ZENKOVICH, B. A. 1956. Jagd auf Meeres Reisen, Leipzig.

ADAM A. PACK, Hawaiian Center for Whale Research, a program of The Dolphin Institute, 420 Ward Ave., Suite 220, Honolulu, Hawaii 96814, U.S.A. and Kewalo Basin Marine Mammal Laboratory University of Hawaii, 1129 Ala Moana Boulevard, Honolulu, Hawaii 96814, U.S.A.; e-mail: pack@hawaii.edu; DAN R. SALDEN, Hawaii Whale Research Foundation, Southern Illinois University at Edwardsville, Edwardsville, Illinois 62026-1772, U.S.A. and P. O. Box 1296, Lahaina, Hawaii 96761, U.S.A.; MARK J. FERRARI AND DEBBIE A. GLOCKNER-FERRARI, Center for Whale Studies, 39 Woodvine Court, Covington, Louisiana 70433-4724, U.S.A.; LOUIS M. HERMAN, Hawaiian Center for Whale Research, a program of The Dolphin Institute, 420 Ward Ave., Suite 220, Honolulu, Hawaii 96814, U.S.A. and Kewalo Basin Marine Mammal Laboratory University of Hawaii, 1129 Ala Moana Boulevard, Honolulu, Hawaii 96814; HARRISON A. STUBBS, Hawaii Whale Research Foundation, P. O. Box 1296, Lahaina, Hawaii 96761, U.S.A.; JANICE M. STRALEY, University of Alaska Southeast, 1332 Seward Avenue, Sitka, Alaska 99835, U.S.A. Received 22 January 1997. Accepted 31 October 1997.

[1] The Hawaiian Center for Whale Research is the name under which the Kewalo Basin Marine Mammal Laboratory's humpback whale research program now operates.

[2] Historical accounts of whaling for humpbacks and other rorquals state that they sink when killed (Slijper 1962, Tomilin 1967). Whale D, however, floated unsupported. Observations of live humpback whales "resting" at or near the surface without moving are common in Hawaiian waters and are possibly explained by air in the lungs.

[3] On two occasions when whale A was near but not in contact with whale D, its genital slit was also observed to be open.

[4] A portion of the mitochondrial control region and a portion of an actin intron (two variable regions in humpbacks) were sequenced from both skin specimens at Harvard University by Dr. Frank Cipriano. They yielded respectively 463 and 244 base pairs of overlapping sequences. Both the control region sequences and the actin intron sequences from the two specimens were identical in the regions of overlap, providing strong evidence that both specimens were from the same whale.

MARINE MAMMAL SCIENCE, 14(4):873–881 (October 1998)

THE NORTHERN ELEPHANT SEAL IN OREGON: A PUPPING RANGE EXTENSION AND ONSHORE OCCURRENCE

The northern elephant seal, *Mirounga angustirostris*, has undergone a phenomenal population growth in the past 100 yr, recovering from a population that numbered tens or perhaps low hundreds at the turn of the century to an estimated 127,000 individuals in 1991 (Stewart *et al.* 1994). Northern ele-

Table 1. Monthly maximum numbers of northern elephant seals (excluding pups) observed at Shell Island, Cape Arago 1978–1996. *—no census during month.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	No. censuses
1978	*	*	*	*	*	*	1	0	0	0	*	*	8
1979	*	*	1	3	4	1	0	0	4	7	0	0	60
1980	*	*	1	3	4	1	0	0	4	0	0	0	12
1981	0	0	0	*	*	*	1	*	*	*	1	*	5
1982	0	1	*	1	*	2	2	0	*	*	1	0	8
1983	*	1	*	0	1	1	2	2	0	0	0	2	15
1984	2	1	1	0	1	1	2	0	0	1	0	1	29
1985	1	1	1	1	1	1	1	1	3	1	3	1	19
1986	3	*	1	1	*	2	1	*	*	7	1	1	16
1987	1	1	1	*	7	3	4	*	12	12	16	1	21
1988	1	1	*	10	9	6	0	*	5	12	2	0	14
1989	0	0	*	7	13	6	0	0	16	37	5	0	19
1990	0	1	2	48	60	13	0	2	*	2	1	0	16
1991	0	0	*	*	*	20	2	0	27	14	9	3	17
1992	0	1	*	40	46	11	6	3	14	25	16	4	87
1993	8	12	11	10	26	4	4	4	17	21	*	2	57
1994	20	19	7	*	*	14	7	4	*	17	*	1	22
1995	32	26	13	*	35	13	5	5	*	12	9	*	29
1996	20	16	9	*	*	10	9	*	*	17	*	15	22
1997	23	20	11	end of observations									58

