Food of Ringed Seals and Bowhead Whales near Point Barrow, Alaska

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Ringed Seals, *Phoca (Pusa) hispida,* and Bowhead Whales, *Balaena mysticetus*, are ecologically important components of the Chukchi-Beaufort marine ecosystem. Ringed Seals are present in the area throughout the year in association with sea ice. Their numbers and spatial distribution vary greatly in relation to seasonal changes in ice cover. Bowhead Whales winter in the Bering Sea and summer in the Beaufort Sea and Amundsen Gulf. They pass close to Point Barrow during their spring and fall migrations. Both species are regularly taken by Eskimo hunters from the settlement of Barrow.

Ringed Seals are presently numerous in this region and are probably at or near the carrying capacity of their habitat. The Bering-Chukchi-Beaufort Sea population of Bowhead Whales was greatly reduced during the late 19th century and the population is still below the level that existed prior to commercial whaling. Ecological relationships between these two marine mammals are unclear. This note indicates that in the vicinity of Point Barrow, Alaska, these two species utilize the same primary prey items and hence some competition for food may exist.

Methods and Materials

Table 1 lists the pertinent information regarding the 16 Ringed Seals and 2 Bowhead Whales from which stomach samples were collected. All animals were taken in the vicinity of Point Barrow (71°23′N, 156°30′W). Samples utilized included the entire contents of stomachs obtained from the seals and small subsamples of stomach contents from the Bowhead Whales.

When possible, each animal was weighed and measured, and the date, time, and location of capture noted. Age determinations for seals were based on examination of claws and/or teeth. All contents of the seal stomachs were gently washed on a 1.0-mm mesh screen and preserved in 10% formalin for later examination. The two subsamples of stomach contents from Bowhead Whales were preserved in 10% formalin.

Laboratory analysis of material involved macroscopic sorting followed by microscopic examination and identification of prey. Food items were identified using appropriate taxonomic keys and from voucher specimens maintained at our laboratory and at the University of Alaska Marine Museum Sorting Center. The volume of each type of food was measured by water displacement. Where possible, numbers and size ranges of prey items consumed were determined.

Results

As no clear time-, sex-, or age-related differences in diet were apparent, the data from all 16 Ringed Seals were pooled. Over three-quarters of the combined total volume of food was euphausiids (*Thysanoessa inermis* and *T. raschii*), which occurred in 11 of 16 stomachs examined. Gammarid amphipods (*Anonyx nugax, Gammaracanthus loricatus, Acanthostepheia behringiensis, Gammarus zaddachi,* and *Atylus* sp.) were also found in 11 stomachs but comprised only 4.6% of the combined total volume. Hyperiid amphipods (*Parathemisto libellula* and *P. abyssorum*) occurred in seven stomachs, always in association with euphausiids, and accounted for 0.3% of the total combined volume. Isopods (*Saduria entomon*) were found in only two stomachs but made up 15.9% of the total combined volume. This high percentage was largely the result of a seal taken on 13 June 1976 the stomach of which contained 200 ml *Saduria.* Shrimp (*Sclerocrangon boreas, Lebbeus polaris,* and *Pandalus* sp.), mysids (*Mysis litoralis* and *Neomysis rayii*), and squid (species unknown) appeared in a few stomachs in small volumes. Fishes were represented almost entirely by otoliths. Otoliths of 30 Polar Cod (*Boreogadus saida*), two Capelin (*Mallotus villosus*), and one Saffron Cod (*Eleginus gracilus*) were identified. Fish remains occurred in five seal stomachs.

TABLE 1—Ringed Seal and Bowhead Whale specimens from which stomach contents were examined

Date of capture	Sex	Weight (kg)	Standard length	Age (yr)	Source of specimen
Seals					
Feb.-Aug. 1975	M	—	86.2 cm	3	ADF&G[1]
Apr.-July 1975*	M	55.5	119.7 cm	10	NARL[2]
Apr.-July 1975*	M	48.2	115.4 cm	11	NARL
Apr.-July 1975*	M	50.9	121.5 cm	17	NARL
Apr.-July 1975*	M	47.3	117.8 cm	10	NARL
Apr.-July 1975*	F	43.2	112.5 cm	13	NARL
Apr.-July 1975*	M	37.7	110.4 cm	4	NARL
Apr.-July 1975*	M	35.0	113.7 cm	6	NARL
Apr.-July 1975*	M	53.6	124.0 cm	18	NARL
3 Sept. 1975	F	11.8	—	pup	ADF&G
11 May 1976	M	49.8	121.5 cm	8	NMFS[3]
25 May 1976	M	—	106.0 cm	6	NMFS[3]
25 May 1976	M	—	97.0 cm	5	NMFS[3]
13 June 1976	M	59.1	125.0 cm	14	ADF&G
7 Aug. 1976	M	40.9	119.1 cm	8	ADF&G
7 Aug. 1976	F	38.6	114.4 cm	11	ADF&G
Whales					
10 Sept. 1976	F	—	16.0 m	—	NMFS[4]
20 Sept. 1976	F	—	14.3 m	—	NMFS[4]

