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Summary report of tag data for yellowfin and bigeye tuna by Japanese tagging programs

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Summary

Japan conducted large scale tropical tuna tagging projects targeting bigeye and yellowfin tunas in the subtropical and temperate areas of Japanese water (around Nansei Islands and in the east off central Honshu, respectively) after 2000. There is an ongoing skipjack tagging project in the Nansei Islands in which tagging of bigeye and yellowfin tunas is also conducted. In the three tagging projects, a total of 4,648 bigeye and 14,866 yellowfin were tagged and released, of which 490 (10.5%) bigeye and 1,142 (7.7%) yellowfin were recaptured as of January 2017. Some fish moved to equatorial area or central Pacific. Most of the recapture was short term, although some fish were recaptured over 180 days after release. The fish were mainly recaptured by pole-and-line, purse seine, troll and so on. The data may be useful for input data in the stock assessment models for both species, as well as for considering boundaries of areas for stock assessment.

1. Introduction

Tagging is very important and useful for the stock assessment studies of tunas by estimating migration and behavior, natural mortality and growth. Recently stock assessment of yellowfin and bigeye tuna in the western and central Pacific Ocean (WCPO) is conducted by using Multifan-CL, which incorporates fish movement based on tag data. In the latest stock assessment for WCPO yellowfin and bigeye tuna in 2014, tag data for the Pacific Tuna Tagging programme (PTTP), Regional Tuna Tagging Project (RTTP) and tagging conducted in the Coral Sea were used (Davies et al., 2014; Harley et al., 2014). These tagging projects were conducted mostly in the equatorial area with some part in the subtropical area of south and central Pacific. Therefore, no information on the fish released in the temperate and subtropical areas of the northwestern Pacific was included.

Japan conducted two large scale tagging programs (national projects) targeting bigeye and yellowfin tunas; one is in the southwestern part of Japan (around Nansei Islands, subtropical area) during 2000-2010 and the other is in the east off central Honshu (temperate area) during 2006-2010. Overview of each project is reported by Matsumoto *et. al.* (2007) and Matsumoto and Okamoto (2008), respectively. Although tag data were once submitted for use in 2011 stock assessment, we got some progress both in the quality and quantity of the data. We also have yellowfin and bigeye tuna tag data by other research projects including skipjack tuna tagging project in the Japanese water.

This paper briefly summarizes overview of tagging programs and tag data for yellowfin and bigeye tunas conducted by Japan to provide general information and also to consider for the use in the stock assessment model.

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2. Overview of tagging programs

Table 1 shows summary of two large scale tagging programs targeting yellowfin and/or bigeye tuna. In the Nansei Islands area (southwestern part of Japan, 24-29°N, 123-130°E, Fig. 1), the fish for tagging were mainly caught by pole-and-line, handline and troll mainly by chartered and research vessels. In the offshore central Honshu (offshore central part of Japan, temperate area, 33-36°N, 142-145°E, Fig. 1), the fish for tagging were mainly caught by pole-and-line in a research vessel.

Yellowfin and bigeye tagging is also conducted in an ongoing skipjack tagging project by NRIFSF in cooperation with Ajinomoto Co. Inc. around Yonaguni Island (a part of Nansei Islands, 23°N, 123°E) since 2011 (Table 1). Some small scale tagging was also conducted during research cruise or by chartered and commercial vessels, and a few tag recoveries for yellowfin and bigeye have been obtained. All the fish were released at Area 1 for 2014 stock assessment except for a part of fish in the small scale tagging.

3. Results of tagging

3.1 Fish size released

Length frequencies of tagged fish by large scale tagging in each area are shown in Fig. 2. As for bigeye tuna, most fish ranged between 30 and 70 cm FL with a mode around 55cm in the Nansei Islands, whereas most fish ranged between 50 and 85 cm FL with a mode around 55 cm in the offshore central Honshu. As for yellowfin, most fish ranged between 20 and 70 cm FL with a mode around 40cm in the Nansei Islands, whereas most fish ranged between 45 and 60cm FL with a mode around 55 cm in the offshore central Honshu.

