

Larval Melanophore Patterns of *Thunnus alalunga* and *T. thynnus* from the Mediterranean

Hiroshi Kohno, Tadayoshi Hoshino,
Fujio Yasuda and Yasuhiko Taki

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The identification of the larvae of the genus *Thunnus* is usually based on the distributional patterns of melanophores on the body. Extensive knowledge of individual, growth-associated, and geographic variations in these patterns is required to make accurate identification of species.

However, there is little information so far available on this matter. Richards and Potthoff's (1974) paper, dealing with *Thunnus* larvae from the Atlantic, is probably the only report referring to such variations. They suggested the advantageous situation of the Mediterranean for studies of larval *Thunnus*, since there are no other *Thunnus* species than *T. alalunga* and *T. thynnus* and identificational confusion can be minimized.

It is the purpose of this study to elucidate exact ranges of variation in larval melanophore patterns of the above-named two species from the Mediterranean and compare melanophore characteristics of Mediterranean specimens with those of samples from other localities.

Material and methods

A total of 191 *Thunnus* larvae were collected by a plankton net of 1.4 m in diameter, hauled horizontally, from 10 stations in the Mediterranean Sea around the Aeolian Islands (38°30'N, 15°00'E) to the north of Sicily, during the period from 19 to 27 July, 1979, on the cruises of the research vessel Centro Pesca of Ente Siciliano per la Promozione Industriale. These larvae were identified as *T. alalunga* (N=74, 2.19~6.34 mm in notochord length, NL) and *T. thynnus* (N=117, 2.53~5.25 mm NL), based on the standard mentioned below. Notochord length was taken from the tip of the upper jaw to the posterior end of the notochord.

Results

Identification. One hundred and ninety-one

larvae were identified as *Thunnus* species following Ueyanagi and Watanabe (1964), Dicenta (1975), Scaccini et al. (1975) and Ahlstrom (in Fritzsche, 1978: 64). These specimens apparently represent only two species, *T. alalunga* and *T. thynnus*, because the genus *Thunnus* is represented solely by these two species in the Mediterranean and they are known to spawn in this study field (Bini, 1968; Postel, 1973; Tortonese, 1975). According to previous studies (e.g. Ueyanagi, 1969; Matsumoto et al., 1972; Scaccini et al., 1975; Dicenta, 1975), these two species are distinguishable by the presence or absence of melanophores on the trunk.

Frequency distribution of our specimens in terms of total number of melanophores on the trunk showed a sharp separation into two groups, one group having no melanophores and the other with more than one melanophore and with a frequency distribution rather clearly representing a normal curve (Fig. 1). There was no individual having one melanophore. This fact seems to confirm the previous conclusion

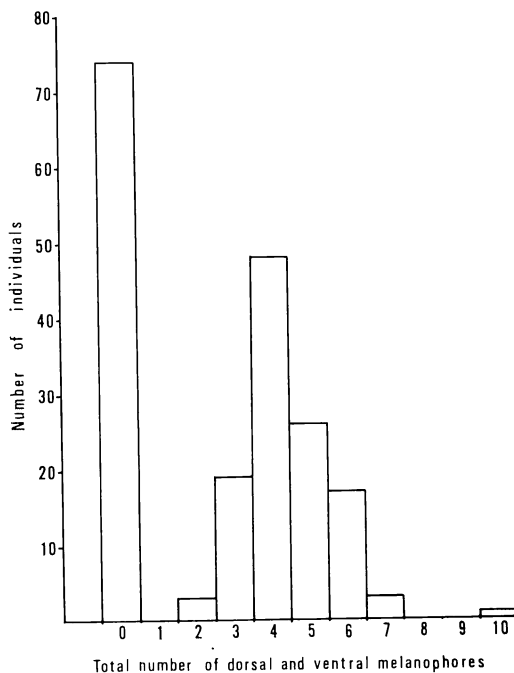


Fig. 1. Trunk melanophores frequency histogram of *Thunnus* larvae. Two groups, one having no melanophores and the other with more than one melanophore, are clearly recognized.

