivers of the Pacific Ocean coast (Okeanskaya River, Tuharka River, Utesnaya River, Srednyaya River, and Perevalnaya River) was 103,5 thousands of m^2 (Lepskaya et al. 2011).

In Shumshu Island (the North Kuril Islands) intensive pink salmon reproduction occurs in 15 Rivers. In addition there are several rivers of lower value. But inspection of spawning sites in Shumshu Island hasn't been conducted yet. In the third Island of the North Kuril Islands (Onekotan Island) there is a small number of spawning rivers. And pink salmon abundance is sufficiently lower than in Paramushir Island. So in assessment of the total north Kuril pink salmon abundance Onekotan rivers are negligible.

Results

Pink salmon fisheries in the regions examined is based mainly on the runs of the two temporal forms of pink salmon migrating from the Pacific Ocean (Kaev 2002). Ivankov (1967), who described the phenomenon for the first time, consider them as seasonal races (Ivankov 1993), but Gritzenko (1981) believes them to be local populations differed in spawning and run time. In some years pink salmon migrating from the Sea of Japan runs to the northwest coast of Sakhalin that is why quite large catches are observed here even in the beginning of July (Fig. 3). Moreover in the northwest coast of Sakhalin incidental catch of pacific pink salmon migrating along the coast to the Amur River and other rivers of continental coast takes place. Thereupon statistical data on catches and runs of pink salmon in the rivers of the northwest coast are represented separately from the other fishing regions of Sakhalin (Tab. 1, 2).

