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Summer leopard seal ecology along the Antarctic Peninsula

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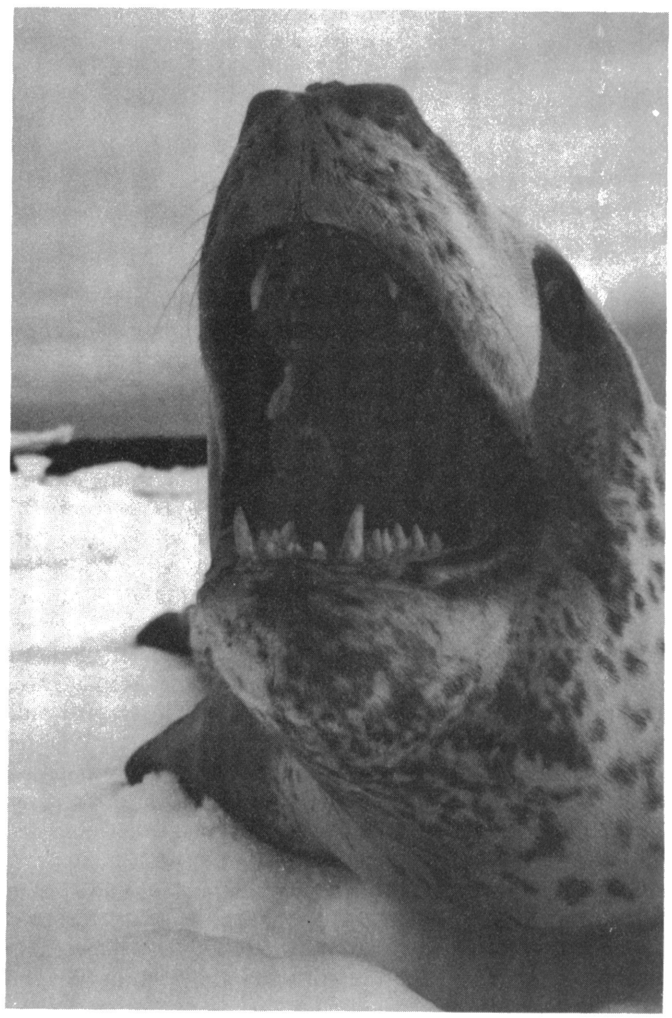
From late December 1980 through March 1981, we studied leopard seals *(Hydrurga leptonyx)* around Palmer Station (64°46'S 64°04'W) and in adjacent waters from the R/V *Hero.* This was the final season of a 3-year study of the species. The objectives were: (1) observe and examine adult females to obtain more precise information on the timing, social organization, and success of mating; (2) handle weaned pups as well as seals of other ages to obtain information on growth and maturation; and (3) quantify information on feeding and food habits and examine age-related food preference and seasonal change in food habits.

We concentrated on capture and release, radio telemetry, collection, and visual and underwater acoustic observation. We also gathered information on crabeater seals *(Lobodon carcinophagus)* and Weddell seals *(Leptonychotes weddelli)* as it pertained to leopard seal ecology (e.g., distribution) and activity (e.g., feeding); we were especially interested in crabeater seal pup predation by leopard seals. We captured leopards on ice floes by injecting them with an immobilizing drug and then, if necessary, pulling a heavy canvas bag over the heads of lightly immobilized seals (Stirling 1966). Nineteen leopard seals were captured, measured, and examined for scars, wounds, and ectoparasites. Toenails (to determine age), blood samples and smears (to identify blood parasites), and vaginal smears from females (to check for evidence of estrus) were taken. Radio transmitters were attached to 14 leopard seals. Radio tracking was conducted from Zodiacs (inflatable rubber boats), the R/V *Hero,* and three antenna masts at islands near Palmer. In addition, 18 adult females were collected for reproductive material, teeth (for aging), blood smears and comprehensive tissue samples (for parasite quantification), and stomach contents (for food type and amount). Preliminary examination of the reproductive material indicates that adult females ovulate and implant by late January or early February. More thorough examination of the ovaries and reproductive tracts should clarify whether delayed implantation occurs in leopard seals and should yield detailed information on the timing of reproductive events. Intraspecific scarring in leopard seals was not as extensive or severe as that seen in crabeaters and Weddels; fresh wounds were most common in January.

Leopard seals of all ages and both sexes used the waters around Palmer throughout the season. Drifting pack ice was plentiful when we arrived. We began to see leopards in early January, and they became increasingly common into February. Leopard seals were always present and available for handling as long as ice was accessible to us. Leopards were present even when ice was absent, and sometimes we saw them many kilometers from ice.

Leopard seals, regardless of their sex and age, appear to feed effectively on whatever is most accessible (figure). Within the same bay and at the same time, different leopards fed on seals, penguins, fish, krill, and (rarely) squid. Commonly, one individual was found to have taken two different items at the same feeding or within several hours. Unexpectedly dense concentrations of leopard seals, from 10 to 20 or more in Arthur Harbor, sometimes occurred in midseason when numerous



Leopard seal showing cusped dentition for grasping and straining.

crabeaters and Adélie penguin chicks were also present and feeding on the abundant krill. Leopards showed no inclination to scavenge, either from penguin, seal, or whale carcasses.

