

OCCASIONAL PAPERS OF THE MUSEUM OF
ZOOLOGY

UNIVERSITY OF MICHIGAN

ANN ARBOR, MICHIGAN

UNIVERSITY OF MICHIGAN PRESS

COTTUS HUBBSI, A NEW COTTID FISH FROM
THE COLUMBIA RIVER SYSTEM IN
WASHINGTON AND IDAHO

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OF all North American fresh-water fishes, probably no group is of more potential significance to the evolutionist than is the genus *Cottus*. Among its many forms convergent and divergent evolution is rife, geographic variation is often extreme, and individual variation may be great. The parallel evolution of almost all characters in diverse phyletic lines renders difficult the recognition of natural affinities. *Cottus* appears to be a plastic group, and in attempting to fit morphological variants into an orderly arrangement the systematist repeatedly experiences frustration.

In the course of a study of geographic variation in *Cottus rhotheus* (Rosa Smith), we discovered several lots which contained *rhotheus* and, in addition, a distinct new form. Some additional collections included only the undescribed species. The seven record stations are in the upper Columbia River basin in Washington and in the Salmon River drainage in Idaho. We take especial pleasure in naming this species for Carl L. Hubbs, who recognized the form as undescribed and from whose broad experience with North American fishes we have drawn freely.

Cottus hubbsi agrees in many characters with *C. rhotheus* and has been confused with that species. It seems likely, however, that its closest allies are to be found in the assemblage which includes *bairdii* of eastern United States, *punctulatus* of the Rocky Mountain region, and *shasta* of the Sacramento River system. It is possible that *hubbsi* is a subspecies of *bairdii*, but pending results of a much needed critical revision of the genus it is accorded full specific status.

We wish to thank Leonard P. Schultz and Robert R. Miller, of the United States National Museum (U.S.N.M.), for permitting the loan and examination of specimens in that institution, and we are indebted to Dr. Miller for data on certain type specimens. Dr. Hubbs has read the manuscript and offered numerous helpful criticisms.

***Cottus hubbsi*, new species**
(Pl. I, Map 1)

MATERIAL.—The holotype, U.M.M.Z. No. 145161, an adult 78.8 mm. in standard length, was collected in the Entiat River, 1 mile above Entiat, Chelan County, Washington, on August 23, 1932, by Leonard P. Schultz and Marvin Bowers. Three paratypes were taken with the holotype: U.M.M.Z. No. 145160 (2), 78 and 81 mm. long, and U.S.N.M., No. 142968 (1), 69.5 mm. long.

Additional paratypes are as follows:

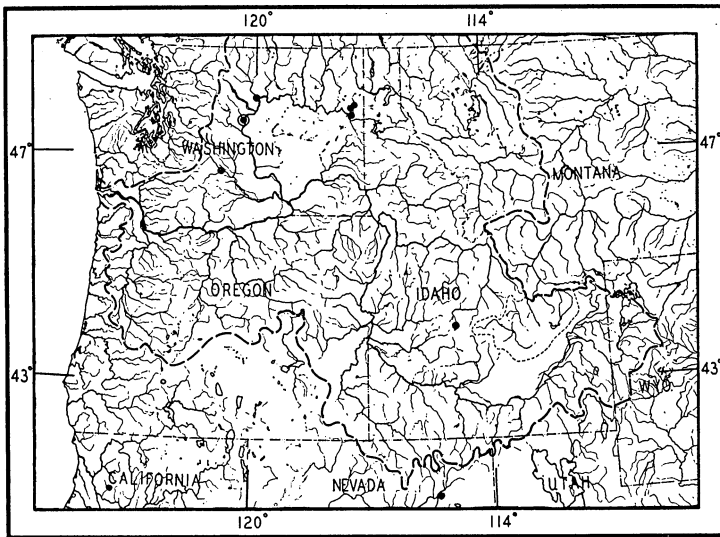
U.M.M.Z. No. 98802 (2), 24 and 96 mm. long, and U.S.N.M. No. 142969 (2), 24 and 49 mm. long, collected in the Naches River, 5 miles above Naches, Yakima County, Washington, on September 2, 1932, by Schultz and Bowers.

U.S.N.M. No. 142967 (2), 62 and 70 mm. long, collected in the Methow River, near Pateros, Okanogan County, Washington, by Loyd A. Royal.

