Identification Local Stocks of Sockeye and Chinook Salmon by Scale Pattern Analysis from Trawl Catches of R/V "*TINRO*" Worked by Program of the Bering-Aleutian Salmon International Survey (BASIS) in September–October 2002

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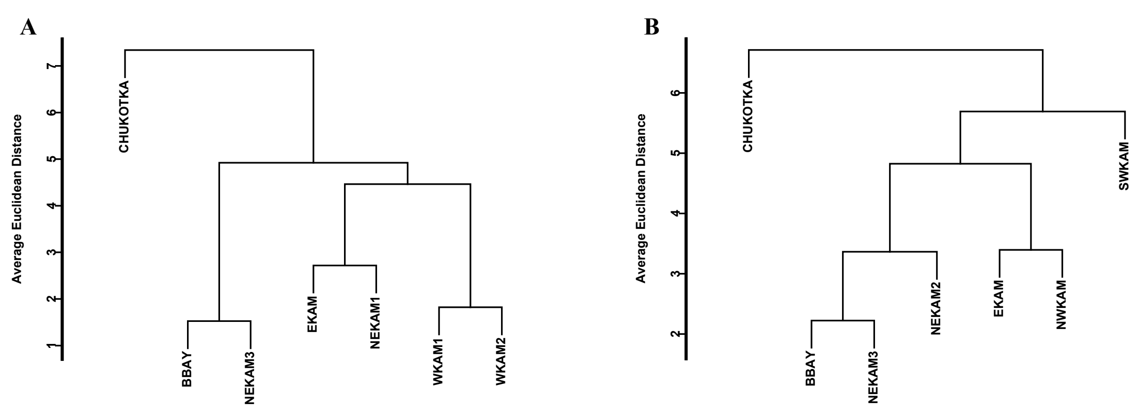
In this work, we used sockeye and chinook salmon scales collected from Asian and North American rivers and off-shore catches in June–August 2001–2002 as baselines. The total number of standard scales was: sockeye salmon–1,954 specimens (including 1,571 fish from 12 stocks in Kamchatka, 183 fish from two stocks in Chukotka and 200 fish from Bristol Bay), chinook salmon–1,528 specimens (including 887 fish from eight stocks in Kamchatka and 641 fish from three Alaskan stocks). Scale samples of ocean caught immature sockeye and chinook salmon were collected during the Bering-Aleutian Salmon International Survey (BASIS) trawl surveys conducted by the R/V "TINRO" in the Russian Exclusive Economic Zone in September–October 2002. Total sample size used for the mixture analysis of ocean caught immature salmon was: sockeye salmon–1,307 aged specimens and 854 identified specimens, chinook salmon–229 aged specimens and 91 identified specimens.

Age estimation and analysis of scale criteria were made on the basis of NPAFC standard methods (Davis et al. 1990). Scale structure analysis included measuring the following parameters: freshwater growth zone (radius), the first ocean year growth zone (width, number of circuli, intercirculi spacing combined by triplets). Data baselines were formed using cluster analysis of scale standards by dominant age groups (MathSoft 1997). The discrimination power of scales was determined on a simulated baseline and mixture using maximum likelihood (Millar 1987, 1990).

Results of the cluster analysis indicate that sockeye and chinook salmon stocks diverged between west and east Kamchatka (Figs. 1 and 2). Sockeye salmon stocks from Alaska were closer to the local stocks of Olutorsko-Navarinski district. The stocks from the Olutorsko-Navarinski district will most likely be identified as Bristol Bay sockeye in a mixed fishery due to the large abundance Bristol Bay sockeye salmon relative to North-East Kamchatka sockeye salmon stocks. For chinook salmon the difference between Asian and American stocks is more evident. The discrimination power of simulated baseline was about 93% for sockeye salmon and about 85% for chinook salmon.