In March, weaned crabeater pups with extensive, raking, fresh wounds from leopard seal canines increasingly became apparent. Most pups seen toward the end of summer bore such signs of recent attacks, just as most adult crabeaters bear scars from leopard seal teeth (Siniff and Bengtson 1977). Weddell pups commonly hauled out on beaches around Bismarck Strait, but only one was seen with old scars from canine puncture wounds, possibly from a leopard. None of the weaned elephant seal *(Mirounga leonina)* pups that appeared from midsummer on showed signs of leopard seal attack.

This project was supported by National Science Foundation grant DPP 77-21946. The manager and personnel of Palmer Station, as well as Capt. Lenie and the crew of the R/V *Hero*, again provided consistent, invaluable support and direct, energetic assistance. We gratefully acknowledge their essential help.

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Milk intake of Weddell seal young estimated by tritiated water and ^{22}sodium turnover

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Weddell seal young, like other phocid seals, exhibit rapid growth during a relatively short nursing period, gaining about 100 kilograms in 6 to 7 weeks. Since there are no morphological adaptations of adult mammary glands in Weddell seals, apart from sinusoidal vessels in lactating glands, which might account for their rapid growth (Tedman 1981; Tedman and Bryden 1981), we believe it is important to determine to what extent the high fat content of the milk (up to 60 percent) and the milk secretion rate are responsible for the large weight increases. Although the milk composition of many phocids is known, we lack complete information on milk yield for this group.

Owing to the disturbance associated with repeated handling of young and separation from their mothers, as well as difficulties involved in measuring urine and fecal losses, it would be difficult to obtain reliable data on milk intake by Weddell seal pups by weighing pups before and after suckling. Radioactive isotopes such as tritiated water (HTO) and ^{22}sodium (^{22}Na) have been used successfully to measure water and sodium turnover rates, respectively, and, in turn, to measure milk intake by offspring in some domestic and wild species (Green and Newgrain 1979; Macfarlane, Howard, and Siebert 1969). The main advantage of these methods is that they reduce disturbance to mother and offspring to a minimum (Wright, Jones, and Gentry 1974).

A combination of HTO and ^{22}Na was used to make two independent estimates of milk intake by Weddell seal young on the sea ice at Turtle Rock, McMurdo Sound, between 18 October and 10 December 1980.

Newborn pups and their mothers were tagged within 3 days of birth. At the beginning of the experiments, each of 11 randomly selected pups (6 days postpartum) was given an intravenous injection of 0.4 milliliter of hypotonic ^{22}sodium chloride (^{22}NaCl) solution (1.85 millibecquerels per milliliter) and 1 milliliter of tritiated water (370 millibecquerels per milliliter). They were isolated from their mothers for 5 hours to allow equilibration of the isotope, after which a blood sample was obtained from the extradural vertebral vein. The dilution of isotopes during the equilibration period provided estimates of body water and exchangeable Na pools. Pups were then returned to their mothers.

Blood samples were collected at 3-day intervals, and pups were reinjected at 15 days (with 1 milliliter of HTO and 0.8 milliliter of ^{22}NaCl) and at 27 days (with 1 milliliter of HTO and 1 milliliter of ^{22}NaCl) postpartum following the procedure outlined in the preceding paragraph. A final injection of 1 milliliter of HTO was given at the end of each experiment to check the pups' total body water content. Four lactating seals not involved in the previous experiments were given intravenous injections of 1 milliliter of HTO at 6 days and 35 days postpartum to calculate changes in body composition. On each occasion, a blood sample was collected 5 hours after injection. All blood samples were allowed to clot, after which serum fractions were drawn off and frozen along with red-cell fractions.

Isotope turnover is derived from fractional turnover rate $[(\ell n I-\ell n F)/t]$ and body pool, where I is the initial isotope concentration in the blood after equilibration and F is the final isotope concentration in the blood at time "t" (days) after injection. Milk intake estimates are calculated from isotope turnover rates and water and sodium contents of milk.

Milk samples (2 milliliters) were collected from the mothers of each of the 11 pups at approximately 6-day intervals. A subcutaneous injection of 4 milliliters of oxytocin (P-M Oxytocin, Ethnor Pty. Ltd., N.S.W.; 10 I.U.'s (international units) per milliliter usually was required to obtain samples using a human milk expressor.

Pups were weighed at intervals of approximately 6 days to check growth rates and to relate milk intake to weight gain. Cows were weighed during the first week postpartum and again near weaning to quantify weight loss.

Analysis of blood and milk samples is continuing. In addition to sodium and water content (for use in milk intake calculations), milk samples are undergoing detailed analyses (fat,