U.M.M.Z. No. 145162 (2), 25 and 65 mm. long, and U.S.N.M. No. 142970 (2), 43.5 and 65.5 mm. long, collected in Dragoon Creek, tributary to Little Spokane River, 5 miles south of Deer Park, Spokane County, Washington, on August 25, 1932, by Schultz and Bowers.

U.M.M.Z. No. 98675 (2), 31 and 71 mm. long, collected in the Little Spokane River at Chattaroy, Spokane County, Washington, on August 26, 1932, by Schultz and Bowers.

U.M.M.Z. No. 129736 (3), 35 to 60 mm. long, collected in a small branch of the Little Spokane River, the head spring in the fish hatchery, 4 miles north of Spokane, Spokane County, Washington, between March and May, 1940, by P. V. Gustafson.



MAP 1. Distribution by record stations of *Cottus hubbsi*; the type locality is encircled. The heavy broken line outlines that part of the Columbia River drainage system which lies in the United States.

The following specimens are identified as *Cottus hubbsi*, but are not designated as paratypes:

U.M.M.Z. No. 118076 (2), 37 and 101 mm. long, collected in Alturas Lake Creek, at bridge to Petitt Lake, tributary to Salmon River, Sawtooth National Forest, T. 8 N., R. 14 E., sec. 32, Blaine County, Idaho, on July 23, 1934, by I. A. and Anne Rodeheffer.

DIAGNOSIS.—This form takes a place among those species of *Cottus* which have a spine and 4 rays in the pelvic fin; well-

developed palatine teeth; a complete or almost complete lateral line; and a prominent, but embedded, backward projecting preopercular spine, with 2 smaller but well-developed spines below. The posterior nostril is semitubular. The median fins are of moderate length; dorsal VII or VIII, 16 to 18; anal 12 to 14. There are 14 to 16 pectoral rays. The body is rather robust, and the caudal peduncle is deep (its depth 3.7 to 4.6 in head length). There are 22 or 23 caudal vertebrae. The moderate-sized head is contained 2.9 to 3.2 times in the standard length. The mouth is not especially large, the maxilla extending to below the anterior half of the eye. The prickles on the body vary but little; they are restricted to a cluster mesial to the pectoral fin. The dorsal fin has a median dark band and 1 or 2 conspicuous dark blotches; there are 3 dark crossbands at the base of the second dorsal fin; and the pectoral fins are marked with broad crossbars.

DESCRIPTION.—The moderately robust body is deepest at origin of dorsal, from which point the dorsal contour is very gently curved to base of caudal. The ventral contour is almost straight, with a slight outflaring at the middle of the anal fin; greatest depth (in the holotype), 4.3 in standard length. The caudal peduncle is deep and markedly compressed; its least depth, 13.0 in standard length and 4.4 in head length. (Proportional measurements of 10 specimens, expressed in thousandths of the standard length are given in Table I.)

The head is gently arched from the dorsal fin to the upper lip, the contour scarcely broken by the upper rim of the orbit. Head length (including opercular membrane), 2.95 (2.9 to 3.2) in standard length. Viewed from above, the head is smoothly rounded and more or less semicircular anteriorly; the straight anterolateral edges of the head extend from the preorbital to the angle of the preopercle and flare outward at an angle of 65° with each other. The greatest width is almost equal to the length of the head. The snout is produced, the upper lip broadly visible in dorsal aspect, snout length 3.5 in head length and 1.5 times the orbital diameter. The lips are thick and subequal in forward extension; in ventral view the upper

TABLE I

MEASUREMENTS OF TEN SPECIMENS OF *Cottus hubbsi*

The proportions are expressed as thousandths of the standard length. Specimens numbered 1 and 2 are from U.M.M.Z. No. 145160; 3 is the holotype, U.M.M.Z. No. 145161; 4 and 9 are from U.M.M.Z. No. 98675; 5 and 8 from U.S.N.M. No. 142967; 6 and 10 from U.M.M.Z. No. 145162; and 7 from U.M.M.Z. No. 129736.

