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Author(s): Edward C. Raney

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## Subspecies and Breeding Behavior of the Cyprinid Fish *Notropis procne* (Cope)

By EDWARD C. RANEY<sup>1</sup>

THE northern swallowtail shiner, *Notropis procne procne* (Cope), is a small species that apparently reaches its northern limit in Catherine Creek, the inlet of Seneca Lake, Lake Ontario drainage, New York. Its presence here has been attributed by Greeley (1928: 98) to a former canal connection with the Susquehanna system to the south. The use of the southern outlet of glacial Seneca Lake in the late Pleistocene is here considered an equally valid possible explanation. It is also found in the Delaware and Susquehanna of New York and ranges southward in Atlantic Coast streams to the James River in Virginia. It is represented from the Roanoke River system in Virginia southward to the Santee drainage in South Carolina by *Notropis procne longiceps* (Cope).

A detailed diagnosis of *procne* and related species has been prepared by Hubbs and Raney (1947). A key to the subspecies of *procne* appears below. Most of the differences are only average ones but the two usually can be separated by the summation of characters.

- 1a. Body deeper, body depth about equal to head length. Head deeper, depth at occiput when measured forward from posterior border of eye reaches beyond tip of snout. Body pigmentation generally darker; in breeding dress, body light straw color with light yellow fins; no dark pigment flecks laterad of deep seated melanophores along base of anal fin; dark lateral band wider anteriorly; darker on midline of back below posterior half of dorsal fin; more pigment on upper lip and snout as viewed from below. Snout averages shorter, slightly shorter than eye. Maxillary reaches to or beyond a vertical from front of eye. Mouth slightly sloping posteriorly but almost horizontal anteriorly, appearing slightly hooked in breeding adults, usually reaches a level between the orbit and the lower edge of the pupil. Mouth more inferior. Lower jaws somewhat pointed at symphysis. There is no difference in head length; it enters the standard length 4.0 times in both subspecies. *Notropis procne procne* (Cope), northern swallowtail shiner.
- 1b. Body more depressed, depth of body much less than head length. Head shallower, depth at occiput when measured forward into distance from posterior margin of eye reaches tip of snout. Body lighter colored; at breeding season body is yellow with orange in pectoral fins; some pigment flecks scattered laterad of anal fin; narrower dark lateral band; dark mark on midline of back below last half of dorsal fin varies but generally is not well developed; less pigment on upper lip and lower border of snout. Snout slightly longer, usually equal to or longer than eye. Maxillary not reaching to a vertical from front of eye. Mouth slopes slightly upward, does not level off anteriorly, and usually reaches the level of the lower margin of the pupil. Mouth less inferior. Lower jaws rounded at symphysis. *Notropis procne longiceps* (Cope), southern swallowtail shiner.

Northward the typical subspecies is most often found in upland streams and small rivers, and is generally classified as uncommon. It also has been taken in two lakes of the Susquehanna drainage, New York (Greeley, 1936:

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82). To the south it becomes more abundant, especially in piedmont and mountain streams of Maryland, Virginia, and North Carolina. Its toleration of turbid water and sand bottom conditions, which usually exist in the piedmont streams, is good and here it is often found in large numbers. Its niche in the stream is usually in or near moderate riffles. A general avoidance of both the deeper pools and torrential rapids was noted. Most *procne* have been observed near the bottom in small schools.

#### SEXUAL DIMORPHISM

Sexual dimorphism is not pronounced in *procne*. The separation of the sexes would be difficult or impossible at other than the breeding season, since the slightly shorter pectoral and pelvic fins of the female are only average differences. The length of the first pectoral ray of the male when measured forward from the origin of the pectoral fin, reaches nearly to the front of the eye while in the female it goes to the middle of the eye. The pelvic fins of the male are longer; the longest ray reaches the orifice of the anal papilla posteriorly. In the female it barely reaches the anterior base of the protruding anal papilla and even in its extreme variation does not attain the orifice. The first ray of the anal fin of the male is much shorter than the first pectoral ray while in the female they are equal or subequal. The pectoral fins of the breeding male are further modified. They are thickened and bowed strongly outward at about the middle. The distal end is bent upward and inward. This modification along with the well developed breeding tubercles on the upper pectoral surface assists the male in grasping the female by a pectoral lock at spawning. In breeding condition preserved females can easily be recognized by the larger, rounded, and more protuberant anal papilla, the greater body depth due to the eggs, and by the relatively finer and fewer nuptial tubercles.

