Abstract.— The tripletail, *Lobotes surinamensis*, is the only member of the family Lobotidae in the western Atlantic Ocean, and its life history is poorly understood. We describe development of tripletail larvae, clarify the literature on their identification, and discuss their temporal and spatial distribution in the northern Gulf of Mexico. Larval tripletail are characterized by 1) a vaulted, median supraoccipital crest with spines along the leading edge; 2) precocious, heavily pigmented pelvic fins; and 3) large preopercular spines. In addition, the surface of the frontal and supraoccipital bones have a reticulated pattern of depressions or "waffled" appearance. Transition to juvenile stage begins at about 9.0-9.5 mm standard length. Tripletail have three supraneurals, six branchiostegal rays, 11 + 13 vertebrae, 27 dorsal rays (XII, 15), and 14–15 anal rays (III, 11–12). Overall, 75% of tripletail larvae were found in waters ≥28.8°C, ≥30.3 ppt, and at stations ≥70 m deep. Larval tripletail were collected primarily from July through September and almost exclusively in surface tows. Tripletail spawn offshore. Juveniles, although sporadic, are apparently not uncommon in Gulf of Mexico estuaries during summer.

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Larval development of tripletail, *Lobotes surinamensis* (Pisces: Lobotidae), and their spatial and temporal distribution in the northern Gulf of Mexico*

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The percoid family Lobotidae is usually considered to comprise two genera with about four species (Nelson, 1984), although Johnson (1984) only included *Lobotes*, questioning the affinity of *Datnioides*. The tripletail, *Lobotes surinamensis*, is cosmopolitan and found in all warm seas (Fischer, 1978); one adult was recorded as far north as St. Margarets Bay, Nova Scotia (44°37'N, 64°03'W (Gilhen and McAllister, 1985). *Lobotes surinamensis* is the only member of the family in the Gulf of Mexico (Gulf) (Hoese and Moore, 1977). Tripletail generally occur along the Gulf coast from April through early October (Baughman, 1941) and migrate south during fall and winter (Merriner and Foster, 1974). Although apparently abundant nowhere, adult and juvenile tripletail are not uncommon in bays, sounds, and estuaries along the north-central Gulf coast during summer (Baughman, 1941; Benson, 1982). Tripletail up to 18.6 kg and 89 cm standard length (SL) have been caught, but most average between 1 and 7 kg (Gudger, 1931; Baughman, 1941). Tripletail often are included as a category in Gulf fishing rodeos (Benson, 1982) because of their reputation as "a bold biter" and strong fighter (Gudger, 1931; Baughman, 1941). Tripletail enter the commercial catch on the east and west coasts of Florida and a few tons are taken annually (Fischer, 1978).

The development of tripletail larvae and their spatial and temporal distribution is poorly understood. Hardy (1978) compiled information on tripletail life history. Uchida et al. (1958) and Konishi (1988) provide limited information and illustrations of tripletail larvae off Japan; however, Konishi's 5.1–mm larva is misidentified. Johnson (1984) commented on cranial morphology. Our objectives were to describe the development of tripletail larvae, to clarify the literature on their identification, and to discuss the spatial and temporal distribution of larval tripletail in the northern Gulf of Mexico.

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Materials and methods

Tripletail larvae were obtained from museum collections throughout the Gulf of Mexico to determine their spatial and temporal distribution. These include collections from the Southeast Area Monitoring and Assessment Program's (SEAMAP) ichthyoplankton surveys of the Gulf from 1982 through 1986 (SEAMAP 1983–1987[1]); National Marine Fisheries Service (NMFS, Panama City, Florida) and Louisiana State University (LSU) collections from within riverine and oceanic frontal zones off the Mississippi River delta; and collections made by the Gulf Coast Research Lab (GCRL), Ocean Springs, Mississippi, and by Freeport-McMoRan Inc., New Orleans (Appendix Tables 1 and 2).

SEAMAP collections from 1982 to 1986 represent the first time-interval for which a complete set of data were available. Standard ichthyoplankton survey techniques as outlined by Smith and Richardson (1977) were employed in data collection. SEAMAP stations sampled by NMFS vessels were arranged in a systematic grid of about 55–km intervals. NMFS vessels primarily sampled waters >10 m deep. Each cooperating state had its own sampling grid and primarily sampled their coastal waters. Latitude 26°00'N was the southern boundary of the survey area. Hauls were continuous and made with a 60–cm bongo net (0.333-mm mesh) towed obliquely from within 5 m of the bottom or from a maximum depth of 200 m. A flowmeter was mounted in the mouth of each net to estimate volume of water filtered. Ship speed was about 0.75 m/sec; net retrieval was 20 m/min. At stations <95 m deep, tow retrieval was modified to extend a minimum of 10 minutes in clear water or 5 minutes in turbid water. Tows were made during both day and night depending on when the ship occupied the station. Overall, 1,823 bongo-net tows were collected and processed during these years. The SEAMAP effort from 1982 to 1984 also involved the collection and processing of 814 neuston samples taken with an unmetered 1×2 m net (0.947–mm mesh) towed at the surface for 10 minutes at each station. SEAMAP sampling during April and May was primarily beyond the continental shelf, whereas that during March and from June through December was over or immediately adjacent to the shelf at stations <180 m deep. No samples were taken during January and February. Additional information on the temporal and spatial coverage of SEAMAP plankton surveys is found in Stuntz et al. (1985), Thompson and Bane (1986, a and b), Thompson et al. (1988), and Sanders et al. (1990).

Collections from frontal zones off the Mississippi River delta include 311 surface-towed 1×2 m neuston net samples (0.333–mm mesh) made by NMFS. NMFS samples were collected during May, August, September, and December (1986 to 1989), although not all four months were sampled each year (Appendix Table 1). We also examined 63 surface-towed 1–m^2 Tucker trawl samples (0.363–mm mesh) taken at seven stations during July 1987, and 45 surface-towed multiple opening/closing net and environmental sensing system (MOCNESS) (Wiebe et al., 1976) samples (0.363–mm mesh) collected at five stations during April 1988. These samples were from LSU collections. In addition, we examined 17 samples from stations taken by LSU inside the 100-0m isobath during October 1990. The sampling area during October 1990 extended 140 km west from Southwest Pass of the Mississippi River delta along the inner-to mid-shelf. Samples were collected with a 60–cm bongo net (0.333–mm mesh) towed obliquely to the surface from 5 m of the bottom or from a maximum depth of 50 m (Appendix Tables 1 and 2).

Museum collections from GCRL and Freeport-McMoRan, Inc. were primarily taken off Mississippi Sound and within the Barataria Bay system of Louisiana, respectively. Gear type and most environmental data were not available from these two institutions (Appendix Table 2).