3.2 Fish movement

Fig. 3 shows the movement of the fish based on tag data. As for bigeye tuna, many of the fish released in the Nansei Islands moved northeastward, and reached between around Kyusyu to east off central Honshu, and a part of the fish moved to the south and reached east off Philippines. The fish released in the offshore central Honshu moved to the various directions, and several fish moved eastward or southeastward. A few fish moved to the central Pacific Ocean. Several fish moved to different area (outside of Area 1) used for 2014 stock assessment.

As for yellowfin tuna, many of the fish released in the Nansei Islands moved northeastward as with bigeye tuna, but certain number of fish moved to the south (around Philippines, Indonesia and PNG).

No fish moved to east of 160°E. Several fish moved to different area (outside of Area 1) for 2014 stock assessment, most of which were to the Area 7. Very few fish released in the offshore central Honshu were recaptured, and so movement pattern is not clear.

3.3 Tag recapture period

Fig. 4 shows frequency distribution of days at liberty (10 days' interval) with its cumulative frequency for each species and area of release. The number of recapture is largest just after release and it sharply decreased with time both for bigeye and yellowfin tuna, except for yellowfin tuna released

in the offshore central Honshu, whose number of recapture is very small. As for bigeye tuna, the proportion of longer term recapture (e.g. after 100 days) was higher for the fish released in the offshore central Honshu than those in the Nansei Islands. The proportion of cumulative number of recapture at 179 days (before tag mixing period for 2014 stock assessment) was 78%, 80% and 55% for bigeye and yellowfin tuna released in the Nansei Islands and bigeye tuna in the offshore central Honshu, respectively. Fig. 5 shows the movement of the fish whose days at liberty were >180.

3.4 Fishery for recapture

Fig. 6 shows the proportion of fishing method of recapture. Pole-and-line was most dominant for both species. Purse seine and longline followed for bigeye tuna, whereas troll was second dominant for yellowfin tuna. In the offshore central Honshu area, pole-and-line (mainly offshore fishery), purse seine and longline fisheries are mainly operated. On the other hand, in the coastal area of Nansei Islands, coastal (small scale) fisheries such as troll, pole-and-line (mainly coastal) and handline fisheries are mainly operated. Main area for recapture and fisheries dominant in each area may have affected recaptured fisheries.

4. Discussion

Although the number of individuals are not huge both for yellowfin and bigeye tuna by Japanese tag data, it is mainly composed of the data released in the temperate and subtropical areas of the northwestern Pacific. It may provide some information on the fish movement in the WCPO. Therefore, it is worth considering using for the input data in the stock assessment models for both species.

At the latest stock assessment for both species, north-south boundary in the northern hemisphere was 20°N. As for Japanese tag data, several fish moved to the south beyond this boundary. Also, 20°N in the western area roughly corresponds to northern boundary for Philippines coastal fisheries. Therefore, we propose to keep or not substantially change this boundary at least in the western part.

5. Future outlook of tagging program

Currently there is no plan for new tagging project by Japan targeting yellowfin and/or bigeye tunas. However, some fish are released in the coastal area of southwestern Japan in our ongoing tagging project of skipjack tuna, and so we can expect increase in the data in the future. We don't have information on tag reporting rate. It is desirable to estimate based on tag seeding experiment.

Acknowledgements

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Table 1. Summary of tagging projects in which yellowfin and bigeye tunas were released.

Project	National tropical tuna tagging project	National tagging project for bigeye tuna	Skipjack tagging project with Ajinomoto Co. Inc.
Primary target species	BET and YFT	BET	SKJ
Area released	Nansei Islands (southwestern Japan) 24-29°N, 123-130°E	Offshore central Honshu 32-36°N, 142-148°E	Nansei Islands (southwestern Japan) around 23°N, 123°E*
Period of release	Mar. 2000-Oct. 2010	Jun. 2006-Jul. 2010	Jun. 2011- *
Season of release	All year (mainly spring to autumn)	Summer	Mainly winter to spring
Fishing method	PL, troll, HL, etc.	PL	Mainly troll

* The area and period in which yellowfin and/or bigeye tuna were released.

Table 2. The number of tag release and recapture for each project as of January 2017. Small scale tagging is not included.