The tubercles are best developed on the top of the head of the male. They are moderately coarse, conical, and are rather evenly spaced over the top of the head with a somewhat more prominent ring about the upper eye. A similar type of tubercle is on the upper opercle with smaller ones on the lower opercle, cheek, lips, and underside of the head and breast. Relatively smaller ones also line the posterior margin of each scale. Those on the anterior sides and the back, in front of the dorsal fin, are larger than those on other scales. The upper surface only of the pectoral fin rays is covered by villiform tubercles which form a sandpaper-like surface. Fine tubercles also line the rays of both sides of the anal and dorsal fins and the upper surface of the ventral fins. The female possesses fewer and smaller tubercles on the head, body, and fins. Those on the head and body of the female are barely perceptible to the touch while in the male they are quite rough.

The lower lobe of the deeply notched caudal fin is rounded and shorter than the upper lobe. This is true only of spawning adults and is due to erosion as the breeding fish brush over the sand and fine gravel.

Living and freshly preserved males had a light yellow tinge to the pectoral, ventral, and dorsal fins. The body of both sexes was a light straw color. In water the males were darker and more active. Both sexes of the southern subspecies, *procne longiceps*, were much more yellow.

BREEDING BEHAVIOR

Nothing has been written concerning the breeding habits of *Notropis procne*. Fowler (1909: 533) predicted that "it probably spawns in late spring or early summer." This contention was given added weight when females with well developed eggs were found in the upper Susquehanna drainage near Willseyville, Tioga County, New York, on July 10, 1938. The breeding behavior was seen on June 18, 1946, in Covington River, a tributary of the Rappahannock River, 4 miles south of Washington, Rappahannock County, Virginia. Here the Covington River was a medium sized mountain stream of rather short pools and long and usually moderately swift riffles which varied in width from 30 to 50 feet. The water was white and clear and the flow was approximately 50 cubic feet per second. Vegetation was sparse and mostly limited to algae. The bottom was largely rubble and gravel but occasionally there was considerable sand and silt, especially in the deeper pools. Fish were generally common and 13 species and one hybrid were collected. Other than *Notropis procne procne* the following were obtained: *Notropis analostanus* (Girard), many in high breeding color with well developed nuptial tubercles; *N. cornutus cornutus* (Mitchill), abundant, many adult males with some of the nuptial color still observable; *N. cornutus cornutus* × *Clinostomus vandoisulus*, 3 hybrids, one with some red along its sides; *Clinostomus vandoisulus* (Valenciennes), several adults which appeared to have finished spawning; *Nocomis micropogon* (Cope), common, one old nest of pebbles observed; *Exoglossum maxillingua* (LeSueur), common, one old nest about 12 inches in diameter made of small pebbles was seen at the head of a riffle; *Rhinichthys atratulus atratulus* (Hermann), abundant; *R. cataractae* (Valenciennes) subsp., several in riffles; *Catostomus commersonnii commersonnii* (Lacépède), common; *Hypentelium nigricans* (LeSueur), several; *Micropterus dolomieu dolomieu* Lacépède, one juvenile; *Lepomis auritus* (Linnaeus), one juvenile in riffle; *Boleosoma vexillare* Jordan, common in slower riffles, males in dark nuptial dress.

Breeding activity probably occurred throughout a rather shallow riffle about 8 to 12 inches deep since a large number of ripe specimens were taken there. However, it was definitely observed only in a second shallower channel at the side of the main riffle in water about 4 inches deep. The bottom was fine gravel and sand, the current moderate, and the water white and clear. Observations were made at a distance of only 6 to 10 feet rather late in the evening of a cloudy day. Air and water temperature was 78°F. at 8:30 P.M.

