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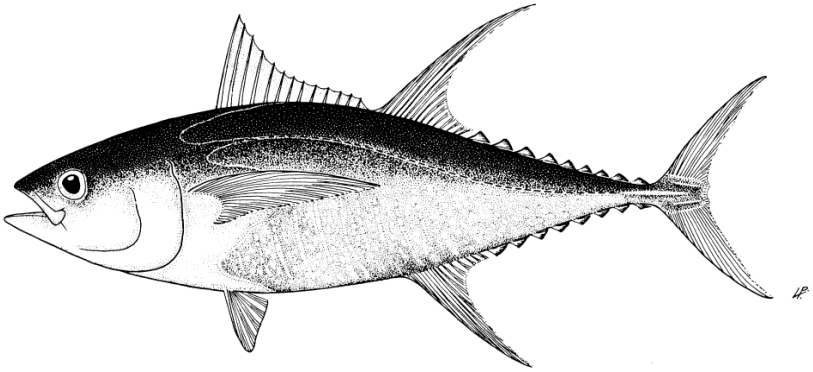
Report of the ongoing tagging project on tropical tunas around Japan



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Report of the ongoing tagging project on tropical tunas around Japan

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Summary

Tropical tuna tagging project around Japan has been conducted by Fisheries Agency of Japan since 1999. Until the end of 2002, 981 bigeye and 3581 yellowfin tunas, mainly small fish, were tagged and released in the southwestern part of Japan (24-30°N, 123-130°E), and 141 bigeye and 295 yellowfin were recaptured. They were usually recovered within a short time and distance, especially for bigeye. The movement is limited and most movements are northeastward. Yellowfin indicated slightly larger movement than bigeye. No large movements were observed. Archival tagging was also conducted. Of 51 bigeye and 47 yellowfin attached with archival tag, 9 bigeye and 4 yellowfin were recaptured. Data could be successfully downloaded from 8 bigeye and 2 yellowfin. Archival tag data indicated that swimming depth of bigeye tuna changed depending on the time of the day; it usually dived deeper during the daytime and stayed in the shallower depth during the night. This project will be continued in the future and detailed analyses will be scheduled in the near future.

1. Introduction

Tropical tunas (yellowfin and bigeye tunas) are commercially very important not only in Japan but also in many countries in the world. But most stocks are reducing or at a lower level than before probably because of high exploitation. That is why more detailed and more precise stock assessment studies are necessary and urgent. In the past, tropical tunas, especially bigeye tuna, were caught mostly by longliners, but, in recent years, the proportion of surface catch, especially purse seine fishery, is increasing. As for yellowfin tuna, purse seine fishery is now main fishing gear in all oceans. In the vicinity of Japan, especially in the southern part, coastal fisheries targeting small tunas such as pole-and-line, handline and trolling are important for the local areas, but it has not been known to what extent these coastal fisheries exploit the stock in the region and what is the relation to the stock nearby..

Therefore, it is necessary to collect basic biological parameters such as, movement, migration, growth, natural mortality (M) and so on for adult fish as well as for juveniles in order to answer the above questions.

Tagging is very important and useful for the stock assessment studies of tunas. Natural mortality, movement, growth and so on can be estimated from tagging, and these results are used to analyze the status of stocks with the assessment models such as VPA, production model and Multifan-CL. So

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far, there were no large tagging around Japan targeting tropical tunas. Under these situations, Fisheries Agency of Japan (Japanese government) has started tropical tuna tagging project around Japan since 1999 in order to enhance the knowledge on biology of tropical tunas. In this project it was originally aimed to tag and release about 1,000 fish (tropical tunas, mainly bigeye tuna) annually. This paper briefly summarizes the results of this project conducted by the end of 2002.

2. Method

This tagging project is funded by the Fisheries agency of Japan and entrusted to Kagoshima and Okinawa Prefecture Fisheries Research Stations under the guidance of the National Research Institute of Far Seas Fisheries (NRIFSF) and Japan NUS Co., Ltd.