Temperature and salinity data were from the sea surface. Hydrographic data from stations where larvae were taken were multiplied by the total number of larvae collected at each station to derive median and mean hydrographic values. This method gives weight to distribution of larvae rather than to distribution of stations. We used percent cumulative frequency for defining the relationship between distribution of larval tripletail and water temperature, salinity, and station depth. Percent frequency indicates the range of hydrographic conditions most often associated with occurrences of tripletail larvae. Median, mean, and percent cumulative frequency statistics were calculated (SAS Institute, 1985).

An examination of tripletail larvae was made to describe developmental morphology. Body measurements were made on 21 tripletail between 2.2 and 23.0 mm SL (Table 1) according to the methods of Hubbs and Lagler (1958) and Richardson and Laroche (1979). Measurements were made to the nearest 0.1 mm with an ocular micrometer in a dissecting microscope. We follow Leis and Trnski's (1989) criteria for defining length of preopercular spines, body depth, head length, eye diameter, and

[1] SEAMAP. 1983–1987. (plankton). ASCII characters. Data for 1982–1986. Fisheries-independent survey data. National Marine Fisheries Service, Southeast Fisheries Center: Gulf States Marine Fish. Comm., Ocean Springs, unpubl. data.

Table 1

Morphometrics of larval tripletail (*Lobotes surinamensis*) from the northern Gulf of Mexico. Measurements are expressed as % standard length (SL).

SL	*n*	Preanal length	Head length	Snout length	Orbit diameter	Greatest body depth	Upper jaw length	Prepelvic distance
2.2–2.4	2	60.5–66.0	29.0–29.5	6.5–7.0	12.5–13.5	25.0–27.5	11.5–14.5	—
4.0–5.9	3	60.0–70.0	37.5–40.0	7.5–10.0	14.0–14.5	40.0–53.5	20.0–20.0	37.5–55.0
6.0–7.9	4	69.5–79.5	38.0–43.0	6.5–9.5	14.0–16.0	51.0–59.5	15.5–17.5	38.0–57.0
8.0–9.9	4	68.0–77.5	34.5–38.5	5.5–6.5	14.0–15.5	58.0–59.0	14.0–15.5	39.0–48.0
10.0–11.9	2	68.5–74.0	38.0–39.0	6.0–6.5	14.5–15.0	54.0–56.5	14.0–14.5	39.0–40.0
13.0–14.9	2	71.5–72.5	35.5–37.0	6.5–7.0	13.0–14.0	55.0–57.5	13.5–14.0	40.0–44.5
15.0–16.9	2	72.5–77.5	34.5–35.5	6.0–6.5	12.5–13.0	56.5–58.0	12.5–13.0	42.0–47.5
21.0–23.0	2	74.0–76.5	39.5–41.5	7.0–8.0	12.0–13.0	54.5–58.0	13.0–14.0	46.5–52.0

eye diameter/head length ratio. We consider notochord length in preflexion and flexion larvae synonymous with SL in postflexion larvae and report all lengths as SL unless otherwise noted. Specimens were fixed in 10% formalin and later transferred to 70% ethyl alcohol. Representative specimens were illustrated with the aid of a camera lucida. Because of the paucity of material, only two specimens were cleared with trypsin and stained with alizarin to examine head spines. We examined the surface of the occipital and frontal bones with a scanning electron microscope (SEM) after the epithelium was partially digested with trypsin. Soft rays of the dorsal and anal fins were counted when their pterygiophores were visible, and spines were counted when present.

Results

Larval morphometrics and pigmentation

Ninety-eight larval or juvenile tripletail were examined during this study (Appendix Table 2): 7 were preflexion or flexion (≤5.0 mm), 34 were postflexion (5.1 to 9.5 mm), and 57 were transforming or juvenile (>9.5 mm). Body depth increased rapidly during preflexion and flexion with depth >50% SL by 5.0 mm. The gut was straight. Larvae had 24 myomeres which became obscured by pigment in postflexion larvae. Preanal length was 60–65% SL in preflexion larvae and increased to 70–75% SL in larvae ≥5.0 mm. Head length averaged 29% SL during preflexion and increased to about 40% SL in juveniles. The head became increasingly steep, and the upper profile of the forehead was concave by 20.0 mm. The eye was large and had an orbit diameter usually from 35 to 40% head length (12.5 to 15.0% SL) by 4.0 mm. The upper jaw reached about mid-eye. Pelvic fins were precocious, heavily pigmented, and inserted behind the pectoral fins near mid-body, usually about 40–50% SL (Table 1). The pelvic fins extended past the anus by 4.0 mm.

Early preflexion larvae of 2.2–2.4 mm were sparsely pigmented; pigment was primarily restricted to the head and abdomen. On the head, external pigment was present on the posterior surface of the midbrain, posteriorly at the base of the supraoccipital crest, on the nape, and immediately anterior to the cleithral symphysis (Fig. 1). By early flexion (4.0 mm), pigment was added between the fore- and mid-brain and on the preopercle above the dorsal-most preopercular spine (Fig. 1). Pigment occurred at the tip of the upper and lower jaws and at the angle of the preopercle near the base of the angle spine by 5.0 mm. The head became heavily pigmented during postflexion. By 10.0 mm, a band of pigment extended diagonally across the head from the nape to the orbit and from below the orbit to the angle of the preopercle (Fig. 1). The eye was at the apex of this chevron-shaped band of pigment. Two parallel stripes of pigment were present between the orbits by 14.0–15.0 mm, extending from the nares to the anterior margin of the supraoccipital crest. These pigment stripes became better formed as larvae developed. On the abdomen, melanophores were distributed dorsally over the air bladder, and dorsally and ventrally along the visceral mass and hindgut of early larvae (Fig. 1). By early flexion, pigment also was present on the pectoral axilla, posteriorly over the visceral mass and hindgut, and was scattered laterally over the body above the visceral mass. Body pigmentation increased rapidly during early postflexion and extended posteriorly to the caudal peduncle by 6.0 mm (Fig. 1). Blotches or mottled areas of pigment formed over the body by 8.0–9.0 mm, becoming more evident as larvae developed (Fig. 1).

Pigment along the ventral midline between the anus and notochord tip was restricted to four to five

melanophores in early larvae. By early flexion, only one or two postanal melanophores were present along the ventral midline and these were located on the caudal peduncle and at the posterior margin of the hypural bones (Fig. 1). Pigment was also present on the developing pelvic fins by early flexion. Melanophores were distributed over the dorsal and anal spines by 6.0 mm and over the anterior-most dorsal and anal rays by 8.5–9.5 mm. Pigment covered all but the distal tips of the dorsal and anal rays by 15.0 mm. Only the base of the caudal- and pectoral-fin rays were pigmented by 13.0–14.0 mm (Fig. 1) and pigment covered about 50% of the caudal fin in a 23.0-mm larva. Pigment occurred only over the proximal portion of the dorsal-most pectoral-fin rays in the 23.0-mm larva.

