Problems Identifying Tuna Larvae Species (Pisces: Scombridae: *Thunnus*) from the Gulf of Mexico

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The identification of tuna larvae of the genus *Thunnus* is very difficult. Five species of the genus *Thunnus* may spawn in the Gulf of Mexico: *albacares*, *obesus*, *alalunga*, *thynnus*, and *atlanticus*. Criteria for their identification have been established by Matsumoto et al. (1972), Potthoff (1974), and by Richards and Potthoff (1974). A combination of pigment patterns and osteological characters is the criteria used. Pigment patterns are used for larvae in the 3mm-NL to 10mm-SL size range, and osteological characters are used in larvae larger than 5 mm NL just during and after notochord flexion. Larvae larger than 7 mm SL are rare and pigment characters are not as useful since juvenile pigmentation begins to obscure the larval pigmentation, and larvae less than 5 mm NL usually do not have sufficient cartilage or bone development to determine vertebral counts or first closed hemal arch location. The combination of both character sets does allow for reliable identification in most cases. Clearing and staining larvae and the subsequent osteological examination are very time-consuming, whereas pigment pattern analysis is quite fast during normal larval ichthyoplankton identification. We conduct extensive ichthyoplankton surveys of the Gulf of Mexico annually (Richards et al. 1984, Kelley et al. 1986), and it is impractical to clear, stain, and perform osteological examination on all *Thunnus* obtained. In this study we cleared, stained, and osteologically examined all *Thunnus* larvae collected in 1982 (Richards et al. 1984) to determine a baseline value for species occurrence.

Methods

A total of 362 *Thunnus* (4.5 mm NL–9.1 mm SL) larvae were examined for the presence of black pigment on the upper and lower jaw tips, along the ventral midline of the tail, along the dorsal midline, along the lateral midline, and on the caudal fin. Since these specimens had been fixed in formalin and preserved in ethanol, red pigments were no longer present. All *Thunnus* larvae taken during 1982 and a few from 1983 were utilized, except for those which were typical *T. thynnus* (possessing pigment on both the dorsal and ventral margins of the tail) or those specimens less than 4.4 mm NL. Following pigmentation examination, specimens were cleared and stained following Potthoff (1984), and vertebral counts and position of the first closed hemal arch determined. Species identification followed the criteria established by Matsumoto et al. (1972), Potthoff (1974), and by Richards and Potthoff (1974) for North Atlantic *Thunnus* species (Table 1).

Results

Of the 362 larvae, 95 larvae will not be considered further because 4 were typical *thynnus*, 11 had no tail pigment and were too small for osteological data, 61 had ventral tail pigment and were too small for osteological data, 3 were not *Thunnus*, and 16 were lost or badly damaged during the clearing and staining process. Of the remaining 267 larvae, 241 could be reliably identified (Table 2). Most of the larvae consisted of the *atlanticus* morph with ventral tail pigment (72.7%), although a few (6.0%) lacked this. Those with ventral tail pigment are inseparable from *obesus* except by osteological criteria, and those without it are inseparable from *albacares*. Only 4.9% were *obesus*, only 6.0% were *albacares*, and 2 larvae (0.7%) were *alalunga*. The remaining 26 larvae (9.7%) cannot be positively identified (Table 3). These data demonstrate the variability which can be found in these species.

Discussion

When Richards and Potthoff (1974) made a similar study, their specimens were mainly from the Caribbean Sea and Straits of Florida. They also found that the abundant species was *atlanticus*, with few *albacares* and *obesus* larvae confirmed in the western Atlantic. These results confirm this same

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Table 1
Criteria for identification of larval *Thunnus*.

	alalunga	*albacares*	*atlanticus*	*obesus*	*thynnus*
Dorsal tail pigment	No	No	No	No	Yes
Ventral tail pigment	No	No	Yes/No	Yes	Yes
Lower jaw pigment	No	Yes	Yes	Yes	Yes
Vertebrae	18+21	18+21	19+20	18+21	18+21
First hemal arch	10	11	11	11	10

Table 2
Characters of confirmed identifications of larval *Thunnus* (4.5 mm NL–9.1 mm SL). The characters of the remaining 26 unidentifiable larval *Thunnus* are given in Table 3.

No.	%	Ventral tail	Dorsal tail	Vertebrae	Haemal arch	Identification
194	72.7	Present	Absent	19+20	11	*atlanticus*
16	6.0	Absent	Absent	19+20	11	*atlanticus*
16	6.0	Absent	Absent	18+21	11	*albacares*
13	4.9	Present	Absent	18+21	11	*obesus*
2	0.7	Absent	Absent	18+21	10	*alalunga*
26	9.7	See Table 3				*Thunnus* sp.

Table 3
Characters of unidentifiable larval *Thunnus*.

No.	Ventral tail	Dorsal tail	Vertebrae	Haemal arch	Possible identity
5	Present	Absent	20+19	11	*atlanticus*
4	Present	Absent	18+21	10	*atlanticus/obesus/thynnus*
3	Absent	Absent	18+21	12	*albacares*
2	Present	Absent	19+21	11	*atlanticus/obesus*
1	Absent	Present	19+20	11	*atlanticus/thynnus*
1	Absent	Absent	19+20	10	*alalunga/albacares/atlanticus*
1	Absent	Absent	19+20	13	*alalunga/albacares/atlanticus*
1	Present	Absent	18+21	10	*obesus/thynnus*
1	Absent	Absent	20+19	11	*albacares/atlanticus*
1	Present	Absent	18+21	12	*atlanticus/obesus*
2	Present	Present	19+20	10	*atlanticus/thynnus*
2	Present	Present	19+20	12	*atlanticus/thynnus*
2	Present	Present	19+20	—	*atlanticus/thynnus*

trend for the Gulf of Mexico. Of the larvae shown in Table 2, 78.7% are definitely *atlanticus* with 10.9% *albacares* or *obesus*. The two *alalunga* were a surprise, as the adults of that species have not been taken in the Gulf of Mexico (Collette and Nauen 1983:81); but given the variability found in these larval characters, these data should not be used as unequivocal criteria for recording this species in the Gulf. We have speculated on the identity of the specimens listed in Table 3; as one can see, this speculation raises possibilities but not certainties.

Thunnus atlanticus is very common in the Gulf of Mexico and spawning is widespread as evidenced by larval data (Richards et al. 1984). *Thunnus albacares* supports a developing fishery, but spawning may not be as widespread based on our 1982 data. In future studies focusing on albacares, researchers will have to use cleared and stained specimens to confirm larval abundance reliably, since about 50% of those larvae lacking ventral tail pigment may be *atlanticus* morphs or possibly even *alalunga* (Table 2). Recently, Graves et al. (1989) have shown that small juveniles 10–21 mm

TL of *T. albacares* could be distinguished electrophoretically from *T. obesus*. In the 10–12 mm TL range, some of their specimens had ventral tail pigment and some did not, but had the *albacares* electrophoretic character. The ventral or dorsal tail pigment seen in specimens this large is the juvenile pattern and not the larval pigment pattern. Distinguishing between larval and juvenile pigmentation is very difficult in these transforming sizes, and care must be taken to document the size and nature of the pigment.

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