Fish were caught mainly by pole-and-line or trolling and partly by rod and reel (jigging or bait fishing) with minor amount by longline gear using chartered or research vessels. These operations were conducted around several islands of Kagoshima and Okinawa Prefectures (Nansei Islands, southern part of Japan, about 24-30°N, 123-130°E, Fig. 1), mostly by the operations around 'payao' (anchored floating or underwater fish aggregating devices, Fig. 2). A total of 96 days fishing was conducted from March 2000 to December 2002 (Table 1). Tagging was conducted almost all year round, but the percentage of the first quarter (January to March) is much less than the other quarters because winter is off-season for tuna fishing.

Dart tags (conventional tag, about 2mm in diameter and 15cm long, yellow in color, produced by HallPrint) were mainly used, and most fishes were double tagged (attach two tags for one fish). Archival tagging (data storage tag, Lotek Ver.1.0 or Ver.1.1, 100mm in total length except for the stalk, 16mm in diameter and 52g in air) was also conducted by inserting a tag to the abdominal cavity. Relatively larger fish were used for archival tagging. Archival tags were set to record depth and ambient/internal temperatures every 256 seconds. This tag internally estimates daily position, though not so accurate, from the time of sunset and sunrise.

Priority was given to tag bigeye and yellowfin tunas, but other species such as skipjack were also tagged and released deploying the same dart tag when possible.

Species, fork length (to the nearest 0.1, 0.5 or 1cm), time and release position were recorded for the fish released.

3. Results

3.1 Summary of release and recapture

Table 2 shows summary of the number of tagged and recaptured fish. A total of 981 bigeye and 3581 yellowfin have been tagged and released during the three years. 141 bigeye (recapture rate is 14.4%) and 295 yellowfin (8.2%) have been recaptured as of December 2002. Besides, 996 skipjack was also tagged and 25 were recaptured (2.5% recovery rate). In this report we mostly report the results of bigeye and yellowfin.

Length frequencies of tagged fish are shown in Fig. 3. As for bigeye tuna, most fish ranged between 40cm and 70 cm FL and the mode of length was around 50cm. As for yellowfin, the fish were relatively smaller than bigeye and the mode was around 40 to 45cm.

3.2 Horizontal movements of tagged fish by conventional tagging

Fig. 4 shows horizontal movement (straight course) of recovered fishes between released and recovered position. As for bigeye tuna, most fishes moved northeastward or very nearby area and were recaptured around payao, and none of them were reported in the open ocean. There seems to be a strong influence in this northeast movements by the Kuroshio Current. In the case of yellowfin, similar to bigeye, most fishes moved northeastward or nearby area, but they moved longer distance than bigeye on average. Some of yellowfin moved to the coastal area or offshore of the central Japan (around 140 to 150°E). Three fishes moved in the opposite direction to the coastal water of Philippines.

Fig. 5 and Fig. 6 show number of fish recaptured and cumulative frequency of recapture plotted against days at liberty. As for bigeye, the number of recapture quickly decreased as the time passes, especially within a month or so, and most fish (about 90%) recaptured were within 150 days at liberty and only a few fish after one year or more. This trend was similar for yellowfin, but the decline of the recapture was not so quick as bigeye.

Fig. 7 shows the relationship between days at liberty and the distance moved. As for bigeye, most fish recaptured within 100 days did not make long distance movement (less than 100 nm) and the longest distance traveled was less than 400nm except one fish. On the other hand, yellowfin moved longer distance than bigeye; some fish moved about 1000nm in 100 days.

3.2 Results of archival tagging

As is shown in Table 2, 51 bigeye and 47 yellowfin were tagged with archival tag and 9 (17.6%) bigeye and 4 (8.5%) yellowfin were recaptured. However, the tag itself was not recovered or data could not be downloaded due to malfunction of tag for one bigeye and two yellowfin. Summary of archival tagging for bigeye is shown in Table 3. Usable data for bigeye were obtained for fishes that were 7 to 143 days at liberty. Of these, two were recaptured at the same payao and three were caught at nearby payao where they were tagged. The other three moved somewhat longer distance and showed very similar movement; they were released at the same payao (24-22°N, 122-53°E) and recaptured almost at the same position (around 25°N, 125°E).