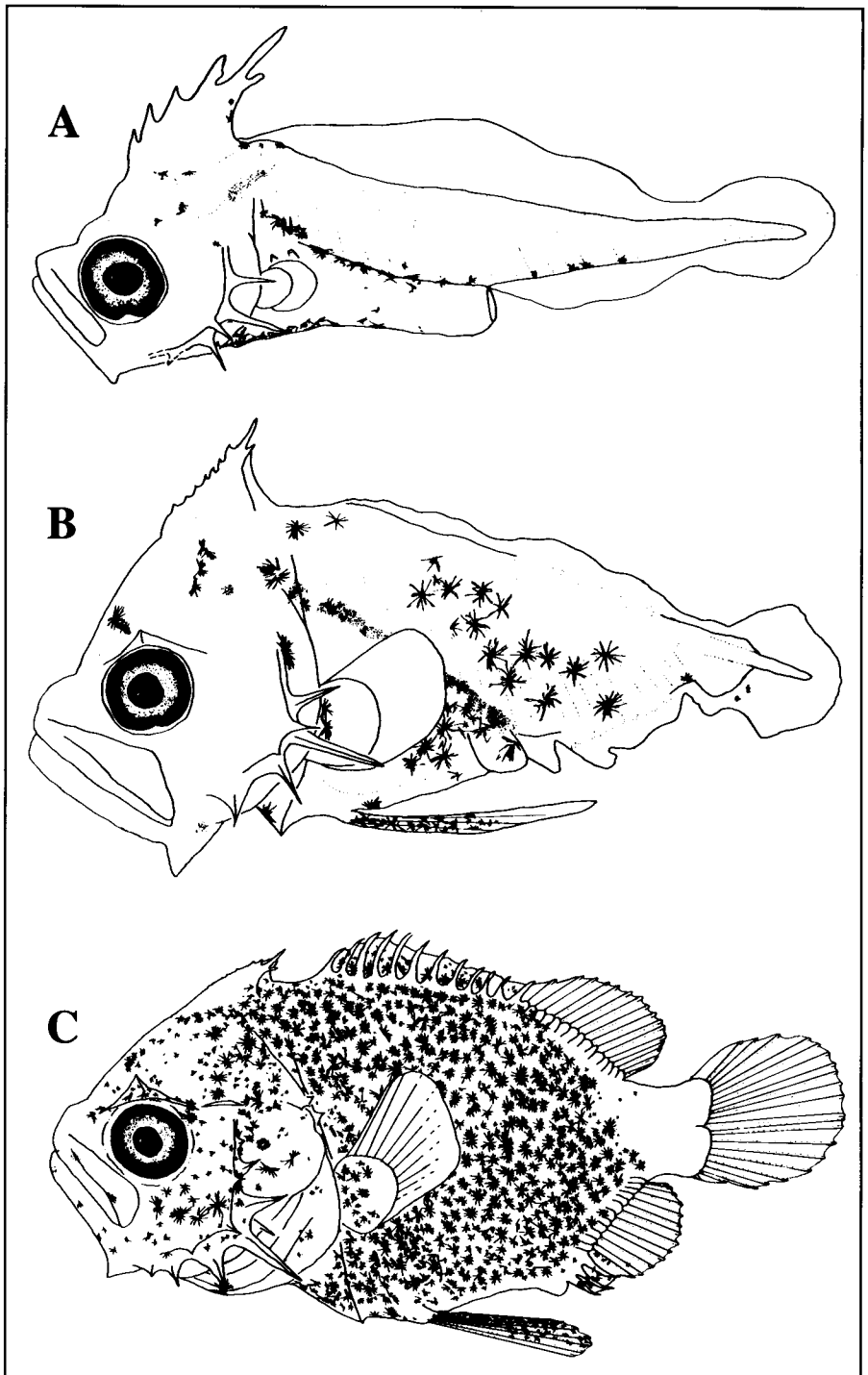

Figure 1

Larval development of tripletail (*Lobotes surinamensis*) from the northern Gulf of Mexico. (**A**) 2.2 mm, (**B**) 4.0 mm, (**C**) 6.3 mm, (**D**) 8.5 mm, (**E**) 10.8 mm, (**F**) 13.7 mm. All measurements are standard length (SL).

Head spination and fin development

Tripletail larvae were characterized by a vaulted, median supraoccipital crest, which originated above mid-eye, and by numerous spines and ridges on the head. Larvae of 2.2–2.4 mm had five to six spines along the leading edge of the supraoccipital crest and one spine on the posterior edge (Fig. 1). Usually eight spines occurred along the leading edge of the crest by 4.0 mm, giving the crest a serrate appearance. Length of the crest and its spines decreased as larvae grew (Fig. 1); and the entire supraoccipital crest was resorbed by 15.0–16.0 mm. The surface of the supraoccipital and frontal bones had a reticulated pattern of depressions or "waffled" appearance (Fig. 2). Because so few preflexion larvae were collected, we were unable to determine when this character first appeared. A large, laterally projecting supraorbital ridge with a single spine was present above the eye of tripletail larvae by 4.0 mm. Both the supraorbital spine and ridge were resorbed by 19.0 mm. Single, simple spines were present on the

posttemporal and supracleithrum by 4.5 mm; a low, simple ridge occurred along the pterotic at about 5.0 mm (Fig. 1). The posttemporal and supracleithral spines were partially covered by epithelium but both they and the pterotic ridge were visible on the largest specimen examined.

Tripletail larvae developed two series of preopercular spines, one along the outer shelf and the other along the inner shelf. Both outer and inner shelves have dorsal and ventral limbs. Three spines occurred along the posterior margin of the outer shelf of 2.2–2.4 mm larvae, the longest at its angle (Fig. 1). A fourth spine was forming but was small at 2.2 mm. Fifth and sixth spines were added by 6.0 mm; a seventh spine, by 7.0 mm. One to two small additional spines were added as larvae grew. By 15.5 mm, three to five spines were visible along the dorsal margin of the outer preopercular shelf, one at the angle, and usually three along the ventral margin; the anterior-most spine along the ventral margin was short and blunt (Fig. 1). All spines along the outer shelf were present in the largest specimen examined (i.e., 26.0 mm). Along the inner preopercular shelf, one spine was present in 2.2–2.4 mm larvae and three to four spines by 5.0 mm (Fig. 1). Spines along the inner shelf were short and blunt and covered by epithelium. A spine occurred along the posterior margin of the subopercle by 6.0–6.5 mm, near but dorsal to the angle spine of the outer preopercular shelf. The subopercular spine was resorbed by 20.0 mm. A small, flexible spine was present dorsally on the opercle by 10.0 mm. This spine was difficult to locate on unstained larvae because it was covered by integument.

