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HYPENTELIUM ROANOKENSE, A NEW CATOSTOMID FISH FROM THE ROANOKE RIVER IN VIRGINIA

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The Roanoke River system of Virginia is well known for its endemic fishes from the early ichthyological explorations of Cope (1869) and Jordan (1890) and the more recent studies of Raney and Lachner (1946c). Long overlooked in the small mountain streams of the upper headwaters is a dwarf species of hog sucker for which we propose the name.

Hypentelium roanokense, new species

Figure 1

DIAGNOSIS

A small *Hypentelium* adapted for life in swift water. Posterior fontanelle reduced to a slit, body heavy with foreshortened trunk, and posterior lobe of air-bladder reduced in size; scales and pectoral rays markedly reduced in number; fins, especially the dorsal, anal, and pectorals, larger; longitudinal streaks of alternating light and dark well developed on back and sides; dark saddle between dorsal origin and occiput not crossing midline of back; mouth larger and less inferior; lips coarsely papillose with some plicae on inner edge. Also differs in minor pigmentary characters.

This species has been unrecognized by those who have studied Roanoke River fishes in the past. Cope (1869, p. 236) records *Hypentelium nigricans* (LeSueur) as "abundant in the Roanoke, James, Kanawha and Holston." Jordan (1890, p. 122) notes them to be "common; specimens dark in color. Lat. 1. 47." Fowler (1913, p. 53) reports *nigricans* from "Roanoke River, Holston River and Sinking Creek, Virginia." This report doubtless included specimens of Cope's still extant in the Academy of Natural Sciences of Philadelphia. We recently examined two specimens bearing the

data A.N.S.P. Nos. 6779-6780, Roanoke River, Virginia, collected by E. D. Cope. One specimen of each species is represented. The *nigricans*, 86 mm. standard length, is typical for that species with 46 lateral line scales and pectoral rays 17-17. The smaller specimen, 55 mm. long, is *roanokense* and has 42 scales. Fowler (1923a, p. 11) also records young of *nigricans* from the Dan River west of Danville, Pittsylvania County, Virginia. Fowler (1923b, p. 12) again reports *nigricans* from the Roanoke River. In his latest work Fowler (1945, p. 74) gives the records noted above but lists them as subspecies, *Hypentelium nigricans nigricans*. He (p. 338) considers *etowanum* as a subspecies and gives some color notes on fresh alcoholic specimens.

In the early stages of this investigation when few specimens of *Hypentelium* were available from the Roanoke, we (Raney and Lachner, 1946a, p. 7) considered the differentiation to be incomplete in *roanokense*. An intensive collecting trip in June, 1946, yielded 92 additional specimens of *roanokense*, some of which were taken with *nigricans*. A study of this large series proves our former concept of intergradation to be without foundation and the two kinds in the Roanoke to be fully differentiated.

Materials were borrowed from the United States National Museum (U.S.N.M.), Washington, D. C., through the courtesy of the Curator of Fishes, Dr. Leonard P. Schultz, and Associate Curator, Dr. Robert R. Miller. Mrs. Marie Poland Fish also assisted by checking certain locality data. Dr. Reeve M. Bailey, Curator of Fishes, Museum of Zoology, University of Michigan (U.M.M.Z.), kindly sent us specimens under his care. Dr. Carl L. Hubbs collected considerable material reported herein

TABLE 1
SCALE AND FIN RAY COUNTS OF *Hypentelium*

Species	roanokense		nigricans											
River system and states	Roanoke, Va. Holotype	Roanoke, Va. Paratypes	Roanoke, Va.	Atlantic, S. of Roanoke, N. C., S. C.	Appomattox, Va.	James, Va., W. Va.	Rappahannock, Va.	Potomac and upper Chesapeake, Va., Md.	Susquehanna, N. Y.	Lake Ontario, N. Y.	Ohio (except New and Tenn.), Pa., Ohio, W. Va., Ill., N. Y.	New, Va., W. Va., N. C.	Tennessee, Va., N. C.	Total (nigricans)
Lateral line scales	50		—	—	—	—	—	1	—	—	—	—	2	3
	49		1	—	—	1	—	1	—	2	—	4	3	12
	48		—	—	—	4	—	2	2	—	7	10	12	37
	47		6	3	—	10	3	9	4	3	20	10	19	87
	46		16	2	2	8	1	11	11	15	22	7	10	105
	45		6	2	3	1	7	5	7	4	7	—	8	50
	44	5	5	—	2	2	—	—	1	1	1	—	—	12
	43	15												
	42	24												
	41	31												
	40	22												
	39	4												
	38	1												
Total		102	34	7	7	26	11	29	25	25	57	31	54	306
Mean		41.4	45.8	46.1	45.0	46.6	45.6	46.5	46.0	46.0	46.4	47.4	47.0	46.4
Scales above lateral line	8		2	16	2	7	1	—	2	1	7	9	13	58
	7	1	66	18	—	—	15	3	14	18	12	18	24	175
	6		11	—	—	—	1	—	—	—	53	4	—	6
Total		79												239
Mean		6.9												7.2
Scales below lateral line	7		—	2	—	—	—	—	—	—	—	1	—	3
	6	1	56	24	2	7	—	3	4	2	31	15	18	113
	5		23	8	—	8	3	12	15	11	32	10	12	111
Total		79												227
Mean		5.7												5.5
Pectoral rays (total left plus right)	38		1	—	—	—	1	—	—	—	—	—	1	3
	37		4	—	—	—	1	—	—	—	1	1	2	9
	36		12	1	1	8	1	—	—	2	7	7	14	53
	35		4	2	1	6	—	1	—	1	10	5	5	35
	34		8	4	3	9	4	4	2	10	27	13	8	92
	33		2	4	—	—	2	2	9	3	8	3	1	32
	32		36	1	2	—	2	1	10	7	3	2	—	28
	31		18	—	—	—	—	—	4	1	1	—	—	6
	30		40	—	—	—	1	—	—	—	—	—	—	1
	29		4	—	—	—	—	—	—	—	—	—	—	—
	28	1	2											
Total		102	34	7	7	27	8	8	25	24	57	31	31	259
Mean		30.9	35.1	34.6	33.9	35.0	33.3	33.6	32.4	33.4	34.2	34.5	35.4	34.3
Dorsal rays ¹	12		6	1	1	—	—	—	—	2	2	1	4	11
	11	1	74	21	5	7	25	10	24	22	48	27	43	255
	10		3	—	—	—	1	1	1	2	6	1	6	19
Total			83											285
Mean			11.0											11.0

¹ For additional counts, see Hubbs (1930, p. 42).

