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Ecological Characteristics of Chum salmon (*Oncorhynchus keta*) in the Penzhina and Talovka hypertidal Estuary (Northwest Kamchatka)

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Penzhina River mouth 14.07.2014 Tidal phase (Water level – 1192 cm)


Penzhina River mouth 14.07.2014 Ebb tidal phase (Water level – 315 cm)

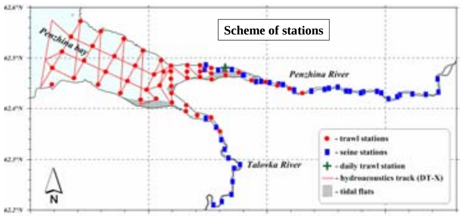
Introduction

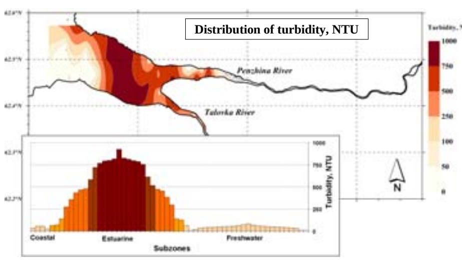
This study is based on the results of our integrated fieldwork in the Penzhina and Talovka Rivers mouth (northwest Kamchatka). One of the greatest hypertidal estuary with the tidal level variation about 13 m and more is placed in the mouth reach of these rivers (it's the maximum in Russia and one of the greatest ones in the world). Unlike the most of other hypertidal river mouths, economic activities in this area are almost completely absent. Despite the unique conditions, this estuary has never been studied.

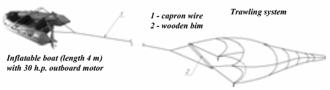
During July–September 2014, geomorphological and hydrological conditions, species composition of aquatic fauna, abundance distribution and migrations, feeding interactions of hydrobionts in the estuary and the low reach of the rivers were studied. Fisheries and sealing impact on the estuary ecosystem was estimated.

Methods

Hydrological observation conducted using various STD equipment. Fish catches carried out by beam–trawl, seine and gillnets. Spatial distribution of plankton, nektobenthos and fishes in the estuary studied using scientific echosounder BioSonics DT–X (transducer 200 kHz).







Environment Conditions

During the observation period the length of the river and sea waters mixing zone (*MZ*) in the estuary exceeded about 50–60 km and more. Under the influence of tides, *MZ* reversively moved: during flood tidal phase – towards the rivers, and during ebb tidal phase – back to the sea. According to the features of the *MZ* dynamic and abundance distribution of hydrobionts in the estuary three conditional subzones with mobile borders were segregated:

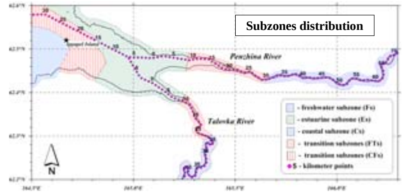
freshwater subzone (main abiotic factors: water salinity *S* <1‰, considerable tidal variability of turbidity *T*, water speed and current directions *V*); ***estuarine*** subzone (*S* from 1–2 to 10–14‰, considerable tidal fluctuations of *S*, *T*, *V*, and water level *H*);

coastal subzone (*S* from 10–14 to 24–25 ‰, tidal fluctuations *S*, *V*, and to a lesser degree *T* and *H*).

The Structure of Communities, Abundance, Biological Characteristics and Feeding Interactions of nektobenthos and juvenile fishes in the Estuary

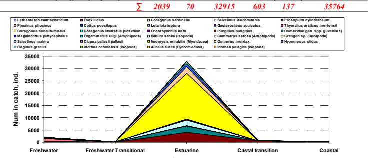
The each subzones had a different structure of pelagic communities and their borders moved during a daily tidal cycle.

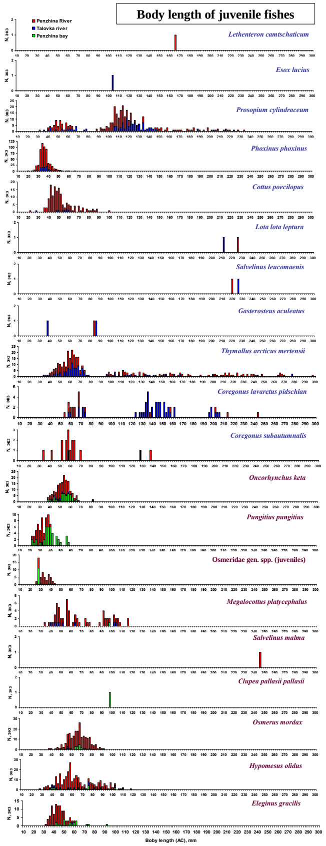
A 1 species of cyclostomes, 18 species of fishes and 8 species of invertebrates in our catches was found. The maximum nektobenthos and fish abundance registered in the estuarine subzone. The basic prey items of fish juveniles were: in the rivers – imago of Diptera and larvae of Ephemeroptera; in the sea – mysids of genus Neomysis; in the sea – pelagic copepods genus Eurytemora.