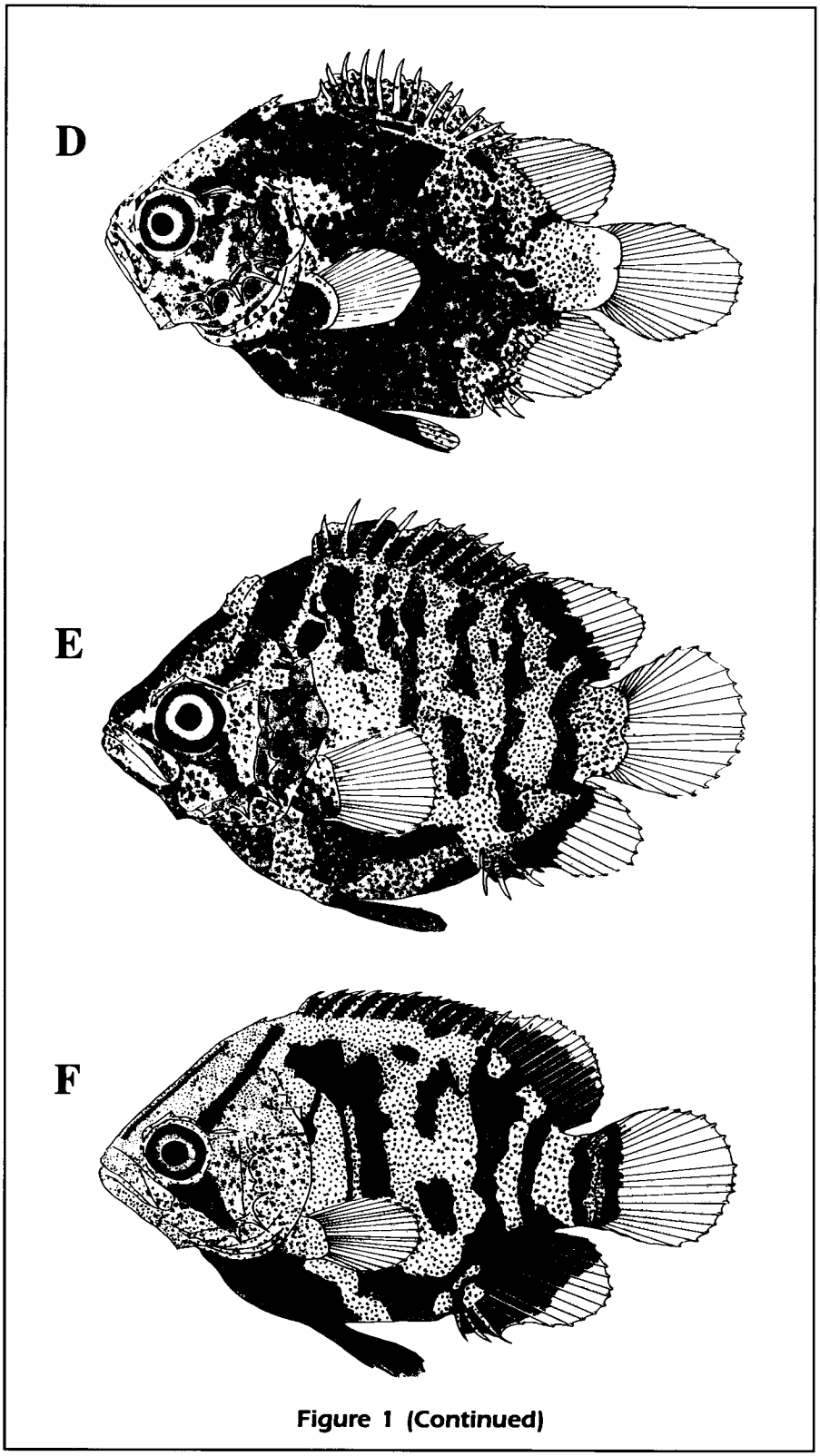

Figure 1 (Continued)

A continuous median finfold extended posteriorly around the body from the nape to the anus of early larvae. Pelvic fins were precocious and elongate (usually >25% SL) and had a full complement of

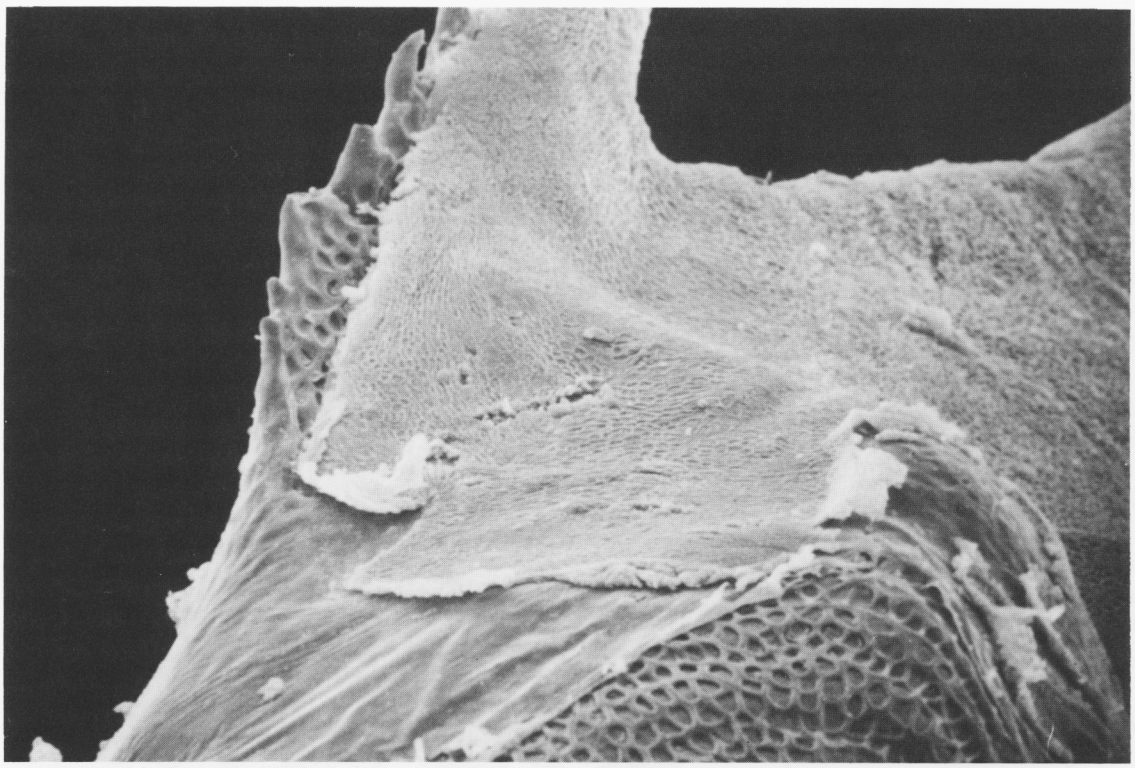

Figure 2

Scanning electron micrograph of the supraoccipital and frontal bones of a 6.3–mm standard length tripletail, *Lobotes surinamensis*, from the northern Gulf of Mexico. Magnification: 280×.

elements (I, 5) by 5.0 mm (Table 2). We were unable to determine when the pelvic-fin buds formed or flexion began because of a lack of specimens between 2.4 and 4.0 mm. Development of the hypural complex (by 4.0 mm) coincided with that of the pterygiophores of the dorsal and anal fins. Anlagen of caudal-fin rays formed obliquely in the caudal finfold. The central-most caudal-fin rays formed first and development proceeded outward from mid-base. Notochord flexion was complete by 5.0 mm. The adult complement of 9+8 principal caudal rays were present by 7.0 mm, as were all procurrent caudal rays by 9.0–9.5 mm. All dorsal- and anal-fin pterygiophores were present by 4.5–5.0 mm and both dorsal and anal spines developed before their rays in each fin. Dorsal and anal spines began to develop anteriorly and proceeded posteriorly to a full complement of elements in each fin by 6.5 mm. Pectoral rays began to form at 5.5–6.0 mm and a full complement (16 rays) was present by 7.0 mm (Table 2). A

Table 2

Fin ray counts of larval tripletail (*Lobotes surinamensis*) from the northern Gulf of Mexico. Measurements are in standard length (SL).

