

**IDENTIFICATION AND OCCURRENCE OF *THUNNUS* LARVAE COLLECTED FROM THE GULF OF MEXICO AND THE MEDITERRANEAN SEA BY THE SHOYO-MARU CRUISE IN 1994 WITH THE REVIEW OF RECENT IDENTIFICATION STUDY OF LARVAL *THUNNUS***

*Ueyanagi, S., Y. Nishikawa, S. Tsuji*

**SUMMARY**

Larval tuna identification, particularly in the genus *Thunnus* was clarified and reported in detail based on the cooperative study of the Larval Tuna Identification Workshop, held in Honolulu, Hawaii, in 1970 (Matsumoto *et al.*, 1972).

Some identification problems, however, remained and were noted to be resolved in that identification of *T. tonggol* has yet to be confirmed, *T. maccoyii* needs to be confirmed, and identification of *T. atlanticus* was not resolved, etc. (Matsumoto *et al.*, 1972). Since then, the early life history study of tunas has been continued and those identification problems were mostly resolved as indicated in this paper.

**RÉSUMÉ**

L'identification des larves de thonidés, en particulier de *Thunnus*, est expliquée et détaillée à partir des résultats des recherches conjointes menées dans le cadre des Journées d'Identification des Larves de thonidés, qui ont eu lieu en 1970 à Honolulu, Hawaï (Matsumoto *et al.*, 1972).

Toutefois, certains problèmes d'identification doivent encore être étudiés. L'identification du *T. tonggol* et du *T. maccoyii* n'est pas confirmée et celle du *T. atlanticus* n'a donné aucun résultat (Matsumoto *et al.*, 1972). Les études sur les premières étapes vitales des thonidés ont été poursuivies et les recherches sur l'identification ont donné les résultats suivants.

**RESUMEN**

Se aclara e informa detalladamente sobre la identificación de las larvas de tónidos, particularmente del género *Thunnus*, basándose en el estudio cooperativo de las Jornadas de Trabajo sobre Identificación de Larvas, celebrado en Honolulu, Hawaii, en 1970 (Matsumoto *et al.* 1972).

Sin embargo, persistían algunos problemas de identificación por resolver en cuanto a que la identificación de *T. tonggol* aún estaba por confirmar, *T. maccoyii* necesitaba confirmación, y la identificación de *T. atlanticus* no estaba resuelta, etc. (Matsumoto *et al.*, 1972). Desde entonces, ha continuado el estudio de las primeras fases vitales de los tónidos, y tales problemas de identificación se resolvieron en su mayor parte, como sigue.

**1. Indian and Pacific Oceans :**

Based on the specimens obtained from the eastern Indian Ocean and northwestern Pacific Ocean, melanophore patterns in tuna larvae of the three species—*T. thynnus*, *T. maccoyii* and *T. obesus* — were examined and discussed for those on the dorsal and ventral margins of the trunk, the mid-lateral trunk and the caudal fin region (Nishikawa, 1985). Nishikawa found that melanophore patterns vary among larvae of individual tuna species but typical ones often bear specific characteristics.

For the identification of *T. maccoyii* larvae, melanophore patterns in the caudal fin region are considered particularly important to distinguish *maccoyii* larvae from *thynnus* larvae. He also noted that there is a slight difference in the sizes of the melanophores on the dorsal margin of the trunk between two species, being smaller in *maccoyii* larvae than in *thynnus* larvae as was previously noted (Ueyanagi, 1969). He also found that some larvae lack melanophores on the dorsal margin of the trunk (15% of

specimens), which may confuse them with *obesus*.

For the identification of *T. obesus* larvae, the following melanophore patterns are noted. Larval *obesus* are completely lacking melanophores on the dorsal margin of the trunk. There are no internal melanophores. Nearly all of larvae have one melanophore on the ventral margin of the trunk. Melanophore size is fairly small comparing to those of *thynnus* and *maccoyii*.

Nishikawa & Rimmer (1987) made an illustrated guide for the identification of larval scombroid fishes. Descriptive notes on the larvae of genus *Thunnus* and the following key to the species are included in this Report.

