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Cross-references: *Beach*; *Beach Ridge*; *Coastal Geomorphology*; *Coastal Plain*; *Littoral Processes*; *Oriented Lakes*; Vol. I: *Fetch*; Vol. II: *Astroblemes and Meteorite Craters*; *Explosion Craters*; *Wind Measurement*, *Wind Roses*.

CARTOGRAPHY—*See* pr Vol. VI

CASE HARDENING—*See* INDURATION

CASPIAN SEA

Dimensions and Shape

The Caspian Sea is the greatest saline lake in the world. Its area is 436,000 km^2, and its volume is 77,000 km^3 (average depth 180 m). The sea is 1200 km long from north to south. The coasts are slightly indented. Connected to it, there are the almost closed Gulf of Karabogaz(gol) (18,000 km^2) and a series of small bays: Gurguyanian Bay, Tourkmen Bay, Krasnovodsky Bay, Baku Bay and others. Apart from the Volga Delta, there are a few islands: Tiuleny, Chechen, Artem, Giloy, Ogurchinsky, and Koulaly, and also some small islands in the Baku and Apsheron archipelagos. Most of the inflow into the Caspian Sea is carried by the following rivers from the north and west: the Ural,

TABLE 1.

River	Volume Delivered (km³)	Proportion of Whole Delivery (%)
Volga	270.83	76.3
Kura	17.22	4.9
Ural	13.17	3.7
Terek	11.31	3.2
Others	42.65	11.9
	355.18	100

Volga, Terek, Sulak, Samur, Kura; from the south, Sefidrud, Gurguen and Atrek rivers. Table 1 shows volumes and percentages (from Zenkevitch, 1963).

Climate

The climate of the Caspian Sea is complex. In the north, the frost reaches as low as -38°C, while in the south, the January temperatures are

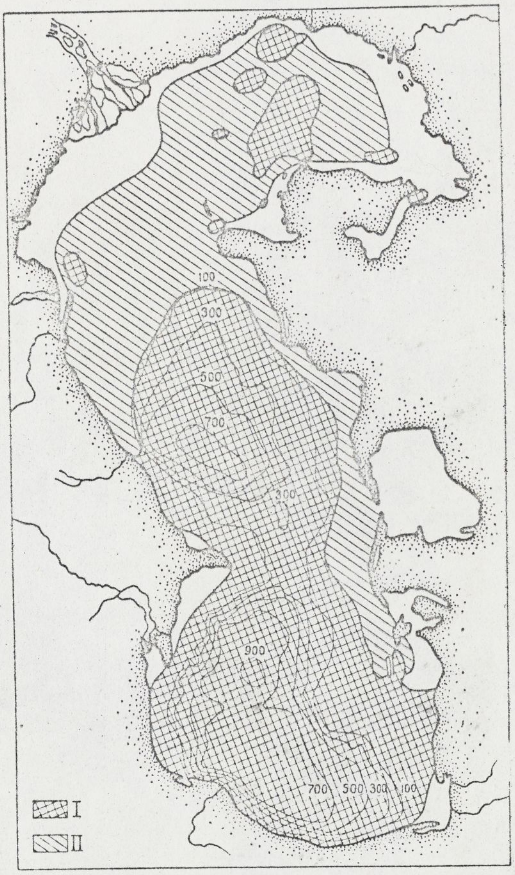

FIG. 1. Bathymetric map of the Caspian Sea (Knipovich, 1936) with main sediment classes: (I) fine-grained, (II) coarse-grained (Klenova: sketch-map from Zenkevitch, 1963). (By permission of George Allen & Unwin, London, England)

$+5$ to $+9$°C. The climate is arid on the northern and eastern coasts. The mountainous coasts in the west, southwest and south have humid warm climates. The precipitation in the south and southwest is 1500 mm, but at Krasnovodsk on the east coast, it is only 120 mm. The entire Caspian drainage area is enormous (3.7×10^6 km^2). The inflow (Table 1) is increased to 451 km^3 by direct rainfall. Evaporation accounts for 86.6 cm annually.

A monsoon-type regime with the dominant northeast winds is characteristic for the Caspian Sea in winter, particularly for its northern part. The monsoon character diminishes in summer when land breezes prevail.

The Bottom Relief

The Caspian Sea is divided in three roughly equal parts according to bottom morphology. In the north part, the depth is no more than 20 m (Fig. 1). The middle part has a maximum depth of 790 m and is bordered by a sill from the southern part with a depth not less than 170 m (Apsheron sill). The South Caspian, with depths down to 980 m, has a very complex relief in the west and a broad flat shelf in the east. The maximum depth in the Gulf of Karabogaz(gol) is 10 m (*Gol* = Gulf in the Turkmen language).

Hydrological Features

The north Caspian freezes in winter. In summer, the mean surface temperature is 22–25°C; near the east coast, it is 27–30°C. The bottom temperature in the basins is always constant at 5–6°C.

The salinity is 0.3‰ in the north Caspian, with the freshening effect of the Volga River, and rises southward gradually to 14‰ (southeast). In the Gulf of Karabogaz(gol), the salinity is 300‰, a classic evaporating basin.

Due to the great difference in conditions in the northern and southern parts of the sea, a vertical circulation is provided in summer by the heating and evaporation and in winter by the outflow of cold waters from the north Caspian into the middle and south basins. Oxygen is still present even at the maximum depths. Some H_2S contamination occurs locally but only for a short time.

The currents are formed by the winds and by density differences between fresh northern waters and more saline southern ones. The general Caspian water movement is cyclonic (Fig. 2). Two circulations develop at a depth of 300 m and more in the middle and southern basins. A coastal current moves along the western shore from the Volga delta southward, and northward along the eastern shore.

A steady current into the Karabogaz(gol) partly compensates for the evaporation from the gulf surface. Nevertheless evaporation (500.7 km^3) prevails over the water inflow (422.4 km^3); this leads to permanent precipitation of salts.

FIG. 2. Current systems of the Caspian Sea (A. Mikhalevsky, 1931; from Zenkevitch, 1963). (By permission of George Allen & Unwin, London, England).

On the shallow northern coasts there are wind-generated tides.

Caspian Sea Level Oscillations

The instability of the sea level is a characteristic feature of the Caspian Sea. Many serious falls took place in the past; at the present time, a fall has been proceeding since 1930. Over this period, the sea level has been lowered by more than 2 m and in 1952 was 27.6 m below ocean level. Decline in the water level has changed coastal shapes, mostly in the northern part. Many bays disappeared and islands increased. Some islands changed into peninsulas, e.g., Cheleken and Sara islands, etc. The Emba River does not flow into the sea any more. The area of the Volga Delta has increased very much owing to the emergence of the bar. Oscillations for the period 1886–1936 are shown in Fig. 3; documentation exists to indicate major oscillations over many centuries.

Geological Structure

The Caspian Sea is situated in a broad tectonic depression of heterogeneous origin. Its northern part belongs to the southeast margin of the Russian Platform. A buried folded system of Paleozoics trends from the Mangyshlak peninsula to the Volga Delta. The southwest part of the Caspian has a geosynclinal origin. The boundary between the platform and the geosynclinal parts of the sea floor strikes from the Terek River to Krasnovodsk. The bottom, south of the Terek mouth, continues the structure of the Caucasian foredeep.

The Apsheron sill at the boundary of middle and south Caspian, between the Apsheron and Krasnovodsk peninsula is a complex geologic structure. The Tertiary Caucasus folding, the southern edge of the Krasnovodsk platform, and the Tertiary folding of the northern border of the Turkmen depression all converge here.

The south Caspian between the Kura and Turkmen depressions is an area of subsidence and continuous sedimentation from Paleozoic time, and possibly earlier. Geophysical investigations show that in the south Caspian depression the granite layer is absent, (i.e., oceanic type crust).

Geological History

As on the Russian Platform, it is possible to see the alternation of more or less north–south and east–west movements in the geological history of the Caspian Sea. The Caspian has been united frequently with the Black Sea and, through it, connected to the World Ocean at the times of east–west

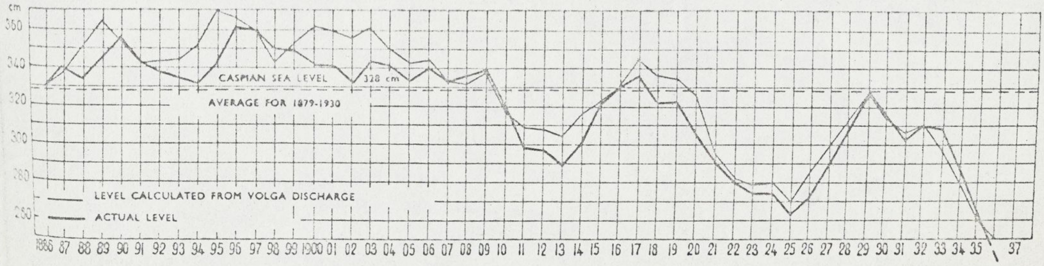

FIG. 3. Fluctuations in the Caspian Sea level 1886–1936 (Brujevitch, 1938; from Zenkevitch, 1963). (By permission of George Allen & Unwin, London, England.)

warping. Open connection with the Mediterranean ceased from the Miocene onward, but narrow marine connections were later re-established from time to time. A brackish Miocene basin was widespread in southeastern Europe. Further transgressions and regressions affected the Caspian depression. One of the greatest regressions was at the beginning of the Pliocene.

At that time, the Caspian Sea occupied only its southern basin and a thick series of sands, silts and clays was deposited, later to become one of the richest oil fields. This regression, named the Balakhan stage, was replaced by the broad Akchagylian transgression. The Caspian basin extended at that time northward to the middle Volga. The Akchagyl Sea was not fresh, but the route of its connection with the ocean is not clear as yet; possibly it was in the north. During the Akchagyl transgression, a tendency for submeridional subsidence is indicated.

The later stages of Caspian development were marked by oscillations in level with ever decreasing areas of transgression. The transgressions of lower Pleistocene (Bakunian), middle Pleistocene (Khazarian) and upper Pleistocene (Khvalynian) are notable. They left many terraces and raised beaches on the Caspian shores, at heights from 300 down to 7 m above present sea level.

The levels of Quaternary terraces are tilted with the continuing orogenic activity of the Caucasus geosyncline. The older terraces of lower Bakunian are the most deformed. The base of the Bakunian is at 200–300 m in the Kura and Terek depressions and rises to 280–320 m above sea level at the southeast end of the Caucasus. The tilting of the younger terraces is less. Maximum deformation is also seen at the southeast termination of the Caucasus.

The regressive phases left submarine terraces and plains on the sea floor. The most clearly expressed level at −700 m probably belongs to the Pliocene. The submarine terrace and the slope break at −300 m are also very marked. The depth of the Caspian shelf outer edge varies from −60 to −120 m. The position of the shelf edge is almost everywhere related to tectonic movements, except off the deltas.

The Caspian Sea is an area of recent orogeny. Structural lines of the mainland continue under the sea floor. Anticlinal folds across it form numerous islands, banks and reefs (Figs. 4 and 5). Many of these anticlinal domes are also oil and gas bearing. The greatest offshore oilfield is the Neftyanye Kamni ("Oil Stones"), represented primarily by a group of small rocks near where passing ships had noted the oil seeps and gas blows.

Geophysical investigations have revealed many oil-bearing structures expressed only very slightly in the bottom relief. The structural lines of the west coast continue not only on the shelf and slopes but also into the bottom beyond the slopes. The latest echo-sounding data show that in the north-west part of the south Caspian, the sea bottom is a

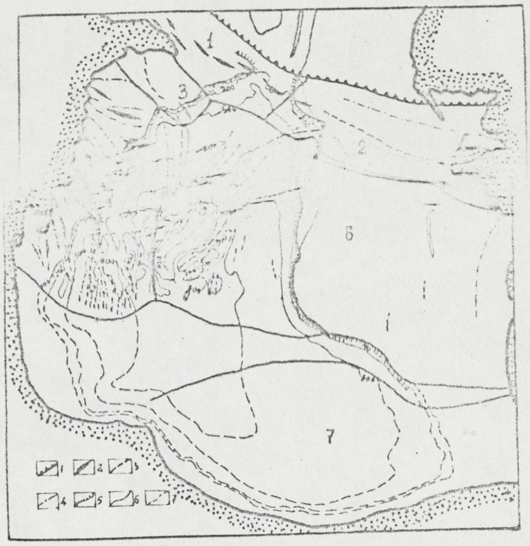

FIG. 4. Sketch map of South Caspian tectonics (after V. F. Soloviev, L. S. Kulakova *et al.*, 1962): (1) southern boundary of epihercynian platform; (2) anticlinal structures fixed by seismic prospecting and by boring; (3) anticlinal lines shown in the relief; (4) synclinal lines; (5) shelf break; (6) isobaths from echo-sounding data; (7) isobaths from nautical charts.

The figures on the sketch-map: (1) region of Apsheron Archipelago anticlinorium; (2) continuation of structures of Balkhan depression into sea floor; (3) continuation of Apsheron Peninsula anticlinal zones south eastward into sea floor; (4) region of structures of Baku archipelago; (5) South-Caspian anticlinal zones, eastern part; (6) shelf—tectonic structures are not expressed in relief; (7) Elburz foredeep.

system of young submeridional ridges 300–400 m high above the surrounding basins (Fig. 4). As in the shallows, many of these structures have oil and gas shows.

Mud Volcanoes

Sedimentary "volcanism" is very widely developed in the Caspian area. Many mud volcanic islands crown the structures on the western and eastern shelves and slopes of the South Caspian. Many submarine explosions are noted here. The sediments contain breccia layers of sedimentary "volcanic material."

Sediments

The present sedimentation in the Caspian Sea depends mainly on two factors: the clastic detritus mostly from the Caucasus and the precipitation of calcium carbonate brought down by the Volga and Ural river waters. The inflow of these two rivers comprises 80% of the total. They drain the region of the chernozem soils; because of this, the carbonates are dominant in their waters. The Caspian Sea receives only 12% of its river water

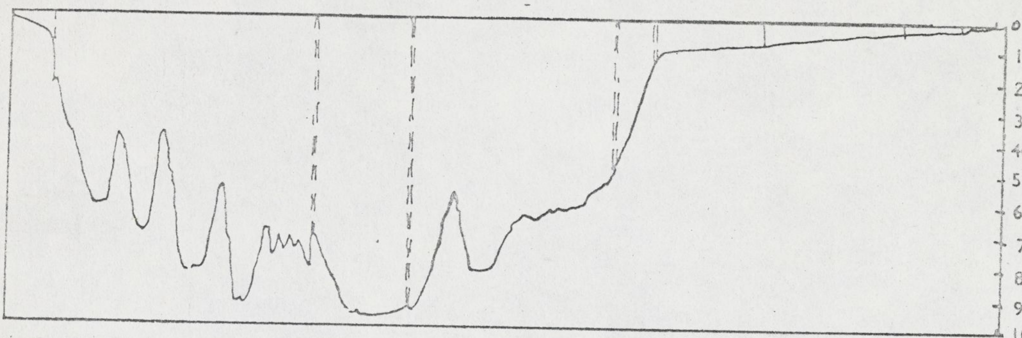

FIG. 5. An east-west profile across the Southern Caspian showing anticlinal ridges of the southwest and the broad shelf of the southeast (Soloviev, Kulakova and Agapova; from Zenkevitch, 1963). (By permission of George Allen & Unwin, London, England.)

from the Caucasus coast, but this includes the most part of the solid inflow. Only one river, the Kura, carries into the sea 36% of all suspended matter. The eolian dust from the east plays a minor role.

Caspian water is marine in origin, but is modified by a great quantity of carbonates and sulfates. It is oversaturated in the $CaCO_3$ which precipitates to the extent of 94 g/m^2 yearly. The $CaCO_3$ accumulates in the shallows and in places of active hydrodynamics in the form of shells, shell sand, oolite and recent submarine "calcrete", and in pelitic form in the muds.

The north Caspian Sea bottom is covered by coarse-grained sediments, mostly sand with a large proportion of shell fragments and unbroken shell. The fields of pure shell occur locally, for example, in the southern part of the northern Caspian. This field continues southward along all the east coast. The shell sediments are composed of Dreissensidae and Cardidae. Most fine-grained sediments occur near the mouth areas of the Terek, Volga and Ural rivers, but also in the central basin of the north Caspian at 8–9 m.

North Caspian sediments contain some quantity of organic carbon, increasing in fine-grained sediments from 0.45% for sand to 1.36% for mud (mean values). This quantity of organic carbon is enough to make a slightly reducing environment; therefore, the fine-grained sediments are of greenish-gray color. The CO_2 content ranges from 2 to 30%.

The distribution of sediments in middle Caspian depends on the bottom relief. Sand with a small admixture of shell and silt—product of river transport—prevails in the shallow depths near the west shore. The sand is well sorted by the north and northeast waves. The sand is replaced by muddy sand, sandy mud and mud at the increasing depth. The $CaCO_3$ in these sediments is not above 12–15%. The $CaCO_3$ content rises quickly with decreasing depth near the east coast to 92% and even more in certain spots.

Outcrops of Quaternary rocks, and among them of shell-limestones and also oolite sand and recent "calcrete," are noted on the east coast fronting rocky shores. Fine-grained mud accumulates in the bays and is composed of pelitic carbonates. Organic carbon in the middle Caspian sediments range from 0.30% for sand to 2.51% for mud. Its content decreases with increasing of $CaCO_3$ in sediments of the same grain size.

The sediment distribution on the western shallows of the southern Caspian varies very much according to the structural relief. Elevations of the submarine slope are areas of abrasion, the products of which fill up the deeper places. Patches of present-day bottom abrasion (negative sedimentation) often occur here near the eastern coast, and frequently oolite sand and "calcretes" form at these points.

The mineral particles are brought in mainly by the Kura river. It carries out a clayey mud which reaches eastward into the deep basin. The lime content of the sediments in the west is not more than 10–12%, increasing quickly eastward. Sediments in the eastern shallows contain up to 90% $CaCO_3$. There are also shell, oolite sand, and "calcretes" here and carbonaceous pelite in the calm waters.

Mud and clayey mud in the south Caspian basin contain 2.28% (mean) organic carbon. It increases to 3% in the areas of mud volcanoes. The increasing of the mean organic carbon content from 1.22% for 1934 to 1.74% for 1956–1959 has been noted (Pakhomova, 1961).

The manganese content in the Caspian sediments ranges from 0.03% for sand to 0.15% for mud; phosphorus, from 0.03% in sand and shell to 0.08% in the clayey mud. The relative enrichment by manganese and phosphorus is observed near river mouths. Mean manganese content is 0.08–0.09% in the middle and south Caspian at the greater depths, reaching to 0.3%; a maximum occurs near the west coast. The phosphorus content increases on the submarine threshold slopes (more 0.1%).

The Apsheron sill is an erosion area. Quaternary rocks (according to latest data, upper Khvaly-

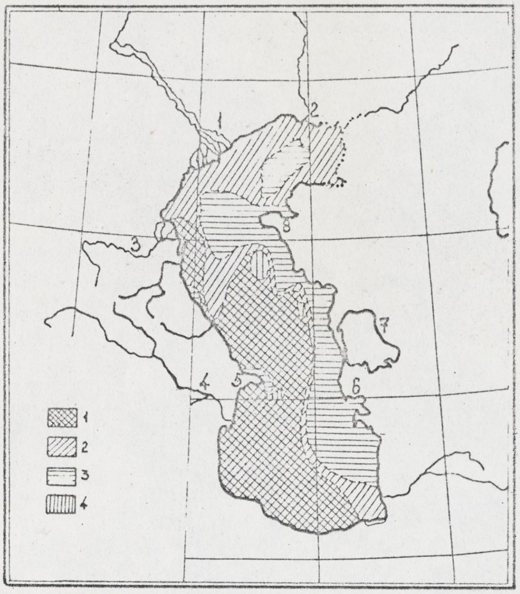

FIG. 6. Recent sediment facies of the Caspian sea: (1) clastic facies; (2) clastic carbonate facies; (3) carbonate facies; (4) diatom-carbonate facies. Geographic names: (1) Volga River; (2) Ural River; (3) Terek River; (4) Kura River; (5) Apsheron Peninsula; (6) Krasnovodsk Peninsula; (7) Karabogazgol; (8) Mangyshlak Peninsula.

nian) lie under a thin cover of recent sediments and, in some places, occur directly at the surface.

Facies

Caspian sediments are generally of clastic, clastic-carbonate and carbonate facies. In places of slow clastic and carbonate sedimentation, the remains of diatom plankton increase relatively; they occur very widely in the Caspian. The quantity of soluble SiO_2 in the richest samples yet found is 12%, and it is possible also to distinguish the carbonate-diatom facies there (Fig. 6).

The main source of the clastic material is in the west, where the rivers have maximum turbidity on account of steep slopes and the continuing Caucasus uplift. Some clastics are carried in by the Volga and Ural rivers. Along the west coast and near the Apsheron Peninsula, the source of clastics are bottom outcrops of Tertiary rocks and Quaternary clays and submarine banks of old Caspian shell limestones. The erosion of mud-volcanic islands and of products of submarine explosions is an important source of sediments in the south Caspian.

All this material is transported by currents and settles in the accumulation areas, i.e., on the slopes and in central parts of the middle and south Caspian basins. Off the east coast the accumulation of clastics is bounded to the narrow nearshore belt

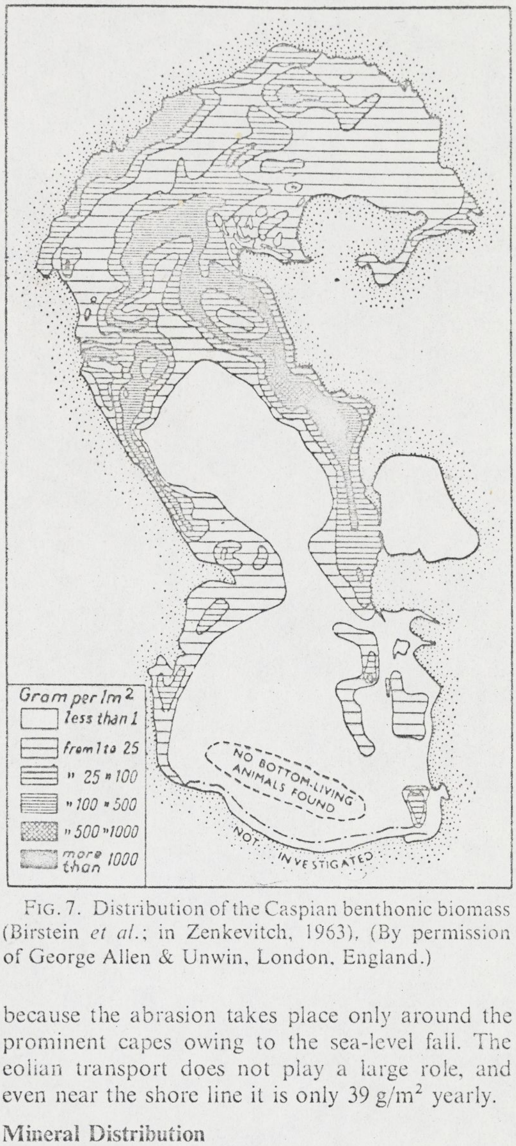

FIG. 7. Distribution of the Caspian benthonic biomass (Birstein *et al.*; in Zenkevitch, 1963). (By permission of George Allen & Unwin, London, England.)

because the abrasion takes place only around the prominent capes owing to the sea-level fall. The eolian transport does not play a large role, and even near the shore line it is only 39 g/m^2 yearly.

Mineral Distribution

Mechanical sorting and differentiation of clastics also modifies the mineral composition. There is a tendency to enrich the coarse-grained sediments by quartz (among the light minerals) and by amphiboles, kyanite, garnet, zircon (among the heavy ones). Micas have the opposite tendency. Limonite accumulates in the areas of recent submarine abrasion and in the coarse grained sediments; pyrite occurs in the muds. Changes of mineral composition take place following the direction of the current, for instance, the quantity of amphiboles, epidote and others including quartz, rises in the northern Caspian, but diminishes gradually southward along the west coast as far as the Apsheron sill. The concentration of these minerals increases again on the Apsheron sill indicating the erosion of older sediments.

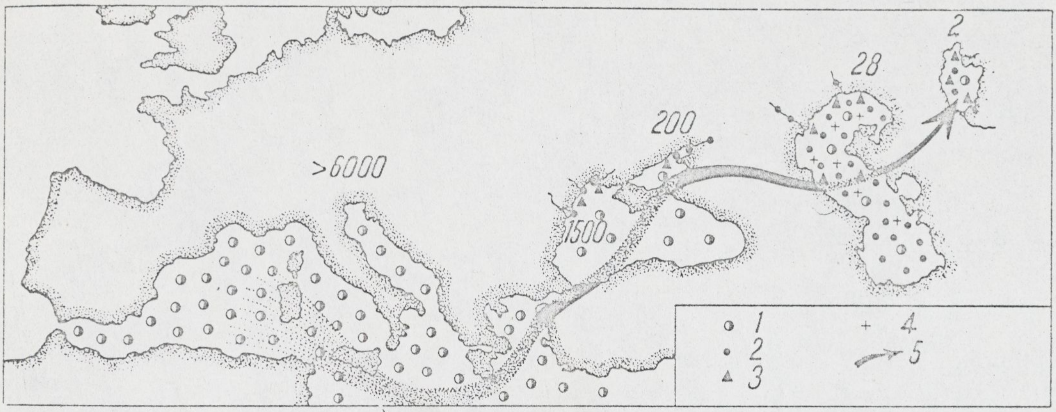

FIG. 8. Qualitative abundance of Mediterranean flora and fauna reaching into the Caspian (and eventually Aral) Sea. Note reduction in species from over 6000 to 2 and modification by other sources. (1) Mediterranean fauna; (2) Caspian fauna; (3) Freshwater fauna; (4) Arctic immigrants; (5) Migration direction (Zenkevitch, 1963). (By permission of George Allen & Unwin, London, England.)

The southern Caspian has its own source of clastic mineral grains. Thus the pyroxenes appear in a considerable measure in the region of Baku Archipelago near the west coast and southward of Krasnovodsk Peninsula in the east. Near the east coast, barite and celestite from Tertiary rocks are noted among the heavy minerals.

Chemical Features

The clastic sediment facies pass into clastic-carbonate and carbonate as one moves away from the source of the clastics. Because of that the chemical composition also changes. The river discharges, especially of the Kura and Volga rivers, are a mixed assemblage corresponding to the average rock composition of the drainage area. The proportion of the chief components continues through the processes of transportation and accumulation, but the sediments are enriched by carbonates, i.e., the ratios of insolubles to solubles decrease.

Iron content rises on the areas of the slow sedimentation, magnesium is augmented in the oolite sands. The quantity of insolubles increases in shell and shell-oolite sand, more in the geosynclinal areas in comparison with the platforms.

Flora and Fauna

The benthonic biomass (Fig. 7) is largely concentrated in the shallows of the north and east, i.e., in the carbonate facies. The composition of the fauna is very varied and reflects the geological history with four main elements, as indicated in Fig. 8 (Zenkevitch, 1963).

Conclusion

In the closed Caspian Basin, we can see all stages of sedimentary differentiation in time and space. Clastic sediments near the west mountain coast are the products of recent denudation of the Caucasus mountain system that was formed in the Tertiary, but where orogenesis still continues.

Clastic-carbonate and carbonate facies originate from the solution products of older rocks forming the Russian Platform. They are deposited on the areas where the clastics become less. Salts, the most soluble components of the terrigenous discharges, precipitate today in the eastern bays of the Caspian, although their migration may have begun as early as the lower Paleozoic.

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Cross-references: *Abrasion*; *Cryptodepressions*; *Kara-Bogaz Gulf*; *Quaternary Period*; *Sediment Transport*. Vol. I: *Black Sea*; Vol. II: *Evaporation*. pr Vol. VI: *Salt Deposits*; *Soils*.

CATASTROPHISM—*See* pr Vol. VI, ACTUALISM; GEOLOGY, PHILOSOPHY OF; UNIFORMITARIANISM

CATCHMENT AREA—*See* DRAINAGE BASIN

"CATTLE TRACKS"—*See* TERRACETTES, LYNCHETS AND "CATTLE TRACKS"

CAVES—*See* LIMESTONE CAVES; SPELEOLOGY

CHAMPLAIN SEA

The Champlain Sea, a term first used by C. H. Hitchcock (Vermont Geological Survey) in 1861, formed when the shrinking Laurentide glacier withdrew north of the St. Lawrence Lowland and admitted water from the Atlantic Ocean. It covered roughly 20,500 square miles in Ontario and Quebec, between Quebec City and Lake Ontario, including part of the lower Ottawa River valley and the Lake Champlain valley in New York and Vermont.

Extensive but discontinuous shore features, mainly beach ridges, on the south side of the basin, and terraced glacial and proglacial deltas on the north side show that the present altitude of the highest marine submergence is about 650–750 feet in the north and 450–525 feet in the south. It has not yet been possible to trace very far the strandlines of individual water planes except in the Champlain valley.

In the central part of the lowland, marine "clay," locally as thick as 200 feet but generally about 100 feet thick on the north side, wedges out on the south side. It is mainly rock flour and is highly unstable. Earth-flow landslides are common wherever the clay supports escarpments higher than about 50 feet; these have caused much property damage and some loss of life. The clay commonly contains fossil *Yoldia arctica* (formerly *Leda arctica*) and is called "Leda clay." Locally, north of the St. Lawrence River, the clay contains lenses of till and stony marine clay and, in places, has been overridden by a readvancing glacier.

Marine fossils are abundant and reveal the character of the water. Species are numerous and shells are robust in the east near the ocean, but in the west and south where the salinity was low, species are few, and shells are small and thin. Preservation of the fossils depends on the presence of lime in the enclosing sediments so that the fossil record is poor in places, especially near the Precambrian shield. The early, deep phase of this sea was subarctic water containing a littoral mollusk fauna characterized by *Hiatella arctica*. Later, the sea was shallower, and water was a boreal type with relatively low salinity characterized by *Mya arenaria*. The water turned fresh before the basin was drained, and the typical pelecypod is *Lampsilis siliquoidea*.

The Champlain Sea formed after the Laurentide glacier retreated from the Highland Front moraine system in southern Quebec, which was deposited about 12,700 years ago. The maximum submergence during the *Hiatella* phase occurred about 11,400 years ago according to radiocarbon dates on shells. Rapid isostatic uplift caused a relative fall of water level from a present altitude of 565 feet at Montreal to about 160 feet by 10,900 years ago. The shallower water was warmer, and the *Mya arenaria* phase began. Some depression of the crust and local relative rise of sea level followed, probably resulting from the readvance of ice to the St. Narcisse moraine, and a second submergence to about 250 feet near Montreal occurred about 10,300 years ago. By roughly 9300 years ago, uplift west of Quebec City caused a bedrock sill to block the entry of the sea, and the water freshened to form the *Lampsilis* lake when the water level stood at about 185 feet near Montreal. This lake drained as the St. Lawrence River cut a gorge through the bedrock sill. From about 8500 to about 7000 years ago, the rate of eustatic sea-level rise equaled and at times exceeded the rate of isostatic uplift, and occasionally brackish water extended up the St. Lawrence River almost to Montreal.

There is no satisfactory recent comprehensive statement on the Champlain Sea; selected references are listed below.

J. A. Elson

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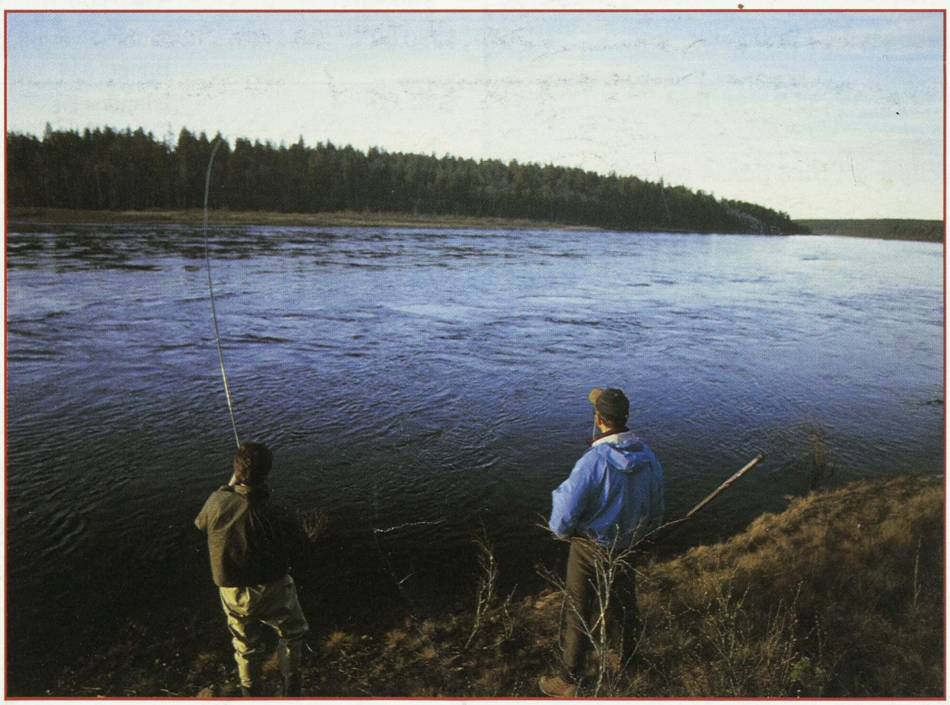
Fish for Atlantic Salmon on Russia's Ponoi River this Summer

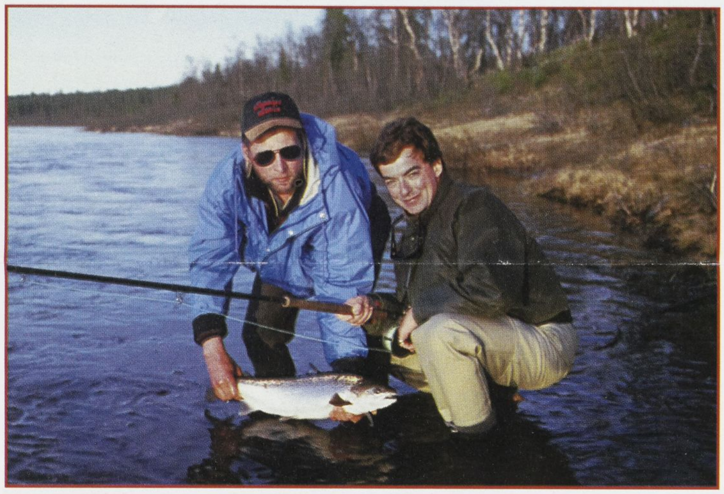
My first fishing trip to Russia took place in August of 1990 when I was part of the exploratory team that went to that country to look over their salmon resource. We had permission to fly into the very center of the province to fish the fabled Ponoi River. This was a first for westerners for up to that time we had only been allowed to fish around the edges in rivers that had been hammered by locals with nets, spears and poisons.

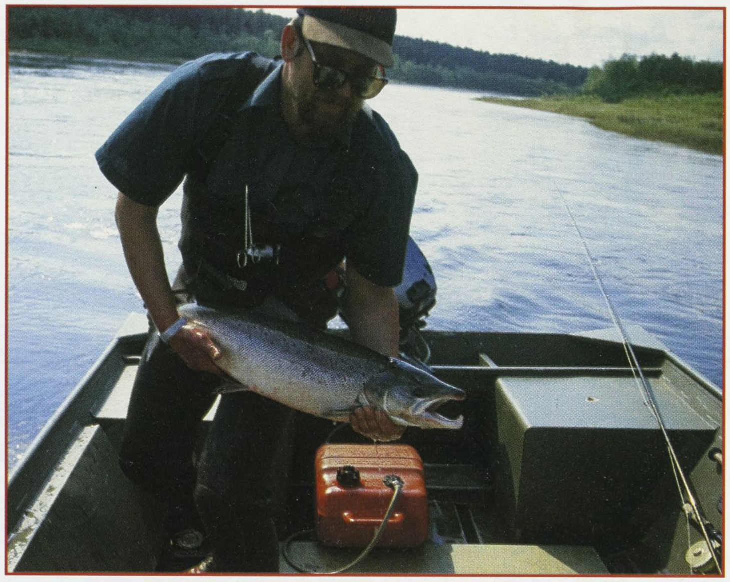


I recall vividly the camp which Tim Rajeff had hastily constructed for us and the various Russian personnel which he had hired or was forced to take on as part of the overall camp compliment. But most of all I remember the fishing which we enjoyed. The flow of water in the river was at its lowest since 1930 and all the people we met told us we would be disappointed. However the fish did not seem to mind the lowness of the water, because we took several salmon from pools all along the river. The rest is history. Rods on the Ponoi River have become the most sought after in the entire salmon fishing world. And it all began at Pacha Creek camp.

This year we will be offering rods at this small camp. The camp can accommodate up to 8 rods per week. All of the beats are served by American built boats manned by Russian guides. Matter of fact all of the staff is Russian. Many of them are fluent in speaking English including Volodia Rifkin the camp manager. Volodia was my guide the first week I fished the Ponoi, although today he is a much better angler than he was then. I fished this camp last summer for 5 weeks and in spite of low water once again, we still caught many salmon. The camp average over the years has been about 30 salmon per angler. However you really do need to fish a Spey type rod which allows you to cover more of the water. (Although our high rod last summer used a single handed rod.)

The cost of a weeks fishing at Pacha Creek is $3700.00 per rod based on double occupancy. This price includes your flight to and from the camp, fishing from Saturday to the





following Friday night, one guide per two anglers, meals, and a snug two-man wall tent (12 foot by 15 foot) to sleep in. The camp facility is practically identical to the lower camp, with the two man wall tents, shower house and large dining tent. The weeks that are available at this time are July 1st-8th, July 8th-15th, September 2nd-9th and September 9th-16th. Call soon to reserve your spot. The Ponoi River is well worth the money.

Rods...

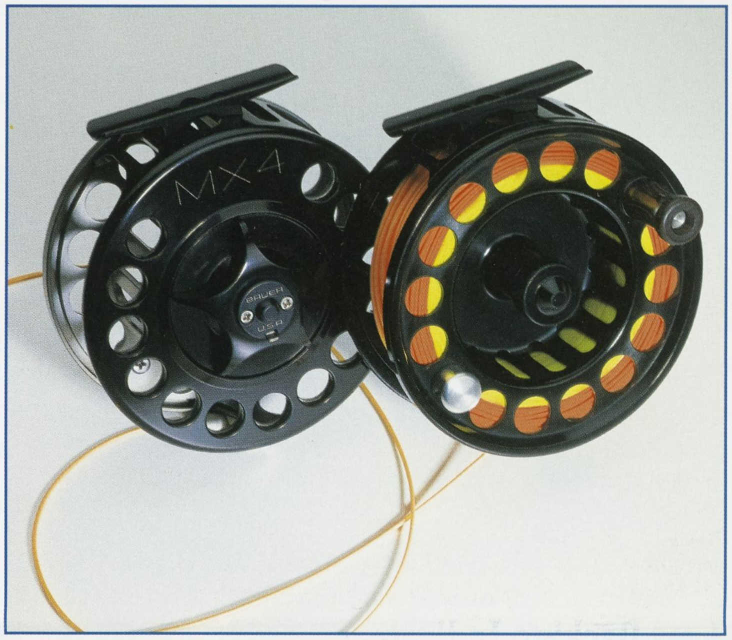
Currently we stock Scott Powr-Ply, Thomas & Thomas, Loomis, and Abel Rods. With these four rod makers we can satisfy practically any anglers needs. A few suggested rod/reel/line outfits are shown below. Each outfit includes rod, reel, backing spliced to an S/A or RIO standard floating fly line.

Rods	Rod Price	Outfit Price	
T & T Vector Series 8½ ft ,3 pcs., 5 wgt. Rod	$600.00	Bauer M3 Marquis #5	$ 980.00 $ 810.00
T &T Vector Series 9 ft., 6 pcs. 5 wgt. Rod	$665.00	Bauer M3 Abel TR2	$1045.00 $ 940.00
T & T Horizon Series 9 ft., 4 pcs. 8 wgt. Rod	$530.00	Tibor Everglades Bauer M4	$1115.00 $ 930.00
T & T Spey Rod 14 ft., 3 pcs., 9 wgt. Rod	$685.00	Islander #4 Tibor Gulf Stream	$1195.00 $1330.00
Scott Powr-Ply Eclipse 8½ ft., 3 pcs., 4 wgt. Rod	$585.00	Abel #0 Marquis #5	$ 945.00 $ 795.00
Scott Powr-Ply Heliply 8'8" , 3 pcs., 10 wgt. Rod	$575.00	Islander #3 Abel Super 10	$1055.00 $1265.00
Scott Powr-Ply G-Series 9 ft., 2 pcs., 6 wgt. Rod	$495.00	Teton #4 System 2L	$ 680.00 $ 630.00
Scott Powr-Ply STS 909/3 9 ft., 3 pcs. 9 wgt. Rod	$550.00	Islander #2 Bauer MX5	$1005.00 $1160.00
Loomis FR963-GLX 8 ft., 2 pcs. 3 wgt. Rod	$535.00	Teton #3 Abel #0	$ 710.00 $ 895.00
Loomis FR1087-3 Trilogy 9 ft., 3 pcs., 7 wgt. Rod	$440.00	Bauer MX4 Tibor Everglades	$1000.00 $1005.00
Loomis FR10812-3 Nautikos 9 ft., 3 pcs. 12 wgt Rod	$465.00	Islander #4 Abel #4	$ 975.00 $1130.00
Abel Saltwater 9 ft., 3 pcs., 12 wgt. Rod	$695.00	Islander #4 Tibor Gulf Stream	$1205.00 $1340.00

Bauer Fly Reels...

A few years ago I found a reel that really fascinated me at the annual tackle show. It was the Bauer Reel. I decided that this reel had a future and signed on as a dealer with them. I have not regretted it. The Bauer reel has a very lightweight frame yet its design is structurally quite strong with a newly designed draw-bar which activates the drag. The clutch inside this frame is quite simple, indeed it is ingenious. It eliminates all "slap" and is fail safe. The double sided disc which applies the drag is also quite simple, and did I mention this is a Wide Arbor design so that with each turn of the handle you are picking up quite a lot of line. I have used these reels on False Albacore and Atlantic salmon and they hold up very well against these strong fighting fish. Why not try them against your favored game fish?

Model	Diameter	Weight	Line Wgt.	Capacity	Reel	Spool
MXP1	3.25"	4 ozs.	WF1-3F	WF2 50 YDS	$395.00	$180.00
MXP2	3.25"	4.4 ozs.	WF3-5F	WF5 100 yds	$435.00	$190.00
MX4	4.00"	8 ozs.	WF8-9	WF8 225 yds.	$545.00	$245.00
MX5	4.25"	8.8 ozs.	WF9-10	WF10 225 yds.	$595.00	$265.00
MX6	4.30"	9.6 ozs.	WF11-13	WF12 325 yds.	$645.00	$285.00



Fly Tying Materials and Tools

We will carry fly tying materials, however we will not be able to carry all of the small little items that are available on the market today. Still, we will keep a good inventory of Hoffman, Hebert, and Whiting dry fly necks on hand, as well as some of Phil Castlemans Jungle Cock capes, Indian Crow feathers and Speckled Bustard. In time we will build up our inventory to include most all of the materials available today. Call us and ask for the items you are looking for. We probably have it in stock or we can get it for you.

Our Whiting (Hoffman-Hebert-Miner) brand of dry fly necks are available in all grades priced from $35.00 up to $125.00. Our most popular prices seem to be in the $60.00 range which will purchase a Silver grade of neck. These Silver grades of necks will comfortably tie down to a size 20-22 with ease.

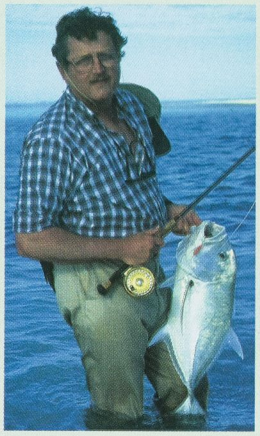
We also stock a good sampling of fly tying tools including the old standby HMH, accompanied by Renzetti and Dyna-King products. Our small hand tools are from Matarelli and Griffin with a few of my own items such as hand polished hackle pliers. Call me and I will fill you in on what we have available.

Fly Lines in Stock

We have been carrying and using the Mastery Fly Lines for years and occasionally had the opportunity to use some of the newer breed of fly lines. I have decided to stock some of these fly lines such as the Wulff Triangle Taper from TT3/4F up through the Spey tapers: TT8/9F-TT11/12F, and the Teeny five-foot sink tip fly lines WF3F/S to WF6F/S, backed up by Jim's often used Saltwater sinking shooting heads in sizes TS250,350,450,550,650,and 750 grains. Also new are the RIO Spey fly lines in their Windcutter and Accelerator configurations with interchangeable sink tips that provide those of us who do use the two handed rod with all kinds of options on the stream. We can splice and rig all of these lines with loops or permanently slice them to your backing.

Bill Hunter's Favorite Bonefish Flies

I love wading the flats with a small box of Bonefish flies, a roll of tippet material and plenty of targets. Bonefish take those flies which appear to represent "food"—easily taken food at that. Most of the flies which I carry around with me possess that bonefish "food" look. Tied on stainless steel hooks, these flies have proven their worth in oceans around the world, from Christmas Island to Andros Island. If you have a trip planned for a particular destination, just mention the name to me and I will set you up with the right box of bonefish and permit flies.



Bonefish Patterns	Price ea.	Hook Size
Agent Orange	$2.00	2, 4, 6
Bonefish Special-Gold	$2.25	2, 4, 6
Bonefish Special-Tan	$2.25	2, 4, 6
Clouser Minnow-Lime	$2.25	2, 4
Clouser Minnow-Tan	$2.25	2, 4
Clouser Minnow-Pink	$2.25	2, 4
Crazy Charlie-Apricot	$2.00	2, 4, 6, 8
Crazy Charlie-Brown	$2.00	2, 4, 6, 8
Crazy Charlie-White	$2.00	2, 4, 6, 8
Flats Fodder-Tan	$2.00	2, 4, 6
Flats Fodder-Orange	$2.00	2, 4, 6
Flats Fodder-Yellow	$2.00	2, 4, 6
Gotcha	$2.00	2, 4, 6
Gotcha-wgtd.	$2.25	2, 4, 6
Orange Gotcha	$2.00	2, 4, 6
Orange Gotcha-wgtd.	$2.25	2, 4, 6
Snapping Shrimp	$2.00	2, 4, 6
Victor's Candy	$2.00	2, 4, 6
Permit Crabs		
Anderson's McCrab	$6.00	1/0, 2
Borski's Chernobyl Crab	$3.00	1/0, 2
Del Brown's Crab	$6.00	1/0, 2
Whitlock's Salt Crab	$4.25	1/0, 4

Announcement…

We are back in the business of running a full service Fly Shop…

On a cold day in November 1988, my wife Simone and I turned our back on the shop that we had created and walked away from 15 years of very hard but rewarding work. We were both quite tired and wanted to rest for a spell. I elected to rest by working as a consultant, which also left me free to fish the globe. And fish it I did. From one end of the world to the other, I fished, exploring rivers, flats and oceans. I fished for my long time friends the Bonefish, Tarpon, Atlantic salmon and its near relative the Sea Trout. And I found new friends along the way, the Marlin and Pacific Sailfish. I fished for odd fish such as the Lenok and Taimen, and countless other species in the various oceans of the world. Along the way I met dozens of fly fishermen from various parts of the globe, many of whom I befriended. From the coastal rivers of Chile to the islands of the Pacific to the salmon rivers of Norway and Iceland. I have spent my entire adult life chasing large game-fish with a fly rod. I can tell anyone what to fish based upon my own first hand experiences.

In October of 1999 we left New Boston and settled in New London, N.H. New London is located about 50 miles northwest of New Boston and as a town had everything we needed. Shortly after we arrived in town a small storefront became available on Main Street. Simone and I talked about renting it and opening a fly fishing store. We both realized that many things have changed in the industry over the last 12 years. There is a totally different generation of anglers out in the world today. However the fish are the same and the sport itself has not changed. We decided to give it a try. I rented the store and hung out our company sign. We are back in business again.

I am available to aid anyone who is contemplating a trip to practically anywhere in the world. And we are learning more about our local trout, bass and salmon fishery. We have all the major brands of tackle available to us here in the shop and are slowly building up our fly tying materials inventory. Please contact us by phone, fax or come visit us at the shop.

Visa/MC Accepted

Bill and Simone Hunter

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Sending this along in response to your inquiry, or as information that may be of interest to you.
– Bill

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Dr. I. A. Chereshnev
Laboratory of Freshwater Hydrology
Institute of Biology and Pedology
Far East Science Center
Academy of Sciences USSR
690022 Vladyvostok
USSR

Air Mail

Dear Dr. Chereshnev:

I was happy to hear that the charr specimens were finally received. The specimens of S. "aureolus" were previously examined and the pyloric caeca removed when counted. ~~I wanted to be positive~~ The S. aureolus specimen came from a lake in the Rocky Mountains of Idaho. They were introduced there in 1925 from Sunapee Lake, New Hampshire. After lake charr, S. namaycush, were introduced into Sunapee Lake, the native charr became extinct ~~there~~. This particular group of ~~charrs~~ charr occur, only as disjunct relict lacustrine populations in northeastern North America. ~~Thus~~ I ~~include~~ classify all of the described forms of this group -- ~~of~~ aureolus, marstoni, and oquassa -- ~~ap~~ as S. alpinus oquassa. S. a. oquassa probably represents a rather primitive form of alpinus. They average about 20-21 gillrakers, 38-42 pyloric caeca, and 64 vertebrae.

Have you made a critical comparison of S. confluentis with the "stone" charr (S. albus)? ~~or S. kronotskoi~~ Many thanks for the color slides, photographs, and a copy of the publication on the systematics and ecology of Far Eastern fishes. I have some reservations on the position of the branching points of figure 3 ~~of~~ in the paper you coauthored ~~with several~~ in this publication.

2

~~others~~. This phenogram of figure 3 was derived from characters of the skull. ~~which~~ These characters are subjected to non genetic influence (ontogenetic changes with age and growth) and genetic influence from feeding specializations which may not be correlated with phylogeny. The upper half of figure 3 (which ~~can~~ might be considered as the _S. alpinus_ complex) shows the charr of Lake Dalnye, Kamchatka to be the most divergent form, with the Lake Nachinskoye (Kamchatkan) charr and _S. neiva_ sharing ~~it~~ a most recent common ancestry.

I have never seen specimens of any of these charr and rely on literature descriptions and zoogeographical evidence. However, I can find no evidence of any real differences between Nachinskoye and Dalnye charr with each other or both of them collectively from the Chukotsk charr (_S. taranetzi_ - _andriashevi_). It appears quite logical that during the late Pleistocene, the Chukotsk charr ~~was~~ ~~had~~ was anadromous with a continuous distribution to Kamchatka. A warming climate disrupted this continuous distribution leaving some relict lacustrine populations in Kamchatka. "_S. neiva_", on the other hand, appears to be virtually identical to _S. a. erythrinus_ of lakes in the

(3)

what limits of malma char
" " czerski -
2 form
alpinus - large spots - taranetzi
28 mm 68 m

Isolates E. European & E. Arctic S. alpinus, S. taranetzi differentiates - * they occur sympatric in rivers at lower Tahanyr, where Nizhnyays, here according to Mithin(18) - 2 anadromous forms exist + differ in body form. - - Then No less a question on tax. position of S. taranetzi perhaps finally 'to speak' only after detailed study of zone of sympatry of this taranetzi char with S. czerski & S. alpinus.

Reshetnikov Yu. S. - Omul of the Penzhina R. - ibid: 49 - 105

Andreev, V. L. & V. V. Volobuev - Statistical analysis of morphometric characters of the kundsha, ibid: 106 - 113

Specimens 1. - Chikhacheva (N. Japan sea)
2 L. Lagunnoe (Kurile Is.)
3. Ocean off Kunashir (Kurile) 4 - near, around L. Lagunnoe
5. Motykleika R. (N. Okhotsk)

rakers (1) 13.4 - (2) 15.8 D 12 A 10-11
rbr. 12

Chereshnev, I. A. Systematics of anadromous char from the Ioniveem R. basin, Chukotsk Pen. ibid: 114-125.

large spots D 9-11 A 8-9 rakers 22-29 (24-26)
caeca 34-61 (42-52) vert 65-71 br. 11-12
- all over Chukots - very large spots ca. 25 rakers 45 caecae, 68 vert.
Arctic coast of Chukot.

Glubokovskii, M.K., I.A. Chereshnev, Ye. V. Chernenko, and R.M. Viktorobskii. 1979. Distribution of groups of Arctic ~~groups~~ charrs (genus Salvelinus) on the Asiatic coast of the Pac. Ocean. p. 86-98, in: Systematics and ecology of fishes of the Continental waters of the Far East. A.N. S.S.R., Far East. Sci. Cent. Inst. Biol. & Pedology, Vladyvostok.

S. malma not only in Pacific Ocean basin but on Asiatic Coast - from Amguema R. and Chaun - N. Am. Chukostk Sea drainages (Pt. Barrow) & Beaufort Sea (Hershel & Mackenzie R. Also ecotypes in Yukon & Mackenzie

— Okhotsk basin S. neiva sympatric w/ malma & S. leucomaenis ; .

In L. Nachinski (western Kamchatka), malma & Salvelinus sp. - which according to our data is close to group S. czerskii - S. neiva, In L. Dalnye (E. Kamchatka) malma & S. sp. sympatric. In many waters of the Chukotkst Pen. malma & Arctic charr are sympatric

In this zone of sympatry, reproductively isolated, no hybridization = "good" species

p. 87: Arctic charr invaded Pacific Basin (S. neiva & L. Nachinski) - Arctic charr fm. eastern part of Arctic Ocean - in particular Chukotsk & L. Dalnye - is position of

Shaposhnikova believed the anadromous charr from Balyktakh R. of L. Kotelni differs from anadromous S. alpinus of Kara R. ~~area~~ in form of endocranium, upper jaw, - bone, supraethmoid & vomer.

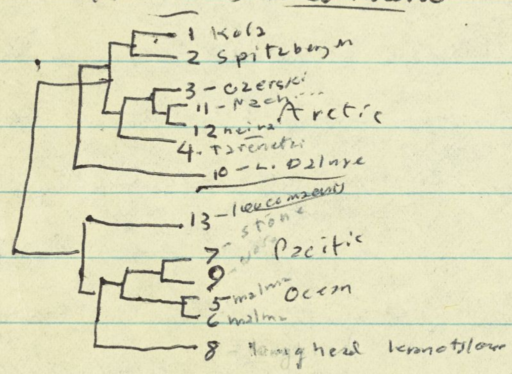
On Chukotsk, besides malma, 2 charr occur - S. andriashevi & S. taranetzi - mainly

(2)

00 anadromous ecotypes →

780 specimens skulls studied — 60 characters

1. S. alpinus resident (Kola Pen)
2. " " anadromous Spitzbergen
3 S. czerski - Indigirka R.
4. S. taranetzi - anadromous, Kukeekkuyum R.
5. S. malma . " "
6. S. malma resident, Kamchatka R.
7. S. albus resident, " "
8. longhead char. L. Kronotskoye.
9. Nose char "
10. L. Dalnye char
11. L. Nachinskoe "
12. S. neiva
13 S. leucomaenis Kamchatka R.



(1) footnote 67: – Our study on skulls – that S. tarentzi of L. Achchen (type local.) and some other waters of Chukotia, a S. andriashevi fm. L. Estikhet). data only on taranetzi related & based belong to S. andriashevi ~~becomes~~ is will be discuss – – in another publication relationship

L. Dalnye char derived fm. S. taranetzi - not malma as Savvaitova –

Arctic char penetrate into Pacific via 2 routes –

S. neiva (derived fm. S. czerskii) across Lonsko-Okhotsk

– during sea regression via Paleo Penzhina → L. Dalnye.

Taranetzi across Bering Straits.

headwaters of the Lena River basin (also in headwater lakes of Kolyma River basin). ~~It~~ "*S. neiva*" is most probably derived from a headwater transfer from the north into the Okhota River basin.

The charr named *S. czerski* from the Indigirka basin (virtually identical to *S. jacuticus* of Lena River) differs from the "*tarenetzi*" charr of Chukoskt by fewer caeca, fewer vertebrae, and smaller spots. Have you found the geographical ~~demark~~ demarcation between the *tarenetzi* and the *czerski* types of charr? The Kolyma River is the major drainage between the Indigirka (*czerski*) and the Chaunsk Bay region (*tarenetzi* or *andriosheri*). What type of charr is native to the lower Kolyma?

I have been invited to present a paper at the Artic charr symposium in Winnipeg, Canada, and I believe I will attend this symposium. You mentioned that you and your associates would contribute a paper on Asiatic charr. Does one of your group plan to attend this symposium?

You ~~also~~ wrote about the problems you have encountered in ~~trying~~ your attempt to have a paper published in Voprosy Ikhtiologii. I might suggest that Glubokovsky and you write a paper and send it to me. I can edit it, ~~work in~~ add my own information and opinions and rewrite the paper, adding my name as a coauthor.

If the Winnepeg Arctic charr symposium plans to publish a proceedings, such a publication would be most appropriate for an authoratative paper on the S. alpinus complex. Another logical publication outlet would be the Canadian Journal of Aquatic Science (formerly Journal of the Fisheries Research Board of Canada).

Mrs. Savvaitova wrote in her rebuttal to my paper in the charr monograph that my problem is that I have studied only preserved museum specimens whereas she ~~has~~ is familiar with living specimens. Then I ~~so~~ read again her paper on the charr of the Kukakkuyum River coauthored with Volobuyev and Vasilyeva and looked at the slides you sent me of these same charr. The differences apparant in your slides clearly demonstrate two distinct species (and this spotting difference is consistantly maintained in sympatric populations of Dolly Varden and Arctic charr over a wide area in both Asia and North America).

Thus, from Savvaitova's (et al.) conclusion that

(5)

the two types of charr in the Kukekkuyum River exhibit intermediacy and may only be seasonal races of a single species, would lead me to suggest that familiarity with live specimens has not been very helpful to her understanding of charrs.

I must mention that ~~[illegible]~~ I still retain some special skills learned during my stay in Leningrad many years ago. I wanted to make Okroshka, my favorite Russian soup with the last cucumbers picked from my garden. In the USA kvass is not known so I had to make my own ("samogon" kvass). The kvass and the resulting okroshka turned out very fine.

When I saw Barsukov at the American ichthyology meetings in 1979, he brought me some black current seeds (chernaya smorodina) to plant in my garden so I would have a supply of the leaves to use in one of my favorite Russian dishes, marinated mushrooms. £

Sincerely,

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28 April 1965

Dr. Bob Behnke
Zoölogical Institute
Academy of Sciences
Leningrad B-164
USSR

Dear Bob:

Thanks for your letter and the offer of help. I'm very sorry you've been sick. Hope the Spring and Summer are brighter.

Andriashev has sent the pictures and promises the text when it is off the press. Instead of you getting involved with meristic counts as I had requested it would be better now to just get the descriptions as published. There is a great slowdown here, however, in getting translated. If you or your wife have any time it would be tremendous to have the translation made by you as soon (or sooner) as the paper appears. This would be on the main character differences and body proportions: T.L., S.L., head into S.L., eye into head, i.o. width into head. Or, if he presents it in mm's that would be even quicker and would'nt need translation - except re: the <u>acoustico-lateralis</u> of the head.

I'm wrapping a New York Times section for you. What else can we send? Please keep an eye open, too, for the needs of our colleagues there as it may be possible to find a publication or something they need, and I would like to do that.

Please given warmest regards to A.N. Svetovidov, his kind secretary, his daughter and to the Andriashevs, to Lindberg and the librarian.

I hope you meet those most interesting people in the Arctic and Antarctic Institute also. They have a fine staff and an interesting Museum.

Sincerely,

Dick M.

Richard Gordon Miller

TAXONOMIC RELATIONSHIPS OF CHARS OF THE GENUS *Salvelinus* IN THE BASIN OF THE KAMCHATKA RIVER

M. K. Glubokovskii

UDC 597.0/5-2/9
ZOOLOGY

In the basin of the Kamchatka River, earlier investigators separated five ecological forms of chars of the genus *Salvelinus*, whose taxonomic status was ambiguous, and also *S. leucomaenis*. Two more ecological forms, diadromous benthophages and diadromous predators, were discovered by the author. Investigation of their external characters provided no clue as to the genetic relationship between these forms and their taxonomic status. A study in comparative anatomy of the osteological structures of the skull resulted in chars from the Kamchatka basin being divided into two phenotypes. A division of this kind, based on morphological data, is consonant with the separation of Kamchatka chars according to their character of feeding in fresh water. On the other hand, within each of these phenotypes there are both diadromous and riparian ecological forms of chars. There are many arguments favoring specific status for groups of chars separated morphologically and ecologically. One of these groups has been identified with the common Pacific species *Salvelinus malma* (Walb) and the other from the Kamchatka basin has been treated by the author as a new species. From the basin of the Kamchatka River three separate species of chars have appeared. They are: *S. leucomaenis*, *S. malma*, and *Salvelinus* sp.

The ecology and external structure of chars of the genus *Salvelinus* in the basin of the Kamchatka River were investigated before (Savvaitova, 1961, 1963, 1970, 1973; Savvaitova and Maksimov, 1970; Kokhmenko, 1970; and others). In addition to "kundzha" (*Salvelinus leucomaenis*), five more ecological forms of chars living sympatrically were separated. It was assumed that some of them might prove to be twin species (Savvaitova and Kokhmenko, 1970), but according to a hypothesis which developed later all these ecological forms belong to one polytypic species, *S. alpinus* (L.), and are now found at different stages of sympatric divergence (Savvaitova, 1973). Thus, according to modern conceptions there are two species of chars inhabiting the basin of the Kamchatka River, *S. alpinus* and *S. leucomaenis*.

However, the taxonomic rank of these different ecological forms remains ambiguous to this day. In particular, their origin is incomprehensible. Reliable cases of sympatric divergence leading to the development of isolated forms are, as yet, unknown and the possibility of such an occurrence is not very likely (Meyer, 1974). Added to this, a comparative osteological study of the different forms of chars in the Kamchatka basin has never been conducted although the promise of such an undertaking for taxonomic purposes has been held out by many authors (Norden, 1961; Shaposhnikova, 1972; and others). We know of two studies on the osteology of chars in the Kamchatka basin. In the article by Reshetnikov and Savvaitova (1962), the Kamchatka basin chars are not even considered. Shaposhnikova (1971) does not list the characters differentiating the ecological forms of chars because of a sparse collection of specimens.

MATERIAL AND METHODS

The material studied (155 specimens) was collected in the lower reaches of the Kamchatka River near Lake Azabachi. Besides the regular methods for separating ecological forms of chars (character of feeding, external appearance, and habitat), the technique of parasitic indication was used (Makhovenko, 1972). In a comparative osteological analysis those elements of the skull offering prospects for morphological division of chars were investigated. These included the chondrocranium, parasphenoid, vomer, maxillary, premaxillary, dentary, preopercular, hyomandibular, supraethmoid, frontale, glossohyal, ceratohyal, and basibranchial.

The indices chosen for this analysis proved more often than not to be inconvenient, since too many were required to describe adequately the complex form of bone. It involved a great loss of time in preparatory work,

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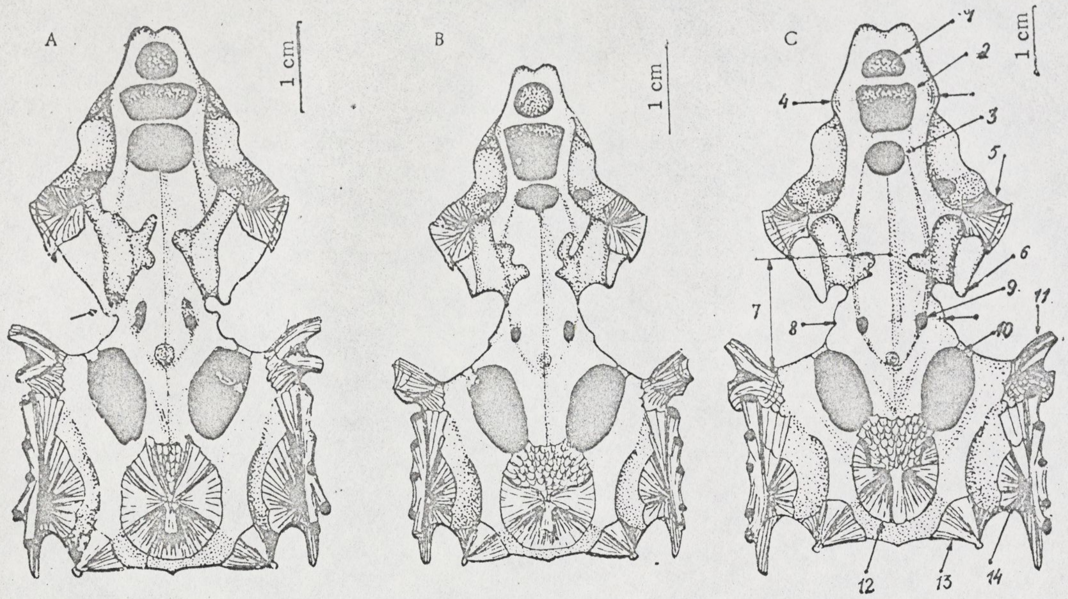

Fig. 1. Chondrocranium of chars of the basin of the Kamchatka River. A) Diadromous predator (arrow points to anomaly), B) diadromous benthophage, C) S. lencomaenis. 1) rostral pit, 2) anterior ethmoidal fontanelle, 3) posterior ethmoidal fontanelle, 4) width of rostral base, 5) ethmoidal lateral, 6) posterior wing of ethmoidal section, 7) length of cartilaginous bridge, 8) width of cartilaginous bridge, 9) medial fontanelle, 10) dorsal fontanelle, 11) sphenoticum, 12) supraoccipital, 13) epioticum, 14) pteroticum.

especially when masses of material were to be studied. For this reason we elaborated another system of describing the morphology of chars which consisted of separating out an independent series of variability in characters. A comparative morphological analysis of the species of the genus Salvelinus (S. fontinalis, S. leucomaenis, S. malma, S. alpinus, S. boganidae, and S. neiva) and populations of chars of vague taxonomic status found in different regions of Eurasia revealed that the degree with which some osteological characters were expressed was not always intercorrelated. For example, in some species or populations of chars the character A was expressed maximally and the character B minimally, in others the picture may have been the reverse, and in still others there was observed polymorphism of the character B with a stable character A, or vice versa. The extent to which these osteological characters were expressed could not be tied up with the character of ecology of the chars. Consequently, a number of independent variations was formed by each of these morphological characters possessing a different degree of expression in different species and populations of chars. This independence was detected only in analysis of morphological variability on the level of Salvelinus, whereas different species of chars are characterized by a mosaic of variously expressed characters. For example, three series of independent variability were established:

1. Shifting of lateral processes anteriorly–posteriorly. In S. alpinus, S. leucomaenis, S. boganidae, and S. neiva and in chars of some ecological forms from the basin of the Kamchatka River, the processes were found at the level of construction of the bone, and in S. malma and the Kamchatka chars of some of the other ecological forms they were anterior to the constriction.

2. Bifurcation or fusion of the lateral processes. In S. alpinus and S. boganidae and some forms of Kamchatka chars they were bifurcated at the end and in S. leucomaenis and S. malma they were fused.

3. Presence or absence of constriction after the central part of the bone. In S. leucomaenis the constriction was present and in all the other species and populations we studied it was absent.