TABLE 2
LATERAL LINE SCALES PLUS PECTORAL RAYS IN *Hypentelium*

Drainage and States	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	Total	Mean
<i>Hypentelium ro-anokense</i> , Roanoke, Va.	1	3	10	18	26	21	18	6	—	—	—	—	—	—	—	—	—	—	—	103	72.1
<i>Hypentelium nigricans</i> , Roanoke, Va.	—	—	—	—	—	—	—	—	—	1	2	3	6	8	11	2	1	—	—	34	80.9
Atlantic, south of Roanoke, N. C. and S. C.	—	—	—	—	—	—	—	—	—	—	—	2	—	4	—	1	—	—	—	7	80.7
Appomattox, Va.	—	—	—	—	—	—	—	—	—	2	2	—	2	—	1	—	—	—	—	7	78.9
James, Va. and W. Va.	—	—	—	—	—	—	—	—	—	—	1	1	5	7	3	4	3	1	1	26	81.7
Rappahannock, Va.	—	—	—	—	—	—	—	—	1	1	—	4	—	2	—	—	—	—	—	8	78.9
Potomac and upper Chesapeake, Va., Md.	—	—	—	—	—	—	—	—	—	—	1	3	2	2	—	—	—	—	—	8	79.6
Susquehanna, N. Y.	—	—	—	—	—	—	—	—	3	4	6	7	2	3	—	—	—	—	—	25	78.4
Lake Ontario, N. Y.	—	—	—	—	—	—	—	1	—	—	5	6	7	3	—	2	—	—	—	24	79.8
Ohio (except New & Tenn.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. Y., Pa., Ohio, W. Va., Ill.	—	—	—	—	—	—	—	—	1	—	1	10	16	14	8	3	3	—	—	56	80.6
New, Va., W. Va., N. C.	—	—	—	—	—	—	—	—	—	—	1	—	5	6	9	6	2	2	—	31	81.7
Tennessee, Va., N. C.	—	—	—	—	—	—	—	—	—	—	—	—	1	5	8	6	7	3	1	31	82.9
TOTAL (all <i>nigricans</i>)	—	—	—	—	—	—	—	1	5	8	19	36	46	54	40	24	16	6	2	257	80.8

and gave personal assistance and encouragement on a recent visit to the United States National Museum. Dr. Henry W. Fowler made available Cope's Roanoke specimens and otherwise assisted us when at the Academy of Natural Sciences of Philadelphia, (A.N.S.P.) Pennsylvania. Dr. C.M. Breder, Jr., Curator of Fishes, the American Museum of Natural History (A.M.N.H.) has given valued suggestions. A grant from the Trustee-Faculty Research Committee, Cornell University, Ithaca, New York, defrayed a large part of the cost of the field work. Specimens labeled C.U. are in the Fish Collection of Cornell University.

RANGE AND RELATIONSHIPS

Heretofore but two species of *Hypentelium* have been generally recognized; *nigricans*, a wide-ranging species, is known from southern Minnesota through the en-

tire Mississippi River and Lake Michigan drainages of Wisconsin, the lower peninsula of Michigan, southern Ontario, and New York; south to Georgia on the east side of the Appalachians; to the Tennessee River system of Georgia and Alabama, to the Gulf slope of Mississippi and to southwestern Arkansas and eastern Oklahoma (see Hubbs and Lagler, 1941, p. 42, and Hubbs, 1945, p. 14). According to Hubbs (1930, p. 43) *nigricans* appeared to be fairly consistent in its systematic characters throughout its range. Counts made during the course of this study of specimens in the United States National Museum and Cornell University Fish Collection have shown some slight variation, none of which is considered to be of the level of subspecific differentiation. Some of these minor differences in scale and fin counts are given in tables 1 and 2. Scattered local popula-

tions sometimes show variations in fin length. The pectorals and anal are most variable, a character complicated somewhat since adult males have longer anal fins (see Raney and Lachner, 1946b, p. 77). Some populations, especially those in eastern Maryland, have light and dark streaks better developed along the sides of the body. Other *nigricans* differ in the size and degree of inferiority of the mouth. Some variation in color was noted; there is a tendency for the body to be more coppery in some localities. Interestingly, those *nigricans* found just across the watershed in the mountain headwaters of the James, New, and Tennessee river systems in Virginia and North Carolina have more scales and pectoral rays, an opposite trend from *roanokense*. Further studies are needed on the geographical variation of *nigricans*, particularly those from the Atlantic waters of North Carolina, South Carolina, and Georgia.

Hypentelium etowanum (Jordan), described and known only from the Alabama River system, was considered a subspecies by Jordan (1877, p. 346; 1878, pp. 159, 162) and Fowler (1945, pp. 24, 338). Hubbs (1930, p. 43) regarded *etowanum* as a full species since no evidence of intergradation was found. It is separated on the basis of 10 dorsal rays (rather than 11), red lower fins, and differences in general physiognomy. No new information is available on this species. The few specimens of *Hypentelium* which we have seen from streams south of the Roanoke River system, other than the Alabama system, have been typical *nigricans*.