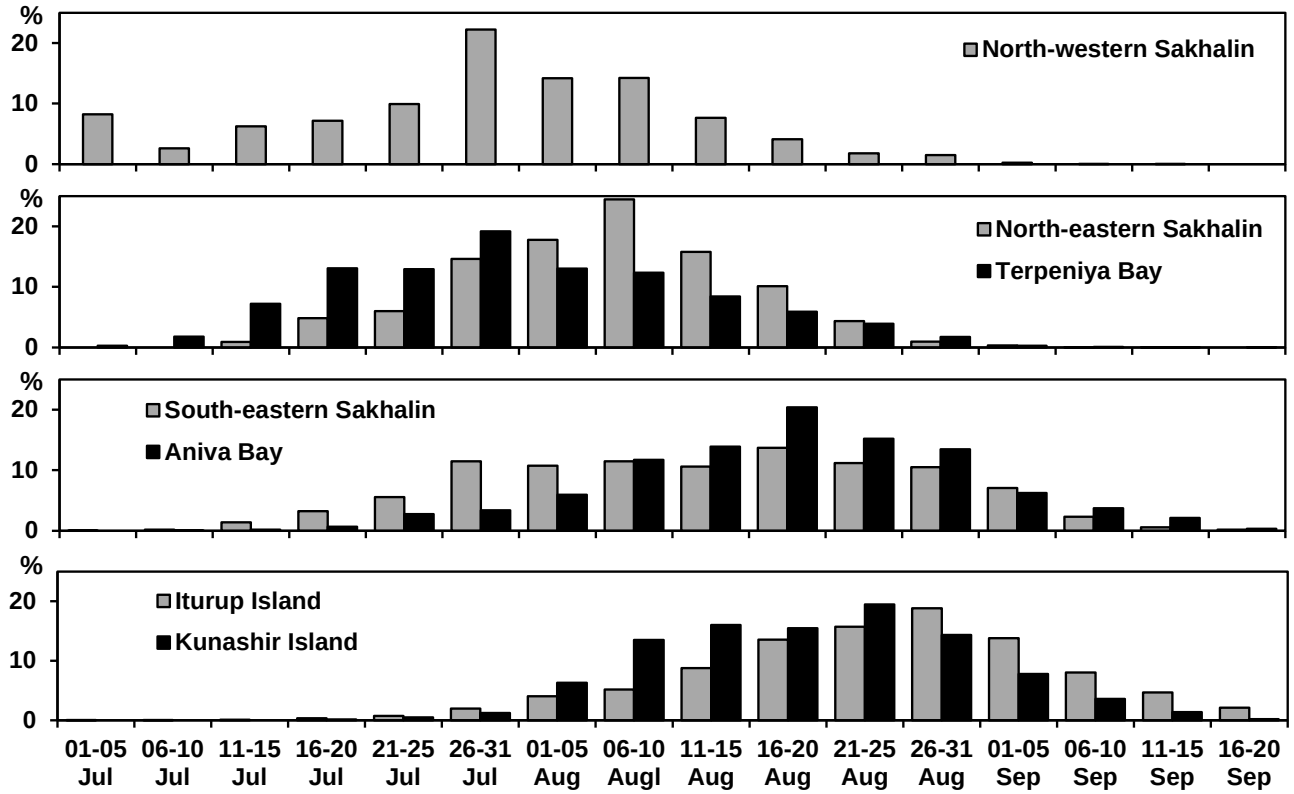

Fig. 3. Dynamic of pink salmon catches in different regions of Sakhalin-Kuril region over five-day periods in 2008–2013.

On going from the North Sakhalin to the South Kuril Islands a gradual shift of pink salmon running time to later dates happens. But differences in running time in the northwest coast of Sakhalin and Terpeniya Bay are connected not only with such a peculiarity of migration time but also with intraspecies structure of pink salmon. So a part of early seasonal form fishes is higher in the runs in Terpeniya Bay (Kaev 2012b). Moreover in the south end of northeast Sakhalin a part of pink salmon migrating to Terpeniya Bay are caught. From the trawl catches value (Shuntov Temnykh 1996) near the south end of northeast Sakhalin a formation of pink salmon concentration happens. A part of the pink salmon migrates afterwards northward along the coast. And the other part enters to Terpeniya Bay doubling a cape. In this connection we think that it would be statistical data on pink salmon abundance in the northeast coast of Sakhalin and in Terpeniya Bay should be represented jointly (the north part of East Sakhalin).

As tagging and catch dynamics analysis show a part of pink salmon migrating into Aniva Bay is caught in the south part of the southeast coast of Sakhalin (Rudnev 2007). That is why we represent statistical data on the south part of the East Sakhalin jointly (southeast coast of Sakhalin and Aniva Bay).

Later pink salmon run into Aniva Bay in comparison with the southeast coast of the Island is also partly caused by pink salmon intraspecies structure, because in Aniva Bay a percentage of early temporal form decreased substantially during last years (Kaev 2012c).

Table 1. Pink salmon catches in different localities of Sakhalin-Kuril region in 1985-2013 (metric ton)

Year	North-western Sakhalin	Eastern Sakhalin		Southern Kuril Islands*	Northern Kuril Islands
		Northern part	Southern part		
1985	1440	10810	18170	32350	
1986	610	3	619	11913	
1987	2030	2007	24230	22250	
1988	220	5	1170	10651	
1989	660	8079	52340	14582	
1990	720	500	8260	19010	
1991	1600	12950	72740	31160	
1992	1310	1250	18510	22140	
1993	1200	13178	14860	9056	
1994	829	797	39485	33929	
1995	816	14636	44590	28536	
1996	1186	4368	10525	29241	
1997	1568	20829	47482	26613	210
1998	843	5691	20950	28617	245
1999	861	22350	58633	16109	25
2000	412	633	5680	43886	200
2001	1914	24826	69166	23310	243
2002	640	2272	3823	37764	83
2003	1823	32164	54003	18557	267
2004	287	2075	11717	32898	281
2005	1397	34770	68893	31818	115
2006	162	9676	76115	45163	160
2007	1574	50269	54277	45372	16
2008	459	18642	38123	32182	44
2009	5033	72279	152066	25062	282
2010	876	15912	38672	29975	340
2011	4743	90214	78982	6344	279
2012	1838	29068	37349	27439	725
2013	6862	134979	27907	18690	726

* Including catch in Urup Island 150 t (2000) and 270 t (2001)

