Seals, Fur Seals, Sea Lions, and Walrus

Peter Reijnders, Sophie Brasseur, Jaap van der Toorn, Peter van der Wolf, Ian Boyd, John Harwood, David Lavigne, and Lloyd Lowry

IUCN/SSC Seal Specialist Group
IUCN/Species Survival Commission

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Foreword

IUCN Conservation Action Plans are practical guides to action to safeguard components of the world's biological diversity. They review the status of a group of species, consider the nature and significance of threats to them, and propose ways in which their future can be secured.

Seals, sea lions, and walruses together constitute a diverse and ancient group of animals, found in all the main seas and oceans of the world and in one isolated inland lake—Baikal. They play an important part in marine ecosystems. Several species have been exploited by people since antiquity. Some remain important to indigenous peoples, especially in the Arctic. Others were brought to the brink of extinction by commercial exploitation in the past, but have recovered under more recent protection. Still others, especially in the tropics, hover near extinction. One species and one subspecies appear to have disappeared forever during the past 40 years.

This Plan looks in turn at the 34 species of pinnipeds, with their various subspecies. It considers their present and past distribution, ecology, population size, use by people, and the threats they face. It reveals a diverse situation, with some species abundant, widespread, increasing and facing no threats, and others likely to be lost unless the conservation measures proposed in this volume succeed. Fourteen species or subspecies—a high proportion of the world's total—are singled out for urgent action.

I commend this volume to those who want a brief but authoritative review of the status of the world's seals in 1993, and especially to those concerned with conserving these fascinating and important components of marine ecosystems.

Martin W. Holdgate
Director General
IUCN—The World Conservation Union

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Introduction

The primary goal of the IUCN/SSC Seal Specialist Group in preparing this Conservation Action Plan is to increase awareness of pinnipeds and their conservation needs and to promote activities to prevent the serious decline and extinction of species and populations. The recommended actions include research to evaluate problems and threats in time to recommend effective solutions before drastic action is needed. This plan includes an overview of the status of all pinniped species, followed by recommended actions. This report is an important contribution to the further implementation of the Global Plan of Action for Marine Mammals, initiated in 1985 by FAO/IUCN/IWC/UNEP and described by Nielsen (1986).

Humans have had an impact on pinnipeds from early historical times. Indigenous subsistence hunting of pinnipeds changed during the 17th century, gradually developing into the modern sealing industry. This change, which started by paying rewards via bounty schemes to limit or remove pinnipeds as competitors for fish resources and later lead to maximizing the catch for commercial purposes, had significant effects on some stocks. In the last 50 years, another change in people’s attitude to pinnipeds has become apparent: the appreciation of pinnipeds as an essential and valuable component of a healthy marine ecosystem. This has led to a more conservation-oriented style of management, in which conflicting views have to be accommodated: pinnipeds are regarded by many as a common inheritance to be conserved in their own right, whilst considered by others to be a natural resource to be harvested, or a nuisance to be exploited or sometimes even eradicated. In addition to direct exploitation, indirect impacts such as entanglement and pollution have begun to threaten certain pinniped stocks in the last few decades. Factors operating singly or in combination have resulted in depleted populations, with some species, such as the monk seals and Hooker’s sea lions, becoming threatened. The inclusion of species or subspecies in the IUCN Red List of Threatened Animals does not take into account more abundant species which may have one or more populations threatened. This plan includes actions that address such populations or stocks.

There are five principal international instruments relevant to the conservation of pinnipeds:

1. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979);
2. Convention on Conservation of European Wildlife and Natural habitats (Bern Convention, 1979);
3. Convention for the protection of the Mediterranean Sea against pollution (Barcelona Convention, 1976) and its related protocol, Protocol Concerning Mediterranean Specially Protected Areas (Geneva, 1982);

There are also bilateral or trilateral agreements on the management of seal stocks. At the national level, there is legislation to ratify international conventions and incorporate their provisions into national laws. There are also separate laws on nature protection and hunting. Despite the fact that such laws exist in most countries, it is evident that legal systems do not always provide adequate protection and cannot prevent species and populations becoming threatened. This Action Plan aims particularly to secure the future of those species and populations under the heaviest pressure. As part of the process of preparing the Action Plan, the Seal Specialist Group has revised the listing and Categories of Threat that were assigned to pinnipeds in the 1990 IUCN Red List. The new revised list is given below. This listing will appear in the 1993 IUCN Red List. The definitions of the IUCN Categories of Threat are given in Appendix 1.

- *Monachus tropicalis* Ex
  Caribbean monk seal
  Caribbean
- *Zalophus californianus japonicus* Ex
  Japanese sea lion
  Japan, North Korea, and South Korea
- *Monachus monachus* E
  Mediterranean monk seal
  Mediterranean, Mauritanian, and North African coasts
- *Monachus schauinslandi* E
  Hawaiian monk seal
  Hawaii
- *Phoca hispida saimensis* F
  Saimaa seal
  Finland
- *Arctocephalus philippi* V
  Juan Fernandez fur seal
  Chile
- *Arctocephalus townsendi* V
  Guadalupe fur seal
  Mexico, U.S.A.
**Eumetopias jubatus**
Steller's sea lion
North Pacific coasts

**Phoca hispida bonica**
Baltic seal
Baltic sea

**Phocarctos hookeri**
Hooker's sea lion
New Zealand

**Phoca caspica**
Caspian seal
Caspian sea

**Phoca hispida ladogensis**
Ladoga seal
Russia

**Neophoca cinerea**
Australian sea lion
Australia

**V** *Odobenus rosmarus laptevi*
K
Laptev walrus
Commonwealth of Independent States
(The taxonomic status of the Laptev walrus as a subspecies is uncertain. Pending further research it is currently classified as having a K status.)

**Phoca vitulina mellonae**
K
Ungava seal
Canada, Greenland

**V**
The focus of the Seal Specialist Group is to promote implementation of this Action Plan by government agencies and conservation organizations to achieve the recovery of severely threatened species to safe and viable population levels.

**V**
Those interested in assisting the implementation process should write to the Chairman of the Seal Specialist Group, Dr. Peter Reijnders (address in Appendix 3).

**R**
Reference:
1. Classification of Pinnipeds

Modern pinnipeds are represented by 34 species of fur seals, sea lions, true seals, and walrus. There is still some controversy about the early origins and evolution of these animals and, hence, about their classification. It is generally agreed, however, that the pinnipeds evolved from a terrestrial ancestor, an arctoid carnivore related to modern dogs, bears, weasels, and raccoons, all members of the mammalian order Carnivora. Within the Carnivora, the pinnipeds are usually classified into three families: the fur seals and sea lions (family Otariidae), the walrus (family Odobenidae), and the true seals (family Phocidae).

The three pinniped families are easily distinguished. Fur seals and sea lions, which are often seen in circuses, marine parks, and aquaria, balancing balls on their noses, are able to bring their hind flippers underneath the body in order to walk or run, somewhat awkwardly, on land. In water, the large front flippers provide propulsion, whereas the hind flippers serve mainly as rudders for steering. These animals also have a small external ear, a flap of skin supported by cartilage, just behind the eye, near the opening to the internal ear. For this reason they are often called the “eared seals.” Fur seals, as their name implies, have a well-developed coat made up of long, coarse guard hairs overlying a thick, dense woolly underfur that traps a layer of air to insulate the animal. The fur seal pelt, like that of the sea otter, Enhydra lutris, and many semi-aquatic mammals (e.g. beaver, Castor canadensis), is essentially waterproof and traps air within its structure to provide insulation in water. Sea lions, which are generally larger than fur seals and tend to live in warmer climates, have thinner coats than those of fur seals. Both fur seals and sea lions also have a layer of fat beneath the skin—called blubber—that provides additional insulation, especially when the animals are in water.

In contrast, the true seals have flippers that extend behind the body, and cannot be brought forward in order to walk. Locomotion on land or ice is limited largely to crawling and wriggling, using the front flippers for traction and propulsion. Nonetheless, true seals are not nearly as awkward on land and ice as is often believed: in fact, they are remarkably agile and can move with considerable speed when necessary. In water, it is the hind flippers that provide propulsion, whereas the fore-flippers, which are smaller than those of fur seals and sea lions, are held pressed against the body during fast swimming and are used mainly for steering when the animal wants to change direction. True seals do not have external ears and, for this reason, are sometimes called “earless” seals. Their pelage is thinner than that of otariid seals, being comprised of short, stiff guard hairs overlying a thin but dense layer of woolly underfur that does not trap air but rather becomes wetted to the skin when the animal is in water. Some true

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seals, such as the monk seal and northern elephant seal, have lost the woolly underfur and, consequently, have thinner coats than those of true seals living in colder climates. In the absence of a thick pelt, the blubber layer, which is thicker in phocid seals than in otariids, provides most of the animal's insulation.

The walrus exhibits a combination of traits, some of which are typical of fur seals and sea lions, and others which resemble traits of true seals. The intermediate position of the walrus family in the evolution of the pinnipeds is perhaps most obviously reflected in its limb structure and modes of locomotion. The structure of the hind flipper resembles that of the true seals but, like fur seals and sea lions, the walrus can bring its hind flippers forward underneath the body to walk on land. The hind limbs of the walrus cannot support the animal's weight however, so the walrus is more awkward at walking than otariids are. In water, the walrus may paddle with the fore-flipper in a manner similar to fur seals and sea lions or propel itself by moving the hind flippers in a lateral motion like true seals. Another feature that walruses share with phocid seals is the lack of an external ear. Unlike the other pinnipeds, the walrus is virtually naked, its coat being reduced to scattered hairs over the surface of the body; it depends entirely on a thick blubber layer for insulation, both in air and in water. Male and female walruses are also the only modern pinnipeds in which the canine teeth are greatly enlarged as tusks.

Because of the controversy about pinniped origins, the precise relationship among the three pinniped families is the subject of continuing debate. Many biologists believe that the pinnipeds have a diphylectic origin from arctoid carnivores. According to this view, otariids and odobenids arose from a common ancestor, related to modern ursids (bears) in the North Pacific off present day California, whereas phocid seals arose from a mustelid like carnivore in the North Atlantic. If this view were correct, then otariids and walruses would be more closely related to each other and to other terrestrial ursids than they would be to phocid seals. The phocids, on the other hand, would be more closely related to modern weasels than to other pinnipeds. Classification schemes based on this hypothesis accordingly place the otariids and the odobenids together in one superfamily, the Otarioidae, and the phocid seals in another, the Phocidae.

The results of a number of recent studies are, however, inconsistent with the diphylectic theory. Rather, they lend considerable support for the alternative hypothesis that all pinnipeds are monophyletic. The most convincing evidence, which is entirely incompatible with diphyly, comes from studies with highly repetitive DNA (Arnason & Widegren, 1989) and macromolecular sequences (Romero-Herrera et al., 1978; De Jong, 1982; 1986). Additional support for monophyly comes from recent studies of comparative anatomy (e.g. Wyss, 1987; 1988; 1989; Berta et al., 1989).

According to the monophyletic view, all pinnipeds evolved from a single ancestor (still an arctoid carnivore) whose precise identity is not yet known. This lineage eventually gave rise to the earliest known pinniped, Enaliarctos, which first appears in the fossil record about 23 million years ago (Berta et al., 1989). Cladistic analyses suggest that Enaliarctos represents the sister taxon of all other pinnipeds. Among the latter group, modern otariids represent a conservative family that split off from the main line of pinniped evolution first. The separation of walruses and phocid seals occurred more recently. This view suggests, therefore, that walruses and phocid seals share a more recent common ancestor and, consequently, are more closely related to each other than they are to otariid seals.

Acceptance of the monophyletic theory has several implications regarding pinniped taxonomy. Most obviously, the old superfamilies, Otarioidea and Phocoidea, disappear from the classification scheme. Within the order Carnivora, Enaliarctos, together with the more recent pinnipeds, comprise a monophyletic group, which Berta et al. (1989) named the Pinnipemorph, without specifying a taxonomic ranking. The old name, Pinnipedia, was retained for all remaining pinnipeds, both extinct and extant, including the modern otariids, odobenids, and phocids, but again no attempt was made to specify a taxonomic level (Berta et al., 1989). Whether the Pinnipedia once again warrant subordinal status within the order Carnivora remains to be resolved.

Despite this controversy, it is still possible to provide a functional and relatively uncontroversial classification of modern pinnipeds, which is adequate for our purposes here. Such a classification is outlined in Table 1. A list of species, subspecies and common names for each of the pinnipeds discussed in this volume is provided in Table 2.

References
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<td><em>Mirounga angustirostris</em></td>
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2. An Overview of the Status of Pinniped Species

This section gives an overview of the current knowledge of the status and population biology of pinniped species. Each species is treated separately, as are subspecies that require special attention. General information was derived from the following sources:


The reference list provided after each species includes the sources specifically referenced in the text. Scientific names are consistent with the sources mentioned in the taxonomy section. In addition, much useful information was provided by members of the Seal Specialist Group and other experts. Information is given under the following headings:

Nomenclature: taxonomic status of the species and, if necessary, an overview of the history of the nomenclature.

Description: measurements and a general description, often accompanied by a picture.

Distribution: habitat and geographical range, including information on stocks and breeding areas. In addition, the distribution and known breeding areas are presented on a map (see Fig. 1).

Population dynamics: relevant parameters, such as age at maturity, pregnancy rate, gestation period, longevity, and mortality.

Population size: current or most recent estimates of abundance and population trends.

Figure 1. World map indicating the detailed maps used in this chapter. The letters coincide with the letters on the detailed maps.
Feeding: diet composition and, if known, nutritional requirements.

Trophic relations: natural competitors and predators.

Human impact: interactions with fisheries and impact of other human activities on the species.

Exploitation: data on harvests and management regulations.

Threats to the population: factors having a negative effect on the population now or in the near future. Current and proposed status in the IUCN Red List of Threatened Animals, if appropriate.

References: relevant references.

Status Descriptions

Family Otariidae
Subfamily Otariinae

Steller’s Sea Lion
Eumetopias jubatus (Schreber, 1776)

Nomenclature: Another name used for the Steller's sea lion is the Northern sea lion. Occasionally, this species is incorrectly referred to as Eumetopias jubata.

Description: Steller's sea lions are the largest of the otariids. They show marked sexual dimorphism, males being larger than females. The average standard length is 282 cm for males and 228 cm for females (maximum of about 325 cm and 290 cm respectively); weight of males averages 366 kg and females 263 kg (maximum of about 1,120 kg and 330 kg respectively) (Calkins & Pitcher, 1982; Loughlin & Nelson, 1986; Hoover, 1988). The pelage is light buff to reddish-brown and slightly darker on the chest and abdomen (Loughlin et al., 1987). The males have distinctive manes (King, 1983). Newborn pups are about 1 m long, weigh 16-23 kg, and have a thick, dark brown pelage that molt to lighter after 6 months (Loughlin et al., 1987).

Distribution: The range of this species is from the Sea of Japan at 43°N, north to the Pacific rim at 66°N and then south, down the North American Pacific coast to San Miguel Island at 34°N (Hoover, 1988). In the breeding season, the males form territories on exposed rocks and beaches. The breeding range goes only to about 60°N. Some movement occurs between areas, especially by juveniles.

Population dynamics: The age of maturity is 3-6 years for females, and 3-7 years for males (Calkins & Pitcher, 1982). Males are not able to defend territories before they are 9 years old (1. Lowry, pers. comm.). The annual pregnancy rate of mature females is 60-67%. Gestation lasts one year, including a delay of implantation of about 3 months. Females may live up to 30 years old and males to about 20 years. Mortality rates are poorly known.

Population size: Loughlin et al. (in press) summarize the following data for Steller's sea lion populations: the 1989 range-wide count was about 65,000 animals, resulting in an estimated population size of about 110,000 animals. The count included 10,000 in the Commonwealth of Independent States (15% of range-wide count), 3,500-3,800 in the Kamchatka region (Burkanov et al., 1991), 46,000 in Alaska (71%), 5,000 in Canada (8%), 2,300 in Oregon (3%), and 1,700 in California (3%). This range-wide population size is about one third of that estimated in the 1960s. There is an overall tendency of decline in the population size, especially in the northern Gulf of Alaska, waters of the Commonwealth of Independent States, and the Aleutian Islands.

Feeding: The diet consists of commercial and non-commercial fish species and cephalopods. The commercially exploited walleye pollock (Theragra chalcogramma) is an important part of the diet (Lowry et al., 1989).

Trophic relations: Steller's sea lions show a considerable dietary overlap with Phoca vitulina and Callorhinus, and possibly with Zalophus in the southern part of the species' range. Natural predators include sharks and killer whales (Orcinus Orca). In the Commander Islands, the Arctic fox (Alopex lagopus) is recorded as attacking newborn pups (Vertyaykin, 1986).

Human impacts: Steller's sea lions are killed in nets in fisheries off Alaska. In 1982 between 958 and 1,486 drowned in the nets of trawl fishermen in the Shelikof Strait. Due to changes in fishing techniques and gear, this number was reduced to 237-355 in 1984 (Loughlin & Nelson, 1986). Estimated annual mortality of incidentally caught Steller's sea lions in Alaska declined from about 2,000 animals during the early 1970s to less than 100 animals in 1988 (Perez & Loughlin, 1991). An unknown number may be shot during commercial fishing operations. Tissue contaminant levels are generally low in most parts of their range.
Exploitation: This species is protected in the U.S.A. and the Commonwealth of Independent States (CIS) is proposing to add it to their "red" species list. Small numbers are taken for subsistence use in Alaska and Japan. Although they are no longer allowed to be taken for public display in the U.S., some are still taken in commercial fisheries and for scientific research.

Threats to the population: The population throughout the central and western Gulf of Alaska and the Aleutians has undergone a dramatic decline of approximately 80% from the 1960s through 1990 (Merrick, R.L., 1991). U.S. surveys in 1989 show a decline of 65% between 1985 and 1989 and 82% from 1956-1960 to 1989 (Loughlin et al., in press). Deliberate killing by fishermen, disease, incidental take by fisheries, and reduced food supply have been suggested as factors which may have contributed to this decline (Lowry et al., 1989). This species was listed as threatened under provision of the U.S. Endangered Species Act in April 1990, and it will be included in the 1993 IUCN Red List as Vulnerable.

References:

California sea lion
*Zalophus californianus* (Lesson, 1828)

Nomenclature: Three subspecies are recognized: *Zalophus californianus californianus* (Lesson, 1828), *Zalophus californianus wollebaeki* (Sivertsen, 1953) and *Zalophus californianus japonicus* (Peters, 1866), each living in a clearly separate range.

Description: Males measure on average 340 cm and weigh 275 kg. Females are much smaller: 180 cm and 91 kg. Pups are about 75 cm long and weigh 7-9 kg at birth. The coat is dark greyish brown to black. The adult males are darker colored, have a thick neck and a prominent sagittal crest.

Distribution: Males form territories during the breeding season on rocks, sand, or gravel beaches and the waters around them. Z.e.
*californianus* ranges from Mexico (19°N) to British Columbia (51°N) and breeds from 19°N to San Miguel Island (34°N) and throughout the Gulf of California (B. Stewart, pers. comm.). Occasionally, births are recorded at the Farallon Islands, but these are anomalous and inconsequential on a population level. *Z. c. wolfbaeki* occurs exclusively on the Galapagos Islands. *Z. c. japonicus* was located in the Sea of Japan, but is now probably extinct.

**Population dynamics:** Vital parameters are not well known. Age of maturity for both sexes is about 4-5 years. Females produce one pup each year. First year mortality is about 60% (Auroles & Sinsel, 1988). Females mate 3-4 weeks post-partum. Gestation lasts about 11 months (maximum) and lactation from 6 to 12 months. Longevity is estimated to be around 15-24 years.

**Population size:** The *Z. c. californianus* population (U.S.A. and Mexico) was estimated at 145,000 individuals (Le Boeuf et al., 1983), 96,000-130,000 of which were estimated to occur in the U.S.A. in 1990 (B. Stewart, pers. comm.). Despite estimated mortality in gillnets and entanglement in debris (Stewart & Yochem, 1987), the populations in California continue to increase rapidly (Stewart et al., in press). The *Z. c. wolfbaeki* population was estimated at 30,000 individuals (Trillmich, 1979). The Japanese sea lion, *Z. c. japonicus*, is probably extinct.

**Feeding:** In Oregon, California, and Baja California, the more frequent preys of *Z. c. californianus* are anchovy (*Engraulis mordax*), Pacific hake (*Merluccius productus*), jack mackerel (*Trachurus symmetricus*), rock fish (*Sebastes* sp.) and market squid (*Loligo opalescens*) (Antonelis et al., 1984; De Anda, 1985; Lowry et al., 1990; Lowry et al., 1991). In the southern Gulf of California, main prey are deep sea fish, *Aulopus* sp., *Neobithynus* sp., and *Promonogrammus* sp. (Auroles et al., 1984), in the northern Gulf hake (*Merluccius* sp.), anchovy (*Engraulis mordax*), rock fish (*Sebastes* sp.) and Mackerel (*Scomber* sp.) (Orta, 1988). *Z. c. wolfbaeki* feeds mainly on sardine, (*Sardinae sagax*) (Trillmich & Dellinger, 1991). Feeding habits of *Z. c. japonicus* are unknown.

**Trophic relations:** Near the Californian sea lions’ primary rookeries at San Miguel and San Nicolas Islands, the diets of the fur seal and the harbor seal (*Phoca vitulina richardsi*) are known to overlap (B. Stuart, pers. comm.). The Californian sea lions might also compete for habitat and food where their habitats overlap with the Steller’s sea lion (*Eumetopias jubatus*), the Galapagos fur seal (*Arctocephalus galapagoensis*) and the harbor seal (*Phoca vitulina richardsi*). In the case of the Steller's sea lion this cannot be very intensive because of spatial and temporal separations (Antonelis et al., 1990). Mother fur seals compete for haul-out space. Natural predators include sharks and killer whales (*Orcinus orca*).

**Human impacts:** As both the commercial fisheries and the Californian sea lion seek species such as anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), Pacific mackerel (*Scomber* sp.), herring (*Clupea pallasi*), and market squid, this might lead to conflict. Californian sea lions are known to damage fishing gear and steal fish from nets or fish in the nets. As a result, many sea lions drown in nets. DeMaster et al. (1982) report that in 1980 at least 1,571 sea lions were killed, mainly in gill nets. Estimates for 1983-1988 range from 2,207 to 4,288 sea lions killed per year (J. Barlow, pers. comm.). Pollution, especially with DDT and PCB, may have been connected with premature pupping in the early 1970s but there is no evidence of it being a population problem now. Mate (1982) points out the possibility of the exchange of diseases between sea lions and humans.

**Exploitation:** The Californian sea lion is a protected species throughout its range (except for Japan) and only a few are taken for public display purposes. The recent successes in rehabilitating sick and injured wild sea lions and captive breeding may render capture of live animals unnecessary.
Threats to the population: The increase in environmental toxins may have negative effects on the population. Z. c. japonicus is included in the IUCN Red List as being probably extinct.

References:


Southern sea lion
*Otaria byronia* (Blainville, 1820)

Nomenclature: There is some confusion about the correct scientific name of this species. Although *Otaria byronia* is now...
widely accepted, *Otaria flavescens* (Shaw, 1800) is still used as an alternative (Vaz-Ferreira, 1982). Common names that are used instead of southern sea lion include South American sea lion and Patagonian sea lion.

**Description:** Males measure on average 260 cm long and weigh around 300 kg. Females are usually about 210 cm long and weigh 150 kg. Pups measure around 80 cm and weigh from 10 to 15 kg. Male pups are usually larger than females. The southern sea lion has a dark brown dorsal side and a yellowish-brown ventral surface. Males have lighter colored manes. Females have no manes, but have lighter colored fur in the head and neck area. Pups are born with a black coat. After a few months they become grey and this changes at the age of one year to reddish-brown.

**Distribution:** The southern sea lion occurs on both the Atlantic and Pacific shores of South America. On the Atlantic side the range extends from Rio de Janeiro at 23°S down to the southern tip of the continent at 55°S. On the Pacific side, it occurs as far north as Zorritos in Peru (4°S). There is no obvious migration.

**Population dynamics:** The age of maturity is 4 years for females and 5-6 years for males. The pregnancy rate is unknown. Gestation lasts about one year. Lactation lasts 6-12 months. Longevity is about 20 years. Adult mortality is unknown. Pup mortality ranges from 2% to 50%, depending on the crowding in the rookery.

**Population size:** Counts from land, boat, and airplane were carried out in the 1950s and 1960s, when the total population size was estimated at 273,500. Torres et al. (1979) give a total estimate of 100,000 between 18°20’S and 56°31’S. Vaz-Ferreira (1982) reports population estimates for Uruguay (30,000), the Falkland (Malvinas) Islands (30,000), and Peru (20,000). C. Campagna (pers. comm.) estimates a population size of less than 50,000 sea lions in Argentina. The total number of animals censused by Aguayo and Maturana (1973) was 25,324 in Chile, between 18°20’S and 39°27’S.

**Feeding:** According to Aguayo and Maturana (1973), southern sea lions around Valparaíso (33°S) feed on rock fish (*Sebastes* sp.), South Pacific hake (*Merluccius gayi*) and herring (*Clupea pallasi*). Molluscs and crustaceans like squid and sea snails are also part of their diet. Oliva (1984) states that in 35°34’S elephant fish (*Callihynchus cupensis*), Peruvian anchovy (*Engraulis ringens*), and grenadier (*Macrourus megallanicus*) are eaten; and in 36°20’S this species feeds on grenadier. South American pilchard (*Sardinops sagax*), cusk-eels (*Genypterus* sp.) and butter fish (*Stromateus* sp.). Squid and octopus are also eaten.

**Trophic relations:** Although the South American fur seal, *Arctocephalus australis*, lives in the same area, there seems to be little interaction or competition. Pups are occasionally attacked by the leopard seal, *Hydrurga leptonyx*, while all age groups are preyed on by sharks and killer whales (*Orcinus orca*).

**Human impacts:** Southern sea lions are processed on a small scale for human food production (Araya et al., 1987). Illegal poaching on a national scale occurs along the littoral of Chile. Fishermen capture this species to maintain for *Lithodes santolla* fisheries (Torres et al., 1990).

**Exploitation:** The southern sea lion is protected in Argentina. Currently there is no harvest in the Falkland Islands. In Chile, southern sea lions are considered to be harmful, and governmental authorities obtain them without special permits. In Uruguay there is an annual harvest of about 3,000 pups.

**Threats to the population:** The Falkland (Malvinas) Islands population declined dramatically from 380,000 in the late 1930s to 30,000 in the 1960s. This decline has continued, and only 15,000 were counted in the late 1980s. This recent decline may be connected with increased fishing activity in the region. In Peru, sea lions are still killed for this reason. In Chile, southern sea lions are reported to be killed by fishermen and people involved in salmon (*Salmo salar*) aquaculture (C. Campagna, pers. comm.).

**References:**
Population size: Estimates of the total population used to range from 3,000-5,000. New estimates are much higher: 10,000-12,000, due to previous underestimation (N. Gales, pers. comm.). The population seems stable, with no indication that it is declining.

Feeding: Generally their diet is very broad, consisting of many species of fish, including salmon (Salmo salar), whiting (Micromesistius australis) and sharks, as well as cephalopods (especially sepia) and some penguins (N. Gales, pers. comm.).

Trophic relations: The New Zealand fur seal, Arctocephalus forsteri, lives in the same area, but there is apparently no interaction. Sharks are the main predators.

Human impacts: In the 17th and 18th century Australian sea lions were heavily harvested by sealers. Their distribution was reduced around Bass Strait during this period. Nowadays the sea lions are occasionally killed in fishing nets and cray-pots as well as by direct shooting. Other impacts are recreational use of islands disturbing the sea lions. The impact of either has yet to be quantified (N. Gales, pers. comm.).

Exploitation: There is no harvest of this population. Some animals are occasionally captured for public display or for research. Since the species is fully protected, a permit is required.

**Australian sea lion**

*Neophoca cinerea* (Pérnon, 1816)

Description: Adult males range in length from 200 to 250 cm and their weight is 250-300 kg. Females are 130-180 cm long and weigh about 70-110 kg. Pups are 62-68 cm long and weigh 6.4-7.9 kg. Males are blackish brown in color with manes around the shoulders. The head is cream colored. Directly after the molt, females are silver grey, which slowly fades to brown. Pups are chocolate brown with a pale crown (N. Gales, pers. comm.).

Distribution: Australian sea lions occur on sandy beaches and on smooth rock. They live on the Australian islands from Houtman's Abrolhos (28°S, 112°E) to the Pages Islands (34°S, 138°E).

