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CONTRIBUTION TO THE ICHTHYOLOGY OF ALASKA, WITH DESCRIPTIONS OF TWO NEW FISHES

BY CARL L. HUBBS AND LEONARD P. SCHULTZ*

IN studying fish collections made by and for the senior writer in Alaska during 1939, and specimens in the United States National Museum, we have identified certain species of marine fishes which do not appear to have been previously recorded from the Territory. One species, *Artedius delacyi*, is described as new. The others have been known either from more southerly waters on the North American coast, or from the Commander Islands off the coast of Kamtchatka. The supposedly Asiatic genus *Crossias* is shown to occur in Alaska, and its status is discussed at some length. *Sebastodes swifti* is recorded for the second time and indicated as probably distinct from *Sebastodes aurora*. The range of *Sebastodes maliger* is extended to Prince William Sound. Correct fin-ray counts are given for the three species of *Bothrocara* which occur in Alaska.

The burbot of interior Alaska and adjacent fresh waters in North America and Siberia is named as a new subspecies, *Lota lota leptura*.

Sebastodes swifti Evermann and Goldsborough

Sebastodes swifti.—Evermann and Goldsborough, 1907: 285–86, Fig. 36 (original description; Yes Bay and Kasaan Bay, Alaska).

* Curator of Fishes, United States National Museum.

One half-grown fish, the third specimen referable to this species, was taken by the senior author by shrimp trawl in Frederick Sound, between Frederick Point and Coney Island, Alaska, on September 1, 1939, at a depth of 45 to 80 fathoms. Since this specimen corresponds rather well with the descriptions of *Sebastodes aurora,* it was compared with the types of *S. aurora* and *S. swifti,* and with data from a large specimen of *S. aurora* examined at Stanford University. The following cranial spines are present on all 5 specimens: nasal, preocular, supraocular, postocular, tympanic, parietal, coronal, and nuchal. The peritoneum is always blackish or dusky, the mandible is scaly, the interorbital space is flattish with concavities between the ridges, and the lower jaw does not enter the profile. Other features are presented in Table I. The data in this table indicate that *Sebastodes swifti* has 18 or 19 pectoral fin rays (8 or 9 of which are unbranched), instead of 17 or 18 (6 or 7 unbranched) as in *S. aurora.* The number of gill-rakers (counting the one at the angle as on the lower limb) are 9 or 10 + 21 in *swifti,* instead of 6 to 8 + 16 to 19 in *aurora.* There are 7 soft anal rays instead of 6. Although the series of specimens is small, the characters seem sufficiently distinctive to warrant the continued recognition of *S. swifti* as a species distinct from *S. aurora.*

In life the specimen from Frederick Sound was a rather clear red over the body and fins. The dark markings were brown on the body and black on the side of the face.

Sebastodes maliger (Jordan and Gilbert)

The range of this rockfish (see Hubbs and Schultz, 1933: 29) is extended to the Prince William Sound region, on the basis of a half-grown specimen taken by Walter J. Eyerdam in a herring net, during the summer of 1940, in the vicinity of Thumb Bay, Alaska. It deviates from descriptions of the species and of the subgenus *Pteropodus* to which *maliger* is referred, in having embedded scales on the posterior and outer parts of the mandible. Some specimens from Puget Sound, however, are also scaled in this region.

TABLE I

COUNTS AND MEASUREMENTS FOR *Sebastodes aurora* AND *S. swifti*

Species	*Sebastodes aurora*			*Sebastodes swifti*	
Specimen*	S.U. No. 3890	U.S.N.M. No. 48239		U.S.N.M. No. 57821	U.M.M.Z. No. 126297
Standard length in mm.	260	171	147	134	105
Measurements in thousandths of standard length					
Greatest depth of body	.....	357	368	328	324
Length of head	.....	410	415	362	362
Diameter of eye	.....	117	122	116	105
Width of interorbital space	.....	64	68	60	57
Length of upper jaw	.....	187	191	194	200
Least depth of caudal peduncle	.....	99	102	90	100
Longest gill-raker	.....	47	61	54	52
Longest dorsal spine	(3rd)	152 (4th and 5th)	163 (4th and 5th)	131 (4th)	133 (5th and 6th)
Length of second anal spine	154	175	197	146	162
Least preorbital distance	.....	2	2	2	2
Gill-raker formula	7 +17	6 + 19	8 + 20	10 + 21	9 + 21
Scale formula	?—68?—14	7—78—16	?—?—16	7 or 8—76—13 or 14	6—77—14
Pores in lateral line	35	34	33	32	32
Pectoral fin rays	17–17	18–18	17–17	19–18	19–19
Unbranched pectoral fin rays	7–6	7–7	7–7	9–8	8–9
Anal soft rays	6	6	6	7	7
Dorsal rays	XIII, 13	XIII, 13	XIII, 13	XIII, 13	XIII, 14

* The data are as follows:

S.U. (Stanford University) No. 3890: "Albatross" Station 2891, 34° 25′ 00″ N. Lat., 120° 42′ 00″ W. Long.

U.S.N.M. (United States National Museum) No. 48239: "Albatross" Station 2948, 33° 55′ 30″ N. Lat., 119° 41′ 30″ W. Long. (types of *S. aurora*).

U.S.N.M. (United States National Museum) No. 57821: "Albatross" Station 4234, Yes Bay, Behm Canal, Alaska (holotype of *S. swifti*).

U.M.M.Z. (University of Michigan Museum of Zoology) No. 126297: Frederick Sound, between Frederick Point and Coney Island.

Artedius delacyi, new species

This new cottid, from Kodiak Island, Alaska, is very closely related to *Artedius lateralis,* which has been reported as ranging from Point Conception, California, to southern British Columbia (Hubbs, 1926*a:* 7; Schultz and DeLacy, 1936: 127). We are able to extend the range of *A. lateralis* to the northern end of the Queen Charlotte Islands, where 3 large specimens (U.S.N.M. Nos. 103544–45) were collected by Allan C. DeLacy and Wilbert M. Chapman, on December 12, 1934, at Cox Island, which is located in the eastern end of Parry Passage between Langara Island and Graham Island. It hardly seems probable, however, that the two species will be found to overlap in their distribution. Jordan and Gilbert's (1899: 456) record of *Artedius lateralis* from Unalaska now proves to have been based on specimens of *Astrolytes fenestralis,* as shown by a re-examination of their specimen (U.S.N.M. No. 23934) as well as other examples from the same region. The false record of *Artedius lateralis* from Bering Island has been treated elsewhere (Hubbs 1926*a:* 7).

The outstanding apparent distinction of the new species, as compared with *Artedius lateralis,* lies in the thicker lips and the less depressed and more declivous, more rounded, and blunter muzzle. The width of the upper lip, measured sagittally, and the least width of both lips below the suborbital margin, are each as great or almost as great as the least suborbital width, instead of being 0.6 to 0.8 as wide (as in adults of *A. lateralis*). The head averages shorter, measuring 2.75 to 2.85 rather than 2.5 to 2.8, usually 2.6 or 2.7 times in the standard length.

Artedius delacyi has none of the distinctive features which led to the generic separation of *Parartedius hankinsoni, Allartedius corallinus,* and other species (Hubbs, 1926*a*).

The holotype, a mature male 79 mm. in standard length (99 mm. total length), was collected in a tide pool in Uyak Bay, Kodiak Island, Alaska, by Allan C. DeLacy, on September 26, 1939, with 2 paratypes, a mature male and a mature female, respectively 85 and 90 mm. long (total lengths, 106 and

112 mm.). The types are deposited in the University of Michigan Museum of Zoology and the United States National Museum, as follows: holotype, U.M.M.Z. No. 126490; male paratype, U.S.N.M. No. 117494; female paratype, U.M.M.Z. No. 126491.