Size (mm SL)	*n*	Dorsal	Anal	Pectoral	Pelvic	Caudal
4.0	1	Finbase	Finbase	—	3	—
4.5	1	II, Anlagen	I, Anlagen	Anlagen	I, 5	4 + 3
5.0	1	VII, Anlagen	I, Anlagen	Anlagen	I, 5	6 + 6
6.3	1	XII, 15	II, 12	13	I, 5	7 + 7
7.1	1	XII, 15	III, 12	16	I, 5	3 – 9 + 8 – 2
10.2	1	XII, 15	III, 11	16	I, 5	4 – 9 + 8 – 4

cleared-and-stained 10.2–mm specimen had three supraneurals, six branchiostegal rays, four upper and four lower procurrent caudal rays, 11+13 vertebrae, 27 dorsal rays (XII, 15), and 14–15 anal rays (III, 11–12). Scales first appeared at 9.0–9.5 mm and marked the beginning of transition to the juvenile stage.

Spatial and temporal distribution

Overall, 75% of tripletail larvae in this study (Appendix Table 2) occurred at surface water temperatures ≥28.8°C (median=28.9°C, range=27.6–31.0°C), at salinities ≥30.3 ppt (median=31.3 ppt, range=22.0–36.0 ppt), and at stations ≥70 m deep (median=205 m, range=1–2707 m) (Figs. 3 and 4). Larvae <5.0 mm were collected only at stations ≥110 m deep. The two smallest larvae (2.2 and 2.4 mm) were taken on 28 July 1987 in a Tucker trawl sample at a station 110 m deep off Southwest Pass of the Mississippi River (Appendix Table 2). Other life stages were collected throughout the study area (Fig. 5, Appendix Table 2).

Tripletail larvae were taken almost exclusively from July through September. Two specimens were collected in neuston nets outside this time period, one taken on 21 May 1983 (7.0 mm) and the other by GCRL on 9 October 1968 (10.2 mm) (Appendix Table 2). Salinity (36.5 ppt) and station depth (2,707 m) for the May specimen were the maximums recorded for a station where larvae were collected during this study (Appendix Table 2).

Larval tripletail were collected primarily near the surface. Only 2 of 528 oblique bongo-net collections between July and September yielded tripletail larvae (n=6, 6.0–9.0 mm, 18 September 1985). Of 537 total surface net tows taken during this same time period, only 31 tows (5.8%) collected tripletail lar-

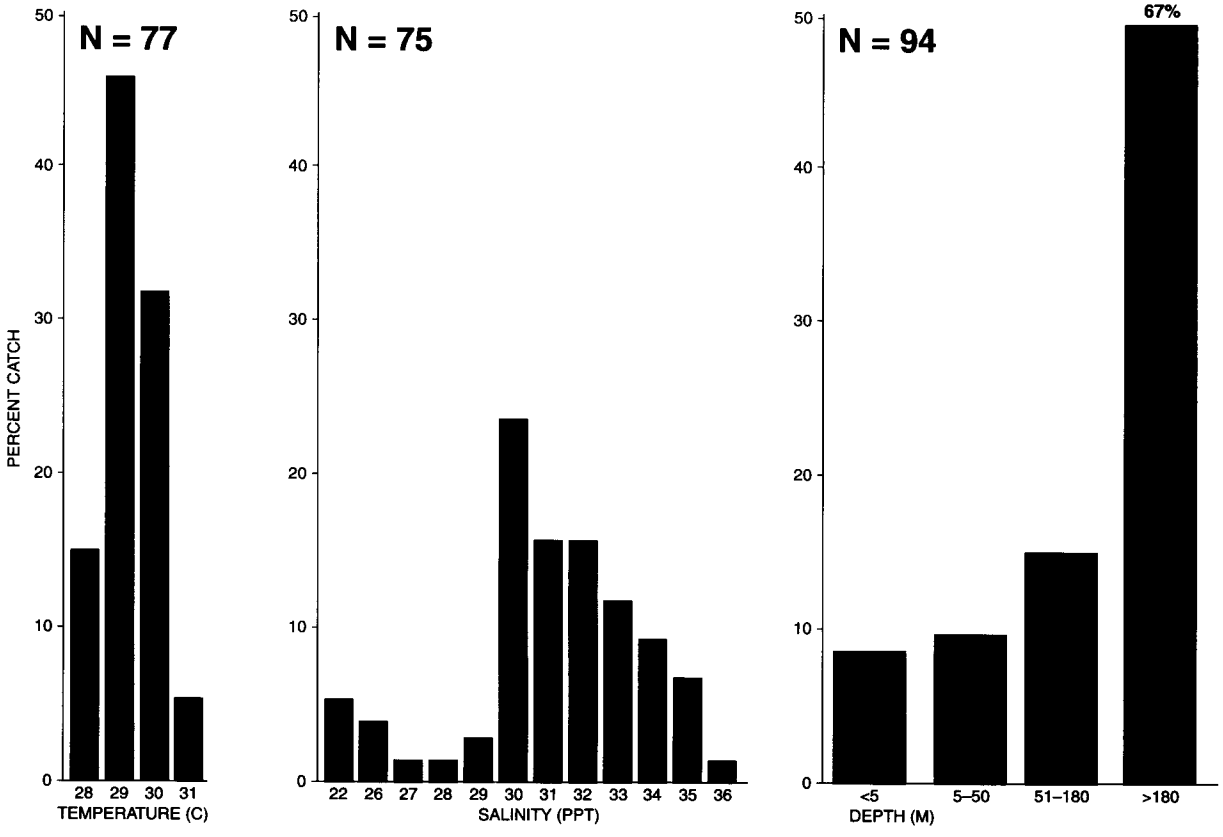

Figure 3

Summary of hydrographic data from positive catch stations for larval tripletail (*Lobotes surinamensis*) in the northern Gulf of Mexico. Percent catch is sum of larvae by interval divided by total number of tripletail larvae collected overall. Discrepancies in n (number of larvae), among parameters, are the result of missing hydrographic data. Depth is station depth.

