Northeast Gulf Science

Volume 5
Number 1 *Number 1*

Article 13

10-1981

Identification of Small (<3 >mm) Larvae of King and Spanish Mackerel, *Scomberomorus cavalla* and *S. maculatus*

Sally L. Richardson
Gulf Coast Research Laboratory

John D. McEachran
Texas A&M University

DOI: 10.18785/negs.0501.13

IDENTIFICATION OF SMALL (< 3mm) LARVAE OF KING AND SPANISH MACKEREL, *Scomberomorus cavalla* and *S. maculatus*

Ichthyoplankton surveys in the Gulf of Mexico off Texas yielded larvae of *Scomberomorus cavalla* and *S. maculatus* as small as 1.8 mm standard length (McEachran et al., 1980), the smallest ever reported from field collections. These small larvae, < 3 mm SL, are described here for the first time with emphasis on diagnostic pigment characters.

The larvae of these important pelagic species (Manooch, 1979; Trent and Anthony, 1979) are potentially valuable resource assessment tools (Houde, 1977; Smith and Richardson, 1977) in the Gulf of Mexico and Western Atlantic. Because the larvae of these two species may co-occur (McEachran et al., 1980), correct identification of each species is critical to the success of any such venture. Although myomere counts (Wollam,, 1970) will separate the two species (42-43 for *cavalla* and 52-53 for *maculatus*), they are tedious and often impossible to make on small, damaged larvae. The information presented here allows easy separation of even damaged specimens, as long as the melanistic pigment in the head and nape region is still visible.

Wollam (1970) described the larval development of king and Spanish mackerel > 3 mm SL, but few descriptions of larvae < 3 mm exist and none of these provides comparative data adequate to distinguish the two species. Ryder (1882) described the eggs and newly hatched larvae (ca. 2.4-3.2 mm SL) of *S. maculatus*. Hildebrand and Cable (1938) described larvae and juveniles (2.75-22 mm SL) they called *S. maculatus,* but the 3-5.75 mm specimens were incorrectly identified and the identity of the 2.75 mm specimen is subject to question (Wollam 1970). Mayo (1973) provided a description of *S. cavalla* from hatching (2.98 mm SL) to 7.42 mm SL. The descriptions by Ryder (1882) and Mayo (1973) were presumably based on living or recently preserved reared material and do not correlate well, in terms of size, developmental state, and pigment characteristics, with the preserved plankton material discussed in this paper. We provide data to assist in the practical separation of small (< 3 mm SL) larvae of these two species in mixed plankton samples.

METHODS

Larvae were collected during ichthyoplankton surveys conducted in the northwestern Gulf of Mexico off Texas from 1975 to 1977 (McEachran et al, 1980). All material was preserved in a solution of 7% buffered formalin and seawater. Length measurements are standard length, from anterior margin of snout to notochord tip. Additional measurements of larvae were made according to definitions given by Wollman (1970). Illustrations were made with the aid of a camera lucida.

RESULTS AND DISCUSSION

(Figure 1; Tables 1-3)

The smallest larvae taken of both king and Spanish mackerel were 1.8 mm SL. This is smaller than the size at hatching reported for each species, 2.98 mm SL (Mayo, 1973) and ca. 2.40 mm SL (Ryder, 1882). This may reflect shrinkage due to formalin preservation (e.g. Farris, 1963; Schnack and Rosenthal, 1978; Rosenthal *et al.*, 1978, Theilacker, in press) as both previous studies presumably were based on live or recently preserved material. The 1.8 mm specimens in this study have no remnants of yolk, i.e. they are in a post yolk-sac, preflexion condition. They are more developed than the ca. 2.4-3.0 mm