Population dynamics: Females are mature at 4.5-6 years of age and males at 6 years or more. The annual pregnancy rate of mature females is 70-80%. Gestation lasts 18 months, which is unique among seals. There is evidence that the delay in implantation is about 5-6 months and the placenta disappears about 12 months (N. Gales, pers. comm.). Longevity and mortality rates are not known.
Threats to the population: None known. This species will be included in the 1993 IUCN Red List as Rare.

References:

Hooker's sea lion
Phocarctos hookeri (Gray, 1844)

Nomenclature: Hooker's sea lion is also called the New Zealand sea lion.

Description: Males of this species are 250-350 cm long and weigh 300-450 kg. Females are much smaller: 200 cm and 160 kg. Pups are about 75 cm. Pups are sexually dimorphic from birth. Males average about 7.9 kg and females 7.2 kg. At 20 days male pups are up to 3 kg heavier than females. Adult males are dark blackish-brown with dark manes. Females have a silver grey dorsal side and a creamy white ventral surface. Male pups are light chocolate brown with light stripes down the nose to the top of the head and the nape of the neck. Female pups are light creamy brown to light chocolate brown.

Distribution: Hooker's sea lions breed and mate on sandy beaches in the New Zealand Subantarctic. They reside mainly on the Auckland Islands (50°S, 166°E), but also on the Snares (48°S, 166°E) and on Campbell Island (52°S, 169°E). Hooker's sea lions also reach the mainland of South Island (B. Stewart, pers. comm.).

Population dynamics: Not much is known about the vital parameters of this species. Males become sexually mature at the age of 5 years. The age of maturity for females is 3-4 years. Gestation lasts 12 months. The pregnancy rate of mature females on rookeries is about 80% per year. Adult mortality is unknown. Pup mortality at the end of one year is about 35%. Males live at least 23 years and females to at least 18 years.

Population size: Recently there have been censuses of several islands, resulting in the following population estimates: Enderby: 1,000; Dundas: 2,000; Snares: 50; Campbell: 100. The total population size was estimated at around 5,000, but in recent counts (1992, pers. comm. M. Cawthorn) the population was found to be in the order of 10,000-15,000 animals.

Feeding: The diet includes cephalopods, prawns, crayfish, crabs, and small fish. Occasionally penguins are taken.

Trophic relations: Several pinniped species live in the same area, including the New Zealand fur seal, Arctocephalus forsteri, the leopard seal, Hydrurga leptonyx, and the southern elephant seal, Mirounga leonina, but there is no evidence of competition for food. Predators include the killer whale (Orcinus Orca), sharks, and leopard seal.

Human impacts: In the northern part of their range, Hooker's sea lions are occasionally killed by fishermen.

Exploitation: Because of its remoteness there has been no exploitation of this species. A few sea lions may be killed illegally.
Male Hooker’s sea lion (*Phocarctos hookeri*).

for use as crab bait. The uninhabited Auckland Fauna Reserve forms part of the habitat of Hooker’s sea lion.

**Threats to the population:** Commercial squid fishing, 12 to 40 nautical miles north of the two largest rookeries, is resulting in an annual incidental mortality of females of 2.4/1 (M. Cawthorn, pers. comm.) and an estimated total catch of about 100-200 Hooker’s sea lions (Cawthorn, 1985). There is also juvenile mortality caused by the presence of rabbit burrows. Recognizing these threats, an IUCN Recommendation adopted at the IUCN General Assembly in 1990 urged the New Zealand Government to declare a Marine Mammal Sanctuary, to ban trawl fishing from the feeding grounds of Hooker’s sea lions, or take other effective measures to protect Hooker’s sea lions and promote an increase in their population (IUCN, 1991). This species will be included in the 1993 IUCN Red List as vulnerable.

**References:**
IUCN. 1991. 18th General Assembly Resolutions and Recommendations.

**Subfamily Arctocephalinae**

**Guadalupe fur seal**
*Arctocephalus townsendi* (Merriam, 1897)

**Nomenclature:** Considered by some to be a subspecies of *Arctocephalus philippi* (Peters, 1866).

**Description:** Very little is known about this species. The Guadalupe fur seals are sexually dimorphic. Males are about 180 cm and weigh approximately 100 kg; females are about 120
cm—their weight is unknown. Pups are probably 60 cm at birth. The fur is black, becoming light ventrally. They have an elongated snout and elongated flippers.

**Distribution:** This species lives on rough rocky shores. Although almost all Guadalupe fur seals are found on Guadalupe Island, 6-10 animals were counted on the Californian Channel Islands (Stewart, 1981).

**Population dynamics:** Limited census data exist. Some population studies are in progress.

**Population size:** In 1987 Mexican scientists counted 3,259 Guadalupe fur seals at Guadalupe Island. From this Gallo estimates the population to consist of about 6000 animals (J.P. Gallo, pers. comm.) After 1928 this species was thought to be Extinct, but it was rediscovered in 1954. There has been a slow, but steady increase in population size since then. The pup production is estimated to be about 1,500 annually (J.P. Gallo, pers. comm.).

**Feeding:** Although their diet has not been well studied, Guadalupe fur seals have been observed to eat squid and lanternfish (Reeves et al., 1992).

**Trophic relations:** There is a large northern elephant seal, *Mirounga angustirostris*, colony on the same island, but they are believed to be completely segregated ecologically. There is also a smaller colony of Californian sea lions.

**Human impacts:** There are possibly interactions of the fur seal with the lobster fishermen during the terrestrial phase, but sea conflicts with fishermen are undocumented.

**Exploitation:** None. Its habitat is protected by the Mexican government and guided tours are not allowed in the area.

**Threats to the population:** Since the population recovered from an apparently very limited number of individuals, there may be a lack of genetic diversity. Measurement of genetic variation should therefore be given high priority. The species is included in the IUCN Red List as Vulnerable.

**References:**


**Galapagos fur seal**

*Arctocephalus galapagoensis* (Heller, 1904)

**Nomenclature:** This species was originally described as a subspecies of *Arctocephalus australis*, but is now recognized as a separate species.

**Description:** The Galapagos fur seal is quite small: males are usually no larger than 150 cm and females no larger than 130 cm. Territorial males weigh 60-75 kg, adult females about 30 kg. Pups weigh between 3 and 4.5 kg at birth.

**Distribution:** This species breeds on rocky shores with sea caves. It is found only on the Galapagos Islands. It is widely distributed in the archipelago, the main colonies being located on the western islands with the largest populations on Isla Fernandina and Isla Isabela.
**Population dynamics:** Females mature at 3-4 years. Young are weaned at ages between 1-3 years, depending on environmental conditions. Territorial males are 7-10 years old.

**Feeding:** Galapagos fur seals feed at night mostly at depths of between 10 and 50 m. Their main diet is myctophids, bathylagids, and small cephalopods.

**Population size:** Censuses were carried out in 1978 and 1988/1989. The population size was estimated at about 40,000 animals but may presently be lower due to the impact of the 1982-1983 El Niño (Trillmich, 1991).

**Trophic relations:** There appears to be no competition for food with the Galapagos sea lion, *Zalophus californianus wollebaeki*. The terrestrial habitats of the two species are well separated.

**Human impacts:** Fur seal losses through gill netting did occur, but the problem seems to be solved.

**Exploitation:** This species has been severely overexploited in the past, but is currently not exploited. It is protected under Ecuadorean law by the Galapagos National Park Service.

**Threats to the population:** The spread of introduced dogs could presently endanger local fur seal populations. Otherwise no threats are known.

**References:**


**Juan Fernandez fur seal**
*Arctocephalus philippi* (Peters, 1866)

**Nomenclature:** This species was formerly placed, together with *Arctocephalus townsendi*, in the separate genus *Arctophoca*, but it is now included in the genus *Arctocephalus*.

**Description:** Males are about 200 cm long and weigh around 140 kg. Females are much smaller at about 140 cm and 50 kg. Male pups measure 68 cm and are 6.8 kg in weight; female pups measure 65 cm and are 6.2 kg in weight (Torres, 1987b). The
external characteristics of this species are very similar to those of *Arctocephalus townsendi*. The fur is black, somewhat lighter on the ventral part and on the chest. The snout and flippers are elongated.

**Distribution:** This species occurs in the Juan Fernandez Archipelago and on the Desventuradas Islands, off the coast of Chile (Aguayo, 1979). Every year from 1983 onwards, adult and juvenile males have been observed hauling out in the South American fur seal rookeries at Punta San Juan mainly during autumn and winter. Juan Fernandez fur seals have not been reported as breeding in Peru since 1983.

![Graph of Juan Fernandez fur seal distribution](image)

**Feeding:** The diet consists of fish and cephalopods, *Dosidicus gigas*, *Octopotentis sp.*, *Tremoctopus violaceus*, *Torades filippovae*, and *Morotenthis banksii* (Torres, 1987a).

**Trophic relations:** Sharks and killer whales (*Orcinus orca*) prey on the Juan Fernandez fur seal. Leopard seals, which are incidentally observed at the Juan Fernandez Archipelago, are also known to prey on them (Torres, 1987b).

**Human impacts:** In 1982, young males were observed with plastic wrapped around their necks, and this has often been observed on other animals (Torres, 1990) since then.

**Exploitation:** There is no commercial harvest of this species. There maybe some illegal catch for lobster bait. Local people in 1985, a total of 4,700 specimens were counted over the whole archipelago. On the Desventuradas Islands, 300 specimens were counted in 1975 (Torres, 1985). During more recent surveys the total population size for the breeding season 1990-1991 was estimated at 12,000 animals (J. Francis, pers. comm.).

**Population dynamics:** In 1983 the yearly population increase was expected to be over 21%. No further data are available.

**Population size:** This species was nearly exterminated in the 16th to 19th centuries. It was rediscovered in 1965. A census in 1970 indicated about 750 fur seals present in the Juan Fernandez Archipelago. On the Desventuradas Islands only two were sighted. According to local fishermen, the actual population of the Desventuradas may be higher because this species tends to hide in sea caves. During a census carried out
believe in rendered oil as a treatment of arthritis. Poaching has been prohibited since 1965 (Aguayo, 1979). The status of total protection was given to all Arctocephalus species in Chile in 1978 (Torres, 1987b).

Threats to the population: Because of its limited size, the population is vulnerable. Lack of genetic diversity may be an additional problem. Arctocephalus philippii is included in the IUCN Red List as Vulnerable.

References:

South American fur seal
Arctocephalus australis (Zimmerman, 1783)

Nomenclature: Two subspecies have been described: Arctocephalus australis australis (Zimmerman, 1783) for the Falkland population and Arctocephalus australis georgicae (Nehring, 1887) for the mainland population. The validity of these subspecies is disputed.

Description: The males of this species reach a length of about 700 cm and a weight of 160 kg. Females are up to 150 cm long and weigh on average 60 kg and can go up to 90 kg. Pups weigh between 3 5 and 7 kg at birth. Males are bigger than females at all ages. Adult males are blackish-grey in color and have poorly developed manes. Females and immature males are greyish-black with a lighter ventral surface.

Distribution: This species is widely distributed in South America from Tierra del Fuego in the south to the latitude of São Paulo (Brazil), and up to 13°S in southern Peru in the North. They are also found in the Falkland (Malvinas) Islands (Vaz-Ferreira, 1982; Bonner, 1981; Majluf & Trillmich, 1981). This species usually occupies rocky coast.

Population dynamics: Females become mature at the age of three years and their first pups occur at age four; males become mature at seven years. The annual pregnancy rate of mature females averages 80%. The standard length for pregnant females is between 104 and 140 cm (Batalles et al., 1985). Gestation lasts one year. Lactation lasts six months in Peru (P. Majluf, pers. comm.), and in Uruguay between eight and twelve months (Vaz-Ferreira & Ponce de Leon, 1987). Longevity is unknown. Pup mortality varies according to local circumstances, ranging from 4% to 82%. Adult mortality is not known.

Population size: Ground, boat, and aerial counts have been carried out in several areas. The Falkland (Malvinas) population size totals 15,000-16,000 animals. On the mainland, the largest population size is in Uruguay, with 252,000 animals. In Peru, the population size is about 20,000 and still increasing (P. Majluf, pers. comm.). The total mainland population size is about 307,000. For many areas there are no accurate counts available, but for most areas the population seems to be either stable or increasing.

Figure 10. Distribution of the South American fur seal (Arctocephalus australis). Known breeding areas are indicated by arrowheads.
Feeding: The diet contains a wide variety of organisms, mostly fish (anchovy (*Engraulis ringens*) among others), but also cephalopods, crustaceans, lamellibranchs, and sea snails. In southern Chile the species also feeds on lobster krill (*Munida* sp.) (Siefeld, 1983).

Trophic relations: In Peru, pups are frequently eaten by South American sea lions, killer whales (*Orcinus Orca*), and sharks (Malluf & Trillmich, 1981). Abduction of fur seal pups by South American sea lions has also been observed in the Uruguayan population (Vaz-Ferreira & Bianco, 1987).

Human impacts: South American fur seals were taken by nomadic canoes groups of indigenes (the Alacuf and Yarana) from the Ticra del Fuego archipelago and western Patagonian channels. This is no longer a major pressure as these tribes are almost extinct. Chilote fishermen in the south Chilean archipelago do still take some. In Peru, poaching still occurs outside protection zones. The species was also formerly a target of commercial sealers who depleted the populations. The Uruguayan population is still regularly harvested by a state agency (Vaz-Ferreira & Ponce de Leon, 1987).

Exploitation: In Uruguay there was an annual harvest of up to 12,000 immature males per year (Vaz-Ferreira, 1982), but more recently (between 1987 and 1991) the harvesting rate was around 5,000 per year (F. Cappoza, pers. comm.). In southern Chile, seals are illegally exploited as a source of free bait for the king crab fishery. The same phenomenon was observed in Argentina, but with a less pronounced impact. As the fishery is decreasing due to overexploitation, hunting pressure is being reduced, although casual captures in shark nets have been reported for Uruguay and Argentina (Scialabba, 1989).

Threats to the population: Increased offshore oil exploitation may create environmental problems that could affect the population. The limited number of large, dense breeding aggregations could make this species particularly sensitive to the effects of oil spills. Poaching for fur and meat may account for most of the human induced mortality in Peru.

References:


Subantarctic fur seal
*Arctocephalus tropicalis* (Gray, 1872)

Nomenclature: This species is occasionally confused with *Arctocephalus gazella*, with which it breeds sympatrically at Marion Island and in the Crozet Archipelago, but it is clearly a different species. It is also called the Amsterdam Island fur seal or Marion Island fur seal.

Description: Males are usually about 180 cm long and weigh about 165 kg. Females measure 145 cm and 55 kg. Pups are 65 cm at birth and weigh about 5 kg. This fur seal is brown to dark grey in color, with a yellow chest and throat area which is most apparent in males, particularly adult males, and a dark brown ventral area. Bulls are usually darker than females.
**Distribution:** The subantarctic fur seal occurs on the following islands or groups of islands: Tristan da Cunha, Gough Island, Prince Edward Island, Marion Island, Crozet Island, Amsterdam Island, Saint Paul Island, Heard Island, and Macquarie Island. Shaughnessy (1982) distinguishes three different breeding groups: the Tristan da Cunha-Gough group, the Prince Edward group, and the New Amsterdam-Saint Paul group. This species has also been reported to breed at Crozet Archipelago (Jouventin et al., 1982) and at Macquarie Island (Shaughnessy et al., 1988). One pup was reported from Heard Island in 1987-1988 (Goldsworthy & Shaughnessy, 1989). In 1991, the species was confirmed to have bred on the Crozet Archipelago as well as Heard and Macquarie Islands (I.S. Wilkinson, pers. comm.).

**Population dynamics:** Females attain maturity at 4-6 years of age (Bester, 1987). Gestation lasts 51 weeks and lactation 9-10 months (Kerley, 1985). Longevity is unknown. The annual mortality rates are as follows: neonatal: 0.9%; 1-3 weeks: 37%: 3 weeks to 5 months: 1-2%. This results in an average mortality for the first 5 months of 47%. Mortality from weaning to the age of 2 years ranges from 40 to 50% annually. Adult mortality is unknown.

**Population size:** The most recent estimates of the total population size are given in Croxall and Gentry (1987). Gough Island (Tristen Da Cunha Group): 200,000; Prince Edward and Marion Islands: 70,000 (Wilkinson & Bester, 1990); French subantarctic Territories—Amsterdam, Saint Paul, Crozet Islands: 40,000 (excl. yearlings); Macquarie Island: about 50. This amounts to a grand total of at least 310,000 animals. Most of the populations show an annual growth rate on the order of 15% or more. The total population has been severely overexploited but seems now to be recovering well.

**Feeding:** The diet consists of several fish species, cephalopods, euphausiids, and penguins.

**Trophic relations:** This species breeds sympatrically with Arctocephalus gazella on Marion Island, where competition for space and food might be expected. There are some indications that interbreeding occurs between these two species. A. tropicalis also breeds sympatrically with A. gazella at Crozet Archipelago and at Macquarie Island. The subantarctic fur seal is preyed upon by sharks and killer whales (Orcinus Orca).

**Human impacts:** Island populations of this species were severely depleted, and in many cases virtually eliminated, by sealers in the early and later 19th century. As late as the 1950s, seals were being taken on a small scale at Gough Island for fishing bait, and even for skins (a few hundred, on an experimental basis, by fishing ships).

**Exploitation:** There is currently no harvest of this species, though some animals have been taken for display purposes. All the colonies are protected. Marion and Prince Edward are covered by the Sea Bird and Seal Protection Act of South Africa, and Gough and Tristan by the Tristan da Cunha Conservation Ordinance of 1976. New Amsterdam and Saint Paul are regulated by the French Chamber of Deputies. At Macquarie Island, the fur seals are protected by the Tasmanian Department of Parks, Wildlife and Heritage.

**Threats to the population:** Currently none and all known populations of this species have been increasing.

**References:**
Jouventin, P., J.C. Stahl & H. Weimerskirch. 1982. La
Antarctic fur seal
*Arctocephalus gazella* (Peters, 1875)

**Nomenclature:** Also known in the past as the Kerguelen fur seal, this species has been confused with *Arctocephalus tropicalis* and *A. australis*.

**Description:** There is a large degree of sexual dimorphism. Adult males range from 165 to 200 cm in length and 90 to 210 kg in mass. The equivalent ranges for females are 115 to 140 cm and 25 to 55 kg (Payne, 1979; Boyd & Duck, 1991). Pups are 60-73 cm at birth and 4.5 to 6.5 kg (Boyd & McCann, 1989; Doidge & Croxall, 1989). The back and sides of adults are grey to brownish with a dark gingery ventral surface. Juveniles and adult females often have a creamy throat and chest. Pups are normally black at birth. Occasional light-phase individuals are born (approximately 1:2000 births) where the fur is creamy-white. Many of these survive to breed but white females rarely give birth to white pups. White males have been observed to defend territories.

**Distribution:** The species has a circumpolar distribution mainly south of the Antarctic Convergence to approximately 65°S. The major breeding location is at South Georgia. Other breeding colonies are found on the South Shetland Islands, South Orkney Islands, South Sandwich Islands, Bouvetoya, Marion, Heard, Macquarie, and McDonald Islands, Iles Crozet, Prince Edward Islands, and Iles Kerguelen.

**Population dynamics:** Age of first reproduction is 3-4 years for females and 6-10 years for males. The peak of births occurs during early December (Duck, 1990). Lactation lasts 120 days. There is a period of embryonic diapause lasting 3 months (Boyd,
South Georgia Antarctic fur seals of 1.1 x 10^7 tons. Winter food consumption over the South Georgia shelf was 1.4 x 10^7 tons. The consumption biomass is divided between krill (69%), fish (19%) and squid (12%). At South Georgia and in the South Shetland Islands the consumption biomass is divided between Antarctic krill, *Euphausia superba* (69%), fish, mainly *Champsocephalus gunnari* (19%), and squid, *Martialis hyades*, *Kondokottia longimana*, and *Moroeuthis glacialis* (12%) (North et al., 1983; Doig & Croxall, 1985). Some birds are also taken at South Georgia. At Heard Island, fish, especially pelagic myctophids (e.g. *Gymnoscopelus nicholsii*) and octopus (*Octopus*), were the major component of the diet in summer and winter (Green et al., 1989), although the frequency of squid in the diet was greatest in winter (Green et al., 1991). Fur seals at South Georgia appear to select krill with a high energy density (Croxall & Pilkington, 1984). Feeding on krill occurs close to the surface.

**Trophic relations:** The leopard seal (*Hydrurga leptonyx*) preys on juveniles and pups but probably only has a significant impact on populations at the south of the distribution.

**Human impacts:** The species was depleted to the brink of extinction by commercial sealing in the late 18th century. It is now protected throughout its range. Rate of entanglement in man-made debris, such as fishing net and nylon string, was 0.4% of individuals in 1988-1989 (Croxall et al., 1990). Entanglements have been noted since the late 19th/20th (Honner & McConn, 1942). The majority of entangled fur seals probably die as a result of drowning or starvation.

**Exploitation:** There is no harvest of this species. The species is totally protected in all areas south of latitude 60°S under the Agreed Measures for Conservation of Antarctic Fauna and Flora, adopted under the Antarctic Treaty, and also under The Convention for the Conservation of Antarctic Seals. North of the Antarctic Treaty area, Antarctic fur seals are protected by the nations which hold the islands where fur seals breed. The Falkland (Malvinas) Islands Dependencies Conservation Ordinance provides protection for Antarctic fur seals on South Georgia and the South Sandwich Islands.

**Threats to the population:** None known.

**References:**

South African fur seal
Arctocephalus pusillus pusillus
(Schreber, 1776)

Nomenclature: This is one of the two subspecies of Arctocephalus pusillus that are currently recognized. The other is A. p. doriferus. A common name also frequently used for this species is Cape fur seal.

Description: The males measure about 200-230 cm and weigh 200-360 kg. Females are about 120-160 cm and weigh 40-80 kg. Pups measure 60-80 cm and weigh 5-6 kg at birth. The fur of the males is dark grey on the dorsal side and lighter ventrally. Females have a brownish-grey dorsal surface and are light brown ventrally. Pups are black at birth.

Distribution: This species occurs along the south and west coasts of South Africa and Namibia (southwest Africa). There is no migration.

Population dynamics: Females become sexually mature at age three. The age of maturity for males is unknown. The annual pregnancy rate of mature females is 80-85%. Gestation lasts about 1 year, which includes a delay of implantation of about 4 months. Lactation can last up to 12 months. Natural mortality of pups is highly variable but averages 25%. In captivity the oldest animal recorded to date is a 19 year old female. It is thought that less than 8% of the South African fur seals will reach 25 years of age in the wild (P. Wickens, pers. comm.).

Figure 13. Distribution of South African fur seal (Arctocephalus pusillus pusillus). Known breeding areas are indicated by arrowheads.
Cow, pup, and bull South African fur seal (Arctocephalus pusillus pusillus).

Population size: Using aerial photography and tag recapture techniques the population size is estimated to be at most 2 million and is increasing at approximately 3% per annum (Butterworth & Wickens, 1990). The annual pup production is over 300,000. From field observations, Rand (1967) estimated the average harem size to be 28 animals (range: 7-66), but the size is thought to be closer to an average of 7, based on population modelling (Butterworth & Wickens, 1990).

Feeding: The South African fur seal forages on pelagic schooling fish and cephalopods. Among the fish, munsborders (Trachurus), pilchards (Sardinapilchardus), anchovies (Engraulis capensis), and hake (Merluccius sp.) are most common. Among the cephalopods, Loligo is the most common. Stomachs that were examined contained 75% fish, 17% cephalopods, and 8% crustaceans (David, 1987a). They consume at most 1,000 kg of fish per animal per year, which means a total consumption of at most 2 million metric tons of fish annually for the whole population (Butterworth & Wickens, 1990).

Trophic relations: The fur seals' diet overlaps with that of hake and other ground fish, several bird species, cephalopods, dolphins, sharks, and whales. They consume an amount of fish similar to that taken by fisheries (P. Wickens, pers. comm.). Increases in the fur seal population have caused displacement of several bird colonies (Crawford et al., 1989). The fur seals are preyed on by sharks and killer whales (Orcinus orca). Pups on land are taken by the black-backed jackal and brown hyena (David, 1987b).

Human impacts: There is considerable interference with commercial fisheries, especially in the purse seine fisheries for pilchard (Sardinapilchardus) and anchovy (Engraulis capensis) and the trawler fisheries for hake. South African fur seals have been seen taking fish from the nets, or even from the ship, and chasing fish out of the net. Occasionally some seals become entangled in the nets and drown. Fur seals also get entangled in lost gear, such as nets and fishing lines. In a survey, 0.12% of the population was in some way entangled in lost gear (Shaughnessy, 1985).

Exploitation: The average annual harvest was about 75,000 pups (aged 6 1/2-10 1/2 months after the first molt) and 1,400 bulls for the period 1973-1982. Maximal Sustainable Yield (MSY) policy was removing 35% of pups and a number of bulls. Since then an average of 25,000 pups and 9,000 bulls have been killed but annual numbers killed have been highly variable (Wickens et al., in press). Apart from the hunting, the fur seal population is exploited as a major tourist attraction at Cape Cross, False Bay, and Mossel Bay (Wickens et al. in press). In 1990, a moratorium was placed on sealing in South Africa until further research has been carried out. Seal harvesting continues in Namibia.

Threats to the population: None known.

References:


Australian fur seal
Arctocephalus pusillus doriferus
(Wood Jones, 1925)

Nomenclature: This is one of the two subspecies of Arctocephalus pusillus, to which the South African fur seal belongs. The Australian fur seal has also been described as a separate species as Arctocephalus tasmanicus or Arctocephalus doriferus, but its inclusion in Arctocephalus pusillus is now widely accepted. Another common name for this species is Tasmanian fur seal.

Description: The males measure 200-225 cm and weigh 220-360 kg. Females are 125-170 cm and weigh 36-110 kg. At birth, male pups measure 64-81 cm and weigh 3-12.3 kg, female pups measure 62-79 cm and weigh 4.5-10 kg. There is marked sexual dimorphism, with the males being dark greyish-brown with a paler ventral surface and coarse manes, while females are a pale fawn to greyish-brown with a pale throat and a brown ventral surface. At birth, pups are black. After the molt they turn greyish-fawn with a pale throat.

Distribution: The Australian fur seal lives from 32°28'S to 43°52'S and from 152°33'E to 142°E. It occurs along the Australian coast from Seal Rocks in New South Wales, through South Tasmania, to Lady Julia Percy Island, Victoria.

Population dynamics: The age at maturity is 3-6 years for females and 9-12 years for males. The annual pregnancy rate of mature females is 68%. Gestation lasts 51 weeks, including a three month delay of implantation. Longevity and adult mortality are unknown. Pup mortality in the first 2 months is 15%.

Population size: A comprehensive survey was conducted in 1986 (Warneke, 1988). It covered all nine breeding sites and 11 non-breeding sites by aerial photography. The number of pups was estimated at 8,000; this was adjusted by comparing ground counts with aerial counts at one of the breeding colonies. Based on this, in 1991 a tentative estimate was made of the total population: 30,000-50,000 animals (S.D. Goldsworthy and P.D. Shaughnessy, 1991).

Feeding: This fur seal is a deep diver and probably obtains its food from deeper waters. It is known to dive to at least 500 m. Squid, octopus, and a wide range of fish are taken, depending on seasonal availability and local opportunity (Shaughnessy & Warneke, 1987).

Trophic relations: There is no overlap and hence no competition with Arctocephalus forsteri or Neophoca cinerea. The main predators of this species are the white shark and the killer whale (Orcinus Orca).

Human impacts: There is intensive interaction with local fisheries. Significant numbers of immature fur seal are killed in nets or traps, or shot by fishermen.

Exploitation: There is no harvesting of this species, as its territories are protected by State Law.

Threats to the population: The main problem areas for this fur seal are: increased pollution of its habitat with pesticides and heavy metals, and increased disturbance. A significant proportion of mortality is caused by net entanglement and by fishermen’s shooting (Shaughnessy & Warneke, 1987).

References:
New Zealand Fur Seal
Arctocephalus forsteri (Lesson, 1828)

Nomenclature: The Australian population was originally described as belonging to Arctocephalus doriferus (which name is now used for a subspecies of Arctocephalus pusillus), but later it was realized that this animal was similar to the New Zealand fur seal, described as Arctocephalus forsteri.

Description: Males of this species measure 145-250 cm and weigh 120-185 kg. Females are 125-150 cm and weigh 25-50 kg. Pups are 40-45 cm at birth and males weigh on average 3.9 kg, females 3.3 kg. There is marked sexual dimorphism in this species. Males have thick manes and are much darker than the females. They have a dark brown to black dorsal surface with a lighter ventral area. Females are brown to dark brown with greyish tones. Pups are black at birth, turning greyish-brown after molt.

