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# Seal Eating by Walruses in the Bering and Chukchi Seas

**L. F. Lowry[1] and F. H. Fay[2]**

[1] Alaska Department of Fish and Game, 1300 College Road, Fairbanks, AK 99701, USA
[2] Institute of Marine Science, University of Alaska, Fairbanks, AK 99701, USA

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**Summary.** Walruses (*Odobenus rosmarus*) feed primarily on benthic invertebrates, but they are known to eat seals (Phocidae) occasionally, ostensibly when the benthic foods are unavailable. We investigated reports of a marked increase in occurrence of seal-eating walruses in the Bering Strait region in the late 1970's by examining stomach contents of animals taken in the spring harvests by Eskimos. We also obtained relevant information during visual surveys of marine mammals in the region. Our findings from the stomachs indicated that seal eating was 10 to 100 times more common during the 1970's and early 1980's (0.6 – 3.0%, $N = 645$) than it had been in the previous three decades (0.07 – 0.20%, $N = 4015$). In addition, we observed walruses in possession of seal remains in 1978 and 1979, where we had not seen such a phenomenon before in the previous 25 years. We attribute the increased predatory interaction between seals and walruses partly to a larger walrus population and, especially in 1979, to unusually restrictive spring ice conditions, which tended to cause greater than usual overlap of their distributions. Stomach contents of walruses taken in the Chukchi Sea in summer, where the ranges of walruses and seals overlap broadly in all years, have indicated a similarly high rate of occurrence of seal eaters (8.6% in the 1960's, $N = 35$; 11.4% in 1983, $N = 44$). As a whole, our findings indicate that most of the seal eating is predation, rather than scavenging of carrion. They also indicate that it is not rare or aberrant but common behavior, and that it could exert a significant impact on seal populations in some areas.

## Introduction

Walruses (*Odobenus rosmarus*) throughout the Artic have been known for a long time to eat seals (Phocidae) occasionally. The occurrence of this carnivory has been well documented (see reviews by Fay 1960; Krylov 1971), but some controversy remains over whether it is predation or scavenging, as well as over its significance to the walruses and to the seal populations involved. Because walruses apparently feed primarily on bivalve mollusks and secondarily on other types of benthic invertebrates, their occasional feeding on the flesh of other pinnipeds has been regarded as aberrant behavior and attributed to scarcity or inaccessibility of normal foods (Gray 1927; Freuchen 1935; Chapskii 1936; Vibe 1950). The reported higher incidence of carnivory in males than in females suggests a sex-related function, not yet understood (Fay 1982).

Our attention was drawn to this subject once again by several oral reports from Alaskan Eskimos of an unusually high proportion of walruses with seal remains in their stomach in the annual catch from the Bering Strait region in 1978 and, especially, 1979. In those years also, we observed for the first time in our experience living walruses with remains of seals in their possession, and we found parts of seals in stomach contents of several walruses taken in the same region. More recently, in the western Chukchi Sea, we witnessed the taking of a walrus that had the remains of a seal on the ice around it, as well as parts of the seal in its stomach. Further, we found seal remains in the stomachs of several other walruses collected in the same region at that time.

In this report, we present our findings and observations in the interest of contributing further to solution of the question of predation versus scavenging by walruses. In addition, we offer some suggestions as to possible causes of the higher incidence of carnivory in the northern Bering Sea in recent years.

## Methods

We obtained samples of stomach contents of walruses taken at several locations in the northern Bering Sea during the spring hunt by Alaskan Eskimos at various times between 1952 and 1982 and from a series of walruses collected during a Soviet-American research cruise in the western Chukchi Sea in summer 1983 (Fig. 1). For most of the walruses

