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Early Development of the Blue Sucker, *Cycleptus elongatus*

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***Cycleptus elongatus*, a large-river catostomid of the southeastern and central United States, was artifically spawned from broodstock taken from the Alabama River in Alabama. Larvae were reared to the juvenile stage. Posthatching ontogeny of larvae of *Cycleptus* is similar to that reported for other catostomids. Distinguishing characteristics for protolarval blue suckers are preanal and total myomere counts, pigment pattern, dorsal origin of the median fin fold, ratio of eye diameter to head length, and sizes at particular stages of development. The blue sucker in later phases of development is distinguishable from other catostomids by numbers of preanal and total myomeres and length of dorsal fin.**

THE blue sucker, *Cycleptus elongatus* (Le Sueur 1817), represents a monotypic genus of the family Catostomidae. In the central United States, the blue sucker ranges from the Rio Grande along the Mexican border of Texas to the Mobile Bay drainage in Alabama and northward into the upper Mississippi, Missouri, and Ohio Rivers. Information on the life history of this inhabitant of moderate to large rivers is meager because of extreme habitat selectivity of both adults and young (Moss et al., 1982). Collected from swift currents over firm substrates, blue suckers are typically underrepresented in survey collections from these difficult-to-sample areas (Smith-Vaniz, 1968). Only one record of an early life history stage exists, that of a single larva from the Missouri River (Pflieger, 1975). In this paper, we describe the development of early life history stages as an aid for identification of larvae of *C. elongatus*.

Materials and Methods

Between 1 and 8 March 1981, adult blue suckers were captured in monofilament gill nets below Jones Bluff Dam on the Alabama River in Alabama. Methods of inducing ovulation, stripping of eggs, and culturing of larvae were described by Semmens (1985).

A series of 101 eggs and larvae at various developmental stages was preserved in 10% formalin and later transferred to 5% formalin buffered to pH 7.0 with ammonium hydroxide. This series was cataloged into the reference collection of the Larval Fish Identification and Information Center, Tennessee Valley Authority, Norris, Tennessee as DS48 TV1800.

Morphometric and meristic characteristics were observed with a stereomicroscope equipped with an ocular micrometer and polarizers. Measurements were total length, standard length, preanal length, and head length, head depth, body depth at the anus, and eye diameter. Counts were preanal, postanal, and total myomeres and numbers of fin rays. Fin fold development, pigment patterns, squamation, and body morphology were observed. Only those characteristics of taxonomic significance are discussed. Unless otherwise noted, all measurements (in mm) given in the text are total lengths.

Early Development

Eggs (2.3–4.0 mm in diameter).—Adhesive at fertilization; nonadhesive after 5 min of gentle agitation and mixing with Fullers earth; water-hardened eggs spherical, averaging 3.1 mm in diameter (N = 15); "Eyed-egg" stage at 5 d after fertilization; approx. 20% of the three liters of eggs hatched 6 d after fertilization.

Protolarvae (6.4–10.8 mm). Morphology.—Newly-hatched larvae 7.1 mm (N = 8, range = 6.4–7.5 mm), poorly differentiated, head slightly decurved over club-shaped yolk sac, oral pit (stomodeum) but no opening, urostyle straight; median fin placement or outline undefined (Fig. 1A); dorsal fin fold origin at 13–14th preanal myomere; pectoral buds present as small flaps antero-dorsally to the yolk sac; otic vesicles present. By 8.8–9.2 mm, head in line with body axis; mouth subterminal and open; four gill arches present; incipient opercle visible; fin fold continuous around urostyle to anus, then forward ventrally to anterior portion of yolk sac (Fig. 1B); otic vesicles present; pectoral buds paddle-

