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# A review of the fishery and size data for the purse seine fleet operating in the Japan Sea (Fleet 3).

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## INTRODUCTION

The tuna purse seine fleet operating in the Japan Sea (Fleet 3) is catch mainly Pacific bluefin tuna (PBF) of older than age 3. The catch data and the size measurement data of this fleet were used for the stock assessment, and the CPUE data was prepared for the future stock assessment (anonymous, 2012; Kanaiwa et al., 2012). In the past stock assessment workshop held in Shimizu at 2012 by the ISC PBF working group (PBFWG), the yearly difference of the size frequency data in this fleet (Fig. 1) was one of the issues as a cause of the bad-fits to the current stock assessment model (anonymous, 2012).

It is necessary to reduce a clear misfit for the construction of the reasonable stock assessment model. Then, because of that, the PBFWG discussed if the size selectivity of this fishery (Fleet 3) was changed during the assessment period. To treat the size selectivity of the SS model, to investigate the actual conditions of the fishery is important, however, it was not performed well in the last work shop because of a limited time. Thus, further investigation for this fleet was required to construct the reasonable stock assessment model.

In this document, the circumstances of the purse seiner operated in Japan Sea were reviewed to comprehend the reasons for the difference among the yearly size frequency data. We checked the size & age compositions and operating details (date, position, catch amount etc…) of each set.

## MATERIALS and METHODS

Length sampling data to be used in estimation of catch at size (ISC/12-1/PBFWG/07) were associated with operating date, position, and catch quantities, recorded in the log book. These size data with setal details are available from 2000 to 2010, while the catch@size data have been created for 1887 to 2010 though.

## RESULTS

Table 1 shows annual catch and the outline of the size measurements conducted in each year. In 1981 and 1982, this fleet caught over 1000 tons of PBF. The annual caches after those years remained around 500 tons, until 2003. Since 2004, the catch level has exceeded 1000 tons annually by the reason of the increases in the number of the vessels and sets. Size measurements have been high coverage and most of the landings were sampled.

Figure 2 shows the operation positions with average fish age in each set. In

Figure 3, a cumulative proportion of the catch in each year time-series is given. Only a few sets were made in June between 1996 and 2003, the most catch having been made in the mid- to late-July. The main age-class in these sets were ages 5-6 in 2000, ages 6-7 in 2001, ages 7-8 in 2002, and age 9 in 2003 (Fig. 2). Those could be considered as representing the strong year-class of 1994.

From 2004 to 2006, the catch of this fleet increased possibly associated with increased sets with expansion of operates towards the north and the east (Fig. 2). The sets in June increased year by year during this period. The main age-class, among others, of those sets were age 3 in 2004, age 4 in 2005, and ages 5-6 in 2006 (Fig. 2 2004-2006). Those could be considered as the year-class of 2001.

In 2007 and afterward, set in June occupied more than a third of the total sets (Fig. 3), and caught younger PBF (age 3-4), which accounted more than a half of the total catch weight. Those young fish sets tended to be concentrate in the north-eastern part of fishing area in the Japan Sea. The most sets in July caught older age fish (5+), while some still caught ages 3 and 4.

Figure 4 shows the frequency distributions of the fish caught in each set. The sets at 7/9 in 2003, 6/27 in 2004, and 7/3, 4, and 15 in 2007 had, a strong mode in the frequencies are found at age 3. On the other hand, the sets which caught mainly age 6 (i.e. 2001-2004, and 7/15, 19 in 2007) or older fish did not have clear mode as the sets which caught age 3as more proportions of other age-class fish are in the same set.

**DISCUSSION**

As shown above, this fishery experienced two types of changes. The one is a quantitative change, which appeared as increase in the number of the vessels and sets at 2004. This increase was occurred at the same period of time for the decrease in the number of sets of purse seine in Pacific Ocean side (fleet 4). Some of the vessels was came from Pacific Ocean side to Japan Sea in this period.

And the other is a qualitative change in terms of fishing area and season, which appeared around 2007. The size frequencies prepared for past stock assessments showed some shift of catches to smaller fish after 2007. This is the reflection of new development of fisheries, i.e. expansion of fishing season (in June) and grounds (towards north-east) in order to target age 3 and 4 fish, since 2007. In 2007 and afterwards, a lot of sets caught age 3-4 fish in June at northeast Japan Sea every year. According to the interview with fishers, a finding of the new fishing ground in northeast of the Japan Sea have made it possible to catch age 3-4 fish every year, and those were encouraged by the relatively high market price of fish.