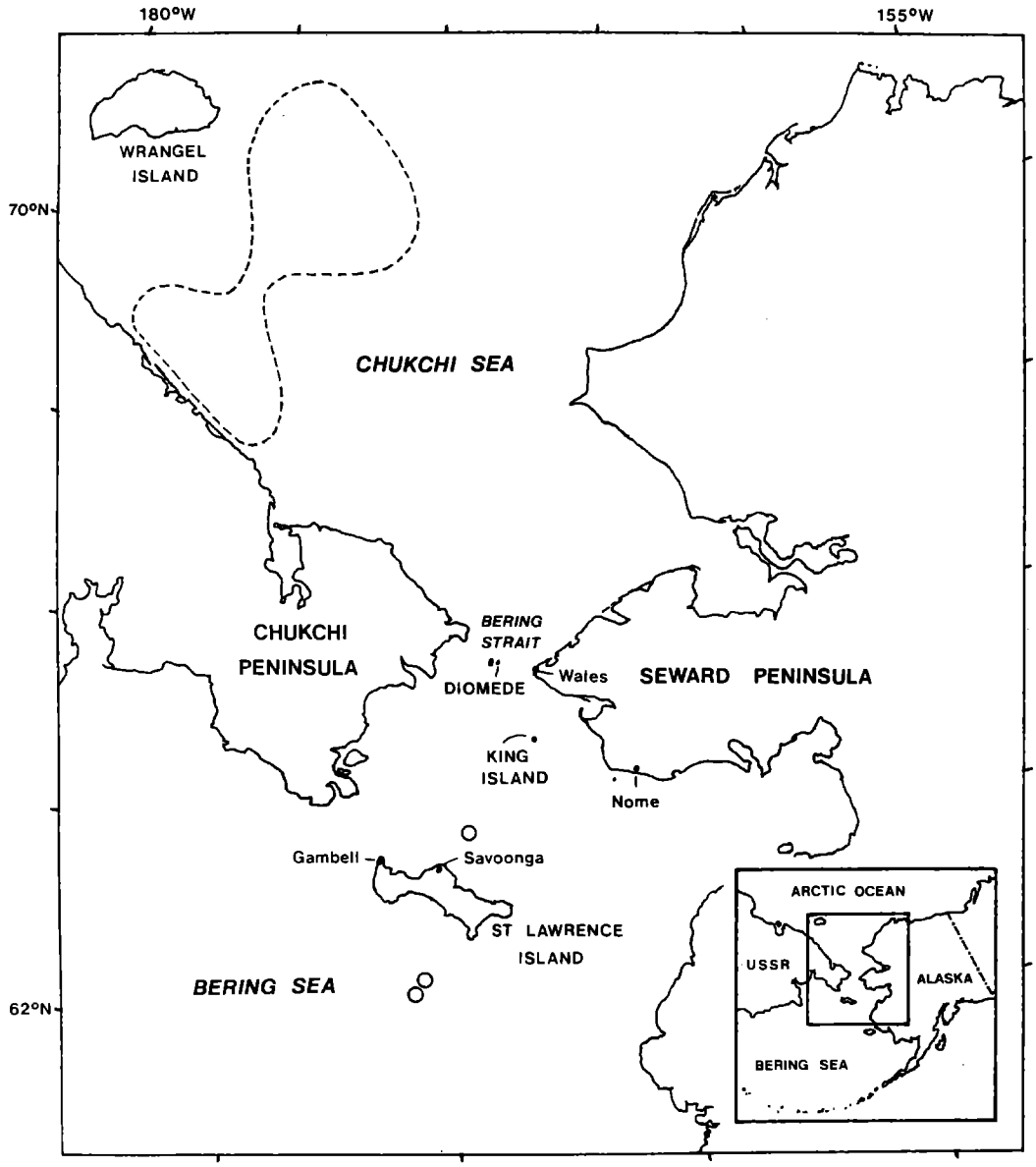


**Fig. 1.** Map of the northern Bering Sea and Chukchi Sea showing the locations of villages at which walrus stomach contents were collected, the area in which walruses were collected from the *ZRS Zykovo* (*dashed lines*), and the localities in which living walruses with seal remains (*circles*) were seen during aerial surveys

from which stomach contents were obtained, the date, location, and sex had been recorded. The ages for some were determined from counts of cementum layers visible in thin, sagittal sections of teeth; for others, ages were estimated principally on the basis of morphology of the tusks. Contents of a few stomachs from the Eskimos' catch were examined qualitatively in the field, then discarded; most were preserved in 10% formalin, then shipped to our laboratories, where we sorted, identified, counted, and weighed the various components of the ingesta. The stomach contents from the walruses collected in the Chukchi Sea were analysed in the same way aboard the ship, immediately after they were collected. The remains of seals were identified to species, principally on the basis of characteristics of their pelage. Further information on the walruses from which the seal remains were obtained was solicited from the hunters who had killed them.