The body is rather robust anteriorly, with a dorsal contour which slopes in a weak curve from the origin of the dorsal fin forward to the tip of the muzzle and backward to the slender caudal peduncle. Greatest depth of body, 4.2 (4.7, 4.9);[1] least depth of caudal peduncle, 5.1 (5.0, 5.0) in head to end of opercular membrane and 1.7 (2.0, 1.8) in length of peduncle. Length of head, 2.75 (2.85, 2.8). The depth of the head is about two-thirds the width of the head, which is approximately one-fourth greater than the depth of the body. The angle of the muzzle in side view is 56° to 59°. Length of snout in head, 3.4 (3.5, 3.8); length of orbit, 4.7 (5.0, 4.7); length of upper jaw, 1.85 (2.0, 2.1); distance from orbit to tip of preopercular spine, 2.75 (2.8, 2.85); from orbit to upper angle of gill opening, 2.5 (2.3, 2.3). Least suborbital width in orbit, 1.95 (2.0, 1.9); least fleshy interorbital width, 2.0 (2.0, 1.8); least bony interorbital width, 3.0 (2.8, 2.9). The fleshy interorbital is almost flat, with a slight median crease but without definitely elevated rims.

The rather short preopercular spine is bifid and covered with skin, as in *Artedius lateralis;* below this is a blunt, completely embedded tubercle. The nasal spines are short and covered with skin, and each bears a slender cirrus (either a cirrus or a fringed flap in *Artedius lateralis*). The teeth are in villiform bands on the jaws, vomer, and palatines, and are of uniform size; none is canine-like. The anterior nostril opens as a short tube with a posterior cirrus; the posterior nostril is in a simple tube half as high as the pupil. There are 2 or 3 cirri near the upper posterior angle of the premaxillary. A small cirrus is present or absent on the orbit. The supraorbital cirrus is simple or fringed. The few cirri on the top of the

[1] The measurements of the 3 types are listed in the following order: holotype (male paratype, female paratype).

head are irregularly arranged in 3 transverse rows and in 2 longitudinal series, with a very few cirri near the midline, including one just in front of the first dorsal spine. There are 3 or 4 cirri along the preopercular margin, and 1 near the tip of the bony opercle. On the upper and lateral surfaces of the head there are numerous pores.

The lateral line pores number 34 or 35, plus 2 on the caudal fin. The first 16 or 17 pores bear 1 to 3 cirri, of which those on the light areas before and behind the second main dark crossbar, and sometimes those in the light area behind the first bar, are enlarged and flaplike; an isolated cirrus may occur on one or more of the light areas on the posterior part of the body and a flap is either present or absent on the light spot at the caudal base. The lateral line plates are embedded anteriorly and medially and obsolescent posteriorly; a few of the least concealed plates bear 1 or 2 minute spines, but none could be described as denticulate.

The head is wholly scaleless. The dorsal band of serrate scales extends from above the first pore in the lateral line to the base of the last soft dorsal ray, thus not nearly to the end of the last dorsal membrane. The lowermost scales in each row tend to coalesce basally. There are 26 (27, 30) scale rows, and a maximum of 9 or 10 scales in a row.

Fin rays: dorsal, VIII (IX, IX)–16 (16, 15); anal, 12; pectoral, 14–15 (15–14, 15–15); pelvic, I, 3. The dorsal fins are barely connected at the base. The spinous dorsal is especially high in the holotype, but in all 3 specimens the first 2 spines are noticeably shorter than are the third to the sixth, which are of subequal height. Only the female, however, agrees closely with *Artedius lateralis* (Hubbs, 1926: 6) in having the first 2 spines subequal and about 0.7 as high as those which follow. The height of each spine in percentage of the height of the highest one is as follows: I, 78 (75, 64); II, 86 (82, 69); III, 99 (97, 100); IV, 100 (98, 93); V, 96 (100, 98); VI, 96 (98, 93); VII, 84 (97, 90); VIII, 58 (79, 82); IX — (57, 53). Measurements into the head of the longest ray in each fin: first dorsal, 2.5 (2.8, 3.1); second dorsal, 2.1

(2.0, 2.0) ; anal, 2.4 (2.5, 2.3) ; pectoral, 1.25 (1.3, 1.3) ; pelvic, 2.5 (2.9, 2.5). The pectoral fin extends to above the base of the fourth (or third) anal ray. The pelvic reaches two-thirds (or little more than half) the distance to the origin of the anal fin.

In coloration this species agrees closely with *Artedius lateralis* and its closest relatives. In the holotype, however, the pattern is considerably obscured by the general darkening of the whole body (no doubt a feature of the nuptial male). The top of the head is blackish, and the bars and light blotches of the back do not contrast sharply. The darkened color of the lower sides of the urosome extends nearly to the anal fin, instead of leaving a wide translucent band, and the ventral light spots tend to be small and complete, rather than being markedly enlarged and cut off into semicircles, as in the female type. The belly is dusky instead of clear, and the ground color of the lower side of the head is sooty blackish, instead of purplish gray. The anal is sooty black, with little trace of the dark and light checkering on the rays. The caudal and pectoral fins are also darkened and show only a trace of the light spots on the dusky rays. The pelvic is blackish rather than whitish. Instead of being light with dusky vermiculations, the dorsals are sooty, with light spots arranged in rows which do not reach the upper margin of the fins. Between the first 2 spines is a conspicuous transparent area, separated by a concave edge from the black upper part of this membrane (the female shows these markings very faintly). One paratype, a less highly developed male, somewhat approaches the female in its coloration.

The first dark crossbar extends from the fourth to seventh (or fifth to eighth) dorsal spines downward and forward to the axil of the pectoral fin. The second bar is weaker than is the first or the third. The third bar extends downward and slightly forward from the base of the third to fifth (or second to fifth) dorsal soft rays to the lateral line, so as to partially enclose a prominent light spot on the lateral line. Only mottled traces, best indicated by paired blotches on the lateral

line, represent 2 dark bars lying between the third bar and the dark half-ring which encloses ventrally the prominent light semicircle around the end of the dorsal base. A dark bar at the caudal base is deflected forward on the axial line to partially surround a bright oval spot. Traces of the dark bars are evident below the lateral line. The 3 or 4 blotchy dark bars below the eye are scarcely discernible in the males.

When received fresh in formaldehyde, the types showed life colors much like those of *Artedius lateralis*. Especially noticeable in the males was the transparent salmon-ocher color on the side of the abdomen and the lower part of the tail region. The head was reddish; the dark bars on the back, bright coralline (that is, pinkish lavender, like coralline algae); the light bars, olive. The first dorsal fin was boldly marked with deep red spots, and with a brilliant red wedge between the first 2 spines (as in *A. lateralis*). The markings on the second dorsal and anal were greenish black in one male, reddish brown in the other.

The adult female, as in *A. lateralis,* was greenish on the lower part of the head, and the flesh of the belly region and above the anal fin was tinted with the same color. There was a strong overwash of ocher on the posterior sides of the abdomen. The light areas along the lateral line and between the dorsal blotches were bright coralline.

We take pleasure in naming this species for its collector, our former student and collaborator, Allan C. DeLacy.

Radulinus asprellus Gilbert

The following specimens, collected in Alaska, appear to provide the most northerly and westerly records of this species, which has hitherto been known to occur from "Burrard Inlet, B. C., to Farallon Islands, California" (Schultz and DeLacy, 1936: 127). In the United States National Museum there are 3 collections made by the "Albatross" in 1887–88 as follows: No. 53651, from Station 2882, at 46° 09′ 00″ N. Lat., 124° 22′ 30″ W. Long.; No. 53652, from Station 2870, at 46° 44′ 00″ N. Lat., 124° 32′ 00″ W. Long.; and No. 53653, from Station 2872,

at 48° 17′ 00″ N. Lat., 124° 52′ 00″ W. Long. One specimen, U.S.N.M. No. 60433, is from Kasaan Bay, Prince of Wales Island. The most westerly record for this species is for two specimens, U.S.N.M. No. 103684, trawled by the *Zaprora,* on June 15, 1932, at 56° 10′ N. Lat., 153° 38′ W. Long., which is somewhat south of Kodiak Island. Another example, U.M.M.Z. No. 127696, was trawled with shrimp in the general vicinity of Petersburg, in 1939; it was received from Earl N. Ohmer.

Myoxocephalus parvulus Gilbert and Burke

Myoxocephalus parvulus.—Gilbert and Burke, 1912: 59–60, Fig. 12 (original description; Medni and Bering Islands). Schmidt, 1929*a:* 411–14 (as probable synonym of *Porocottus sellaris*). Soldatov and Lindberg, 1930: 236–38 (comparisons). Rendahl, 1931*a:* 44 (genus); 1931*b:* 46–49 (Avatcha and Achomten bays, eastern Kamtchatka; description and critical notes).

