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Habitat utilization by small cetaceans in summer in the North Pacific

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The vast pelagic environment of the North Pacific Ocean (NPO) is an important habitat for a number of small cetacean species. Since the 1980s, the National Research Institute of Far Seas Fisheries (NRIFSF) has conducted systematic cetacean sighting surveys to estimate the abundance and distribution patterns of each species. These surveys have covered almost the entire area of the NPO, extending from the equator to the Sea of Okhotsk and from the Japanese coast to the west coast of North America (Miyashita, 1993a, b). Here we outline the results of these long-term sighting surveys conducted by the NRIFSF and review the distribution patterns of several small cetacean species in the NPO.

The NRIFSF sighting surveys during summer months from July to September have covered more than 300,000 nautical miles of trackline between 1983 and 2006 (Fig. 1). Numerous species have been encountered in these surveys, and their geographic distributions have been observed to vary in response to latitudinal temperature and salinity gradients. The NPO is primarily divided into the cyclonic subarctic gyre, which is characterized by cool and low-salinity water, and the anti-cyclonic subtropical gyre, which is characterized by warm high-salinity water (Pearcy, 1991; Tomczak and Godfrey, 2003). The

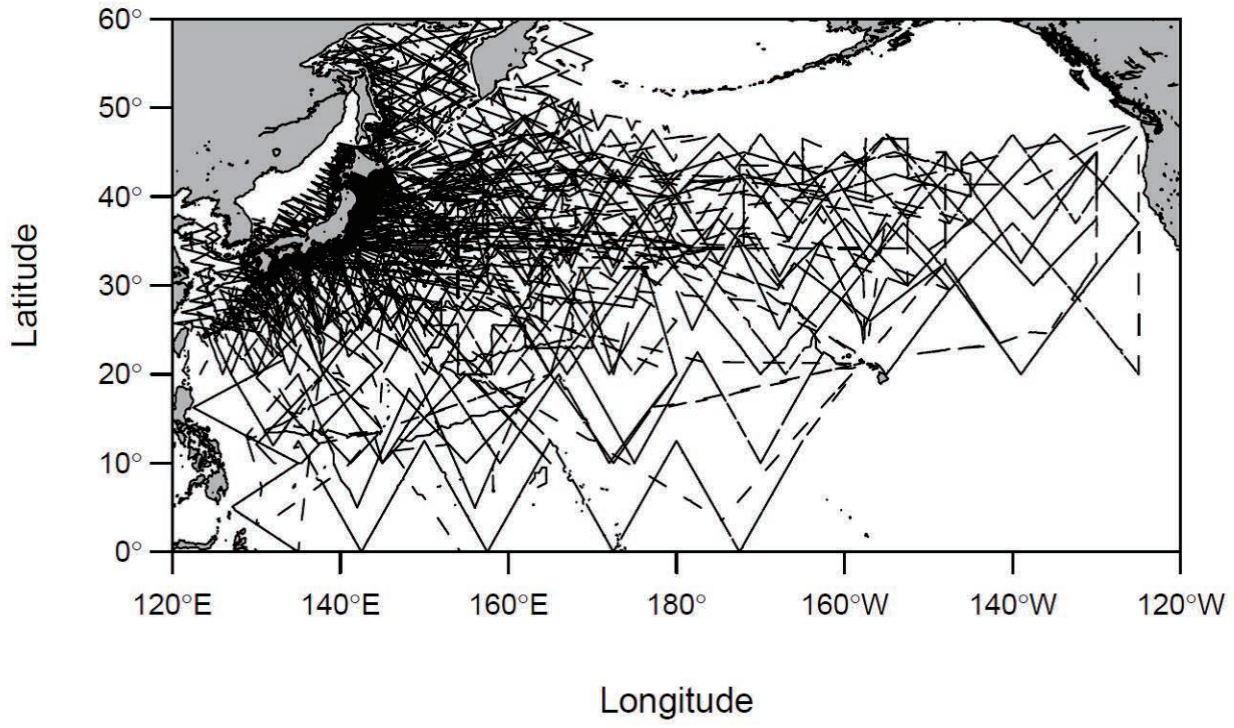

Fig. 1. Map of shipboard survey tracklines conducted by NRIFSF in summer seasons from 1983 to 2006.

