

Seals



IUCN
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SPECIES SURVIVAL COMMISSION



Foreword

Wild animals and people are both part of the natural environment, and there has always been a close relationship between them. From earliest times, that inter-relationship has ranged from the practical to the aesthetic; from nourishment of the body to nourishment of the spirit. Although most of our animal protein now comes from domesticated species, wild animals are still an important source of protein for local populations in some parts of the world. The same continuity can be seen today in the artistic representation of wildlife found in many societies, which can trace its lineage from Stone Age cave paintings.

From prehistoric times, animal skins and furs have been used for protection and, later, for adornment. The fur trade evolved in response to these needs. Today, 85-90% of the world trade now involves farm-raised species, mainly mink and fox, which are considered part of normal agriculture.

Nevertheless, several wild fur-bearers have dramatically declined in numbers. Conservation is imperative if some of the threatened species are to survive and sustained yields are to be maintained. Indeed, the World Conservation Strategy points out the importance of wild animals and plants as a source of income for rural communities. This is especially true of the wild fur trade in Canada. There are, therefore, very practical reasons for the fur trade becoming involved in conservation, which it has by close association with wildlife management.

Involvement of the fur trade in conservation on a major scale dates from the early 1970s when one particular species was the focus of concern. Following the sharp decline in the flow of leopard skins from producing areas, the International Fur Trade Federation (IFTF) took the unprecedented step of introducing a voluntary ban on handling leopard and some other species - several years, in fact, before the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) came into force.

The fur trade has contributed to funding research into the status of leopard and cheetah in sub-Saharan Africa, in cooperation with IUCN - The World Conservation Union. This interest in cats continued with support for a survey of the status of South American species, again in cooperation with IUCN.

IUCN is pleased to acknowledge the substantial financial support and cooperation of the IFTE, which has made possible the preparation and publication of conservation action plans for fur-bearing mammals, and has also provided for this series of public education booklets. Conservation of the world's biological diversity is dependent upon all of us. We welcome your support.

Seals

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Mediterranean monk seal (*Monachus monachus*) near Alonissos Island, Greece. Seals are coastal dwelling carnivores which have evolved a series of remarkable adaptations to equip them for aquatic life.

Few people would have any difficulty recognising a seal. It is a coastal-dwelling mammal characterised by a lithe, streamlined body. The head is usually sharp in profile, merging into the trunk to give the body a tube-like appearance. All four limbs are modified as flippers which propel and steer the animal at high speed through the water.

Seals belong to a group of animals often referred to as "pinnipeds" (Order Pinnipedia), a term derived from the Latin words pinna (wing) and pes (foot). Pinnipeds are therefore "wing-footed mammals".

The origin of present-day seals is still unclear. The earliest fossil records date from the Miocene period, some 20 million years ago. Seals undoubtedly evolved from land carnivores and probably lived in lakes, rivers and inland seas, later adapting to the coastal and marine environment where they have since prospered.

Most species now live around coastlines, islands or ice packs which provide an essential means of escaping from the water to rest, bask in the sun, mate or give birth. It is this need to remain on land or ice during a portion of their annual life cycle that has made seals particularly vulnerable to predation by man. Today they are found in every ocean of the world but are most abundant in the seas surrounding the Arctic and Antarctic poles.

The seal family

Although they may not have had a common ancestor, all seals, sea lions and walrus are sufficiently similar to be grouped together in a single taxonomic order. Pinnipeds may be divided into three families: the **Phocidae** ("True Seals"), which are represented by 18 species worldwide, the **Otariidae** ("Eared Seals"), which includes the fur seals and sea lions (14 species), and the **Odobenidae** of which the walrus is the sole living representative.

The family Otariidae may be further subdivided into the Otariinae (sea lions) and Arctocephalinae (fur seals). The most obvious differences between these two groups are the blunter nose and sparse underfur of the sea lions, compared with the sharper nose and abundant fur of the fur seals. Most sea lions are also larger than fur seals.

The family Phocidae may also be subdivided into two subfamilies: the Phocinae (or northern phocids) and the Monachinae (southern phocids), although the geographical terminology may occasionally be misleading. The most obvious features which distinguish these groups are the claws on the fore and hind flippers of members of the subfamily Phocinae, which are much larger than those of the Monachinae.

Pinnipeds spend much of their life in water but all species return to land or ice to breed. Different modifications of the hind flippers make some more mobile on land than others. Members of the family Phocidae - which may be marine, estuarine or freshwater species - are not able to bend their hind flippers forwards at the ankle so their movement on land is slow and cumbersome. Phocids also lack an external ear flap (pinna).

Sea lions, fur seals and walrus are all strictly marine mammals and are able to bend their flippers forwards at the ankle, giving them much more flexibility and manoeuvrability on land.



Northern fur seal (*Callorhinus ursinus*) clearly showing the flippers which give the group its name - Pinnipedia - or wing-footed mammals.

There is a long and detailed history of contact between man and seals. Almost wherever seals occurred, they played a role in the lives of coastal-dwelling people, and gave rise to many legends. A seal skin coat dragged along the ground would apparently protect a field from hailstones. Wearing such a coat is reputed to protect the owner from lightning. A seal's flipper placed beneath a pillow at night was reputed to be a certain cure for insomnia. Bering Strait Eskimos believe that the souls of seals remained with their urinary bladders and that, by returning these to the sea, the soul joined fresh bodies that could, in turn, be hunted.

Seals have well-developed sight, hearing and touch. Their vision is restricted to black and white and their eyes are generally large, measuring up to 6cm in diameter in the case of the fur seal and the southern elephant seal. They are particularly well-adapted to functioning in water but vision is also good on land, especially under bright conditions. The eyes have no tear ducts, so that tears often stream down the face, contributing to the animal's charm and appeal. A seal's sense of hearing is also acute, especially underwater.



Common seal (Phoca vitulina) showing characteristic large eyes and well developed facial whiskers.

Seals have a wide repertoire of vocalisations which are used on land, either as alarm calls or to deter enemies or rival seals. Sound is especially important between a mother and offspring. Even from an early age, pups produce a loud, barking sound which can be identified by the mother. Recognition is always confirmed by smell.

Roaring is a commonly-used tactic to proclaim dominance, especially amongst male sea lions. The Australian sea lion is a particularly noisy species, barking almost continuously during the breeding season. Some species, like elephant seals, have developed elaborate, pendulous nasal sacs which amplify their vocal statements as beachmaster, and transmit their resonating decree far along the beach. Underwater, seals produce

a very different series of calls, which are best described as a series of clicks, whistles and chirps. The information transmitted by these sounds is, as yet, unclear but may be used in echolocation for detecting prey or assisting with navigation.

All species have facial whiskers, which are probably used to detect vibrations in the water, such as those produced by fish. Most seals have quite short whiskers but in some, like the Antarctic fur seal, they may measure up to 48cm. The short (8-9cm), stout, moustache-like whiskers of a walrus are more like quills than whiskers and are thought to play an important role in detecting buried prey such as shellfish, as the animal roots through mud and sediment.

Seal Skin and Body Temperature Control 3

To overcome the problem of living under freezing conditions, seals have undergone modifications to the structure of their skin, as well as a series of behavioural and physiological adaptations. Many seal pups are born with a luxurious fur which enables them to retain heat in what are often hostile environmental conditions.



The harp seal (Phoca groenlandica) is well adapted to living in hostile environmental conditions.

Seal skin is composed of three distinct layers: an outer epidermis forms a thin, impervious protective layer over the entire body. Beneath this is the dermis which is thicker (3-4mm in northern fur seals), and consists of dense connective tissue supplied with many blood vessels. It houses the hair follicles and is loosely connected to the underlying blubber, which is composed of fat cells. The blubber layer, which is 1-2cm thick in the harbour seal, can be up to 10cm in the walrus and ele-

phant seals, providing insulation against the often-freezing waters, and also serving as a vital energy reserve during extended periods of fasting. As with other mammals, seals moult their old skin each year. Their first moult usually takes place after 3-4 months. Adults usually moult several months after the breeding season. The moulting period, which may take two weeks, is, after the breeding season, the second-longest period of time that an adult seal spends on land.

Maintaining an even body temperature

Unlike humans and many other vertebrates, seals do not sweat to cool down. Instead, they rely on a complex system of diverting or restricting their blood supply. If a seal is too hot, it will first increase the blood flow from central organs, such as the heart and lungs, towards the skin. Flippers, which lack blubber, have rather poor insulative properties and are richly supplied with blood vessels. Seals may therefore remain cool by simply spreading their flippers and waving them about. Fur seals have more difficulty dissipating heat than conserving it and therefore spend a lot of time fanning. Where practicable, seals take a quick dip in the ocean to cool off.

ian monk seal practise a less strenuous option and seek the cool shade of the islands' vegetation during the hottest part of the day.

In freezing temperatures, body heat is retained by a contraction of the blood vessels in the skin and blubber layers so that a peripheral temperature of 1°C is maintained. This is sufficient to prevent freezing. Seals of the polar regions have a lower body temperature than those living under temperate conditions, which means that they are less likely to lose heat to the freezing waters in which they live.