Measurement	1	2	3	4	5	6	7	8	9	10	Mean
Standard length (mm.)	81.6	78.9	78.8	70.5	69.5	64.9	62.7	62.0	30.9	26.7	62.7
Head length (including opercular membrane)	340	349	349	349	364	342	321	342	327	330	341
Greatest depth	227	230	239	222	269	206	222	200	205	221	224
Least depth	78	83	82	73	85	79	72	74	80	77	78
Body width (behind pectoral fin)	204	211	216	194	216	200	167	185	187	.....	198
Predorsal length	355	347	363	360	376	361	343	360	358	354	358
Caudal peduncle length	159	160	153	161	150	156	139	153	165	.....	155
Distance from anus to base of caudal	468	447	470	461	463	476	463	477	500	.....	469
Prepelvic length	297	325	304	305	311	297	319	313	307	292	307
Distance from tip of snout to origin of anal fin	583	605	578	601	560	581	589	574	547	.....	580
Highest dorsal spine	94	98	98	101	109	109	105	106	.....	.....	103

TABLE I.—(Cont.)

Measurement	1	2	3	4	5	6	7	8	9	10	Mean
Basal length of first dorsal fin	195	200	230	214	223	220	183	202	.....	.....	208
Highest dorsal soft ray	148	150	163	135	.....	159	148	152	.....	.....	151
Basal length of second dorsal fin	397	387	393	375	417	372	423	403	.....	.....	396
Highest anal ray	136	145	135	145	157	154	133	132	.....	.....	141
Basal length of anal fin	301	266	280	278	309	302	305	298	.....	.....	292
Longest pectoral ray	297	314	283	283	319	309	279	300	311	322	302
Length of pelvic fin	216	216	215	215	216	231	209	226	217	226	219
Length of caudal fin	222	230	231	221	249	239	231	234	.....	.....	232
Head width	350	342	337	350	368	316	313	331	308	288	330
Head depth	203	211	217	211	229	206	215	197	178	194	206
Snout length	101	098	098	095	109	096	089	097	090	090	096
Orbit length	070	077	080	082	082	076	070	081	098	094	081
Postorbital length of head	192	196	187	189	187	185	179	169	150	158	179
Bony interorbital width	035	031	027	040	035	032	038	024	026	.....	032
Upper jaw length	142	137	146	149	153	140	129	132	130	131	139
Mouth width	172	174	161	189	200	159	158	163	150	.....	170
Length of preopercular spine (from upper angle of base)	025	025	028	030	030	029	035	034	028	028	029
Distance from tip of snout to tip of preopercular spine	271	269	268	284	294	279	271	284	269	259	275

lip is hidden by the lower. The mouth is exposed, nearly horizontal, and extends almost to a line through the center of the pupil; upper jaw length, 2.6 in head length. The suborbital width is nearly two-thirds the orbital length. The narrow interorbit is depressed; its body width 2.3 (2.0 to 3.2) in length of orbit. The orbit length is contained 4.5 times in the head length.

The preopercle is armed with a strong, somewhat flattened spine which projects backward and is gently curved upward; below it there is a smaller, downward projecting spine and anterior to it a still smaller, but sharply pointed, antrorse spine. The subopercle, as usual in this genus, has a sharp spine at its anteroventral corner. The opercle terminates in a flattened, bluntly pointed spine. All these spines are embedded in skin. The branchiostegal rays number 6-6 in 5 specimens (including the holotype) examined. The villiform teeth on the jaws and vomer are well developed, and each palatine bears strong teeth in an elongate, broad band which is readily visible without dissection. The anterior nostril opens through a short tube, which is somewhat higher than the elliptical prominence about the posterior nostril. Although it has a thicker base and an apparently heavier wall, the posterior tube approaches that of *C. tubulatus* in height.

The dorsal, anal, pectoral, and pelvic fin ray counts are given as frequency distributions (Table II). The spinous and soft dorsal fins are in contact at their bases but are not (or only narrowly) conjoined. The caudal fin has 12 principal rays of which 10 are branched. The only variation from the normal pelvic ray count, I,4, occurs on the left side of the holotype which has a rudimentary fifth soft ray that is somewhat less than half as long as the adjacent ray. An occasional pelvic ray is forked near its tip. The rays in the dorsal, anal, and pectoral fins are uniformly unbranched (as counted, the last ray of the second dorsal and anal fins is double at the base).

The lateral line is usually complete in half-grown to adult specimens (it fails to be complete by half the diameter of the

TABLE II

FREQUENCY DISTRIBUTIONS OF FIN RAY COUNTS IN *Cottus hubbsi* AND *C. rhotheus*

Counts of the holotype of *hubbsi* are indicated by asterisks. The last ray of the second dorsal and anal fins is counted as double at base.