phant seals have now reoccupied many of their former breeding sites (Radford *et al.* 1965, Odell 1971, Stewart and Yochem 1986) and are continuing to expand their breeding range (Stewart *et al.* 1994). In 1981 elephant seals established a breeding colony on the Point Reyes mainland, a site at which there is no historical evidence for breeding (Allen *et al.* 1989). In this paper we discuss a further expansion of the pupping range of the northern elephant seal to Shell Island, Cape Arago, Oregon (43°18′45″N, 124°24′5″W). When not on land for breeding or molting, elephant seals range widely in the northern Pacific ocean and are present offshore of Oregon during a large portion of the year (Stewart and De Long 1995). We examine the recent history and pattern of onshore occurrences by northern elephant seals in Oregon.

Shell Island is one of a complex of offshore islands in the Oregon Islands National Wildlife Refuge at Cape Arago, Oregon. The island beach is connected to the mainland at spring low tides and can be entirely covered with water during storms. Periodic censusing of northern elephant seals that come ashore at Shell Island has occurred since 1978. Counts were made at various times of day by (1) visiting Shell Island and directly counting the number of animals present, (2) aerial surveys, or (3) observing animals with a 20× power spotting scope from the adjacent mainland (500 m from Shell Island). The number of surveys varied greatly among years. The average number of surveys per year was 25 and the range was from 5 to 87 (Table 1). Visits to Shell Island have been greatly reduced since 1992 to minimize disturbance to Cal-

ifornia sea lions (*Zalophus californianus*), which began to use the island year-round; this is not thought to have introduced bias into the counts, because one can view the entire island from the mainland observation site. However it has affected when counts can be conducted, as at higher tidal elevations sea lions can obscure our view of elephant seals. Hence, since 1992, counts have been taken around the low-tide period. The number of California sea lions at Shell Island increases dramatically in mid-March as they begin their annual southern migration. This mass of animals can obscure our view of young elephant seals on the island. Elephant seals are capable of making a pelagic trip to sea 12–14 wk after birth, (Thorsen and Le Boeuf 1994). Thus, for births in early January, seals would leave the beach around the beginning of April. Because we are unable to be certain that an individual is present on Shell Island after mid-March, we call an elephant seal pup successful if it has survived to mid-March.

To assess the role of storm events in the survival of elephant seals born at Shell Island, we used data on wave heights measured by two buoys moored offshore. The Coquille Buoy (TP 03504), operated by the US Army Corps of Engineers and the California Dept. of Boating and Waterways was moored at 43°6.6′N 124°30.6′W, 28 km from Shell Island during 1995 and 1996. Buoy #46002, operated by NOAA's National Data Buoy System, is moored at 42°53′N 130°26′W, approximately 500 km from Shell Island. We compared the January–March 1995 and 1996 data sets for wave heights greater than 5 m from the two buoys using a multiple regression. There was a significant correlation at $P < 0.0001$ $r = 0.779$, $n = 654$. We used the number of hours with wave heights greater than 5 m at buoy #46002 for January–March 1993–1997 as a measure of storm intensity.

On visits to Shell Island from 1979 to 1991, the tag numbers of 22 previously tagged animals were recorded and information on their sex, age at tagging, and tagging site was obtained from records kept at various established tagging sites. Since 1992 few tags have been read because of the reduction in the number of visits to Shell Island.

To determine the pattern of onshore occurrences by northern elephant seals in Oregon away from Shell Island we used observations of 43 previously tagged animals which have been recorded opportunistically since 1978.

Maximum numbers of northern elephant seals occurred at Shell Island during spring (April–June) and fall (September–November), although seals were seen ashore during all months of the year (Table 1). Numbers were lowest during July and August and, until 1993, during December–March. Small numbers of animals have been present during the breeding season (December–February) since at least 1982 (Table 1), although until 1993 these observations in most instances represented single individuals.

Northern elephant seals have given birth at Shell Island since 1993 (Table 2). It was not possible to determine the exact number of pups born each year as, depending on the weather at the time of birth, the pups could have been washed from the island before we observed them. Thus these data are presented as minimum number of births. Shell Island is not an ideal site for pupping.