Table 2. Pink salmon abundance in the Sakhalin-Kuril region in 1985–2013 (thousand of fishes)

Year	North-western Sakhalin		Eastern Sakhalin				Southern Kuril Islands*		Northern Kuril Islands
			Northern part		Southern part				
	Fishery	Escapement	Fishery	Escapement	Fishery	Escapement	Fishery	Escapement	Fishery
1985	1360	1163	9872	21732	16559	8937	30567	2558	
1986	585	904	2	3490	566	1320	11096	1618	
1987	1836	1322	1751	3655	20192	4566	19175	2298	
1988	201	775	4	3880	999	2914	9602	1790	
1989	583	903	6495	4457	42422	13680	12443	1975	
1990	626	917	370	8239	6505	7652	14917	2833	
1991	1461	1197	10884	13017	61840	12296	24743	3657	
1992	1066	1065	854	7865	13212	6462	14737	3096	
1993	940	1022	8952	11788	9875	3763	5984	2036	
1994	727	1929	835	8964	37161	17523	27049	4620	
1995	627	869	10375	15353	29746	9955	18028	2557	
1996	1119	1037	3764	4328	8752	8736	22608	3009	
1997	1089	1735	15380	17448	35056	8542	16939	2118	157
1998	887	1376	5471	3962	19193	6150	24258	3920	206
1999	736	1250	17208	14162	42342	9157	10924	1771	17
2000	392	496	566	4185	4166	5019	28968	4498	150
2001	1724	1639	19964	7826	51942	7688	15878	1789	176
2002	496	1345	1844	994	2698	4429	25946	4136	52
2003	1340	922	23532	13165	40971	5375	13950	1739	185
2004	273	400	1499	1488	7883	3098	21706	2194	204
2005	1244	848	30714	9706	55818	5333	25220	3056	
2006	159	632	8197	4741	61372	5498	32730	1950	
2007	1164	1123	38480	20337	37676	4526	32564	3710	
2008	387	295	14212	5138	28911	3792	21166	1496	
2009	3917	995	49740	11079	101885	6325	16019	1853	
2010	881	672	12372	5994	29322	5222	19785	2010	
2011	3752	1554	74006	8982	60339	3415	4524	1388	
2012	1666	453	23920	5922	30944	5766	18659	1481	481
2013	4777	1626	96476	11619	17629	3347	11984	1431	397

* Including catch in Urup Island 100 thousands of fish (2000) and 186 thousands of fish (2001)

We think it reasonable to represent statistical data on pink salmon abundance separately for the South and the North Kuril Islands.

Differences in catching time in Iturup Island and Kunashir Island (South Kuril Islands) are partly connected with intraspecies structure of pink salmon: late temporal form dominates in Iturup Island whereas early temporal form dominates in Kunashir Island (Kaev Romasenko 2013). Some shift of pink salmon catching time in Iturup Island comparing to Kunashir Island is caused also by differences in catching methods. In Kunashir Island commercial catch is carried out only by pound nets, whereas in Iturup Island the catch is carried out both by pound nets in coastal waters and in fences in river estuaries (regulation of fish access for reproduction).

Salmon fishery in Paramushir Island and Shumshu Island (the North Kuril Islands) ranks as special. From the Pacific Ocean side, where the fishery is substantially concentrated, not only North Kuril Islands pink salmon is caught but pink salmon migrating to different reproduction regions in the Sea of Okhotsk. That is why catching dynamics of pink salmon near the Pacific Ocean shore of the islands is determined in different years by the ratio of abundance of different migrating stocks and the time of their migration into the Sea of Okhotsk. So in even years (1998, 2000, and 2004) when the abundance of pink salmon is high just the abundance causes July maximums in catching dynamics curve of pink salmon (Fig. 4). For the odd years characterizing by low abundance of west Kamchatka stocks we couldn't reveal any relations of pound net catching dynamics with runs power to any region of coastal fishery (Lepskaya et al. 2011). From 2009 till present fishery in the region is carried out by drift net drift nets in coastal waters. Because of the fact the percentage of fishes migrating through the straits to the other reproduction regions in the Sea of Okhotsk shore is increased substantially in catches. Consequently fishery time shifts to earlier dates. So in 2013 9.1 % of pink salmon were caught in June, 53.0 % – in July, and 37.9 % – in August.