Our sightings of walruses in possession of seal remains in 1978 and 1979 took place during helicopter surveys of marine mammals over the pack ice of the northern Bering Sea. Those surveys, based from the NOAA ship *Surveyor*, were flown at altitudes of 40 to 100 m and were designed principally for censusing pinnipeds over large areas. The sighting of a walrus with seal remains in 1983 was from the Soviet vessel *Zykovo* in the western Chukchi Sea.

## Results

### *Walrus Stomach Contents*

We examined the food in the stomachs of 364 walruses taken in the Bering Strait region from 1952 to 1982 and found that five of those stomachs contained parts of seals (Table 1). The other 359 stomachs contained only benthic invertebrates (Fay et al. 1977; Lowry et al. 1981; Fay and Stoker 1982a, b). Three of the five stomachs with seal remains also held a few benthic invertebrates (Table 2).

In aggregate, the five seal-eating walruses from the Bering Sea had consumed parts of seven different seals: three spotted (*Phoca largha*), two ringed (*P. hispida*), and two bearded (*Erignathus barbatus*). All of the spotted seals definitely were young of the year; both of

**Table 1.** Number of walrus stomachs examined that contained seal remains/number containing food by any kind per year in the Bering Strait region during this study

| Locality | Year | | | | | |
|---|---|---|---|---|---|---|
| | 1952–1969 | 1970 | 1975 | 1979 | 1980 | 1982 |
| Gambell | 0/34 | – | 0/13 | 1/15 | 0/47 | 0/31 |
| Savoonga | – | – | 0/14 | 1/15 | 0/25 | 0/ 5 |
| Nome | – | – | 0/ 7 | – | 0/ 3 | 0/ 3 |
| King Island | – | – | 0/ 2 | – | – | 0/ 2 |
| Wales | – | – | – | 1/ 2 | 0/ 5 | 0/ 3 |
| Little Diomede | – | 0/4 | 1/71 | 1/21 | 0/15 | 0/27 |
| Total | 0/34 | 0/4 | 1/107 | 4/53 | 0/95 | 0/71 |

the ringed seals were older than that; the bearded seals appeared to be young individuals. The parts of the seals were mainly pieces of skin and blubber (84% by weight), sometimes with subcutaneous muscle attached; visceral organs made up 13%, and sketetal muscle 3%. The skin and blubber were mostly together, in more or less rectangular chunks and strips 15 to 40 cm long by 2 to 14 cm wide; the largest of those weighed more than 1 kg. Where thickness of the skin and blubber was measurable, it ranged from 3.0 to 4.5 cm; i.e., these were normally fat seals. The viscera and skeletal muscle were in smaller, more irregular chunks than the skin and blubber.

We also examined the food in the stomachs of 44 walruses taken in the western Chukchi Sea in 1983 and found remains of seals in five of those (Table 3). The other 39 contained only benthic invertebrates (Fay, unpublished data). Four of the five with seal remains also held some benthic invertebrates. All of the seals that had been eaten were ringed seals, though bearded and ribbon (*Phoca fasciata*) seals also were present in the area. At least one of the consumed seals was a pup of the year, and one was a mature adult; the ages of the other three were indeterminate. About 77% by weight of the seal remains were of skin and blubber, 18% were of visceral organs, and 5% were of bones, claws, and skeletal muscle. The thickness of skin and blubber where measurable was about 2.5 to 3.0 cm.

Walruses in whose stomachs we found seal remains included seven males ranging in ages from 7 to 25 years, two females estimated to be 7 and 8 years old, and one of unknown sex and age.