Before 2007, catches of age 3-4 fish in June were scarce. This fishery used to catch a same year-class fish through several years (i.e. 1994 year-class in 2000-2003, 2001 year-class in 2004-2006). In past, the year-classes of 1994 and 2001 clearly appeared in the catch of the other pruse seine fleets, including fleets 2 and 11. The purse seine fleet in the Japan Sea was no exception.

The age compositions of each set suggested that fish of older ages (5+) form a school of mixed age structure in July and August in the Japan Sea. These age structures change depending on the relative abundances of various year-classes. For this reason, and together with the fact that only a very few sets were made in June, which seem to catch mostly ages 3-4 fish, there were no specific target age before 2006.

These analysis suggested clearly that the Japan Sea purse seine fleet (Fleet 3), went through two types of historical changes (quantitative and qualitative changes). The yearly fluctuations in size frequencies before 2006 might have reflected the strength of each year-class because it was difficult to target the fish of specific age. After 2007, the fishing operational pattern was qualitatively changed, catching only young age (age 3-4) fish in June at northeastern part of the Japan Sea. Thus, the size frequency distributions, which were shifted to relatively smaller fish after 2007, should have reflected this qualitative change.

**References**

M. Kanaiwa, I. Tsuruoka, A. Shibano, T. Shimura, R. Uji, Y. Ishihara, Y. Takeuchi (2012). Update of estimated catch at size by Purse Seiner in Japanese sea. ISC/12-1/PBFWG/07.

Anonymous (2012). Report of the ISC Pacific Bluefin tuna working group workshop.