A total of 76 independent series of variability was separated, 20 of which showed promise for the morphological division of different ecological forms of chars from the basin of the Kamchatka River (Table 1). The extent to which the character was expressed within the series was evaluated by the threshold principle (Granovskaya and Bereznaya, 1974); that is, the state of the character was described as (+) or (–). This method allowed for a very full and uniform description of morphological parameters of different species, populations and forms of chars. In addition, we focused attention on the presence or absence in sympatric forms of chars with similar minor defects and right–left asymmetry in the construction of osteological structures. This in-

TABLE 1

No. of character	Element of skull	State of character	Presenc (+) or absence (−) of character in the ecological form						
			Riparian benthophage	Diadromous benthophage	Non-feeding diadromous I	Non-feeding diadromous II	Diadromous predator	Riparian predator	Stone char
1	Chondrocranium	Anterior and posterior ethmoidal fontanelle of equal size	−	−	−	+	+	+	+
		Anterior ethmoidal fontanelle twice as large as posterior fontanelle	+	+	+	−	−	−	−
2	Chondrocranium	Distance between wings of ethmoidal section wider than cartilaginous bridge	+	+	+	−	−	−	−
		Distance between wings of ethmoidal section equal to width of cartilaginous bridge	−	−	−	+	+	+	+
3	Chondrocranium	Posterior part of ethmoidal section does not reach half the length of the cartilaginous bridge	+	+	+	−	−	−	−
		Posterior part of ethmoidal section more than twice as long as cartilaginous bridge	−	−	−	+	+	+	+
4	Chondrocranium	The sphenoticum broadens toward the periphery and its anterior and posterior processes form a furca	−	−	−	+	+	+	+
		Anterior and posterior processes of the sphenoticum are parallel, not forming a furca	+	+	+	−	−	−	−
5	Chondrocranium	Anterior protuberance of supraoccipital touches dorsal fontanelle	+	+	+	−	−	−	−
		Anterior protuberance of supraoccipital does not touch dorsal fontanelle	−	−	−	+	+	+	+
6	Parasphenoideum	Lateral processes anterior to constiction of bone	+	+	+	−	−	−	−
		Lateral processes at level of constriction	−	−	−	+	+	+	+
7	Parasphenoideum	Lateral processes bifurcate at end	−	−	−	+	+	+	+
		Lateral processes do not bifurcate	+	+	+	−	−	−	−
8	Parasphenoideum	Anterior section not wider than central part	−	−	−	+	+	+	+
		Anterior section broader than central part	+	+	+	−	−	−	−

9	Parasphenoideum	Central part narrower than posterior part	+	+	+	−	−	−	−
		Central part broader than posterior part	−	−	−	+	+	+	+
10	Vomer	Height of head not smaller than its width	−	−	−	+	+	+	+
		Height of head distinctly smaller than its width	+	+	+	−	−	−	−
11	Maxillare	Part of bone bearing teeth, erect	+	+	+	−	−	−	−
		Part of bone bearing teeth, convex above	−	−	−	+	+	+	+
12	Maxillare	Posterior part of bone bent above	−	−	−	+	+	+	+
		Posterior part of bone not bent above	+	+	+	−	−	−	−
13	Dentale	Upper margin of bone concave	−	−	−	+	+	+	+
		Upper margin of bone erect	+	+	+	−	−	−	−
14	Dentale	Posterior indentation of bone (between ascending and descending processes) oval	+	+	+	−	−	−	−
		Posterior indentation of bone with two apices (Fig. 2)	−	−	−	+	+	+	+
15	Dentale	Anterior end of bone low, less than 0.3 of base height	−	−	−	+	+	+	+
		Anterior end of bone not lower than 0.5 of base height	+	+	+	−	−	−	−
16	Glossohyale	Posterior part of bone rounded	+	+	+	−	−	−	−
		Posterior part of bone bluntly truncated	−	−	−	+	+	+	+
17	Glossohyale	Lateral sides of bone with small elevation (Fig. 2)	−	−	−	+	+	+	+
		Elevation absent at lateral sides of bone	+	+	+	−	−	−	−
18	Hyomandibulare	Height of bone nearly equal to its width	+	+	+	−	−	−	−
		Height of bone nearly twice as large as its width	−	−	−	+	+	+	+
19	Frontale	Anterior part of bone pointed	+	+	+	−	−	−	−
		Anterior part of bone bluntly truncated	−	−	−	+	+	+	+
20	Frontale	Lateral sides of bone nearly parallel	−	−	−	+	+	+	+
		Lateral sides of bone converge at a distinct angle	+	+	+	−	−	−	−

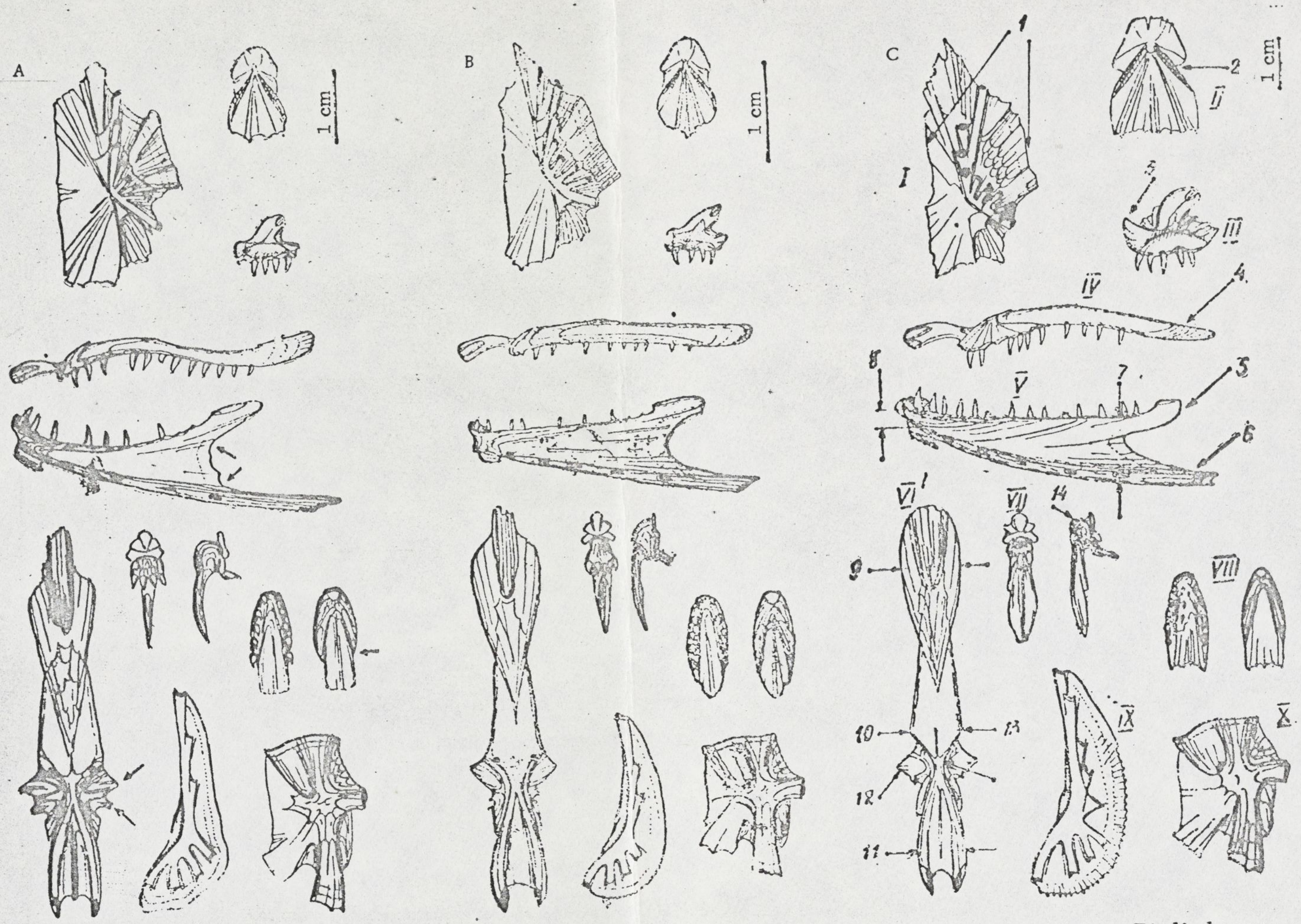

Fig. 2. Bones of the skull of chars from the Kamchatka River basin. A) Diadromous predator, B) diadromous benthophage, C) S. leucomaenis, I) frontale; 1) lateral sides of bone; II) supraethmoidal: 2) constriction; III) premaxillary: 3) dentate process; IV) maxillary: 4) posterior end of bone; V) dentary: 5) ascending process, 6) descending process, 7) base height of bone, 8) height of anterior margin of bone; VI) parasphenoid: 9) width of anterior section, 10) width of central section, 11) width of posterior section, 12) lateral process, 13) constriction of bone; VII) vomer: 14) head of bone; VIII) glossohyale; IX) praeopercular; X) hyomandibular. Arrows shown in A indicate the characters specific for the given species.

formation made it possible to a certain degree to evaluate the extent of reproductive isolation of sympatric forms of chars.

RESULTS

In the basin of the Kamchatka River there were formerly observed five ecological forms of chars: diadromous, lacustrine-riparian, benthophages, lacustrine-riparian predators, brook and stone (Savvaitova, 1973). The division of chars into ecological forms corresponds to the different combinations of two specific niches, as Vasnetsov (1953) interprets it: a specific niche by the character of feeding (benthophage or predator) and a specific niche by the topological character (diadromous or riparian char).

With respect to diadromous chars from the basin of the Kamchatka River the specific niche by the character of feeding in fresh water was unknown. We were able to ascertain that diadromous chars of the Kamchatka are not uniform in character of feeding. There are among them:

1. Non-feeding diadromous. Huge quantities are caught in the riverbed of the Kamchatka in July and August. Their outward appearance and composition of that of a parasitic fauna (Makhovenko, 1972) indicate recent migration to fresh water.

2. Feeding diadromous. Caught at the estuary of the Bushuiki River. These chars still had their silver-blue "sea" color, but "freshwater" signs — small, pinkish spots above the lateral line — were starting to show. Evidence of having lived in the sea were the marine parasites inside them (Anisakis sp. and others — data of T. E. Butorinal). The stomachs of these diadromous chars were filled with food and the presence of abundant quantities of freshwater parasites was an indication of feeding eagerly in fresh water (Butorina, 1975). It is highly probable that some of the diadromous, non-feeding chars in the Kamchatka riverbed forage for food in the proestuarine areas of small rivers; that is, they become feeding diadromous chars. By the character of filling their stomachs and specific parasite indicators, these chars are clearly divided into two groups: a) diadromous char-predators, feeding on smelts, stickleback, and young salmon, and b) diadromous char-benthophages, feeding on the larvae of insects and molluscs.

The difference in specific niche by the character of feeding was not only characteristic for the riparian chars but also for the diadromous.

The data of Kokhmenko (1970) on the tangible differences in character of feeding between char-predators and char-benthophages is confirmed by parasitological analysis (Butorina, 1975), but the attachment to a predatory way of life or feeding on benthos is not absolute. This has been demonstrated by the discovery of non-specific parasite indicators for the given ecological form. However, the extensiveness of infection of char-predators and benthophages by some parasite indicators differs by 20 times and the intensiveness by 25 times (Butorina, 1975).

In external structure, all the ecological forms of chars mentioned above differ very little. Their characteristic plastic and meristic characters are intergraduated (Savvaitova, 1970, 1973). The specific elements of color are commonly used to differentiate these forms: diadromous chars are distinguished from all riparian chars by the silver-blue background of the body (which, to be sure, does not remain once they are in fresh water), and riparian predators and riparian benthophages whose undersides vary in color, bright orange in benthophages and pale gray in predators.

Osteological structures of the skull make possible the division of different ecological forms of Kamchatka chars into two morphological groups (Table 1, Figs. 1, 2).

1. The group which includes riparian char-benthophages, diadromous char-benthophages, and part of the non-feeding diadromous chars from the Kamchatka riverbed (these are indicated in Table 1 as diadromous, non-feeding chars I).

2. The group which includes riparian char-predators, diadromous char-predators and the other part of the non-feeding diadromous chars from the Kamchatka riverbed (in Table 1 they are given as diadromous, non-feeding chars II), and stone chars (we investigated only five specimens of the latter and hence their inclusion in the given phenotype is only provisional). Each of these groups is characterized by specific osteological characters which are joined in a stable correlative complex (Table 1). This morphological division corresponds to their differentiation by character of feeding into predators and benthopages, both diadromous and riparian forms entering each group. We were unable to establish the osteological specifics of chars of these forms which occupy the same specific niche in the character of feeding. Moreover, in char-predators, diadromous chars, and riparian chars there were found similar defects in the arrangement of teeth on the glos-

TABLE 2. Number of Specimens of Chars of Different Ecological Forms Deviating from the Morphological Standard (Table 1)

Ecological form	Number of deviating characters							
	0	1	2	3	4	5	6	7
Lacustrine, riparian benthophage	0	4	3	5	6	2	0	0
Diadromous benthophage	1	7	7	2	1	0	0	0
Non-feeding diadromous char I	2	18	12	7	2	0	0	0
Non-feeding diadromous char II	0	1	3	3	1	0	0	0
Diadromous predator	1	3	6	7	2	0	1	0
Lacustrine-riparian predator	1	4	5	5	3	2	1	1
Stone char	1	2	1	1	0	0	0	0

sohyale and basibranchial (mosaic absence of teeth), deformed curve of the posterior part of the right maxillary, scales on the lower surface of the median part of the parasphenodeum, and specific asymmetry of the left orbital incision of the chondrocranium (shown in Fig. 1 by an arrow). In our investigations the occurrence of such defects ranged from 5 to 15% and were more or less evenly divided between the diadromous and riparian forms in the given morphological group. These small defects are rigidly connected with the complex of specific, osteological characters that typify each morphological-ecological group.

The stability of specific complexes of osteological characters is not absolute, but the number of characters deviating from the standard, "ideal" complex is not large. In each specimen two to four characters were usually separated out, the maximum being 7 out of 20 (Table 2). Chars of the intermediate phenotype were not found. All the osteological characters separated for the differentiation of these two morphological groups deviated from the standard with approximately the same frequency. It can be assumed that each of the phenotypes investigated was of a polythetic, not monothetic, character (in Snith's interpretation, quoted by Bailey, 1970), that is one of the osteological characters taken individually cannot be sufficient proof of the affiliation of the given specimen of char to one or the other separated phenotypes. The morphological division of chars of the Kamchatka basin was conducted on the threshold principle, where the overwhelming majority of osteological characters permitted the assignmentof the given char to a specific phenotype.

"Kundzha" (S. leucomaenis) of the Kamchatka River basin is easily distinguished from chars of the aforementioned morphological-ecological groups by its ecology as well as esteology (Figs. 1C and 2C). Chars of this species investigated form a rather uniform but polythetic phenotype.

In closing, we wish to add that small specimens of chars of the genus Salvelinus (AC 25 cm) cannot be referred to one or the other phenotype by their osteological characters.

CONCLUSIONS

From the material presented it is clear that chars of the basin of the Kamchatka River separate very easily into groups by their ecological as well as osteological characters. All ecological forms of chars having the same specific niche in character of feeding in fresh water fall within one phenotype. All non-feeding chars from the Kamchatka riverbed belong to one of the phenotypes separated.

In addition, both of these morphological-ecological groups have a specific set of minor defects. In our view, this fact speaks of their individualization. Indeed, the only explanation for these similar, minor defects of the osteological structures of diadromous and riparian forms of chars having the same specific niche in character of feeding is their genetic alliance. On the other hand, the separated morphological-ecological groups should be isolated from each other, otherwise if conditions were reversed similar defects would be seen in all the sympatric forms.

In this way we are given the opportunity of viewing the separated morphological-ecological groups as two independent population systems, each of which includes diadromous and riparian forms and occupies a specific niche in character of feeding in fresh water. The presence of diadromous and riparian froms within the framework of one population system was observed in S. malma from other regions of the Pacific coast of Asia (Kubo, 1967).

Consistent with the widely accepted concepts of a biological species (Mayer, 1968), the extent of isolation of sympatric populations is irrevocably bound up with their taxonomic rank. In the given situation, two variants are theoretically conceivable: either these morphological-ecological groups are acotypes and hence reproductive isolation between them must be absent, or we are dealing here with two sympatric, reproductively isolated twin species.

We have no immediate data on the extent of reproductive isolation of these two sympatric populations, but we can make an indirect evaluation (which, by the way, most taxonomic studies do). We consider that reproductive isolation among separated morphological-ecological groups can be judged by the specific distribution of character anomalies and also by the characters that distinguish two sympatric populations in the chars. Morphological investigation of these populations has revealed that they are differentiated by a complex set of characters (Table 1), while osteological characters that define each of the sympatric, morphological-ecological groups join in very stable specific complexes. The latter cannot be connected with the specific niche in character of feeding which is the only ecological feature that is similar in adult chars of diadromous and riparian forms of the given population system. This is demonstrated by the fact that the characters of independent series of variability correlate weakly with the peculiarities of the ecology (in particular, feeding) of different species and populations of chars. For example, a wave-like curved maxillary which is characteristic of char-predators of the Kamchatka basin (characters 11 and 12 in Table 1) also occurs in the "long-nosed" char in Lake Kronotskii, which feeds wholly on benthos. The predator S. fontinalis also has an erect maxillary that is specific for the population of the Kamchatka char-benthophages. An analogous conclusion may be made with respect to many other osteological characters. Accordingly, it is impossible to explain the specifics of the osteology of the sympatric populations of the Kamchatka chars by their ecological features. Besides, if the separated morphological-ecological groups of chars were echotypes, then numerous specimens of an intermediate phenotype would be encountered (Matveev, 1972), but this has not been observed.

Consequently, we feel it possible to acknowledge the specific rank of each of the morphological-ecological groups of chars investigated.

Comparative osteological analysis showed that the morphological features of the skull of diadromous and riparian chars-benthophages of the Kamchatka River basin were similar to those of chars of the Anadyr, Kronotskaya, and Taui Rivers, which are referred to the species S. malma. For this reason there is every justification for identifying the morphological-ecological group of "chars-benthophages" of the Kamchatka basin (in this group is included part of the non-feeding diadromous chars of the Kamchatka riverbed) with the widely distributed Pacific species S. malma.

The identification of another species of char from the basin of the Kamchatka River (to which are allied diadromous and riparian char-predators, part of the non-feeding diadromous chars of the Kamchatka riverbed and, most likely, stone chars) with some earlier description of a species of the genus Salvelinus is not possible with the data we have at hand.

On the basis of osteological and ecological analyses, there are three separate species of chars of the genus Salvelinus in the basin of the Kamchatka River. They are Salvelinus leucomaenis, Salvelinus malma, and Salvelinus sp.

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Salvelinus albus SP. N. FROM THE BASIN OF THE KAMCHATKA RIVER

M. K. Glubokovskii

UDC 597
ZOOLOGY

A new species of char, *Salvelinus albus*, of the genus *Salvelinus* (Salmonidae, Pisces), which was found in the Kamchatka River basin and Krotnotskoye Lake, is described. It is anadromous and freshwater and is differentiated from the closely related and sympatric *S. leucomaenis* and *S. malma* by cranial structure and ecological features. Some craniological characteristics which distinguish the new species from other species of chars are investigated.

Chars of the genus *Salvelinus* (Salmonidae, Pisces) are a striking example of the complexity in classification confronting the taxonomists. The attempts to determine their taxonomic status by employing traditional methods have ended in failure (Savvaitova, 1973; Viktorovskii, 1975a, b) and have thus actuated the search for new approaches in solving the "problem of the chars." Comparative analysis of cranial morphology, which has been successfully applied in constructing the system of other Salmonidae (Dorofeeva, 1967; Svetovidov et al., 1975), may be the answer.

In the process of examining an extensive collection (more than 1300 specimens from different parts of the Soviet Union), a new species of char was discovered. Its description is given below. Part of the collection was provided by our colleague at the Zoological Institute of the Academy of Sciences of the USSR, G. Kh. Shaposhnikova, to whom we express our appreciation.

More than 60 taxonomically important characters pertaining to the form of the chondrocranium and other bones of the skull were involved in the comparative anatomy analysis. The method of investigation and some of the results, which provide the basis of this article, are contained in our previous studies (Glubokovskii, 1976, 1977), and made possible a shortened descriptive version of the new species.

Salvelinus albus sp. n.
(Figs. 1-3)

Salvelinus malma, part. Berg, 1948: 288; Savvaitova and Reshetnikov, 1961: 127; Omel'chenko, 1975: 76; Viktorovskii, 1975b: 464.

Salvelinus alpinus, part. Savvaitova, 1961a: 1696; 1961b: 695; 1963: 17; 1970: 300; 1973: 67; Kokhmenko, 1970: 117; Savvaitova and Kokhmenko, 1971: 37; Zakharova, Novikov, and Savvaitova, 1971: 537; Vasil'ev and Savvaitova, 1972: 19; Vasil'ev, 1975: 417.

Salvelinus sp. Glubokovskii, 1977: 24.

The holotype is a freshwater char caught on September 4, 1975, in the Azabach'ei River (lower reaches of the Kamchatka River). The female was in the second stage of maturity, length (AC) 45 cm and is now preserved at the Zoological Institute of the Academy of Sciences of the USSR (No. 45451). The paratypes are also preserved at the Institute (No. 45452 freshwater chars and No. 45453 anadromous chars).

Description. D III-IV 9-11, A III-IV 8-9, P I 11-14, V I 8-9, II 130-144 (135), branchiostegal rays 10-13, gill-rakers 18-25 (22), pyloric appendages 22-44 (31), vertebrae 63-67 (65). Length (AC) to 86 cm (average 50 cm). *S. albus* is anadromous (marine) and freshwater. The two forms are differentiated by color and ecological features. In coloration the anadromous "pelagic" form has a background color grading from silvery blue at the sides to blue-green on the back; the belly is white; the head is of a purplish hue, its sides slightly darker; the fins are grayish yellow, the background color of the abdominal, pectoral, and anal fins being orange;

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the first rays of the anal and abdominal fins are white. After being in fresh water for some time, the marine chars begin to manifest the elements of freshwater livery, primarily light pink spots less than a pupil in diameter scattered all over the body. After a few months in fresh water the anadromous chars have the identical coloration of the freshwater chars. The sides of the freshwater specimens are gray in the background with a violet tinge; the back and head are slightly darker; the belly is white or yellow; the caudal fin is gray, the others dingy orange; the first rays of the abdominal and anal fins and the lower rays of the caudal fins are white; numerous reddish-violet spots less than a pupil in diameter are scattered all over the body; there are more spots above the lateral line but they are smaller in size, whereas the spots beneath the line are larger but less in number. The nuptial color of S. albus is reminiscent of that of the Dolly Varden char except for the more yellowish sides and paler hue of the belly.

The differentiation of S. albus from other species of chars was revealed in a comparative analysis of the characters of cranial anatomy. The specimens of S. albus were more than 25-30 cm in length and were characterized by the following anatomical features of the skull (Figs. 2 and 3).* Chondrocranium: The end of the rostrum is the level of the medial fontanelles; a rostral pit and anterior and posterior ethmoid fontanelles are present; the ethmoid fontanelles are approximately the same in size; the anterior margin of the supraoccipital does not connect with the dorsal fontanelles; there is a deep, saddle-shaped notch between the anterior and posterior processes of the sphenotic. Supraethmoid: The length of the bone does not exceed 60% of the distance between the posterior ends of the pterotic; the width of the head is not less than 40% (usually more than 50%) of the length of the bone; the length of the caudum does not exceed 140% of its width; the caudum is wider than the head; the posterior end of the caudum is notched; there is no constriction between the head and the caudum. Frontal: The length of the anterior section (from the anterior end of the bone to the point where the canal of the seismosensory system curves) does not exceed 125% of the maximum width of the bone; the rostral end of the bone is obliquely notched; the outer margin of the bone near the anterior contour of the orbit sharply fractures (often seen as a prominence). Parasphenoid: The wing contours of the ethmoid region are conical; the ethmoid region is neither wider nor shorter than the orbital; the auditory region is narrower than the orbital; the apices of the lateral processes are bifurcated and lie at the junction of the orbital and auditory regions. Vomer: The shaft of the bone tapers caudally; the height of the central part of the shaft is not greater than its width; teeth are present only on the head. Premaxillary: The ascending process is vertical, its dorsal end tapering slightly posteriorly, the anterior margin has a saddle-shaped notch. Maxillary: The bone profile is undulant; the central section of the bone (bearing teeth) is arcuately curved dorsally, at its dorsal side there is a keel; the posterior section of the bone (edentulous) is spade-shaped, its height greater than the height of the posterior half of the central section. Dentary: The dorsal margin of the bone (including the lobe of the ascending process) is arcuately curved ventrally; the posterior notch (between the ascending and descending processes) often has two apices; the dorsal apex of the posterior notch is shifted upwards and slightly overlaps the base of the lobe of the ascending process; the dorsal margin of this lobe does not fracture sharply. Glossohyal: The ventral contour of the bone is oval, its caudal end is notched, and the lateral sides often form a step at the level of the last pair of teeth; the ventral surface of the bone is flat. Hyomandibular: The height of the bone is not less than 190% (usually about 200%) of its width beneath the opercular process. Preopercular: The dorsal lobe of the bone is relatively narrow; the ventral branchings of the canal of the seismosensory system do not reach the bone margin.

The identification of small chars (AC less than 25-30 cm) on the basis of the above listed characters is impossible because of the highly generalized nature of the skull structure in the juvenile and the dwarf spawners of Salmonidae (Glikman et al., 1973; Romanov, 1976). According to our data, as the chars grow (more than 20-25 cm in length), morphogenetic processes rapidly accelerate with the result that most of the specific distinguishing features of the craniological characters become manifest.

It should be noted that the phenone of S. albus bears a polythetic character (Sokél, 1967), that is, the entire complex of enumerated craniological characters determines its distinguishing features, although the deviation of a small number of any characters from the standard cited cannot be viewed as an obstacle in the way of identifying a concrete specimen with the given species. The complex of characters itself represents the specific distinguishing features, not an individual character (Glubkovskii, 1977). Our data indicate that the polythetic character of the phenone of S. albus, as in other species of chars, is associated with asynchronous morphogenesis of skull structures in the postembryonal ontogenesis of species of the genus Salvelinus.

*See Figs. 2 and 3 for illustration of the symbols used. All items refer to the fish in its natural position.

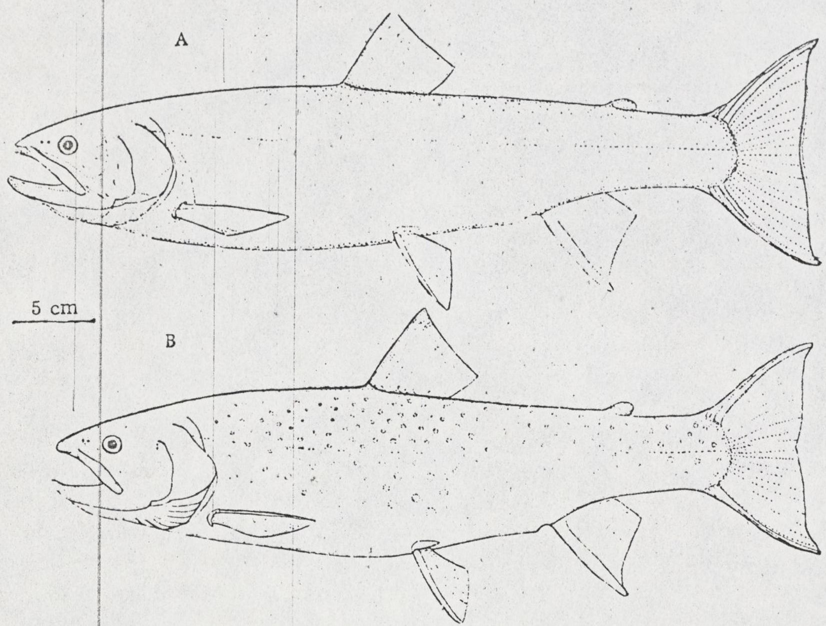

Fig. 1

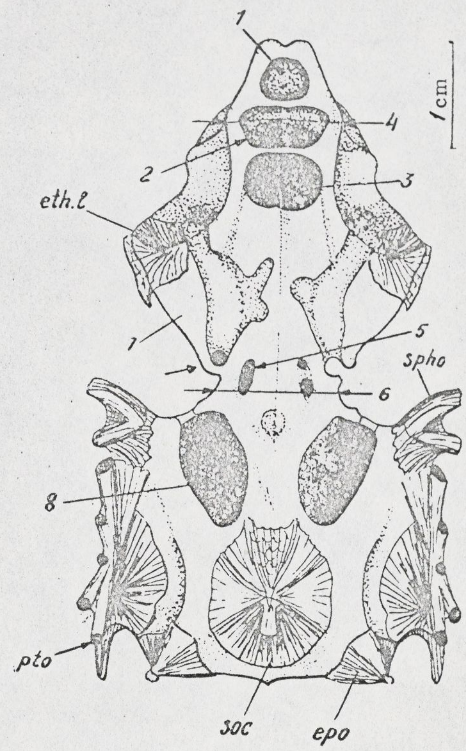

Fig. 2

Fig. 1. Anadromous (A) and freshwater (B) modified forms of Salvelinus albus sp. n.

Fig. 2. Chondrocranium of S. albus from the basin of the Kamchatka River. 1) Rostral pit; 2) anterior ethmoid fontanelle; 3) posterior ethmoid fontanelle; 4) width of rostral floor; 5) medial fontanelle; 6) width of roof of interorbital septum; 7) wing of ethmoid region; 8) dorsal fontanelle; epo) epiotic; eth. l.) ethmoid lateral; pto) pterotic; soc) supraoccipital; spho) sphenotic.

Area of Distribution. At the present time populations of S. albus are known from the lower reaches of the Kamchatka River and Kronotskoye Lake. Related to this species in the latter body of water are "white" (Viktorovskii's term, 1975b) populations of chars. The specific conditions of the lake have left their imprint on some of their ecological features, but out data show that differences in the skull anatomy of the "white" chars (Fig. 4) do not go beyond the range of the individual variability of the phenone of S. albus and this makes it possible to include them within the composition of the species.

It cannot be ruled out that during further investigation, the "Dolly Varden" chars inhabiting Ushkovskii Lake and other water bodies of the mid-channel of Kamchatka River (Savvaitova and Maksimov, 1970) may prove to be a local population of S. albus with anomalous body coloration (Glubokovskii, 1977). Taranets (1933) described the "Dolly Varden" from Ushkovskii Lake as S. malma infraspecies kuznetzovi.

Ecological Data. One of the ecological features of S. albus may be designated as a predatory character of feeding in fresh water. The anadromous forms of this species, having traveled from the estuary, occur in masses in the lower reaches of the Kamchatka River at the end of May and beginning of June. At this time they have a "pelagic" coloration, cling to the riverbed, and scarcely feed. In August and September there are concentrations of S. albus in the estuarial spaces of the small rivers (for example, in the area of Bushuiki River) energetically feeding on pond smelts, ninespine stickleback, and the young of sockeye salmon and silver salmon. For the entire summer the freshwater forms of S. albus are found near the small tributaries of the Kamchatka River (for example, near Azabach'ei River) where they live on small fishes (pond smelts, ninespine stickleback, and the young of sockeye salmon). We do not have verified information on winter and spring migrations of S. albus nor on their spawning grounds, but parasitological study indicates that the freshwater forms of this species do not abandon fresh water (data from T. E. Butorina).

In Kronotskoye Lake there are only freshwater (lacustrine) forms of S. albus. The adult "white" chars eat only the spawners of land-locked sockeye (Oncorhynchus nerka kennerlvi) whose average length is about

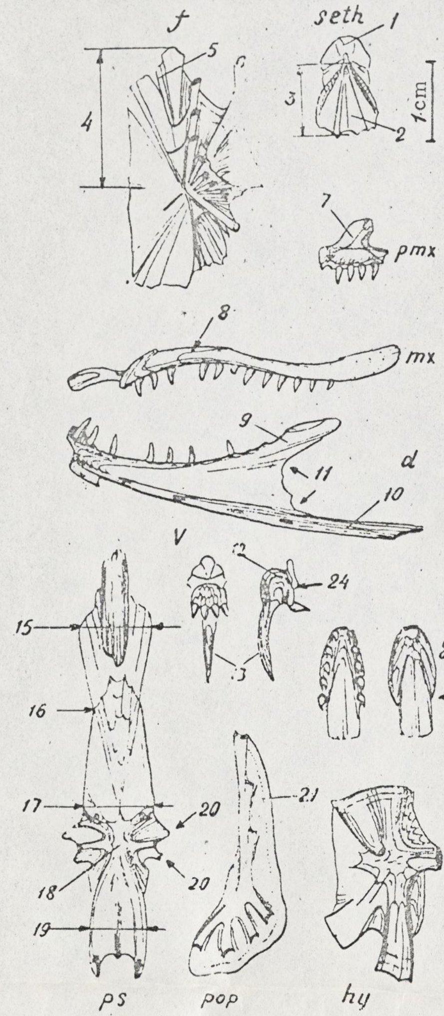

Fig. 3

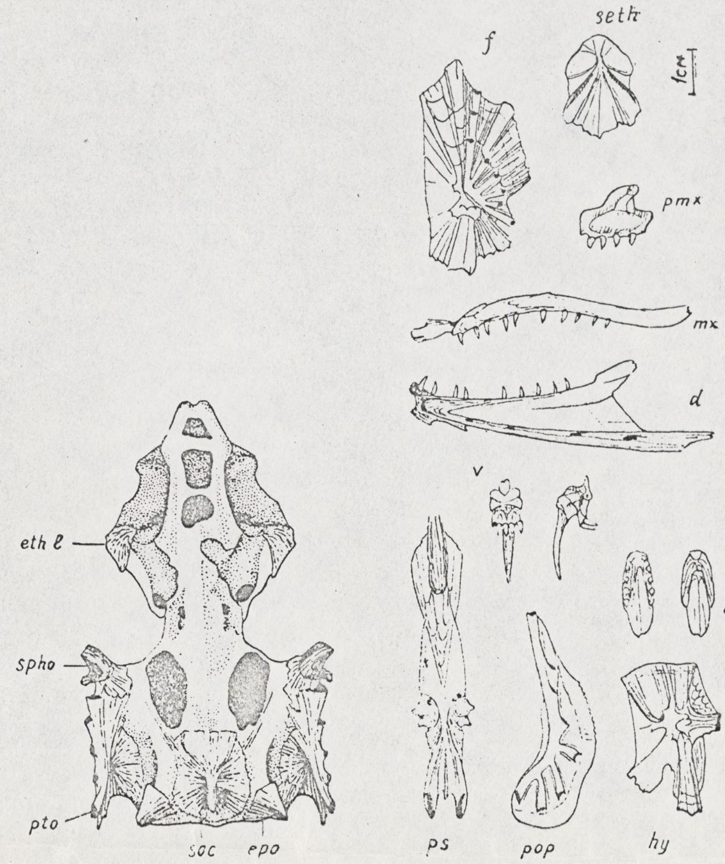

Fig. 4

Fig. 3. Some skull bones of S. albus from the Kamchatka River basin. 1) Head; 2) caudum; 3) length of caudum; 4) length of anterior section;)5 rostral end; 6) fracture on outer margin; 7) ascending process; 8) keel; 9) base of lobe of ascending process; 10) descending process; 11) apices of posterior notch; 12) head; 13) shaft; 14) step at lateral side; 15) width of ethmoid region; 16) junction of ethmoid and orbital regions; 17) width of orbital region; 18) junction of orbital and auditory regions; 19) width of auditory region; 20) bifurcated lateral process; 21) dorsal lobe; d) dentary; f) frontal; g) glossohyal; hy) hyomandibular; mx) maxillary; pmx) premaxillary; pop) preopercular; ps) parasphenoid; seth) supraethmoid; v) vomer.

Fig. 4. Chondrocranium and some skull bones of S. albus from Kronotskoye Lake. The symbols are the same as in Figs. 2 and 3.

20 cm. In this context, S. albus in Kronotskoye Lake start to eat fish* only when they are 45-50 cm long. The "white" char juveniles (AC to 45 cm) feed on benthos. The adult chars gravitate toward the bottom of the lake and have the typical silvery-green "pelagic" coloration. We note that Kubo (1967) observed an analogous, freshwater, pelagic form of S. malma from Lake Shikaribetsu (Hokkaido) which fed at the bottom of the lake (zooplankton) and had a body coloration of silver. In the basin of this lake there are three more forms of S. malma. These include the dwarf-stream form, the freshwater-alongshore form, and the anadromous form (marine). The last two forms are analogous to the freshwater and anadromous specimens of S. albus from the basin of the Kamchatka River. The chars of all four of the above-enumerated forms spawn together and make

*According to T. E. Butorina (1975), freshwater S. albus in the basin of Azabach'ei River start to eat small fish in their second year at a length of 10-12 cm.

up one population of S. malma in Lake Shikaribetsu. Hence the individual forms of S. malma in this lake (as in most other water bodies) cannot be treated as systems following an independent course of evolution. It is probable that this holds true also of char forms of other species, including S. albus.

Comparative Observations. All the species of the genus Salvelinus described earlier were separated on the basis of the characteristics of external structure, but these characters are inappropriate for reliable separation of species of chars (Savvaitova, 1961a). For this reason we are differentiating S. albus sp. n. from the other species of the genus only on the basis of the distinguishing features of the skull anatomy.

Salvelinus albus belongs to the Pacific group of species and is phylogenetically close to S. malma and S. leucomaenis (Viktorovskii, 1975a, b; Glubokovskii, 1976). It is sympatric with the latter two species in the basins of Kamchatka River and Kronotskoye Lake. According to Viktorovskii's data (1975a, b), S. albus ("white" char), S. malma and S. leucomaenis are distinguished kariologically in the basin of Kronotskoye Lake. The ecological and antomical differences between S. albus and S. malma from the Kamchatka River basin were discussed earlier (Glubokovskii, 1977).

As opposed to S. albus, the following osteological characters are characteristic for S. leucomaenis. Chondrocranium: The anterior end of the pterotic is adjacent to the anterior process of the sphenotic; a saddle-shaped notch between the processes of the sphenotic is absent; the anterior margin of the supraoccipital connects with the dorsal fontanelles. The head of the supraethmoid is separated from the caudal bone by a constriction. Parasphenoid: The orbital region is narrower and shorter than the ethmoid region; the contour of the wings of the ethmoid region are lanceolate in design; the apices of the lateral processes are not bifurcated; the caudal end of the orbital region is separated from the lateral processes by a constriction. The shaft of the vomer is lanceolate. There is a toothlike protuberance in front of the ascending processes of the premaxillary. Maxillary: The bone is arcuately curved in the dorsoventral plane; there is no keel at the dorsal side of the central section of the bone; the posterior section of the bone is chisel-shaped, it is not as high as the central section of the bone. Dentary: The lobe of the ascending process is shifted caudally nearly to the level of the end of the descending process; the dorsal margin of the bone is straight; the apex of the posterior notch considerably overlaps the base of the lobe of the ascending process. The ventral contour of the glossohyal is ovate.

The craniological differences of S. albus from species of chars of the Arctic group (Glubokovskii, 1976) are still more marked. We shall present only the most striking of these. All the species of chars of the Arctic and Atlantic and S. neiva which we investigated differed from S. albus by the following characters. Chondrocranium: The rostral pit, anterior and posterior (with the exception of S. alpinus), and ethmoid fontanelles are absent; the anterior margin of the supraoccipital connects with the dorsal fontanelles; there is no saddle-shaped notch between the anterior and posterior processes of the sphenotic. Supraethmoid: The length of the bone exceeds (with the exception of S. fontinalis) 60% of the distance between the posterior ends of the pterotic; the width of the head is less than 40% of the length of the bone; the length of the bone caudum is less than 140% of its width. Frontal: The length of the anterior section is more than 130% (often more than 150%) of the maximum width of the bone; the rostral end of the bone is pointed. Parasphenoid: The orbital region is narrower than the ethmoid; the ventral contour of the wings of the ethmoid region is lanceolate (with the exception of S. alpinus). Vomer: The height of the head is less than its width; the teeth are not only arranged in a transverse row on the head but also (with the exception of S. neiva) form a cluster hanging under the shaft. Maxillary: The bone profile is not undulant; the posterior section of the bone is short, chisel-shaped. Dentary: The lobe of the ascending process (with the exception of S. fontinalis) is directed caudally and its dorsal margin has a sharp fracture. Glossohyal: The ventral surface of the bone is U-shaped; the lateral sides of the ventral contour of the bone are wanting in a step.

Each species of the Arctic group of charps is differentiated from S. albus sp. n. by a number of other craniological characters.

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Star Route Box 20204
Fairbanks, Alaska 99701
22 August 1983

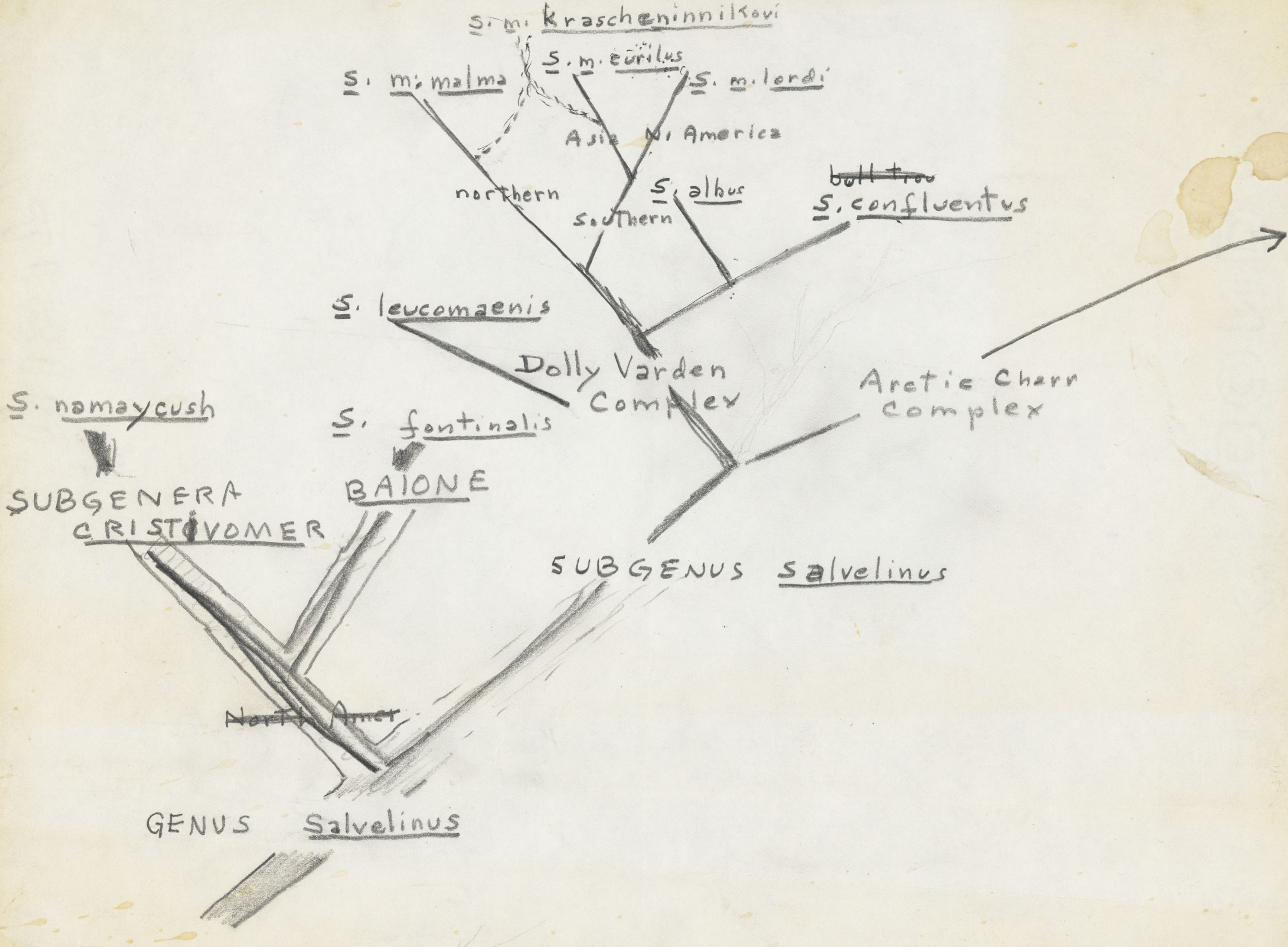
Dear Sir,

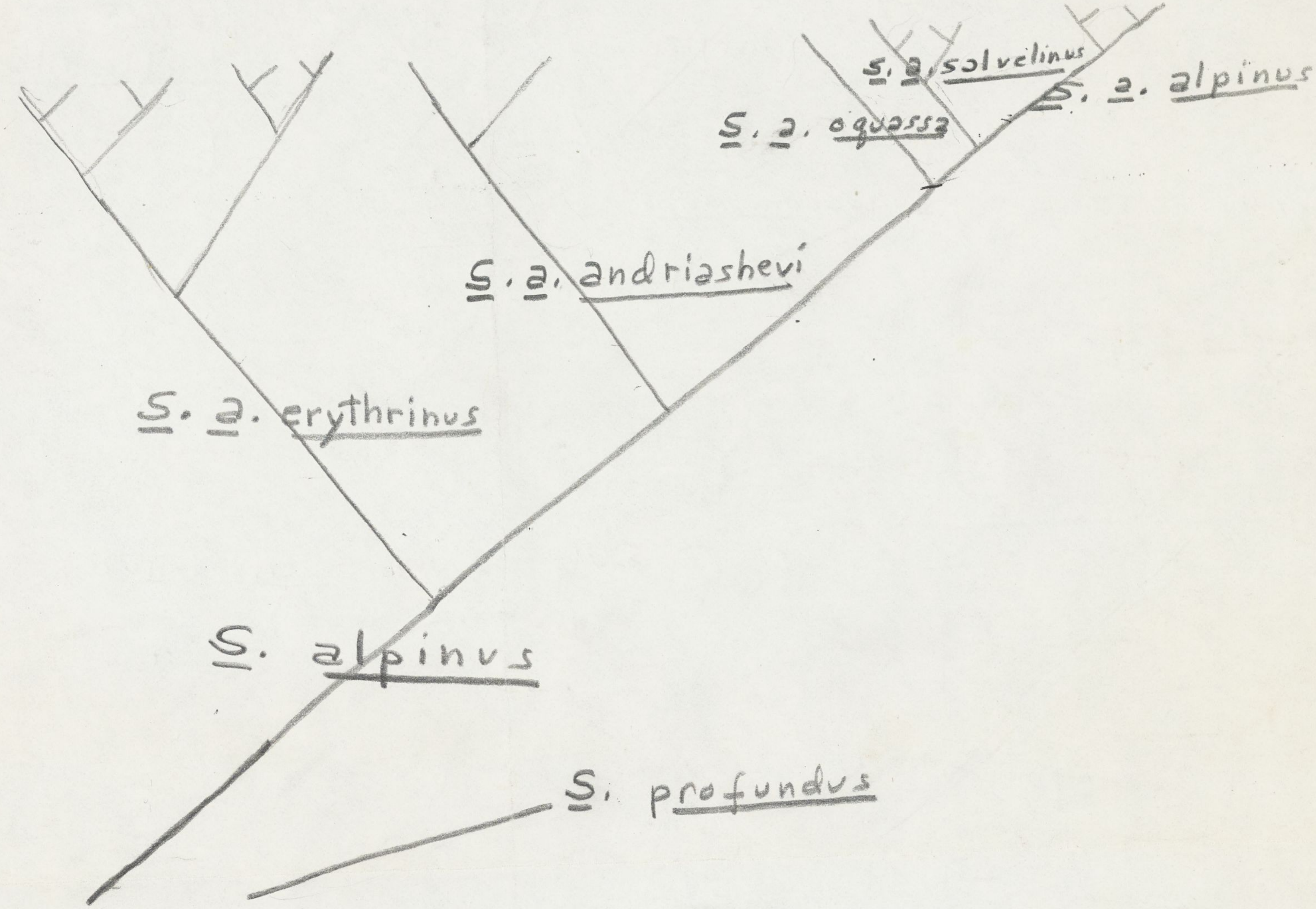
While I was recently a guest of the Institute of Biological Problems of the North in Magadan, U.S.S.R., I was asked to hand-carry these two books and the specimen out of the country and mail them to you. As I understand it, the specimen is of the new species described on p. 67 of РЫБЫ В ЭКОСИСТЕМАХ ЛОСОСЕВЫХ РЕК ДАЛЬНЕГО ВОСТОКА. It is the only specimen of the species in the U.S.A.

I assume that you have been corresponding with scientists in Magadan and that you understand this parcel. If there is any confusion, feel free to write to me at the above address.

Sincerely,

Annette Jones


S. m. krascheninnikovi
S. m. eurilus
S. m. malma
S. m. lordi
Asia N. America
northern
southern
S. albus
~~bull trout~~
S. confluentus
S. leucomaenis
Dolly Varden Complex
Arctic Charr Complex
S. namaycush
S. fontinalis
SUBGENERA
CRISTIVOMER
BAIONE
SUBGENUS Salvelinus
~~North Amer~~
GENUS Salvelinus



ARCTIC CHARR COMPLEX

dr. R. J. Behnke
United States Department of the Interior
Fish and Wildlife service
Bureau of sport Fisheries and Wildlife
Cooperative Fishery Unit
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USA

Savvaitova
① ✓ immunoelectroph. of Salvelinus 1971
② L Azabache - Lr R. + Draut K. 1969
③ parshnensis - mykiss 1967
④ - Salvelinus . (Cristovomer Holongus series 69
5 gairdneri - mykiss proteus
(+ Brutta ischchan, salar) 70
⑥ ✓ Kamen char Kamchatka R. 70
⑦ sympatric char - L. Azabache 71

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[Fish Species]

Russia
pictures


15

West Chukotka 8.08.1978

Chaunsk Bay. East-Siberian Sea drainages

Chaun River Basin

Anadromous Salvelinus taranetzi Kag.

immature male

g.r. 26, Pc 49

Kurile Islands, May, 1976

Kunashir Island, „Peschanaja" River,

„Peschanoe" Lake („Sand River and Sand Lake)

Catadromous Salvelinus leucomaenis


10
20
30
40
50

Chukotsk Peninsula, 14.08.1976

Seutakan Lake, Seutakan River basin

Bering Sea drainages

Anadromous chars

Above *Salvelinus taranetzi* Kap., spawning male

Below *Salvelinus malma* Walb., spawning male


1 9

Chukotsk Peninsula, 23.10.1978

Amguema River Basin, Chukotsk Sea drainage

Anadromous chars

Above *Salvelinus taranetzi* Kag.

immature male, g.r.27, Pc 53

Below *Salvelinus malma* Walb.

immature female, g.r.23, Pc 20

Salvelinus leucomaenis

п/о Камчатка,
р. Налычева, 100 км к сев. от Петропавловска
авг. VIII 1961

-presented by Dr. Racc - Moscow, Mar. 17, 1965

ICHTHYOLOGIA, Vol. 8, No. 1, 135—154, 1976.

MORPHOLOGICAL BASES OF THE CLASSIFICATION OF THE SALMONOID FISHES

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Svetovidov, A. N., Dorofeeva, E. A., Klyukanov, V. A., Shaposhnikova ,G. Ch. (1975): *Morphological Bases of the Classification of the Salmonoid Fishes.* — Ichthyologia, Vol. 8, No. 1, 135—154.

Classification of *Salmonidae* species of fishes is treated, in the work, on the base of osteological researches of skeleton of the head. It is estabilished as the most appropriate to include three families into *Salmonoidea* suborder, i.e. *Osmeridae, Salmonidae* and *Plecoglossidae.*

The classification of salmonids and families closely related to them united into the suborder Salmonoidei is insufficiently elaborated in many respects as well as, however, of other families of the order *Salmoniformes.* The *Osmeridae* not very numerous in genera and species and the *Plecoglossidae* consisting of one monotypic genus can be considered to be well studied at alpha-taxonomy stage, i.e. analytical one (Mayr et al., 1953: 17, 19) as a result of investigations of the recent years (McAllister, 1963, 1966; Klyukanov, 1966, 1969, 1970a, 1970b, 1971, 1972, 1973). However, there is no reliable knowledge in the considerably larger family Salmonidae even on species composition of some polytypic genera and on subspecific one of many polymorphic species. Not taking in mind the *Plecoglossidae* according to the above reason, we can say that the *Osmeridae* is in general thoroughly studied by the mentioned authors in the sense of beta-taxonomy stage, or synthetic one of Mayr, as well as to some extent in the sense of gamma-taxonomy stage, or Mayr's study of species formation and of the factors of evolution one. As to the *Salmonidae,* the subfamilies and genera referring to it are recognized distinctly enough and are characterized systematically. In the prevailing number of the genera it has been established which species refer to them. However, infraspecific variability of a number of polymorphic species is still insufficiently studied in some genera. It is not clear yet which is their composition and what are the differences among them, some infraspecific forms are considered as species and vice versa some species are referred as inftraspecific forms to polymorphic species. Despite the great number of publications and in particular on polymorphic species the *Salmonidae* is studied in this respect insufficiently. Analytical stage, or alphataxonomy one, refers to the level at which the species are characterized and named rather closely corresponds to the begining stage of systematic studies. As to the two other stages the main attention is paid to the species and infraspecific variation. The aim of synthetic stage, or betataxonomy one, is »the arranging of species into a natural system of lesser and higher categories« and that of gamma-taxonomy »in the analysis of intraspecific variation and evolutionary studies« (Mayr et al., 1953: 19). In classifying one »must try to find an orderly arrangement of the species, characterize and arrange higher categories ,devise a classification, decide whether two similar forms should be considered to be one species or two, determine whether the similarites of two species are due to convergence of habitus or to close phylogenic relationship, whether or not the higher categories represent monophyletic groups« (Mayr et al., 1953: 17). In studying species formation and of the factors of evolution, which is in the close contact »with the other branches of biology, with genetic and cytology, with biogeography and ecology, with comparative anatomy and paleontology« (Mayr et al., 1953: 18) the same questions are kept in mind, namely: »how species originate, how they are related and what this relationship means, their origin and changes, to find out which factors enhance and which retard evolutionary changes« (Mayr et al., 1953: 8). It is evident from the above said that the study of higher categories consists only in characterizing and arranging these, devising a classification and decision whether they represent monophyletic groups. Certainly the aims and methods of study and estabilishment of the higher categories are insufficiently determined by the both stages of systematics.

Classification, as was stressed more than once by one of the authors (Svetovidov, 1946: 183, 1948: 19, 1952: 11, 1953: 394, 1955: 368, 1956: 535, 1968: 1823) must be based on the complex of morphological peculiarities, functionally connected with the most typical biological property of the studied systematic group and developed as a result of interrelation of organism and habitat. Mostly the complex of such morphological characters which serve as a bases of the classification is associated with movement and mode of life in different parts of water environment, sometimes with feeding, rarely with reproduction of the systematic group studied. The change of this complex of morphological peculiarities is usually connected with their changes in the process of ontogeny of the group. Therefore it is especially important to take into consideration the structure of the larval stages which is usually the starting point for the classification. It should be added that for studying phylogeny and elaborating the classification the fossil remains are of great importance.

If contents, principles and methods are understood in such a way the classification corresponds to systems of morpho-biological level (Yudin, 1972: 32), the aim of which is to find out causal relations between structure, mode of life and history of formations of studied groups. They are elaborated on the basis of phylogeny reconstructed by methods of comparative morphology ,functional anatomy, comparative ecology, and synthesis is realized on comparative-anatomical, morpho-functional and ecological aspects. Systems of this level represent the result of unification of principles and methods of preceding it systems of classical phylogenetic level with those of studies on morphological adaptations and ecology. Systems of classical phylogenetic level are based on data on transformation of organs and their parts in comparatively anatomical, ontogenetic and morphological rows. They reflect the process of evolution from the morphological aspect only as functional meaning of morphological structures is not discussed in them. Yudin's diagnostic level preceding to classical one corresponds to alpha-taxonomy stage, or Mayr's analytical one.

The classification on the basis of principles and methods of the systems of morpho-biological level is established only in a few groups of fishes — gadids (Svetovidov, 1946, 1948, 1953, 1956, 1959, 1968), clupeids (Svetovidov, 1952, 1955, 1959) and anarchichadids (Barsukov, 1953). Unfortunatoly, the classification of salmonids and allied families cannot be established at this level as they are insufficiently studied in some respects.

First of all information about fossil remains of salmonids and especially on families related to them is extremely poor and it does not contain data enough to elaborate their phylogenetic relations and to establish the classification. Among a few publications known there are only several ones in which the skeleton is described and figured (Cope, 1870; Vladimirov, 1946; Uyeno and Miller, 1963; Cavender and Miller, 1972) and in the other ones only descriptions of bones, otoliths and scales are given. It should be mentioned that skeleton structure of salmonids is to a great degree cartilaginous with weakly connected bones and conditions of their inhume od not give any hope to expect in future some fossil remains of salmonids well preserved.

As to ontogeny it has not been studied either to a necessary degree in the salmonid fishes. Together with detailed studies of embryology and larval development mainly of food fishes (Vogt, 1842; Parker, 1873; Ziegler, 1882; Auerbach ,1904; Beer, 1927; Price, 1934; Schakenbeck, 1935, Ivanov, 1937; Battle, 1944; Evropeitzeva, 1949; Soin, 1947, 1963; Disler, 1957; Smolyanov, 1957; Knight, 1963; Smirnov, 1964; Tchernyaev, 1968; Vernier, 1969, and other) some species and even genera of no commercial importances are not studied. Besides the present data because of heterogenity and often insufficiency of descriptions and illustrations can not to be used.

Therefore the classification of salmonids and closely related families can be established on the classical phylogenetic level only, even not on the basis of the method of threefold parallelism, but only on the basis of comparative morphological data, as embriological and paleontological ones are not enough for this purpose.

Classification of salmonids suffered considerable modifications during the recent decades, especially during recent years, and the number of families which were referred to them was unequal, depending on the characters used. On the basis of osteological characters the suborder Salmonoidei and families referred to it were characterized by Regan (Regan, 1913: 289—290) and Berg (1940: 425—429). The following living families were referred to the suborder by them.

Regan	Berg
Salmonidae (S)[1]	*Salmonidae* (S)
Argentinidae (A)	*Thymallidae* (S)
Microstomidae (A)	*Plecoglossidae* (S)
Osmeridae (S)	*Osmeridae* (S)
Retropinnidae (G)	*Argentinidae* (A)
Salangidae (G)	*Bathylagidae* (A)
Galaxiidae (G)	*Microstomidae* (A)
Haplochitonidae (G)	*Xenophthalmichthyidae* (A)
	Salangidae (G)
	Retropinnidae (G)
	Haplochitonidae (G)

Later the *Opisthoproctidae* was added to the families included into the suborded by Regan (Norman, 1966: 102). This family and the *Galaxiidae* are considered by Berg (1940: 248, 254) the fist as a suborder, the latter as an order.

Later on (Gosline, 1960: 352) the suborder *Salmonoidei* was devided into three superfamilies: the *Salmonoidae, Argentinoidae* and *Osmeroidae.*

Then (Greenwood et al., 1966: 394) only the *Salmonidae* (includuing the *Thymallidae* and *Coregonidae,* considered by many authors as a family), *Plecoglossidae* and *Osmeridae* were referred to the suborder *Salmonoidei.* The *Argentinidae* (including *Xenophthalmichthyidae*) *Bathylagidae* (including *Microstomatidae* = *Microstomidae*), and *Opisthoproctidae* are separated by these authors into the suborder *Argentinoidei.* The *Salangidae, Retropinnidae, Galaxiidae* and *Aplochitonidae* (*Haplochitonidae*) are united into the suborder *Galaxioidei.* It is necessary to mention also the suborder *Stomiatoidei* of salmoniform fishes and the *Gonostomatidae* referred to it, which is considered to be close to the *Osmeridae.* These suborders were not characterized systematically.

The suborder *Galaxioidei* as it was confirmed by detailed osteological study (McDowall, 1969) forms quite a compact group uniting all referring to it families of the southern hemisphere, except the northern family *Salangidae.* Salangids are an offshoot of the salmonid-osmerid or osmerid-plecoglossid lineage, probably a neotenic derivative of some of these, and they are not a part of the sauthern galaxiaid radiation (Gosline, 1960: 35, diagr. 2; McDowall, 1969: 816). Perhaps it should be considered to be a particular group, a suborder.

In studying in the same respect the suborder *Stomiatoidei* (Weitzman, 1967) some similarity was discovered in the skeleton structure of the families *Gonostomatidae* and *Osmeridae.* On the basis of their similar morphology this author believes it is apparent that the last family is more closely related to the suborder *Stomiatoidei* than to *Salmonoidei* and separats it into the suborder *Osmeroidei.* Excepting that it is indicated that the *Plecoglossidae* seems much more similar to the *Osmeridae* than to the *Salmonidae* and thus if two suborders are recognized it must be referred to

[1] In brackest are the initial letters of the names of the suborders to which the families are referred by Greenwood et al. (1966).

	SALMONOIDEI			STOMIATOIDEI		
	Osmeridae	Salmonidae	Plecoglossidae	Gonostomatidae	Astronsthidae	Sternoptychidae
Perichondral bones	Hypethmoid Interethmoid Exethmoid Infraethmoid	Hypethmoid (in Salmoninae and Coregoninae)	Ethmoid — endochondral ossification ot ethmoid cartilage	Hypethmoid Exethmoid (fused), Interethmoid Infraethmoid	Hypethmoid Exethmoid (fused) endochondral ossification	Endochondral ossification of ethmoid cartilage
Mesethmoid	Paird (in Hypomesinae singl)	Singl	Fused with endochondral ossification	Fused with hypethmoid (in Vinciguerria paird)	Fused with hypethmoid	Fused with endochondral ossification
Interorbital septum	Cartilaginous (in Hypomesinae membranous)	Cartilaginous (in Coregoninae and Thymallinae membranous)	Membranous	Membranous		
Orbitosphenoid	Absent	Present (in Thymallinae absent)	Absent	Absent		
Basisphenoid	Absent	Present	Absent	Present		
Parietals	Not meeting (in Hypomesinae meeting)	Not meeting (Salmoninae) or meeting (Coregoninae, Thymallinae)	Meeting	Meeting	Not meeting	
Sensory canal	Open	Closed		Closed (in Polymetme open)	Closed	
Dorsal fentaneles	Absent in Thaleichthys and Spirinchus	Present		Present		
Orbital bones	Complet orbital reng			Reduced number (in Polymetme complete orbital ring)	Reduced number	
Teeth on mesopterygodid	Present	Absent	Present	Present (in Vinciguerria absent)	Absent	
Supramaxilla	One	One	Absent	Two	Two	Two
Connection of parapophyses with precaudal vertebrae	Not fused			Fused		
Connection of nural arches with centra	Not fused			Fused		
Suprapreopercle	Absent	Absent (in Salmoninae present)	Present	Absent		
Postcleithrum	Present		Absent	Absent		
Ischial processes	Present (in Thaleichthys and Spirinchus cartilaginous)	Present		Absent		
Preural and ural centre	Fused	Not fused	Fused	Fused		

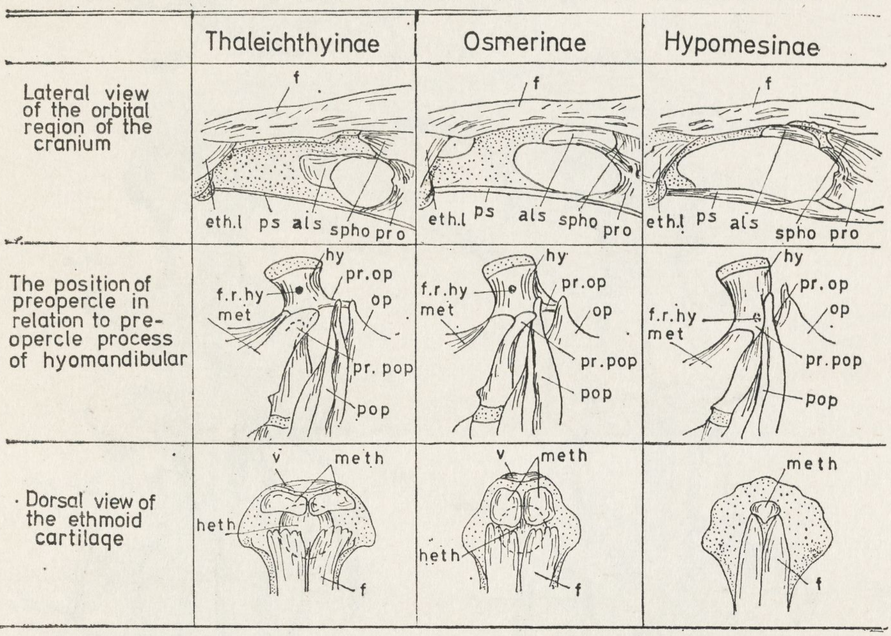
the *Osmeroidei* rather than to the *Salmonoidei* (McDowall, 1969: 821). The *Osmeridae, Plecoglossidae* and also *Salangidae* in the opinion of the latter should be in one suborder. Whether this suborder should include the family *Salmonidae* as a suborder *Salmonoidei*, or exclude the *Salmonidae*, comprising the suborder *Osmeroidei* with a seperate suborder *Salmonoidei* is a problem needing study.

Our studies showed that the family *Salangidae* should be regarded as a reparate branch which evolved evidently independently from the families united into the suborders *Salmonoidei* and *Galaxioidei*. The problem of the position of the *Salangidae* in the salmoniform classification needs a further study.

Comparative studies of the families of the suborder *Salmonoidei* and some of *Stomiatoidei* (Klyukanov, 1973) show that the osteological characters do not confirm close relation of the family *Osmeridae* to the suborder *Stomiatoidei* (Tab. 1). The characters used by Weitzman to recognize in separating the *Osmeridae* as a suborder and some other ones examined by us reveal that osmerids are only more primitive than the other families of the suborder *Salmonoidei*. Weitzman supposes that the main character which show's similarity of osmerids with gonostomatids is a complete set of perichondral ethmoid bones. However, there are considerable differences in the structure of the ethmoid region in the *Osmeridae* and *Gonostomatidae*. In osmerids the perichondral ethmoid bones are not fused and not in contact, being separated from one another by cartilage. We beleive that this character must be considered to be a primitive one in the structure of the ethmoid region. In gonostomatids not only the perichondral ethmoid ossifications but even the dermal mesethmoid is fused. Weitzman mentions some other characters which he thinks show similarity between the *Osmeridae* and *Gonostomatidae*. However, these characters to some degree witness in favour of similarity of osmerids with the other families of the suborder *Salmonoidei*.

Besides the characters considered by Weitzman, a number of primitive ones are proper to osmerids. These are: chondrocranium is well developed, the interorbital septum is cartilaginous, the mesethmoid is paired, the vomer with traces of a paired origin, toothed but shaftless, the parietals are not meeting in the midline, the auditory capsule is large, there is a full series of orbital bones, the mesopterygoid and the basibranchial plate are toothed, the preopercle is connected with preopercular process of the hyomandibular only by the ligament, head sensory canals are not closed, neural arches and the epipleurals are present, the parapophyses of the precaudal vertebrae are free of their centra, there are cartilagionus ischial processes of the pelvic girdle. Comparative osteological study of the *Salmonidae* and *Plecoglossidae* shows that a part of these primitive characters is typical of them to some degree, some of them being common to all the three families, e.g. a complete series of the orbital bones, the neural arches and the parapophyses of the precaudal vertebrae are free from their respective centra. The other characters are peculiar only to some of primitive genera. On the basis of the considered primitive characters the suborder *Salmonoidei* consists of three families: the *Osmeridae, Salmonidae*, and *Plecoglossidae*. Besides the primitive characters of osmerids are more similar to the type of skeleton structure of the ancestral form of which salmonoids and stomiatoids must be apparently regarded as specialized derivatives. Some similarity in the structure of the skeleton between the primitive families *Osmeridae* and *Gonostomatidae* can be explained only by their position in the begining of the both suborders.

Tab. 2. — Skeleton structure in the subfamilies of the *Osmeridae*.



Letterings: f. r. hy — foramen ramus hyomandibularis; hy — hyomandibular; met — metapterygoid; op — opercle; pop — preopercle; pr. op — opercle process of hyomandibular; pr. pop — preopercle process of hyomandibular. Others letterings as in fig.

In the revision of the family *Osmeridae* (McAllister, 1963) the osmerids are devided into two subfamilies under the Berg's (1940) names, the *Osmerinae* and *Hypomesinae.* However Chapman (1941b) considers *Thaleichthys* to be the most primitive genus because of the excessive development of the chondrocranium and the joint wings of the alishpenoid over the parasphenoid. This suggestion has not been taken in mind, however, these characters are the main distinction of *Thaleichthys* from the other genera. Comparative osteological study of all the osmerid genera reveals a number of characters in which *Thaleichthys* conspicuously differs from the other genera of the subfamily *Osmerinae* (Tab. 2) and it should be placed in a distinct one, the *Thaleichthyinae* (Klyukanov, 1970a). Thus, the three subfamilies of the *Osmeridae* are adopted: the *Thaleichthyinae, Osmerinae* and *Hypomesinae.* As it has been mentioned that the primitive characters are proper to a full extent to the suborder *Tha leichthyinae* as well as a number of other ones differing it from other subfamilies (Fig. 1). These are: the brain cavity extends over the alisphenoids,

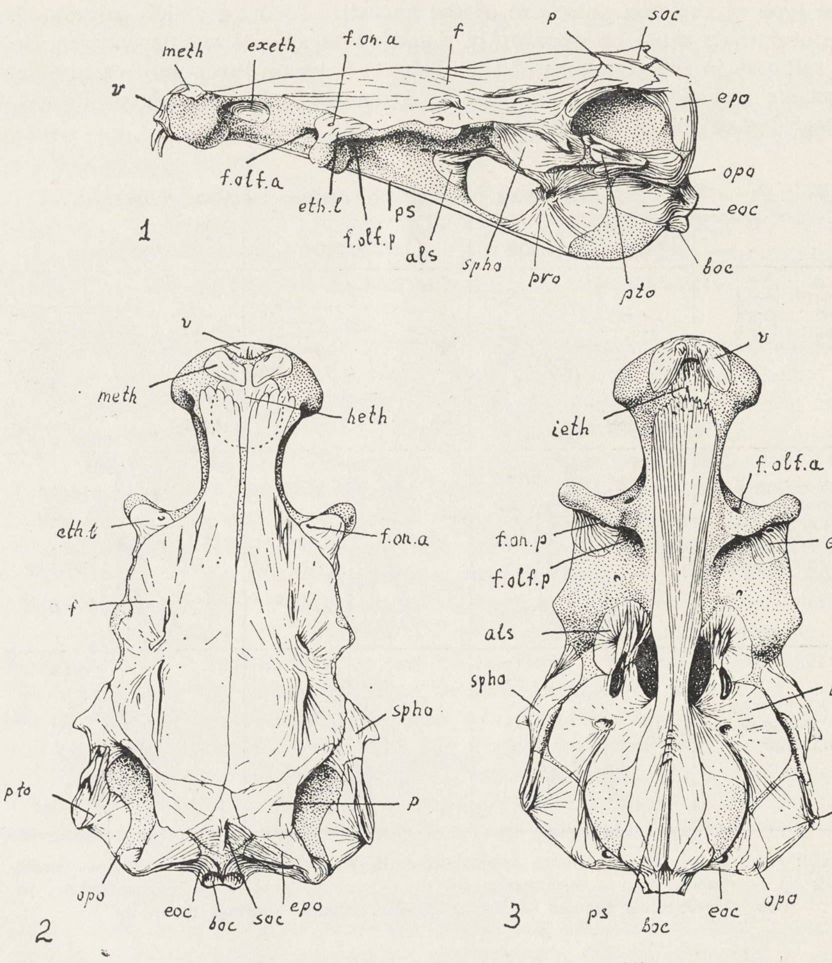


Fig. 1. Cranium of *Thaleichthys pacificus*.

Letterings: als — alisphenoid; boc — basioccipital; eoc — exoccipital; epo — epiotic; eth. l — lateral ethmoid; exeth — exethmoid; heth — hypethmoid; f — frontals f. olf. a — foramen olfactorius anterior; f. olf. p — foramen olfactorius posterior; f. on. a — foramen orbitonasale anterior; ieth — intraethmoid; meth — mesethmoid; opo — opisthotic; p — parietal; ps — parasphenoid; pro — prootic; pto — pterotic; soc — supraoccipital; spho — sphenotic; v — vomer.

which form its floor, up to the lateral wings of the ethmoid cartilage, thus forming the interorbital septum, the mesethmoid plates are placed across the ethmoid cartilage, the closed portion of the dentary extends over three--quater of its length and there are fulcral scales in front of the caudal fin rays. In the subfamily *Osmerinae* (Fig. 2) the brain cavity extends only up to the anterior edge of the alisphenoids being limited in front by cartilaginous interorbital septum; the alisphenoids form only lateral walls of the brain cavity; there is a pair of fontanels on the roof of the cranium; auditory capsules are narrow and oval; perichondral bones of the ethmoid re gion are reduced; paired ethmoid plates are placed parallel to each other; the parietals can meet in the midline; the closed portion of the dentary is no more than a half to one third of its length; the dorsal end of the preopercle adjoins the preopercular process of the hyomandibular; the ischial processes of the pelvic girdle are ossified and there are no fulcral scales in front of the caudal fin rays (Klyukanov, 1969).

