The importance of the north Satsunan area, southern Japan as the spawning and nursery ground for small pelagic fish

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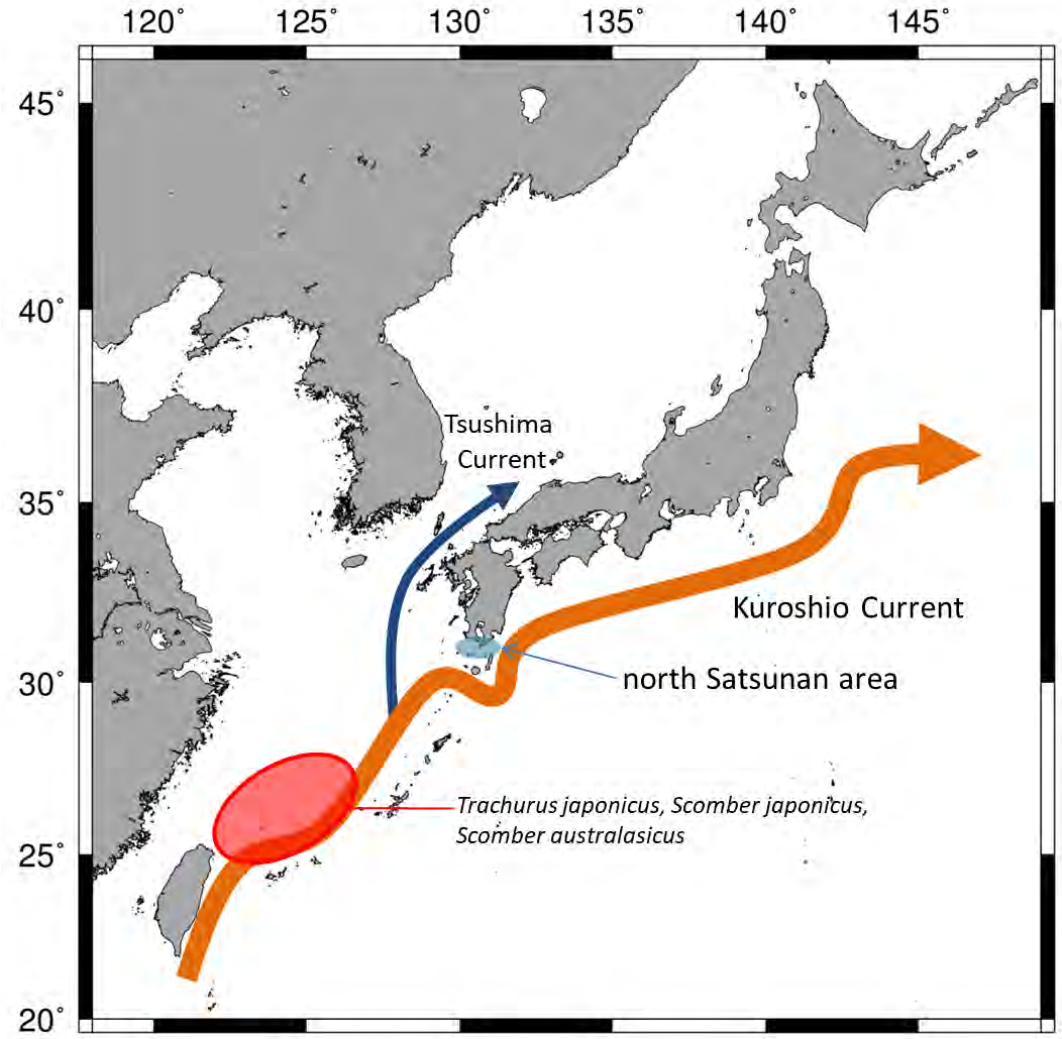
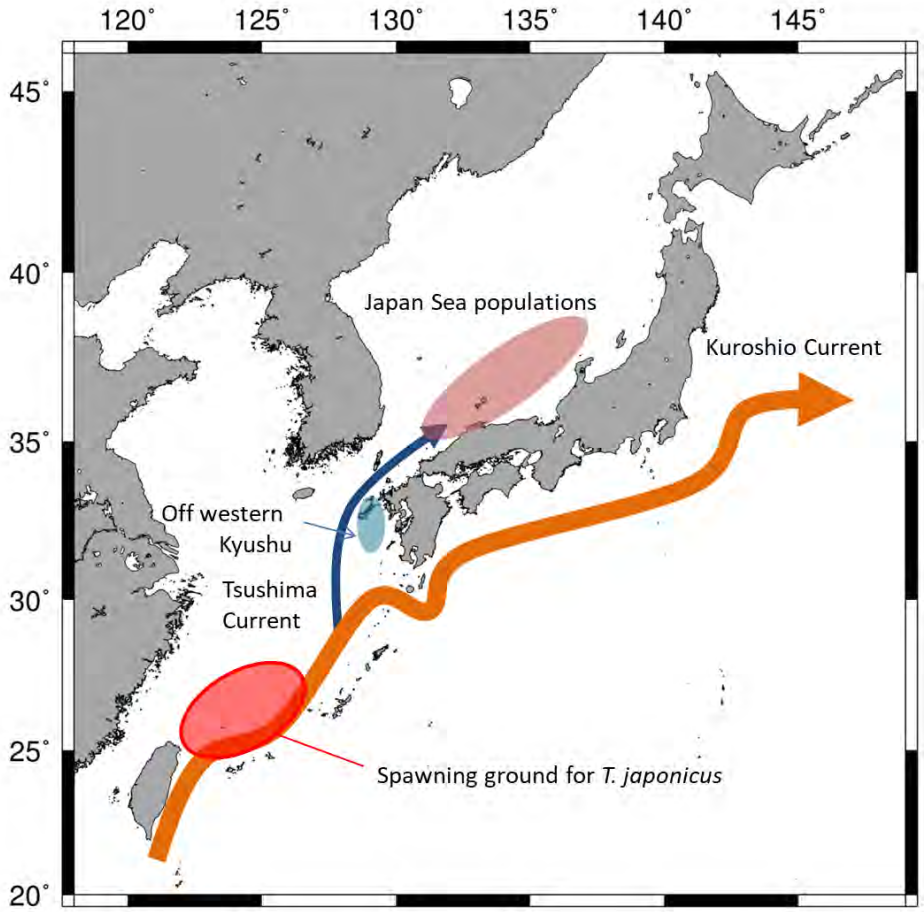
Main spawning ground for small pelagic fish