Fig. 9 shows typical pattern of the temporal change in swimming depth, ambient water temperature and internal temperature of bigeye tuna. Based on these, swimming depth and daily patterns are somewhat different depending on the individuals, but the fish stayed deeper during the daytime and swam at shallower depth at night, regularly making quicker up and down movements. This pattern of swimming almost coincides with the past studies. As for temperature, changes in the internal temperature seemed to be caused by the changes in swimming depth. Internal (abdominal) temperature during the deep diving was much higher than the ambient water temperature, and its variation was much smaller.

More detailed studies are planned not only on vertical movement but also on horizontal movement, especially in relation to the position of payao.

4. Future outlook of tagging program

This program will continue in the near future. Current annual target is set to tag and release 1000 fish (mainly bigeye tuna) including 30 fish for archival tagging. However, it appears to be a

bit difficult to attain these goals especially the number of bigeye tuna to be tagged mostly due to the lower availability in the current tagging area. We may try to find a better location and way to tag bigeye.

As for archival tagging, new version of tag (Lotek LTD-2310), which is smaller and has much more memory size than the old versions, will be mainly used from now on.

Table 1. Number of days of tagging cruise in each year and quarter.

	Quarter				
Year	1	2	3	4	Total
2000	2	13	4	11	30
2001	1	12	10	8	31
2002	2	17	6	10	35
Total	5	42	20	29	96

Table 2. Summary of tag release and recapture by year, species and tag. Data is limited to the fish tagged and released until December 2002. "Year" is based on released date.

Species	**Bigeye tuna**						**Yellowfin tuna**						**Total**					
Tag	**Dart tag**			**Archival tag**			**Dart tag**			**Archival tag**			**Dart tag**			**Archival tag**		
Year	Release	Recapture	Percentage of recapture	Release	Recapture	Percentage of recapture	Release	Recapture	Percentage of recapture	Release	Recapture	Percentage of recapture	Release	Recapture	Percentage of recapture	Release	Recapture	Percentage of recapture
2000	439	99	22.6%	20	6	30.0%	1,174	165	14.1%	13	0	0.0%	1,613	264	16.4%	33	6	18.2%
2001	374	35	9.4%	13	1	7.7%	1,435	88	6.1%	24	2	8.3%	1,809	123	6.8%	37	3	8.1%
2002	168	7	4.2%	18	2	11.1%	972	42	4.3%	10	1	10.0%	1,140	49	4.3%	28	3	10.7%
Total	981	141	14.4%	51	9	17.6%	3,581	295	8.2%	47	4	8.5%	4,562	436	9.6%	98	13	13.3%

Table 3. Summary of archival tagging for bigeye tuna.

Item	Results
Duration of release	Oct. 2000-Oct. 2002
Position of release	Around Nansei Islands （southern part of Japan, 24-28°N, 122-130°E）
Fork length at release (cm)	48-75cm (average 57.0cm)
Number of release	51
Number of recapture	9
Percentage of recapture	17.6%
Number of data download	8
Days of data acquired*	8-144days (average 41.4days)
Distance moved (nm, in a straight course)*	0.0-128.0nm