Distribution: This species usually occurs on rocky coasts. A population is present on the southern coast of Australia, from 117°E to 136°E (West Australia and South Australia). Another population lives in New Zealand (Stewart Islands). Populations are also found on the subantarctic islands of Snares, Auckland, Campbell, and Bounty (Wilson, 1981), and there is a small breeding population in southern Tasmania at Maatsuyker Island (Brothers & Pemberton, 1990). In summer this species occurs on and around the South Island, south of 43°S, and in winter it can also be found on the North Island, up to 34°S. There is also a non-breeding population of almost 2,000 animals on Macquarie Island each April-May (Shaughnessy et al., 1988).

Population dynamics: Females become mature at 4-6 years of age, males at 10-12 years. Lactation lasts 10-11 months. Other population dynamic parameters are unknown.

**Northern fur seal**

*Callorhinus ursinus* (Linnaeus, 1758)

**Nomenclature:** Other common names often used for this species include Alaskan fur seal, Pribilof fur seal and North Pacific fur seal.

**Description:** Adult males of this species are on average 210 cm long and weigh 180-270 kg. Adult females measure 100-140 cm and weigh 30-50 kg. At birth male pups are, on average, 55-63 cm in length and weigh 5.4-5.9 kg, while female pups are 53-62 cm long and weigh 4.5-4.8 kg. This species is characterized by its short down-curved rostrum, long pinnae, and long rear flippers. Males vary in color from grey to reddish-brown to black. Females have silvery-grey dorsal and reddish-brown-ventral surfaces with a dull white to grey blaze on the chest. Pups are black with lighter coloring on the ventral surface.
Distribution: There are five stocks based at the following locations: Pribilof Islands, Commander Islands, Robben Island, Kuril Islands (Kamennye Iovuski Islands and Srednev Rocks) and San Miguel Island. A new colony has established itself on Bogoslof Island in the Aleutian Islands. As there is a southbound migration in winter, the overall range includes much of the north Pacific Ocean north of the convergence zone. Most of the population is concentrated along the edges of the continental shelf.

Population dynamics: Owing to changes in the market and costs of producing furs, this species has lost what was once a high commercial value. Because of its previous commercial value and current concern about reduced status, this species has been intensively studied. Females reach maturity at the age of 2-5 in both Asian and North American populations. Males reach the height of their reproductive status at about 9 years of age. The annual pregnancy rate for adult females is in excess of 80%. Gestation lasts 11 weeks, which includes a delay of implantation of 3.5 to 4 months. Lactation lasts 4 months. Longevity of this species is 25 years. Pup mortality is variable, but on average it is about 10% before weaning. Total first year mortality is 50%. For age groups 1 to 3, annual mortality is 20%. For age groups 3 to 7, the mortality for males is 20% and for females 11%. Adult annual mortality for males is 38% and for females 11%.

Population size: Prior to 1900, this species was twice severely overexploited. This resulted in reductions from which it recovered. Declines since 1956 have resulted in significantly reduced population levels. Currently the stock sizes are: Pribilof Islands: 900,000; Commander Islands: 225,000 230,000; Robben Island: 55,000 65,000; Kuril Islands: 50,000-55,000; San Miguel Island: 4,000. The total population size is therefore estimated at 1.2 million animals (Fowler, in press).

Feeding: Northern fur seals are opportunistic feeders; they usually take the most abundant fish and cephalopod species available (Kajimura, 1985). The diet includes squid, hake, anchovy (Engraulis mordax), herring (Clupea palasi), sand lance (Ammodites sp.), capelin (Mallotus villosus), pollock (Theragra chalcogramma), mackerel (Scomber sp.), and smelt (Osmerus mordax). They consume about 10% of their body weight in fish per day. Vladimirov (1980) estimates the total annual food consumption of the Asian fur seal population in the northwestern Pacific to be about 250-300,000 tons. Another estimate is much higher. Robben stock 80,000-95,000, Commander stock 250,000-300,000, and Kuril stock 50,000-60,000 tons per year (A. Kurzin, pers. comm.).

Trophic relations: There is a considerable overlap in diet with Steller’s sea lion, (Eumetopias jubatus), and harbor seals, (Phoca vitulina). Adults fall prey to sharks and killer whales (Orcinus orc). While pups can be taken by Steller's sea lions.

Human impacts: Part of the seals’ diet consists of fish of interest to commercial fisheries. Also, some fur seals are drowned in gill nets. Fishery-related debris also takes a toll on fur seals, possibly taking a significant percent of the population each year. Up to 0.7% (about 0.3% currently) of the seals harvested on the Pribilof Islands have been observed entangled in debris. On the Asian islands 0.2-2% of the population is harvested.

Exploitation: Following the termination of the Interim Convention on the Conservation of the North Pacific Fur Seal in 1984, the northern fur seal is now managed on land independently by the
Commonwealth of Independent States and the United States. There is no international management in the pelagic environment. About 1,500 bachelors per year on the Robben Islands are taken for commercial use, as are about 5,000 grey pups on the Commander Islands (Vladimirov, 1991). About 2,000 young males from the Pribilof population are taken for subsistence purposes.

**Threats to the population:** Potential threats include a reduction in food supply by over-exploitation of the fish stocks and incidental mortality in drift-net fisheries. Also included are the potential negative effects of oil exploitation in the Bering Sea, which could result in noise disturbance by supply and survey ships, or contamination by pollution. Mortality from entanglement in marine debris such as fragments of trawl webbing (and other fisheries-related plastics) is of serious concern.

**References:**

**Family Odobenidae**

**Subfamily Odobeninae**

**Walrus**

*Odobenus rosmarus* (Linnaeus, 1758)

**Nomenclature:** Two subspecies are commonly recognized: the Atlantic walrus, *O.r. rosmarus* (Linnaeus, 1758), and the Pacific walrus, *O.r. divergens* (Iliger, 1815). A third subspecies has been proposed, the Laptev Sea walrus, *O.r. laptevi* (Chapski, 1940), but this is not generally accepted.

![Atlantic walruses (*Odobenus rosmarus rosmarus*), Spitsbergen.](image)

**Description:** The walrus is a very large and robust pinniped, with a cinnamon-brown skin that becomes lighter with age. The skin is covered with short coarse hair. The walrus' most distinctive features are the large tusks (enlarged upper canine teeth). Adult Atlantic walrus males measure 300 cm average and weigh approximately 800-900 kg. Adult females measure about 270 cm and weigh between 500 and 600 kg on average. There are indications of variations within the subpopulation of Atlantic walruses. The Pacific walrus is slightly larger. Adult males reach an average body length of 320 cm and weigh 1,200 kg. Adult females are on average 270 cm long and weigh 830 kg. In both subspecies calves measure approximately 120 cm and weigh 60 kg.

**Distribution:** The Atlantic walrus is found in two distinct areas: (1) in the eastern Atlantic Arctic, where it occurs in eastern Greenland, Spitsbergen, Svalbard Franz Josef Land, Barents and Kara Seas (the relationships between the groups in these areas have yet to be determined); and (2) in the western Atlantic Arctic: east Canadian Arctic and west Greenland. In these areas there are indications of the existence of more or less isolated subpopulations. The Pacific walrus is principally found in the Bering and Chukchi Seas, although in summer they may range into the Beaufort and East Siberian Seas. The walrus migrates with the movement of the pack ice. Shore haul outs also occur in some regions.
Population dynamics: Although females can ovulate at four years of age, the majority do not give birth until they are 7-8 years old. Males become sexually and socially mature at about 15. About 40% of the mature females calve in any given year. Birth rate (calves per total population) is estimated at 0.07 to 0.11 in *O. r. rosmarus* (Mansfield, 1973) and 0.12 to 0.17 in *O. r. divergens* (Fay, 1982). Gestation lasts 15 months, including a delay of implantation of 3-3.5 months. Lactation lasts 1 to 2 years. Longevity is about 40 years. Estimates of annual natural mortality for Pacific walruses range between 3% and 5% (Fay et al., 1989, DeMaster, 1984). The instantaneous growth rate of the Pacific population in the Soviet zone during the period 1958 to 1975 was estimated at 0.067 (Sease & Chapman, 1988). DeMaster (1984) suggested that an adult female harvest of 2% to 5% could be sustained.

Population size: The Pacific walrus is by far the most numerous population, estimated at over 230,000 in 1985 (Gilbert, 1989). The Atlantic walrus has been extirpated from some areas, but several thousand animals occur in the region from Hudson Bay to the White Sea (Fay et al., 1990). Fedoseev estimated that in 1982, 4,000-5,000 walruses occurred in the Laptev Sea (Fay et al., 1990).

Feeding: The walrus feeds mainly on molluscs (95% in numbers and weight) and on other benthic invertebrates, such as crustaceans and worms. They are usually taken at water depths of less than 80 m. Walruses are known to eat between 4% and 1% of their body weight a day (for adult males this is 50-80 kg per day). They occasionally prey on fish, and seals, mostly ringed seals.

Trophic relations: There is some dietary overlap with the bearded seal *Erignathus barbatus*. Killer whales (*Orcinus Orca*) and polar bears (*Ursus maritimus*) prey on walrus calves and may occasionally prey on older animals.

Human impacts: Exploration for oil and other human activities in the marine environment have the potential to disturb walruses. The greatest impact is from direct harvest.

Exploitation: Since 1980 about 4%-6% of the population of the Pacific walrus has been killed annually (about 10,000-15,000 animals). The recent annual kill of Atlantic walruses in Greenland is estimated at about 400 animals (about 20 of these in eastern Greenland; Born, 1990). Catches recorded in Canada in the period 1972-1985 averaged 533 animals per year (Richard & Campbell, 1989). The harvest of the walrus is regulated. Since 1972, only subsistence hunting has been allowed in Alaska for Eskimos, Indians, and Aleuts, but no limits are imposed. In the Pacific region of the Commonwealth of Independent States, the quota is set at 5,000 animals.
In Canada the allowed kill is 4 animals per hunter per year, with a ban on export of hide and tusks. In east Greenland, walrus hunting has been banned since 1956 (Born, 1990). In other areas in Greenland hunting is regulated, with only licensed Danish citizens allowed to hunt walrus. There has been no harvest in the northeast Atlantic since 1952. No Atlantic walruses are taken in either the Norwegian or the western sector of the Soviet Arctic. In the Laptev Sea, only natives and members of scientific expeditions are allowed to kill walruses.

**Threats to the population:** Overexploitation of local stocks is one of the major threats in some areas. In the U.S. harvest by local hunters have not been limited to ensure they are within biological limits. There have been investigations into the feasibility of mollusc harvests in the Arctic. If molluscs were to be exploited, there could be a reduction in food supply for the walrus. Arctic oil exploitation can create ecological problems and the traffic involved may disturb walruses. The lack of international management regimes may allow certain shared populations to be overexploited. The Laptev walrus, *O. r. laptevi* is currently included in the IUCN Red List as Insufficiently Known.

**References:**


**Family Phocidae**

**Subfamily Phocinae**

**Grey seal**

*Halichoerus grypus* (Fabricius 1791)

**Description:** In the eastern Atlantic the males of this species are generally 195-250 cm long and weigh 170-310 kg. Females have a length of 165-210 cm and a weight of 103-180 kg. Canadian grey seals (Sable Island) are larger: males can weigh over 400 kg and females 256 kg at the beginning of the breeding season. Pups at birth are 95-105 cm long and weigh 11-20 kg. The seal species exhibits pronounced sexual dimorphism. Males are dark with light patches and have an elongated snout with a wide heavy muzzle. Females are light-colored with dark spots. Pups are born with long-haired fur and molt after 2-3 weeks.

**Distribution:** There are discrete stocks in the northwest Atlantic, the northeast Atlantic, and the Baltic. The west Atlantic stock ranges from Cape Chidley in the north of Labrador, through
Newfoundland, Nova Scotia, and the Gulf of St. Lawrence to Nantucket. The range of the northeast Atlantic stock extends eastward from Brittany in France to northern Norway (possibly Svalbard), and from Iceland to the White Sea. The majority of the northeast Atlantic stock breeds around the British Isles, with the largest colonies off the northwest coast of Scotland. There are small colonies in France, the Netherlands, and Germany, and larger colonies in Iceland, the Faeroes, Norway, and the Commonwealth of Independent States (CIS).

**Population dynamics:** Females become sexually mature at three to five years, and males at six, although they may not be socially mature until they are eight years of age or older. In the Baltic this can occur earlier (Söderberg, 1976). Gestation lasts 11 months, including 3 months delayed implantation. Annual pregnancy rates of 83-94% have been recorded (Hoyt, 1988). The longevity for females is 46 years and for males 26 years. Estimates of mortality for adult females are in the ranges 5-13.5%. Natural pre-weaning mortality is normally 10-40%. It may be as high as 60% at crowded sites on some Scottish colonies (Summers et al., 1975) and on storm-washed beaches; it is lowest for ice-breeding colonies or those on sandy beaches (e.g. Siobob & Zwanenberg, 1990, reported a mortality of 8-12% on Sable Island).

**Population size:** The size of the northwest Atlantic stock was estimated to be 80,000-110,000 in 1987 (Zwanenburg & Bowen, 1990); the Canadian population is increasing but the rate of increase is uncertain because there are no reliable estimates of trends for the population in the Gulf of St. Lawrence. The size of the British population in 1990 was estimated at 85,100 (Hiby et al., 1992); it has been increasing by around 7% annually. Elsewhere in the northeast Atlantic, population sizes are estimated to be: Iceland 11,600 (Hauksson, 1987). Norway 3,000 (Wig, 1987a, b), Ireland 2,000, the White Sea (1,000-2,000). Helle and Stehnman (1990) estimated the size of the Baltic population to be 2,000-3,000 animals.

**Feeding:** Grey seals feed on a wide variety of fish species, cephalopods, and crustaceans (Benoit & Bowen, 1990a, b; Hammond & Prime, 1990). Diet is known to vary from place to place, and seasonally and from year to year at individual sites (Prime & Hammond, 1990). Animals which haul out at a particular site may have quite different diets depending on whether they feed offshore or close to the haulout site (D. Bowen, pers. comm.).

**Trophic relations:** There may be some dietary overlap with the harbor seal (*Phoca vitulina*). Killer whales (*Orcinus Orca*) and sharks can be predators in some areas (Brooke & Beek, 1981).

**Human impacts:** Many of the fish species in the grey seals’ diet are commercially exploited, so there is a potential conflict with fisheries. The interaction is probably indirect. Grey seals cause damage to set nets, and some seals drown in nets, or are shot by fishermen. Another concern relating to the fisheries is that the grey seal acts as a vector of the codworm, *Pseudoeiurus nova decipiens*. Since the life cycle of the codworm is a complex one, the importance of the grey seal therein is hard to determine.

**Exploitation:** Grey seals have in the past been exploited for their skins and other products in the UK, Iceland, Canada, and the Baltic. Current management in some northeast Atlantic areas of this species is related to its perceived effect on fisheries, either as a direct competitor or as a vector of parasites.

**Threats to the population:** The status of the Baltic and White Sea population is unclear. It has suffered a severe decline this century; there appear to be significant problems due to pollution.

![Figure 18](image-url). Distribution of the grey seal (*Halichoerus grypus*). Known breeding areas are indicated by arrowheads.
with organochlorines and incidental entanglement in fishing gear (Helle & Stenman, 1990).

References:


Eastern Atlantic harbor seal

Phoca vitulina vitulina (Linnaeus, 1758)

Nomenclature: Of the common or harbor seal, Phoca vitulina (Linnaeus, 1758), four subspecies are commonly recognized: the eastern Atlantic harbor seal, P. v. vitulina (Linnaeus, 1758), the western Atlantic harbor seal, P. v. concolor (DeKay, 1842), the western Pacific harbor seal, P. v. stejnegeri (Allen, 1902), and the eastern Pacific harbor seal, P. v. richardsi (Grey, 1864). The latter three subspecies will be discussed separately.

Description: The length of males ranges from 150 to 180 cm and the weight from 55 to 130 kg. Females measure 120-150 cm and weigh 45-105 kg. Pups measure 70-90 cm at birth and weigh 9-11 kg. The color of the harbor seal is variable: grey to brownish grey with black spots. Characteristic of the harbor seal are the nostrils that form a V shape.

Distribution: The eastern Atlantic harbor seal occurs around Svalbard, Iceland, the British Isles and Ireland, in Norway up to Finnmark, in the southwestern part of the Baltic, in the Wadden Sea, and on the North Sea coasts of Denmark, the Netherlands, and Brittany (France).
Population dynamics: Females become mature at the age of three to five years. Gestation lasts 10.5-11 months, including a 2-month delayed implantation. Lactation lasts 4-6 weeks. The annual pregnancy rate of adult females is on average 87%; in the Kattegat-Skagerrak, pregnancy rates are 92% (Häkkinen & Heide-Jørgensen, 1990). Pregnancy rates of 96% were found in the Danish Wadden Sea and the Limfjord areas (B. Larsen & N. Nørgaard pers. comm.). Longevity is 35 years for females and 25 years for males. For the Wadden Sea, first year mortality is 60% (Reijnders, 1978), and annual adult mortality about 10%. For the Kattegat-Skagerrak area, it is estimated that juvenile mortality is 33-52%, and adult survival is about 91% (Häkkinen & Heide-Jørgensen, 1990).

Population size: The population in Great Britain consisted of at least 25,000 animals in 1987, although telemetric studies suggest that it may have been as high as 46,000-47,000 (Thompson & Harwood, 1990). The minimum size of the Kattegat/Skagerrak population was 5,500 in 1986. In 1987, the population size was estimated at over 6,000 (T. Häkkinen, pers. comm.). In 1988, after a virus epidemic, the population size was estimated at 7,900 (Harkonen & Heide-Jørgensen, 1990). The population in Ireland comprised at least 1,500-2,000 seals. The Norwegian population consists of about 4,000 animals (Bjørge, 1987) and the Icelandic population may be as large as 28,000 animals. The Baltic population is probably not higher than 200 individuals (Helle, 1983). The Wadden Sea population size in 1980 was estimated at 4,000-5,000. In 1987 this had increased to nearly 10,000 animals. In 1988 a viral infection killed a large portion of the Wadden Sea and Kattegat/Skagerrak population and also part of the population of eastern England and The Wash. In Britain, the calculated mortality (based on the results of surveys conducted before and after the epidemic) varied from 48% in The Wash to 0% on the west coast of Scotland. In the Wadden Sea and Kattegat/Skagerrak, surveys revealed a 60% decline in numbers after the virus outbreak (Dietz et al., 1989). The populations in the Wadden Sea and Kattegat/Skagerrak are recovering rapidly since the virus, as exemplified by the population size of 1992: Wadden Sea 7,250 and a prediction of 5,200 in Kattegat/Skagerrak.

Feeding: A number of prey species are taken and the diet varies considerably both in time and in space. This species feeds predominantly in inshore waters on a wide variety of fish species, such as flounder (Platichthys flesus), sole (Solea vulgaris), herring (Clupea harengus), cod (Gadus morhua), whiting (Merlangius merlangus), and sand eels (Ammodramys sp.), but mussels, crabs and squid are also eaten (Härkönén, 1987).

Trophic relations: Not much is known about predation or competition with other top marine predators.

Human impacts: Many human activities have an influence on harbor seal populations. Seals sometimes feed in areas used by commercial fisheries and they may become entangled in nets. Several areas of their habitat, especially the Wadden Sea and the Baltic, are severely polluted. Negative effects on the seals’ reproductive performance have been demonstrated (Reijnders, 1986). Contaminant burdens in seals were found to correlate with immuno-suppressive characteristics. Tidal flat areas where harbor seals haul out at low tide are often visited by tourists, especially in the Wadden Sea, which creates disturbances. But harbor seals are also disturbed on rocks and non-tidal sandy beaches. Land reclamation projects, such as the Delta Project in the Netherlands, reduce the seals’ habitat.

Exploitation: The harbor seal was heavily hunted during the 19th and first half of the 20th century, in both the Wadden Sea (Reijnders, 1992b) and Kattegat/Skagerrak (Härkönén, 1987). Hunting is now prohibited in the Wadden Sea area (The Netherlands, Germany, Denmark, and Swedish waters). Hunting of harbor seals is currently only permitted in Norway and Iceland, where there may be an annual catch of 5,000-7,000. In the United
Threats to the population: An important threat to the harbor seal comes from pollution, especially in the Wadden Sea (Reijnders, 1986). Disturbance and habitat changes due to land reclamation and construction works have caused the disappearance of the harbor seal from the southern part of the Netherlands after it had previously been severely reduced by overexploitation and pollution (Reijnders, 1985). Incidental kills in fisheries also take their toll on the harbor seals. As pointed out earlier, an outbreak of a viral infection in 1988 severely reduced several populations in the North Sea. The virus was identified as the Phocid Distemper Virus, very similar to CDV morbillivirus (Osterhaus & Vedder, 1988). The long-term effects on the population are still unclear. Some possible trends are given for the Wadden Sea (Reijnders, 1989). No further outbreaks have been observed since 1988, although occasionally infected animals are still observed (G. Hendemann, pers. comm.; I. Vedder pers. comm.).

References:

Western Atlantic harbor seal
Phoca vitulina concolor (DeKay, 1842)

Nomenclature: The harbor seals living in freshwater lakes in Canada are occasionally assigned to separate subspecies, Phoca vitulina mellonae (Doutt, 1942), and will be discussed below.

Description: The length of males ranges from 150 to 180 cm and the weight from 55 to 105 kg. Females measure 120-150 cm and weigh 45-87 kg. Pups measure 70-90 cm at birth and weigh 9.11 kg. The color of this harbor seal is variable: grey to brownish grey with black spots.

Distribution: This seal occurs from Maine north to Ellesmere Island in the Canadian Arctic and west to Hudson Bay. This range includes Nova Scotia, Newfoundland, Labrador and Baffin Island. This seal species is also found in Greenland.

Population dynamics: Females become mature at the age of three years. The pregnancy rate is on average 81%. Gestation
Figure 20. Distribution of the western Atlantic harbor seal (Phoca vitulina concolor). Known breeding areas are indicated by arrowheads.

lasts 10.5-11 months, including a delay of implantation of 2.5 months. Lactation lasts 24 days (Muelbert & D. Bowen, pers. comm.). Longevity is 35 years for females and 25 years for males. Adult mortality is probably about 13%. The pre-weaning mortality ranges from 13-17% with shark mortalities accounting for 6-7% of this. Subadult mortality is around 16%.

**Population size:** Complete cohort tagging of pups on Sable Island since 1978 showed a pup increase of 3%-5% until 1989, after which production appears to have levelled at 500 pups a year (W.T. Stobol unpublished). The population size in Canada is estimated to be 30,000 to 40,000 animals. No estimates are available for Greenland. Payne and Selzer (1989) estimate the U.S.A. population size at 4,700 animals. The total western Atlantic harbor seal population size could well be from 40,000 to 100,000.

**Feeding:** The species feeds mainly on local fish, including herring (Clupea harengus) and flounder (Platichthys flesus). In eastern Canada, mackerel (Decapterus macarellus), squid, sand lance (Hyperoplus sp.) and silver hake are also consumed (D. Bowen, pers. comm.).

**Trophic relations:** There are no data on competition, but it is likely that there is a possible dietary overlap with the ringed and grey seal. Possible predators include polar bears (Ursus maritimus) and killer whales (Orcinus Orca). Pups are preyed on by foxes and large birds of prey. On Sable Island, sharks are also known to prey on pups (P. Brodie, pers. comm.).

**Human impacts:** There is some interaction with commercial fisheries, as part of the seal’s diet consists of fish of commercial interest. There are reports of seals damaging fishing gear.

**Exploitation:** In the U.S.A. the harbor seal is protected. There is no hunting in Atlantic Canada. The Inuit take very small numbers in the north. In Greenland there is some hunting by aboriginals, who take 100-200 seals per annum.

**Threats to the population:** none known.

**References:**


**Western Pacific harbor seal**

*Phoca vitulina stejnegeri* (Allen, 1902)

**Eastern Pacific harbor seal**

*Phoca vitulina richardi* (Grey, 1864)

**Nomenclature:** Both *P. v. stejnegeri* and *P. v. richardi* have been given subspecies status. The western Pacific harbor seal, formerly the Kuril seal or insular seal, was given the status of a species: *Phoca insularis*, also *Phoca kuriensis*. In 1977 it was included as a subspecies in *Phoca vitulina* and *Phoca vitulina richardi* was given the correct spelling *Phoca vitulina richardi*. 

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Description: Of *P. v. stejnegeri* the adult males measure 114-186 cm and weigh 87-170 kg. Adult females are 160-169 cm long and weigh 60-142 kg. At birth pups measure 98 cm and weigh 19 kg. Of *P. v. richardsi* adult males measure 161 cm and weigh 87 kg on average. Adult females average 148 cm long and weigh 65 kg. At birth pups measure 82 cm and weigh 10 kg. The subspecies are similar in appearance. There are dark and light varieties. The light variety has a dark dorsal surface and pale side and a ventral surface with spots that tend to coalesce. There are also pale areas around the eyes and snout. The dark variety has a nearly black background of densely packed spots, some of which are encircled by lighter fur. The majority of these seals are of the dark color phase.

Distribution: *P. v. stejnegeri* occurs on Pacific Islands: from Hokkaido (Japan) through the Kuril Islands, along Kamchatka to the Commander Islands and the western Aleutian Islands. They tend to occur in small groups on rocky shores and islands. *P. v. richardsi* ranges from Cedros Island (Baja California) along the Pacific coasts of the United States, Canada, and Alaska, through the Aleutian Islands to the Pribilof Islands.

Feeding: The diet consists mainly of fish, including flat fish, herring (*Clupea pallasii*), cod (*Gadus macrocephalus*), walleye pollock (*Theraegra chalcogramma*), and hake (*Merluccius productus*), but also includes squid, octopus, and shrimp. The composition varies regionally and seasonally, depending on local availability. The daily consumption is estimated to be 2-3 kg.

Trophic relations: The diet of this species overlaps with that of the northern fur seal (*Callorhinus ursinus*), the California sea lion (*Zalophus californianus*), and the Steller’s sea lion (*Eumetopias jubatus*). The main predator is probably the killer whale (*Orcinus Orca*) and young seals are preyed on by sharks.

Population dynamics: The onset of sexual maturity for females is at 3-5 years of age and for males at 3-6 years. The annual pregnancy rate of adult females is 88%, but in British Columbia (a growing population) it is 90-96%. Gestation lasts 10.5-11 months, including a delay of implantation of 2.5 months. Lactation lasts 4-6 weeks. Longevity is around 20 years for males and 30 years for females. The annual mortality rate in British Columbia for pups is 25%, and 9% for juveniles of both sexes aged 1 to 5 years, 15% for adult males, and 5% for adult females (P. Olesiuk, pers. comm.).

Population size: Population estimates are available for only a few areas. The British Columbia population is estimated at 100,000 and increasing at an intrinsic rate of 12.5% per year (P. Olesiuk, pers. comm.). The Alaskan population size was estimated at about 260,000 in 1970 but a major decline has occurred in some areas (Hoover, 1988). The population at San Miguel Island consists of between 1,445 and 2,168 seals (Yochum et al., 1987). The minimum count in California is over 20,000 seals (Hanon, pers. comm.). About 330 seals occur in Japan (Wada et al., 1991). Estimates for other areas are: about 1,900 in the Kuril Islands; 1,500 in the Commander Islands and 200 animals in Kamchatka (Hayana, 1988).

Human impacts: Because of the remote areas they occupy, harvest levels of *P. v. stejnegeri* are very low. This is also the case for incidental catches, except for waters around Hokkaido Island, Japan. In this area removals exceed recruitment. Intensive use of large salmon (*Salmo salar*) traps and smaller gillnets cause many casualties. In Alaska, harbor seals (*P. v. richardsi*) may be taken by natives for subsistence purposes. Many of the principal prey species are fished commercially. In 1980 in California, 132 seals were caught and killed in gillnets (DeMaster et al., 1983). From 1983 to 1985, 834-2,028 seals were estimated to have been killed in gillnets in this area (J. Barlow, pers. comm.). In the Columbia River (Oregon/Washington) about 100 seals are taken annually in gillnets (B. Mate, pers. comm.). Interaction with the gillnet fisheries is common in some parts of Alaska (Hoover, 1988). This is also the case with the small population in Japan (Wada et al., 1991).
Exploitation: In the U.S., harbor seals may be taken by natives for subsistence and by fisherman to protect their gear or catch. Prior to 1970 there was a bounty on seals in Alaska, and 8,000-12,000 animals may have been killed in some years. This was also the case in British Columbia, where about 6,000 animals were killed a year.