Species and Locality	Dorsal Spines						Dorsal Soft Rays						Anal Rays					
	7	8	9	No.	Mean	15	16	17	18	No.	Mean	10	11	12	13	14	No.	Mean
<i>hubbsi</i>																		
Naches River	1	3	.....	4	7.75	.....	.....	3	1	4	17.25	.....	.....	3	1	.....	4	12.25
Entiat River	1	3*	.....	4	7.75	.....	.....	3*	1	4	17.25	.....	.....	2*	2	.....	4	12.50
Methow River		2	.....	2	8.00	.....	.....	1	1	2	17.50	.....	.....	.....	2	.....	2	13.00
Little Spokane River system	6	3	.....	9	7.33	.....	.....	8	1	9	17.13	.....	.....	3	5	1	9	12.78
Salmon River		2	.....	2	8.00	.....	.....	1	1	2	16.50	.....	.....	.....	2	.....	2	12.00
All localities	8	13	.....	21	7.62	.....	.....	16	4	21	17.14	.....	.....	10	10	1	21	12.57
<i>rhotheus</i> (many localities)	22	141	43	206	8.10	66	122	30	2	220	15.85	2	24	125	64	4	219	12.20
Species and Locality	Pectoral Rays (both sides)						Pelvic Rays (both sides)											
	13	14	15	16	17	Mean	1,4	1,5	No.	Mean	1,4	1,5	No.	Mean				
<i>hubbsi</i>																		
Naches River			2	6	.....	8	8	15.75	8	.....	8	.....	8	.....	8	.....	8	1, 4.00
Entiat River			4	4*	.....	8	8	15.50	7*	1*	8	.....	8	.....	8	.....	8	1, 4.13
Methow River				4	.....	4	4	16.00	4	.....	4	.....	4	.....	4	.....	4	1, 4.00
Little Spokane River system			5	.....	.....	18	18	14.72	18	.....	18	.....	18	.....	18	.....	18	1, 4.00
Salmon River			2	2	.....	4	4	15.50	4	.....	4	.....	4	.....	4	.....	4	1, 4.00
All localities			5	16	.....	42	42	15.26	41	1	42	.....	42	.....	42	.....	42	1, 4.02
<i>rhotheus</i> (many localities)	1	6	141	188	.....	364	364	15.65	223	.....	223	.....	223	.....	223	.....	223	1, 4.00

pupil in the holotype), and extends to the posterior end of the second dorsal fin in specimens about 25 mm. in standard length. There are 33 pores along the body (33 or 34 in 10 paratypes in which the line is fully developed). The cephalic branches of the lateral-line system are traced with difficulty externally, but they are readily revealed by removing the skin. The nomenclature for canals and pores follows that employed by Hubbs and Cannon (1935: 9-10, Pl. 2). There are 4 small pores in the lateral canal. The first is at its posterior end just anterior to the upper angle of the branchial aperture, and 3 others, each opening at the end of a tube which projects downward and backward, are in a row between it and the back of the eye. A supratemporal canal, with 3 pores, joins the lateral canal opposite the side tube of the third pore in that canal. The lateral canal branches just behind the eye to form the supraorbital and infraorbital canals. A coronal pore lies on the midline of the top of the head between the posterior borders of the eye. An interorbital pore lies just behind each posterior nostril; the posterior nasal pore is at the tip of a short lateral branch of the supraorbital canal midway between the nostrils, and the anterior nasal pore is in front of the anterior nostril. The infraorbital canal consists of 10 pores; the first emerges from the anterior edge of the canal just below the junction with the supraorbital canal; the tenth lies at the end of the canal just below the anterior nostril; the others all emerge from side branches which project backward or downward from the canal, the second and third lie well back on the cheek behind the eye, the fourth just in front of the upper preopercular spine, the fifth to the seventh below the eye, and the eighth and ninth along the lower edge of the preorbital bone. The operculomandibular canal, which is not connected with the other canals, consists of 11 pores, the lowest 9 of which are enlarged: the first pore is at the upper end of the preopercle just below the lateral canal; the second lies near the upper angle of the base of the principal preopercular spine; the third, fourth, and fifth emerge below (or anterior to) the 3 spines, respectively, and lie along the edge of the preopercle;

the sixth is at the anterior end of the lower arm of the preopercle and immediately above the seventh, which is at the posterior end of the mandible (Pl. I, upper figure); the 4 anterior pores lie along the outer edge of the mandible and may be hidden from view (as is the tenth pore on the right side of the specimen figured). The anterior pores of the 2 sides open separately at the lateral ends of a transverse depression.