## *Other Observations*

*28 May to 9 June 1978, Vicinity of St. Lawrence Island to King Island.* In the course of about 30 h of helicopter surveys of marine mammals, we sighted more than 2,000 walruses, most of which were adult females with dependent young. On 30 May, about 85 km northeast of the village of Savoonga, one of us (FHF) sighted a swimming walrus which was carrying the skin of a seal. The walrus was holding one end of the skin in his mouth, clasping part of it against his body with the right forelimb, and allowing the rest to trail behind as he dove beneath an ice floe. The walrus appeared to be a subadult male. The skin was large enough to have been from an adult ringed or spotted seal, or from a young bearded seal.

**Table 2.** Stomach contents of seal-eating walruses from the northern Bering Sea

| Specimen no. | Date | Location | Age | Sex | Seal remains | | | | Other ingesta (g) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Species | Skin and blubber (g) | Viscera (g) | Skel. muscle and bones (g) | | |
| DW-344-75 | 10 Jun 75 | Bering Strait, near Little Diomede I. | 15 | M | *Erignathus barbatus* | 1772 | 1563 | 432 | 276 (clams and snails) | Aliquot out of 10.5 kg total |
| DW-50-79 | 28 May 79 | Bering Strait, near Little Diomede I. | – | – | *Phoca largha*<br>*E. barbatus* | 4346<br>3060 | 549<br>Ø | 32<br>Ø | None | About half of total contents |
| WLW-100-79 | 9 Jun 79 | Bering Strait, near Cape Prince of Wales | 13 | M | *P. largha* | 3774 | 265 | 30 | 87 (clams) | Entire contents of stomach |
| SVW-2-79 | 20 May 79 | Bering Sea, near Savoonga, St. Lawrence I. | 12 | M | *P. hispida* | 3646 | 482 | 120 | 23 (polychaete, amphipod, and holothurean) | Entire contents of stomach |
| GW-11-79 | 13 May 79 | Bering Sea, near Gambell, St. Lawrence I. | – | M | *P. hispida*<br>*P. largha* | 3323 | 265 | Ø | None | Aliquot from a a 16- to 18-kg total |

**Table 3.** Stomach contents of seal-eating walruses from the western Chukchi Sea

| Specimen no. | Date | Location | Est. age | Sex | Seal remains | | | | Other ingesta (g) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Species | Skin and blubber (g) | Viscera (g) | Skel. muscle and bones (g) | | |
| ZY-44 | 31 Jul 83 | Chukchi Sea, 55 km NE of Cape Schmidt | 10 | M | *Phoca hispida* | 724 | Ø | Ø | trace (snail) | Strongly digested, mainly bones and hair |
| ZY-137 | 7 Aug 83 | Chukchi Sea, 35 km NW of Herald Shoal | 7 | F | *P. hispida* | 380 | Ø | 8 | None | Entire contents of stomach |
| ZY-147 | 8 Aug 83 | Chukchi Sea, 70 km NW of Herald Shoal | 8 | F | *P. hispida* | 534 | 835 | Ø | 119 (clams, snails, and shrimps) | Entire contents of stomach |
| ZY-156 | 8 Aug 83 | Chukchi Sea, 35 km E of Herald I. | 25 | M | *P. hispida* | 570 | Ø | 18 | traces (snail, octopus, hermit crabs) | Entire contents of stomach |
| ZY-203 | 8 Aug 83 | Chukchi Sea, 130 km E of Cape Schmidt | 7 | M | *P. hispida* | 1403 | Ø | 217 | 4 (snails) | Entire contents of stomach |

*15 to 28 April 1979, Bering Sea Ice Front, Vicinity of 62°20'N, 170°25'W.* While flying over the sea ice on 20 April, about 95 km south of St. Lawrence Island, one of us (LFL) saw a walrus diving into the water, leaving behind a dark object on the ice. That object was part of a spotted seal pup (SUVL-4-79), and in the snow around it were tracks only of the walrus. We collected the remains of the seal and resumed the flying. A few moments later, about 8 km to the northeast, a group of 10 to 15 glaucous gulls (*Larus hyperboreus*) was seen rising from the ice, where the remains of another spotted seal pup (SUVL-5-79) lay. Only the footprints of the gulls were evident around the carcass of the seal. The remains of this seal also were collected for further examination. Our findings were as follows:

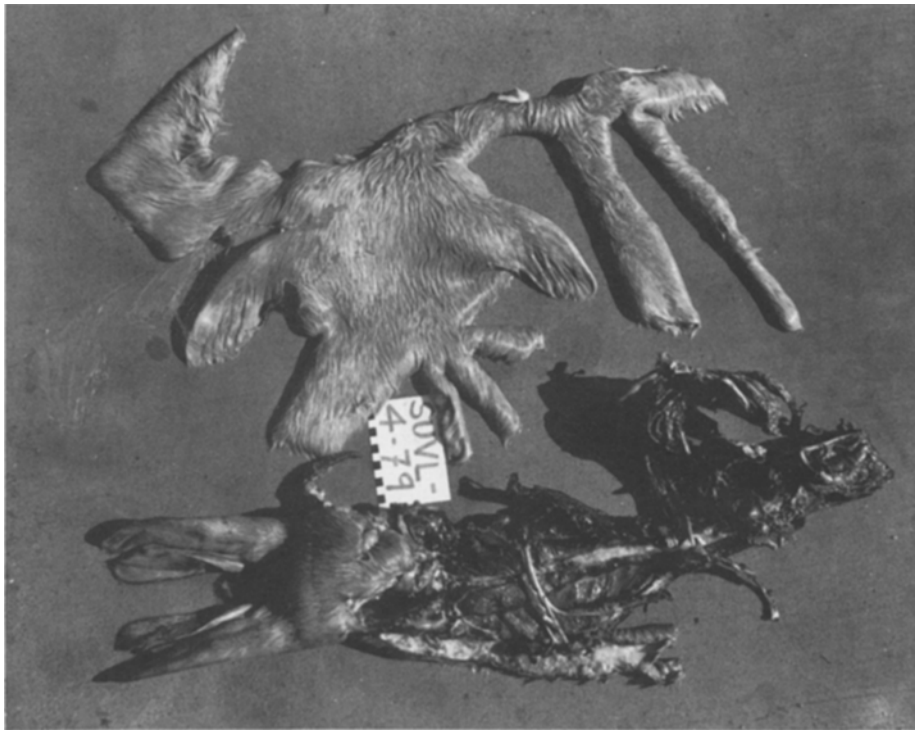


**Fig. 2.** Remains of spotted seal pup SUVL-4-79

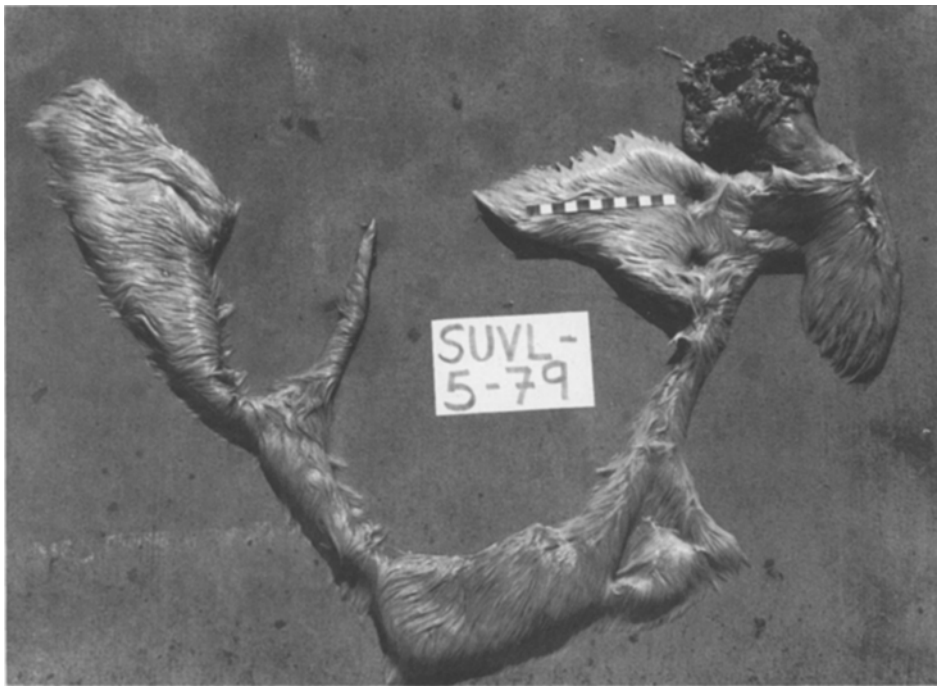


**Fig. 3.** Remains of spotted seal pup SUVL-5-79

SUVL-4-79: Male spotted seal pup in lanugo pelage (Fig. 2), for which measurements (Scheffer 1955) were: standard length 94.5 cm; tail length 10 cm; foreflipper length 19 cm; foreflipper width 13.2 cm; hindflipper length 23.4 cm, hindflipper width 27 cm; blubber thickness on chest 2.1 cm. The carcass was in two pieces, the largest of which (6.1 kg) consisted of both hindflippers connected to the axial skeleton and head (removed in photo). Most of the hide and blubber had been removed from the torso, except for a strip about 6 cm wide by 50 cm long, but remained intact on the head and hindquarters. The rib cage had been opened; some of the ribs were missing, and the vertebral column had been broken just anterior to the pelvis. All of the thoracic and abdominal viscera were absent, and some skeletal muscle had been removed from the posterior parts of the body. The head was intact but showed an area of subcutaneous hemorrhage in the right temple, where the animal had been struck by a blunt object before death, possibly with sufficient force to render it unconscious. We found no other signs of antemortem injuries in this or the second part of the carcass. The latter was a smaller piece (3.75 kg), which consisted of both foreflippers, connected by hide and blubber over the chest and with parts of the abdominal and thoracic hide and blubber also attached. Most of those attachments had been torn into strips, 1.5 to 8 cm wide by 12 to 37 cm long. The edges of all strips were very smooth, not ragged.