Of this species the senior author collected 3 specimens, 54 to 59 mm. in standard length, in rocky tide pools at Sea Lion Neck and at Palovina Reef on St. Paul Island of the Pribilof group. They are the first to be recorded for the North American side of Bering Sea—if *M. parvulus* is distinct from *M. sellaris.* The St. Paul specimens agree with the distinctive features of *M. parvulus* as pointed out in the original description. There are no prickles behind the pectoral (perhaps, as Schmidt thinks, because all examples of *parvulus* are young from tide pools). There are no pores above the anal fin. As Schmidt intimated, however, the value of this character needs checking. The idea that *M. sellaris* has such pores may have been drawn from the small light spots shown on Bean's plate (1887: Pl. 18) of "*Cottus quadrifilis.*" These spots probably represent the position of prickles which become well developed only in adult males, as stated for the nominal subspecies *Porocottus sellaris ochotensis* Schmidt (1929*a:* 411). The coloration agrees in full detail with that of the holotype of *M. parvulus,* as described and figured. The criterion of the more numerous dorsal spines (9 instead of 8) does not hold, as 2 of our fish have 8 and only 1 has 9 spines. The eye varies from

about 0.07 to 0.08 of the standard length. Rendahl (1931*b:* 47–49) indicated a similar variation in the number of dorsal spines, and gave measurements of the eye in small specimens as 0.085 and 0.088.

The Alaskan specimens of *M. parvulus* certainly belong to a species different from *M. sellaris,* as represented by an example 53 mm. in standard length, collected in Peter the Great Bay, Siberia, and sent to the University of Michigan by the Museum of Zoology of the Academy of Sciences at Leningrad. The specimen has 4 well-developed, sharp preopercular spines; a large eye (0.12 of the standard length); 2 ridges behind the eye instead of only 1; fine cirri in place of broad supraorbital and occipital flaps; 2 cirri instead of none between the 2 just mentioned; and a thin instead of leathery skin. The fin rays number: dorsal, VIII–12; anal, 9; pectoral, 16–17.

The fin rays of our specimens vary as follows: dorsal, VIII or IX–13 or 14; anal, 11 or 12 (last ray of dorsal and anal counted as a double ray); pectoral, 17.

It seems certain that the St. Paul specimens are identical with *M. parvulus,* but the status of the species of *"Porocottus"* is so confused that we do not here attempt a final decision as to whether *parvulus* is a valid species. In these fish the extra preopercular spine, often held to be diagnostic of *Porocottus* (the third spine from above), is either absent or weakly developed. This evidence confirms the treatment of Gilbert and Burke and of Rendahl (1931*a:* 43–44; and 1931*b:* 46), who synonymized *Porocottus* with *Myoxocephalus.* Further confirmation is furnished by an adult of *Myoxocephalus polyacanthocephalus* from near King Cove, Alaska, for this specimen has 4 spines on each side, rather than the usual number, 3.

An examination of pertinent material in the United States National Museum does not negate the conclusion that *M. parvulus* is probably a valid species.

The specimens from St. Paul Island were described in the field as follows: The markings are bold. The main light saddle varies: it may be creamy and olive-brown, bright coralline (pinkish lavender), or variegated with coralline; it may be

followed by a smaller, coralline blotch. The saddle on the caudal peduncle is creamy to olive, or olive-white, or dusky pinkish. The bright speck at the caudal base is bright rosy, silver-rose, or silver-white. The head and nape are variegated with cream, rosy, and green, or are very deep olive. The narrow bar below the middle of the first dorsal may be greenish black, becoming bright red near and on the fin. Most of the rest of the back is deep dusky. The dark saddles become blackish near a light margin. The spinous dorsal is irregularly marked, but is mostly dark medially and paler fore and aft. The dull soft dorsal is barred with deep olive, but the anal is crossed by bright pink or red bars. The caudal fin has a yellow lower margin and in one or two specimens a yellowish posterior edge, and its deep greenish bars lie on a blotched base of bluish gray, becoming pink toward the margin of the fin. The lower part of the body may be boldly spotted with silver, or finely speckled with blue-gray. The main, curved light bar on the pectoral fin is almost white, becoming cream below; or brownish, grading to watery orange on lower part; or largely pink. Posteriorly this fin is blotched with greenish black and pink or orange.

Genus *Crossias* Jordan and Starks

This genus, now reported for the first time for North America, was based by Jordan and Starks (1904: 296) on a new species, *Crossias allisi,* from Japan. It was indicated as related to *Pseudoblennius* and *Bero,* though differing in having 3 pelvic soft rays, no palatine teeth, and no penis. The resemblance of *Crossias* to those genera is probably superficial, and correlated with a rock-reef habitat; the species of *Crossias* also look very much like the members of the American tide-pool group Oligocottinae (Hubbs, 1926*b,* and Schultz, 1938).

The genetic relationships of *Crossias* obviously lie with *Myoxocephalus* and *Porocottus,* as stated by Schmidt (1929*b:* 503). In fact, the distinction of *Crossias* from *Myoxocephalus* is not trenchant. The supposedly diagnostic features of *Crossias,* as pointed out by Schmidt, are as follows:

. . . . on the second and third ray in the male 1–2 rows of short spine-like appendages. On the lower side of the pectoral rays of the male osseus tubercles. Cutaneous flaps over the eyes (supraorbital flaps) and on the occiput. Cirri on the tips of spines of the first dorsal fin. Lateral line consisting of two rows of pores, one above the other below the central channel, which is closed, without scales and pores. Small sculpins. . . .

The clasping structures on the pelvic fins are apparently developed in all species of *Crossias,* though evident only in nuptial males. Similar structures, however, are developed in at least one species of *Myoxocephalus.* In a mature male of *M. axillaris* from near King Cove, Alaska, the second pelvic ray carries a trace of tubercular enlargements and the third ray bears strong bony processes in 1 row branching into 2 irregular rows. Nuptial tubercles are developed on the inner side of the pectoral fins of males in several species of *Myoxocephalus,* for instance in *M. polyacanthocephalus* (Jordan and Evermann, 1898: 1977, footnote; also in a specimen at hand from near King Cove, Alaska) and in *M. verrucosus ochotensis* (Schmidt, 1929*a:* 418, Fig. 4).

The tentacles on the head and spinous dorsal fin are none too distinctive, because they are occasionally or even characteristically simple in some forms of *Crossias,* according to the Russian ichthyologists cited. When simple, they are not very sharply distinguishable from the cirri developed on the top of the head and from the filamentous tips of the dorsal spines, which are developed in some species of *Myoxocephalus,* particularly in *M. niger* (which was taken with *Crossias albomaculatus* in reef pools on the Pribilof Islands).

An examination of the material at hand shows that the characters of the lateral line are also differences of degree. In *Crossias allisi* the axial pores are obsolete even in the half-grown, and the regularly arranged, paired lateral pores, one above and one below each obsolescent lateral line plate, are at the end of relatively long side tubes. In adult specimens of *C. albomaculatus,* these structures are similar, except that very small axial pores are developed anteriorly, where the lateral pores are increased in number and tend to lose their regular arrangement. In the species of *Myoxocephalus* the plates vary

from weak to strong, and from concealed to exposed, but the axial pores remain open, and the lateral pores are typically less distant from the axis of the lateral line (large adults of *M. polyacanthocephalus, M. jaok, M. axillaris,* and *M. niger* were examined).

In the young of *Crossias albomaculatus* about 25 mm. long the lateral line (undeveloped toward the caudal) is a conspicuous tube opening by large axial pores, and the paired lateral pores have been developed only near the head. The process of lateral line formation in *C. albomaculatus* is apparently as follows: the main tube with its pores develops from the head backward; before the tube and line reach the caudal fin, paired lateral pores develop near the head, and again this process continues backward (these pores when first formed are small, but they gradually enlarge); later each lateral pore near the head becomes multiple, and this change proceeds backward; in the meantime the axial pores become reduced in size and then obliterated, from the tail region forward (the retrogression reversing the direction of the progressive development). The same sequence of events takes place in *Myoxocephalus,* but at a slower rate.

