

Daily age of skipjack tuna, *Katsuwonus pelamis* (Linnaeus), in the eastern Indian Ocean

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ABSTRACT

We examined otoliths of 25 skipjack tunas (42.8 to 66.2 cm fork length (FL)) caught in the eastern Indian Ocean during January and March in 2004 to determine their size-at-age. Three different increment patterns were observed in the otoliths etched with 10% HCl, which were similar to those observed in skipjack tuna otoliths in the Pacific Ocean. Skipjack tunas in the eastern Indian Ocean were found to attain about 45 cm FL in 1 year and 50 to 55 cm FL in 1.5 years.

INTRODUCTION

Skipjack tuna, *Katsuwonus pelamis* (Linnaeus), is a commercially important cosmopolitan scombrid in tropical and temperate waters. A direct method for studying age and growth have not been established for this species and there have been no reliable estimate of growth rate.

Methods for estimating age and growth of fishes by using otolith microstructure have rapidly progressed in recent years. We have established the procedures of preparation and observation of skipjack tuna otoliths in the Pacific Ocean and found 3 increment patterns in the sagittal otoliths; narrow increments around the core (nucleus), wider increments at the medial area between the nucleus and the marginal zone, and narrower increments at the marginal zone (Tanabe et al., 2003a). The increments around the nucleus had been validated as daily increments in larval skipjack tunas during the first 5 days after hatching (Radtke, 1983). We validated the daily deposition of increment at the medial area by analyzing marginal increment width in juvenile skipjack tunas sampled several time in a day (Tanabe et al., 2003b). We also validated daily formation of increments at the marginal zone by observing oxytetracycline marked otoliths of captive fish (Unpublished). Now we are able to determine age of skipjack tuna over the whole life span by counting the daily growth increments between the nucleus and the rostrum in sagittal otoliths.

In this study, we applied the method of otolith analysis to skipjack tuna caught in the eastern Indian Ocean. We confirmed that the increment pattern of otoliths in the Indian Ocean was similar to that in the Pacific Ocean, and determined size-at-age of 25 fish of 42-66 cm FL.

MATERIALS AND METHODS

Skipjack tunas were collected by pole & line, trolling, and longline fishing during the Japanese feasibility tagging cruise by the Taikai-maru No.2 in the Eastern Indian Ocean from January to March 2004 (Table 1 and Figure 1). All skipjack tunas were measured in FL and body weight on board. The head of each fish was removed and kept frozen. In the laboratory, sagittal otoliths were dissected out, cleaned, dried, and mounted on a glass slide. Otolith surface was dissolved with 10% HCl for etching procedures. Each otolith was embedded on a glass slide with enamel resin. After these preparations, the number and width of daily increments between the nucleus and the rostrum edge was measured by using an otolith measurement system (Ratoc System Engineering, Tokyo, Japan). The system was composed of a light microscope (Olympus Optical, Tokyo, Japan), charge-coupled device camera (KY-F70B; Victor) and a personal computer. The magnification of the light microscope was x200.

RESULTS and DISCUSSION

Sagittal otoliths of Skipjack tunas, (N=25, 42.8 to 66.2 cm FL), were measured in number and width of daily increments between the nucleus and the rostrum edge. Three types of increment patterns were observed on the sagittal plane of the otoliths (Figure 2), which were similar to those in the Pacific Ocean. Otolith radius –FL plots of skipjack tuna in the Indian Ocean were distributed in the range of plots for fish in the Pacific (Figure 3, Tanabe et al., 2003a).

Figure 4 showed the relationships between age in days and FL. Daily age of fish from 42.8-66.2 cm FL ranged from 310 to 723. Fish larger than 60 cm FL was variable in the relationship between the number of increment and the fish size. Skipjack tunas in the Eastern Indian Ocean seemed to attain around 45 cm FL at 1 year old and about 50 to 55 cm FL at 1.5 years old. For fish > 60 cm FL, more otoliths should be examined to clarify the source of the variability the relationship between age and FL.