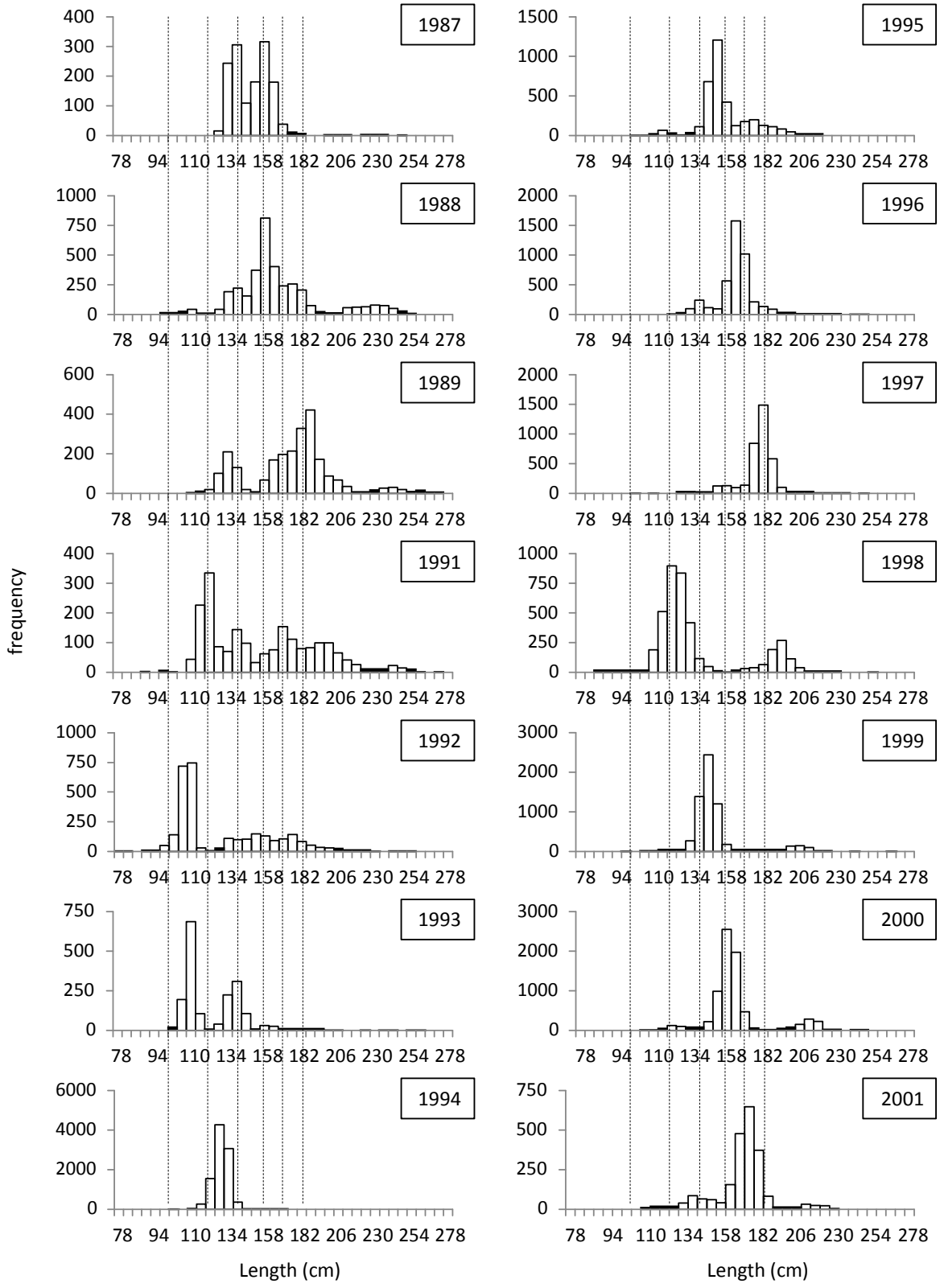



**Fig. 1** Catch at Size of Fleet 3 used for present stock assessment for PBF.

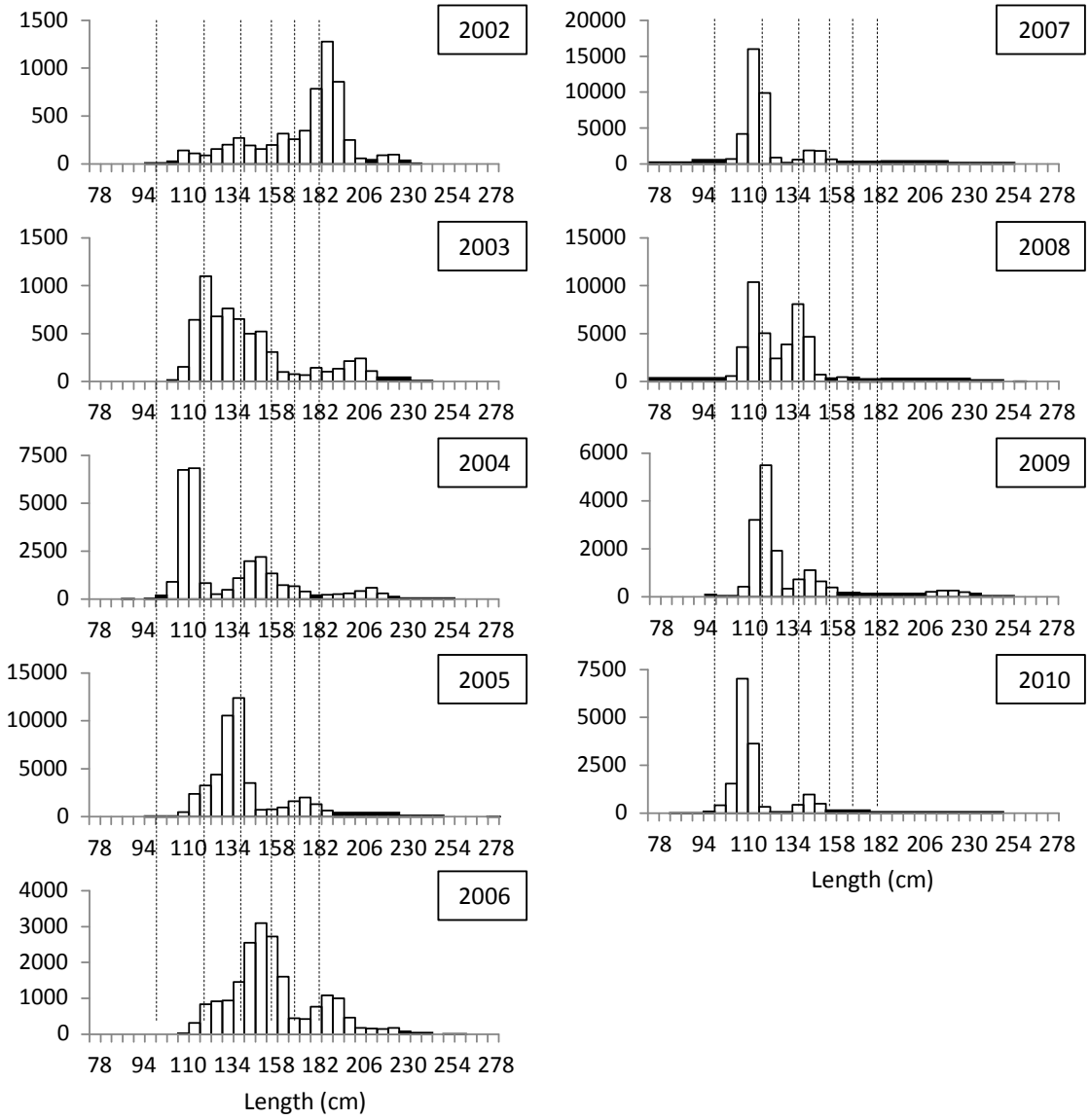



**Fig. 1** Catch at Size of Fleet 3 used for present stock assessment for PBF.

**Table 1** The annual catch and the outline of the size measurements conducted in each year. Those were rewrote from Kanaiwa et. al. (ISC/12-1/PBFWG/07).