All forms of *Crossias* appear to be small fishes, but the adult size varies greatly in *Myoxocephalus.* They tend to be more compressed and more brightly colored, but in these respects too there is much variation in *Myoxocephalus.*

Further study of various species of the two groups will be needed to judge the advisability of maintaining *Crossias* as a genus distinct from *Myoxocephalus.* Pending such an investigation, the *status quo* should probably be maintained. Taranetz (1935*b*: 88) has synonymized *Crossias* with *Porocottus,* although recognizing *Porocottus* as distinct from *Myoxocephalus.*

The resemblance between *Crossias beringi* Soldatov (1916) and *Argyrocottus* may be more than superficial and suggests the possibility that *Crossias* as now constituted is a polyphyletic group.

It may be noted that *Crossias beringi,* in violation of the

International Rules of Zoological Nomenclature, has been divided into two formae, neither of which bears the name of the species (Soldatov, 1916; Schmidt, 1929*b*: 504–5; Soldatov and Lindberg, 1930: 231–32, Figs. 39–40). Rendahl restricted the name *Crossias beringi* to "*Crossias beringi* forma *meridionalis*," which therefore became a synonym. Until intergradation between the two forms is proved, *Crossias borealis* Soldatov should probably rank as a full species.

Crossias albomaculatus Schmidt

Crossias albomaculatus.—Schmidt, 1916: 619–21, Fig. 4 (original description; Medni Island); 1929*b*: 504, 506 (comparisons; variation; Medni Island). Soldatov and Pavlenko, 1930: 230, 233–34, Fig. 41 (description, in Russian). Rendahl, 1931*b*: 37–39 (Listwenitchnaja Bay, eastern Kamtchatka; description; comparisons).

A series of young to adult specimens of this sculpin, the first to be reported from North America, were collected by the senior author and H. D. Gray in a tide pool on the black lava reef of Sea Lion Neck, near the north end of the east side of St. Paul Island, Pribilof Islands, in Bering Sea, on July 23, 1939. A young example was found in a large collection made by shrimp trawl at a depth of 10 to 20 fathoms, at the junction of Frederick Sound and Dry Strait in Southeastern Alaska, on September 1, 1939 (circumstances make it seem almost impossible that this specimen was inadvertently mixed with the trawl collection).

Hitherto the species has been known only from Medni Island of the Commander group, off the Kamtchatka coast opposite the end of the Aleutian chain, and from the east coast of Kamtchatka. It is of interest that *Myoxocephalus niger* and *M. parvulus*, taken in the same pool on St. Paul Island, are also reported from Medni Island.

The specimens at hand correspond well with the published accounts of *Crossias albomaculatus*. The one nuptial male shows the clasper-like appendages on the pelvic rays, just as described and figured, but the processes on the pectoral rays are rudimentary. On the top of the head there are 3 pairs of multifid tentacles and numerous simple cirri, as in no other

species of the genus. The tips of the dorsal spines and the adjacent edge of the interspinal membranes bear clusters of cirri (the figure of *C. albomaculatus* shows, by artist's error, a single cirrus on each spine).

Counts of dorsal and anal rays in the St. Paul specimens average lower than those assigned the species (Table II), but this discrepancy is probably due to our practice of counting the last soft ray in these fins as a double ray.

TABLE II

FIN-RAY COUNTS IN *Crossias albomaculatus* FROM ST. PAUL ISLAND

	Number of Fin Rays								
	8	9	10	11	12	13	14	15	16
Dorsal spines	5	14	1	.....	.....	.....	.....	.....	.....
Dorsal soft rays	.....	.....	.....	.....	.....	.....	3	9	8
Anal rays	.....	.....	1	9	9	1	.....	.....	.....
Pectoral rays (right)	.....	.....	.....	.....	.....	1	15	4	.....

The specimen from Frederick Sound corresponds with young of like size from St. Paul Island. The fin rays number: dorsal, IX–16; anal, 12; pectoral, 15–14. The upper part of the body as well as the top of the head is covered with papillae (these later develop into cirri on the top of the head). On the pectoral there are 2 characteristic blackish blotches, one large and submedian, the other ventral.

The following life-color description was based on the nuptial male, with variations as shown by other specimens in parenthesis. The large, light diamond on the nape is dusky coralline (often brown or olive but generally with more or less coralline—that is, lavender-pink; the diamond is olive-brown in the largest fish, which has dark saddles and a brick-red occiput). The 4 (rarely 3 or 5) light areas behind the nuchal one are more or less coralline, and slightly (to strongly) vermiculated with brown (sometimes leaving the ground color in round spots). The last of the light bars forms a rounded saddle (which is generally the most strongly tinted with coralline, and is similar in color to the round spot on the caudal base; the

latter spot is sometimes greenish). The dark bars are deep brown (deep olive to brick-red). The lower sides are marked with rather round and regular, coralline to greenish spots (sometimes reddish-centered and green-edged; few, irregular and more or less silvery in the young). In the one mature male these spots become intensely silvery on the sides of the belly (as in only a few of the other specimens); and in this male only, these silver spots are set off by a blackish edge. The sides of the abdomen are salmon; the lower parts, creamy white; the breast, silvery; the throat, whitish (in most of the females and in all the young the abdomen and the lower sides of the head are watery green). The spinous dorsal bears an anterior and a posterior reddish black bar (sometimes scarcely reddish; bright red inside dusky edges in the largest specimen; uniformly reddish in young). The soft dorsal is variously barred with reddish; the anal is finely barred with pink and blackish green. The caudal is variably marked with reddish (red to brown) crossbars.

Bothrocara pusilla (Bean)

Two Alaskan specimens referable to this species were collected in 1939, one by the senior author at a depth of 45 to 80 fathoms in Frederick Sound between Frederick Point and Coney Island, and the other by Earl N. Ohmer, in the general vicinity of Petersburg. When checked with published accounts, they were found to differ in having a greater number of rays in the vertical fins. They were therefore compared directly with the types of all three species usually referred to the genus *Bothrocara,* and the fin rays in the types were recounted. The type of *Maynea pusilla* Bean (U.S.N.M. No. 45360) has 110 dorsal rays + 7 on the upper half of the caudal fin, and 99 anal rays + 7 on the lower half of the caudal; the type of *Bothrocara mollis* Bean (U.S.N.M. No. 45359) has 110 + 6 or 7 dorsal rays and 94 + 6 or 7 anal rays (these counts were made with great difficulty, owing to the poor condition of the types). The type of *Bothrocara remigera* Gilbert (U.S.N.M. No. 75820, in good condition) has 14 pectoral rays, and 110 + 7

dorsal rays and 99 + 7 anal rays, and rather strong teeth on the palatines. The teeth in the jaws of *B. mollis* are weaker than in *remigera* or *pusilla,* but otherwise similar; there are a few on the vomer, but none occur on the palatines of the partially destroyed type. The mouth cavities of *mollis* and *remigera* are brownish and the snout is longer than in *pusilla.* Otherwise the three species look remarkably alike. Certainly one must doubt the validity of the separation of *mollis* and *remigera,* but *pusilla* is obviously a distinct species. A definite determination of the status of these species as well as that of the genus must await the study of ample fresh material.

Chapman (1940: 39–40) has recently recorded and discussed a specimen of *Bothrocara,* referred to *B. mollis,* from off Queen Charlotte Islands. However, since his fin ray counts differ from those of the types of *Bothrocara,* Dr. Chapman kindly sent the specimen to the National Museum and upon comparison with types it turned out to be a specimen of *Lycodapus mandibularis* Gilbert, which has been reported from off California. Thus the range is extended considerably to the northward. Our counts are: dorsal, 86; anal, 76; pectoral, 8.

Lota lota leptura, new subspecies

Gadus Lota (identification correct to species).—Richardson, 1823: 20 ("every river and lake in the country," that is, along "the shore of the Polar Sea"; natural history; account may refer entirely to intergrades, *leptura* × *maculosa*; probably excluding references to Pennant's account).

Lota lota.—Regan, 1911: 218–21 (range, in part; size in Alaska).

Lota vulgaris (synonym of *Lota lota*).—Günther, 1862: 359–60 (synonymy, range, and records, in part).