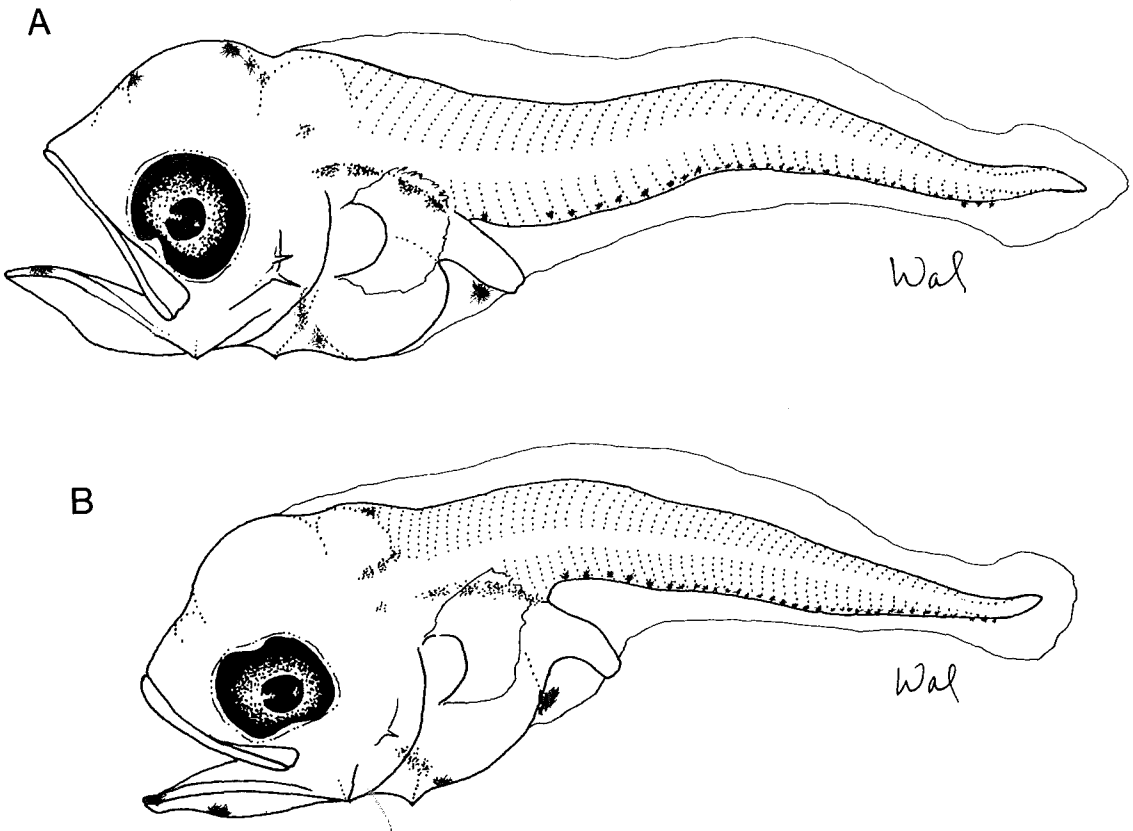

Figure 1. Larvae of A) *Scomberomorus cavalla*, 2.3 mm SL and B) *Scomberomorus maculatus*, 2.1 mm SL.

SL specimens illustrated by Ryder (1882) and the 2.98 mm specimen illustrated by Mayo (1973) but less developed than the 3.1 and 3.3 mm specimens of Wollam (1970).

The most readily observable diagnostic character of these small (1.8-3.0 mm) larvae is pigmentation. Larvae of *S. cavalla* all have 1-5 melanophores dorsally over the posterior portion of the mid-

Table 1. Summary of selected melanistic pigment characters on small (< 3 mm) larvae of *Scomberomorus cavalla*. +, present; -, absent; number indicates count of melanophores.