Threats to the population: *Phoca vitulina stejnegeri* suffers severe losses through incidental catch in Japan. The population is maintained at a fairly stable level by immigration from the nearby Kuril Islands. Measures should be taken to reduce the current level of these incidental catches. (J.J. Burns, pers. comm.). Currently *Phoca vitulina stejnegeri* is included in the IUCN Red List as being Vulnerable, but the Seal Specialist Group considers that only the population in Hokkaido should be listed. Oil spills, as recently shown by the Exxon-Valdez accident, may have an effect on seals in some areas. Incidental catches in fishing gear and shooting may also be important factors. Disease does not appear to have had a major effect on Pacific harbor seals. Populations in some parts of Alaska declined by approximately 85% between 1970-1988, but the cause of the decline is not known (Pitcher, 1990).

References:


mens (carcasses) have been added and used for studies and analysis (T. Smith, pers. comm.).

**Distribution:** The presence of seals in lakes of the Ungava peninsula, Quebec, Canada, was first reported by Low (1898). Since that time sightings have been confirmed from Lac des Loups Marins, or Lower Seal Lake (located between 56°18'N and 73°45'W to 74°20'W), and its outflow, the Nastapoka River (Doult, 1942; Power & Grégoire, 1978; Berrouard, 1984; Smith & Horonowitsch, 1987). There are unconfirmed reports of seals having once been in Lake Minto and Upper Seal Lake (Doult, 1942; Mansfield, 1967). Recent studies have cited seals in other lakes including Lac a l'Eau Claire, Lac Bourdel, and Lac Bienville, and seal vocalizations have been recorded in several other lakes (unpublished data from Hydro Québec).

**Population dynamics:** Nothing is known about the population dynamics of these seals. The female animal collected by Doult (1942) was pregnant, however, indicating that breeding probably occurs in Lac des Loups Marins. During the numerous sightings made by Hydro-Québec, no births or newborn pups were observed. Several large females, seen hauled out along the ice edges, might have been pregnant.

**Population size:** No reliable estimates exist. A maximum of 500 animals was the “guess” of Doult (1957), cited in Schefler (1958). Power and Grégoire (1978) indirectly calculated two estimates of 200 and 600 animals. Based on tenuous extrapolations of seal densities of 0.1 seal/km² in the Lac des Loups Marins, a population size of 120-170 seals is estimated for an area of 1,200 km².

**Feeding:** Power and Grégoire (1978) suggested that the brook trout (*Salvelinus fontinalis*) and the lake trout (*Salvelinus namaycush*) are the primary prey of this seal, but provided no direct evidence to support this hypothesis. Recent stomach analysis of the new carcasses confirms that Ungava seals feed on brook trout. Most otoliths were of very small fish.

**Trophic relations:** No data available.

**Human impacts:** The Ungava seal faces an uncertain future. As part of the Grande-Baleine section of the proposed James Bay II hydroelectric development, Hydro-Québec is considering a partial diversion of the headwaters of the Nastapoka River. According to Hydro-Québec, this will reduce the water level of the Lac des Loups Marins by 20 cm (Perreault & Rougie, 1989). Since the seals may rely on areas which remain ice-free in winter because of strong currents, and also depend on under-ice shoreline shelters (Smith & Horonowitsch, 1987), a reduced lake level could result in increased mortality of seals in winter. Seasonal alterations of discharge rates brought about by the James Bay II project could also affect the distribution and abundance of the seals’ prey, and could contaminate the lake with methyl mercury produced by the flooded, decomposing vegetation.

**Exploitation:** Low (1898) reported Cree Indian kills on the order of 30 animals per year, and Doult (1942) also mentioned this hunt. There are indications that native people living in the area continue to take a few animals intermittently.

**Threats to the population:** While committed to beginning the construction of the Grande Baleine project in 1997, Hydro-Québec has yet to release any of its studies of the development’s potential impact on the area’s environment and wildlife. This information must be made public, and comprehensive environmental impact hearings convened, before a proper assessment can be made of the project’s likely effects on the Ungava seal. There is a danger that this will not occur prior to the initiation of further development. This

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Figure 22: Distribution of the Ungava seal (*Phoca vitulina mellanae*).
species will be included in the 1993 IUCN Red List as Insufficiently Known.

References:

Figure 23. Distribution of the Larga seal (Phoca largha). Known breeding areas are indicated by arrowheads.

Larga seal
Phoca largha (Pallas, 1811)

Nomenclature: In some cases this seal is referred to as Phoca vitulina largha, but its status as a separate species is now commonly accepted. Another name for the Larga seal is the spotted seal.

Description: There are some differences between different populations. Bonner (1979) gives the following dimensions: males: 150-170 cm and 85-110 kg; females: 140-160 cm and 65-115 kg; pups: 75-90 cm and 7-12 kg. Popov (1982) gives measurements for this species that are somewhat larger: males: 210 cm and 150 kg; females: 170 cm and 90-115 kg. The coat of this seal has a pale silver background and is dark grey along the dorsal surface scattered with brown to black oval spots. Pups are born with white or grey long-haired fur.

Distribution: The Larga seal lives along the coasts in summer and along the pack ice in winter. It occurs in the Bering Sea, Chukchi Sea and along the Arctic coast of Alaska and from the Sea of Okhotsk south to Hokkaido, the Po Hai Sea, and the northwest Yellow Sea.

Population dynamics: Females become mature at 3-4 years and males at 4.5 years. Popov (1982) mentions 4.5 and 5-6 years (respectively). The pregnancy rate is unknown. Gestation lasts 10.5 months and lactation lasts 4 weeks. The longevity is about 35 years. The mortality rate in the first year is 45%, and for all other age classes is 8-10%.

Population size: Popov (1982) estimated the Bering Sea population at 135,000. Fedoseev’s estimate was about 100,000 (Fedoseev et al., 1988). Even this number is considered an overestimation of the current population size (Burkanov et al., 1988). The Sea of Okhotsk population was estimated by Popov (1982) at 130,000.

Feeding: When near the ice, the Larga seal feeds on fish, cephalopods, and crustaceans. In Alaska it seems to prefer small schooling fish.

Trophic relations: Data in Lowry et al. (1982) indicate competition with other pinnipeds, including Eumetopias, Callorhinus, P. vitulina, P. hispida, and P. fasciata. The predators of the Larga seal are bears and foxes.

Human impacts: Larga seals sometimes eat fish out of the fishing gear, and to defend their landings, fishermen shoot the seals. The impact of this mortality on the population has yet to be assessed (V. Burkanov, pers. comm.).

Exploitation: The total annual harvest of this seal in the Commonwealth of Independent States is estimated at 10,000-
15,000. Popov (1982) mentions quotas set for the Bering Sea at 5,000, and for the Okhotsk Sea at 6,000 for ship-based hunts. For land-based hunts a quota of 2,000 is set. This gives a total allowed catch for the Commonwealth of Independent States of 13,000 seals. In Alaska there has been no recent monitoring of the native harvest.

**Threats to the population:** Oil and gas development may affect the habitat used by the Larga seal. Some seals are caught in fishing gear, and commercial fishing may affect their food supply in certain areas.

**References:**


**Ringed seal**

*Phoca hispida* (Schreber, 1775)

**Nomenclature:** The species was first described as *Phoca hispida* by Schreber in 1775. Fabricius called it *Phoca foetida* in 1776. Several subspecies have been recognized, each with their own specific range. These are: *P. h. hispida* (Schreber, 1775), (*P. h. krascheninnikovi*) (Naumov & Smirnov, 1935), which had initially been given a separate status as a subspecies, but it is now

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*Figure 24.* Distribution of the ringed seal (*Phoca hispida*): 1—*P. h. hispida*, 2—*P. h. ochotensis*.
Arctic ringed seal (Phoca hispida hispida), Spitsbergen.

Recognized as a subpopulation of P. h. hispida; P. h. ochotensis (Pallas, 1811); P. h. botnica (Gmelin, 1785); P. h. ladogensis (Nordquist, 1899); and P. h. saimensis (Nordquist, 1899). The latter three subspecies will be dealt with in separate accounts.

Description: The adult ringed seal has a mean length of 130 cm (range 99-157 cm) and weighs around 68 kg (range 45-107 kg). Males are slightly larger than females. The color of the coat is dark grey with a grey to black dorsal surface with oval white rings. The ventral surface is light grey. Pups have a length of 55-65 cm and weigh 4-5 kg at birth. Pups are born with white long-haired fur and molt after 4-6 weeks.

Distribution: P. h. hispida: Arctic coasts of Europe, the Commonwealth of Independent States, the North Bering Sea, Canada, and Alaska, including Nova Zemlya, Svalbard, Greenland, and Baffin Island. P. h. ochotensis: Kamchatka, Okhotsk Sea, and southward to 35°N, along the Japanese Pacific coast.

Population dynamics: The ringed seal female becomes mature at the age of 4-7 (at the age of 3 years in Svalbard, Lydersen & Gjertz, 1987), males at 5-7. The annual pregnancy rate of mature females is 80-95% (Smith, 1973, 1987). Popov (1982) estimates annual pregnancy rates of 70% for P. h. hispida (73% for the population in the Bering Sea), and 80% for P. h. ochotensis. Gestation lasts up to 10.5-11 months, including a delay of implantation of 3.5 months. The longevity is 46 years. The overall annual mortality is 15%. The annual mortality for all age classes except pups is 9%.

Population size: The world population size of the ringed seal is estimated to be 6-7 million animals. The population of P. h. hispida is not known, but despite the uncertainties, the estimate of Bychkov (in Frost & Lowry, 1981) of 2.5 million is a realistic minimum. Popov (1982) estimated the size of the population in the Bering Sea at 70,000-80,000. The population size of P. h. ochotensis is about 800,000-1,000,000.

Feeding: Ringed seals feed on a variety of prey including benthic, nektic, and planktonic organisms. In winter a large portion of the diet is made up of polar (Arctogadus glacialis) and Arctic cod (Boreogadus saida); in summer, crustaceans and other invertebrates.

Trophic relations: There is an overlap in range and food choice with some other pinnipeds, bowhead whales (Balaena mysticetus), belugas (Delphinapterus leucas), birds, and fish (Frost & Lowry, 1981). There is extensive predation on the ringed seal by polar bears (Ursus maritimus), but also by arctic foxes (Alopex lagopus), killer whales (Orcinus orca), and occasionally walruses. Ringed seal pups are preyed on by glaucous gulls and ravens (Lydersen & Smith, 1989).

Human impacts: Exploration for oil in the Arctic may lead to disturbance of the seals.

Exploitation: The total annual C.I.S.-American harvest is between 12,000 and 16,000 seals. The species has never been taken in larger numbers. Popov (1982) mentions harvests of 7,000 for the Sea of Okhotsk, 2,000-3,000 for the Bering Sea, and 3,500 for the White Sea. The harvest in the White Sea has been reduced to less than 1,500 animals (Yu. Timoshenko, pers. comm.). In Greenland the catches are 70,000-100,000 for 1979-1983, after which it is not documented. Ringed seals are also caught by Inuit (Canada). The Maximum Sustainable Yield (MSY) level is probably around 8%. In Alaska, natives are permitted to hunt the ringed seal but harvest levels are not monitored.

Threats to the population: The population in general is not in danger. However, especially in the Baltic, the population is under pressure due to the high level of pollution. Oil and gas development may affect the species.

References:
Baltic ringed seal

Phoca hispida botnica (Gmelin, 1785)

Nomenclature: This seal is also called the Baltic seal.

Description: The Baltic ringed seal is rather similar in appearance to P. h. hispida and it is the largest subspecies of the ringed seal in body mass (Helle, 1992).

Distribution: This seal inhabits the northern and central parts of the Baltic Sea. The largest populations are found in areas of most permanent and thickest ice cover in the Gulf of Bothnia, Finland, and Riga (Helle & Stenman, 1990).

Population dynamics: This seal species reaches sexual maturity at the age of 3-6 years, females somewhat earlier than males, on average. Annual pregnancy rate of mature females is over 95%. Reproduction has been severely disturbed by uterine pathology since the late 1960s. In the end of the 1970s, for instance, 50-60% of the mature females were sterile for the rest of their lives. The frequency of pathological changes decreased from its peak during the 1980s to about 30%-40% in 1990. Mortality of pups is unknown, but annual mortality at 5-15 years is less than 10% on average; this increases when the animals get older. Longevity has been recorded to 40 years (Helle & Stenman, 1990).

Population size: Frost and Lowry (1981) mention a population size for P. h. botnica of 10,000-50,000. In the early 1980s however, this population was no larger than 10,000 animals (Helle, 1983; Halkka, 1987). The total population size is estimated to be 5,000-8,000 (Helle & Stenman, 1990). Of these, about 3,000 live in the Gulf of Bothnia (Helle, 1986a; b; Härkönen & Heide-Jørgensen, 1990). The estimates of the population size in the Gulfs of Finland and Riga are less accurate (Tormosov & Espienko, 1986). According to reproductive data, the Baltic ringed seal population is probably slightly recovering at present (1991).

Feeding: The Baltic ringed seal feeds mainly on schooling fish, such as Baltic herring (Clupea harengus) and smelt (Osmerus eperlanus), and crustaceans, especially Mesidotea entomon (Söderberg, 1975; Tormosov & Rozov, 1987).

Trophic relations: The grey seal and harbor seal are the only seals inhabiting the same waters as the Baltic ringed seal. While the habitat use of these species is very different, they overlap marginally in feeding biology and breeding areas. There are no natural predators in the Baltic ecosystem.

Human impacts: The main interference with human activities originates from environmental pollution, fishing activities, and disturbance (mainly ship traffic through ice). In the Baltic Sea the ringed seal is a victim of pollution. The high prevalence of sterility caused by uterine occlusions has been attributed to high levels of PCBs (Helle et al., 1976).

Exploitation: The Baltic ringed seal has been heavily exploited in the 1900s, and as a result the annual catch has crashed from over 20,000 at the beginning of the century to none in 1989 (Helle & Stenman, 1990). Hunting has been prohibited since 1988.

Threats to the population: The most important threats are still environmental toxins. The Baltic Sea is extremely vulnerable to pollution because of the small water mass, slow water exchange, and high industrial activities around the sea. Fisheries are another threat to the population, leading to the death of several tens of young seals a year through accidental catches. A third danger to the population is the ship traffic through ice: active vessel traffic through breeding areas may break birth lairs and cause excessive disturbance by noise. This species will be included in the 1993 IUCN Red List as Vulnerable.

References:
Trophic relations: There are no other top predator species in the lake competing with the Ladoga seal. There are no natural predators.

Human impacts: There is a commercial fishery for smelt and cisco, but no interactions of the seals with this fishery are recorded. Nor has an increase in fishing affected the seal population (Yablokov, 1985).

Exploitation: Commercial exploitation of the Ladoga seal is prohibited. The annual catch is between 200 and 300 animals as bycatch in different fisheries (I. Filatov, pers. comm.).

Threats to the population: Industrialization around Lake Ladoga is resulting in pollution from organic wastes and chemicals including dioxin (Cave, 1990). This species will be included in the 1993 IUCN Red List as Vulnerable.

References:

Ladoga seal

Phoca hispida ladogensis (Nordquist, 1899)

Description: Adult Ladoga seals are 150 cm long and weigh 60-70 kg. Pups are 50-60 cm at birth and weigh 4-5 kg. There are three different types of Ladoga seal coats (Popov, 1979). 47% of the seals have a dark brown coat with light ring-shaped patterns; 29% have a dark brown coat with light vein-like patterns; 17% have a light coat with a dark dorsal belt and indistinctly defined rings and brown spots; the coat of the other 7% is not described by Popov.

Distribution: This seal is found only in Lake Ladoga in Karelia (Russia), Commonwealth of Independent States (CIS).

Population dynamics: Females reach maturity at the age of 4-5, males at the age of 6-7. Other parameters are unknown, except for the lactation time, which is about 1.5-2 months (I. Filatov, pers. comm.).

Population size: The population size in 1979 was estimated at 10,000-12,000 seals and thought to be stable (Fedoseev et al., 1979). E. Helle (pers. commun., 1992) reported a population size of 10,500-12,500 with a tendency to increase.

Feeding: This species feeds mainly on smelt (Osmerus eperlanus), ruffe (Gymnocephalus cernuus), burbot (Loxia lota), and cisco (Coregonus artedii).

Figure 26. Distribution of the Ladoga seal (Phoca hispida ladogensis). Known breeding areas are indicated by arrowheads.
Saimaa seal

Phoca hispida saimensis (Nordquist, 1899)

Description: The Saimaa seal is similar in appearance to the Baltic ringed seal, but is a little smaller and darker in color. Pups are grey compared to the white-coated pups born to Ladoga seals and Baltic ringed seals (Hyvärinen & Nieminen, 1990).

Distribution: The Saimaa seal is found only in Lake Saimaa in southeast Finland.

Population dynamics: The Saimaa seal reaches maturity between the ages 3 and 7 years. Lactation lasts 5-8 weeks. In the early 1980s pup mortality was 10-20% with an additional 40% caused by entanglement in fishing nets during the first year of life (Sipilä et al., 1990). Longevity is 30-40 years. Mortality rates at older ages are not recorded.

Population size: In 1971 the population size was estimated at about 250 animals. Helle (1983) estimated the population size at 100-150 animals. Sipilä and Hyvärinen (1990) estimate the population size at around 140. The latest estimate, based on more accurate methods, gives a population size of 160-180 seals (Sipilä, 1991).

Feeding: This seal feeds mainly on small schooling fish such as whitefish and vendace.

Trophic relations: Since this species lives in complete isolation, there is no real competition and there are no natural predators.

Human impacts: The main impact of humans on the Saimaa seal consists of disturbance, pollution, and habitat destruction.

Exploitation: This species has been protected since 1955. To prevent incidental kills of this rare seal, fisheries are banned from the main breeding areas.

Threats to the population: Despite the preventive measures, seals are occasionally entangled in fishing nets. Pollution, especially organochlorines and heavy metals, still poses a threat to this population. A recent threat is the water level control for a power plant, which can cause breaking of the ice in the breeding season, with disastrous effects for the newborn pups. An overall increase of pressure from human activity on the lake may reduce the distribution area for the seals. Increased boat traffic and tourism cause more disturbance. The building of summer cottages around the lake can lead to habitat destruction. Phoca hispida saimensis is included in the IUCN Red List as Endangered.

References:

Baikal seal

Phoca sibirica (Gmelin, 1788)

Nomenclature: This species is also referred to as Pusa sibirica, but the genus Pusa is now considered to be a subgenus of Phoca.
Figure 28. Distribution of the Baikal seal (Phoca sibirica).

Description: This seal measures 1.20-1.40 m and weighs 63-70 kg. Pups are 64-66 cm at birth and weigh 4-4.2 kg. The back of this species is a uniform dull grey, with lighter sides and a silvery belly. Pups are born with long white hair.

Distribution: This seal is found only in Lake Baikal, a fresh water body, about 640 km long, in the southeastern Commonwealth of Independent States.

Population dynamics: The age at maturity for females is 2-5 years and for males 4-7 years (Thomas et al., 1982; Reeves, in press). The annual pregnancy rate of adult females is 88%. Gestation lasts 11 months and lactation 2-2.5 months. Longevity and the natural mortality rate are unknown.

Population size: About 60,000-70,000 seals are estimated to live in Lake Baikal (Pastukhov, 1990; Yablokov, 1985).

Feeding: The Baikal seal feeds on more than 19 species of fish, but only four are of great importance as prey: Malayalkolomyanka (Comephorus dybowskii), bolshaya golomyanka (C. baikalensis), and the sculpins, Cottocomphorus grevingky and C. inermis (Stewart et al., 1992). The commercially most important fish species, omul (Coregonus atruninalis migrotrius), amounts to only 1% of the diet (Popov, 1982).

Trophic relations: There is no competition with other top predators. Brown bears (Ursus arctos) occasionally kill a few seals near the shore line but this does not have a significant effect on the population (B. Stewart, pers. comm.).

Human impacts: There is a low level of interaction with commercial fisheries. Pollution of the lakes by paper and pulp mills can potentially affect the seals, either directly or indirectly through their food sources.

Exploitation: There is an annual harvest of seals for furs. Roughly 5,000-6,000 Baikal seals, mostly pups, are killed each year. Harvest is now aimed at reducing the population to about 50,000 animals (Yablokov, 1985).

Threats to the population: Because mostly young seals are caught (50-60% of the total catch), the structure of the population may be affected. In 1986 only 19% of the population was between three and six years old, which is a vital age group for the population’s replenishment. Many of the wounded seals that are shot from boats are not recovered and are left to die. Mortality from hunting may therefore be much higher (20-40%) than the records of commercial harvest might suggest. Another concern is that in mild years the seals cannot complete their molt on the ice and go to the shores instead. Molting seals are often disturbed by boaters and gunners who hauled out on shores. As a consequence, some 10,000 pups were lost in 1981. The pollution of the lakes by the paper and pulp mills might have a negative effect on the seals in the future. Recent opening of the Siberian oil fields and the completion of the Baikal-Amur railroad have spurred additional industrial development. In the period 1987-1988 several thousand Baikal seals died of a viral disease (morbillivirus) closely related to canine distemper (Grachev et al., 1989).

References:
Fisheries Series No. 5, 72-73.

**Caspian seal**

*Phoca caspica* (Gmelin, 1788)

**Nomenclature:** This species is also referred to as *Pusa caspica*, but the genus *Pusa* is now considered to be a subgenus of *Phoca*.

**Description:** This seal measures 130-140 cm (180 cm at most) and weighs 50-60 kg up to 86 kg (Popov, 1982). Pups are 67-79 cm at birth and weigh 5 kg. They have an ash-grey back with light grey sides and ventral surface. Males have dark spots, while females have lighter spots. Pups are silvery-grey at birth.

**Distribution:** This seal lives only in the Caspian Sea in the southwestern Commonwealth of Independent States bordering northern Iran.

**Population dynamics:** The age of maturity for females is 4-5 years and for males 6-7 years. The annual pregnancy rate of adult females ranges from 40% to 70% (Popov, 1982). Gestation lasts 11 months. Longevity is about 35 years. Pup mortality during lactation is 22%.

**Population size:** The total population size is estimated to be 500,000-600,000. Popov (1982) estimated the number of reproductive females in 1973 at 90,000.

**Feeding:** The Caspian seal feeds on gobies, sculpins, clupeids, cyprinids, crustaceans, and shrimp. In the Ural River estuary carp (*Cyprinus carpio*), roach (*Rutilus rutilus*), and pikeperch (*Stizostedion lucioperca*) are eaten in large quantities (B. Stewart, pers. comm.).

**Trophic relations:** There is no obvious competition with other top predators. Wolves that live on the islands in the northern Caspian Sea have been reported to kill 17-40% of the suckling pups and 1% of the nursing female Caspian seals on these islands. The Caspian seals may also fall prey to large eagles.

**Human impacts:** There is an intensive fishery of cyprinids and clupeids, the main food sources for the seals.

**Exploitation:** Caspian seals have been intensively harvested for more than 200 years (Reeves, pers. comm.). There has been a regulated harvest of 60,000-65,000 pups per year. The quota is currently set at 50,000 (Popov, 1982).

**Threats to the population:** While the population is thought to be stable, degradation of the Caspian Sea ecosystem and seal habitat is a potential threat (B. Stewart, pers. comm.). Another threat to this population is overexploitation of its main food

Figure 29. Distribution of the Caspian seal (*Phoca caspica*).
sources (Yablokov, 1985). This species will be included in the 1993 IUCN Red List as Vulnerable.

References:

Harp seal
*Phoca groenlandica* (Erxleben, 1777)

Nomenclature: This species was originally noted by Fabricius in 1776 but was described by Erxleben in 1777. Grey (1850) changed the name to *Pagophilus groenlandicus*, but the species is now again included in the genus *Phoca*, following Burns and Fay (1970). The species is also known by a number of common names, the most popular being Greenland seal and saddleback.

Description: Adult male and female harp seals are, on average 169 cm long and weigh approximately 130 kg (Innes et al., 1981).

On average, newborn pups measure about 80-85 cm and weigh about 10-11 kg. Males are silvery-grey with a black head and a horseshoe-shaped band across the back and flanks. Females usually have a lighter-colored head, the "hat" is also fainter and can be fragmented. Pups have a silky-white fur at birth which is molted after about two weeks. After molting, they are silvery-grey with irregular dark and black spots, and are known as "beaters". The spotted pelts is retained until maturation at four years or older; such animals are called "bedlamers" (Lavigne & Kovacs, 1988).

Distribution: Three populations of harp seals are recognized, each with a distinct whelping area (Sergeant, 1976): The Barents Sea population, reproducing on the “east” ice in the White Sea; The east Greenland population, reproducing on the “west” ice near the island of Jan Mayen; and the northwest Atlantic population (off the east coast of Canada) breeding on ice in the Gulf of St. Lawrence (Gulf herd) and off the coast of Newfoundland and Labrador (front herd). From these whelping regions, the seals disperse widely into subarctic and Arctic waters during the summer and autumn. Tagging results indicate some movements of young animals between regions but there is no evidence of breeding females moving from one population to another.

Population dynamics: Females become mature at about 4-5 years and males at 5-8 years. This may be density dependent and annual pregnancy rate of mature females is over 90% (Bowen et al., 1981). Gestation lasts about 11.5 months, including a 3-4 month period of delayed implantation (Stewart et al., 1989). Lactation lasts an average of 12 days (Lavigne & Kovacs, 1988). Average life span is about 15-20 years; maximum recorded is over 30 years. Annual adult natural mortality rate for adult harp seals is estimated at around 10% per year; natural mortality rates of younger animals are thought to be somewhat higher (Roff & Bowen, 1986).

Populations size: For the Northwest Atlantic population, estimates of annual pup production for the late 1970s and early 1980s, based on mark-recapture techniques, were in the order of 500,000-550,000 (Warren, 1991), not very different from several estimates arising out of a 1990 aerial survey (562,100 ± 78,000), by the Canadian Fisheries Scientific Advisory Committee (CAFSAC), 1991; 536,400 ± 115,300 (SE) from aerial photographic surveys and 577,900 ± 38,800 (SE) from a combination of photographic and visual estimates (Stenson et al., 1991)). Because of differences in the methodologies employed, the available data do not lend themselves to analyze trends. Consistently, Cooke et al. (1986) were unable to determine whether the population had been increasing or decreasing slightly or had been relatively constant during the preceding fifteen years. Recently, CAFSAC (1991) concluded, on the basis of some simplistic calculations, that the current population size might be in the range of 2.4-4.2 million animals. The lower figure is quite similar to the 1981 population estimate of 2.04-2.15 million provided by the Northwest Atlantic Fisheries Organization (NAFO) Scientific Council (NAFO, 1981). The higher figure suggests that the population has increased with reduced hunting in recent years;
this possibility remains to be verified because the calculations themselves actually assumed that the population had increased. The present status of the other two stocks is even less certain. There is some evidence that the population in the White and Barents Seas underwent a population decline in the 1980s, coincident with the decline in the capelin stock (Hiltnæ & Olsen, 1988). Some estimates suggest that the number of whelping females declined in the late 1980s by about 50%, from a high of 140,000 to 71,000 in 1988 (International Council for the Exploration of the Sea (ICES), 1990). If this were true, it would suggest that current population size is in the order of 500,000 or less, down from an estimated 1.0 million in the early 1980s (Lydersen et al., 1991). There is very little data available to assess the current size of the Jan Mayen population. Estimates of pup production in recent years have ranged from 27,500-31,500 (ICES, 1990), not very different from the 25,000 estimate from the late 1970s (FAO, 1979), to 50,000-75,000 (ICES/NAFO, 1991). These uncertain figures suggest that current population size may be in the order of 100,000-400,000 seals, but the paucity of data precludes any analysis of population trends.

Feeding: Harp seals eat a wide variety of prey species ranging from small invertebrates (e.g. crustaceans) to fish. Diet varies with seal age and with area and season. Feeding habits of northwest Atlantic harp seals are better known than those of the other two populations (e.g. Sergeant, 1976; Lavigne et al., 1981; 1985; Bowen, 1985; Angantyr & Kapel, 1991; Murie & Lavigne, 1991). A review of the literature indicates that this population eats more than 50 species of invertebrates and more than 30 species of fish, the most important being capelin (Mallotus villosus), polar cod (Boreogadus saida), amphipods, and euphausids. Harp seals feeding along the ice edge in the Barents Sea are known to consume amphipods, euphausids, and decapods (e.g. shrimp, prawns). Another feeding data were obtained from harp seals that invaded Norwegian coastal waters in the late 1980s (Haug et al., 1990). Because these seals were taken in waters beyond their normal range and many were in poor condition, their stomach contents, which included a variety of fish (including Atlantic cod (Gadus morhua), saithe (Pollachius virens), haddock (Melanogrammus aeglefinus), Norway pout (Trisopterus esmarkii), herring (Clupea pallasi), and capelin) and, to a lesser extent, prawns and squid, may not reflect normal feeding patterns.

