Genetic Stock Identification of Chinook Salmon, *Oncorhynchus tshawytscha* (Walbaum)

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The Kamchatka Peninsula is the only area in Asia where chinook salmon, *Oncorhynchus tshawytscha (Walbaum)*, are abundant. There are two big river drainages (Kamchatka River on the east coast and Bolshaya River on the west coast of the Peninsula) with abundant populations of chinook salmon and many small chinook populations inhabiting smaller Kamchatkan rivers.

Using starch gel electrophoresis, we studied the protein gene frequencies at approximately 70 loci in 14 collections from 7 rivers including the Kamchatka and Bolshaya rivers. Thirty loci were found to be variable in Asian populations. Genetic diversity was highly significant among Kamchatkan populations. The most extensive differences between populations of Kamchatka and Bolshaya rivers were found at *ALAT*, sAH*, sIDHP-2*, mMDH-2*, MPI*, mSOD-1*, TPI-4*, sMEP-1*, sMEP-2**, and *GPI-A**. We did not find significant genetic differences within the same watershed, and the spring and summer adult runs in Kamchatka River did not differ significantly. The genetic distances were analyzed by cluster and principal component analysis (Fig. 1, 2), which revealed similar patterns. The western and eastern Kamchatka populations formed different clusters and the West Kamchatka populations divided further into three clusters – northern (Utka, Vorovskaya, Hairusova) and southern (Bolshaya, Bistraya) ones.

We made a comparison with allozymes data on American populations selected from preliminary publications and international baseline (Bartly and Gall, 1990; Gall et al., 1992; Teel et al., 1999). It revealed the great differentiation between Asian and North American populations of Chinook salmon. The allelic frequencies at 24 loci were different among regional groups of Asia and North America (*sAAT-1,2*, mAAT-1*, mAAT-2*, ADA-2* sMDH-B1,2*, PGM-2*, PEP-LT*, PEPD-2*, sAH*, sIDHP-1*, sIDHP-2*, sAAT-3* PEPA*, PEPB-1*, sSOD-1*, TPI-4*, GPI-B1,2*, IDDH-1*, sMEP-1*, sMEP-2* MPI*, PGK-2*, PEPD-2**, and *FDHG*).* The *GPIB1,2*, sMEP-2*, PEPA** and *sSOD-1** loci were almost monomorphic in Asia and polymorphic in North America. The *IDDH-1** locus, on the contrary, was highly polymorphic in Asia while almost monomorphic in North America. There were significant differences between regional population groups in *ALAT**, *ADA-2** and *TPI-4** loci. The Asian populations were the most similar to North American populations from northwestern Alaska and Bristol Bay, though there were some loci significantly different between those regional groups of populations (*sAAT-3*, sAH*, IDDH-1*, sIDHP-1*, sMDH-B1,2*, MPI*, PEP-LT*, PEPD-2**, and *PEPB-1*).*

Thus, genetic differentiation affords an excellent opportunity to discriminate Asian and North American populations of chinook salmon with high precision and accuracy.

In 1998 the mixed-stock fisheries collections from catches in Russian EZ were analyzed using allozyme genetic data (Fig.3, 4) from international baseline (Teel et al., 1999). The predominant stocks were from Kamchatka and Bolshaya River drainages, and also from northwest of Kamchatka peninsula (Fig.3). Among American stocks only Kodiak populations contributed more then 1% in the catches, but still the percentages were low (Fig.3). We estimated stock compositions in different seasons and in mature fish. The Alaskan fish were found in catches in May and mostly in immature fish when their percentage reached as much as 25% (Fig. 4).

Fig. 1. UPGMA –dendrogram calculated by Nei's standard genetic distances on 43 allozyme loci in 10 populations of chinook salmon from Kamchatka Peninsula *(sAAT-1,2*; sAAT-3*; mAAT-1*; mAAT-2*; ADA-1*; ALAT*; sAH*; mMDH-2*; CK-A1*; CK-A2*; CK-C2*; CK-B*; GPI-A*; GR*; IDDH-1*; IDDH-2*; mIDHP-2*; sIDHP-1*; sIDHP-2*; LDH-B1*; LDH-B2*; LDH-C*; sMEP-1*; sMEP-2*; mMEP-2*; sMDH-B1,2*; mMDH-2*; MPI*; PGDH*; PGK-1*; PGK-2*; PK-1*; PEPA*; PEPB-1*; PEPD-1*; PEPD-2*; PGM-2*; mSOD-1*; sSOD-1*; TPI-1*; TPI-2*; TPI-3*;* and *TPI-4*).*