S.L.	VMM*	NAPE	FORE-BRAIN	MID-BRAIN				HINDBRAIN		LOWER JAW	
				DORSAL		POST-LATERAL			ANTERO-		
				ANTERIOR	POSTERIOR	LEFT	RIGHT	DORSAL	VENTRAL	LEFT	RIGHT
2.0	36	—	—	1	3	—		—	+	1	1
2.2	33	—	—	1	1	—	—	—	+	1	1
2.3	26+	—	—	1	3	—	—	—	+	1	1
2.3	36	—	—	2	3	—	—	—	+	1	1
2.3	31	—	—	—	2	—	—	—	+	1	1
2.3	33	—	—	2	3	—	—	—	+	1	1
2.3	32	—	—	—	3	—	—	—	+	1	1
2.3	31	—	—	—	2	—	—	—	+	1	1
2.3	34	—	—	—	2	—	—	—	+	1	1
2.3	30	—	—	1	3	1	—	—	+	1	1
2.4	29	—	—	1	2	—	—	—	+	1	1
2.5	32	—	—	—	3	—	—	—	+	1	1
2.6	32	—	—	—	3	—	—	—	+	1	1
2.6	31	—	—	—	2	—	—	—	+	1	1
2.6	32	—	—	1	2	—	—	—	+	1	1
2.6	36	—	—	2	4	1	1	—	+	1	1
2.7	30	—	—	2	5	—	—	—	+	2	1
2.7	31	—	—	—	2	—	—	—	+	1	1
2.9	32	—	—	2	5	—	—	—	+	1	1
2.9	29	—	—	—	2	—	—	—	+	1	1

*Ventral midline melanophores, postanal. Count includes 1-4 "caudal" spots located in the finfold where the base of the caudal fin will develop.

DOI: 10.18785/negs.0501.13

Table 2. Summary of selected melanistic pigment characters on small (< 3 mm) larvae of *Scomberomorus maculatus*. +, present; -, absent; number indicates count of melanophores.

S.L.	VMM*	NAPE	FORE-BRAIN	MID-BRAIN				HINDBRAIN		LOWER JAW	
				DORSAL		POST-LATERAL			POSTERO-		
				ANTERIOR	POSTERIOR	LEFT	RIGHT	DORSAL	VENTRAL	MEDIAL	TIP
1.8	30+	+	—	—	—	—	—	—	+	1	—
1.9	28+	+	—	—	—	—	—	—	+	1	—
2.0	38	+	—	—	—	—	—	—	+	1	+
2.0	33	+	—	—	—	—	—	—	+	1	+
2.0	39	+	—	—	—	—	—	—	+	1	—
2.1	40	—	—	—	—	—	—	—	+	1	—
2.1	39	+	—	—	—	—	—	—	+	1	+
2.2	37	+	—	—	—	—	—	—	+	1	—
2.2	41	+	—	—	—	—	—	—	+	1	—
2.3	35	+	—	—	—	—	—	—	+	1	—
2.3	36+	+	—	—	—	—	—	—	+	1	+
2.4	31	+	—	—	—	—	—	—	+	1	+
2.4	29	+	—	—	—	—	—	—	+	1	—
2.4	29	—	—	—	—	—	—	—	+	1	+
2.5	?	+	—	—	—	—	—	—	+	2	—
2.5	40	+	—	—	—	—	—	—	+	1	+
2.5	28	—	—	—	—	—	—	—	+	1	—
2.5	22	—	—	—	—	—	—	—	+	2	+
2.8	29	—	—	—	—	—	—	—	+	1	+
2.9	39	—	—	—	—	—	—	—	+	1	+

*Ventral midline melanophores, postanal. Count includes 1-5 "caudal" spots located in the finfold where the base of the caudal fin will develop.

brain. Additionally, some specimens have a melanophore on one or both sides of the anterodorsal portion of the midbrain. Also, an internal melanophore may be present on one or both sides of the midbrain postlaterally. The latter is usually present on specimens > 3 mm. This midbrain pigment is usually not found on *S. maculatus* of similar size. A spot of pigment is also present internally along the anteroventral base of the hindbrain on all specimens. A melanophore (rarely two) is consistently present midway along the dorsal surface of the left or right dentary and usually both. No pigment occurs in the nape area. Total number of ventral midline melanophores is 29-36, generally decreasing with development. Melanophores are also present dorsally over the gas bladder and gut, along the anteroventral margin of the gut near the cleithrum and immediately anterior to the anus on the ventral margin.