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boundary between these two water masses is formed by the Kuroshio Current and the Kuroshio Extension. In association with these gyral systems, the NPO can further be divided into distinct domains based on oceanographic fronts, and the following species have been observed in each of these domains: Dall's porpoise (*Phocoenoides dalli*) in the subarctic domain, Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) in the transitional domain, short-beaked common dolphin (*Delphinus delphis*) in the transition zone, and pantropical spotted dolphin (*Stenella attenuata*) in subtropical waters. Dall's porpoise was typically sighted north of 42° N (Fig. 2a), while the Pacific white-sided dolphin and short-beaked common dolphin both exhibited zonal distributions extending from the Japanese coast to close to the west coast of North America between 37–47° N and 34–42° N, respectively (Fig. 2b, c). The pantropical spotted dolphin was sighted in a latitudinally broad range extending from the equator to 37° N in both coastal and offshore waters (Fig. 2d). Several epipelagic and mesopelagic fish and squid communities were also associated with these oceanographic structures (e.g., Pearcy, 1991; Pearcy *et al*., 1996; Sassa *et al*., 2002; Willis *et al*., 1988). Physical environmental parameters, such as water

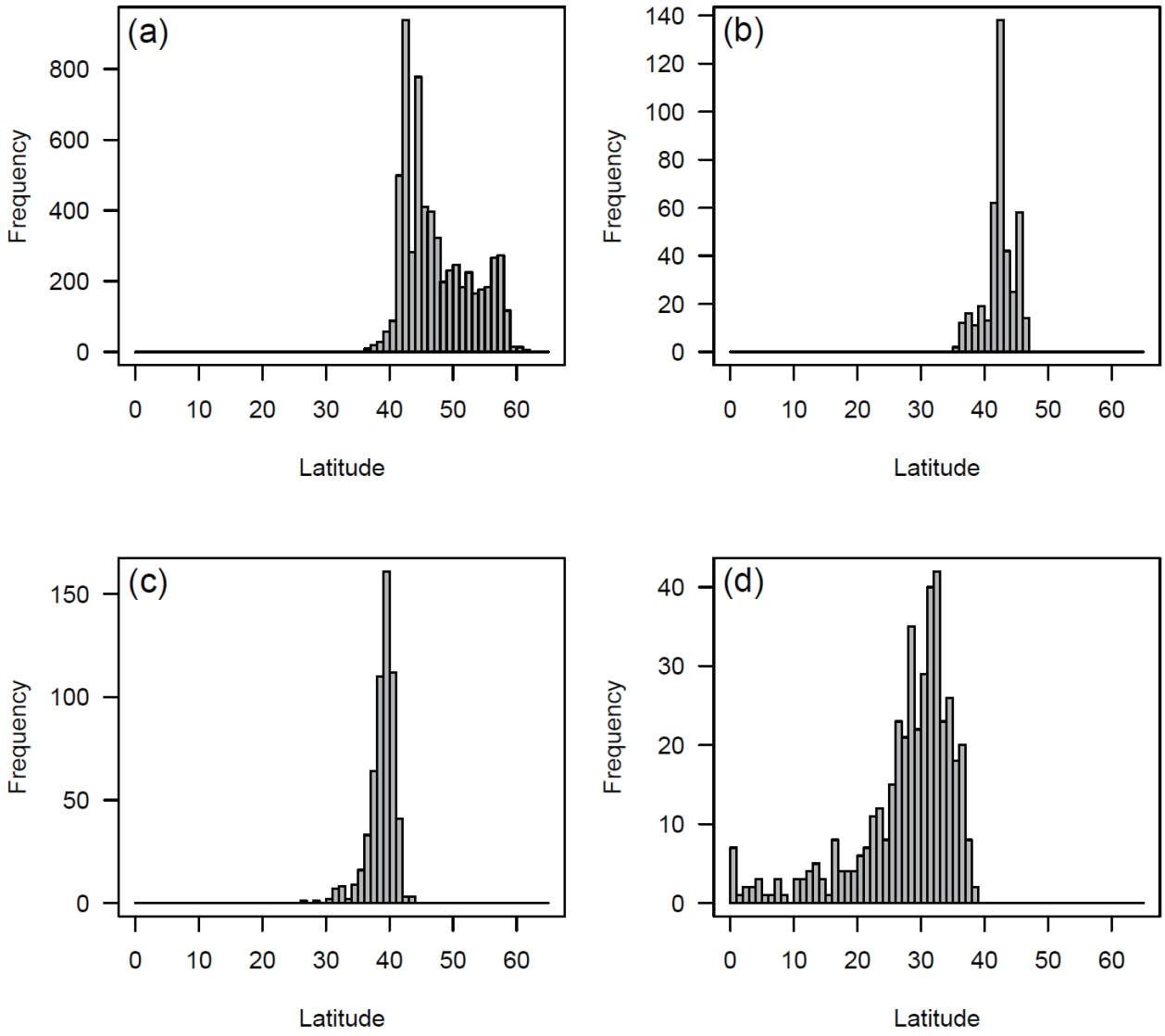

Fig. 2. Frequency distributions of the numbers of sightings for every 1° latitude (a: Dall's porpoise, b: Pacific white-sided dolphin, c: short-beaked common dolphin, and d: pantropical spotted dolphin).

temperatures and salinity, as well as primary productivity and the resulting food availability, are all important determinants of extant biogeographical characteristics of cetacean species.

In recent years, satellite environmental data have become widely distributed through international databases. Since these data show the current and previous features of marine physical environments, applying these data to our study will facilitate a more comprehensive understanding of distribution patterns, population structure, and long-term trends in abundance of cetacean species in the NPO. Future studies on modelling the relationships between cetacean distributions and environmental variables are required.

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