| Year | Vessel | Vessel with Landing data | Landing | Landing with length data | Catch(#) | Catch(ton) | Measured fish(#) | Coverage (%) |
|---|---|---|---|---|---|---|---|---|
| 1974 | - | - | - | - | - | 0.0 | - | - |
| 1975 | - | - | - | - | - | 0.1 | - | - |
| 1976 | - | - | - | - | - | 0.0 | - | - |
| 1977 | - | - | - | - | - | 0.0 | - | - |
| 1978 | - | - | - | - | - | 2.8 | - | - |
| 1979 | - | - | - | - | - | 0.0 | - | - |
| 1980 | - | - | - | - | - | 0.0 | - | - |
| 1981 | - | - | - | - | - | 1,297.2 | - | - |
| 1982 | - | - | - | - | - | 1,614.6 | - | - |
| 1983 | - | - | - | - | - | 570.2 | - | - |
| 1984 | - | - | - | - | - | 806.6 | - | - |
| 1985 | - | - | - | - | - | 448.0 | - | - |
| 1986 | - | - | - | - | - | 16.0 | - | - |
| 1987 | 1 | 1 | 2 | 2 | 1,419 | 249.9 | 791 | 55.7 |
| 1988 | 5 | 5 | 10 | 10 | 3,539 | 742.1 | 2,006 | 56.7 |
| 1989 | 3 | 3 | 4 | 4 | 2,395 | 579.9 | 1,166 | 48.7 |
| 1990 | - | - | - | - | - | 149.0 | - | - |
| 1991 | 4 | 4 | 7 | 7 | 2,024 | 224.2 | 1,300 | 64.2 |
| 1992 | 4 | 4 | 6 | 6 | 2,913 | 469.0 | 2,220 | 76.2 |
| 1993 | 2 | 2 | 3 | 3 | 1,801 | 82.7 | 1,284 | 71.3 |
| 1994 | 2 | 2 | 4 | 4 | 9,608 | 694.4 | 1,935 | 20.1 |
| 1995 | 3 | 3 | 3 | 3 | 3,508 | 496.1 | 1,035 | 29.5 |
| 1996 | 6 | 6 | 6 | 6 | 4,238 | 450.0 | 2,772 | 65.4 |
| 1997 | 5 | 5 | 9 | 8 | 3,955 | 707.9 | 1,902 | 48.1 |
| 1998 | 4 | 4 | 8 | 7 | 4,265 | 325.5 | 2,240 | 52.5 |
| 1999 | 4 | 4 | 8 | 8 | 6,129 | 578.6 | 3,333 | 54.4 |
| 2000 | 5 | 5 | 10 | 10 | 7,548 | 746.9 | 3,775 | 50.0 |
| 2001 | 5 | 5 | 5 | 5 | 2,193 | 239.0 | 1,365 | 62.2 |
| 2002 | 5 | 5 | 13 | 13 | 5,976 | 598.8 | 3,190 | 53.4 |
| 2003 | 4 | 4 | 14 | 14 | 6,649 | 571.0 | 2,895 | 43.5 |
| 2004 | 8 | 8 | 36 | 36 | 27,102 | 2,100.0 | 9,122 | 33.7 |
| 2005 | 11 | 11 | 55 | 55 | 47,120 | 3,693.5 | 15,626 | 33.2 |
| 2006 | 10 | 10 | 50 | 50 | 19,418 | 2,011.8 | 10,814 | 55.7 |
| 2007 | 9 | 9 | 49 | 48 | 41,911 | 2,122.9 | 17,073 | 40.7 |
| 2008 | 9 | 9 | 60 | 58 | 44,500 | 3,028.2 | 19,961 | 44.9 |
| 2009 | 9 | 9 | 31 | 28 | 16,513 | 1,298.8 | 2,328 | 14.1 |
| 2010 | 8 | 8 | 27 | 26 | 18,409 | 1,051.6 | 3,325 | 18.1 |