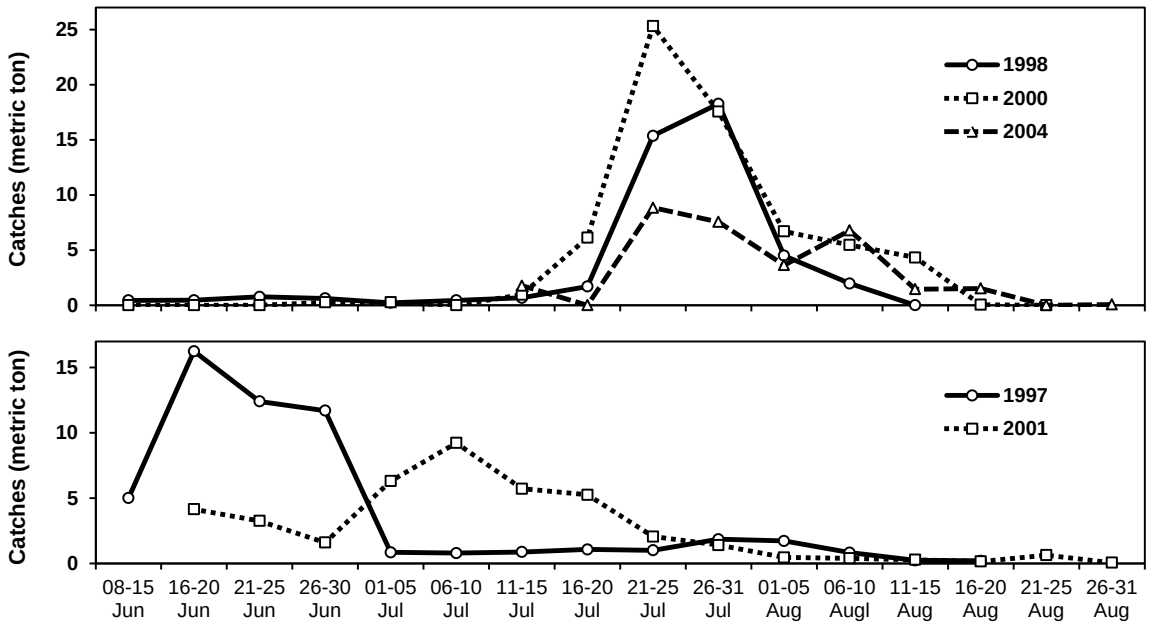

Fig. 4. Pink salmon catches by the pound nets on the Pacific coast of Paramushir Island over five-day periods in even and odd years

Conclusion

From the regions considered the South Kuril Islands have the greatest commercial importance in catching biomass of many years (41.0 %). The south part of the east cost of Sakhalin has a bit lesser percentage (39.6 %), and then its north part follows (17.6 %). If pink salmon return abundance is considered then the south part of East Sakhalin leads (39.4 %), then the South Kuril Islands (32.0 %) and the north part of East Sakhalin (25.6 %) follow. The main reason of the discrepancy of regions' significance in size of catch and return abundance is the large percentage of fishery in south regions in comparison with the north regions (49.3 % and 72.8 % in the north and south parts of East Sakhalin and 87.5 % – in the South Kuril Islands). In turn it is caused by large size of rivers in the north part of the east Sakhalin cost and necessity of bigger spawner access to spawning sites correspondingly. In addition in the south part of Sakhalin and South Kuril Islands most of fish hatcheries is concentrated. It increases possibilities of additional pink salmon catch. The North Kuril Islands set apart because fishery there is based to a far greater extent on salmon migrating in the other reproduction regions and catch size is connected not with status of the stocks but with fishery organization.

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