Yet another heat-saving mechanism is huddling, which greatly reduces body

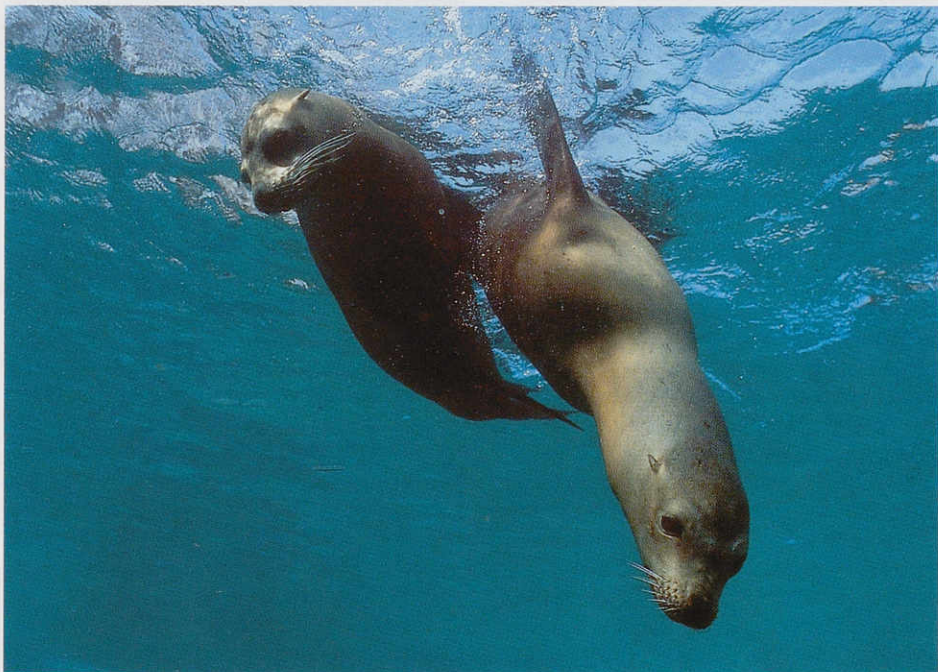


A northern elephant seal (Mirounga angustirostris) flicks damp sand over its body to keep cool.

Californian sea lions - the familiar clowns of the circus ring - have an additional trick. They use their flippers to scoop and flick damp sand over their voluminous bodies: as the moisture evaporates from the sand, the seal's skin is cooled. Other species such as the Hawai-

ian monk seal practise a less strenuous option and seek the cool shade of the islands' vegetation during the hottest part of the day. In freezing temperatures, body heat is retained by a contraction of the blood vessels in the skin and blubber layers so that a peripheral temperature of 1°C is maintained. This is sufficient to prevent freezing. Seals of the polar regions have a lower body temperature than those living under temperate conditions, which means that they are less likely to lose heat to the freezing waters in which they live. Yet another heat-saving mechanism is huddling, which greatly reduces body heat loss. Walrus and sea lions are particularly gregarious and huddle together in great mounds. On land, sea lions may also conserve heat by tucking their flippers under their body. Walrus calves shelter under their mother's chest during particularly bad weather.

Well-developed breath-holding and diving ability is vital to pinnipeds' survival. Seals increase both their rate and depth of breathing before diving but they do not dive with full lungs, since this would merely create greater buoyancy.



California sea lions (Zalophus californianus) may dive to depths of more than 250 metres.

True seals actually exhale most of their breath before diving. These species have greater blood volume per unit of body weight than other mammals - that of the Weddell seal, for example, being about two-and-a-half times that of an equivalent-sized man. In addition, their blood contains three times the oxygen-carrying haemoglobin of man. By slowing their heart rate, seals economise on their available oxygen, prolonging their dive time. Because of their ability to dive with a limited supply of nitrogen, seals also avoid decompression problems - known as "the bends" in man.

True seals have much better breath-holding capacities than eared seals, which rarely dive for longer than five minutes. The South African Cape fur seal is capable of hunting its prey below 100m, while the Californian sea lion has been recorded at a depth of 73m under natural conditions, and 250m following training. In comparison, however, true seals can dive for much longer periods; elephant seals may remain submerged for more than 30 minutes, and one record-breaking 73-minute dive by a Weddell seal was recorded under natural conditions.

The eared seals

Eared seals - so called because of their small external, scroll-like ears - are all marine species. They include the fur seals and sea lions (Family Otariidae). All are highly social animals, usually living in colonies of several hundred individuals. One of the most striking features about these species is their sexual dimorphism, with males being much larger than females - up to five times heavier in the case of the Northern fur seal.

Sea lions are generally larger and have blunter snouts than fur seals. A sea lion's flipper also tends to be shorter than that of a fur seal. The most obvious difference between the two groups, however, is the presence of abundant underfur in the fur seals, which is quite sparse in sea lions.

All eared seals are generalist feeders which take a wide range of prey. They tend to concentrate in areas where rising ocean currents carry nutrients to the surface, feeding on a variety of open-sea and bottom-dwelling organisms, both fish and invertebrates. The 14 living species of eared



Steller's sea lions (Eumetopias jubatus) in Alaska.

seals are widely distributed throughout the world's major oceans: from Japan to Mexico; on the Galapagos Islands, and on the western and southeastern coasts of South America; on the south and southwestern coasts of southern Africa; on the southern coast of Australia and South Island, New Zealand, and on many oceanic islands encircling Antarctica. There are no ice-breeding eared seals.

Sea lions

Sea lions are widely distributed throughout the Pacific region, ranging from the cold seas of the northern Pacific Ocean around the Pribilof and St Lawrence Islands, south to the tip of South America and New Zealand. Five species occur: the northern (Steller's) sea lion, the Californian sea lion, the southern sea lion, the Australian sea lion, and the New Zealand (Hooker's) sea lion.

Steller's sea lion is the largest representative, with adult males measuring almost 3m and weighing approximately 560kg (weights of up to 1,120kg have been recorded). Females are much smaller, weighing about 260kg and measuring less than 2.3m. Both sexes are light-buff-to-reddish-brown, with adult males developing a heavy muscular neck and a mane of long, coarse hair. The preferred habitat of Steller's sea lion is rocky islets and beaches. This species is abundant (the population is estimated at 110,000 animals) and is widely distributed throughout the cooler regions of the North Pacific, ranging from Hokkaido in the west, to the southern waters of California. Sea lions are highly gregarious and often occur in groups of several hundred individuals.



Australian sea lion and pup (*Neophoca cinerea*).

The **Californian sea lion**, as its name suggests, occurs mainly in Californian waters, but there are two other subspecies. One occurs on the Galapagos Archipelago, and the other is thought to inhabit Japanese waters, although it is unclear whether this sub-species still survives. Both sexes are a greyish-brown-to-black colour.

The **southern sea lion** is found on both the Atlantic and Pacific coasts of South America, ranging from Peru southwards around Cape Horn and north towards Uruguay. It is the only species of sea lion that enters the Atlantic Ocean. Its appearance is far more variable than the Californian sea lion, generally dark brown, with adult males having a lighter-coloured mane of slightly longer, coarser hairs on their neck region. Females are also dark brown, with the back of the head and neck a dull yellow colour.

The **Australian sea lion** is only found within Australian waters, occurring on many offshore islands in southern and southwestern Australia. An estimated 10,000-12,000 animals survive. Males are a rich chocolate-brown colour, with a mane of coarse hair. The hairs on top of the head and the nape of the neck are usually white in adult bulls. Females are a silvery

grey/fawn colour. The Australian sea lion is noted for its aggressive behaviour towards other members of its species.

The **New Zealand, or Hooker's, sea lion** is the rarest of all sea lions, with an estimated population of 10,000-15,000 animals. This species has a very restricted distribution, with the greatest concentrations occurring on the Auckland Islands, Snares and Campbell Island, south of New Zealand. It also reaches the mainland of South Island.

Sea lions have few natural predators; leopard seals, great white sharks, blue sharks and killer whales pose the most serious threats, especially to weaned pups. Apart from some subsistence hunting of Steller's sea lion by Aleutian natives, the only other species that have been exploited on a commercial basis are the Australian and southern sea lion. Commercial harvests of the southern sea lion continue in both Chile and Uruguay. The annual Chilean harvest is about 3,000 pups.

Throughout their range, seals are almost certainly killed each year by fishermen, either for fish bait or because they are seen as a threat to fish populations. One of the greatest threats to the survival of sea lions in recent years, however, has been entanglement in drift fishing nets. In Alaska during the 1982 fishing season, an estimated 1,000-1,500 northern sea lions drowned in fishermen's nets. Through modifications in fishing techniques and equipment, this number has recently been reduced. Nonetheless, an estimated 2,500 sea lions die annually in US fishing operations and as many as 12,500 in other fishing enterprises worldwide. While some sea lion populations may be able to withstand such losses, others clearly cannot. Commercial Japanese squid fishing - just 12-40 nautical miles north of the two largest Steller sea lion rookeries - is resulting in an annual incidental catch of about 100 animals. On Auckland Island, pup mortality amongst Hooker's sea lion is quite

high; pups frequently enter rabbit burrows for shelter but many get stuck and starve to death. Such localised losses, together with the increased trend for intensive marine fishing operations, continue to pose a serious threat to sea lion populations worldwide.

Fur seals

Like sea lions, fur seals are large animals, males measuring 1.5-2.2m, while females are considerably smaller. All fur seals are similar in colour: adult males are a dark blackish-brown with long hairs on the neck forming a coarse mane. Females are brownish-grey with a slightly lighter-coloured belly. Only the sub-Antarctic fur seal has a distinctive creamy-coloured chest and face, and a brush of longer hairs on the head which rise to form a crest when the animal is agitated. Newborn pups have soft black coats which are moulted for an adult coat at about 3-4 months. Although mainly confined to the temperate and sub-Antarctic waters of the southern hemisphere, a few species live under subtropical conditions in the Pacific Ocean.