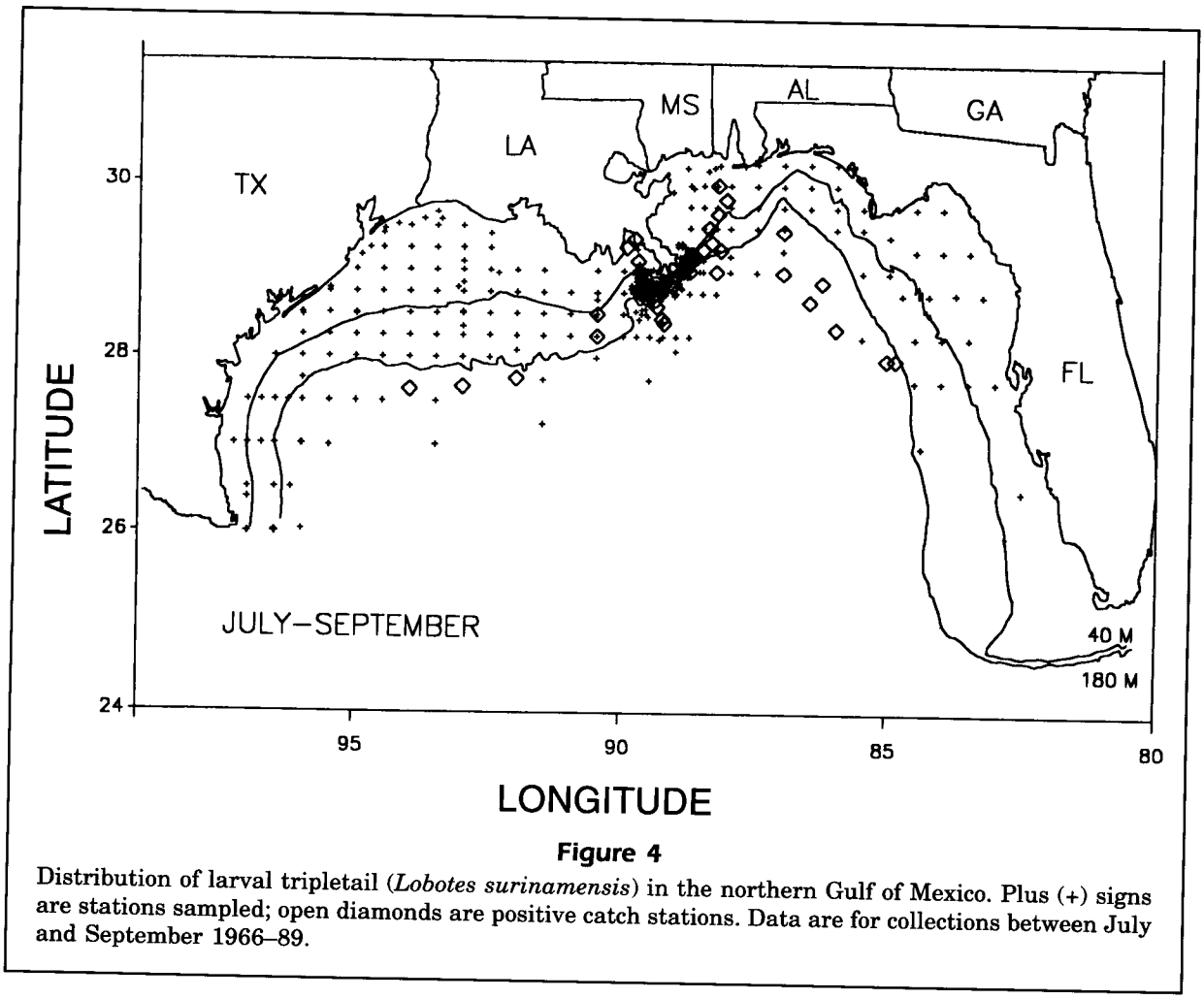

Figure 4

Distribution of larval tripletail (*Lobotes surinamensis*) in the northern Gulf of Mexico. Plus (+) signs are stations sampled; open diamonds are positive catch stations. Data are for collections between July and September 1966–89.

vae (n=79) (Appendix Tables 1 and 2). Larvae from GCRL and Freeport-McMoRan collections also occurred primarily between July and September, but collection data are not available (e.g., total number of stations sampled and extent of sampling area).

Discussion

The developmental morphology of tripletail larvae from the Gulf generally agrees with limited information provided by Uchida et al. (1958) and Johnson (1984). Larval tripletail are characterized by 1) a vaulted, median supraoccipital crest with spines along the leading edge; 2) precocious, heavily pigmented pelvic fins; and 3) large preopercular spines (Uchida et al., 1958; Johnson, 1984; this study). The supraoccipital crest is resorbed by 15.0–16.0 mm SL in Gulf specimens (this study) and by 17.5 mm TL (probably about 16.0 mm SL) off Japan (Uchida et al., 1958). Johnson (1984) described the surface of the frontal and supraoccipital bones of tripletail larvae as rugose. We would characterize these bones as having a "waffled" appearance rather than an elevated one, as implied by rugose (Fig. 2). Regardless, this modification is found in relatively few other taxa (Johnson, 1984). Sequence of fin completion in larval tripletail is P_2–D_1–D_2–A-P_1 and is unlike the six patterns described by Johnson (1984). The third anal spine is the last dorsal- or anal-fin element to form. The dark band of pigment extending backward from above and below the orbit in 10.0–mm larvae is present at 8.3 mm SL (10.6 mm TL) off Japan (Uchida et al., 1958) and in juveniles and adults (Gudger, 1931; Breder, 1949). We did not find the nasal spine noted by Uchida et al. (1958). The 5.1–mm TL specimen listed as *L. surinamensis* by Konishi (1988) lacks a supraoccipital crest and precocious pelvics, and it has a small, multi-serrate supraorbital ridge rather than the single supraorbital spine we found. Thus, we believe that Konishi's 5.1–mm TL specimen is not *L. surinamensis*.