The development of prickles on the body is remarkably uniform in the available series of 21 specimens. These are well developed, but are confined to an area that is approximately covered by the appressed pectoral fin. In the holotype and most other specimens a few prickles are present in that region just above the lateral line. In a few specimens the prickled area extends a short distance behind the tip of the pectoral fin, but prickles are never developed near the dorsal fins or on the posterior half of the body.

The caudal vertebrae (hypural included) in 3 paratypes number 22, 22, and 23.

The contrast of light and dark pigment is well marked in *C. hubbsi*. There are 3 dark blotches on the anterior part of the back, the first on the nape, the second and third at opposite ends of the base of the first dorsal. Below the second dorsal, there are 3 crossbands each of which extends ventrally to, or slightly below, the lateral line. A dark band encircles the caudal peduncle at the base of the caudal fin. The side below the lateral line is generally rather light, but is clouded with dark to form more or less evident blotches. The top of the head is marked with diffuse spots or mottles. The light lower surface is heavily and uniformly sprinkled with melanophores, which are grouped to form diffuse blotches only on the lower jaw, and even these are usually indistinct. Typically, the lower lip is rather uniformly dark brown. The first dorsal is heavily sprinkled with melanophores basally; just within the light margin it has a submedian darker band, on which there are 1 or 2 black blotches (one is in the posterior third, another is usually developed on the anterior spines, but is scarcely evident in the holotype). The rather dark second dorsal is

crossed by about 4 ill-defined oblique series of diffuse dark blotches on the rays. The anal fin is lighter and bears only 3 or 4 oblique series of dark spots. The caudal is conspicuously marked with 3 or 4 broad, vertical dark bands, of which the 1 near the distal border is the broadest and most regular. The pectoral is boldly barred with 5 or 6 irregular dark bands. In adults the pelvic is heavily dusted with melanophores and has a few irregular dark spots; in young specimens the fin is pale.

COMPARISONS.—As judged from museum specimens, *Cottus hubbsi* has been confounded with *C. rhotheus* by some workers who have handled it. It is true that the species agree in many characters that have been regarded as diagnostic of *rhotheus*, but in collections which include both species (as in those of the Naches, Entiat, Methow, and Little Spokane river systems) they may be readily differentiated at a glance. These species are contrasted in Table III, and fin ray counts for *rhotheus* are included for comparative purposes in Table II. *Cottus rhotheus* is apparently most intimately related to *Cottus caroliniae* (Gill), a species from the southeastern United States which, with its several subspecies, differs from the more northern *Cottus bairdii* (as well as from *C. hubbsi*) in many of the same characters that separate *rhotheus* and *hubbsi*. *Cottus hubbsi*, on the other hand, is regarded as a geographic representative of *C. b. bairdii* and *C. b. kumlieni* of the northeastern states and of *C. bairdii punctulatus* and *C. b. semiscaber* of the northern Rocky Mountains and parts of the Great Basin.¹ *C. hubbsi* differs from these 4 subspecies of *bairdii* in having the lateral line complete or almost complete (instead of not extending beyond the posterior end of the second dorsal). In specimens from about 25 to 40 mm. long the lateral line extends at least to below the posterior end of the second dorsal fin in *hubbsi*, usually far short of that point in the subspecies of

¹ So far as yet known *C. b. punctulatus* and *C. b. semiscaber* appear to be geographically remote from *C. b. bairdii*, being separated by the Great Plains, but the morphological differences are slight and subject to such variation that the forms may best be regarded as subspecies.

TABLE III

COMPARISON OF *Cottus rhotheus* AND *Cottus hubbsi*

This comparison is based on all of the available material of *C. hubbsi*. *C. rhotheus* exhibits considerable geographic variation, and the characters here attributed to it are those which obtain in the area where the ranges of the 2 species overlap. Specimens of *rhotheus* from the coastal region of Washington and Oregon usually have the head somewhat shorter, the lateral line not extending onto the base of the caudal fin (often not quite complete), and the prickles on the body much reduced (sometimes entirely absent). In examples from above the falls in the Palouse River system; the body is speckled, the dorsal crossbands are indistinct, and the prickles are much reduced or absent.