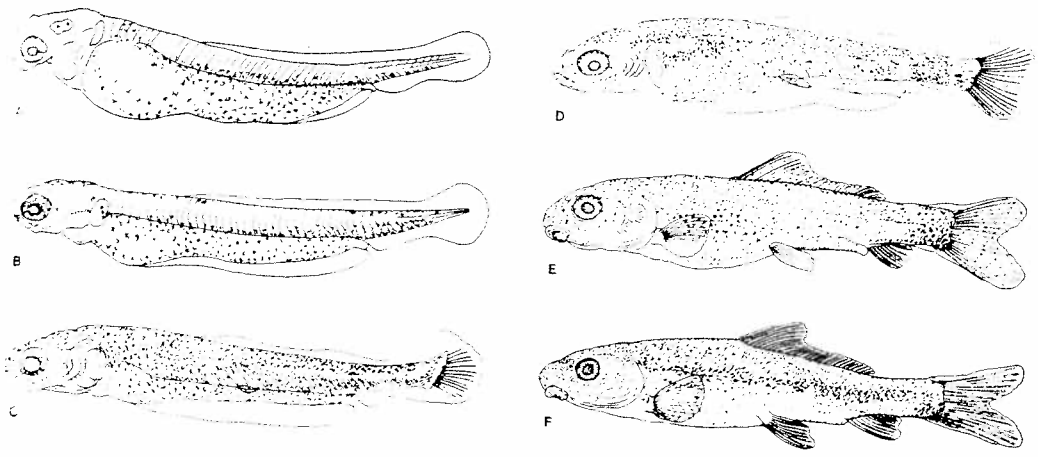

Fig. 1. Early developmental stages of *Cycleptus elongatus*. A. Protolarva at hatching, 7.1 mm; B. Protolarva, 9.5 mm; C. Mesolarva, 12.4 mm; D. Mesolarva, 16.2 mm; E. Metalarva, 28.3 mm; F. Juvenile, 46.5 mm.

like; tip of urostyle upturned slightly. Between 9.0 and 9.8 mm, body shape more terete as yolk is absorbed; by 9.9–11.0 mm mouth terminal; at 10.1 mm dorsal fin outline partly differentiated, caudal fin becoming truncate; yolk absorbed by 10.5–10.7 mm. Pigmentation.—At hatching, eyes pigmented, melanophores scattered over yolk sac, a diffuse row of melanophores ventrally on the caudal peduncle. By 7.1–9.2 mm (1–3 d after hatching), mid-ventral pigmentation intensified, spreading dorsally on posterior yolk sac; medial line of pigment extending posteriorly from heart region along the yolk sac dorsum to the anus and postanally as a scattered row of melanophores along venter; peduncle progressively more heavily pigmented laterally and dorsally through protolarval phase; 10–12 melanophores scattered along dorsum anterior to fin fold origin; three or four melanophores on dorsum of head; nasal pits pigmented. By 10.0–10.8 mm, midlateral line of pigment present; ventral bar of pigment extending from head dorsum ventrally to heart region; ventral pigmentation intensified.

Mesolarvae (9.9–23 mm): Morphology.—By 9.9–10.7 mm, three or four caudal rays formed, urostyle angled upward, posterior edge of the caudal fin slightly emarginate; pelvic-fin buds present by 12.8 mm (Fig. 1C); by 14.5 mm, all 18 caudal rays present. By 16.2 mm, anal (5) and dorsal (7–8) rays formed (Fig. 1D); long dorsal fin and anal fin outlines discernable, but not entirely separated from caudal-fin fold; single-chambered gas bladder apparent; no pelvic or pectoral rays. Adult ray counts attained in median fins by 23 mm. Pigmentation.—Two or three melanophores on lower jaw; line of melanophores extending forward from dorsum of gut, dividing dorsoventrally at pectoral fin, upper row extending forward to base of brain, lower row extending ventrally to heart region and posterior gill chambers; mesolarval development characterized by increasingly denser pigmentation on snout, dorsum of head, opercle, and lateral sides and dorsum of body.

Metalarvae (23.4–28.3 mm): Morphology.—Median-fin rays.—caudal 18, dorsal 25–27, anal 8; (Fig. 1E) in the size range preserved: pectoral rays 11–13, pelvic rays 7–8; dorsal, caudal, and anal-fin folds distinctly separate; mouth again subterminal and ventral, overhung by snout; gas bladder two-chambered. Pigmentation.—Dorsally, a double row of melanophores extending length of body; internally, dorsal visceral membranes heavily pigmented; externally, pigmentation as described for mesolarvae now denser; distinct caudal spot, extending onto ventral lobe of caudal fin from peduncle venter; one or two melanophores along anterior rays of dorsal fin; ventrally, melanophores along gut, beginning below pelvic fins and extending posteriorly to anus.

Juveniles (32.7–46.5 mm): Morphology.—Adult fin rays counts (caudal 18, dorsal 25–28, anal 8, pelvics 10–11, and pectoral 15–16) in all fins by 32.7 mm; mouth subterminal; lips thick, heavily papillose; anal and pelvic fins falcate.

TABLE 1. MEANS (STANDARD ERROR OF THE MEAN) OF MORPHOMETRIC AND MODES (RANGES) OF MERISTIC DATA FOR EARLY LIFE HISTORY STAGES OF THE BLUE SUCKER, *Cycleptus elongatus*.