*Limited to the fish whose data of tag could be downloaded

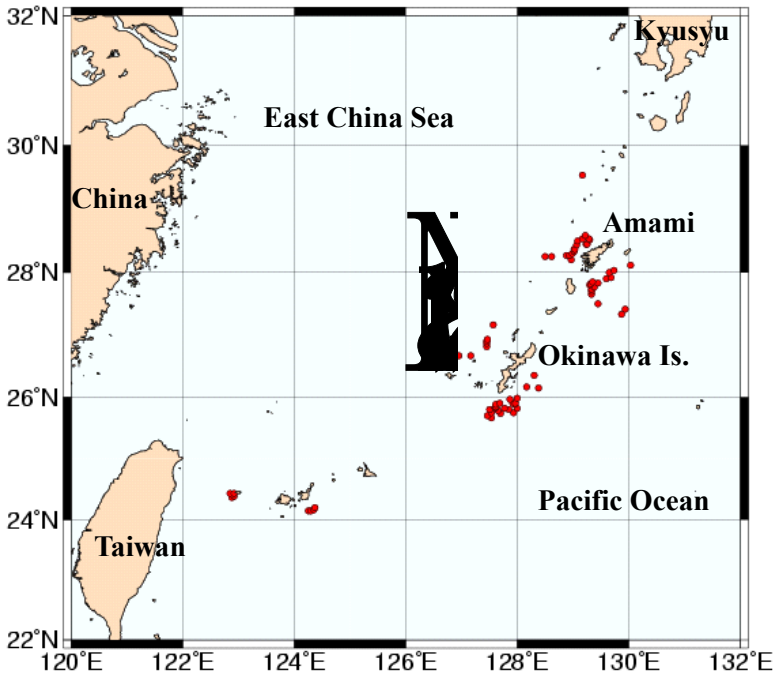

Fig. 1 Position of tag and release.

Fig. 2 An examle of 'payao' around which tagging was conducted.

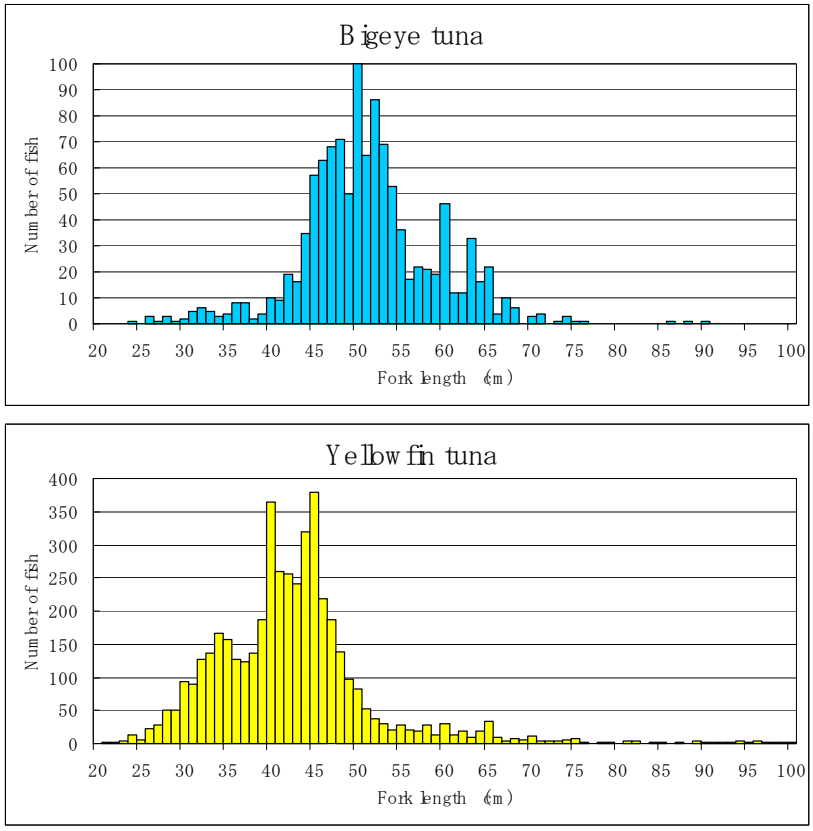

Fig. 3 Length frequency of tagged and released fish.