Table 2. Number of northern elephant seal adults and pups at Shell Island during breeding season.

Year	Max. no. of adults in February	Minimum no. of pups born	No. of pups surviving to March 15
1993	12	3	0
1994	19	5	0
1995	26	3	0
1996	16	1	0
1997	20	8	7

Only in 1997 did pups survive to 15 March at this site (Table 2); in all other years storms, common to the Oregon coast in winter months, washed pups from the island before they were capable of independent life. Storm events, measured by wave heights in excess of 5 m at buoy #46002, were much less common in February and March 1997 than in previous years (Fig. 1). In January 1997, 64% of the waves in excess of 5 m occurred in the first two days of the month before any of the pups that survived in 1997 were born.

Six of the 1997 pups were weighed and tagged with white flipper tags. We cannot be sure that the 1997 pups survived to make the trip to sea, as after 15 March the number of California sea lions on Shell Island did not allow reliable observations of the presence or absence of elephant seal pups. However, the two lightest pups moved to the mainland beach in early March and we were able to track their progress almost daily; one left the beach on 28 March, the other on 8 April.

There were 22 previously tagged animals observed at Shell Island during the period 1979–1991; of these, 18 were tagged at Año Nuevo, California, three at the Farallon Islands, California, and one at San Miguel Island, California. Most tagged animals were observed over a period of no more than two to three weeks, but there were some instances of repeated visits to Shell Island. Two 1-yr-old females were seen during the spring molting haul-out period and then again in July of the same year; a 1-yr-old female seen in the spring of 1989 returned the next spring; and one male, a 1-yr-old at first sighting, was seen in May or June for three years in a row. Sixty-four percent of the tagged seals were less than 2 yr old and no seals were older than 5 yr (Table 3). A higher number of tagged females (15) was seen than males (7). We have only one record of a tagged animal after 1992, an 8-yr-old female, born at Año Nuevo, who gave birth at Shell Island in 1997.

Northern elephant seals come ashore on beaches all along the Oregon coast; they are usually either molting, sick, or dead. Analysis of tags from 43 previously tagged animals showed that 93% were from Año Nuevo, with smaller numbers from the Farallon Islands (5%) and San Nicolas Island, California (2%). Eight of these animals were found dead on the beach. All of the previously tagged seals observed were less than 2 yr old, with the exception of a dead 10-yr-old female. Twenty of the seals were male and 19 female, the sex

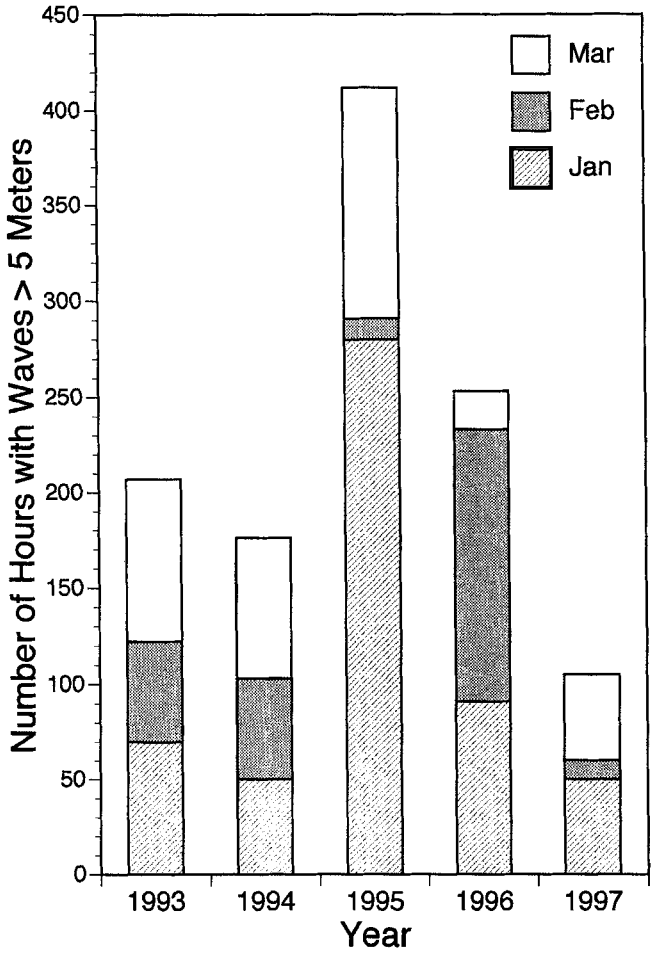

Figure 1. Frequency of storm events on the Oregon coast in January–March 1993–1997 as measured by wave heights in excess of 5 m at NOAA buoy #46002.