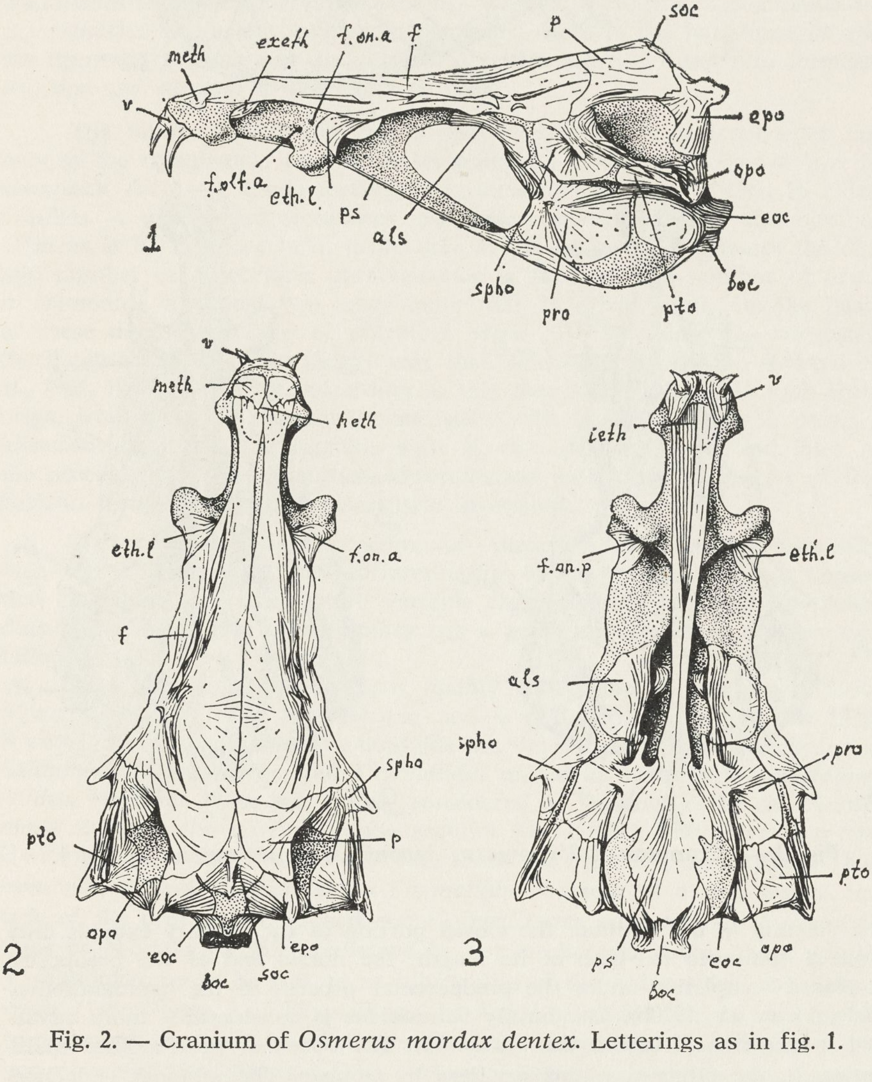


Fig. 2. — Cranium of *Osmerus mordax dentex*. Letterings as in fig. 1.

In the most advanced subfamily *Hypomesinae* (Fig. 3) the interorbital septum is membranous, the auditory capsules are elongated and oval-shaped, the perichondral ossifications in the ethmoid region are reduced and in some species are absent; the mesethmoid is unpaired; the parietals

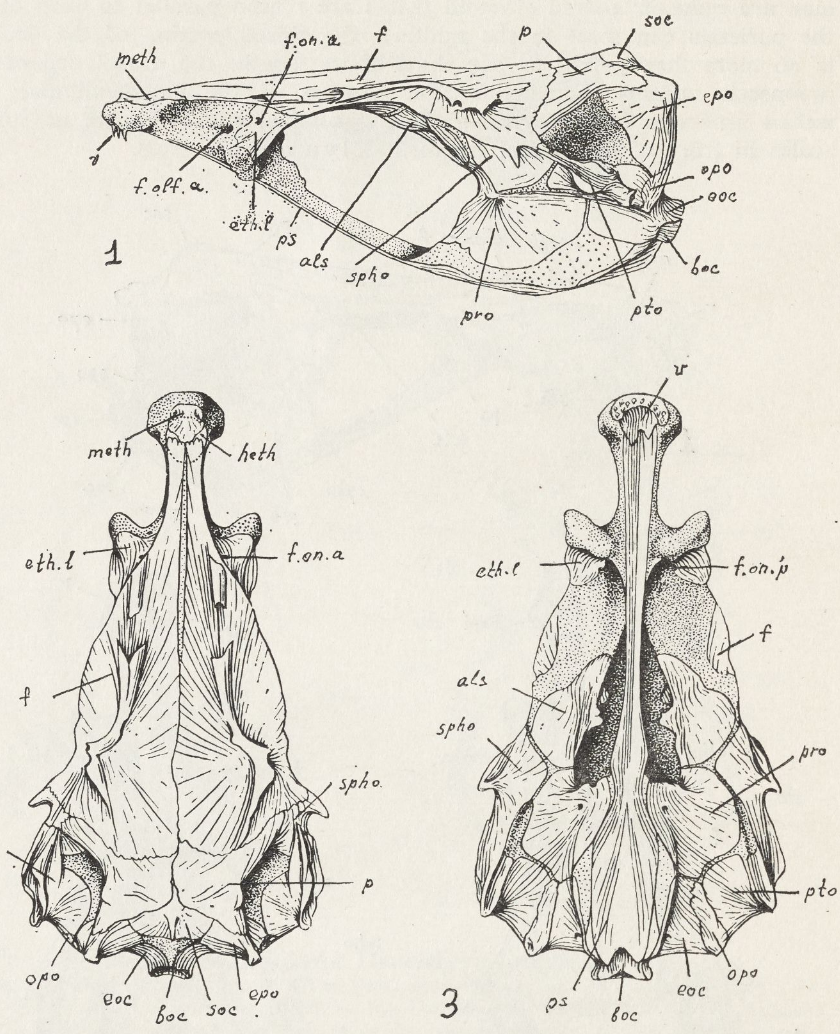


Fig. 3. — Cranium of *Hypomesus japonicus*. Letterings as in fig. 1.

are meeting in the midline; the closed portion of the dentary extends only from a quater to one-fifth of its length; the dorsal end of the preopercle is placed completely under the preopercular process of the hyomandibular (Klyukanov, 1970b). The family *Salmonidae* is considerably more advanced in skeleton structure than osmerids. The bones of perichondral ossification in the ethmoid region are less in number. The ethmoid endochondral ossifications are peculiar of only two subfamilies and the degree of their development are very variable, from weak ossifications in the ethmoid cartilage of some salmonid species to a well separated hypethmoid in whitefishes. The mesethmoid in all salmonids is single. There are less toothed bones, teeth lack in the mesopterigoid of all the species, and in whitefishes the jaws are toothless. Meanwhite in salmonids there is a number of primitive characters peculiar to osmerids: the skull is weakly ossified, the most part being cartilaginous. In many salmonids the interorbital septum is also cartilaginous. The parietals in salmonids are not meeting in the mideline, there is usually a basibranchial plate which sometimes is toothed. Epipleurals are constantly present in some genera (graylings) and in some whitefishes these occur rarely (salmons). Besides there are in salmonids some primitive characters lacking in osmerids, there is the basishpenoid and the upturned preural and ural vertebral centra are not fused into terminal one and the stegural is not fused to them.

The family *Salmonidae* has a special position in the suborder not only in the osteological respect by its polyploid origin. It is known that in salmonids there are much more chromosomes (2n = 52—102) than in allied families. A part of chromosomes are metacentrics and thus the number of arms is 100 or close to it, meanwhile in the majority of teleosts the diploid number of acrocentric chromosomes is 48. Thus the number of arms in salmonids is almost two times more than in other fishes. On the basis of these data the theory of polyploid origin of salmonids was suggested (Svärdson, 1945). This theory was then developed by Ohno (Ohno et al., 1965, 1968, 1969, 1970). According to this theory the salmonids took their origin from a diploid ancestor or ancestors with 48 chromosome by polyploidization. As a result tetraploids with 96 chromosomes arose and later in the process of further evolution diploidization took place by means of Robertson translocations and pericentric inversions.

The polyploid origin of salmonids throws a light on the unusually high degree of variability and differentiation of the family since it is known that polyploids are often more variable than diploids and the polyploidy thus being the source of variability has a great importance in species evolution.

According to some authors mainly americans (Everhart, 1950; Slastenenko, 1958; Needham and Gard, 1959; Vladykov, 1970; Nybelin, 1971, and others) salmonids are devided into three families: the *Salmonidae, Coregonidae,* and *Thymallidae* united in the superfamily *Salmonoidea.* However these are mainly considered as subfamilies of the *Salmonidae* although the latter by some authors (Gill, 1893, 1895; Jordan and Evermann, 1896; Tchernavin, 1923; Berg, 1940, and others) has been placed in a distinct family *Thymallidae* because of a long dorsal fin, lack of the orbitosphenoid and some other. Later on osteological examinations by Norden (1961) confirmed by our studies show that three groups of salmonids are to be treated as subfamilies of the *Salmonidae:* the *Salmoninae, Coregoninae,* and *Thymallinae.* It should be added that in cariological respect they represent a single group of old polyploids the further evolution of which was different. The subfamily *Salmoninae* is characterized by the greatest variety in chromosome number from 52 chromosomes in *Oncothynchus gorbuscha* to 92 in *Brachymystax lenok.* Of considerable importance in the evolution of the subfamily are the Robertson translocations and pericentral inversions (Simon, 1963; Simon et Dollar, 1963; Dorofeeva, 1967c, 1972; Nygren et al., 1971b). The subfamily *Coregoninae* is characterized by rather small variations of the chromosome number between genera and species. Probably the evolution of cariotypes of whitefishes species is connected only with inversions leading to the recombination of genes and hence the total number of chromosomes remains stable (Booke, 1968). The subfamily Thymallinae in cariological respect is studied insufficiently. However, the data on the large chromosome number in the cells of the European grauling (2n = 102) with a large number of metacentrics (Nygren et al., 1971a) show the peculiar way of the evolution of cariotypes of the subfamily.

As to the osteological distinctions of the subfamilies of the *Salmonoidae* (Tab. 3), in the *Salmoninae* there is the orbitosphenoid and the interorbital spetum is cartilaginous but the hypethmoid is usually lacking and only in some species there is a small ossified plate in the ethmoid cartilage; the parietals are separated from each other; the suprapreopercle and the basibranchial plate are present; the vomer, jaws, the palatines and the tongue are largetoothed (Norden, 1961; Dorofeeva, 1967a, 1967b, 1968, 1972; Dorofeeva et Seratlic, 1972; Shaposhnikova, 1967a, 1968b, 1971a).

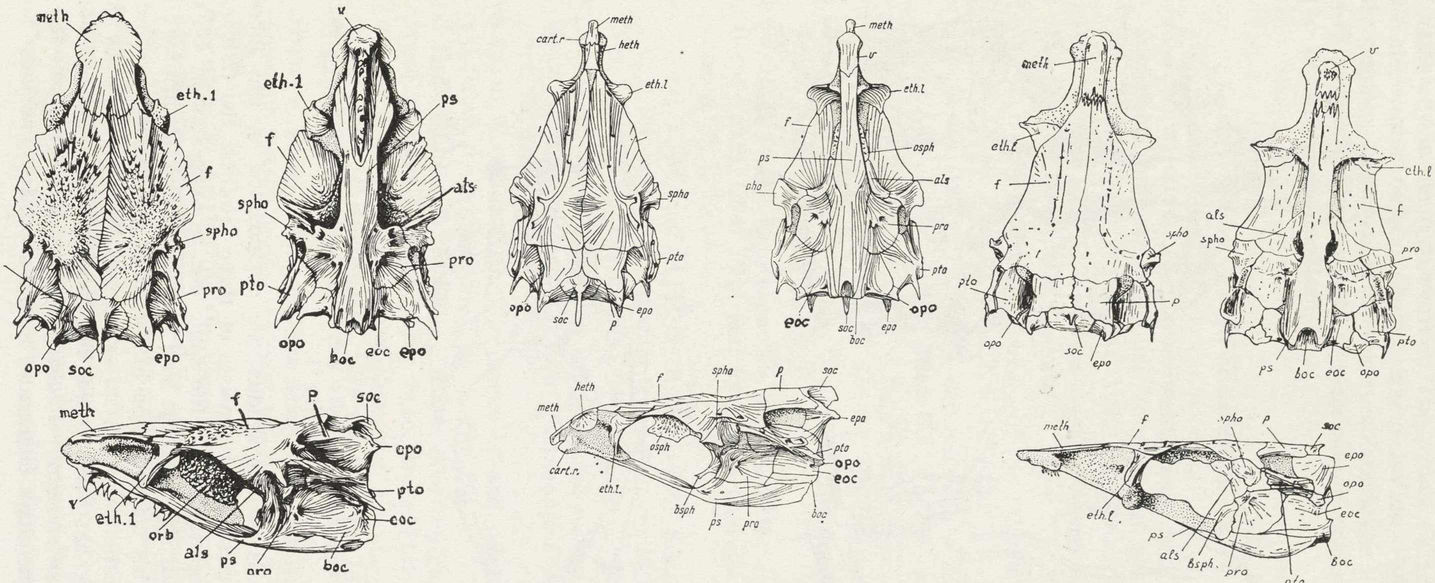
In the subfamily *Coregoninae* (Tab. 3) the orbitosphenoid is present but the interorbital septum is membranous, the hypethmoid is present, the parietals usually meet in the midline, the suprapreperсle is absent, jaws are toothless or teeth are weakly developed on other bones (Shaposhnikova. 1967b, 1968a, 1970, 1971b, 1973).

The subfamily *Thymallinae* (Tab. 3) differs from the previous two in the absence of the orbitosphenoid and perichondral ossifications in the ethmoid cartilage there are always also epipleurals, the parietals are meeting in the midline, the suprapreopercle and the basibranchial plate are absent, teeth ar present only in jaws (Norden, 1961).

The *Plecoglossus* has been placed by some authors (Bertin et Arambourg, 1958; Norman, 1966; Nelson, 1970) in the family *Osmeridae*. However, our studies of osteology and of some other characters show that it should not be referred to osmerids but is to be placed in a separate family, the *Plecoglossidae* (Klyukanov, 1973). This point of view coinsides with that of Chapman (1941a) who also treats *Plecoglossus* as a family.

The *Plecoglossidae* is the most advanced family of the suborder. Besides primitive characters which are common for all families of the suborder the *Plecoglossidae* has only a few of these: the mesopterygoids and the basibranchial plate are toothed. However, there are some characters of high organization: endochondral ossification of the ethmoid cartilage, the mesethmoid being fused to it, the wings of the frontals ventraly form a part of lateral walls of the skull, the vomer is toothless. These characters and of the floor of the mouth cavity allow to consider the *Plecoglossidae* as a specialized ramus of the main leneage of salmonoids (Fig. 4).

Tab. 3. — Osteological characters of the subfamilies of the *Salmonidae*.
Letterings: bsph — basisphenoid; orb — orbitosphenoid. Others letterings as in fig. 1.



Salmo trutta — *Coregonus lavaretus* — *Thymallus thymallus*

Characters	Salmoninae	Coregoninae	Thymallinae
Orbitosphenoid	Present	Present	Absent
Interorbital septum	Cartilaginous	Membranous	Membranous
Parietals	Not meeting	Meeting (usually)	Meeting
Suprapreopercle	Present	Absent	Absent
Basibranchial plate	Present	Absent (in Prosopium present)	Absent
Teeth	Toothed: maxilla, premaxilla, vomer, palatine, tongue	Maxilla toothless; some bones weakly toothed	Toothed maxilla and prema xilla, weak vomerinae and palatine teeth

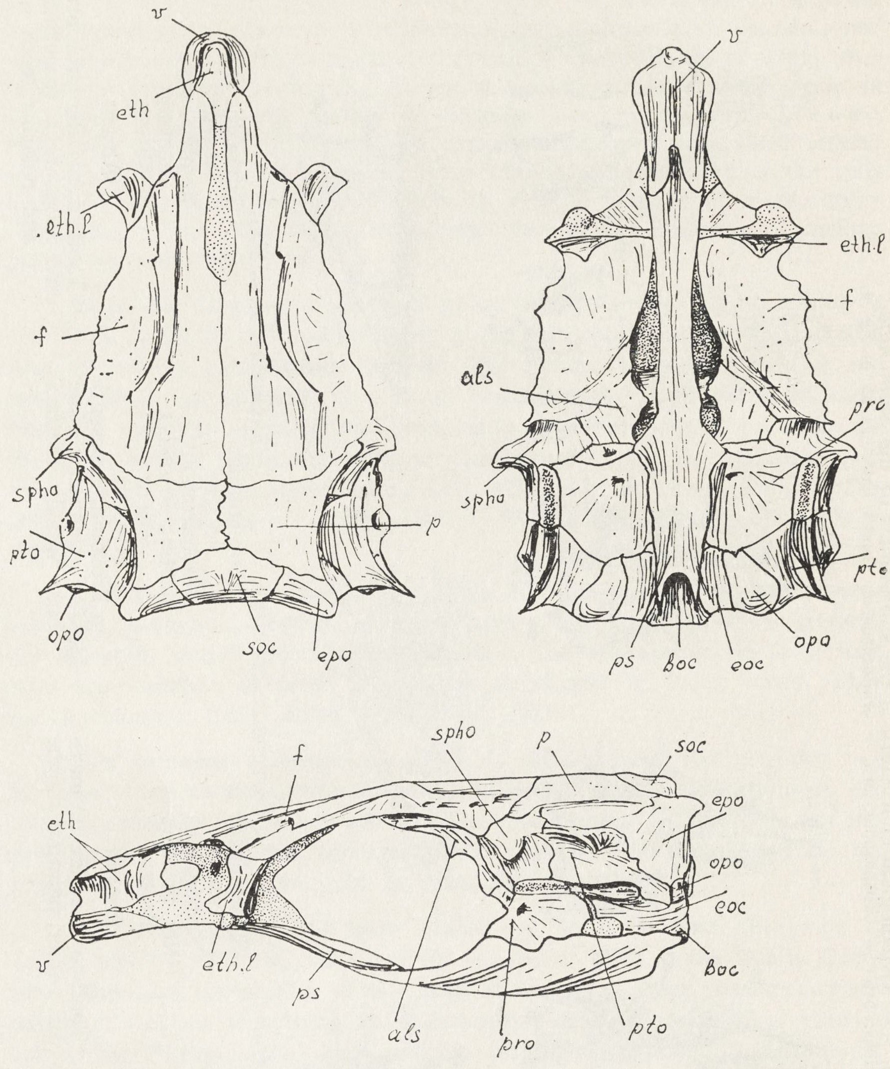


Fig. 4. Cranium of *Plecoglossus altivelis.* eth — ethmoid. Others letterings as in fig. 1.

Thus on the basis of our studies the composition of the suborder *Salmonoidei* is characterized and consists of three families: the *Osmeridae. Salmonidae,* and *Plecoglossidae,* i.e. the same one as suggested by Greenwood et al. (1966) but the leaneage and the succession is different. The family *Osmeridae* in this classification in the most generalized one and the most close to the hypothetical ancestral salmonoid. Within the family *Osmeridae* successive lineage has been traced. The most primitive *Thaleichthys* is separated into a distinct subfamily *Thaleichthyinae* which possesses the greatest number of the primitive characters in the suborder. The most advanced subfamily is the *Hypomesinae*. The widely differentiated family *Salmonidae* also seems to be comparatively primitive. Three independent groups of development represented by three subfamilies are apparent in it. The family *Plecoglossidae* represented by a monotypic genus is a specialized branch of the suborder *Salmonoidae*.

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MORFOLOŠKE OSNOVE KLASIFIKACIJE SALOMONIDNIH RIBA

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Izvod

U današnje vrijeme nema opšteprihvaćenog gledišta na sistem podreda *Salmonoidei*. Razni autori uključuju u taj podred različit broj familija. U većini slučajeva je to uslovljeno razlikama u osobinama koje se koriste za opis podreda.

Na osnovu naših istraživanja morfologije salmonoidea, kao i ispitivanja niza drugih autora, utvrđeno je da je najcjelishodnije u taj podred uključiti tri familije: *Osmeridae*, *Salmonidae* i *Plecoglossidae*. Primitivne osobine zajedničke svim familijama su: potpuna serija kostiju oko očnog prstena, parapofize i neuralni luci se ne spajaju sa tijelima kičmenih pršljenova. Pored toga, mnoge drevne osobine građe su izražene prvenstveno kod primitivnih rodova tih familija: perihondralna okoštanja u etmoidnoj oblasti, parna mezetmoidna kost hrshavičava međuočna pregrada, tjemene kosti se međusobno ne dotiču postoje zubi na mesopterygoideum i na bazalnoj pločici, sejsmosensorni kanali na glavi su otvoreni, postoje epipleuralia, pleuralni i uralni pršljenovi se ne spajaju.

Te osobine su u potpunosti izražene kod roda *Thaleichthys* iz familije *Osmeridae*, koja je u cjelini, očito najbliža ishodnom osmeridnom tipu predačkih formi podreda *Salmonoidei*.

Na osnovu osteoloških proučavanja familija *Osmeridae* je podjeljena na tri podfamilije: *Thaleichthyinae*, *Osmerinae* (nova podfamilija) i *Hypomesinae*, koje se međusobno razlikuju građom rskavičave lobanje, oblikom i položajem alisphenoideum, mesethmoideum i metapterygoideum, a također i osobenostima spajanja praeoperculum i operculum sa nastavcima hyomendibulare.

Familija *Salmonidae* znatno više odstupa u pogledu građe skeleta, nego familija *Osmeridae*. Samo neki rodovi iz te familije imaju neke od primitivnih osobina koje karakterišu *Osmeridae* (hrskavičava međuočna pregrada, razmaknute tjemene kosti, postojanje zuba na bezibranhialnoj pločici, postojanje epipleuralia). Pored toga kod salmonida postoje neke drevne osobine građe koje nisu svojstvene za *Osmeridae* (na primjer pleuralni i uralni pršljenovi se ne stapaju i dr.).

Familija *Salmonidae* zauzima u sistemu podreda naročito mjesto ne samo u vezi sa osobenostima skeleta, nego i zbog svog poliploidnog porijekla čime se, vjerovatno, i objašnjava njena šira diferencijacija i plastičnost.

Familija *Salmonidae* se dijeli na tri podfamilije: *Salmoninae*, *Coregoninae* i *Thymallinae*, koje se karakterišu prisustvom ili odsustvom hypethmoideum, orbitosphenoideum, supra — praeoperculum, rasporedom zuba na vomeru, nepčanom i jezičnom kosti, oblikom lobanje i morfologijm hromozoma.

Familija *Plecoglossidae* najviše specijalizovana u podredu, sačuvala je samo neke primitivne osobine građe. U isto vrijeme ona ima niz karaktera visoke organizacije (endohordalno okoštavanje etmoidne hrskavice i spajanje sa njom mezetmoida). Osobenosti građe zuba, vilica i dna usne duplje daju osnovu da se familija *Plecoglossidae* smatra specijalizovanom granom podreda *Salmonoidei*.

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SYSTEMATIC RELATION OF SOME REPRESENTATIVES OF THE FAMILY SALMONIDAE

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Shaposhnikova, G. Ch. (1975): *Syptematic relation of some representatives of the family Salmonidae.* — Ichthyologia, Vol. 7, No. 1, 61—70.

Six genera were stadied: *Salvelinus, Hucho, Brachymystax* of the subfamily *Salmoninae* and *Stenodus, Prosopium* and *Coregonus* of the subfamily *Coregoninae.* Osteological investigations allowed to establish their most typical characters and to determine the systematic position in the family and in some cases to give descriptions of intrageneric taxons.

According to the views of the majority of ichthyologists, the family *Salmonidae* an be devided into three subfamilies; the *Salminnae, Coregoninae,* and *Thymallinae.* However, at present there is no generally accepted opinion on the systematic position of whitefishes. Some authors (Cope, 1872; Vladykov, 1970; Nybelin, 1971 and others) accepted them as a family, but most of scientists (Regan, 1914; Berg, 1940; Norden, 1961; Greenwood et al., 1966; Behnke, 1972 and many others) place whitefishes into the family *Salmonidae.* Those who consider coregonids as a family ground this view as follows: besides external distinctions (large scales, pearl tubercles on it in the spawning period and some others) there are important osteological differences between salmons and whitefishes. Thus unlike the coregonids, salmonids have toothed maxilla, a branch of lateral line canal on the preopercle is connected with the temporal canal by means of a small ossified tube, suprapreopercle; the hypethmoid, and dermosphenotic are absent. The absence of the hypethmoid is doubtful, since there is a similar bone in *Salmothymus ohridanus* from the Lake Ochrid, Yugoslavia.. At the same time the bone which in whitefishes is known under the name dermosphenotic appearently has the same functions in other salmonids despite the different position of lateral-line canal on ~~the~~ it. It is accepted that the parietals of whitefishes meet in the midline, while in salmonids they are separated by the sup raoccipital. According to our data (Shaposhnikova, 1971: 476) in some species of Coregonus it is separated in one third of the specimens studied. Thus the trustworthy ostelogical difference is the absence of suprapreopercle in whitefishes, toothles maxilla and weak development of teeth on other bones, which allow us to consider coregonids as a subfamily.

Some authors (Gill, 1893, 1895; Jordan and Evermann, 1896; Chernavin, 1923; Berg, 1940; Wilimovsky, 1954 and other) separate also *Thymallinae* as the family on the basts of external peculiarities and of the skeleton structure. This opinion has been disproved by Norden (Norden, 1961).

Six genera are distinguished in the subfamily *Salmoninae,* three genera in the *Coregoninae,* and one genus in the *Thymallinae.* The following genera were studied: *Brachymystax, Hucho* and *Salvelinus* of the subfamily *Salmoninae; Prosopium, Coregonus* and *Stenodus* of the subfamily *Coregoninae.* The external distinctions of the species of these genera are given in the keys of L. S. Berg (1948) and other authors.

Their position in the system and the taxonomic status of some of them were not clear enough untill recent time, which made us to look for more reliable criteria for elucidation of these problems. Osteological investigations allowed us to solve many of the problems.

The genus *Brachymystax* was described by Günter (Günter, 1866) mainly on the basis of the external structure of the head and the arrangement of teeth. Some osteological data were used by other authors as well (Berg, 1909; Norden, 1961; Rousenfell, 1962; Vladykov, 1963) however this genus was not subjected to a detailed study and its position was not quite clear. On the basis of our investigations were discovered some details of skeleton structure which allowed us to give a description of representatives of the genus from different parts of the area (Shaposhikova, 1968). The main peculiarities of *Brachymystax* are: a relatively small mouth, the lower jaw articulated with the skull ahead of or beneath a vertical with the posterior orbital margin, the upper jaw does not reach this border. The distance from the tip of the snout to posterior margin of the maxilla normally not more than 45% of the head length. The skull is comparatively narrow and high. The shaft of the vomer is toothless, the teeth on the head of the vomer and on the palatins form a continuous arched line. The cartilaginous rostrum is rounded in front. The mesethmoid is long, anteriorly rounded with a wedge-shaped posterior margin. The basibranchial plate is present, but toothless. The lingual teeth are situated only along the margins. The postorbitals usually cover more than a half of the distance from the posterior margin of the orbit up to the preopercle. The frontals extend far to the rear, covering the greater part of the parietals and supraoccipital. The genus *Brachymystax* is represented by a single species, *B. lenok* (Pallas). It is evident that many characters vary quite considerably wich prove the morphological heterogenerity of *B. lenok* in different waters.

In the opinion of several authors (Norden, 1961; Rounsefell, 1962) *Brachymystax* is the most primitive in the subfamily *Salmoninae* and we cannot but agree with it. Some morphological peculiarities prove this view: relatively small mouth, less developed teeth. Cariological studies of E. A. Dorofeeva also prove primitiveness of the cariotype in comparison with other representatives of the subfamily (the chromosome number is 92. chromosome arms 102).

There was some lack clarity on the position of the genus *Hucho,* Günter 1866 in the family *Salmonidae.* Some authors (Spilmann, 1961) even include *Hucho* in the genus *Salvelinus,* the others regard it as possible to place it in the subfamily *Huchonidae* (Jordan and Mc Gregor, 1925). Diagnostics of several species of this genus was based mainly on biometric indicators. Description of certain elements of the skeleton is included into papers of several authors (Jordan and Snyder, 1902; Antipa, 1909; Berg, 1909), the attention was mainly paid to the arrangement of the teeth. The fullest information on the osteology of *Huche* is to be found in a monograph by Norden (1961; 725—753). As a result of our osteological and biometric investigations we could give a detailed description of skeletons of different species of the genus *Hucho* and clear out their taxonomic position (Shaposhnikova, 1968). The genera *Hucho* and *Brachymystax* are similar in many respects. The absence of teeth on the shaft of the vomer and the specing between teeth on the head of the vomer and the palatines are regarded as distinguishing features of both genera. Position and shape of the frontals are also similar. The most significant difference between them is the position and size of jaws of the adult fishes. The mouth of *Hucho* is larger, the distance from the tip of the snout to posterior margin of the maxilla is normally not less than 45% of the head length. The skull is comparatively wide. The mesethmoid is broad and has lateral processes. Postorbitals usually covers less than half of the distance from the posterior margin of the orbit to the preopercle. One of the species of the genus *Hucho perryi* (Brevoort) is so peculiar that it was supposedly separated as a subgenus *Parahucho* Vladykov. The differences that we have established confirm this point of view. Only this subgenus has a basibranchial plate and small teeth on the medial part of the lingual plate. The cartilaginous rostrum has a poorly visible cavity. The number of vertebrae is much less than in other species. The scales are larger, the rows of lateral-line scales not exceeding the number of pored scales, whereas in the other species of *Hucho* there are always more rows of lateral-line scales. The subgenus *Hucho* Günther includes three species: *H. hucho* (L.), *H. taimen* (Pallas) and *H. ishikawai* Mori, the subgenus *Parahucho* Vladykov comprises only one species — *H. perryi* (Brevoort).

Toothless shaft of the vomer is typical of the polytypical genus *Salvelinus* (Nilsson) Richardson 1832, as well as of *Brachymystax* and *Hucho.* But unlike them on the head of the vomer teeth are arranged in several rows, there is usually a small interspace between them and those on the palatins. The cartilaginous rostrum of some *Salvelinus* speces is notched in front, but less than in *Salmo.* The hypethmoid as in other representatives of the subfamily *Salmoninae* is absent as a rule, but rarely an ossified plate occurs in this place.

The shape of the mesethmoid varies, normally it is rounded in front, with lateral processes, the posterior margin sometimes deeply split. The frontals are comparatively shorter than in *Brachymystax* and *Hucho* and tightly connected by inner margins almost on the whole their length. Teeth on the jaws are well developed, mouth is large, length and shape of the maxilla varies and contrary to the existing opinion (Berg, 1948) cannot be a diagnostical character. The basibranchial plate is present, and has well developed teeth, but subgenus *Baione* De Kay. On the lingual plate of some species teeth are present not only in the margins but in the middle part also. Distance between the postorbital bones and the preopercle is large. Tabulars are very small of different length with canal of the lateral line incide, their number is greater than in other salmonids. The shape and position of some bones, the vomer in particular, show similarity of the genus *Salvelinus* to the genus *Salmo*. The teeth arrangement on the head of the vomer in in several rows seems to be a premis to their appearance on the shaft. The appendix (which is) on the head of the vomer on which they are disposed, is almost contiguous to the it shaft.

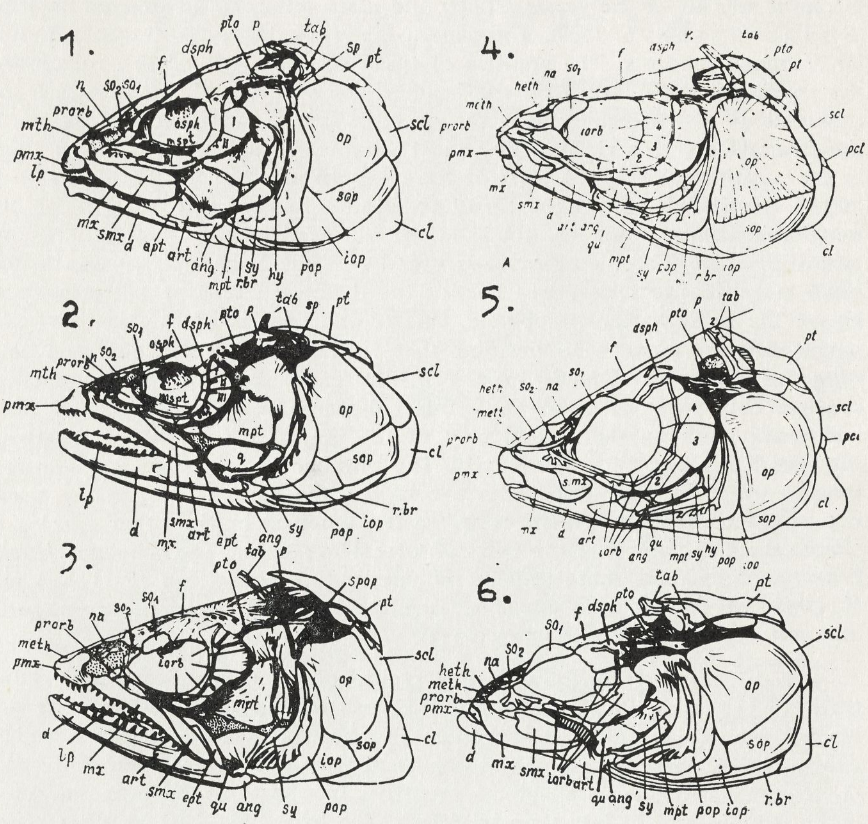

Fig. 1. — Lateral view of the heads.

1. *Brachymystax lenok*. 2. *Hucho hucho*. 3. *Salvelinus lepechini*. 4. *Prosopium cylindraceum*. 5. *Coregonus lavaretus*. 6. *Stenodus leucichthys nelma*. (I — 6 are repeated in fig. II — III). Abbreviations in Figs I and II = ang. angular; art, articular; cl, cleithrum; d, dentary; dsph, dermosphenotic; epo, epiotic; eth. l., lateral ethmoid; f, frontal; heth. hypethmoid; hy, hyomandibular; iop, interopercle; iorb, infraorbital; meth, mesethmoid; mpt, metapterygoid; mx, maxilla; na, nasal; op, opercle; opo, opistotic; osph, orbitosphenoid; p, parietal; pcl, postcleithrum; pmx, premaxilla; pop, preoperckle; prorb, preorbital; pt, posttemporal; pto, pterotic; qu, quadrate; r. br., branchiostegal ray; scl, supracleithrum; smx supramaxilla; so_1, so_2, supraorbital; soc, supraoccipital; sop, subopercle; spho, sphenotic; spop, suprapreopercle; sy, symplectic; tab, tabular.

Intrageneric taxonomy of the genus *Salvelinus* is not clear enough. Two subgenus are distinguished at present. *Salvelinus* R i c h a r d s o n and *Baione* D e K a y, 1842. Specific composition of the first subgenus is not clear. The second subgenus includes only one species — *Salvelinus fontinalis* (M i t c h i l l) (S h a p o s h n i k o v a, 1971).

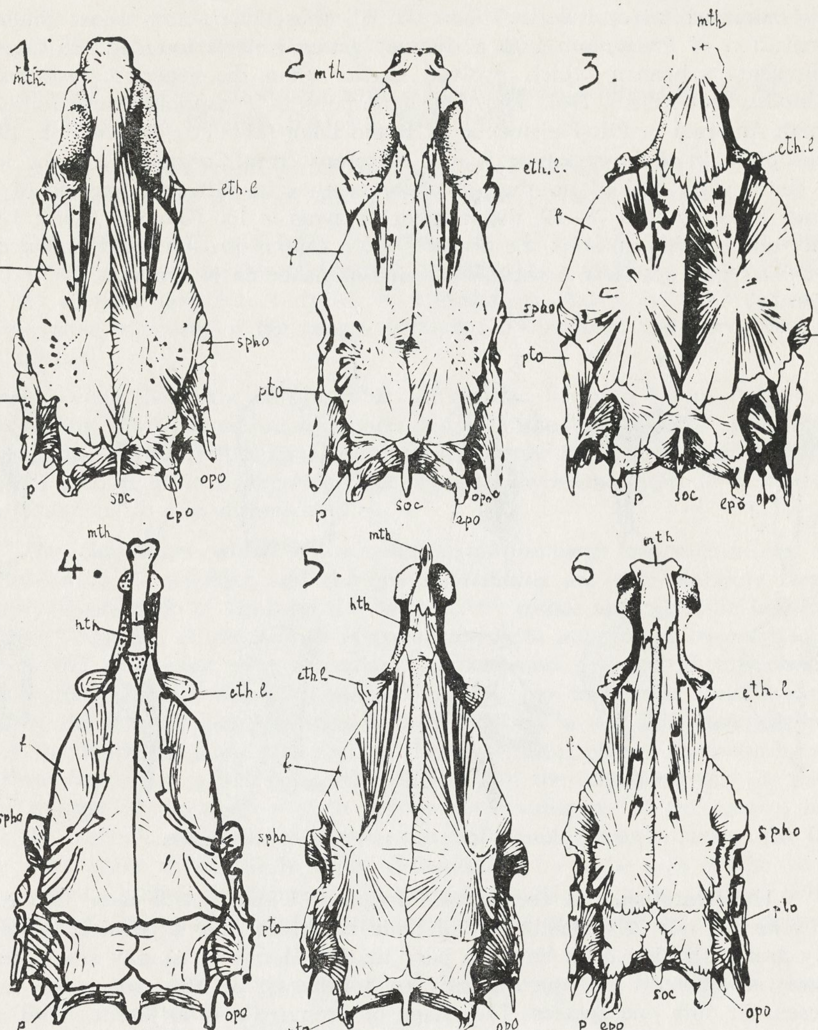

Fig. 2. Dorsal view of the skulls.

Whitefishes of the *Prosopium* M i l n e r, 1878, were considered to be the only subgenus, as their nostrils are separated by a single round flap instead of the two in *Coregonus*. Study of skeletons allowed to discover much important distinctions, in particular presence of an ossified basibranchial plate. The juveniles of this genus have »parr marks« on the sides of body. These characters show their relationship with the *Salmoninae.* Besides *Prosopium* has short and wide first supraorbital, the preorbital is longer and of a different shape than in *Coregonus,* the same as the hypethmoid and some other bones. The parietals are broadly meeting in the midline. The orbital ring is always not closed, there is a large interval between the first supraorbital and dermosphenotic. All these characters show that the separation of *Prosopium* into a distinct genus is well founded. This genus represents a branch which evolved earlier than the genera *Coregonus* or *Stenodus* (Norden, 1961: 751). Fossil remains of *Prosopium* were found in North America in Plio-Pleistocene of Idaho Lake (Miller, a. Smith, 1967). Prosopium in their cariotype is also different from *Coregonus* on the level of genus. The diploid number of chromosomes in different species of the genus *Prosopium* is 78—82, the number of arms is 100 (Booke, 1968: 1970) Only one species inhabits the Soviet Union, that is *Prosopium sylindraceum* (Pallas et Pennant), 6 species are distinguished in N America (Norden, 1970: 78)

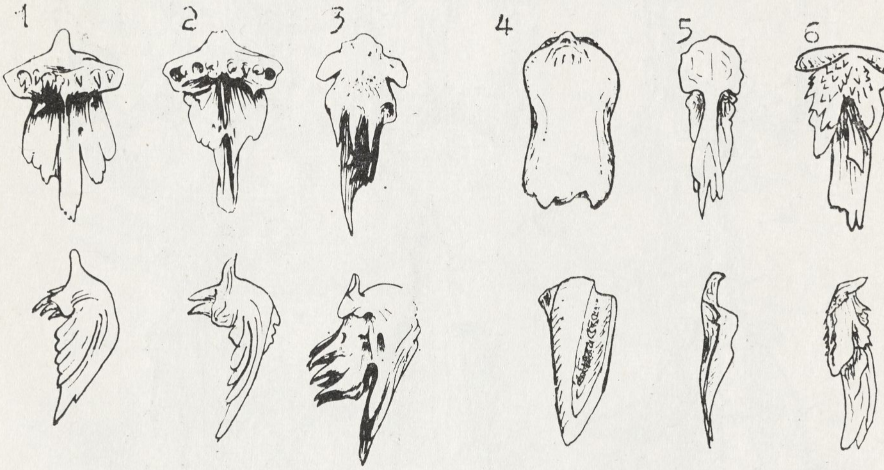

Fig. 3. Ventral and lateral view of the vomers.

The whitefishes of the genus *Coregonus* Linné, 1758 have two flaps between the nostrals. Basibranchial plate is absent. The preorbital is relatively small, the juveniles have no parr marks. Mouth is usually small, teeth poorly developed, the maxilla always toothkess, on the vomer the teeth present in only one species. The shape of premaxilla is different, from narrow plate sharpened downwards to a massive bone which forms the snout area. Position and shape of the lower jaw varies. Orbital ring is normally not closed, only in one species the first supraorbital is large and is almost contiguous to dermosphenotic. The parietals are usually in a certain degree connected with each other, but in some specimens they were not joined throughout their extent. In establishing intraspecific system we based first of all on the position of mouth and the shape of jaw bones (Shaposhnikova, 1968a). On this basis two subgenera were distinguished: *Leucichtys* and *Coregonus*. The first includes the whitefishes with an upper or terminal mouth, maxilla normally extends beyond the front margin of the eye, the proximal part of the maxilla is less than half as large as the distal one. In whitefishes with an upper mouth the lower jaw is large, extending beyond the tip of the upper one. The subgenus *Coregonus* includes all the whitefishes with a lower mouth. The maxilla is shorter, its proximal part is usually larger than a half of the distal one, the lower jaw is comparatively small and never extends beyond the tip of the upper one.

Diploid number of chromosomes in different whitefishes is 80, the number of arms is 98—108 (Booke, 1968: 1678).

Coregonids are represented in the Soviet Union by 10 species, the number of species in America and Europe need to be more precise.

Gill (1893: 120) and later Chernavin (1923: 104) considered it to be possible to separate the subfamily *Stenodontidae* with one genus *Stenodus*, but a more detailed study of its morphology disproofed this opinion. The skeleton structure of the genera *Stenodus*, *Prosopium* and *Coregonus* is very similar.

However there are considerable differences between them. (Shaposhnikova, 1967). Hypethmoid penetrates into the cartilage as in coregonids, but has a different shape. The ventral contour of parasphenoid is straight, not curved as in *Coregonus*. The shape of hyomandibular in *Stenodus* and *Coregonus* is also different.

The characters which show relationship between representatives of the subfamily *Salmoninae* and the genus *Stenodus* are the relatively large mouth, the presence of teeth on the head of the vomer and on some jaw bones. The structure of the mouth is connected with adaptation to predatory feeding and is treated as a secondary phenomenon. Instead of the strong conic teeth typical of the *Salmoninae*, *Stenodus* has numerous small, sharp teeth on the lingual plate, palatins and premaxilla, in the skin covering bones of the branchial apparatus and on the pharyngeal plates. Postorbitals as in *Salmoninae* cover a half or a little bit more of the distance from the posterior margin of the orbit up to preopercle. Peculiarity of this genus, besides the outlook, depends on the presence of the supraarticular on the lowore jaw, which is absent in other *Salmonidae*, by large size of the first supraorbital which is contiguous with dermosphenotic forming a closed orbi tal ring. The parietals appear to be in some degree separated by the supraoccipital.

Genus *Stenodus* is represented only by one species *Stenodus leucichthys* (Güldenstadt).

~~In the end~~ The figures 1,2,3 ~~are shown which~~ illustrate the most important osteological peculiarities of the studied genera of the *Salmonidae* family.

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SISTEMATSKI ODNOSI NEKIH PREDSTAVNIKA PORODICE SALMONIDAE

ŠAPOŠNIKOVA, G. Ch.

Izvod

Porodica *Salmonidae* je podijeljena na tri podporodice: *Salmoninae, Coregoninae* i *Thymallinae.* U prvoj podporodici ističu se šest rodova, u drugoj tri i u posljednjoj jedan.

Istraživano je šest rodova: *Salvelinus, Hucho, Brachymystax* podporodice *Salmoninae* i *Stenodus, Prosopium* i *Coregonus* podporodice *Coregoninae.* Osteološka istraživanja omogućila su nam da ustanovimo njihove najtipičnije karaktere i da determinišemo sistematski položaj u porodici i u nekim slučajevima da damo opis unutar rodovskih taksona.

Salvelinus ima zube samo na glavi vomera, često u nekoliko redova, sa malim prostorom između njim i nepca. Usta su velika. Bazibranhialna ploča ima dobro razvijene zube. Kod podroda *Baione* oblik i položaj nekih kostiju pokazuju bliskosti toga roda sa rodom *Salmo*. *Hucho* ima jedan red zuba na glavi vomera, upravo na prostoru između njih i nepčanih zuba. Bazibranhialna ploča je predstavljena (prisutna) samo kod podroda *Parahucho*. *Brachymystax* je blizak rodu *Hucho* i razlikuje se od posljednjeg položajem i veličinom čeljusti, oblikom lobanje i nekih kostiju. *Stenodus* zauzima intermedialni položaj između podporodica *Salmoninae* i *Coregoninae*. Usta su velika, zubi vrlo slabo razvijeni. Orbitalni prsten je zatvoren. Postoji supraartikulatrna kost na donjoj čeljusti (vilici). Kod *Prosopium* usta su mala, vomer i bazibranhialna ploča su bez zuba. *Coregonus* se razlikuje od *Prosopium*-a otsustvom bazibranhialne ploče. Oni imaju samo nosnicu podjeljenu sa dva zaliska.

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SYSTEMATIC RELATIONS OF SALMONS OF THE GENUS SALMO

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Dorofeeva, E. A. (1974): *Systematic Relations of Salmons of the Genus Salmo.* — Ichthyologia, Vol. *6,* No. 1, 27—36.

The paper deals with some characteristics of the head skeleton structure and karyotypes of some species belonging to genus *Salmo (S. salar, S. trutta, S. ischchan, S. carpio, S. marmoratus, S. letnica),* with their interrelations and their systematic status.

The systematic relations of species of the genus *Salmo* are still not quite clear. Many questions concerning real status and size of some species and subspecific forms and also relations between them remain disputable. It is difficult to give a precise definition of systematic position of some species and subspecies of salmonids, since characters of external morphology often transgress and are subjected in ontogenesis to considereble functional and sexual changes. As to osteological characters, which in taxonomic investigations should be preferred to other anatomic structures, as they are more constant, in salmonids they are subjected to age and sexual changes, so that only the material which is homogeneous in sex, size and functional state can be used in investigations.

The difficulty of defining the species to which some forms of salmons belong, using the usual systematical methods, required other methods of study. Particularly successful was the combination of the classical morphological method with the karyological one. It is known that different species of salmonids have different karyotypes which differ in number and morphology of chromosomes. However, in some species which are sharply different in external structure such differences in karyotypes were not discovered by the modern methods. Therefore the application of karyological data for the purpose of systematics in some cases is limited and should be combined with detailed study of external and internal morphology.

In the family *Salmonidae* distinct differences between genera are established to a considerable degree by osteological characters (Tchernavin, 1923, Tchernavin, 1937, 1938 1938a; Vladykov, 1962; Hadžišče, 1961, 1962; Norden, 1961; Reshetnikov and Savvaitova, 1962; Shaposhnikova, 1968, 1971 and others).

Investigations of the skeletons of some species, in particular of the genus *Salmo,* began in the middle of the past century (Agassiz, Vogt, 1845; Bruch, 1861 and others) but their results were not used for the purpose of systematics and no conclusions were made in this respect. In this connection, differences between species of this genus were establiched by external characters, and only occasionally data about the shape of the vomer and about the teeth arrangement on it were used. Recently, this situation changed somewhat, due to investigations of the skeleton of some species of *Salmo* with the purpose to evaluate their systematic status and relations (Tortonese, 1954; Norden, 1961; Seppowaara, 1962; Vladykov, 1963; Dorofeeva, 1967, 1968; Savvaitova and Maximov, 1968; Behnke, 1968; Miller, 1972 and others).

It is considered that the genus *Salmo* has a different number of species. The most widely accepted are *S. trutta* L., *S. ischchan* Kessler *S. letnica* Karaman, *S. carpio* L., *S. marmoratus* Cuv., *S. salar* L., *S. mykiss* Walbun, *S. gairdneri* Richardson, *S. clarki* Richardson, *S. chrysogaster* Needham et Gord, *S. gillae* Miller, *S. aguabonita* Jordan, *S. apache* Miller. The last seven Pacific species are united into the subgenus *Parasalmo* (Vladykov, 1963). Besides, in the rivers of Turkey an endemic species *S. platycephalus* (Behnke, 1968) has been described. It was separated as a particular subgenus. However its taxonomic status and relations with other species of the genus are not sufficiently clear, as the detailed data about skeleton structure and the structure of chromosomes are not available.

On the basis of our study of *S. salmo, S. trutta, S. ischchan, S. marmoratus* and partly of *S. letnica* we managed to establish that they are distinctly different in outline of external margins of skull, in shape of vomer, mesethmoid, of lingual plate and premaxilla (Dorofeeva, 1967a, 1967b; Dorofeeva and Seratlich—Savich, 1972).

In comparison of the skulls of the species studied it was established that frontal bones of *S. trutta* are dilated and protrude over eye-sockets, the ethmoid part of the skull is relatively short, the occipital part of the skull is dilated (fig. 1).

S. ischchan is the most different form from *S. trutta* by the shape of frontal bones, which become narrow in front of sphenotic. The greatest length of frontal bones of Sevang trout is closer to sphenotic and in the sea trout they are widest in their medial part. The skull of *S. ischchan* is on the average narrower than in *S. trutta.*

S. letnica has the outline of external margins of the skull similar to those of *S. ischchan;* its occipital part is somewhat wider.

S. marmoratus is greatly different in the shape of the skull. It has external margins of frontalia dilated near the posterior margin of the eye--sockets sphenotica are more developed and considerably protrude on each side of the skull. The frontal bones are long, their posterior end reaches supraoccipital and partly covers it. Ethmoidal region is moderately long, endochondral ossification being a thickened, bone plate inside the ethmoidal cartilage.

The tendency to formation of endochondral ossification in ethmoidal cartilage is observed in many species in the subfamily *Salmoninae:* in *Salmothymus ohridanus* (Hadžišče, 1961), *Hucho perryi* (Shaposhnikova, 1968), *Salmo trutta caspius* (Tchernavin, 1938). In some of them,

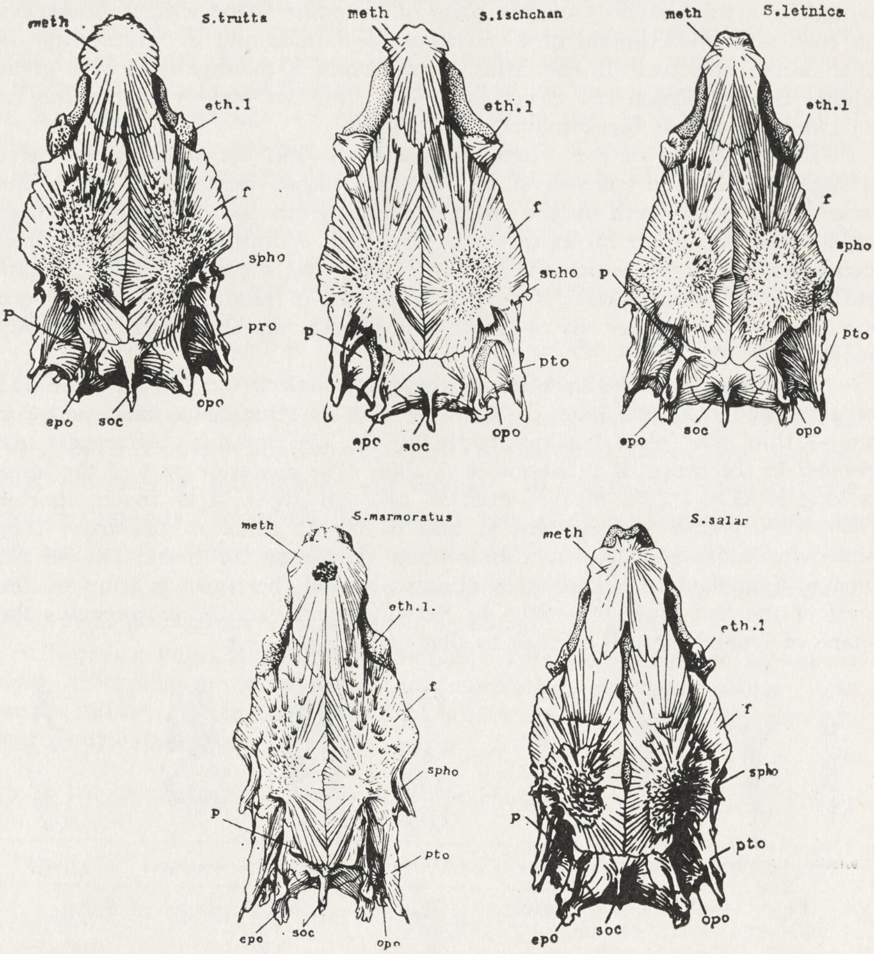


Fig. 1. — Dorsal views of crania of Salmo
S. trutta/length of cranium/ —75,5 mm,
S. ischchan —69 mm, S. letnica —65,3 mm,
S. marmoratus —100,7 mm, S. salar —90,1 mm
epo-epioticum, eth. 1.-ethmoidale laterale, f-frontale, meth-mesethmoideum.
opo-opisthoticum, p-parietale, spho-sphenoticum

they are constantly present, as in *S. marmoratus;* while in others they have been observed only in some specimens.

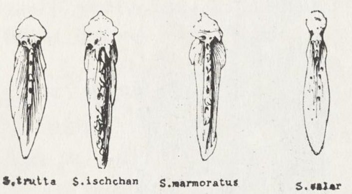
Besides the peculiarities named, greatly developed uplifted crests on pterotica are typical of *S. marmoratus.* The skull of *S. marmoratus* is the narrowest among the skulls of other species.

Considerable differences in the skull shape have been observed in *S. salar.* Its frontals are protruding over the eyesockets, ethmoidal part of the skull is considerably elongated, more than in all other species. The skull of *S. salar* is narrower than in *S. trutta.*

Mesethmoideum (supraethmoideum). In sea trout this bone is represented by a thick slightly convex plate of irregular shape with prominences on each side. Mesethmoid of *S. ischchan, S. letnica* and *S. marmoratus* is of a similar structure. In the latter the structure is distinguished by a great length. In the salmon the mesethmoid is a thin flat plate with margins of an indefinlte shape, quadrangle-like (fig. 1).

Vomer. Head of the vomer in sea trout has the shape of isosceles triangle (fig. 2). The transversal row of teeth begins immediately under the base of the head, teeth on the shaft of adults form one or two long longitudal rows. A similar structure was observed in other species studied, excluding *S. salar* in which the head of vomer has a pentagonal or sexagonal shape or rounded one. The transversal row of teeth is separated from the head of the vomer by a narrowing. Teeth on the shaft from one short row.

Os iinguale. In all species of the genus *Salmo* the lingual plate can be separated into two parts — anterior one, carrying teeth, and posterior one — thin bone plate lacking teeth (fig. 3). The greatest differences are present in the shape of this bone in *S. salar*. The posterior part of the bone is long is 82.1—172.3% of the anterior one; in trout it is much shorter 27.0—45.0%. Teeth arrangement is also different: while in sea trout they are two almost parallel rows, in salmon they meet in front. The widest part of lingual plate of salmon is situated behind the teeth, in trout on the level of the last pair of teeth. In Sevang trout and *S. marmoratus* the shape of lingual plate is similar to that of the sea trout.



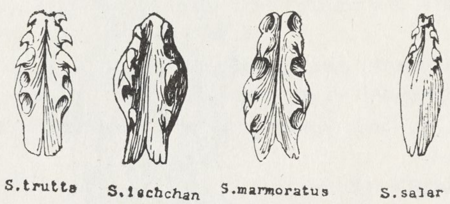


Fig. 2. — Vomers of Salmo Fig. 3. — Lingual plates of Salmo

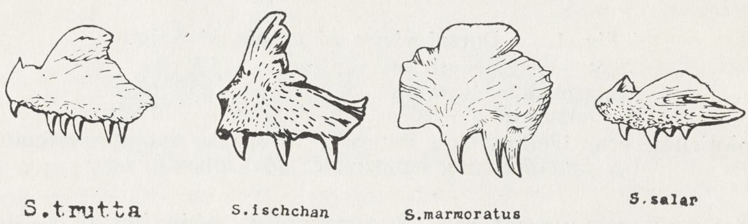


Fig. 4. — Premaxillare of Salmo

Praemaxillae. The premaxillae of all the species studied differ greatly from each other (fig. 4). The greatest differences have been observed in salmon. Its premaxilla is wing-shaped, its width is 38.0—49.0% of the length, in trout it is much shorter and wider 60.0—71.0%. The anterior ascending process is higher in salmon and the posterior one is higher in trout. In

Sevang trout this process is considerably removed forward. The permaxilla of *S. marmoratus* is wide with poorly expressed processes.

The osteological peculiarities of European representatives of the genus *Salmo* show that among these species the most similar ones are *S. trutta, S. ischchan* and *S. letnica* which has not been studied well enough yet. *S. carpio,* which has not been studied from the osteological point of view, apparently also belongs to this group. As to *S. marmoratus,* according to our data (Dorofeeva and Seratlich-Savich, 1972) it has a peculiar position, somewhat closer to *S. trutta,* than to *S. salar.* However it will be possible to establish finally its relationship to other species of the genus *Salmo* only after a study of its karyotypes.

S. salar has also a peculiar position in the system of the genus representing an independent line in the evolution.

The osteological study of Pacific species of the genus *Salmo* showed a number of their obvious differences from European representatives of the genus (Vladykov, 1963; Savvaitova and Maximov, 1968) and on the basis of these peculiarities only, even without taking into consideration the external morphology and biology, they can be separated as a peculiar subgenus *Parasalmo.* They retain the greatest similarity with sea trout among the European Salmo. Taking into consederation the greatest similaryty of sea trout with other species, it should apporenthy be accepted as the most generalized species in the system of the genus.

Together with osteological differences between species of the genus *Salmo,* differences in the number and morphology of chromosomes have been establised, on the basis of which these species can be put into the same groups (table 1).

Tab. 1. — Chromosome Number and Morphology in Salmons and Trouts (Salmo)

Taxon	2n	m—sm	a	Arm no.
S. trutta	80	16—20	60—64	96—100
S. ischchan	80	16	64	96
S. letnica	80	24	56	104
S. carpio	80	18	62	96
S. salar	56—60	12—16	40—48	72—74
S. clarki (lewisi)	64	42	22	106
S. gairdneri	60	44	16	104
S. aguabonita	58	46	12	104
S. apache	56	50	6	106

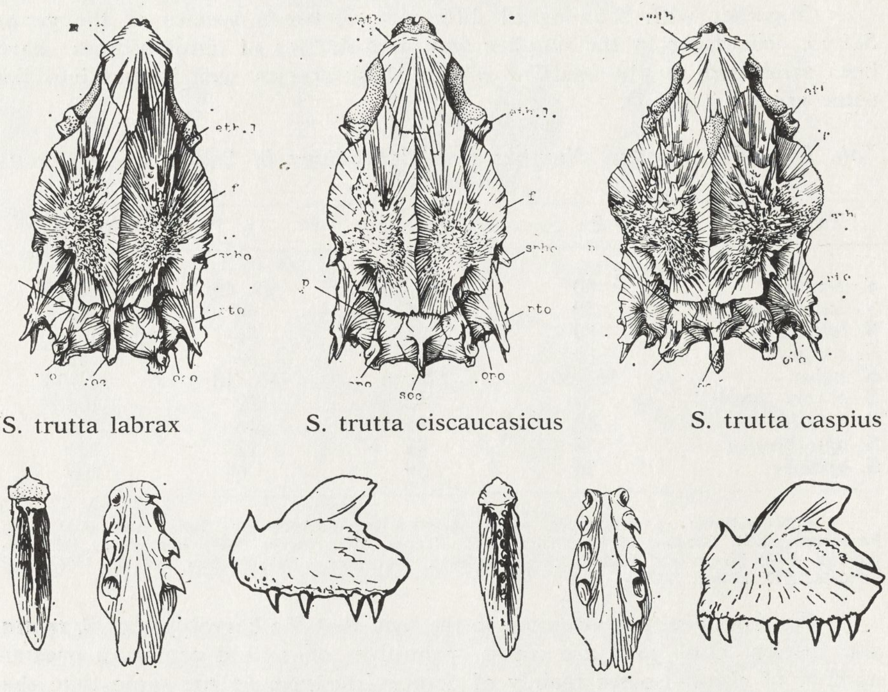
Abbreviations: m-metacentric, sm-submetacentric, a-acrocentric. Data are taken from Prokofjeva, 1934; Svadson, 1945; Wright, 1956; Lieder, 1956; Merlo, 1957; Boothroyd, 1959; Dimovska, 1959; Simon and Dollar, 1963; Dorofeeva, 1967; Rees, 1967; Nygren and al., 1968, 1971; Roberts, 1970; Miller, 1972.

We must also pay attention to the fact, that the karyotypes of *S. trutta* and species close to it are most primitive ones and contain a greater number of chromosomes mainly of acrocentric type. At the same time the species of subgenus *Parasalmo* have more complicated karyotypes represented in the most part by metacentric chromosomes.

S. salar, from the karyotypical point of view, is different, to an equal degree, from both of these groups, first of all, by a comparatively small general number of arms. Thus the European species of the genus *Salmo* as the Pacific ones (Miller, 1972; Behnke, 1973) are heterogeneous and represented at least by two or three evolutionary lines.

Osteological differences between subspecies are considerably smaller than between species and consist mainly in size of several bones and their processes and in the width of their skulls, but they also can be used for the division of infraspecific forms in the species. The Caspian and the Black Sea salmons are good examples of this, as their systematic status remained disputable for a long time. They were considered to be an independent species and subspecies of *S. trutta* or *S. salar* (Pallas, 1811; Kessler, 1877; Kavraisky, 1897; Lönnberg, 1900; Berg, 1908, 1916, 1948; Barach, 1941, 1957; Abdurakhmanov, 1962 and others).

On the basis of skeleton study we managed to establish (Dorofeeva, 1967) that all osteological peculiarities, typical of *S. trutta* are present in these forms (the shape of external margins of skull, of vomer, of mesethmoid, of lingual plate and premaxilla) and they differ from it only in the width of skull and several bones (fig. 5). All the forms studied, as well as the sea trout, have a similar number of chromosomes 2n = 80 (Dorofeeva, 1965). Such a degree of distinction is usually observed in subspecies (Svetovidov, 1952). Therefore the Caspian and the Black



S. trutta labrax S. trutta ciscaucasicus S. trutta caspius

Fig. 5. Dorsal views of crania and selected bones of salmons from Black Sea and Caspian Sea

Sea salmon should be considered to be a subspecies of *S. trutta*. At the same time it has been discovered that the salmons of the Caspian Sea are heterogeneous by osteological characters, which was the ground for their separation into two subspecies *S. trutta caspius* (the Kura river) and *S. trutta ciscaucasicus* the rivers of the western shore of the Caspian Sea, except the Kura.

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SISTEMATSKI ODNOSI SALMONIDA RODA SALMO

E. A. DOROFEEVA

Izvod

Sistematski odnosi vrsta iz roda *Salmo* do sada su nedovoljno razjašnjeni. Mnoga pitanja realnosti i obima nekih vrsta i intraspecijskih formi su ostala nejasna, a isto tako su nejasni i srodnički odnosi među njima.

Na osnovu proučavanja osobenosti skeleta vrsta iz roda *Salmo* utvrđene su razlike između *S. salar, S. trutta, S. ischchan, S. letnica, S. carpio* i *S. marmoratus.* Te vrste se razlikuju uglavnom oblikom spoljašnjih krajeva lobanja, njenom širinom, oblikom rala (vomer), srednje etmoidne kosti. jezične i međuvilične kosti i oblikom otolita. Imajući u vidu osteološke osobenosti tihookeanskih lososa, sve vrste roda *Salmo* se mogu podijeliti u tri grupe: 1. *S. trutta* i njoj bliske vrste — *S. ischchan, S. letnica, S. carpio* i

S. marmoratus; 2. *S. salar;* 3. *S. mykiss, S. gairdneri* i *S. klarki* (podrod Parasalmo).

Uporedo sa osteološkim razlikama utvrđene su i razlike u broju i morfologiji hromozoma, na osnovu kojih se te vrste mogu podijeliti na iste (kao gore navedene) grupe.

Osteološke razlike među podvrstama su mnogo manje nego među vrstama i sastoje se prvenstveno u veličini pojedinih kostiju i njihovih nastavaka ili širini lobanje, ali mogu poslužiti za razgraničavanje intraspecijskih formi vrsta roda *Salmo.* Broj hromozoma kod intraspecijskih formi u većini slučajeva je jednak. Na osnovu kranioloških i karioloških osobenosti je dokazana nesumnjiva pripadnost kaspijskih i crnomorskih pastrmki vrsti *Salmo trutta.*

ЗООЛОГИЧЕСКИЙ ЖУРНАЛ

1975, том LIV, вып. 4

УДК 597.553.2 Salmonidae: 592/599 : 001.4

СИСТЕМАТИЧЕСКИЕ ОТНОШЕНИЯ НЕКОТОРЫХ ПРЕДСТАВИТЕЛЕЙ СЕМЕЙСТВА SALMONIDAE

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Семейство лососевых делится на 3 подсемейства: Salmoninae, Coregoninae и Thymallinae. В 1-м различают 6 родов, во 2-м — 3 и в 3-м — 1. Изучались 6 родов: *Salvelinus, Hucho, Brachymystax* (подсемейство Salmoninae) и *Prosopium, Coregonus* и *Stenodus* (подсемейство Coregoninae). Остеологические исследования позволили установить наиболее характерные их черты и определить систематическое положение в семействе, а в ряде случаев дать описание внутривидовых таксонов. У *Salvelinus* зубы только на головке сошника, чаще в несколько рядов, между ними и небными небольшой промежуток. Рот большой, пластинка на базибранхиале с хорошо развитыми зубами у всех, кроме подрода *Baione*. Форма и расположение некоторых костей говорит о близости этого рода к *Salmo*. У *Hucho* зубы на головке сошника в 1 ряд, промежутка между ними и небными нет. Пластинка на базибранхиале есть только у выделенного нами подрода *Parahucho*. Род *Brachymystax* близок к роду *Hucho*, отличается от последнего положением и размером челюстей, формой черепа и отдельных костей. У *Prosopium* рот маленький, сошник без зубов. Есть пластинка на базибранхиале, без зубов. *Coregonus* отличается от *Prosopium* отсутствием базибранхиальной пластинки. Только у представителей этого рода носовые отверстия разделены двумя лопастинками. У своеобразного рода *Stenodus* зубы есть, но слабо развиты. Рот большой: орбитальное кольцо замкнуто. На нижней челюсти обычно есть надсочленовая косточка.