Gadus (*Lota*) *maculosa* (misidentification as to subspecies).—Richardson, 1836: 248–51 ("every river and lake from Canada to the northern extremity of the continent"; Pine Island Lake; Fort Good Hope, lower Mackenzie River; detailed description; account may refer entirely to intergrades, *leptura* × *maculosa*; natural history).

Lota maculosa.—Bean, 1881: 244, 268, 271 (Nulato, Yukon River; range, in part). Jordan and Gilbert, 1883: 802 (range, in part). Bean, 1884: 235–40 (natural history, in part; reaches 60 pounds in Alaska). Murdock, 1885: 130 (Meade River and

Kuaru, Alaska; natural history). Turner, 1886: 92 (Yukon River, at Nulato, and from Mission to Fort Yukon; natural history). Bean, 1887: 303, Pl. 14, Fig. 2 (records and distribution in Alaska; natural history notes by Nelson). Jordan and Gilbert, 1895: 486 (Yukon, Nushagak, and other rivers of northern Alaska). Gilbert, 1896: 456 (Nushagak, Alaska). Jordan and Evermann, 1898: 2550–51 (range, in part). Bean, 1903: 701–4 (range, in part; natural history in Alaska). Evermann and Goldsborough, 1907*a:* 224, 349 (records in Alaska and through the Yukon basin; not including the copied figure); 1907*b:* 111, 114 (literature records for Canada, in part; may refer to intergrades, *leptura* × *maculosa*). Halkett, 1913: 25, 79 (range, in part; not the figure).

Lota lota maculosa.—Berg, 1933: 750–51, Fig. 721 (diagnostic characters; synonymy and range, in part; the pertinent material refers to the "American nalim" as an inhabitant of eastern Siberia; references to other treatises on this form in Russian).

The burbot of the Yukon River system in Alaska and Canada, and of other streams and lakes in Alaska, are obviously separable, at least subspecifically, from *Lota lota lota* of Europe and most of Siberia and from *Lota lota maculosa* of eastern North America. The work of Berg (1933: 747–51, Figs. 718–21) and the examination of young specimens in the United States National Museum show that the same hitherto unnamed form inhabits the streams of Siberia ("Anadyr and to the south to the Kurfa Bay region"), north and east of the range of *L. l. lota,* which occurs southeastward to Sakhalin. This zoogeographical pattern finds a partial parallel in the distribution of *Dallia pectoralis, Catostomus catostomus,* and certain salmonoids.

Limited material in the United States National Museum suggests that intergrades between the subspecies *leptura* and *maculosa* inhabit the Mackenzie and Fraser river systems and the Rocky Mountain waters tributary to Hudson Bay (but apparently not the lakes and streams near Hudson Bay). The few specimens at hand from the Missouri River system also appear somewhat intermediate between the two subspecies, though they are probably referable to *L. l. maculosa.* Material from the Columbia River system has not yet been measured.

TABLE III

DISTANCE FROM NOTCH AT END OF DORSAL FIN TO END OF VERTEBRAL COLUMN, DIVIDED BY DISTANCE FROM DORSAL FIN NOTCH TO ANAL FIN NOTCH, IN *Lota lota*

The data are taken from Tables V to VIII, with additional figures for adults of *L. l. maculosa*.

	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	No.	Ave.*
Lota lota lota																	
Sakhalin	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	1.47
Europe	.....	.....	3	3	2	5	1	.....	.....	.....	.....	.....	.....	.....	.....	14	1.28
Lota lota maculosa																	
New England	1	.....	1	4	5	7	7	5	.....	.....	.....	.....	.....	.....	.....	30	1.39
Great Lakes	.....	1	2	10	13	5	13	3	3	.....	.....	.....	.....	.....	.....	50	1.36
Labrador	.....	1	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	3	1.36
James Bay	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1.36
Upper Mississippi	.....	.....	.....	1	7	8	2	3	.....	.....	.....	.....	.....	.....	.....	21	1.40
Missouri R. system	.....	.....	.....	.....	1	2	2	3	1	.....	.....	.....	.....	.....	.....	9	1.53
Intergrades?																	
Mackenzie R.	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1	1.73
Fraser R. system	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	1	1.63
Waterton L., Mont.	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1	1.75
Lota lota leptura																	
Siberia	.....	.....	.....	.....	.....	.....	.....	1	.....	1	1	.....	2	1	1	7	2.00
Alaska	.....	.....	.....	.....	.....	.....	1	1	2	4	4	5	3	1	2	23	1.93

* The averages were computed from the base data.

The most diagnostic feature of *Lota lota leptura* seems to be the slender, long, and acute posterior end of the isocercal caudal region. This character is expressed as a ratio: distance from notch at end of dorsal fin to end of vertebral column, divided by the distance between the notches at the ends of the dorsal and anal fins (Table III). There is little overlap and no apparent age variation in the measurements. The two published figures of *leptura*, based respectively on an Alaskan and a Siberian specimen (Bean, 1887, Pl. 14, Fig. 2; Berg, 1933, Fig. 721) accurately portray this distinctive character, by which *leptura* differs from the European subspecies, *lota,* as well as from the common American form, *maculosa.*

In other respects *L. l. leptura* appears to agree closely with *L. l. maculosa.* On the average both American forms have shorter pectoral fins than the typical, European subspecies (Tables V to VIII), partially confirming the distinction pointed out by Jordan and Evermann (1898: 2551). The distance from the tip of the snout to the origin of the dorsal fin probably averages slightly greater in *leptura* and *maculosa* than in *lota* (Tables V to VIII), though the difference does not deserve the emphasis accorded by Berg (1933: 750–51). Because of the slightly shorter pectoral fin and longer predorsal space in *leptura* and *maculosa,* the pectoral fin in the adults usually fails to reach the vertical from the origin of the dorsal fin. In *L. l. lota,* the pectoral reaches approximately to below the origin of the first dorsal fin, varying some in either direction. This difference is brought out in Berg's excellent figures (1933: Figs. 718–21) of *L. l. lota* and *L. l. leptura,* in Jordan and Evermann's cut (1900: 3308, Pl. 364, Fig. 897) of *L. l. maculosa,* and in most of the drawings of the European form, for instance the one given by Regan (1911: 220, Pl. 20, Fig. 1). A few of the figures for *L. l. lota* by European authors show a pectoral as short as in a typical example of *leptura* or *maculosa,* but these illustrations are rather crude. The criterion under discussion is expressable as a ratio, distance from tip of snout to origin of dorsal fin divided by distance from tip of snout to end of pectoral fin (Table IV). It will be noted that

TABLE IV

DISTANCE FROM TIP OF SNOUT TO ORIGIN OF DORSAL FIN, DIVIDED BY DISTANCE FROM TIP OF SNOUT TO END OF PECTORAL FIN, IN *Lota lota*

The data are taken from Tables V to VIII, with additional figures for adults of *L. l. maculosa*.

Subspecies, General Locality, and Standard Length	0.87–0.89	0.90–0.92	0.93–0.95	0.96–0.98	0.99–1.01	1.02–1.04	1.05–1.07	1.08–1.10	1.11–1.13	1.14–1.16	1.17–1.19	1.20–1.22	1.23–1.25	1.26–1.28	1.29–1.31	No.	Ave.*
Lota lota lota																	
Sakhalin																	
94.5 mm.	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	0.97
Europe																	
148 mm.	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1.00
181–455 mm.	1	1	1	3	1	2	2	1	.....	1	.....	.....	.....	.....	.....	13	1.00
Lota lota maculosa																	
New England																	
56–63 mm.	.....	.....	.....	.....	.....	2	2	.....	1	1	.....	.....	.....	.....	.....	6	1.07
181–590 mm.	.....	.....	.....	.....	2	2	7	8	1	4	.....	.....	.....	.....	.....	24	1.08
Great Lakes																	
58–144 mm.	.....	.....	.....	.....	.....	1	3	.....	2	1	.....	.....	.....	.....	.....	7	1.09
197–700 mm.	.....	.....	.....	.....	1	5	4	7	12	7	4	1	1	.....	1	43	1.11
Labrador, 440–495 mm.	.....	.....	.....	.....	.....	.....	.....	1	2	.....	.....	.....	.....	.....	.....	3	1.11
Upper Mississippi																	
82–106 mm.	.....	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	2	1.03
184–565 mm.	.....	.....	.....	.....	.....	.....	.....	3	4	8	2	2	.....	.....	.....	19	1.14
Missouri R. System																	
160–478 mm.	.....	.....	.....	.....	.....	.....	.....	6	2	.....	1	.....	.....	.....	.....	9	1.11
Intergrades?																	
Mackenzie R. System																	
190 mm.	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	1	1.08
Fraser R. System																	
333 mm.	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1.03
Lota lota leptura																	
Siberia																	
50–68 mm.	.....	.....	.....	.....	2	2	2	1	.....	.....	.....	.....	.....	.....	.....	7	1.04
Alaska																	
110–144 mm.	.....	.....	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	2	1.06
173–590 mm.	.....	.....	.....	.....	.....	.....	4	6	2	2	5	1	1	.....	.....	21	1.13

* The averages are taken from the base data.