Table 3. Sex and age of previously tagged northern elephant seals at Cape Arago 1979–1992.

	Number of	
Age	Females	Males
<1	1	2
1–2	11	0
2–3	2	2
3–4	1	1
4–5	0	2

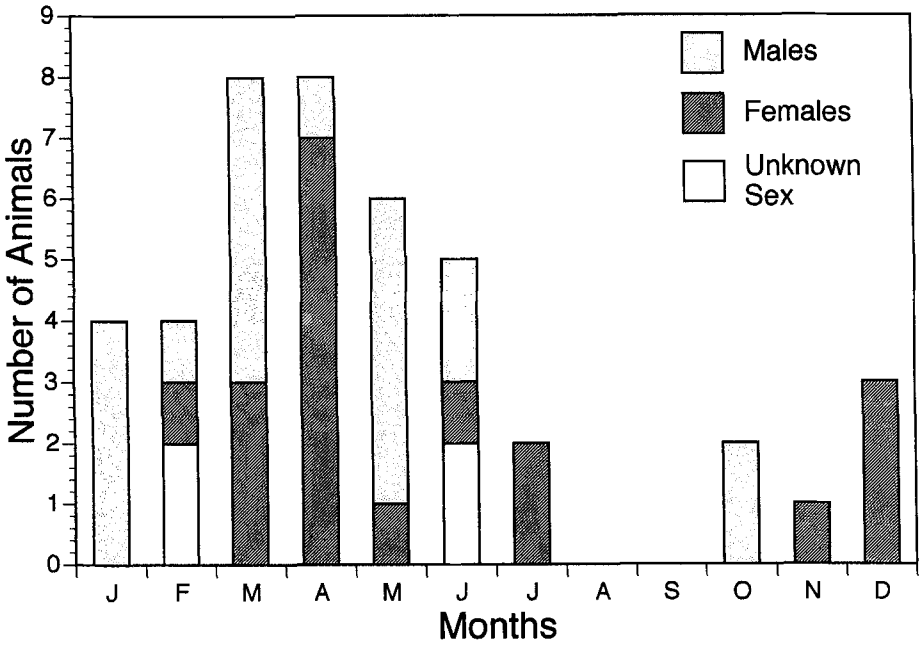

Figure 2. Seasonal occurrence and sex of previously tagged northern elephant seals onshore in Oregon, excluding Cape Arago, 1979–1993.

of four was unrecorded. Fifty-six percent of the animals were present during March–May, smaller numbers were present during other months of the year, and no seals were seen in August or September (Fig. 2). Of the animals seen between July and December half were young of the year. On 18 December 1982 an untagged northern elephant seal gave birth to a still-born pup at Newport, Oregon (44°37′24″N, 124°03′54″W). The female died soon after the birth.

The first published account of an elephant seal occurring in Oregon was of an adult male found dead on the beach approximately 30 km south of Shell Island in 1952 (Freiburg and Dumas 1954). Live northern elephant seals were first documented on Shell Island during September and October 1968, when two young males were present (Mate 1969). The following year, two older males were recorded in July (Mate 1970). Small numbers (1–4) of elephant seals occurred sporadically at Shell Island until the mid-1980s; since that time increasing numbers have been present during the spring and fall. The peak in numbers during April–June reflects the period of molting for females and immature males (Le Boeuf *et al.* 1972), and the September–November peak is when immature animals of both sexes rest onshore, often north of their breeding site (Condit and Le Boeuf 1984). The virtual absence of northern elephant seals from Shell Island in July and August reflects the period when adult and subadult males come to shore to molt at established rookeries and most other age classes appear to be at sea (Orr and Poulter 1965, Condit and

Le Boeuf 1984, Stewart and Delong 1995). Prior to 1992 no previously tagged animal at this site was older than 5 yr, and most were from Año Nuevo or the Farallon Islands. This pattern of young animals colonizing new sites from the closest rookeries is consistent with other recent colonization events (Le Boeuf *et al.* 1974, Allen *et al.* 1989). No groups of animals were present during the breeding season until 1993, when adult females and subadult males were first seen. We do not know the ages or the origins of most of the females that gave birth at Shell Island.

