ミナミマグロ 1 歳魚の加入指標のためのピストンライン曳縄モニタリング調査 2013/2014 の結果報告

Report of the piston-line trolling monitoring survey for the age-1 southern bluefin tuna recruitment index in 2013/2014

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要約

ミナミマグロ *Thunnus maccoyii* 1 歳魚の加入指数を求める曳縄調査を、2014 年 1 月から 2 月に、2006 年以降と一貫した方法で実施した。この調査では、豪州船を用船し、西オーストラリア州南岸の Bremer Bay 沖に設定した単一ライン（ピストンライン）上を曳縄をしながら 1 日に一往復、合計 14 ラインを調査した。ピストンラインの周辺海域及び Esperance -Albany 間の海域のミナミマグロ分布状況も調査した。航海を通じて漁獲したミナミマグロは 392 個体で、その内 44 個体にはアーカイバルタグを、3 個体にはポップアップアーカイバルタグを装着して放流した。

Summary

In January and February 2014, the trolling research survey that provides the data for recruitment index of age-1 southern bluefin tuna Thunnus maccoyii (SBT) was carried out in similar manner since 2006. In the survey, a chartered Australian vessel goes and back on the same straight line (piston-line) off Bremer Bay in the southern coast of Western Australia using trolling for a total of 14 lines. The adjacent area of the piston-line and the area between Esperance and Albany were also surveyed. During the cruise, a total of 392 SBT individuals were caught. Among them, 44 fish were tagged archival tags, and other 3 fish were deployed pop-up archival tag.

1. Introduction

Recruitment level is crucial information on stock management of fish, including southern bluefin tuna (*Thunnus maccoyii*, SBT). Since 2006, Australia has had the largest national allocation of TAC of SBT in CCSBT (Anon. 2006). Most of the Australian catch, used for farming, is mainly age three with a range between two and four, which is the earliest age of SBT fished compared to other nations' fisheries. Given high fishing pressure in their younger life stage, monitoring the recruitment level of SBT in their early life stage becomes much more important than in previous years.

Several research activities have been attempted for the recruitment monitoring of SBT. Since 1989, Japan has conducted a series of recruitment monitoring surveys within a cooperative research framework with Australian scientists. Japan carried out a trolling and pole-and-line catch monitoring survey from 1989 to 1993, and then carried out an acoustic monitoring survey using sonar and echo sounder from 1995 to 2006, for age-1 SBT distributed off the southern coast of Western Australia (Itoh 2006). These researches had been providing the recruitment indices of age-1 SBT to CCSBT for years. Australia carried out a scientific aerial survey in the Great Australian Bight in South Australia since 1993 and also provided the recruitment indices, as aerial survey index, to CCSBT (Eveson et al. 2006). However, because the aerial survey index is for SBT age two to four which is the same age of the Australian purse seine catch, it gives little time of consideration to regulate the fishery based on the results of the research survey. Catch information of SBT age-1 off the southern coast of Western Australia had been provided by the CCSBT SRP tagging program since 2001, but the areas surveyed by the cruise were limited and the tagging was suspended in 2007.

The acoustic index derived from the acoustic monitoring survey predicted the low recruitment levels of the 1999-2001 year classes of SBT which was confirmed by the model based assessment so that it was likely to be a reliable index. However, the survey was ceased after the final survey in 2006 due to the budget restriction. Alternatively, a type of survey that can be done with lower cost was sought. Since 2006, we have carried out a monitoring survey that a chartered Australian vessel go-and-back on a single straight transect line and find SBT schools by catching with trolling (Itoh and Kurota 2006, Itoh and Sakai 2007, 2008, 2009a, 2010, Itoh et al. 2011, 2012a, 2013). In January and February 2014, we carried out the 9th trolling monitoring survey. This paper describes general results of the survey and index

calculated is described in another paper (CCSBT-ESC/1409/34).

2. Materials and methods

An Australian vessel, St Gerard M with 18 m in total length, was chartered (Fig.1). The vessel was also used in the surveys for last eight years. Three researchers and two Australian crew members were on board.