*Exact date of capture unknown but estimated from reproductive state of specimens.
[1] Provided by Alaska Department of Fish and Game personnel.
[2] Provided by Naval Arctic Research Laboratory personnel.
[3] Provided by Robert Everitt, National Marine Fisheries Service.
[4] Provided by J. R. Patee and Robert Everitt, National Marine Fisheries Service.

Subsamples of stomach contents from Bowhead Whales consisted of 17.5 ml from specimen number 76-B-6F and 33.0 ml from number 76-B-7F. Since only subsamples were examined, pooling of data may not be justified. Prey items in the two samples, however, were similar and little error should result from combining them.

Euphausiids (all identifiable material was *Thysanoessa raschii*) made up 90.3% of the total combined volume. Gammarid amphipods (*Gammarus zaddachi, Acanthostepheia behringiensis, Monoculoides zernovi,* and *Rozinante fragilis*) accounted for 6.9%, and the hyperiid amphipod *Parathemisto libellula* made up 2.7%. One sample contained a partial carapace of an unidentifiable shrimp, another contained a small pebble.

Discussion

The primary items found in the stomachs of Ringed Seals taken from different geographical regions indicate marked variation in food consumed. In an examination of 47 Ringed Seal stomachs taken near Baffin Island during August and September, Dunbar (1941) found that the amphipod *Parathemisto* (= *Themisto*) *libellula* was the predominant food. Mysids (*Mysis oculata*) were commonly eaten and other amphipods, euphausiids, and fishes were occasionally consumed. The same general results were reported by McLaren (1958). In the northwestern Bering Sea and the Sea of Okhotsk, euphausiids (*Thysanoessa raschii*) appear to be the chief food item. Shrimps, amphipods and various schooling fishes are sometimes important in the diet (Fedoseev 1965; Fedoseev and Bukhtiyarov 1972; Nikolaev and Skalkin 1975). Kenyon (1962) found shrimp (*Pandalus* sp.) to be the primary food, with fishes, mysids, and gammarid amphipods eaten in small quantities in Bering Strait during May and June. Johnson et al. (1966) in an extensive investigation of the foods of Ringed Seals near Point Hope and Kivalina, Alaska, found fishes (*Boreogadus saida, Eleginus gracilus,* and cottids) to be the main food during November through February. Beginning in March and continuing through June, crustaceans (shrimps, amphipods, crabs, and mysids) made up the bulk of the Ringed Seal's diet at these locations. Results from other localities in the eastern Bering and Chukchi Seas follow the same general pattern (Lowry, Frost and Burns, unpublished data).

It appears that food consumed by Ringed Seals at any given place and time will consist of the most abundant and available suitable species which, in the western Beaufort Sea during late spring and summer, apparently is euphausiids. It is noteworthy that a seal

collected 150 km east of Point Barrow, 35 km offshore on 20 August 1976 (data not included in this report) had also eaten almost entirely euphausiids. In 247 Ringed Seal stomachs containing food, which we have examined from Alaskan waters other than the Beaufort Sea, euphausiids have occurred in only 15. Of those, 11 were taken in the northeastern Chukchi Sea, at Point Hope, in late May 1976.

Bowhead Whales are considered to feed in a skimming mode utilizing their highly specialized baleen plates (Nemoto 1970). They would therefore be expected to feed mostly on copepods and to a lesser extent on euphausiids and other zooplankters. Tomilin (1957) cited indirect evidence indicating that the copepod *Calanus finmarchicus* and the pteropod *Limacina helicina* are major food items. MacGinitie (1955) reported that bowheads (presumably near Barrow) ate euphausiids, mysids, pteropods, and copepods. Mitchell (1975) indicates that in the eastern Arctic, bowheads sometimes eat benthic amphipods as well as mysids and other similar zooplankters.