The initiation of pupping at Shell Island is no doubt a response to the continued population growth of the northern elephant seal. The northern extent of the historical breeding range is unknown but is not thought to extend to Oregon. Zooarcheological evidence from excavations of sites in central Oregon (Lyman 1988) and northern California (Hildebrandt 1984, Lyman 1989) indicate that northern elephant seals were not a regular part of the native people's diet. The only elephant seal specimens from 2,774 pinniped remains collected in these studies were of one individual from one site in central Oregon (Lyman 1988). Elephant seals were important to aboriginal subsistence in California (Stewart *et al.* 1994). The near absence of elephant seal material from zooarcheological studies in Oregon suggests that elephant seals did not breed along the Oregon coast. Thus, the colonization of Shell Island probably represents an expansion outside of the northern elephant seal's historical breeding range. A similar expansion has taken place in northern California, 150 km south of Cape Arago. In 1994 the presence of a live-stranded northern elephant seal pup prompted aerial surveys of Castle Rock, off Crescent City, California (41°46′N). Twenty-three northern elephant seals were sighted 17 March 1994, including 11 identified as pups; preweaned pups have been washing up on the mainland shore adjacent to Castle Rock since at least 1985 (personal communication, D. Jaques and C. Strong, Crescent Coastal Research, 7700 Bailey Rd., Crescent City, California 95531, U.S.A.). Elephant seals have been observed hauling out on the Washington coast and offshore islands at various times of the year since at least since the mid-1980s, but no pupping has been observed (personal communication, S. Jeffries, Washington Department of Wildlife, Mail Stop EX12, Olympia, WA 98504).

Shell Island is the only site in Oregon that is regularly visited by elephant seals. Young animals, less than 2 yr old, come ashore at other sites in Oregon but do not occur with any regularity. Shell Island is not an ideal site for elephant seal pupping because the island is awash during storms. Thus, pup survival will be dependent on weather conditions during the pupping season. We can think of no other outer coast locations in Oregon where northern elephant seals could form successful breeding colonies; there are no large islands within the state with beaches that are immune from high tide or winter storm surge. The stillbirth on the Newport beach in 1982 was likely the result of a stranding of a sick female, and this area does not represent a potential pupping site.

Although there is a precedent for northern elephant seal colonies to be established on mainland beaches (Le Boeuf and Panken 1977, Allen *et al.*

1989), there are few suitable mainland beaches in Oregon. Most have large surf zones in winter or have foredunes artificially steepened and stabilized by the introduction of European beach grass (*Ammophila arenaria*), which precludes retreat by elephant seals from wave-swept beaches at high tide or during storms. A few beaches in the vicinity of stream mouths, where the stream's meandering prevents the formation of a large foredune, have become regular haul-out areas for harbor seals; there is no use of these sites by northern elephant seals at this time. In conclusion, we do not expect to see an expansion of the northern elephant seal pupping range to other sites in Oregon and we believe that pup survival at Shell Island will be highly variable and dependent upon weather conditions.

Acknowledgments

The U.S. Fish and Wildlife Service granted J. Hodder access to Shell Island as part of the Oregon Islands National Wildlife Refuge and provided information on aerial surveys they conducted of the area. We thank Michael T. Wilson who assisted with elephant seal surveys in 1993 and 1994 and the numerous people who have marked elephant seals in various pupping sites and whose efforts allowed us to say so much more about the animals we see in Oregon. We are grateful to B. Le Boeuf, the Point Reyes Bird Observatory personnel, and B. Stewart for providing information on the tagged animals. We thank R. L. Pitman and B. Stewart for useful comments on a draft manuscript.

Literature Cited

Allen, S. G., S. C. Peaslee and H. R. Huber. 1989. Colonization by northern elephant seals of the Point Reyes Peninsula, California. Marine Mammal Science 5: 298–301.

Condit, R., and B. J. Le Boeuf. 1984. Feeding habits and feeding grounds of the northern elephant seal. Journal of Mammalogy 65:281–290.

Freiburg, P. E., and P. C. Dumas. 1954. The elephant seal (*Mirounga angustirostris*) in Oregon. Journal of Mammalogy 35:129.

Hildebrandt, W. R. 1984. Late period hunting adaptations on the north coast of California. Journal of California and Great Basin Anthropology 6:189–206.

