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Short Paper

Sighting survey of cetaceans in the Tsugaru Strait, Japan

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The Tsugaru Strait is located between the Oshima Peninsula and the Shimokita/Tsugaru Peninsula, and connects the Sea of Japan with the Pacific Ocean (Fig. 1). In this area, warm and cold currents meet and mix, which allow a diverse biotic abundance. Cetaceans in this region have not been studied since the research of Kawamura *et al.* over 20 years ago,[1] which was based on the data provided by ferry crews, and it is likely that some species were misidentified or unintentionally overlooked. The current study reports recent cetacean sightings in the Tsugaru Strait made by trained observers.

The survey was conducted on the bridges (30 m above water level) of two ferries: (1) Horus (7192 t, 37 km/h) and (2) Venus (7198 t, 37 km/h). Both ferries travel the Hakodate–Aomori route (Fig. 1). The sighting survey was performed for 58 days (6102 km) between May 2003 and November 2004, under ocean conditions of >5 km visibility and <2.75 m wave height. Each day, a round trip survey was conducted on the 07:30 hours Aomori-bound ferry and the 12:30 hours Hakodate-bound ferry. Each one-way trip took 220 min, and three observers usually joined the sighting survey. The search efforts and observation records were collected according to the methods used in Southern Ocean Whales and Ecosystem Research by the International Whaling Commission.[2]

Most sightings were made by the 'naked eye' and cetacean species were identified using 8x binoculars.

Data collected on the daily sighting efforts included the wave height and the swell scale of six fixed positions on the survey course. Each sighting record contained: (a) the species name, (b) group size, (c) observers' notes of the observed animal(s), and (d) the GPS position of the vessel. Visual records were obtained with a digital video camera and digital still camera with a telescope, and were also used to confirm species identification.

The observers were specifically trained to identify the cetacean species found in the Tsugaru Strait. The survey accuracy was occasionally verified by three trained observers and one invited observer from Kyoudo Senpaku Kaisha (Tokyo, Japan). The three trained observers and the invited observer joined the sighting survey as scientific observers for the Institute of Cetacean Research of Japan. Furthermore, the observers used a special identification manual designed specifically for this survey to avoid misidentifications.

During the 2-year survey period, at least seven cetaceans were observed in the Tsugaru Strait: Pacific white-sided dolphins *Lagenorhynchus obliquidens*, common dolphins *Delphinus delphis*, Dall's porpoises *Phocoenoides dalli*, bottlenose dolphins *Tursiops truncatus*, harbour porpoises *Phocoena phocoena*, short-finned pilot whales *Globicephala macrorhynchus*, and unidentified cetaceans including an unidentified large sized

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Table 1 Number of groups, total number of animals in the sighting survey (58 days 6102 km), and mean group size of the cetacean species sighted in the Tsugaru Strait

Species	No. groups (%)	No. animals (%)	Mean group size
Pacific white-sided dolphin	341 (82.2)	2778 (92.3)	8.15
Dall's porpoise	4 (0.96)	16 (0.5)	4.00
Common dolphin	5 (1.2)	11 (0.36)	2.20
Harbour porpoise	2 (0.48)	4 (0.13)	2.00
Bottlenose dolphin	3 (0.72)	20 (0.66)	6.67
Short-finned pilot whale	1 (0.24)	1 (0.03)	1.00
Unidentified cetaceans	59 (14.2)	180 (5.98)	3.05
Total	415	3010	7.25

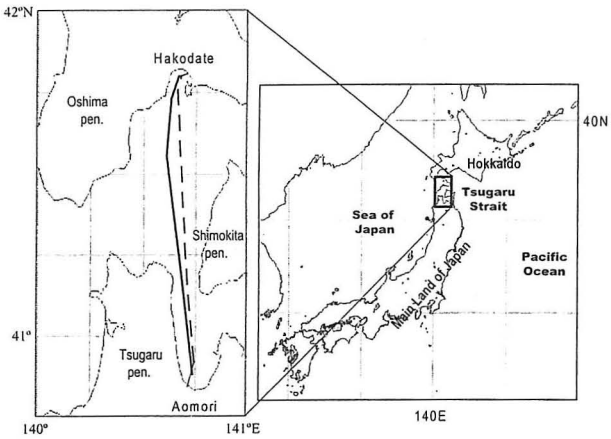

Fig. 1 Location of the Tsugaru Strait and the ferry route of the current study.