- 10a Black pigment present on tail region of body ..... 11  
 10b Black pigment absent from tail region of body ..... 12
- 11a Small black pigment spots on tail: 1-2 on ventral edge, none on dorsal edge; black pigment on underside of lower jaw near tip (usually a pair of distinct spots) ..... *Thunnus obesus*  
 11b Distinct black pigment spots on tail: 1-4 on dorsal edge, 1-5 on ventral edge; 1 or no black pigment spots on caudal fin ..... *Thunnus thynnus*  
 11c Black pigment spots on tail: 0-4 small faint spots on dorsal edge (usually 1; however, up to 15% of specimens may have no dorsal spots, confusing them with *T. obesus*, see notes); 1-4 more distinct spots on ventral edge (usually 1 or 2); 1-3 black pigment spots on caudal fin (usually 2 or 3, and 1 of these may be dorsal to the notochord) ..... *Thunnus maccoyii*
- 12a Black pigment present on underside of lower jaw near tip (usually a single small spot); centre of eye in head profile situated above line of body axis ..... *Thunnus albacares*  
 12b Black pigment absent from tip of lower jaw; centre of eye in head profile situated more or less in line with body axis ..... *Thunnus alalunga*

As for *T. tonggol*, larval specimens were obtained from the Gulf of Thailand and from northwestern coastal waters of Australia and were identified and described (Chayakul and Chamchang, 1988 ; Nishikawa and Ueyanagi, 1991). Larvae of *tonggol* are unique by having melanophores on forebrain area and distinguished on this respect from all of other *Thunnus* larvae. In addition, larvae of *tonggol* are characterized by having the following diagnostic characters : a) one to three melanophores occur along ventral margin of tail, b) melanophores on the 1st dorsal fin first appear at about 5 mm

SL, c) lack of melanophores at the tip of lower jaw (Fig. 1). Apart from the all other *Thunnus* species, larvae of *tonggol* were collected only in nearshore waters.

## 2. Mediterranean Sea :

Scaccini et al. (1975) presented a criteria for identification of larval tunas including *Thunnus*, basing on melanophore patterns.

Recently, larval melanophore patterns of *T. alalunga* and *T. thynnus* from the Mediterranean were examined and discussed aiming to elucidate the ranges of variation in patterns basing on a total of 191 *Thunnus* larvae (*alalunga* 74, *thynnus* 117). (Kohno et al, 1982). For *thynnus*, they noted that some of *thynnus* larvae (6%) lack melanophores on the dorsal margin of trunk. This case is not the typical pattern of *T. thynnus*. They described that lateral melanophores do not appear in specimens from the Pacific unlike the Atlantic and Mediterranean specimens, however, appearances of lateral melanophores were also recognized from the Pacific specimens (Nishikawa, 1985).

For *T. alalunga* larvae, they found the variation of melanophore patterns on the tip of lower jaw and a difference from the Pacific specimens (Table 1).

## 3. Atlantic Ocean :

Juárez (1972) described the larval form of *T. atlanticus*. However, the pigmentation pattern of the larvae noted by Juárez were considered not to be diagnostic for *atlanticus* (Richards and Potthoff, 1974).

Richards and Potthoff analyzed the diagnostic characters of larval *Thunnus* including *atlanticus* collected from the Atlantic Ocean. They found a considerable variability of pigmentation patterns on larvae. Specimens from which melanophore data were obtained were cleared and stained for study of their osteology and for accurate identification. They stated as summary "results have shown that melanophore distributions are unreliable characters for specific identification. This is particularly evident where western Atlantic larvae identified as *albacares*, *alalunga*, or *obesus*, using the traditional melanophore character method, were found to be larvae of *atlanticus* based on osteological features."

Richards et al (1990) set the criteria for larval identification of the five species of *Thunnus* collected from the Gulf of Mexico : *albacares*, *obesus*, *alalunga*, *thynnus*, and

*atlanticus*. The combination of both characters (melanophore character method and osteology) sets does allow for reliable identification in most cases. When we depend only on the pigmentation character for larval identification, we may face the difficulties to distinguish *atlanticus* from *obesus* and also *albacares* / *alalunga*, as around 93% of *atlanticus* larvae have ventral tail pigment and about 7% may lack ventral tail pigment (Richards et al, 1990).

Identification and occurrence of *Thunnus* larvae collected  
by the SHOYO-MARU cruise in 1994

We made identification for the larval specimens of *Thunnus* collected from the Gulf of Mexico and from the Mediterranean Sea, basing on the pigmentation character method and referring the above publications.

Occurrence of *Thunnus* larvae are shown with relevant sampling data (Appendix tables) and summarized by species and area : Gulf of Mexico and Mediterranean Sea (Table 2).

Discussion

As it is difficult to distinguish *obesus* larvae from those of *atlanticus*, we tentatively identified larvae having melanophores on only the ventral margin of trunk as *obesus* / *atlanticus* larvae for the Gulf of Mexico specimens (Table 2). It is necessary to reexamine whether there are any differences or not for the numbers, location and size of melanophores between two species larvae. There might be a possibility that *atlanticus* larvae are included in the larvae we identified as *albacares* (Table 2), for some of *atlanticus* larvae (about 7%) were reported as lacking ventral melanophores for the Gulf of Mexico specimens (Richards, et al, 1990).

