Pacific saury *Cololabis saira* report

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LH, distribution, stock structure

Additional summaries of Pacific saury ecology and fisheries can be found in Yatsu (2019) and in NPFC Report SSC PS06, Annex H (2020).

Pacific saury (*Cololabis saira* Brevoort, 1856) occur throughout the subarctic and subtropical North Pacific Ocean from inshore waters of Japan and Kuril Islands to eastward to Gulf of Alaska and southward to Mexico. Pacific saury is an especially important commercial fish in the Western North Pacific Ocean (Parin 1968; Hubbs and Wisner 1980).

Pacific saury have a two-year life cycle, migrating between summer feeding grounds in the Oyashio Current, the Kuroshio Current, the Kuroshio-Oyashio Transition Zone (KOTZ), and the Japan Sea (Yatsu 2019) and the breeding grounds in the Kuroshio Current off southern Japan (Fukushima 1979; Kosaka 2000). Spawning occurs over a broad spatial and temporal period, during the winter in Kuroshio and subtropical areas and the spring/summer in the KOTZ (Watanabe and Lo 1989). Pacific saury in offshore regions (east of 160E) also migrate westward toward the coast of Japan after October every year (Suyama et al. 2012). There is little genetic evidence for distinct stock structure (Chow et al. 2009), so Pacific saury is managed as one stock.

Pacific saury mature about 8 months after hatching, at around 22cm (Suyama et al. 2016), though there is growth variation depending where larvae have hatched. Age-1 fish grow to 27cm by June and July when Japanese fishery-independent surveys are conducted, and to 30cm when fishery occurs between August and December (Suyama et al. 2006).

Fishery

Pacific saury are managed by the North Pacific Fisheries Commission (NPFC) by its six of its eight memeber countries: China, Japan, Korea, Russia, Chinese Taipei, and Vanuatu (Figure 1). The two other member countries, Canada and the United States, do not have a sustained commerical history with Pacific saury and are rarely caught as bycatch.

Japan was one of the first countries to develop its commerical industrialized fishery for Pacific saury in the 1940's using stick-held dip nets. Stick-held dip nets are the dominant gear for capturing Pacific saury by all countries. Russian and Korean fisheries were subsequently began in the 1950's, and Chinese Taipei commerical fishery in 1975, some of which cocurrently fished squid but then switched over to Pacific saury only in 1990s. China and Vanuatu commenced their fisheries in 2003 and 2004, respectively. China has rapidly developed their fisheries capacity in 2012.

Catch and Stock Status

Historical Japanese data extends to the 1950s, CPUE data by country from the 1980s, and summary statistics have been reported to the NPFC from 1995 to present. CPUE is standardized for all countries using a