SUVL-5-79: Spotted seal pup, sex unknown, in lanugo (Fig. 3), the measurements of which were: foreflipper length 20 cm; foreflipper width 12.6 cm; blubber thickness behind foreflipper 2 cm. The remains, in one piece (2 kg), consisted of a strip of hide and blubber from the right side of the trunk with foreflipper attached. The strip was 2 to 8 cm wide by 110 cm long. In it, near the flipper, were three holes, each about 2 cm in diameter and situated about 3 to 4 cm apart. Other damages to the hide and blubber included a three-cornered tear, 9 by 6 cm, and two linear tears, 5.5 and 6 cm long. None of these holes or tears had been made before death of the seal, as indicated by the absence of hemorrhage in the tissues around them.

*8 August 1983, Chukchi Sea Ice Front, Vicinity of 71°28'N, 174°07'W.* On the ice, several meters away from a large male walrus that had just been killed by hunters, we saw patches of bloody snow and dark chunks of tissue. The hunters later reported that the walrus had been alone on the ice, and that the tissues on the snow were bones and blubber from a seal. Subsequently, the walrus (ZY-156) was found to have more of the seal's remains in his stomach.

## Discussion

From 1952 to 1979, one of us (FHF) conducted research on walruses, primarily at St. Lawrence Island, northern Bering Sea. During that time, a close liaison was maintained with the Eskimo residents of the island, from whom a detailed record was obtained about routine as well as unusual environmental events, as they perceived them. That information was verified insofar as possible by personal observation and by cross-interrogation, until it was either established as reliable or deleted from the record.