	Bigeye tuna			Yellowfin tuna		
Release area/project	Release	Recapture	Recapture rate	Release	Recapture	Recapture rate
National tropical tuna tagging project	2,691	306	11.4%	12,899	986	7.6%
National tagging project for bigeye tuna	1,763	164	9.3%	136	5	3.7%
Skipjack tagging project with Ajinomoto Co. Inc.	194	20	10.3%	1,831	151	8.2%
Total	**4,648**	**490**	**10.5%**	**14,866**	**1,142**	**7.7%**

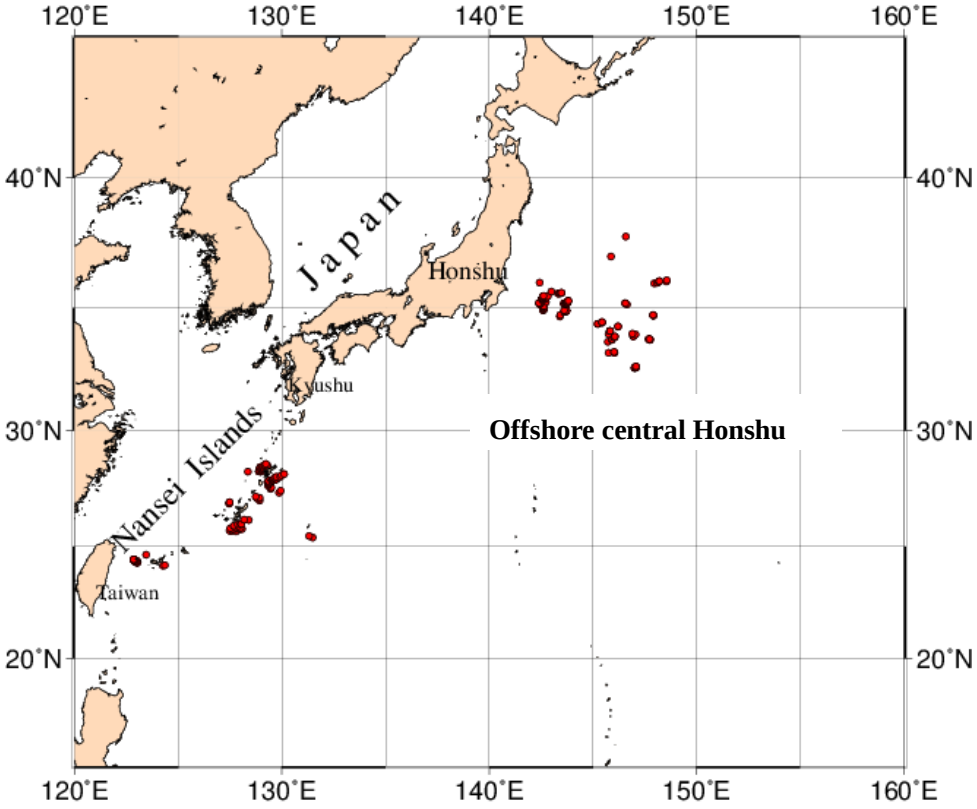

Fig. 1 Position of tag release by Japanese large scale tagging projects.