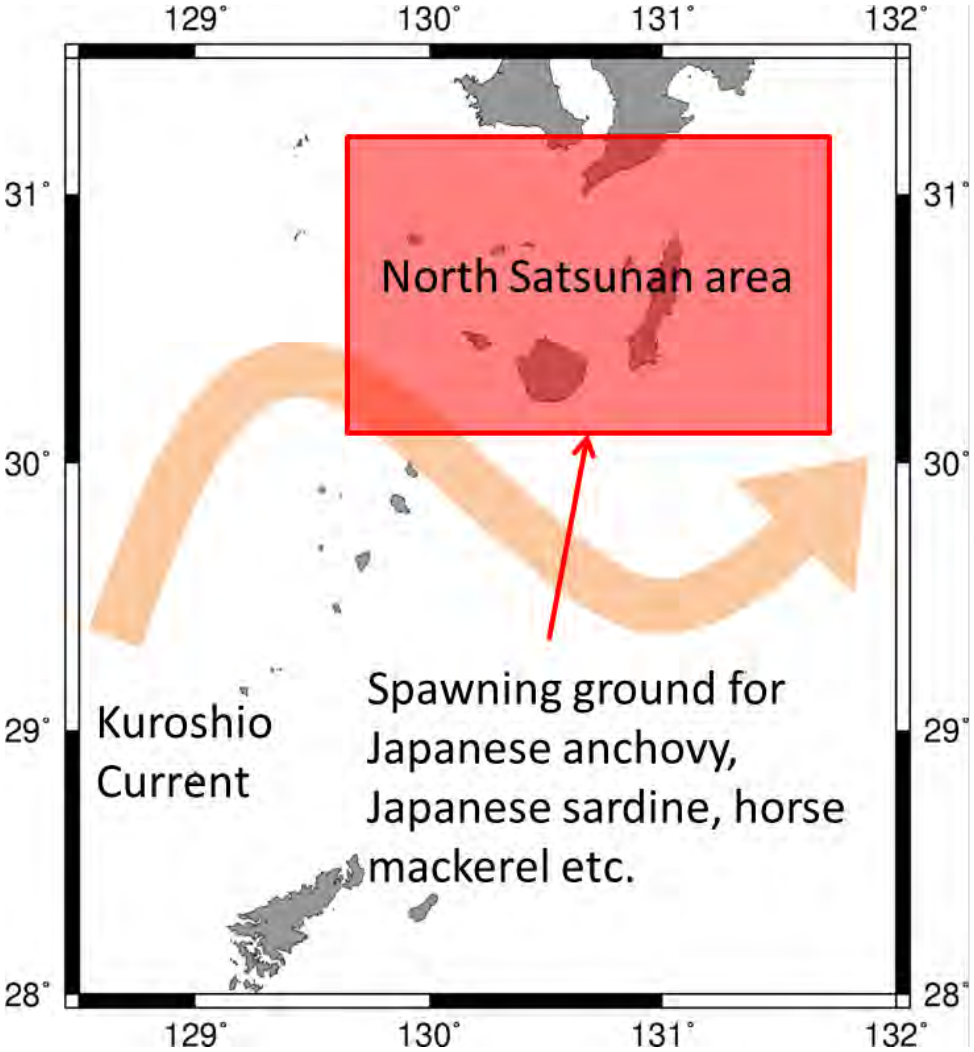
- Small pelagic fish (e.g. horse mackerel, chub mackerel) spawn in north east of Taiwan
- They spawn in the upstream of the Kuroshio and Tsushima Currents and then larvae and juveniles disperse and recruit to the downstream areas where are the most important fishery grounds in our country

Simulation by numerical model



- For horse mackerel, a large spawning ground is found off western Kyusyu
- The area off western Kyusyu would function as more important spawning ground for horse mackerel to support the Japan Sea populations, rather than northeast of Taiwan (Sassa et al. 2016)

North Satsunan area



- The North Satsunan area is located in the midpoint between the upstream of Kuroshio and Japanese Pacific coastal area
- This area has been known as important spawning grounds of small pelagic fish
- The source populations to supply Pacific coastal populations for migratory small pelagic fish?

Fish larvae into Kuroshio by Ohsumi Branch Current ?