From the beginning of that 28-year period, information about seal-eating walruses was solicited repeatedly from the islanders, partly out of curiosity and partly for further investigation of the as yet unsolved question of a potential link between such carnivory and the disease conditions known as trichinosis and hypervitaminosis-A in walruses (Fay 1960; Rausch 1970). Although the islanders possessed a large amount of traditional lore about the seal eaters, they had little first-hand knowledge about them, for the carnivores were scarce at that time. From about 1940 to 1970, only two were reported to have been taken: one at Gambell in 1948 and another at Savoonga in 1957 (Fay, unpublished data). Hence, the frequent oral reports of increasingly common occurrence of seal-eating walruses toward the end of the 1970's was strongly indicative of a major change.

Our findings and those of other investigators working in the Bering Strait region have substantiated the Eskimos' reports. Neither Brooks (1954), nor Burns (1965), nor we saw any evidence of seal eating in stomachs examined during the 1950's and 1960's. Our first finding of seal remains in a stomach was in 1975, and the proportion of stomachs containing them was highest in 1979 (Table 1). Furthermore, the cumulative ratios of seal eaters from samples for the decades of the 1970's and 1980's appears to have been one or two orders of magnitude greater than from samples in the previous three decades (Table 4). These ratios were compared with expected values that were calculated using a constant Poisson rate (p. = 10/4660). Evidence of change in the ratio of seal eaters was indicated by calculating the probability of a more extreme event in the observed direction (DL Thomas and SJ Harbo, personal communication). That tail probability was found to be less than 0.001.

Our findings from stomachs of walruses taken in the Chukchi Sea in summer 1983 also showed a slightly higher ratio of seal eaters (5/44) than in Krylov's (1971) data from the early 1960's (3/35), but the difference was not statistically significant.

**Table 4.** Frequency of occurrence of seal eaters among walruses with food in their stomach, based on Eskimo harvests in the northern Bering Sea, especially Saint Lawrence Island

| Decade | No. walruses with food[a] | Seal eaters[b] | |
|---|---|---|---|
| | | No. | % |
| 1940's | 492 | 1 | 0.20 |
| 1950's | 1395 | 1 | 0.07 |
| 1960's | 2128 | 1 | 0.00 |
| 1970's | 164 | 5 | 3.05 |
| 1980's | 481 | 3 | 0.62 |

[a] Based on the estimated total number of walruses harvested at Gambell and Savoonga (from Fay 1982, Table 39) and the occurrence of food in samples examined from the harvest (25% at Gambell, $N = 135$; 40% at Savoonga, $N = 62$). Data for the 1970's are from Table 1

[b] Based on reports from hunters with the exception of data from the 1970's, which are from Table 1

Our observations of living walruses in possession of seal remains also suggest a higher than usual incidence of carnivory in the late 1970's and early 80's, but this is difficult to quantify. We have surveyed tens of thousands of $km^2$ of walrus habitat in the Bering-Chukchi region over the past 30 years via aircraft, ships, and small boats. In the course of our work, we had not encountered any walruses with parts of seals before 1978. In each of the instances reported here, the pack ice where the observations were made harbored a wide variety of pinnipeds, including ringed, spotted, bearded, and ribbon seals, in addition to the walruses. The coincidence of these species in the same areas is not unusual in late spring in the Bering Sea and during summer in the Chukchi, for they all migrate northward, more or less in synchrony. Except for the spotted seals, they also may summer in the same areas. To find them together in abundance in winter and early spring (April), however, is unusual, for they ordinarily are more segregated then. In years of average or greater extent of the pack ice, spotted and ribbon seals occur near the southern edge, while walruses and bearded and ringed seals generally are farther north, in heavier ice (Braham et al. 1984). In April of 1979, the southern edge of the pack ice was about 600 km north of the average position, which caused the distributions of all five of these ice-associated pinnipeds to be greatly compressed. The result, we suspect, was more frequent contact and interaction among them than had occurred in at least the previous 12 years (Burns et al. 1980).

The frequency of interaction probably has been enhanced lately also by an increase in size of the Pacific walrus population, which has at least doubled in numbers since 1960 (Fay 1982). With that increase, the probability of contact between the walruses and other species may have risen an order of magnitude. Coincident with that increase, apparently, has been a shift in the walrus' diet, more toward alternate prey (i.e., other than bivalves) in recent years (Fay and Stoker 1982a, b). At the same time, a general decrease in fatness of both the males and the females appears to have taken place (Fay and Kelly 1980; Fay 1981). Greater use of seals as food may be simply another consequence of the increased abundance of walruses and greater need for alternate sources of food.