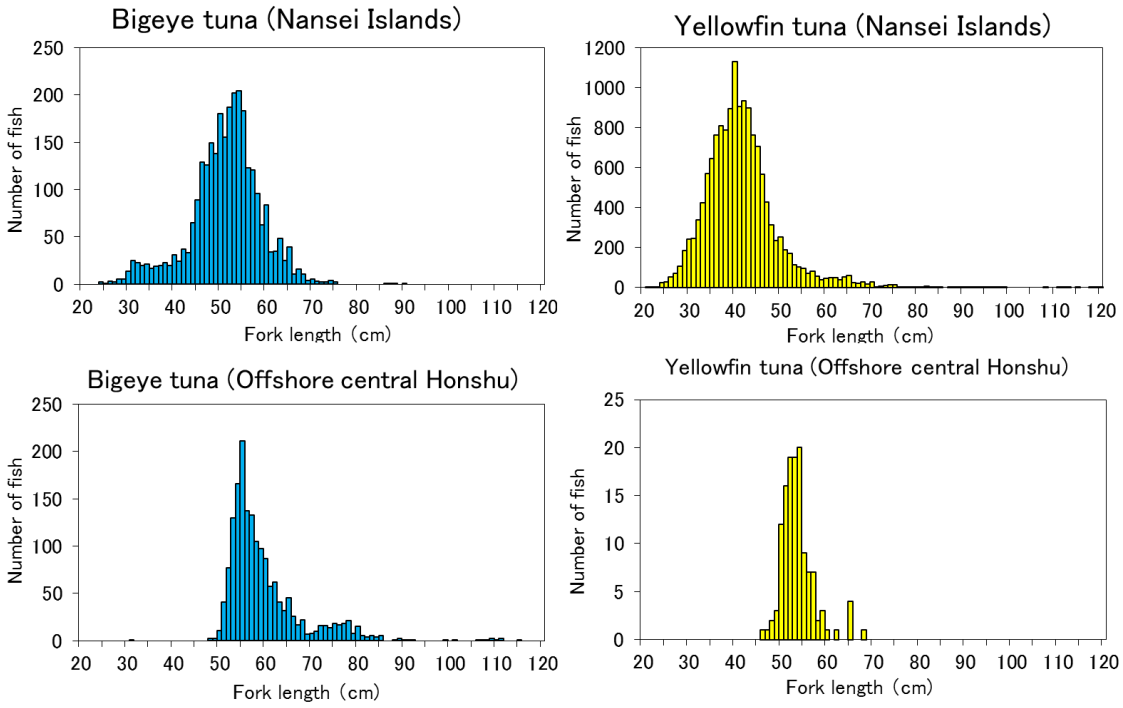

Fig. 2 Length frequency of tagged and released fish.