Small larvae (1.8-3.0 mm) of *S. maculatus* usually have no pigment on the midbrain. However a few (3 out of 25) specimens < 3.0 mm (2.7-2.9 mm) not listed in Table 2 were observed to have one or two melanophores over the midbrain reflecting some within species

Table 3. Measurements (mm) of selected small (< 3 mm SL) larvae of king and Spanish mackerel, *Scomberomorus cavalla* and *S. maculatus*.

Standard Length	Head Length	Snout Length	Orbit Diameter	Upper Jaw Length	Lower Jaw Length	Body Depth at Cleithrum	Body Depth Posterior to Anus	Snout to Anus	Preopercular Spine Length
Scomberomorus cavalla									
2.3	0.65	0.20	0.30	—	—	0.66	0.30	1.2	0.04
2.4	0.80	0.19	0.38	0.45	0.44	0.72	0.32	1.2	0.09
2.5	0.70	0.21	0.32	0.42	—	0.74	0.31	1.2	0.07
2.5	0.80	0.24	0.34	0.42	0.54	0.74	0.34	1.2	0.10
2.6	0.71	0.22	0.30	0.44	—	0.84	0.32	1.2	0.10
2.7	0.84	0.24	0.36	0.46	0.61	0.72	0.31	1.3	0.08
2.7	0.90	0.25	0.34	0.51	0.56	0.82	0.36	1.2	0.14
Scombermorus maculatus									
1.8	0.52	0.04	0.29	0.20	—	0.52	0.22	0.8	—
2.1	0.60	0.14	0.26	0.34	0.42	0.56	0.22	1.0	0.02
2.2	0.62	0.17	0.30	0.36	0.44	0.72	0.26	1.1	0.03
2.2	0.64	0.14	0.31	0.31	0.42	0.55	0.24	1.0	0.02
2.3	0.62	0.18	0.30	0.32	0.46	0.54	0.26	1.1	0.02
2.3	0.70	0.19	0.31	0.42	0.44	0.69	0.30	1.1	0.04
2.4	0.62	0.18	—	0.36	0.43	0.72	0.30	1.1	0.04
2.4	0.72	0.19	0.35	—	—	0.72	0.32	1.3	0.04

variability. Pigment is added to this region on larger specimens (Wollam, 1970). Specimens < 2.5 mm usually (3 out of 25 did not) have dorsal nape pigment which is not found in *S. cavalla*. This nape pigment becomes internal with development and becomes obscured by tissue on larger specimens. All specimens have pigment internally along the mid- and postero-ventral surface of the hindbrain often appearing as a dark line. The location and amount of this ventral hindbrain pigment differs from that on *S. cavalla* in that it is more posterior and more extensive. Also, a prominent melanophore (rarely two) is persistently present on the midventral surface of the lower jaw. The tip of the lower jaw often is pigmented. Ventral midline melanophores of 20 specimens number 22-41. Pigment in the vicinity of the abdominal cavity resembles that described above for *S. cavalla.*

The smallest larvae, 1.8 mm, have no spines in the head region although spines are added to the preopercular margin with development appearing first at the angle. The supraoccipital crest is not present. The larvae have well developed jaws, e.g. upper jaw length averages 57% and 53% HL in king and Spanish mackerel. The eyes are moderately large (44% and 48% HL) and the larvae are relatively deep-bodied at the cleithrum (30% and 28% SL.). They have a typically scombrid appearance (Wollam, 1970) even at these small sizes and a characteristically high number of myomeres as mentioned above.

Differences in lower jaw pigment (lateral dentary compared to mid-ventral) between the two species were noted by Wollam (1970) in larvae > 3 mm, but he stated that the presence of the mid-ventral melanophore of *S. maculatus* was variable. This was found to be a constant feature in the larvae we examined. Wollam (1970) did not note the differences in midbrain, hindbrain, and nape pigment described above. Knowledge of these pigment differences in the jaw, head, and nape regions allows for ease of separation of the two species, even if specimens are badly damaged, including those with damaged heads as long as the melanistic pigment has not completely faded or been eroded.