Fig. 1. A hierarchical clustering dendrograms of the scale pattern baselines of sockeye salmon for the age groups 1.3 (A) and 2.3 (B). **Asia** – EKAM – *Eastern Kamchatka* (river Kamchatka), NEKAM1-NEKAM3 – *North-Eastern Kamchatka* (1 – Karaginski Bay (rivers Khailula and Dranka), 2 – Olutorski Bay (river Anana), 3 – Navarinski district (river Severnaya)), WKAM1-WKAM2 – *Western Kamchatka* (1 – Sobolevski district (rivers Icha, Krutogorova and Vorovskaya, 2 - Bolsheretski district (rivers Bolshaya and Kikhchik)), NWKAM – *North-Western Kamchatka* (river Palana), SWKAM – *South-Western Kamchatka* (river Ozernaya), CHUKOTKA – *Chukotka* (rivers Meynypilgyn and Nygchekveem). **North America** – BBAY - *Central Alaska* (Bristol Bay (Port Moller)).



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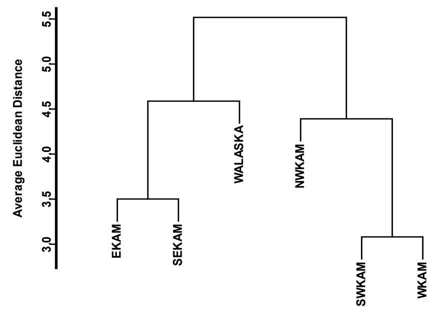
Identification of local sockeye and chinook salmon stocks was carried out by age groups .1 and .2. These groups are the most abundant for both species. Results of the stock identification analyses have demonstrated that Asian stocks of both species were predominant in the Western Bering Sea in September-October. However, stock composition differed among age groups, indicating that the area of the Bering Sea utilized by different age-classes varied during the period of ocean feeding.

The majority of the sockeye salmon catch was represented by the Eastern Kamchatka complex, ranging from 44 to 69% in age .1 and from 42 to 73% in age .2 (Fig. 3). Contributions of Western Kamchatka and Chukotka complexes were considerably lower and more unstable over the analysis by age groups. In the first case, their contribution was from 2 to 14% and from 27 to 42% for age .1 and .2 fish, respectively. In the second case, their contribution ranged from 12 to 21% and from 2 to 5% for the same age groups. Bristol Bay sockeye salmon was most frequent in the area located to the North-East of Olutorski Cape, i.e. closer to the Economic Zone of the USA. They represented 33 and 23% for age groups .1 and .2, respectively. Southward, in the area of Karaginski Bay, the frequency of Bristol Bay sockeye salmon by these age groups was not over 5 and 11%. These ratios general fits the known distribution and migration of age .1 and .2 Asian and American sockeye salmon during the fall feeding period in the Western Bering Sea.

Fig. 2. A hierarchical clustering dendrograms of the scale pattern baselines of chinook salmon combined by age groups 1.2, 1.3 and 1.4. **Asia** – EKAM – *Eastern Kamchatka* (river Kamchatka), SEKAM – *South-Eastern Kamchatka* (river Avacha), WKAM – *Western Kamchatka* (Sobolevski district (rivers Pymta and Vorovskaya)), NWKAM – *North-Western Kamchatka* (river Palana), SWKAM – *South-Western Kamchatka* (Bolsheretski district (rivers Bolshaya, Kikhchik and Utka). **North America** – WALASKA – *Western Alaska* (rivers Yukon, Kuskokwim and Nushagak).



The sample size for assessing the stock composition of chinook salmon in a mixed fishery was not sufficiently large; therefore only preliminary data for the South-Western Bering Sea have been presented in this work (Fig. 4). East Kamchatka stocks were predominant in this region, with Kamchatka River chinook salmon contributing up to 90% of the total Asian river and off-shore catches. For the age groups .1 and .2, the contribution of East Kamchatka stocks was 59 and 67%, respectively. Western Kamchatka chinook salmon did not represent more than 10–20%. The contribution of West Alaskan stocks in the catches was up to 21–23%. It is not excluded that real contribution of American chinook salmon in trawl catches could be higher and could get up to 30–40%, as the results of the mixed fishery simulations have shown that the West Alaska stocks can be misclassified as East Kamchatka stocks. Moreover, the assessment of chinook salmon biomass obtained from the trawl survey of R/V "TINRO" in 2002 (Temnykh et al. 2003) demonstrate rather high level, which does not completely agree with known abundance of this species in Asia.