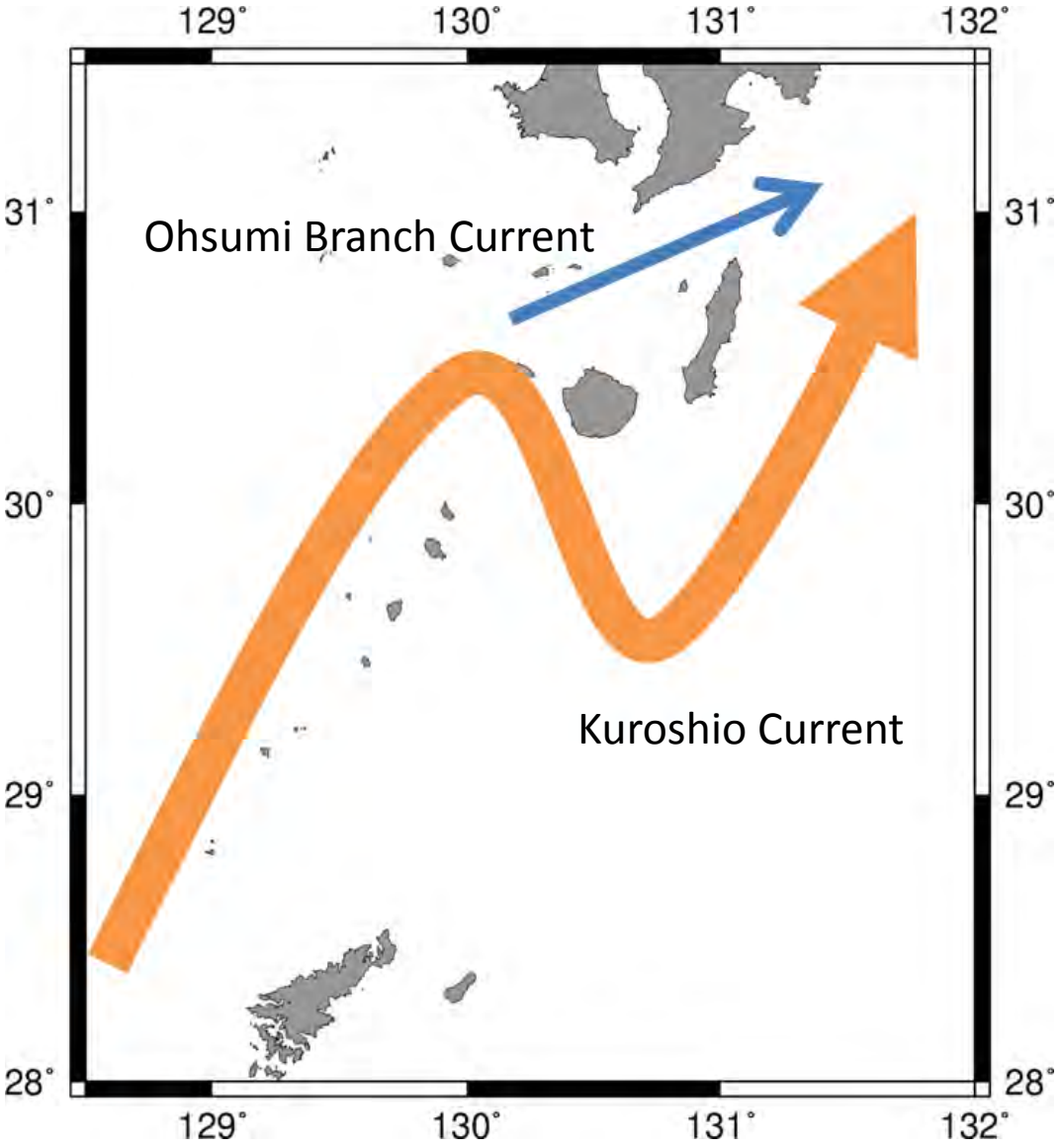


Fig. 5 Kuroshio and Ohsumi Branch Current

The aim of our study

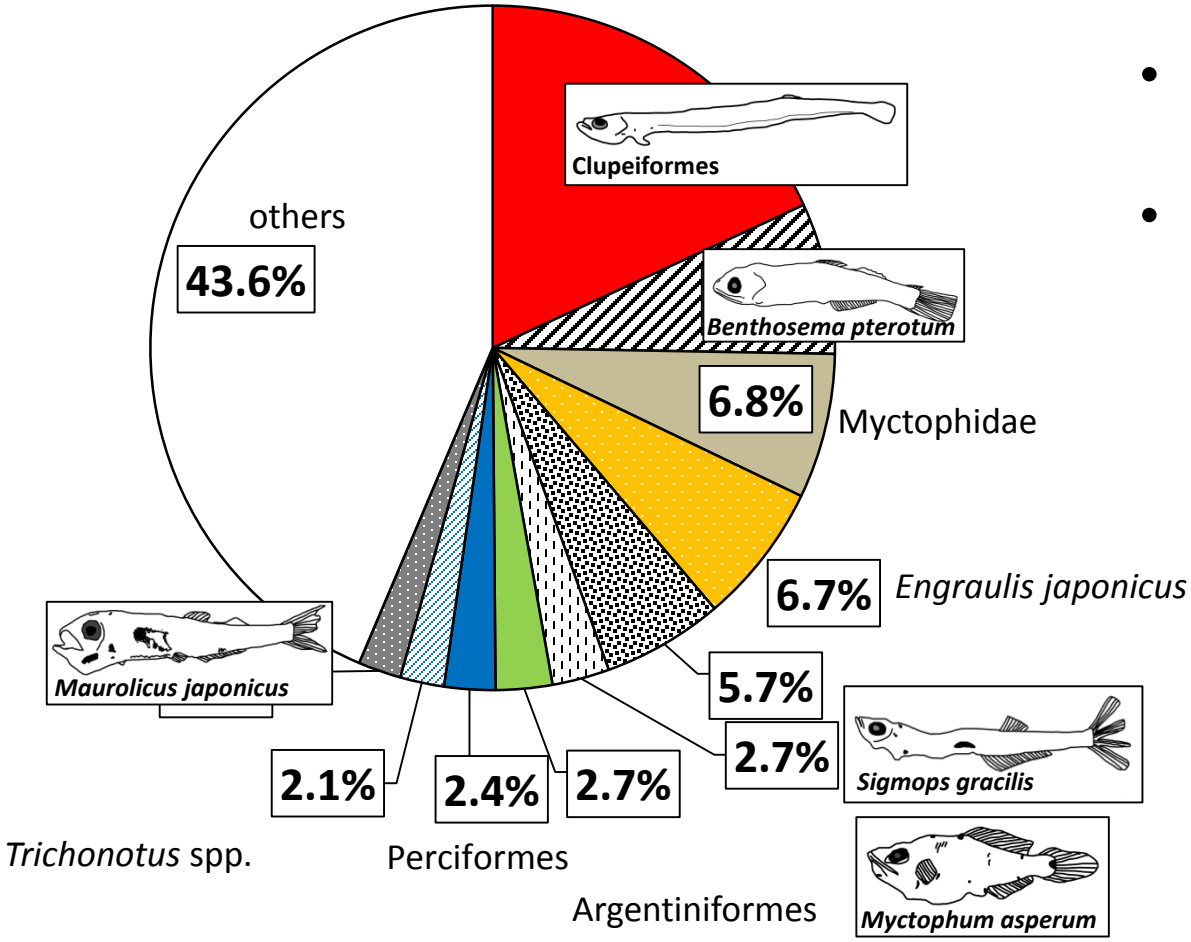
To clarify the importance of the north Satsunan area as the spawning and nursery ground for small pelagic fish

Materials and methods

Fig. 1 Study stations in the north Satsunan area

- We had started the field surveys in February 2015
- By using research vessel Nansei-maru belonging to Kagoshima University, we collect fish sample and record environmental data such as water temperature, salinity and chlolophyl a concentration by CTD
- In the laboratory, we analyze the occurrence patterns and feeding habits of fish larvae

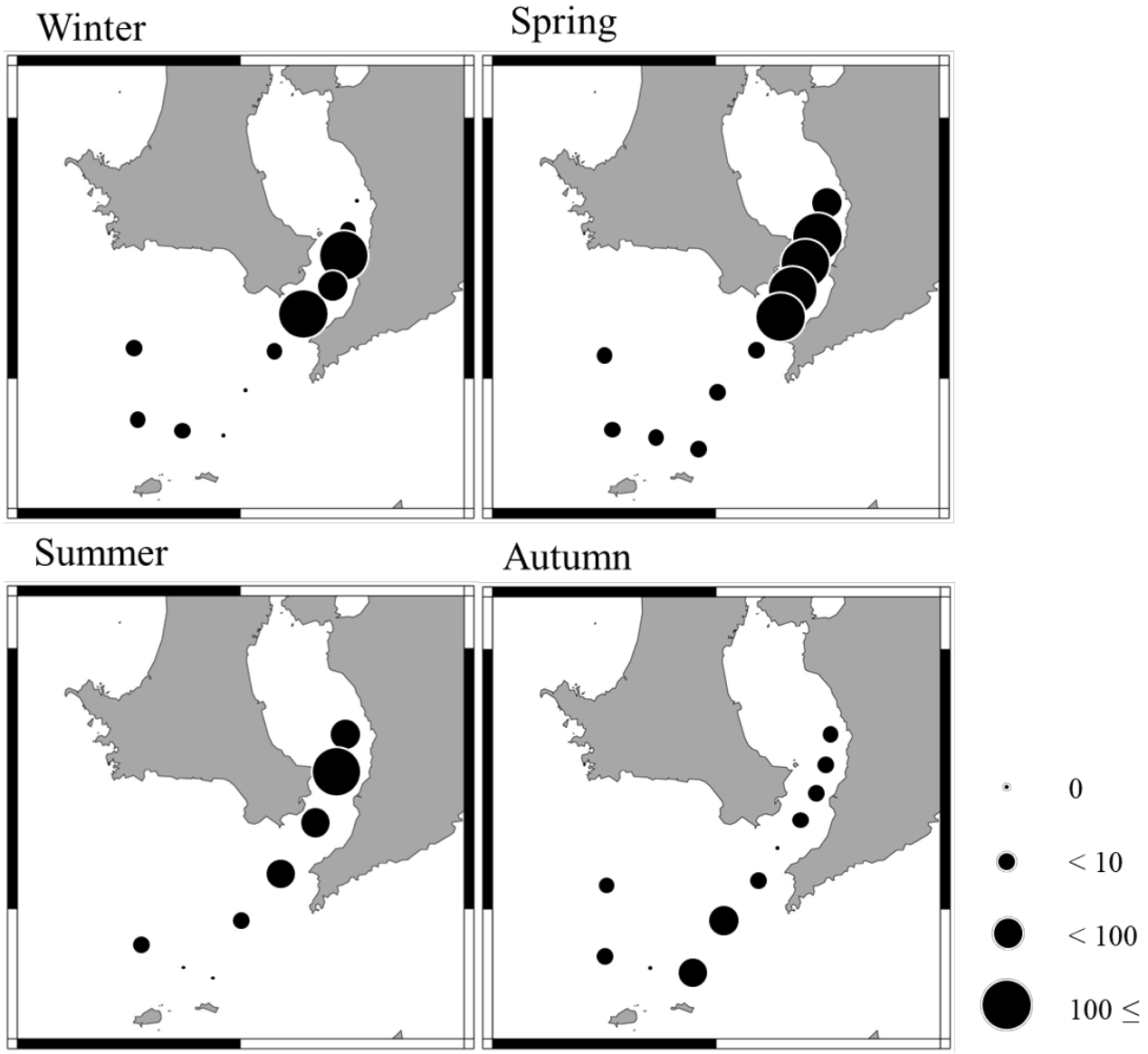
Results



- The most dominant species was clupeid larvae
- In addition, larval mesopelagic species such as lanternfishes, bristlemouths, Japanese pearlsides were dominantly occurred