The results of our very limited sampling of stomach contents from Bowhead Whales agree closely with the statements of Mitchell (1975). Euphausiids are, by far, the most important food item. Hyperiid amphipods, which are apparently associated with swarms of euphausiids, were much less common. The finding of a considerable number of benthic gammarid amphipods indicates that bowheads sometimes forage very near or on the bottom, at least in shallow-water areas. Indications of benthic foraging have been observed and photographed during aerial surveys of bowheads close to shore immediately east of Point Barrow (J. Burns, unpublished observations).

Bowhead Whales migrate apparently in response to seasonal changes in ice conditions. Whales captured at Point Hope and Point Barrow during the northward spring migration in April through June have empty or near-empty stomachs (Johnson et al. 1966; Durham*; Marquette†; G. Seaman, personal communication). Whether bowheads feed on the wintering grounds is not known. Suitable types of foods are available in portions of the Bering Sea, at least during the spring and summer (Nemoto 1957).

Biological processes in the Beaufort Sea are, to a large degree, regulated by the quantity and character of sea ice. Bowhead Whales are the most ice-adapted of mysticete cetaceans and Ringed Seals are the most ice-adapted pinniped occurring in the northern hemisphere. In the northern portion of their range these two species show broad dietary overlap. Ringed Seals are highly euryphagous, and utilize many species of fishes and crustaceans. Bowhead Whales are considerably more stenophagous and depend mostly on swarms of small to medium-sized zooplankton.

The Beaufort Sea experiences extreme year-to-year variation in the extent of summer sea-ice cover. Although sea ice provides a substrate for a special group of algae (Meguro et al. 1966), the primary effect of ice cover is a lowering of overall productivity by drastically decreasing light penetration (Mohr and Tibbs 1963). A decrease in the total primary production of the area would result in lower productivity at higher trophic levels. Stirling et al. (1977) speculate that reduced production caused by the heavy ice conditions of the winter of 1973–1974 may have been responsible for an observed decrease in productivity of Ringed and Bearded Seals. The long-term ecological effect of fluctuations in annual production would be difficult to predict. It seems likely, however, that short-lived stenophagous species would be most rapidly and acutely affected. Specific data on trophic interaction of major components of the arctic ecosystem are urgently needed as potentially drastic long-term environmental modifications such as offshore oil drilling are imminent.

Bowhead Whales, which are currently reduced in numbers and "officially" considered as a rare and endangered species, were once abundant in arctic waters. Scheffer (1976) indicates that the pre-exploitation population level was composed of about 10 000 animals and estimated the present population to be about 2000. No long-term data are available for Ringed Seal numbers. An estimate of the early spring population of Ringed Seals in the area where bowheads summer (Beaufort Sea and Amundsen Gulf) is at least 30 000 animals (Burns and Harbo 1972; Stirling et al. 1977). This number increases greatly during the summer, with the seasonal influx of seals from the south. Two interesting questions arise. As the bowhead population declined, did populations of other marine mammals or birds increase because of increased abundance of food? Will Bowhead Whales be able to regain their former population levels and, if so, will it be at the expense of other species? Unfortunately, no data exist to answer the first question and too little information is presently available adequately to answer the second.

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*F. E. Durham. 1972. Biology of the bowhead whale (*Balaena mysticetus* L.) in the western Arctic. University of Southern California, Los Angeles. Unpublished manuscript.

†W. M. Marquette. 1977. The 1976 catch of bowhead whales (*Balaena mysticetus*) by Alaskan Eskimos, with a review of the fishery, 1973–1976, and a biological summary of the species. National Marine Fisheries Service, NAFC, Seattle, Washington. Processed report. 80 pp.

specimens, and acknowledge project support provided by the U.S. Bureau of Land Management Outer Continental Shelf Environmental Assessment Program and Federal Aid in Wildlife Restoration Project W-17-9.

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Birds and Mammals as Passive Transporters for Algae Found in Lichens

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Although algae are found world-wide, little is known about how their distribution is achieved. An understanding of algal dispersal may in turn be important to understanding lichen distribution. Known mechanisms of algal dispersal include wind dissemination (Proctor 1959) or transport on the external parts of birds (Proctor 1959) and insects (Maguire 1959). Opinions vary as to the success with which algal symbionts (phycobionts) and fungal symbionts (mycobionts) unite in lichen formation. This study attempted to determine whether birds and mammals could serve as transporting agents for phycobionts.

White-throated Sparrows (*Zonotrichia albicollis*), Black-capped Chickadees (*Parus atricapillus*), and House Sparrows (*Passer domesticus*) were mist-netted from two separate areas. One area was located in Branford, Connecticut in a hardwood-hemlock forest, and the other area was a wooded residential area in Bethany, Connecticut. White-footed Mice