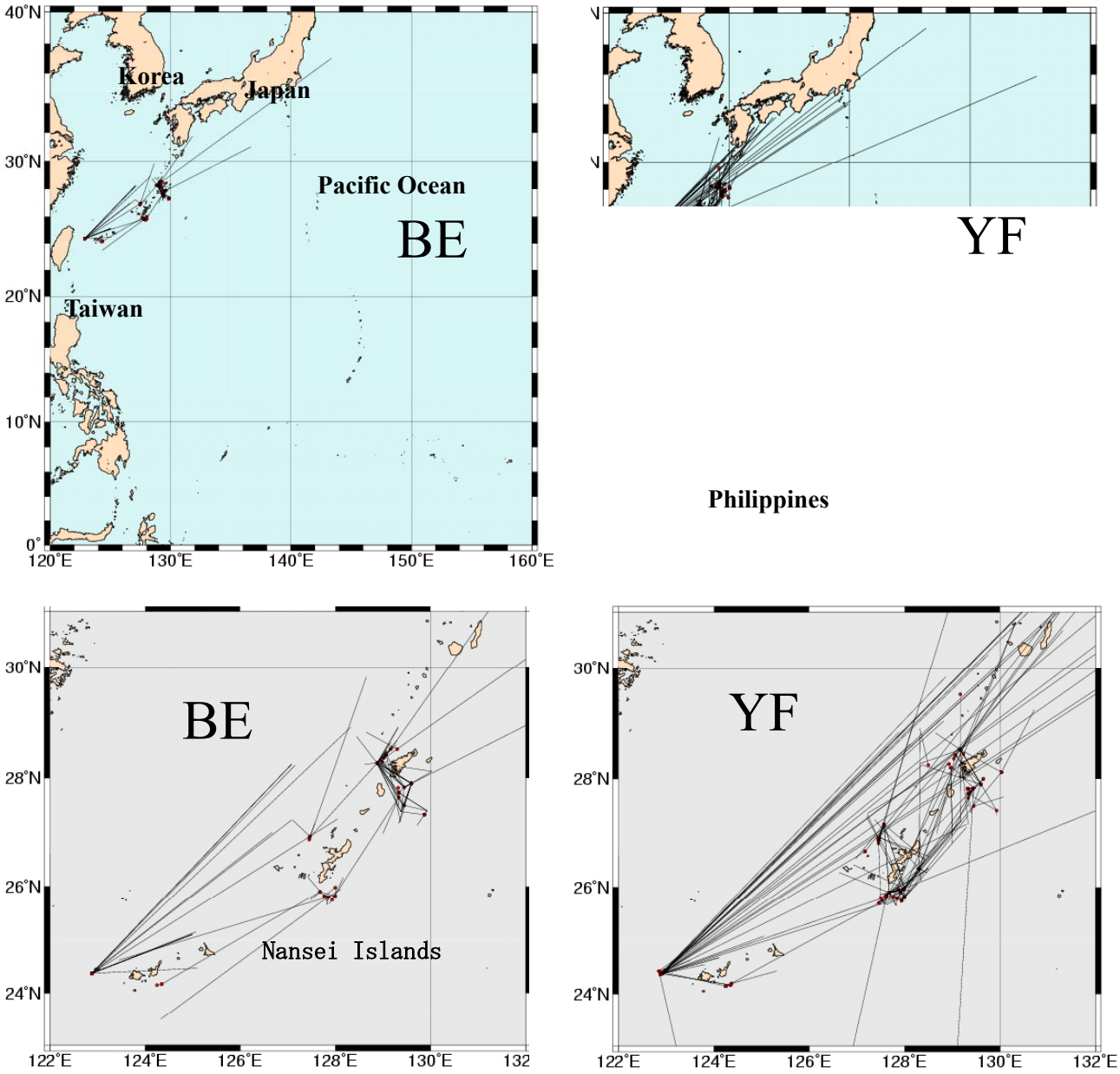

Fig. 4. Movement of bigeye and yellowfin tunas based on tag release and recapture. Circles mean release positions. Upper: all area, lower: around Nansei Islands (southern part of Japan).