How much of this carnivory is predation, and how important is it as a cause of mortality in the seals? Undoubtedly, walruses taken in the Eskimo harvests have access to carrion, for seal and walrus hunting take place in the same areas, and some of the seals are lost due to sinking. However, the location where the seal remains were collected the Bering Sea ice front in 1979 was well beyond the range of native hunters, as were the areas in the western Chukchi Sea where the five seal eaters were taken. The very fresh condition of the two spotted seal pups whose remains were found on the ice suggest to us that the seals were not taken as carrion but were killed by the walruses. The blubber thicknesses of both pups were comparable with those of healthy seals which we had ex-

amined in those areas in the past; hence, they were not starvelings or otherwise impoverished animals. Also, with one exception, we found no signs in them of antemortem injuries, defects, or diseases that might have caused or contributed to their death. The only sign of antemortem injury was the bruise on the head of one pup (SUVL-4-79). That kind of injury is very unusual in pinnipeds other than in walruses, in which it occurs often as a result of strikes with the tusks (Fay and Kelly 1980, and unpublished data). That walruses do kill seals by means of tusk strikes is indicated by two eyewitness accounts reported to us by reliable observers. In the first instance, two hunters (J Otiohuk and B Booshu, personal communication) from Gambell shot a bearded seal that was lying at the edge of a floe. As they approached to retrieve the seal, a walrus rose out of the water alongside it, stabbed the seal twice with the tusks, then pulled the seal off into the water and carried it away. Although the seal presumably was already dead, the walrus appeared to have attacked it, as if trying to kill it. In the second instance, LA Popov (personal communication) and coworkers in March 1977 were observing a harp seal (*Phoca groenlandica*) pup on a floe in the mouth of the White Sea. Suddenly, a walrus rose in the water alongside it, stabbed at the pup with its tusks, and then, seeing the men, withdrew and swam away. The seal was not killed, but the intent was clear.

In other instances cited by Fay (1960) and Krylov (1971), walruses were reported to grasp the seal with the forelimbs and tear open the carcass by means of the tusks. Although this may be the usual method for opening the body initially, we believe that other methods are used to break down the carcass into pieces small enough to swallow. We found that we could tear off longitudinal strips of skin and blubber very easily from the spotted seal pups whose remains we found in 1979. A walrus certainly could tear the skin even more easily then we, by grasping at a ragged end with its mouth and pulling the hide and blubber off in long strips. The walrus' extraordinary oral suction is well documented (Fay 1982), and that is probably the means by which chunks of viscera are torn out of the carcass. Based on our examinations, walruses consume principally the hide and blubber of seals and ingest very little skeletal muscle and bone. This is similar to the foraging pattern of polar bears (*Ursus maritimus*) and appears to be explicable based on the high caloric content of the blubber (Stirling and McEwan 1975).

Fay (1960) noted that, according to walrus hunters in the Bering Strait region, all carnivorous walruses are males, and that the only published report of a carnivorous female was one taken in East Greenland. The four seal eaters we examined from near Bering Strait for which sex was recorded were all males, which supports previous observations. However, in the Chukchi Sea, we found that two of five seal eaters were females, which confirms that, at least in certain circumstances, female walruses can be carnivorous. The youngest seal eater we recorded was 7 years old, which suggests that the habit is confined largely to older subadult and adult walruses.

If the data reported here are representative of the Pacific walrus population as a whole, then its potential for exerting significant predatory pressure on the seals is clearly indicated. All species of seals, as well as walruses, are important resources to coastal residents, and ringed and bearded seals are also the principal prey of polar bears (Smith 1980). The size of the walrus population has increased greatly in recent years, and the magnitude of its predation on seals appears to have risen concurrently. This should be investigated more thoroughly, and it must be reckoned with in any ecosystem-wide management program for northern marine mammals.

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