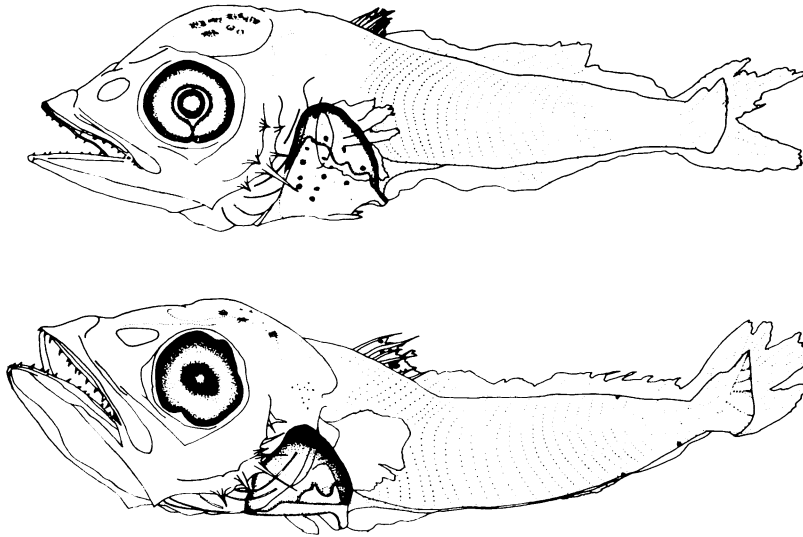


Fig. 2. Top: *Thunnus alalunga*, 6.10 mm NL. Bottom: *Thunnus thynnus*, 5.25 mm NL. Not all melanophores characteristic to each species are present in these specimens.

that *T. alalunga* lacks melanophores on the trunk and *T. thynnus* possesses them on the trunk.

Richards and Potthoff (1974) reported on a 7.5 mm SL specimen of *Thunnus alalunga* with two melanophores on the ventral side of the trunk. This was the only example of *T. alalunga*, among their 77 specimens, having melanophores on the trunk. Moreover, in *T. alalunga*, melanophores appear at larger sizes, usually greater than about 8.0 mm SL (personal communication with Dr. Potthoff). It is therefore most unlikely, though not absolutely impossible, that our specimens identified as *T. thynnus* include *T. alalunga*.

Distribution of melanophores. *Thunnus alalunga* (Fig. 2, top; Table 1): Melanophores were completely lacking on the trunk. There were several melanophores on the midbrain in almost all specimens. Several melanophores were seen on the first dorsal fin-membrane in specimens larger than 6.1 mm NL.

Melanophores on the tip of the upper jaw were observed in size-groups of 4.50~4.99 mm NL and larger, and those on the lower jaw tip were observed in size-groups of 4.00~4.49 mm NL and larger. The frequency of larvae having melanophores on the tip of the upper and/or lower jaw was quite low. Two specimens

larger than 6.00 mm NL had melanophores on the upper jaw tip but not on the lower jaw tip. All but four specimens were observed lacking melanophores on the upper jaw tip, and all but five lacking them on the lower jaw tip. Only one specimen, belonging to the size-group of 5.50~5.99 mm NL, had melanophores on both the upper and lower jaw tips. Melanophores on the caudal region were found on both the dorsal and ventral sides of the notochord and/or on the posterior end of the hypurals (frequency: 74.3% of the total specimens). The occurrence pattern of caudal melanophores was not associated with the size of specimens.

The presence or absence of melanophores on the caudal region was recognized to be subject to individual variation, without any regular patterns of occurrence associated with the size of specimens. On the upper and lower jaws melanophores were observed in a few specimens larger than 4.50~4.99 mm NL and 4.00~4.49 mm NL, respectively. On the other hand, some difference was noticed between localities in the occurrence patterns of melanophores on the lower jaw. Namely, while there was no noticeable difference in size of appearance of upper jaw melanophores, lower jaw melanophores appear at 4.0 mm NL in some specimens from the Mediterranean and at 9.0~10.0 mm

SL in those from the Pacific (Matsumoto et al., 1972). For Atlantic specimens, comparison was not possible due to the identificational confusion of larval *T. alalunga* with *T. albacares* (Bonnaterre).

According to previous studies dealing with Pacific specimens, the presence or absence of melanophores on both jaws can be a key for distinguishing between *Thunnus albacares* and *T. alalunga* (Ueyanagi, 1969; Matsumoto et al., 1972). While larvae of both species lack melanophores on the trunk, the presence of upper jaw melanophores coupled with the lack of lower jaw melanophores in a size range from 5.0 to 9.0 mm SL would indicate *T.*

alalunga (e.g., Ueyanagi, 1969; Matsumoto et al., 1972). The results of this study agree with the past conclusion in the respect that upper jaw melanophores first appeared at about 5.0 mm NL.

However, there were many specimens larger than 5.0 mm NL lacking upper jaw melanophores. In addition, lower jaw melanophores, as reported by Richard and Potthoff (1974) for Atlantic *T. alalunga*, appeared in some of our Mediterranean specimens at a smaller size than in Indo-Pacific specimens examined by Ueyanagi (1969) and Matsumoto et al. (1972). From these facts, it is doubtful that the pattern of jaw melanophores can be a key for larval *T. alalunga*.