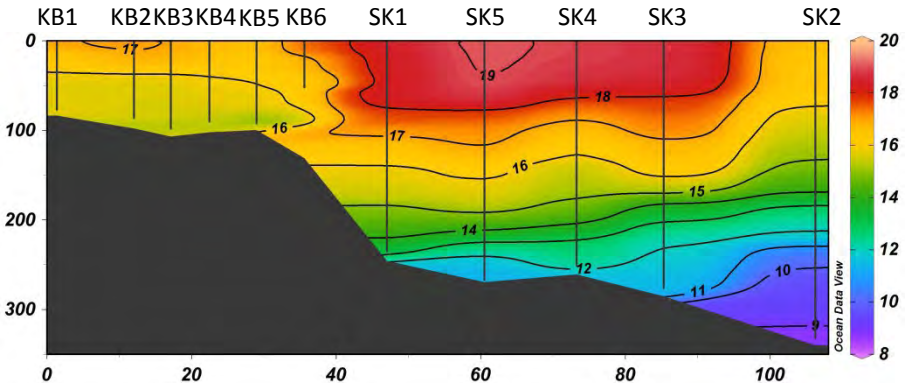
Fig. 2 The percentage of 10 dominant species in study area

The occurrence of larval Japanese anchovy in 2015

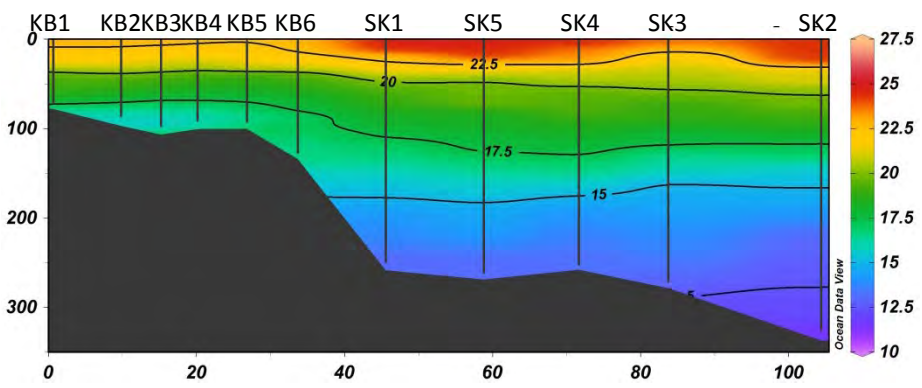


The vertical profiles of water temperature around the mouth of Kagoshima Bay in 2015

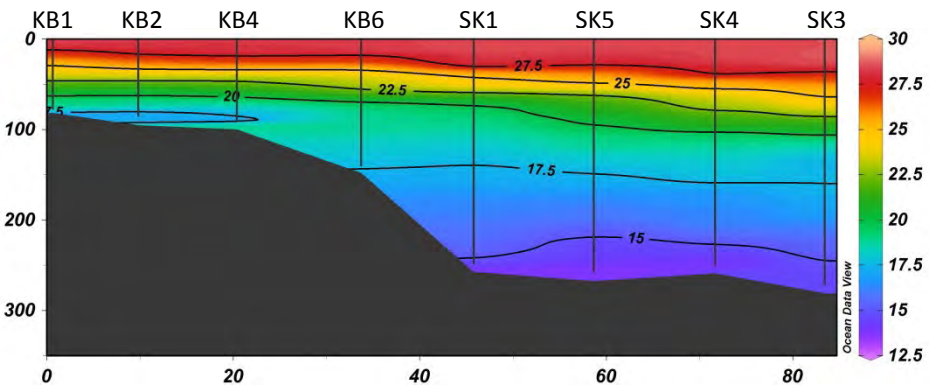
Winter



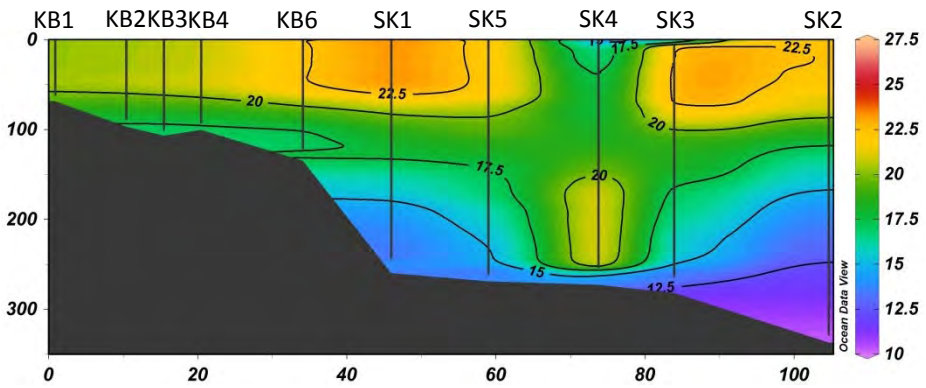
Spring



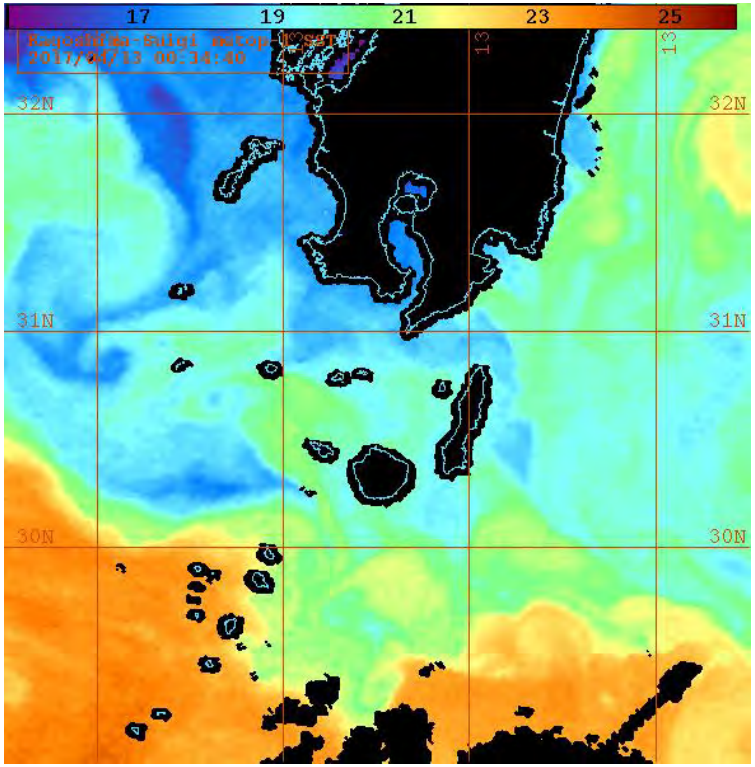
Summer



Autumn



Oceanographic phenomenon from autumn to winter “Kyutyo”