TABLE V

MEASUREMENTS AND COUNTS OF *Lota lota lota*

General locality*	Sakhalin	Europe									
Specimen Number*	1	2	3	4	5	6	7–8	9–10	11–12	13	14–15
Standard length, mm.	94.5	148	181	183	212	231	252–73	279–98	337–52	360	390–423
Thousandths of standard length											
Dorsal fin notch to anal fin notch (A)	58	77	58	68	61	76	66–66	59–67	66–71	66	59–62
Dorsal fin notch to end of vertebrae (B)	86	83	86	93	85	84	75–85	72–90	80–85	91	80–86
Tip of snout to origin of dorsal (C)	344	351	350	344	348	353	369–90	323–47	347–68	364	350–64
Tip of snout to end of pectoral (D)	353	351	362	377	335	335	345–58	359–73	350–55	317	366–79
Length of pectoral	126	140	141	142	121	137	125–38	141–45	131–35	108	144–45
First dorsal base	74	98	77	104	104	102	73–87	79–81	80–85	67	72–83
Length of head	229	215	224	.....	203	208	212–14	215–22	212–24	200	227–27
Ratio, $\frac{B}{A}$	1.47	1.08	1.49	1.37	1.38	1.11	1.14–1.28	1.22–1.34	1.20–1.21	1.38	1.36–1.40
Ratio, $\frac{C}{D}$	0.97	1.00	0.97	0.91	1.04	1.05	1.07–1.09	0.87–0.97	0.99–1.04	1.15	0.95–0.96
Fin rays											
First dorsal	12	13	.....	13	.....	.....	.....	.....	11–11	.....	11–11
Second dorsal	76	67	.....	73	.....	.....	.....	.....	72–72	.....	72–74
Anal	72	65	.....	64	.....	.....	.....	.....	71–74	.....	69–77
Total	160	145	.....	150	.....	.....	.....	.....	154–57	.....	154–60

* More exact locality and other data are given in the text.

TABLE VII

MEASUREMENTS AND COUNTS OF POSSIBLE INTERGRADES,
Lota lota: leptura × *maculosa*

Locality*	Fort Simpson (Mackenzie R.)	Yellowhead L. (Fraser R. system)	Waterton L. (Glacier National Park)
Specimen number*	84	85	86
Standard length, mm.	190	310	skin
Thousandths of standard length			
Dorsal fin notch to anal fin noteh (A)	56	59	.....
Dorsal fin notch to end of vertebrae (B)	97	96	.....
Tip of snout to origin of dorsal (C)	368	374	.....
Tip of snout to end of pectoral (D)	340	363	.....
Length of pectoral	127	129	.....
Length of head	213	231	.....
Ratio, $\frac{B}{A}$	1.73	1.63	1.75
Ratio, $\frac{C}{D}$	1.08	1.03	.....
Fin rays			
First dorsal	11	13	.....
Second dorsal	73	83	.....
Anal	72	78	.....
Total	156	174	.....

* Other data are given in the text.

in this respect the young of the American forms tend to agree with the adults of *L. l. lota.*

To judge from our limited material and from the numerous figures which have been published, the European form has a more rounded as well as a longer pectoral fin. The longest rays are the eighth and ninth, rather than the sixth, seventh, or eighth (*leptura*) or the fifth to seventh (*maculosa*). In this character *maculosa* closely resembles Pietschmann's figures (1934: Pl. 3) of the pectoral fins of the fossil species, *Lota hulai.*

Bean (1884) discussed various possible criteria, but concluded, in agreement with Goode and Bean (1879: 42), that the

TABLE VI

MEASUREMENTS AND COUNTS OF *Lota lota maculosa*

General locality*	New England						Great Lakes—St. Lawrence System																Labrador	James Bay	Upper Mississippi River Basin						Missouri River System			
Specimen Number*	16–20	21	22–27	28	29–30	31–34	35	36	37	38–40	41	42	43	44	45–46	47–48	49	50	51	52	53	54	55–57	58	59	60	61–68	69–71	72	73–74	75–79	80	81–82	83
Standard length, mm.	56–61	63	181–220	255	353–82	450–590	58	62	69	61–79	144	197	219	260	295–99	301–17	312	420	465	490	510	700	440–95	skin	82	106	177–231	260–84	330	510–65	160–284	353	378–78	478
Thousandths of standard length																																		
Dorsal fin notch to anal fin notch (A)	66–71	71	63–74	67	56–67	58–65	69	77	72	66–78	66	61	68	60	62–63	60–60	58	71	62	55	61	59	57–63	.....	79	57	60–68	62–67	58	57–58	51–69	57	51–52	52
Dorsal fin notch to end of vertebrae (B)	74–98	95	87–100	82	82–88	80–89	86	97	87	82–98	76	81	87	87	90–92	90–90	88	75	95	80	82	100	59–91	.....	95	92	83–95	85–92	94	80–81	81–100	86	74–77	85
Tip of snout to origin of dorsal (C)	370–93	373	368–86	380	385–416	384–405	379	403	391	385–92	382	381	379	385	395–400	372–75	394	400	398	376	382	414	398–419	.....	358	339	361–97	370–92	376	389–98	352–91	343	352–63	370
Tip of snout to end of pectoral (D)	352–75	365	322–68	357	368–84	367–88	362	387	341	361–64	340	330	342	329	376–91	332–60	343	352	353	349	347	389	354–82	.....	358	315	320–53	333–42	327	349–49	322–59	306	316–28	316
Length of pectoral	98–116	124	106–32	131	137–46	124–31	112	129	113	131–36	125	107	119	118	142–46	120–36	125	112	131	124	116	117	135–48	.....	128	121	100–24	114–30	112	127–31	110–28	112	103–15	124
First dorsal base	57–89	79	.....	.....	.....	58–66	78	97	65	74–88	75	76	68	69	68–70	66–73	.....	90	.....	82	65	69	82–87	.....	.....	.....	56–79	70–81	70	71–81	.....	.....	.....	.....
Length of head	229–43	238	.....	222	222–38	231–46	224	242	227	228–38	.....	.....	.....	213	.....	.....	215	226	216	212	233	247	220–39	.....	227	193	.....	209–19	218	212–16	.....	.....	202–8	203
Ratio, $\frac{B}{A}$	1.13–1.45	1.33	1.30–1.54	1.24	1.22–1.57	1.22–1.54	1.25	1.26	1.20	1.17–1.50	1.15	1.33	1.28	1.46	1.45–1.46	1.50–1.50	1.52	1.05	1.53	1.44	1.35	1.71	1.04–1.60	1.36	1.20	1.62	1.26–1.56	1.29–1.41	1.63	1.39–1.41	1.33–1.70	1.53	1.41–1.51	1.63
Ratio, $\frac{C}{D}$	1.02–1.16	1.02	1.00–1.16	1.07	1.05–1.09	0.99–1.10	1.05	1.04	1.15	1.07–1.11	1.12	1.15	1.11	1.17	1.01–1.06	1.04–1.12	1.15	1.14	1.13	1.08	1.10	1.07	1.09–1.12	.....	1.00	1.07	1.10–1.20	1.08–1.16	1.15	1.12–1.14	1.09–1.10	1.12	1.10–1.11	1.17
Fin rays																																		
First dorsal	9–12	.....	9–12	10	11–11	.....	.....	.....	.....	.....	10	12	10	9	11–13	11–12	12	.....	10	.....	.....	.....	12–13	12	11	10	10–12	10–12	.....	11–12	10–12	12	10–12	.....
Second dorsal	74–79	.....	72–79	74	77–78	.....	.....	.....	.....	.....	78	68	81	66	76–77	72–73	75	.....	68	.....	.....	.....	64–74	75	69	74	68–80	67–72	.....	74–74	71–84	81	77–81	.....
Anal	68–71	.....	68–75	70	68–71	.....	.....	.....	.....	.....	72	65	66	62	72–73	65–67	72	.....	68	.....	.....	.....	60–71	72	63	72	64–73	65–71	.....	70–70	69–76	75	73–73	.....
Total	154–56	.....	152–60	154	156–60	.....	.....	.....	.....	.....	160	145	157	137	161–61	149–51	159	.....	146	.....	.....	.....	138–58	159	143	156	145–65	144–51	.....	155–56	150–69	168	160–66	.....