Согласно взглядам большинства ихтиологов, семейство лососевых делится на 3 подсемейства: Salmoninae, Coregoninae и Thymallinae. Однако до сих пор нет единого мнения о систематическом положении сигов в широком смысле. Некоторые исследователи рассматривают их в ранге семейства (Cope, 1872; Vladykov, 1970; Nybelin, 1971; Медников и др., 1973 и др.). Большинство же включает сигов в семейство Salmonidae (Regan, 1914; Берг, 1940; Norden, 1961; Greenwood et al., 1966; Behnke, 1972 и др.). Приверженцы самостоятельности сиговых обосновывают этот взгляд тем, что, наряду с внешними (крупная чешуя, эпителиальные бугорки на ней в период нереста), имеются существенные остеологические отличия между лососями и сигами. Так, в отличие от сигов, у лососей есть зубы на максилляре, ветвь сейсмосенсорного канала на предкрышке соединяется с височным посредством небольшой окостеневшей трубочки suprapraeoperculum, нет hypethmoideum и dermosphenoticum. Кость, которая у сигов называется dermosphenoticum, видимо, несет те же функции и у других лососевых, несмотря на различное расположение на ней каналов боковой линии. Считается, что теменные кости у сигов соединены между собой, тогда как у лососей они разделены верхнезатылочной костью. По нашим данным (Шапошникова, 1971: 476), это бывает далеко не всегда, у некоторых видов сигов она разделена ~~лишь~~ у 1/3 особей. Таким образом, достоверным остеологическим различием остается отсутствие у лососей хипэтмоидеум, а у сигов супрапреоперкулюм, зубов на максилляре и слабое их развитие на других

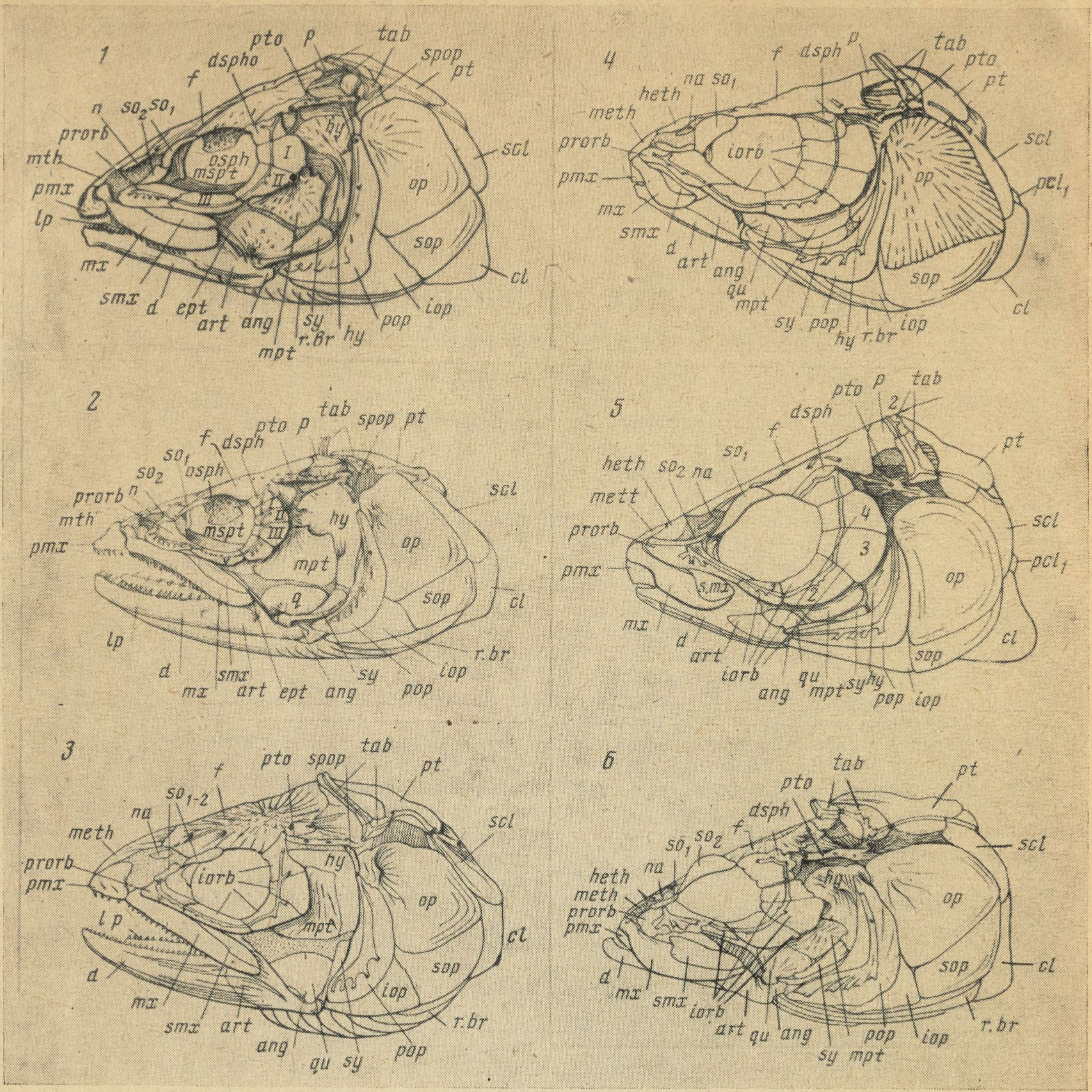

Рис. 1. Черепа, вид сбоку

1 — Brachymystax lenok, 2 — Hucho hucho, 3 — Salvelinus alpinus, 4 — Prosopium cylindraceum, 5 — Coregonus lavaretus, 6 — Stenodus leucichthys nelma (те же названия рыб на рис. 2 и 3). На рис. 1 и 2 приняты следующие обозначения: *ang* — angulare, *art* — articulare, *cl* — cleithrum, *d* — dentale, *dsph* — dermosphenoticum, *epo* — epioticum, *eth. l* — ethmoidale laterale, *f* — frontale, *heth* — hypethmoideum, *hy* — hyomandibulare, *iop* — interoperculum, *iorb* — infraorbitale, *meth* — mesethmoideum, *mpt* — metapterygoideum; *mx* — maxillare, *na* — nasale, *op* — operculum, *opo* — opistoticum; *osph* — orbitosphenoideum, *p* — parietale, *pcl* — postcleithrum, *pmx* — praemaxillare, *pop* — praeoperculum, *prorb* — praeorbitale, *pt* — posttemporale, *pto* — pteroticum, *qu* — quadratum, *r. br* — radii branchostegi, *scl* — supracleithrum, *smx* — supramaxillare, so_1, so_2 — supraorbitalia, *soc* — supraoccipitale, *sop* — suboperculum, *spho* — sphenoticum, *spop* — suprapraeoperculum, *sy* — symplecticum, *tab* — tabulare

костях, что дает право, на основании остеологических данных, рассматривать сигов лишь как подсемейство. В настоящее время делаются попытки выделения сигов в самостоятельное семейство, применяя метод гибридизации ДНК (Медников и др., 1973; Попов, 1973; Попов и др., 1973). Авторы этого исследования нашли, что «род *Coregonus* весьма однородный по структуре генома, обнаруживает четкие различия с ДНК горбуши (семейство Salmonidae) того же ранга, что и род *Osmerus*, выделяемый в самостоятельное семейство Osmeridae. Отсюда следует, что подсемейство Coregoninae следует повысить в ранге, восстановив сем. Coregonidae Jordan» (Попов и др., 1973 : 739). Род *Osmerus* относится к подсемейству Osmerinae, т. е. к одному из трех подсемейств семейства Osmeridae, и, если уж тут проводить аналогии, то логичнее сигов оставить в ранге подсемейства. Нельзя считать правомочными выводы, сделанные на основании сравнения случайно выбранных представителей подотряда Salmonoidei. Обращает на себя внимание, что цифровые критерии оценки таксономических рангов, установленные авторами, не касаются подсемейств.

Ряд авторов выделяют также Thymallinae в самостоятельное семейство на основании как внешних особенностей, так и строения скелета (Gill, 1893, 1895; Jordan and Evermann, 1896; Чернавин, 1923; Берг, 1940; Willimovsky, 1954 и др.). Это мнение достаточно обоснованно опровергнуто Норденом (Norden, 1961).

В подсемействе Salmoninae различают 6 родов; у Coregoninae — 3 и у Thymallinae — 1. Изучались следующие роды: *Brachymystax*, *Hucho* и *Salvelinus* подсемейства Salmoninae и *Prosopium*, *Coregonus* и *Stenodus* подсемейства Coregoninae. Внешние различия представителей этих родов приводятся в определительных таблицах Берга (1948) и других авторов. Положение их в системе, а также таксономический статус некоторых из них до последнего времени были недостаточно ясны, что заставило искать более надежные критерии для освещения этих вопросов. Остеологические исследования позволили разрешить многие из них.

Род *Brachymystax* описан Гюнтером (Günther, 1866) преимущественно на основании внешнего строения головы и расположения зубов. Некоторые остеологические данные приводятся и другими авторами (Берг, 1909; Norden, 1961; Rousenfell, 1962; Vladykov, 1963), однако подробного исследования не производилось и положение этого рода было не совсем ясно. На основании наших исследований обнаружены некоторые детали строения скелета, позволившие дать описание представителей рода из разных мест ареала (Шапошникова, 1968). Основные особенности *Brachymystax* — сравнительно маленький рот, сочленение нижней челюсти с черепом впереди или под вертикалью заднего края глаза, верхняя челюсть не достигает этой границы. Расстояние от конца рыла до заднего края максилляре обычно не более 45% длины головы. Череп сравнительно узкий и высокий. Заглазничные кости, как правило, закрывают не менее половины расстояния от заднего края орбиты до предкрышки (рис. 1, *1*). Хрящевой рострум спереди без выемки, мезэтмоид длинный, закругленный спереди, с клинообразным задним краем. Лобные кости простираются далеко назад, закрывая собой бо́льшую часть теменных и супраокципитале (рис. 2, *1*). Рукоятка сошника без зубов (рис. 3, *1*), зубы на головке сошника и небных костях образуют непрерывную дугообразную полоску. Есть базибранхиальная пластинка, без зубов. Зубы на языке только по краям. Род *Brachymystax* представлен всего одним видом *B. lenok* (Pallas). Удалось наметить признаки, указывающие на морфологическую неоднородность ленков в различных водоемах.

По мнению некоторых авторов (Norden, 1961; Rousenfell, 1962), род Brachymystax — наиболее примитивная форма в подсемействе Salmoninae, с чем нельзя не согласиться. Доказательством этого взгляда служат некоторые морфологические особенности — сравнительно небольшой рот, менее развитые зубы. Кариологические исследования Дорофеевой также говорят о примитивности кариотипа по сравнению с другими представителями подсемейства (число хромосом 92, плеч 102).

О положении рода *Hucho* Günther, 1866 в системе лососевых не было одного мнения. Некоторые авторы относили тайменей к роду *Salvelinus* (Spilmann, 1961), другие считали возможным выделить их в подсемейство Huchoninae (Jordan and McGregor, 1925). Диагностика отдельных видов этого рода базировалась в основном на биометрических показателях. Описание некоторых частей скелета есть в работах ряда авторов (Jordan and Snyder, 1902; Antipa, 1909; Берг, 1909), основное внимание

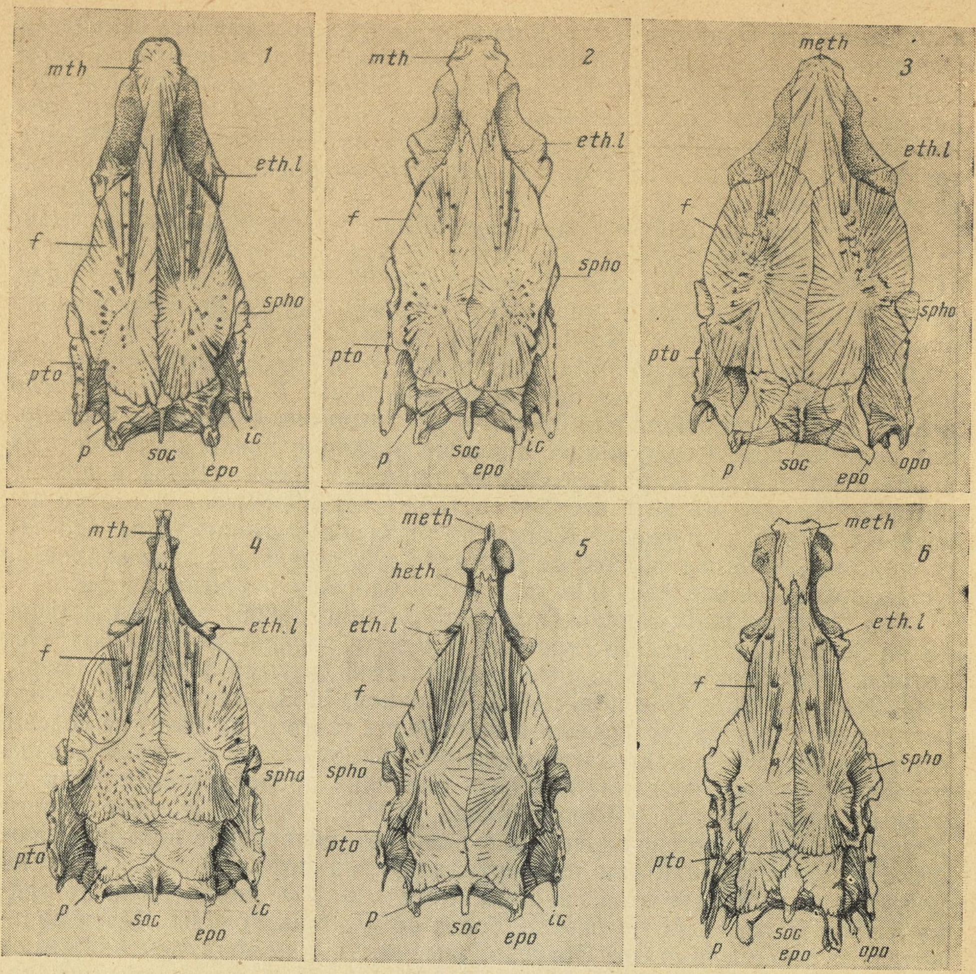

Рис. 2. Черепа, вид сверху

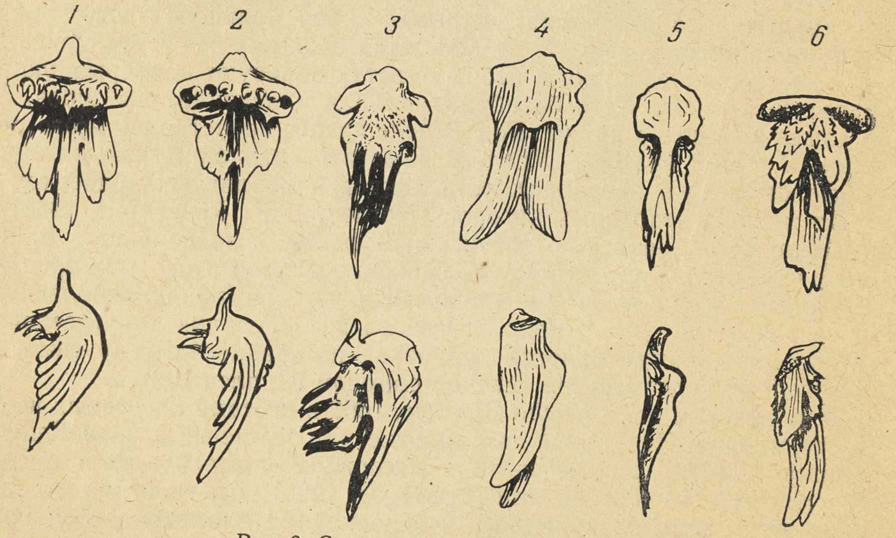

Рис. 3. Сошники, вид снизу и сбоку

обращалось на расположение зубов. Более подробные сведения имеются в монографии Нордена (Norden, 1961). В результате наших остеологических и отчасти биометрических исследований удалось дать подробное описание скелетов разных видов рода *Hucho* и выяснить их систематическое положение (Шапошникова, 1968). Род *Hucho* очень близок роду *Brachymystax*. У обоих родов аналогичное расположение зубов на сошнике (рис. 3, *2*) и небных костях, образующих вместе сплошную линию, а также положение и форма лобных костей. Наиболее существенные различия между ними — это размеры челюстей у взрослых рыб, в связи с чем рот у *Hucho* значительно больше, расстояние от конца рыла до заднего края максилляре обычно не менее 45% длины головы. Заглазничные кости закрывают в среднем не более 45% расстояния от заднего края орбиты до предкрышки (рис. 1, *2*). Череп сравнительно широкий, мезэтмоид относительно короче, с боковыми выступами (рис. 2, *2*). Один из видов рода — *Hucho perryi* (Brevoort) настолько своеобразен, что предположительно был выделен в особый подрод *Parahucho* Vladykov. Нам удалось обосновать правильность этой точки зрения. Только у этого подрода есть базибранхиальная пластинка и мелкие зубы на средней части язычной кости. Хрящевой рострум с едва заметной выемкой. Позвонков значительно меньше, чем у других видов, чешуя крупная, рядов чешуй в боковой линии не более числа прободенных чешуй, тогда как у других видов, как и у ленков, имеется обратная зависимость. К подроду *Hucho* Günther относятся 3 вида *H. hucho* L., *H. taimen* (Pallas) и *H. ishikawai* Mori, к подроду *Parahucho* Vladykov — один *H. perryi* (Brevoort).

Для полиморфного рода *Salvelinus* (Nilsson) Richardson, 1832 так же, как для ленков и тайменей, характерно отсутствие зубов на рукоятке сошника, но, в отличие от них, на головке сошника зубы расположены чаще в несколько рядов (рис. 3, *3*), между ними и небными зубами обычно имеется небольшой промежуток. Зубы на челюстях хорошо развиты, рот большой. Длина и форма верхнечелюстной кости варьируют и, в противоположность существовавшему мнению (Берг, 1948), не могут служить диагностическим признаком. Между заглазничными костями и предкрышкой значительное расстояние. Tabularia представляют собой очень мелкие косточки разной длины, с каналами внутри, число их больше, чем у других лососевых (рис. 1, *3*). Хрящевой рострум у некоторых гольцов раздвоен спереди, но менее, чем у представителей рода *Salmo*. Форма мезэтмоида варьирует, чаще всего он спереди закруглен, имеет боковые выступы, задний край зубчатый, иногда глубоко расщепленный. Лобные кости относительно короче, чем у ленков и тайменей, плотно соединены внутренними краями почти на всем своем протяжении (рис. 2, *3*). Базибранхиальная пластинка у всех видов подрода *Salvelinus* с многочисленными зубами, у подрода *Baione* De Kay — без зубов. На язычной кости у некоторых имеются зубы не только по краям, но и посередине. Форма и расположение отдельных костей, в частности сошника, говорят о близости рода *Salvelinus* к роду *Salmo*. Расположение зубов в несколько рядов на сошнике у некоторых гольцов как бы является предпосылкой к появлению их на рукоятке. Отросток, отходящий от головки сошника, на котором они расположены, почти соприкасается с рукояткой. Внутривидовая систематика рода *Salvelinus* недостаточно разработана. В настоящее время различают 2 подрода: *Salvelinus* Richardson и *Baione* De Kay, 1842. Видовой состав 1-го подрода неясен. Ко 2-му относится 1 вид — *Salvelinus fontinalis* (Mitchill). У всех перечисленных выше представителей подсемейства Salmoninae в передней части хрящевого рострума имеется небольшое окостенение, которое некоторыми авторами отождествлялось с hypethmoideum (Hadžišče, 1962). Однако структура и местоположение этого образования опровергают это мнение.

Сиги рода *Prosopium* Milner, 1878 считались лишь подродом рода *Coregonus*, так как у них носовые отверстия разделены одной круглой лопастинкой, второй же плоской, характерной для других представителей подсемейства Coregoninae, нет. Изучение скелетов позволило обнаружить более существенные отличия, в частности, наличие окостеневшей базибранхиальной пластинки. У молоди особей этого рода имеются темные пятна на теле («parr marks»), эти 3 признака сближают их с лососями. У *Prosopium* короткая и широкая первая надглазничная кость, а предглазничная крупнее и иной формы, чем у других сигов. Орбитальное кольцо всегда не замкнуто, между первой надглазничной и дермосфенотикум большой промежуток (рис. 1, *4*). Также отличается форма хипэтмоидеум и некоторых других костей. Хрящевой рострум уже, чем у других сигов, мезэтмоид длинный, далеко выступает вперед, лобные кости относительно широкие и отличаются конфигурацией. Теменные кости соединены между собой на всем протяжении (рис. 2, *4*). Сошник без зубов, головка и рукоятка не имеют четкого разграничения (рис. 3, *4*). Все эти данные свидетельствуют о возможности выделения *Prosopium* в отдельный род. Этот род представляет более раннюю эволюционную ветвь, чем роды *Coregonus* или *Stenodus* (Norden, 1961: 751). Ископаемые остатки *Prosopium* найдены в Северной Америке в плио-плейстоцене оз. Идахо (Miller and Smith, 1967). По кариотипу вальки также отличаются от сигов на уровне рода. Диплоидное число хромосом у разных видов рода *Prosopium* 78—82, число плеч — 100 (Booke, 1968: 1670). В Советском Союзе обитает лишь 1 вид — *Prosopium cylindraceum* (Pallas and Pennant), в Америке различают 6 видов (Norden, 1970: 78).

У сигов рода *Coregonus* Linne, 1758 носовые отверстия разделены двумя лопастинками. Базибранхиальной пластинки нет. Предглазничная косточка сравнительно небольшая, у молоди нет темных пятен на теле. Рот небольшой, зубы слабо развиты, на максилляре всегда отсутствуют, на сошнике лишь у одного вида. Форма межчелюстных костей различна: от узкой заостренной книзу пластинки до массивной сложной формы косточки, образующей рыльную площадку. Положение и форма нижней челюсти варьируют. Орбитальное кольцо, как правило, не замкнуто (рис. 1, *5*), лишь у одного вида первая надглазничная большая и почти вплотную подходит к дермосфенотикум. Теменные кости обычно в той или иной мере соединены между собой (рис. 2, *5*), но у некоторых особей, в частности вида *Coregonus lavaretus* L., бывают разделены верхнезатылочной. Сошник без зубов, с хорошо заметной головкой, сверху тонкий гребень, проникающий в этмоидальный хрящ (рис. 3, *5*). При построении внутриродовой системы руководствовались прежде всего положением рта и формой челюстных костей (Шапошникова, 1968а). На этом основании выделены 2 подрода — *Leucichthys*, к которому относятся сиги с верхним и конечным ртом, верхнечелюстная кость у них заходит за вертикаль переднего края глаза, проксимальная часть максилляре меньше половины дистальной. У сигов с верхним ртом нижняя челюсть большая, выдается из-под верхней. К подроду *Coregonus* относятся все сиги с нижним ртом, верхнечелюстная кость у них короче, проксимальная часть ее обычно больше половины дистальной. Нижняя челюсть сравнительно небольшая и никогда не выдается из-под верхней. Диплоидное число хромосом у различных сигов — 80, число плеч — 98—108 (Booke, 1968: 1678).

Сиги представлены в Советском Союзе 10 видами, число видов в Америке и Европе нуждается в уточнении.

В свое время Gill (1894: 120), а позже Чернавин (1923: 104) считали возможным выделить подсемейство Stenodontinae с одним родом *Stenodus* Richardson, 1836, но более подробное изучение морфологии *Stenodus* опровергло это мнение. Строение скелетов у представителей родов *Prosopium*, *Coregonus* и *Stenodus* во многом сходно, однако между ними есть и существенные различия (Шапошникова, 1967). Хипэтмоидеум проникает в хрящ, как и у сигов, но имеет другую форму. Вентральный контур парасфеноида прямой, а не изогнутый как у сигов. Форма hyomandibulare у *Stenodus* и у сигов различна. С представителями подсемейства Salmoninae род *Stenodus* сближает сравнительно большой рот, наличие зубов на головке сошника (рис. 3, *б*) и некоторых челюстных костях. Строение рта связано с приспособлением к хищному питанию и рассматривается как вторичное явление. Вместо сильных конических зубов, характерных для Salmoninae, у *Stenodus* появляются многочисленные мелкие острые зубы на языке, небных и межчелюстных костях, в коже, покрывающей кости жаберного аппарата, и на глоточных пластинках. Заглазничные кости, как у большинства представителей Salmoninae, покрывают половину или немного более расстояния от заднего края орбиты до предкрышки. Первая надглазничная кость соприкасается с дермосфенотикум, в результате чего образуется замкнутое орбитальное кольцо (рис. 1, *б*). Это явление наблюдалось еще лишь у одного из видов сигов. Своеобразие рода *Stenodus* обычно обусловливается, кроме внешнего вида, присутствием надсочленовой косточки на нижней челюсти, чего нет у других лососевых. Теменные кости бывают в той или иной степени разделены верхнезатылочной (рис. 2, *б*).

Род *Stenodus* представлен всего одним видом — *Stenodus leucichthys* (Güldenstadt).

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TAXONOMIC RELATIONS BETWEEN SOME REPRESENTATIVES OF THE FAMILY SALMONIDAE

G. Sh. SHAPOSHNIKOVA

Zoological Institute, USSR Academy of Sciences (Leningrad)

Summary

The family Salmonidae is divided into 3 subfamilies: Salmoninae (6 genera), Coreguninae (3 genera) and Thymallinae (1 genus). 6 genera were studied: *Brachymystax*, *Hucho* and *Salvelinus* (Salmoninae), *Prosopium*, *Coregonus* and *Stenodus* (Coregoninae). Osteological studies allowed to establish their most typical features and determine their systematic status within the family and, in some cases, give descriptions of intrageneric taxons. *Brachymystax* is the most primitive genus in the subfamily Salmoninae, it is closely related to *Hucho* and differs from it in the position and size of jaws, the shape of skull and some other bones. *H. perryi* (Brevoort) was found to be so peculiar that it was separated as a subgenus *Parahucho* Vladykov. The shape and position of some bones reveal the similarity between the polytypical genus *Salvelinus* and the genus *Salmo*. The genus *Prosopium* represents a branch which evolved earlier than *Coregonus* or *Stenodus*. *Coregonus* differs from *Prosopium* by the absence of basibranchial plate. Only these genera have nostrils separated by two flaps. *Stenodus* differs from other genera by the presence of supraarticular bone on the lower jaw and by closed orbital ring.

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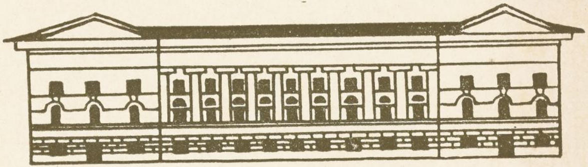
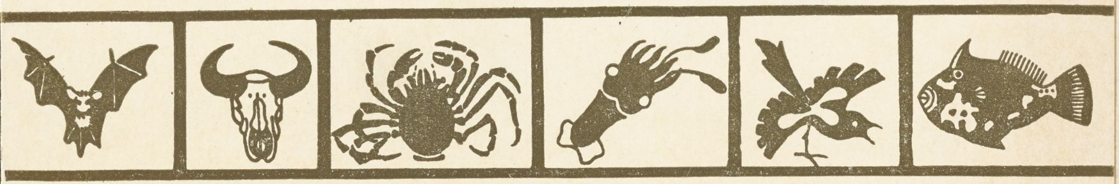


Академия Наук СССР

ЗООЛОГИЧЕСКИЙ ИНСТИТУТ



I wish to all your family good luck and happiness in New Year!

Last autumn I sent you two my reprints on „Systematic relation of some representatives of the family Salmonidae". Now I am sending them for the second time.

I think your translation of common name Acipenser nudiventris – „sheap" sturgeon is correct.

With the best regards

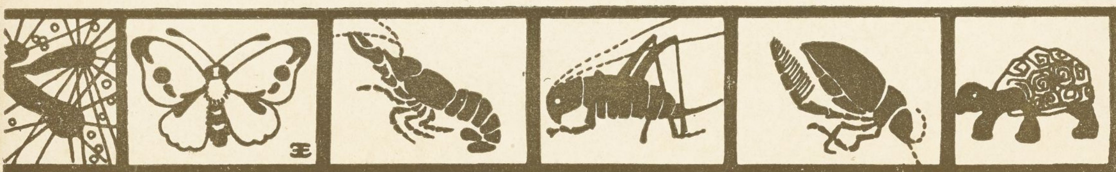
your G. Shaposhn

С Новым Годом!

Happy New Year!

Gluckliches Neujahr!

Bonne Année!



Авиа - бандероль

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Colorado Cooperative Fishery Unit
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Fort Collins, Colorado
80521 U.S.A.

Salm. Zool. Zhur
Osteol- Ichthiolog.

(Brachymystax 92 chromosome)

IMPRIMES

США
Д-ру Р. Бенке
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Leningrad 199164, Zoological Inst.
Academy of Sciences
G. Ch. Shaposhnikova

Ленинград 199164, Зоолог. Инст.
АНСССР Г. Х. Шапошникова

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I.A.Chereshnev
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AIR MAIL

Par avion

new address
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Far East Science Center
Acad. Sci USSR
24 Karl Marx St.
685010 Magadan
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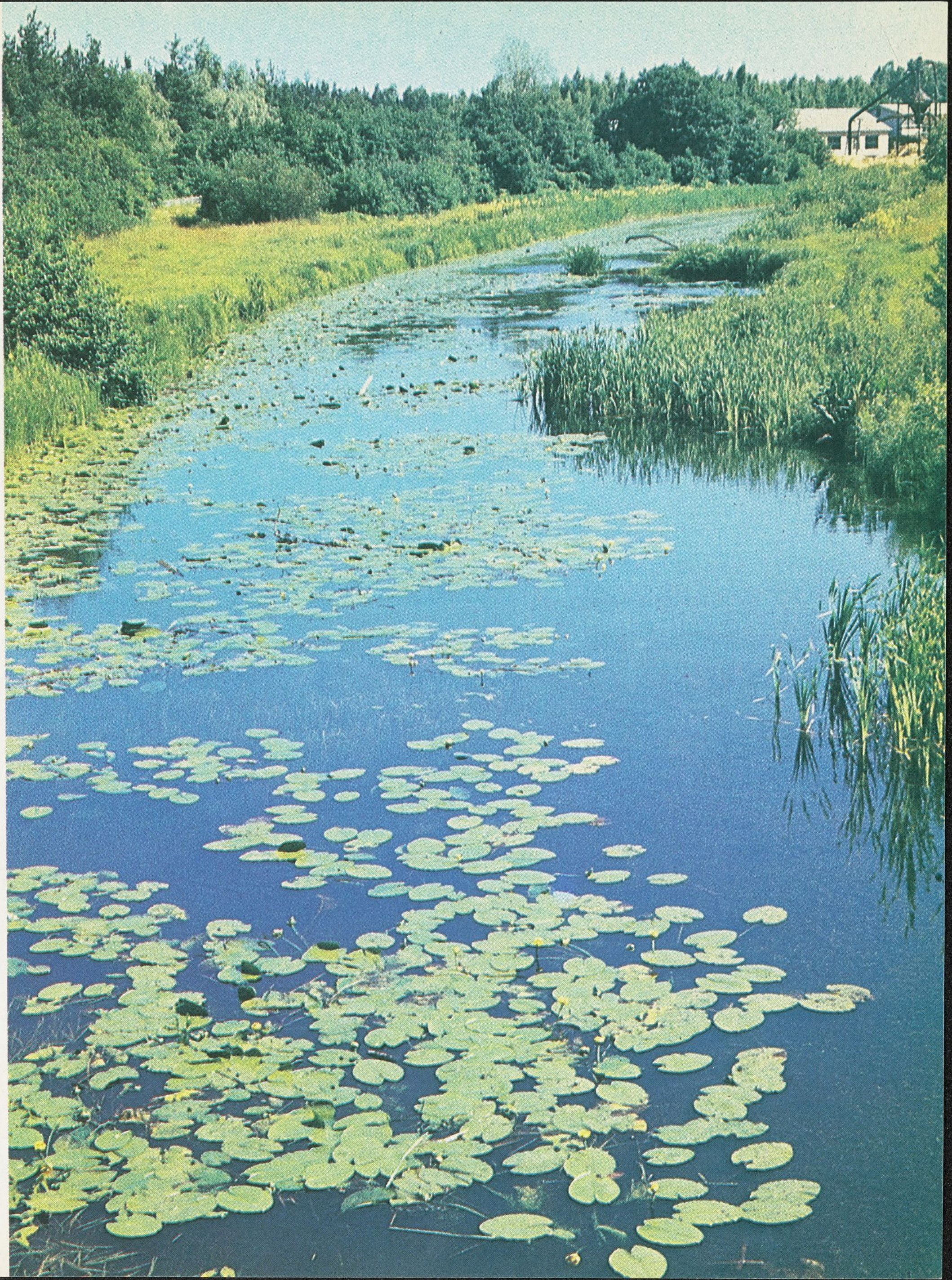
Dr. Robert J. Behnke
Colorado State University
Fort Collins, Colorado, USA
80523
Department of Fishery and Wildlife Biology

[illegible]

В устье Гауи образуется пойма, в которой аккумулируются песок и перегной

Песчаные наносы образовали в устье Гауи широкий пляж. Там образуются новые дюны

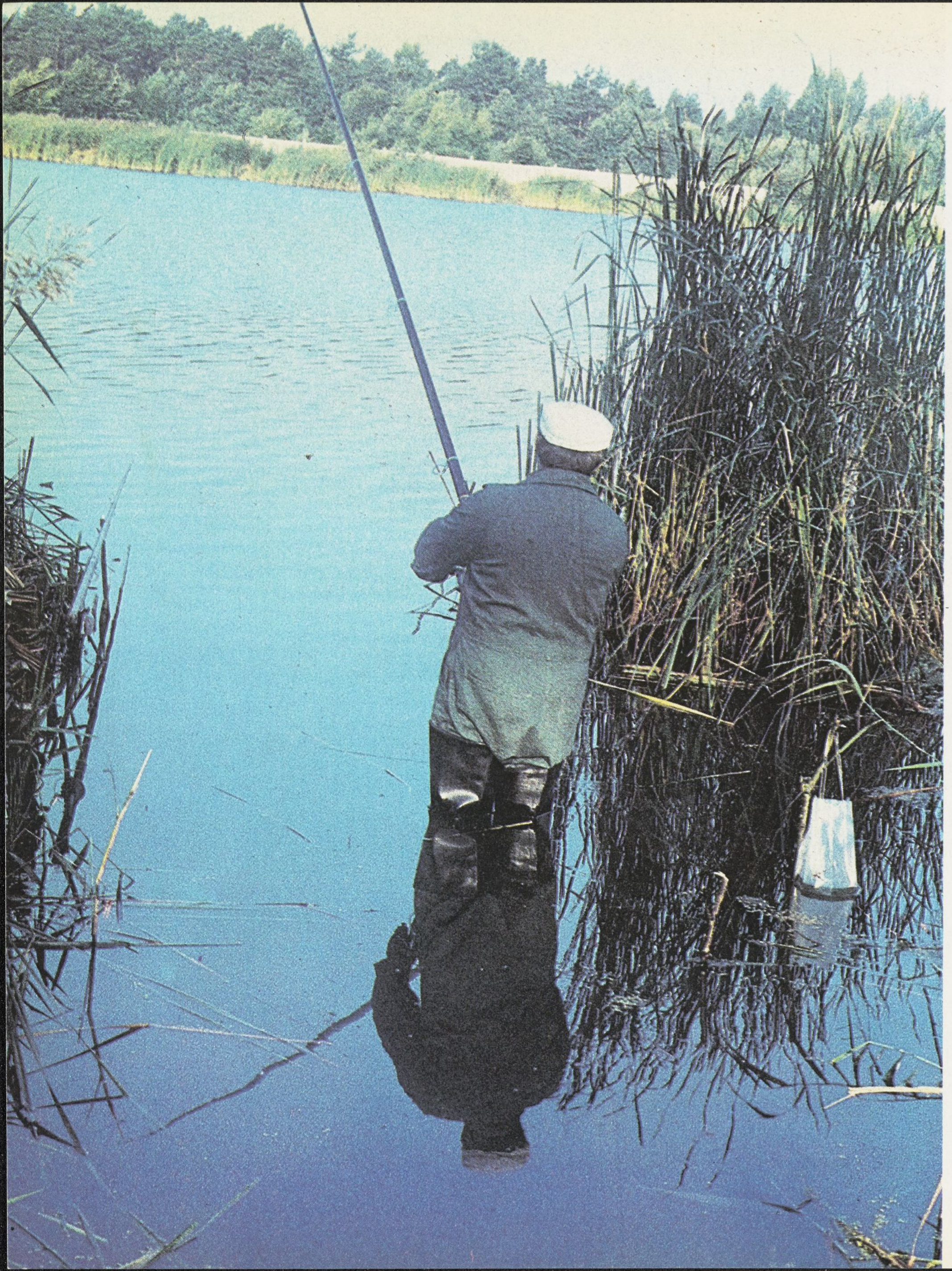


На Вецгауе имеются благоприятные условия для произрастания водяных растений и жизни животных, а также для влаголюбивых растений — гигрофитов

Дягиль на фоне Вецгауи

Березы на абразионном берегу Гауи у Царникавы

Подверженный эрозии берег Гауи ниже Царникавы



Широкие, спокойные воды Вецдаугавы как нельзя лучше подходят для разведения рыбы и рыбалки

ГИДРОГРАФИЧЕСКАЯ СЕТЬ И ВОДОЕМЫ

Наиболее значительным водным богатством Приморского природного парка является акватория прилегающего к нему Рижского залива. Для купания пригодно примерно 100 га морской акватории. По нормативам на одного человека необходимо 30 $м^2$, значит пляж природного парка одновременно может принять 33 000 человек. На участке длиной около 900 м с природным парком граничит Гауя (у Царникавы и впадения в море) с песчаными островами и берегами, подверженными водной эрозии и песчаной аккумуляции. У Царникавы к природному парку во многих местах примыкает Вецгауя (Старая Гауя), а у Вецаки — широкая Вецдаугава. Внутренними водоемами Приморский природный парк не богат. Самая большая река — Ланга, пересекающая территорию природного парка на участке длиной 3,5 км. Контуры старого русла реки свидетельствуют о том, что когда-то Ланга соединяла Киш-озеро с морем. Но блуждающие дюны во многих местах засыпали ее и отрезали от моря, и в настоящее время река обмелела и течет в обратном направлении — в озеро. Самый красивый участок реки, который еще свободен от зарослей и на котором сохранилось зеркало открытой воды, находится напротив параболической дюны.

Живописнейшим внутренним водоемом является Межэзерс (Лесное озеро) в горах Слепотаю, которое, в сущности, представляет собой часть реки Ланги, отрезанной дюной.

В Приморском природном парке находится также гидротехническое сооружение — канал Эймурской станции перекачки, который пересекает природный парк у Межциемса. Этот канал в начале двадцатых годов прорыли безработные. Из-за крутых откосов он имеет ландшафтно-эстетическую ценность.

В самом низком месте лагуны древнего Литоринового моря еще совсем недавно колыхалось Эймурское болото. Его было очень трудно осушить, потому что оно лишь немного превышало уровень моря. Только Эймурский канал позволил отвести в море часть поверхностных вод, а когда была построена станция перекачки и устроены польдеры, можно было произвести дренаж. В настоящее время насосы мощностью 4 $м^3$ в секунду гонят по Эймурскому каналу через природный парк лишние воды бывшего Эймурского болота.

Еще со стародавних времен человека тянуло не только к синему спокойствию, но и к необъятному простору и грозному волнению вод. Лучше всего это противоречивое желание может удовлетворить море

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Lundy : J. I. 1987(1) : 132-135 :
A. G. Chernitskiy - Ecol. physiol. feature asc. w/ age at maturity in S. salar. (Murmansk. Biol. Inst., Kola Br. A.N. SSSR)
1987(1): 162-166 - . E.L. Shurov, Yu. A. Smirnov, Yu. A. Shurtov. adaptation of hatchery salar to river life - behavior & feeding. (Inst. Biol., Karelian Br. A.N. SSSR)
1986(4): 26 - ibid.

- Antonova - North. Dept. Polar N-E I. M.P. X. & O.
Archangel - Pechora - ~~32~~ kg. (70 lb.)

Salmonoid marine fishes
p.101. - Pechora catch
50,000 fish $\bar{x}$ size 15 lb.
$\bar{x}$ 1920-1968 = 350,000 kg. = 770,000 lbs.
1967 5.6, 68 = 4.4 - 69 .9, 70 1.4, 1.1, 1.5, 3.1, 74 2.4, 75 2.4
high 1967 560,000 kg. 1,250,000 lbs.
low 61,000 $\bar{x}$ 20 lb.
low 1969 - 90,000 kg. 200,000 lbs.
7000 fish = i $\bar{x}$ = 13 lb

l.l. salmon - Smirnov. p.44 - Ladoga - 12-13 kg, 30 lb. - to 17 kg. 37 lb.
max. commercial catch = to 200,000 kg - 440,000 lb.

Dr. Robert J. Behnke
Department of Fishery and
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FIRST CLASS

Taimen fishing
Altai

Russian fishermen

- walk 100 km
- build raft
-

TROUT

The Magazine for Trout and Salmon Anglers

5 March —

Hi Bob:

Thought you might enjoy this — keep me posted on your proposed China trip!

Cory

TROUT MAGAZINE

WRITING, ART, PHOTOGRAPHY

Trout is the official magazine of Trout Unlimited, America's leading coldwater fisheries conservation organization. All 50,000 members of TU are subscribers. In addition, approximately 12,000 copies of each issue are sold at newsstands, specialty bookstores, and fishing tackle shops throughout the United States and Canada. Our readers are knowledgeable and literate.

Trout is published quarterly in March (spring issue), June (summer issue), September (autumn issue) and December (winter issue).

BASICS

The editors of Trout take particular pride in the high standards of excellence set for all writing, art, and photography. As a result the magazine continues to win awards year after year.

Quality begins with submissions. We suggest you write a brief letter of query first, enclosing several examples of your published writing. However, if you have a finished manuscript which you believe fits our format, please send it along.

Your manuscript should be original; we do not accept copies, nor do we appreciate learning later that you have made simultaneous submissions to other fishing magazines.

Your proposed feature story should be from 12 to 10 double-spaced typed pages. Your submission should appear on clean white sheets. All pages should be numbered and include the title of your piece and your name. Your full name, address, and telephone number need appear only on the opening page.

Trout operates with an atypically small, spartan staff. At most times planning is underway for material which will be published eight months to a year hence. We do our best to respond to all submissions within 60 days of receipt. Your patience is appreciated. Please include a sufficiently stamped self-addressed return envelope.

Feature stories receive up to $600. Well illustrated articles are paid the premium rate. Payment is made prior to publication. Trout purchases first-time North American reproduction rights to all material unless otherwise agreed with the contributor.

PHILOSOPHY

To capture the excitement of trout and salmon angling in compelling words and beautiful visual images -- that is the essence of our editorial aim.

Trout seeks to promote quality fishing and a quality fishing environment. Our policy is not, however, to favor any particular method of angling above another. We encourage diversity. Primarily we insist on integrity and honesty. Not every trout fisherman in America pursues his sport with a fly; not every angler releases every fish he lands.

Realism is a key element to the profile of Trout. Although catch-and-release, for example, is a vital theme in the pages of our magazine, we would prefer to read a story written with wit and substance, wherein one or two trout are incidentally creeled for dinner, than be subjected to a trite, poorly done article preaching no-kill.

Perhaps a clue to help you successfully write a story for Trout is our philosophy that the periphery in fishing isn't so peripheral. Habitat is important. History is important. Places are important. People are important.

Show us some thought and depth. Write about more than tippet sizes -- tell us about the old general store along the way and wildflowers along the stream and the sparkle of the water and the way the sky looked. How did you feel when you let that 18-incher slip from your fingers back into the icy clear? Surprise your reader. Make him smile. Use real dialogue -- describe the old man chewing on a cigar butt while threading a worm on his hook. Always try to place your reader there. Avoid pronouncements. Share direct experience, not second-hand remembrance or opinion.

INK

What exactly, dear writer, is Trout looking for? The best advice we can provide is the simplest: read. Sit down with several recent issues and absorb feature stories that we have published. Carefully consider topic, style, tone, accompanying illustrations.

It is difficult -- and perhaps dangerous -- to attempt to place in neat categories the variety of feature articles Trout runs, but doing so may help kick-start your imagination.

REGIONALISM is a strong plus for any submission. As true as it may be that all politics are local, so it is with all (or most) fishermen. People want to know about their backyards. Novice anglers are eager for reliable information about where to catch trout; long time anglers are intrigued with the experiences of others on "their" waters. Do not, though, feed Trout anything simplistic -- save it for the hook and bullet tabloids. We want real writing. We want a special angle to your story. We are especially interested in native species. Avoid the exotic; make the commonplace seem special; give it new perspective. brown trout

HOW TO has long been the outdoor writer's grail. We are interested. Yet we would rather hear about how you outsmart brown trout in a neighborhood creek than what fun you had in Alaska last August. Anyone can go to Alaska. But your deepest secrets about fishing productively for wary browns is something else. You either know or you don't. There is no room for fakery. Trout is especially interested in well-written, detailed features about spinning and trolling.

THE FISH themselves are often the most overlooked subject in many popular fishing magazines. Maybe it is easier to talk obsessively about shooting heads and whip finishers; maybe the guys who love that stuff don't really fish. How do trout see? How have salmonids in North America evolved? How do brook trout spawn? Where do steelhead go in the Pacific?

THE LITERATURE of the sport is not overlooked in Trout. We do accept short stories (fiction or non-fiction) with a trout or salmon fishing focus. We are also beginning to look at poetry. Our book review column, The Fishing In Print, is open to freelancers.

CONSERVATION is frequently an underlying theme in where-to and how-to stories we publish, but there are certain topics of scope such that they demand complete articles. Acid rain and its effect on wild brook trout in the Adirondacks? The fight over adequate streamflows for trout in the Delaware River? How populations of wild trout react to stream improvement projects? Please recommend topics of broad regional interest, preferably of national concern. Submit articles about local Trout Unlimited projects (with black-and-white glossy photographs only) for inclusion in our Action Line section; submissions for this section should be considered gratuitous.

PAINT

The editors are constantly at search for unusual, quality angling artwork. Most of the art appearing in *Trout* is assigned and is of two kinds: spot pencil sketches and full-scale paintings. We have a strong preference for loosely done, impressionistic watercolors and acrylics.

Artists who would like to be considered for a future job should send color photographs of representative pieces or tearsheets from published work. Do not send originals. Payment for art varies; we will gladly negotiate.

FILM

Bold, impressive color photography is a critical element of our format. Not all readers actually read, but nearly all at least look at the pictures. When a manuscript arrives, and we open your package, the first thing we usually do is hold your accompanying slide pages to the light. If we like what we see, we are apt to be drawn into your writing. That should say something. A selection of quality photographs is essential to selling us your article. Send at minimum 20 shots; 40 still better. Make sure they are top of the line, your best, all properly exposed and focussed. (Tip: good autumn and winter fishing shots are in demand.)

Trout also purchases photography independent of articles. We require high quality, unblemished color transparencies only from 35mm to 4x5 in size. We do not accept duplicate slides, slides from positive-negative film, or work that has been published elsewhere. Payment for color photography varies from $150 for a full page opposite another author's editorial copy to $300 for a cover.

HOPE COLLEGE

DEPARTMENT OF HISTORY

February 2, 1987

Mr. Thomas R. Pero
Editor, Trout
PO Box 6225
Bend, Oregon 97708

Dear Mr. Pero:

The winter 1987 issue with a notice about the exchange with the USSR prompted me to pull this piece out of a drawer where it had rested ever since I first translated it during a research trip to the Soviet Union in 1973. I wonder if you might find a way to use it. It is old and, no doubt, dated, but I still get anticipatory thrills reading through it. The maps are awful, but they are just to give you an idea of the area in which the article is set.

I found a note to myself clipped to the manuscript. It said, "If this is ever published, be sure to head it with the following quote." It comes from a certain A. Shakhov in an article called "Prazdnik rybolova," or, "Fisherman's Holiday." The quote: "Because he is richer by one dream than they are, the fisherman is set apart from all the rest of humankind."

That is a true notion.

Very truly yours,

G.L. Penrose
Chairman

GLP/jh

Enclosure

HOLLAND, MICHIGAN 49423-3698 / 616-392-5111

HOPE COLLEGE

DEPARTMENT OF HISTORY

March 16, 1987

Dr. Robert Behnke
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, Colorado 80523

Dear Dr. Behnke:

Thank you for your letter of March 9. To answer your question directly, no, I do not have any other articles on Russian sport fishing accumulated, but I have enclosed a piece on taimen that you may find interesting.

You are certainly correct that Russian sport fishing is primitive and that poaching is a serious problem. Poaching is also, to my mind, a relative matter. The Soviet view that all fish and game are state property is by so much more pervasive than our own implicit agreement to the same that it strikes me as inevitable that the average Russian would pilfer. Petr Veliki taxed fishing nets. A radio has to be repaired "na levo," antibiotics are available only through connections, one has to steal to repair a car. There is an old Turkic proverb that was quoted to me in Tashkent, "The goods of the state are like the sea, who would miss a single drop?" Pike and salmon cannot be different, especially in a land so vast that the citizen sees his rural world with the same eyes as our Alaskan brethren see theirs, and they relate to it in the same manner. In this context, primitive may mean cunning, the "khitrost'" of the muzhik who hides a portion of his grain as cleverly as he does his favorite shchuka holes.

As for Jack Holmes, knowing what I do of his politics, I was initially very surprised to hear that he was sleeping with the "eco freaks." The matter was cleared up for me by another colleague who explained that Holmes has property in the area. A threat to one's own ox does have a way of clarifying thought.

Your articles are the first thing I turn to in Trout. They are clear, informative and graceful. May I assume that they will be published in a collection, or should I continue to clip them?

Very truly yours,

G L Penrose

G. L. Penrose
Chair

GLP/jve

Enclosure

HOLLAND, MICHIGAN 49423-3698 / 616-392-5111

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HOPE COLLEGE
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Dr. Robert Behnke
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, Colorado80523

инея была на этот раз совсем белой. Факелы в тайге разгорелись еще больше. Высоко над рекой летели на юг гуси.

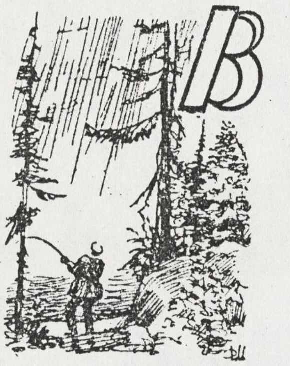
* *
*

Каждая радость оставляет след. Одна меркнет тотчас после рождения, другая живет несколько дней. Есть и такие, которые горят годами. В большинстве случаев это бывает тогда, когда этот огонь мы поддерживаем, ухаживаем за ним. Но таких заботливых людей мало. Большинство из них стремится к новым радостям.

Мои переживания на Томи были настолько сильны, что след от них не исчезал несколько лет. Мало того, он был как бы противоядием против многих огорчений. Случалась какая-нибудь неприятность, ночью вертишься с боку на бок и вдруг вспомнишь, как вокруг лодки ходила пудовая щука. Еще раз переживешь счастье рыболова и крепко уснешь. Недаром мои друзья-рыболовы говорят: поймать большую рыбу — праздник на всю жизнь.

А. Шахов

ПЕРВЫЙ ТАЙМЕНЬ



В поисках ценных дикорастущих трав мы целое лето спускались на лодке по Енисею. Миновав много притоков, подплыли к Кану — не очень быстрой реке. Впрочем, такой она была лишь вблизи устья. По рассказам, Кан все свои четыреста шестьдесят шесть километров, прыгая на порогах, пробегает по тайге в крутых берегах и скалах.

Первый порог находился в четырнадцати километрах от Енисея. В двух километрах ниже порога раскинулась деревушка Подпорог, куда мы на бечевке притащили свою лодку. Дальше на восемьдесят километров нет ни одного селения. Выше падуна километров на двадцать в Кан вбегает речка Немтина, полная крупных хариусов и ленков. Там, как нам сказали, на некошеных лугах много всяких трав, а по брусничным борам

немало глухарей. В долине Нем
того, и медведя. Туда мы и уст
если бы не порог.
О нем нам наговорили мно
сказы взвинтили нас. Николай
мощник, рвался к опасности.
В Подпороге, окруженном
полей на взгорье, мы взяли
вверх. Ефимыч, молчаливый, б
венным в этой местности про
водил лодки через падун.
Шум воды слышался издал
увеличивался. Наконец, по р
дальше, тем больше.
Мы остановились у бурлящ
огромных серых валунов, загро
месте вздымался, лез на камни
дал вниз. С берегов на него гл
— Страсть какая! — замети
оглядываясь вокруг.
— Не вытянуть лодку,— ув
— Вы-тянем! Хоть пустую,
Захаров — рабочий. — Давайте,
да вперед!
— А как же обратно? — спр
— Обратно-то легко. Так и
Захаров. — Хочешь, я один на
— Знаю, ты рисковый чел
сказал ему Семеныч.
— Что вы скажете? — обрат
Он в раздумье снял шапку,
кой по затылку.
— Пустую лодку, конечно,
риском. Сейчас воды много. Ст
— Кроме бечевы, ничего не
— Бечева не выдержит. В
осторожность требуется, иначе.
жит богатства: и оружия, и и
Тут разбилась не одна экспеди
— Наша бечева новая, кре
— Дело, конечно, хозяйское
жет лопнуть.
Мои спутники, ожидая реше
осмотрел страшное место и пр
— Разбивайте палатки. На
Проводник ушел в деревню.
На следующий день на бли
харсв собирали семена трав. Я

немало глухарей. В долине Немтиной можно встретить и сохатого, и медведя. Туда мы и устремились и были бы там скоро, если бы не порог.

О нем нам наговорили много страшных историй. Эти рассказы взвинтили нас. Николай, мой восемнадцатилетний помощник, рвался к опасности.

В Подпороге, окруженном лесами колхозе, с лоскутками полей на взгорье, мы взяли проводника и потащили лодку вверх. Ефимыч, молчаливый, бородатый человек, был единственным в этой местности проводником, который без страха водил лодки через падун.

Шум воды слышался издали. С каждым нашим шагом он увеличивался. Наконец, по реке пошли клочья пены, — чем дальше, тем больше.

Мы остановились у бурлящего потока, он низвергался с огромных серых валунов, загромождающих реку. Кан в этом месте вздымался, лез на камни и с грохотом, весь в пене, падал вниз. С берегов на него глядела черная тайга.

— Страсть какая! — заметил Семеныч, наш старик-повар, оглядываясь вокруг.

— Не вытянуть лодку,— уверенно сказал Николай.

— Вы-тянем! Хоть пустую, но вытянем, — горячо возразил Захаров — рабочий. — Давайте, ребята, выгружать вещи и айда вперед!

— А как же обратно? — спросил Семеныч.

— Обратно-то легко. Так и проскочит меж камней,— заявил Захаров. — Хочешь, я один на ней поеду?

— Знаю, ты рисковый человек. Тебе море по колено,— сказал ему Семеныч.

— Что вы скажете? — обратился я к проводнику.

Он в раздумье снял шапку, наклонил голову и провел рукой по затылку.

— Пустую лодку, конечно, можно провести вверх, но... с риском. Сейчас воды много. Стальной трос есть?

— Кроме бечевы, ничего нет.

— Бечева не выдержит. Видите, какой напор воды? Тут осторожность требуется, иначе... Под этим порогом много лежит богатства: и оружия, и инструментов, и вещей всяких... Тут разбилась не одна экспедиция.

— Наша бечева новая, крепкая,— не сдавался я.

— Дело, конечно, хозяйское, но предупреждаю: бечева может лопнуть.

Мои спутники, ожидая решения, смотрели на меня. Я вновь осмотрел страшное место и приказал:

— Разбивайте палатки. На Немтину пойдем пешком.

Проводник ушел в деревню. Мы поужинали и легли спать.

На следующий день на ближайших лужках Василий и Захаров собирали семена трав. Я и Николай пошли вверх по Кану на разведку. Больших лугов там не оказалось. Скоро пошел дождь, и мы, кроме трех рябчиков, глухаря и двух маленьких мешочков семян клевера, ничего не принесли. Вторую ночь мы провели у порога.

Утром дождь продолжался. Идти на далекую речку Немтину в такую погоду было безрассудно. Но и в палатке не сиделось. Я решил половить на пороге тайменей.

Ох, эти таймени! Сколько было связано с ними надежд и разочарований! В поезде, когда я выехал из Москвы, мой спутник по купе посмотрел на мои вещи и весело сказал:

— Славно! И ружье, и спиннинг. Сразу понятен человек. Вероятно, исследователь? Куда едете?

— На Енисей.

— Значит, на тайменях отведете душу?

Мы разговорились. Спутник оказался страстным рыболовом, он поймал в бурятских реках не одну сотню тайменей. Мне же не только не доводилось их ловить, но даже и слышать, как их ловят. В рыболовной литературе сведения о них настолько скудны, что, кроме описания внешнего вида рыбы и указания, в каких реках Сибири она водится, почти ничего нет.

Из разговоров с пассажирами мне стало известно, что таймени — это лосось, среди сибирских рыб он считается великаном. Чаще всего ловится таймень в четыре-пять килограммов, но иногда можно встретить и трехпудового. Ловить его спиннингом — одна из увлекательнейших охот.

Спутник так разжег мою страсть рыбака, что я с необыкновенным волнением ждал дня, когда смогу вытаскивать из Енисея тайменей. В моем воображении рисовались громадные рыбы, которых я буду чуть ли не каждый день ловить на мой замечательный спиннинг. На него с восхищением смотрел спутник и завидовал.

Первая проба на Енисее, когда я поплыл на лодке, оказалась безуспешной. Также окончилась и вторая. Целый месяц у меня там ничего не выходило. Я не видел ни одного тайменя.

Только потом мне стало известно, что летом на Енисее таймень обычно бывает в верховьях. Весной он уходит в небольшие горные реки, откуда возвращается осенью. И в самом деле, в начале сентября в устье Бирюсы (выше Красноярска) мне пришлось увидеть всплески больших рыб. Целый вечер я хлестал воду спиннингом. Но таймени выскакивали из воды так далеко от берега, что блесна до них не долетала. Лодку же на сильном течении поставить на якорь было нельзя.

Уже более шестисот километров проплыли мы, а ни один таймень еще не был пойман. Мой спутник по вагону, вероятно, за это время поймал бы не один десяток этих великанов.

в там не оказалось. Скоро пошел
чиков, глухаря и двух маленьких
его не принесли. Вторую ночь мы

. Идти на далекую речку Немти-
рассудно. Но и в палатке не си-
пороге тайменей.
было связано с ними надежд и
а я выехал из Москвы, мой спут-
и вещи и весело сказал:
пиннинг. Сразу понятен человек.
а едете?

введете душу?
ик оказался страстным рыболо-
реках не одну сотню тайменей.
дилось их ловить, но даже и
рыболовной литературе сведения
кроме описания внешнего вида
еках Сибири она водится, почти

ами мне стало известно, что тай-
рских рыб он считается велика-
мень в четыре-пять килограммов,
трехпудового. Ловить его спин-
ейших охот.
страсть рыбака, что я с необык-
ня, когда смогу вытаскивать из
бражении рисовались громадные
не каждый день ловить на мой
его с восхищением смотрел спут-

огда я поплыл на лодке, оказа-
нчилась и вторая. Целый месяц
дило. Я не видел ни одного тай-

известно, что летом на Енисее
ховьях. Весной он уходит в не-
возвращается осенью. И в самом
ье Бирюсы (выше Красноярска)
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сна до них не долетала. Лодку
ить на якорь было нельзя.
етров проплыли мы, а ни один
Мой спутник по вагону, вероят-
ы не один десяток этих вели-

И вот я пошел к Канскому порогу попытать счастье. Со мной был Николай. На этот раз он больше присматривался к травам, чем к моему занятию.

Первый заброс спиннингом я сделал вблизи камня, с которого с шумом падал большой поток воды. Боковая струя, закручиваясь, подходила к берегу. Под камнем была яма, где, по моему предположению, обязательно должны находиться таймени.

Блесна упала на струю и побежала к берегу. Никто на нее не польстился.

Забрасывалась она много раз. Ничего!

Я перешел на второй омут. И там повторилась та же история. Но на последнем забросе шнур натянулся — будто блесна зацепилась. Я почувствовал рыбу. Екнуло сердце. Шнур пошел против течения. После недолгой борьбы я подвел рыбу к берегу. Она оказалась щукой килограмма на три.

На следующей яме поймал двух крупных окуней, на соседней с ней — снова щуку. Тайменей не было. Но я не особенно огорчился, испытав и без того много удовольствия. Разве не интересно взобраться на каменную гряду, далеко вдающуюся в реку, и с высокого камня, среди бушующей воды, забрасывать в пену блесну, подводить ее к себе и ждать, ждать, что вот-вот дрогнет удилище, натянется леска?

В эти минуты не замечаешь ни черных, мрачных елей, нависших над берегом, ни моросящего дождя, ни скользких камней, на которые взбираешься с риском упасть в студеный водоворот.

Уже больше километра прошел я вверх по Кану. Порог все тянулся. И вот в очередную яму, под круглый высокий валун, блесна заброшена вновь. Едва она коснулась изумрудной воды, как шнур резко вытянулся.

Пальцем я попробовал задержать движение катушки, но почувствовал такой сильный рывок сначала в сторону, а потом в глубину, что пришлось ослабить торможение. Шнур разматывался с необыкновенной быстротой. Я опять задержал катушку. Удилище тотчас согнулось, и большая рыба взметнулась над водой. Шнур во избежание катастрофы пришлось ослабить. Рыба пошла вглубь. Через несколько секунд я снова задержал катушку. Леска вновь натянулась до предела. Так было много раз. Шнура на катушке оставалось уже не больше десяти метров. Но и рыба ослабевала.

Попробовал повернуть катушку в обратную сторону. Рыба уперлась. Катушка медленно, очень медленно сделала оборот назад, потом второй. «Крокодил»— как я назвал то, что было на крючке, — еле тащился. И вот, когда нас разделяло шагов тридцать, он рванулся на середину реки и снова выбросился высоко из воды. Опять я вовремя отпустил шнур — рыбе не удалось его оборвать. Она пошла в глубину. Хотя движение катушки и тормозилось пальцем, но «крокодил» отвоевывал у меня леску метр за метром. Но не без конца же бороться! Минут через пять рыба выдохлась, и я потянул ее к себе.

Увидев меня, она заметалась, и вода будто окрасилась в красный цвет. Теперь стало понятно, что это был таймень. Там, где он бился, вырастало красное пламя. Такое впечатление происходило от розового хвоста, которым он беспрестанно бил из стороны в сторону. Чего только он не делал! Выскакивал наверх, тряс головой, носом тыкался вглубь.

Наконец, таймень подтянут к самому берегу. Его голова, приподнятая на шнуре, находилась уже в воздухе, серебристое тело с черными крапинками лежало в воде на камнях. Дальше тянуть было уже нельзя: таймень был довольно большой, килограммов на шесть, и леска могла оборваться.

В раскрытой пасти среди редких острых зубов застряла блесна. Крючок вонзился в нижнюю губу.

Николай, увидав мою добычу, побежал ко мне. Бросив спиннинг на берег, я наклонился к рыбе и попробовал схватить ее руками. Таймень, извиваясь, не давался. Скользкое тело уходило из рук. Я прижал его к камням. Но долго ли сильной рыбе вырваться в воде из рук? Таймень уже повернулся головой в реку, чтобы уйти в глубину, но я остановил его за шнур. Он с необыкновенной силой мотнул головой в сторону, и блесна со сломанным крючком звякнула о камень. Ошалевший таймень медленно плыл поверху около острого камня, торчавшего из воды. Николай, подбежав ко мне, схватил спиннинг и ударил концом его по рыбе. Удар пришелся не только по тайменю, но и по острому камню. Рыба метнулась в глубину, а конец моего спиннинга отлетел в сторону.

Николай с растерянным видом повернулся ко мне. Он бормотал какие-то извинения. Но мне было не до них. Я смотрел на то место, где скрылась рыба.

Обескураженный юноша, постояв немного на берегу, полез в воду, вытащил обломок удилища и побрел за мной. Всю дорогу я казнил себя. Поступил как мальчишка! Кто же вытаскивает голой рукой большую рыбу из воды? Разве нельзя было ее ударить камнем или ножом? Наконец, можно было бы лечь на тайменя плашмя. Испугался холодной воды! Эх, рыбак! И спиннинг поломан. Чем я теперь буду ловить рыбу?

В лагерь мы пришли оба хмурые. Семеныч пригласил нас обедать. Мне было не до еды. От обеда отказался и Николай. Он принялся чинить спиннинг, а я с горечью рассказывать историю с тайменем.

— Ничего, эта боль до свадьбы заживет,— успокоил меня Семеныч, после того как я со вздохом закончил рассказ.

— Когда-нибудь поймаете другого,— сказал Захаров.

Через час Николай радостно воскликнул:

— Готово!

И передал мне спиннинг
ивы, наложенная на место
и обмотанная ниткой, была с
— На леченом коне,
уедешь,— сказал я мрачно.
— Попытайте! Может бы
Я попробовал удилище. С
Заплата казалась безобразно
Тяжело вздохнув, я все-
той яме, где ушел таймень,
было. Но по соседству с н
взяла с первого заброса. Я
щал, сердце замерло. Мир дл
ся в то небольшое пространс
дел выскакивающего из реки
порога и мелкий дождь исче
ды. Ровные стуки сердца пре
В борьбе прошло минуть
ных минут! Таймень умаялся
ба подходила к берегу все б
ный рыбак — таймень не уй
длинный нож.
Найдя на берегу отлогое
мень лежал у моих ног. С ра
ку, пониже головы. В таких
венно.
Рыба под ножом изогну
скрылась в глубине.
Я стоял изумленный. Как
стало понятно: конец ножа д
не оказалась такой толстой и
скользнул вниз.
И вновь нож в зубах.
оборвал. Я опять привел его
нулся на бок. Нож до самой
вот с тонкой кожей.
Выбросив тайменя далек
Умирая, он менялся в окрас
сиреневый. Черные крапинки
Следующее утро было сол
тину и к вечеру другого дн
трав.

И передал мне спиннинг. Латка из двух тонких прутьев ивы, наложенная на место слома с противоположных сторон и обмотанная ниткой, была сделана прочно.

— На леченом коне, говорит пословица, далеко не уедешь,— сказал я мрачно.

— Попытайте! Может быть, и уедете,— ответил Николай.

Я попробовал удилище. Оно потеряло гибкость и легкость. Заплата казалась безобразной.

Тяжело вздохнув, я все-таки вновь пошел к порогу. На той яме, где ушел таймень, сколько я ни ловил, поклевок не было. Но по соседству с ней, под большим камнем, рыба взяла с первого заброса. Я подсек. Тормоз на катушке затрещал, сердце замерло. Мир для меня сузился. Он весь вместился в то небольшое пространство, где леска резала воду. Я видел выскакивающего из реки тайменя и больше ничего. Шум порога и мелкий дождь исчезли. Минуты вместились в секунды. Ровные стуки сердца превратились в дробные.

В борьбе прошло минуть десять — огромнейших и прекрасных минут! Таймень умаялся. Пальцы крутили катушку — рыба подходила к берегу все ближе и ближе. О, теперь я опытный рыбак — таймень не уйдет! В зубах у меня был зажат длинный нож.

Найдя на берегу отлогое место, я вывел туда рыбу. Таймень лежал у моих ног. С размаху я ударил его ножом в спину, пониже головы. В таких случаях смерть наступает мгновенно.

Рыба под ножом изогнулась и, подпрыгнув, бросилась и скрылась в глубине.

Я стоял изумленный. Как это могло случиться? Вскоре все стало понятно: конец ножа давно был сломан, а кожа на спине оказалась такой толстой и прочной, что нож, не пробив ее, скользнул вниз.

И вновь нож в зубах. Беглец хотя и ушел, но леску не оборвал. Я опять привел его к берегу. На отмели он повернулся на бок. Нож до самой рукоятки вонзился в белый живот с тонкой кожей.

Выбросив тайменя далеко на берег, я подошел к нему. Умирая, он менялся в окраске. Розовый хвост превращался в сиреневый. Черные крапинки на боках выделялись все резче...

Следующее утро было солнечное. Мы отправились на Немтину и к вечеру другого дня принесли много семян ценных трав.

"On the Rivers of the Altai"

by Vasili Tsikunov

translated from Rybolov-Sportsmen (Moscow,1959) by G. L. Penrose

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*translator's note: The writer will describe most of the fish in some detail and the reader can hazard his own identifications. However, to get started, I can offer the following suggestions based on A. J. McClane's Standard Fishing Encyclopedia and on G. U. Lindberg and A. S. Gerd, Dictionary of the Names of Freshwater Fish of the USSR (in Russian).

taimen--Hucho taimen, an Asian salmonid, reaches 150 pounds.
shchuka--pike, probably Esox lucius.
lenok--Brachymystax lenok, a trout-sized salmonid.
okun--Perca fluviatilis, a large river perch.
nel'ma--Stenodus leucichthys, a Siberian white salmon.
kharius--Thymallus articus, grayling.
elets--probably Leuciscus leuciscus, a dace.
nalim--common except in the Biya, this is Lota lota, or burbot.

Taking taimen on a spinning outfit is no less exciting than fishing for the northern or the Caucasus salmon. The battle with a 30 to 40 kilo fish that requires all one's skill and experience for a successful conclusion compares very well in every way with anything that salmon can provide. And, to take the fish from June into late autumn, to travel through beautiful and wild country, to tempt disaster in dangerous rapids, and to spend your nights around a bonfire under a giant cedar all contributes to the special fascination of stalking taimen in the Altai.

Among the best rivers for rod and reel fishing in the Altai region are the Biya, Katun, and Charysh in the Ob system and the Irtysh tributaries, the Uba and the Bukhtarma. All of these are mountain streams and are quite similar to one another. With the exception of the Biya, they originate in glaciers. They are full of rapids in their upper reaches, the bottoms throughout are strewn with boulders, and their banks are steep and rocky. They feature a seemingly endless alternation of runs and pools interspersed with rapids. The roughest water is very dangerous for boats and rafts. They may be wide and studded with huge rocks, or narrow and heavy rushing between high banks. In all cases, the current throws up high waves and the occasional whirlpool. At times the rivers widen into several slow, shallow channels that are easy to float. The rapids are generally short, never more than 500 meters. The runs can continue for as far as a kilometer.

THE BIYA is the only one of these streams that does not have its origins in the glacial valleys of the Altai range. It flows instead from lake Telets. It is about 400 kilometers long. In its upper reaches the Biya is a typical mountain stream that courses through inspiring and wild country. From its source to the town of Rutochak is a distance of some 70 kilometers in which there are several bad rapids. Local rivermen run the rapids in rafts and boats, but this is not recommended for the inexperienced. The banks are such that it is not difficult to line your boat down. The Biya's pools are deep and some are almost still water. In such pools you can test your skills against taimen that weigh almost as much as a man. It is a very cold river, flowing out of Lake Telets at 5 degrees centigrade and only in summer does the temperature in the lower river reach 15 degrees centigrade. From the lake to the confluence with the Pyzh the Biya is almost always clear. The entire system clears after the snowmelt discoloration is flushed in early June. From this time on into late October there are taimen to cast to in the Biya. As is the case with all the Altai rivers, the Biya can be knocked out of shape for several days by heavy summer rains, but it clears quickly. Though it is the wildest of the Altai streams, dozens of rafts float it each day and one often meets local fishermen. The banks are lined with summer pastures and patches of wild raspberries and currants.

From the town of Biisk to Turochak on the middle river is 200 kilometers by car. The distance from Turochak to Lake Telets has to be done on foot or horseback. Boats are available at Turochak and at the lake. The 300 kilometer float from Turochak to Biisk offers plenty of fishing. Available fish include taimen, shchuka, lenok, okun, nel'ma, kharius, and elets.

Summer is hot in the Altais, though every day there is a cool north wind except on the lower rivers. Flies and mosquitoes are, unfortunately, thick.