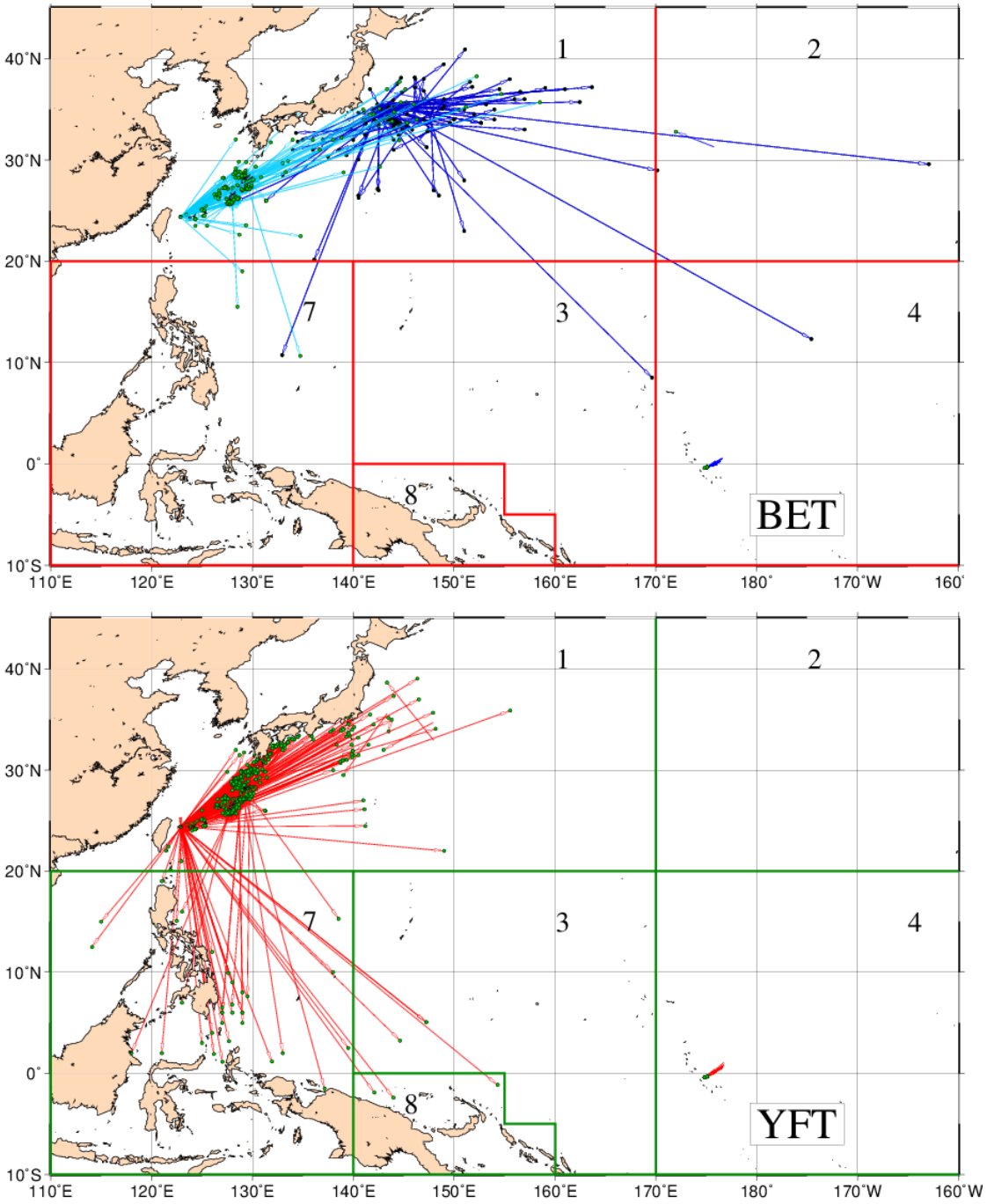

Fig. 3 Movement of the fish based on tag data (top: bigeye, bottom: yellowfin). Circles indicate recapture position. Red (for BET) or green (for YFT) lines indicate boundary of areas used in 2014 stock assessment. The movement of bigeye tuna is color-coded by the area of release (Nansei Islands and others).