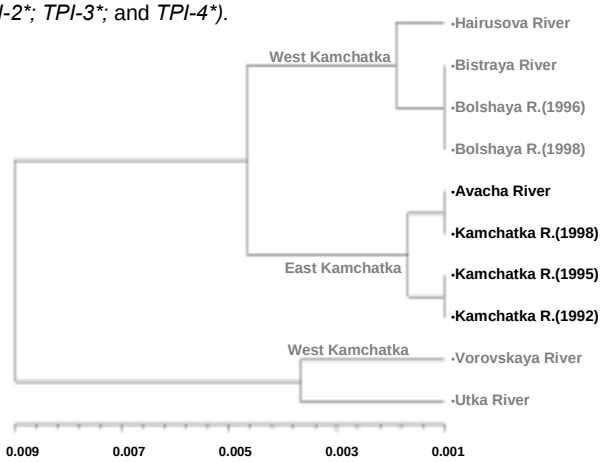

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Fig. 2. Principal component analysis of genetic distances on 43 allozyme loci in 10 populations of chinook salmon from Kamchatka peninsula (the same set of populations and loci as on Figure 1).

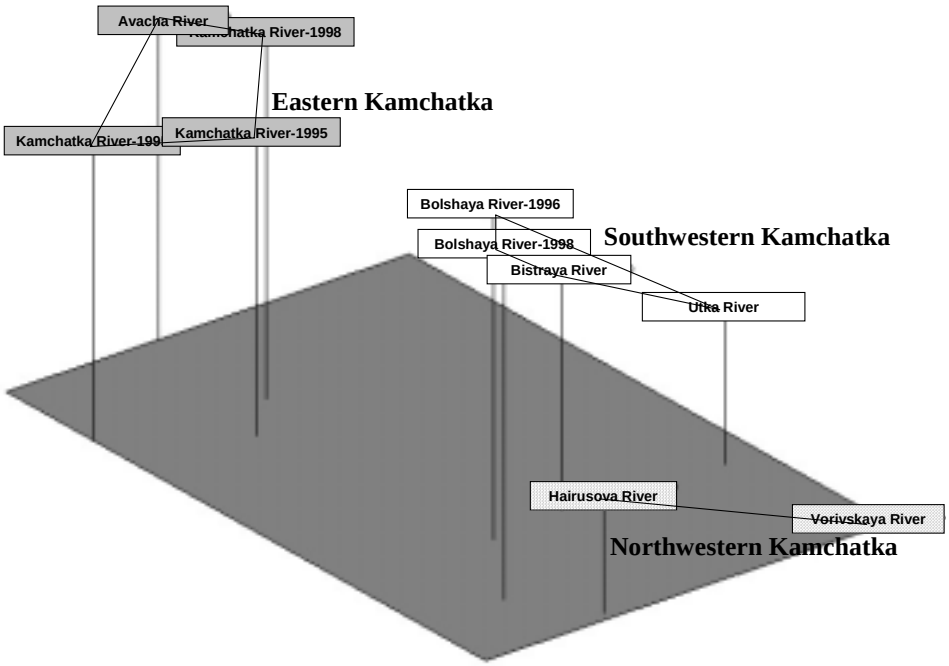
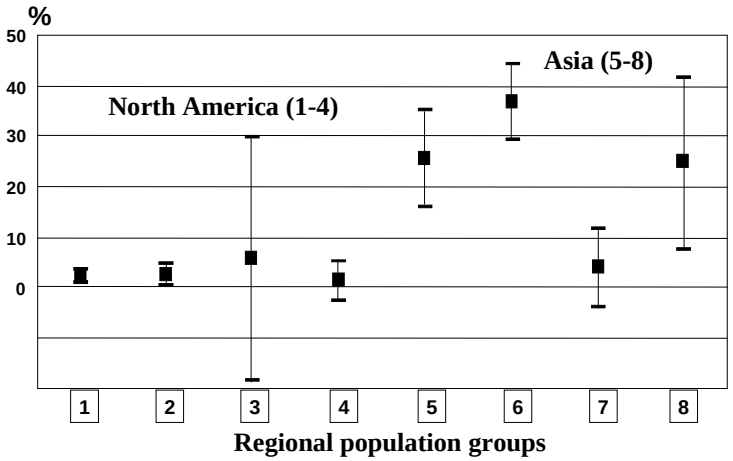


Fig. 3. Stock composition (%) of collections from chinook salmon mixed-fisheries in the Russian Economic Zone in May-July of 1998.



1 – California and Oregon, 2 – Southeastern Alaska, 3 – Kodiak Is., 4 – Bristol Bay, 5 – Northwestern Kamchatka, 6 – Western Kamchatka, 7 – Southeastern Kamchatka, 8 – Kamchatka River Drainage.

Fig. 4. Stock composition (Oregon, Alaska, Kamchatka) in May, June and July (to the left), and in immature and mature (to the right) chinook salmon collections from mixed-fisheries in the Russian Economic Zone in 1998.