THE KATUN is of interest to sportsmen only from Siminski bridge to the confluence with the Biya. There are many good pools that give up taimen of unusual size. The nel'ma, however, is the most abundant fish in the Katun. They are caught during their spawning run from the Ob. The best fishing is from the vicinity of Maima on down to the mouth. Above Maima, nel'ma are rarely taken. The Katun can be fished from the bank, but a boat is much more effective. It is best to bring your own boat, but they can also be rented from local fishermen. From Maima to the mouth the Katun is a safe and interesting float trip. From the headwaters to Siminskii bridge is 150 kilometers by stream and the river is wild and impassable in many places. The banks are steep, the pools are few and hard to fish, though there are good kharius and lenok and the taimen are unusually large. The Katun clears only in September, but then runs free of discoloration until November. Because the better sections of the lower river are quite accessible, the Katun has to be considered very fishable by comparison with more remote streams in the region.

THE CHARYSH can be reached in two ways. To get to the headwaters you go from Biisk to Ust Koksa, a 500 kilometer trip by car, and then you hike another 50 kilometers to the river. Experienced rivermen can float the stream from this point down to Charyshkoe. The second way involves an auto trip from Rubtsovsk to Zmeinogorsk and thence on to Charyshkoe. You may find boats at Charyshkoe or you can build one. The float from Charyshkoe to the confluence with the Ob covers about 200 kilometers, but there are several places to quit the river that are within hiking distance of the railroad. The Charysh has many pools, the bank is beautiful, and there are no dangerous rapids below Charyshkoe. The fish here are taimen and nel'ma. The size of both increases in the lower river. There are fewer large taimen here than in the Biya. You may also pick up the occasional shchuka and okun, there are plenty of kharius and elets, and some large nalim. The river's total length is 400 kilometers. It clears in early June. Spoons produce through October. The usual high water caused by mountain rains are not a serious problem. All considered, this river provides the best and most varied fishing in the Altais.

THE UBA is a beautiful river. It flows between densely forested granite cliffs. There are dozens of bad rapids, the worst of them called Big Ubinskii, the longest and most beautiful in the Altai. This bad water roars on for 7 kilometers in which the river loses 75 meters of elevation. Only very determined and experienced men run this rapids. Such a man is Constantine Kovalev who lives near the rapids and has run them many times on a small log raft. As for me, I lost a boat trying to line it down! The Uba is formed by the confluence of the Belaya and the Chernaya and flows a total of 300 kilometers. From the headwaters to Big Ubinskii rapids is 100 kilometers of difficult water, most of it too dangerous to drift, but all of it passable by lining the boat. The Uba is a safe float only below the big rapids, but even here one has to know the river well and be skilled at manipulating the raft or boat with a pole in tight places. The Uba produces medium sized taimen, up to 10 kilos; numerous shchuka and okun; some nalim and nelma; and many kharius. The river is uniquely beautiful and settlements are found only after Berbukinskoe which is 30 kilometers from the railroad at Shemonakha. The upper river can be reached by narrow gauge railroad which runs from Leninogorsk to the Golukh lumber camp. At the camp you might talk somebody into building you a boat. It is also possible to go from Ust-Kamenogorsk to the lumber camp at Karaguzhikha by car. This route takes you by the Big Ubinskii rapids. It is hard to find boats below the rapids, but you can always knock together a log raft. The Uba, like the

Charysh, clears in June. August and September may bring rains that muddy the water for several days.

THE BUKHTARMA has a milky color all summer long and turns clear and blue-green only in late August or early September. Autumn rains do not affect this river. The upper river, before it is joined by the Belaya, is all white water and the banks are steep. Drift fishing is possible only below the Belaya confluence, but it is quite impossible to find a boat here and thus, the building of a log raft is necessary. While the river is not particularly scenic, it holds lots of fish, and is particularly noted for its taimen. In the lower river nel'ma, okun, and shchuka are also present. In all, it flows 400 kilometers, has many pools and difficult, brushy banks. It is also hard to get to. One must go up the Irtysh from Ust-Kamenogorsk to Gusinaya by steamboat. From there you can get to Zyryachovsk by car, but the final 100 kilometers to the river have to be hiked on foot.

In addition to these rivers, there are, of course, innumerable smaller streams in the area, and all of these are of some interest to sportsmen. Few are wider than 50 meters and many have deep holes that are rich in taimen and kharius. It is especially exciting to fish for taimen in such small waters. In many holes you can see 10 kilo fish casually finning. The Pyzha, Sarakoksha, and Lebed are important Biya tributaries. The Katun receives the Sima, Ursul, and the Koksu. Local fishermen on the Inja, a Charysh feeder, regularly derrick out 20 kilo taimen on very primitive outfits. The Uba system includes the Belaya, the Chernaya, the Stanovaya, and the Beloporozhnaya. The Chernovaya, Khamir, and Turgusun feed the Bukhtarma system. All of these have sporting significance. You should pay particular attention to the mouths of these small streams early in the season, in June. The spawning taimen concentrate here before heading upriver. All of these waters clear by June, and, as you would expect, they clear quickly after autumn rains.

The basic sport fish of the Altai rivers are the taimen, lenok, kharius, and nel'ma. All belong to the salmon family and all have an adipose fin. There are numerous other fish as well. Large nalim, shchuka to 3 kilos, and many dace, called chebak in the Altai. I have caught as many as 150 in a couple of hours. Baitfish in the Altai waters include bullheads,loach and gudgeon.

THE TAIMEN, unlike the salmon does not migrate to the sea. He spends his entire life in the Siberian freshwater river systems. He may reach a length of 3 meters and can grow as heavy as 100 kilos. Casters regularly take 30 kilo fish. The taimen compares very well with the salmon as a fighter. His body is faintly reminiscent of the pike in profile, but he has a much broader back and a rounder head. His mouth is huge with strong canine-like teeth canted slightly back into the throat, and the jaws are very heavy. The coloration is very attractive. Dark pea-sized spots are arranged in "x's" on a grey background. The tail is bright red and the fins are grey like the body color.

The taimen spawns in May and June in the many small tributary streams and creeks. He begins his run while the lower river may still be iced over, but the first freshet of spring has already found its way into his pool. After spawning he drops back down to the main river in slow stages, holding in the pools and runs as he goes. By September he is in the main stream, to lie in the deepest pools until the next spring. He may winter over in his spawning stream, but the pools must be at least 5 meters deep to allow this. In June the taimen goes on a post-spawning feeding binge during which he hits anything that moves, and he hits it hard! His strike gets softer as the summer progresses, especially during daylight hours. At night throughout the season he will hit a spoon hard. In small streams fishing is best early and again late in the day. In the large rivers, in the deepest holes he comes to the bait best during the day. In late August he again feeds well. The closer to fall it gets, the more violently he attacks anything that lives or appears to.

Taimen seem to be conscious of hierarchy. The first fish to hit in any given pool will likely be the biggest one that it holds. After that, the fish come almost in descending order of size. After taking several fish from one pool it is good to move on and rest it for at least a day. At the same time, should you take a very large fish on the first cast, it is certain that other good ones are present and you should continue casting. The strike is strong, but not sharp. Only on occasion does he hit hard, run, and leap clear of the water. When he indulges in aerial displays it is nearly always as a result of having been hooked on short line near the boat or close to shore in shallow water. When the strike comes in the depth of his pool, the spoon just stops. Once the hook is set, the taimen drops to the deepest part of his hole and then slowly and powerfully strips off line. This first run may take some 80 meters off your spool and it is virtually impossible to stop with all but small fish. He will depend on his strength alone, seldom running down a rapids, preferring to stay in his pool and slug it out. No doubt, the most exciting taimen is the 8-15 kilo fish. He is fast as well as strong and can take both your skill and your equipment to the limit. The 20-30 kilo fish fights a slower, but still strong battle. He will sulk on the bottom shaking his head until he weakens and then he will roll on your line. The fundamental rule is to keep the fight within the capacity of your equipment. The taimen is a predator. If your spoon passes through his window, he will take it, generally from the side.

The flesh of the taimen is very delicate, red in color, and very tasty. The taimen in lake Telets are different from the river fish. They have heavier bodies, are darker in color, and they spawn in the fall. Casters regularly take 40 kilo fish in the Biya outflow from the lake.

THE NEL'MA is physically very different from the taimen. It has large scales and is a bright silver color. Its tail is grey, and it has no teeth. It will average 6-8 kilos, though rare individuals can reach 25 kilos. It lives out its life in the quiet waters of large rivers such as the Irtysh and the Ob. The spawning run into the mountain streams occurs in August. The Ob nel'ma run very heavily in the Charysh and the Katun. The Biya does not have runs every year. Irtysh fish ascend the Uba and, in especially heavy runs, the Bukhtarma. The distance the fish travel rarely exceeds 100 kilometers from the home stream. In addition to the migratory fish, there are some resident nel'ma in the smaller rivers. These latter will never exceed 6 kilos, but are not as fatty as the migrants. The resident fish can be taken year around, and in lake Zaisan they are caught in good numbers through the ice.

The nel'ma strike is signalled to the angler when the spoon stops gently. It is immediately evident that you have not got a taimen or a pike. Generally, after a few minutes the nel'ma turns over on his back and can be cranked in. In rare cases, a small nel'ma may wallow briefly on the surface and then roll on his back. The nel'ma requires no particular skill to land, though its soft mouth can defeat the overanxious. The nel'ma that migrate up from the Ob do so in very large schools, but the local fish are found singly or in pairs. One should change to another pool after taking several fish. The nel'ma prefers the quiet backwater near the bank, slow pools with clay bottoms, and the pockets behind large boulders. The nel'ma is considered by many to be better eating than the taimen or kharius.

THE LENOK, which locals call the uskuch, is most widespread in the Katun system. It is rare in the Biya, rarer still in the Charysh, and I have not found them at all in the Uba or Bukhtarma. Evidently, the Irtysh system has no lenok. The lenok spawns a bit earlier than the taimen. After spawning, together with the kharius, the lenok follow the spawning taimen in order to feed on the roe. The lenok is a very pretty trout-like fish. It has the same black spots as the taimen, but they are distributed on a brownish-grey background.

The tail is rose colored with a bright violet shading, the pectoral fins are yellow, the back is irridescent. The teeth are very fine.

Lenok are taken in mixed bags with taimen on spoons. But it is really most sporting to take them with artificial flies or grasshoppers. This latter method offers fast, exciting, and very productive fishing. Lenok hit hardware only towards fall. The strike is not so heavy as that of the taimen and often comes close to the bank within the angler's vision. If spoons are used they should be fished with an erratic retrieve. The lenok is a fine game fish. It fights hard and long and is often lost both because of the vigor of its resistance and the softness of its mouth. Finesse, not force, takes lenok. They are not hard to find on the stream. They like the backwaters under the cover of foam patches and the downstream sides of large rocks just out of the main current. The average lenok runs 2-4 kilos in the Katun, though 8-10 kilo specimens have been landed.

THE KHARIUS is the most plentiful of the Altai gamefish. He spawns in May in the very small feeder creeks. To reach his spawning stream he negotiates countless waterfalls, some as high as two meters. This spawning run of the kharius is one of the prettiest sights on any small river. After spawning he remains in the stream until late fall, holding in pairs in the pockets and holes. The largest fish fall back downstream in autumn, while smaller ones will winter over in the creeks. I have seen this most often in the Katun system. The coloration of kharius changes with his surroundings. Depending upon water color and the bottom, he will be blueish silver, or black, or bright silver. A generalized color scheme would be a smoke grey body with a light rose shade on the tail. The dorsal fin is, of course, particularly pretty. Kharius is a strong, quick, and cautious fish. His average weight is .5 kilos, but the Biya holds individuals weighing up to 2 kilos. Siberian locals catch great numbers of kharius on grasshoppers and artificial flies--one hundred in an evening is no surprise. In the early season, worms are a good bait.

As for the other gamefish in the Altai, the shchuka, and okun are found, of course, in the lower reaches of the larger rivers. Nalim come well to live bait at night in the main streams in the fall where deep fishing with wire line produces excellent results.

Good equipment is essential in Altai fishing. Above all, good quality treble hooks are necessary, and you will need a lot of them. Taimen easily straighten hooks. It is better to use large hooks and miss a few small fish than to miss the chance to land a really big one that you have come thousands of kilometers to battle. Hooks get dull fast on these rocky streams, so a file or hone is also important to have along. Spoons should be of good quality, the heavier the better. I make my own from brass. They are 1.5 mm thick and 120-150mm long with two hook hangers--one on the business end and one in the middle. Color makes a difference. In the upper streams dark bait fish predominate, so dark spoons are preferred, though natural brass will do. In the lower stretches a tinned finish is most productive. Taimen, by the way, will also take an artificial mouse made from rags and squirrel or badger tail. This bait should be fished rapidly back against the current to imitate a swimming rodent.

For nel'ma, use the same spoons, of slightly smaller size, that work for taimen. Any small spoon or spinner worked with an erratic retrieve will take both kharius and lenok.

Heavy sinkers are a must--as much as 50-70 grams. In smaller water this weight can be halved. You can do without bobbers, but if you feel you must use them, bring along three times as many as you think you will need. Taimen tear them off and smash them in the late stages of the fight with their rolling tactics. Swivels and rings should be of high quality and should be capable of bearing at least 25 kilos. Clearly, your everyday terminal tackle will not do in the Altai.

Many anglers use heavier line than is necessary. One hundred fifty meters of .8 or .9mm nylon is sufficient. Once, after losing my outfit in a capsizing, I used a reserve reel with .6mm nylon on a silver fir branch and was able to land dozens of taimen up to 37 kilos. Of course, I lost several large fish on this tackle. Your reel should have sufficient line capacity to handle the largest possible taimen and, most important, it must have a good drag system.

Rods are a matter of personal taste. Mine are homemade with a fir butt and a split bamboo tip. A very stiff rod is not desirable because it means too many lost fish. If you plan to cast for really large taimen from a boat, you will find that a rod more than 2.5 meters long is a handicap since it tires the angler and makes landing the fish a very awkward operation. Local fishermen prefer, and do very well with, fir rods. They are light, durable, elastic, and much preferred over birch or birdcherry.

Over the past several years I have fished from boats, from rafts, and from the bank. Drift fishing from a boat or raft is without question the best way to go. From a boat the angler can pick his spot to cast and can position himself with the anchor in a fight with a big fish. A boat also means recovery of dozens of spoons that would otherwise be lost. It is best to have a partner with you in the boat on these mountain streams. I always inquire about a new stretch of water from the local residents. The lumbermen are particularly knowledgeable. If I discover that there are dangerous places to negotiate I always go well ahead of the rapids and look it over carefully before deciding whether to run it or to line the craft down. Rather than risk disaster, I most often work the boat on the rope from the bank unless conditions make that impossible.

Rubber boats are not worth much here in the Altai. A kayak is not a bad choice if it has two seats and a solid bottom. The boat must be sound, easy to handle, and capable of carrying a certain amount of weight. Flat bottomed boats are great to fish from, but do not handle well in heavy water. Forget your oars. We use only poles and paddles in these wild rivers. It is simply too difficult to get a swift response in tight places using oars.

You should always have a couple of anchors aboard. One should be light and the other heavy enough to hold in strong current. Both should be made fast to the bow. The lighter one is used only when you want to slow your drift, an essential tactic in fishing a long pool carefully. Without the lighter anchor you will either zip through good water or be blown willy-nilly by the wind in open stretches. The boat should be run close to the bank in such a way that you can cast to the main current. If there is a choice, I have found it best to cast from the lower bank to the higher.

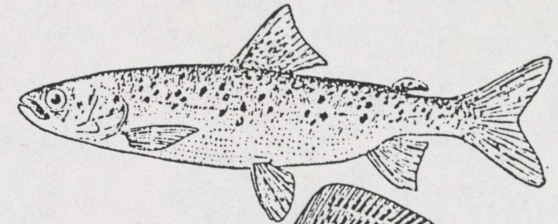
There will be times when a boat cannot be found, or made, and you will be obliged to make do with a raft. A raft, of course, is hard to hold at anchor, so you will be passing up some good water. It is also very difficult, sometimes impossible, to get a raft back up river. When forced to employ a raft it is best to fish from the bank, using the raft only to get from one pool to the next. Without doubt the least productive way to fish the Altai streams is to fight your way through the brush along the banks. On the larger steams it is hardly worth the effort it takes to pack enough supplies for a month on your back. The smaller streams, as I have already noted, are often more fishable from the bank. I have rented horses for short trips along the feeder creeks.

As is the case in any fishing, success depends to a large degree upon your ability to read the water. In the Altai streams this is not very difficult. The structure of these waters virtually shouts "FISH!" Taimen are found in the holes and basins on small streams and at the heads and tailouts of the pools on the larger water. During the mid-season _taimen_ do not hold in the middle of the pools. In June the _taimen_ are found in the faster runs and in shallower water than at other times of the year. In the fall you take _taimen_ from the deepest holes, though they still exhibit a slight preference for the upstream and downstream edges. _Taimen_ will also hold in the slick behind a large boulder in mid-current.

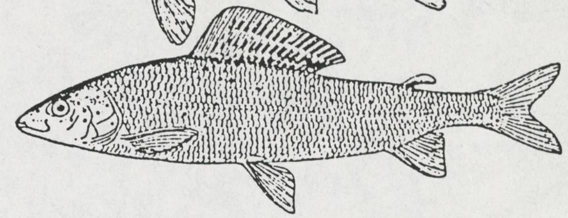
When drifting along the bank you should drop anchor as soon as you feel a strike. If you have to haul anchor to fight a big fish you can pole back upriver to the same spot to cast again. If you have the time, it is always best to fish both sides of a good looking pool. At a bend in the river you should fish from the inside of the curve. Fish the lower side of a confluence. Don't neglect the shallows. In the larger rivers _taimen_ will chase minnows here early and late in the day. Both _taimen_ and _nel'ma_ often reveal themselves as they scatter baitfish to the surface in such places. As a general rule, the speed of your retrieve should slow as the season progresses. The closer to freeze-up it is, the slower and deeper you should fish.

It is not easy to get to the fishing in the Altai mountains, but if you do make it, you will have a store of memories to last a lifetime.

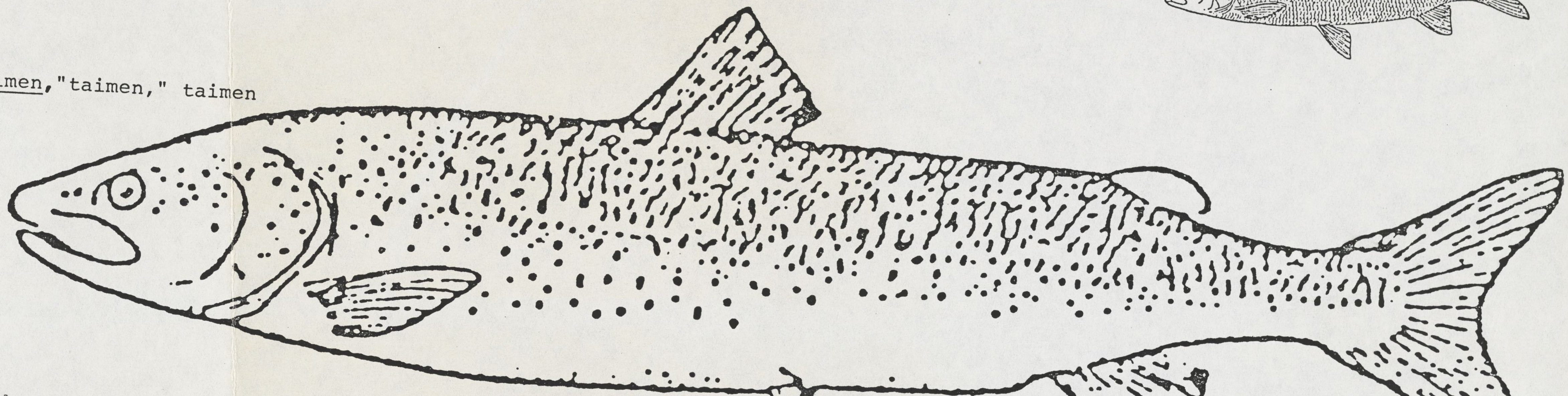
Brachymystax lenok,"lenok," trout



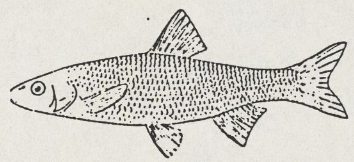
Thymallus thymallus,"kharius,"grayling



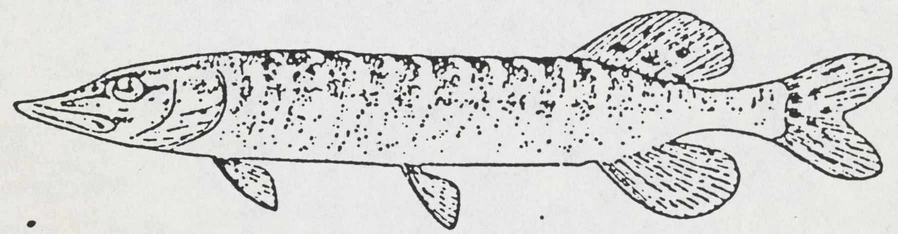
Hucho taimen,"taimen," taimen



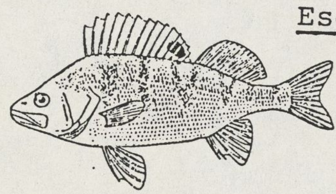
Leuciscus leuciscus,"elets," dace



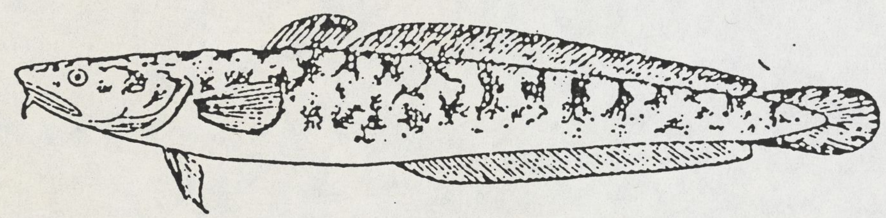
Esox lucius, "shchuka," pike



Perca fluviatilis, "okun," river perch



Lota lota, "nalim," burbot



ALTAYSKIY KRAY
GORNO-ALTAYSKAYA AO
VOSTOCHNO-KAZAKHSTANSKAYA OBLAST'
KHAKASSKAYA AO
TUVINSKAYA AO
UBSA NUUR
BAYAN-ÖLGEY
HOBDO
DZUNGARIA
Barnaul
Biysk
Gorno-Altaysk
Semipalatinsk
Ust'-Kamenogorsk
Leninogorsk
Zyryanovsk
Rubtsovsk
Pavlodar
Kuldja
Kobdo
Gora Belukha
Ozero Zaysan
Teletskoye Ozero
Khrebet Dzhungarskiy Alatau
Sayanskiy Khrebet
Kara Irtish
Urungu
Dzoosotoyn Elesun
54°
52°
50°
48°
46°


SEMIPALATINSK
Barnaul
Biisk
Rubtsovsk
Slavgorod
Pavlodar
Ust Kamenogorsk
Riderski
Ulbinskoe
Zmeinogorsk
Ayaguz
Sergiopol
Narinski
Zaisan
Zaisan Nur
Kara Irtish
Bukhtarma
Tarbagatai
(Ta-cheng)
(Chuguchak)
Chingiz Ula
Chingiz Mts
Kalbinski Mts
Narimski Mts
Sari Tau
Ulan Kara
Kokpekti
Arkatski
Chulak Terek
Degelen
Ashchi Kol
Kulunda
Kulundinskoe
Shimolina
Ust Katun
Tomskoe
Zalesovo
Novo Kormikha
Pospelikha
Charishskaya
Ust Kan
Ongudai
Kosh Agach
Chemal
Shebalino
Tuyungur
Katun
Mt. Belukha
Urulski
Chindagatui
Kanaz
Urtingo
Burdjin hs.
Khaba ho hs.
Chinhuai hs.
Khangai Chulu
Cheng hua sze
Bulun Tokhoi hs.
N.E.Old Torgout
N.Old Torgout
N.W.Old Torgout
W.New Torgout
Ussu Bulukhai
Khoshtologai hs.
Urumkhu
Dsegdere
Cheke
Lo-to-bo
Sha-wan hs.
Olon Buluk
Maili Tau
Birlik
Ding-yuan
Emin hs.
Kergen Daban
Saur Ula
Semistai
Dzhair Ula
Kara Irtish
Urungu
Kazak
A.S.S.R.
Oirat
Hsin Chiang

Brachymystax lenok (Pallas) (figs. 36-38)

Salmo lenok Pallas 1773: 717 - in latin: Abundant in rivers - eastern Siberian Mtns., ~ - Yenisei

Salmo coregonoides Pallas [1814]: 362 tab. LXXIV, fig 2. - Mtns - Altai - Ob, Yenisei, L. Baical, Angara Selenga Lena & Vitim, Kolyma

B. coregonoides: Günther 1866: 163 fig. 2 (2 spec.)

Pallas' length 18 and 21 inches Aronmos

23546 BZM Syntype S. coregonoides Pallas

" S. fluviatilis Pall., S. lacustris Lin., " rivers of Siberia"

No 84, by label ~~Etikette~~ ~~etique~~ preceedent, rules .. on which after naming it S. fluviatilis var. added Sal. Taimen, Skin on left side of body and both sides of head; vomer and palatine bones; dorsal & all unpaired fins damaged, fragmented (fig. 36). L.t. total L - ca. 540 Zank. (Smim : 525 SF 470 l.c. (head) 107.

23560 BZM. Syntype S. coregonoides Pall. " S. fluviatilis Pall. Var. S. Taimen Pall. itin. An S. Lenok & coregonoides Pall. No. 256?" No. 86 on ~~etiquette~~ label by preceedent, rules on which after naming S. fluviatilis variety - added Sal. Lenok?. Skin of left side of body and left side of head; no vomer or palatine bones; dorsal, anal, part caudal fin damaged (fig. 37). T.L. 440, Z.L. 420, S.L. 390, head 86 mm.

Based on Mistake, defined Erroneous determination and notations in catalogue and on label ~~Etiketkax~~, Hax visual obvious as can be seen & that on w/ It. Taimen.

Neither No one or the other specimens - not possible - to designate in qual provisional quality lectotype, such differences for ex. in measurements Pallas' fishes tell little knows us littles (lenth body 1' 1" 5''' - 342.9 mm, length head 2" 8''' - 71.1 mm). Figures are also not a valid basis for description. Both specimens were examined by Günther, who identified them as S. coregonoides. From figure is portrayed, evidently, the smaller specimen (23560). Both of them represent actually all, typical form of the species, but not the later described subsp.

B. lenok savinovi (Mitrofanov 1959). Thus, to here -based on Pallas' international study of the specimens grouped in fast-flowing rivers; i.e., these are fluvial forms, between them and later subsp. - lacustrine.

On structure side of mouth they are close also to typical sharp-snouted form (- see Kifa 1976a 76b., Mina 76)

It follows from this that Vallenciennes (1848: 272) was also studying specimens of S. coregonoides of 13 inche received from Petersburg.

Kifa 1976a - Zoogeografiya i sistematika - zool. [illegible] : 142-56

1976b - Лосос. рыбы - Zool. syst. 46-47.

Mina - ibid: 78.

Кифа, М.И. 1976а. Морфология двух форм ленка (род Brachymystax, сем. Salmonidae) из бассейна Амура и их систематические отношения. В кн. Зоогеография и систематика рыб. Л. Зоол. ин-т АН СССР 1976а: 142-156

1976b Таксономический статус и научные двух форм ленка (- -) из бассейна Амура. - Лососевидные рыбы (морфология, систематика и экология). - Зоол. ин-т АН СС: 46-47.

АКАДЕМИЯ НАУК СССР
ЗООЛОГИЧЕСКИЙ ИНСТИТУТ

А. Н. СВЕТОВИДОВ

ТИПЫ ВИДОВ РЫБ, ОПИСАННЫХ П. С. ПАЛЛАСОМ В „ZOOGRAPHIA ROSSO-ASIATICA"

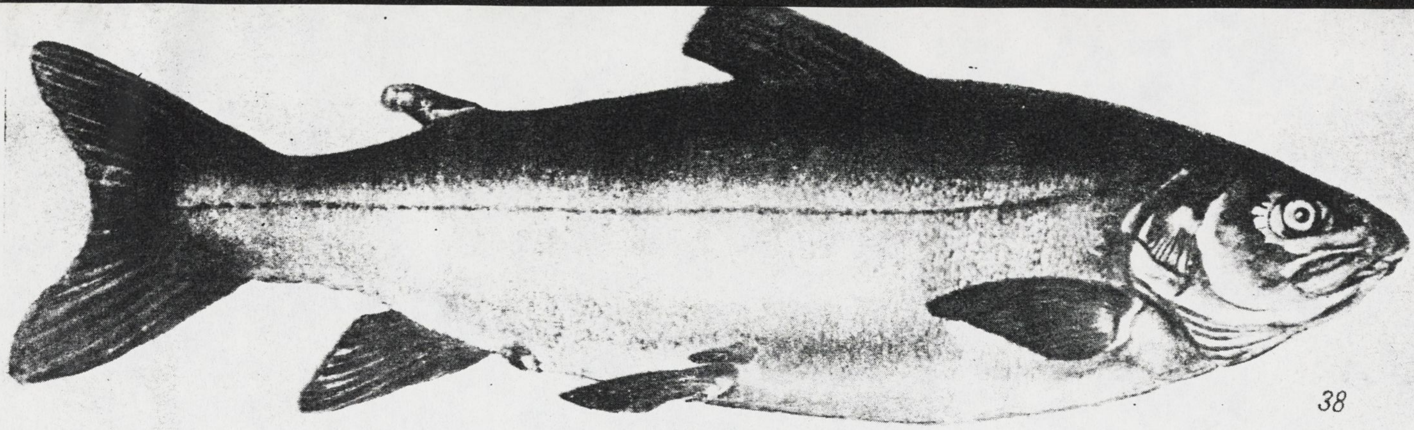
(С ОЧЕРКОМ ИСТОРИИ ОПУБЛИКОВАНИЯ ЭТОГО ТРУДА)

35 р.

Ответственный редактор

| А. А. СТРЕЛКОВ |

ЛЕНИНГРАД
«НАУКА»
ЛЕНИНГРАДСКОЕ ОТДЕЛЕНИЕ
1978



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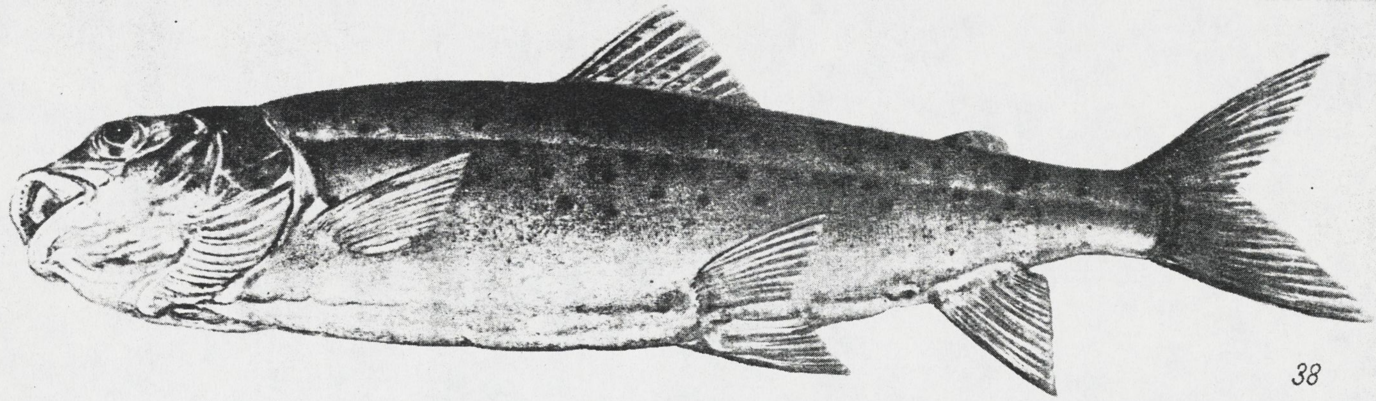

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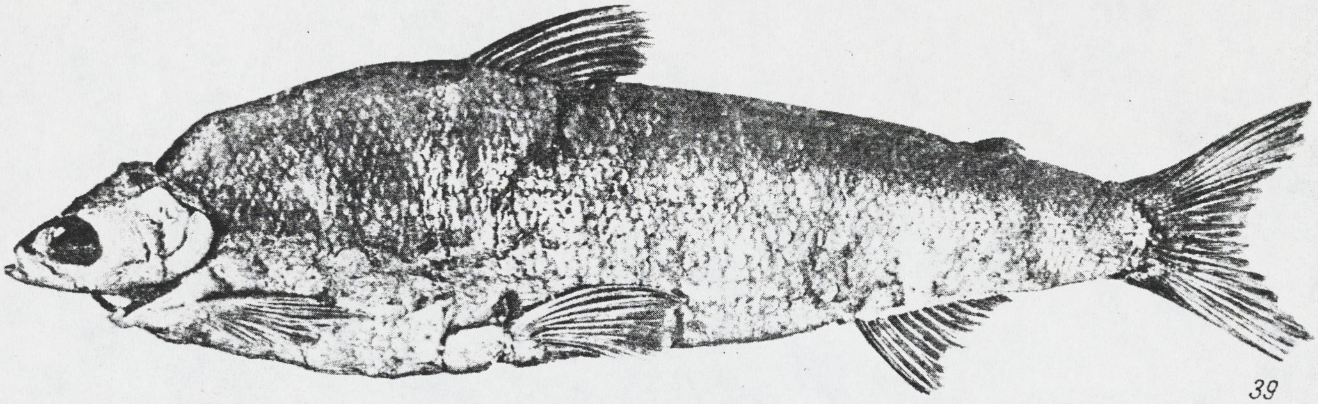

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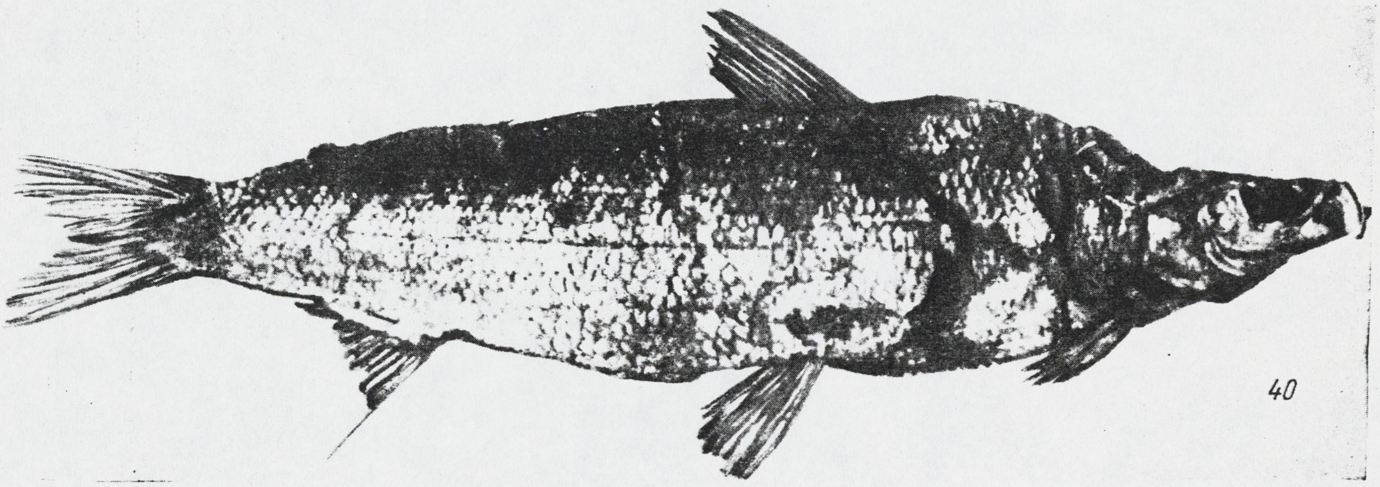
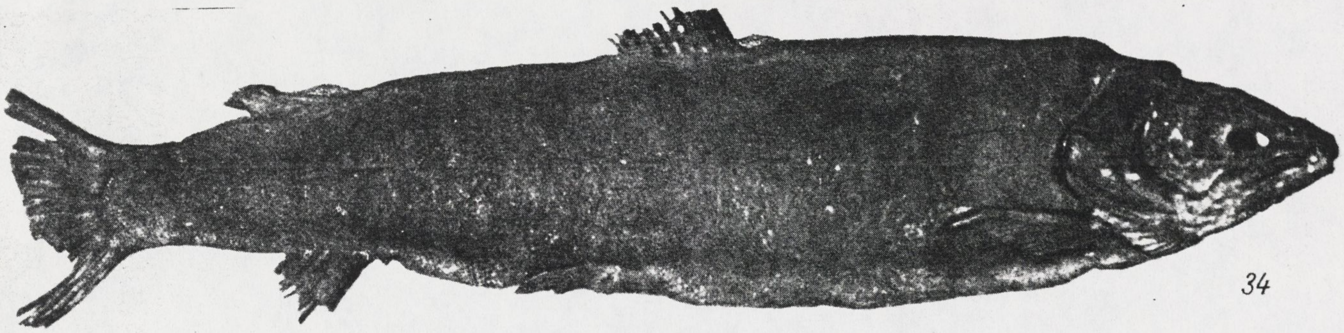


40

Рис. 38. *Salmo coregonoides* Pallas (LXXIV, 1, Паллас ссылается на один рисунок, в Архиве АН СССР их два).

Рис. 39. Лектотип *Salmo clupeoides* Pallas, синтип *Coregonus sardinella* Valenciennes и голотип *C. merki* Günther (23547 BZM).

Рис. 40. Синтип *Salmo peled* Pallas (23555 BZM).



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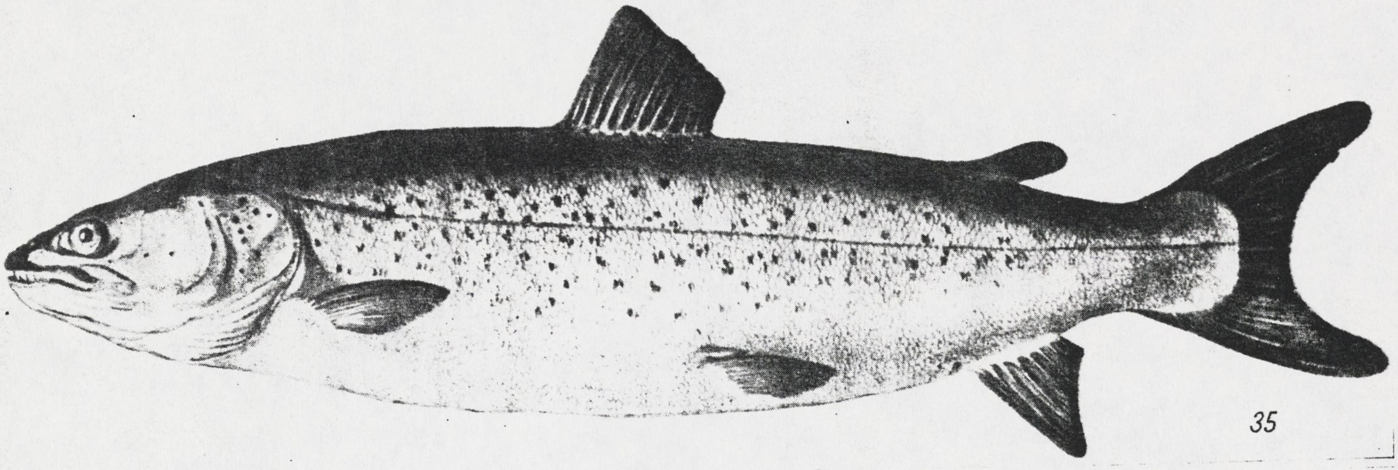

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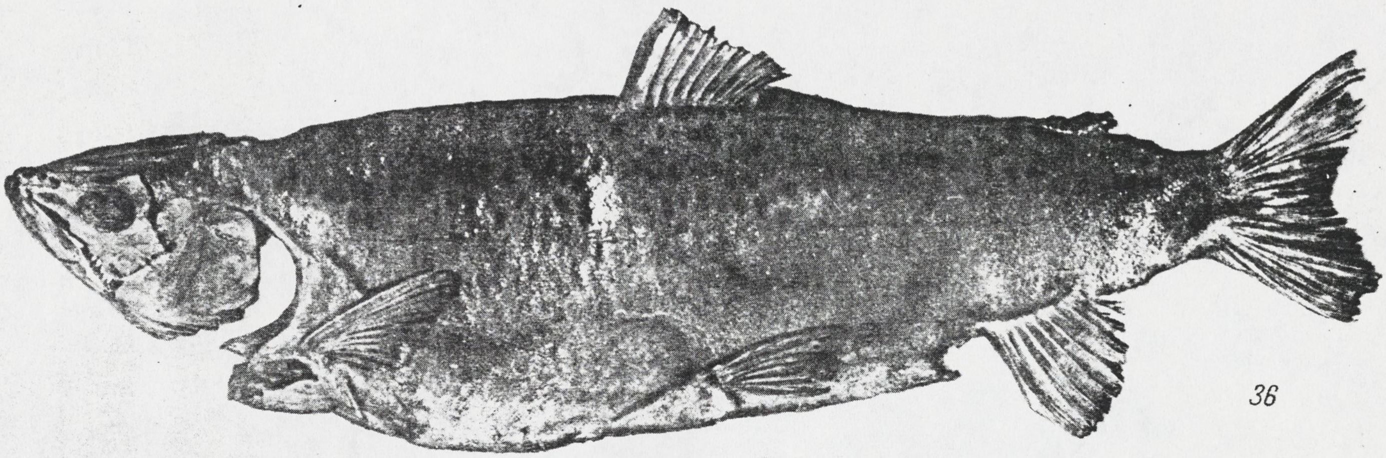

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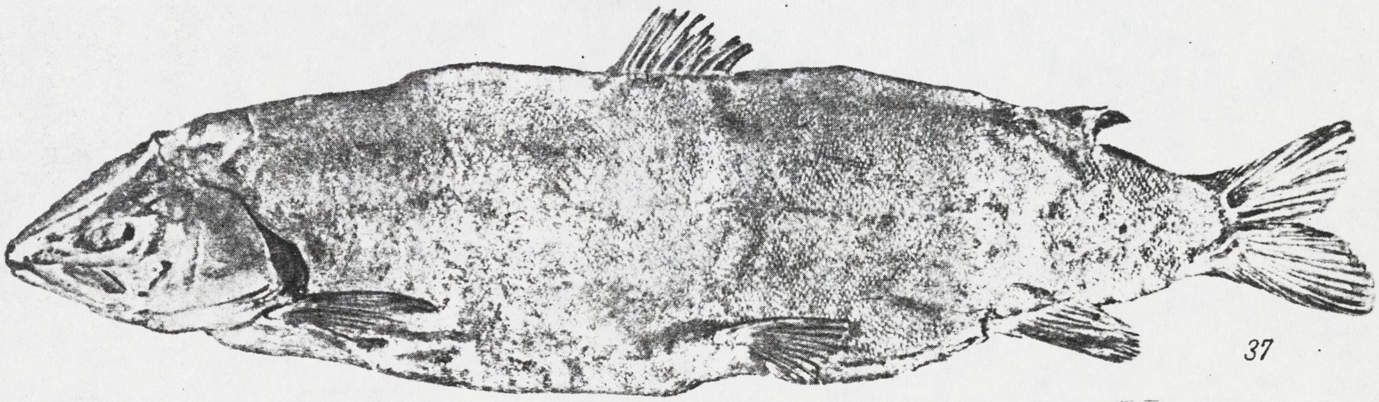


37

Рис. 34. Лектотип *Salmo fluviatilis* Pallas (23561 BZM).

Рис. 35. *Salmo fluviatilis* Pallas (LXXIII, 2).

Рис. 36. Синтип *Salmo coregonoides* Pallas (23546 BZM).

Рис. 37. Синтип *Salmo coregonoides* Pallas (23560 BZM).

V. V. Barsukov

1922-1989

On September 3, 1989 at the age of 66, Dr. V. V. Barsukov, well-known ichthyologist and one of the most senior research workers of the Zoological Institute, USSR Academy of Sciences passed away.

The whole creative period of Dr. Barsukov's life was associated with the Zoological Institute where he worked for 37 years; 17 of which he served as director of the Laboratory of Ichthyology.

Vladimir Barsukov was born on December 2, 1922 in Tobolsk into a large family of teachers. In 1940 he entered the Biological Faculty of Perm University. His studies were interrupted by the Second World War. From 1943 to 1945 he took part in military operations, was wounded twice and received medal of valor. After the war Vladimir Barsukov resumed his studies at the University. In 1949 he began his post-graduate study at the Zoological Institute. He completed that study brilliantly, presenting his thesis in 1953. This work was published in: "The Fauna of the USSR, the family Anarhichadidae". This classical monograph describes the morphological basis for interpreting the main patterns of the evolution of wolffishes from the standpoint of functional morphology. This unique work remains a standard of icthyological research.

After obtaining his graduate degree, Barsukov worked for 2 years at the Biological Station in Borok of the USSR Academy of Sciences and then returned to the Zoological Institute where he worked for the rest of his life -- a long journey from a junior research worker to head of the Laboratory of Ichthyology. During all of those years his life belonged to science and he worked long hours with intensity. His colleagues greatly admired and deeply respected him for his enthusiasm, efficiency and devotion to his work.

In 1981, Barsukov completed his main work, "Rockfishes of the Worlds Ocean, their morphology, ecology, distribution, dispersal and evolution". This work was the basis of the thesis defended by him for the degree of Dr. of Science. In this outstanding work, ideas on patterns of speciation were developed and an original approach for interpreting the phylogenetic history of rockfishes was presented. Barsukov's revision of the subfamily was based not only on comparative anatomy and functional morphology, but also on ecological analyses of more than 120 species. This approach allowed the opportunity to consider relationships within genera of rockfishes from a new standpoint. Results of these studies were reflected in commercial practice.

Barsukov published about 100 scientific works. One fifth of them have been translated and published abroad. He visited United States twice, in 1979 and 1981-1982. As a result of collaboration with American colleagues, joint works were published.

O→

R. J. Behnke, Colorado State University, wrote after death of V. Barsukov: "I have the fondest memories of the friendship of V.V. ("Volodya") Barsukov. He was most instrumental in making my 1964-1965 USA-USSR Academy of Sciences exchange visit a rewarding and enjoyable experience. His warmth and hospitality during visits to his home north of Leningrad remain as memorable events--fishing, swimming and hunting for wild mushrooms while discussing the prospects for world peace.

I saw Volodya at the 1979 ASIH meeting in Maine during his visit to the U.S.A. I saw him again in 1982 when he was at the California Academy of Sciences. His 1981-1982 visit to California was a rather sudden event and the California Academy was not prepared for hosting the head of the ichthyology department of the Soviet Academy of Sciences. Barsukov was housed in a makeshift compartment in the basement of the Academy. He enjoyed his visit and thought everything was just fine despite his rather dismal living quarters. To put things in perspective, one would have to know of the hardships in the life of Barsukov and the toughness of the average Russian. At the end of World War II, Barsukov's army unit was in eastern Europe. With the lack of a transportation network, he and his comrades simply walked 2000 miles home, and thought nothing of it.

I once tried to show Barsukov how to make vodka more palatable by pouring it over ice and adding vermouth to make a martini. He was a true Russian patriot, however, and though such tampering was a desecration. All in all, V. V. Barsukov was one of the most honest and decent persons I have ever had the privilege of knowing".

~~Dr. V. V. Barsukov~~ He was elected an honorary member of the American Society of Ichthyologists and Herpetologists.

During his career, Barsukov took part in many research expeditions to the Irtish and Ob rivers, the Barents Sea, Gulf of Alaska, and Chukotsk Peninsula. In 1957 he took part in the second cruise of the Soviet Antarctic expedition on the research vessel "Ob".

Barsukov participated in research, organizational and public activities. He was a member of the advisory boards of the Zoological Institute and Leningrad University, a member of scientific council on biosphere of the world's oceans and council on data bank of the project 8b HAB.

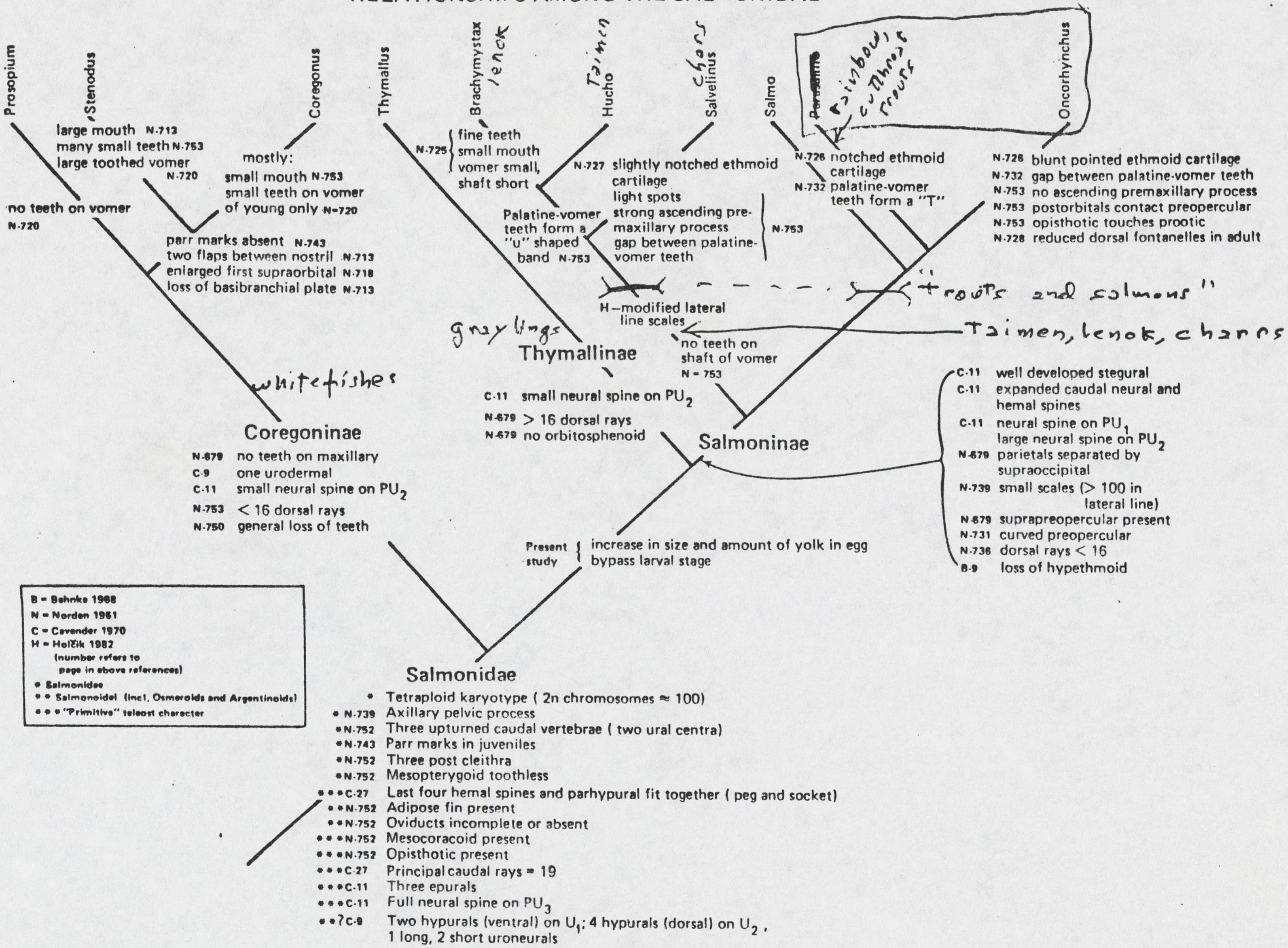
V.V. Barsukov died when he was at the peak of his creative ability. He was making plans for the future and had been working on a manuscript of a new monograph on rockfishes (over 1000 pages). During his last hours, he was writing a paper on fossil forms of ~~red~~ rock fishes and their relations with recent species. The death of Dr. V. V. Barsukov is a severe loss to all ichthyologists and zoologists who knew this remarkable person, man of principle, always friendly and willing to help, his memory will forever remain in the hearts of his friends.

rockfishes

E. Dorofeyeva, Z. Krasyukova,
A. Neelov

Kendall & Behnke 1984

RELATIONSHIPS AMONG THE SALMONIDAE



Professor Robert Behnke
Dept. of Fish Biology
Colorado University
Fort Collins, Colorado 80523

Oct. 12, 1990

Dear Professor Behnke;

Enclosed are the slides and article published in a local newspaper as I promised. I am also going to send you more slides of "limba" (blunt snouted) and lenok (sharp snouted) when I recieve copies.

It is exciting to discover first hand a new species of fish. The fish on slide #1 I caught in slow moving water. It was the first limba to be caught. It was on the Kiundiudey river east of the Lena river. The Kiundiudey flows slightly south of the Arctic Circle.

We began approx. 200 km. up river. The ratio of lenok to "limba" was about 8 to 1 at that point. As we traveled down river the ratio de-creased. On the fifth day it was about 3 lenok to 1 "limba."

In the Tuva republic 9 limba were caught. They were called lenok by the Tuvans.
If possible, can you send me a report on the fish we sent to you. I am also curious as to what scientific name will be given to the fish.

I Will becurrently writing an article in Fly Rod and Reel magazine on this exploratory trip. You have been extremely helpful on your findings. I look forward to hearing from you.

Sincerely,

Lee Hartman

Lee Hartman
Soviet Sports Connection
R.D 1, Box 287-G
Pennsburg, Pa. 18073

Colorado State University

Department of Fishery and Wildlife Biology
Fort Collins, Colorado 80523
(303) 491-5020
FAX (303) 491 5091

November 9, 1990

Dr. William N. Eschmeyer
Department of Ichthyology
California Academy of Sciences
San Francisco, CA 94118

Dear Bill:

I must tell you that I'm thoroughly impressed with your genera of fishes book. The amount of information that was assessed, synthesized, and interpreted is simply mind boggling.

If you're ready to start with updating and revision, I have a problem for you concerning the genus Brachymystax. You list: Brachymystax described by Günther 1866, based on Salmo coregonoides Pallas 1811 -- type by monotypy. The problem concerns the fact that more than one species of Brachymystax exists and the uncertainty of assigning Pallas' names lenok (1773) and coregonoides (1811) to these species.

During the past few years, sport fishing in Siberian waters has become increasingly popular with American anglers. Some of these anglers are good field naturalists and it became apparent to them that they were catching more than one species of Brachymystax. This summer two specimens, known by the common names of "lenok" and "limba", caught in the Lena River basin were sent to me for identification. Enclosed is a copy of a letter to one of these anglers detailing the problems concerning a decision on correct nomenclature.

Pallas named Salmo lenok in 1773 (vol. 2 of "Reise" -- through provinces of the Russian empire). Pallas' 1811 publication (vol. 3 of Zoogeographic Rosso-Asiatica) contains a description of another "lenok" as S. coregonoides. Both of the descriptions mention that the upper jaw "slightly" extends beyond the lower jaw (lenok and coregonoides both are characterized with slightly subterminal jaws). The description of coregonoides includes mention of a "fleshy" protuberance or extension associated with upper jaw.

Günther 1866, vol. 6, catalogue of fishes . . . created the genus Brachymystax on the basis of small ova size (actually mature "lenok" ova are not much smaller than the ova of other salmonine fishes). Günther refers to "two specimens from Pallas' collection . . . one (no. 86) is 18 inches long and evidently the typical specimen; the other (no. 84) is 21 inches long, and although named "<u>G. fluviatilis</u> var. <u>taimen</u>", is most certainly another individual of the same species."

Günther illustrates the head of a fish with a slightly subterminal jaw. Under the caption "1. <u>Brachymystax</u> <u>coregonoides</u>", and beneath the figure, <u>Salmo</u> <u>lenok</u>, Pallas, Reise . . . and ---------- <u>coregonoides</u>, Pallas, Zoogr. Ross-As. is written. It seems apparent that Günther considered Pallas' description of <u>lenok</u> and <u>coregonoides</u> to be based on the same species, and he clearly recognized that the name <u>lenok</u> was published before <u>coregonoides</u>. He probably used <u>coregonoides</u> as the type of genus because this name may have been used by Pallas to label specimen 86, as implied in the above quote, but based on Günther's description of the assumed monotypic genus, <u>B.</u> <u>coregonoides</u> would clearly be a synonym of <u>B.</u> <u>lenok</u>.

You'll note in my letter to Mr. Hartman that there is no doubt that there are at least two species of <u>Brachymystax</u>, which the local inhabitants of the region they fished called "lenok" and "limba". The "limba" specimen has a pronounced subterminal jaw with a massive, fleshy snout. This extreme appearance may be due to old age and large size and could, conceivably, be the same fish described by Pallas with a slightly subterminal jaw.

There is an obvious problem for assigning correct names to species of <u>Brachymystax</u>, but the first step requires better delineation of phyletic lines, then a nomenclatorial revision. M.I. Kifa, 1976, in Zoografia Systematika Ryb, Zool. Inst. Acad. Sci., acted as a revisor to conclude that <u>B.</u> <u>lenok</u> refers to the subterminal jawed species with the higher number of gillrakers, that <u>B.</u> <u>coregonoides</u> is a synonym of <u>B.</u> <u>lenok</u> and the name <u>savinovi</u> is the first name applied to the terminal jawed species with the lower number of gillrakers. As I pointed out, Mori's description of <u>B.</u> <u>tumensis</u> is almost certainly based on the low gillrakered species and it has priority over <u>savinovi</u>.

In any event, Günther and Kifa agree that Pallas' descriptions of <u>lenok</u> and <u>coregonoides</u> refer to the same species, and although Günther selected <u>coregonoides</u> to be the type of <u>Brachymystax</u>, it is a synonym of <u>B.</u> <u>lenok</u>.

Any ideas toward a resolution of nomenclature problems of <u>Brachymystax</u> would be appreciated. Pallas' specimens, if still in British Museum collection, would be a start.

Sincerely,

Robert Behnke

RB/jem

Enclosures

9-1-90

SOVIET SPORTS CONNECTIONS, INC.

Hunt Lane
Flourtown, PA 19031
Telephone: 215-233-9657
Telefax: 215-233-9638

Kuondz R [illegible]

Dear Bill

The largest specimen is what the Russians call "limba". The smaller one is mountain "lenock" They were taken in river Kiundiudey (Кюндюдей) which is between the larger rivers Dianeshka and Undiuliung (Дяньшка и Ундюлюнг) which flow westerly into the Lena, north of the Вилюй.

East of the Lena, North of the Aldan (Northeast from Yakutsk) is the Verkoyansk Mountain range and the distribution of these fish appears to be the rivers which flow east to the Lena and South to the Aldan. I have no information about rivers to the north or east.

Last year we took lenock west of the Lena which differed significantly from these "lenock". The mouth was smaller and tended to be oriented downward, reminiscent of a whitefish. The upper jaw was somewhat "snoutlike". These lenock were nearly always colored with 3 or more (larger 4 or 5) irregular vertical reddish bands — quite crimson. Tails and fins were not colored. There was significant variation in the colored banding. Enclosed is a photo which is atypical as to color but which shows the "overbite" of the jaw.

We took the same lenock this year in Tuva, far to the South, and I believe this to be the "typecal" lenock of the USSR.

These mountain lenok are different. The mouth is larger and more "trout like". Very spotted. Never any "color" anywhere.

The Limba also has the larger mouth but has the "snout like" upper jaw. It is always very brightly colored — more to orangy-red than crimson. Normally, the coloration extends down the entire side of the fish in irregular, connected blotches. The lower half of the tail and the anal posterior fin are also colored.

Lee Hartmann will send you slides of both the Limba and Lenock.

Both fish inhabit the same water but we observed a ratio of 5-6 lenock to each Limba in the headwaters. The ratio gradually evened out to about 40-45% limba as we decended to bigger water. The Limba is a scrappier fish, more aggressive (if that is possible!) and fights better.

They stay in typecal trout water, away from fast currents and frequantly cruise slack water. Both are very aggressive, opportunistic feeders. Stomachs were full of may fly nymphs & adults, caddis cases, and, frequently, mice. In Lenock/Limba water we saw no small forage fish nor did we find small fish in the stomachs, probably because they had long ago been eaten.

Aug 1989

Alenyok River, Yalat[illegible]

Zool.
zhurn
1990. 69(7): 80-98
ОСТРОРЫЛОГО
ТУПОРЫЛОГО
ДЕНКА.
Kuznda R.
h. Leprindo
saviinnai

Along some shallower, braided river streaches we found only Grayling and it appears to us that Lenock/Limba totally dominate the deeper waters.

Both are unbelievably aggressive. Frequently, we lost fish but recast quickly and rehooked them. One ~~time~~ — six times the limba rushed the artificial mouse before he was successfully hooked!

The Limba reputedly ranges up to 7 kg but the largest we took was about 4. They averaged 2½-3 kg. The Lenock ~~were~~ only slightly smaller. The river was quite fertile and is consistant with our experience last year. The sizes are dependant on the fertility of the water. In a given river or a given reach they tend to be all about the same size. In 3½ actual fishing days six of us landed over 250 fish in the 2½-3 kg range.

If you publish anything after your examination I would appreciate a mention as to your source of information. I have now hired a full time fishing scout who will be investigating other regions and we would be pleased to continue the relay of information.

Best Wishes

Bill Davies

First trout/salmon stamps on sale in 1991

The Pennsylvania Fish Commission will be selling the first of state trout/salmon stamps in 1991.

The stamp depicts the state fish, the brook trout, intercepting a Mayfly nymph — a scene that is repeated day in and day out in many of Pennsylvania's coldwater streams.

The stamp is more than something to be affixed to a fishing license, according to the commission — it is a symbol of the conservation of our natural resources.

The Fish Commission, well known for its leadership in the conservation field and its slogan "Resource First," made the commitment to protect, conserve and enhance the natural resources of the Keystone State — in this case, the natural coldwater resources of the commonwealth.

In addition to the stocking of 5.3 million legal-sized trout annually and the upgrading of existing hatcheries, the trout/salmon stamp will also help pay for the management of wild, native and stocked trout waters within the state.

Trout are a symbol of cold, clean waters that must be managed to ensure that trout have suitable habitat. Studies are also necessary to determine angler use of the resource.

Studies indicate when streams are becoming degraded and what might be done to stop such degradation. Size and creel limits are also a management tool designed to provide trout fishing opportunities and to allow trout to provide recreation and still reproduce and grow in a healthy environment.

Coldwater streams in which most trout live are often headwater streams and tributaries to larger streams. The trout is perhaps the most fragile of all species found in the commonwealth and can be the first to signal problems that may filter into our larger waterways, which may affect other species and eventually the water we drink.

The enforcement and protection of our coldwater resources will also be paid for in part by the trout/salmon stamp. Few realize the hours waterways conservation officers spend patrolling our coldwater streams, not only to enforce fishing regulations but also to track down and prosecute those who would, and often do, pollute our coldwater resources.

Salmon, of course, are found primarily in the waters and tributaries of Lake Erie — a lake thought to be dead not many years ago. Coho, steelhead and the occasional chinook salmon are taken from the lake's waters, and coho migrate into the tributaries each fall along with a growing number of steelhead.

Taking fish that weigh six pounds or more from small streams offer many the experience of a lifetime. The time it takes to collect eggs and rear these fish is expensive and time consuming, as are the studies that hopefully will lead one day to larger runs of both coho and steelhead in Erie tributaries.

Landlocked Atlantic salmon are taking up residence in selected inland lakes throughout the state, and such plantings are the result of studies to determine if water quality and forage are suitable for such stockings.

Protecting, conserving and enhancing the coldwater resources of the commonwealth in the manner that Keystone State anglers have grown accustomed to costs money, more than the commission can generate from license sales.

Because more money is spent on trout and salmon than any other species, the commission has asked that the trout and salmon angler pay the additional costs through a trout/salmon stamp.

Sportsmen have always been the leaders in conservation and they have always been willing to step forward to pay for the steps necessary to insure the future of any species.

Trout and salmon anglers throughout the state have cast their votes, and many have shown their willingness to pay the extra dollars it will cost to protect, preserve and enhance the future of Pennsylvania's trout and salmon.

Limited edition prints of the stamp artwork are also available. For information and prices regarding the limited edition prints, write to: Fly Fisherman's Gallery, P.O. Box 330, Ennis, Mont. 59729. The Pennsylvania Fish Commission will receive royalties from sales.

Siberians catch Delano angler's respect

By EMERSON HEFFNER
Standard-Speaker Staff Writer

The fondest memory Delano native Lee Hartman has of his recent, groundbreaking trout fishing trip in the Soviet Union isn't about the speckled, red-tinged river fish he caught.

It's about people.

Sure, Lee will never forget that he was one of the first anglers ever to catch a limba, a rainbow trout-like fish that swims in the cold river waters of Siberia.

And you can bet he'll always remember raft-floating down virgin Russian rivers, fishing where no one has ever fished before, in search of the legendary taimen — a fish believed to be a species of salmon that grows to 150 pounds.

But if you ask the 47-year-old flyfishing expert what single thing stands out in his three-week Soviet adventure, he'll tell you about the people of Sangar in northern Siberia.

Just a few days into the trip, Lee and his five American companions found themselves stranded in Sangar, a tiny, dirt-road village about the size of Delano, when a helicopter that was to take them to their camp was on a firefighting mission.

The group of anglers knew nobody, had nowhere to spend the night and had nothing to eat. When some village residents took them into what appeared to be a town hall and sat them at a table upstairs, they didn't know what to expect.

"Here they sent runners out to each of the houses to collect food so they could cook us up a meal," Lee said. "It was unbelievable."

The Americans were stunned by the generosity because every piece of food the village people, like most Soviets, get is severely rationed.

"You've got to understand, these people get 3½ pounds of meat a month, and one bottle of vodka a month," Lee said. "Everything is rationed because of food shortages."

As the local people went upstairs in pairs to greet the Americans, the rest of the townfolk gathered downstairs. Some musicians brought their guitars and drums and set up their band.

Then, the Americans were brought downstairs to join the residents in a party that featured the band playing rock-and-roll, Russian songs and Elvis hits.

"It was the true spirit of Glasnost," Lee said. "I was just shocked that they took to us like they did. This was not set up like the rest of the trip — this was spontaneous."

Culture shock

The trip, which started Aug. 14 when Lee, Soviet Sports Connection company President Bill Davies and four other flyfishing experts flew out of New York City to Moscow, was set up by Davies to discover where American anglers can fish for three Soviet species of river fish.

"We were the exploratory group," Lee said. "They're going to start sport fishing once we find and establish fishing in the better rivers."

Davies' company sent a group of fishermen north of Leningrad last year to establish an Atlantic salmon fishery there, but Lee's group was the first ever to go east of the Lena River, the third largest river in the Soviet Union.

After a two-day stopover in Moscow where they toured Red Square in a Greyhound bus for just the six of them and feasted both nights at Georgian and Russian restaurants ("We didn't see any shortages in these restaurants," Lee said), the group got its first taste of culture shock at a domestic airport.

The Americans needed to take a plane 4,000 miles from Moscow to Yakutsk in northern Siberia, but the things they saw at the airport almost made them turn back.

The terminal had no toilets or toilet paper, and their plane had bald tires, no seat belts and was loaded with flies. The meal for the eight-hour flight was a boiled, cold chicken leg served with a tea-mineral water combination.

The first thing they saw in Yakutsk was a plane that was pushed to the side of the runway after it had crashed four months earlier.

"It's really bad . . . there's truly a cultural difference," Lee said. "You just wonder how the country has survived the way it has."

Some people didn't survive, as Lee would soon learn.

The Americans spent two more days in Yakutsk, a city the size of Hazleton but with no buildings taller than three stories. The entire city sits two feet off the ground, since buildings are constructed on stilts to protect the structures from permafrost. "It's a strange looking city," Lee said.

When the group went to board a helicopter for the flight to camp on the Kiundiudey River, they were delayed four hours because two helicopters were down in the hills of Siberia.

Lee found out later that one helicopter had crashed, killing everyone on board, and the other was having mechanical problems.

"Needless to say we got pretty concerned, since our mode of transportation for the next two weeks was helicopter," he said.

They finally caught a plane to Sangar where, after their night of unexpected celebration with the villagers, they took a helicopter to camp just above the Arctic Circle.

Fishing time

As soon as the helicopter landed, Lee said, most of the anglers got their rods and reels together and began casting into the small river.

But Lee, a Pennsburg, Montgomery County resident who is an electrical technician for a pharmaceutical company, wanted to investigate the ways of the water.

He walked downstream a bit where he saw Mayflies fluttering through the air, and then he saw a large fish rising in a quiet pool.

"That's when I got excited," he said.

Soon Lee and his fishing partners were hauling in lenock, fish that resemble brown trout and weigh three to eight pounds. But everyone got excited when, after catching about a dozen lenock, Lee hooked into what the Soviets call a limba.

"We were the first ones to catch that fish on a fly rod," he said. "But we're not sure if it is a limba or not. There's no classification on this fish anywhere in the world."

The American anglers also question whether the Lenock and Limba are salmon, as Soviet biologists claim. Lee said salmon have more than 12 rays on their anal fins, while trout have between 10 and 12 rays. "I only got up to 12 rays on the limba and lenock," he said.

"Another question I have is, most salmon run to the sea, and these fish don't — they stay in the same water in the rivers."

To clarify the debate, the group sent some of each species to a fish biologist at the University of Colorado, but Lee said the specimens were damaged in handling and mostly decomposed. So, he will send close-up fish photos to the scientist, who will make a determination and publish his results.

Whatever the fish are, Lee said they are good, tough fighters that make short, hard runs when hooked, but they seldom jumped like he hoped they would.

On their five-day float trip, the Americans caught about 60 fish a day, and when cutting some open to clean them for eating, they discovered mice-like creatures in their stomachs.

The fishermen, of course, switched from their Mayfly patterns to a mouse imitation that the fish hit like bass, sometimes whacking a mouse with their tails before engulfing them.

"They would attack that mouse to no end," Lee said. "It was better than any Mayfly pattern."

No lunkers

On the fifth day, the group took a helicopter to the Danashey, a huge river twice the size of the Delaware, to fish for taimen, a species with a 40- to 50-year lifespan.

With only about an hour to fish before darkness settled in at around 11 p.m., the group caught only two small taimen of about three pounds. "They were babies," Lee said.