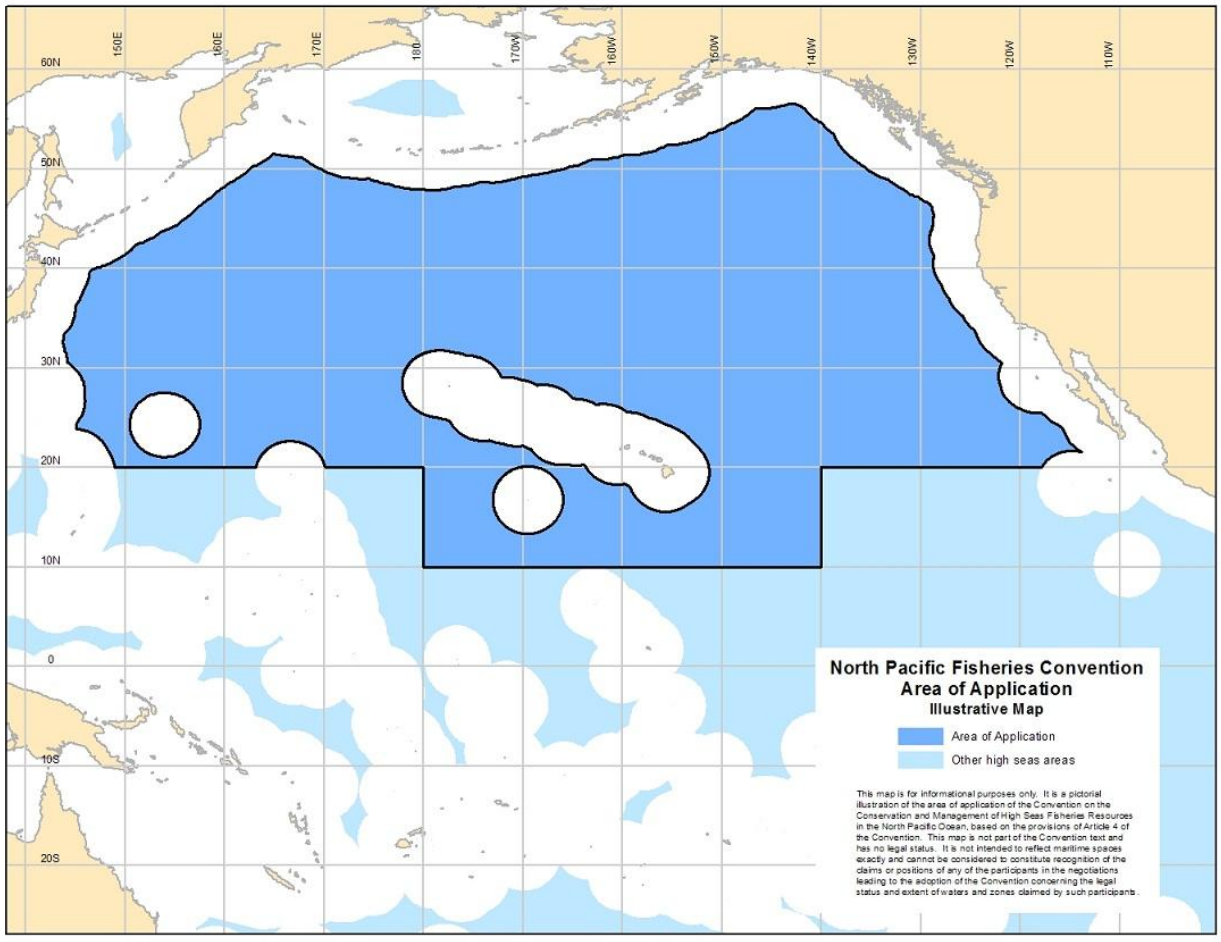

Figure 1: NPFC convention area

generalized linear model, and CPUE from Japan (early and late datasets differentiated), China, Chinese Taipei, Korea, and Russia are used in stock assessment models. Japanese and Russian catches mainly occur within their respective Exclusive Economic Zones (EEZs), which China, Chinese Taipei, and Vanuatu fisheries mostly occur within the NPFC high seas Convention Area (CA) (Figure 2). Catches in the CA have been increasing, and are largely driven by China and Chinese Taipei (Figure 3). An increasing proportion of catch is occurring in the NPFC CA waters overall (Figure 4).

Pacific saury were not managed intensively until a 2015 NPFC resolution to assess the stock was established, and the first stock assessments in 2019 and 2020 were conducted using a Bayesian state-space surplus production model. The ratio between estimated biomass and biomass required for Maximum Sustainable Yield (B:Bmsy) was 0.46 (80%CI 0.30-0.67), indicating the stock was overfished (North Pacific Fisheries Commission 2021a). Examining the CPUE used in the stock assessment models, CPUE has been declining across all countries (Figure 5).

In 2019, a Total Allowable Catch (TAC) limit of 330,000 metric tons in all areas was established for 2020 (North Pacific Fisheries Commission 2019). Total TAC was raised slightly for 2021 and 2022 to 333,750 tons in all areas, and 198,000 metric tons in the high-seas CA (North Pacific Fisheries Commission 2021b). These new TACs are a 52.9% and 56.2% reduction from the maximum catch from the total areas and NPFC convention area, respectively. However, the 2021-2022 TAC is only a 89.2% reduction from the average total catch.