The new species, *roanokense*, is limited to the headwater streams of the Roanoke River system. *H. nigricans* also occurs in the Roanoke but generally is found in the larger streams. However, both species were taken together at five localities; *roanokense* alone was collected at 13 places, and *nigricans* was obtained at six other localities. When taken together or alone each species could be separated by a glance, and no hybrids were noted. Only 34 specimens of *nigricans* are available compared with 103 of *roanokense*. Neither species appears to be as common as does *nigricans*

in more northern and western drainages. In 15 collections *roanokense* was taken in small creeks and in three cases in the headwaters of rivers, the Roanoke and North Mayo. During the greater part of the summer these rivers are relatively small streams. On the other hand *nigricans* was secured in rivers in six cases and in small streams five times. In all collections except one where the two species occurred together, *roanokense* was more common; in this single case one specimen of each was collected. Detailed distribution as represented by available specimens of *roanokense* and *nigricans* within the Roanoke River system is shown on the map (fig. 2). A detailed study of the ecology and breeding behavior of these species where they occur together would be most illuminating.

A study of the available specimens indicates a close relationship between *nigricans* and *etowanum*. On the other hand *roanokense* has probably evolved from *nigricans* stock but is fully differentiated and may be easily separated. Many of the differences are given in table 3. A few others were observed in a comparison of the two species when taken together. For example *roanokense* has a broader head and snout; more dark pigment in the anal fin; generally darker ground color on body; longer pectoral fins; and in adults, the anal fin reaches far beyond the end of the hypural while it barely reaches the hypural in *nigricans*.

KEY TO THE SPECIES OF *Hypentelium*

- 1A. Dorsal fin rays 10. More highly colored in life; lower fins red, basal part of dorsal fin orange, snout reddish, lips orange. Range: Alabama River system..... Alabama hog sucker, *Hypentelium etowanum* (Jordan)
- 1B. Dorsal fin rays 11. Colors generally dull; lower fins light orange or brown, snout and lips dusky or light but not orange..... 2A
- 2A. Posterior fontanelle reduced to a slit. Air-bladder reduced in length and thin. Lateral line scales 41. Pectoral fin rays 31. Lateral line scales plus pectoral fin rays 72.

TABLE 3

COMPARISON OF SOME CHARACTERS OF *Hypentelium roanokense* AND *Hypentelium nigricans*
(*Hypentelium etowanum* may be distinguished on basis of 10 dorsal rays, rather than 11, and red lower fins)

SPECIES	<i>roanokense</i>	<i>nigricans</i>
Posterior fontanelle	Reduced to a slit	Large, rectangular
Air-bladder	Reduced in adults; posterior lobe short and thin	Not reduced radically
Size	Dwarf, largest female 125 mm. (4.9 in.) total length; largest male 105 mm. (4.1 in.) (Table 6)	Larger (see Raney and Lachner, 1946, for growth study)
Scales in lateral line	Larger; 38-44 (mean 41.4)	Smaller; 44-50 (mean 46.4)
Pectoral fin rays	Fewer; 28-33 (mean 30.9)	More; 30-38 (mean 34.3)
Lateral line scales plus pectoral rays	Fewer; 68-75 (mean 72.1)	More; 75-86 (mean 80.6)
Dark saddle between origin of dorsal and occiput	Obsolescent, not crossing midline of back	Well developed, although broken into spots in some large adults
Alternating longitudinal light and dark streaks		
1. Along the sides	Prominent	Missing or poorly developed
2. On the back	Developed	Absent
Coloration of snout	Dusky with overlying irregularly shaped dark markings	Dusky, more or less evenly pigmented
Mouth	Larger and less inferior	Smaller and more inferior
Lips	Coarsely papillose on outer edges, subpiculate on inner	More finely papillose
Caudal fin	Shorter with shallow fork	Longer and more deeply forked
Anal and dorsal fins	Longer	Shorter
Caudal peduncle depth	Less deep (see table 5)	Deeper
Eye (progressively smaller in relation to head length in large specimens)	Smaller	Larger

Dark saddle before dorsal fin obsolescent, not crossing midline of back. Lips subpiculate on inner edge. Light streaks developed along scale rows on back. Dwarf species; largest specimen 6 inches. Range: Upper Roanoke River system, Virginia.....
.....Roanoke hog sucker, *Hypentelium roanokense*, new species

2B. Posterior fontanelle large and rectangular. Air-bladder normal. Lateral line scales 46. Pectoral rays 34. Lateral line scales plus pectoral fin rays 81. Dorsal saddle before dorsal fin well developed; crosses midline of back. Lips papillose on inner edge. Lacks light streaks on scale rows on back. Reaches a length of 14.5 inches. Range: Widespread in North America; occurs in the Roanoke River

system but not in the Alabama River system.....
.....Common hog sucker, *Hypentelium nigricans* (LeSueur)

MATERIAL

The holotype (A.M.N.H. No. 17025) is a breeding male 63 mm. standard length collected by Edward C. Raney, Ernest A. Lachner, and Roman A. Pfeiffer on April 3, 1941, in Horse Pasture Creek, at U. S. Highway 58 crossing, 1.5 miles northeast of Spencer, Henry County, Virginia; the paratypes, not differing from the holotype in any essential characters, are listed below. All are from the Roanoke River system, Virginia.

TRIBUTARIES OF DAN RIVER

Henry County: C.U. No. 9580: 1 female 64 mm. long, taken by Raney, Lachner, and Pfeiffer, on April 3, 1941, in Leatherood Creek, 10 miles west southwest of Callands. U.M.M.Z. No. 143184: 4 males and 7 females 49 to 59

mm. standard length, collected by Carl L. Hubbs and E. P. Creaser, on May 17, 1931, in North Mayo River at Virginia Highway 12 (with 5 *nigricans*). C.U. No. 10495: 1 female 117 mm., collected by Raney, Lachner, and R. D. Ross, on June 22, 1946, in Beaver Creek, 1.5 miles northwest of Martinsville.