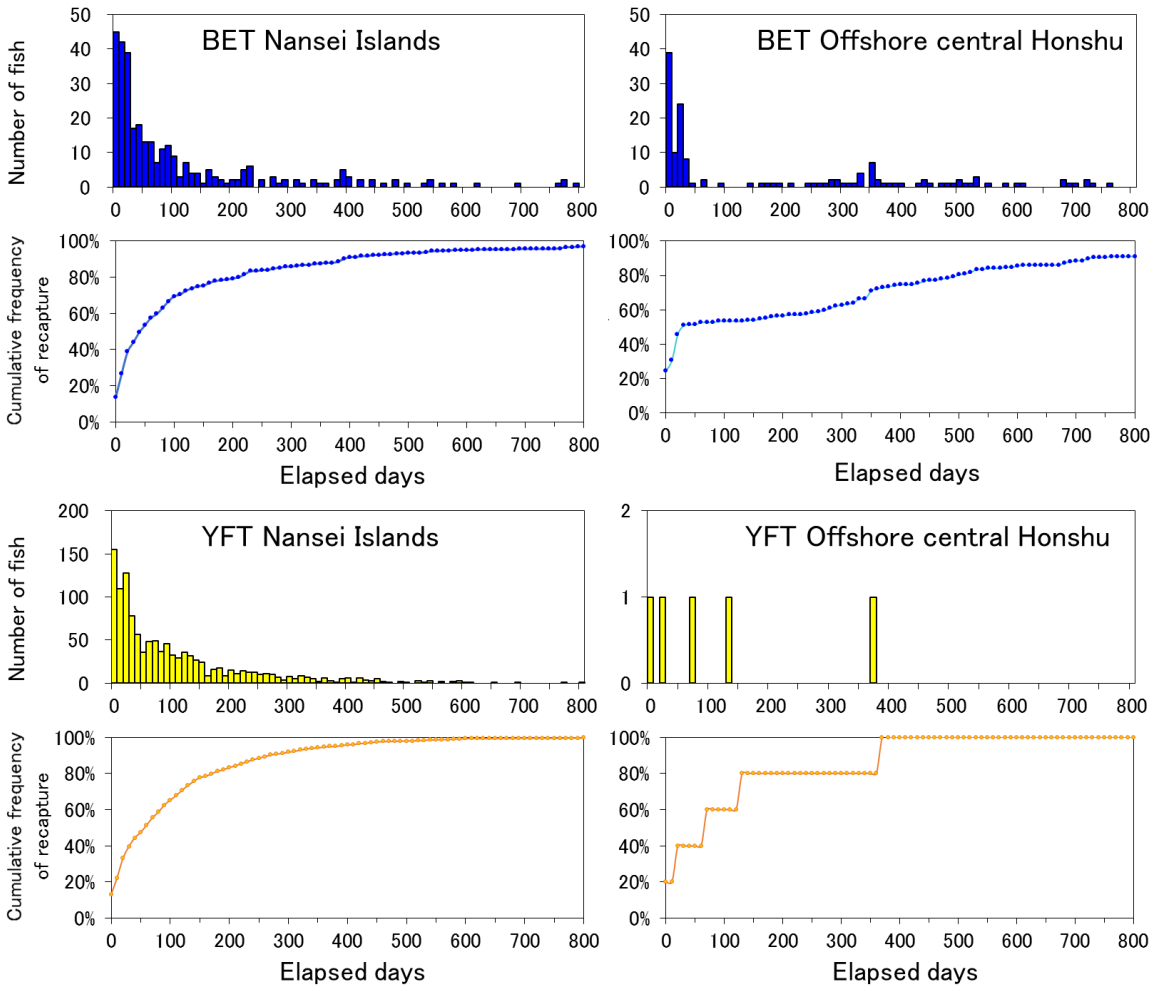

Fig. 4. Frequency distribution and cumulative frequency for days at liberty for each species by the place of release.