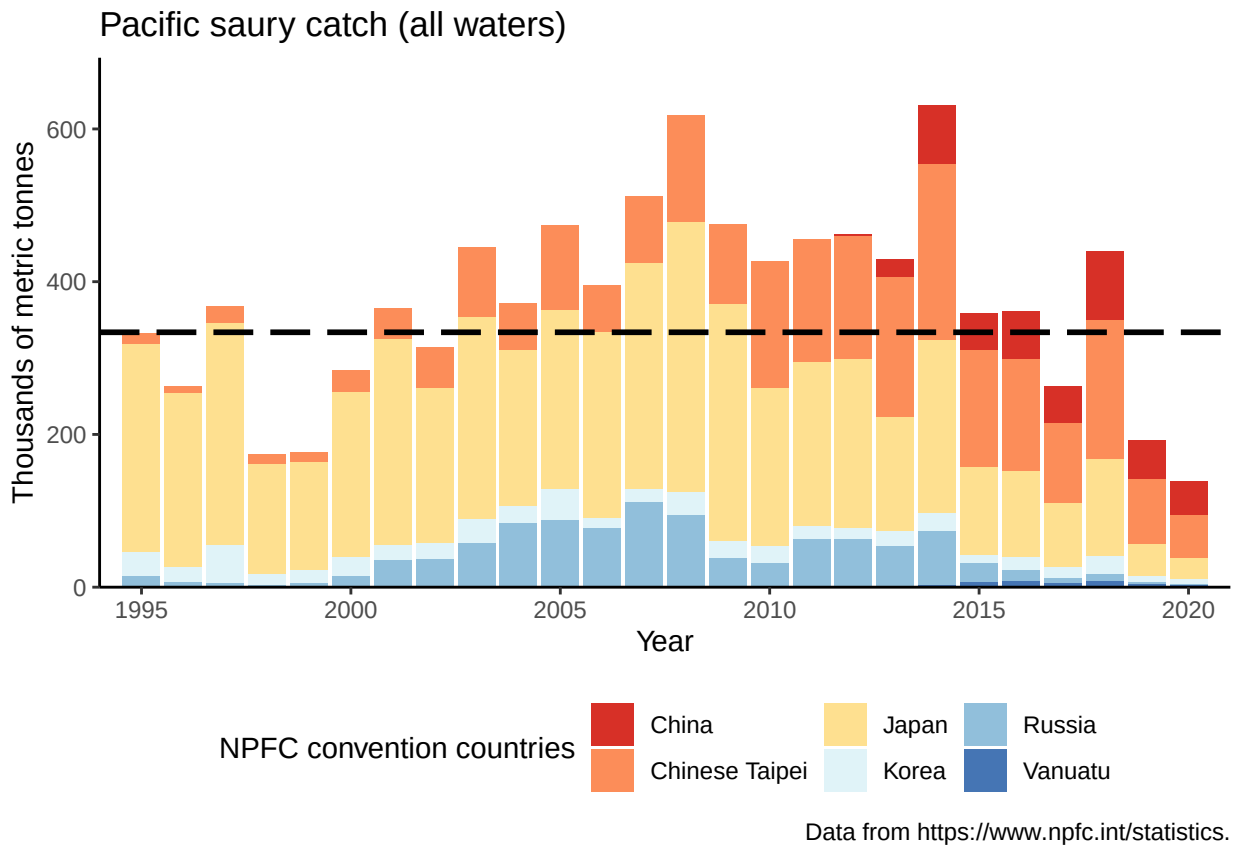

Figure 2: Total Pacific saury catch reported to the NPFC. Black dashed line indicates 333,750 metric ton TAC instituted for 2021 and 2022.