Patrick County: C.U. No. 9555: 1 female 64 mm., taken by Raney, Lachner, and Pfeiffer, on April 3, 1941, in Anglin Creek, 1 mile west of Patrick Springs. U.S.N.M. No. 104029; 1 male 51 mm., secured by Leonard P. Schultz and Earl D. Reid, on June 13, 1937, in Spoon Creek, 3 miles south of Critz on route 58. C.U. No. 10490: 3 males and 2 females 50 to 75 mm., collected by Raney, Lachner, and Ross, on June 22, 1946, in Spoon Creek, 2 miles south of Critz (with 1 *nigricans*). C.U. No. 10486: 7 males and 6 females 41 to 104 mm., taken by Raney, Lachner, and Ross, on June 22, 1946, in branch of North Mayo River, 1.7 miles south of Stella and 5 miles west of Spencer (with 1 *nigricans*). C.U. No. 10482: 19 males and 20 females 56 to 105 mm., taken by Raney, Lachner and Ross, on June 23, 1946, in Peters Creek, 6.5 miles southwest of Stuart.

ROANOKE RIVER AND TRIBUTARIES

Appomattox County: U.S.N.M. No. 100170: 1 female 48 mm. long, taken by S. Abraham, in Cub Creek (East Branch).

Bedford County: C.U. No. 10485: 1 female 101 mm., collected by Raney, Lachner, and Ross, on June 21, 1946, in Elk Creek, 10 miles west of Lynchburg. C.U. No. 10496: 2 males and 2 females 55 to 79 mm., collected by Raney, Lachner, and Ross, on June 21, 1946, in Goose Creek, 4 miles west of Thaxton.

Campbell County: C.U. No. 10488: 1 male 88 mm., taken by Raney, Lachner, and Ross, on June 20, 1946, in Little Falling River, 4 miles west of Redhouse (with 1 *nigricans*).

Charlotte County: C.U. No. 10483: 2 males 59 to 60 mm., collected by Raney, Lachner, and Ross, on June 20, 1946, in Cub Creek, 3.5 miles west of Madisonville.

Franklin County: C.U. No. 10484: 1 male and 2 females 78 to 102 mm., collected by Raney, Lachner, and Ross, on June 22, 1946, in north branch Chestnut Creek, 5 miles south of Rocky Mount.

Montgomery County: C.U. No. 10492: 4 males and 11 females 44 to 108 mm., seined by Raney, Lachner, and Ross, on June 22, 1946, in Roanoke River, 2 miles north of Allegheny Springs (with 11 *nigricans*).

Pittsylvania County: C.U. No. 8432: 1 female 107 mm. long, collected by Raney and Lachner, on April 7, 1940, in Sycamore Creek, 2.5 miles southwest of Alta Vista.

Roanoke County: U.S.N.M. No. 103980: 2 females 69 and 74 mm. long, taken by Schultz and Reid, on June 18, 1937, in Roanoke River at Bennett's Mills.

Collections of *Hypentelium nigricans* not

taken with *roanokense* in the Roanoke River system, Virginia, and used in the comparisons and data given in tables 1 to 4 and plotted on figure 2 are listed below:

C.U. No. 5969: 1 adult female 180 mm. long, secured by Raney, Lachner, and Pfeiffer, on April 3, 1941, in the headwaters of the Dan River, 2 miles northwest of Vesta, Patrick County. U.M.M.Z. No. 95333: 7 juveniles 51 to 71 mm. long, collected by Hubbs and Creaser, on May 16, 1931, in Tinker Creek, just north of Cloverdale, Botetourt County. C.U. No. 10494: 3 juveniles 72 to 86 mm., seined by Raney, Lachner, and Ross, on June 21, 1946, in a tributary of Tinker Creek, at Blue Ridge, Botetourt County. U.M.M.Z. No. 95406: 1 yearling 47 mm., collected by Hubbs and Creaser, on May 17, 1931, in Blackwater River, north of Rocky Mount and 1 mile south of Gogginsville, Franklin County. U.M.M.Z. No. 95334: 2 immature males 65 and 68 mm. long, taken by Hubbs and Creaser, on May 16, 1931, in Roanoke River, near Salem, Roanoke County. C.U. No. 8354: 1 immature female 86 mm. long, secured by Crosswell Henderson, in October, 1940, in Roanoke River, near Roanoke, Roanoke County.

DESCRIPTION

Many of the characters of *roanokense* are shown in figure 1. Additional descriptive characters appear in the key and discussion of relationships given above. Data on counts and measurements are recorded in tables 1 to 6. Further descriptive items based on the holotype and 102 paratypes which are similar in character to the holotype follow. Unless specifically noted counts and measurements were made in a manner described by Hubbs and Lagler (1941, pp. 12-20).

The scales are larger than in other *Hypentelium*. Lateral line scales of holotype 42; of paratypes 38 to 44, mean 41.4; scales above lateral line to origin of dorsal 7, in paratypes 6 to 8, mostly 7; scales below lateral line to origin of anal 6, in paratypes 5 and 6, mostly 6, scales around caudal peduncle 16. Dorsal fin rays 11, in paratypes 10 to 12, mostly 11; caudal rays 18 in all; anal rays 7 in all. Pelvic rays 9-9 (left-right) which is the usual number. Some variation occurred among the paratypes as follows: one with 8-8, two with 8-9, four had 9-8, 63 with 9-9, one had 10-9, and one had 10-10. In *nigricans* the pelvises are almost always 9-9 but with

TABLE 4

CORRELATION DIAGRAM OF LATERAL LINE SCALES AND TOTAL NUMBER OF PECTORAL FIN RAYS OF *Hypentelium* FROM THE ROANOKE RIVER SYSTEM, VIRGINIA
(*nigricans* in italics in upper right-hand corner, *roanokense* in lower left-hand corner)