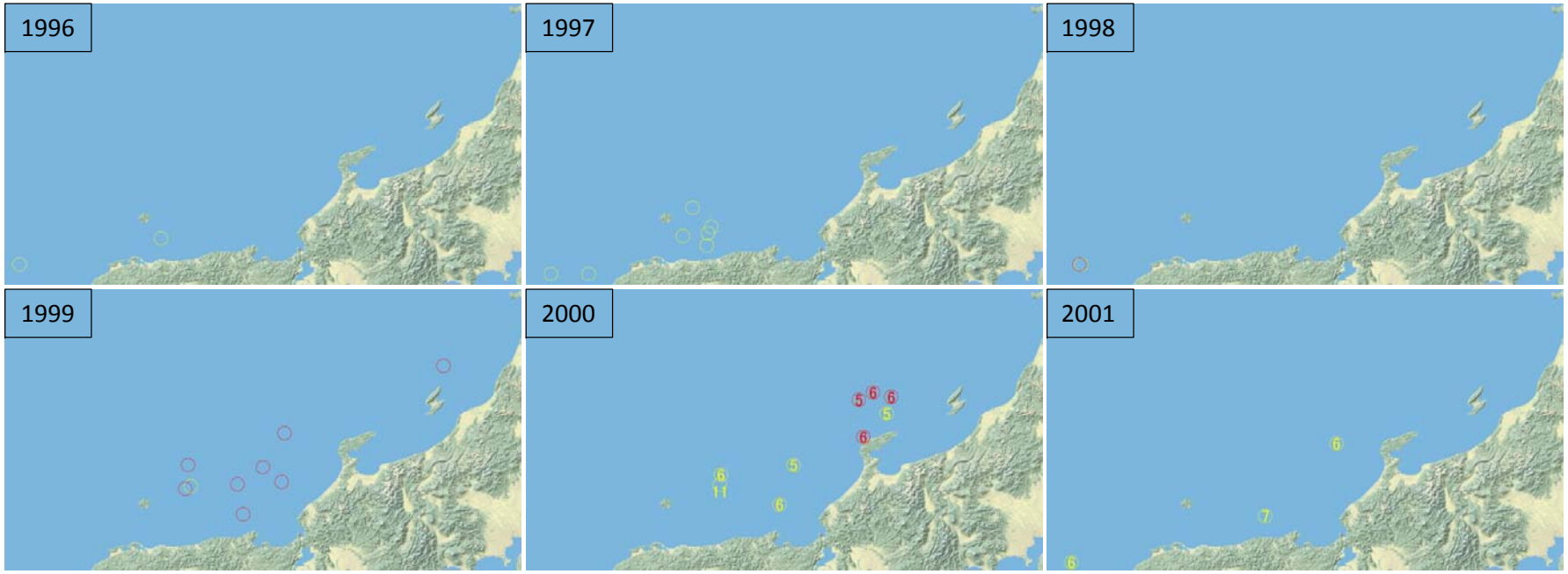
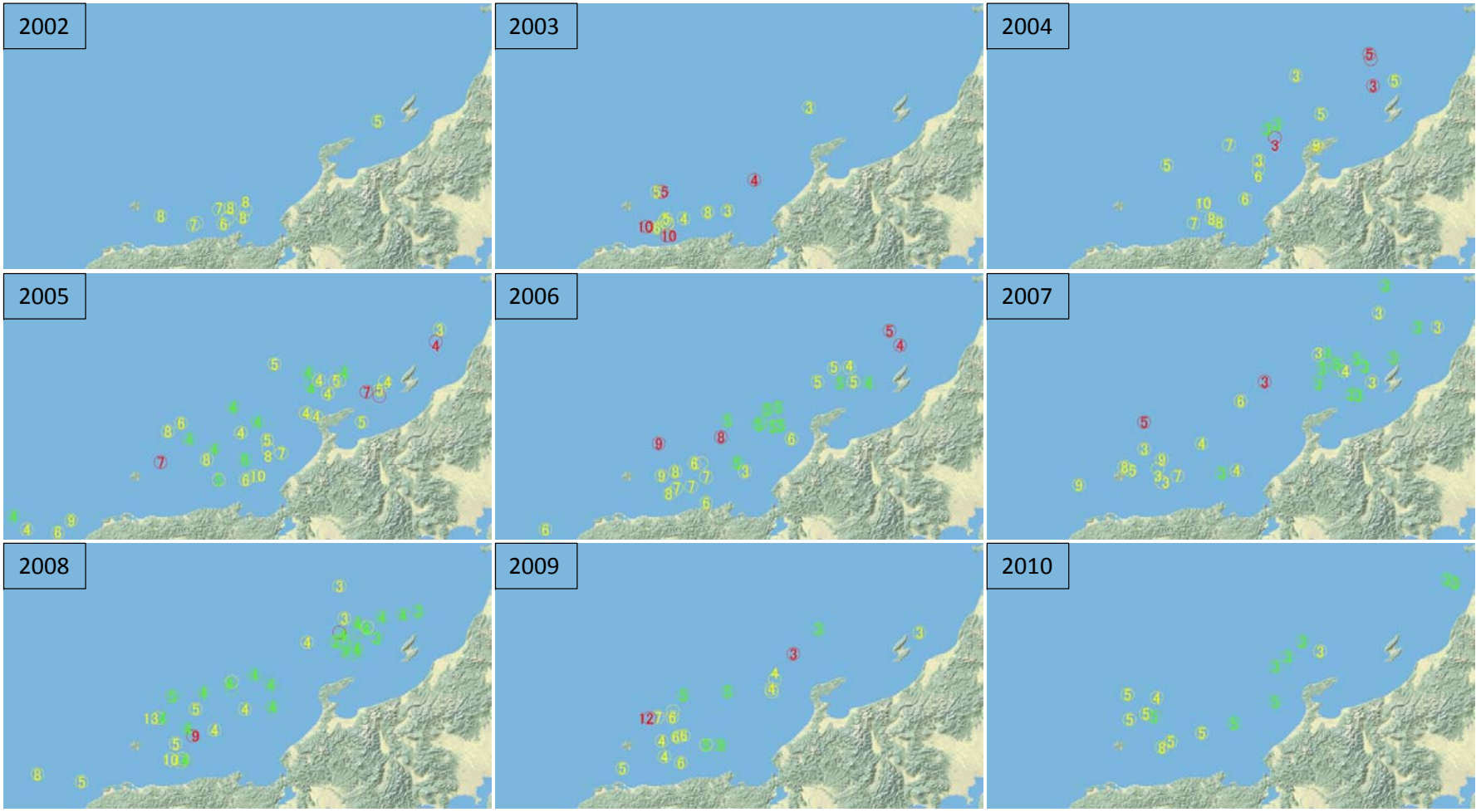