Believed extinct in 1928, the **Guadalupe fur seal** was rediscovered in 1954 on the rocky shores of Isla Guadalupe, Baja California. Its habitat is now strictly protected by the Mexican Government. Now thought to number about 6,000 animals, this is one of the rarest of all seals. It is a dusky black colour, with the head and shoulders appearing grey because of the lighter tips to the fur.

The **Galapagos fur seal** is only found on the Galapagos Archipelago through which it is widely distributed. The main colonies occur on the western islands of Fernandina and Isabella. This is the smallest species of fur seal, with males measuring up to 150cm and females no larger than 130cm. Males are also heavier (60-75kg) than females (30kg). The body is a



The Galapagos fur seal (Arctocephalus galapagoensis) has been severely over-exploited but is now protected by Ecuadorean law.

grey-brown with a tan muzzle. Galapagos fur seals feed mainly at night on smelt and molluscs. The most recent estimate of its population was about 40,000 animals but this may now be lower due to the impact of the 1982-1983 El Niño phenomenon. This species has been severely over-exploited in the past, but is currently protected under Ecuadorean law.

The **Juan Fernandez fur seal** is one of the least-known species of seal. It is only found along the Juan Fernandez Archipelago and Desventuradas Islands off the coast of Chile. This species was almost exterminated during the 16th-19th centuries as a result of over-exploitation. It was only re-discovered in 1965. A 1970 census recorded fewer than 800 animals but the population is now estimated at about 12,000. This species is quite similar to the Guadalupe fur seal, with black fur which is somewhat lighter on the chest and underside. Fish, molluscs and lobsters are its favourite prey. No longer harvested, the Juan Fernandez fur seal was given full protection by the Government of Chile in

1978. Some seals may, however, still be killed for lobster bait.

The **Antarctic fur seal** occurs on islands south of the Antarctic Convergence (where the cold Antarctic waters sink below the warmer sub-Antarctic currents), extending to about 65°S. The main breeding grounds are on South Georgia. Adults are grey-brown along the back and sides, with a creamy throat and chest and a dark ginger-coloured ventral surface. Males are easily distinguished by their manes which have a lot of white hairs, giving them a grizzled appearance. The Antarctic fur seal does not migrate and, although it feeds largely on krill, it has been known to prey on fish, squid and even sea birds.



South American fur seals (*Arctocephalus australis gracilis*) were once heavily exploited but stocks are now well-managed.

The **South American fur seal**, as its name suggests, is found on rocky shores along the coastline and offshore islands of South America between Lima (Peru) in the Pacific Ocean, and São Paulo (Brazil) on the Atlantic side. South American fur seals were formerly taken by indigenous people (Alacaluf and Yamana). This harvest is no longer a threat as these tribes are themselves almost extinct. Of greater consequence was the targeting of this species by

sealers, but today this practice continues only in Uruguay, where about 5,000 animals are taken each year. Some subsistence hunting still takes place amongst the Chilean Chiloté tribe, although it is unlikely that this will have any serious impact on its long-term status. The number of South American fur seals is unknown, but the mainland population has been estimated at 307,000 animals (252,000 alone in Uruguay) with an additional 15,000-16,000 on the Falkland Islands.

The **sub-Antarctic** or **Amsterdam Island fur seal** is grey-brown with a yellow chest and throat and a dark brown underside. Bulls are usually darker than females. This species lives on isolated sub-Antarctic islands north of the Antarctic Convergence, chiefly those of the Tristan de Cunha group, as well as on Marion, Prince Edward, Crozet, Amsterdam and St Paul. The sub-Antarctic fur seal has been seriously over-exploited in the past but its numbers have recovered since sealing stopped. Most populations now show an annual growth rate of approximately 15% and the population is estimated at 310,000 animals. It is a generalist feeder, preying on several different species of fish, cephalopods and penguins.

The **South African** or **Cape fur seal** is the largest of all fur seals and in many ways resembles sea lions more than fur seals. Measuring up to 2.3m, an adult bull may weigh 200-360kg. Adult females are much smaller, measuring from 1.2 to 1.6m in length and weighing about 40-80kg. A mature bull has a coarse, dark outer coat with a paler underside. Females are brownish-grey. Numbering some two million animals, this species frequents the waters of southern and southwest Africa where there are over 20 separate colonies. Although they occur mainly in coastal waters and do not make regular migrations, small groups do range widely when feeding, preying on pelagic fish (pilchard, an-

chovies and hake) and cephalopods. Adult bulls have been recorded at distances of 160km from land, but the long distance record is held by one group of animals which journeyed over 1,500km from the South African coastline!



The New Zealand fur seal (Arctocephalus forsteri) is now protected throughout its range.

The **Australian fur seal** is a localised species found only within the Bass Strait and on rocky shorelines off the coasts of Tasmania, Victoria and southern New South Wales. The population, now protected by law, is estimated at 30,000-50,000 animals. Adult males are dark grey-brown with a well-developed mane of coarse hair on their necks and shoulders. The slightly lighter tips to the hairs of the mane give the animal a pale-coloured area over the back of the neck. Females are a silvery-grey colour on the back, with a creamy-yellow throat and chest and a chocolate-brown abdomen. The Australian fur seal feeds mainly on squid, octopus and a wide variety of pelagic fish. Dives of up to 500m have been recorded when feeding. There are many interactions with local fisheries

and large numbers of immature seals are killed in nets or traps each year. Some are even shot by fishermen. Other threats are the increasing levels of pollution from pesticides and heavy metals, as well as increased disturbance from tourists and fishermen.

The preferred habitat of the **New Zealand fur seal** is exposed rocky coasts where offshore reefs offer protection from heavy seas. This species feeds on a wide range of surface, mid-water and even bottom-dwelling prey (barracuda, octopus, squid and small fishes, mostly non-commercial), as well as lobster and crabs. It has been known to dive to 500m in search of prey. Two distinct populations occur: one on the southern coast of Australia (West and South Australia), the other around New Zealand where they tend to migrate from South Island to North Island as winter approaches. This species resembles the Australian fur seal, but adult coat colour merges from dark grey-brown on the back to a lighter grey-brown underside. The thick underfur is a rich chestnut colour. The New Zealand population is now estimated at 30,000-50,000 animals, and recent surveys suggest that the Australian population numbers 27,000. This species is protected throughout its range and is not exploited.

The **northern fur seal**, also known as the Alaskan, Pribilof and North Pacific fur seal, ranges widely throughout the North Pacific Ocean, from Honshu on the Japanese side, across the chain of Aleutian Islands to the Alaskan coastline and south to San Diego, California on the American side. Within this vast area, there are five major populations: the Pribilof, Commander, Robben, Kuril and San Miguel Islands. Most of the species (now estimated at 1.2 million animals) is concentrated along the edges of the continental shelf and, in winter, there is a southward migration.

The walrus: monarch of the Arctic

The **walrus** - with its stocky, cinnamon-coloured body, whiskered, sorrowful-looking face and long white tusks - is as symbolic of the Arctic as are ice floes and snow. Restricted to a circumpolar distribution from eastern Canada and Greenland to north Eurasia and western Alaska, the walrus is one of the few creatures to have successfully adapted to the pack ice regime of this inhospitable climate. Measuring over 3m, an adult male may weigh in excess of 1,200kg, making it one of the largest of all pinnipeds. Females are smaller but they too create an impressive figure, measuring almost 2.7m in length. The walrus is the only species within its genus. Two subspecies are recognised: the Atlantic and Pacific walrus.

On land or ice, walruses stand and walk on all four limbs. The heels of the hind flippers are brought in under the rump for support and the toes are turned forward and outward; the palms of the forelimbs support the trunk and the fingers are turned outward and back. In water, the walrus propels itself by means of its hind limbs, using the forelimbs mainly as rudders. This sculling with the hind limbs is an adaptation for bottom feeding in which a slow, methodical movement is more advantageous than high speed.

Walruses feed primarily on molluscs such as clams, cockles and mussels that abound on continental shelves of the northern seas. They also eat about 40 other species of invertebrates, including several species of shrimp, crab, snail, octopus, sea cucumber, marine worms and, occasionally, other seals.

Walruses rely more on touch than any other sense to locate their food. During the winter they feed in total darkness. At other times, they feed in murky water or at depths where light penetration is poor. Contrary to popular opinion, walruses do not use their tusks to remove shellfish from the sediment.

Instead, prey is extracted using the snout, similar to pigs rooting in soil. Deeply buried prey are unearthed by an ingenious method which involves squirting large amounts of water at high pressure into the sediment. This trick provides an entertaining sight in zoos when people are showered with water from a walrus!

The tusks - which may measure up to 55cm in length - serve primarily to determine social status: in any herd, the largest animal with the largest tusks is usually the dominant member. Greatly enlarged canine teeth, found on both males and females, tusks are used in fighting other walruses, and in defence against polar bears. They may also be used to gain purchase on the slippery ice when emerging from the water.



The walrus (Odobenus rosmarus) has long been hunted for its ivory.

Walruses are particularly cherished by Eskimos as a major source of food, clothing and other materials on which these people have depended for thousands of years. A ready market for the gleaming tusks, second only in size and quality to those of an elephant, was established in Europe, North America and Asia. So great was the level of exploitation, that walrus

populations were severely depleted during the 18th, 19th and 20th centuries by commercial hunters from Europe and North America who hunted these animals for their tusks, skin and oil.