For the Mediterranean *Thunnus* larvae, we found rather many specimens which have melanophores on the ventral margin and lack those on the dorsal margin of trunk. Occurrences of those pigmentation pattern were often for the small sized larvae less than 4 mm SL and scarce for larger larvae. As for *albacares* larvae, artificially fertilized and reared, appearances of small melanophores on the ventral margin of the trunk were

noted for small sized larvae less than 4 mm TL, however, those melanophores disappeared with growth (Mori, et al, 1971). Although we have no evidence, *alalunga* larvae are considered also to show same pattern of pigmentation with development, as both *alalunga* and *albacares* larvae (larger than 4 mm SL) are same type lacking melanophores on the trunk unlike other *Thunnus* species. So, we identified larval specimens having melanophores on the ventral margin of trunk as *alalunga* in case of small larvae less than 4 mm SL, while we identified those larvae larger than 4 mm SL as *thynnus*. The latter case is considered to be a variation of typical pigmentation pattern of *thynnus* larvae. The number of *thynnus* specimens ( $\geq 4$  mm SL) lacking dorsal melanophores were of a total specimens ( % of the total). From the results in Kohno et al (1982) paper (Table 3), ratio of this type of larvae ( $\geq 4$  mm NL) was 1/14 (7 %). Also this ratio is calculated from the table in Richards and Potthoff (1974) as about 7 % (Table 4).

## References

- Chayakul, R. and C. Chamchang. 1988 : Description and identification of longtail tuna larvae, *Thunnus tonggol* (Bleeker) in the Gulf of Thailand. Rep. Workshop on small tuna, seerfish and billfishes in the Indian Ocean. IPTP/87/GEN/13 : 71-79.
- Juárez, M. 1972 : Las formas larvarias del *Thunnus atlanticus*. Mar y Pesca (Inst. Nac. Pesc., Cuba), (78) : 26-29.
- Kohno, H., T. Hoshino, F. Yasuda and Y. Taki. 1982 : Larval melanophore patterns of *Thunnus alalunga* and *T. thynnus* from the Mediterranean. Japan, J. Ichthyol. 28 (4) : 461-465.
- Matsumoto, W. M., E. H. Ahlstrom, S. Jones, L. Klawe, W. J. Richards, and S. Ueyanagi. 1972 : On the clarification of larval tuna identification particularly in the genus *Thunnus*. Fish. Bull. U.S. 70 : 1-12.
- Mori, K., S. Ueyanagi and Y. Nishikawa. 1971 : The development of artificially fertilized and reared larvae of the yellowfin tuna, *Thunnus albacares*. Bull. Far Seas Fish. Res. Lab., (5) : 219-232.
- Nishikawa, Y. 1985 : Identification for larvae of three species of genus *Thunnus* by melanophore patterns. Bull. Far Seas Fish. Res. Lab., (22) : 119-130.
- Nishikawa, Y. and D. W. Rimmer. 1987 : An illustrated guide to identification of larval tuna, billfishes and other scombroid fishes (Suborder Scombroidei). Report 186, CSIRO Marine Laboratories. 20 pp.
- Nishikawa, Y. and S. Ueyanagi. 1991 : Morphological development of larvae of longtail tuna. Bull. Far Seas Fish. Res. Lab., (28) : 1-13.
- Richards, W. J. and T. Potthoff. 1974 : Analysis of taxonomic characters of young scombrid fishes, genus *Thunnus*. In Blaxter, J. H. S. (ed.). The early life history of fish : p. 623-648. Springer-Verlag, Berlin, Heidelberg, New York.
- Richards, W. J., T. Potthoff and Jong-man Kim. 1990 : Problems identifying tuna larvae species (Pisces : Scombridae : *Thunnus*) from the Gulf of Mexico. Fish. Bull. U.S. 88 : 607-609.
- Scaccini, A., R. Sara, C. Piccinetti and M. G. Piccinetti. 1975 : Uova e larve di tonno pescate nelle Sicilia occidentale e loro allevamento. Min. Mar. Memoria, (39) : 1-199, figs. 1-59.
- Ueyanagi, S. 1969 : The spawning of the southern bluefin tuna (*Thunnus maccoyii*) as indicated by the occurrence of its larvae. Bull. Far Seas Fish. Res. Lab., (1) : 1-4.

Table 1. Frequency of occurrence of melanophores on the tip of two jaws and on the caudal region in larval *Thunnus alalunga* and *Thunnus thynnus* by size-group.