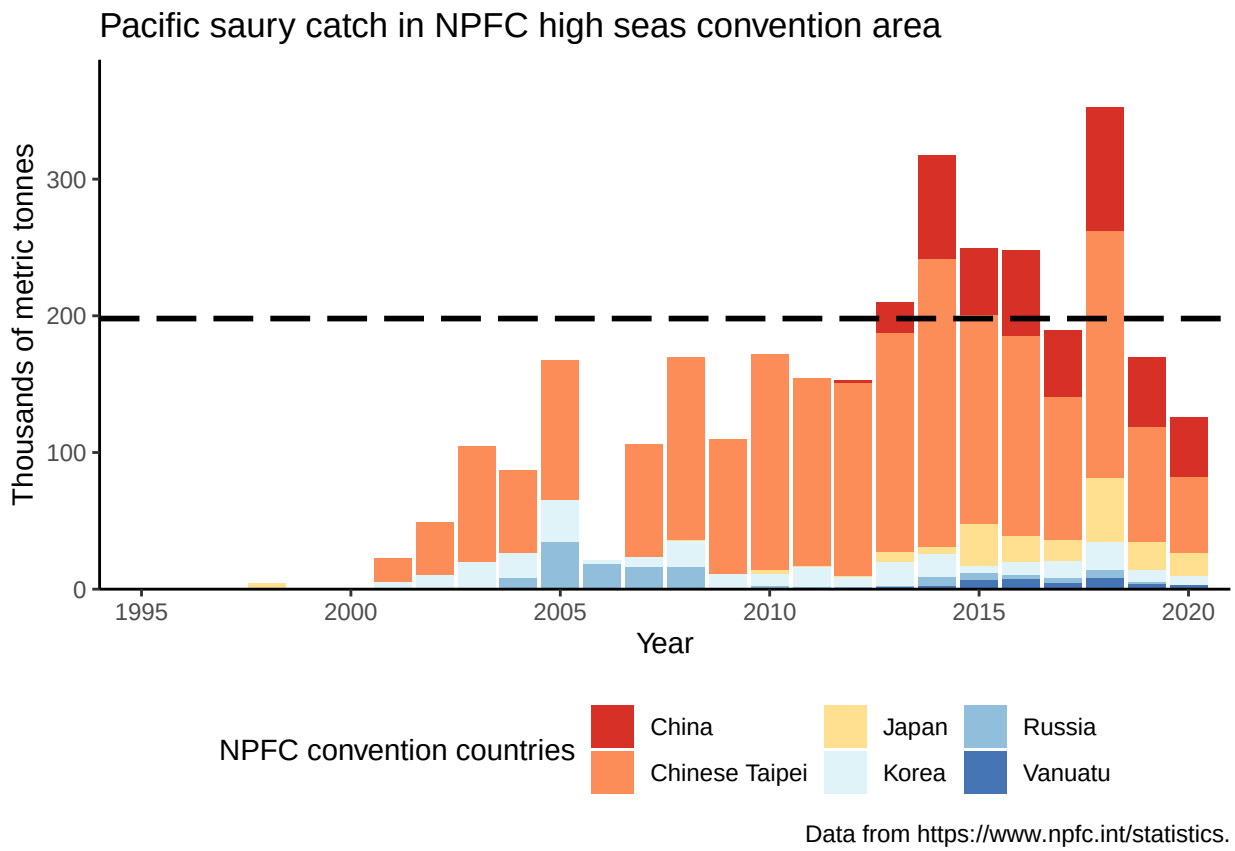

Figure 3: Reported Pacific saury catches in the NPFC high seas convention area. The black dashed line indicates 198,000 metric ton TAC instituted for the high seas in 2021 and 2022.