Trophic relations: Harp seals share common prey species with a variety of other predators, including Atlantic cod (Gadus morhua), Greenland halibut (Reinhardtius hippoglossoides), sea birds, fin whales (Balaenoptera physalus), minke whales (Balaenoptera acutorostrata), and humans. Polar bears (Ursus maritimus), killer whales (Orcinus orca), sharks, and humans are the main predators of this species.

Human impacts: All three populations are still hunted, either on their breeding grounds or in Arctic and subarctic waters during the summer months. Additional animals (thousands) are killed as incidental catches in commercial fishing gear (Woodley & Lavigne, 1990). Commercial fisheries for important prey species, such as capelin in the northwest Atlantic and in the Barents Sea, may potentially impact on resident populations (FAO, 1991).

Exploitation: All three populations have been exploited for centuries. In the late 1960s, harp seal exploitation in the Northwest Atlantic came under the auspices of the International Commission for Northwest Atlantic Fisheries (ICNAF), which was subsequently dissolved and partially replaced by the NAFO. The current NAFO quota is 186,000 animals per year but annual catches in recent years have fallen short of this, averaging about 31,000 between 1983 and 1991, largely because of a lack of markets for the products. This population is also hunted off West Greenland during the summer months. The reported annual catch from 1980-1985 was in the range of 12,000-19,000 seals (Kapil, 1986). Exploitation at Jan Mayen and in the White and Barents Seas has been conducted under the auspices of a Joint Norwegian-Soviet Fisheries Commission and a working group of the ICES and, more recently, by a joint ICES/NAFO working group. For the Jan Mayen population, annual quotas between 1987 and 1992 ranged from 7,200-28,000 animals whereas the average catch for the period 1983-1991 was about 7,000 seals. For the White Sea population, annual catch between 1981 and 1981 averaged 64,000 seals; since 1983 quotas have ranged from 40,000 (the 1989-1992 quota)-80,000.

Threats to the population: Historically, the main threat was overexploitation of the stocks. With the recently reduced seal catch, a more pressing issue is now the question of food availability. Reduced food availability, either the result of overfishing of commercially important prey (FAO, 1979; Stewart & Lavigne, 1984; also see section V.3.2.2.), climate change (see section V.4.1), or some combination of the two, remains a threat to harp seal populations, especially in the Barents Sea and in the northwest Atlantic. The apparent increase in incidental catches of harp seals in fishing gear, particularly off Norway in 1986-1988 and off Newfoundland in recent years (Woodley & Lavigne, 1991), may be another cause for concern. Similarly, concern has been expressed about the deleterious effects of environmental
contaminants, particularly for harp seals feeding in the St. Lawrence River estuary (Malouf, 1986). Additionally, the threat of oil spills, for example, in the northwest Atlantic off the east coast of Canada, will remain as long as exploration and drilling continue. Some concern has also been expressed about the impacts of tanker traffic, particularly in places like Lancaster Sound in the eastern Canadian Arctic, which is an important summering area for a number of marine mammals, including harp seals (Mansfield, 1983).

References:

Ribbon seal

Phoca fasciata (Zimmerman, 1783)

Nomenclature: In 1983, Zimmerman described this seal and named it Phoca fasciata. In 1873 Gill put this seal in a separate genus and named it Histrionophoca fasciata. Burns and Fay (1970) included it again in the genus Phoca. This seal is also called the banded seal.

Description: This seal measures on an average 155-165 cm up to 190 cm (Popov, 1982) and weighs 70-80 kg and up to 100 kg (Popov, 1982). At birth, pups are 80-90 cm long and weigh 9-10 kg. Males are dark chocolate brown to black with white to yellowish bands around the neck, flippers, and hind part. Females
Figure 31. Distribution of the ribbon seal (Phoca fasciata).

have similar coloration, but less distinct. Pups are born with long white hair, which is replaced after the molt by a coat with blue-grey dorsal and silver-grey ventral surfaces.

**Distribution:** Ribbon seals occur principally in the Sea of Okhotsk and in the Bering Sea. They are associated with pack ice during January to May and appear to be pelagic during the open water season.

**Population dynamics:** Females are mature when they are 2-4 years old and males when they are 3-5 years (Burns, 1981); Popov (1982) gives 4-5 and 5-6 years, respectively. The annual pregnancy rate of adult females is 85%. Gestation lasts 10.5-11 months. Ribbon seals may live to the age of 22-26 years. First year mortality is 44% and the annual mortality rate for older age classes averages 11.2%.

**Population size:** Stirling (1979) estimated the Bering Sea population size at 100,000, and the Okhotsk Sea population size at 140,000. Popov (1982) arrived at estimates of 60,000 for the Bering Sea and 133,000 for the Okhotsk Sea. Population surveys have not been adequate and the actual abundance and trends are poorly known.

**Feeding:** The ribbon seal feeds primarily on fish like pollock (Theragra chalcogramma), eelpout (Zoarces viviparus), and Arctic cod (Boreogadus saida), as well as cephalopods and bottom invertebrates.

**Trophic relations:** There may be competition for food with other pinniped species including fur seals, Larga seals, harbor seals, and Steller’s sea lions. Possible predators are killer whales (Orcinus Orca) and sharks.

**Human impacts:** Some important ribbon seal prey are harvested by commercial fisheries and a few animals are caught incidentally in fishing gear. Oil and gas exploration has been proposed for some parts of the species’ range in the Bering Sea.

**Exploitation:** In Alaska, only subsistence hunting occurs, and less than 100 animals are taken per year (Burns, 1981). In the Commonwealth of Independent States, a permit system is in effect which allows a harvest of 3,000 ribbon seals in the Bering Sea and 3,500 in the Sea of Okhotsk. In the past, this species has been overexploited.

**Threats to the population:** There is a potential for overexploitation, which has occurred in the past. Competition for food with other predators and commercial fisheries may limit population growth or result in declines.

**References:**

**Hooded seal**

**Cystophora cristata** (Erxleben, 1777)

**Description:** The average length of males is 230 cm (up to 285 cm) and average weight 250 kg (up to 435 kg). Females measure on average 200 cm (up to 230 cm) and average weight is 180 kg (up to 350 kg). Pups (“bluebacks”) are 90-115 cm long and weigh 19 to 25 kg at birth (Kovacs & Lavigue, 1991). Hooded seals are grey, with black irregular patches. The males have an inflatable hood (bladder), which is an enlargement of the nasal cavity. To inflate it, they close the nostrils. (This is not necessary for the proboscis of elephant seals.)
**Distribution:** Hooded seals are migratory animals. They occur throughout the Northern Atlantic. There are a few distinct breeding sites: the West Ice (Jan Mayen region), the Davis Strait at 64°N, the Front (Newfoundland), and the Gulf of St. Lawrence. Molting takes place in two locations: in Denmark Strait (southeast Greenland) used by the Newfoundland and Davis Strait whelping stocks, and off northeast Greenland at 73-78°N used by the Jan Mayen whelping stock (ICES, 1990).

**Population dynamics:** On average females reach their sexual maturity at 4 years but some may become mature at the age of 3. The onset of maturity in males is not well known but a few data indicate 4-6 years. The annual pregnancy rate of adult mature females is 95%. Gestation lasts about 11.5 months, including a 3-4 month delay of implantation. Lactation lasts 4 days (Bowen et al., 1985, Wiig, 1985, Kovacs & Lavigne, 1991). The natural mortality rates for the northwest Atlantic stocks have been estimated to range from 7% to 13% (NAFO, 1983).

**Population size:** Recent estimates of pup production in the Davis Strait and the Newfoundland (Front) patches were about 19,000 and 62,000 respectively (Bowen et al., 1986), corresponding to a total northwest Atlantic hooded seal population size of approximately 325,000 animals. The Jan Mayen stock is estimated at about 200,000 based on a pup production of 50,000 (ICES/NAFO, 1991). This brings the estimate for the total hooded seal population to approximately 300,000-600,000 specimens.

**Feeding:** Adult hooded seals feed on Greenland halibut (*Reinhardtius hippoglossoides*), redfish (*Sebastes marinus*), polar cod (*Arcogadus glacialis*), and squid. Pups feed mainly on capelin (*Trisopterus minutus*), polar cod, and amphipods.

**Trophic relations:** Although their area of distribution partly overlaps with the harp seal (*Phoca groenlandica*), the extent of possible competition between hooded seals and other marine species has not been assessed. Sharks and polar bears (*Ursus maritimus*) are predators of the hooded seal.

**Human impacts:** No interactions with fisheries have been recorded.

**Exploitation:** Average catches at Jan Mayen were 25,600 for 1968-1975, 15,400 for 1976-1982, 597 for 1983-1984 and 4,900 for 1985-1990 (ICES, 1990). At Newfoundland catches were between 5,000 to 10,000 for 1946-1965, 12,000 to 13,000 for 1966-1982, whereas it decreased to a few hundred. In the Denmark Strait the former catch of 15,000 since World War II, was discontinued in 1961. The catches of hooded seals in Greenland increased from 1,000 to 2,000 in the 1950s to 5,000-6,000 in the 1980s (Kapel, 1986).

**Threats to the population:** Current harvest levels for hooded seals are low and appear to pose no threat for the species. However, hooded seal skins are valuable and there is a potential for overexploitation. Any increase in harvest levels should be combined with a detailed monitoring program. Competition for food with other predators and commercial fisheries may limit population growth or result in declines.

**References:**


Bearded seal
_Erignathus barbatus_ (Erxleben, 1777)

_Nomenclature:_ There are two subspecies commonly recognized, each with its own geographical range: _E.b. barbatus_ (Erxleben, 1777) and _E.b. nauticus_ (Pallas, 1811).

_Description:_ Adult bearded seals are 225-270 cm long and weigh 275-340 kg. Pups are 87-120 cm long and weigh 25-43 kg. Bearded seals are brownish-grey, occasionally with a reddish-brown face and neck. They have long moustachial whiskers, which curl in tight spirals. Their front flippers are rather square. Pups are dark with white patches on the back and on the flippers.

_Distribution:_ The bearded seal's distribution is circumpolar with a northern limit at 80-85°N. _E.b. barbatus_ is found from the Laptev Sea westwards to the Hudson bay. It ranges as far south as the Gulf of St. Lawrence. _E.b. nauticus_ ranges from the Laptev Sea eastward to the Canadian Arctic, up to Baffin Island. It occurs as far south as the Sea of Okhotsk or even Hokkaido. In most areas it migrates following the seasonal advance and retreat of sea ice.

_Population dynamics:_ Females reach maturity at ages 5-6; males at 6-7 years (Burns, 1981). The annual pregnancy rate of mature females in Alaska is 85% and in the Commonwealth of Independent States 75% (Popov, 1982). Gestation lasts 10.5-11 months including a delay of implantation of 2.5-3 months. Lactation lasts 12-18 days. Mortality rates are unknown except for the Okhotsk Sea where the first year mortality is 22% (Popov, 1982).

_Population size:_ Data on abundance are very incomplete. The northern Pacific population (Laptev Sea, Chukchi Sea, Bering Sea, Okhotsk Sea, and Japan) has been estimated to consist of 300,000 to 450,000 animals. Popov (1982) gives an estimate for the Okhotsk Sea of 180,000-200,000 and for the Bering Sea of 250,000, which would mean that the Pacific population size is over 450,000 animals. There are no estimates for the Atlantic population.

_Feeding:_ The bearded seal feeds mainly on bottom invertebrates, such as crustaceans, molluscs, and polychaetes, but some fish are eaten including sculpin (Myxocephalus quadricornis), flounder (Platichthys flesus), and Arctic cod (Boreogadus saida) (Lowry et al., 1980).

_Trophic relations:_ There is some overlap in diet with walruses, for molluscs (Lowry et al., 1980). The main predator is the polar bear (Ursus maritimus). Occasionally killer whales (Orcinus orca) will take bearded seals.

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Figure 33. Distribution of the bearded seal (Erignathus barbatus): 1 = Erignathus barbatus barbatus, 2 = Erignathus barbatus nauticus.
**Human impacts:** The tanner crab, which is a major part of the diet of the bearded seal, is taken by major commercial fisheries (Lowry et al., 1982). There is a potential for disturbance from oil explorations.

**Exploitation:** Quotas have been set for hunting by the former U.S.S.R. in the Okhotsk Sea (5,000) and the Bering Sea (3,000). These quotas are for land-based hunters. Ship-based sealing is prohibited. In Greenland, about 500-1,000 seals are caught annually. There are no records for Canadian sealing. There is a considerable loss during the hunt, because many bearded seals sink when they are killed and are not directly retrieved. In Alaska, natives can hunt bearded seals, and the harvest is not monitored or regulated. No harvest is allowed in the Barents Sea or the White Sea.

**Threats to the population:** At the current level of exploitation there is no risk of overexploitation.

**References:**

**Subfamily Monachinae**

**Mediterranean monk seal**

**Monachus monachus** (Hermann, 1779)

**Description:** Males are on average 241 cm long and weigh 315 kg. Females are 238 cm long and weigh 300 kg. Pups are 88-103 cm at birth and weigh 16-18 kg. Pups have a black woolly coat with a white or yellow patch on the belly. The adult monk seal can
be any color from dark brown or black to light grey. It is often lighter ventrally.

**Distribution:** The monk seal was formerly widespread throughout the Mediterranean, the northwest coast of Africa, and the Black Sea, where it hauls out on sandy and rocky beaches as well as in caves. Now they are confined to remote and undisturbed areas where they breed in caves. The monk seal now occurs in countries around the Mediterranean Sea, on islands in the Adriatic Sea and Aegean Sea, on Madeira (Desertas Islands), the Atlantic coast of Morocco, and Mauritania. There have been no sightings in the Black Sea during the past five years.

**Population dynamics:** There is little information about this seal. One four-year-old female was observed to be sexually mature (Marchessaux, 1989).

**Population size:** The total population size is probably no larger than several hundred and is declining. Estimates made for parts of the Mediterranean monk seal's range give the following: Albania: 20; Algeria: 10-30; Cyprus and Turkey: 20-50; Desertas: 8-10; Greece: 200-250; Libya: 0-20; Mediterranean Morocco: 10-20; peninsula of Cap Blanc (Mauritania): 130; Croatia: 25. (Anselin et al., 1990; Reijnders et al., 1988, Marchessaux, 1989).

**Feeding:** Almost nothing is known about the diet of the Mediterranean monk seal, but it has been observed to feed on both fish and cephalopods.

**Trophic relations:** There is probably no competition for food; killer whales (*Orcinus orca*) and sharks are believed to prey on the seals in some areas (El Amrani, pers. comm.).

**Human impacts:** The Mediterranean monk seal is perceived as a competitor by fishermen in the eastern Mediterranean where seals are killed deliberately. Throughout its range there are reports of death following entanglement in fishing gear. Locally, food availability may have been reduced by overfishing. Disturbance during the pupping season may result in desertion and high pup mortality.

**Exploitation:** The Mediterranean monk seal is protected throughout its range. There are two protected areas created especially for monk seals, Desertas Islands in Madeira and the marine park “Northern Sporades” in Greece. There are future plans to set up nature reserves to protect the seals’ habitat. Despite the protection, monk seals are still killed by fishermen.

**Threats to the population:** This small population of secretive animals, spread out over a large area is very vulnerable. Important threats are deliberate killing, loss of habitat, incidental entanglement, and disturbance. Threats from pollution, disease, and reduction in food supply should not be ignored. *Monachus monachus* is included in the IUCN Red List as being Endangered.

**References:**

**Caribbean monk seal**  
*Monachus tropicalis* (Grey, 1850)

**Nomenclature:** The Caribbean monk seal is also referred to as the West Indian monk seal.

**Description:** This seal was 200-220 cm long and weighed 160 kg. Pups were 85 cm long. Pup weights are unknown. This seal was greyish-brown with a yellowish ventral surface. Females had a slightly darker ventral surface.

**Distribution:** The former range of this species was from the Bahamas through the Florida Keys and the Yucatan peninsula into the Caribbean Sea, including Cuba and Jamaica.

**Population dynamics:** No data available.

**Population size:** The Caribbean monk seal is believed to be extinct. Recent surveys of its former habitat have given no indications of the presence of living seals. This view was reaffirmed by a 1984 census (Le Boeuf et al., 1986).

**Feeding:** No data available.

**Trophic relations:** Its main predators are/were sharks.

**Human impacts:** This monk seal was reportedly very sensitive to disturbance.

**Exploitation:** This species was severely overexploited in the
past. Since it is believed to be extinct, no protective measures are being taken.

**Threats to the population:** *Monachus tropicalis* is included in the IUCN Red List as being Possibly Extinct.

**References:**


**Figure 35.** Former distribution of the Caribbean monk seal (*Monachus tropicalis*).

**Hawaiian monk seal**

*Monachus schauinslandi* (Matschie, 1905)

**Description:** Males grow up to 210 cm and can weigh 230 kg. Females can be as long as 230 cm and weigh up to 273 kg. Pups are 100 cm at birth and weigh 16-17 kg. This seal has a slate-grey to brown dorsal surface and a light silvery-grey to yellow-brown ventral surface.

**Distribution:** This seal is common on sandy beaches of five small atolls in the northwestern two-thirds of the Hawaiian Archipelago: Kure Atoll, Pearl and Hermes Reef, Lisianski Islands, Laysan Island, and French Frigate Shoals. The stocks at Midway Islands have been reduced to a few individuals and small breeding populations occur at the Necker and Nihoa Islands. Sightings outside the Hawaiian Archipelago are rare. Animals normally remain at their natal island, and inter-island migrations are infrequent.

**Population dynamics:** Lactation lasts 6 weeks. Five-year-old females have given birth, but mean age of first birth is probably at least age 6. Survival to age 5 is approximately 50%.

**Population size:** In 1957-1958, total beach counts were approximately 1,200 seals. Counts declined to 475 by the early 1980s, and increased to 585 in 1987. Total population sizes are known to be approximately 2.5 times the beach counts.

**Feeding:** From seal and spewing collections the diet is known to include octopus, lobster, and many reef fish species including eels.

**Trophic relations:** There is no obvious competition with other marine predators. The main predators of monk seals are sharks.

**Human impacts:** This seal species is very sensitive to human disturbance.

**Exploitation:** There is no current exploitation of this seal. The breeding area is in the Hawaiian Islands National Wildlife Refuge (HINWR) and the State of Hawaii Seabird Sanctuary at Kure Atoll. Access to these refuges requires permits.

**Threats to the population:** This small population is very sensitive to disturbance. If unrestricted access to the refuge is allowed, it will almost certainly mean the extinction of this species. The main reason for the decline at Kure Atoll and Midway was human disturbance, leading to changes in distribution and poor recruitment over two decades. Another threat is attacks on females by adult males, which causes high female mortality and reduces the reproductive potential of these popula-

**Figure 36.** Distribution of the Hawaiian monk seal (*Monachus schauinslandi*). Known breeding areas are indicated by arrowheads.

**References:**
has a dark dorsal surface with mottled lateral and ventral surfaces. Pups are born with grey to dark grey long hair and molt after six weeks.

Distribution: This seal lives in inshore waters, and breeds on fast ice, close to land. It has a circumpolar distribution around the Antarctic Continent and breeds there. Smaller numbers also occur and breed on South Georgia, the South Sandwich Islands, the South Shetland Islands, and the South Orkney Islands.

Population dynamics: Females become mature at 3-6 years of age and males at 7-8 years. The annual pregnancy rate of mature females is 70-80%. Gestation lasts 11 months, including a delay of implantation of 2 months. Lactation lasts approximately 6-7 weeks, until their sixth week pups gain 2.6 kg a day and respective weight loss in cows is 5.8 kg a day (Reijnders et al., 1990). Longevity is 25 years. Annual male mortality is 30-50% and female annual mortality 13-18%. The long-term dynamics of the Weddell seal population in McMurdo Sound have been the subject of intensive study (Stirling, 1971; Testa & Sinnerf, 1987; Testa et al., 1990). In addition, this species has provided an opportunity for considerable research into the physiology of diving in marine mammals (Kooymen, 1989).

Population size: The total population size is estimated to be larger than 750,000 seals.

Feeding: Weddell seals feed on fish, primarily Dissostichus, Trematomus, and Pleuragramma (Testa et al., 1985; Plötz et al., 1991).

Trophic relations: There is no obvious competition. Predators of the Weddell seal are the leopard seal (Hydrurga leptonyx) and the killer whale (Orcinus orca).

Weddell seal
Leptonychotes weddellii (Lesson, 1826)

Description: Males of this species are 280 cm long and the females are slightly longer, at 260 cm. They can weigh up to 400 kg. Pups measure 120 cm in length and weigh 22-25 kg. This seal

Figure 37. Distribution of the Weddell seal (Leptonychotes weddellii).
Human impacts: There has been some disturbance of Weddell seals in the immediate vicinity of Antarctic scientific stations.

Exploitation: There is no current exploitation. In the past, some Weddell seals were taken for food for people and dogs. Any commercial harvest would be regulated under the Convention for the Conservation of Antarctic Seals and the Convention of Antarctic Marine Living Resources (CCAMLR). There is, however, no present prospect of exploitation.


Ross seal
Ommatophoca rossii (Grey, 1844)

Description: Males are 168-208 cm in length and weigh 129-216 kg. Females are 196-236 cm long and weigh 159-204 kg (Laws & Hofman, 1979). Pups measure 105-120 cm and weigh 27 kg. The dorsal surface of these seals is dark to chestnut colored and the ventral surface is silvery-white with dark stripes along the neck from the chin to the chest.

Distribution: This species is widely distributed in the Antarctic pack ice. Its distribution is circumpolar but it is most abundant in the Ross and King Haakon VII Seas, especially close to the edge of the fast ice floes (Laws & Hofman, 1979; Ray, 1981).

Population dynamics: Age at sexual maturity is thought to be 3-4 years for females and 2-7 years for males (Ray, 1981). There is no information about age distributions or survivorship. Populations have been observed in December (Tikhomirov, 1975) and births probably occur in early November (Tikhomirov, 1975; Thomas et al., 1980). Òrtesland (1970) reported a high pregnancy rate in September. Delayed implantation probably lasts 2-3 months (Skinner & Westlin-van Aarde, 1989).

Population size: Analysis of the censuses carried out between 1968 and 1983 indicate that the population size of Ross seals on the pelagic pack ice of the Southern Ocean are minimally in the order of 130,000 (Frickson & Hanson, 1990).

Feeding: Squid form a major part (47%) of the diet, followed by fish (34%) and krill (19%) (Laws, 1977). Squid of the species Psychroteuthis glacialis and Alluroteuthis antarcticus have been recovered from the contents of two Ross seal stomachs.

Trophic relations: No data.

Human impacts: None known.

Exploitation: There is no commercial exploitation. A few have been taken by ships, for food. The species is totally protected under the Agreed Measures for Conservation of Antarctic Fauna

Threats to the population: Currently none.

References:

Threats to the population: None known.

References:


Crabeater seal
**Lobodon carcinophagus** (Homborn and Jacquinot, 1842)

Description: There is little sexual dimorphism in size and appearance. Adult males measure 2.57 m in length and 224 kg in weight while females are 2.51 m and 277 kg respectively (Laws, 1979). Pups are 1.20 m long and 20 kg at birth and are born with a light grey lanugo (Laws, 1979). Adults have a relatively uniform light grey coloration. Adult males are frequently scarred, possibly as a result of fighting during the breeding period (Siniff et al., 1979).

Distribution: This seal occurs throughout the Antarctic pack ice. Actual distribution probably depends on ice conditions so summer and winter distributions probably differ considerably. Populations may be segregated into young and adults groups, and into breeding and non-breeding groups (Gilbert & Erickson, 1977). Concentrations of juveniles can occur, especially during the breeding season, in the austral spring (Siniff et al., 1979). Individuals have been observed to move over large distances, for example, from the western Weddel Sea into the Bransfield Strait.

Population dynamics: The mean age of sexual maturity in females varies from 2.5 to 4.2 years and these variations may be related to changes in food abundance (Bengtson & Laws, 1985). Births occur mainly during the second half of October. Lactation lasts 2-3 weeks and pups gain weight at 1.2 kg a day (Shaughnessy & Kerry, 1989). Males attend females during and after lactation, forming mated pairs for 1-2 weeks (Siniff et al., 1979). Although many population samples have been obtained, information about age distributions is sketchy. Annual mortality is about 14.5% (Laws, 1977b). The age distribution provided by Bengtson and
Siniff (1981) suggests significantly lower annual adult than juvenile female mortality. Around the Antarctic Peninsula the age structure has shown strong cohorts separated by 4-5 years (Testa et al., 1991).

**Population size:** Estimates of population size have been based on aerial surveys of pack ice; these estimates were then extrapolated to the whole of the pack ice area (Gilbert & Erickson, 1977). There is therefore an unknown margin of error in these estimates which suggest a minimum of 9-11 million in the Weddell Sea, 1.3 million in the Amundsen and Hellinghausen Seas, 650,000 for the Glatz and George V Coasts and 600,000 for the Adelie, Claire, and Hanzare Coasts. Analysis of censuses carried out between 1968 and 1983, indicate that the population size of the crabeater seals on the pelagic pack ice of the Southern Ocean is minimally in the order of 7 million (Erickson & Hanson 1990). The authors believe this estimate is conservative and a more realistic estimate of the continental population would be 11-12 million.

**Feeding:** The main food taken is Antarctic krill, *Euphausia superba* (Laws, 1977a; Oritsland, 1977). Foraging dives occur mainly at dusk and dawn. This behavior is similar to that found in other krill-eating pinnipeds (Bengtson & Stewart, in press). Dives down to 300 m have been recorded.

**Trophic relations:** Long-term trends in age at sexual maturity may be a response to changes in food abundance associated with pelagic whaling in the Southern Ocean (Bengtson & Laws, 1985). In addition the quasi cyclical changes in age structure could be linked to predation by leopard seals (Testa et al., 1991). Heavy predation of pups by leopard seals has been observed (Siniff et al., 1979). In addition, there is predation of crabeater seals by killer whales (*Orcinus Orca*) (Smith et al., 1981). Naumov and Chekunova (1980) estimated the total food biomass consumed by crabeater seals was 40.45 million tons per year.

**Human impacts:** None known.

**Exploitation:** There is no commercial exploitation although 800 were taken by the Soviet Union in 1987 for scientific purposes. The Convention for the Conservation of Antarctic Seals regulates any potential exploitation.

**Threats to the population:** None. Future krill exploitation might affect this seal and other components of the Antarctic ecosystem.

**References:**

Figure 38. Distribution of the crabeater seal (*Lobodon carcinophagus*).
Leopard seal

*Hydrurga leptonyx* (de Blainville, 1820)

**Description:** Male leopard seals can be up to 750-370 cm long and weigh 200-455 kg. Females are 241-3 38 cm long and weigh 225-591 kg. Pups are 150-160 cm long and weigh 35 kg. The leopard seal is characterized by a long streamlined body and massive, almost reptilian looking head. The seal is grey colored, darker dorsally than ventrally, and spotted.

**Distribution:** The leopard seal has a circumpolar distribution and is usually found near the Antarctic pack ice. It is regularly recorded at Macquarie Island, South Georgia, the South Orkney and South Shetland Islands, and on subantarctic islands; it may be migratory. There is a seasonal presence of juveniles at Kerguelen

and Macquarie Islands with great numbers in September and October (Borsa, 1990; Roosseveld & Eberhard, 1980).

**Population dynamics:** The age at maturity is probably 3-7 years for females and 2-6 years for males. Longevity is over 26 years. The mortality rate for age 0-1 is 25%, for age 1-10: 8% and for ages over 10 years: 5%.

**Population size:** Analysis of the censuses carried out between 1968 and 1983, indicates that the population size of leopard seals on the pelagic pack ice of the Southern Ocean is minimally in the order of 300,000 (Erickson & Hanson, 1990).

**Feeding:** The leopard seal is an opportunistic predator. The diet is composed of approximately one third krill, one third fish and squid, and one third seabirds and seals (Laws, 1977). Penguins of all Antarctic species are taken, and weaned crabeater seal pups and juvenile Antarctic fur seals are the main seal species taken (Lowry et al., 1988).

**Trophic relations:** There is some potential competition with the crabeater seals for krill. The only known potential predator is the killer whale (*Orcinus Orca*).