The Pacific walrus is by far the most numerous species, estimated at more than 230,000 animals. This species is still hunted, but its harvest is regulated. Since 1980, about 4-6% of the population of the Pacific walrus is killed annually (10,000-15,000 animals). Information is less precise for the Atlantic population, but several thousand animals occur in the region from Hudson Bay to the White Sea. Since 1972, only subsistence hunting has been allowed in Alaska for Eskimos, Indians and Aleutians, but no quotas have been set. The recent harvest of Atlantic walrus in Greenland is estimated at about 400 animals. In the Pacific region of the former USSR, there is a quota of 2,000 animals each year. Similar restrictions are imposed in Canada, Greenland and in the Laptev Sea.



The *ringed seal* (*Phoca hispida*) is the most common of all the Arctic-dwelling seals.

The true seals

True seals (Family Phocidae) probably originated in tropical, warm waters where one group - the monk seals - still lives. The great majority now occur at high latitudes in both northern and southern hemispheres. There are 18 living species of true seals which fall into two subfamilies: the Monachinae ("southern seals") and the Phocinae ("northern seals"). All northern seals breed on ice, with the exception of the harbour seal which prefers slightly warmer regions, ranging as far south as Baja California, Mexico. Of the southern seals, the four Antarctic seals breed on ice. Northern and southern elephant seals breed off California and in the temperate-to-sub-Antarctic parts of the southern ocean, respectively.

Unlike eared seals, true seals swim by powerful sideways movements of their hindquarters. The long, broadly-webbed feet are effective flippers, but are virtually useless for locomotion on land. Respiration and circulation in true seals have been adapted so that the animal can spend long periods of time underwater. One of the longest dive records is held by the Weddell seal, which may dive to 600m when feeding.

Northern seals

The northern seals or Phocinae comprise ten species which inhabit the temperate and Arctic waters of the northern hemisphere. Species include the Arctic and sub-Arctic-dwelling bearded seal, the hooded seal of the north-west Atlantic region, and a collection of ice-breeding seals which include the Baikal, Caspian, Baltic, grey, harbour, harp, ringed and spotted seals. Most northern phocids are 1.3-1.8m in length, although grey, hooded and bearded seals are somewhat larger, measuring 2.2-2.7m. Apart from most of the harbour seals and the hooded and bearded seals, the northern phocids are born with a first coat of white woolly hair.

This is shed after two to three weeks for a coat more similar in appearance to that of adults.

Bearded seals - so called because of the profusion of moustache-like whiskers - and ringed seals, live in the high Arctic. This species feeds on benthic invertebrates such as crustacea, molluscs and worms, but sculpin, flounder and Arctic cod are also eaten.

The **ringed seal** is the most common of the Arctic-dwelling seals (numbering from six to seven million animals), found anywhere there is open water in fast ice. Its coat is light grey, with black spots surrounded by lighter rings, giving the species its name. The underside is often a silver-grey colour. Five subspecies have been described, including the **Ladoga seal**, whose 12,000 members are confined to Lake Ladoga in Karelia, and the **Saimaa seal** from Lake Saimaa in southeast Finland. Fewer than 180 Saimaa seals remain today. This species is now completely protected and all fishing has been banned from the main breeding areas.

The **harp seal** and **hooded seal** live in the seas around Labrador and Greenland, with the harp seal extending its range to the Arctic coast of Russia. Adult male and female harp seals are, on average, 169cm long and weigh approximately 130kg. Males are silvery-grey with a black head and a horseshoe-shaped band across the back and flanks. Females are usually lighter in colour. Pups have a silky-white fur at birth, which is moulted after two weeks. Harp seals eat a wide variety of prey, from small crustacea to fish. Immature harp seals have been exploited for their fur for centuries and the species is still hunted in some parts of its range, despite considerable pressure to stop this activity.

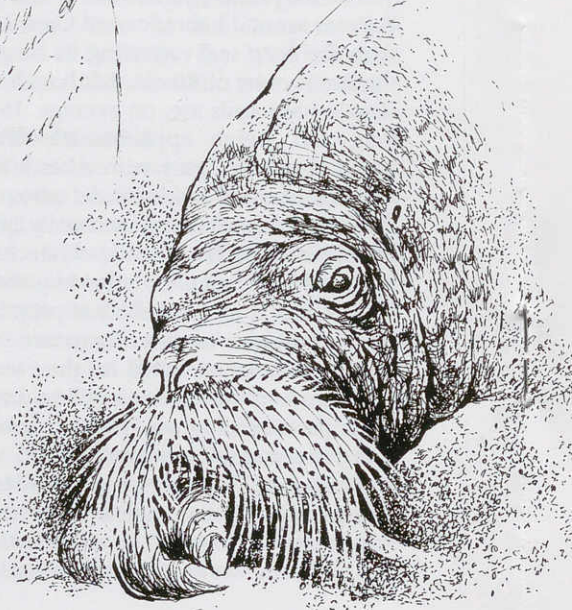
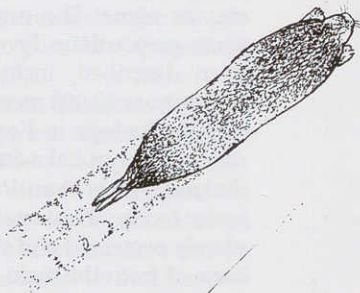
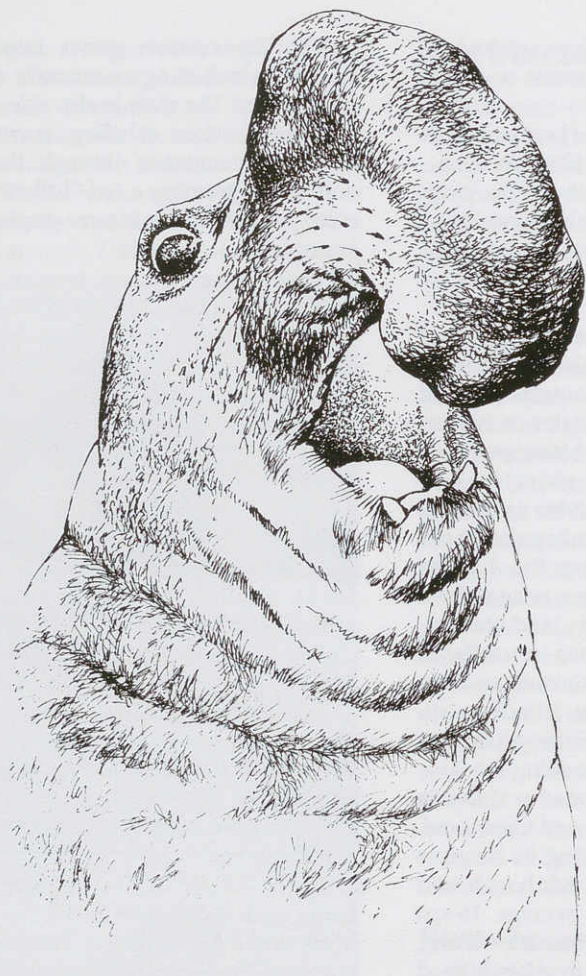
The hooded seal takes its name from the enlargement of the male's nasal cavity which forms a "cushion" on top of the head and is inflated with air when the nostrils are

closed. The cushion grows larger with time, thus indicating an animal's age and social status. The male is also able to close one nostril when exhaling, everting the internasal membrane through the other nostril, and forming a red "balloon"! The exact purpose of this bizarre display is not known.



The hooded seal (Cystophora cristata) is an animal of the deep waters and heavy ice floes feeding on squid, redfish and Greenland halibut.

In the North Pacific, the **ribbon** and **Larga seals** live between the Sea of Okhotsk and the Bering Sea. The Larga seal spends the summer months foraging along coasts, shifting to pack ice as winter approaches. Its population is estimated at about 100,000 in the Bering Sea and another 130,000 in the Sea of Okhotsk. This species is still harvested in the Commonwealth of Independent States, where a quota of 13,000 seals is set each year. There has been no recent monitoring of the native harvest in Alaska. Little is known about its ecology. Ribbon seals live under much the same conditions as Larga seals, feeding on pollack, eelpout and Arctic cod as well as cephalopods and benthic invertebrates. Its population is thought to be in



(clockwise from top left)

Bull elephant seal roaring.

Female harp seal adopting a threat posture to an approaching pup which is not her own.

Grey seal in the look-out position known as "bottling".