Lateral line scales	TOTALS	—	—	—	—	1	4	8	4	12	4	1	—	34
	3	4	40	18	36	2	—	—	—	—	—	—	103	—
48	—	—	—	—	—	—	—	—	—	1	—	—	—	1
47	—	—	—	—	—	1	3	2	—	—	—	—	—	6
46	—	—	—	—	1	2	3	2	—	6	2	—	—	16
45	—	—	—	—	—	—	1	—	—	3	2	—	—	6
44	—	—	4	1	—	1	1	—	—	2	—	1	5	5
43	—	—	5	5	5	—	—	—	—	—	—	—	15	—
42	1	—	14	3	7	—	—	—	—	—	—	—	25	—
41	1	2	10	3	14	1	—	—	—	—	—	—	31	—
40	1	2	7	6	6	—	—	—	—	—	—	—	22	—
39	—	—	—	—	3	1	—	—	—	—	—	—	4	—
38	—	—	—	—	1	—	—	—	—	—	—	—	1	—
	28	29	30	31	32	33	34	35	36	37	38		TOTALS	

Pectoral fin rays

TABLE 5

PROPORTIONAL MEASUREMENTS OF *Hypentelium* FROM THE ROANOKE RIVER SYSTEM, VIRGINIA
(Mean and range values are given)

Species	<i>Hypentelium roanokense</i>		<i>Hypentelium nigricans</i>
Specimens	Holotype	20 Paratypes	17 Specimens
Standard length in mm.	63	48-107	47-197
In standard length			
Predorsal length	2.1	2.1 (2.0-2.2)	2.1 (2.0-2.1)
Dorsal origin to occiput	4.1	4.1 (3.7-4.4)	4.0 (3.5-4.3)
Body depth	4.7	4.9 (4.1-5.4)	5.0 (4.6-5.4)
Body width	5.3	5.6 (4.1-6.5)	5.7 (5.0-6.1)
Caudal peduncle length	6.0	6.2 (5.5-7.1)	6.0 (5.6-6.5)
Anal fin length ¹	3.8	4.3 (3.7-5.2)	5.2 (4.3-6.1)
Dorsal fin length	3.4	3.5 (3.3-4.1)	3.9 (3.6-4.8)
Head	3.7	3.7 (3.4-3.9)	3.6 (3.4-3.9)
In head			
Snout length	2.0	2.0 (1.9-2.3)	2.0 (1.8-2.2)
Bony interorbital	3.1	3.1 (2.8-3.5)	3.1 (2.6-3.4)
Pectoral fin length	1.1	1.2 (1.0-1.3)	1.2 (1.1-1.4)
Pelvic fin length	1.3	1.5 (1.3-1.7)	1.6 (1.4-1.9)
Dorsal fin origin to lateral line	2.1	2.1 (1.9-2.5)	2.2 (2.0-2.5)
Pelvic fin origin to lateral line	2.7	2.7 (2.0-3.2)	3.1 (2.9-3.7)
Caudal peduncle depth	3.6	3.4 (3.0-4.0)	3.1 (2.9-3.5)
Head depth at occiput	1.6	1.6 (1.4-1.7)	1.6 (1.5-1.7)
In snout			
Eye	2.1	2.2 (1.9-2.9)	2.3 (1.9-3.9)
In distance from pectoral fin origin to pelvic fin origin			
Pectoral fin length	1.1	1.1 (1.0-1.3)	1.2 (1.0-1.5)
In distance from occiput to origin of dorsal fin			
Dorsal fin length	0.9	0.9 (0.8-1.1)	1.0 (0.9-1.1)

¹ Length of all fins measured from the origin to the posterior tip of the longest or last ray, whichever distance was greater.

about the same degree of variation as noted above for *roanokense*. The pectoral fin rays are reduced in *roanokense*, the holotype having 14-14 (28); the paratypes vary from 14-14 to 16-17 with a mean total value of 30.9 pectoral rays. Table 4 is a correlation diagram showing the relationship between the reduction in lateral line scales and number of pectoral rays in *roanokense* and *nigricans* from the Roanoke system.

Various proportional measurements of the holotypes and paratypes are given in table 5. The body is heavy and foreshortened forward, giving it a stockier and more terete appearance than *nigricans*. The ventral contour is horizontal except at the base of the anal fin where it slopes abruptly upward but levels out again along the caudal peduncle and parallels the dorsal surface. At the snout the dorsal contour is rather less abrupt than in *nigricans*, rises evenly from the concave region between the eyes to a point at or before the dorsal, hence decreases abruptly and again levels off near the posterior base of the anal fin. The dorsal fin is large, its posterior margin reaching a vertical from the origin of the anal fin in the holotype. All the lower fins are also large; the pectoral almost reaches the pelvic origin in the holotype and exceeds this point in many paratypes. The pelvic fin reaches the base of the anal papilla. The anal fin is very large and reaches the last small scales extending out on the base of the caudal fin. The size is small; the largest specimen is a female 117 mm. in standard length.

Among the modifications for life in small swift streams other than the short heavy body is the reduction in the size of the air-bladder in adults. It is in two parts; the posterior half is small and thin, occupying a position far forward in the body cavity. Compared with small specimens (50 mm. standard length) of *nigricans* the posterior lobe of the bladder is only slightly shorter but is much thinner. In large adults of *roanokense* the difference in comparative length of the air-bladder is notable. The posterior fontanelle is reduced to a slit which usually may be seen through the skin of the head just anterior to the nape. In

nigricans the posterior fontanelle is relatively large and rectangular. The parallel development undergone by *roanokense* and the two species of *Thoburnia*, other suckers found in a similar habitat in mountain streams of Virginia, in regard to the above two characters is most striking. Characters of *Thoburnia* have been studied by Hubbs (1930, p. 44) and Raney and Lachner (1946c).