ACKNOWLEDGMENT

Wayne A. Laroche illustrated the larvae and provided technical assistance. Lyman E. Barger, L. Alan Collins, Allen Dixon and William Slingerland sorted mackerel larvae from the plankton samples. John H. Finucane assisted with confirmation of species identifications. This research was supported in part by the Texas A&M University Sea Grant Program, Project No. 53533.

LITERATURE CITED

Farris, D.A. 1963. Shrinkage of sardine *(Sardinops caerulea)* larvae upon preservation in buffered formalin. Copeia 1963: 185-186.

Hildebrand, S.F. and L.E. Cable. 1938. Further notes on the development and life history of some teleosts at Beaufort, N.C. Bull. U.S. Bur. Fish. 48(24): 505-642.

Houde, E.D. 1977. Abundance and potential yield of Atlantic thread herring, *Opisthonema oglinum,* and aspects of its early life history in the eastern Gulf of Mexico. Fish. Bull., U.S. 75: 493-512.

Manooch, C.S., III. 1979. Recreational and commercial fisheries for king mackerel, *Scomberomorus cavalla*, in the South Atlantic Bight and Gulf of Mexico, U.S.A., p. 33-41. *In* E.L. Nakamura and H.R. Bullis, Jr. (eds.). Proceedings: Colloquium on the Spanish and king mackerel re-

DOI: 10.18785/negs.0501.13

sources of the Gulf of Mexico, March 16, 1978. Gulf States Mar. Fish. Comm. No. 4.

Mayo, C.A. 1973. Rearing, growth, and development of the eggs and larvae of seven scombrid fishes from the Straits of Florida. Ph.D. Thesis, Univ. Miami, Coral Gables, Fla. 128 p.

McEachran, J.D., J.H. Finucane, and L.S. Hall. 1980. Distribution, seasonality and abundance of king and Spanish mackerel larvae in the northwestern Gulf of Mexico (Pisces: Scombridae). Northeast Gulf Sci. 4(1): 1-16.

Rosenthal, H., D. Kuhlmann, and O. Kukuhara. 1978. Shrinkage of newly hatched larvae of the Red Sea bream (*Chrysophrys major* Temminck and Schlegal) preserved in formalin. Arch. fur Fischwiss. 29 (1-2): 59.

Ryder, J.A. 1882. Development of the Spanish mackerel (*Cybium maculatum*). Bull. U.S. Fish. Comm. 1:135-172.

Schnack, D., and H. Rosenthal. 1978. Shrinkage of Pacific herring larvae due to formalin fixation and preservation. Meeresforschung. Rep. Mar. Res. 26(3-4): 222.

Smith, P.E., and S.L. Richardson (Editors). 1977. Standard techniques for pelagic fish egg and larva surveys. FAO Fish. Tech. Pap. 175, 100 p.

Theilacher, G.H. in press. Changes in body measurements of larval northern anchovy, *Engraulis mordax*, and other fishes due to handling and preservation. Fish. Bull, U.S. 78 (3).

Trent, L., and E.A. Anthony. 1979. Commercial and recreational fisheries for Spanish mackerel, *Scomberomorus maculatus*, p. 17-32. *In* E.L. Nakamura and H.R. Bullis, Jr. (eds.). Proceedings: Colloquim on the Spanish and king mackerel resources of the Gulf of Mexico, March 16, 1978. Gulf States Mar. Fish. Comm. No. 4.

Wollam, M.B. 1970. Description and distribution of larvae and early juveniles of king mackerel, *Scomberomorus cavalla* (Cuvier), and Spanish mackerel, *Scomberomorus maculatus* (Mitchill); (Pisces: Scombridae); in the western North Atlantic. Fla. Dept. Nat. Resources, Tech. Ser. No. 61, 35 p.

Sally L. Richardson, *Gulf Coast Research Laboratory, East Beach Drive, Ocean Springs, MS 39564*

John D. McEachran, *Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843*