The research area was off the south coast of Western Australia between off east of Esperance (123E) and Albany (118E), including off Bremer Bay (Fig. 2). The area covers about 500 km x 70 km. Within the research area, continental shelf of 70 m in depth extended largely from the coast and then dropped sharply to deeper than 500 m in depth at shelf edge within 2 km distance. The piston-line laid between the two points same as previous years; one was at 34°29.2′S - 119°23.1′E and the other was at 34°44.9′S - 119°36.9′E so that the piston-line covered a range from continental shelf to offshore through shelf edge in distance of 35.9 km. In addition to the piston-line, adjacent areas, east, west or south (offshore) of the piston-line as well as the areas west to off Albany and east to off Esperance, were also surveyed in order to examine whether the piston-line is a representative area in regard to SBT distribution.

The vessel operated trolling at speed of 7-8 knots. Eight trolling lines at maximum were trolled. Each line has one hook with a plastic lure. The specifications of the trolling gears were consistent with those used in the last year survey. Because the index derived from the survey is based on the number of SBT schools, not the total number of SBT individuals caught, we did not try to maximize the number of fish caught.

Individuals caught of any species were measured its length. SBT in good condition were tagged with an archival tag (Lotek Inc., LAT2310 or LAT2810L) and one CCSBT conventional tag following the CCSBT tagging procedure. Some other relatively large SBT individuals in good condition were tagged with pop-up archival tag (Wildlife Computers Inc., mini-PAT). Some other SBT individuals were weighed and taken biological samples (stomach contents, otoliths and muscle tissue). There were some SBT individuals only its length measured and released.

Vertical profile of temperature and salinity (conductivity) were measured down to just above sea bottom or 200 m in depth using a CTD (JFE Advantech Co. ltd., CTD

RINKO-Profiler). GPS position data were recorded every ten seconds. Underwater video images were taken sometimes during trolling conducted out of the piston-line. A video camera in waterproof case was towed and placed 20-30 m behind of the vessel and 2-3 m below the sea surface. The camera took image toward below and behind direction. The images taken were observed later in laboratory and SBT presence was checked on PC monitor.

3. Results

The vessel departed Esperance on 25 January 2014, which was eight days later than the survey in 2013. The vessel surveyed off Bremer Bay from 26 to 30 January, and then went further west and surveyed an area between Bremer Bay and Albany from 31 January to 5 February. The vessel came back and surveyed off Bremer Bay again from 6 to 7 February. The vessel left off Bremer Bay and surveyed the area east of Esperance up to 123E from 8 to 11 February and back to Esperance on 11 February in which the research survey was finished.

Usually, the vessels engaged in the research survey from 6:00 to 18:00 and anchored in calm bay at night. While there were several days in rough sea, we could carry out the surveys for 17 days among 18 days. The piston-line was surveyed off Bremer Bay in seven days for 14 lines.

During the cruise, a total of 392 fish individuals were hooked, including 198 SBT, 18 skipjack *Katsuwonus pelamis*, 115 bonito *Sarda orientaris*, 8 yellowtail kingfish *Seriola lalandi,* 1 mackerel *Scomber australasicus* and 52 unidentified individuals which escaped far from the vessel. Among the 392 SBT individuals, 44 SBT were implemented archival tags in their body cavity with CCSBT conventional tags on their dorsal. Other 3 SBT were attached the pop-up archival tags. 102 SBT were killed for biological sampling. Total weight of SBT killed was 256.2 kg for 102 individuals.

Many SBT were caught off Bremer Bay not only on the piston-line but also in adjacent areas (Fig. 2). Few SBT were caught on shelf edge nor offshore area. Compare to previous years, it was remarkable that most of SBT were caught in the half of continental shelf closer to the coast in 2014 as observed in 2013.

Length frequency of SBT caught is shown in Figure 3. SBT caught ranged from 45 to 80 cmFL. SBT caught in 2014 is consistent with that of this area in previous 17 years in terms that fish around 50 cmFL, presumably age-1, was the main

component. In previous three years, 2011-2013, SBT length frequencies in the survey had several modes and considered to be consisted of different sub-cohorts in age-1. In 2014, only one mode was observed for age-1 fish with mode at 47cm FL which appear to be age 1.0 fish born in January-February 2013 (Itoh et al. 2012b).

Underwater video images were taken 26 times, reaching 33 hours in total. Those footages were under observation in laboratory.