Stage	Percent total length				Percent head length		Mode (range)			Percent (Myomeres)	
	Standard length	Head length	Preanal length	Body depth	Head depth	Eye diameter	Preanal myomeres	Postanal myomeres	Total myomeres	Preanal/total	Postanal/preanal
Protolarvae N = 79 6.4–10.8 mm TL	95.3 (.01)	16.5 (.01)	72.3 (.02)	8.2 (.01)	67.4 (.04)	38.4 (.03)	38 (35–40)	10 (8–12)	48 (46–50)	79.2	23.9
Mesolarvae N = 13 10.15–16.2 mm TL	93.4 (.02)	19.8 (.01)	73.9 (.02)	9.2 (.01)	60.2 (.03)	33.1 (.02)	38 (37–40)	9 (7–10)	47 (45–48)	80.9	23.7
Metalarvae N = 3 23.4–28.3 mm TL	84.6 (.01)	22.7 (.01)	65.4 (.01)	12.2 (.01)	61.7 (.02)	24.6 (.01)	38 (37–38)	9 (8–9)	47 (45–47)	80.9	23.7
Juveniles N = 6 32.7–46.5 mm TL	82.0 (.01)	21.4 (.01)	63.0 (.01)	10.7 (.01)	61.0 (.02)	23.3 (.01)	*	*	*	*	*

* Obscured by melanophores and body opaqueness.

Squamation present along lateral midline of caudal peduncle on smallest juvenile (32.7 mm); largest juvenile (Fig. 1F, 46.5 mm) scaled all along lateral body above midline anteriorly to head, scaled below midline on peduncle; remainder of body, including mid-dorsal region, unscaled. Pigmentation.—Heavy midlateral stripe from head to caudal fin, with dense melanophores above midline and scattered pigment below; dark caudal spot from peduncle to two-thirds the distance to distal edge of lower caudal fin lobe; upper caudal fin lobe unpigmented; concentration of melanophores at pectoral base extending onto most anterior rays; anal and pelvic fins unpigmented. Dorsum of head and snout heavily pigmented, dense double row of melanophores still present; venter of body generally unpigmented; dense internal row of melanophores seen ventrally from behind pelvic fins to anus; posteriorly, scattered row of melanophores along both sides of anal fin to base of caudal fin.

Taxonomic Diagnosis

Preanal and total myomere counts are of basic utility for identifying similar families of freshwater larval fishes. For the blue sucker, the ratios of preanal to total myomeres (0.79–0.81, Table 1) and postanal to preanal myomeres (0.24) are the most taxonomically useful values for distinguishing larval cyprinids and catostomids (Snyder, 1979).

Seven genera of catostomids, encompassing 22 species, are sympatric with the blue sucker. With the exception of *Catostomus*, larvae of *Cycleptus* have the highest modal number of total myomeres (47) which completely distinguishes *Cycleptus* from six of the sympatric catostomid genera. Preanal myomere counts (mode = 38, range 35 rare to 40) also distinguish larvae of *Cycleptus* from *Carpiodes*, *Ictiobus*, *Minytrema*, and *Erimyzon* (Hogue and Buchanan, 1977; Fuiman, 1979a; Yeager and Baker, 1982). Numbers of preanal myomeres for the genera *Moxostoma*, *Catostomus*, and *Hypentelium* overlap the range for *Cycleptus* (Buynak and Mohr, 1978a, 1978b; Fuiman and Witman, 1979). However, only species of *Catostomus* have modal numbers of preanal myomeres as high as that for *Cycleptus*.

Although pigmentation characteristics are often of limited utility for taxonomic diagnosis, the magnitude difference of pigmentation density between early stages of *Cycleptus* and that of similar catostomids is easily recognized. Pigmentation on *Cycleptus* from hatching and throughout the protolarval phase (Fig. 1A–B) is much more extensive over the yolk sac and midlateral areas than that of either *Catostomus* or *Hypentelium*. Also, unlike early larvae of *Catostomus commersoni*, which has anterior dorsal pigmentation arranged in three rows, and *C. catostomus* (sympatric only in extreme western range), which has distinct anterior dorsal pigment in a single row (Fuiman, 1982), larvae of *Cycleptus* have a single row of scattered melanophores along the dorsum that becomes progressively much denser than that for *Catostomus*.

Hatching sizes (Fuiman, 1979b) for *Hypentelium* (9.3 mm, SD = 1.2) and *Catostomus* (10.1, SD = 0.8) are greater than for *Cycleptus* (7.1 mm, SD = 0.3). Early stages of *Cycleptus*, which have an average ratio of eye diameter to head length of 0.38, are distinguishable from *Hypentelium* and *Catostomus*, which have ratios of greater than 0.46 and 0.42, respectively (Fuiman, 1982). The dorsal origin of the fin fold at the 13–14th preanal myomere for *Cycleptus* is farther posterior than for *Hypentelium* (10th myomere). Yolk absorbtion in *Cycleptus* (10.5–10.7 mm) occurs at a smaller size than for either *Hypentelium* (13.5 mm) or *Catostomus* (11.9–13.4 mm).

By 10.1 mm, the margin of the long dorsal fin of *Cycleptus* has begun differentiating and is completely separated from the caudal fin by 17.0 mm. In combination with the high preanal and total myomere counts, this characteristic allows taxonomic separation of mesolarval, metalarval, and juvenile *Cycleptus* from all other species of catostomids.

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