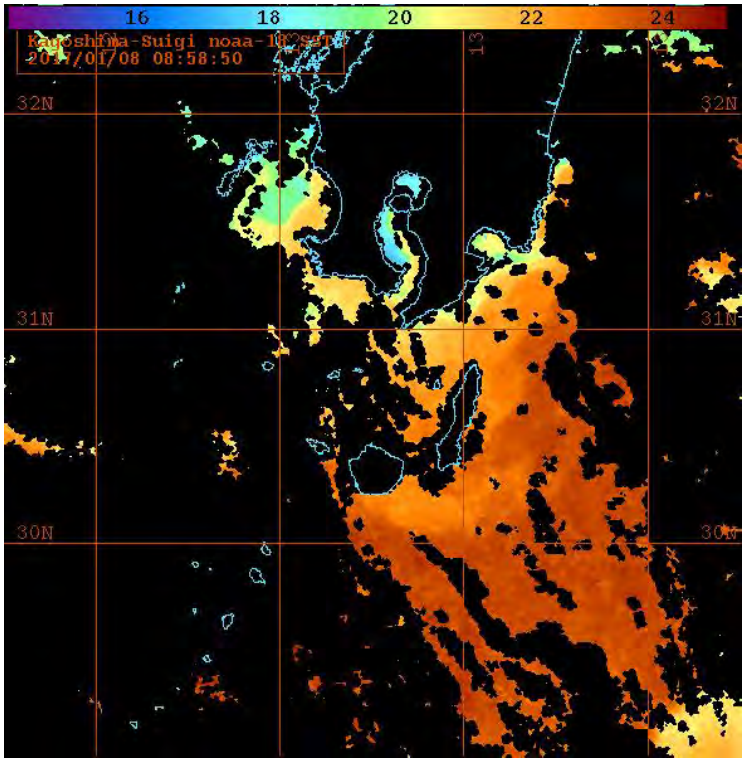


Fig. 3 The satellite images of surface seawater temperature around the mouth of Kagoshima Bay (left: the normal condition, right: time of Kyutyo)
http://kagoshima.suigi.jp/websatelite/start.htm

The upwelling causes bloom of phytoplankton

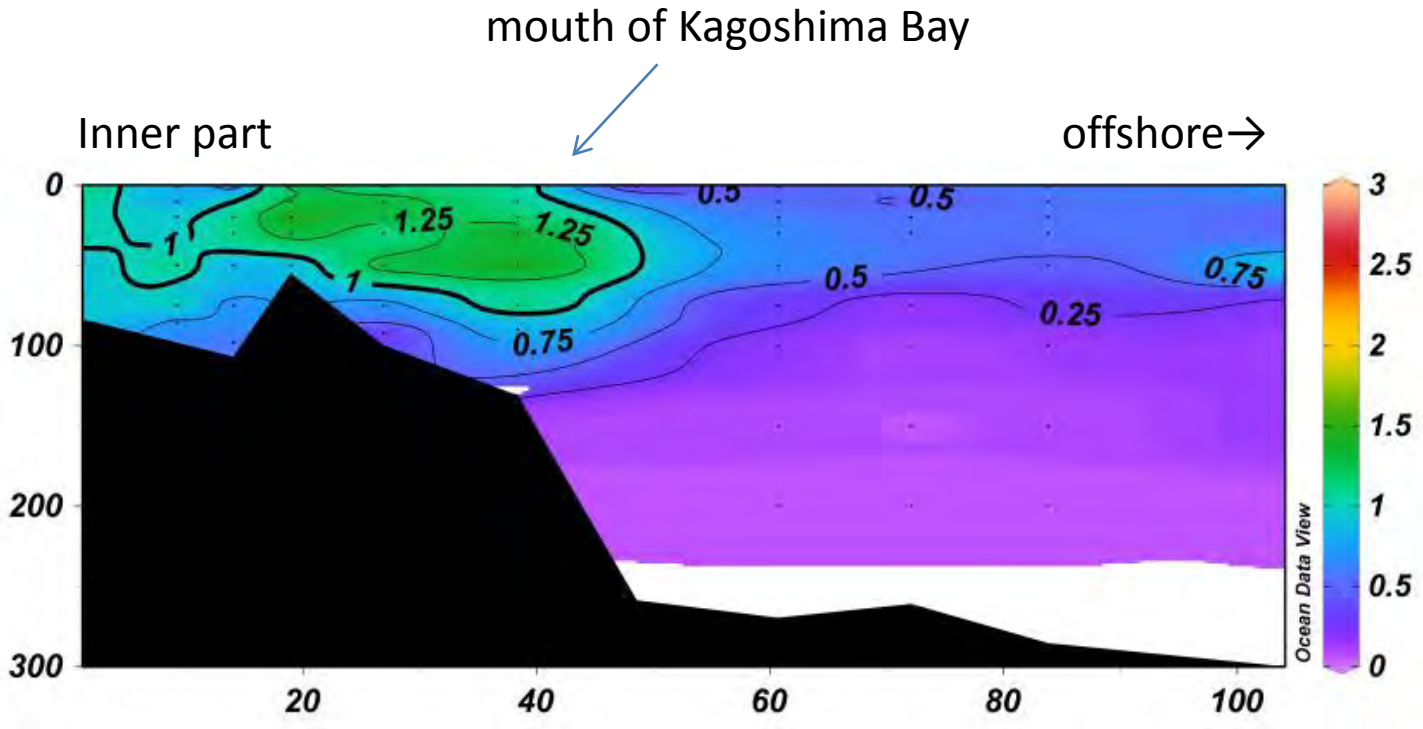
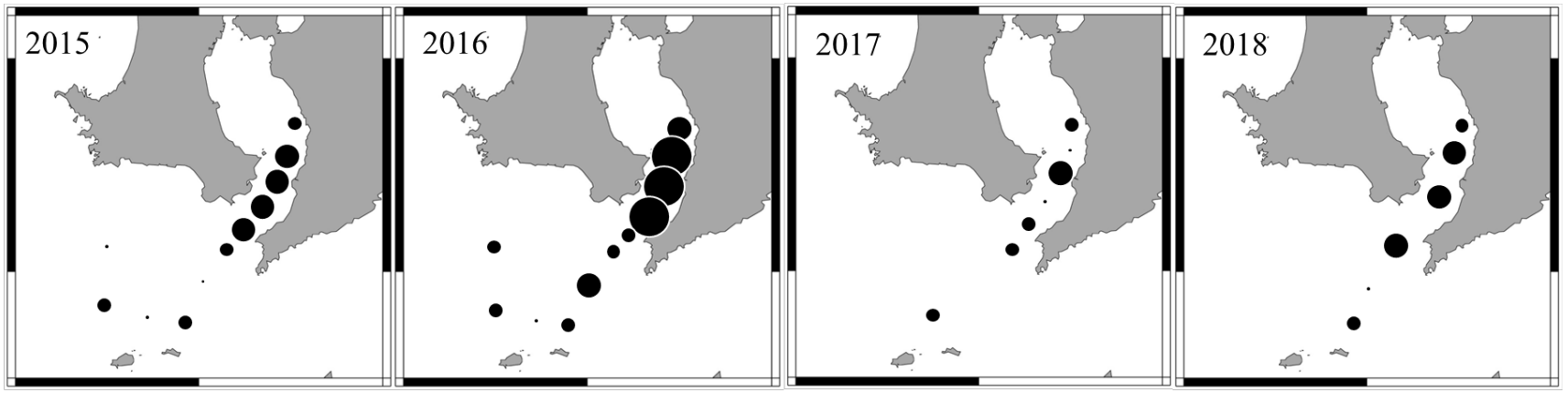