Growth estimate of this study was similar to the direct estimates of the Western and Central Pacific Ocean (Figure 4, Tanabe et. al., 2003a, Uchiyama and Struhsaker, 1981). The results for skipjack tuna growth in Maldives based on tagging data (Adam, 1999) were quite different from the results of our study. We considered that the discrepancy in growth of fish from Maldives and of our study was due to the lack of data for fish < 40 cm FL in Maldives.

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Table 1. Collection date for skipjack tuna specimens used for the sagittal otolith daily increment analysis.

Sam pling data	Latitude	Longitude	Sam pling Gear	No.of fish	FL (cm)
25 Jan	15 ° 13S	116 ° 52E	Long line	1	48.0
17 Feb	14 ° 14S	104 ° 12E	Pole and Line	1	49.3
17 Feb	13 ° 48S	103 ° 47E	Trolling	1	49.0
2 Feb	5 ° 58S	94 ° 27E	Trolling	1	59.4
23 Feb	3 ° 47S	92 ° 53E	Pole and Line	1	49.0
8 Mar	9 ° 4S	98 ° 45E	Pole and Line, Trolling	2	50.2-51.4
10 Mar	8 ° 14S	94 ° 57E	Trolling	1	57.7
10 Mar	7 ° 53S	95 ° 15E	Pole and Line	3	47.0-49.9
11 Mar	7 ° 8S	97 ° 55E	Pole and Line	3	45.2-50.1
12 Mar	8 ° 31S	99 ° 28E	Pole and Line	10	42.8-48.4
12 Mar	8 ° 18S	99 ° 5E	Trolling	1	66.2

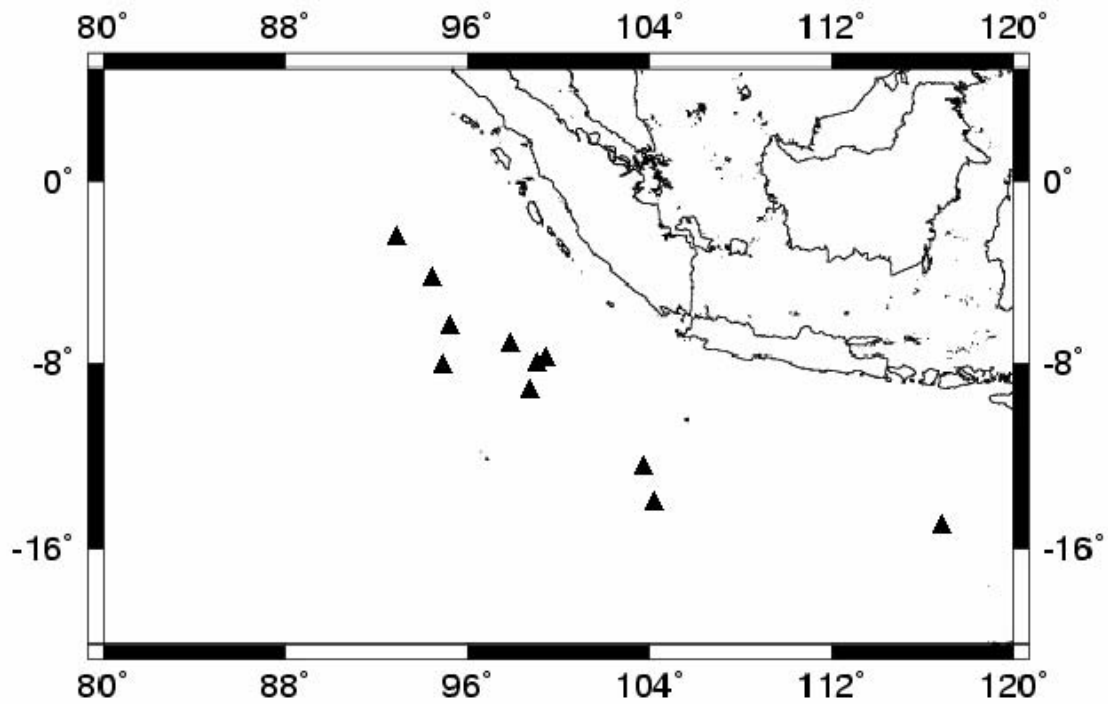


Figure 1. Sampling location (closed triangle) of skipjack tunas in 2004.

