Decision-Rules for Leaping Adélle Penguins (*Pygoscelis adeliae*)

Ken Yoda

Department of Zoology, Graduate School of Science, Kyoto University, Sakyo-ku, Kyoto 606-8502, Japan

Adélie penguins *Pygoscelis adeliae* were tested as to whether they jump with optimal energy efficiency when moving out of the sea to the land. Adélie penguins risk predation if the jump fails. Swimming penguins usually launch up the side of sea ice to a surface higher than sea level. Analysis of jumping behaviour recorded by a video camera showed that the trajectory of the centre of gravity of the birds during the aerial phase of jumping was parabolic, indicating that the success of landing depends on three parameters at the time of take-off from water: speed, angle and distance from the point of emergence to the ice edge. There was a negative relationship between distance and the take-off angle, suggesting that penguins adjust their take-off angle to the distance from the ice edge. The comparison among hypotheses revealed that penguins did not jump with optimal energy efficiency. Instead, they aimed for the refracted image of the edge of the cliff, which from underwater appears higher than it actually is. This direction-dependent rule seems to be more robust and reliable than the optimal energetic strategy.

Like Father, Like Son; Foraging Pattern of the Pelagic Birds During Chick Rearing Period

Nariko Oka

The Yamashina Institute for Ornithology, Abiko, Chiba 270-1145, Japan

Pelagic seabirds generally stay at sea all the time for a few years before making their first landfall, and delay their first breeding up to at least 6 years of age on average (Warham 1996). The examples that some birds even bred within a few meters of its natal nest site indicate their prominent site fidelity and locating abilities. They probably select to forage to suitable feeding waters, using some recognition system they have inherited, while limited studies have ever done to examine where they utilize foraging and how they conduct foraging trips at offshore and pelagic waters.

We studied the foraging zone and trip patterns during chick rearing season and chick growth pattern, using the streaked shearwaters *Calonectris leucomelas*, mainly breeding in the warm current along the Japanese Archipelago. Both sexes of six pairs breeding on the Mikura Island in the northern range of the Kuroshio Current, Japan, were tracked with satellite transmitters in summer and autumn, 2003. They were found to alternate to conduct the short distance trips around the breeding island for several days and the long distance trips north to the convergent waters off northern Japan for about 10 days on average repeatedly.

Chicks (*ca.* 30 birds) attained 30 % over the mean adult body mass at the peak period and showed obesity. Each chick showed surfing-wave body mass growth throughout the nestling period, that was caused by the combination of short and long distance trip pattern of parents. Chicks partitioned their growth energy into two periods during nestling season; the first half for the growth of skeletal body parts and the second half for the growth of the body parts related to flight (Oka *et al.* 2002). These growth patterns evidently functioned to be adaptive buffer against energy insolvency, arisen from the absence of parents for frequent long distance trips. Parents heavily utilized the fronts of the convergent waters far from their breeding island. The reasons why they delay their first breeding are discussed from the viewpoint of foraging strategy shown in our study.

A Preliminary Study on Analysis of Number-concept Formation in a Beluga

Tsukasa Murayama

School of Marine Science and Technology, Tokai University, Shimizu, Shizuoka 424-8610, Japan

Dolphins and whales are essentially social mammals, so they spend their lives in schools consisting of many hundreds or thousands of individuals. They show a variety of complex social behavior in their schools, suggesting

that they need highly developed cognitive ability to maintain such schools. In living in groups, they have to recognize that how many individuals are there in their own school, or which individual is the first, the second..., or how many (natural) enemies are there around themselves,... and so on. Generally, dolphins are thought to possess a highly developed information processing system. Then, in order to realize their number-concept formation of the dolphin, I examined the capability of solving complex problems in terms of counting ability.

A male beluga *(Delphinapterus leucas,* BW 580 kg, BL 358 cm) which was kept in Kamogawa Seaworld aquarium, Japan, was used as a subject in the present study. In the training session, the subject was trained to use Arabic numerals to name the number of items by using the conditional discrimination method. One or two fin(s), mask(s), boot(s) and ball(s) was/were shown to the subject as a sample stimulus. Then, two targets were displayed as comparisons: there was drawn an Arabic numeral 1 or 2 on each target. (These targets were named "target 1"and "target 2", respectively.) When one item was presented to the subject, he had to touch the target 1 with his tip of the snout to receive a reward (which is one or two pieces of fish). Similarly, when two objects were shown to the subject, he was given a reward by touching the target 2. As those training sessions proceeded, the beluga learned to select the target correctly corresponding to the number of samples in all the items. After the subject reached a criterion level of correct responses – 80% over two consecutive sessions, the following tests were conducted. In testing session, the sample stimulus was displayed to the beluga in a variety of patterns and angles. However, the subject responded accurately, and the percent of correct responses was maintained at high levels.

These results indicate that the subject could recognize the number of objects – one and two. To be sure, the beluga could count the number of objects and could name the number with some artificial medium such as Arabic numerals. However, this demonstration leaves room for doubt as to whether those numerals used by the subject were actually symbolic. So, further examination is needed.

Geographical Movements of the Bottlenose Dolphins Coming to the Coastal Waters off the Kii Peninsula

Toshihide Iwasaki

Cetacean Population Biology Section, National Research Institute of Far Seas Fisheries, Shimizu, Shizuoka 424-8633, Japan

Cetaceans are resources of sustainable use (utilizations including such as dolphins watching and dolphin-swim). For sustainable use of cetaceans, it is necessary to manage not only the individual species, but also the individual stock. The bottlenose dolphins coming to the coastal waters off the Kii Peninsula are harvested by the dolphin fisheries for food and for educational display in the aquaria. Where did those dolphins come from and where will they go? Geographical distribution of the bottlenose dolphins in the western North Pacific in the summer season can be divided into apparent 2-3 groups similar to other dolphin species (Miyashita 1993). Are those groups representing stock separation? To answer this question, the National Research Institute of Far Seas Fisheries started satellite tracking of the bottlenose dolphins in 1994. Tracking results revealed that the bottlenose dolphins around Kii Peninsula moved to the eastward (offshore the Honshu Island), to the westward (off the coast of Kyushu Island) and to the southward (offshore the Kuroshio Current). So it became necessary to consider the mixing of offshore and coastal individuals (identical stock?). My presentation will show the geographical movements of the bottlenose dolphins. Next, I will discuss the reason why they utilize such a wide range of waters comparing with the seasonal movements of other fishery resources and oceanographic data. Finally, I will point out problems to be resolved in the future tracking.

Function of Dives in Migrating Marine Animals

Katsufumi Sato

International Coastal Research Center, Ocean Research Institute, University of Tokyo, Otsuchi, Iwate 028-1102, Japan

Air-breathing aquatic animals—turtles, penguins, and seals—are thought to dive in order to forage underwater. They feed on marine organisms such as seaweed (green turtle), krill (penguins), and fishes (penguins and seals). However, some dives may not be for foraging.

Satellite-relayed data loggers (SRDLs), attached to green turtles after nesting in 2003, transmitted, via satellite,