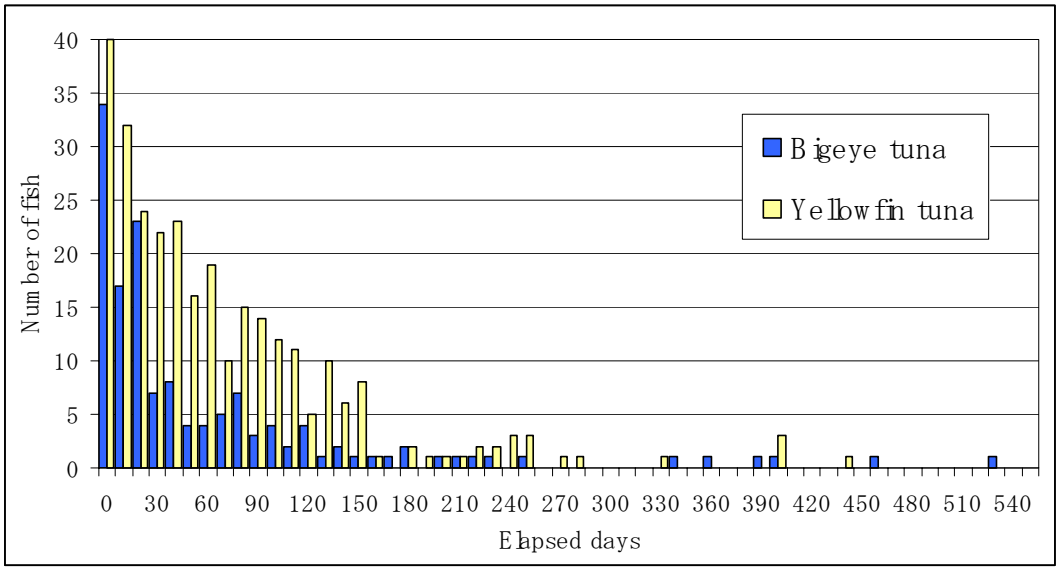

Fig. 5. Frequency of elapsed days (days at liberty) for recaptured fish.

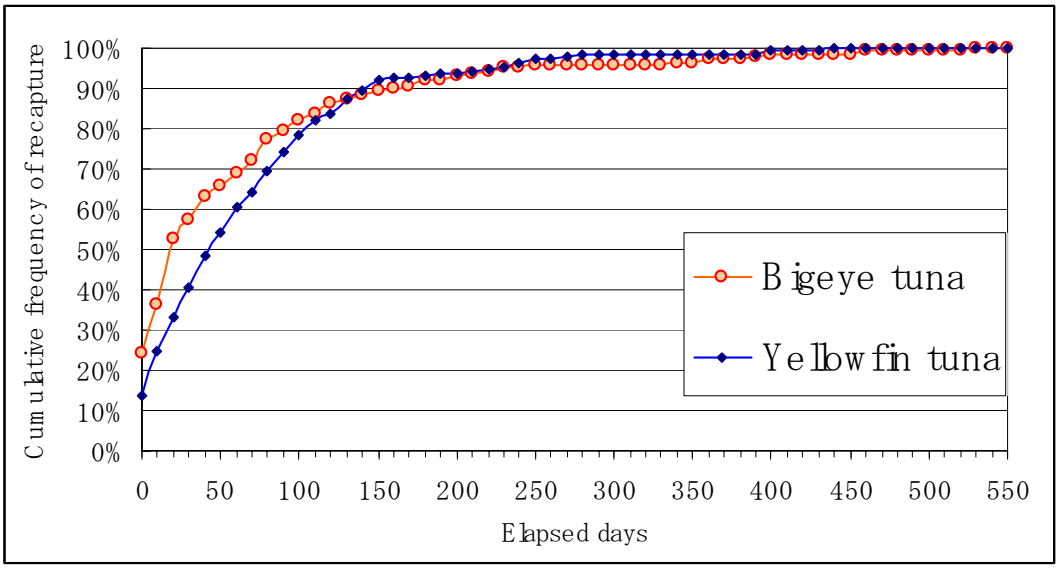

Fig. 6. Cumulative frequency of elapsed days (days at liberty) for tag recapture.