**Human impacts:** None.

**Exploitation:** Some seals are taken for research purposes and some were previously killed for dog food, but otherwise there is no catch of leopard seals. Any commercial harvest would be regulated by the Convention for the Conservation of Antarctic Seals (CCAS) and CCAMLR.

**Threats to the population:** None. Future krill exploitation might have negative effects, directly and indirectly, on the food supply of the leopard seal.
Southern elephant seal
*Mirounga leonina* (Linnaeus, 1758)

**Nomenclature:** The southern elephant seal is also referred to as the southern sea elephant.

**Description:** Probably the largest pinniped, the southern elephant seal shows striking sexual dimorphism in size and appearance. The average mass of males when fully grown is 2,200 kg with a length of 420 cm while for females, mass is 500 kg and length 266 cm, although breeding females vary greatly in size (Laws, 1953; Boyd et al., 1992; Fedak et al., 1992). Mean pup mass at birth is 45 kg for males and 40 kg for females while average weaning mass is 114 kg for males and 117 kg for females at South Georgia (McCann et al., 1989). Average weaning mass can vary from 87 to 111 kg depending on the location and the year (SCAR, 1991). Data from Macquarie Island suggest that elephant seals there are smaller than at South Georgia (Bryden, 1968; Bryden, 1969).

**Distribution:** The distribution is circumpolar with major breeding and molting concentrations on islands in the region of the Antarctic Convergence. Traditionally, three distinct populations have been distinguished: South Georgia, Macquarie, and Iles Kerguelen. Elephant seals breeding at Valdes Peninsula on the mainland of South America and at the Falkland (Malvinas) Islands are thought to be a distinct population from that at South Georgia. Similarly, the populations at the Prince Edward Islands and Iles Crozet are considered to be distinct from that at Iles Kerguelen and Hearol, and the small population in the Tristan de Cunha Islands and Gough Island may also be distinct. Thus there may be at least five breeding populations, although their foraging areas may overlap (SCAR, 1991). Available data suggest that foraging areas are over the Antarctic continental shelf break and in the area of the Antarctic Convergence (Hindell et al., 1991; Fedak et al., 1992).

**Population dynamics:** Most females at South Georgia reach sexual maturity at age 3 years and give birth to their first pup at age 4 years (McCann, 1980). Age at sexual maturity occurs 1 year later at Macquarie Island (Hindell, 1991). Sexual maturity may occur at age 4 years in males but few males breed until they reach the age of least 10 years (Jones, 1981). On average, 40% of maternal total body energy is utilized by mothers during pupping. This represents a weight loss of 8 kg/day and females lose 4 5 kg/day during the molt. Females regain lost energy reserves during the foraging phases of the annual cycle when they gain weight at the rate of 1.1-2.3 kg/day. Males lose 12 kg/day during the breeding season (Fedak et al., 1992). Survivorship appears to be lower in the Macquarie Island population than at South Georgia, especially up to age 1 year (Hindell, 1991). Ninety percent of males die before the age of 10 years while 90% of females die before the age of 14 years (McCann, 1980). The annual cycle occurs in two phases of foraging at sea, split by periods of fasting ashore during the breeding season and molt (Laws, 1956a). Southern elephant seals have a highly developed polygamous mating system where dominant males defend harems of females during the mating period (Laws, 1953; McCann, 1981). Mating occurs at the end of lactation, which lasts 23 days. Adult males spend considerably longer than this ashore during the breeding season (38 days) than females (25-30 days). Molt in both sexes lasts 30-
40 days. Males have an annual cycle of testicular growth and recrudescence (Laws, 1956b; Griffiths, 1984). Delayed implantation in females lasts 3 months (Laws, 1956b).

**Population sizes:** Total pup production in 1990 for all southern elephant seal populations combined was 189,000 of which 100,000 were born at South Georgia (SCAR, 1991). The total population size is 700,000-800,000. Populations in the Indian and Pacific Ocean sectors of the Antarctic have been in decline. Numbers at Macquarie Island declined at 2.1% per annum between 1949 and 1984 (Hindell & Burton, 1987). Greater annual rates of decline have been recorded in recent years at Marion Island (-4.8%), Heard Island (-2.4%), Iles Kerguelen (-4.1% in 1977, possibly now stable), and Iles Crozet (-5.7%). In contrast, numbers in the Atlantic Ocean sector appear to be stable or increasing with maximum rates of increase 3.2-5.1% occurring at Valdes Peninsula (SCAR, 1991).

**Feeding:** Information is mainly derived from sampling stomach contents. Although some fish remains have been found in the stomachs of elephant seals from the Macquarie population, the major components in the diet are cephalopods. Of these, the squid *Kondakovia longimana* and *Monorhachis knipovichi* represent over 50% of the biomass of squid eaten by both males and females. Southern elephant seals dive continuously while at sea to average depths of 300-400 m, and some dives exceed 1,000 m. Mean dive duration is 25-30 minutes. This pattern of diving is probably associated with feeding on mesopelagic squid (Boyd & Arnbom, 1991; Hindell, 1991; Fedak et al., 1992). Average daily velocities across the surface depend on location and diving behavior but average about 1 m/s while in transit to and from feeding areas. Some seals may have highly specific foraging areas located up to 2,000 km from the breeding site while others appear to roam widely during the foraging phases of the annual cycle.

**Trophic relations:** The gross energy requirement for the South Georgia population is 2.28 x 10⁶ tons of squid each year (Boyd et al., 1992). Similar estimates are not available for other populations. Southern elephant seals have few predators, although weaned pups and juveniles are preyed upon by killer whales (*Orcinus Orca*).

**Human impacts:** There is some evidence that weaning mass is lower at Macquarie Island, Iles Kerguelen, Heard Island, and Marion Island than in the South Georgia and Peninsula Valdez populations, suggesting that the Indian and Pacific Ocean populations have a reduced food supply. However, there is no evidence that recent population declines are related to fisheries in the Southern Ocean (SCAR, 1991).

**Exploitation:** This species was formerly heavily exploited for oil. At South Georgia, a controlled, sustainable harvest of adult
males continued until 1964. Populations were undoubtedly severely depleted by this harvest. In the South Orkney Islands a few young male molting elephant seals were killed for dog feed in the 1950s and early 1960s. Any future exploitation within the Antarctic Treaty area (south of 60°S) would be regulated by the Convention for the Conservation of Antarctic Seals, while north of this area the Convention on Antarctic Marine Living Resources and national measures for the islands on which the species breeds apply. The Falkland (Malvinas) Islands Dependencies Conservation Ordinance provides protection for southern elephant seals on South Georgia and the South Sandwich Islands.

**Threats to the population:** Development of new fisheries at high latitudes could have a significant impact on elephant seal populations (SCAR, 1991).

**References:**


**Northern elephant seal**

*Mirounga angustirostris* (Gill, 1866)

**Description:** There is a marked sexual dimorphism in this species. Males can be as large as 450 cm and weigh up to 2,000 kg in the beginning of the breeding season in Dec.-Jan. and 1,000-1,200 kg at the end in March (Stewart & DeLong, 1992; Stewart & Huber, 1992). Females can be 360 cm long and weigh 900 kg. At birth, male pups are 153 cm long and weigh 36 kg and female pups are 147 cm long and weigh 31.5 kg. Males have a pronounced proboscis and rugose, corrugated neck shields. The coat color is the same for males and females: dark grey to brown.
with males usually darker. Pups are born with long black hair and become silverly after molt (Stewart & Huber, 1992).

**Distribution:** Northern elephant seals occur on islands off California. The breeding range is from central Baja California to central California. Outside the breeding season they can travel north up to British Columbia. There are ten known colonies. The largest ones are: Isla San Benito, Isla de Guadalupe and San Miguel Island. The other colonies are: Isla Cedros, Los Coronados, San Nicolas Island, Santa Barbara Island, Año Nuevo Island, Southeast Farallon Island, and the Point Reyes peninsula.

**Population dynamics:** Females reach sexual maturity at the age of 2 years and males at 7-9 years. Gestation lasts 11.3 months, including a delay of implantation. This has never been documented for this species, but it can be assumed that embryonic growth resumes early June following the molt after fertilization in January and mid-February (B. Stewart, pers. comm.). The annual pregnancy rate of mature females is 95%. Longevity is 14 years for males and 18 years for females. Pup mortality is highly variable: Año Nuevo: 15-26%; southeast Farallon: up to 73%; Los Coronados: 5-10% and the Californian Channel Islands 4-10%. Survival rate at Año Nuevo is 30-50% to age 1 and 8-25% for subadult males and females, respectively. Female mortality rates do not differ from males during the first 3 years of life, but are lower than males thereafter (Stewart & Huber, 1992).

**Population size:** The lowest count of this species was between 1884 and 1892: somewhere between 8 and 20 were known to remain. Since then there has been an almost exponential increase throughout the range. In 1957 there were 13,000 northern elephant seals and in 1976, there were 48,000. The population was estimated to be 175,000 in 1992 (Stewart et al. 1992). Growth in California has been 14% per year for nearly 50 years.

**Feeding:** The northern elephant seal feeds on a wide variety of organisms, including skates, rays, sharks, squid, hake (*Merluccius productus*), shrimp, euphausiids, octopus (*Octopus* sp.), whiting (*Micromesistius poutassou*), and crab. However, primary prey are deep water squids (Antonelis et al., 1987; DeLong & Stewart, 1991).

Foraging ranges are in the mid-Pacific (females) and the Gulf of Alaska and eastern Aleutian Islands (males) (Stewart & DeLong, 1990; 1997).

**Trophic relations:** There is probably no competition between the northern elephant seals and other pinnipeds such as the California sea lion, the northern fur seal, or the Pacific harbor seal, because they feed on different species and breed at different times. Possible predators are sharks and killer whales (*Orcinus Orca*).

**Human impacts:** Some seals are killed by fishermen. Occasionally, seals get entangled in fishing nets; for 1980 only 25 cases of entanglement were reported (DeMaster et al., 1985).

**Exploitation:** Since the population was hunted to near extinction in the 19th century, there has been no exploitation of this species. The northern elephant seal is protected in Mexico and the U.S.A.

**Threats to the population:** Unknown.

**References:**

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3. Threats to Pinnipeds

In this chapter we consider the actual and potential threats that may affect the future status of pinniped populations. Most of these are the direct or indirect result of human activities. The nature of these effects was classified by an FAO Working Party on Marine Mammals (FAO, 1978) based on the discussions at the Scientific Consultation on the Conservation and Management of Marine Mammals and their Environment which was held in Bergen in 1976. The Working Group classified anthropogenic effects into four categories: direct causes of death and injury; changes in behavior; changes in reproductive rates; and changes in distribution and abundance. We have chosen to use an alternative classification based on the factors that could affect pinniped populations rather than their consequences. These can be conveniently arranged, in terms of the immediacy of their effect, into:

- immediate threats (the result of directed harvesting or incidental mortality in fisheries activities);
- intermediate effects (primarily the results of habitat degradation as a result of human activities, but also the result of our lack of basic scientific information about certain species); and
- longer-term threats (due to climate change, the loss of genetic diversity and the lack of a coherent framework for evaluating the effect of perturbations to marine ecosystems).

Immediate Threats

Directed harvest and international trade

In the past many pinniped species have been virtually exterminated by excessive exploitation. Notable examples are the Antarctic, Guadalupe and Juan Fernandez fur seals, and the northern elephant seal (Busch, 1985). Although the demand for seal products has declined dramatically in the last decade, a number of pinniped species are still harvested commercially. These include the southern sea lion (Uruguay), South American fur seal (Uruguay), South African fur seal (Namibia), Baikal seal (CIS), Caspian seal (CIS), harp seal (Canada, Norway and CIS), and hooded seals (Canada and Norway). In addition, there are substantial subsistence harvests of walrus (Canada, CIS, Greenland, U.S.A.), large seal (CIS), ringed seal (Canada, CIS, Greenland, U.S.A.), ribbon seal (CIS, U.S.A.), hooded seal (Greenland), and bearded seal (CIS, Greenland). Although few of the reported catches appear to be large in proportion to the size of the population from which they are taken, catches in the former Soviet Union are poorly documented. Reported catches of Caspian seals are, however, large in proportion to population size and the area of available habitat. There is a pressing need for better documentation of continuing commercial and subsistence harvests, and of the basis on which quotas (where they exist) are set. The problems of international trade in pinniped products are documented in detail in Appendix 2.

Incidental catch by commercial fisheries

At least 20 species of pinnipeds are known to be caught incidentally during commercial fishing operations (e.g. Woodley & Lavigne, 1991). Such incidental catches appear to have contributed to population declines in northern fur seals and Kuril seals in the north Pacific, and in harp seals from the Barents and White Seas, and may have been partially responsible for the decline of Steller’s sea lions in the north Pacific. Incidental catches also appear to have had detrimental impacts on the populations of Hooker’s sea lion off the Auckland Islands; harbor seals off Newfoundland (P. v. concolor) and Alaska (P. v. richardsoni), grey seals in the eastern Baltic and of endangered Mediterranean and Hawaiian monk seals. While other species are also taken in fishing operations, some—like the harp seals in the northwest Atlantic—in large numbers, there are insufficient data to evaluate the impact on the population.

Several factors appear to influence incidental catches of pinnipeds, including behavioral traits of species, age of individuals, type of fishing gear, and the degree to which species’ ranges overlap with activities of commercial fisheries. More and better data on the incidental catches of pinnipeds (and seabirds and cetaceans) by individual fisheries are required to evaluate properly the magnitude of the problems and their potential impact on specific populations.

Direct killing by fishermen

In areas where seals are observed to remove fish from the gear or cages of commercial fisheries operators there is often strong antipathy towards seals. As a result, fishermen may deliberately kill seals in an attempt to reduce their perceived impact. In some cases (southern sea lions in Chile, grey seals in Iceland) such deliberate killing is encouraged by national governments through bounty schemes. In other cases (e.g. grey seals and harbor seals in the U.K.) it is condoned by existing legislation and may be encouraged by local bounty schemes. Although the number of seals killed in this way is poorly documented, it does not appear
to be large. However, in the case of the Mediterranean monk seal, the surviving population is so small that any additional mortality is extremely detrimental to the species' chances of survival. Urgent action is therefore necessary to reduce, and ultimately to stop entirely, deliberate and illegal killing of monk seals by fishermen.

Intermediate Threats

Episodic mass mortalities

The deaths of large numbers of harbor and Baikal seals in 1987 and 1988 (Dietz et al., 1989a; Grachev et al., 1989; Osterhaus et al., 1989), and the high prevalence of virus antibodies in seal populations worldwide (e.g. Bengtson et al., 1991; Dietz et al., 1989b; Markussen & Have, 1992; Visser et al., 1991) have underlined the potential vulnerability of pinnipeds to disease epizootics. In addition, the impact of ENSO (El Niño Southern Oscillation) events on Pacific pinnipeds (Testa et al., 1991; Trillmix & Ono, 1991) has indicated how pinnipeds may be vulnerable to a wide range of episodic phenomena which may cause mass mortalities in an unpredictable way. Such mortalities have a demographic effect which is out of proportion to their impact on average annual mortality (Harwood & Hall, 1990) and it is therefore important that their potential effect is explicitly included in all management plans for pinnipeds. International movements of livestock and marine disposal of domestic animal, medical, and veterinary waste have probably resulted in marine mammals being exposed to a much wider range of disease agents than was the case in the past. As a result, it is likely that episodic mass mortalities may occur more frequently in the future, an effect that may be amplified by the effects of pollution, disturbance, loss of genetic diversity, and climate change (see further details in sections below).

Habitat degradation

Habitat degradation can take a variety of forms from outright loss of habitat because of excessive disturbance (which is probably the reason for the disappearance of monk seals from large areas of their former range) to more subtle effects like increased foraging costs due to a decline in prey abundance. We have grouped these effects under five general headings:

1. Environmental contaminants

Heavy metals and organochlorines

The bodies of marine mammals sometimes contain very high levels of pollutants. Two classes of pollutants have given particular cause for concern: the heavy metals and the organochlorines. Predatory animals tend to carry higher concentrations than their prey. In general, the higher up the food chain an animal is, the higher the concentration of pollutants in its body will be: a process known as bioaccumulation. In addition to this, most animals have a limited ability to break down these compounds which therefore tend to accumulate in their bodies as they get older. Marine mammals are generally at the very top of the marine food chain, so it is not surprising that high concentrations of heavy metals are sometimes found in the livers of seals, and high levels of organochlorines can occur in their blubber.

Organochlorines

Humans have created, and continue to create, a wide range of organic molecules. Most of these never leave the chemists' laboratories, but practical applications are found for some and, as a consequence, they may enter the marine environment. Many of these molecules are extremely difficult to detect and the biological effect of most is not known. The organochlorines (OCs) have had widespread use since the 1920s. There are now well-
developed methods for measuring their concentration and there is a considerable body of information about their biological effect. The OCs that have caused most concern are the insecticides DDT, dieldrin, and mirex, and the PCBs (polychlorinated biphenyls). Not only are these chemicals highly persistent, but they are more soluble in fat than in water, so they can become concentrated in the tissues of seals, which rely on fat as an energy store. When this store is finally used, extra high levels of OCs may be released into the animal’s bloodstream.

PCBs had a wide range of industrial applications, primarily as fire retardants and as heat absorbants (used particularly in electrical transformers, capacitors, and in hydraulic fluid). They were first manufactured in the 1920s and production increased until the late 1960s when their toxicity was finally recognized. The manufacture and discharge of these OCs has been tightly controlled in developed countries for nearly two decades, but there has probably been considerable production in eastern Europe. Significant quantities may still enter the marine environment from the atmosphere and as a result of careless disposal or leakage from storage sites (e.g. Lau et al., 1991a; Marquenie & Reijnders, 1990). Although DDT is still widely used in developing countries, its use in western Europe and North America has decreased dramatically and environmental levels have also declined. However, PCB levels have declined much less, if at all, possibly because they are more persistent. The highest OC levels occur in marine mammals from the coastal waters of the northern hemisphere, suggesting that, at least historically, the main source was discharge through river systems. However, significant levels have been recorded in animals from the mid-oceans in the southern hemisphere, so there must be some input via the atmosphere.

In recent years there has been growing concern about the effects of the highly toxic dioxins and furans. These are present as impurities in commercially produced PCBs. They occur in automobile emissions and in the output from chlorine bleaching plants. They are also generated in some high temperature combustion processes, for example if PCBs are incinerated at too low a temperature. Dioxins and furans have been detected in the bodies of marine mammals from the Arctic to New Zealand (Bignert et al., 1989; Beck et al., 1990; Buckland et al., 1990; Norström et al., 1990; Rappe et al., 1981). This widespread distribution is not surprising if the major input to the seas is from the atmosphere. However, the recorded levels in marine mammals are similar to those found in humans from the same geographical area. This suggests that dioxins and furans do not bioaccumulate in the same way as the other OCs and therefore may not pose any greater threat to marine mammals than they do to other wildlife.

Acute exposure to OCs causes severe damage to the liver, kidneys and skin, but marine mammals are unlikely to be exposed to levels of this kind. The major concern is over subacute toxic effects. The toxicity of the OCs appears to be related to the similarity of some of these compounds to important biological molecules. For example, dioxins, some PCBs and their breakdown products have a similar stereochemistry to thyroxin. But most PCBs do not have this property. Only about 100 of the 209 known individual PCB congeners occur in the commercial mixtures which may enter the marine environment, and the coplanar PCBs (which are believed to be the most toxic) make up only 1% of this mixture (Kawmam et al., 1989; Tanabe et al., 1987). Unfortunately it is very difficult to measure levels of these coplanar PCBs accurately.

The biochemical effect of OCs

Because of the similarity of some OCs to biological molecules, their presence in an animal’s blood induces the activity of a group of liver enzymes known as mixed function oxidase enzymes. Not only do these break down the OCs (producing new molecules which may be even more similar to biological molecules than their parents) but also some of the animal’s own steroid hormones. This can lead to a hormonal imbalance which can affect reproduction (Safe, 1984). The impact of OCs on hormones and development in marine organisms is reviewed in Reijnders & Brasseur (1992). In addition, some PCB molecules have a strong tendency to combine with a blood chemical called transthyretin, which is involved in the transport of vitamin A and thyroid hormones. Normally, most of the thyroid hormone in the blood is bound up with transthyretin. However, PCBs and their breakdown products can saturate the transthyretin, leaving large quantities of thyroid hormone and vitamin A in circulation, where they are then excreted by the kidneys (Brouwer et al., 1990). These changes could make animals more vulnerable to infection. Reijnders and his colleagues (Brouwer et al., 1989; Reijnders, 1986) have shown that seals fed a diet of fish from the Wadden Sea (which were known to be contaminated with PCBs) exhibited a lower pregnancy rate and had lower thyroid hormone and vitamin A levels than seals fed less contaminated fish from the north Atlantic. In addition, the methysulphonyl metabolites of DDT are known to cause serious disruption of the cortex of the adrenal gland in mice which could interfere with their resistance to disease (Jonsson et al., 1990). Such compounds have been detected in seals (Jansson et al., 1975), and their presence may explain the adrenocortical hyperplasia and associated disease symptoms which have been observed in Baltic seals with high OC levels (Bergman & Olsson, 1985).

Evidence from marine mammals in the wild

The evidence from wild marine mammals is all circumstantial but it can be used to construct a convincing picture that high OC levels in seals can be extremely detrimental. The fertility rate of harbor seals in the Dutch part of the Wadden Sea is much lower than that of seals in the German and Danish sectors. Dutch seals also have much higher PCB levels than seals from elsewhere in the Wadden Sea, so the reduced fertility is thought to be a consequence of PCBs interfering with their hormone balance (Reijnders, 1982). Grey seals and ringed seals in the Baltic have low fertility, a high incidence of sterility caused by deformity of the uterus, and a complex of other deformities and abnormalities which appear to be the result of poorly functioning adrenal glands. They have high levels of PCBs and DDT, so these observed changes could be the result of the effect of PCBs, DDT, and or their metabolites on the adrenal glands (Bergman & Olsson, 1985). Finally, in relation to the outbreak of phocine distemper which killed 17,000 common
seals in the North Sea during 1988, seals in this area have high OC levels and immunosuppression is caused by OCs. This is one of a number of possible factors thought to have influenced the extent of the outbreak (Simmonds & Johnston, 1989). A high proportion of dead seals examined in Germany had abnormalities of the thyroid gland, which could have been due to pollution effects but which also could have been caused by the distemper virus itself (Schumacher et al., 1990).

Petroleum hydrocarbons

Hydrocarbons can be conveniently divided into aliphatic and aromatic compounds. The major source of all hydrocarbons in the marine environment is from the extraction, transportation and incineration of fossil fuels. Although the most spectacular sources are from wrecked tankers and blowouts at oil production platforms, routine tanker operations and municipal waste are the two largest sources (Neff, 1990). Direct fouling of fur by oil spills can have dramatic effects on thermal conductivity of fur in otariids, but the effect on phocids is much less (St Aubin, 1990).

Aromatic hydrocarbons may account for about 20% of the total hydrocarbons in crude oil. They are the most toxic of the major classes of compounds in oil, and the polycyclic aromatic hydrocarbons (PAHs) are known to be potent carcinogens. The toxicity of petroleum to marine organisms is directly correlated with the concentration of light aromatics (Neff, 1990), but the most toxic components are rapidly lost by evaporation from oil spills. PAHs have been recorded in seal tissues, but at relatively low levels (Héllou et al., 1990).

The acute toxicity of the aliphatic compounds tends to increase with molecular weight, but high molecular weight compounds have a low solubility in water and therefore constitute a relatively minor hazard to marine organisms. Problems attributed to the ingestion of hydrocarbons have been reported in French grey seals and harbor seals (Babin et al., 1990).

Tar balls are produced by long-term weathering of oil slicks and are now widely distributed throughout the world’s oceans. They seem to pose no particular threat to pinnipeds, but a high incidence of fouling by tar has been reported among grey seal pups at Froan, Norway (Morten et al., 1992).

2. The effect of commercial fishing activity on food availability

Although there is an extensive literature on the perceived competitive interactions between seals and fisheries (see e.g. the papers in Beddington et al., 1985) the focus of attention has generally been on the potential effect of seal predation on fisheries yield. Reports of a possible effect on seal populations as a result of a reduction in prey availability are rare. Stewart and Lavigne (1984) recorded a significant decline in the condition of female harp seals from the Gulf of St. Lawrence during a period when stocks of capelin were at a very low level. Haug et al. (1991) proposed that the large scale invasion of harp seals into southern Norway in 1987 and 1988 was a direct consequence of the crash of capelin stocks in the Barents Sea during 1985-1986. The decline of the Alaskan population of the Steller’s sea lion since the 1960s may, to some extent, be a consequence of the large quantities of pollock (Theragra chalcogramma) fished in this area (Loughlin, 1991). The likely effects on marine mammals of changes in food availability as a result of fishing have been reviewed by ICES (1992). The predicted consequences are: increased foraging effort, reduced juvenile growth, increased mortality during the first months of life, reduced birth and weaning weight of pups, and (ultimately) reduced birth rate.

Evidence for these effects comes from changes in food availability which were not the result of fishing. The best evidence comes from otariid seals, where females forage during lactation and are thus sensitive to changes in the local availability of preferred prey species (Trillmich & Ono, 1991). Härkönen & Heide-Jørgensen (1991) present evidence of the effects of an increase in the availability of small fish in the Kattegat/Skagerrak on the growth rate of yearling harbor seals; and Thompson et al. (1991) have documented changes in the foraging behavior of harbor seals in the Moray Firth following a reduction in inshore abundance of overwintering clupeids.

Inevitably, the evidence linking the observed changes in the seal population to the results of fishing is circumstantial (as is the evidence for a detrimental effect of seal predation on catches of fish). Most evidence comes from retrospective studies and these are difficult to interpret. It is often difficult to determine, for example, whether observed changes in seal populations following a decline in prey abundance are solely the result of overfishing or of environmental changes, or a combination of both. (See ICES (1997) for a summary of the problems involved in interpreting recent changes in the East Ice harp seal population.)

The problem will not be resolved until better information is available on how seal predation on a particular species responds to changes in abundance of all preferred prey species. An outline protocol for the way in which these problems of competition might be addressed is provided by Butterworth & Harwood (1991). Although prototype devices are available to collect the data which is required to fulfill this protocol, there is an urgent need for enabling technology to make such equipment more widely available.

3. Disturbance

Many, but not all, habitats used by pinnipeds are in areas that are relatively remote from human activities. The degree and consequences of the contact they have had with humans influences how pinnipeds respond to disturbance. At one extreme, seals that live in the Antarctic and have had no significant contact with terrestrial predators virtually ignore the presence of humans (although helicopters cause chaotic behavior). In contrast, Arctic seals are very wary and usually will flee from even the slightest unusual sound.

As human activities expand and diversify in areas where they overlap with pinniped habitats, and as they move into new areas, there is the potential for impacts on pinniped behavior and habitat use. Although the general nature of probable responses is known, there have been few studies to quantify responses and their impact. Kelly et al. (1988) showed that ringed seals will leave their subnivean lairs and go into the water when approached by snow machines, helicopters, and people walking on skis. The rate of abandonment of lairs was greater near oil industry seismic lines than at distances away from the lines. Several studies have shown

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that human activity affects the haul out behavior of harbor seals (e.g. Renouf et al., 1981; Allen et al., 1984). Walrus behavior may be affected by aircraft (Salter, 1979), icebreakers (Brueggeman et al., 1990), and perhaps fishing activity (L.F. Lowry, pers. comm.). Disturbance of Steller’s sea lion rookeries may cause problems for mothers and pups (Lewis, 1987), and repeated disturbance apparently caused one rookery to be permanently abandoned (Kenyon, 1962).

The impact of such changes may vary depending on circumstances. For some populations there may be a surplus of adequate habitat, and animals may be able to alter their distribution to avoid unacceptable situations. Some species may successfully accommodate to new conditions by changing their behavior patterns. The most significant impacts would be likely to occur with species that respond strongly to human presence because of repeated negative interactions, and that have small populations with limited habitat. This situation applies to some endangered and vulnerable species.

Increased tourism in the Mediterranean has certainly limited the available habitat for monk seals, either directly through activities such as boating and anchoring in areas with breeding caves, or indirectly through the building of resorts close to monk seal distribution areas. The establishment of protected areas, in order to form a network of marine reserves throughout the Mediterranean, has been proposed to mitigate these problems (Reijnders et al., 1988).

The U.S. Coast Guard occupation of Green Islands at Kure Atoll in 1961 and the subsequent human disturbance of monk seals on the beaches is believed to be the cause of changes in distribution and poor recruitment over two decades (Kenyon, 1972). A low point in the recruitment was reached in 1986 when a single pup was born. Low pup survival was arrested in 1981 by collecting weaned female pups born at Kure Atoll placing them in a large protective enclosure for their first summer. Along with the U.S. Coast Guard procedural changes aimed at reducing seal disturbance, this practice has resulted in very high juvenile survival. A high proportion of the population now consists of immature seals (Gilmartin & Gerrodet, 1986).