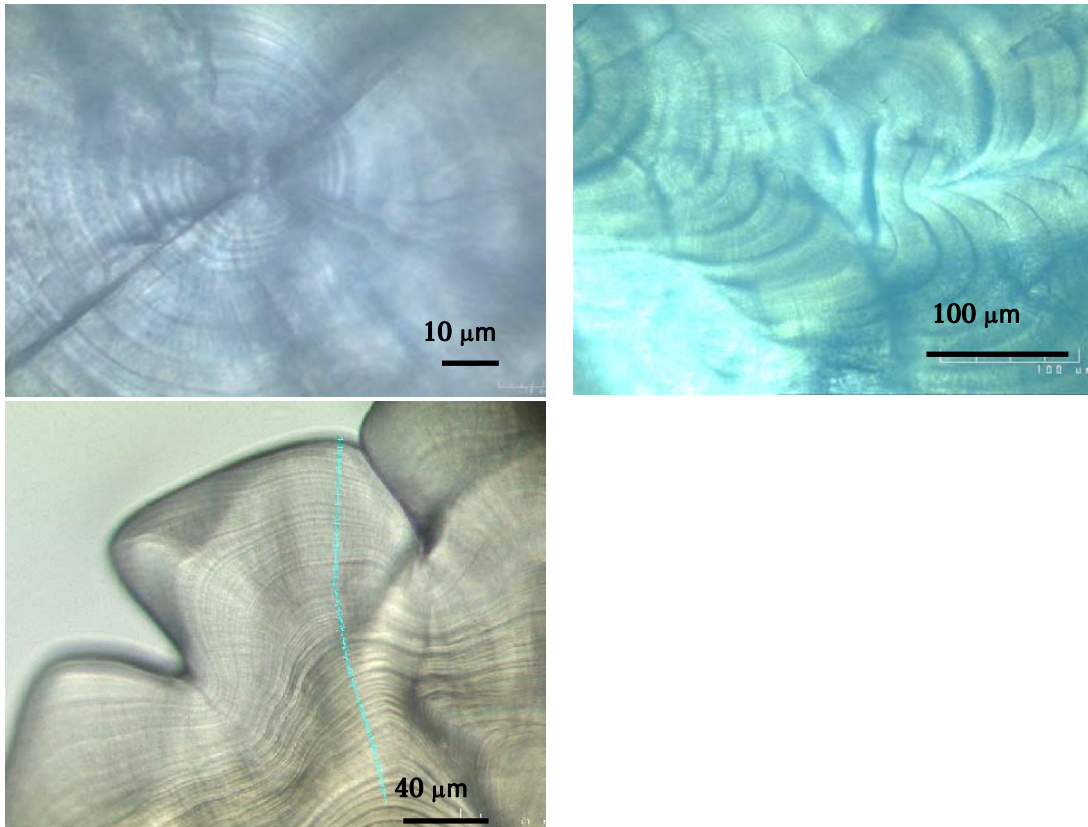


Figure 2. Daily increments in the sagittal otoliths of skipjack tuna in the Indian Ocean. The sagittal plane of otolith is divided into three areas: the nucleus area around the nucleus found in the larval stage (upper left); the medial area corresponding to the juvenile stage (upper right); and marginal area in the young-adult stage (bottom left). Blue line on bottom left panel indicate counting path of daily increment.