Comparison between national waters and NPFC convention area

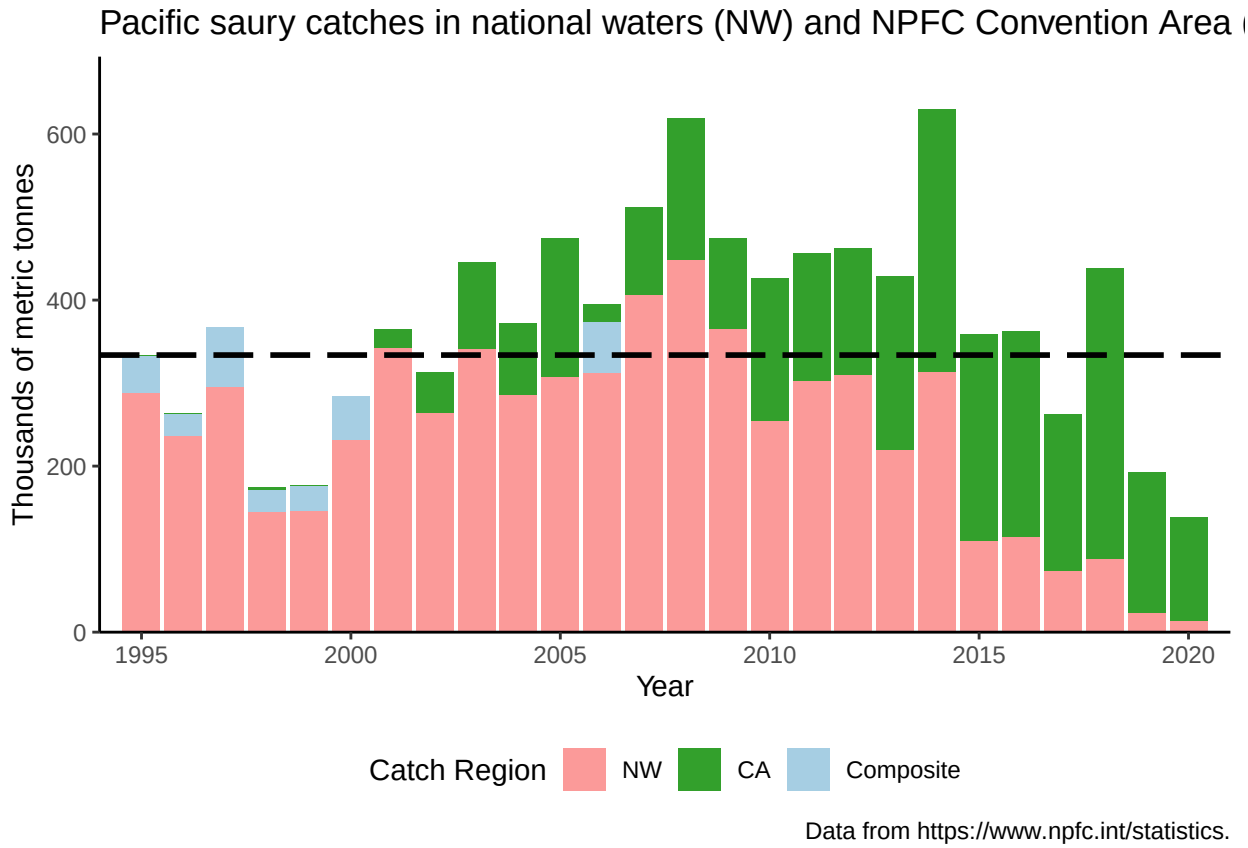

Figure 4: Comparison of Pacific saury catch within National Waters (NW, within 200 nautical miles of land) and in the high seas NPFC Convention Area (CA). Black dashed line indicates 333,750 metric ton TAC instituted for 2021 and 2022.