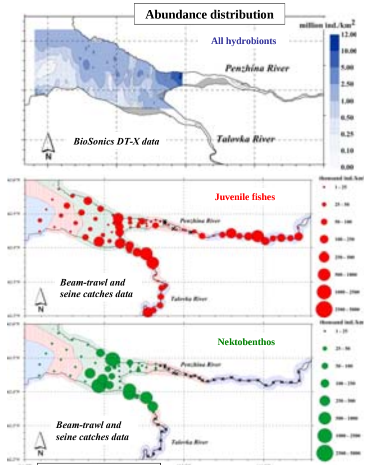


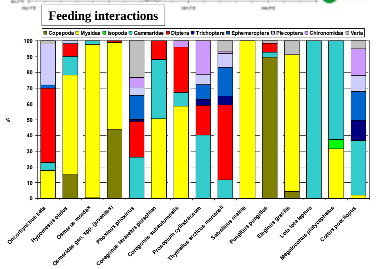
Juvenile fishes and nektobenthos composition (by catch data)

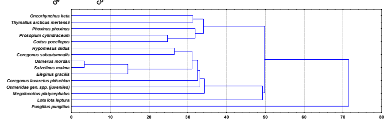
Species composition of comunities		Fs	FTs	Es	CFs	Cs	∑
		Catch Abundance, ind.					
Freshwater	*Lethenteron camtschaticum*	2	–	–	–	–	2
	Esox lucius	1	–	–	–	–	1
	Coregonus sardinella	1	–	–	–	–	1
	Salvelinus leucomaenis	2	–	–	–	–	2
	Prosopium cylindraceum	343	2	–	–	–	345
	Phoxinus phoxinus	1140	1	2	–	–	1143
	Cottus poecilopus	152	–	1	–	–	153
	Lota lota leptura	1	–	1	–	–	2
	Gasterosteus aculeatus	2	–	2	–	–	4
	Thymallus arcticus mertensii	320	4	1	–	–	325
	Coregonus subautumnalis	10	5	2	–	–	17
	Coregonus lavaretus pidschian	47	11	4	–	–	62
Estuarine	*Oncorhynchus keta*	15	5	164	4	–	188
	Pungitius pungitius	3	2	3838	510	99	4452
	Osmeridae gen. spp. (juveniles)	–	1	2580	12	–	2593
	Megalocottus platycephalus	–	1	65	–	–	66
	Eogammarus kugi (Amphipoda)	–	1	30	–	–	31
	Sabura sabini (Isopoda)	–	36	2319	4	1	2360
	Gammarus setosa (Amphipoda)	–	1	272	33	8	314
	Crangon sp. (Decapoda)	–	–	31	–	–	31
	Salvelinus malma	–	–	1	–	–	1
	Clupea pallasii pallasii	–	–	1	–	–	1
	Neomysis mirabilis (Mysidacea)	–	–	18731	21	–	18752
	Osmerus mordax	–	–	2635	1	–	2636
	Hypomesus olidus	–	–	1270	1	–	1271
	Eleginus gracilis	–	–	962	1	–	963
Coastal	*Idothea ochotensis* (Isopoda)	–	–	3	16	26	45
	Aurelia aurita (Hydromedusa)	–	–	–	–	2	2
	Idothea pelagica (Isopoda)	–	–	–	–	1	1
	∑	2039	70	32915	603	137	35764





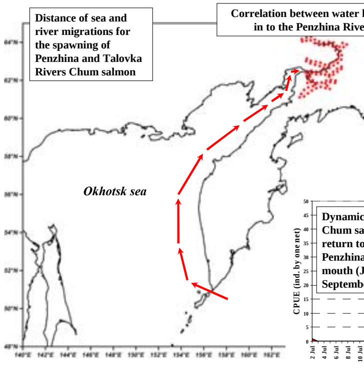


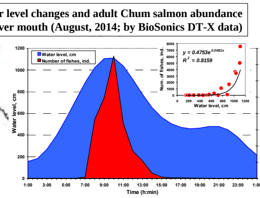


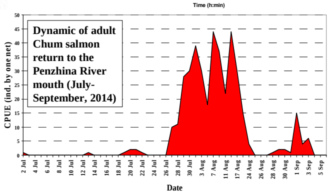


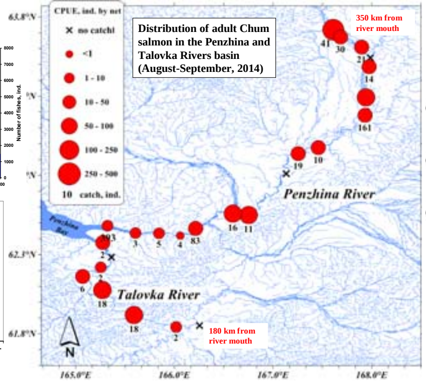
Chum Salmon Biological and Ecological Characteristics