The anglers had to return then to Yakutsk, and from there they flew to Kyzyl, a town the size of Mahanoy City in southern Siberia on the Mongolian border.

There they had a day to fish in the Little Yennesy River, a "high and wild" piece of water loaded with grayling, a common food fish between one and two feet long.

"They were fun," Lee said. "None of us ever caught grayling before."

He said there were hundreds of grayling in the river, and "you couldn't help catch them" during the day. But a guide told them lenock and taimen hit at night, so Lee and another American fished a river tributary at dusk.

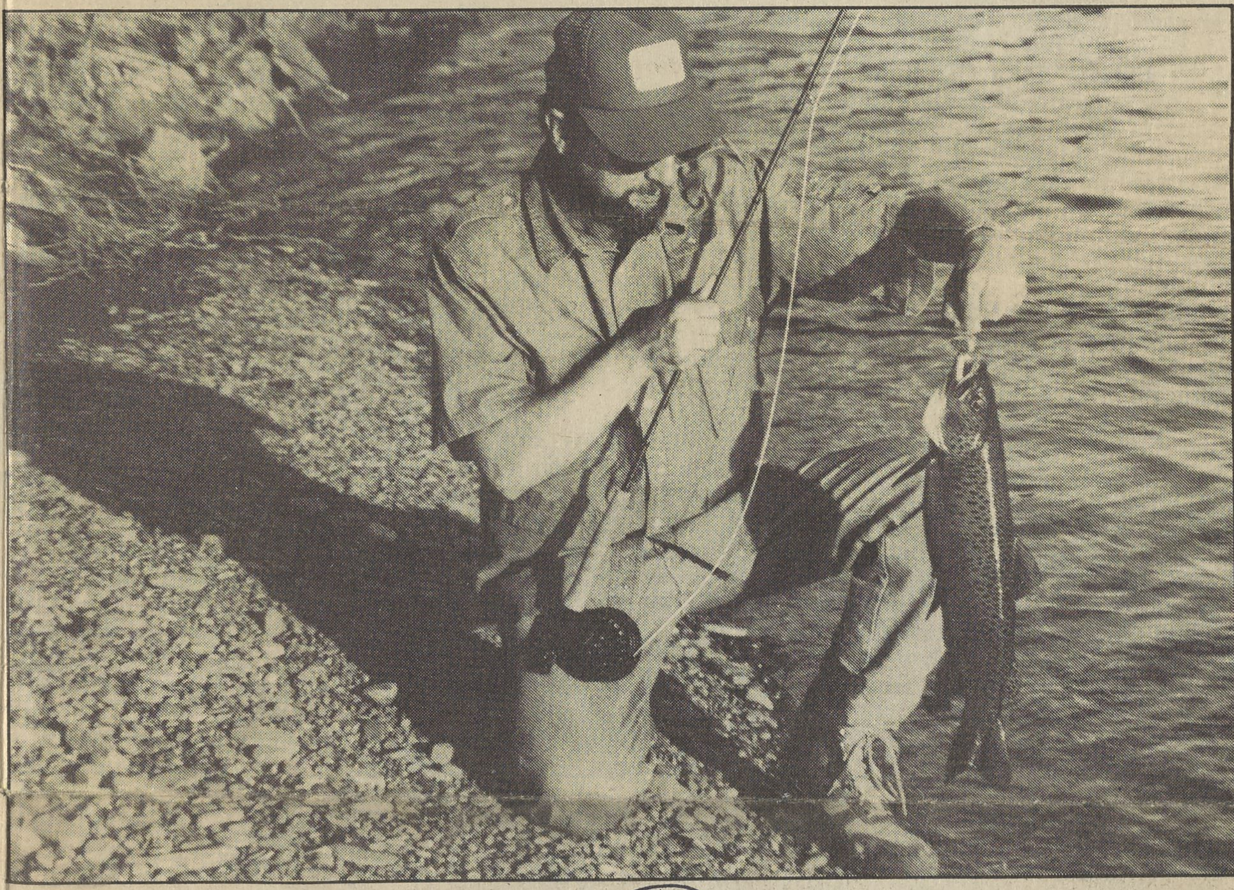
"It was just getting dark and, bingo, we started hitting the lenock," he said. "But oddly enough, they were calling the lenock down there what looked like the limba in the north.

"That's where the confusion comes in, and that's why we sent some off to Colorado. We have to make sure which is which."

Although the group missed the big fish, a wealthy Russian they met on the flight back to Moscow showed them pictures of 45-pound taimen he caught just an hour south of where the Americans were fishing near the Mongolian border.

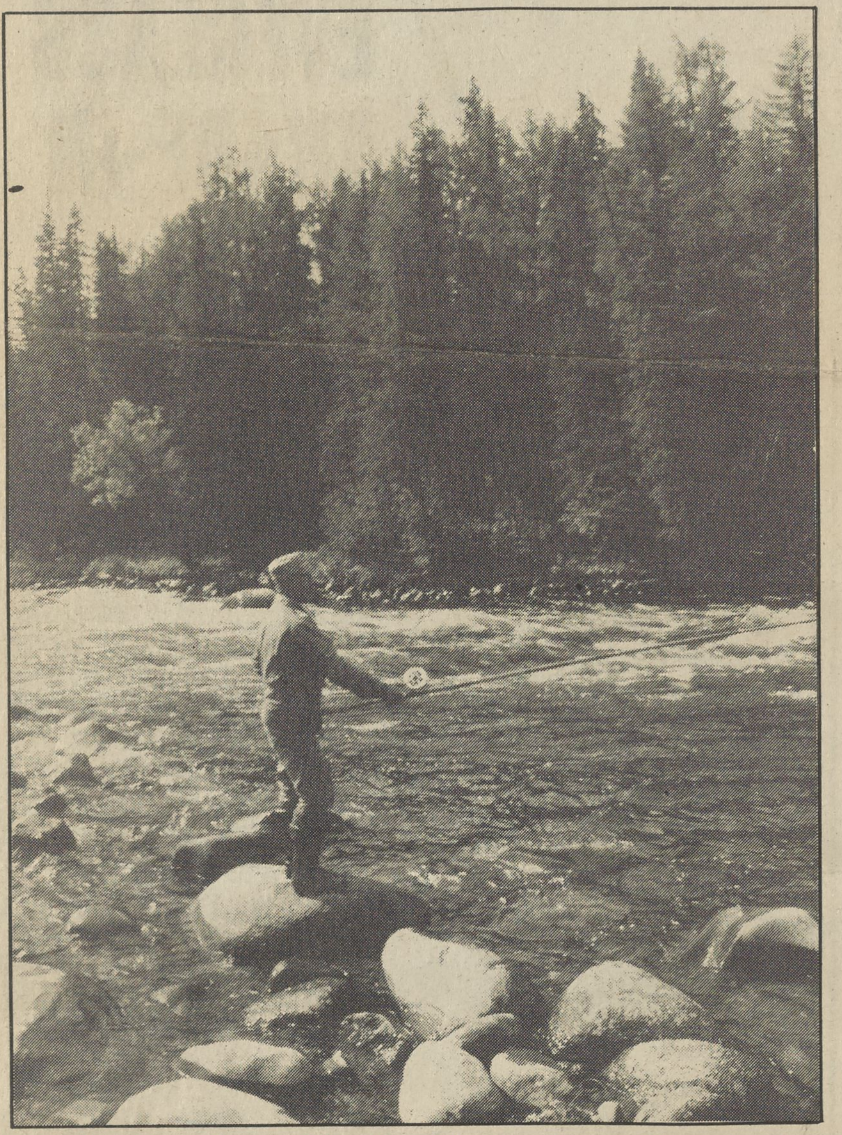
Still, Lee said he will probably exclude the southern area from his next trip and concentrate on more virgin rivers in northern Siberia.

"It's the best," Lee said. "There are a lot of rivers yet to be explored."

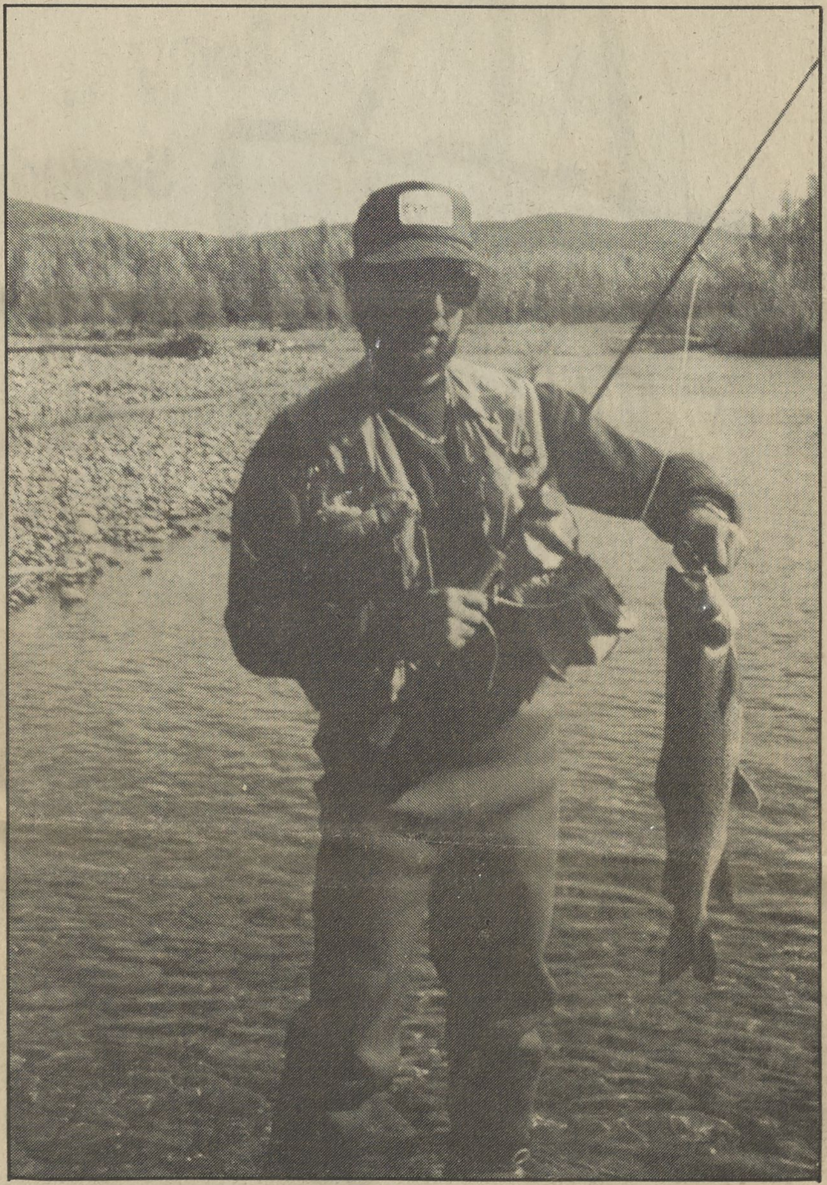


Delano native Lee Hartman holds a trout-like Limba as he kneels next to a Siberian river. The flyfishing expert, during a three-week trip to the Soviet Union in August, was one of the first anglers to ever catch the species on a fly rod.

ОСТРОРЫЛ (ostroryl - sharp snout)



A Soviet sportsman fishes in a Siberian river with a primitive, 18-foot baitcasting rod.



Lee Hartman hefts a Lenock fish. Lee and five other American anglers sent two species of Soviet fish to a Colorado biologist to determine if they are trout or salmon.

ТУПОРЫЛ (typoryl - blunt snout)

Weatherly

Gerry Sell,
211 Carbon St.,
427-4539

Leave items at
Weatherly Pharmacy, Weatherly Plaza
J&E Supermarket, Main & Hudsondale

Dart league slated to start

The Flying Aces Dart League will start on Wednesday at 7:30 p.m. at the clubhouse. Teams are: Electra Glides - Rick Knepper, Joe Makuch, Carl Mengle, Dave Markle and Brian Miller; Low Riders - Darrell Davidovich, Bill Hughes, Jonathan Eroh, Mark Kunkel and Joe Furmanchin; Wide Glides - Jake Stallone, Dan Kairewich, Joe Dolinsky, Ray Derosiers Jr. and Joe Rayno; Soft Tails - Dan Gerhard, Joe Marino, Kevin Baade and Jim Esposito; Super Glides - Bob Bednar, Shawn Markle, Dick Fairchild, Al Fedorick and Jeff Mehlig; Sportsters - Bruce Douglas, Dave Kotch, John Mengle, Bruce Thomas and Ed Grega.

All members are asked to be on time.

BUSY BEES

There are still a few seats available for the Zion Lutheran Church Busy Bees' trip to the Franklin Mills Outlet Mall near Philadelphia on Thursday. The bus will leave the Fell Street side of the church at 8 a.m. and the mall at 5:30 p.m.

For reservations call Margaret Hughes, 427-8123.

ROUNDBALL CLUB

The Weatherly Roundball Club parents of Weatherly varsity basketball players and varsity cheerleaders are urged to attend a Roundball Club meeting today at 7:30 p.m. at the Weatherly High School in Mr. Antinozzi's room.

FUNDRAISER RETURNS

A reminder is given to all students and parents, kindergarten through eighth grade, that PTA fundraiser orders (stick-ees, trays and Christmas wrap) and money are due on Tuesday.

FLOWER CLUB

Mrs. Jack Kokinda was the guest speaker/demonstrator for the Weatherly Flower Club.

She used a variety of materials for her wreaths--forsythia branches, straw, grapevine and huckleberry twigs. For decorations she used a number of colorful and attractive items--silk and dried flowers, herbs, greens and other plant materials.

The awards made were: A, first, prom arrangements - Elva Dargay, second; Maxine Jeffries, third; B, graduation arrangements - Margaret Hughes, first; Doris Sturtevant, second; Elva Dargay, third; specimens - chocolate pepper, Pat Hametz, first; yard long bean - Pat Hametz, first; white and purple dahlias - Paula Gregory, both firsts; small dahlia, Maxine Jeffries, third; love lies bleeding, Elva Dargay, first; purple aster - Elva Dargay, first.

The October meeting will be held on Thursday, Oct. 11. The theme will be "Turn Back the Clock."

The executive committee is hoping that former members will attend and bring any Flower Club memorabilia to share with current members.

Central Michigan, in a 1963 basketball game, took down 111 rebounds against Alma.

Tresckow

Emil Gaydoscik, correspondent
Leave items at
98½ E. Market St., Tresckow

Church news

St. Michael's

First Friday confessions will be heard Thursday from 5:30 to 6 p.m. and Friday before the 8 a.m. Mass. The devotion to the Blessed Virgin Mary will begin at 7 p.m. Visiting of the sick and shut-ins of the parish will begin on Friday at 9 a.m.

Rosary devotion with benediction will be held every Tuesday during October at 7 p.m. except for today when the rosary will be recited at 7 this evening.

St. Bartholomew's

Confessions are heard one-half hour before all weekend Masses.

St. Joseph novena will be held after Mass Wednesday.

The rosary will be recited after Mass on Tuesday.

A cross country meet will be held October 28 at Cardinal Brennan High School in age categories 6-8, 9-11, 12 and over.

CENTER MENU

The menu at the Senior Nutrition Center for this week is as follows:

Today: herbed baked chicken, oven brown potatoes, green beans, creamed cabbage, fruit cocktail, wheatbread.

Tuesday: tomato juice, franks and beans, Harvard beets, salad with dressing, rice pudding, snowflake roll.

Wednesday: pineapple juice, sausage sandwich on roll, winter mixed vegetables, buttered diced carrots, watermelon.

Thursday: blended juice, turkey pot pie, buttered corn, Jello, fresh pear, biscuit.

Friday: roast beef, brown gravy, fortified mashed potatoes, peas, tossed salad with dressing, cantaloupe, rye bread.

Activities for the week: Thursday - legal tips.

LEAGUES TO MEET

Jockey's Dart League will meet Tuesday at 7 p.m. The matches will start at 7:30. The Pool League will meet Wednesday at 7:30 with the games starting at 8.

14 killed, thousands stranded by floods

DHAKA, Bangladesh (AP) — Flooding in dozens of northern villages killed 14 children, stranded tens of thousands of people and damaged crops across wide areas, news reports said Sunday.

Nine children drowned in flooding over the past week in Sirajganj, 65 miles northwest of Dhaka, said United News of Bangladesh, a news agency.

The rain-swollen Jamuna river overflowed its banks in Sirajganj last week, displacing about 300,000 villagers. Many took refuge on the roofs of their mud-and-straw houses.

The Bengali-language daily Sangbad said five children drowned in northwestern Pabna and Manikganj districts after they fell off rooftops into floodwaters Friday and Saturday.

The paper also said floods have affected about 100,000 people in the Sylhet and Netrokona districts in the northeast.

Flooding in this low-lying delta nation annually kills hundreds of people. The region's worst recent floods killed 1,400 people in 1988.

Dart league results

In the Tresckow Fire Company Dart League Sunday night, all the action was on board #2 when the Hydrants swept three games from the undefeated Helmets. On board #1, it was the Hosemen on top of the Laddermen 2-1. And on board #3, it was the Axemen sweeping three games over the Pumpers to move into first place.

Frank Samec was voted the shooter of the week by helping the Hydrants sweep the Helmets.

Those shooting 30 and over were: Dave Mazur 30; Frank Mroz 30 and 36; John Masyado 33; Tom Moro 30; Frank Samec 32, 33 and 38; Jim Lockwood 30, 31 and 32; Shawn Markle 32, 34 and 37; Mike Marusak 31; Connie Minzola 35 and 36; Scott Minzola 35; Jack Callavinni 31, 32 and 32; Mike Fatula 37; Lacey 35, 36 and 40; Rich Contrady 36, 37 and 37; Bruce Noro 32; and Paul Petrulsky 42.

Tom Moro received the rescuer award for the week. High game of the week was shot by Paul Petrulsky with a 42. The high series went to Lacey with a 111. The new high team game was shot by the Hydrants with a 156.

The standings now are as follows: Axemen 8-1; Helmets 6-3; Hydrants 6-3; Hosemen 4-5; Laddermen 2-7; Pumpers 1-8.

The schedule for the week is as follows: Board #1, Pumpers vs. Helmets; board #2, Hosemen vs. Axemen; board #3, Hydrants vs. Laddermen.

PIZZA SALE

The Tresckow Fire Company will serve pizza on Friday from 2:30 to 9:30 p.m. Take-out orders are available by calling 455-5701.

SUPERVISORS TO MEET

The board of supervisors of Banks Township will meet in regular session at 7:30 this evening in St. Bartholomew's Founders' Hall in Tresckow.

CYO NEWS

St. Michael's Chargers will hold a basketball clinic on Friday at the McAdoo-Kelayres gym from 7:05 to 8:40. All players are asked to report at 6:45.

Any parent who has not filled out a permission slip may do so at this time.

4 dead, 19 hurt in bus crash

CEBU CITY, Philippines (AP) — A minibus carrying passengers to a mountain village lost its brakes and plunged into a ravine, killing four people and injuring 19, police said Sunday.

A 5-year-old girl was among those killed in the accident Saturday night, police said.

Police said the vehicle was headed for the nearby village of Mananawan, south of Manila, when the accident occurred. No further details were given.

KLINE ASH PICKUP

Effective Saturday through Saturday, April 6, 1991, ashes will be collected in Kline Township by Motto Disposal, Hazleton.

ST. PAT'S PRACTICE

St. Patrick's CYO basketball team will begin practice sessions Thursday from 7:05 p.m. to 8:40 p.m.

Players are asked not to report before 6:55 p.m.

6 killed, 24 hurt in bus accident

PERPIGNAN, France (AP) — A bus carrying elderly French tourists veered off a highway and into a gully Sunday, killing six passengers and injuring 24, police said.

Thirteen of the injured were seriously hurt and taken to nearby hospitals in the Eastern Pyrenees region of southernmost France.

The group had spent the night in Andorra, a tiny country wedged between France and Spain. The crash occurred near Perpignan, a city on the Mediterranean coast just north of the border with Spain.

According to police, the bus driver reported that the brake system began to fail and the bus skidded along a soft shoulder of the road before plunging about 16 feet down an embankment. The driver was slightly hurt.

The passengers were from the area around Calais, an English Channel port.

Zuber

(Continued from page 19)

present rank and given command of Troop S in Milesburg, where he remained until April 1985 when he assumed command of the Turnpike Detail. Six months later he was transferred to Troop N.

Zuber is married to the former Dolores M. Stoffa of Coaldale, and they are the parents of five children — Maria, a scientist employed with the National Aeronautics and Space Administration at the Goddard Space Center in Maryland; Joann, a critical care nurse at Lehigh Valley Hospital Center in Allentown; Joseph Jr., an industrial engineer with Allied-Bendix in Montrose; Stephen, a financial insurance retirement analyst in Allentown; and Andrew, an accountant with the Marriott Corp. in Washington, D.C.

Group

(Continued from page 19)

"Two Divided by Love." Grill said the record company didn't think "Temptation Eyes" was going to be a hit, and it had sat on the shelf for two years before it was released.

There was one more Top 20 hit in 1971, "Glory Bound." The band's breakup concluded in 1973, but in 1982, the last single released, "She Didn't Know Me," didn't go anywhere "because the record company wouldn't promote it," Grill said.

"Four months later, Bon Jovi recorded it, and it was a hit for them," he said.

Grill, a Los Angeles native, now makes his home in Orlando, Fla. because he is a fishing buff. He and the new Grass Roots play about 135 dates a year, and he spends the rest of the time fishing.

McAdoo

Leave items at Widmann Discount Store
16 N. Kennedy Dr. or
Country Corner Gift Shop, 1 N. Kennedy Dr.
Advertising-Circulation: 455-3636 or 668-2183

Burritos edge out The Doctor in 9th

Beefy's Burritos, who trailed the entire game, rallied to score a 9-8 win over the Deck Doctor and the championship Saturday in the McAdoo Original Softball League.

Behind 8-6 in the bottom of the ninth inning, leadoff hitter Gerald DeBalko singled, followed by a single by Anthony Stratchko.

With no outs and runners on first and second, Norman Baneravage hit a towering fly ball to advance the runners to second and third. Rich Schmeer followed with a scarifice fly to rightfield to score DeBalko and make the score 8-7.

Tony Giranda followed with a two-out single to score Stratchko to tie the score at 8-8.

The table was then set for Dave Kolbush, who hit a 2-1 pitch between Dan Leshko in leftfield and Gene Furlani in left-center and Giranda scored from first on Kolbush's double to win the game.

The championship came in Burritos' second year in the league.

Dave Kolbush was named offensive player of the day. Other contributors to Burritos' offense were: Tony Giranda, Gabe Zapotosky, Gerald DeBalko, Anthony Stranko, three singles each; Norman Baneravage, two singles; Rich Schmeer, Mike Scarlot, Billy Zabrosky and Anthony Befano, one single each.

Deck Doctor was paced by Joe Chernigo with thre hits each; Dan Leshko and Joe Forish with two singles each, and Gene Furlani, Ed Bumbulsky, Jake Yanoshik and Evel Butala and Ed Mack with one single each.

Billy Mack was defensive player of the week, and Beefy Befano had the shag of the week.

The East-West All Star Game will be played this Saturday at 2 p.m. All players who are to participate should be at the field by 1:30 p.m.

Pie sale slated

The McAdoo Ambulance Association will hold their annual Thanksgiving pie sale.

Pumpkin, apple, coconut custard, lemon meringue and cheese cake pies will be sold.

Pies will be delivered Monday, Nov. 19. The deadline for placing orders is Tuesday, Nov. 12. Orders can be placed with any association member or by calling 919-1281.

Fire hydrants to be tested

The Kline Township Fire co. will be testing fire hydrants today and Tuesday between 6 p.m. and 9 p.m.

The testing will be going on throuhgout the township.

Kline Township Fire Chief Gary Perna advised residents if their tap water becomes brown or dirty, to keep the faucet open and the water will become clean.

For any problems or information on the testing, call Perna at 929-3655.

WORK SESSION

Members of the Kline Township Fire Co. will have a mandatory work session today at 6:30 p.m. at the firehouse.

Concerned Citizens will meet Tuesday

The Concerned Citizens of Schuylkill County, Inc., McAdoo Division, will meet Tuesday at 7 p.m. in St. Kunegunda's R.C. Church hall.

Tina Soley, a case manager for the Economic Opportunity Cabinet of Schuylkill County, will be the guest speaker.

She will speak on the activities of the Cabinet, which include: adult attendant care, housing, emergency food operations, crisis intervention, home weatherization, job search, job training, counseling, drug and alcohol programs, homeless assistance, visiting nurses programs and literacy programs.

The public is invited to attend.

CHINESE AUCTION

The ladies auxiliary of the Kline Township Fire Co. met last week to finalize plans for for a Chinese auction planned for Sunday at St. Patrick's School hall.

The doors will open at 12:30 p.m., and the auction will begin at 2 p.m. Items have been solicited from local businesses, and members of the community have also been generous.

Anyone who would like to donate items is asked to contact any member of the auxiliary for pickup.

Tickets for the event can be purchased from any auxiliary member or at the Standard Drug Store.

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РЫБОЛОВНЫЙ И ОХОТНИЧИЙ ТУРИЗМ

США: Хант Лэйн
Флауртаун, PA 19031

Уильям Дейвис
Президент


SKF

#2 YAKUT REPUBLIC, U.S.S.R.
KIUNDIUDEY RIVER
LEE HARTMAN

SEPT 1990


SKF

#1 - TUVA REPUBLIC, U.S.S.R
SERLIG-KHEM RIVER
LEE HARTMAN

8/27

Professor Robert Behnke
Dept. of Fish Biology
Colorado State University
Fort Collins, Colorado 80523

Nov. 15, 1990

Dear Dr. Behnke,

Thank you for your report on your findings of fish specimens sent to you. It is evident more study is needed to clarify each fish species.

I have enclosed two photos for you to look at. Photo #1 shows fish caught in Tuva republic at junction of Serlig-Khem River and Taymak River. Although there is a direct resemblance of this fish to the one in photo # 2, caught in Yakut republic, the mouth structure looks quite different. In all, nine of these fish were caught in Tuva, all at night. This seems to indicate they are primarily night feeders.

Possibly there are three and maybe four different species of lenok in Siberia. Bill Davies informed me the lenok caught west of the Lena River in 1989 were different than the fish of our expedition.

Consequently we plan to have a scientific expedition next season to clarify our findings. Would you be interested in joining with us on such a venture. Please let us know how you feel about this so formal plans can be made.

Sincerely,

Lee Hartman

Lee Hartman
Soviet Sports Connection

cc: B. Davies

Colorado State University

Department of Fishery and Wildlife Biology
Fort Collins, Colorado 80523
(303) 491-5020
FAX (303) 491-5091

November 1, 1990

Mr. Lee Hartman
RD 1, Box 287-Q
Pennsburg, PA 18073

Dear Mr. Hartman:

After represervation of the decomposed specimens, I was able to make a more thorough examination of the "lenok" and the "limba". From my examination of the specimens, from the slides and photos sent by you and Bill Davies, from Bill's account of fish caught in various areas of the Lena River basin, and a review of Russian literature, I'll tell you more about the lenok than you'll need to know, but as more anglers catch lenok and more questions arise on its classification, I can use this letter as a reference source.

There is no doubt that the specimen designated as "limba" (about 550 mm, with subterminal jaws and overhanging snout) and the specimen designated as "lenok" (about 475 mm with terminal jaws) represent two distinct species of the genus Brachymystax. Which species should be classified as Brachymystax lenok and the scientific name of the other species, however, is uncertain.

A highly condensed history leading to the present uncertainty of species recognition in the genus Brachymystax is as follows. The first (and therefore valid) species name given to any form of lenok was "Salmo lenok" by P.S. Pallas in 1773, based on a form of lenok from the Yenesei River basin. In 1811, Pallas named another species of "lenok", "Salmo coregonoides" based on lenok of Ob, Irtysh, Yenesei, Selenga, Lena, and Kolyma basins. Pallas' descriptions are insufficient to unmistakably assign the names of lenok and coregonoides to the terminal-jawed and subterminal-jawed species you know as "lenok" and "limba". Pallas did describe and illustrate his species lenok with the upper jaw "slightly longer than the lower jaw" (slightly subterminal). His species coregonoides is as also described with a slightly subterminal jaw and with a fleshy snout.

The genus Brachymystax for "lenok" species was created in 1866 by A. Günther, who recognized Pallas' species coregonoides as having a fleshy snout. The simplest procedure to assign scientific names to the limba and lenok would be to consider B. lenok as the species with the terminal jaw and B. coregonoides as the species with the subterminal jaw (your "limba"). There are problems of rectitude for such a decision, however. It seems probable that Pallas' original description of lenok in 1773 was based on the species with the subterminal jaw, and there is a possibility that a third, presently unknown, species exists, based on Bill Davies' description of "mountain lenok" and "lenok" caught in eastern and western tributaries of the Lena, and on descriptions of "intermediate" forms in the Russian literature.

L.S. Berg, the most famous Russian ichthyologist, published "The freshwater fishes of the Soviet Union and adjacent countries" in 1948. This work is regarded as the standard reference on the fishes of the USSR. Berg, however, believed that the terminal-jawed and subterminal-jawed lenok could be explained by sexual dimorphism and that all lenok should be classified as a single species, B. lenok. Thus, the information given in Berg's work on B. lenok in regards to distribution, reproduction, growth, feeding, etc. represents a composite of two (or more) species.

From 1972 to the present a series of papers in the Russian literature have clearly documented the occurrence of two distinct species of lenok. The species with the subterminal jaw has more gillrakers (bony projections) on the first gill arch (typically 26-28) than does the species with the terminal jaw (typically 20-22) and the ethmoid bone on the anterior part of the skull (snout area) is more narrow in the species with the subterminal jaw (your "limba"). A 1976 paper concluded that the name B. lenok should go with the species with the subterminal jaw and higher gillraker number ("limba") and the name B. savinovi should be used for the species with the terminal jaw and lower number of gillrakers. I used these two names to designate the two species of lenok in my article in the summer issue of Trout. There are questions, however, on the validity of the name savinovi for the terminal-jawed species. A Japanese ichthyologist, T. Mori, published a paper on Korean fishes in 1930. Mori identified a lenok with a fleshy snout (subterminal jaws) from the upper Yalu River as B. coregonoides; the lenok of the Korean river draining to the west to the Yellow Sea were identified as B. lenok, and the lenok in rivers draining to the east to the Sea of Japan was described as a new species, B. tumensis. If the name B. coregonoides is rejected for the subterminal-jawed, fleshy-snouted lenok with a high number of gillrakers because this species is, most correctly, B. lenok (coregonoides would be a "synonym" [a more recent name] of lenok), then the correct scientific name for the species with terminal jaws and a lower number of gillrakers would be the first name published in the literature that undoubtedly applies to this species. Based on the low number of gillrakers (18-23) recorded for the lenok south of the Amur basin in China, and for lenok inhabiting rivers south of the Amur draining to the Sea of Japan (Primore region of USSR), I assume that this same species occurs in northeast Korea and was named tumensis by Mori in 1930 (savinovi named in 1956, thus would be a synonym of tumensis if both names apply to the same species.

Besides all of this confusion in regards to the correct scientific names to be used to designate the two species, Bill Davies' observations on two distinct forms of lenok occurring in east and west side tributaries to the Lena River is substantiated by reports in the Russian literature of "intermediate" forms of lenok which may have typical gillraker counts of 22-23 or 24-25. Hybridization between the two species has been given as a probably explanation for the intermediates, but their widespread occurrence (Amur, Ob, Yenesei, and Lena basins) suggests to me that a third species may be involved.

In view of such uncertainties concerning the classification of species in the genus Brachymystax, most of the current Russian literature avoids the use of scientific names and refers to the two species as ostroryl (sharp snout) and tuporyl (blunt snout) lenok. The sharp-snouted lenok is the species with the subterminal jaws, fleshy snout and higher gillraker county (your "limba"). This is not an accurately descriptive common name for this species in view of the massive, broad snout it possesses. It does have a tiny acute tip to the snout, however, whereas in the other species (your "lenok") the snout is smoothly rounded.

To clarify the classification of species in the genus Brachymystax, characters that can by unambiguously associated with a particular species must be found. Eventually, such species-specific characters may be discerned from biochemical analysis and chromosomes, but examination of the two specimens suggest some leads.

The "limba" specimen has 9 upper and 18 lower (27) gillrakers, as would be expected in the subterminal-jawed (ostroryl) species. The gillrakers have numerous tiny teeth (denticulation) on their posterior sides. On the lower arch the rakers begin as "normal" blade-shaped rakers, but, along the arch they become flattened and, eventually, bifurcated at their terminus. Unfortunately, the "lenok" specimen was gutted and the gill arches removed so I could not make comparisons for species-specific differences in gillraker structure. The "limba" specimen differed from the "lenok" specimen in having more numerous and more pronounced spots on the adipose fin, operculum and cheek, and by vertical bands of pigmentation on the dorsal fin rays and membrane. Are these characteristics consistent and clear-cut between the species? I noted a relatively broader horizontal gape to the mouth of the "limba" in comparison to the "lenok" - perhaps allowing it to engulf larger prey.

The photos and testimony assert that only the "limba" species develops bright red colors on the body. This may prove to be a "species-specific" character (your specimens came from the Kyundyudei River, a Lena tributary north of confluence with

Vilyui). How well coloration and spotting distinctions characterize the different species cannot be assessed until more information on populations of various river basins is available.

For future trips where different forms of lenok are caught, besides color photos and notes on spotting and dorsal fin markings, the heads of specimens kept for consumption could be preserved in formalin. With a few heads (containing gill arches) of each form (e.g., "limba", "lenok", "mountain lenok"), I could analyze for species-specific distinctions in gillraker structure and cheek-opercular spotting.

In regards to how to refer to species of lenok of the genus Brachymystax, enclosed is a diagram of a family tree of the family Salmonidae. Note that lenok (Brachymystax) form one branch in the subfamily Salmoninae, and the salmon and trout (Oncorhynchus and Salmo) form another. Thus, lenok (all species of Brachymystax) are salmonid (or salmonine) fishes more closely related to taimen and charrs than they are to salmon and trout - but with common names, anything goes, there are no rules to associate common names with classification based on evolutionary relationships. I checked a list of local common names for lenok that have appeared in the literature. "Limba" is not listed, so its use must be very local.

Sincerely,

Robert Behnke

Enclosures

RB/jem

Osinov, A.G. I.I. Il'in, S.S. Alekseev.

ОСИНОВ, А.Г., И.И. ИЛЬИН, С.С. АЛЕКСЕЕВ. 1990.

forms of lenok

ФОРМЫ ЛЕНКОВ РОДА Brachymystax (Salmoniformes, Salmonidae) В СВЕТЕ ДАННЫХ ПОПУЛЯЦИОННО-ГЕНЕТИЧЕСКОГО АНАЛИЗА. Zool. Zhur. 69(8): 76-90.

in light of data pop-

15 enzymes, 31 loci. gen. D w/in

0.0-0.111 sharp
0.0-0.107 blunt
between .019-.216

Don't fit Kifa's criteria as 2 sp. - each a complex of forms differing in morphology - clearly distinct in sympatry, but, as whole, overlap in all characters.

(Kuanda R. (Lena-Vitim) - 3 coll. 1985, 86, 88 hybrids 8.5%, 4.5%, 3.3%) but hybrids mainly young, immature only one sex. mature - prob. dif. mortality against hybrids.

- large seasonal dif. in one form or another and % hybrids at same site.

Markakul and outlet, Kaldzhir R. have 2 morphol. distinct forms of sharp nose (Mina & Alek '85) - differ only slightly in ~~SDH~~ EST-5 (D = .002)

- Although fit Biols sp. concept of reproduct. isol. - lack of 'gap' between sp. in any characters - not good Tax. sp. - Conclude classify as one sp. B. lenok.

ЗООЛОГИЧЕСКИЙ ЖУРНАЛ

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А.Г. ОСИНОВ, И.И. ИЛЬИН, С.С. АЛЕКСЕЕВ

ФОРМЫ ЛЕНКОВ РОДА *BRACHYMYSTAX* (SALMONIFORMES, SALMONIDAE) В СВЕТЕ ДАННЫХ ПОПУЛЯЦИОННО-ГЕНЕТИЧЕСКОГО АНАЛИЗА

Методом электрофореза в ПААГ исследованы 15 ферментных систем, кодируемых 31 генным локусом, в алло- и симпатрических популяциях двух форм ленка из разных частей ареала. Оценки средней гетерозиготности варьируют у острорылой формы в диапазоне от 0,011 до 0,061, а у тупорылой формы – от 0,000 до 0,015. Уровень генетической дифференциации (D_{Nei}) между разными популяциями острорылой формы от 0,000 до 0,111, у тупорылой формы – от 0,000 до 0,107, а между формами – от 0,019 до 0,216. В областях симпатрии формы репродуктивно изолированы, хотя ограниченный обмен генами, видимо, происходит. Данные электрофореза подтверждают правильность идентификации двух форм и гибридов F_1 по морфологии. Генетических маркеров, позволяющих однозначно идентифицировать обе формы на всем ареале, не найдено. Предполагается монофилетическое происхождение острорылой и тупорылой форм ленка.

После того, как Кифа (1976) предложил рассматривать в качестве отдельных видов *Brachymystax lenok* и *B.savinovi* острорылую и тупорылую формы ленка из бассейна Амура, был проведен ряд исследований фенетической и филетической структуры рода *Brachymystax,* считавшегося ранее монотипическим (Шапошникова, 1968). Их результаты обобщены Миной (1986), вкратце они сводятся к следующему. Главной особенностью структуры рода является существование в нем двух монофилетических группировок – острорылой и тупорылой, представители которых распространены по всему ареалу рода и образуют ряд алло- и симпатрических популяций (рис. 1). Однако эти группировки не соответствуют диагнозу различаемых Кифой видов, каждая представляет собой комплекс форм, значительно различающихся по морфологии.

В местах совместного обитания обнаружены промежуточные особи, видимо, являющиеся гибридами F_1 (Алексеев, 1983, 1985). Острорылые и тупорылые ленки различаются в областях симпатрии весьма четко, но если рассматривать ареал в целом, трансгрессируют по всем признакам, что не позволяет разделить род *Brachymystax* на два таксономических вида. В пределах каждого комплекса форм наблюдается клинальная изменчивость признаков, по которым производится диагностика острорылых и тупорылых ленков в областях симпатрии.

Для объяснения механизмов формирования структуры рода предложена гипотеза, согласно которой современный ареал рода заселялся изначально морфологически близкими, но частично репродуктивно изолированными предками острорылых и тупорылых ленков, соответственно, с запада на восток и с востока на запад. В областях симпатрии происходило смещение признаков, при этом признаки каждой формы по мере ее проникновения в область, занятую другой формой, все более уклонялись от исходных значений, в результате чего и возникли клины (Алексеев и др., 1986).

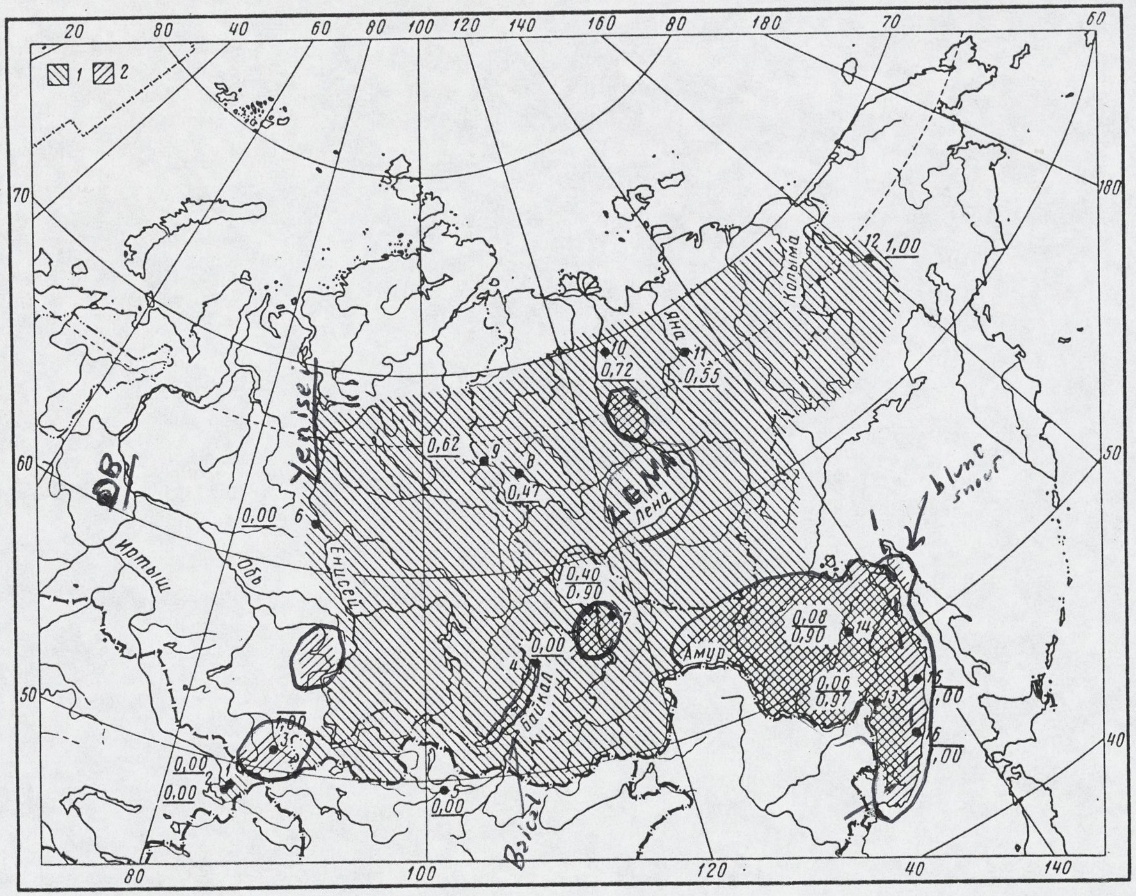

Рис. 1. Ареалы острорылой (*1*) и тупорылой (*2*) форм ленка на территории СССР (по имеющимся на сегодняшний день данным) и места взятия выборок. Нумерация выборок как в табл. 1. Частоты аллеля Sod-3 (125): над чертой – у острорылой формы, под чертой – у тупорылой

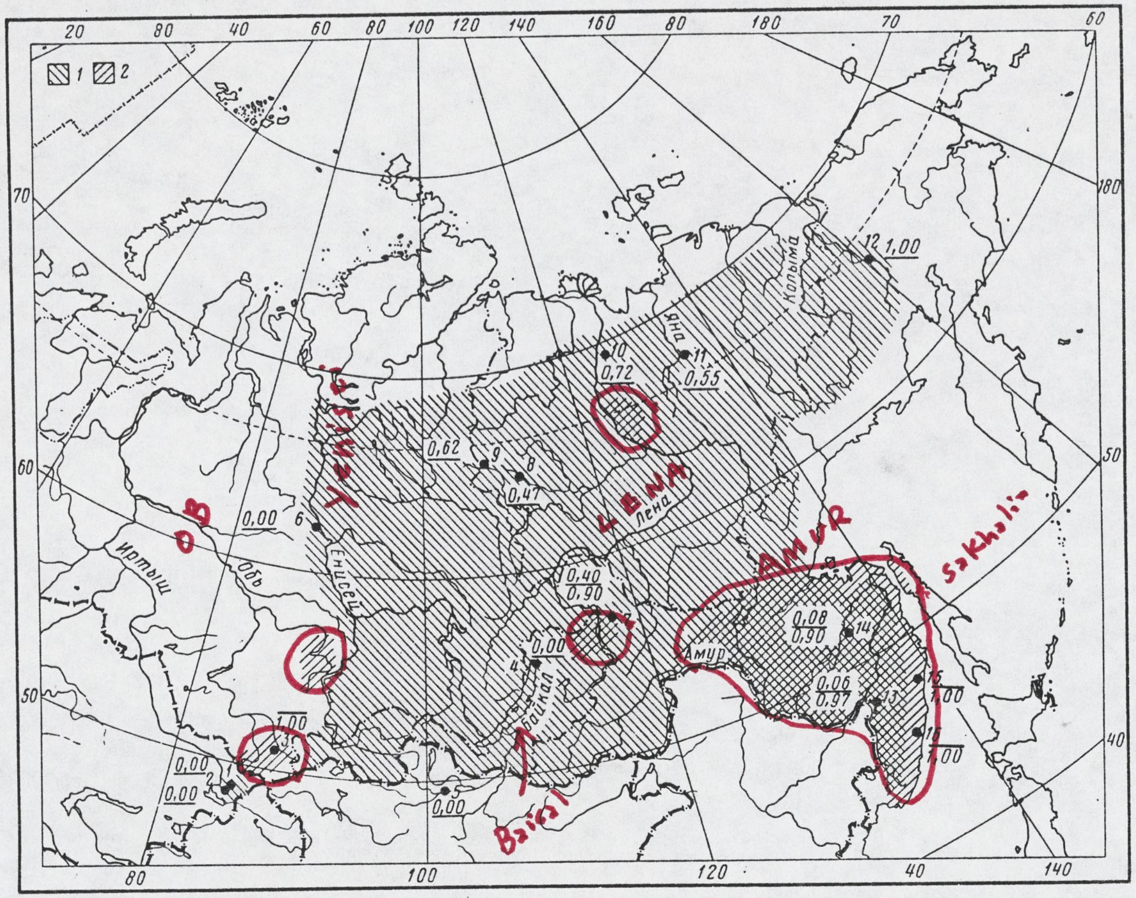

Рис. 1. Ареалы острорылой (*1*) и тупорылой (*2*) форм ленка на территории СССР (по имеющимся на сегодняшний день данным) и места взятия выборок. Нумерация выборок как в табл. 1. Частоты аллеля Sod-3 (125): над чертой – у острорылой формы, под чертой – у тупорылой

Known distribution of blunt-snouted (lenok) and sharp-snouted ("lamba") forms of Brachymystax

Таблица 2

Частота аллелей полиморфных ферментных локусов, оценки средней гетерозиготности (H) и доли полиморфных локусов (P) у острорылой (о) и тупорылой (т) форм ленка, рассчитанные по 31 локусу (включая 20 мономорфных)

Локус	Аллели	Популяция (форма)													
		Марка-коль (о)	Кальд-жир (о)	Пыжа (т)	Селен-та (о)	Фроли-ха (о)	Куанда (о)	Куанда (т)	Морко-ка (о)	Верхо-вье Ви-люя (о)	Хор (о)	Хор (т)	Севе-рное При-морье (т)	Цент-раль-ное При-морье (т)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sod-3	125	–	–	1,00	–	–	0,39	0,91	0,55	0,62	0,04	0,99	1,00	1,00
	100	1,00	1,00	–	1,00	1,00	0,61	0,09	0,45	0,38	0,96	0,01	–	–
Mdh-X	100	1,00	1,00	1,00	1,00	0,73	0,02	1,00	–	–	–	0,13	–	–
	70	–	–	–	–	0,27	0,98	–	1,00	1,00	1,00	0,87	1,00	1,00
Sdh-2	100	1,00	1,00	–	0,85	0,22	–	1,00	–	–	0,06	–	–	–
	120	–	–	1,00	0,15	0,78	1,00	–	1,00	1,00	0,94	1,00	1,00	1,00
Sdh-1	100	1,00	1,00	1,00	1,00	1,00	0,94	1,00	1,00	1,00	0,83	0,99	1,00	1,00
	120	–	–	–	–	–	0,06	–	–	–	0,17	0,01	–	–
Pgi-1	100	1,00	1,00	1,00	0,81	0,78	1,00	1,00	1,00	1,00	0,61	1,00	1,00	1,00
	80	–	–	–	0,19	0,22	–	–	–	–	0,39	–	–	–
Aat-1	100	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,78	0,87	0,92	0,92	1,00	1,00
	70	–	–	–	–	–	–	–	0,22	0,13	0,08	0,08	–	–
Ldh-1	75	–	–	–	–	–	–	–	–	–	–	–	1,00	1,00
	100	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	–	–
Mdh-3	100	1,00	1,00	1,00	0,93	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,99	0,92
	80	–	–	–	0,07	–	–	–	–	–	–	–	0,01	0,08
Ldh-4	100	1,00	1,00	1,00	1,00	0,98	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
	80	–	–	–	–	0,02	–	–	–	–	–	–	–	–
Est-5	100	0,50	0,23	–	1,00	1,00	0,30	0,08	0,67	0,68	0,28	–	–	–
	110	0,50	0,77	1,00	–	–	0,70	0,92	0,33	0,32	0,72	1,00	1,00	1,00
Est-6	100	–	–	–	1,00	1,00	0,30	0,08	0,67	0,68	0,28	–	–	–
	110	1,00	1,00	1,00	–	–	0,70	0,92	0,33	0,32	0,72	1,00	1,00	1,00
freq. polymorph. – P, m		0,032	0,032	0,000	0,097	0,130	0,161	0,097	0,130	0,130	0,226	0,130	0,032	0,032
% polymorphic loci – H		0,016	0,011	0,000	0,022	0,036	0,047	0,015	0,056	0,051	0,061	0,013	0,001	0,001

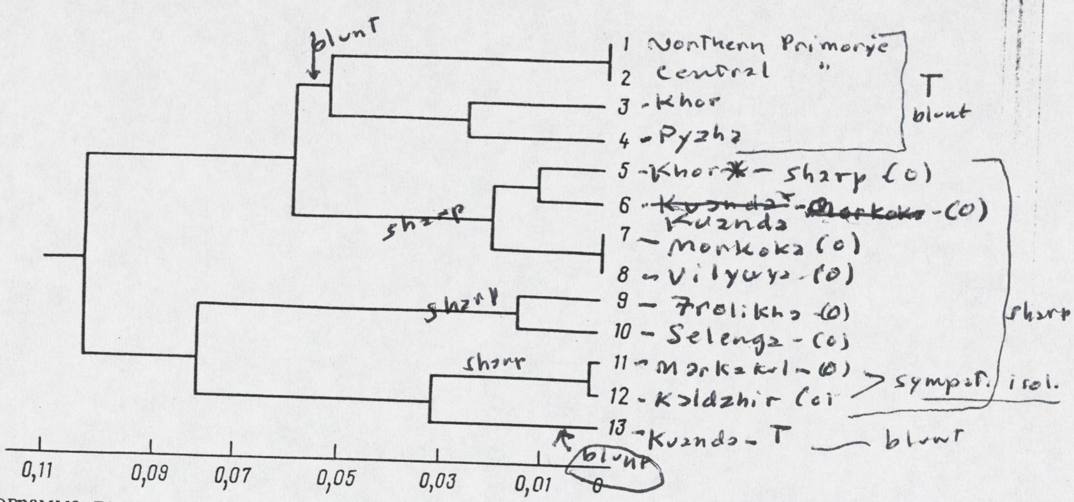

Рис. 4. Дендрограмма, построенная по индексам генетических расстояний между популяциями (формами) ленка: *1* – Северное Приморье (т), *2* – Центральное Приморье (т), *3* – Хор (т), *4* – Пыжа (т), *5* – Хор (о), *6* – Куанда (о), *7* – Моркока (о), *8* – верховья Вилюя (о), *9* – Фролиха (о), *10* – Селенга (о), *11* – Маркоколь (о), *12* – Кальджир (о), *13* – Куанда (т). По оси абсцисс – генетические расстояния

Khor + Amur

Kuanda - Vitim
Lena

ПРОИСХОЖДЕНИЕ ДВУХ ФОРМ ЛЕНКА И ИХ СТАТУС

Сложность полученной картины не позволяет однозначно принять одну из двух основных гипотез, объясняющих происхождение форм ленка (Мина, Васильева, 1979). В том случае, если бы острорылая и тупорылая формы возникали неоднократно и независимо в разных частях ареала, т.е. если бы в современных областях симпатрии имела место первичная интерградация, можно было бы ожидать большего генетического сходства симпатрических популяций разных форм, чем алло-

Таблица 3

D.

(выше диагонали) между популяциями ленка, рассчитанные по 31 аллозимному локусу

8 9 10 11 12 13

Хор (т)	Моркока (о)	Верховья Вилюя (о)	Кальджир (о)	Маркаколь (о)	Пыжа (т)	Приморье (т) *
0,125	0,043	0,044	0,083	0,070	0,114	0,171
0,166	0,084	0,086	0,058	0,046	0,136	0,216
0,019	0,012	0,013	0,080	0,080	0,053	0,054
0,062	0,104	0,102	0,029	0,035	0,035	0,107
0,044	0,028	0,030	0,077	0,080	0,081	0,081
	0,040	0,038	0,099	0,107	0,026	0,035
0,961		0,000	0,109	0,103	0,076	0,076
0,963	1,000		0,111	0,105	0,074	0,074
0,906	0,897	0,895		0,002	0,071	0,146
0,899	0,902	0,900	0,998		0,080	0,154
0,974	0,927	0,929	0,931	0,924		0,069
0,966	0,927	0,929	0,864	0,857	0,933	

= 0,000 (I > 0,999). Индексы, приведенные в таблице, относятся к популяциям рек Приморья 3

Number of fish **

form*

Location (River, Lake)

Date

No.

Таблица 1

Выборки ленка, использованные для популяционно-генетического анализа

№	Место (река, озеро)	Дата	Форма*	Число рыб**
1.	Оз. Маркаколь басс. Иртыша (Оби)	V–VI 1988	*о*	22 (60)
2.	Р. Кальджир, - outlet басс. Иртыша (Оби)	V–VI 1988	*о*	20 (46)
3.	Р. Пыжа, басс. Бии (Оби)	V 1988	*т*	9
4.	Оз. Фролиха (басс. оз. Байкал)	XI 1983	*о*	30
5.	Р. Селенга (МНР, басс. оз. Байкал)	VII–VIII 1988	*о*	20
6.	Р. Сарчиха (басс. Енисея)	X 1988	*о*	(7)
7.	Р. Куанда, оз. Леприндокан [басс. Витима (Лены)]	VI, XI 1988	*о*	27 (104)
			т	16 (27)
			п	3 (5)
		IX 1987	*о*	(133)
			т	(68)
			п	(5)
8.	Р. Моркока, басс. Вилюя (Лены)	VIII 1988	*о*	20 (63)

№ No.	Место (река, озеро) Location (River Lake)	Дата Date	Форма Form	Число рыб** No. of fish **
9.	Верховье р. Вилюй (басс. Лены)	X 1988	*о*	8
10.	Р. Улахан-Тирехтях, басс. Джарджан (Лены)	IX 1989	*о*	(16)
11.	Р. Адыча (басс. Яны)	VII 1989	*о*	(10)
12.	Р. Омолон (басс. Колымы)	IV, VI 1989	*о*	(38)
13.	Р. Хор [басс. Уссури (Амура)]	V 1989	*о*	25
			т	45
			п	1
		V 1987	*о*	(17)
			т	(29)
14.	Р. Дуки [басс. Амгуни (Амура)]	VIII 1980	*о*	(19)
			т	(14)
			п	(7)
15.	Реки Самарга, Единка, Венюковка (северное Приморье, басс. Японского моря)	IV 1988	*т*	34 (51)
16.	Р. Таежная (центральное Приморье, басс. Японского моря)	IV 1988	*т*	6 (16)

See Key per 1–16 & 17.

17.

Примечания. *Формы, предварительно идентифицированные по морфологическим признакам: *о* – острорылая, *т* – тупорылая, *п* – промежуточные особи.

**Число рыб, тестированных по полному набору аллозимных локусов, приведено без скобок; в скобках – число рыб, тестированных только по Sod-3.

** - all enzymes — only Sod-3 ( )

форетические данные, с одной стороны, подтверждают их генетическую близость (D = 0,002), с другой – свидетельствуют об их определенной репродуктивной обособленности (различие по частотам аллелей единственно полиморфного у них локуса Est-5 достоверно при $P < 0{,}05$).

ГЕНЕТИЧЕСКАЯ ДИФФЕРЕНЦИАЦИЯ ДВУХ ФОРМ ЛЕНКА НА АРЕАЛЕ

Данные о генетических дистанциях между изученными выборками приведены в табл. 3. Оценки дистанций между разными популяциями острорылой (0,000–0,111; $\bar{D}$ = 0,062) и тупорылой (0,000–0,107; $\bar{D}$ = 0,056) форм сходны. Диапазон варьирования D между популяциями разных форм больше (0,019–0,216; $\bar{D}$ = = 0,093). Между симпатрическими формами в бассейне р. Куанды и р. Хор значения D равны соответственно 0,084 и 0,044. Картина взаимоотношений между разными популяциями представлена на дендрограмме (рис. 4). Проверку правильности топологии дендрограммы проводили по методу, предложенному Ли (Li, 1981). Выявлено лишь одно несоответствие. Вместо полученного порядка кластеризации к популяциям верховья Вилюя и р. Моркоки должна сначала присоединиться популяция острорылой формы ленка из бассейна р. Куанды, а лишь затем из р. Хор. Учитывая географическое положение этих популяций (рис. 1), это действительно выглядит более логичным.

В целом картина взаимоотношений разных популяций ленка весьма неоднозначна, если ее рассматривать с точки зрения их возможных филетических отношений. Так, популяция тупорылого ленка с самого восточного (реки Приморья, р. Хор) и самого западного (р. Пыжа) участков ареала образовали один кластер, но неожиданное положение заняла популяция тупорылого ленка из бассейна р. Куанды. Достаточно логично объединение выборок острорылых ленков, относящихся к одному бассейну, а также образование двух кластеров группами популяций острорылой формы западной и восточной (начиная с бассейна р. Куанды) частей ареала, однако последние объединяются с основным кластером тупорылой формы (рис. 4).

identity above diag. distance below

Индексы генетического сходства (ниже диагонали) и стандартные генетические расстояния (выше д

Популяция (форма)	Фролиха (о)	Селенга (о)	Куанда (о)	Куанда (т)	Хор (о)	Хор (т)
Фролиха (о)		0,016	0,062	0,118	0,060	0,125
Селенга (о)	0,984		0,104	0,092	0,100	0,166
Куанда (о)	0,940	0,901		0,084	0,011	0,019
Куанда (т)	0,889	0,912	0,920		0,106	0,062
Хор (о)	0,942	0,905	0,990	0,899		0,044
Хор (т)	0,882	0,817	0,981	0,940	0,957	
Маркока (о)	0,958	0,919	0,988	0,901	0,073	0,961
Верховья Вилюя (о)	0,957	0,918	0,987	0,903	0,970	0,963
Кальджир (о)	0,921	0,944	0,924	0,971	0,926	0,906
Маркаколь (о)	0,932	0,955	0,923	0,966	0,924	0,899
Пыжа (т)	0,892	0,873	0,948	0,966	0,922	0,974
Приморье (т)*	0,843	0,806	0,947	0,899	0,922	0,966

*Генетические расстояния между популяциями рек Центрального и Северного Приморья D = 0,000 в целом.

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Биологический факультет МГУ,
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(Москва)

Поступила в редакцию
5 января 1989 г.

Tikchik Narrows
Lodge, Alaska

December 31, 1990

Professor Robert Behnke
Fishery & Wildlife Biology
Colorado State University
Fort Collins, CO 80523

Dear Mr. Behnke:

Your name was given to me by Fred DeCicco with the Alaska Dept. of Fish & Game. Mr. DeCicco told me that you were very knowledgeable about the fisheries in the Soviet Union and that you might be able to assist me in answering some questions that I have.

I have been trying to find a book or research paper on HUCHO PERRYI (Sea Run Taimen). I have caught this species of fish in the Khabarovsk Region of the Soviet Far East and am interested in finding out about their life cycle and distribution. Do you know of any publications on Hucho Perryi?

I also talked with Mr. DeCicco about the possibility of any Steelhead or Rainbow trout stocks in the Soviet Far East. I have sportfished a number of rivers and have not run across any trout. Do you have any information about Steelhead or Trout in the Soviet Union?

I have spent days talking with local Soviet Ichthyologists and found that their knowledge was somewhat limited and conflicting even amongst themselves. I am sure that a lot gets lost in the translation.

I have been in the sportfishing business here in Alaska for the past 18 years and last spring had the opportunity to fish in Russia. I also serve a chairman of the Board of Fisheries for the State of Alaska which is how I met Mr. Decicco. I am not a biologist but after 4 years on the Board of Fisheries I have a fair understanding of fisheries.

P.O. Box 220248 • Anchorage, Alaska 99522 • (907) 243-8450

The fisheries of the Soviet Far East are fascinating to me. A year ago I had never even heard of Sea Run Taimen and I have not heard of anyone else who has. Fred DeCicco found the scientific name in a Japanese fisheries book while looking for info on Oncorhynchus Masu (Cherry Salmon).

Any assistance you could provide would be greatly appreciated.

Sincerely,

Bud Hodson


Tikchik Narrows

Special Weeks at Tikchik Narrows Lodge, Alaska at Special Prices

S	M	T	W	T	F	S
			JUNE			
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

FATHER AND SON/DAUGHTER WEEK 1991

"Share the Dream!"

DATE: . . . . **June 15-22, 1990.** This will be our 6th annual Father and Son/Daughter Week, and is the first operating week of our season. The temperatures are warm — 60º to 70º during the day, and the days are endless in the Land of the Midnight Sun.

PRICE: . . . . . . Our regular package price of $3,900 for the paying party (or father) and $2,050 for the son or daughter. Although we call this our Father and Son/Daughter Week, it is open to Mother/Daughter, Mother/Son, etc.

FISHING: . . . We have very good fishing for all of our fresh water species at this time. In fact, this week offers some of our best Char, Lake Trout, Northern Pike, Grayling and Rainbow Trout fishing. It has been our experience that the fishing is fast enough to keep the younger anglers from getting "bored," or the novice frustrated.

We will also be fishing for King Salmon. Every year we have some of your best days of King Salmon fishing during this week. ***Why wait!***

This is a great opportunity to introduce your son(s) or daughter(s) to Alaska and Tikchik at a reduced cost.

S	M	T	W	T	F	S
			SEPTEMBER			
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

ALL ROUNDER WEEK 1991

PRICE: . . . . . . $3,600.00 per person per week. This price includes all of the services of our standard package: lodging, meals, guides, daily flyout, etc. Please see our rates and information sheet for complete details.

WEEK: . . . . . . **September 21 - 30** — 9 days and 8 nights. We have added two extra days of fishing and/or bird hunting to compensate for possible bad weather days if we cannot fly.

WEATHER: . Unpredictable weather, cooler temperatures and less hours of daylight are the reasons why many anglers shy away from late September in Alaska. Daytime temperatures range from the low 50's to low 40's. Nighttime temperatures will range from the low 40's to low 20's. In a week's time we can expect two to three days of stormy weather with rain and wind.

FISHING: . . . The fishing is excellent for all of our fresh water species, especially Rainbow Trout, Char and Grayling. The Rainbows will be active with their deep red stripe more vivid than ever. The Char will have turned that beautiful gold and pink that they are so famous for. Although we are at the very end of our Silver Salmon run, we should catch good numbers of the Silver Salmon, including some ocean fresh Silvers. An added bonus is that the other lodges in the area are closed for the season, thus we have all of the rivers and streams to ourselves.

BIRD SHOOTING: . We combine this week with Duck shooting and Ptarmigan hunting. Bag limits are liberal. Our Duck shooting is over decoys with well trained dogs and bag limits are usually taken each day. The Ptarmigan hunting is in the higher elevations in open tundra country.

Tikchik Narrows Lodge, Alaska

1991 RATES and INFORMATION

LOCATION

Tikchik Narrows Lodge is located in Southwest Alaska in the 1.5 million acre Wood-Tikchik State Park. Bordering the park to the west is the Togiak National Wildlife Refuge which encompasses 4.7 million acres of land. The Wood-Tikchik area contains 13 major lakes which stack one above the other. The western edge of the lakes extend, in beautiful fjords, into the rugged Kilbuck Mountains. Togiak Wildlife Refuge contains 3 major river systems draining the Kilbuck Mountains to the southwest.

This area of Alaska is only accessible by float plane and is over 300 miles from the nearest connecting road system. Tikchik Narrows Lodge is totally isolated. We are not located in a town or village like most other lodges in Southwest Alaska. Our neighbors are the undisturbed fish and wildlife which abound in this area.

ACCOMMODATIONS

Our guests are accommodated in separate cabins. Each cabin has two large comfortable guest rooms, each room with private modern bathroom facilities, independent hot water heaters, thermostatically controlled forced air heat, fully carpeted, twin beds and a spectacular view of Nuyukuk Lake and the rugged snow capped Kilbuck Mountains.

LODGE

The main lodge is located on the tip of a narrow peninsula, which separates Tikchik and Nuyukuk Lakes (Tikchik Narrows). The lodge has large comfortable lounging areas with a natural stone fireplace and a unique circular dining room.

Both the main lodge and the dining room are enclosed by large picture windows, which offer a spectacular panoramic view.

MEALS

Our meals reflect the preference in American fine dining. We have a pre-planned menu each week, offering main courses of New York steak, roast duck, lasagne, prime rib with Yorkshire pudding, turkey and filet mignon. We serve freshly baked homemade breads and pastries, and have our produce and vegetables flown in fresh each week. We also serve a wide selection of hors d'oeuvres featuring a fish appetizer from the day's catch.

Our guests start each day with a hearty wholesome 4 course breakfast. Your lunches are packed picnic style for a streamside meal, unless you would prefer a fish shore lunch cooked by one of our expert guides. The shore lunches are definitely something you will not want to miss during your stay with us.

Wine is always served with our evening meal and is available at an additional cost for shore lunches.

If you have any special dietary requirements just let us know.

THE FISHING

Nowhere else in the world will you find a greater variety and volume of sportfish than in Bristol Bay, Alaska. Called the *"Salmon factory of the world"* Bristol Bay offers five species of Salmon: King, Sockeye, Chum, Pink and Silver salmon and 7 species of fresh water fish: Rainbow Trout, Arctic Grayling, Arctic Char, Dolly Varden, Lake Trout, Northern Pike and, in the Kuskokwim drainage, the Sheefish.

We fish the entire western half of Bristol Bay which includes the Nushagak, Wood River, Tikchik Lake, Togiak River drainage's and some of the rivers in the Kuskokwim drainage.

The waters we fish vary in size from very large rivers to tiny streams and everything in between. We also fish the lake and the interconnecting shorter rivers between the lakes. The rivers that we fish in the western half of Bristol Bay produce about 75 percent of the King Salmon, Silver Salmon and Chum Salmon caught in the entire Bristol Bay drainage.

With our unique variety of water to fish, both spin and fly fishermen will find our waters challenging for the advanced anglers yet accommodating for novice anglers. Above all . . . our fishermen catch fish, lots of fish and enjoy the sport of doing so.

FISHING FROM THE LODGE

Tikchik Narrows Lodge offers great fishing right in front of the lodge. It is not uncommon to see salmon from the deck of the lodge. Rainbow Trout, Lake Trout, Arctic Char, Arctic Grayling, Northern Pike, Sockeye Salmon and Pink Salmon can all be caught in the narrows in front of the lodge.

We have excellent fishing available from the lodge by boat. Nuyukuk, Tikchik, and Chauekuktuli Lakes offer great fishing along with numerous rivers and streams nearby. Usually the largest Rainbow Trout, Arctic Grayling, Northern Pike and Arctic Char are taken in the local waters near the lodge by our guests.

DAILY SCHEDULE

Each day's fishing assignments are scheduled the evening before. Where we fish each day will depend on each fisherman's preference. Each evening our guests will know where they are going, who their pilot is and who their guide will be. The pilots and guides get with the guest after dinner to suggest which tackle to take and to let the fishermen know how to prepare for the next day's fishing adventure.

Breakfast is served at 7:00 a.m. The airplanes and guides are ready to depart shortly after breakfast. We return to the lodge each evening between 4:30 p.m. and 6:00 p.m. Dinner is served at approximately 7:30 p.m.

EQUIPMENT

AIRPLANES — We own and operate 4 float equipped aircraft. Three 6-passenger De Havilland Beavers along with one 4-passenger Cessna 206. Our aircraft are in excellent condition and are well maintained throughout the entire season.

BOATS — We keep boats and motors (some jet equipped) on six different rivers throughout the season. The use of these boats allows our guides the mobility to provide our fishermen with the best fishing everyday. We also have several boats at the lodge for fishing our local waters.

GUIDES

Each day's fishing excursions are fully guided. We employ 12 guides along with 4 pilot/guides to insure that our guests receive tailored, personal attention and service. Our guides are mature, friendly, knowledgeable fishermen who will not only provide the best fishing, but are able and willing to help with technique, if need be. Our guides are safety conscious and understand that not all of our guests are expert fishermen. Whether you're a novice or an expert, our guides will be accommodating to your needs.

FLYFISHING — Many of our guides are expert fly fishermen. A week at Tikchik Narrows Lodge can be equal to a week at a professional flyfishing school. Whether you want to learn fly tying, casting, presentation or how to fight a big fish, you can be assured that our guides have the skill and patience to teach you.

GETTING TO THE LODGE

You should plan on traveling to Anchorage, Alaska for your flight to Dillingham, Alaska. **Northwest, Delta United** and **Alaska Airlines** all have daily flights to and from Anchorage from all of the major cities in the U.S.

You should plan on a Saturday arrival in Dillingham Alaska. **Mark Air** has daily flights between Anchorage and Dillingham on 737 jet aircraft. The round trip airfare between Anchorage and Dillingham will cost about $270.

We will be in Dillingham to meet you when your flight arrives. From Dillingham we will transfer you to our float planes for the trip to the lodge.

RATES

The 1991 rates are $4,100 per person per week (package price). Trips start on Saturday and end the following Saturday.

The package price ***includes*** all meals, lodging, fully guided daily flyout fishing excursions (weather permitting) and transportation between Dillingham and the lodge.

The package price ***does not include*** personal gear, rods, reels, lures, flies, liquor, fishing licenses and gratuities.

RESERVATION REQUIREMENTS

We require a $1,800 deposit per person to confirm a reservation. Full payment is due 60 days prior to arrival.

Payments are refundable only if the cancelled space can be fully rebooked with guests acceptable to Tikchik Narrows Lodge. After February 1, all refunds will be subject to a cancellation fee of 10% of the package price.

TACKLE

When your fishing trip with Tikchik Narrows Lodge has been confirmed, we will send you a "what to bring" list, covering suggested tackle, lures, flies, clothing, etc.