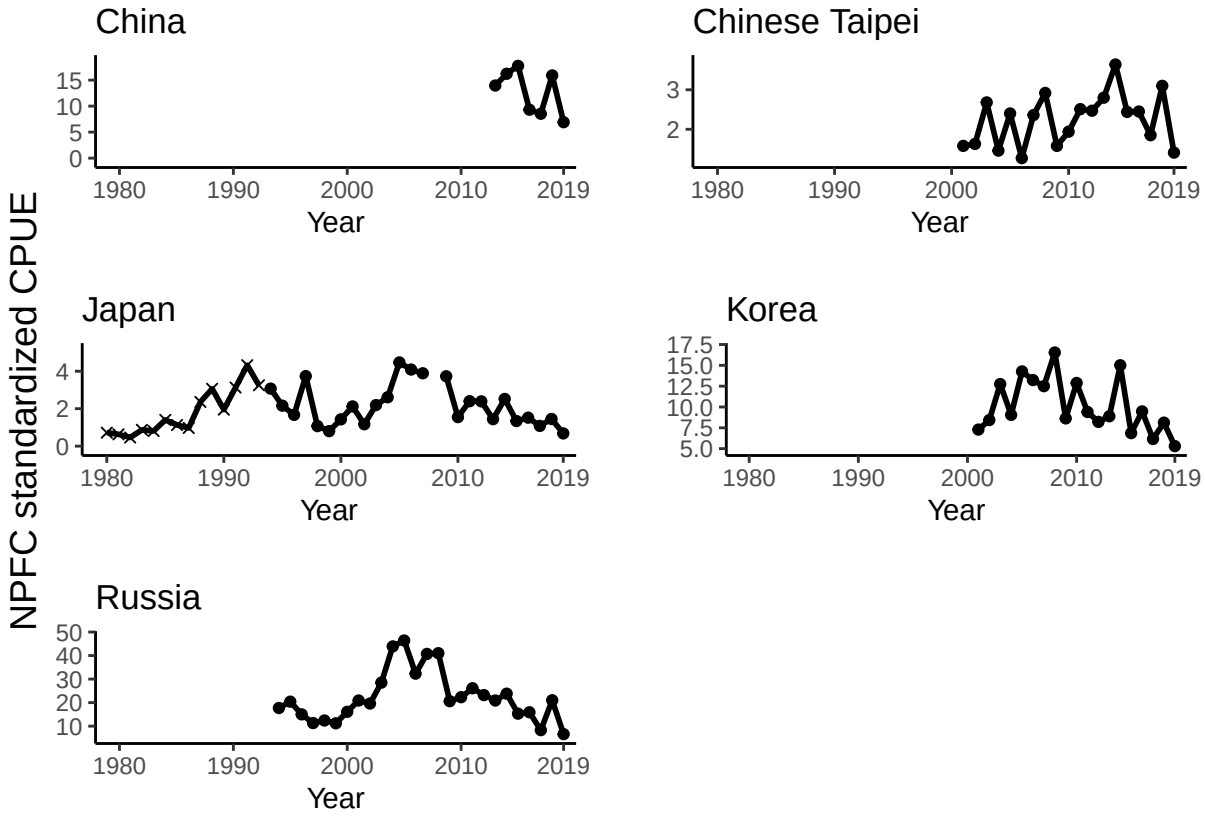

Figure 5: Time series of standardized CPUE indices used by the NPFC to estimate Pacific saury stock abundance and status. X's and O's in the Japan figure represent catch data from "early" and "late" catch record periods.

Overlap with IYS 2022 expedition

Zone 1 of the IYS Expedition overlaps strongly with the summer feeding grounds and autumn fishing grounds of Pacific saury (Figure 6 & 7). In addition, coho salmon are known to be predators of saury as well (Sato and Hirakawa 1976). In a review paper on Pacific salmonid feeding ecology, Brodeur (1990) reported that Chinook, coho, and masu salmon opportunistically feed on saury. Changes in the Kuroshio and the KOTZ could influence production or interactions between salmon and Pacific saury.