4. Discussion

Fishery data are basic information to assess current stock status of SBT in CCSBT. Especially, CPUE of Japanese longline, which covers wide area and season and wide age range and based on detailed information reported from fishermen, is a long time series index more than 40 years for SBT stock status. Aerial survey is also a valuable research. It covers wide area in a short duration in the Great Australian Bight by using airplane and data of school biomass is derived as an estimation of spotter. However, there is no index that directly reflects the status of SBT stock in whole ranges in both age and geographical distribution. Therefore, we need to collect information from as many as possible to decide stock status appropriately. Trolling survey provide an important information of age-1 SBT.

SBT of age three and more are distributed so widely in the area between off New Zealand and off Cape that means a fraction of the whole stock is the subject of the aerial survey in the Great Australian Bight and longliners in Taiwan and Japan. SBT of age-1 is thought to be distributed in the coastal area of Western Australia (Itoh and Sakai 2009b). A recruitment index derived from SBT age-1 in Western Australia by any measure (not restricting trolling catch) has a potential that represents whole the stock at an age.

There are advantages of the trolling survey compared to the acoustic survey and the aerial survey, which is complementary with other methods. Species identification and size of SBT are definite data which were actually measured in the trolling survey. The trolling survey is a robust research against wind, wave and swell. There were few days that suspended the research during the cruise due to rough sea condition in eight years. We did not find a tendency that SBT were less caught in rough sea condition.

To derive accurate year trend in index of recruitment level, we need to exclude

other factors that fluctuate by year. Carrying out the research in consistent method for all years is a good way for this. We have not changed the vessel used, gear specification used, and general research method for nine years. The research area has been consistent for nine years where the main research area has been off Bremer Bay and carried out the piston-line survey. It is expected that an index which reflects only for annual SBT recruitment change is derived relatively easily.

Actually, agreements of trends were observed between the trolling survey indices derived from this survey and several recruitment indices from the CCSBT stock assessment, e.g. recruitment from OM and CPUE of age-4 SBT in Japanese longline (CCSBT-ESC/1409/34). Up to now, the trolling survey appeared to succeed in providing data for the recruitment index that represents the whole age-1 SBT stock. Then, there is no need to change the current survey design so far.

However, it does not guarantee the survey design to be appropriate in future. There are several points of concerns to be pointed out relating representativeness of the research data against the whole age-1 stock. One concern is that SBT distribution within the research area changed by year. For example, few SBT were caught on the shelf edge in 2013 and 2014, though many SBT were caught there in previous years (Itoh et al. 2013).

Another concern is distribution of SBT in other areas. A part of SBT age-1 may have already left the survey area at the time of the trolling survey. Some fish may have not yet arrived, or some fish may do not come the trolling survey area. However, we have little information that shows existence of large amounts of age-1 SBT outside of the trolling research area in January and February. Even though aerial survey reported “age-1” fish in Great Australian Bight, their definition of less than 8kg to be age-1 (Eveson et al. 2013) was too large for age-1 fish which actually weigh about 3 kg. Electronic tagging or examination on the environmental condition would be an effective way to know distribution dynamics of age-1 SBT.

Sub-cohort structure is also of concern. A significant part of age-1 SBT was large size SBT corresponding to age-1.3 in the research of 2011, 2012 and 2013 (Itoh et al. 2012b). Composition of age-1 SBT in the research returned in 2014 which was mainly smaller fish of age-1.0 SBT as same as that before 2010. However, its effect on the research design or index is unclear.

Such uncertainties on potential existence of age-1 SBT outside of the research area and season may harm the representativeness of the trolling index. However,

it would be little effect if proportion of the outside fish was negligible or such a proportion was stable over years. If such a proportion changed largely by year probably due to the fluctuation of oceanic conditions, it makes a large impact on the trolling index. Although we should be careful for such a possibility, there is no actual information to support the possibility so far.

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Figure 1 St Gerard M, used for the research