We have a large inventory of lures and flies available for purchase at the lodge. We do not furnish the terminal tackle (rods, reels, waders, etc.) We do keep a large inventory of excellent quality rods and reels, both spin and fly, along with hip boots and waders for our guests to use on a loaner basis in case of rod breakage, equipment failure and lost luggage. We furnish terminal tackle only on prior request and on a limited basis.

CATCH AND RELEASE

In the spirit and necessity of conservation, we adhere to strict catch and release policies with our fresh water species of fish. We do allow and promote our clients to keep a couple of salmon. We will be happy to fillet, wrap, package and freeze your salmon for you to take home.

OUR PHILOSOPHY

Our guests come to Alaska to experience the finest fishery in the world. We are in the sportfishing business to provide that service, and we've been told that no other operator in Alaska out-fishes us. But we do not want your Alaskan adventure to stop with merely great fishing. We are committed to all of the extras that will add that special touch to your stay with us. Whether it means flying extra miles to show you a grizzly bear and cub or having our chef cook your fish just the way you like it, we are here to make your trip memorable.

Your smallest needs are important to us. Our goal is to have every guest leave Tikchik totally satisfied with the desire to return to our very special angling paradise.

YOUR HOST'S

Bud and Holly Hodson have been in the sportfishing business for the past 17 years, all of which have been in the Wood River - Tikchik Lakes area of Alaska. Bud started out as a fishing guide before advancing to pilot/guide. Bud and Holly have built a reputation for developing one of the best sportfishing operations in the world and that reputation has continued on with Tikchik's.

Bud's 17 years of fishing experience in the area will be the difference between good fishing and great fishing. His enthusiasm for fishing and more importantly seeing others catch fish is just one of the reasons why Tikchik Narrows Lodge is in a class of it's own.

Holly is your hostess and maintains the smooth running of the lodge accommodations and meals. She sees to all of the extras and provides the Alaskan hospitality her guests deserve. Holly's sincere desire to make each guest feel welcome and comfortable is one of the reasons many of our guests return to fish with us year after year.

FOR RESERVATIONS

Contact:

Bud Hodson, Tikchik Narrows Lodge, P.O. Box 220248, Anchorage, Alaska 99522

(907) 243-8450, Fax: (907) 248-3091

WHEN TO COME — Weekly Fishing Chart

	JUNE			JULY				AUGUST				SEPTEMBER				OCT
	2nd week	3rd week	4th week	1st week	2nd week	3rd week	4th week	1st week	2nd week	3rd week	4th week	1st week	2nd week	3rd week	4th week	1st week
King Salmon		■	■	■	■	■	■									
Red Salmon			■	■	■	■	■	■	■	■	■					
Chum Salmon			■	■	■	■	■	■	■							
Pink Salmon						■	■	■	■	■	■	■	■			
Silver Salmon							■	■	■	■	■	■	■	■	■	■
Rainbow	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Trophy Rainbow	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Arctic Char	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Dolly Varden	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Arctic Grayling	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Northern Pike	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Lake Trout	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

The fishing chart shows when the different salmon species are available. The fresh water species are always available.

Colorado State University

Department of Fishery and
Wildlife Biology
Fort Collins, Colorado 80523
(303) 491-5020
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January 9, 1991

Mr. Bud Hodson
P.O. Box 220248
Anchorage, AK 99522

Dear Mr. Hodson:

The taimen you caught in the Tumin River are probably Hucho perryi, if indeed they are sea-run or anadromous fish. A problem for correct identification is that all species of huchen or taimen do not much differ in external appearance. The species, H. perryi, however, is very distinct from other species "internally". Compared to other taimen, H. perryi is the only anadromous species, it has about 6-10 fewer vertebrae, teeth are present on the basibranchial plate (between gill arches), and on the middle of the tongue, and it has more than 20 fewer chromosomes (62 vs. 82-84). It is highly divergent from other taimen, but this divergence is not apparent from external appearance.

H. perryi was first mentioned in 1856 in J. C. Brevoort's work: "Notes on some figures of Japanese fish" (illustrations of fishes made by artists with Admiral Perry's expedition), where it was named "Salmo perryi". Not a great amount of information has been available on the species since. It is known to exist on Hokkaido and Sakhalin and has been reported from the Soviet mainland south of the Amur River--in tributaries to Tartar Gulf and Sea of Japan (southward to Vladyvostok). The Russian literature does not list H. perryi for the Amur River basin (only H. taimen - or, perhaps, more precisely, Hucho hucho taimen). H. taimen occurs north of the Amur to the Uda R. and H. perryi is assumed to occur in coastal rivers south of the Amur to Vladyvostok. I have not seen an adequate taxonomic description of the taimen from south of the Amur basin, however, which undoubtedly identifies these fish as H. perryi. Were all the taimen in your photos of fish caught south of the Amur (drainages to the Tartar Gulf)?

In the summer 1990 issue of Trout, I had an article, "How many species", which provides a brief summary of information and classification of some of the little known salmonid fishes such as H. perryi, taimen, lenok, etc. Also be aware that two different species of lenok occur in the Amur and Uda river basins. The most comprehensive work on huchen or taimen is: "The Eurasian huchen, Hucho hucho, the largest salmon in the world", by Holcik, Hensel, Nieslanik, and Skacel. English translation is available from Kluwer Acad. Publ., P.O. Box 358, Hingham, MA 02018-0358. I believe it sells for about $120-130. This book, however, does not have much on H. perryi and lacks critical authenticity in regards to many details.

You mentioned you caught H. perryi in the "Kharbarovsk region". I assume any H. perryi you caught were in the coastal rivers (such as the Tumin), east of Khabarovsk, and not in the Amur basin. If you have any knowledge of sea-run taimen in the Amur, please inform me.

I note that Klineburger Worldwide Travel advertises several trips for "taimen salmon" to Khabarovsk for 1991. A problem for supplying trophy taimen for increasing numbers of anglers is that long-lived species such as taimen are extremely susceptible to over-exploitation. A 40-50 lb. taimen is probably more than 20 years old. It doesn't take much exploitation to remove many years of production from a large area of a river. In most areas of the USSR, even essentially uninhabited regions, large taimen are rare. Exploitation to feed crews performing geological or natural resource surveys, can virtually eliminate large taimen from an area.

Thank you for the beautiful photos--the only good color photos I have seen of H. perryi. In 1957 the late Paul Needham and I collected rainbow trout in Alaska. I recall that our Nushagak River basin collection were of Tikchik rainbow. One of the conclusions of the study is that the rainbow trout north of the AK Peninsula are probably more closely related genetically to the original mykiss rainbow trout of Kamchatka than they are to rainbow trout along the Pacific Coast south of the AK Peninsula (but all are very closely related).

Making fish collections based at a luxury lodge would certainly be doing it in style, but perhaps not as exciting as camping on rivers and lakes with the bears--but I was much younger then.

Sincerely,

Robert Behnke

Colorado State University

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Fort Collins, Colorado 80523
(303) 491-5020
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January 10, 1991

Mr. Tom Knight
Klineburger Worldwide Travel
3627 1st Avenue South
Seattle, WA 98134

Dear Mr. Knight:

Enclosed is a copy of a letter concerning Hucho perryi. Mr. Hodson mentioned his trip was centered at Khabarovsk; perhaps he was one of your clients. I have been picking up bits of new information on little known Asiatic salmonid fishes from American anglers. Also enclosed is copy of letter concerning the lenok. If your anglers note distinctions and take photographs of lenok caught in various areas and send the information to me, I would be grateful. One (or perhaps two) species of lenok might be characterized by red coloration--the other more "common" or "blunt snouted" lenok species, reputedly lacks red colors.

I note in your recent literature that you will have trips for steelhead and rainbow trout in Kamchatka this year. I would be very interested to hear what you find. A recent paper by I. A. ev Chereshnev (Inst. Biol. Problems of the North...at Magaden) in Voprosy Ikhtiologii (1990, no. 5) lists all fish species that are known to occur or probably occur in the Soviet Northeast--in all river drainages from north of the Uda River, around the Chukokst Peninsula to Chaunsk Bay. No steelhead or rainbow trout (mykiss) or lenok or taimen are listed for any of the 29 rivers. It has been assumed that mykiss occurs in the Penzhina River (northernmost drainage on Kamchatka), but Chereshnev does not list it.

Last year Chereshnev named a new species of char from a few rivers tributary to the northern Okhotsk Sea (including the Yama River, where I note a trip for coho salmon is scheduled). The new species of char is similar to Dolly Varden but has rows of light colored spots along the dorsal surface and on the dorsal, adipose and caudal fins. Perhaps when your group is in Magadan a visit with Chereshnev can be arranged to obtain the latest information on species distribution.

I would also be interested to hear what you learn of the Atlantic salmon of the Pechora River. Historically, the Pechora was noted for the largest salmon and the greatest commercial catch of any Soviet river. In recent years, I understand, that considerable environmental degradation occurred, mainly from improper logging in key areas of the watershed and salmon runs have suffered.

The brochure on the Pechora states that anglers will be able to sample lenok, Arctic grayling, Dolly Varden, etc. Lenok are not known from the Pechora (westernmost distribution is a tributary to the Ob--taimen are known from one upper Pechora tributary, but are not ubiquitous). The common Pechora grayling is the European grayling, T. thymallus--but Arctic grayling were recently recorded from some sites in the Pechora basin. Dolly Varden are not known to occur west of the Chukotsk Peninsula.

The Soviet Union covers a vast area and the fishes of much of this area are not well known; thus, I would appreciate any bits of information from anglers fishing in remote areas.

Sincerely,

R. Behnke

Robert Behnke

Thomas M. Knight

PHOTO/JOURNALISM

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January 15, 1991

Robert Behnke
COLORADO STATE UNIVERSITY
Department of Fishery and Wildlife Biology
Fort Collins, Colorado 80523

Dear Robert:

Thanks for your January 10 letter. You should note at the outset that I will be leaving Klineburger Travel this coming Friday, January 18, to pursue my freelance writing and also guide trips to the Soviet Union with another company. Please keep this information confidential for the present. Thank you.

With regards to lenok, in Mongolia (Selenge River tributary) last year we caught the "red coloration" species and in the USSR (Mayamakan River) the lenok did not have the red coloration and were also obviously "blunt."

I consider myself a better than average photographer and did take some outstanding slides of the red lenok. I did not go on the USSR trip, but do have slides of the blunt lenok also..not as good as my Mongolia slides, but adequate. There are obvious differences. I also have slides of the grayling caught in Mongolia..a female I believe. I also have a series of closeup of taimen. I would be happy to send you duplicate slides for your collection if you wish. I would contact Dr. Ed Brothers (see enclosed reference sheet) for taxonomy and aging. Ed did all the collecting for the Smithsonian, American Museum, UW, Canadian National Museum and California Academy of Sciences. He's a hell of a nice person and I'm know you will enjoy talking with him as you both "speak the same language."

I will be going to a different set of rivers than described in the literature you recently received from Klineburger's. My operator in the USSR has basically arranged trips for taimen (Podkamennaya Tunguska River, central Siberia), perryi (Lutoga River, Sakhalin Island), chinook (Tigil River, Kamchatka Peninsula), Atlantic salmon (Pechora River) and coho/steelhead/resident rainbow (Inja River, Magadan area or undetermined as yet, Kamchatka Peninsula). I am tentatively scheduling two trips (I won't be going on all of them, but most) on each of these streams. I intend to take detailed slides of every species encountered and will be happy to share them with you.

Regarding Mr. Hodson: Bud Hobson is running a series of trips out of Khabarovsk this year. Unfortunately, for "advertising" purposes he is claiming to be fishing for "sea-run taimen." I was going to write him, but am glad you did to inform him of the difference between taimen and perryi. I would, however, not expect his advertising to change and it is unfortunately the public will be misled. I do know the differences!

In mid-February or mid-March, I will be going to Moscow to confer with our operator regarding the 1991 trip details.In their correspondence with me they mention (never with scientific or Russian names) species such as "East Siberian Char", "sima", "lake char", "Siberian salmon", and "salmon trout." Here is where you could help me out. If you could provide me with information on the following subjects prior to my leaving for Moscow, it will greatly benefit your research and mine:

1) A list of <u>Soviet sports species with names in Russian, scientific and English.</u> This way I can communicate effectively with my Soviet partners.

2) A detailed (if possible) list of those rivers on the Kamchatka Peninsula your research indicates contain <u>summer-run steelhead and/or resident rainbow trout.</u>

3) Reputedly there is <u>at least one river on the Kamchatka that contains a run of chinook salmon equal to the genetic strain in size of those in the Kenai River of Alaska.</u> Do you know this river(s).

4) I have heard of the problems on the Pechora and I will discuss this with my Soviet partners. Do you have a suggestion for an alternative river for Atlantic salmon, <u>not</u> on the Kola Peninsula?

5) Do you have Mr. <u>I. A. Chereshnev's address in Magadan</u>, so that I might write as well as visit him?

Thanks very much for any help you can give me. It will be invaluable.

Regarding listing Arctic grayling lenok, Dolly Varden as being in the Pechora, I am aware that these only exist in eastern Siberia and the wording was misleading.

Regarding harvesting large taimen: The fishery by my company will insist on catch and release, with the exception of obvious "gill hooked" fish and one specimen per angler. I am working with a outstanding taxidermist who can make mounts from good photographs. However, with taimen there are not sufficient specimens in the USA to make molds.

I enjoyed your letter. I have forwarded copies to Frank Haw and Ed Brothers.

Please correspond in the future to my home address.

Best regards,

Tom Knight

NORTHWEST OUTDOOR WRITERS ASSOCIATION

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MONGOLIA and SOVIET UNION TAIMEN FISHING REFERENCES

Dr. Ed Brothers...Ithaca, NY...607-257-1532 Biologist

Frank Haw...Olympia, WA...206-754-4568 Biologist

George Pollaty, Jr....Rosewell, GA,...404-973-0528

Guido Rahr...Portland, OR...503-245-1142

Tony Lee...Anchorage, AK...907-694-2047

Tom Ursia...Sanford, ME...207-324-7151

Dave and Zelda Green...Wapato, WA...509-877-3600

Dr. Granger Avery...Port McNeil, BC...604-956-3377

Park Gail...Cody, WY...305-587-3445

Dan and Kathie Pennie...Bloomington, MN...612-455-1861

Dick Lareau...Bloomington, MN...612-474-3945

Both will probably be going to USSR with me this year.

Tom

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January 28, 1991

Mr. Thomas M. Knight
17709 69th Ave. W.
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Dear Mr. Knight:

I would much appreciate copies of slides showing the different forms of lenok and their localities. Please note the forms of lenok you encounter this year as you explore new waters--the shape of snout, terminal or subterminal jaw, coloration, degree of redness, etc. I'll be writing a paper on Brachymystox, and its confusing taxonomy and would be grateful for any information from diverse areas.

I. A. Chereshnev is with the Institute for Biological Problems of the North, Far Eastern Division, USSR Academy of Sciences, Magadan. If you meet him, tell him I would be grateful if he could give you a preserved specimen of Salvethymus svetovidovi, a new genus and species of char he named last year from a lake on the Chukokst Peninsula to relay to me.

In a recent paper, Chereshnev listed the fish fauna of all rivers from north of the Uda, around the Chukokst Pen. No lenok, taimen, or rainow (or steelhead) were listed. Previously, rainbow or steelhead (mykiss) had been assumed to occur in some rivers outside of Kamchatka such as the Penzhina and the Lonkovaya (near the Ola). I will be very interested to hear what you learn this year about mykiss distribution.

Enclosed are copies of edited pages from a monograph I am writing on western trout concerning mykiss. Because mykiss is not a commercial species, it has received little study concerning details of life history. All available information does not indicate summer run steelhead on Kamchatka. Where known, the runs begin in late August-September, typically peaking in Oct. (fall runs). At least one run in Bolshaya R., appears to come up the river just before spawning in May-June. Much is yet to be learned about mykiss in the Far East and new information can be obtained by American anglers fishing the Far East. I would be particularly interested to learn more about the reputed estuarine form of rainbow trout on Kamchatka, perhaps with a life history similar to coastal cutthroat trout.

Chinook salmon is a minor salmon species in Asia. The annual commercial catch averages only 5-10% of the North American chinook catch (250,000-500,000 fish vs. 3.5 to more than 5 million). The Kamchatka River run supports the only major commercial chinook fishery in the Far East (up to 95% of total catch). I have not seen any literature that indicates unusual large size of any particular run of Far Eastern Chinook, comparable to Kenai R., Alaska. Typical size of spawners appears to be 15-20 lbs. As with rainbow trout, the relatively low commercial importance of chinook in the Far East results in little data on this species and another opportunity for American anglers to fill in gaps of knowledge on distribution, times of runs, size, range, etc.

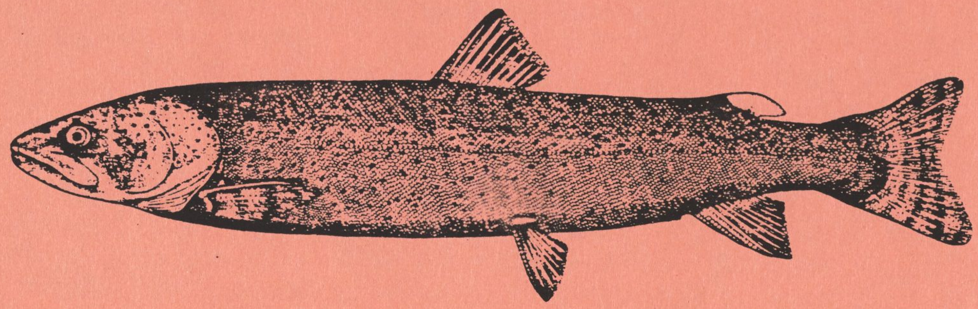
The Russian names of Pacific salmons, except for masu salmon, are pronounced the same as scientific species names--"chaveetsha" (chinook) "kisutch" (coho), "keta" (chum), "gorbusha" (pink), "nerka" (sockeye). The masu salmon is typically called "sima" or "masu". The term "losos" typically refers to Pacific salmon, in general, but is also used for large Caspian Sea brown trout. "Semga" typically refers to Atlantic salmon, but is also used for Kamchatkan rainbow trout, especially steelhead. Resident rainbows may be called "mykeezha." For chars of the genus <u>Salvelinus</u>, the term "golets" refers to char in general (all species in the genus). The Far Eastern char, <u>S. leucomaenis</u> is called "kundzha"; Dolly Varden, <u>S. malma</u>, is "malma"; the stone char of the Kamchatka River, <u>S. albus</u>, is called "Kamen golets". The name "sig" or "seeg" refers to whitefish (Coregonus) and "omul" refers to cisco type of whitefish. Inconnu or sheefish is "nelma."

Sincerely,

Robert J. Behnke

THE TAIMEN

World's Largest Salmon



by Tom Knight

The taimen salmon belongs to the genus Hucho, within the Salmonid Family. The huchen group is strictly Eurasian in its indigenous habitat and encompasses one of the greatest ranges of any freshwater fish species. However, despite considerable research within the past decade, knowledge of the genus Hucho is still meager.

There are four species of Hucho,which includes the species *Hucho hucho hucho,* the huchen or Danube salmon, and *Hucho hucho taimen*, the taimen salmon. Of the genus Hucho, much has been written recently about the huchen, as it is the second largest salmon and found in more populated areas of Western Europe. The huchen range is confined basically to the Danube River drainage and taimen to the Ural-Siberian-Amur drainages, most of which eventually flow into the Arctic Ocean. These two ranges are disjunct and separated by an extensive region known as the Eastern European Flatland. Range of huchen is less than five percent of taimen, and huchen populations are presently endangered by commercialization and habitat deterioration.

Taimen, on the other hand, inhabit expansive watersheds in Soviet Siberia, northern China and northern Outer Mongolia and, to date, have not experienced the widespread degradation of habitat as has its cousin, the huchen. However, in eastern Soviet Union, recent 1989 exploratory trips by American anglers found taimen populations in certain regions subjected to intense fishing pressure, as like most salmon, its food value is extremely high. In fact, some choice Soviet waters holding taimen are now accessible only by helicopter. Klineburgers did host a highly successful exploratory trip this past July into extremely remote Siberian waters which produced outstanding fishing.

Klineburger Worldwide Travel has been conducting hunting trips into Outer Mongolia and the eastern Soviet Union for over twenty years. Coincidentally, this is where impressive populations of taimen also occur. The main Mongolian drainage is the Selenge River system, a vast watershed which flows into Lake Bakal in Russia, the world's largest (by volume..it is over 9,000 deep) freshwater body of water. Taimen have been documented throughout this system and others in Mongolia, but there has been little interest by native people to fish for them, either for recreation or commercially. This is reflected in the Mongol diet, which consists of virtually 100% red meat. Virtually every Siberian and Mongolian watershed holds taimen.

Taimen, and two hucho relatives, is an exclusive freshwater salmonid predominantly inhabiting flowing water, but is also found in lakes and reservoirs. One Hucho (*Hucho hucho perryi*)is diadromous, freely moving between brackish estuary waters and saltwater during summer months, but residing in rivers during the winter. Except during the spawning period, taimen inhabit streams in primarily in the foothill zone. They prefer cold waters with a rich oxygen content and a diverse riverbed. Contrary to huchen, taimen often occupy the lower stretches of primary rivers. These lower reaches provide the required cold water as they flow north into Arctic oceans.

Typically, adult Hucho inhabit "clean-cut" habitat types, the character of which depends on the size of the fish. Both huchen and taimen are found in identical habitats, with taimen also occurring, as mentioned, in lowest portions of river systems. During higher or muddy water, such as during spring runoff, taimen hug the bank or enter a calmer tributary. In morning and late afternoon they frequent tailouts or the head end of pools. At night they move into shallower parts of a stream and at mid-day are found in deep holes, or at the mouths of cooler tributaries. During the first June exploratory trip, anglers found bridges to be a definite key to taimen habitat. Bridges undoubtedly provide shade and the structure for making pools. Big taimen prefer pools and they saw taimen lying in deep water beneath two bridges. They caught taimen out of both bridge pools during the day, with mouse imitation topwater lures and wet streamer flies.

Specifically, scientific literature states that taimen are found; in deep holes below rapids, boulders, man-made weirs and slucies, and waterfalls; in water shaded by overhanging vegetation; in calm waters behind rocky projections; above and below mouths of tributaries; in scoured out areas of a streambed; and in narrowest places in a stream. It appears from describing literature that taimen prefer similar freshwater habitat chosen by adult chinook salmon.

Younger taimen preference for specific habitat is directly related by the presence of fish prey species. These locations would include side branches of main bodies of water, calm areas near a bank, broad riverbeds with many braided channels of shallow, flowing water and small tributaries.

Juvenile taimen, two to four-years old, co-habitat the same stream portions as adults, only here a certain hierarchy is maintained; adults to the upper part of a pool and younger ones behind. The largest adults are frequently the first taimen in a pool to take a presented bait-- a situation most anglers can presumably live with! Adult taimen also feed more actively at night.

The greatest age of a hucho has been recorded as 20-years for huchen and an almost unbelievable age of 55-years for taimen. These specimens were 46 and 57.6-inches long respectively. Researchers estimate that huchen are capable of living <u>60 to 100</u>-years and taimen <u>100 to 170</u>-years. Preliminary estimates of the 14 to 16 pound taimen caught on the June trip were around 15-years old, and over 50 years for the 65-pounder.

Although attaining enormous size, adult taimen spawn in the very upper extremes of their drainage in the smallest tributaries possible. They are strictly spring spawners, taking advantage of high water runoff and the summer period to hatch eggs prior to freeze-up.

Capability of taimen to reach mammoth size for a strictly freshwater fish has long been known. Since World War II, western anglers had persistently heard "rumors" of a gigantic fish that looked like a salmon and lived somewhere in the vastness of Siberia. In

Mongolian folklore, there is a story of a huge taimen found icebound in a river. The winter was particularly severe and the nomadic, normally meat-eating tent dwellers cut off pieces of its flesh throughout the winter, which saved them from starving. After the spring thaw, the taimen swam away, none the worse for wear! Two reoccurring Soviet tales claim the only ways to land a 100-pound plus taimen is to shoot it with buckshot when it jumps; or live-bait it with a muskrat or lemming, attached to parachute cord tied to a riverbank sapling, let the fish play itself out..and hope the tree remains rooted!

This last fish story may have some merit. Recent treking travelers to Mongolia recounted their guides putting out trot lines when camped along a riverbank for the night. They baited the lines with live, foot-long or larger freshly caught perch and then tied it to a large branch of an overhanging tree or sapling. In the morning the heavy lines were pulled in and never were any taimen under 1-meter (about 35 to 40-pounds) caught. In many cases, the stout lines were simply snapped off.

Recent taimen tales are not the only ones. Roy Chapman Andrews, discoverer of dinosaurs in the Gobi Desert and collector of most of the American Museum of Natural History's Asian mammals, tells in his classic 1920's book, <u>Across</u> <u>Mongolian</u> <u>Plains</u> of .... "three foot trout which were herded into the shallows" which also "tasted very good." Anglers on the June exploratory trip can attest to this last statement. Taimen have white meat and broiled taste like exceptionally sweet yellow perch..only without all the bones.

And the legend continues! Some 1989 elk hunters returning from Mongolia recount a number of intriguing fish tales. One recalled he was watching a duck swimming down a stream. As it drifted past him, a mammoth hole appeared in the river and the duck disappeared ...fly fishermen take note! Another party stopped on a bridge to take pictures of a particularly scenic view. One looked off the bridge and into the water. There in a pool below lay "...huge 'logs' from 4 to 6-feet long, just finning in the current...and I left my salmon rods at home," he lamented. (Note: the June exploratory fishing trip might have found this bridge, for they did see large taimen in a pool below a bridge and managed to tempt one of them into hitting a mouse imitation lure). A third hunter had the savy to borrow a rod and reel in Ulan Bator before heading into the wilds. At camp along a stream one evening he tossed a crude spoon into the water. The rod was vintage something, line about 50-pounds test of 'rope' and the reel belonged in someone's collection. The lure hit the water and instantly "...a fish of about 50-pounds nailed it, jumped a couple times and headed downstream. I held on, but the reel froze and exploded into bits and pieces!" End of fishing!

Largest recorded huchen was one of 132 pounds (73.2 inches) caught in the Danube River, January 9, 1873. Largest known taimen was a <u>231-pounder</u> (<u>84 inches</u>) taken in a commercial net in the Kotui River in 1943. This monster fish was not aged. Data on record catches of taimen are very sparse, particularly in the USSR and Mongolia. In June, one fisherman from the first exploratory trip did hook a taimen that was estimated to be well in excess of 100 pounds...the fish jumped clear of the water in view of several other spectators and was over five feet in length...the taimen broke off after a five minute battle. In the Soviet Union this year, however, a flyfisherman landed one in the 60-pound range. The fact that taimen attain larger size than huchen is due to two factors: Taimen inhabit larger rivers, often to their estuary and Bergmann's rule, which in simple terms states that: Members of a genus or species attain larger size the further north in latitude (or south in the Southern Hemisphere) they occur. For example, the largest bears and moose occur in Alaska, largest tigers in Siberia, largest whitetail deer in Maine and Alberta, largest chinook salmon in Alaska, and largest lake trout in Northwest Territories, etc. Most taimen habitat is well north of huchen occurrence.

Physically, taimen resemble muskies and northern pike, or similar to a spawned-out steelhead and Atlantic salmon "snakes." Their body is round and elongated like that of a pike, with a larger and flatter head than Pacific salmon. They have an enormous mouth with awesome dental equipment, resembling that of tropical freshwater species. Teeth are sharp as a barracuda, extended inward like a shark, and will cut any leader easily. They are colorful, not exhibiting the bright silver form of fresh Pacific salmon or steelhead. As they grown older and larger, they get progressively darker. Chinook-like black "X's" dot the entire grey body, predominantly the upper portions, including the head, tail, dorsal and ventral fins. The tail and anal fins are a crimson red. Dark vertical stripes tip all other fins. The adipose is proportionably larger than other salmonids and is off-white in color; other fins are grey, matching body coloration. Head and gill plates are distinctly lighter than the body.

Diet of taimen is, as expected, tremendously varied to accommodate such a large biomass. The relative size of taimen prey varies proportionably with both age of this predator and season of year. Taimen consume prey anywhere from 10-45% of their own size; taking larger food in the fall, presumably to build up body fat for a lean Siberian winter.

Early biologists describe the taimen as being "a voracious and insatiable predator." Sixty-four (64) different species of fish have been found in taimen including northern pike, chum salmon, pink salmon, Atlantic salmon, Arctic char, Arctic grayling, brown trout, lenok, and young taimen. One author states that grayling are the "favorite" food of the huchen. This can be verified as every taimen caught during the 1990 trips had grayling in their stomachs. Researchers have documented a 70-pound taimen to contain a 6.5-pound chum salmon, but indeed an 80-pound (estimated) taimen caught in 1989 contained not one chum, but four individuals of 4 to 5 pounds each! Besides fishes, taimen also relish amphibians, reptiles, small mammals, and birds, including ducks. Taimen prey heavily on lemmings during their periodic migrations in which the rodents are forced to cross streams and rivers. Siberian chipmunks, muskrats, mink, and squirrels are also consumed. Over indulgence seems to be the taimen's downfall; an 11-pound taimen was found choked to death trying to swallow an 11-pound northern pike, and another also was discovered choked to death after attempting to consume a puppy (species not noted) which had fallen into its watery grave.

Taimen actively search for prey and pursuits are so aggressive that they themselves are sometimes stranded in shallow water. Taimen have been observed lying at the bottom of a pool, slowly moving their tail in order to raise bottom sediment, thus attracting smaller fish, luring them closer in order to seize them. One researcher noted a taimen hunting in this fashion able to consume minnows on an average of one every seven minutes. Biologists have also noted that taimen hunt in groups, one portion of the group lying in ambush, the other driving the prey towards the ambushers. Mongolians natives have observed graying jump out of water onto dry land to escape the vicious herding actions of taimen. Strike reactions are primarily visual; only when prey move do taimen become aroused.

All this leaves one to speculate that taimen might be considered to be one of the most "intelligent" freshwater fish, comparable to killer whales, wolves and lions in their development of specialized social hunting skills. In any case, from early youth on, taimen are fierce predators, their prey selection and size increasing with their growth and an appetite that seemingly knows no bounds.

Mongol and Siberian native sportfishing methods are extremely crude in comparison to our sophisticated techniques. Short fiberglass rods or even long cane poles, large reels circa the 1930's and thick 40# plus test line seem to be the rule. However, some successful Russian anglers use a very large leather fly tied to resemble a lemming or muskrat. They cast it across a pool, twitching it as one would a bass bug. If there is a large taimen in the pool, it will definitely strike. If nothing is aroused in several casts, the anglers go on to the next piece of water. It's not known if the Russians were using fly fishing tackle. Some Soviet anglers in eastern USSR seine a stream for 6 to 8-inch "green perch" for bait, attach a hook and fish it live. Obviously, any live bait is incredibly effective. Similar methods used by North American anglers to lure solitary, large muskies into striking should prove excellent.

One of the nice "problems" of taimen fishing is the variety of other species which will also be caught. A common occurrence is the very real difficulty in getting through the lenok (*Brachymystax lenok*), a brown trout lookalike, to tempt a taimen. Lenok take flies and lures readily, from #16 dry flies to large topwater mouse imitations. Five and six-pounders are common and they can go over ten. Also available are Dolly Varden, northern pike and in many river systems trophy-sized Arctic grayling. In fact, the world's record for Arctic grayling could be broken on a Siberian taimen trip.

Taimen will strike instantly at anything appearing wounded and any lure imitating crippled prey is highly effective. In reviewing the available literature, several types of lures appear to be most prevalent. These include single body or jointed Rapalas, other single and jointed diving plugs, large spoons and spinners. Also common is use of a "cut plug" minnow, which are seined from the stream, fished with a weight and cast into moving current or deep pools.

All of this presents some interesting speculation on what fishing techniques from other parts of the world might be applied to taimen? A northwest angler on an exploratory trip in September 1989 in Siberia caught an 80-pounder using a 3/4-ounce Hotrod spoon in nickle-fire dot finish. Two years ago a Japanese exploratory trip yielded taimen up to 88-pounds in a remote Mongolia stream...lures unknown. All of the mentioned lures are obviously effective. Large, spoons used for Alaska's chinook such as Pixie, Krockodile, Daredevil and Mepps Giant Killer should on the tackle list. Other lures might include big Spin-N-Glos, 025 Hot Shot, Magnum Tadpolly and Magnum Wiggle Wart. However, 1990 anglers found silver Vibrax/Mepps/Metric/Panther Martin spinners in sizes 3 to 6 the most effective underwater lure. The artificial mouse was by far the best topwater bait.

Fly fishermen will probably have trouble hooking a really large taimen, unless some monster flies are used. Four-inch mouse flies were used in 1989 year by an American exploratory group; the biggest taimen landed was only 35-pounds, but it had four, 10-inch fish in its gullet and stomach! These anglers used 8 to 10-weight fly rods with shock tippets. They did relate though, seeing huge forms rise from the depths of pools, with distance between eyes estimated at 6-inches or more across; these monsters just followed the flies to the surface, then slid back into the depths...the offering seemingly not meaty enough to tempt a strike. In 1990, some superb , jointed mouse imitations to 6 inches long were created by an Atlantic salmon angler and used with excellent success in Siberia.

Large and gaudy 4/0 tarpon streamer flies might seem to be just the ticket, but then again they might be too small. Taimen to 11-pounds were taken in June by American anglers using tarpon streamers and sculpin patterns. Perhaps some modified flies like those used for big game billfish would be in order? Fly fishing tackle used for chinook salmon and tarpon would be the minimum appropriate to land a taimen of over 100-pounds. The jumping ability of taimen is legendary. Even if a 100-pounder is hooked, with a heavy current to multiply its weight advantage together with its jumping skills, it is doubtful one this size could be beached with fly tackle. If it does happen, it will take the most skillful angler and all the luck in the world to do so.

1990 marked the first serious attempt to discover the full potential of taimen fishing. Five Klineburger exploratory trips of up to twelve persons each journeyed to Mongolia and Siberia's fabled taimen waters from June to September. The cast was impressive; they included the world's foremost authority on aging fish by microscopic sectioning of the otilith (the inner ear) and the northwest's most famous salmon biologist, both of whom collected specimens for the Smithsonian Institution, American Museum of Natural History, California Institute of Science and the Canadian National Museum; writers and photographers for Sports Illustrated and Esquire magazines; a top official in the Atlantic Salmon Council; a film crew for National Geographic Magazine's 'Explorer' television series; a film crew from the British Broadcasting Corporation; one of Alaska's most well-known fishing and hunting guides; plus expert fishermen from the US, Canada and Britain. By now we know a bit more about the exclusive world of the taimen:

Taimen exist in the most remote and exotic parts of the globe, are the biggest salmonid species, have a growth rate among the fastest of freshwater species...only sturgeon live longer. As new rivers are found with larger angling potential, it is inevitable that taimen will become the world's newest "in" sportfish. All of us fortunate enough to fish for them should exercise extreme care that newly discovered sportfishable populations of taimen do not undergo the fate of their Hucho cousin, the Danube salmon. While we cannot control other governments' management policies, we can do our part to emphasize to them the precious quality of this spectacular fisheries resource.

Taimen are special creatures; they are possibly destined to become the fishing equivalent to Marco Polo Sheep, the world's most elusive and spectacular hunting trophy. A hunter returning from Mongolia last year wrote Klineburgers "...I thought the fishing potential was virtually unlimited. There are not many places in the world where you can stand on the banks of a river, see not one single human footprint, watch eagles flying by the dozens in the distance, and hear the bugling of a bull elk in the background, while fish very willingly and actively strike at your feet. I envy those who will be exploring this untapped fishery and look forward to reading about it in the future. Best wishes."

#####

UPDATED LAST: November 7, 1990

NOTE: The above information was compiled from recent fishing expeditions, available scientific and historical literature, recent news articles, secondary and first hand accounts of visits by western hunters and travelers to Mongolia and the Soviet Union, plus information supplied by government officials and citizens of those countries.

SUGGESTED READING

BOOKS

The first three books are Andrews' accounts of his collecting trips for the American Museum of Natural History...all out of print (see your library).

"ACROSS MONGOLIA PLAINS" by Roy Chapman Andrews

"THE HEART OF ASIA" by Roy Chapman Andrews

"TO THE ENDS OF THE EARTH" by Roy Chapman Andrews

"EAST OF THE SUN, WEST OF THE MOON" by Teddy and Kermit Roosevelt
Story of the 1920's Roosevelt collecting trip for the American Museum of Natural History.

"THE EURASIAN HUCHEN, HUCHO HUCHO, LARGEST SALMON OF THE WORLD"
by Holcik, Hensel, Nieslanki and Skacel (translated)
This is the most current scientific writing on taimen..1988.

"FRESHWATER FISHES OF THE USSR AND ADJACENT COUNTRIES"
by Leo S. Berg (translated)
Out of print two volume scientific work.

"MONGOLIA" by Silvio Micheli
A story written by an Italian in search of Marco Polo's route.

"THE MONGOLS" by David Morgan
An excellent history of Mongolia and available in paperback through your local bookstore.

MAGAZINE ARTICLES

"THE FIELD"...'Fishing in Mongolia'...September 1966 (English)

"NATIONAL GEOGRAPHIC"...February 1985, March 1962 and June 1933

"CALIFORNIA ANGLER"...'A Taste of Siberia'...January 1990

"ALASKA OUTDOORS'...'Fishing for a Living Legend'...January 1990

"THE ATLANTIC SALMON JOURNAL"...'Mongolian Giants'...Spring 1990

"SALMON, TROUT, STEELHEADER"...June 1990

"TROUT"...'How Many Species?'...Summer 1990

VIDEO

'THE LAST EMPEROR"
Suggest viewing to understand China's recent history during your tour to Mongolia with sightseeing in Beijing. Rent it from your local video store prior to your trip.

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Dear Angling Enthusiast:

For those of you responded this year to our announcements that we would be generating fishing tours in Siberia and Mongolia on an even larger scale than previously, here are the 1991 schedules.

For those who are unaware of our program, I hope the enclosed material will be informative.

We have greatly expanded the program over last year, with some exciting developments. The taimen fishery had been expanded to six rivers in both Siberia and Mongolia and we fully expect a 100-pounder to be caught this year, making it "the world's largest salmon."

We will be the first Western anglers ever to fish the storied Kamchatka Peninsula. Depending on time of year, we will sample the chinook, sockeye and silver salmon runs, plus experience an entirely new fishery for steelhead, the "Soviet" steelhead. Additionally, resident rainbow are available during the entire season from May to November.

And, for Atlantic salmon enthusiasts we have succeeded in gaining permission to fish the huge Pechora River system northeast of Moscow. This is the largest Atlantic salmon watershed in the USSR, and probably the world. The largest Atlantic salmon recorded from the Pechora was 89 pounds.

Trips are all-inclusive from either New York or San Francisco. Airfare included is based on coach, but you are welcome to upgrade.

New York itinerary for Atlantic salmon is $4,600.
San Francisco itinerary for taimen, Pacific salmon and steelhead is $5,300.

Deposit required to hold space is 40%; final payment is due 90-days prior to departure date. Please call for openings. Space is very limited.

Tight lines,

Tom Knight

Tom Knight
Angling Program Manager

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Proposed 1991 Schedule for Taimen Salmon Fishing in Northern Outer Mongolia with Travel through China

Day 1 (Friday) Angler would leave his hometown and arrive San Francisco to connect with mid-afternoon flight to Beijing.

Day 2 (Saturday) Evening arrival in Beijing. You'll be met by a Klineburger representative and driven via mini bus to hotel for overnight accommodations.

Day 3 (Sunday) Sightsee Beijing. A full day of guided sightseeing in and around Beijing, including the Great Wall, Tian-Men Square and traditional Peking duck dinner.

Day 4 (Monday) Morning at your liesure for individual sightseeing or shopping. Mid-afternoon air departure for Ulan Bator. Upon arrival you'll be met by a Klineburger representative of Zhuulchin, the Mongolian National Tourist Organization. Connect with air service to outpost city with final travel via 4-wheel drive vechicles to camp.

Day 5 - 9 Fish for Taimen, Lenok and Arctic grayling on the selected river. Accommodations are yurts. Included in the package are all meals, vehicle transportation, services of guides and interpreters..

Day 10 (Sunday) Fish in the morning with afternoon transfer back to Ulan Bator for overnight accommations.

Day 11 (Monday) Depart Ulan Bator for flight to Beijing. Arrive Beijing Noon. Remainder of day for sightseeing.

Day 12 (Tuesday) Full day of sightseeing in Beijing's Forbidden City and for last minute shopping.

Day 13 (Wednesday) Depart Bejing early morning and arrive San Francisco same day at 10am due to change in International Date Line.

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Proposed 1991 Schedule for Salmon and Steelhead Fishing on Kamchatka Peninsula with Travel through China

Day 1 (Friday) Angler would leave his hometown and arrive San Francisco to connect with mid-afternoon flight to Beijing.

Day 2 (Saturday) Evening arrival in Beijing. You'll be met by a Klineburger representative and driven via mini bus to hotel for overnight accommodations.

Day 3 (Sunday) Sightsee Beijing. A full day of guided sightseeing in and around Beijing, including the Great Wall, Tian-Men Square and traditional Peking duck dinner.

Day 4 (Monday) Morning flight to Harbin with connections to Khabarovsk. Overnight Khabarovsk with morning connection to Petropavlovsk on the Kamchatka Peninsula. Connect then with helicopter flight to fishing camp. Fish that afternoon.

Day 5 - 9 Depending on the season, fish for chinook or coho salmon (sockeye, chums and pinks also available), Soviet summer steelhead and resident rainbow. Included in the package are all meals, services of guides, boats, tent or cabin accommodations and interpreters.

Day 10 (Sunday) Fish in the morning with afternoon transfer back to Petropavlovsk for overnight accommations.

Day 11 (Monday) Depart Petropavlovsk for flight to Khabarovsk and Beijing. Remainder of day for sightseeing in Beijing.

Day 12 (Tuesday) Full day of sightseeing in Beijing's Forbidden City and for last minute shopping.

Day 13 (Wednesday) Depart Bejing early morning and arrive San Francisco same day at 10am due to change in International Date Line.

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Proposed 1991 Schedule for Atlantic Salmon Fishing in the Soviet Union with Travel through Moscow from the United States

Day 1 (Saturday)	Arrive from client's city to New York and depart in the afternoon.
Day 2 (Sunday)	Arrive Moscow in mid-morning. Transfer by Klineburger representative to hotel. Dinner at a local restaurant.
Day 3 (Monday)	Breakfast at the hotel. Sightseeing in Moscow, with lunch and dinner at other restaurants.
Day 4 (Tuesday)	Breakfast at hotel and transfer to airport for flight to the outpost city. Transfer to helicopter for flight to fishing camp on the selected river.
Day 5 - 10	Six full days of fishing. Accommodations are either tent camps or cabins and all meals, licenses, services of guides, interpreter and use of boats are included.
Day 11 (Tuesday)	Depart fishing camp by helicopter for outpost city. Flight back to Moscow. Overnight Moscow.
Day 12 (Wednesday)	Depart Moscow for either Copenhagen or Frankfurt. Overnight in one of these cities.
Day 13 (Thursday)	Flight from either Copenhagen or Frankfurt back to the United States.

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Proposed 1991 Schedule for Salmon Fishing in Khabarvosk or Magadan with Travel through China

Day 1 (Friday)	Angler would leave his hometown and arrive San Francisco to connect with mid-afternoon flight to Beijing.
Day 2 (Saturday)	Evening arrival in Beijing. You'll be met by a Klineburger representative and driven via mini bus to hotel for overnight accommodations.
Day 3 (Sunday)	Sightsee Beijing. A full day of guided sightseeing in and around Beijing, including the Great Wall, Tian-Men Square and traditional Peking duck dinner.
Day 4 (Monday)	Morning flight to Harbin with connections to Khabarovsk. Then connecting flight to fishing camp, if in Khabarovsk area, or connecting flight to Magadan and then flight to Magadan area fishing camp. Fishing in afternoon if possible.
Day 5 - 9	Fish for taimen, Northern pike, lenok and Arctic grayling on the selected river. Or, fish for silver salmon on Magadan area river. Accommodations are yurts. Included in the package are all meals, vehicle transportation, services of guides and interpreters..
Day 10 (Sunday)	Fish in the morning with afternoon transfer to either Magadan or Khabarovsk. Ovenight either city.
Day 11 (Monday)	Depart either Khabarovsk or Magadan for flight to Beijing. Arrive Beijing with remainder of day for sightseeing.
Day 12 (Tuesday)	Full day of sightseeing in Beijing's Forbidden City and for last minute shopping.
Day 13 (Wednesday)	Depart Bejing early morning and arrive San Francisco same day at 10am due to change in International Date Line.

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SOVIET UNION AND MONGOLIA FISHING SCHEDULES...1991

The following schedules are based on New York and San Francisco gateway city departures. All Far East Soviet and Mongolian itineraries will travel San Francisco to Beijing, Khabarovsk or Ulan Bator, thence to final destination. Sightseeing in Beijing is included, along with some sightseeing in Khabarovsk and Ulan Bator. The Atlantic salmon itinerary is based from New York to Moscow, thence to the fishing area.

These trips are based on group travel. Klineburger Travel reserves the right to reschedule trips that are not filled with at least four (4) clients.

Final schedules will not be known prior to end of December 1990 and clients should be aware that actual dates may vary two or three days from the following. Air travel to and within the Soviet Union and Mongolia have not yet been finalized for 1991.

SPECIES	FOREIGN CITY	US GATEWAY	ROUND TRIP .....DATES OF TRAVEL.....	MAX. # ANGLERS
		Maymakan River		
Taimen Salmon	Khabarovsk, USSR	Sat - Wed	#1 July 13 - July 24	6
			#2 July 27 - Aug 07	6
			#3 Aug 10 - Aug 21	6
			#4 Aug 24 - Sept 04	6
			#5 Sept 07 - Sept 18	6
			#6 Sept 21 - Oct 02	6
		Maja River		
Taimen Salmon	Khabarovsk, USSR	Sun - Fri	#1 June 02 - June 14	5
		Mon - Sat	#2 June 17 - June 29	5
		Sat - Sun	#3 Aug 24 - Sept 08	5
Taimen Salmon	Khabarovsk, USSR	Sat - Wed	#1 May 18 - May 29	6
			#2 June 01 - June 12	6
			#3 June 15 - June 26	6
			#4 June 29 - July 10	6
			#5 July 13 - July 24	6
			#6 July 27 - Aug 07	6
			#7 Aug 10 - Aug 21	6
			#8 Aug 24 - Sept 04	6
			#9 Sept 07 - Sept 18	6

Tugur River

Taimen Salmon	Khabarovsk, USSR	Sat - Wed	#1 May 18 - May 29	6
			#2 June 01 - June 12	6
			#3 June 15 - June 26	6
			#4 June 29 - July 10	6
			#5 July 13 - July 24	6

Uda River

Taimen Salmon	Khabarovsk, USSR	Sat - Wed	#1 May 18 - May 29	6
			#2 June 01 - June 12	6
			#3 June 15 - June 26	6
			#4 June 29 - July 10	6
			#5 July 13 - July 24	6

Orchon/Selnge River Systems

Taimen Salmon	Ulan Bator, Mongolia	Fri - Wed	#1 July 26 - Aug 07	6
			#2 Aug 09 - Aug 21	6
			#3 Aug 23 - Sept 04	6
			#4 Sept 06 - Sept 18	6
			#5 Sept 20 - Oct 02	6
			#6 Oct 04 - Oct 16	6
			#7 Oct 18 - Oct 30	6

Kukhtui River

Silver Salmon	Khabarovsk, USSR	Fri - Tues	#1 Aug 30 - Sept 10	5
		Sat - Wed	#2 Sept 07 - Sept 18	5
		Sun - Thurs	#3 Sept 15 - Sept 26	5

Yama River

Silver Salmon	Magadan, USSR	Sat - Wed	#1 July 20 - July 31	6
			#2 Aug 03 - Aug 14	6
			#3 Aug 17 - Aug 28	6
			#4 Aug 31 - Sept 11	6

Pechora River

Atlantic Salmon	Moscow, USSR	Sat - Thurs	#1 July 13 - July 25	6
			#2 July 27 - Aug 08	6
			#3 Aug 10 - Aug 22	6
			#4 Aug 24 - Sept 05	6
			#5 Sept 07 - Sept 19	6

Bol'shava River

Chinook Salmon Petropavlovsk, USSR Fri - Wed	#1 May 17 - May 29	6
	#2 May 31 - June 12	6
Chinook/Sockeye Salmon	#3 June 14 - June 26	6
	#4 June 28 - July 10	6
Sockeye Salmon	#5 July 12 - July 24	6
Sockeye/Silver Salmon	#6 July 26 - Aug 07	6
Silver Salmon	#7 Aug 09 - Aug 21	6
	#8 Aug 23 - Sept 04	6
Silver Salmon/Summer Steelhead	#9 Sept 06 - Sept 18	6
Summer Steelhead	#10 Sept 20 - Oct 2	6
	#11 Oct 04 - Oct 16	6
	#12 Oct 18 - Oct 30	6
	#13 Nov 01 - Nov 13	6

NOTES ON THE SALMONID FAMILY

Taimen salmon spawn in the spring in the very smallest upper tributaries, then progressively follow dropping water levels during the summer into lower stretches of the river systems. Taimen are resident in freshwater throughout the year.

Atlantic salmon, like their cousins the steelhead, enter the rivers during the summer through fall and remain there throughout the winter. Therefore, they are available in large numbers throughout the summer and into the fall months. However, Atlantic salmon spawn in the fall, whereas steelhead spawn in the spring.

Resident Rainbow are present in the Bol'shava River year round and success raters would be comparable to Alaskan rivers i.e. best in May and early June and again in September and October. **Sockeye, chum and pink salmon** runs enter the Bol'shava between the chinook and steelhead runs and will be encountered. The sockeye run begins right after the chinook, often concurrent, and peaks the end of July. **Chum and pink salmon** are present in the river during July and August.

Like all anadromous fish runs, the start and peak of individual runs may vary by up to several weeks, depending on a variety of environmental conditions. Low water conditions in a river may delay a particular run until adequate rains provide high enough flows for the fish to ascend to their spawning areas.

PROFESSIONAL ADVENTURES
KLINEBURGER

January 07, 1993

Dr. Robert J. Behnke
Department of Fishery and Wildlife Biology

Fort Collins, CO 80523

Dear Robert J.:

For over four decades, Professional Adventures has searched out the most exciting and rewarding spots in the world to visit. For our fisherman friends, no one place has been more rewarding than our recent opening of the Russian Far East to western sportsmen. The end of the cold war has made everyone breathe a bit easier, but sports fishermen in particular have benefited beyond their wildest dreams. Siberia has been closed to westerners since World War One, and the Kamchatka peninsula has been closed to even Russians for almost as long. If you can imagine what Alaska was like before the gold rush in 1849, then you have some idea of what awaits you when you book an adventure with us this year.

No one is more experienced, no one is more knowledgeable, no one has delivered on their promises as well as Professional Adventures in Siberia and Kamchatka. We are now booking our fourth season of Russian sport fishing and the fish are there already, waiting for you. The Maymakan River, with its crystal clear gravel bedded holes, only needs you to gather up its bounty of Hucho hucho taimen, the "Siberian River Tiger". Year after year, no one has left empty-handed, every one of our clients has landed the legendary taimen. Every year, every fisherman, no exceptions.

This perfect success rate is the result of much careful planning on our part, and 1993 figures to be the best year yet. The programs have proven themselves, whether it's pacific salmon in Kamchatka or taimen in Siberia, nothing is left out and nothing is left to chance. We'll get you there, we'll make you comfortable, and you'll land the fish you now only dream about.

This is our invitation to you. Be a pioneer with us, enjoy the bounty of these untouched rivers, and meet the people of this vast and opening land. Each moment you spend in this magnificent country will stay with you forever. This is something you can give yourself that will never disappear.

Best regards,

Jon

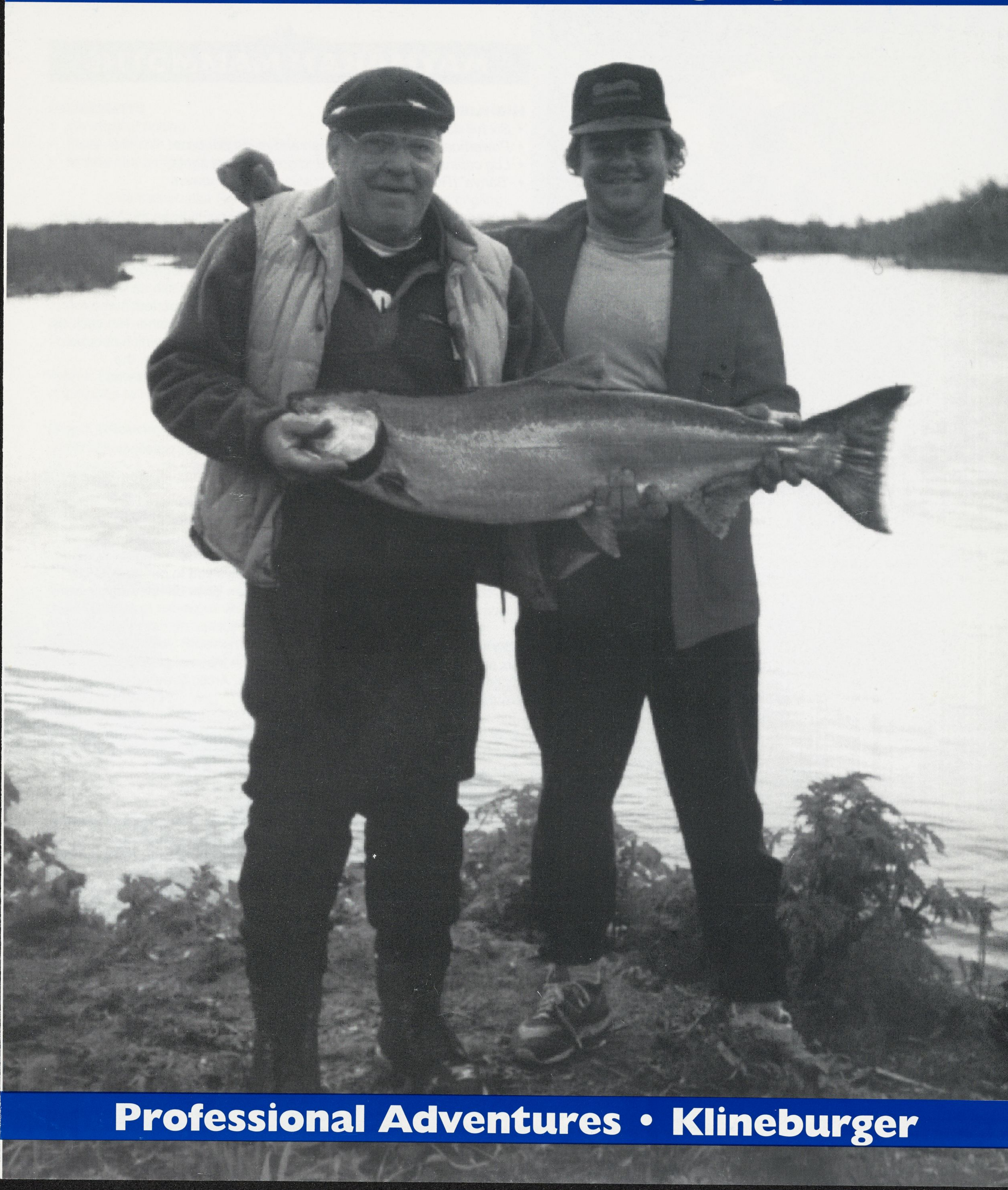
Jon Bates
Angling Program Director

P.S. Mexico Sportsman, Inc. is now a part of the Professional Adventures • Klineburger family and specializes in fishing south of the border. We operate the best fleets in Mexico. Call for information on fishing, charter and resorts that we have available in Mazatlán, Cabo San Lucas, Puerto Vallarta, Cancún and Cozumel at 1(800)-633-3085.

Encl.
JB/lb
CIS Fishing 93

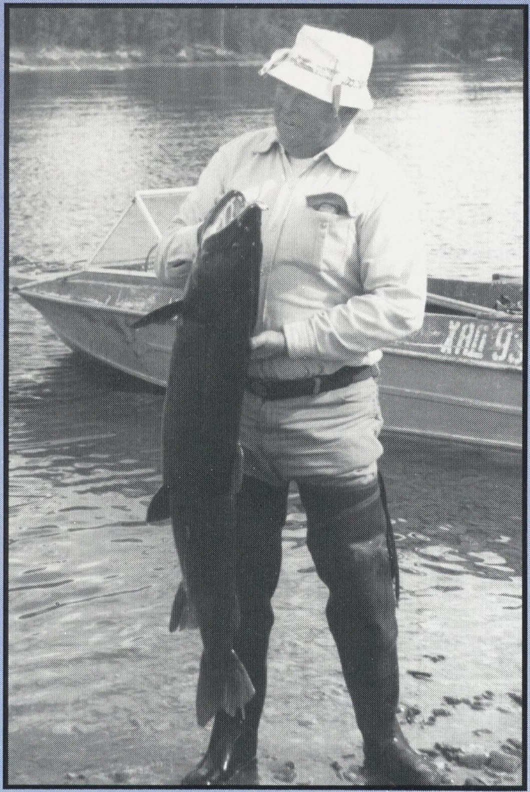
3627 FIRST AVENUE SOUTH • SEATTLE, WASHINGTON 98134
Corporate Office (206) 343-9699 • Fax (206) 682-8868 • Toll Free (800) 232-3708 • Telex 185283

Russian Sportfishing Expeditions

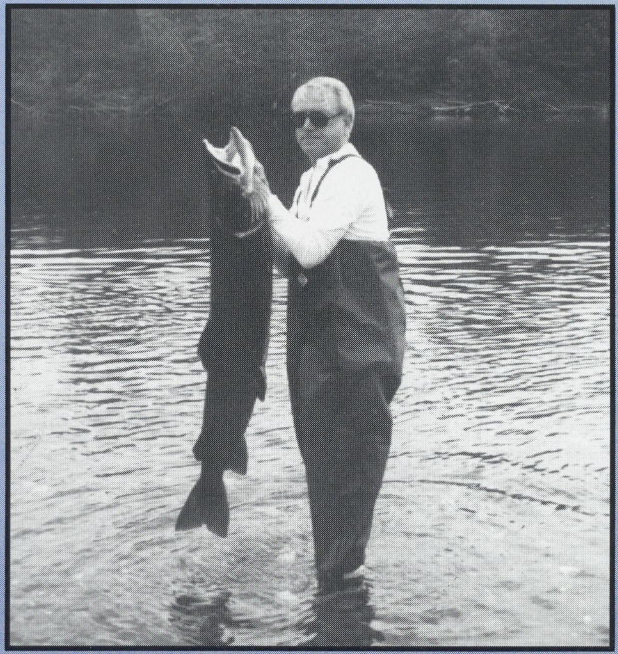


Professional Adventures • Klineburger

Want To Catch The World's Largest Salmon ?



Ken Wise of Seattle, WA with a hefty 46" Taimen from Siberia's Maymakan River.



Terry Peabody holds up an armful of trophy Taimen in the pristine waters of the Maymakan.

MAYMAKAN MAMMOTHS

HIGHLIGHTS

- *Six full days of fishing*
- *Powerboats with one fisherman and guide per boat*
- *Log cabins with wood stove and generator for lights*
- *'Banya' (Russian Sauna) with solar heated showers*

In the virgin wilderness of Eastern Siberia flows the Maymakan River, carving its way through the vastness of Russia, eventually emptying into the waters of the Arctic Ocean. To fish on this river is an angler's dream, its clear, pristine waters offering not only relaxing pleasure to the senses, but an overflowing bounty of fish as well.

Numerous deep bedded gravel holes are a perfect home for the Siberian River Taimen *(Hucho hucho taimen)* and other fish such as the Lenok, Arctic Grayling and the Northern Pike, all of which abound here. An area so remote it is accessible only by helicopter, the Maymakan has rarely been fished, and beckons the angler who demands something special.

Day 1 (Sunday)
Anchorage to Khabarovsk, crossing the international dateline.

Day 2 (Monday)
Upon arrival, you are met by your Professional Adventures representative and transferred to your hotel for dinner.

Day 3 (Tuesday)
After a hearty breakfast, a charter airplane flys you to our outpost city and continue via helicopter to the Maymakan River camp. Early arrival allows us to fish late afternoon.

Days 4-9 (Wednesday - Monday)
Six full days of superb fishing on the pristine Maymakan River. Opportunity to fish for River Taimen, Lenok, Arctic Grayling and Northern Pike.

Day 10 (Tuesday)
After morning fishing, helicopter transfer to our outpost city and connect with a flight to Khabarovsk.

Day 11 (Wednesday)
Morning sightseeing tour of Khabarovsk and last minute shopping prior to our afternoon flight to Anchorage, arriving early A.M. the same day.

DEPARTURES
We can only accommodate 5 passengers per departure.

#1 June 20 - 30	#3 Aug 1 - 11	#5 Aug 29 - Sept 8
#2 July 18 - 28	#4 Aug 15 - 25	#6 Sept 12 - 22

PRICE **$5,200 including roundtrip international airfare on Alaska Airlines**

INCLUDES
Anchorage - CIS - Anchorage international & internal airfare/transfers, all meals, sightseeing, guides, and interpreters.

Questions? Call us today at (800) 232-3708!

Cover Photo of Jerry & Brad Hermanson on the Bystraja

KAMCHATKA PENINSULA

HIGHLIGHTS

- *Six days of fishing*
- *River rafts with two guides/two fishermen per raft*
- *Mobile tent camp - cover many miles of water each day*

The Kamchatka Peninsula's Bystraja River offers an angling adventure unlike any other. This Russian River runs northwest of the city of Petropavlovsk, spilling into the Sea of Okhotsk - and is home to prodigious runs of legendary Pacific Salmon.

Along the beautiful banks of the Bystraja is a lush greenness like that found only in Hawaii, an overgrown and unspoiled paradise. The river's gravel bottomed holes teem with Chinook, Coho Salmon, Steelhead, resident Rainbow Trout, Dolly Varden and Arctic Grayling. The Bystraja River - a journey unparalleled in the angling world.

Day 1 (Sunday)
Anchorage to Khabarovsk, crossing the international dateline.

Day 2 (Monday)
Upon arrival, you are met by your Professional Adventures representative, with time to explore the city before our evening flight to our final destination, the Kamchatka Peninsula.

Day 3 (Tuesday)
Arrive early morning, transfer to our starting point on the Bystraja river, and fish the rest of the day.

Days 4 - 7 (Wednesday - Saturday)
Four full days of fishing as we river raft with our mobile base camp. Opportunity to fish (in season) for Chinook, Coho (Sockeye, Chum and Pink available), Steelhead, resident Rainbow Trout, Dolly Varden, and Arctic Grayling.

Day 8 (Sunday)
Fish until early afternoon, evening flight to Khabarovsk.

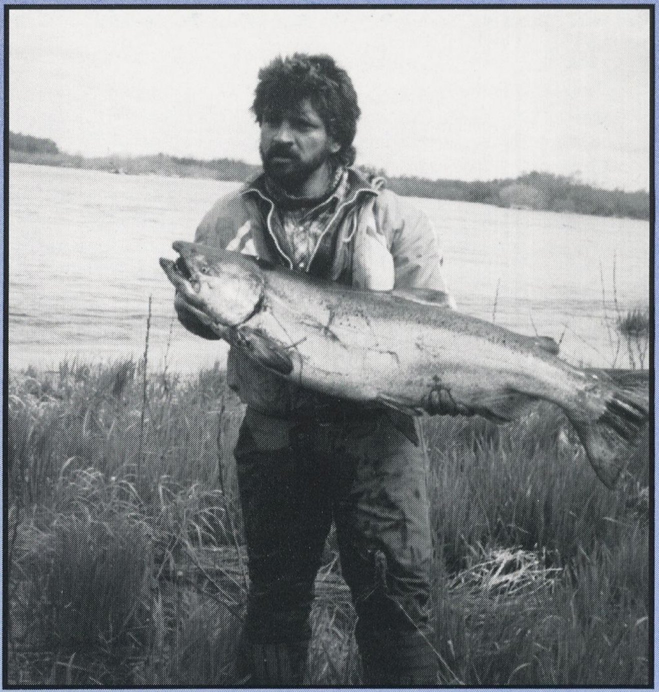
Day 9 (Monday)
Local sightseeing and shopping, afternoon flight to Anchorage, arriving early A.M. same day.

DEPARTURES
We can accommodate only 6 passengers per departure.

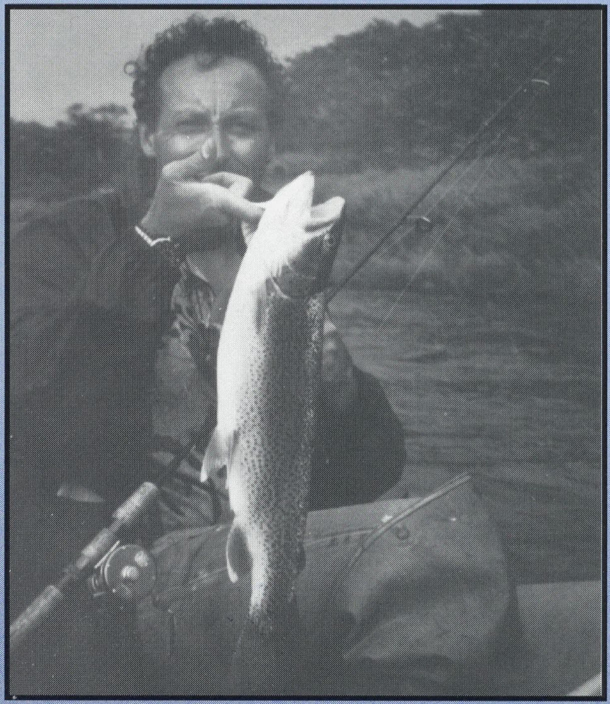
Chinook Salmon	Coho Salmon	Combo Coho / Taimen
#1 May 30 - Jun 6	#1 Aug 22 - 30	#1 Aug 22 - Sep 28
#2 Jun 6 - 14	#2 Aug 29 - Sep 6	#2 Sep 5 - 22
	#3 Sep 5 - 13	(Call for info & prices)

PRICE **$4,200 including roundtrip international airfare on Alaska Airlines**

INCLUDES
Anchorage - CIS - Anchorage international & internal airfare/transfers, all meals, sightseeing, guides and interpreters.



Dima, our Russian Master Guide, proudly displays a 39 lb. Chinook landed in the waters of the Bystraja.



Jon Bates with a beautiful Rainbow Trout taken from the Bystraja.

General Conditions

The Fishing

Local officials have requested, with the agreement of Professional Adventures • Klineburger (PA•K), that all fishing shall be conducted on a catch and release basis. In the event a trophy fish is caught, each angler will be permitted to keep one fish if he/she so desires.

Seasons

We will operate from mid May through September depending upon chosen species.

Included

Meeting upon arrivals in all guest cities. Round-trip air transfer from Anchorage, AK to your outpost city and helicopter flights to fishing areas. All overnight accommodations and meals as indicated in itineraries, hotels, tents, cabins, guide service, fishing as outlined, fishing licenses, interpreters, power boats or river rafts, visas and processing.

Not Included

Airfare to and from your home city to Anchorage. Accommodations and meals enroute to departure cities, alcoholic beverages, items of a personal nature, fishing equipment, laundry, room service, and gratuities. Any special individual transfers not coordinated with group arrival or departure, phone calls, baggage insurance, excess baggage charges, any itinerary modification or deviation as requested by passengers, gratuities to guides and camp staff.

When You Go

Due to the complex nature of ticketing and reservations in the CIS, all reservations for your trip will be processed by PA•K in Seattle, Washington. PA•K will coordinate airline schedules and tickets to and from your host city for all passengers. We will obtain your required visas, and will arrange accommodations and services prior to the start of your fishing trip as required by the itinerary, and assist with any additional excursions in any way possible.

Terms and Conditions

Reservations/Payments

Contact Professional Adventures • Klineburger at (206) 343-9699 or (800) 232-3708 Fax: (206) 682-8868 to obtain further details and make reservations. A deposit of 40% is required at the time of reservation. Final payment is due 60 days before departure.

Price

Quoted prices are based on the latest information available and are subject to change at any time before departure, without notice.

Cancellation

Deposits are non-refundable unless the client can be replaced. For cancellations made 14 days or less prior to departure, no refunds can be made. In any event, the company's only responsibility will be to refund amounts paid which have not previously been paid to third parties. Cancellation insurance is available and is recommended. Receipt of a deposit by PA•K is acknowledgement that you have read and accept the terms and conditions herein.

Responsibility

PA•K acts only as a limited representative for clients or their agents in engaging the services or other persons to provide transportation, lodging, tours, guides, and other travel services. Neither PA•K nor its employees, officers, directors, agents or affiliates will be responsible or liable for any loss, injury, death, or damage to any person or property (i) arising out of arrangements made on behalf of any person by PA•K or (ii) caused by or arising out of travel or other activities undertaken as a result of such arrangements.

Thank you and welcome to the Professional Adventures • Klineburger family!

NOTES

Alaska Airlines

PROFESSIONAL ADVENTURES • KLINEBURGER

PROFESSIONAL ADVENTURES

KLINEBURGER

3627 First Avenue South • Seattle, Washington 98134
Corporate Office (206) 343-9699 Toll Free (800) 232-3708 Fax (206) 682-8868

MONGOLIA & RUSSIA ANGLING PROGRAM

Sport Fishing History in the Making

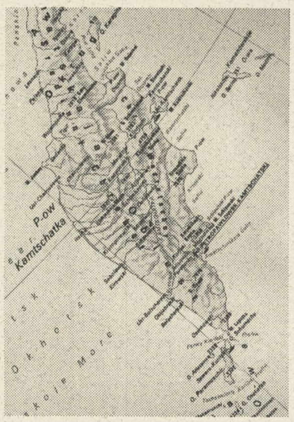
Join Klineburger Worldwide Travel in unparalleled sportfishing expeditions to new angling locations in the Soviet Union and Mongolia.

The salmon-rich waters of the legendary Kamchatka Peninsula will challenge even the most experienced angler.