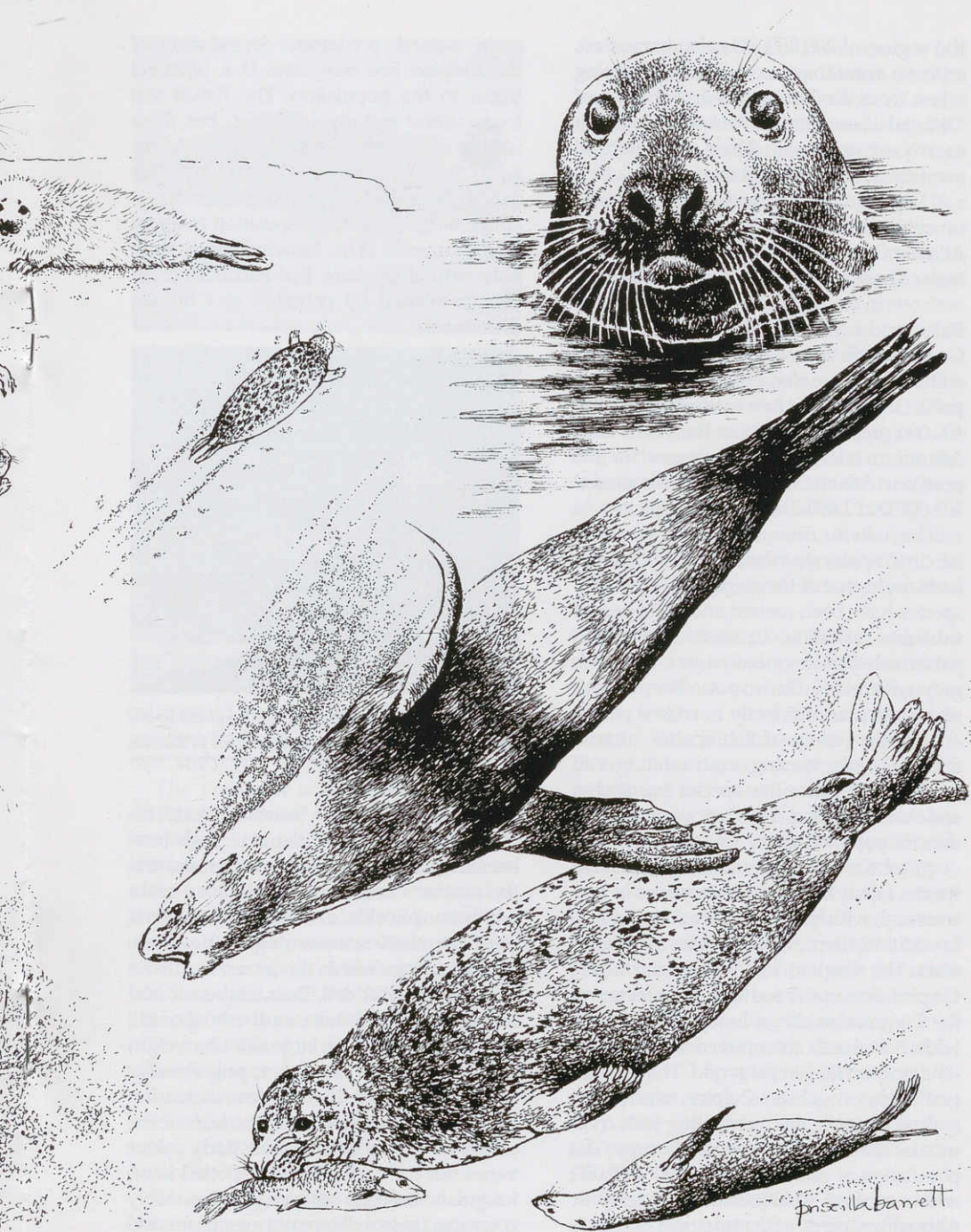
Australian sea lion vocalising underwater; also demonstrating the "flying" with the four flippers mode of swimming employed by the Otariidae (eared seal) family.

Harbour seal demonstrating the sideways hind flipper swimming motion employed by the Phocidae (true seals).

All seals swim easily upside down - like this South African fur seal.

This walrus is sucking up clams from murky water; the very strong vibrissae play an important part in locating food items.

The mode of locomotion on ice leaves distinctive trails, as in the bearded seal (left) and the ringed seal (right).



priscilla barrett

the region of 200,000. It is also harvested, with an annual quota of 6,500 seals being taken from the Bering Sea and the Sea of Okhotsk. Less than 100 animals are taken each year in Alaska. Their main natural predators are bears and foxes.

Harbour seals and grey seals are found on either side of both the North Pacific and Atlantic Oceans, totalling some 125,000 animals. There are three populations of grey seal: one in the northeast Atlantic, one in the Baltic and one in the northwest Atlantic. Coat colour is very variable but there is generally a dark hue along the back, fading to a paler underside. An estimated 80,000-100,000 grey seals occur in the north west Atlantic, while population figures for the northeast Atlantic and Baltic are estimated at 103,000 and 2,000-3,000, respectively.

The harbour, or common, seal has a similar circumpolar distribution (but at a lower latitude) to that of the ringed seal. Five subspecies have been named and there is considerable variation in coat colour and pattern; they are frequently a grey/brownish grey with many black spots. The harbour seal feeds predominantly in coastal waters on a wide variety of fish species such as flounder, sole, herring, cod, whiting and sand eels. Because this species has such a wide and scattered distribution, overall figures for population size are unavailable.

All of the above are far-ranging marine species (apart from some subspecies of harbour seal) with quite extensive distributions. In addition, there are two species of "inland" seals. The Caspian seal is restricted to the Caspian Sea in the southwestern corner of the Commonwealth of Independent States, while Baikal seals are confined to Lake Baikal - the deepest lake in the world. The Caspian seal feeds on gobies, sculpins, crustaceans and occasionally fish, competing with commercial fisheries for some of its prey. The population is estimated at 500,000-600,000, with a quota of 50,000 seals taken each year. Although wolves and eagles are the seal's

main natural predators, degradation of the Caspian Sea ecosystem is a potential threat to the population. The Baikal seal feeds almost exclusively on fish but there is little competition with commercial fisheries. An estimated 60,000-70,000 seals live in Lake Baikal but a culling programme is aimed at reducing the population to about 50,000 animals. The brown bear is their only natural predator, but Baikal seals are also threatened by pollution and human disturbance.



Baikal seals (Phoca sibirica) are confined to the deepest lake in the world - Lake Baikal in Russia.

Southern seals

The Monachinae or "southern seals" include the monk seals, Antarctic seals (crabeater, leopard, Ross and Weddell seals) and the northern and southern elephant seals. Southern phocids are larger than their northern relatives, measuring 2.2-3m. There are four species within this group of Antarctic seals: the Weddell, Ross, crabeater and leopard seals. The most southerly species - the **Weddell seals** - are large animals, weighing up to 400kg in the early spring. Females are slightly larger than males, measuring some 260cm. In relation to the size of the animal, the head seems small. Body colour varies but the coat is heavily spotted in an irregular fashion. Although reasonably common, these seals are not gregarious and



Weddell seal and pup (*Leptonychotes weddellii*), *Signy Island, South Orkneys.*

tend to come singly to breathing holes in the ice. More than 750,000 Weddell seals are thought to occur.

Ross seals are found in regions of heavy pack ice, with the greatest concentrations occurring on King Haakon VII Sea. Total population is estimated at 130,000, but little is known about their lifestyle as a result of the hostile conditions under which they live. The Ross seal seems to be adapted for rapid swimming and fast manoeuvres in order to catch squid and octopus. It is easily distinguished from other seals by characteristic dark streaks on the head and shoulders.

The **crabeater seal** has a circumpolar distribution, living in the open seas and hauling out on drifting pack ice. It is probably one of the most abundant large mammals in the world, possibly as a result of an increase in food availability following the decline in baleen whales. Crabeater seals have a modified dental arrangement which is specialised for filtering shrimp-like krill from the water. Krill account for an estimated 90% of its diet. Small quantities of fish and squid are also taken. Population estimates have been made from aerial surveys which suggest that there may be as many as 12 million crabeater seals in the Antarctic.

The solitary **leopard seal** lives along the outer fringes of the pack ice, occupying a

similar range to that of the crabeater, but extending further north to South Georgia and Macquarie Island. The leopard seal is a large animal -females measuring 240-340cm with a weight range of 225-590kg - and an opportunistic predator, feeding on krill, young crabeater and Antarctic fur seals, penguins and fish. The world population is estimated at a minimum of 300,000 animals. Its only known natural predator is the killer whale.

With their huge bulk and short mobile proboscis, the two species of elephant seal are distinctive and impressive animals. The **northern elephant seal** lives off the Californian coast, and the **southern elephant seal** has a circumpolar distribution and is the largest of all seals. Adult males measure almost 4.5m and weigh about 2,200kg. Females, in contrast, are much smaller (around 270cm) and lighter (500kg). Females are also usually darker in colour than males.

Apart from size, one of the elephant seal's most outstanding features is its inflatable proboscis, only fully developed in males, and from which the animal gets its name. This elaborate appendage is thought to serve as a resonating chamber, amplifying the roar of harem bulls.

The only natural predators of the southern elephant seals are leopard seals (which have been known to attack pups), and killer whales, which may also attack immature animals. Mortality is particularly high amongst the pups, either from predation when they first leave the rookery, or as a result of being squashed under a harem bull pursuing a rival or potential mate. Another frequent cause of infant mortality is the pup's black fur coat which attracts the sun's heat. Such body heat may melt the underlying snow, causing the pup to become trapped in a pit, from which it cannot escape.

The southern elephant seal has been heavily exploited over the centuries. It is now

fully protected and numbers have risen to an estimated 700,000-800,000. Although it is no longer directly threatened by hunting, its preferred prey - squid - has also attracted the attention of large commercial fishing fleets. It remains to be seen whether such pressures will influence the status of elephant seals and other Antarctic species.



Southern elephant seal (*Mirounga leonina*) showing characteristic proboscis.

The northern elephant seal is very similar to its southern relative, but is significantly smaller and lighter. Sexual dimorphism is again visible, males being much larger and heavier than females. This species occurs on the western coast of the USA, with breeding concentrated on several islands off the Californian coast. Its southern limit is Baja California, Mexico. Outside the breeding season, males may range as far north as Alaska. The general pattern of breeding behaviour is similar to that of the southern species, described above. Their preferred food is also deep-water squid, but a wide range of other species, including skate, ray, hake, shrimp, octopus, whiting and crab, is also taken. They may dive more than 1,000m in search of prey.