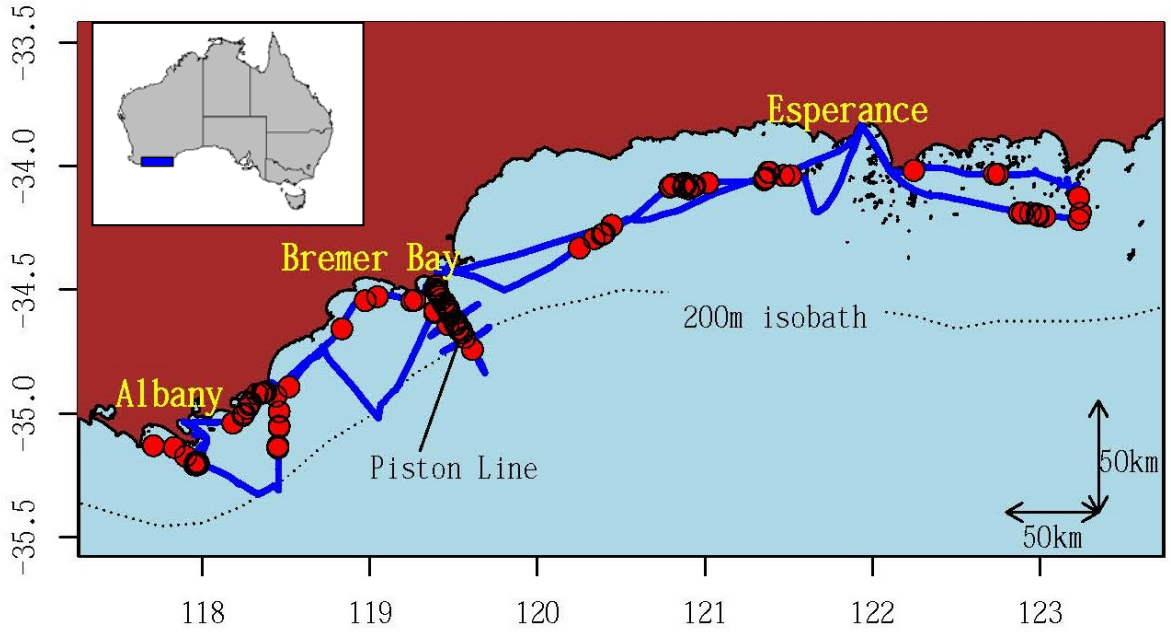

Figure 2 Trajectory of the vessel and location of SBT caught (circles) in the 2014 trolling survey.

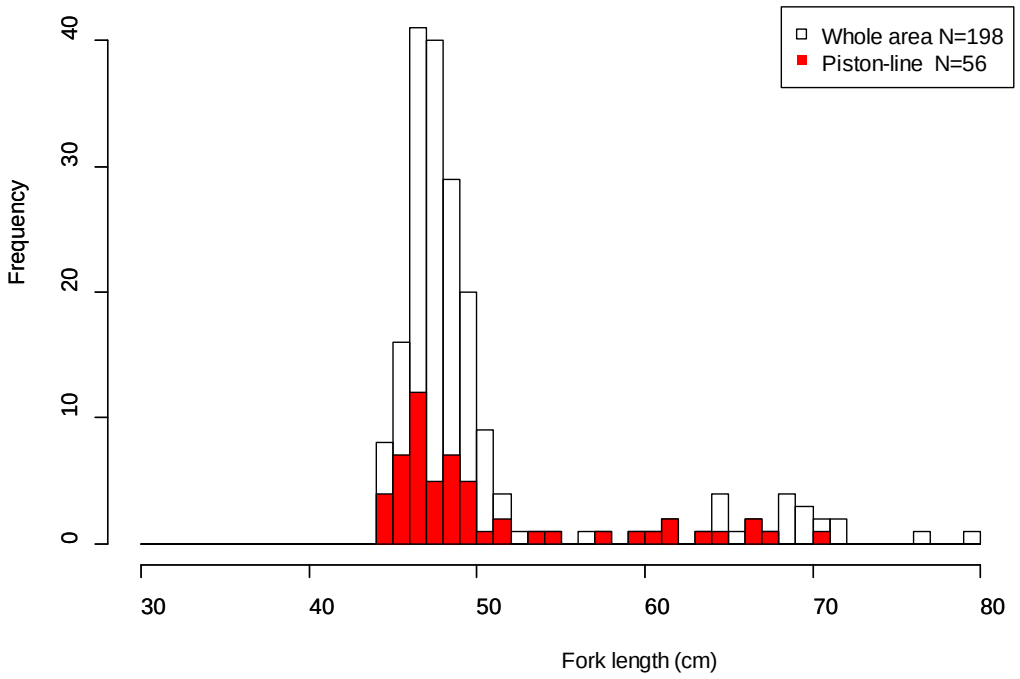

Figure 3 Fork length frequency distributions of southern bluefin tuna caught in the 2014 cruise. That of fish caught off Bremer Bay (119E-120E) is also show as Piston-line.