When first noted the behavior was markedly different from that of any cyprinid previously observed. A quick scoop over the spawning ground with a 10-foot seine yielded about 10 ripe *procne* of both sexes. Those that escaped commenced courtship and spawning activities immediately. From 15 to 25 adults remained in an area about 3 by 12 feet. The sand and fine gravel was clean, having been swept off by the almost constant and intense movements of the fish.

The sexes on the spawning grounds were about the same size, but the males could be distinguished immediately by their more active behavior and darker color. They occupied definite territories which they guarded from the intrusion of other males. Distances between males varied from about 5

inches on one downstream area, where 4 males were concentrated, to a span of 12 to 18 inches on other parts of the spawning grounds. The more widely separated males were much more successful in spawning partly because they spent less time fencing with other males. Most were apparently oblivious of our presence but one that held a territory near a small log was easily frightened and swam under it for shelter when disturbed. Incidentally, he did not often succeed in actually spawning.

The behavior pattern of an individual male follows. He assumed a position headed upstream somewhere within the cleared area which constituted the spawning ground and remained close to but not on the bottom. The main movement was a lateral one of about 3 inches with a quick return to the original position, and this was followed immediately by a similar movement to the opposite side. A diagram of his path resembles a laterally widened figure 8. The territory was approximately 6 by 6 inches. His movements to either side were greatly speeded upon the approach of another *procne*. Incidentally no other species was present in the immediate area to complicate the picture. When a male came within or near the guarded territory he was met by a head on rush. However, two males seldom appeared actually to collide. At times they edged each other aside but not with great vigor since in most cases they were of equal size. In the face of a determined rush an intruder usually quickly turned aside and beat a retreat. If he chose to stand his ground the two chased each other in a circular path for several seconds. Each male then returned to his original territory and resumed his active lateral movements. Occasionally several males attempted to invade a territory and a swirling group, their numbers increased by the addition of several late comers, moved rapidly over the spawning grounds. Within several seconds these groups scattered and each male returned to his place.

In contrast the females remained rather quietly below or laterad of the large spawning area. When ready to deposit eggs one came upstream and usually stopped slightly below and immediately downstream from a male. Sometimes she attempted to move up through a territory past a male. He quickly blocked her off from further upstream progress by throwing his body in her path but without appearing actually to strike her. The female then stopped and the male swam quickly from side to side, the tempo of his action greatly increased. With a female within 2 to 4 inches and downstream from the male, conditions were set up for the actual spawning act. He suddenly dropped downstream with his head still facing upstream and moved only slightly to either side. If the female held her position the male backed down beside her and inserted his pectoral fin underneath her head or breast and at the same moment threw his caudal peduncle across the posterior part of her body. This forced the female downward to the bottom, both vibrating vigorously for about a second, and the eggs were laid in the sand which was stirred up at this moment by the rapidly moving bodies. At the completion of the spawning act the female was not tossed upward as has been observed in some other minnows, but moved slowly downstream to the area below the spawning grounds.

Relatively few eggs of the total complement were laid at one spawning, and the same female would return to spawn again after a short period. Probably several days were required for the deposition of all the eggs of one

*procne*. The male immediately returned to his lateral movements in his territory and spawned again with another female within a few minutes.

The actual embrace at spawning was similar to that observed in several other cyprinids and described in detail for *Rhinichthys atratulus atratulus* by Traver (1929: 118). The other phases of courtship and territorial behavior are unique. Nothing is known of the breeding behavior of the other species of *Notropis* in the Atlantic drainage related to *procne*, namely *heterolepis*, *volucellus*, *bifrenatus* and *alborus* (see Hubbs and Raney, 1947). Indeed, few observations have appeared on the spawning habits of this large and widespread genus. The more pertinent papers are by Hubbs and Walker (1942: 101) on *Notropis longirostris* (Hay), Hankinson (1930: 73) on *Notropis spilopterus* (Cope); Greeley (1935: 94) and Stone (1941: 289) on *Notropis analostanus*; Hankinson (1932: 415) and Raney (1940a: 1; 1940b: 131) on *Notropis cornutus*; Hankinson (1932: 417), Pfeiffer (1942: 13), and Raney (1940c: 361) on *Notropis rubellus* (Agassiz); and Greeley and Greene (1931: 88) on *Notropis hudsonius hudsonius* (Clinton). The breeding behavior of *procne* is least like that of *longirostris* and *hudsonius* and probably approaches that of *cornutus* more than any of the other known species.