Because tripletail have a cosmopolitan distribution, their larvae may be confused with many taxa. Larval tripletail resemble larvae of caproids, some carangids, cepolids, drepaneids, ephippids, leiog-

nathids, lethrinids, priacanthids, and *Hapalogenys* sp. These taxa generally have a median supraoccipital crest, an elongate spine at the preopercular angle, and about 24 myomeres (except cepolids which have 28+ myomeres). In addition, cepolids are lightly to moderately pigmented and have fewer dorsal spines and more soft dorsal-fin rays than tripletail (Leis and Trnski, 1989). Species of other families may have a median supraoccipital crest during development, but most have pelvic fins inserted anterior to pectorals. Also, larvae of other percoid families are usually not as deep-bodied and as heavily pigmented as tripletail by early postflexion, and few possess an elongate preopercular spine and low myomere count. Of the aforementioned taxa, only caproids, carangids, ephippids, and priacanthids occur in the Gulf of Mexico. Larvae of the caproid genus *Antigonia* are most similar to tripletail but have a serrate frontal crest and lower jaw, a very long and serrate preopercular angle spine, and more than 39 dorsal and 26 anal elements (Tighe and Keene, 1984; Leis and Trnski, 1989). In carangids, the two anterior-most anal spines are separated from the third by a distinct gap and most species have a low, median supraoccipital crest with dorsal serrations; other carangids lack a supraoccipital crest entirely. Some carangids also have a precocious dorsal fin with elongate anterior spines or rays, or a serrated preopercular angle spine. Drepaneids have pigment on the pectoral fins and multiple barbels along the lower jaw. Both larval drepaneids and ephippids are rotund and have pelvic fins inserted anterior to the pectorals. In addition, the Gulf ephippid *Chaetodipterus faber* has a supraoccipital crest with a single spine dorsally rather than the vaulted, serrate supraoccipital crest found in tripletail. Atlantic spadefish also have more anal fin elements (tripletail: A. III, 11–12; Atlantic spadefish: A. III, 17–18). Larval leiognathids and lethrinids have a supraoccipital crest that originates above the anterior margin of the eye and both taxa are lightly pigmented (Leis and Trnski, 1989). Also, lethrinids have higher anal fin counts and serrations along the lower jaw (Leis and Rennis, 1983), and leiognathids have a distinctive pattern of pigment ventrally on the tail (Leis and Trnski, 1989). Priacanthids have serrate dorsal, anal, and pelvic spines and other serrate ridges and spines on the head that tripletail lack (Johnson, 1984). *Hapalogenys* sp. larvae are extremely similar to tripletail but *Hapalogenys* sp. apparently lack pigmented pelvic fins, have a serrate supraorbital ridge, have a lacrimal spine, and have pterotic spines or a ridge (Johnson, 1984).

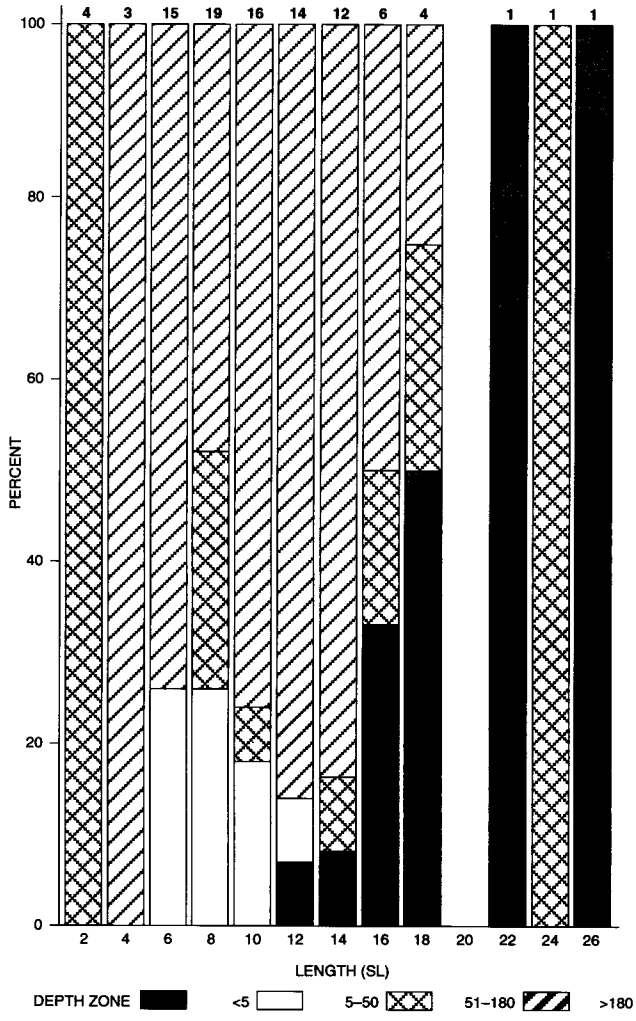

Figure 5

Distribution of larval tripletail (*Lobotes surinamensis*) in the northern Gulf of Mexico with respect to station depth (m). Length classes are combined as follows: 2 mm = 1.0–2.9 mm, 4 mm = 3.0–4.9 mm, 6 mm = 5.0–6.9 mm, etc. All measurements are standard length (SL). Numbers above bars are number of larvae in each length category.

Collections of early larvae (this study) and gravid females (Baughman, 1941; Merriner and Foster, 1974) suggest that tripletail spawn primarily during summer along both the U. S. Gulf and Atlantic coasts. In the Gulf, spawning begins in May, based on the collection of a 7.0–mm larva, and extends through September with peak spawning during July

and August (Appendix Table 2). These findings support Baughman's (1941) observation that eggs in gravid females are largest during July and August and small or absent thereafter. Larvae are collected primarily during August and September off Japan (Uchida et al., 1958).

Tripletail spawn offshore. This hypothesis of offshore spawning is supported by the collection of all larvae <5.0 mm at stations on the outer shelf and in oceanic waters. We found no published information on larval distribution as related to water temperature, salinity, or station depth of capture.

Larval and juvenile tripletail are collected primarily in surface tows (Uchida et al., 1958; this study). Juveniles are often collected with drifting sea weeds, including *Sargassum*, and near floating objects (Baughman, 1943; Breder, 1949; Uchida et al., 1958; Dooley, 1972; Benson, 1982) as they float on their side (Gudger, 1931; Breder, 1949). The size at which tripletail become associated with drifting sea weeds is poorly known, but Uchida et al. (1958) collected juveniles between 10.0 and 20.0 mm TL in seaweeds.

Adult tripletail occur primarily in gulf waters, but enter passes, inlets, and bays near river mouths (Gudger, 1931; Baughman, 1941). The degree to which tripletail utilize estuaries during their life history is unknown. Juveniles are apparently not uncommon (although they may be sporadic) in Gulf coast estuaries during the summer. We examined eight specimens (14.5–26.0 mm) collected at the surface in waters ≤3 m deep (Fig. 5). Modde and Ross (1981) collected 236 juvenile tripletail (size range not given) during 1976 in the surf zone of Horn Island, Mississippi, but only one during 1975 and five during 1977. Juveniles also occur in shallow waters (1–3 m) within the Barataria Bay system of Louisiana.[2] In contrast, juvenile and adult tripletail in the Indian River lagoon off the east coast of Florida occupy areas which average 30–31 ppt. The lagoon typically goes hypersaline, to 40 ppt, during spring when most tripletails first appear in the lagoon. Tripletail have not been observed or captured in extensive collections of oligohaline areas of the St. Lucie River and Sebastian Creek.[3]

Adult tripletail generally occur along the Gulf coast from April through early October (Baughman, 1941) and are caught in great numbers in Mobile Bay, Alabama, and along the Mississippi coast during summer (Baughman, 1941). Greatest concentrations of adults are found along the northern Gulf from St. Marks, Florida, to the St. Bernard River, Texas (Baughman, 1941). Seasonality of adults suggests that tripletail migrate south during fall and winter and return in spring (Merriner and Foster, 1974). Tripletail congregate around sea buoys, beacons, pilings, and other objects (Gudger, 1931) but have been collected in a wide variety of habitats including rocky and coral reef areas in deeper water (Baughman, 1941).