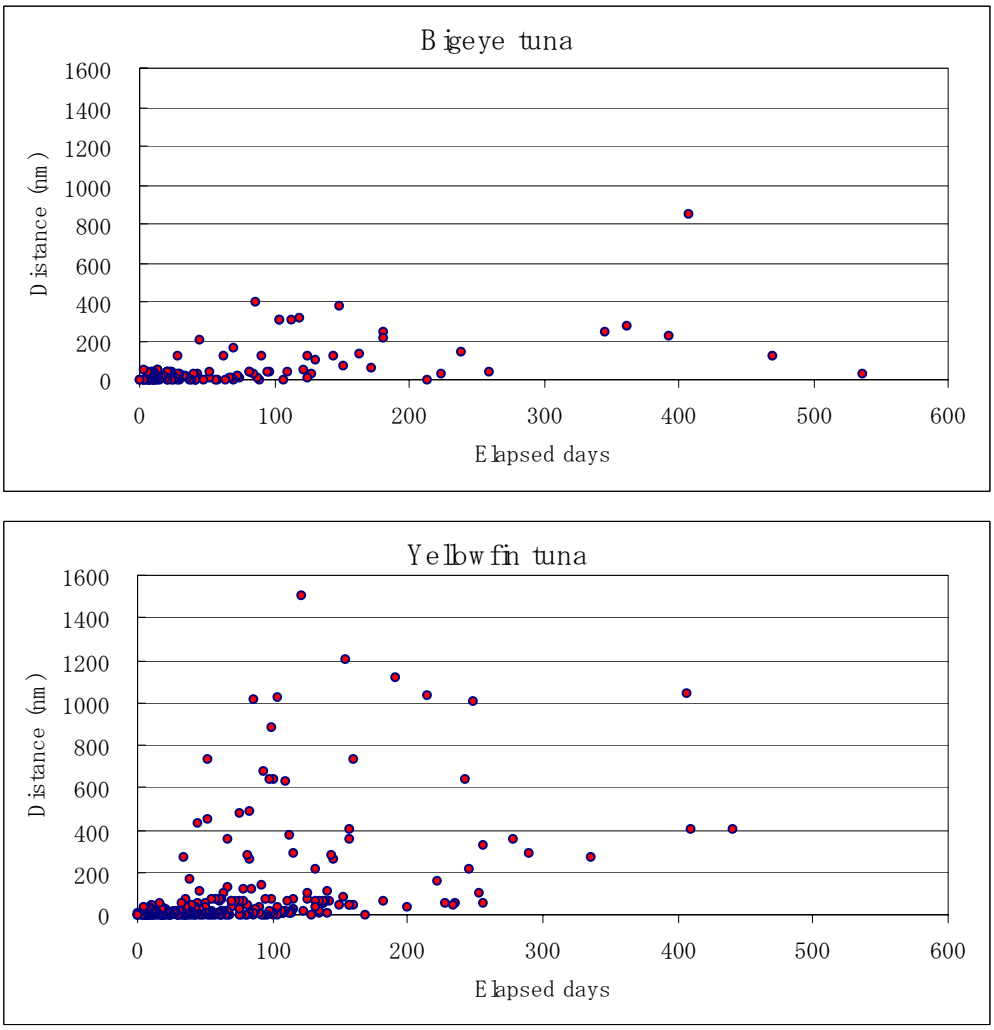

Fig. 7 The relationship between elapsed days (days at liberty) and distance moved (straight course) based on tag recapture data.

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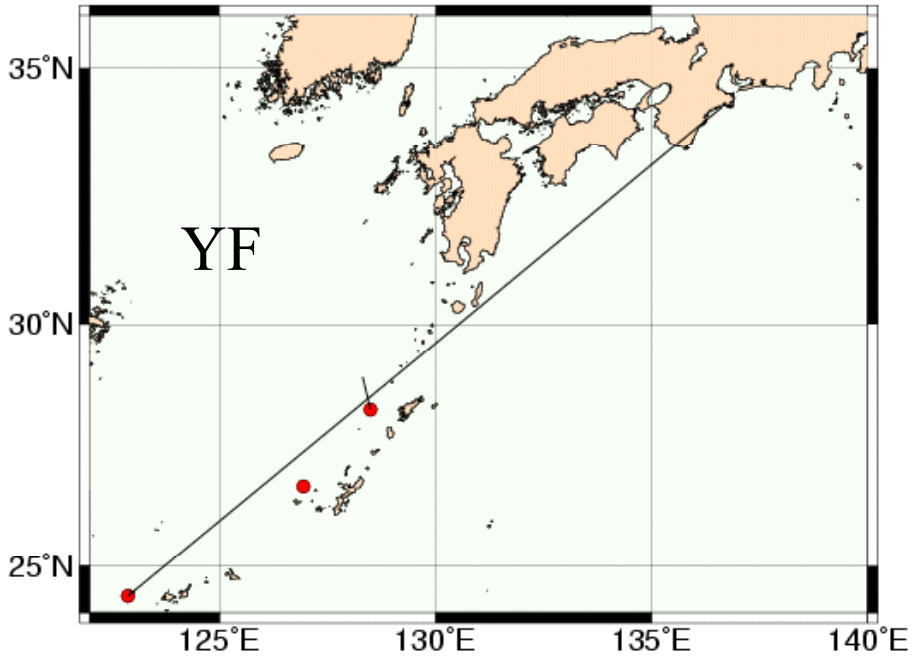