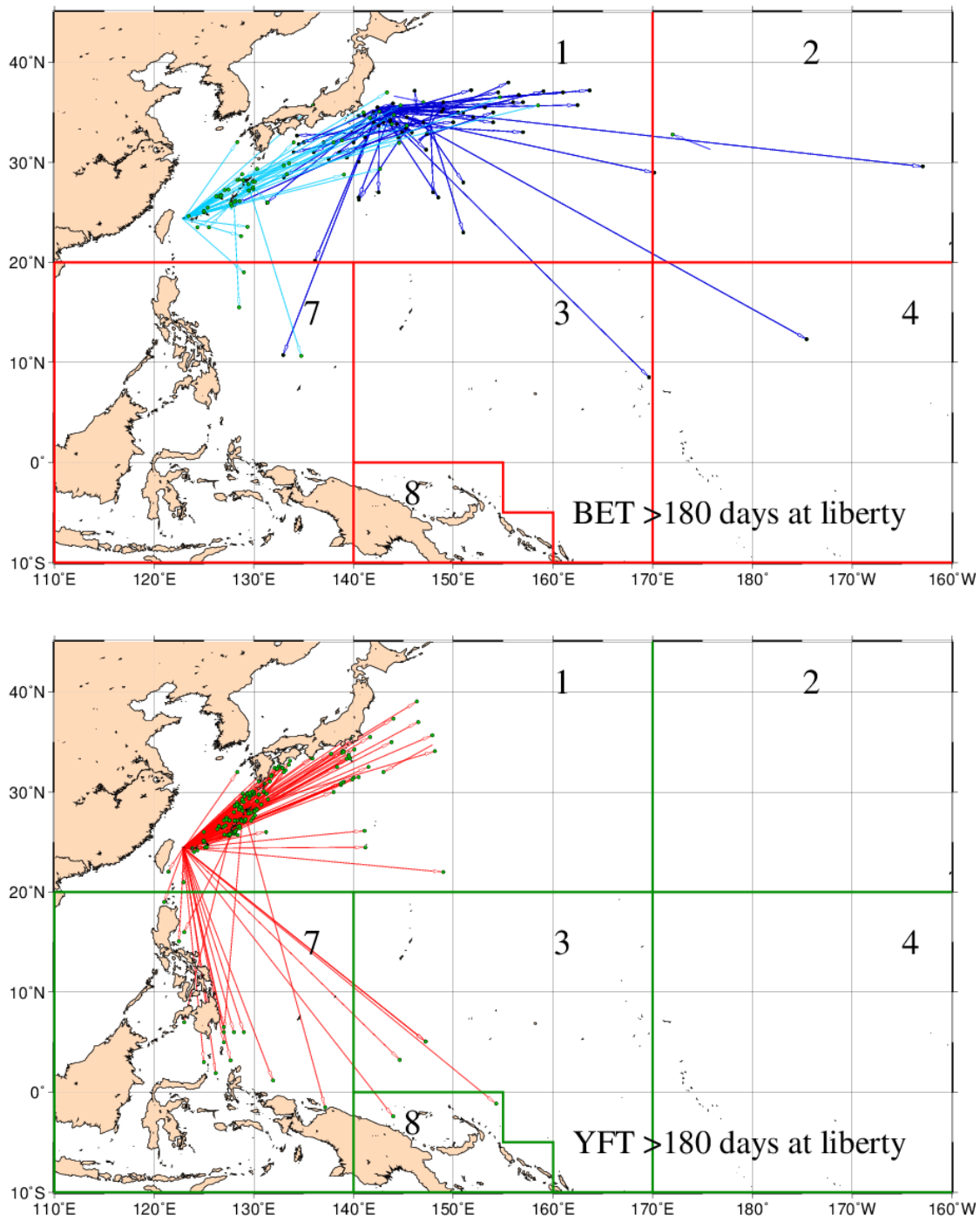

Fig. 5 Movement of the fish based on tag data (top: bigeye, bottom: yellowfin) for the fish whose days at liberty are >180. Circles indicate recapture position. Red (for BET) or green (for YFT) lines indicate boundary of areas used in 2014 stock assessment. The movement of bigeye tuna is color-coded by the area of release (Nansei Islands and others).

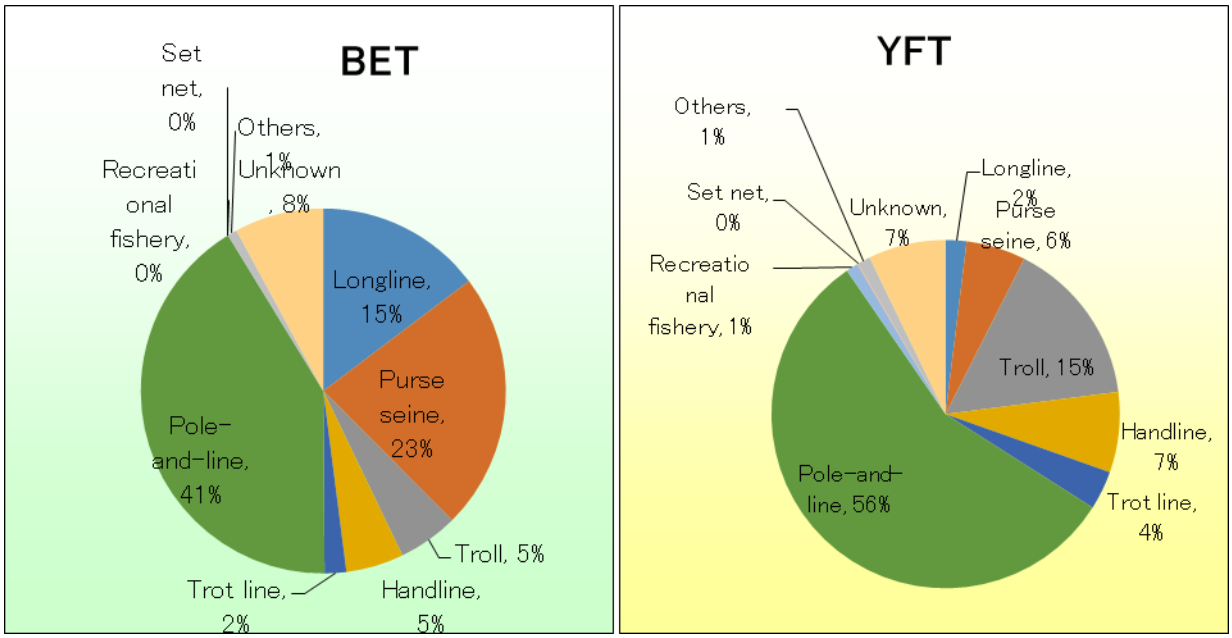

Fig. 6 Proportion of fishing method for recapture for each species.