Fig. 3. Distribution of principal complexes of immature sockeye salmon local stocks in the western part of the Bering Sea and adjacent waters of the north-western part of the Pacific Ocean from trawl catches in September–October 2002. A – age groups 1.1 and 2.1, B – age groups 1.2 and 2.2.

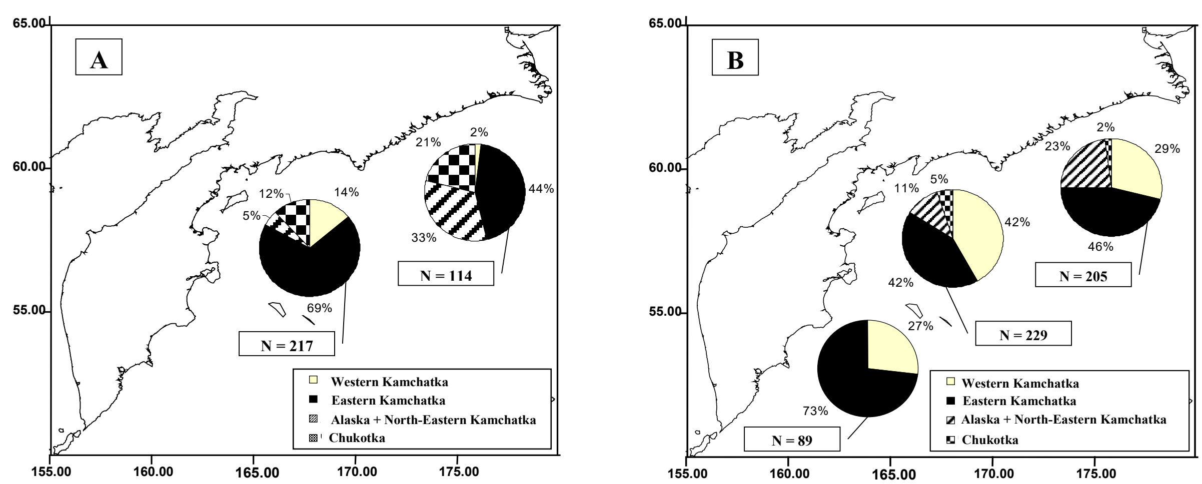
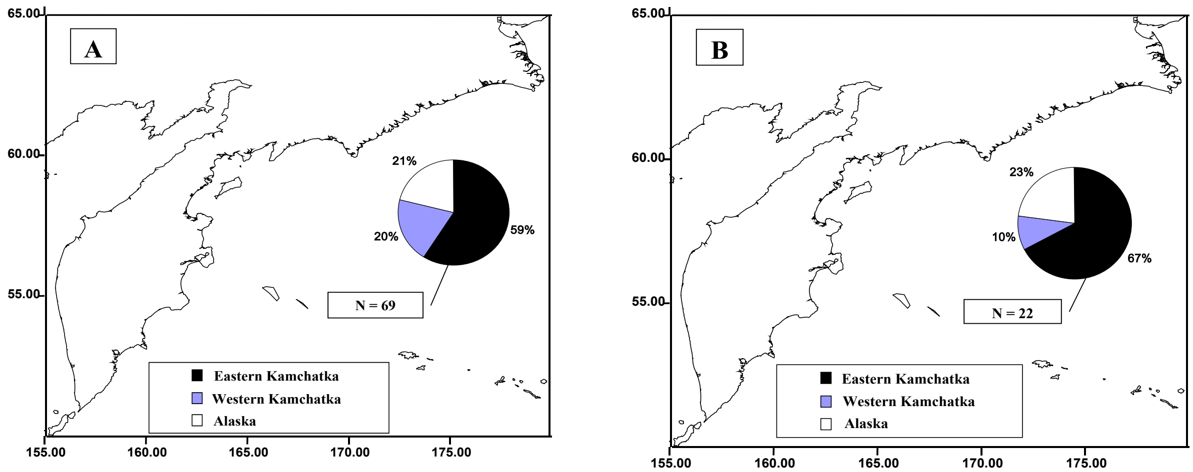


Fig. 4. Distribution of principal complexes of immature chinook salmon local stocks in the western part of the Bering Sea from trawl catches in September–October 2002. A – age groups 1.1, B – age groups 1.2.



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