Feeding strategy and prey consumption of Antarctic minke whale *Balaenoptera bonaerensis* in the Southern Ocean

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The Antarctic minke whale (*Balaenoptera bonaerensis*) is the most abundant baleen whale species in the Southern Ocean. They feed mainly on the Antarctic krill (*Euphausia superba*). Quantitative information on prey consumption of whales is useful to understand their feeding ecology and role in the ecosystem. The purposes of this study are 1) to investigate the feeding strategy of Antarctic minke whales based on information on freshness and diurnal change in stomach contents, 2) to estimate the amount of prey consumed by whales. Estimates are made for whales of different reproductive status as it is expected that the energy requirements vary among them and 3) to investigate yearly changes in prey consumption. The analysis is based on the data from whales taken by JARPA (Japanese Whale Research Program under Special Permit in the Antarctic) in a longitudinal sector between 35ºE and 145ºW, south of 60ºS. Sampling was conducted in the austral summer seasons from 1987/88 to 2004/05, mainly in the months from December to March. Daily prey consumption by the whales in each reproductive status group was estimated using energy-requirement and energy deposition. The whales feed mainly before 5AM, which suggest that they cease to feed early in the day. Daily prey consumptions were estimated as 2.7 to 3.5 % of body weight. A decreasing yearly trend was found in the amount of prey consumed, which coincides with the increase in abundance of other baleen whales species in the research area, possibly feeding on the same prey species.

Prey consumptions and feeding strategies of three baleen whale species around the Kuroshio-current extension

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Common minke *Balaenoptera acutorostrata*, sei *B. borealis* and Bryde's *B. edeni* whales are all common whale species in the western North Pacific where the Kuroshio-current extension transports large amount of fish eggs and juveniles of commercially important Japanese anchovy *Engraulis japonicus*, Pacific saury *Cololabis saira* and *Scomber* spp., to pelagic waters. These three whale species sometimes feed on the same fish resources despite having different distribution patterns and foraging strategies, e.g. whales can feed on different developmental stages of the fishes or change food items according to changes in the

environment. The purposes of this study are 1) to estimate the amount of fish resources consumed by the three whale species and, 2) to investigate the difference of feeding strategies among these whale species by examining the diets, length classes of the fish consumed and the environmental variables where whale and prey species were sampled. The three whale species used in this study were sampled during the Second Phase of the Japanese Whale Research Program under Special Permit in the western North Pacific (JARPN II) from May to September during 2000-2007. The research area involved the longitudinal sector between the Pacific coast of Japan and 170°E, and the latitudinal range between 35° and 50°N. Prey species of whales were identified by examining their stomach contents, and the amount of prey consumed in the research area was estimated by extrapolation using information on food consumption per individuals and abundance of whales. To address the second objective of the study, the fishes taken from the stomach contents were examined by length classes and the geographical positions of whales sampled (and the prey species) were plotted against data on sea surface temperature (SST) and height (SSH) obtained from satellite images for each year.

-Is the distribution pattern of krill the determinant factor of the distribution pattern of Antarctic minke whale?-

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Predator-prey relationships in the polar region, especially in high latitude area such as the Ross Sea of Antarctic have been rarely studied quantitatively in a spatial context because of the difficulty to collect an extensive data set in such harsh environments. A multi-disciplinary study combining cetacean, krill and oceanographic surveys was carried out as a part of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA) in the Ross Sea in austral summer in 2005. Generalized Additive Model (GAM) based spatial modeling was applied to assess the effect of prey distribution on the distribution pattern of Antarctic minke whales in the Ross Sea. A hierarchical structure with three strata of spatial models is considered in this study: (1) presence and absence of Antarctic and ice krill, (2) biomass density of Antarctic and ice krill and (3) school counts of Antarctic minke whales. Three abiotic factors, distance from physical boundary (combination of coast, ice edge and shelf ice lines), integrated temperature and

salinity mean from surface to 200m (ITEM-200 and ISAM-200) as well as latitude and longitude were used as covariates for models (1) and (2). Predicted surfaces of krill were also used as covariates in the model (3). The scale of interactions between Antarctic minke whales and the environmental factors were investigated at a segment length of 5 n.miles. Predicted school counts of Antarctic minke whales were low where ice krill were distributed while it was high where Antarctic krill were distributed. The results indicated that the abundance of Antarctic minke whales could be related to the biomass of Antarctic krill. Continuation of the multi-disciplinal ecological survey is critically important to detect interactions between fluctuations of abundance of marine mammals and their preys.