Like the southern elephant seal, the northern species is now completely pro-

tected and the population has made a remarkable recovery from fewer than 20 animals in the late 1880s, to more than 125,000 today. Although the northern elephant seal shares its habitat with several other pinnipeds - Californian sea lion, northern fur seal and Pacific harbour seal - it feeds on different species and breeds at different times of the year. One possible threat to the long-term viability of this species, however, might prove to be the lack of genetic diversity, which could render the population vulnerable to environmental change.

Monk seals are the only pinnipeds that live in warm, subtropical seas. They are also the rarest of all seals. One species is even feared extinct. On account of their apparent inability to adapt to a changing environment, monk seals have been referred to as "living fossils", comparable to the last of the dinosaurs. Both remaining species - the **Mediterranean** and **Hawaiian monk seals** - are already so severely endangered that, unless rapid action is taken, they too will almost certainly disappear in the near future.

The Mediterranean species is dark brown or black with a lighter-coloured underside. Adult females may reach 240cm in length and weigh 300kg. Males are about the same length but are slightly heavier (315kg). This species feeds on octopus and fish such as eel, carp, whiting, sardine and bonito. Because of the commercial value of these fish, conflict between the seals and fishermen is inevitable. Over-exploitation of fish stocks in the Mediterranean may also have an effect on the distribution and breeding success of this species. Pollution from increased tourism and agricultural developments also threaten their survival.

Once abundant enough to have a Greek city, Phocaea, named after it and even to support a commercial fishery in the 15th century, this species is now reduced to just a few groups scattered throughout the Mediterranean. The total

population is probably no larger than 1,000 animals and is thought to be declining. The largest concentration occurs in the eastern Aegean Sea, with its distribution ranging from the Black Sea through the Mediterranean to the Atlantic Ocean, where it occurs on Madeira and along the coasts of Morocco and Mauritania.

The Hawaiian monk seal is similar in size to its Mediterranean cousin, but is a slate-grey colour. This species is found on sandy beaches in the leeward chain of the Hawaiian Islands. Little is known about its ecology although it too is vulnerable to human disturbance. Sealing expeditions in the 19th century severely reduced these populations, and later expeditions to the islands in search of guano, whales and

other exotic items further disturbed their environment. The population was estimated to be 1,200 animals in 1956-1958. By 1980, only 700 remained.

The third species that has been described is the **West Indian** or **Caribbean monk seal**. Its range once extended from the Bahamas through the Florida Keys and the Yucatan Peninsula into the Caribbean Sea, including Cuba and Jamaica. The first reference to this species was recorded from the second voyage of Columbus in 1494: anchored by a rocky island south of Haiti, eight "sea wolves" that slept on the sand were killed on one occasion. From the 17th to 19th century, the Caribbean monk seal was so abundant that it was captured for its oil. Today it is feared extinct.



Mediterranean monk seals (*Monachus monachus*) are severely endangered. Unless rapid action is taken they will almost certainly disappear in the near future.

Despite their extraordinary prowess in the water, pinnipeds are still bound to their terrestrial origins and return to land at least once a year to breed. Breeding is timed to coincide with the most optimal environmental conditions, particularly weather and food availability. It is also a time when seals are most exposed to the weather and most vulnerable to terrestrial predators, including man.

Pups are born with a very fine, soft coat - lanugo - which protects them from excessive heat loss. This coat is moulted after several weeks (in true seals) or months (in eared seals) and replaced with a denser, more water-proof mantle. The birth of a seal pup is usually a rapid event owing to the torpedo shape of its body. This is especially critical for species like the harbour seal which hauls out on rocks or sand banks between tides. In this species, the lanugo is actually shed when the pup is still in the womb and the newly-born pup is able to swim within a few minutes of birth. Pinnipeds normally produce a single young, but twins have been recorded. Shortly after birth, the pup begins to suckle. Seal milk is especially rich in fat and protein: nearly 50% is fat (compared with just 3.5% in cow's milk), providing a layer of blubber for the rapidly-growing pup.



Female Galapagos sea lion (Zalophus californianus) suckling calf.

After giving birth, most females remain on land with their offspring during lactation. Suckling behaviour varies according to the seal's habitat. The hooded seal (which

breeds on ice floes), may only suckle its pups for 4-5 days. In contrast, the Mediterranean monk seal, which breeds in caves, may continue to feed its offspring for 2-3 months. Once lactation is finished, however, all adult seals disperse. Some mothers escort their offspring to the sea, spending time with them in the protected shallow waters of a bay. Others abandon their pups on the beach where siblings group together for several days or weeks until they, too, finally take the plunge and enter the sea.

Mating takes place shortly after parturition, usually before the pup is weaned. Reproduction strategies vary considerably: some, like elephant seals, maintain a distinct territory, with males and females forming a dominance hierarchy in which the males fight aggressively for mating rights. Successful males mate with the most females and therefore sire more offspring. For the majority of other species, however, mating is a far less dramatic experience and is often opportunistic, with no harems formed. In such cases, males and females haul out at traditional breeding sites and form large breeding colonies.

In the case of the walrus, during the breeding season (January - February), small groups (10-15 animals) of mature females and juveniles haul out on ice floes, in between feeding bouts. Unlike fur seals and sea lions, walruses mate in the water. Gestation lasts 15 months and the female gives birth to a single calf. Newborn pups may weigh as much as 50kg and measure 1.4m. Lactation and weaning may last for up to

two years, which means that females can only breed every second year. For this reason, the walrus has the lowest reproduction rate of any pinniped and of mammals in general. Females become sexually mature at 5-7 years. Males, in contrast, are much slower to reach maturity, frequently taking 15 years. The average life span of a walrus is about 40 years.



A Hooker's sea lion (Phocarctos hookeri) bull defends his harem, Enderby Island, New Zealand.

The Antarctic fur seal displays yet another pattern of reproduction. Females reach sexual maturity at 3-4 years of age. Males do not become mature until they are at least seven years old. During the winter months - May to October - adults remain at sea and little is known about this phase of their life. In late October, breeding bulls move ashore and begin to establish territories. At this stage, there is little fighting as there is plenty of space on the beach. As the beach fills up, however, boundary disputes are frequent, and fighting commonplace. The first cows arrive ashore 2-3 weeks later, heavily pregnant from the previous year's mating. By the first week in December, 50% of the pups have been born and 90% will have been born within three weeks. For almost a week, the mother remains on land nursing and caring for her pup. At the end of this period, the female is again receptive to mating.

During the intervening time, the adult bulls are very active, constantly fighting with other males in order to establish positions of dominance. Although bulls do not actively herd females into a discrete group, they do attempt to prevent other males from approaching females that are receptive to mating. They may also attempt to interfere with the matings of neighbouring bulls. This period is therefore a particularly frantic time on the beach, with large, 200kg bulls hurtling through the crowded colony, attempting to protect and mate with as many females as possible. Pup mortality is high as the tiny bodies are squashed under the tremendous bulk of the bulls.

Pinnipeds, like certain land mammals, exhibit a phenomenon known as "delayed implantation". Once a female has mated, the fertilised egg develops in the uterus, but only for a short time. When the fertilised egg reaches a stage of development known as the blastocyst, development stops and no further activity takes place until the blastocyst is implanted in the uterine wall. Among the pinnipeds, this delay - which may last several months - is designed to enable the females to postpone giving birth until feeding and climatic conditions are optimal. Once implantation has taken place, the development process proceeds normally. The period of gestation is 8-15 months, depending on the species.

In some species, lactation may continue for 3-4 months, during which time the female may make repeated feeding excursions to the sea, returning again to feed her offspring. Grey seals, however, do not feed during lactation and remain on land for 2-3 weeks. Abandoned elephant seal pups congregate towards the back of the beach, where they are in less danger from the large bulls patrolling the shoreline. When the cow returns from a feeding excursion, she calls to the pup, who responds with its own call, confirming its identity by smell.

Seals are opportunistic feeders, varying their diet according to local conditions of food abundance and shortages. The Antarctic circumpolar species, for example, have developed many preferences such as fish, deep water cephalopods, tiny crustacea, or even other seals.

One of the most extreme examples is the crabeater seal of the sub-Antarctic. It feeds almost exclusively on the small shrimp-like crustacean, Antarctic krill. At the opposite end of the world, the ringed seal of the Arctic also feeds extensively on crustacea. The southern elephant seal and the Ross seal feed largely on squid, while the walrus and the bearded seal feed mainly on bottom-dwelling invertebrates such as clams. Many sea lions commonly take birds that are resting on the water, and some take the young of other seals. Walruses occasionally feed on ringed seals but the most consistent predator of other seals is the leopard seal which feeds extensively on crabeater seals, as well as taking fish, krill and birds.

The jaws and teeth of pinnipeds are adapted for grasping prey, rather than for chewing, as with most other carnivores. Seals surface to eat large prey but smaller items are generally consumed underwater. Plankton feeders like the crabeater or ringed seal have elaborately cusped teeth through which water can be strained out of the mouth before the prey is swallowed. Most seals are capable of undergoing prolonged fasts during the breeding season and moulting phase. Their blubber layer, which acts as a food store as well as insulation, is very important for this purpose.

The stomachs of many seals have been found to contain large numbers of stones, some as large as a tennis ball! They appear to be ingested deliberately but their exact purpose has never been fully understood.



Grey seal (Halichoerus grypus) feeding in Helgoland, Germany. Most seals are opportunistic feeders; larger prey are eaten at the surface.

Humans and seals have interacted for many centuries. Many of the more fanciful mariner tales have undoubtedly been based on seal observations. Early explorers and settlers of coastal regions of northern Europe, Asia, Greenland, and Canada quickly realized that a seal could provide a convenient package of food, clothing and oil. Subsistence hunting as practised by traditional indigenous communities in the northern hemisphere, and later in South America, probably had little impact on seal stocks. It was not until commercial hunting began in the 18th century that the ecological balance was seriously upset.