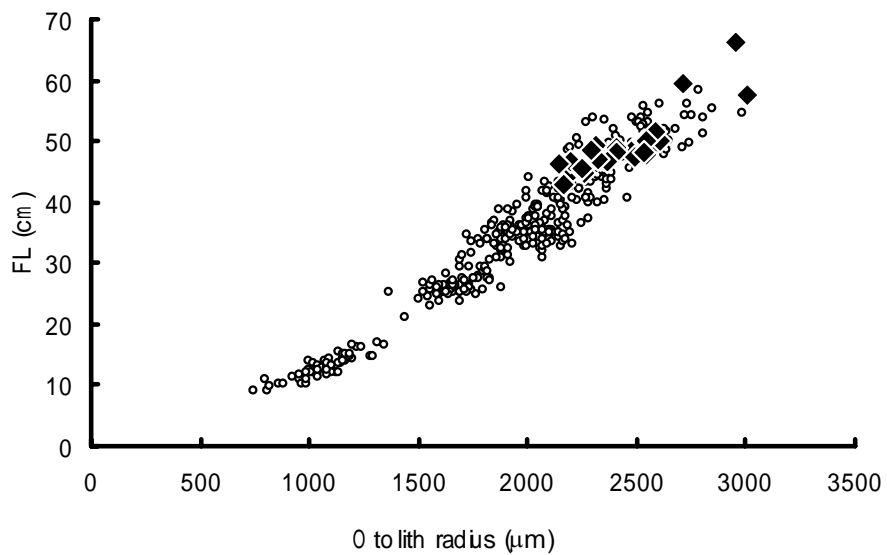


Figure 3. Relationship between the otolith radius and FL of skipjack tuna during the juvenile and adult stages. Open circle for the western Pacific Ocean (Tanabe et al. 2003a) and closed diamond (for the eastern Indian Ocean).

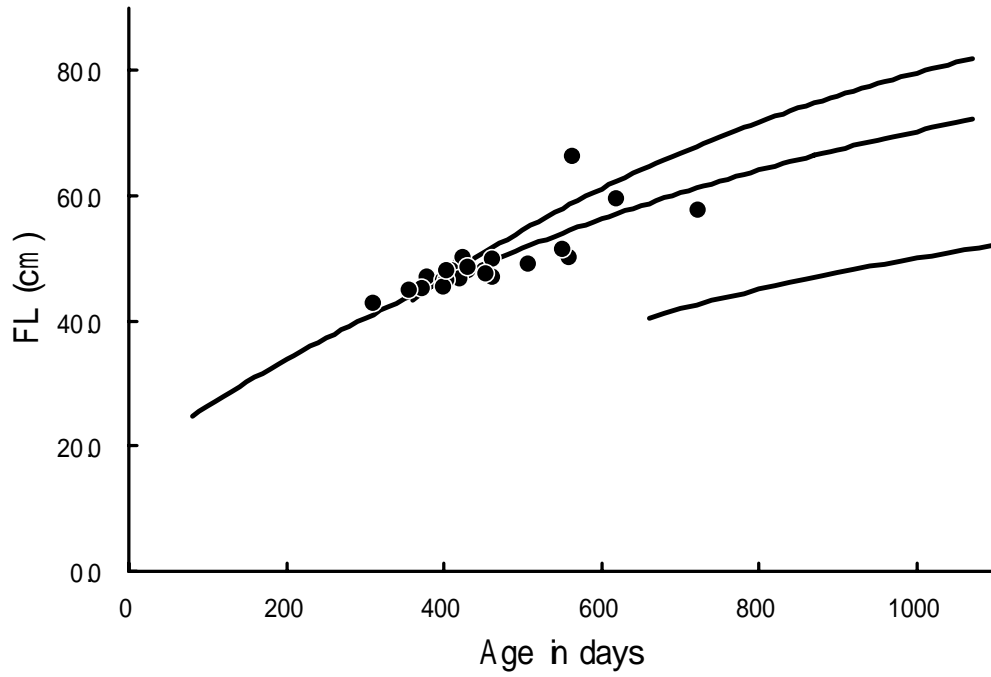


Figure 4. Relationship between estimated age in days and FL of skipjack tuna in the eastern Indian Ocean (date) in comparison with von Bertalanffy growth curves of the previous studies from the central Pacific Ocean (Uchiyama and Struhsaker 1981), the western Pacific Ocean (Tanabe et al., 2003a) and Maldives (Adam 1999).