The mouth is relatively large and less inferior than in *nigricans*. The lips, especially the upper, are modified in adults. They are coarsely papillose on the outer border, but plicate on the inner edge. This is one of the strongest differences noted, since the lips in *nigricans* have smaller papillae and show no tendency toward plicae formation.

The body is rather sharply bicolored with the dark background of the back extending about one and one-half scale rows below the lateral line. Each scale has a narrow longitudinal light area through the middle. These line up to produce a pronounced longitudinal streaking of alternating light and dark. It is observable on the back in front and behind the dorsal. Some populations of *nigricans* have these light streaks along the sides, and, according to Jordan (1877, p. 346), they are also an outstanding feature of *etowanum*. In neither of these species are the light streaks developed on the back.

Four dark saddles cross the back. The first and broadest is at about the middle of the dorsal fin, the next is just posterior to the dorsal fin base, the third is a little anterior of a point midway between the dorsal base and the base of the caudal, and the last is a narrow one just anterior of the caudal base. No saddle crosses the back between the occiput and the dorsal fin origin, a character which *nigricans* possesses. The remains of this saddle are present along the side. After crossing the back the saddles are inclined forward and finally are expanded laterally into a broad dark band broken by small light areas. The occiput is outlined in black.

The background color of the head is dusky with additional dark irregular blotches. They cover the snout and side of

head just below the eye. The opercle, above and in front, is dark with overlying darker blotches. The dorsal aspect of the pectoral and pelvic fins is irregularly and rather sparsely speckled with dark. The middle rays of the anal fin are dark. The dark in the middle of the dorsal fin mostly coincides with the location of the dark saddle on the back. The dorsal fin rays are also dusky near the edge in some. The scales on the posterior caudal peduncle overlying the hypural plate are dusky, but the last row of small scales at the base of the fin is light. The caudal fin membranes are dusky near the base. This dark tends to run out to the edge of the fin in the more dorsal and ventral rays and meets a faint darkish band edging the fin. The area in the middle of the fin is relatively light. The life colors of an adult paratype collected in Spoon Creek, 2 miles south of Critz, Patrick County, on June 22, 1946, are as follows. Dorsal half of body and head brown crossed by black saddles. Lower sides and belly white. Pectoral, ventral, and anal fins light orange. Caudal fin with light copper near base. Dorsal with dusky streak. Iris brown. In Peters Creek, 6.5 miles southwest of Stuart, Patrick County, 39 paratypes were taken in red silt-laden water. These specimens were copper colored dorsally where *roanokense* is normally brown or blackish.

There is no sexual dimorphism in coloration, but some other differences are noted. Adult males, although smaller than females, have all fins longer. The difference in size of the anal fin is most notable, and two individuals of the same size but opposite sexes may be separated at a glance. In mature males the length of the anal fin goes into the standard length from 3.5 to 4.0 (mean 3.6) times rather than 3.7 to 4.1 (mean 4.0) times. The pelvic fin length into standard length is 4.5 to 5.2 (mean 5.0) compared to 5.2 to 5.9 (mean 5.6) in females. The difference in the dorsal, pectorals, and caudal is a little less than that for the other fins. The holotype, a breeding male only 63 mm. in standard length, is covered with pearl organs. They are strongest on the anal and caudal fins where a row of strong conical tubercles lies laterad

of each fin ray; those on the lower half of the caudal are larger than those placed more dorsally. Smaller tubercles line the rays on the upper side and a few are seen underneath the pectoral and pelvic fins, and still smaller ones are present on the dorsal fin. Small pearl organs cover the head and dorsal aspect of the body. Ventrally they become more scarce. The females also have smaller pearl organs on the same parts of the body. They are particularly well developed on the head and anterior body and form a fine shagreen which is rough to the touch.

The scales are similar to, but slightly more elongate than, those of *nigricans* which have been described and figured by Raney and Lachner (1946b, p. 80). The pharyngeal arch is moderately curved with a single row of teeth numbering about 40-40 in one paratype. The base of the arch is about twice as broad as high. The teeth are comb-like, each with a broad base which narrows until gradually at one-third of its length the two edges are parallel. Each tooth widens abruptly near the distal edge. The teeth are about three times as high as wide rather than four to five times in *nigricans*. The edges appear to be slightly more raptorial with a rather sharp point on one border and with a long, relatively sharp grinding surface. They are not molariform, although those near the symphysis of the arches are most sturdy and somewhat rounded.

In an adult paratype the gill rakers are 9 + 10, counting all rudiments. We count a few more in *nigricans*, but no detailed study was made on the variation in this character. The largest developed gill rakers near the center of the arch go about 1.7 times in the longest gill filaments. Each outer gill raker on the first arch is triangular in shape with the outer edge the longest leg. The shorter leg is attached to the gill bar. The inner side has a row of six to eight fleshy papillae and is covered with smaller fleshy tubercles which are larger and more numerous than in *nigricans*.