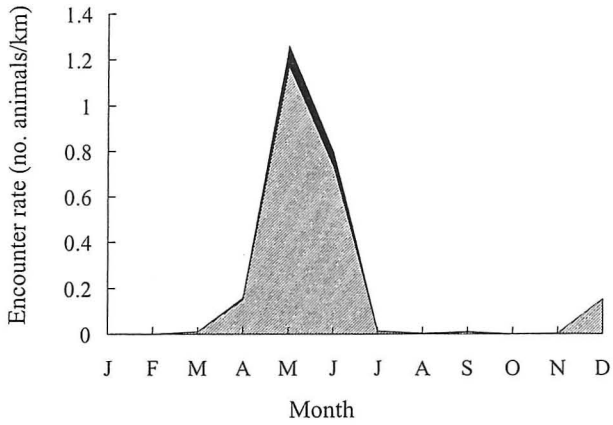

Fig. 2 Monthly changes in the encounter rates (number of animals observed/km) of Pacific white-sided dolphins (▨) and other species (■) of cetaceans.

cetacean (Table 1). The observers sighted 415 groups of cetaceans, totaling 3010 animals. The most common sighting was the Pacific white-sided dolphin; 2778 animals in 341 groups were observed, constituting 82% of the total sightings and 92% of the total number of observed animals (Table 1). The Pacific white-sided dolphin also had the largest mean group size (8.15) of all the observed species.

The number of cetaceans peaked in May, drastically declined in June and July, and remained near zero for the rest of the year (Fig. 2). One group of 17 Pacific white-sided dolphins was observed on 14 December 2003, and a group of two Pacific white-sided dolphins was observed on 13 November 2004, but no other cetaceans were observed from October to January during the 15-day survey (1695 km sighting effort).

The encounter rates (number of animals per km) in the months of April, May, June and December were 0.16, 1.26, 0.80 and 0.15, respectively, but the average encounter rates were less than 0.01 for the other months (Fig. 2). In particular, Pacific white-sided dolphins were regularly observed between late March and early July, rarely observed in September, November and December, and not observed during the rest of the year. Although seen less frequently, the other dolphin species were observed during the same months as the Pacific white-sided dolphins.

Figure 3 shows the geographical distribution of the observed cetaceans. Forty-four percent of the observed cetacean groups were found in the Mutsu Bay area (40°50′–41°10′), while only 20% were found in the central part of Tsugaru Strait (41°21′–41°35′).

Although the results of Kawamura *et al.*[1] contained the possibility of the misidentification or unintentional overlooking of species, the species composition of the cetacean population observed was drastically different from that of the current study. The Pacific white-sided dolphin accounted for 54% of the total number of observed groups in the previous study, but accounted for 82% in the current study. Both studies therefore found that the

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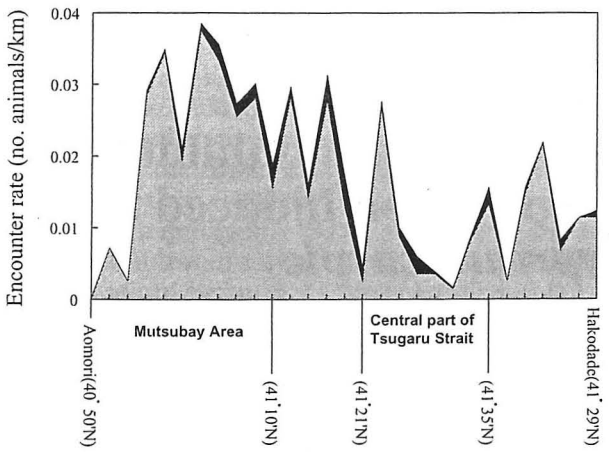

Fig. 3 Monthly changes in the encounter rates of Pacific white-sided dolphins (▩) and other cetacean species (■) across each (2 min) latitude division between Aomori and Hakodate.

Pacific white-sided dolphin was the most common cetacean species in the Tsugaru Strait. The current study found that common dolphins comprised 1% of the observed cetaceans, while the previous study reported that common dolphins made up 19% of the observed cetaceans. Furthermore, no striped dolphins were observed during the current survey, despite their inclusion in the identification manuals, whereas this dolphin species accounted for 11% of the observed cetaceans in the previous study.[1]

In conclusion, the present survey has provided information on the species composition, seasonality, and the geographical distribution of cetaceans in the Tsugaru Strait during 2003 and 2004. In addition, a change was noted in the species composition compared to a previous study.[1] In the Pacific Ocean, interdecadal changes in climate and oceanic conditions may affect the abundance and migration of animals,[3,4] therefore it might also affect conditions in this Tsugaru Strait, warranting further investigations that are already underway.

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