* More exact locality and other data are given in the text.

prime difference between the European and American forms lies in the number of vertebrae (60 or 61 in *lota;* 64 in *maculosa*). Some new vertebral counts in *maculosa, lota,* and *leptura* are listed:

Counts for *Lota l. maculosa*—
Round Pond, Connecticut River drainage, New Hampshire: 24 + 38 = 62; 24 + 38 = 62.
Potsdam, New York: 25 + 38 = 63.
Otter Lake, Michigan: 24 + 37 = 61; 26 + 36 = 62.
North Branch of Flambeau River, Wisconsin: 25 + 39 = 64; 26 + 38 = 64; 27 + 38 = 65.
Missouri River system, Wyoming: 25 + 38 = 63.
Counts for *Lota l. lota*—
Europe: 24 + 36 = 60; 24 + 39 = 63.
Counts for *Lota l. leptura*—
Alaska: 25 + 38 = 63; 25 + 39 = 64; 25 + 39 = 64; 26 + 40 = 66.
Siberia: 26 + 40 = 66; 26 + 38 = 64; 26 + 40 = 66; 26 + 40 = 66; 25 + 39 = 64.

These data on the number of vertebrae indicate that the European and common American forms of *Lota* possess approximately the same number of vertebrae, but that the Alaskan and Siberian form (*leptura*) has on the average more vertebrae. An adequate number of counts might indicate an average of one or two more vertebrae in *leptura* than in *lota* and *maculosa.*

Certain counts and measurements for the three subspecies of *Lota lota* as here recognized are given in Tables V to VIII. We find no acceptable basis for the separation of other subspecies, though we have studied material from various parts of the ranges of the three forms here recognized. No adequate material is at hand, however, to check on the status of *Lota lota kamensis* Markun (1936), from the Kama River of the Volga system. Markun thought that this form may be intermediate between the European subspecies and the "*Lota lota maculosa*" (= *L. l. leptura*) of northeastern Siberia. Fortunately, Markun made a statistical study of the characters of the Kama River form. In comparing our counts with his, it would seem that on the average *L. l. leptura* has fewer fin rays, a slenderer

tail region, and a longer distance from the tip of the snout to the origin of the dorsal fin. A great difference appears in the measurements for the distance from the tip of the snout to the end of the pectoral fin, but here either a slip in translation or a typographical error seems evident in Markun's figures.

DESCRIPTION.—The following description is based on the holotype, U.S.N.M. No. 29916, a specimen 535 mm. from tip of snout to end of last vertebra, collected by E. W. Nelson at Kotlik, Alaska, June 20, 1881. Kotlik is near one of the mouths of the Yukon River, on Norton Sound. In addition certain measurements and counts of 22 paratypes are recorded in Table VIII. Locality and other data for each specimen are given in the list which follows this description.

Sixty-nine paratypes (U.S.N.M. No. 76848), from 28 to 63 mm. in standard length, were caught in a linen trap at a lake near Nijni Kolymsk, Siberia, by N. W. Widding, in September, 1914. In the same month he took 134 paratypes (U.S.N.M. No. 76847), 23 to 64 mm. long, from a pond near Kolyma, Siberia, in a cloth trap.

The measurements of the holotype are expressed in thousandths of the standard length. Length of head, 221; length of snout, 65.5; diameter of eye, 25; fleshy interorbital width, 64; tip of snout to rear edge of maxillary, 97; postorbital length of head, 135; greatest depth of body, 122; distance from notch at posterior end of second dorsal to similar notch at rear of anal fin, 43; distance from notch at posterior end of second dorsal to tip of last vertebra, 89; distance from tip of snout to origin of first dorsal fin, 389; distance from tip of snout to posterior tip of pectoral fin, 351; length of pectoral fin, 135; length of longest ray in first dorsal fin, 52; longest ray of second dorsal, 67; longest ray of anal fin, 60; longest ray of pelvic fin, 122; length of base of first dorsal, 71; the sixth and seventh pectoral rays are longest.

The number of fin rays in the holotype are as follows: dorsal, 12–73; anal, 75; pectorals, 20–20.

Nine gill-rakers were counted on the first gill-arch.

TABLE VIII

MEASUREMENTS AND COUNTS OF *Lota lota leptura*

General locality*	Siberia		Alaska											
Specimen number*	87–90	91–93	94	95	96–102	103	104–5	106–7	108–10	111†	112	113	114–15	116
Standard length, mm.	50–64	54–63	110	144	173–250	243	503–05	522–25	525–610	535	542	550	615–85	705
Thousandths of standard length														
Dorsal fin notch to anal fin notch (A)	48–52	52–56	39	49	48–54	52	47–49	38–44	41–50	43	41	50	45–47	48
Dorsal fin notch to end of vertebrae (B)	94–111	89–107	84	97	85–109	100	99–115	82–86	72–83	89	91	100	75–80	81
Tip of snout to origin of dorsal (C)	352–82	378–92	361	389	352–98	379	360–65	381–85	370–89	389	408	378	378–408	385
Tip of snout to end of pectoral (D)	344–58	370–88	346	361	322–49	346	331–43	344–53	298–329	351	338	345	356–58	364
Length of pectoral	101–33	124–35	107	143	110–26	134	120–22	126–44	92–109	135	129	133	125–39	130
First dorsal base	.....	.....	.....	.....	.....	.....	.....	?–80	63–77	71	.....	.....	93–97	70
Length of head	216–51	228–49	224	238	210–18	210	207–20	196–211	187–202	221	219	225	218–29	218
Ratio, $\frac{B}{A}$	1.90–2.26	1.60–2.07	2.14	2.00	1.74–2.02	1.91	2.11–2.34	1.87–2.30	1.46–1.90	2.07	2.20	2.01	1.58–1.78	1.71
Ratio, $\frac{C}{D}$	1.02–1.09	1.00–1.03	1.04	1.08	1.06–1.18	1.09	1.06–1.09	1.09–1.11	1.18–1.24	1.11	1.21	1.09	1.05–1.15	1.05
Fin rays														
First dorsal	11–14	10–13	12	13	10‡	11	13	12–13	10–12	12	11	12	10–14	10
Second dorsal	73–80	75–80	73	68	76	67	70–72	69–76	72–75	73	72	73	73–74	69
Anal	71–77	71–71	71	70	70	67	69–70	68–72	68–70	75	63	67	69–73	68
Total	158–67	156–64	156	151	156	145	153–54	153–57	153–54	160	146	152	152–61	147

* More exact locality and other data are given in the text.

† Holotype.

‡ One count of fin rays in this series.

Data for Specimens of *Lota lota*, for Which Counts and Measurements Are Given in Tables V to VIII

These specimens are in the collections of the United States National Museum (U.S.N.M.), University of Michigan Museum of Zoology (U.M.M.Z.), and the University of Wisconsin (U.W.). Other specimens were measured for the critical ratios.

Lota lota lota (Table V)

1.—U.S.N.M. No. 105233: Tym River, Sakhalin; July 26, 1929.

2.—U.S.N.M. No. 24188: France; M. Goldsmith.

3.—U.S.N.M. No. 28427: Lago di Como, Italy; Italian Commission, Berlin Fishery Exhibit.

4.—U.M.M.Z. ——: Haardermeer, Holland; Jan Metzelaar, December 20, 1926.

5.—U.S.N.M. No. 28574: Seine River, France; Muséum d'Histoire Naturelle, Paris.