Disturbance can have a local impact on less vulnerable populations. This is demonstrated in the case of the harbor seals in the Kattegat/Skagerrak and Wadden Sea, where repeated disturbance at haul-out sites caused them to desert particular sites. The establishment of sanctuary areas in disturbed regions might prevent desertion, as it has been observed that in the Kattegat/Skagerrak animals in undisturbed areas are hauled out for longer periods than animals in areas with more disturbance (ICES, 1991).

A well-known tourist activity in the Wadden Sea is crossing the tidal flats between the mainland and the Frisian Islands by foot. Discussions between the organizations involved and the State Nature Management Directorate about the routing of those crossings have resulted in minimizing the risks of disturbance to seals.

Information on the effect of noise on pinnipeds is rather scarce (Peterson, 1981; Davis et al., 1990). Noise can interfere with the ability of pinnipeds to explore their environment and communicate with each other. Furthermore, heavy noise generated from seismic operations, icebreakers, and drilling operations might cause serious discomfort. Davis et al. (1990) reviewed information on underwater noise and its impact on marine mammals in the Arctic. They tentatively conclude that short-term behavioral reactions and temporary displacement of various marine mammals occur. They also state clearly that the scarcity of direct evidence of serious consequences should not lead to the conclusion that marine mammals are not stressed or affected in some other way.

4. Changes in the physical environment

Physical attributes, as well as biological and environmental factors, determine the suitability of pinniped habitats. While a considerable amount of information has been gathered on the distribution of pinnipeds, especially when they are hauled out, there is little understanding of what physical factors influence habitat use.

It is possible to regulate human activities in such a way as to avoid physical alterations of pinniped habitats. In order to do so it is necessary to identify the specific habitats being used and understand which habitat features are of significance.

For many species it is relatively easy to identify important habitats if adequate care is taken in surveys or telemetry studies. For rare and elusive species such as the Mediterranean monk seal all of the important locations being used are not yet known.

There have been relatively few attempts to measure the physical characteristics of habitats that make them suitable for pinnipeds. Locations that are used for hauling out on land are often very specific and traditional, suggesting that there are certain factors that make them preferable to others. For example, walruses prefer terrestrial haul-outs with easy access to deep water because the animals find it difficult to move across extensive, shallow areas (L.F. Lowry, pers. comm.). Burns (1970) described segregation in pack ice habitats used by seals in Bering and Chukchi seas, but he did not identify what specific features were responsible for the different distribution patterns.

Some actual and potential physical impacts of human activities on pinniped habitats have been documented. Icebreakers and the presence of offshore structures may alter ice characteristics and result in changes in distribution of ringed seals (Stirling, 1988). While there may be some benefit to the seals from additional access to leads and cracks, this also results in exposure to polar bear (Ursus maritimus) predation and possibly to contaminants. Construction of dams for hydroelectric power may result in elimination of the habitat of the Ungava seal (D. Lavigne, pers. comm.). The endangered Saimaa seal is threatened by human-caused fluctuations in water levels of Lake Saimaa (T. Sipilä, pers. comm.).

5. Ignorance

For a number of pinniped species or subspecies we know so little about their population or taxonomic status that it is impossible to evaluate their vulnerability to the wide range of threats to which they are likely to be exposed.

Although it is unlikely that the Caribbean monk seal still survives, this needs to be confirmed by a thorough survey of suitable sites. The taxonomic status of the Laptev walrus and of
Phoca vitulina mellonae needs to be confirmed. Basic information on the population biology and foraging movements of the Mediterranean monk seal, the Guadalupe fur seal, and the Juan Fernandez fur seal is required urgently so that the relative importance of the potential threats to these endangered species can be evaluated.

Longer-term Threats

The changes that humans have made to the global environment during the last millennium and the changes that are likely to occur over the next century will almost certainly have a profound effect on the distribution and nature of the habitat that will be available to pinnipeds. At present there is a wide range of projections concerning the nature and magnitude of these changes. We can only speculate on the way in which these projected changes may affect the long-term survival of the different pinniped species. In this section we consider how climate change might affect pinniped behavior and distribution, how the current and future genetic diversity of surviving populations may influence their ability to respond to this change, and how our limited understanding of the underlying processes which control marine ecosystems limits our ability to predict the consequences of longer term environmental change.

Climate change

The distribution of modern pinnipeds, like that of most organisms, appears to be constrained directly and indirectly (e.g. through effects on prey species) by climate. Changes in climate might, therefore, be expected to affect the distribution and abundance of pinniped populations. Such changes have been observed in the past (e.g. Vibe, 1987) and, in recent years, abnormal variations in climate, such as unseasonably cold summers in the northwest Atlantic, have been accompanied by sightings of northern pinnipeds in areas beyond their traditional ranges. Similarly, short-term increases in water temperatures associated with El Nino have important consequences for pinniped populations living in the Pacific Ocean (Trillmich & Oro, eds., 1991). Of particular concern today is the possibility that the world is entering a period of global warming, and the effects that this might have on pinniped populations.

Pinnipeds as a group are largely restricted to polar and subpolar regions in both the northern and southern hemispheres, where sea-surface temperatures during the warmest month do not exceed 20°C (e.g. Davis, 1958; also see Lavigne et al., 1989). While it is unlikely that such warm water temperatures directly constrain pinniped distribution, there is increasing evidence that the accompanying warm air temperatures may be limiting during those times when animals are obligated to spend time on land (e.g. during molting and reproduction). The very adaptations that allow pinnipeds to stay warm in water constrain their ability to dissipate heat in air when temperatures exceed certain limits.

If global temperatures are indeed increasing, effects on the physiology, behavior, and ecology of pinnipeds could be profound. In warm environments, pinnipeds on land can overheat (e.g. Watts, 1992); this may be especially problematic for young or small animals (because of their relatively high metabolic rates and high surface area to volume ratios, respectively), and may even lead to death of pups due to heat prostration. If environmental temperatures were to increase, and if such increases were to result in higher levels of neonatal mortality, this would ultimately affect population sizes. In other cases, seals appear to avoid terrestrial conditions by remaining submerged. The consequences of such constraint would depend on the reasons that pinnipeds haul out of the water in the first place. In some cases—for example, among rookery breeders, which must spend and extended period ashore for reproductive reasons—the reason is obvious, and the consequences of constraining it are relatively clear (e.g. reduced reproductive success). For other species (e.g. harbor seals), however, the benefits of hauling out are less clear. Unable to rest on land, seals may be forced to spend more metabolic energy thermoregulating in a relatively cold aquatic environment, leading to increased prey consumption. This has implications in areas where pinnipeds are already perceived as competitors with sport and commercial fisheries. Seals may also become more vulnerable to aquatic predators, which could result in a decline in their numbers. Such potential consequences of global warming cannot be assessed adequately, however, without greater understanding of the factors that influence haul out behavior and the price that pinnipeds pay when prevented from doing so.

In colder environments, when overheating is not a concern, changes in environmental temperatures may have very different effects. At certain times of year, for example, a small increase in ambient air temperature may result in a large increase in the numbers of animals hauled out on shore (e.g. Boulva, 1973). At high densities, pinnipeds, like other animals, become increasingly susceptible to epizootics. Indeed, many documented mass mortalities experienced by seal populations this century have occurred following a period of unseasonably warm temperatures, when populations were said to be increasing or when seal densities on shore were described as being unusually high (Schmitz & Lavigne, 1990). Elevated temperatures are also known to suppress the immune systems of some animals, and this may be another way in which climate change could contribute to an increased incidence of pinniped epizootics. It is possible, therefore, that the frequency of "seal plagues" may increase as a result of global warming (Schmitz & Lavigne, 1990).

In addition to such direct effects of climate change on pinnipeds, there are a number of possible indirect effects. For example, changes in climate (specifically, water temperature), can have marked effects on the distribution of prey species. Under such circumstances, pinnipeds may be unable to find adequate food. This could lead to a loss of condition, reduced reproduction, and increased starvation or, alternatively, to a change in the distribution as animals seek out suitable prey elsewhere.

Any long term warming trend is, therefore, likely to have (indeed, may already have had) repercussions on the distribution and abundance of pinniped populations. Some species may disappear completely from regions where environmental conditions exceed their thermal tolerance limits, either because of increased mortality or because of movements to more hospitable environments. If we are indeed entering a period of global
warming that is due largely to human activities, and if we assign any importance to minimizing the impact of such changes on all components of the global ecosystem—including both pinnipeds and humans—then an intensified research/monitoring program on habitat requirements and distribution range of certain key species should be started.

**Genetic diversity**

In general, the ability of a species to respond to environmental change will depend on the range of genetic variability present within the population. Small populations will tend to lose genetic variability by genetic drift at a rate which is inversely proportional to their effective population size. In addition, populations which have been through a bottleneck of extremely low numbers are likely to have reduced genetic diversity. Many pinniped species which were subject to excessive exploitation in the past (see chapter 2) have been through such bottlenecks. In the case of the northern elephant seal this is known to have resulted in a substantial reduction in genetic diversity when compared to the closely related southern elephant seal (Donnell & Sclander, 1974; Hoelzel, pers. comm.).

The effect of bottlenecks on genetic diversity, and the relationship between genetic diversity and the ability to respond to environmental change are controversial issues (see e.g. Carson, 1990; Lande, 1988; Ralls et al., 1988; Simberloff, 1988), and there is no definitive scientific opinion. There is certainly a pressing need to establish levels of genetic diversity within and between pinniped populations worldwide in order to identify those populations which are potentially most vulnerable to these effects.

**References**


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4. Recommended Conservation Actions

The selection of priorities, and projects proposed to address them, is based on the foregoing chapters 2 and 3, supplemented by additional background material drawn from the list of proposals submitted to the FAO/IUCN Global Plan of Action for Marine Mammals.

Three different sets of conservation actions are recommended: (1) actions that focus on threatened pinnipeds, (2) actions to evaluate major threats to pinnipeds, and (3) actions that will improve our knowledge about the position and role of pinnipeds in the multi-species oriented management of marine ecosystems.

It is considered that the first two sets of actions should be accorded the highest priority as they not only contribute directly to the protection of some endangered species but also prevent other species from needing to be classified as endangered in the near future. However, it is emphasized that the projects under 3 are also a high priority as they might provide basic information for an adequate long-term global action plan. The order of listing within the several sets of proposed actions does not indicate a priority ranking.

The actions are briefly outlined, however full proposals can be provided by members of the Seal Specialist Group and organizations that either have been consulted by the Group or have submitted project proposals for the Global Plan of Action.

Activities: Monitor reports of unconfirmed sightings of monk seals in the Caribbean. Those which occur in the known range of the species and in apparently suitable monk seal habitat should be investigated further. In particular, remote areas of suitable habitat along the Cuban coast (including offshore islands) should be surveyed for the species.

Output: Reports.

Use of Output: Confirm status of species; if sightings are verified, these will provide a basis for drafting suitable conservation measures, including habitat protection.

Japanese sea lion (Zalophus californianus japonicus)

• Determine whether the Japanese sea lion still survives

Objectives: Determine whether Zalophus californianus still exists in the Sea of Japan.

Background: The presence of Zalophus in the Sea of Japan is confirmed by several specimens in museums and reports from zoologists. The most recent documented reports from this area are from the late 1950s.

Activities: Surveys of areas in the Sea of Japan known to have been inhabited by Japanese sea lions; interviews with zoologists, fishermen, and local inhabitants.

Output: Report.

Use of Output: Design and implement measures to protect Japanese sea lions, if they still exist.

Endangered Species

Mediterranean monk seal (Monachus monachus)

• Involve fishermen in the protection of the Mediterranean monk seal

Objectives: Determine social and economic incentives (including alternative fishing techniques and aquaculture) which might alter the attitude of fishermen towards seals and eliminate deliberate killing. Build good relations between conservation organizations and fishermen in the range of the species with a view to developing a sense of pride in the species among the fishermen.
Background: The current size of the Mediterranean monk seal population may be less than 500 individuals. Deliberate killing is probably the major threat to the species in the Mediterranean.

Activities: Socio-economic study on feasibility of changing fishermen’s attitudes toward the monk seal, with particular emphasis on Greece, Turkey, Morocco, and Mauritania.

Output: Effective conservation action for the species on a local scale.

Use of output: Development of a model approach for conservation of the species at a local level.

- Determine the status of Mediterranean monk seal populations
  Objectives: Determine distribution, current status, and levels of interchange between monk seal populations. Identify, where possible, local factors affecting abundance and productivity.

Background: The Mediterranean monk seal population is at a critically low level, but much of the potential habitat of the species has not been adequately surveyed. The viability of known populations in the eastern Mediterranean depends critically on the level of interchange between adjacent groups. Detailed information on the location, status, and movements of local populations is essential to direct future conservation actions. Awaiting results of satellite monitoring the Hawaiian monk seal.

Activities: Field observations with minimum interference based on the recognition of individual animals and the use of a central register.

Output: Tracking results. Reports with observed data.

Use of output: Basis for assessing priority sites for conservation measures and habitat protection.

- Establish a captive breeding program for Mediterranean monk seals
  Objectives: Establish captive breeding colonies for Mediterranean monk seals at a minimum of two locations. Maintain health and genetic diversity of seals in captive colonies.

Background: The Mediterranean monk seal is at critically low numbers and is in danger of extinction. Threats from habitat degradation, fishing, and disease are increasing, which makes long-term survival of the species in the wild unlikely.

Activities: Identify and equip facilities appropriate for captive colonies. Recruit seals from rescue and rehabilitation programs and if that is not sufficient, capture seals from the wild and transport to facilities. Monitor health and condition of captive animals. Exchange individuals to maintain genetic diversity.

Output: Continued existence of the species. Opportunity to study and monitor individuals to learn more about their biology.

Hawaiian monk seal (Monachus schauinslandi)

- Continuation of ongoing recovery activities for the Hawaiian monk seal
  Objectives: Implement activities identified in the Hawaiian Monk Seal Recovery Plan

Background: As required by the U.S. Endangered Species Act, a Recovery Plan for the Hawaiian monk seal was adopted in 1983. The Recovery Plan and subsequent workplans describe activities that should be conducted in order to assist the recovery of this endangered species.

Activities: Monitor population status, examine habitat requirements, determine factors limiting population growth, implement and enforce management actions.

Output: Information on the status and trends of monk seal populations, protection of Hawaiian monk seal habitat, reduction of human impacts on population recovery.

Use of output: Evaluation of factors limiting the Hawaiian monk seal population and implementation of necessary management measures.

- Reduction of “mobbing” behavior of male Hawaiian monk seals
  Objectives: Suppress testosterone levels and change adult male Hawaiian monk seal behavior patterns to correct adult sex ratios functionally without physically removing adult males. Functional removal should indicate whether there are any significant negative consequences of permanently removing selected adult males from the breeding population.

Background: In the past 30 years, Hawaiian monk seal populations have declined substantially and the adult sex ratios of several main breeding populations have become abnormal with as many as three males for each adult female. The abnormal sex ratio is thought to lead to mobbing behavior, in which large groups of adult males injure and kill adult and immature females. Drug therapy has been used successfully to reduce testosterone levels in captive Hawaiian monk seals.

Activities: In the first year, a sample of known male mobbers will be treated with a testosterone suppressing drug at the beginning of the breeding season. Behavior and testosterone levels will be monitored. If results are favorable, a larger group of males will be treated to balance the adult sex ratio effectively, and determine whether there are unanticipated negative consequences from this functional but reversible alteration.
Output: Information on potential unanticipated consequences of removing adult males from the breeding population. Results will be summarized in a report.

Use of output: Aid to management and recovery of Hawaiian monk seals, indicating utility of certain long-term solutions to problems in age/sex structure in small populations. Possible use with other endangered pinniped populations with abnormal age/sex distributions.

- **Determine Hawaiian monk seal foraging and movement patterns**
  
  **Objectives:** Determine foraging habitats, behavior, and offshore movement patterns of Hawaiian monk seals.

  **Background:** Continued survival of Hawaiian monk seals requires determination and conservation of its essential habitats. The pelagic movements and foraging patterns of monk seals are poorly known, and it is therefore difficult to assess the nature and extent of interactions with human activities.

  **Activities:** Pilot studies in year 1 will determine and refine techniques for handling seals and attaching satellite linked transmitters. In years 2 and 3, transmitters will be attached to seals and their movements and behavior will be monitored by satellite.

  **Output:** Report with analyzed data.

  **Use of output:** Aid to conservation and management by defining critical habitat and potential for fishery interactions. Techniques developed in this study may be usable for Mediterranean monk seals.

- **Monitor and mitigate impacts of fishing on Hawaiian monk seals**

  **Objectives:** Determine where and how interactions occur between fisheries and Hawaiian monk seals, and the number of seals involved. Develop methods and regulations to eliminate impacts on seals.

  **Background:** Diversification and expansion of commercial fisheries in monk seal habitat near the Hawaiian Islands is resulting in negative interactions. Several injured seals have been observed. Additional mortality may cause the population to decline.

  **Activities:** Place observers on fishing boats and examine seals on beaches for evidence of fishery interactions.

  **Output:** Report with recommendations for fishery management.

  **Use of output:** Development and implementation of regulations to prevent death or injury of monk seals due to commercial fishing.

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**Saimaa seal (Phoca hispida saimensis)**

- **Development and implementation of recovery plan for the Saimaa seal**

  **Objectives:** Protection of breeding areas from disturbance, such as building holiday cottages on the shoreline and the use of snowmobiles in the area in wintertime. Preventing gillnet fisheries in the breeding area during late winter and early summer.

  **Background:** The Saimaa seal population has sharply decreased during the past 50 years. In the 1940s and 1950s, many seals were persecuted and shot by fishermen. During the next two decades environmental toxins such as mercury are suspected to have caused a decrease in pup production. In addition to that, from the 1970s on, pups have been accidentally caught in gillnets. Disturbance and artificial lowering of the lakes' water level in winter, also results in a decrease in pup production.

  **Activities:** Monitor population status, examine habitat requirements, create a cooperation with local authorities, land owners and fishermen.

  **Output:** Reports with analyzed data.

  **Use of output:** Implementation and enforcement of management actions in cooperation with the local administration, landowners and fishermen to bring about a recovery in the population of this species.

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**Vulnerable Species**

**Juan Fernandez fur seal (Arctocephalus philippii)**

- **Investigate feeding biology of Juan Fernandez fur seal.**

  **Objectives:** Determine diet composition of the Juan Fernandez fur seals.

  **Background:** This species was reduced to a very low level and although the population appears to be recovering well, there is a strong potential for competition between the fur seal populations and human fisheries, should either grow.

  **Activities:** Attach telemetry equipment to seals, sample prey stocks in foraging area and collect stomachs of entangled specimens for food analyses.

  **Output:** Reports.

  **Use of output:** Aid to management of commercial fisheries around the islands to ensure the recovery of the Juan Fernandez fur seal populations.
Guadalupe fur seal (Arctocephalus townsendi)

• Determine numbers and population parameters of Guadalupe fur seals
  Objectives: Determine numbers, age/sex composition, and productivity of the Guadalupe fur seal population.

  Background: This species was reduced to a very low level and the population may now be recovering. Little is being done to monitor its recovery.

  Activities: Observations and counts of animals hauled out.

  Output: Report with analyzed data.

  Use of output: Assessment of population status, development of conservation measures.

Steller’s sea lion (Eumetopias jubatus)

• Investigate feeding biology of Steller’s sea lions
  Objectives: Determine areas used for feeding, and prey abundance, distribution, and utilization in those areas.

  Background: In much of Alaska Steller’s sea lions have undergone a major and rapid decline in numbers. There is evidence that animals are under nutritional stress. Commercial fisheries remove millions of tons of potential prey each year from these areas.

  Activities: Attach satellite-linked telemetry to sea lions. Sample prey stocks in feeding areas to determine abundance and characteristics.

  Output: Reports identifying feeding areas and management needs.

  Use of output: Aid to understanding causes of sea lion decline, and management of commercial fisheries in the Gulf of Alaska and Bering Sea to ensure the recovery of the Steller’s sea lion.

• Continuation of ongoing recovery activities for the Steller’s sea lion
  Objectives: Implement activities required for recovery of the Steller’s sea lion population.

  Background: The Steller’s sea lion has been listed as a threatened species under the U.S. Endangered Species Act. A draft Recovery Plan has been developed and should be implemented. The Recovery Plan describes activities that need to be conducted in order to assist the recovery of this threatened species. Some interim conservation measures have already been put into effect.

  Activities: Monitor population status, examine habitat requirements, determine factors limiting population growth, implement and enforce management actions.

  Output: Protection of Steller’s sea lion habitat, reduced mortality and increased productivity.

  Use of output: Evaluation of factors limiting the Steller’s sea lion population and of necessary management measures.

Baltic ringed seal (Phoca hispida botnica)

• Effects of pollution and disturbance on the present status of the threatened Baltic ringed seal population
  Objectives: Study effects of changing pollution levels on seal populations and of ice-breaker activities on breeding success.

  Background: Early this century the Baltic ringed seal populations were reduced considerably by exploitation, and more recently by pollution and disturbance. Contaminants have been shown to affect reproductive success directly. Grey seals in the Baltic, although currently not classified as vulnerable, may also be affected by pollution and disturbance.

  Activities: Aerial surveys. Collection of tissue samples. Field observations, especially of ringed seal lairs with measurements of ambient and subnival noise. Field observations and tissue collections from grey seals.

  Output: Report with analyzed data.

  Use of output: Improve conservation measures related to findings.

Hooker’s sea lion (Phocarctos hookeri)

• Implementation of recovery program for Hooker’s sea lion
  Objectives: To implement a recovery program for Hooker’s sea lion, including the following aspects: Assessing level of incidental mortality in fisheries and introducing measures to alleviate the problem; managing rabbit populations on breeding islands; and re-assessing population size and possible growth rates.

  Background: Hooker’s sea lion is a rare species with a limited range. The population seems to be static. They are taken incidentally in intensive squid trawl fishing, which began in the early 1970s near their breeding grounds on the Auckland Islands. The incidental catch is high in relation to the small population size. The effect of the incidental catch on the population size is unknown. There is also juvenile mortality caused by the presence of rabbit burrows.

  Activities: Collection of data and specimens from fishing vessels. Examine effects of incidental catch on age and reproductive status. Revision of fishing regulations to reduce incidental mortality. Management of rabbit populations. Aerial surveys and ground counts.
Output: Recovery plan document.

Use of output: To guide to the recovery process for this threatened species.

Caspian seal (Phoca caspica)

- Assessment of status and harvest sustainability of the Caspian seal
  Objectives: Assess the current size and trend of the Caspian seal populations; monitor commercial harvest; determine other sources of mortality; model impacts of mortality on the population.

  Background: The Caspian seal has been subjected to variable but generally high levels of direct human harvest. Estimates of population size are of unknown accuracy, and may not be sufficient to monitor impacts of the harvest and other factors.

  Activities: Surveys to determine distribution and abundance; monitor age and sex composition of the harvest; determine biological parameters by sampling harvested animals; assess other factors that may be influencing population status.

  Output: Report with management recommendations.

  Use of output: Design and implement conservation measures.

Ungava seal (Phoca vitulina mellonae)

- Taxonomic identity of the Ungava seal
  Subject area: Management, conservation, and taxonomy.

  Objectives: Determine whether the freshwater seals in the Seal Lakes of northern Quebec, Canada, deserve unique subspecific status.

  Background: The harbor seals in the Seal Lakes of northern Quebec have been given subspecific status. Because this designation was based on only two specimens, it remains in doubt. Now that the existence of seals in the Seal Lakes is potentially threatened by the proposed James Bay II hydroelectric development, it is imperative that the correct identity of the freshwater seals be established.

  Activities: Identify the availability of biological samples from the Ungava seals that might be used to examine affinities with other harbor seals. Use the most appropriate techniques (e.g., morphometrics, enzyme analyses, molecular techniques, etc.) to compare freshwater seals with other populations and subspecies of Phoca vitulina to establish whether they are sufficiently different to warrant subspecific designation.

  Output: Reports.

  Use of Output: To provide input into the assessment of potential environmental impacts of the proposed James Bay II hydroelectric development.

Other Species of Concern

Laptev walrus (Odobenus rosmarus laptevi)

- Determine the status of the Laptev walrus
  Objectives: Determine the taxonomic identity, numbers, and distribution of walruses in the Laptev Sea.

  Background: Small numbers of walruses occur in this area, but their taxonomic status is unclear and their abundance is not well known. The population is severely depleted and not recovering even though hunting is now prohibited. Commercial development may be affecting animals.

  Activities: Collect blood samples or tissue from entangled animals to investigate taxonomic identity and conduct aerial and shipboard counts of walruses.

  Output: Report on taxonomic status and on numbers of animals seen; mapping locations of sightings.

  Use of output: Aid to classification, estimate population size, basis for population monitoring, habitat protection.

Actions to Evaluate Major Threats

Immediate Threat

Incidental catch
Incidental catch of pinnipeds in commercial fishing gear
**Objectives:** Determine the extent of incidental catches of pinnipeds and their impact on populations or species.

**Background:** Wherever the distribution of pinnipeds overlaps in space and time with commercial fisheries, there is the potential for them to be caught incidentally and killed in the process. To date, some 22 species of pinnipeds have been reported taken as incidental catches, and in at least seven cases it has been suggested that incidental takes have contributed to population declines. Data on the extent of incidental catches of pinnipeds is, however, extremely limited and is not adequate to assess either the true extent of the problem or the impacts on populations.

**Activities:** Design a standardized protocol for collecting data on incidental take of pinnipeds in fishing gear. Attempt to ensure that observer programs currently in place for other species (such as cetaceans or marine turtles) also collect relevant data for pinnipeds. Encourage the development of similar observer programs for those fisheries where the incidental take of pinnipeds, particularly of endangered species or populations, is thought to be a problem.

**Output:** Improved data on incidental take and potential impacts on pinnipeds populations.

**Use of output:** Development of appropriate conservation methods to minimize incidental take of pinnipeds in fishing gear.

**Direct harvest**

**Better documentation of harvests and their consequences**

**Objectives:** To obtain better documentation of harvests of pinnipeds in the Commonwealth of Independent States, all walrus harvests, and harvest of Arctocephalus australis in Uruguay; to provide adequate monitoring of exploited pinniped populations; to improve the quality of trade statistics so that these provide a more accurate reflection of the numbers of pinnipeds which are taken.

**Background:** Available information on the size of pinniped populations within the former Soviet Union and on the annual harvest is insufficient to determine whether these takes can be sustained. A similar problem exists with the harvest of walruses in the United States. Better statistics are required. In addition, there is a need for a monitoring program for each species which is sufficiently precise to provide an adequate indication of any adverse effects caused by exploitation. Where adequate information on harvest levels is not available from national sources, international trade statistics may provide some information. However, the nature of these statistics is often inadequate for this purpose (e.g. where exports of South African fur seal penis bones are simply classified as “bones” it is impossible to determine how many seals are represented by a specified quantity of bones). Therefore these statistics need to be formulated in terms which can be related directly to seal numbers.

**Activities:** Approach the Commonwealth of Independent States, United States, Canadian and Uruguayan authorities for better harvest statistics. Provide advice on appropriate monitoring techniques, with particular emphasis on the assessment of walrus populations using visual classification of age and sex classes.

**Output:** Improved definitions of trade units which can be related to pinniped numbers.

**Use of output:** Improved assessment of the conservation status of harvested species.

**Intermediate Threats**

**Diseases**

Determine and monitor the incidence of diseases in pinnipeds

**Objectives:** Determine and monitor the incidence of viral and other diseases in pinnipeds.

**Background:** Some populations of pinnipeds are decreasing while others are increasing or stable. Disease is often suggested as a possible factor in declines. Agents of disease are known to occur, but their influence is sometimes unclear. In some areas (e.g., the northeast Atlantic and Lake Baikal) disease definitely has had severe impacts on pinniped populations.

**Activities:** Collect, analyze, and archive serum and tissue samples from stranded animals, bycatch, research activities, and other sources.

**Output:** Reports identifying the types and prevalences of diseases currently occurring, and archived tissues that can be used in future studies.

**Use of output:** Assessment of current influence of disease on pinniped populations, and ability to address future disease concerns.

**Habitat degradation**

**Contaminants and other pollution**

- **Impact of contaminants on reproduction and the immune system in pinnipeds**

  **Objectives:** Determine influence of contaminants on hormonal cycles, physiological processes, and the immune system. Investigate metabolism, turnover, and excretion rate of contaminants such as PCBs during the annual reproductive cycle.