AGE AND GROWTH

The dwarf character of this species as compared to *nigricans* is demonstrated by a

TABLE 6

LENGTH FREQUENCIES FOR EACH AGE GROUP OF *Hypentelium*
FROM THE ROANOKE RIVER SYSTEM, VIRGINIA
(Included are all *Hypentelium* taken in the Roanoke, numbering
103 *roanokense*, all types, and 34 *nigricans*)

Age in Years	I				II				III		IV		V		VI	VII
	<i>roano- kense</i>		<i>nigri- cans</i>		<i>roano- kense</i>		<i>nigri- cans</i>		<i>roano- kense</i>		<i>roano- kense</i>		<i>ro- ano- kense</i>	<i>nigri- cans</i>	<i>nigri- cans</i>	
Species																
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♀	♀	♂	♀
Total length in mm.	280	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
	240	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	215	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
	160	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
	155	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
	140	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
	135	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
	130	—	—	—	—	—	1	1	—	—	—	2	—	—	—	—
	125	—	—	—	—	—	—	—	1	—	—	2	1	—	—	—
	120	—	—	—	—	1	—	—	1	—	—	1	1	—	—	—
	115	—	—	—	—	1	—	—	1	—	—	—	1	—	—	—
	110	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—
	105	—	—	1	1	1	—	—	—	—	—	1	—	—	—	—
	100	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—
	95	—	—	1	—	3	—	—	1	—	1	1	—	—	—	—
	90	—	—	1	1	2	3	—	—	—	—	—	—	—	—	—
	85	—	—	1	1	6	7	—	—	—	—	—	—	—	—	—
	80	1	—	3	3	3	6	—	—	—	—	—	—	—	—	—
	75	1	—	—	4	8	4	—	—	—	—	—	—	—	—	—
	70	6	1	1	1	4	—	—	—	—	—	—	—	—	—	—
	65	4	7	1	2	1	—	—	—	—	—	—	—	—	—	—
	60	4	7	1	3	—	—	—	—	—	—	—	—	—	—	—
	55	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	16	17	10	16	25	26	3	2	1	4	3	9	2	1	1	1
Range	63- 81	57- 71	62- 105	60- 105	66- 105	75- 120	132- 160	130- 139	—	110- 125	90- 100	97- 140	124- 127	—	—	—
True Mean	68.1	63.1	82.3	76.0	80.1	88.4	149.0	134.5	95.0	118.8	96.3	120.7	125.5	215	240	280

study of the age, based on an examination of the scales, of available specimens. The data are given in table 6. Total length is used to make the information comparable to growth data for *nigricans* from other localities published elsewhere by Raney and Lachner (1946b, p. 82). Total length may be converted to standard length by multiplying total length by 0.81, and, conversely, standard length converted to total by multiplying by 1.23. Even though only a few specimens of *nigricans* in the higher age groups are available from the Roanoke, the data show the main growth trend to be like that of *nigricans* elsewhere.

On the other hand *roanokense* always grows more slowly and by the end of the second year has fallen far behind. Figure 3 shows this striking difference when the growth rate of *roanokense* is compared with that of *nigricans* from the Genesee River in New York.

Most males mature at two years of age. However, two mature males only one year old and 71 mm. total length, with well-developed nuptial tubercles, were examined in a collection taken in North Mayo River, Henry County, on May 17, 1931. One other male one year of age in the same collection was not sexually mature, as revealed

by an examination of the testes, although some breeding tubercles were present. The scales revealed that coincident with attainment of maturity in its third summer the growth of the male is relatively slow. Until this time males grew slightly faster and reached a larger average size. However, during the third summer of life the females grow faster, overtake the males, then mature and spawn when three years old. In age groups 3, 4, and 5 only four males as compared with 15 females were found. This trend indicates a differential death rate which, although based on few data, is probably significant. It parallels the situation existing in *Thoburnia rhothoea*, as reported by Raney and Lachner (in press).

HABITAT

The type locality, Horse Pasture Creek, 1.5 miles northeast of Spencer, Henry County, Virginia, is a shallow open stream about 15 feet wide with a rather unstable sand bottom which is constantly shifting. Although white in color the water carries a rather heavy load of sand and fine silt

which gives it a slightly turbid appearance. The current was moderate and the flow about 20 cubic feet per second on April 3, 1941. The other species taken here were *Catostomus c. commersonnii*, *Nocomis leptocephalus*, *Notropis cerasinus*, and *Ambloplites rupestris rupestris*.

Most paratypes were taken in small streams, usually under 25 feet in width, although they are not uncommon in the upper reaches of the Roanoke River. In many cases the bottom of the streams was of shifting sand with little or no gravel. In these situations cover was furnished by logs, leaves, and detritus. Peters Creek, 6.5 miles southwest of Stuart, Patrick County, yielded most specimens (39 were obtained in one hour's seining) and easily outnumbered any other species present. This stream is a rather swiftly flowing mountain brook only 10 feet wide with mostly sand bottom but also with considerable loose rubble and gravel in the riffles. It carried a heavy load of red silt and the *roanokense* were quite red, more so than at any other locality.

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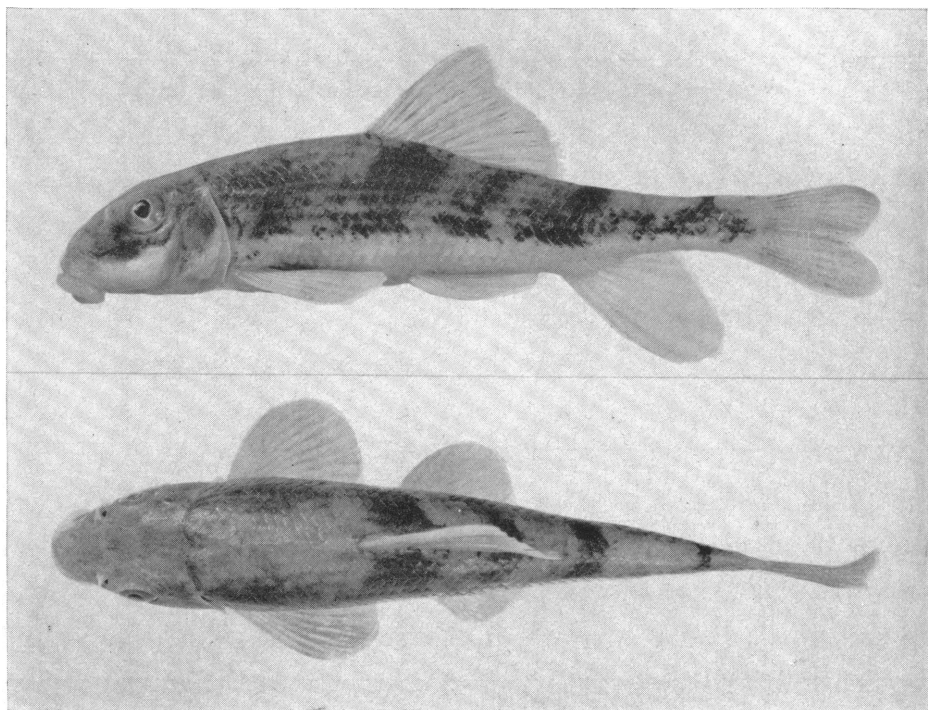