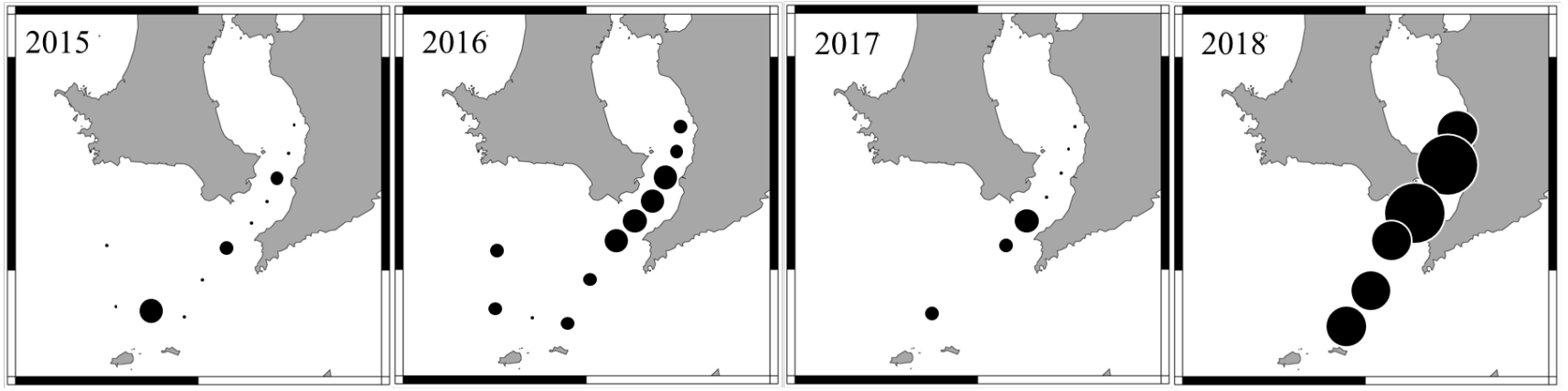
Fig. 4 The vertical distribution of Chl.a concentration around the mouth of Kagoshima Bay on March 2016

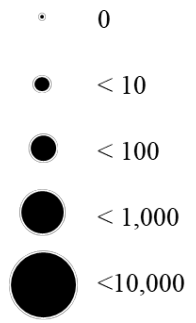
The occurrence of larval horse mackerel and two Scomber species during the winter season from 2015 to 2018

Trachurus japonicus

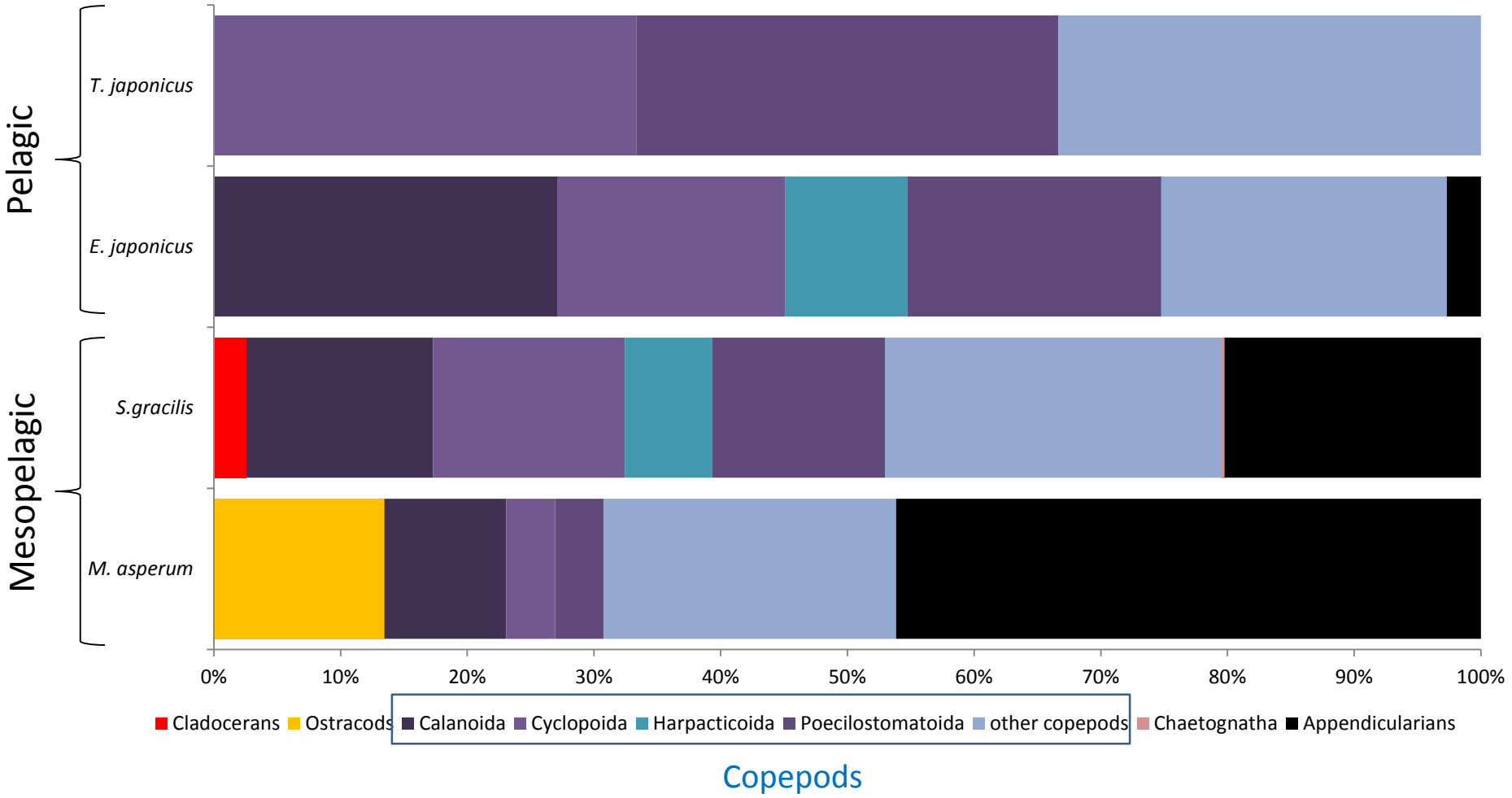


Scomber spp. (*S. japonicus*, *S. australasicus*)