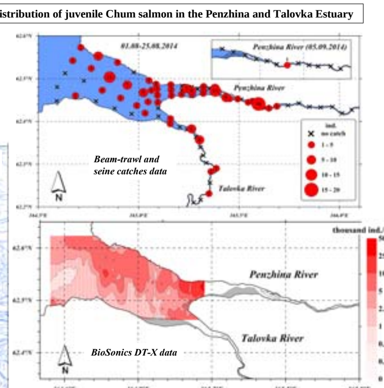
Chum salmon was dominate species of Pacific salmon in our catches (we also caught adult Pink salmon as single). The peak of returns of chum salmon to the Penzhina River mouth was registered in the middle of August, 2014. The average length (AC) adult chum was 55 cm, weight – 2160 g, fecundity of females – 2030. It is more lower than in other areas of the West Kamchatka. The age of chum salmon in returns was 2+ (0.3 %), 3+ (80.8 %) and 4+ (18.9 %). The smolts of chum salmon migrated from the rivers in the estuary within all summer. and registered in the mouth of the Penzhina River in the beginning of September. During down stream migration chum salmon juveniles fed intensively (average stomach fullness index was 382°/ₒₒₒ). The adult chum salmon returned to the rivers only during flood tidal phase. Chum salmon smolts migrated from the rivers in the estuary only during ebb tidal phase and could go away on distance more than 25 km from the river mouth (less for one day). Such high speed of migration promoted by powerful ebb currents. Our results has shown that chum salmon of the Penzhina and Talovka rivers has a biological distinctions from chum another areas of the West Kamchatka. Also we noted that only this species of Pacific salmon (among of genus Oncorhynchus) has a necessary ecological adaptations for effective reproduction in the large river systems and for habitat in the hypertidal estuary.

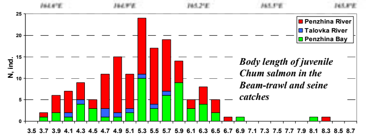


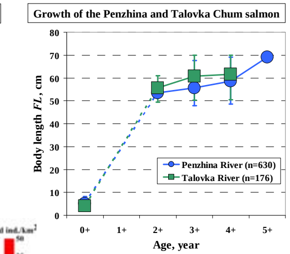


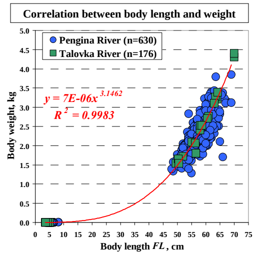












Some basic biological parameters of adult Chum salmon of the Penzhina and Talovka Rivers, 1975-2014

Year	% of female	Avg. body length *FL*, cm	Avg. body weight, kg	Avg. fecundity of female, eggs	Age, years 2+	3+	4+	5+	6+	Avg. year, years	N, ind.
Penzhina River											
1975	71.2	60.5	2.71	2509	9.0	78.3	12.3	0.4	–	3.04	520
1982	65.5	57.3	2.41	–	–	–	–	–	–	–	58
1983	70.0	55.9	2.16	–	–	–	–	–	–	–	20
1984	62.2	58.5	2.51	–	–	–	–	–	–	–	111
1988	–	52.7	2.01	2132	59.1	35.5	5.4	–	–	2.46	93
1990	67.6	57.9	2.72	2711	5.2	39.3	53.0	1.6	0.9	3.51	111
1993	62.4	64.3	2.63	–	1.1	92.7	5.6	0.6	–	3.06	178
2002	61.6	56.3	2.47	2280	6.3	39.1	51.8	2.8	–	3.51	396
2005	42.0	58.9	3.52	2598	–	66.4	33.6	–	–	3.34	295
2011	61.7	60.2	2.25	–	0.9	56.1	42.1	0.9	–	3.43	107
2014	61.2	55.2	2.18	2031	0.3	80.9	18.8	–	–	3.19	361
Average	*62.5*	*58.0*	*2.51*	*2377*	*10.2*	*61.0*	*27.8*	*0.9*	*0.1*	*3.19*	*∑ 2250*
Talovka River											
1979	71.5	55.9	2.40	2491	10.1	79.3	10.6	–	–	3.01	179
1980	52.0	53.5	1.85	1886	10.0	90.0	–	–	–	3.00	10
1981	63.3	56.6	2.38	2321	16.7	78.3	5.0	–	–	2.88	60
1989	40.4	58.5	2.47	2118	6.4	88.3	5.3	–	–	2.99	94
1990	46.0	61.0	2.88	2438	10.0	52.4	37.6	–	–	3.28	176
1991	61.2	56.0	2.16	2350	18.0	75.3	6.7	–	–	2.89	75
Average	*55.7*	*56.9*	*2.40*	*2267*	*11.8*	*77.3*	*10.9*	*–*	*–*	*3.01*	*∑ 594*