There is a long tradition of human exploitation of seal stocks worldwide.

Commercial exploitation

There is a long tradition of human exploitation of seal stocks worldwide. The walrus and harp seals were among the first species to be exploited, with hunters taking advantage of the seals' natural tendency to group together in large colonies out of the water. The northern fur seal was also heavily exploited during the 18th century, with an estimated 2.5 million animals killed on the Pribilof Islands between 1786 and 1867. In 1911, the North Pacific Fur Seal Convention (the first international seal protection agreement) was signed, banning open-sea sealing and bringing an essential reprieve for this species. In the interim, under successful management, seal stocks at the Pribilof Islands have recovered.

First discovered by Captain Cook when he landed at South Georgia in 1775, the Antarctic fur seal was the subject of another intensive harvest. Having no previous experience of terrestrial predators, Antarctic species remained on land when the sealers arrived. Early reports state that most animals in a colony remained asleep when humans landed on the beaches, oblivious to the threat that they posed. By 1822, an estimated 1.2 million animals had been taken from South Georgia, while another 250,000 were killed on the South Shetland Islands during a three-year period. Both populations were thought to be doomed.

As the numbers of fur seals declined, sealers in the southern oceans focused their attention on the much larger elephant seals as a source of blubber, which yielded fine oils when boiled. This highly wasteful practice - whereby the carcass was left unused - often went hand in hand with the exploitation of the great whales, which were also hunted for oil. Elephant seals did not, however, experience the same heavy level of hunting as, for example, the Antarctic fur seal stocks. In fact, the offtake from this species formed the basis of a well-controlled and lucrative industry in South Georgia between 1910 and 1964. The demise of elephant seal hunting coincided with the cessation of whale hunting, and elephant seals are no longer commercially exploited.

Probably the most controversial issue relating to sealing in recent years has been the culling of "whitecoats" (harp seal pups), especially in Newfoundland. The fur is highly prized because of its fine, soft texture, designed to buffer the pup from the freezing winds of the Arctic. Protected for centuries by their remote and inhospitable climate, harp seals suffered extensively as whaling and sealing vessels explored new hunting and trading grounds. Many populations were seriously depleted as a result, but successful protection measures initiated and promoted by non-governmental organisation have enabled harp seal populations to recover. Strong public reaction to the killing of the appealing infants has prevented the resumption of any whitecoat harvest.

Seals and fishermen

There is no doubt that seals take fish from nets. They are undoubtedly attracted by the offer of a free meal. It is still not clear to what extent there is direct competition between seals and fisheries. However, because of the huge quantities of fish harvested by modern fisheries, man is a serious threat to seal populations. In many places, fishermen still deliberately kill seals and the Californian, Southern and Steller sea lions, in particular, because they consider them a major threat to their livelihood. This issue is of special concern when dealing with species such as the monk seals which are now recognised as being critically endangered.

The recent innovation and spread of fish farms in sheltered coastal waters have also created an artificially attractive feeding opportunity for many seal species, especially in the northern hemisphere. Seal raids on fish farms are now commonplace, as are conflicts between seals and farm operators. The continuing growth of fish farming enterprises throughout the world

could intensify this problem because of the large financial losses which can result from seal damage.

On a happier note, the Australian sea lion may be symbolic of an improving relationship between seals and man. Sea lions at Seal Bay, Kangaroo Island, are now so accustomed to humans that tourists can mingle with the seals on the beach.

Opportunities for viewing seals are greatest among coastal species in proximity to dense human populations, for example in California, Australia, South Africa and the United Kingdom. This activity is becoming popular and, if properly managed, could result in considerable financial returns for local communities. Like all tourism ventures, however, it requires careful monitoring and periodic re-evaluation to ensure that the welfare of the wildlife is not jeopardised.

Other threats to seals

A major threat to all seal populations is the risk of entanglement in fishing nets, especially drift nets, tangle nets, and fish traps, which are made of toughened synthetic materials.

At least 20 species of pinnipeds are known to be caught incidentally during commercial fishing operations. This activity has probably contributed to population declines in northern fur seals and western Pacific harbour (Kuril) seal in the North Pacific, and harp seals from the Barentz and White Seas. It may also have been a factor in the decline of Steller's sea lion in the North Pacific, Hooker's sea lion off the Auckland Islands, harbour seals off Newfoundland and Alaska, grey seals in the eastern Baltic and the endangered Mediterranean and Hawaiian monk seals. Various methods for scaring marine mammals away from fishing gear are under development, but none looks particularly promising at present.

Fishing lines are sometimes lost at sea and old, tangled or torn nets are commonly discarded overboard from trawlers. These pose a serious threat to all marine animals. Many seals, whales and dolphins drown or are injured as a result of discarded nets or fishing lines. Financial incentives, such as payments to fishermen who return damaged nets to their home port, could help reduce negligent dumping of fishing gear.

Tourism is another significant threat. In the Mediterranean, for example, the habitat of the monk seals is affected by boaters anchoring near breeding caves, and by commercial development, pollution and increased noise levels. Human disturbance is particularly serious if it occurs during the breeding season. Repeated disturbance at one Steller's sea lion rookery led to it being permanently abandoned.

Pollution

In addition to overfishing and habitat disturbance, one of the most serious threats to seal populations worldwide is pollution. Pollutants such as heavy metals (lead, mercury and cadmium), and organochlorines (a range of synthetic organic compounds), accumulate in all animals. Mammals at the top of the food chain, such as seals, therefore tend to accumulate high concentrations of these compounds which they are unable to break down. Such pollutants are no longer restricted only to developed countries; they are now found worldwide. Not surprisingly therefore, tissues of seals from the Arctic to Antarctic have been found to contain organochloride pesticides such as dieldrin and DDT. At the very least, a heavy accumulation of such compounds might affect the animal's physiology, possibly making it more susceptible to infection. Sufficiently heavy doses may result in a decreased breeding performance, abnormal behaviour and even death.



Injured Antarctic fur seal demonstrating the danger of discarded plastic packing straps.

One of the main problems when dealing with organochlorines is that they persist for a long time in nature. It is also often difficult to attribute a direct cause of death to a pollutant, such as an organochloride product. In the late 1980s, the mysterious death of large numbers of harbour and Baikal seals alarmed ecologists. As more evidence was obtained, it became obvious that this was not a localised problem. But it was some time before scientists finally pinpointed the cause of these fatalities as being a virus - phocine distemper. In the North Sea area alone, 17,000 seals died in 1988. While pollution was not the major cause of death for these animals, evidence now suggests that many may have been in such a weakened condition because of pollutant contamination that they were more susceptible to viral infection than would normally have been the case.

A potentially major, but sporadic, source of pollution comes from the petroleum industry, either as a result of oil tanker spills, blow-outs or washing of tanker containers at sea. Direct fouling of a seal's fur is an especially serious problem for fur seals (and other eared seals) as it can reduce the insulative properties of the fur, leading to hypothermia and starvation.

For many seal species, a conservation management programme is now imperative, given the level of man's activities in the marine environment. Specific conservation measures have already been drawn up and implemented for selected species.

In more general terms, however, three different modes of action have been identified by the IUCN Seal Specialist Group for a broader approach to pinniped conservation. These include:

- action that focuses on threatened pinnipeds
- action to evaluate major threats to pinnipeds
- research that will improve our knowledge of the role of pinnipeds in the marine ecosystem, permitting better management of marine resources.

Monk seals are a particularly urgent case for conservation as their numbers are now critically low. Records indicate serious population declines in recent decades. These declines can be attributed to different factors: in the case of the Mediterranean monk seal, increased human disturbance from tourists and fishermen, as well as pollution, direct persecution and lack of suitable breeding sanctuaries are to blame. Future conservation proposals for this species include the establishment of buffer zones for feeding and resting; protection of caves and other breeding sites; coordination of information and research; and an environmental education programme for local people, including fishermen, tourists and tour operators. The problems regarding conservation of the Mediterranean monk seal are further enhanced by the fact that it is an international problem (unlike the Hawaiian species), with at least ten countries involved in its welfare.

The Hawaiian monk seal is also critically endangered, having suffered heavily in the past from over-hunting. Many animals are

thought to have died as a result of toxic poisoning in the 1970s, possibly as a direct result of pollution. For the Caribbean monk seal, conservation efforts may have arrived too late as the species may now be extinct. It has not been sighted since the early 1950s. A renewed effort should, however, be made to investigate whether the species still exists. If it is relocated, then an appropriate conservation management programme should be implemented without delay, taking into account the lessons learned from ongoing efforts to conserve the other extant species.

Like the Caribbean monk seal, the Japanese sea lion is also feared extinct since it has not been observed in the Sea of Japan since the early 1950s. It too should be the subject of further surveys, and interviews should be conducted with local people and fishermen to discover if any seals have been seen in recent years.

Another species requiring urgent attention is the Saimaa seal. The Saimaa is already fully protected by law, but less than 200 animals remain. Fishing has now been banned from this species' main breeding areas. There is still considerable disturbance, however, especially from tourists and occupants of shoreline cottages. A habitat management programme needs to be implemented to monitor toxicity levels of Lake Saimaa and ensure better management of the seasonal water levels.