Character	<i>rhotheus</i>	<i>hubbsi</i>
Head length (including opercular membrane)	Contained 2.65 to 3.0 (usually 3.0 or fewer) times in standard length	Contained 2.9 to 3.2 (usually 3.0 or more) times in standard length
Mouth	Hyperbolic as viewed from below; larger, maxilla to below posterior border of pupil in large adults, anterior border of pupil in young	Semicircular as viewed from below; smaller, maxilla to below anterior part of pupil in adults, anterior border of orbit in young
Caudal peduncle	Slenderer, its depth contained 4.8 to 6.4 times in head length	Deeper, its depth contained 3.7 to 4.6 times in head length
Skin on body and fins	Thinner	Thicker and more leathery
Lateral line	Typically extending onto base of caudal fin in half-grown and adults; usually almost or quite complete in large young	Typically extending to or almost to base of caudal in half-grown and adults, but not developed on base of caudal rays; usually extending only to about posterior end of dorsal base in large young
Dorsal soft rays	Usually 15 or 16 (mean, 15.85); extreme range, 15 to 18	Usually 17 (mean 17.11); range 16 to 18
Prickles on body	Commonly well developed and covering upper sides far back on body, sometimes to base of caudal; occasionally much reduced	Restricted to a small area mesial to pectoral fin

TABLE III.—(Cont.)

Character	<i>rhotheus</i>	<i>hubbsi</i>
Dorsal crossbands below base of second dorsal	2, each typically narrower, most often involving the bases of 3 or 4 rays	3, typically broader, the first and third most often involving the bases of 4 or 5 rays each, the second only 2 or 3 rays
Pigmentation on under side of head, in half-grown and adults (not or scarcely developed in young of either species)	Melanophores larger and usually clustered to form diffuse blotches and mottles, especially on lower lip and jaw; chin boldly spotted	Melanophores smaller and more regularly disposed, not forming blotches on branchiostegal membranes; mandibles sometimes with faint blotches; chin rather uniform
Pigmentation on pectoral fin	More speckled; crossbars narrower and less regular	More strongly banded; crossbars broader and more regular
Pigmentation on first dorsal fin	Irregularly spotted, median dark band usually not evident	With a more or less diffuse median dark band, which is usually darkened near the anterior end and forms a conspicuous black blotch near the posterior third of fin

bairdii. In *bairdii* the prickles on the body are most often wanting or less well developed than they are in *hubbsi*, but in specimens from the Snake River system (*semiscaber*) they are sometimes equally well developed.

Cottus shasta, from the upper Sacramento River system, stands as another geographic representative in the same series of forms. Morphologically, it appears to be more like *hubbsi* than is any other form in the genus. The lateral line is even better developed than in *hubbsi*, usually extending a short

distance onto the base of the caudal fin, but the palatine teeth are fewer, are disposed in a single or double series (instead of in 2 or 3 series), and are confined to an area that is shorter and narrower. *C. shasta* differs further from *hubbsi* in having more rays in the vertical fins (compare the following counts, based on 19 specimens of *shasta*, with those given for *hubbsi* in Table II: dorsal spines, 8 in 5, 9 in 13, and 10 in 1; dorsal soft rays, 17 in 8, and 18 in 11; anal rays, 13 in 6, and 14 in 13), in having a clear-cut dark subocular bar (disrupted or poorly defined in *hubbsi*), and in the narrower crossbands on the pectoral fin.

Three other nominal species of North American *Cottus* are said to have well-developed palatine teeth (contrary to the statement by Hubbs and Schultz, 1932: 4, we find none in *C. ricei*). Of these only the Pacific coastal species, *C. asper*, is well known; it differs strikingly from *hubbsi* in having more caudal vertebrae (25 to 29), more dorsal and anal fin rays, and (usually) in the heavy investment of prickles on the head and body. *Cottus bendirei* (Bean, 1881), from Rattlesnake Creek in the Malheur basin, near Camp Harney, Oregon, was described as having only 3 soft rays in the pelvic fin, and the body smooth. Snyder (1908: 101) regarded *bendirei* as synonymous with *C. punctulatus*. Robert R. Miller examined the type of *Pomatocottus bendirei* (U.S.N.M. No. 24196) and writes:

After almost 70 years in preservative it has lost all of its original coloration except for a few dark splotches on the interradial membranes of the spinous dorsal fin. The body is soft and the skin quite lax. It differs from paratypes of *hubbsi* in the U. S. National Museum in having: (1) no trace of prickles (Schultz, 1936: 179, erred in crediting this species with prickles on the body and head); (2) a somewhat smaller eye and a deeper caudal peduncle, so that the diameter of the eye enters the least depth of the caudal peduncle 1.3 times (rather than 1.0 or less); (3) the interorbital broader, its least bony width entering the diameter of the orbit about 2.0 (instead of 2.6 to 3.6) times; (4) the upper jaw longer, its length entering that of the head about 2.2 (rather than 2.4 to 2.7) times; and (5) the outline of the mouth conspicuously narrower and more horseshoe-shaped as viewed from below. The pelvic fin rays number I, 3 on the left but I, 4 on the

right, the fourth soft ray represented by an inconspicuous, but very definite, basal part which can be seen only under good light and high magnification. *C. hubbsi* is clearly a form distinct from *bendirei*.

Uranidea greenei Gilbert and Culver, from the Snake River in Idaho, differs from *hubbsi* in dorsal (VI, 19) and pelvic (1, 3) ray counts, in the single preopercular spine, in the very incomplete lateral line, and in other respects.

All other described species of *Cottus* from North America differ from *hubbsi* in lacking a well-developed band of teeth on the palatines; in most species these bones are edentulous, but *Cottus beldingii* and a few other species sometimes have a weak band of palatine teeth. The Pacific coastal and Alaskan species, *C. aleuticus*, *C. protrusus* Schultz and Spoor, 1933, and *C. chamberlaini*, contrast with *hubbsi* also in having the posterior nostril more definitely tubular, and in having only 1 or 2 preopercular spines. *C. aleuticus* and *C. protrusus* have incomplete lateral lines and have 24 or more caudal vertebrae. A group of apparently closely interrelated forms (*beldingii* from the Great Basin and Columbia River system, *macrops* of the Sacramento system, *klamathensis* from the Klamath basin, *tubulatus* from the Snake River system, and *annae* of the Colorado basin) differ from *hubbsi* in the common character of the single preopercular spine; of these forms only *beldingii* has the lateral line complete, and only *macrops* has developed prickles mesial to the pectoral fin. The Snake River species, *C. leiopomus*, has no preopercular spine and the body is devoid of prickles.

Two species, *C. tenuis* and *C. princeps*, from the Klamath Lakes contrast strikingly in having some of the pectoral rays branched and the lateral line incomplete. *C. tenuis* is further distinct in having only 3 soft pelvic rays, and *princeps*² differs

² Gilbert (1898: 11-14) described *C. evermanni* and *C. princeps* from adjacent localities. The original figures (drawn by different artists) have numerous minor differences, but indicate (as do the descriptions) significant agreement in most characters. Study of topotypic material by us and of the 2 type specimens by Robert R. Miller demonstrates that *princeps*, like *evermanni*, has branched pectoral rays. Schultz (1936: 177-78) separated these species on the

in having long, soft dorsal and anal fins, many (26) caudal vertebrae, a heavily prickled body, and a broad union of the dorsal fins.

In addition to lacking palatine teeth, *C. gulosus*, from streams near the Pacific coast, differs from *hubbsi* in having an incomplete lateral line, only 2 preopercular spines, and more (usually 14 to 16) anal rays. The Canadian and Great Lakes species, *Cottus ricei*, is sharply set off by the extreme development of the sickle-shaped upper preopercular spine and, usually, by the heavily prickled body. *Cottus asperrimus*,³ *C. marginatus*, and *C. cognatus* normally have only 3 soft rays in the pelvic fin (except that the typical subspecies of *cognatus*, from Arctic America, usually has I, 4 pelvic rays). The Sacramento River species *C. asperrimus* differs further from *hubbsi* in having the lateral line incomplete, the spinous dorsal shorter, and the prickles well developed; *C. marginatus* of the Columbia basin contrasts in having 2 preopercular spines (the second reduced to a flat lobe) and in having the anal fin longer; *C. cognatus* from Arctic America and the northern states stands apart because of the very incomplete lateral line.