**Fig. 2** The operation positions and average age in each operation. Each color indicates the operation month; Jun: green, July: yellow, August: red.

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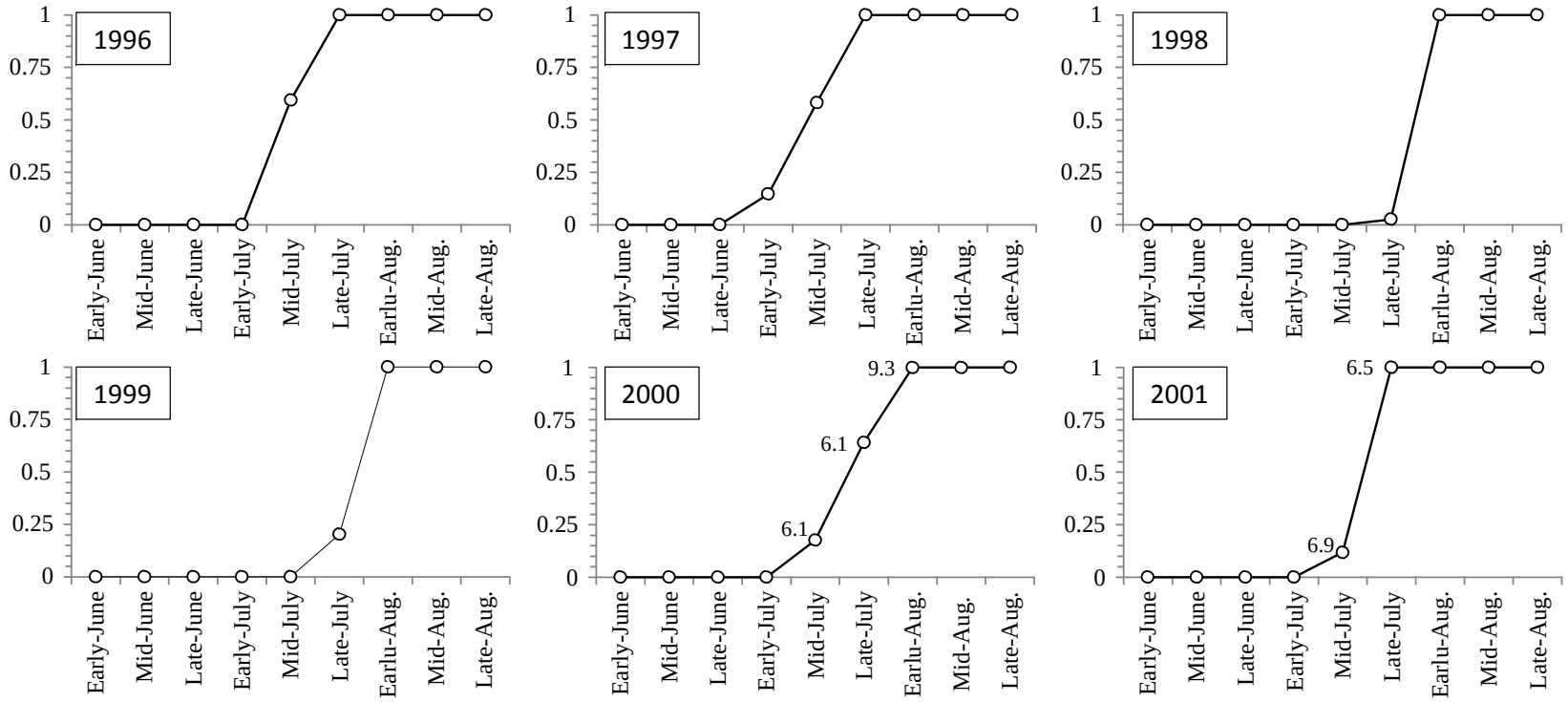
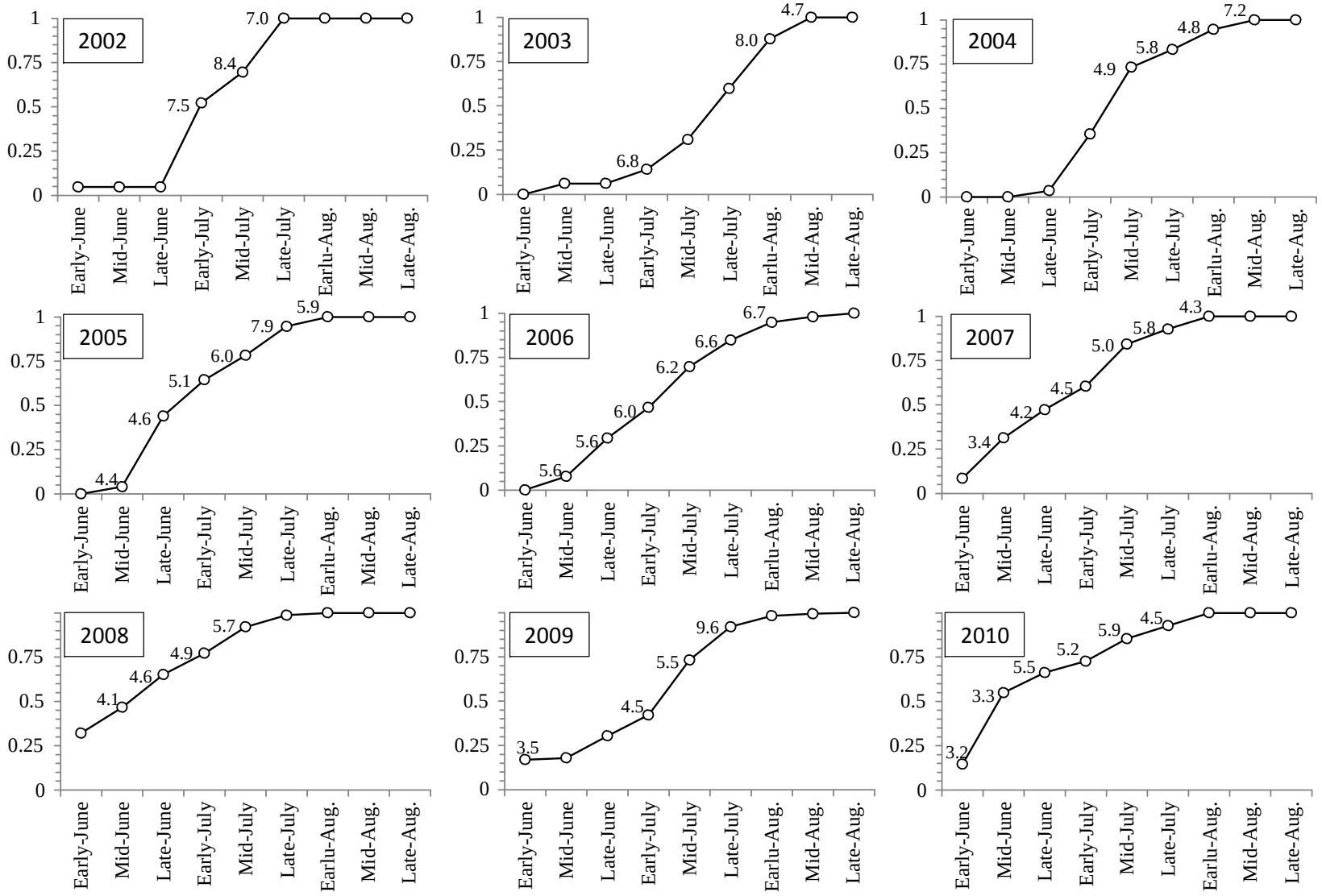



**Fig. 3** The time-series change in the cumulative proportion of catch. Data were aggregated by 10-days interval. A number written besides a marker indicates the average age in each 10-days interval.