  **Background:** High values of contaminants have been reported in several marine mammal species. Some seal populations suffer from low birth rates. The contribution of pollution to disease problems, such as the recent virus outbreak in the North Sea harbor seal populations, remains unclear.
Activities: Blood sampling and subsequent analysis for hormones, cholesterol, contaminant contents, and analysis of immunoreponse.

Output: Basic research for assessing pollution effects on pinnipeds.

• Collection of baseline contaminant data, blood, and tissue for future analyses.

Objectives: Acquisition of comparative data on present contaminant burdens in pinnipeds and archiving of blood and tissue for future analyses.

Background: Understanding of the impact of certain levels of contaminants in tissues of pinnipeds is often hampered by the lack of reference data. Although no completely unpolluted areas exist, it is essential to collect baseline data on the occurrence of contaminants in pinnipeds, for as many areas as possible. Furthermore, blood and tissues of pinnipeds from some areas should be archived for future analysis when new toxic compounds are detected and improved analytical techniques become available.

Activities: Collect, analyze, and archive blood and tissue samples from pinnipeds according to internationally standardized protocols.

Output: Reports on present occurrence and levels of contaminants, and archived samples that can be used in future studies.

Use of output: Assessment of current and future impact of pollution on pinnipeds.

• Alteration of food supply due to commercial fisheries

Objectives: Improve current understanding of potential interactions between pinnipeds and commercial fisheries. Ensure that human fishing activities are conducted in a manner which minimizes impacts on other predators, including pinnipeds.

Background: There has been concern for some time that large-scale commercial fishing operations may reduce the amount of food available to pinniped populations. Examples include: fisheries for capelin in the Barents Sea and in the northwest Atlantic off eastern Canada and their possible impacts on harp seal populations, which also eat capelin; and the pollock fishery in the north Pacific off the coast of Alaska and its possible contribution to the decline of the now threatened (under U.S. Endangered Species Act) Steller's sea lion population. In such cases when fish stocks have declined, it has been impossible to determine unequivocally whether correlated changes in seal populations were solely the result of fishing activities or of changing environmental conditions, or whether overfishing and environmental changes were both involved.

Activities: Detailed re-assessment of available data for those cases where observed changes in pinniped populations were correlated with increased fishing activities or environmental changes. Monitoring of pinniped populations which may be impacted in the future by large-scale commercial fisheries for their prey, e.g. harp seals in the Barents Sea and Steller’s sea lions in Alaska. Ideally, such work would involve the collaboration of pinniped biologists, fishery biologists, and physical oceanographers. Further research on the potential interactions between pinnipeds, their prey and their potential competitors (including commercial fisheries). The latter activity should include involvement of theoretical ecologists and ecosystem modelers.

Output: Reports, scientific papers, advice to management authorities.

Use of output: Where appropriate, develop fishery management plans, including quotas, which take into account the feeding requirements of pinnipeds (and other marine predators), in order to minimize impacts of human fishing activities on components of marine ecosystems, including pinnipeds.

Disturbance

Determine impacts of disturbance on pinniped behavior and habitat use.

Objectives: Determine the impacts of disturbance caused by human activities on pinniped behavior and habitat use.

Background: In areas where they co-occur, pinnipeds are generally wary of humans and avoid contact. As human activities intensify in existing areas of overlap and move into new areas, there is great potential for alteration of pinniped behavior and habitat use. Some changes may result in successful adaptations while others may have a negative influence on population dynamics and status. The responses of pinnipeds to various disturbance factors (e.g., human presence, underwater noise, airborne noise) are poorly known.

Activities: Field observations and experiments to describe responses of pinnipeds to various types of disturbances. Laboratory studies to determine physiological response to various disturbances including hearing thresholds and responses to sound of different types.

Output: Reports with analyzed data.

Use of output: Develop conservation and management plans, regulate human activities to minimize impacts on pinnipeds.

Changes in physical attributes of habitat

Evaluate impacts of physical habitat alteration on pinniped habitat use.

Objectives: Evaluate impacts of physical habitat alteration caused by human activities on pinniped habitat use.
**Background:** Physical characteristics of habitat are important in determining their suitability for pinnipeds. While many of these characteristics are determined by environmental factors, certain human activities (e.g., dredging, dam building, ice breaking) have direct physical effects on pinniped habitats. Such changes may alter how pinnipeds use these habitats, or may render them unsuitable.

**Activities:** Field observations and experiments to document the responses of pinnipeds to changes in physical characteristics of their habitat.

**Output:** Reports with analyzed data.

**Use of output:** Develop conservation and management plans, regulate human activities to minimize impacts on pinnipeds.

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**Long-term Threats**

**Changes in genetic diversity/fitness**

Description and comparison of genetic diversity in pinnipeds.

**Objectives:** Determine levels of genetic variability in populations of related species that have and have not been through bottlenecks. Investigate the potential of molecular techniques for identifying pinniped subspecies and stocks.

**Background:** A number of pinniped species (e.g., *Monachus monachus* in the northeast Atlantic, *Arctocephalus gazella*, *Mirounga angustirostris*) have been reduced to very low levels by excessive exploitation and persecution. Such populations may have reduced genetic variability as a result of this, and may therefore have limited ability to adapt to habitat change. Modern techniques from molecular genetics can be used to compare levels of genetic diversity in closely related species (e.g., *M. leonina* with *M. angustirostris*, *A. gazella* with *A. philippii* and *A. townsendi*) which have responded differently to bottlenecks. This will give an indication of the importance of bottlenecks for species adaptability. In addition, such studies will provide baseline information on levels of genetic variability within well recognized pinniped taxonomic units which can then be used to determine the taxonomic distinctness of certain currently recognized but disputed subspecies, such as *Phoca vitulina* mollonae and *Odobenus rosmarus* laptevi. In addition, such techniques may provide potentially useful tools for distinguishing between stocks within species.

**Activities:** Collect tissue samples (blood or skin) from appropriate species and subspecies and analyze for genetic variation.

**Output:** Report with analyzed data.

**Use of output:** Improved understanding of effects of population reduction. Potential tools for subspecific and stock identification.

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**Lack of monitoring of species status**

Gather basic information for species that are Insufficiently Known

**Objectives:** Develop methods for estimating abundance of pinnipeds, and provide baseline data for population monitoring.

**Background:** For several pinniped species the available estimates of abundance are outdated, of unknown accuracy, or otherwise inadequate. Examples include pinnipeds of the Okhotsk, Bering, and Chukchi Seas (inhabited by spotted, ribbon, and bearded seals) and of the Antarctic (inhabited by Ross, crabeater, and leopard seals). There is no program in place to monitor abundance of these species, although they may be harvested, may interact with commercial fisheries, and may be impacted by other human activities. Given the current lack of data, major population changes could go undetected. Due to the wide distribution of some of these species, multi-national assessment efforts will be required.

**Activities:** Aerial and shipboard counts of seals, attachment of telemetry devices.

**Output:** Reports with analyzed data, including descriptions of monitoring protocols.

**Use of output:** Assessment of species status, development of conservation and management plans, and implementation of population monitoring.

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**Actions Needed to Improve Knowledge about the Role of Pinnipeds in Ecosystems**

**Feeding ecology and population dynamics**

- **Improving equipment to track pinnipeds at sea**

  **Objectives:** Technical improvements such as miniaturization of radio-tags and linkage with Global Positioning System to determine seal movements and feeding (confined to certain areas) in relation to other daily activity patterns.

  **Background:** Activities of seals at sea are very imperfectly known. Use of radio transmitters has until recently largely been limited to coastal activities. Improvement of techniques will enhance involvement of other disciplines.

  **Activities:** Apply radio transmitters to seals. Field observations and analyses of data.

  **Output:** Report with analyzed data and observations.

  **Use of output:** Aid to seal conservation and management.
• Activity recorder for seals
  
  **Objectives:** To develop an existing activity recorder for information on seals in the water. To get a better understanding of their interaction with fisheries.

  **Background:** Activities of seals are imperfectly known. Three recorders have been constructed which could be attached to the backs of seals. More data are needed to calculate potential foraging ranges, and energy costs of propulsion and thermal maintenance.

  **Activities:** Development and production of recorders both in the laboratory and in the field. Field observations.

  **Output:** Report with data of recordings and observations.

  **Use of output:** Aid to management of seals in surveyed areas, basis for general application of recorders.

• Ice-associated pinnipeds in the eastern Bering Sea
  
  **Objectives:** Determine status of ice-associated pinnipeds, identifying stocks e.g. in the eastern Bering Sea. Determine food habits in the ice front and estimate productivity.

  **Background:** Assessment techniques for some species of pinnipeds are poorly developed. Surveys have not been conducted since the mid-1970s.

  **Activities:** Conduct aerial surveys. Collect and analyze specimens. Tag seal pups.

  **Output:** Status report with analyzed biological data.

  **Use of output:** Aid to pinniped conservation in the area.

Interaction with commercial fisheries

  **Objectives:** To gain better insight into potential interactions between pinnipeds and commercial fisheries.

  **Background:** Interactions of some pinnipeds with fish stocks and fisheries have become an important aspect of controversial public policy debates about the perceived need for culling programs to control seal numbers. Lack of suitable databases currently hinders ecological research which might well resolve existing controversies.

  **Activities:** For those pinnipeds potentially involved in interactions with fisheries (e.g. harp seals in the Barents Sea and in the northwest Atlantic; grey seals on both the northeast and northwest Atlantic; harbor seals in both the east and west coasts of Canada and in Alaska; Steller’s sea lions in Alaska; South African fur seals in southern Africa), collection of all published data on energy requirements, feeding habits, and distribution of the pinnipeds, all data on abundance and distribution of prey species, and all data on relevant fisheries. Analysis of feeding habits data, availability of prey species and fishery yields. Use of these data as input for modelling studies of the possible ecosystem interactions between seals, fish stocks and fisheries.

  **Output:** Reports, scientific papers, advice to management authorities, public education programs to explain the nature of interactions between pinnipeds and fish.

  **Use of output:** Help resolve existing conflicts between pinnipeds and fisheries. Provide a knowledge base for the rational development of management plans, both for pinniped populations and fisheries, including the setting of fishery quotas that take into account the food requirements of pinnipeds and other marine predators.

Additional ecosystem considerations

  **Objectives:** To understand better the role that pinnipeds play in marine ecosystems and how population changes may affect the ecosystem. To incorporate ecosystem considerations into the management of pinniped populations and their prey.

  **Background:** The need to manage ecosystems rather than individual populations is a common theme in current discussions about the management of pinnipeds and their prey. The reality is, however, that marine ecosystems are extremely complex and that there is simply not enough known to “manage” them. Nevertheless, there is a need for research to improve the understanding of the functioning of marine ecosystems. There is also a need to incorporate, wherever possible, ecosystem considerations into the management of both pinnipeds and their prey.

  **Activities:** Interdisciplinary research, involving teams of biologists who specialize in the various components of marine ecosystems, from phytoplankton to whales, physical oceanographers, ecosystem modelers, and theoretical ecologists.

  **Output:** Reports, scientific papers, advice to management authorities.

  **Use of output:** Resolution of conflicts which arise out of uncertainty about the functioning of the marine ecosystem (including perceived conflicts between pinnipeds and fisheries). Improve management of various components in marine ecosystems, including pinnipeds.
Appendix 1. The IUCN Categories of Threat

Extinct (Ex)
Species not definitely located in the wild during the past 50 years (criterion as used by the Convention on International Trade in Endangered Species of Wild Fauna and Flora).
N.B. On a few occasions, the category Ex? has been assigned; this denotes it is virtually certain that the taxon has recently become extinct.

Endangered (E)
Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.
Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. Also included are taxa that may be extinct but have definitely been seen in the wild in the past 50 years.

Vulnerable (V)
Taxa believed likely to move into the 'Endangered' category in the near future if the causal factors continue operating.
Included are taxa of which most or all the populations are decreasing because of overexploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security has not yet been assured; and taxa with populations that are still abundant but are under threat from severe adverse factors throughout their range.
N.B. In practice, 'Endangered' and 'Vulnerable' categories may include, temporarily, taxa whose populations are beginning to recover as a result of remedial action, but whose recovery is insufficient to justify their transfer to another category.

Rare (R)
Taxa with small world populations that are not at present 'Endangered' or 'Vulnerable,' but are at risk.
These taxa are usually localized within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

Indeterminate (I)
Taxa known to be 'Endangered,' 'Vulnerable,' or 'Rare' but where there is not enough information to say which of the three categories is appropriate.

Insufficiently Known (K)
Taxa that are suspected but not definitely known to belong to any of the above categories, because of lack of information.

Threatened (T)
Threatened is a general term to denote species which are 'Endangered,' 'Vulnerable,' 'Rare,' 'Indeterminate,' or 'Insufficiently Known' and should not be confused with the use of the same term by the U.S. Office of Endangered Species. In this volume it is used to identify taxa comprised of several sub-taxa which have differing status categories.

Commercially Threatened (CT)
Taxa not currently threatened with extinction, but most or all of whose populations are threatened as a sustainable commercial resource, or will become so, unless their exploitation is regulated. This category applies only to taxa whose populations are assumed to be relatively large. In practice, this category has only been used for marine species of commercial importance that are being overfished in several parts of their ranges.
Appendix 2. Harvest and International Trade in Seals and Seal Products

Amie Brautigam, IUCN/SSC Trade Specialist Group and Jørgen Thomsen, TRAFFIC International

Pinnipeds have been exploited for centuries for food and a variety of products, most importantly oil and hides. The southern elephant seal (*Mirounga leonina*) has been particularly killed for oil, while the fur seals (*Arctocephalus* and *Callorhinus*) and hair seals, such as the harp and hooded seals (*Phoca groenlandica* and *Cystophora cristata*) have been killed for their skins and meat. Commercial sealing expeditions to the Americas and polar regions since as early as the sixteenth century harvested millions of animals and resulted in dramatic reductions in some populations of several of the *Arctocephalus* and the two *Mirounga* species, and the near extinction of others. In addition, overexploitation and other human-induced pressures were most likely responsible for the extinction of the Caribbean monk seal (*Monachus tropicalis*) and the extinction of the Mediterranean monk seal (*Monachus monachus*) over most of its former range.

Although many pinniped species continue to be harvested for food and other products by native people, especially in Arctic regions, international trade has been largely restricted to skins, oil, and walrus ivory and products made from them. Live specimens occasionally but consistently enter trade for zoos and aquaria. An apparently increasing trade centers on seal penises and bacula, sought for aphrodisiacal purposes in Oriental markets.

Several species of pinnipeds are regulated in trade under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The Guadalupe fur seal (*Arctocephalus townsendi*) and the monk seal (*Monachus* spp.) benefit from complete protection from international trade through their inclusion in Appendix I of the treaty. The remaining *Arctocephalus* species and *Mirounga leonina* are included in CITES Appendix II. The walrus (*Odobenus rosmarus*) is included on Appendix III for Canada. In addition, exploitation and international trade in these and other species have been and continue to be governed by various national and international regulatory regimes, among them the Interim Convention on the Conservation of North Pacific Fur Seals of 1981 (now expired), the Convention for the Conservation of Antarctic Seals of 1978, and the U.S. Marine Mammal Protection Act of 1972.

Barzdo and Caldwell (1982) and Dixon (1984) have reviewed levels of international trade in seals, the latter exclusively in skins for the European market. They identified the following species as those most heavily exploited for international commercial markets during the periods they studied: *Arctocephalus* spp., *Callorhinus ursinus*, *Phoca groenlandica*, *Phoca hispida*, *Phoca vitulina*, and *Cystophora cristata*. According to Dixon, the European market in seal skins focused primarily on four species: *Arctocephalus pusillus pusillus*, *Phoca hispida*, *Phoca groenlandica*, and *Cystophora cristata*, and ten exporting countries: Canada, Greenland, Iceland, Namibia, Norway, South Africa, the United Kingdom, Uruguay, the United States, and the Commonwealth of Independent States. Many of these are importing and re-exporting countries. A 1984 prohibition by the European Economic Community of imports of baby seal skins of *Phoca groenlandica* and *Cystophora cristata* appears to have altered considerably the volume and species composition of European seal skin imports and is known to have had severe economic consequences for countries, such as Canada and Greenland, that formerly exported much higher numbers of skins.

There is considerable international demand for seal penises and bacula, commonly referred to as "seal sticks," and in some parts of the world the entire genital tract is extracted from the seal carcass for subsequent sale. This trade involves at least *Arctocephalus* spp. from South Africa and Uruguay and *Callorhinus ursinus* from the United States, but possibly other species, too (A. York, U.S. National Mar. Fish. Serv., pers. comm. 1989). The bacula and the latter species sold for U.S. $35.00 in 1989 and is currently reported to be worth more than the pelts; one kilogram comprises the bacula of over 40 subadult male *Callorhinus ursinus* (A. York, pers. comm., 1989 in Brautigam, 1989).

The most specific set of statistics available for evaluating current levels of international trade in seal products are those compiled by the CITES Parties in their annual reports of trade in CITES-listed species. Because not all countries are party to CITES or report on CITES trade and because many pinniped
species are not listed on CITES, these data are far from representative of trade in this taxon. In addition, because CITES statistics document international transactions only, harvest levels in CITES-listed species for domestic markets are likely to be significantly higher than that indicated by trade figures. A review of CITES statistics for the years 1980 through 1988 highlights the following:

1. *Arctocephalus australis*. According to the FAO Yearbook of Fishery Statistics (Anon., 1981; 1988b; 1989b; 1990), between 6,000 and 10,000 specimens of this species were killed in Uruguay annually between 1980 and 1988. CITES reports, however, document a comparatively minor trade in products of this species, usually limited to 200-300 skins. The majority of skins reported to be exported in recent years were to Japanese companies. Exports in 1988 totalled 274 skins.

2. *Arctocephalus pusillus pusillus*. In the early 1980s, South Africa’s reported exports of skins of this species ranged from as high as almost 190,000 in 1982 to as low as 700 in 1986; 1988 reported seal skin exports from South Africa totalled 10,000. Countries importing skins have also shifted from Germany, formerly the largest importer along with Norway and Denmark, to Hong Kong.

The population of *A. pusillus pusillus* is estimated to exceed one million animals. Wildlife authorities in Namibia and South Africa have followed a management policy that called for the culling of between 20,000 and 40,000 animals per year during the 1970s and 1980s, with the result that large numbers of stockpiled skins were put on the market in the early 1980s (see Figure 43). The proposed culling of 40,000 animals for export of skins and bacula to Taiwan in early 1990 was suspended in response to protests from animal welfare groups (New York Times, 3.07.1990). Recently the South African government has announced a two year cessation of harvesting this population.

The decline in seal skin exports from South Africa and Namibia may have been offset by an apparent increase in exports of seal bacula and products derived from them, registered variably as “bones,” “specimens,” or “derivatives.” Large shipments of *Arctocephalus* derivatives, reported as illegal, were intercepted on import from Hong Kong into the United States in both 1984 (7,261) and 1988 (10,655). South Africa’s export of 45 kg of bones to Hong Kong in 1980 was followed by reported exports in 1986 of 530 kg of “specimens” to Hong Kong, as well as 112 kg of “specimens” to Taiwan; of 133 kg of bones to Hong Kong in 1987; and, most recently, in 1988, of 778 kg of bones to Hong Kong.

3. *Odobenus rosmarus*. International trade in Pacific walrus from the United States is governed by the U.S. Marine Mammal Protection Act, which prohibits commercial trade in walrus products other than native handicrafts. Nevertheless, the CITES data appear the most revealing with respect to trade in walrus, particularly in the light of speculation that increased trade pressure has resulted from prohibition of international trade in African elephant ivory. From as few as four trade records in 1981, trade increased to 64 records by 1988. Certain of these records are worthy of note. As these figures cover changes before the introduction of the CITES ban on ivory trading, it is difficult to use them as an index for present and future trade.

Possibly the most indicative series of statistics involve United States exports of walrus tusks and imports of walrus carvings for commercial purposes. In 1986, for example, the U.S. reported exporting 23 kg of tusks to Hong Kong and 68 kg of tusks to Taiwan for commercial purposes; in 1988, 158 kg of tusks were reported to be exported by the U.S. to Hong Kong for commercial purposes. As for imports, in 1983, the U.S. reported importing 610 ivory carvings for commercial purposes from Hong Kong; in 1984, an import of 1,084 carvings from Hong Kong was reported as illegal, indicating it was probably seized; in 1986, over 8,000 walrus ivory carvings (7,978 illegal from Hong Kong) were imported into the U.S. for commercial purposes, most from Hong Kong but others from the United Kingdom and Denmark (Greenland); in 1987, the volume of carvings imported from Hong Kong increased to 9,900; and in 1988 to almost 25,000, all for commercial purposes.

Also worthy of note are the 588 kg of “bones” the former Soviet Union reported exporting for commercial purposes to Germany in 1986 (reported by Germany in 1987 as import of 400 bones). Although it is impossible to state with certainty what these bones actually were, it is likely that they were tusks to be used by the German ivory carving industry. More interesting, however, are these first official statistics indicating that the Commonwealth of Independent States is commercializing internationally the products from its walrus harvest. Trade between the United States and Canada in walrus tusks and carvings may also be worthy of note. U.S. exports to Canada ranged from 293 carvings in 1983 to 694 in 1988. Canada, in turn, exported 99 carvings to the U.S. in 1985 and 342 carvings to Germany, 15 carvings to France, and 110 carvings to Japan in 1988.

The mid-1970s, the potential value of walrus deriving from the Alaskan hunt was estimated to be U.S. $750,000; by 1980, the U.S. Fish and Wildlife Service has reported the trade had developed into a “multi million dollar industry” (Palmasano et al., 1980 in Anon., 1987). The 1987 price for raw tusks of Pacific walrus was U.S. $55/kg, with resale bringing the price up to around U.S. $130/kg. Once cut and worked, the price was estimated to reach U.S. $1,400-1,800/kg (Anon., 1987).

There is evidence of illegal trade in raw ivory from the Alaskan walrus hunt for purposes other than native handicrafts. In 1981, federal agents seized more than 5,500 kg of illegally traded walrus ivory (representing 5,500 animals) with a wholesale value of U.S. $450,000. Markets for this ivory
were traced to London, Hong Kong, Taiwan, and Tokyo; moreover, two dealers outside Alaska were implicated in an estimated U.S. $3.5 million annual dealings in walrus ivory. Further investigations in subsequent years resulted in at least 115 walrus tusks being seized in 1982 and 117 in 1983 (Anon., 1987). In at least one incident in 1987, 100 lbs. (representing about 8 walrus) of walrus ivory were seized in a U.S. Fish and Wildlife Service investigation of illegal big-game hunting in Alaska (Washington Post, 30.01.1987). In addition, U.S. Fish and Wildlife Service officials estimate that currently 10% of the walrus killed by Alaska Eskimos, about 400, are killed illegally by “headhunters” (New York Times, 15.08.1989).

There are no reports on international commercial trade in walrus penises or bacula, however it is known that they are sold to tourists in Alaska at U.S. $75.00 a piece. This is a considerable increase in price over CAN $5-10/piece price in Canada in 1980 (Riewe & Amsden, 1980 in Anon., 1987).

Current harvests of walrus and the way these are managed have been cause for concern. Fay et al. (1989) claim that the Pacific walrus was at very high levels in the late 1970s and the decline, primarily due to density-related reduction in fecundity and calf survival, is accelerated by the harvest. An apparently declining population and potential overharvest at a current level of 7,500 animals per year, as well as evidence of increased and/or illegal trade in walrus ivory, may point to a need for increased focus on measures to ensure exploitation does not result in a continuing reduction of this population.

Customs and harvest statistics for both CITES Parties and non-Parties provide additional evidence of exploitation and trade of other pinniped species. Noteworthy are:

**Canada**
Exports of as many as 137,164 seal skins in 1984 were reduced to as few as 100 skins in 1986. This number has since increased to about 10,000-20,000 per year in recent years (Figure 44). The total collapse of Canadian seal skin exports in the mid-1980s was a result of the restrictions imposed by the EEC on the export of certain baby seal skins as well as dramatic change in consumer attitudes as a consequence of anti-sealing campaigns. The majority of seals harvested were and still are of two species, *Phoca groenlandica* and *Phoca hispida*, in that order. Harvest levels appear to have regained some of the numbers recorded in the early 1980s prior to the anti-sealing campaigns. In 1988, for example Canada harvested 84,238 individuals of *P. groenlandica* (Anon., 1990).

**Denmark and Greenland**
Although all Greenland seal skin transactions were formerly carried out through Denmark, the Greenland authorities are increasingly organizing these transactions themselves. Nevertheless, Danish statistics provide indicators of volumes and trends in this trade. Danish exports of Greenland skins of *Phoca groenlandica* and *P. hispida* have fallen steadily during the 1980s, from some 110,000 in 1979 to only 6,831 skins in 1989. These statistics indicate a total collapse in the Greenland seal skin trade, which is known to have had serious economic consequences for the indigenous communities in Greenland.

Greenland seal harvest figures have generally remained much larger than export figures, indicating the continued importance of seals as a source of meat and other products in Greenland. Reported 1988 harvest figures for *P. groenlandica*, *P. hispida*, and *Cystophora cristata* were 8,879, 50,757, and 1,669 respectively (Anon., 1990).

**Norway**
Whereas Norwegian Customs statistics indicate that country’s past and continued importance as an intermediary for fur

![Figure 44. Harvest of all seals 1983-1988 (Reported harvest: source: TRAFFIC International from FAO Fishery Statistics).](image-url)
skins from Namibia and South Africa, its harvest figures indicate the apparent continued importance of *P. groenlandica* and *Cystophora cristata* as sources of blubber and other products. Total harvest numbers of 85,071 animals of these two species in 1976 fell to as few as 11,436 in 1984 but rose again to 35,110 in 1988, with *P. groenlandica* comprising at least 75% and as high as 99.6% of the harvest since 1976. Skins from this harvest are apparently used within Norway. The wholesale price per skin has dropped by almost two-thirds since 1980 (Anon., 1988a).

**United States**

Most noteworthy among the seal species utilized for subsistence purposes in the United States is the North Pacific fur seal (*Callorhinus ursinus*). Harvested under international agreements from 1911 until 1985, when the Interim Convention on Conservation of North Pacific Fur Seals expired, the species is now subject to the national regulations of the countries in which it occurs. A commercial harvest of female fur seals from 1956-1968 on St. Paul Island in the Pribilof Islands, Alaska, where the largest population of this species occurs, was adjusted to a harvest of 25,000 subadult males through 1984, from which time only an annual subsistence harvest of about 2,000 has been allowed. An almost two-thirds drop in this population since the 1950s prompted the U.S. National Marine Fisheries Service in 1988 to designate the Pribilof population as a “depleted stock” under the U.S. Marine Mammal Protection Act, thereby instituting increased protection measures.

Although considerably lower today than at the time of commercial harvest, U.S. exports of skins of this species have continued since 1984. Because no inventory was made of seal skins and baccala in stock at that time, U.S. authorities have reported experiencing difficulties enforcing export regulations, and there are concerns that stock from commercial harvest may be serving as a loophole for international trade in illegally taken animals. In 1987, for example, 3,000 units of baccala plus 1,400 were detained when consigned to a Hong Kong company; over 10,000 units were detained in 1988 (Anon., 1989a). A proposal to include this species on Appendix II of CITES was withdrawn prior to the 1989 CITES meeting; experts on the species felt that these problems notwithstanding, international trade was not a threat to this species’ survival.

It is known that the fishing fleets of Japan, the Commonwealth of Independent States, South Korea, and Taiwan are harvesting pinnipeds in the southern hemisphere, around the Antarctic. The volumes are not reported, but the catch limits established under the Convention for the Conservation of Antarctic Seals provide some indication of at least the potential harvest: 175,000 *Lobodon carcinophagus* and 5,000 *Leptonychotes weddelli*. The former species, in particular, is known to be utilized as a source of meat for both animals and people.

Although current figures appear to be unavailable, reports from early 1980s (Barzdo & Caldwell, 1982) and in this volume indicate the harvest of substantial numbers of seals of several species in the former Soviet Union. Those species appearing to warrant more further investigation of impact of harvest on populations are two of the land-locked seals *Phoca hispida* and *P. sibirica*, given their relatively low population sizes; others however, such as *P. hispida*, may also merit attention.

The worldwide reported seal harvest has followed the general harvest pattern apparent with individual species. Reported harvest levels dropped in the mid-1980s because of anti-sealing campaigns (Figure 45), although available information points to harvests having continued at largely the same levels. Based on these data, it would appear that seal products remain important wildlife commodities in both internal and international commerce.

**References**


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