Feeding habits of larval fish in the study area



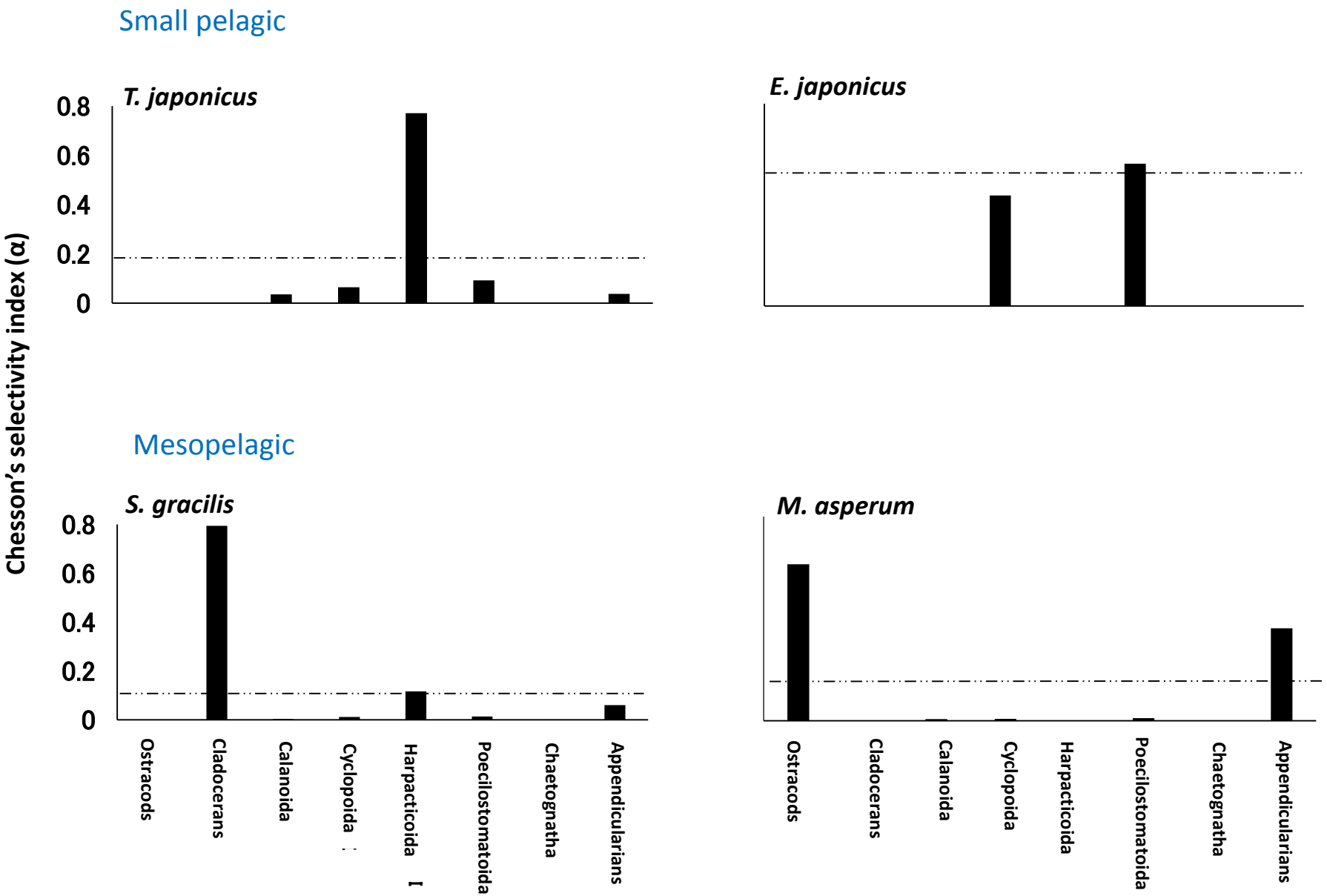
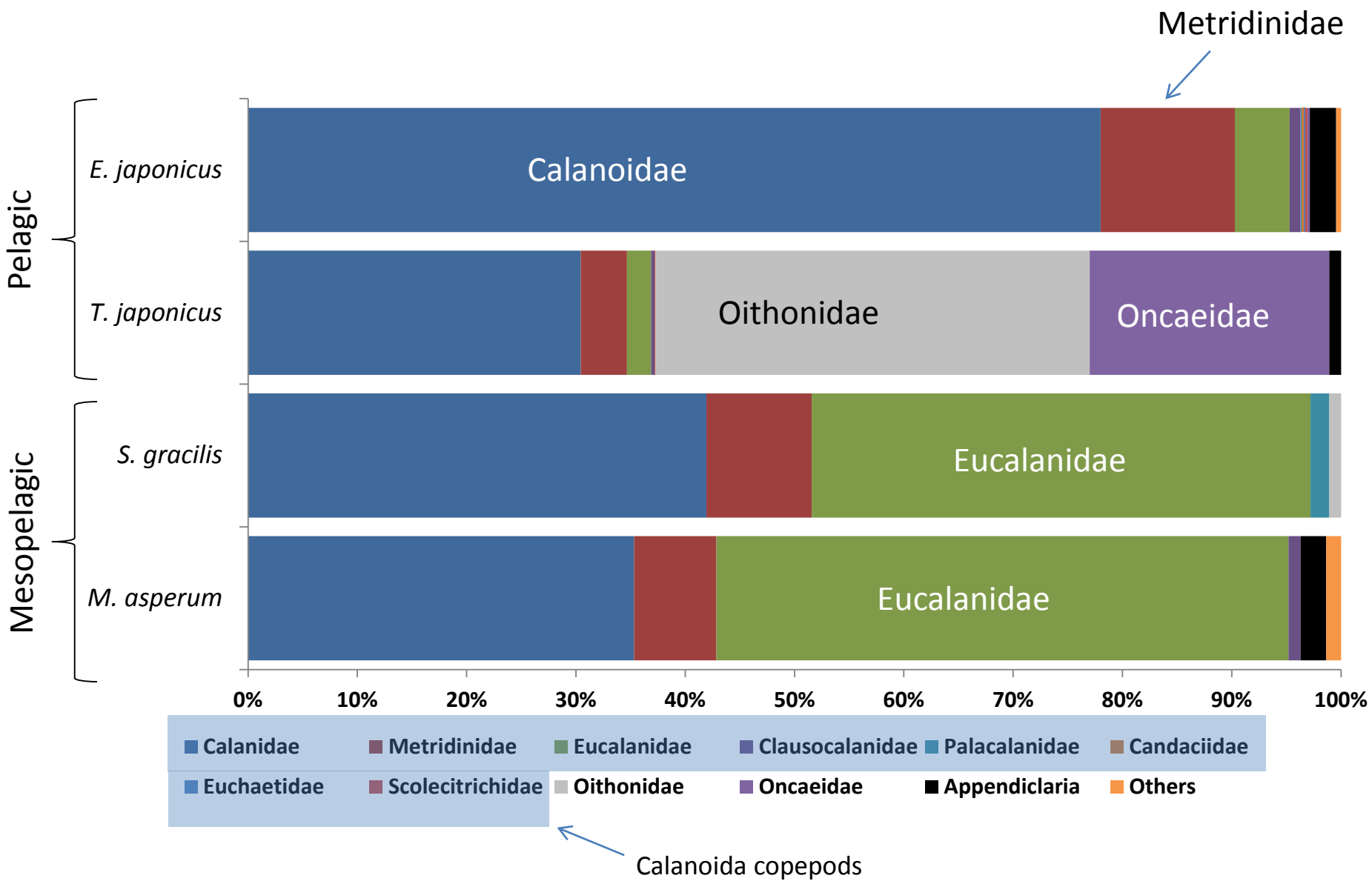
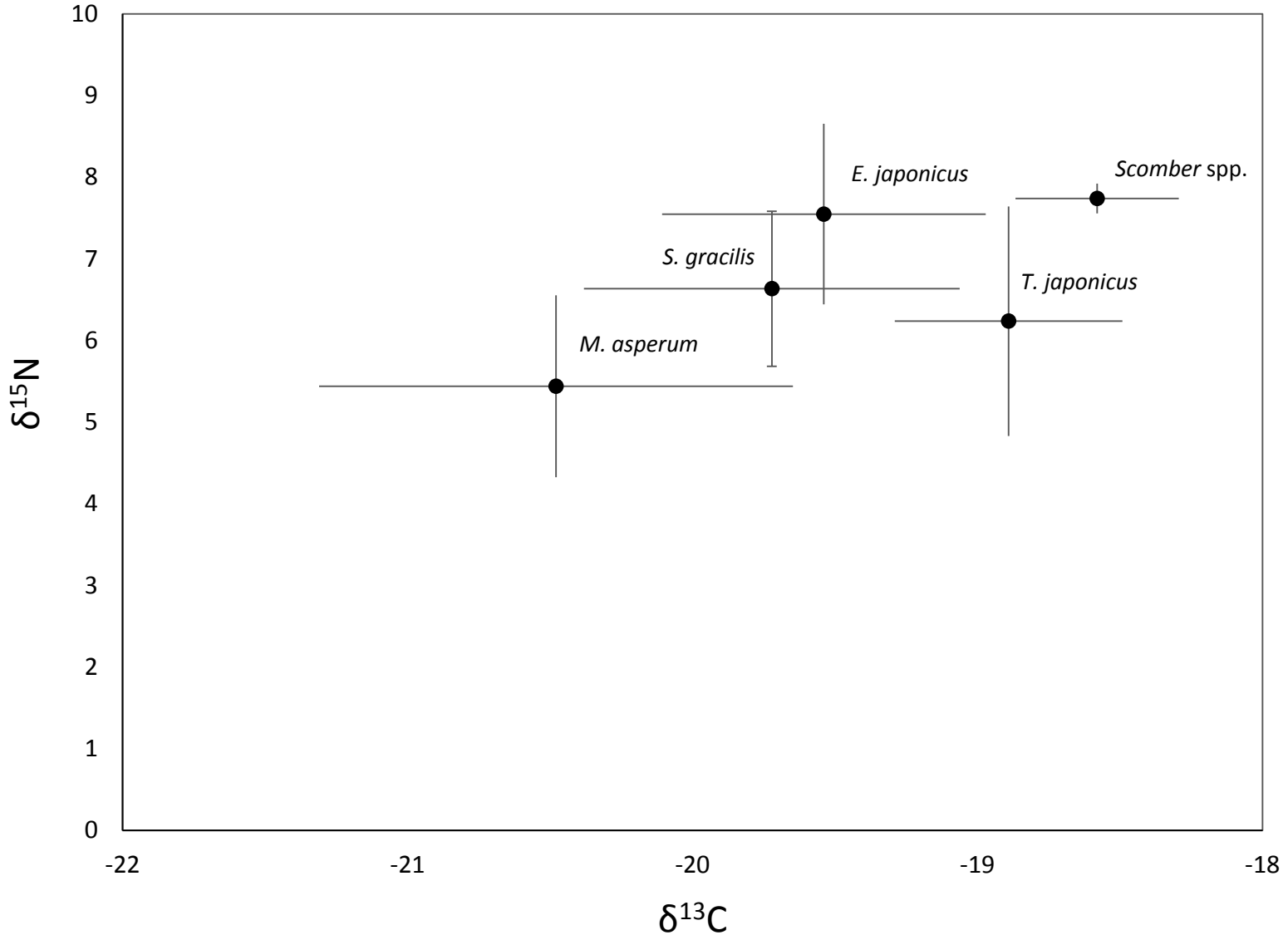