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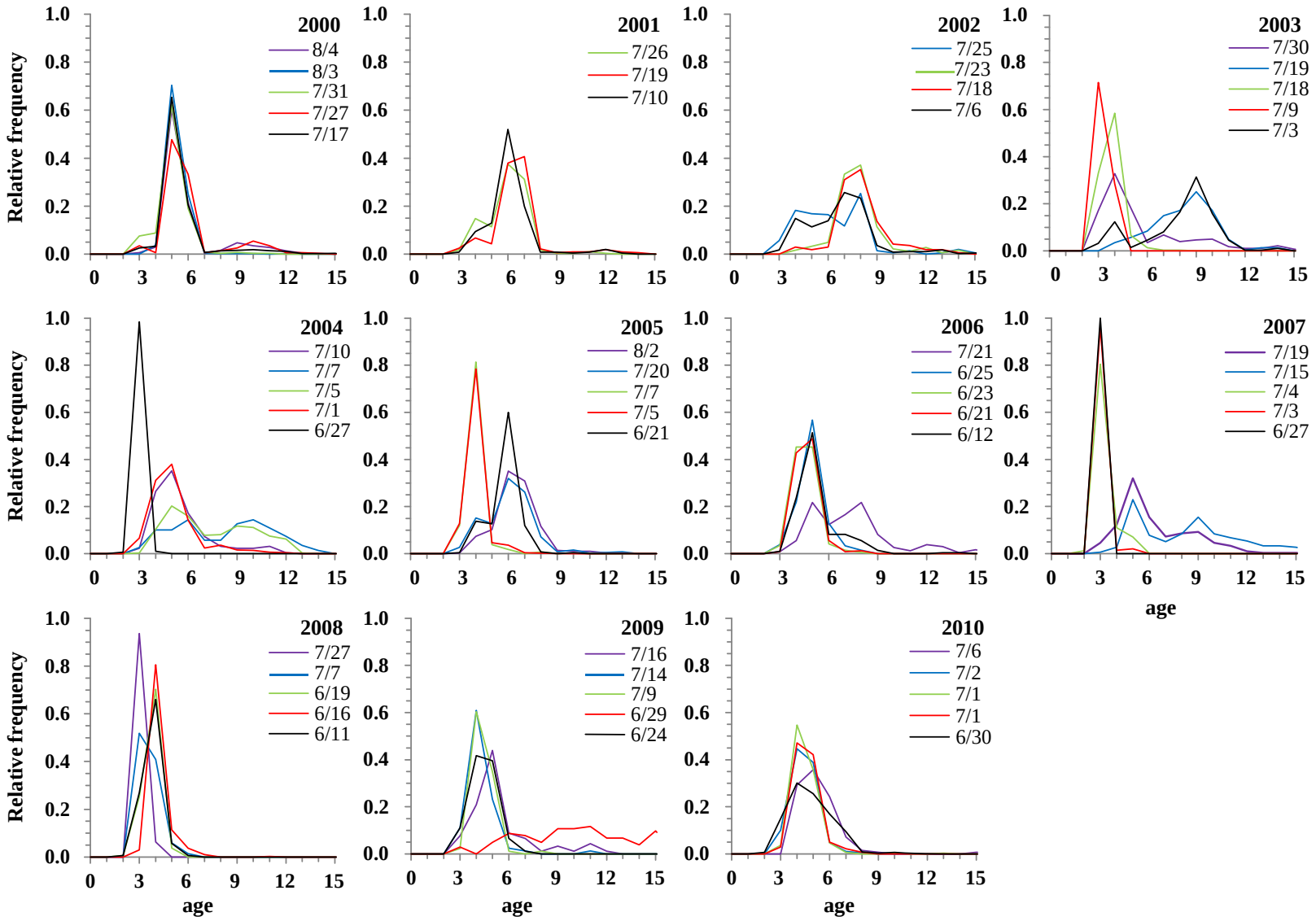


**Fig. 4** Age frequency distribution for each set. In each year, top five of sets in the coverage of size measurement were selected.