The correlation between the size reached by each of the sexes and the tendency to hold territories and to fight among the males is marked. Males are larger and have stronger and longer nuptial tubercles, especially on the head, in *cornutus*, *analostanus*, and *spilopterus*. All three species fight to hold territories. In *procne*, *longirostris*, and *hudsonius* the sexes reach equal lengths and have relatively small tubercles; *procne* attempts to hold a territory while *longirostris* does not. The former fights off males that attempt to intrude, while a male *longirostris* will battle males that attempt to follow his temporary mate. In *hudsonius* details of the behavior of the males at spawning are not known. Greeley and Greene (1931: 88) report that a large number of individuals mill about in a close packed group. The male *rubellus* are smaller than females and are covered with fine tubercles. There is relatively little fighting among males. They spawn in loosely knit groups which move about from one part of a riffle to another or utilize the nests of *Nocomis* or other species.

#### AGE AND LENGTH

A collection made over the spawning area and in nearby riffles yielded 86 adult *procne* of which 48 were males and 38 females. A greater number of males is to be expected under the conditions where they are more active and engaged in guarding territories and is probably not an accurate indication of the actual sex ratio. An examination of the length frequency distribution of these 86 adults presented in Table 1 shows a pronounced bimodal condition. The scales revealed that the smaller adults, those ranging from 33 to 39 mm. standard length, were only one-year-old. The larger of the two modes, containing adults from 43 to 52 mm. long, consisted of two- and three-year-old specimens. The short life span indicated for *procne* is similar to that found in two other small species, *Notropis volucellus volucellus* (Cope) and *Notropis rubellus*. Black's (1945: 457) studies of *volucellus* from Shriner Lake, Indiana, revealed that a great preponderance of the individuals survive only

one winter and that few, if any, live through a third winter. In *rubellus* from the Alleghany River system of New York, Pfeiffer (1942: 13) found that some specimens were mature at one year. All spawn when two- and three-years-old and few reach a greater age.

TABLE I

LENGTH FREQUENCY DISTRIBUTION OF 86 ADULT *Notropis procne procne* TAKEN FROM A SPAWNING AREA AND NEARBY RIFFLES OF COVINGTON RIVER, RAPPAHANNOCK COUNTY, VIRGINIA, ON JUNE 18, 1946

Standard length in mm.	Frequency of 2- and 3-year age groups		Standard length in mm.	Frequency of the one-year age group	
	Male	Female		Male	Female
52	—	1	39	1	1
51	—	1	38	3	1
50	1	—	37	3	1
49	2	3	36	4	3
48	4	5	35	1	—
47	8	5	34	—	1
46	14	3	33	—	1
45	5	10			
44	2	—			
43	—	2			
No.	36	30		12	8
Mean	46.5	46.6		36.9	36.1

The sexes of *procne* attain the same length. An examination of several hundred specimens from a number of northeastern localities, now deposited in the Cornell University fish collection, revealed few specimens to be over 2 inches in standard length. Fowler (1909: 533) makes the general statement that *procne* averages about 2½ inches in length. If it is assumed that he referred to total length, our findings are in substantial agreement although our average is closer to 2¼ inches with an occasional large individual reaching nearly 3 inches. Greeley (1936: 76, plate 1) figures a female in color. This specimen, 2¾ inches in total length, was collected in Oquaga Creek, New York.

## LITERATURE CITED

BLACK, JOHN D.