Le Boeuf, B. J., and K. J. Panken. 1977. Elephant seals breeding on the mainland in California. Proceedings of the California Academy of Sciences 41:267–280.

Le Boeuf, B. J., R. J. Whiting and R. F. Grant. 1972. Perinatal behavior of northern elephant seals and their young. Behavior 43:121–156.

Le Boeuf, B. J., D. G. Ainley and T. J. Lewis. 1974. Elephant seals of the Farallones: Population structure of an incipient breeding colony. Journal of Mammalogy 55: 370–385.

Lyman, R. L. 1988. Zoogeography of Oregon coast marine mammals: The last 3,000 years. Marine Mammal Science 4:247–264.

Lyman, R. L. 1989. Seal and sea lion hunting: A zooarchaeological study from the southern northwestern coast of North America. Journal of Anthropological Archaeology 8:68–99.

Mate, B. R. 1969. Northern extension of range of shore occupation by *Mirounga angustirostris*. Journal of Mammalogy 50:639

Mate, B. R. 1970. Oldest tagged northern elephant seal recovered in Oregon. California Fish and Game 56:137.

ODELL, D. K. 1971. Censuses of pinnipeds breeding on the California Channel Islands. Journal of Mammalogy 52:187–190.

ORR, R. T., AND T. C. POULTER. 1965. The pinniped population of Año Nuevo Island, California. Proceedings of the California Academy of Science 32:377–404.

RADFORD, K. W., R. T. ORR AND C. L. HUBBS. 1965. Reestablishment of the northern elephant seal *Mirounga angustirostris* off central California. Proceedings of the California Academy of Science Series 31:601–612.

STEWART, B. S., AND R. L. DELONG. 1995. Double migrations of the northern elephant seal, *Mirounga angustirostris*. Journal of Mammalogy 76:196–205.

STEWART, B. S., AND P. K. YOCHEM. 1986. Northern elephant seals breeding at Santa Rosa Island, California. Journal of Mammalogy 67:402–403.

STEWART, B. S., B. J. LE BOEUF, P. K. YOCHEM, H. R. HUBER, R. L. DELONG, R. J. JAMESON, W. SYDEMAN AND S. G. ALLEN. 1994. History and present status of the northern elephant seal population. Pages 29–48 *in* B. J. Le Boeuf and R. M. Laws, eds. Elephant seals. University of California Press, Berkeley, CA.

THORSON, P. H., AND B. J. LE BOEUF. 1994. Developmental aspects of diving in northern elephant seal pups. Pages 271–289 *in* B. J. Le Boeuf and R. M. Laws, eds. Elephant seals. University of California Press, Berkeley, CA.

JANET HODDER, Oregon Institute of Marine Biology, University of Oregon, P. O. Box 5389, Charleston, Oregon 97420, U.S.A.; email: jhodder@oimb.uoregon.edu; ROBIN F. BROWN, Oregon Department of Fish and Wildlife, 7118 N.E. Vandenberg Avenue, Corvallis, Oregon 97330, U.S.A.; CHRIS CZIESLA, Oregon Institute of Marine Biology, University of Oregon, P. O. Box 5389, Charleston, Oregon 97420, U.S.A. Received 17 September 1996. Accepted 30 October 1997.

MARINE MAMMAL SCIENCE, 14(4):881–883 (October 1998)

WEDDELL SEAL (*LEPTONYCHOTES WEDDELLII*) FEEDING ON GENTOO PENGUINS (*PYGOSCELIS PAPUA*)

Dietary studies of Weddell seals have indicated that they feed primarily on fish, with varying proportions of squid, krill, and other invertebrates being recorded (Bertram 1940, Dearborn 1965, Øritsland 1977, Laws 1984). Although the dietary composition shows seasonal and geographical variation in the proportions of fish, cephalopods, and invertebrates (Dearborn 1965, Green and Burton 1987), there is only one record of a Weddell seal preying on a penguin (Todd 1988).

On three occasions during the 1996–1997 austral summer at Port Lockroy, 64°49′S, 63°30′W, we saw a Weddell seal eating freshly killed adult gentoo penguins, which it dismembered by throwing them around in a manner similar to that used by leopard seals (*Hydrurga leptonyx*). We are confident that only one individual was involved in killing penguins because there was only a small resident population of six seals around Port Lockroy. Most were in-