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.

** Melanophores present on two jaws.

Table 2. 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 larval *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

Table 3. Relation of the number of dorsal and ventral melanophores in larval *Thunnus thynnus*.

Number of dorsal melanophores	3	2	3	3	2	—	—	1
	2	4	31	15	13	—	—	—
	1	2	13	13	8	—	—	—
	0	—	1	2	2	—	1	1
		1	2	3	4	5	6	7
		Number of ventral melanophores						

Table 4. Relation of the number of lateral and internal melanophores in larval *Thunnus thynnus*.

Number of internal melanophores	2	1	2	1	—
	1	8	3	2	—
	0	20	11	3	3
		0	1	2	3
		Number of lateral melanophores			

from areas other than the Indo-Pacific.

Thunnus thynnus (Fig. 2, bottom; Tables 1~4): Several melanophores were found on the midbrain, but not on the forebrain. In a specimen of 5.25 mm NL the first dorsal fin-membrane had several melanophores.

All specimens lacked melanophores on the upper jaw tip. Although melanophores on the lower jaw tip appeared in many larvae, there was no particular pattern associated with the size of specimens with the exception that all of larvae less than 3.0 mm NL lacked them there. Melanophores were found on the dorsal (0~3 in number) and ventral (1~7) edges of the trunk, on the lateral side (0~3) of the trunk, and internally (0~2) near the vertebral column. The number of specimens having melanophores on the dorsal edge of the trunk were 110 of a total of 117 specimens (94.0% of the total number), on the lateral side were 25 of 54 (46.3%) and internally were 17 of 54 (31.5%) (63 specimens were damaged and not available for observation of melanophore patterns on the lateral side and the internal trunk). There were no specimens lacking melanophores on the ventral edge of the trunk. Many larvae had melanophores on some or all of the four regions

on the trunk mentioned above, but no definite pattern associated with the size of specimens emerged. No clear relationship was found in numbers between dorsal and ventral melanophores and between lateral and internal melanophores. In many larvae, melanophores were found on the caudal region (42.7% of the total specimens), but no particular pattern was associated with the size of specimens.

The presence or absence of melanophores on the lower jaw was recognized to be subject to individual variation, though all of larvae lacked them on the upper jaw. The number of melanophores on the trunk also varied between specimens, though melanophores were present in all specimens on the ventral edge of the trunk. Though upper jaw melanophores are acquired in some individuals of *T. thynnus* from the Atlantic at about 5.00 mm SL (Richards and Potthoff, 1974), they were absent in all of our 15 specimens of 4.00~5.25 mm NL. A slight difference in the occurrence of melanophores on the lower jaw tip and trunk are also recognized between *T. thynnus* from the three localities, i.e., the Mediterranean, the Atlantic (Richards and Potthoff, 1974) and the Pacific (Matsumoto et al., 1972): all specimens larger than 3.0 mm SL from the Atlantic and 4.0 mm SL from the Pacific have lower jaw melanophores, while melanophores appear only in about 40% of total specimens larger than 3.0 mm NL from the Mediterranean; internal melanophores appear less commonly in our specimens (31.5% of the total specimens) than in Atlantic specimens (about 50%); lateral melanophores do not appear in specimens from the Pacific but develop in those from the Atlantic (0~6 in number) and the Mediterranean (0~3 in number and 46.3% of the total specimens).

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(Tokyo University of Fisheries, 4-5-7 Konan, Minato-ku, Tokyo 108, Japan (HK: presently at Department of Fisheries, Faculty of Agriculture, University of Tokyo, Bunkyo-ku, Tokyo 113, Japan; TH: presently at Southern Fisheries Research Center, Deception Bay, Queensland 4508, Australia))

地中海産ビンナガとクロマグロ仔魚の黒色素胞分布パターン

河野 博・星野忠義・安田富士郎・多紀保彦

地中海産のビンナガとクロマグロの仔魚は軀幹部の黒色素胞の有無により明瞭に識別された。

両種の両顎、軀幹および尾部の黒色素胞の出現状態には個体差が認められた。また、従来太平洋産のビンナガとキハダは両顎の黒色素胞の出現状態で識別されているが、地中海産のビンナガでは太平洋産キハダとは明瞭な識別がつかなかった。一方、クロマグロの各部位の黒色素胞の出現状態には地中海、大西洋、太平洋の間で地理的変異が認められた。

(108 東京都港区港南 4-5-7 東京水産大学 (河野: 現在東京大学農学部水産学科; 星野: 現在 Southern Fisheries Research Centre, Austria))