- 1945 Natural history of the northern mimic shiner, *Notropis volucellus volucellus* Cope. Inv. Indiana Lakes and Streams. *Ind. Dept. Cons. and Dept. Zool. Ind. Univ.*, 2: 450-469.

FOWLER, HENRY W.

- 1909 A synopsis of the Cyprinidae of Pennsylvania. *Proc. Acad. Nat. Sci. Phila.*, 1908: 517-553, pl. 1.

HUBBS, CARL L., and BOYD W. WALKER

- 1942 Habitat and breeding behavior of the American cyprinid fish *Notropis longirostris*. *COPEIA*, 4: 101-104.

HUBBS, CARL L., and EDWARD C. RANEY

- 1947 *Notropis alborus*, a new cyprinid fish from North Carolina and Virginia. *Occ. Pap. Mus. Zool., Univ. Mich.*, 498: 1-17, 3 figs., 1 pl.

GREELEY, JOHN R.

- 1928 Fishes of the Oswego watershed. In: A Biological Survey of the Oswego River System. *Suppl. 17th Ann. Rept. N. Y. Cons. Dept.*, 1927: 84-107, pls. 1-12.  
1935 Fishes of the watershed with annotated list. In: A Biological Survey of the Mohawk-Hudson Watershed. *Suppl. to 24th Ann. Rept. N. Y. Cons. Dept.*, 1934: 63-101, pls. 1-4.  
1936 Fishes of the area with annotated list. In: A Biological Survey of the Delaware and Susquehanna Watersheds. *Suppl. to 25th Ann. Rept. N. Y. Cons. Dept.*, 1935: 45-88, pls. 1-4.

GREELEY, JOHN R., and C. WILLARD GREENE

- 1931 Fishes of the area with annotated list. In: A Biological Survey of the St. Lawrence Watershed. *Suppl. 20th Ann. Rept. N. Y. Cons. Dept.*, 1930: 44-94, pls. 1-12.

HANKINSON, T. L.

- 1930 Breeding behavior of the silverfin minnow, *Notropis whipplii spilopterus* (Cope). *COPEIA*, 3: 73-74.  
1932 Observations on the breeding behavior and habits of fishes in southern Michigan. *Papers Mich. Acad. Sci., Arts, and Letters*, 15, 1931: 411-425.

PFEIFFER, ROMAN A.

- 1942 Observations on the life history of *Notropis rubellus*. Abstracts of Papers Presented at the 25th Annual Meeting of the Amer. Soc. Ichthyologists and Herpetologists. (Mimeographed): 13.

RANEY, EDWARD C.

- 1940a The breeding behavior of the common shiner, *Notropis cornutus* (Mitchill). *Zoologica*, 25 (pt. 1): 1-14, pls. 1-4.  
1940b Nests under the water. *Bull. N. Y. Zool. Soc.*, 43(4): 127-135, sev. figs.  
1940c Reproductive activities of a hybrid minnow, *Notropis cornutus* x *Notropis rubellus*. *Zoologica*, 25 (pt. 3): 361-367.

STONE, UDELL BENNETT

- 1941 Studies on the biology of the satinfin minnows, *Notropis analostanus* and *Notropis spilopterus*. Cornell Univ. Abstracts of Theses, 1940: 288-290.

TRAYER, JAY R.

- 1929 The habits of the black-nosed dace, *Rhinichthys atronasus* (Mitchill). *Jour. Elisha Mitchell Scientific Soc.*, 45(1): 101-129, figs. 1-4.

DEPARTMENT OF ZOOLOGY, CORNELL UNIVERSITY, ITHACA, NEW YORK.

## A New Pelobatid Frog from Fukien Province, China

By CLIFFORD H. POPE

IN 1931 I recorded 20 metamorphosing and immature frogs and 4 series of tadpoles from Ch'ungan Hsien, Fukien Province, China, collected by myself. All were tentatively identified as *Megophrys hasseltii*, but material since collected on Mt. Omei, Szechwan Province, and described in 1945 by C. C. Liu as *Vibrissaphora boringii*, genus and species new, convinces me that my determination is erroneous; *Megophrys hasseltii* probably does not occur in China.