Fig. 8. Movement of the fish archival tag was attached. Upper: Bigeye tuna, Lower: yellowfin tuna. Circles mean released positions. The track is based on released and recaptured positions. Data are limited to the fish whose tag data could be downloaded.

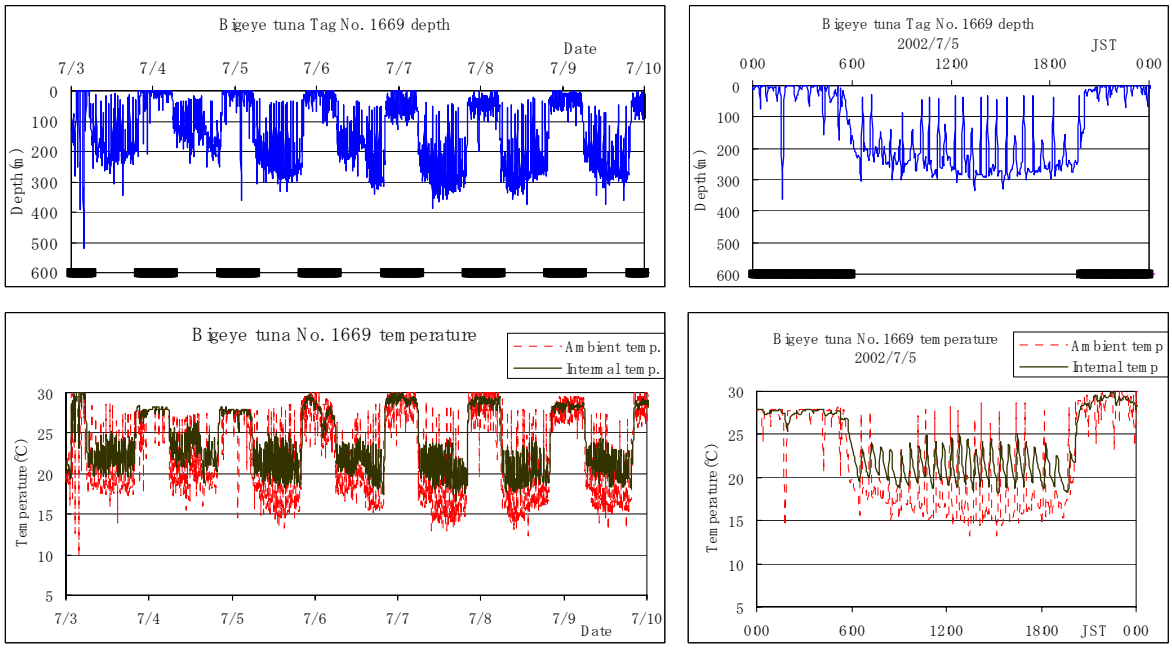

Fig. 9. Typical pattern for the movement (swimming depth) and ambient/internal temperature of bigeye tuna. Upper left: swimming depth for one week, upper right: daily pattern of swimming depth, lower left: ambient and external temperature for one week, lower right: daily pattern for ambient and external temperature. Solid bars mean nighttime.