Fig. 1. *Hypentelium roanokense*, new species. Holotype, an adult male, 63 mm. in standard length, collected by Edward C. Raney, Ernest A. Lachner, and Roman A. Pfeiffer, on April 3, 1941, in Horse Pasture Creek, at U. S. Highway 58 crossing, 1.5 miles northeast of Spencer, Henry County, Virginia. Photographed by Art Smith.

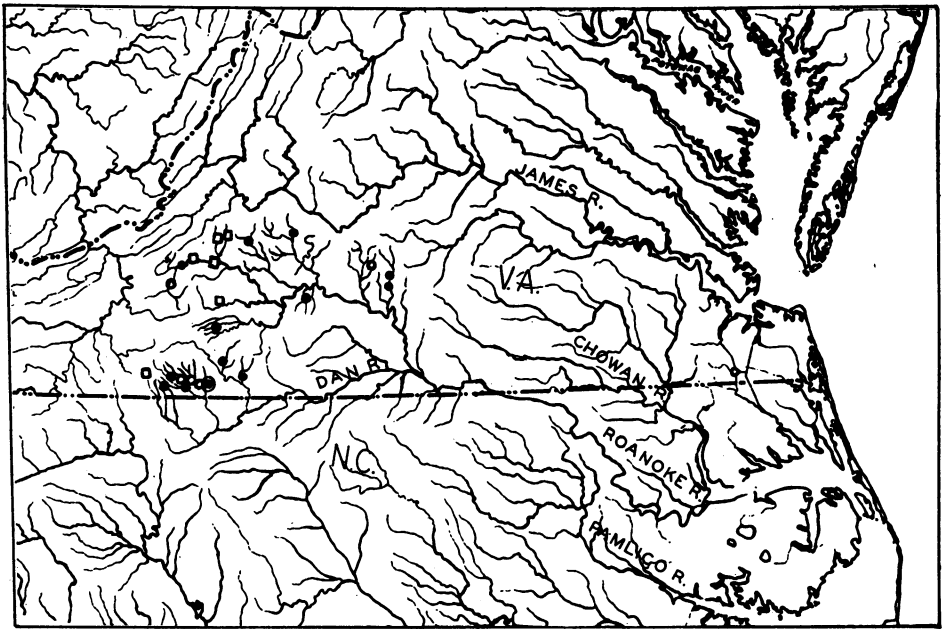


Fig. 2. Record stations for *Hypentelium* in the Roanoke River system, Virginia. A solid circle indicates *roanokense* (the type locality, Horse Pasture Creek, 1.5 miles northeast of Spencer, Henry County, is encircled), a hollow circle records both *roanokense* and *nigricans* taken together, and a hollow square marks localities where *nigricans* alone was collected.

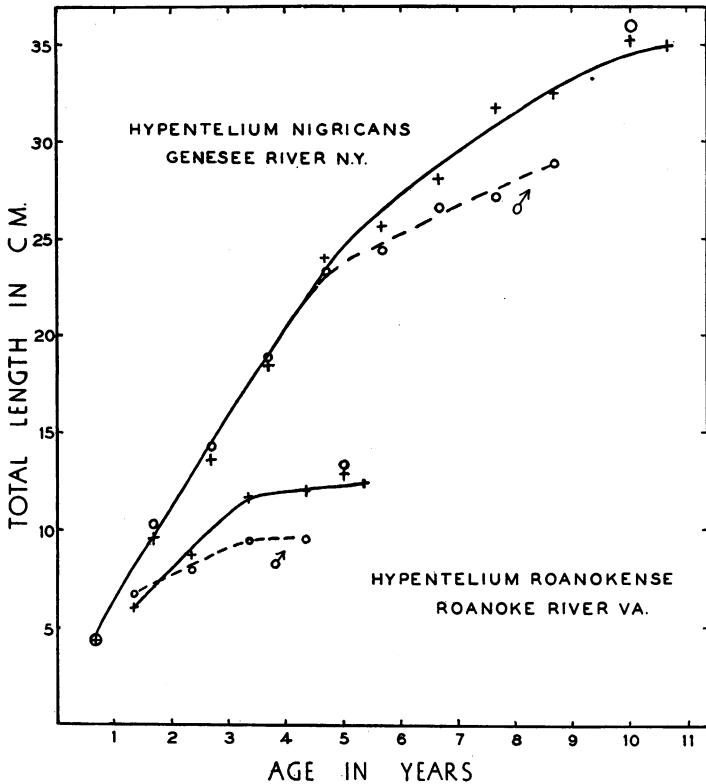


Fig. 3. Growth curves of *Hypentelium* illustrating the dwarf character of *roanokense*. Mean values for each age class are marked with a hollow circle for males and a cross for females. The upper curve of *Hypentelium nigricans* is based on a sample of 181 specimens secured in the Genesee River, 4 miles south of Wellsville, Allegheny County, New York, on August 12-16, 1940 (see Raney and Lachner, 1946b, p. 84). The lower curve of *Hypentelium roanokense* represents 103 specimens, all types, collected in the Roanoke River system, Virginia (see table 6). The available specimens of *Hypentelium nigricans* from the Roanoke fit the upper curve fairly closely.