[2] Leroy Kennair, Freeport-McMoRan, Inc., New Orleans, LA., pers. commun. 1993.

[3] R. Grant Gilmore, Harbor Branch Oceanographic Institution, Fort Pierce, FL, pers. commun. 1993.

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Appendix Table 1

Summary of total number of bongo-net/neuston-net stations examined for tripletail larvae (*Lobotes surinamensis*) in the Gulf of Mexico. Acronyms are as follows: SEAMAP = Southeast Area Monitoring and Assessment Program; NMFS = National Marine Fisheries Service, Panama City, Florida; LSU = Louisiana State University. NS means no samples.

	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SEAMAP										
1982	77[1]/0[2]	69/68	71/73	102/100	26/24	NS	NS	3/8	29/3	NS
1983	15/13	27/27	84/84	55/45	44/42	NS	NS	39/26	NS	24/23
1984	23/0	44/0	46/0	55/54	20/26	155/162	NS	24/0	6/0	36/36
1985	29/0	NS	NS	85/0	39/0	69/0	20/0	4/0	2/0	24/0
1986	NS	24/0	90/0	57/0	10/0	NS	145/0	43/0	73/0	24/0
TOTAL	144/13	164/95	291/157	354/199	139/92	224/162	165/0	113/34	110/3	108/59
NMFS[2]										
1986							46			
1987							68			
1988			55			71				36
1989							35			
LSU										
1987[3]					63					
1988[4]		45								
1990[1]								17		

[1] 60-cm bongo net, 0.333-mm mesh, oblique-tow from depth.
[2] 1 × 2 m neuston net, 0.947-mm mesh, 10 min. surface-tow, unmetered.
[3] 1m² Tucker trawl, 0.947-mm mesh, 3 min. surface-tow each net, nine net collections per station, seven total stations.
[4] 1m² MOCNESS, nine nets of 0.333-mm mesh, 3-min. surface-tow each net, five total stations.

Appendix Table 2

Positive catch station data for tripletail (*Lobotes surinamensis*) larvae from northern Gulf of Mexico waters. Gear codes are: B=bongo net, N=Neuston net, T=Tucker trawl, U=unknown.

Station	Date	Gear	Latitude	Longitude	Station depth (m)	°C	PPT	*n*	Length (mm SL)
SEAMAP[1]									
1420	5–21–83	N	26°30	88°00	2707	27.6	36.5	1	7.0
3235	7–17–84	N	28°15	90°30	70	29.4	25.9	1	8.8
3238	7–17–84	N	28°30	90°30	38	29.4	25.8	1	7.0
3259	7–22–84	N	29°00	87°00	1251	28.9	32.8	1	12.3
2511	8–03–84	N	29°00	88°15	1013	27.6	32.4	7	7.1–18.5
2523	8–03–84	N	29°15	88°30	82	28.0	26.0	1	7.9
2548	8–05–84	N	29°00	88°45	249	27.6	28.7	1	16.8
4231	8–05–84	N	29°28	87°00	486	28.9	30.3	16	6.8–13.0
4201	8–01–85	N	28°00	84°52	205	29.6	30.8	10	10.3–15.9
4204	8–01–85	N	28°00	85°02	265	28.8	32.6	5	9.0–16.5
4210	8–02–85	N	28°21	86°00	457	28.8	32.1	4	6.8–10.0
4216	8–03–85	N	28°53	86°16	335	29.1	31.3	2	9.0
4219	8–03–85	N	28°40	86°30	457	28.9	33.6	1	9.9
4320	8–24–85	N	27°38	94°00	455	28.0	—	1	4.0
4326	8–25–85	N	27°40	93°00	265	29.7	36.0	1	7.8
4332	8–26–85	N	27°46	92°00	457	30.0	35.4	1	9.1
4484	9–18–85	B	29°07	89°44	20	27.8	29.5	2	6.0
4490	9–18–85	B	28°37	90°26	27	27.8	32.6	4	6.4–9.0
LSU[2]									
137	7–28–87	T	28°42	89°29	110	29.5	22.0	2	2.2–2.4
145	7–28–87	T	28°35	89°22	182	29.6	32.5	2	5.0
163	7–30–87	T	28°24	89°14	640	31.0	33.6	2	6.3
168	7–30–87	T	28°24	89°14	640	31.0	33.6	2	6.3
175	7–30–87	T	28°27	89°16	410	29.8	35.3	2	—
177	7–30–87	T	28°27	89°16	410	29.8	35.3	2	4.5
GCRL[3]									
Station 6	7–13–67	N	29°15	88°11	182	—	—	1	12.5
T–108–7–02	8–25–71	U	29°10	88°45	55	—	—	1	8.7
T–108–3–04	8–27–71	U	29°50	88°05	27	—	—	1	11.7
T–208–4–01	8–23–72	U	29°40	88°14	38	—	—	2	7.2–7.3
T–109–6–02	9–21–71	U	29°20	88°21	55	—	—	1	15.4
T–109–5–03	9–22–71	U	29°30	88°24	46	—	—	1	8.6
T–209–2–01	9–15–72	U	30°00	88°14	27	—	—	2	7.7–10.7
Station 5	10–09–68	N	29°19	88°14	73	—	—	1	10.2
Freeport-McMoRan[4]									
2	8–24–71	U	29°16	89°57	1	—	—	1	14.5
3	8–10–71	U	29°22	89°48	3	—	—	2	16.5–18.5
4	8–23–73	U	29°16	89°57	1	—	—	1	26.0
5	8–15–66	U	29°16	89°57	3	—	—	4	11.5–21.5
NMFS[5]									
53	8–28–88	N	29°00	88°53	149	30.3	27.5	1	10.8
58	8–29–88	N	29°07	88°49	82	29.5	29.0	1	13.7
5	9–03–87	N	29°12	88°43	71	29.3	32.8	1	23.0
23	9–25–86	N	28°50	89°05	195	29.4	34.0	2	7.3–13.2
32	9–06–89	N	28°49	89°16	410	29.8	35.3	1	18.7
42	9–26–86	N	29°09	88°40	77	29.3	—	1	8.6
43	9–05–87	N	28°46	89°29	104	29.2	32.1	1	7.5

[1] Southeast Area Monitoring and Assessment Program.
[2] Louisiana State University, Coastal Fisheries Institute, Baton Rouge.
[3] Gulf Coast Research Lab, Ocean Springs, Mississippi.
[4] Freeport-McMoRan, Inc., New Orleans, Louisiana.
[5] National Marine Fisheries Service, Panama City Lab, Florida.