Fish the world's largest Atlantic Salmon runs on the Pechora River Northeast of Moscow . . . an anglers dream.

The remote Maymakan river has rarely been fished, allowing the native Taimen Salmon to grow to mammoth size.

Our Taimen fishing expeditions in the Soviet Union and Mongolia will make history again this year. Explore the details . . .



The Legendary Kamchatka *Itinerary # 1*

The Kamchatka Peninsula lies between the Sea of Okhotsk and the Bering Sea, with Karul Islands running from its southern tip down to Japan. The Bol'shaya and Bystraja Rivers run northwest of the city Petropavlovsk and empty into the Sea of Okhotsk. These rivers are home to tremendous runs of Pacific Salmon. Russian biologists report this fishery to be so immense they refer to it as "The Alaska of 50 years ago".

We are planning arrivals to Khabarovsk Thursday to Thursday, with fishing on the Bol'shaya River or the Bystraja River from Friday to Wednesday. This permits six full days of fishing at the river. River selections will be made at the time of booking depending on the season, species desired, gear type and availability.

Day 1 (Wednesday)
Board afternoon plane to Khabarovsk crossing the international date line. Dinner enroute.

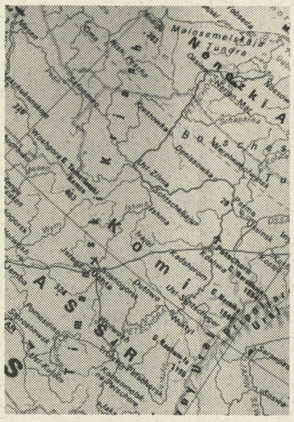
Day 2 (Thursday)
Upon arrival in Khabarovsk. You will be met by a Klineburger representative and transferred to your connecting flight to the outpost city on the Kamchatka Peninsula. Overnight accommodations.

Day 3 (Friday)
After a hearty breakfast, we will take an early morning helicopter flight to the Bol'shaya/Bystraja River camp. An early arrival will allow you time to rig up your tackle and fish most of the day. Lunch and dinner is provided at the base camp.

Days 4 - 8 (Saturday - Wednesday)
Five full days of fishing on the Bol'shaya/Bystraja Rivers. Depending on the season have the opportunity to fish for Chinook, Coho, (Sockeye, Chums, Pink, also available) Steelhead, and resident Rainbow Trout. Late Wednesday afternoon depart from the river camp to the outpost city for dinner and overnight accommodations.

Day 9 (Thursday)
Early breakfast. Plane flight back to Khabarovsk where you will connect with your flight home to the United States.

The land tour cost is $2990.00 US per person Khabarovsk to Khabarovsk.



The Record Breaking Pechora *Itinerary # 2*

The Pechora River is located west of the Ural Mountains and to the east of the Kola Peninsula draining north into the Arctic Ocean. This fishery is world renowned housing the largest runs of Atlantic Salmon and also the biggest fish. The river varies in its gradient and character so it provides the opportunity to fish as you like wading, boat fishing or casting.

We are planning arrivals to Moscow on Sundays with fishing on the famous Pechora River Wednesday through Monday. This itinerary allows six full days of fishing at the river and a few days of sightseeing in Moscow, the capital city of the Soviet Union.

Day 1 (Saturday)
Depart the United States to Moscow. Cross the international date line. Dinner enroute.

Day 2 (Sunday)
Late afternoon arrival in Moscow. After clearing customs and immigrations, you will be met by a Klineburger representative and escorted to the hotel. Dinner and overnight accommodations.

Day 3 (Monday)
This morning we will have breakfast at the hotel and depart for a full day of sightseeing in Moscow, the capital of the Soviet Union. Lunch and dinner.

Day 4 (Tuesday)
Early morning breakfast and transfer to the airport for a flight to the outpost city. Late morning transfer to helicopter for an exhilarating flight to the Pechora River fishing camp.

Day 5 -10 (Wednesday - Monday)
Six full days of fishing for Atlantic Salmon. Meals included.

Day 11 (Tuesday)
Early morning breakfast. Today we will depart fishing camp by helicopter for the outpost city. Transfer to the airport for our flight back to Moscow. Overnight accommodation in Moscow. Breakfast lunch and dinner included.

Day 12 (Wednesday)
Our local Klineburger representative will assist you with your flight connections back to the United States.

The land tour cost is $2,990.00 US per person Moscow to Moscow.

History in the Making...

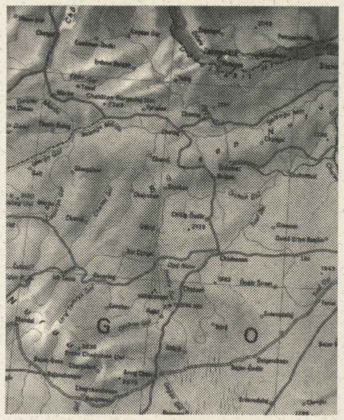
In what may be unparalleled in recent sportfishing history, Klineburger Worldwide Travel has permission from Soviet and Mongolian officials to fish six rivers for Taimen Salmon, Atlantic Salmon, Chinook, Silver Salmon and Soviet Steelhead.

This is exciting news as we have four programs that will challenge even the most experienced angler. Our newest program allows our clients to fish the rich waters of the legendary Kamchatka Peninsula which has been closed to all westerners since the Russian Revolution. Kamchatka's Bol'shaya River is one of the few rivers in the entire Pacific Rim which contains all five major Pacific Salmon species. Scientists have known of the immensity of this fishery for decades and now you, our valued client will be the first to experience this new frontier.

For the Atlantic Salmon enthusiasts, we have secured the rights to fish the Pechora River located northeast of Moscow. This resource rich watershed is home to the largest Atlantic Salmon in both size of the run and genetic size in the world. The Pechora River watershed is ten times that of the Kola Peninsula Umba and Ponoi Rivers combined. We have set up a comfortable tent camp in one of the optimum fishing stretches of this river.

As you know, we made history last year with our Taimen fishing expeditions in the Soviet Union and Mongolia. We have expanded this program to five rivers and fully expect our clients to land some of the largest Taimen ever caught on sports tackle. The largest recorded Taimen caught weighed in at 231 pounds. The Taimen Salmon in these areas has rarely been commercially fished, allowing the species to grow mammoth in size.

We hope that you will join us to be among the first to experience these new frontiers. It is an opportunity to make sportfishing history. Reservations are available now but space is limited. We look forward to being your host during the 1991 season.



Mongolian Giants
Itinerary # 3

The Taimen Salmon which inhabit the watersheds of the eastern Soviet Union and Outer Mongolia have rarely been commercially fished. The size of the fishery is immense - virtually every watershed in Siberia and Mongolia holds Taimen. We will fish one of three river systems all of which have Taimen, Lenok and Arctic Grayling.

We are planning arrivals in Beijing Saturday to Friday which allows 5 full days of fishing and the remainder of the time to sightsee. River selections will be made at the time of booking depending on the season, species desired, gear type and availability.

Day 1 (Friday)
Depart the United States for China. Cross the international date line. Dinner enroute.

Day 2 (Saturday)
After clearing customs in Beijing, you will be met by our Chinese host and transferred to your deluxe overnight accommodations.

Day 3 (Sunday)
This morning we spend a full day exploring the treasures of Beijing - the capital and cultural heart of both modern and historic China. Our trip takes us to Tian-an Men Square , then across the bridge to the Great Wall of China for lunch.Tonight a special Peking duck dinner will be prepared for us. Overnight Jing Guang New World Hotel.

Day 4 (Monday)
This morning is at leisure for sightseeing or shopping. In the afternoon we depart for our flight to Ulan Bator the capital city of Mongolia. Upon your arrival in Ulan Bator, you will be met by a Klineburger representative and transferred to your hotel for dinner and overnight accommodations.

Day 5 (Tuesday)
Today we start our fishing adventure departing via 4-wheel drive vehicle to the river camp. A late afternoon arrival will allow you time to rig up your gear and fish the remainder of the day.

Day 6 - 10 (Wednesday - Sunday)
Your local fishing guide will take you for five full days of fishing for Taimen, Lenok and Arctic Grayling. Meals included.

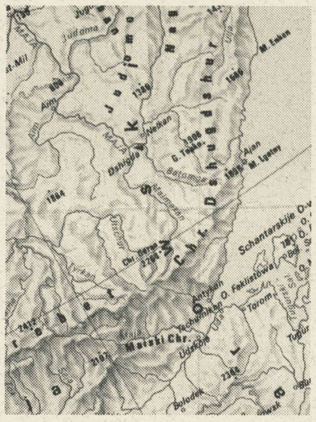
Day 11 (Monday)
An early departure from your fishing camp heading back through to the capital city of Ulan Bator. Meals enroute.

Day 12 - 13 (Tuesday - Wednesday)
This morning we board an early train enroute to Beijing. This is one of the great train trips of the world which takes you through the Gobi Desert. Have your camera ready as the desert is home to a concentration of gazelles, goats, wild horses, herds of camels and native yaks. Overnight accommodation provided enroute. Meals on train ride are not included and at clients' discretion.

Day 14 (Thursday)
Arrive in Beijing where you will be greeted by your Chinese host and taken to your deluxe hotel. Today's hightlights include the ancient Forbidden City and shopping. Breakfast, lunch and dinner.

Day 15 (Friday)
Depart Beijing for an early morning flight back to the United States.

The land tour cost is $3100.00 US per person Beijing to Beijing.



Maymakan Mammoths
Itinerary # 4

The Maymakan river is a watershed in Eastern Siberia flowing eventually into the Arctic Ocean. The river is home to vast runs of Taimen Salmon, Lenok, Arctic Grayling and Northern Pike. It is a very fishable river as it has several fishing holes or backwater sloughs loaded with many different species of fish.

We are planning arrivals to Khabarovsk on Tuesday with fishing on the Maymakan River Thursday through Thursday. This allows six full days of fishing and a day of sightseeing in Khabarovsk.

Day 1 (Monday)
Depart the United States for Khabarovsk. Cross the international date line. Dinner enroute.

Day 2 (Tuesday)
Upon arrival in Khabarovsk, USSR, you will be met by a Klineburger representative and transferred to your hotel for dinner and overnight.

Day 3 (Wednesday)
We wake up this morning and have a full day of sightseeing in the beautiful, metropolitan city of Khabarovsk .

Day 4 (Thursday)
After a hearty breakfast, we will transfer for a flight to our outpost city and continue via helicopter to the Maymakan River camp. An early arrival will allow you time to rig up your tackle and fish most of the afternoon. Lunch and dinner is provided at the base camp.

Day 5 - 8 (Friday - Wednesday)
Six full days of fishing on Maymakan River. You will have the opportunity to fish for Taimen, Northern Pike, Lenok and Arctic Grayling. Meals included.

Day 9 (Thursday)
Transfer to outpost city by helicopter with connecting airplane flight back to Khabarovsk where you will be assisted in your transport to the airport for your flight home.

The land tour cost is $3,800.00 US per person Khabarovsk to Khabarovsk

About Klineburger Worldwide Travel

Klineburger Worldwide Travel has been arranging overseas hunting and fishing expeditions for nearly 30 years. Development of new programs into the most remote and exotic parts of the world is our specialty. Our close ties with Soviet and Mongolia land operators, developed over many years, will ensure your expedition to be of the highest quality. For more information call Jon Bates, Angling Program Director at one of the numbers listed below.

KLINEBURGER
Worldwide Travel

3627 First Avenue South ■ Seattle, Washington 98134
Phone 206.343.9699 FAX 206.682.8868
1.800.232.3708.

KLINEBURGER
WORLDWIDE TRAVEL
A Division of Professional Adventures, Inc.

Gamemasters of the World

3627 - 1st Ave. South • Seattle, Washington 98134
Phone: (206) 343-9699 • Telex: 185283 • Fax: (206) 682-8868

Dear Angling Enthusiast:

Klineburger Worldwide Travel is proud to offer new angling programs that are unparalleled in sportfishing history... We have secured the right to fish six rivers in the Soviet Union and Mongolia.

It took years of intense negotiations with our business associates and key Russian officials to finally allow our clients to fish the legendary Kamchatka Peninsula.

This peninsula which was closed to westerners ever since the Russian Revolution, is now open to our clients. You may be the first to sample the immense fishery of Kamchatka's Bol'shaya River, which is home to all five major Pacific Salmon species, plus Summer Run Steelhead and the Resident Rainbow Trout.

This is exciting news to the sportfishermen because western anglers have known about the existence of the immense Salmon runs on the Kamchatka for 100 years and now they will have the chance to sample a fishery many believe to be the "Alaska of fifty years ago".

For the Atlantic Salmon enthusiasts, Klineburger will be offering fishing trips to a watershed northeast of Moscow called the Pechora River. This river is home to not only the largest run of Atlantic Salmon in the entire world but also the Atlantic Salmon genetically largest in size.

Along with these new developments, we have also expanded our Taimen fishing programs in Siberia and Mongolia. The Taimen fishery has been expanded to five new rivers and we fully expect a 100 pounder to be caught this year, making it "the world's largest Salmon".

To stay on the cutting edge of anlging, Klineburger Worldwide Travel is also offering some exploratory trips to fish two hand-picked rivers in Eastern Siberia - the Ugur and Maya. There are definitely large number of Taimen, Arctic Grayling and Lenok in these rivers. These trips are for the adventurous anglers who want to be the first to test out virgin waters. Call us for more information.

We hope you will join us and be among the first to experience these new frontiers. It is an opportunity to make sportsfishing history. Reservations are available now but space is limited. We will look forward to being your host.

Sincerely,

Jon Bates

Jon Bates
Angling Program Director

ТРУДЫ
Среднеазиатского Государственного Университета
Серия XII-а. География
Выпуск 15

ACTA
Universitatis Asiae Mediae
Series XII-a. Geographia
Fasciculus 15

РЕЗУЛЬТАТЫ
ПАМИРСКОЙ ЭКСПЕДИЦИИ СРЕДНЕ АЗИАТСКОГО ГОСУДАРСТВЕННОГО УНИВЕРСИТЕТА
RESULTS
OF THE PAMIR EXPEDITION OF THE MIDDLE ASIATIC STATE UNIVERSITY

Выпуск 8. Fascicle 8

Н. Кейзер

ОЗЕРО ЯШИЛЬ-КУЛЬ

N. Keizer

LAKE YASHIL-KUL

ИЗДАТЕЛЬСТВО СРЕДНЕАЗИАТСКОГО ГОСУДАРСТВЕННОГО УНИВЕРСИТЕТА
Ташкент—1936—Taschkent

Николай Александрович К е й з е р, профессор Среднеазиатского Государственного Университета, начальник Гидробиологического отряда Памирской экспедиции САГУ

Печатать разрешаю

25. XI. 1935 г. [redacted]

узлит 04052 Заказ 223 Тираж 2063

Ташкент. Тип. Узполиграфкомбината [redacted]

Литературные данные о водоемах Средней Азии настолько бедны, что Памир, на первый взгляд, кажется одной из наиболее изученных в этом отношении областей. Многочисленные экспедиции, работавшие на Памире, в той или иной мере затрагивали его водоемы и в настоящее время о них говорится или упоминается более чем в 40 статьях. Однако, сведения, которые мы там находим, крайне ограничены. В большинстве случаев это путевые заметки, сводящиеся к упоминанию или поверхностному и недостаточному описанию, и лишь в редких случаяж более основательная характеристика отдельных гидрологических моментов или населения того или иного озера.

Наибольшее количество сведений до настоящего времени мы имеем относительно оз. Кара-куль, которому посвящена специальная статья Н. Л. Корженевского, лично проводившего на этом озере ряд работ и подытожившего все литературные материалы, вышедшие до 1926 года. Она является прекрасным показателем того, как недостаточны и отрывочны наши сведения о наиболее изученном водоеме Памира. Все батиметрические данные ограничиваются 7 измерениями Свена Гедна (1894 г.), химизм воды характеризуется одним неполным анализом, температура воды несколькими зимними определениями того же Свена Гедина в придонных слоях на различных глубинах, да одним измерением поверхностной температуры, произведенным Н. И. Корженевским в прибрежной части 26.VIII 1923 года. Еще хуже обстоит дело с вопросами биологическими. Если для планктона Н. И. Корженевский может привести небольшой список Cladocera, Copepoda и Rotifera, то бентос характеризовать, за полным отсутствием данных, бессилен.

После 1926 года до настоящего времени Н Л. Корженевским собраны весьма ценные гидрологические данные, несколько проб планктона обработаны В. М. Рыловым и Н. С. Смирновым, но наши знания об оз. Кара-куль попрежнему носят совершенно случайный и отрывочный характер.

Так обстоит дело с оз. Кара-куль—крупнейшим водоемом Памира, лежащим у самого тракта, озером, которое привлекало внимание почти всех исследователей Памира. О других озерах сведения еще ограниченнее или, вернее, их нет, так как все, что мы знаем о них, это названия, приблизительные размеры, очень редко максимальные глубины и списки организмов, найденных в случайных пробах планктона. То же можно сказать и о других водоемах Памира.

Между тем водоемы Памира представляют исключительный теоретический интерес. Не говоря о весьма разнообразных реках и ручьях, здесь имеется несколько десятков (точного учета в этой области нет) крупных и мелких озер различного происхождения, с различным химическим составом воды, начиная от пресных до самосадочных. Все они подняты до границ возможного существования водоемов, находятся под влиянием совершенно исключительных по своей оригинальности климатических условий, весьма разнообразных в пределах самого Памира, окружены своеобразной животной и растительной жизнью и находятся в центре обширной горной страны.

Все эти моменты дают основание предполагать наличие ряда особенностей, свойственных водоемам Памира, выяснение которых представляет весьма интересную задачу. Важность их изучения усугубляется еще и тем, что Горно-Бадахшанская область предполагает использовать в рыбохозяйственном отношении находящиеся на ее территории воды.

Все указанное выше побудило Памирскую биологическую станцию САГУ приступить к систематическому изучению водоемов Памира, причем первым объектом исследования было избрано оз. Яшиль-куль, на котором работала гидробиологическая партия, состоявшая из Н. А. Кейзера и Н. Г. Луговцовой.

Прежде чем перейти к результатам гидробиологических работ 1934 г., необходимо кратко остановиться на условиях, в которых они протекали.

Работы на оз. Яшиль-куль производились с 6.VIII по 12.IX 1934 года—срок совершенно недостаточный для более или менее подробного исследования озера, имеющего площадь около 48 км.[2] и значительные глубины. К тому же работы шли значительно медленнее, чем это могло бы быть, потому что на озере удалось завести всего одну небольшую шлюпку, которая обслуживала как гидробиологическую, так и ихтиологическую партии. Крайне неблагоприятно влиял и постоянный сильный ветер, делавший невозможной работу на озере после 1 часа дня и весьма затруднявший разборку материала, которую, за отсутствием надлежащего помещения, приходилось производить на открытом воздухе.

Благодаря всем этим затруднениям и кратковременности работ, главное внимание было сосредоточено на восточной половине озера, в западной же половине было сделано незначительное количество промеров, анализов и сборов.

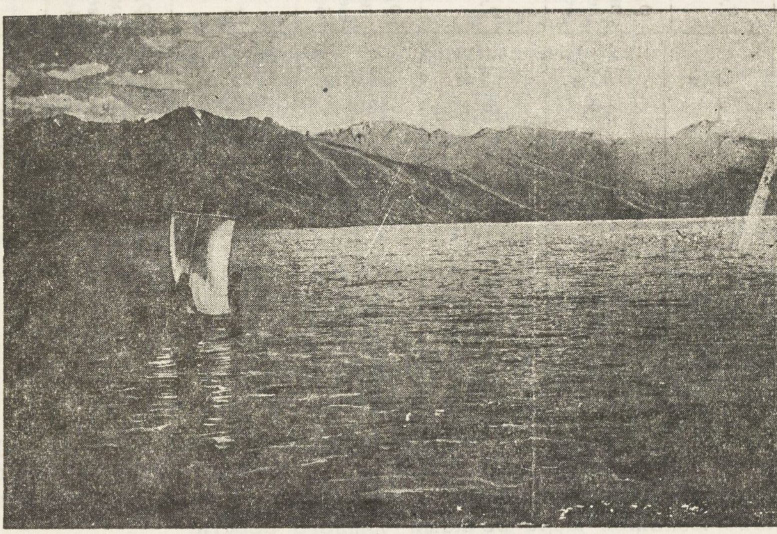
Всего было произведено 214 промеров глубины (12 разрезов), 52 измерения температуры на поверхности и различных глубинах, проделано 18 определений O_2, 2 определения P_h, собрано 34 образца грунтов, 53 качественных и количественных (вертикальный лов с разных глубин) проб планктона, 38 проб (скребом и руками) фауны верхней части литорали, 4 дражных пробы и 44 количественных проб бентоса (дночерпатель Петерсена, малая модель). Кроме того были взяты 4 пробы воды на солевой анализ и произведены сборы водных макрофитов. Собран также материал (15 проб) в мелких водоемах, лежащих в пойме реки Аличура.

После этих предварительных замечаний обратимся к самому озеру.

Яшиль-куль образовался благодаря завалу, перегородившему долину р. Аличура и соответственно этому представляет из себя сильно вытянутый в широтном направлении водоем. Длина его, по данным Корженевского, около 18,6 км, наибольшая ширина около 4,5 км, площадь около 48 км.[2] Все эти цифры являются весьма приблизительными, так как достаточно точных съемок озера не производилось.

Изрезанность берегов незначительна. Лишь в юго-восточной части имеется узкий и длинный залив (длина около 2, наибольшая ширина около 1 км.), в который впадает небольшая речка, да в устьях р. Аличура, разбивающейся при впадении в Яшиль-куль на несколько рукавов, 2 залива меньшей величины. Кроме того, на южном берегу имеется в восточной половине ряд бухт, широко открывающихся на северо-запад, что связано, вероятно, с размывающей деятельностью волны, вызываемой регулярными, значительной силы ветрами, дующими на озере в летнее время.

Берега озера почти всюду крутые, частью скалистые, частью образованные моренами и каменистыми осыпями, с которых в воду скатывается значительное количество камней. Растительности или совсем нет или она развита очень слабо.



26. VIII. 1934 На озере Яшиль-куль. Фото И. Завалина.

Распределение глубин в восточной половине по нашим данным представляется в следующем виде. Залив юго-восточного конца озера очень мелок—0,75—1—2 м., заливы в устье р. Аличура имеют почти такую же незначительную, а местами и еще меньшую (0,5 м.), глубину. Мелководьем занят и весь северо-восточный край озера против устья р. Аличура, причем, однако, область малых (1—2 м.) глубин составляет совершенно незначительную часть озера.

Большая часть Яшиль-куля характеризуется довольно значительными глубинами. Дно от берегов, в особенности южного, быстро понижается, так что на небольшом расстоянии от берега находятся глубины 6—8 и более метров. Понижение дна происходит и с востока на запад, причем область наибольших глубин в восточной половине озера явно сдвинута к южному берегу. Это с достаточной ясностью следует из сравнения результатов промеров глубин по двум разрезам, из которых разрез 1 проведен на расстоянии около 2,0 км. западнее устья р. Аличура и разрез 5 в средней части озера (в западном конце восточной его половины).

Западная половина озера является более глубокой. Здесь наибольшая обнаруженная глубина оказалась равной 52 метрам, на 12 метров больше обнаруженной **Олуфсеном** максимальной глубины. Принимая во внимание, что длина западного Яшиль-куля мало разнится от восточного, следует предполагать, что указанное выше падение дна с запада на восток здесь еще более сильно. Вместе с тем понижение дна от берегов здесь еще значительнее, чем в восточной части (на расстоянии менее 100 м. от берегов глубины до 17 м.); что же касается мелководных (до 5 м.) пространств, то они имеются лишь в устьях рек и занимают совершенно незначительные площади.

Разрез 1		Разрез 5		Разрез 1		Разрез 5	
Расстояние от северного берега	Глубина	Расстояние от северного берега	Глубина	Расстояние от северного берега	Глубина	Расстояние от северного берега	Глубина
150 м.	1 м.	150 м.	3 м.	2450 м.	17,5 м.	1650 м.	18,0 м.
250	1	300	10,0	2750	0 (южн. берег)	1700	17,0
350	1	450	17,0			1750	15,0
700	7,6	600	18,0			1800	0,0 (южн. берег)
950	10,6	750	18,0				
1200	11,5	1050	18,0				
1450	14,2	1300	18,5				
1700	15,5	1450	19,0				
1950	15,75	1450	19,0				
2200	16,5	1600	20,0				

Яшиль-куль питается главным образом водами рек Аличура и притока из оз. Булун-куль, впадающих в восточный конец озера, Большим и Малым Марджанаями, стекающими с северного берега, и в значительно меньшей мере речками южного берега.

Водный режим этих рек и речек очень непостоянен. В начале лета воды в них много, к концу же лета часть из них совершенно пересыхает, а в наиболее крупных уровень сильно понижается.

В связи с этим довольно значительно колеблется и уровень самого озера. Судя по следам оставшимся на камнях и обмелению заливов за время работ, колебания уровня достигают более 0,5 метра.

Сток воды из Яшиль-куля происходит через реку Гунт, вытекающую из западного конца озера.

Переходя к характеристике температуры воды Яшиль-куля, я кратко остановлюсь на наиболее существенных для нее элементах климата, причем использую материалы полученные Б. П. Колмаковым и нами во время пребывания на озере.

Прежде всего следует отметить почти ежедневные западные ветры, достигающие значительной силы. Ветер, как правило, начинается между 12 и 2 часами дня и дует до следующего утра, а в некоторых случаях не прекращается и втечение 2—3 суток. При этом на озере наблюдается довольно сильное волнение, оказывающее, повидимому, на водоем довольно существенное влияние. За счет деятельности волны приходится отнести в значительной мере образование баров, наблюдающихся вдоль южного берега, форму некоторых бухт, отсутствие растительности на отмели в северо-восточной части озера и распределения грунтов в литорали.

Температуры воздуха обнаруживают весьма значительные изменения. Днем (13 час.) в первой половине августа температура воздуха была от 20 до 24°C, во вторую половину того же месяца 17—30°C. Амплитуды суточного колебания температуры воздуха превосходят иногда 24°, но обычно значительно меньше (10—12°C), причем, как нагревание, так и охлаждение воздуха происходят очень быстро.

Температуры поверхности воды колебались от 13,6°C 13.VIII до 9°C 10.IX, причем наблюдались довольно значительные их изменения в течение короткого времени. Так 10.IX в западной части озера температура оказалась 9,0°, а 11.IX—11,6°C. О вертикальном распределении температуры дает представление следующая таблица:

Глубина в метрах	Температура воды в градусах C						Примечание
	Восточная половина				Западная половина		
	18.VIII	19.VIII	29.VIII	1.IX	10.IX	11.X	
0	12,75	13,1	13,0	12,3	9	11,6	Приведенные в таблице измерения температуры произведены термометром Негретти — Замбра в различных местах озера, находящихся, однако, вне влияния притоков.
5	12,75	13,0	—	12,3	9,1	—	
6	—	—	13,0	12,1	—	11,0	
9	—	—	—	12,1	—	10,7	
10	12,5	12,5	13,0	12,1	9,1		
12	—	—	—	12,0	—	10,5	
14	—	—	13,0	12,0			
15	—	—	—	—	9,0	10,5	
16	—	—	13,0	—	—	—	
17	12,0	12,0	—	—	—	—	
18	—	—	—	—	—	10,5	
20	—	—	—	—	9,0	—	
25	—	—	—	—	9,0	—	
30	—	—	—	—	7,0	—	

Из приведенных в таблице цифр видно, что падение температуры с глубиною в Яшиль-куле чрезвычайно незначительно, а в некоторых случаях наблюдается и полная гомотермия от поверхности до дна. Температурный скачек, по крайней мере до 30 метров, отсутствует и лишь глубже замечается более резкое (2°C на 5 метров) понижение температуры. Другой замечательный факт заключается в том, что изменения температуры чрезвычайно быстро проникают на значительные глубины. Это достаточно ясно видно из данных, приведенных для западной половины озера, где в течение суток температура воды на глубинах 15—20 метров поднялась на 1,5° C. Каковы причины этих особенностей в распределении и изменении глубинных температур, пока еще трудно сказать. С одной стороны, очень вероятно существование в Яшиль-куле глубинного течения, возникающего благодаря сгона западными ветрами, о которых говорилось выше, воды к восточному берегу. С другой стороны, чрезвычайно сильное охлаждение поверхностных слоев в ночное время, может вызывать особенно глубокую циркуляцию воды. Дальнейшие исследования дадут возможность выяснить роль вышеуказанных факторов в распределеннии температур воды озера.

Из газов, растворенных в воде, исследовался только кислород, причем получены следующие данные (приводится лишь часть, так как результаты некоторых анализов погибли благодаря несчастному случаю).

Дата и время суток	Глубина в метрах	t°C	O_2 C в мгр. на 1 л.	Дата и время суток	Глубина в метрах	t°C	O_2C в мгр. на 1 л.
18.VIII-34 13 ч. 30 м.	0	15,6	7,83				
	5	13	—				
	10	12,5	6,22				
18.VIII-34 8 ч. — 9 ч.				29.VIII-34 9 час.	0	13	—
	0	12,75	—		10	12,8	6,89
	5	12,75	6,07		15	13,0	6,00
	10	12,5	6,71	10.IX-34 6 ч.	0	9,0	9,53
	15	12,0	6,15		10	9,1	8,44
28.VIII-33 11 ч. 30 м.	0	12,6	5,69	11.IX-34.	10	10,5	8,49
	1,0	12,6	5,77		15	10,5	7,55

Приведенные цифры говорят за то, что в Яшиль-куле вода содержит значительное количество кислорода. Меньше всего его оказалось в заливе юго-восточного конца (28.VIII.1934 г.), быть может, потому, что здесь, при очень незначительной глубине, на дне имеется довольно толстый слой богатого органическими веществами ила, в образовании которого видную роль играет хорошо развитая водная растительность. Все остальные пробы были взяты в открытом озере (13, 18 и 29.VIII в восточной половине, 10 и 11.IX в западной половине) в местах лишенных данной растительности и имеющих глубины 16—19 метров. Результаты их анализа свидетельствуют о хорошем проникновении O_2 в глубину и о незначительном влиянии донных отложений на содержание в воде кислорода.

Анализы на солевой состав воды Яшиль-куля еще не сделаны, так что здесь можно лишь указать на то, что вода в озере совершенно пресная. Реакция воды как на поверхности, так и на глубине 18 м. оказалась слабо щелочной (P_h — 7,5—8). Верхняя часть литорали Яшиль-куля характеризуется преобладанием каменистых грунтов, представленных крупными окатанными камнями, большей частью скатившимися с берегов, или довольно подвижными щебнистыми отложениями, являющимися результатом обработки движущейся водой более крупного материала. Последний тип грунта особенно распространен вдоль южного берега восточной половины озера.

Вдоль северного берега, напротив, встречаются преимущественно отложения состоящие из крупной гальки и валунов. В приустьевых пространствах, на отмелях, залегает довольно значительная толща илистого песка, а в заливах с хорошо развитой донной растительностью образуются темные, богатые органическими веществами грунты, иногда обнаруживающие очень слабый запах H_2S. Как каменистые, так и мягкие грунты на глубине 6 — 10 м. постепенно сменяются серым илом, который покрывает большую часть дна озера.

Все вышеуказанное относится к восточной половине озера; что же касается западной его половины, то немногие данные, которые для нее получены, указывают на то, что здесь мы имеем очень близкую картину характера и распределения грунтов, причем каменистые отложения в литорали распространены еще больше, чем в восточной половине.

Большая часть дна Яшиль-куля лишена макрофитов. Это относится не только к области более или менее значительных глубин, но и к литорали. Благодаря значительной силе и постоянству волнения в открытых местах озера создаются неблагоприятные для прикрепления макрофитов условия, и литораль поэтому является голой почти на всем своем протяжении. Только в заливах восточного конца условия для развития макрофитов благоприятны и здесь они встречаются в значительных количествах, образуя сплошные заросли, выходящие на поверхность иногда на глубинах 1,5 — 2 м.

Главную массу водной растительности составляют рдесты, из которых особенно распространены Potamogeton perfoliatus L. и P. filiformis. Последний образует густые заросли в наиболее мелких местах, первый особенно разрастается на глубинах 0,75 — 1,5 метра. Другие рдесты играют в заливах совершенно подчиненную роль. В заливе юго-восточного конца Яшиль-куля, на незначительных площадях, большщого развития достигает Myriophyllum sp., нитчатка, и спорадически встречается Ceratophyllum sp. Вне заливов макрофиты (Pot. sp. sp.) были обнаружены в виде небольших (несколько кв. метров) редких порослей у северного берега восточной половины Яшиль-куля и в приустьевом пространстве р. Большой Марджанай в западной. Кроме того у северного же берега, на глубине 7 м. была обнаружена не определенная ближе водоросль, образующая невысокий (1 — 2 см.), но довольно густой покров. Эта находка и распределение грунтов дают основание предполагать, что нижние границы литорали находятся на глубине около 10 м.

Обращаясь к животному населению Яшиль-куля нужно сказать, что сборы произведенные на озере еще не обработаны, а поэтому более или менее подробной характеристики его состава и распределения дать нельзя.

У самой поверхности воды и в нижней части зоны заплеска на нижней поверхности камней особенно характерны розовые гидры и мшанки, плотно прикрепляющиеся к субстрату. В меньшем количестве здесь встречаются Planorbis sp., личинки Chironomidae, еще реже Trichoptera (вероятно всего 1 вид) и пиявки, которых мы находили в очень малых количествах. Местами, опять таки единичными экземплярами, попадаются личинки Gammarus sp. В одном месте (южный берег в восточной половине озера, перед заливом) было обнаружено на камнях большое количество губок.

В общем, каменистая литораль характеризуется количественно бедным населением, обнаруживающим ясно выраженные приспособления к условиям жизни в постоянно движущейся воде.

Совершенно иную картину обнаруживает зообентос литорали в мелком (0,5 — 1 м.), сплошь заросшем заливе северо-восточного конца озера. Здесь чрезвычайно сильно развит вагильный микробентос, состоящий из массы Chydoridae и других Cladocera и многочисленных личинок Chironomidae, Cyclopidae, Rhabdocoela и т. п. Очень интересно то, что мы не встретили здесь никаких водных насекомых и личинок (кроме указанных выше), наиболее распространенных в литорали озер (и в заросших водоемах). Быть может (и это в связи с оригинальными климатическими условиями Памира весьма вероятно) они здесь совсем отсутствуют или не пользуются сколько-нибудь значительным распространением. Животные, указанные для каменистой литорали здесь обнаружены не были, за исключением Planorbis, число которых незначительно.

В заливе юго-восточного конца Яшиль-куля у самого берега в полосе прибоя создаются еще менее благоприятные условия, чем на каменистой литорали открытого озера. Дно во многих местах покрыто довольно толстым слоем выщелоченных остатков растений, образующих очень подвижный грунт, постоянно выбрасываемый на берег, где он образует валы в несколько сантиметров высотою. Наряду с этим и волна здесь достигает значительной силы, так что организмы с одной стороны подвергаются воздействию движущейся воды, с другой принуждены жить в воде, несущей большое количество крупных, малопитательных частиц, в беспрерывно перемещающемся субстрате. В связи с этим, вероятно, находится бедность животного населения, характеризующегося в общем теми же чертами, что и население верхней литорали других участков Яшиль-куля. Так, здесь совсем не попадались гидры, мшанки и губки. Остальные же формы встречались в значительно меньшем количестве.

Все это относится к северному берегу залива, подверженному сильному воздействию волнения. Южный берег, более защищенный, не обследовался, но вероятно, что население там значительно богаче.

На некотором расстоянии от берега, на глубинах 0,5—1,5 метра, развиты макрофиты (рдесты и др.). Здесь довольно распространен вагильный бентос (преимущественно Cladocera и Cyclopidae), не достигающий однако такого массового развития, как в густых зарослях северо-восточного залива. Из иловых форм чаще всего встречаются личинки Chironomidae, мелкие двустворчатые моллюски, Planorbis sp. и Oligochaeta g. sp. Гораздо реже попадаются Gammarus sp.

На более значительных глубинах, от 5 до 18 м., в илах мы встречаем очень сходную фауну. Главенствующая роль принадлежит здесь личинкам Chironomidae, Bivalvia и Oligochaeta. В несколько меньшем количестве встречаются Gastropoda, а на глубинах 5—7 м. единичные Gammarus sp. и пиявки. Ориентировочная средняя плотность населения дна, полученная на основании полевых подсчетов—9 проб, дает для серого ила, лежащего на глубинах 5—18 м., 579 организмов на 1 м.^{2}

Для сборов планктона, вследствие отсутствия мелкоячеистых номеров газа, применялась средняя сеть Апштейна из газа № 16. Благодаря этому мы имеем возможность говорить лишь о мезо и части микропланктона. Предварительный просмотр нескольких качественных проб планктона прежде всего заставляет отметить чрезвычайно слабое развитие в нем водорослей. Из них единично попадаются Ceratium hirudinella и еще реже Pediastrum sp. Главную массу зоопланктона образуют Entomostraca, среди которых решительно преобладает Diaptomus paulseni G. O. Sars. Несколько уступает ему в количестве все же многочисленная Ceriodaphnia quadrangula O. F. M. Гораздо меньшую роль играют Cyclops. sp. sp. и Daphnia longispina v. litoralis.

Из коловраток наиболее распространена и многочисленна Asplanchna sp. Anurea aculeata и Notholea longispina постоянно встречаются единичными экземплярами.

О количестве планктона пока можно судить только по нескольким измерениям его объема, дающим на 1 м.^{3} 1,45—2,9 см.^{3} О горизонтальном и вертикальном распределении планктона и его миграции, до разработки собранных проб, говорить преждевременно.

Заканчивая на этом описание Яшиль-куля по данным работ 1934 года я должен оговориться, что оно делается на основании сырых материалов, дальнейшая обработка которых даст возможность углубить и расширить приведенные данные, лучше выяснить специфику водоема, а также исправить неточности и ошибки, которые, быть может, имеются в моем сообщении.

Я полагаю, однако, что и изложенный выше материал дает основания сделать некоторые выводы.

Прежде всего, мы можем отнести Яшиль-куль к олиготрофным озерам. За это говорит его значительная глубина, характер падения дна, почти полное отсутствие илов с запахом H_2S, значительное количество кислорода на больших глубинах, слабое развитие макрофитов, отсутствие резкой границы между литоралью и профундалью, относительная бедность бентосом и планктоном.

Вместе с тем Яшиль-куль обладает некоторыми весьма интересными особенностями, обнаруживающимися даже при таком кратковременном исследовании, каким были наши работы. К ним относится прежде всего чрезвычайная равномерность температуры до глубин около 25 метров и связанная с нею значительная толщина эпилимниона. Благодаря очень глубоко лежащему (между 25 и 30 м.) слою скачка гиполимнион в большей части озера (вся восточная половина и значительная часть западной) отсутствует совершенно; вообще же он по сравнению с эпилимнионом, чрезвычайно мал.

Другая особенность, сразу бросающаяся в глаза, заключается в полном отсутствии многих, обычных для озер, организмов. Как указывалось выше, несмотря на довольно значительное количество ловов, в литоральной зоне не было обнаружено личинок стрекоз, поденок, imago и личинок жуков и некоторых других водных насекомых, фауна которых в Яшиль-куле состоит, повидимому, из личинок Chironomidae и немногих Trichoptera. Это обстоятельство является, как мне кажется, весьма интересным экологически, так как из членов биоценозов Яшиль-куля оказывается исключенным значительное количество наиболее прожорливых хищников. Не останавливаясь на более мелких, пока лишь намечающихся и требующих для своего выявления обработки собранных материалов, особенностях, я кратко коснусь вопроса о кормовых ресурсах озера, которое, быть может, в ближайшем будущем будет использовано в рыбохозяйственных целях. При этом мне, больше чем когда-либо, придется говорить предположительно, так как изучение кормовой базы такого водоема, как Яшиль-куль, требует более длительных и подробных исследований. К тому же и те небольшие материалы, которые удалось собрать за короткий период наших работ, еще не разработаны, так что мне придется ограничиться лишь самыми общими замечаниями.

Как указано выше, зообентос большей части дна Яшиль-куля состоит из вполне пригодных для питания рыб организмов. Преобладание в нем личинок Chironomidae и значительное количество Oligochaeta заставляет высоко оценить его кормовые достоинства. Что касается количественного момента, то немногочисленные взвешивания, проделанные до настоящего времении, дают цифры близкие к используемым в рыбохозяйственном отношении среднепродуктивным озерам Финляндии.

Принимая во внимание более или менее равномерное распределение бентоса до глубин не менее, а вернее и более, 20 метров, наблюдаемых в большей части озера, можно считать запасы корма довольно значительными. Отмеченное ихтиологической партией скопление Schizopigopsis в заливе, заросшем макрофитами, и вскрытия вышеуказанных рыб дают основания причислить к кормовым запасам озера и водную растительность, занимающую, однако, очень небольшие площади.

Кормовая ценность планктона Яшиль-куля, состоящего преимущественно из Copepoda и Cladocera, притом довольно крупных, также является высокой. Приведенные выше цифры показывают, что количества планктона в 1 м.^{3} очень невелики; однако, принимая во внимание объем воды Яшиль-куля, запасы этого рода пищи также можно считать довольно существенными.

Заканчивая на этом свое сообщение, я остановлюсь на вопросе о том, в каком направлении должна вестись работа по исследованию памирских озер в дальнейшем.

Достаточно углубленная характеристика водоема, выяснение его специфических черт и закономерностей, их обусловливающих, возможны лишь при длительном стационарном изучении, позволяющем вскрыть динамику происходящих в водоеме процессов. Такое же исследование необходимо и для определения рыбохозяйственной ценности водоема.

Поэтому я считаю обязательным с ближайшего же года приступить к проведению стационарных работ, которые целесообразнее всего организовать на оз. Яшиль-куль, так как данные 34-го года выдвигают ряд интересных вопросов и дают ценный материал для дальнейших исследований.

Параллельно со стационарной работой должна быть развернута и рекогносцировочная. Ее задача произвести кадастр водоемов Памира и дать материал, который позволил бы выяснить имеющиеся здесь основные типы и наметить объекты дальнейшей, более углубленной, проработки.

Основной темой, определяющей характер и направленние рекогносцировочных и стационарных работ, должно быть изучение состава и распределение биоценозов в зависимости от факторов среды. Эта тема, требующая для своей проработки большого труда и много времени, обеспечит единообразный подход к изучению всех водоемов и, благодаря своей широте, позволит выделить ряд весьма важных теоретически и хозяйственно актуальных подтем.

Summary

Pamir lakes are up to now but incompletly studied. They are however of special interest, owing to the altitude at which the are situated their peculiarities the particular character of their climate conditions and of their surroundings. During the summer 1934 from 6/VIII to 12/IX the Pamir biological station of the Biological institute of the Middle Asia State University performed on one of the largest Pamir lakes Yashil kul hydrobio logical investigations. Very numerous data they obtained are now studied. The lake Yashil-kul has been formed in the valley of the river Alichur in consequence of an mountain slide abstructing the river. It is situated at the hight of 3700 m., its length is about 18,6 km. and its greatest breadth 4,5 km. The banks are nearly devoid of vegetation, very abrupt and stony. A great deal of stones roll down and form the stony ground of the littoral region. Banks are slightly cut. The lake obtains its waters from rivers flowing into it the level of which greatly subsides to the end of summer. Consequently the level of Yashil-kul also changes. Its waters flow out through the river Gunt which issues at the western end of the lake.

The depth of bottom close to the banks is very considerable and only in bays of river mouths there are shallows about 1—2 m. The greatest depth at the eastern part is 20 m, at the western—52 m. The climate is characterized by considerable day variations of temperature, that falls at night below 0°.

Water temperature in the lake varies from 9° to 15° C and these surface changes are speedily passing to a considerable depth. Therefore the metalimnion is absent in the eastern part, and very feebly expressed at the depth of 25—30 m. in the western one.

Water in Yashil-kul is fresh with a slight alkaline reaction (P_h 7,5—8) and contains a considerable quantity of dissolved loxygen at the depth of 15 m[1] In littoral zones stony depositions prevai, but at the depth 6 to 10 m. the bottom is covered with gray slime.

Water vegetation consists chiefly of some species of Potamogeton and Myriophyllum both of which occupy small spaces of the bottom in bays and more rarely in river mouths.

Bentos of the stony littoral is quantitatively and qualitatively poor, characterized by the prevalence of sedentary forms (Hydra sp., Bryozoa) which is due to the considerable water mouvements.

The fauna is richer in bays, among vegetation where Entomostraca and larvae of Chironomidae prevail. In bentos of the littoral zone a number of common insects (imago and larvae) are absent. The population of gray slime consists chiefly of larvae Chironomidae, Buvalvia and Oligochaeta about 580 specimens upon 1 m.[2]

Plancton consists chiefly of Diaptomus paulseni G. O. Surs., Ceriodaphnia quadrangula O. F. M. and Cyclops sp. sp.

Rotifera plays almost secondary role, phitoplancton is extremely poor. Plancton quantity is about 1,45—2,9 cm.^{3} on 1 m^3 All above said makes it obvious, that Yashil kul is an oligotrophic lake with a deviating regime of temperature and some peculiarities in the compositione of its population.

Further study of the collected materials will undoubtedly disclose a series of other specific peculiarities of this high mountain lake.

[1] Analysis of great depths has not been made.

SOVIET UNION AND MONGOLIA FISHING SCHEDULES 1991

Khabarovsk, USSR

Maymakan River

	DEPARTURE DATES	MAX # ANGLERS
Taimen Salmon	#1 July 16 - July 25	4
	#2 July 23 - Aug 01	4
	#3 July 30 - Aug 08	4
	#4 Aug 06 - Aug 15	4
	#5 Aug 13 - Aug 22	4

Ulan Bator, Mongolia

Selenge/Chuluut/Suman River Systems

Taimen Salmon	#1 Aug 17 - Aug 30	6
	#2 Aug 31 - Sept 13	6
	#3 Sept 14 - Sept 27	6
	#4 Sept 28 - Oct 11	6

Moscow, USSR

Pechora River

Atlantic Salmon	#1 July 14 - July 24	6
	#2 July 28 - Aug 07	6
	#3 Aug 11 - Aug 21	6
	#4 Aug 25 - Sept 04	6
	#5 Sept 08 - Sept 18	6

Kamchatka Peninsula Khabarovsk, USSR

Bol'shaya River

Chinook Salmon	*** (#1, #2, #3 #4)**	#1 May 16 - May 23	6
		#2 May 30 - June 06	
Sockeye Salmon	*** (#3, #4, #5, #6)**	#3 June 13 - June 20	6
		#4 June 27 - July 04	6
Sockeye Only	*** (#6)**	#5 July 11 - July 18	
		#6 July 25 - Aug 01	6
Silver Salmon	*** (#6, #7)**	#7 Aug 08 - Aug 15	6

* note: itinerary numbers coincide with species of salmon running

Bystraja River

Silver Salmon/Summer Steelhead	#8 Aug 22 - Aug 29	6
	#9 Sept 05 - Sept 12	6
	#10 Sept 19 - Sept 26	6

Bol'shaya River

Silver Salmon/Summer Steelhead	#11 Oct 03 - Oct 10	6
Summer Steelhead	#12 Oct 17 - Oct 24	6
	#13 Oct 31 - Nov 07	6

The above departure dates reflect start to finish dates from your host city.

The Legendary Kamchatka — Itinerary # 1

Pacific Salmon Enthusiasts

Our 'Legendary Kamchatka' fishing itineraries are filling up quickly. If you are planning on fishing the Kamchatka, there are two ways in which to travel to Khabarovsk; 1) through a direct flight via Anchorage, or 2) through Beijing China. Alaska is the only airline which offers limited flight service to Khabarovsk USSR.

The alternative route to travel to Khabarovsk is by departing from the United States and flying via Beijing China. This is a very popular itinerary adding an exciting China land package to your fishing trip. China is a fascinating destination with interesting cultural events, incredible architecture and history dating back thousands of years.

Day 1 (Sunday)

Depart the United States for China. Cross the international date line. Dinner enroute.

Day 2 (Monday)

After clearing customs in Beijing, you will be met by our Chinese host and transferred to your deluxe overnight accommodations.

Day 3 (Tuesday)

We awaken early this morning to a continental breakfast. Today we spend a full day exploring the treasures of Beijing - the capital and cultural heart of both modern and historic China. Our trip takes us to Tianamen Square where Mao Zedong founded the People's Republic of China. For lunch today, we will journey to the Great Wall of China. After we settle in to our hotel, a special peking duck Dinner will be prepared for us. Overnight Jing Guang New World Hotel.

Day 4 (Wednesday)

This morning is leisure time for sightseeing or shopping. In the afternoon we depart for the train station and enroute to Harbin, China, have your camera ready as you rail through the fascinating small towns and villages. Overnight accommodations are provided . Meals on the train ride are not included and are at the clients discretion.

Day 5 (Thursday)

After a good nights sleep you will awaken to the bustling city of Harbin, China. You will have a few hours to sightsee before we board our flight to the riverside city of Khabarovsk USSR. Upon arrival in Khabarovsk, you will be met by a Klineburger representative who will assist you to connect with your flight to the outpost city on the Kamchatka Peninsula. Dinner and overnight accommodations.

Day 6 - 11 (Friday)

Today we start our fishing adventure. Please refer to the 'legendary Kamchatka' fishing itinerary for complete details.

Day 12 (Thursday)

Depart fishing camp. This afternoon we fly to Harbin China for dinner and overnight accommodations.

Day 13 (Friday)

The morning is free to relax or sightsee. This afternoon get ready to board your Air China flight to Beijing. After arrival in Beijing, you will have time to visit the 1000 buildings of the Forbidden City and walk through the famous Summer and Imperial Palaces. Dinner and overnight accommodations.

Day 14 (Saturday)

Depart Beijing for an early morning flight back to the United States.

The Beijing China land tour cost is $1,025.00 per person Beijing to Beijing.

The price of the tour includes:

1. Meetings upon arrivals in all guest cities.
2. Round trip airfare from Beijing to your fishing area.
3. All overnight accommodations and meals as is indicated in the itinerary.
4. Visa processing.
5. Trip insurance.

Alaska Airlines departure dates
Fly directly into Khabarovsk

Tour # 4	June 27 - July 4
Tour # 5	July 11 - July 18
Tour # 6	July 25 - Aug 1
Tour # 7	Aug 8 - Aug 15

Air China departure dates
Fly to Khabarovsk via China land tour

Tour # 1	May 16 - May 23
Tour # 2	May 30 - June 6
Tour # 3	June 13 - June 20
Tour # 8	Aug 22 - Aug 29
Tour # 9	Sept 05 - Sept 12
Tour # 10	Sept 19 - Sept 26
Tour # 11	Oct 03 - Oct 10
Tour # 12	Oct 17 - Oct 24
Tour # 13	Oct 31 - Nov 07

About The Salmonid Family...

Taimen salmon spawn in the spring in the very smallest upper tributaries, then progressively follow dropping water levels during the summer into lower stretches of the river systems. Taimen are resident in freshwater throughout the year.

Atlantic salmon, like their cousins the steelhead, enter the rivers during the summer through fall and remain there throughout the winter. Therefore, they are available in large numbers throughout the summer and into the fall months. However, Atlantic salmon spawn in the fall, whereas steelhead spawn in the spring.

Resident Rainbow are present in the Bol'shaya River and Bystraja year round and success rates would be comparable to Alaskan rivers, (ie.) best in May and early June and again in September and October. **Sockeye, chum** and **pink salmon** runs enter the Bol'shava between the **chinook** and **steelhead** runs and will be encountered during these expeditions. The **sockeye** run begins right after the **chinook** run, but often concurrent, and peaks at the end of July. **Chum** and **pink salmon** are present in the river during July and August.

Like all anadromous fish runs, the start and peak of individual runs may vary by up to several weeks, depending on a variety of environmental conditions. Low water conditions in a river may delay a particular run until adequate rains provide high enough flows for the fish to ascend to their spawning areas.

General Conditions

We are planning arrivals for Kamchatka Peninsula Bol'shaya Bystraja rivers as well as the Maymakan, Ugur and the Maya rivers in and out of **Khabarovsk** USSR. All Mongolian itineraries will originate in **Beijing** China. The Atlantic Salmon itinerary will originate in **Moscow** USSR.

The Fishing: The Soviets and Mongolians have requested, and Klineburger Worldwide Travel agrees, that all fishing for Taimen and Salmon shall be conducted on a catch and release basis. Each angler will be permitted in the event a trophy fish is caught, the possibility of keeping one fish, if desired. Some of the other species will be kept on a limited basis for camp specialty meals.

Seasons: We will operate from mid May through November depending on species desired.

What the cost includes: Meetings upon arrivals in all guest cities. Round-trip air transportation to your outpost city and helicopter flights to fishing areas. All overnight accommodations and meals as indicated in itineraries, hotels, tents, yurts or cabins, guide service, fishing as outlined, fishing licences, interpreters, power boats or zodiacs, **visas and processing, as well as, trip insurance.**

Not included: Round trip airfare to and from your home city will be handled on an individual basis based on your preference of routing and desires and is not included in the fishing package. We encourage you to consider adding a few days for exploring the city of your destination. Moscow, Beijing, China and Khabarovsk each offers its own distinctive flavor and charms. We would be happy to help customize your adventure.

Accommodations and meals enroute to departure cities, alcoholic beverages, items of a personal nature, fishing equipment, laundry, dry cleaning, (room service and gratuities for same). Any special individual transfers not coordinated with group arrival or departure, phone calls, baggage insurance, excess baggage charges, any itinerary modification or deviation as requested by passengers, gratuities to guides and camp staff.

If you go: All reservations for your trip will be processed by Klineburger Worldwide Travel in Seattle, Washington. Klineburger will coordinate airline schedules and tickets to/ from your host city for all passengers. We will obtain Russian, Mongolia or Chinese visas, and will arrange accommodations and services prior to the start of your fishing trip as required by the itinerary and to meet individual objectives in the Soviet Union, China and Mongolia.

It is necessary that airline ticketing be coordinated through this office due to particular visa requirements and complex air scheduling for our fishing programs.

Terms and Conditions

Reservations/Payments: Contact Klineburger Worldwide Travel at (206)343-9699 or 1-800-232-3708 to obtain further details and make reservations. A deposit of 40% is required at time of reservation. Final payment is due 60 days before departure.

Price: Quoted prices are based on the latest information available and are subject to change prior to final payment.

Cancellation: Deposits are non-refundable unless the client can be replaced. For cancellations made 14 days or less prior to departure no refunds can be made. In any event, the Company's only responsibility will be to refund amounts paid which have not previously been paid to third parties. Cancellation insurance is available and is recommended. Receipt of a deposit by the Company is acknowledgement that you have read and accept the terms and conditions herein.

Responsibility: The Company acts only as a limited representative for clients or their agents in engaging the services or other persons to provide transportation, lodging, tours, guides and other travel services. Neither the company nor its employees, officers, directors, agents or affiliates will be responsible or liable for any loss, injury, death, or damage to any person or property (i) arising out of arrangements made on behalf of any person by the Company or (ii) caused by or arising out of travel or other activities undertaken as a result of such arrangements.

Thermophiles in Kamchatka

Roald Hoffmann

When Stefan Petrovich Krasheninnikov, a 24-year-old Russian student of science, first visited Kamchatka in 1737, he saw mountains that "for many years throw out a continual smoke, but flame only at times." He wrote, "the principal riches of Kamchatka consist in the great number of wild beasts: Among them are foxes, sables, stone foxes, hares, marmots, ermines, weasels, wolves, reindeer, wild and tame, and stone rams." Clearly his mind was on the furs precious to Russians and Chinese. That's why Empress Anne had sent him (actually she had sent some professors of the Russian Academy of Sciences, who opted to stay behind in Siberia and send their student on into the wild lands); this was the reason bands of unruly and rebellious Cossacks were dispatched to subdue the land, exacting tribute in furs from natives.

It did not take me four months to reach Kamchatka, as it did Krasheninnikov from nearby far-eastern Siberia. Only four hours on an aging jet of Reeve Aleutian Airlines from Anchorage. Distant from the Czarist and Soviet sources of power, this was never a rich part of Russia. It's a more than nine-hour flight from Moscow to Petropavlovsk-Kamchatsky, situated on a beautiful natural harbor, which became (along with Vladivostok) a seat of Soviet military power and its main eastern submarine base. The harbor is filled with rusting, decomposing ships.

Like Krasheninnikov, I could not help seeing the volcanoes—it is hard to look up anywhere in Kamchatka and *not* see one in the landscape of the most seismically active place in the Pacific Rim of Fire. And I came to see life. Not fur-bearing mammals, but a microscopic, far older form of life, the thermophiles and extremophiles of the hydrothermal sources of Kamchatka.

Into the Volcano

Workhorse Russian troop-carrier helicopters flew us into the Uzon Caldera. Two hundred thousand years ago a volcano erupted here. The frequent earthquakes fragmented the deposits in the caldera. But around was hard rock, sealing in a kind of giant chemical reactor. Several kilometers below the surface, a magma chamber is buried. Surface water seeps down to it, is sent up as hot steam, corrosive, mixed with volcanic gases. There's dissolution and redeposition of ions under conditions of varying acidity and lots of time—it's a veritable hotbed of geochemistry. Beneath the surface lie layers rich in arsenic, phosphorus, copper, lead, antimony, even gold. Hydrogen sulfide (H_2S) and sulfur are never far away. We saw a little pool, a meter across, bubbling merrily away at 95 degrees Celsius and depositing at the surface a beautiful yellow-orange layer of As_2S_3.

From far away, Uzon is nondescript. Thin "smoke" is the first thing one notices, rising from some shallow lakes. Closer up the lakes and surrounding hills seem a Monet-like landscape of blues, grays, greens and yellows blending into each other. The smoke turns out to be condensing steam; it does the blending. Krasheninnikov saw those marvelous colors too, in the microcosm of a rock; he wrote "the clay in taste is sour and astringent; and if a piece of it, or a stone, is broken, there appears an efflorescence of alum, like a moss, with the colors blue, white, red, yellow, green, and black, which are so mixed as to resemble marble; and when the day is not quite dry, the colors are pretty bright."

Still closer, the pastel landscape breaks up into pools. Some are crystal clear, some muddy, filled with clay. Except suddenly a bubble pops in the clay, more burst explosively, and soon, especially as we smell the hydrogen sulfide, it looks like a nook reserved for some of Dante's less favorite people. The subtle color around the pools comes from mats of bacteria and Archaea. Sometimes we see several rings of slightly different color, each a species flourishing in a different temperature range.

Some Like It Hot

Our group is an international one, nearly all microbiologists here for a small workshop on the enzymology, molecular biology and biochemistry

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the short distance down the river and lifted into place by floating cranes. (The heaviest of the segments weighed on the order of 100 tons.) Coated with epoxy, the mating faces of the segments were clamped together by means of long threaded rods that passed through precast conduits. When the bridge deck was fully in place, it was posttensioned—that is, tied together with cables hidden inside the box sections that ran the length of each deck section.

The name of this centerpiece of the Bath-Woolwich Bridge Project was chosen by a vote of the members of the Bath City Council and the Woolwich Board of Selectmen. Their votes took into consideration the results of an opinion poll in which local citizens voted for their choice by dropping pennies into jars. Among the names considered was the Kennebec Crossing Bridge, which is somewhat redundant, and the Governor William King Bridge, which would have honored Maine's first governor. Other names suggested but not surviving the penny poll were Shipbuilders Bridge, in recognition of the rich shipbuilding tradition of the Kennebec, and Sagadahoc Ferry Bridge. Sagadahoc, the Abnake Indian name referring to the mouth of a river, was the old name for the part of the Kennebec River that flows from Merrymeeting Bay, past Bath and on to the sea. Sagadahoc is also the name of the Maine county in which Bath and Woolwich are located, and hence also the county containing the new bridge. In the end, the straightforward name of Sagadahoc Bridge was the decisive choice of the penny voters and also of the council members and selectmen.

Democratic Adornment

Local community members were also given, through a series of design charettes, the opportunity to participate in the selection of "lighting, landscaping and aesthetic treatments on elements such as piers, approaches and sidewalks." Unfortunately, the involvement of so many diverse points of view, opinions and tastes in the decision-making process appears to have produced some finishing touches that might be considered unharmonious, anachronistic and visually confusing. The bridge proper is a very sleek and graceful structure of monumental proportions. The railings chosen to bound the sidewalk are of two entirely different styles, however, with the one facing the old Carlton Bridge appearing to echo its railings, which have a predominantly vertical appearance, and the one separating pedestrians from motor vehicles having the predominantly horizontal structure of a highway guard rail. The railing on the north side of the bridge, where there is no sidewalk, is also of the guard-rail variety, no doubt required by state highway regulations. (Requirements apparently do not demand tight assembly tolerances, however, for the brand-new railing is remarkably uneven in spots, something especially noticeable to automobile drivers who can sight along the railing the way a carpenter sights along two-by-fours at a lumber yard to choose an unwarped one.) Not only do the inner and outer railings of the new span clash geometrically, but the colors and textures of them are so different as to look like they belong on two different bridges.

The ornate Victorian light standards chosen for the new Sagadahoc Bridge also appear to be curiously out of harmony in style, texture and color with the modern structure. They go with neither of the two railing types and, like the railings themselves, will be seen by some observers to be an anachronism on an otherwise very sleek and attractive modern bridge. Apparently these "certain features of the bridge that were outside the requirements of the contract" were the results of meetings held at the beginning of the project. According to an MDOT public-relations brochure, "integrating these choices into the bridge design ensures that the bridge is aesthetically pleasing and representative of the needs and desires of the community." But had the community and its representatives been presented the opportunity to make these same choices later on in the construction process, when the completed bridge's own form and aesthetic presence would have provided a rational foundation on which to base such judgments, the appurtenances might have been chosen differently and might now be part of a more integrated whole. As it stands, the stately Sagadahoc Bridge looks as if it is wearing hand-me-down railings and light standards. In addition, and appearing to be an afterthought, signs giving directions to local restaurants and craft shops have been installed on wooden posts directly in front of the so deliberately chosen light standards. Ironically and in contrast, the rusting septuagenarian Carlton Bridge looks much more of a whole.

That image will not last, however, for as part of the overall Bath-Woolwich Bridge Project the upper deck of the truss structure of the Carlton Bridge will be demolished to lighten it, thereby enabling heavier trains to be carried by the Maine Central Railroad. Furthermore, in another ironic twist, the lift portion of the bridge will be left in the up position, to match the 75-foot clearance under the new bridge, and will be lowered only when a train needs to cross the bridge. Whether this will obscure the view from the south of the graceful curve of the new Sagadahoc Bridge remains to be seen, but overall there appears to have been less thought given to this and other aesthetic aspects of this twin bridge project than the historic city of Bath and its stately river deserve. These twin bridges present the appearance of an odd couple.

Bibliography

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Figure 1. Hot hydrothermal pools are a fitting environment for thermophilic bacteria and Archaea. The author took this shot of Uzon Caldera in Kamchatka, Russia.

of thermophiles such as live in these springs. A graduate student in the group sticks in a probe with a thermometer, another a piece of *p*H paper. The water is bubbling up at 95 degrees Celsius. The *p*H is 1, about 0.1 molar of sulfuric acid. I would not immerse my finger in that water even if it were cool. Two weeks later, far away, a Yellowstone Park employee dies in an accident, stumbling into a similar boiling pool.

Now I know what a thermophile likes. The world's record is an organism called *Pyrolobus fumarii* that flourishes at 113 degrees Celsius (under pressure, at sea bottom). The pools in Kamchatka are not only acidic, but also basic, up to *p*H 10.5. When I see life rampant under such conditions, or plants growing in what was lava weeks after an eruption, I can't help thinking that the variegated surface of Mars once bore life too.

In the course of the week, I learn a lot about thermophiles. They are some bacteria and mostly Archaea, the third kingdom of life recognized only in recent decades. Most are anaerobic, not requiring (and sometimes damaged by) oxygen. They are the same and not the same. Of course they have membranes and proteins and nucleic acids, all the wondrous molecular machines of the living. But a normal lipid cell wall would decompose at these temperatures, the hydrogen-bonded helices of proteins would unwind, the genes would fragment and not be faithfully reproduced. An acid and hot environment is what people normally use to denature proteins; these creatures love it.

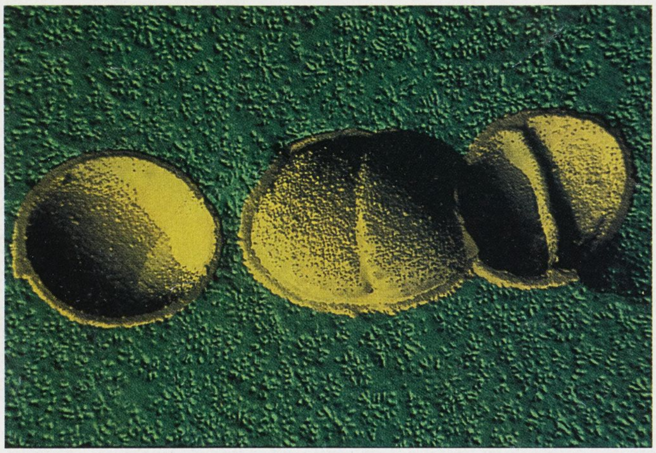
So they are different. Their lipids are linked by sturdier ether groupings instead of esters. Thus bonded, lipid chains span the entire membrane of the cell to form a monolayer wall. The proteins of thermophiles appear to be reinforced by special sequences of amino acids, and have increased ion-pair content buried inside the protein, which, it has been argued, leads to greater intrinsic stability. A better *p*H environment is maintained inside the cell. Auxiliary cell components, such as polyamines and small basic proteins that resemble histones in eukaryotic chromosomes, seem to stabilize nucleic acids.

Eat What's on Your Plate

I've never seen salmon prepared in as many tasty ways as at the rural hostel where we stayed. Thermophiles have to eat too. The building blocks of the remarkably varied archaeal diet in the hydrothermal fields (or submarine volcanic vents) are CO_2, CO, H_2, H_2S, N_2, S and several oxidized sulfur species. That more than suffices, in the presence or absence of oxygen. Some typical reactions are

$$S + \tfrac{3}{2}O_2 + H_2O \rightarrow H_2SO_4$$
$$H_2S + 2O_2 \rightarrow H_2SO_4$$
$$CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$$

Normal green-plant photosynthesis is endothermic, by 481 kilojoules (change in free energy per



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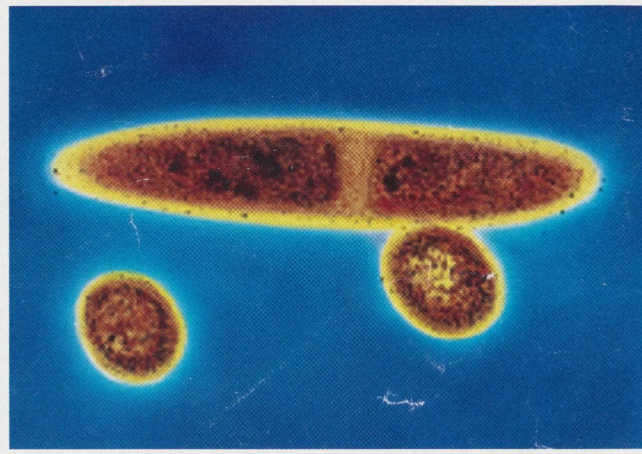

Kari Lounatmaa/Science Photo Library

Figure 2. Microscopic thermophiles such as the bacterium *Streptococcus thermophilus (left)* can be found in extreme environments. Archaebacteria, such as *Methanospirillum hungatii*, shown both lengthwise and in cross section on the right are also extremophiles.

mole CO_2). The energy to get it done comes from light. Who needs light when you can have the H_2S reaction above? It releases 706 kilojoules per mole! That's enough energy to reduce lots and lots of CO_2 to sugar.

Most remarkable are biological systems that use as their source of energy inorganic ions such as Fe^{++} and Mn^{++}. *Thiobacillus ferroxidans'* name tells it all. The oxidation of such metal ions is exothermic, and of course it is used. It is conceivable that much magnetite is of biological origin.

Money, Ethics and Bacteria

I didn't expect to face questions of intellectual property rights and ethics in Kamchatka, but…. As described above, the molecular machinery of thermophiles works—in ways we don't yet completely understand. It does so under conditions that approximate more a heated reaction flask in a lab or a washing machine than an Ithaca winter. This has not escaped the attention of detergent concocters, who want an organic stain-removing enzyme, as well as biochemical supply houses. One enzyme, *Taq* polymerase, which is used in the polymerase chain reaction, apparently has a billion-dollar market.

Taq polymerase was isolated from a thermophilic bacterium, *Thermus aquaticus*, collected in Yellowstone National Park. The park receives not a penny from the manufacturers. The consequences: People get ideas—maybe there are other *Taq* polymerases around. Maybe we can remove dioxins, make a carbon-carbon bond in another, more efficient way. There's money to be made in bioprospecting. There were bioprospectors among us in Kamchatka. And not all working for companies. One industrial biologist was reported as saying, "I've never met an academic who didn't have something to sell." Or who wasn't thinking about a small startup company.

Second, you can understand that Yellowstone National Park is not happy about not getting anything back. How to reward, legitimately, a source of materials that will yield commercial profit—a place, a country? Licenses for sample collecting at Yellowstone now carry a proviso for a royalty if a product from an organism collected in the park is commercialized. I have a feeling that in the absence of a clear agreement of this kind, it will take many a court case to decide what happens if a bioprospecting company takes the DNA of a natural organism, and mutates it in the lab or splices it with a piece of DNA from another organism so as to enhance the production of an enzyme. Whose DNA is it at the end?

The New Biology

This was the first time I was in a meeting of biologists. I noted the following things:

(1) The more molecular they were, the less I understood. The reason was that I have been bypassed by several generations of biochemistry, molecular biology and genetic engineering. And what jargon! It was my fault to let it happen, but also there were a couple of people there who could not conceive that someone could not know what 16S rRNA was. (I learned eventually that it is part of the ribosome. By comparing the sequence of 16S rRNAs from various organisms, scientists can make rough determinations about their evolutionary relatedness.)

Figure 3. Extremophilic fauna in Kamchatka also includes some macrothermophiles. (Photograph courtesy of the author.)