Fig.5. Selectivity index of fish larvae for each prey

DNA meta-barcoding analysis



$\delta^{13}C$ and $\delta^{15}N$ signatures of fish larvae



Conclusions 1

- In north Satsuna area, larval small pelagic fish (Japanese anchovy, mackerels) are abundantly occurred with larval mesopelagic fish
- In autumn and winter, the upwelling causes bloom of phytoplankton, possibly leading to a favorable prey conditions for fish larvae
- The competition for prey resources may not severely arise between small pelagic and dominant mesopelagic species

Conclusions 2

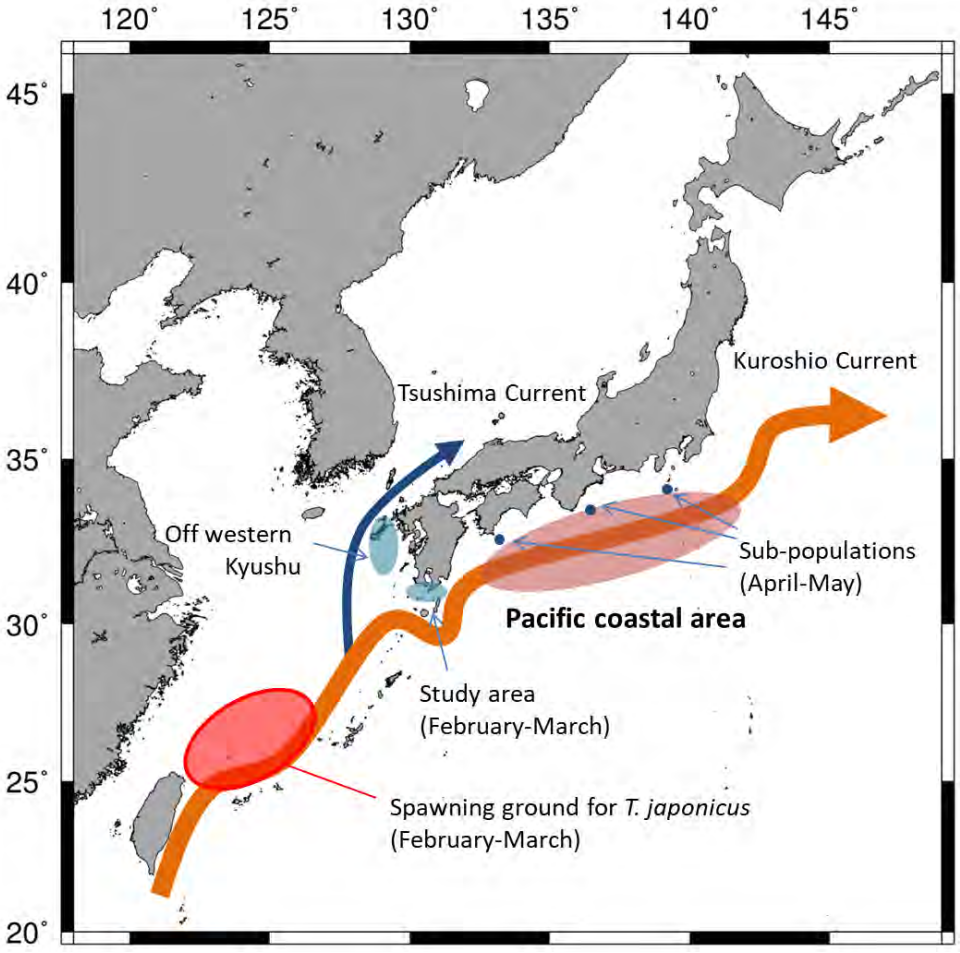


Fig. 6 The recruitment dynamics of horse mackerel ("spawning season" in parentheses)

- For horse mackerel, huge numbers of large juveniles are distributed with early-developmental staged larvae in the Pacific coastal area in April and May
- Large juveniles would include a substantial number of individuals which hatched in north Satsunan area
- North Satsunan area would be used as spawning and nursery ground for small pelagic fish to support populations in the Pacific coastal areas