6.—U.S.N.M. No. 2200: Leeds, England.

7–8.—U.S.N.M. Nos. 28600 and 21166: France; Muséum d'Histoire Naturelle, Paris.

9–10.—U.S.N.M. No. 10098: Lacus Malarew, Sweden.

11–12.—U.S.N.M. Nos. 41110 and 41102: Lake of Morat, Switzerland; Department of Interior and Agriculture, Switzerland.

13.—U.S.N.M. No. 10096: Europe; Bonaparte collection.

14–15.—U.S.N.M. 17333: Sweden; Widegren.

Lota lota maculosa (Table VI)

16–20.—U.M.M.Z. No. 126770: oxbow of Connecticut River, 1.75 miles southwest of North Haverhill, New Hampshire; J. R. Bailey and J. A. Oliver, August 10, 1939.

21.—U.M.M.Z. No. 126771: Otter Brook, at Grange, Coos County, New Hampshire; Bailey and Oliver, August 18, 1939.

22–27.—U.M.M.Z. No. 126772: Round Pond, 8.5 miles northeast of Pittsburg, Coos County, New Hampshire; Bailey and Oliver, September 6, 1939.

28.—U.S.N.M. No. 61432: Cross Lake Thoroughfare, Aroostook County, Maine; W. C. Kendall.

29–30.—U.S.N.M. No. 16865: Lake Winnipiscogee [New Hampshire]; J. Sutherland and R. Appleton, November 29, 1876.

31–34.—U.M.M.Z. Nos. 127002–4: Sebago Lake, Maine; G. P. Cooper and party, July 8–11, 1938.

35.—U.M.M.Z. No. 67941: Big Wolf Creek, Alpena County, Michigan;

Carl L. Hubbs and C. Willard Greene, July 11, 1925.

36.—U.M.M.Z. No. 56533: East Tawas, Iosco County, Michigan; Walter Koelz, October 22, 1917.

37.—U.M.M.Z. No. 57000: Bear Creek, 5 miles south of Houghton Lake, Michigan; Charles W. and Edwin P. Creaser, August 10, 1922.

38–40.—U.M.M.Z. No. 117653: Otto Lake, near headwater of Blanche River, at Swastika, Ontario; Carl L. and Laura C. Hubbs, August 23, 1930.

41.—U.M.M.Z. No. 69593: Black River, just above junction with East Branch, Montmorency County, Michigan; Jan Metzelaar and T. H. Langlois, August 13, 1925.

42.—U.M.M.Z. No. 67703: Sunken Lake, Presque Isle County, Michigan; Carl L. Hubbs, September 17, 1925.

43.—U.M.M.Z. No. 88920: Big Stone Bay, Emmet County, Michigan; Hubbs and party, July 17, 1927.

44.—U.S.N.M. No. 68934: Lake Huron at Port Sanilac, Michigan; Scovell, June 20, 1894.

45–46.—U.M.M.Z. No. 100103: Lake Siskowit, Isle Royal, Michigan; Walter Koelz and party, August 21, 1929.

47–48.—U.M.M.Z. No. 80525: Rush Lake, Marquette County, Michigan; Walter Koelz, August 26, 1924.

49.—U.S.N.M. No. 20977: Outer Island, Lake Superior; J. W. Milner.

50.—U.M.M.Z. No. 72273: Saginaw Bay, opposite Nayamquint Point and Linwood, Michigan; T. H. Langlois, May 4, 1926.

51.—U.S.N.M. No. 20847: Seneca Falls, New York; E. G. Blackford, November, 1877.

52.—U.M.M.Z. No. 81541: Crystal Lake, Benzie County, Michigan; Charles W. Creaser, June 7, 1927.

53.—U.M.M.Z. No. 53684: Lake Mindemoya, Manitoulin Island (in Lake Huron), Ontario; Walter Koelz, November 12, 1917.

54.—U.M.M.Z. No. 56555: Lake Huron, off Alpena 14 miles SE. ½ S., Michigan; Walter Koelz, October 7, 1917.

55–57.—U.S.N.M. Nos. 34121–23: Labrador; L. M. Turner.

58.—U.S.N.M. No. 21911: tributary to James Bay; C. Drexler.

59.—U.S.N.M. No. 64865: White Oak Lake, at Deer River, Minnesota; A. J. Woolman.

60.—U.S.N.M. No. 20392: Fort Ripley, Minnesota; R. Kennicott.

61–68.—U.M.M.Z. No. 78618: North Branch of Flambeau River, 4 miles west of Fifield, Wisconsin; Edwin P. Creaser and Samuel Jones, August 24, 1928.

69–71.—U.W., collections 133, 135, and 136: North Turtle Lake, Wisconsin; George Wagner, August 1–9, 1907.

72.—U.M.M.Z. No. 96539: Trout Lake, Vilas County, Wisconsin; Stillman Wright, July 7, 1927.

73–74.—U.W. collection 127: Fence Lake, Wisconsin; Wagner, July 23, 1907.

75–79.—U.M.M.Z. ——: Missouri River system, Wyoming; James R. Simon.

80.—U.S.N.M. No. 20939: Kansas City, Missouri; Theo. S. Case, February, 1878.

81–82.—U.S.N.M. No. 37777: Big Horn River, Montana; Capt. Charles E. Bendire.

83.—U.S.N.M. No. 6433: Fort Pierre [South Dakota]; Dr. Hayden.

Possible Intergrades, *Lota lota: leptura* × *maculosa* (Table VII)

84.—U.S.N.M. No. 21195: Fort Simpson [on Mackenzie River]; R. Kennicott, August 20, 1859.

85.—U.S.N.M. No. 70450: Yellowhead Lake [Fraser River drainage, near Continental Divide], British Columbia; Ned Hollister, September 1, 1911.

86.—U.S.N.M. No. 87593: Waterton Lake [Hudson Bay drainage], Glacier National Park; Vernon Bailey, July, 1923.

Lota lota leptura (Table VIII)

87–90.—U.S.N.M. No. 76847: pond near Kolyma, Siberia; N. W. Widding, September, 1914.

91–93.—U.S.N.M. No. 76848; lake near Nijni Kolymsk, Siberia; Widding, September, 1914.

94.—U.S.N.M. No. 60698: Lake Bennett, "Alaska" [presumably Lake Bennett, British Columbia, on southern headwater of the Yukon River].

95 and 103.—U.S.N.M. No. 32902: Yukon River, at Andraefsky, Alaska; E. W. Nelson, winter, 1877–78.

96–102.—U.S.N.M. No. 34032: Nushagak River, Alaska; C. L. McKay, October 20, 1882.

104–5.—U.S.N.M. No. 10102: Yukon River.

106–7.—U.S.N.M. No. 29917 and 32823: Yukon River, at Nulato, Alaska; E. W. Nelson, March, 1881, and January, 1878.

108–10.—U.S.N.M. Nos. 32456–58: Kodiak, Alaska; Wm. J. Fisher.

111–12.—U.S.N.M. Nos. 29916 (holotype) and 29915: Kotlik, Alaska [near mouth of Yukon River]; E. W. Nelson, January 20, 1881.

113.—U.S.N.M. No. 29918: Yukon River; E. W. Nelson.

114–15.—U.S.N.M. Nos. 38905 and 38901: Kowak River, Alaska; Lt. G. M. Stoney, January 10, 1886.

116.—U.S.N.M. No. 104429: Naknek River, Alaska; Claude Flock, June 12, 1931.

Supplementary Statement

As this paper passes through page proof we receive a publication by Andriashev (1939) which bears on the status of the species of Cottidae here discussed. He lists *Myoxocephalus parvulus* on page 43, with a question mark, presumably as to its validity. Following Taranetz (1935*a*) Andriashev (1939: 43 and 66) synonymizes *Crossias* with *Porocottus* (see also p. 13), erroneously regards *Crossias albomaculatus* as a western subspecies of *Porocottus bradfordi,* and records *albomaculatus* from Attu and Agattu Islands of the Aleutian Chain. Therefore our records of *Crossias* are not the first for North America. *Porocottus bradfordi* Rutter (in Jordan and Evermann, 1898: 2862–63) is described as having the pelvic rays serrate in the male, and should perhaps be referred to *Crossias* rather than *Myoxocephalus.*

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