Size-group (mm in NL)	Upper jaw		Lower jaw		Caudal region	
	Present	Absent	Present	Absent	Present	Absent
<i>T. alalunga</i>						
<3.00	-	12	-	12	8	4
3.00~3.49	-	19	-	19	17	2
3.50~3.99	-	10	-	10	9	1
4.00~4.49	-	10	1	9	5	5
4.50~4.99	1*	11	2	10	9	3
5.00~5.49	-	6	-	6	5	1
5.50~5.99	1**	2	2	1	1	2
6.00~6.49	2	-	-	2	1	1
<i>T. thynnus</i>						
<3.00	-	7	-	7	4	3
3.00~3.49	-	53	18	35	24	29
3.50~3.99	-	42	21	21	19	23
4.00~4.49	-	7	5	2	2	5
4.50~4.99	-	3	1	2	-	3
5.00~5.49	-	5	3	2	1	4

\* Melanophores present only on upper jaw.

(Kohno, et al, 1982)

\*\* Melanophores present on two jaws.

Table 2. Number of positive tows and of *Thunnus* larvae collected from the Gulf of Mexico and the Mediterranean Sea. (SHOYO-MARU 1994 cruise)

		BFT	ALB	BET/BLT	YFT/ALB	Tunas	
Positive Tows	Total	640	59	148	17	48	8
	% of positive tows		9.22	23.13	2.66	7.50	1.25
G.Mex	Total	158	22	0	17	48	6
	% of positive tows		13.92	0.00	10.76	30.38	3.80
	Med (total)	482	37	148	0	0	2
Med (East)	Total	384	36	148	0	0	1
	% of positive tows		9.38	38.54	0.00	0.00	0.26
	Med (East)	384	36	148	0	0	1
Total number caught	Total	521	623	30	91	17	
	G.Mex	53		30	91	15	
	Med (total)	468	623			2	
	Med (East)	459	623			1	

Table 3 Frequency of occurrence of melanophores on the dorsal and ventral edges of the trunk, on the lateral side of the trunk, and internally near the vertebral column in *Thunnus thynnus* by size-group.

Size-group (mm in NL)	Dorsal		Ventral		Lateral		Internal	
	Present	Absent	Present	Absent	Present	Absent	Present	Absent
<3.00	3	4	7	-	3	3	2	4
3.00~3.49	52	1	53	-	13	13	8	18
3.50~3.99	41	1	42	-	8	9	6	11
4.00~4.49	7	-	7	-	-	-	-	-
4.50~4.99	3	-	3	-	-	-	-	-
5.00~5.49	4	1	5	-	-	3	-	3

(Kohno et al, 1982)

Table 4. Comparison of the number of dorsal and ventral melanophores occurring in *Thunnus thynnus* specimens

		Number of Dorsal Melanophores				
		0	1	2	3	4
Number of Ventral Melanophores	1	1	5	1	3	-
	2	1	12	11	1	1
	3	3	5	8	5	-
	4	-	3	4	2	1
	5	-	2	1	-	-
	6	-	-	-	1	1

(Richards and Potthoff, 1974)

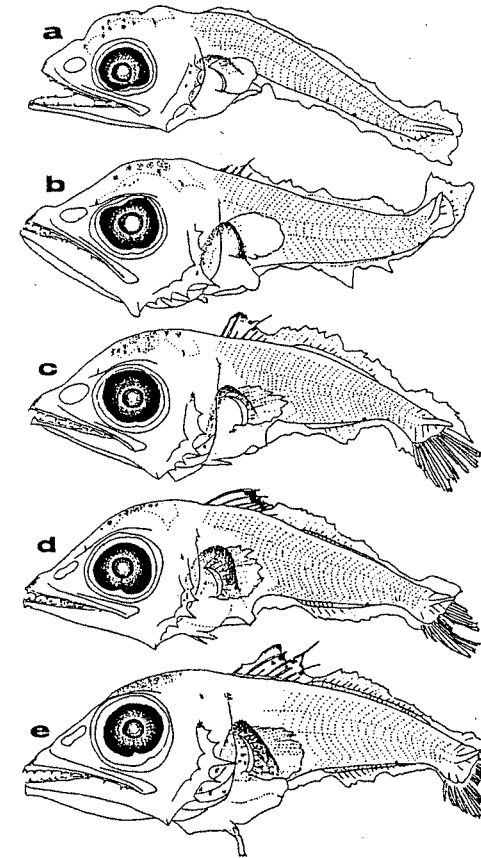


Fig. 1. Development of larvae of *Thunnus tonggol*. a: 3.75 mm NL; b: 4.86 mm SL; c: 5.25 mm SL; d: 5.32 mm SL; e: 5.76 mm SL. (Nishikawa & Ueyanagi, 1991)