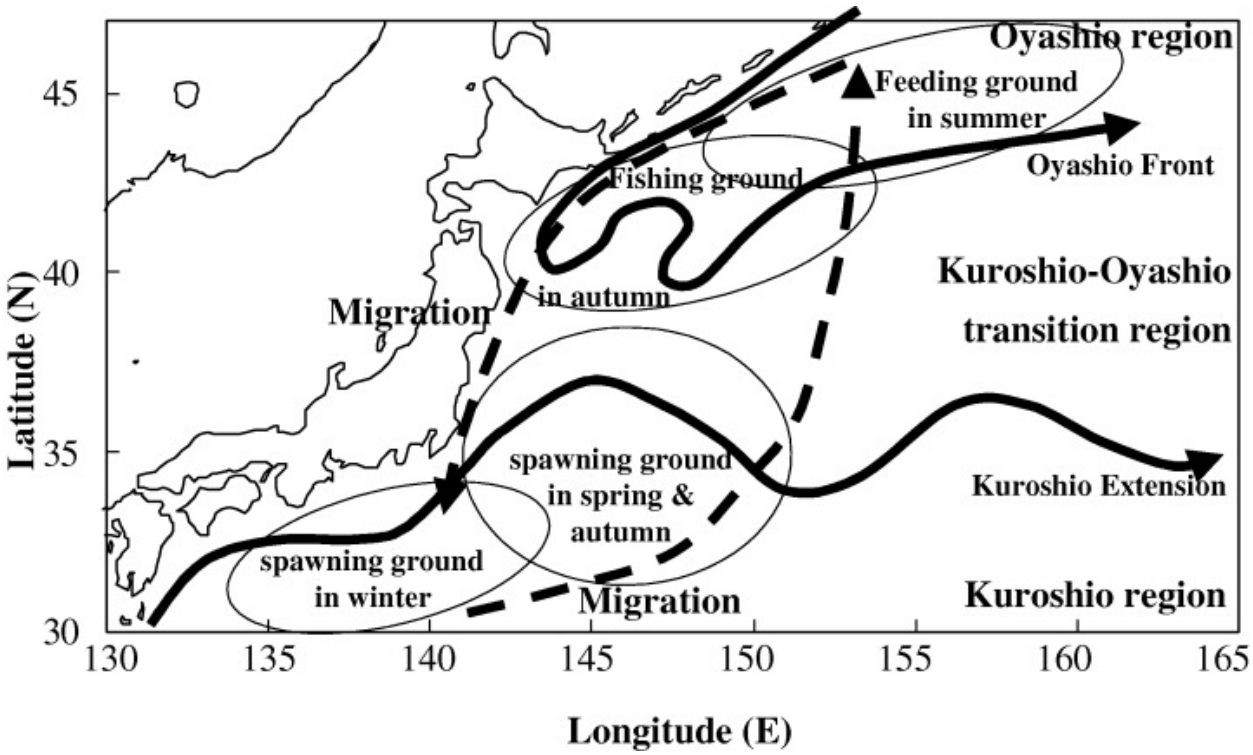

Figure 6: Schematic diagram of life history of Pacific saury and ocean circulations in the northwestern Pacific. Solid lines indicate dominant current systems and dashed lines the migration routes. from Ito et al. 2004.

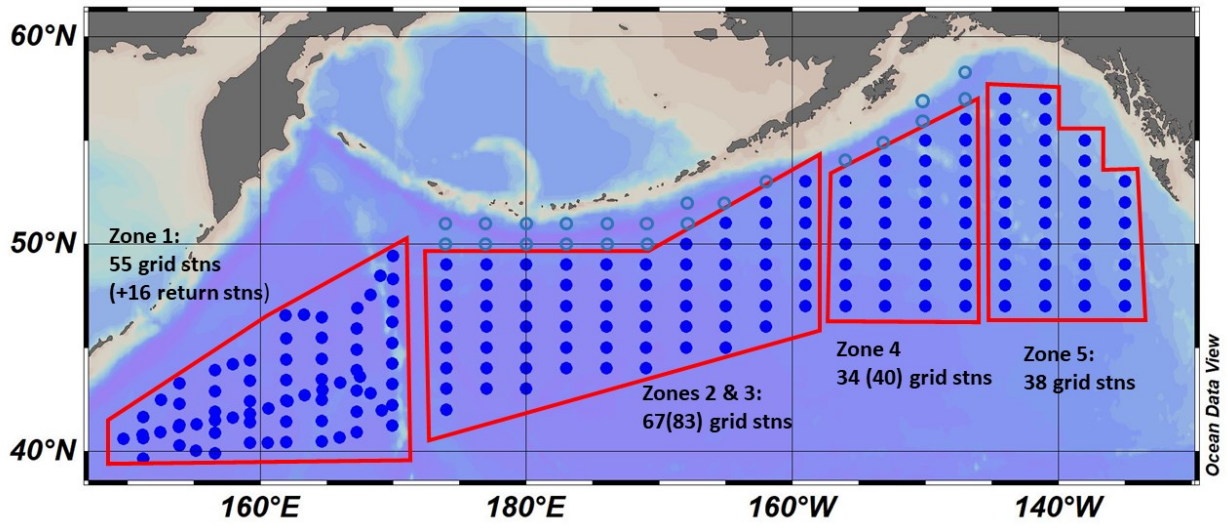

Figure 7: Planned sampling zones for the IYS 2022 Pan-Pacific Winter Expedition.

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