HABITAT.—The available ecological information indicates that *hubbsi*, like most other species of *Cottus*, is an inhabitant of clear streams characterized by a swift current and a rocky bottom. At 3 stations the water was recorded as clear, at a fourth as slightly cloudy; there was no vegetation at 3 localities, some algae at 2 others; the bottom composition was of presence (*evermanni*) or absence (*princeps*) of a preopercular spine. Dr. Miller informs us that the type of each nominal species has the preopercular spine reduced to a weak nubbin. We regard these nominal species as identical, and, as first revisers, select the name *princeps*.

³In synonymizing *Cottus asperrimus* Rutter with *Cottus gulosus*, Snyder (1917: 82) noted the marked development of prickly investment of the skin in the type, but regarded it as at the extreme limit of variation for *gulosus* in this character. Snyder failed to note the correlation of the prickly body with the distinctive pelvic ray count, I, 3 (I, 4 in *gulosus*), and the short first dorsal (5 or 6 spines, usually³ 7 or 8 in *gulosus*). We regard *C. asperrimus* as a valid species.

rock and boulders at 3, gravel and rubble at 1, and lava bed-rock and mud at 1. The streams varied from 5 to 60 feet in width, and *hubbsi* was collected at depths of 1 to 5 feet; the current was moderate at one station, varied from slow to swift at another, and was very swift at 2 stations. *Rhinichthys cataractae* was the commonest associate of *hubbsi*, having been taken at 5 of 6 stations. *Cottus rhotheus* was taken with *hubbsi* at 4 localities, *C. beldingii* was an associate in the Naches River, *C. cognatus* lived with *hubbsi* in a branch of the Little Spokane River, 4 miles north of Spokane, and a subspecies of *C. bairdii* occurred with it in Alturas Lake Creek, Idaho. Trout were taken in 4 of the 6 collections for which species lists are available.

SUMMARY.—*Cottus hubbsi*, a new species from the Columbia River system, is shown by comparison with the other Nearctic forms of the genus to be a generalized member of the complex that centers about *Cottus bairdii*; structurally it appears most similar to *C. shasta* of the Sacramento River system. The forms *punctulatus* from the Rocky Mountains and *semiscaber* from the Snake River drainage, and reputedly from isolated waters of the Bonneville division of the Great Basin, are considered as subspecies of *Cottus bairdii*. *Cottus carolinae* from the southeastern United States is regarded as specifically distinct from *C. bairdii*. *Cottus evermanni* from the Klamath River system is placed in the synonymy of *Cottus princeps*.

LITERATURE CITED

BEAN, TARLETON H.

- 1881 Descriptions of New Species of Fishes (*Uranidea marginata*, *Pomatocottus bendirei*) and of *Myctophum crenulare* J. and G. Proc. U. S. Nat. Mus., 4: 26-29.

GILBERT, CHARLES H.

- 1898 The Fishes of the Klamath Basin. Bull. U. S. Fish Comm., 17 (1897): 1-13, 6 figs.

HUBBS, CARL L., and MOTT D. CANNON

- 1935 The Darters of the Genera *Hololepis* and *Villora*. Misc. Publ. Mus. Zool. Univ. Mich., 30: 1-93, Pls. 1-3.

HUBBS, CARL L., and LEONARD P. SCHULTZ

- 1932 *Cottus tubulatus*, a New Sculpin from Idaho. Occ. Papers Mus. Zool. Univ. Mich., 242: 1-9.

SCHULTZ, LEONARD P.

- 1936 Keys to the Fishes of Washington, Oregon and closely Adjoining Regions. Univ. Wash. Publ. Biol., 2 (4): 103-228, Figs. 1-50.

SCHULTZ, LEONARD P., and WILLIAM A. SPOOR

- 1933 *Cottus protusus*, a New Sculpin from Unalaska Island. Copeia, pp. 142-45.

SNYDER, JOHN O.

- 1908 Relationships of the Fish Fauna of the Lakes of Southeastern Oregon. Bull. U. S. Bur. Fish., 27 (1907): 69-102, Figs. 1-4, 1 map.
- 1917 The Fishes of the Lahontan System of Nevada and Northeastern California. *Ibid.*, 35 (1915-16): 33-86, Pls. 3-4, Figs. 1-9, 1 map.

PLATE I

Cottus hubbsi, holotype, in ventral and lateral aspects; standard length, 79 mm.



Grace Eger '47

