

ANALYSES OF LOCAL-SCALE MIGRATION OF TUNA SPECIES BASED ON
HISTORICAL ARCHIVES AND ITS MECHANISM RELATED TO
OCEANIC ENVIRONMENTAL FLUCTUATIONS IN JAPAN

Yulina Hane, GPSS-GLI, 47-136835
Advisor: Professor Shingo Kimura
Co-Advisor: Associate Professor Motoharu Onuki

ABSTRACT

Japan is one of the largest fish consuming countries around the world with annual fish consumption being about 57kg per person, whereas the world average is 17kg per person. Bluefin tuna (*Thunnus orientalis*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacres*), and albacore tuna (*T. alalunga*) are among one of the commercially important fish species by sales and consumptions both in Japan and worldwide. These species have become a target for the international management scheme, as they have long been depleted by multiple countries for the last five decades. For achieving sustainable tuna fisheries, many studies have been conducted to investigate their life history, migration, and distribution, yet these could be largely affected by different oceanic environmental factors.

Although, there have been many newspaper articles reporting on unexpected short-term and local-scale catch fluctuations of economically important tuna species around Japanese oceans, little to no systematic studies have been conducted to collectively analyze each catch fluctuation reported by newspapers. Fisheries research institutions publish fisheries-related data such as annual catch statistics, but these often fail to reflect catch fluctuations that happen in a short period of time in local waters. On the other hand, historical newspaper archives contain an important source of information regarding those data as well as detailed descriptions about stock and fishing conditions of tuna species for more than 130 years in database. Therefore, it is critical to record and accumulate such information in order to have a

complete understanding of local-scale migration of tuna species in relation to different oceanic environmental fluctuations.

The objective of the present study is to 1) create an archive of historical incidents related to unexpected short-term and local-scale catch fluctuations of bluefin, bigeye, yellowfin, and albacore tunas, 2) investigate the relationship between reported catch fluctuations of these tuna species and historical socio-cultural factors, and 3) identify a clear relationship between reported catch fluctuations and different oceanic environmental factors using the Hokuriku area as a case study.

In order to achieve the objectives 1 and 2, the study performed a newspaper database search for the entire available time periods (1870s up to present time) using three Japanese national papers, *Yomiuri Shimbun*, *Asahi Shimbun*, and *Mainichi Shimbun*. A combination of keywords were used to identify all relevant articles that report on unexpected short-term and local-scale catch fluctuations of four tuna species. All collected articles were sorted out in chronological order and divided into 7 different time periods in order to examine the effect of socio-cultural factors on the geographical distribution of reported catch fluctuations (e.g. improvements in fishing technology). A case study analysis of oceanic environmental fluctuations in the Hokuriku area was conducted in order to achieve the objective 3. Daily mean sea surface temperature and ocean current were used to investigate the hydrodynamic features of the areas of interest.

Results of newspaper database search showed a total of 283 unexpected short-term and local-scale catch fluctuations of four tuna species being reported by three newspapers from 1874 to 2015. Of the articles published in the Meiji, Taisho, and the early Showa periods, 72% did not specify the exact type of species, though it was assumed from the location of catch. Of all the articles published after the mid Showa period, 66% reported unexpected

short-term and local-scale catch fluctuations of bluefin tuna. This may be due to a higher topicality and economical value of bluefin tuna compared to the other three species.

The geographical distribution of catch fluctuations in each time period revealed distinct patterns and characteristics that could be explained by different socio-cultural factors. 1) In the Meiji period (1874-1912), catch fluctuations were mainly distributed along the central and northeast coast in the Pacific Ocean. This could be due to the presence of different oceanic environmental conditions, as main fishing grounds seem to be differed from today. Tuna stock appears to be stable and abundant, presumably with little human-induced impacts such as overfishing and global warming. 2) In the Taisho period (1912-1926), catch fluctuations in the Sea of Japan appeared in addition to those distributed along the central and northeast coast in the Pacific Ocean. This could be due to limited understanding of the distribution of bluefin tuna in the Sea of Japan prior to this period. Investigation of tunas' fishing grounds by fisheries research institutions started around this time period. 3) In Pre-WWII period (1926-1941), catch fluctuations in the southern coast of Japan as well as in the offshore waters appeared. The establishment of local branch offices of newspaper companies in the southern area around 1930-1940s could be partially attributed for catch fluctuations seen in the southern coast. Introduction of a larger fishing vessel equipped with a freezer may be the result for catch fluctuation in the offshore regions. 4) During the WWII (1941-1945), catch fluctuations were reported in the offshore waters near the equatorial regions and the South China Sea as well as the central and northeast coast in the Pacific. These appear to be associated with the invasion around Java Sea by Japanese forces in February 1942. 5) During the General headquarter occupation (1945-1952), all catch fluctuations were reported offshore. These were apparently influenced by the MacArthur Line. 6) During Post-WWII (1953-1986), catch fluctuations were distributed in the central and northeast coast of the Pacific Ocean as well as the southern area of the Sea of Japan. About a half of the articles mention about the

presence of cold water mass, suggesting that investigations on the relationship between oceanic condition and fishing condition were increasingly carried out after the first cold water mass was observed off Kishu area in 1930s. 7) In the Heisei period, catch fluctuations were found over the entire coast of Japan. This could be due to higher commercial value of tunas compared to the other time periods, especially in the Meiji period when people considered bluefin tuna as one of the lowest ranked tunas among all. Also, the awareness toward the conservation for tuna has dramatically increased after the late Showa period, affecting an increasing number of articles found in this time period.

Results of a case study analysis of oceanic environmental fluctuations in the Hokuriku area revealed that a school of bluefin tuna migrate into a wide area of the ocean where warm water mass (15.4°C-22°C) extends along the coast of Noto Peninsula from the southwest to the northeast. In addition, bluefin tuna swim toward the area when there is relatively strong current (50-60cm⁻¹s) flowing into the area of catch.

The study pointed out the significance of newspaper archives in the field of fisheries science, not only as they provide detailed fisheries related data that are not reported by public fisheries reports, but also as they depict the influence of historical socio-cultural factors that could be analyzed over more than 130 years of time span.

Key words: commercially important tuna species, local-scale migration, oceanic environmental fluctuations, socio-cultural influence, newspaper archives