While many species of fur seal were hunted almost to extinction in the 19th century, the overall trend of the 20th century has been one of recovery. The Juan Fernandez fur seal, considered extinct, was rediscovered in 1965; the Guadalupe



Fortunately public opinion and human attitudes to wildlife resources are changing and there is now a much greater level of public awareness of the environment today than there was 50 years ago.

fur seal, thought to have been exterminated in 1928, was rediscovered in 1954; and the Antarctic fur seal has made the most dramatic recovery of all, from near-extinction to a healthy population of between 1.3 and 1.7 million animals today.

Other vulnerable species include Steller's sea lion, the Baltic ringed seal, Hooker's sea lion, the Caspian seal and the Ladoga seal. Although each of these have specific conservation requirements, they all share a common need for more detailed population and habitat surveys before any positive conservation action can be taken. It would be a mistake, however, to assume that only those endangered and vulnerable species are in need of conservation.

Public opinion and human attitudes to wildlife resources are changing, however, and there is consequently a far greater level of public awareness of the environment today than there was 50 years ago. In many ways, seals and other marine mammals, being at the pinnacle of the marine food web, act as indicators of the health of the world's oceans. When something goes

wrong in the oceans, for instance an artificially high level of pollutants or a reduced availability of fish stocks as a result of over-fishing, key predators such as seals and whales suffer. Their plight plays heavily on human emotions and often serves to highlight the need for greater protection of wild populations of marine mammals.

As we learn more about the ecology of wild seal populations, we are better able to design and implement appropriate management techniques. For some species, this will require the establishment of specially designated protected areas, together with revised legislation to protect against further harassment. For others, it might require a strictly controlled harvest and balanced management programme that would benefit the individual species and its habitat. Practical solutions to serious problems such as disturbance and competition for resting and feeding sites must also be found. We can no longer ignore the precarious plight of seals in the wild: to do so would be to condemn them, and many other marine creatures, to extinction.

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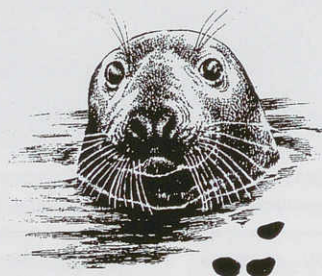
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**Threatened Pinnipeds of the World**

English Name	Scientific Name	Conservation Status
Japanese sea lion	<i>Zalophus californianus japonicus</i>	EXT
Caribbean monk seal	<i>Monachus tropicalis</i>	EXT
Mediterranean monk seal	<i>Monachus monachus</i>	END
Hawaiian monk seal	<i>Monachus schauinslandi</i>	END
Saimaa seal	<i>Phoca hispida saimensis</i>	END
Juan Fernandez fur seal	<i>Arctocephalus philippii</i>	VUL
Guadalupe fur seal	<i>Arctocephalus townsendii</i>	VUL
Steller's sea lion	<i>Eumetopias jubatus</i>	VUL
Baltic ringed seal	<i>Phoca hispida botnica</i>	VUL
Hooker's sea lion	<i>Phocartos hookeri</i>	VUL
Caspian seal	<i>Phoca caspica</i>	VUL
Ladoga seal	<i>Phoca hispida ladogensis</i>	VUL
Ungava seal	<i>Phoca vitulina mellonae</i>	INS
Australian sea lion	<i>Neophoca cinerea</i>	RAR

Key

- EXT:** (Extinct) - species not definitely located in the wild during the past 50 years.
- END:** (Endangered) - species in danger of extinction and whose survival is unlikely if the causal factors continue operating.
- VUL:** (Vulnerable) - species believed likely to move into the "Endangered" category in the near future if the causal factors continue operating.
- INS:** (Insufficiently known) - species known to be "Endangered", or "Vulnerable" but where there is not enough information to say which category is appropriate.
- RAR:** (Rare) - species with small world populations that are not at present "Endangered" or "Vulnerable", but are at risk.

Common name

Scientific name

Family Otariidae

Northern (Steller's) sea lion
 Californian sea lion
 Galapagos sea lion
 Japanese sea lion
 Southern sea lion
 Australian sea lion
 New Zealand (Hooker's) sea lion
 Guadalupe fur seal
 Galapagos fur seal
 Juan Fernandez fur seal
 Falkland fur seal
 South American fur seal
 Sub-Antarctic fur seal
 Antarctic fur seal
 South African fur seal
 Australian fur seal
 New Zealand fur seal
 Northern fur seal

Eumetopias jubatus
Zalophus californianus californianus
Zalophus californianus wollebaeki
Zalophus californianus japonicus
Otaria byronia
Neophoca cinerea
Phocartos hookeri
Arctocephalus townsendi
Arctocephalus galapagoensis
Arctocephalus philippi
Arctocephalus australis australis
Arctocephalus australis gracilis
Arctocephalus tropicalis
Arctocephalus gazella
Arctocephalus pusillus pusillus
Arctocephalus pusillus doriferus
Arctocephalus forsteri
Callorhinus ursinus

Family Odobenidae

Atlantic walrus
 Pacific walrus

Odobenus rosmarus rosmarus
Odobenus divergens

Family Phocidae

Grey seal
 Eastern Atlantic harbour seal
 Western Atlantic harbour seal
 Western Pacific harbour seal
 Eastern Pacific harbour seal
 Ungava seal
 Larga seal
 Arctic ringed seal
 Okhotsk Sea ringed seal
 Baltic seal
 Saimaa seal
 Ladoga seal
 Caspian seal
 Baikal seal
 Harp seal
 Ribbon seal
 Hooded seal
 Atlantic bearded seal
 Pacific bearded seal
 Mediterranean monk seal
 Hawaiian monk seal
 Caribbean (West Indian) monk seal
 Weddell seal
 Ross seal
 Crabeater seal
 Leopard seal
 Southern elephant seal
 Northern elephant seal

Halichoerus grypus
Phoca vitulina vitulina
Phoca vitulina concolor
Phoca vitulina stejnegeri
Phoca vitulina richardsi
Phoca vitulina mellonae
Phoca largha
Phoca hispida hispida
Phoca hispida ochotensis
Phoca hispida botnica
Phoca hispida saimensis
Phoca hispida ladogensis
Phoca caspica
Phoca sibirica
Phoca groenlandica
Phoca fasciata
Cystophora cristata
Erignatus barbatus barbatus
Erignatus barbatus nautilus
Monachus monachus
Monachus schauinslandi
Monachus tropicalis
Leptonychotes weddellii
Ommatophoca rossii
Lobodon carcinophagus
Hydrurga leptonyx
Mirounga leonina
Mirounga angustirostris

- Beachmaster:** dominant male seal on a rookery.
- Blubber:** a thick layer of fat beneath the skin of seals and whales.
- Bull:** adult male seal.
- Cephalopod:** a marine group of molluscs that includes cuttlefish, squids, and octopuses.
- Cow:** breeding female seal.
- Dominance:** a system of hierarchy whereby higher-ranking individuals have control of certain aspects (food, mating rights or space) of the life and behaviour of lower-ranking members.
- Dorsal:** the top/upper surface of an animal.
- El Niño:** a periodic upwelling of ocean currents which results in food and water temperature fluctuations.
- Harem:** a group of females of the same species that are the mates of a single male.
- Haul-out:** a piece of land or ice where seals rest or breed.
- kg:** kilogramme.
- Lanugo:** the name given to the soft white coat of infant seals.
- m:** metre.
- Mollusc:** a phylum of invertebrates that includes snails, clams, mussels and octopuses.
- Pelagic:** living in the upper water layers of the open sea.
- Pinna:** a small extension of the external ear.
- Pup:** infant seal.
- Rookery:** a colony of breeding seals.
- Rostrum:** the forward projection or extension of the snout.
- Sexual dimorphism:** a case where a male and female of a species differ consistently in, for example, size, colour or shape.
- Ventral:** the underside of an animal.

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IUCN

Founded in 1948, IUCN - The World Conservation Union - is a membership organisation comprising governments, non-governmental organisations (NGOs), research institutions, and conservation agencies in 120 countries. The Union's objective is to promote and encourage the protection and sustainable utilisation of living resources.

Several thousand scientists and experts from all continents form part of a network supporting the work of its six commissions: threatened species, protected areas, ecology, sustainable development, environmental education and training. Its thematic programme includes tropical forests, wetlands, marine ecosystems, plants, the Sahel, Antarctica, population and sustainable development, and women in conservation. These activities enable IUCN and its members to develop sound policies and programmes for the conservation of biological diversity and sustainable development of natural resources.

Species Survival Commission

Role of the SSC

The Species Survival Commission (SSC) is IUCN's primary source of the scientific and technical information required for the maintenance of biological diversity through the conservation of endangered and valuable species of fauna and flora, whilst recommending and promoting measures for their conservation, and for the management of other species of conservation concern. Its objective is to mobilise action to prevent the extinction of species, sub-species and discrete populations of fauna and flora, thereby not only maintaining biological diversity but improving the status of endangered and vulnerable species.

Objectives of the SSC

1. To participate in the further development, promotion and implementation of the World Conservation Strategy; to advise on the development of IUCN's Conservation Programme; to support the implementation of the programme; and to assist in the development, screening, and monitoring of projects for conservation action.
 2. To maintain an international network of independent volunteer members selected for their expertise in species conservation and to provide a forum for the exchange of views and scientific information on species and populations of conservation concern.
 3. To cooperate with the World Conservation Monitoring Centre (WCMC) in developing and evaluating a data base on the status of, and trade in, wild flora and fauna, and to provide policy guidance to WCMC.
 4. To provide advice, information, and expertise to the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and other international agreements affecting conservation of species or biological diversity.
 5. To carry out specific tasks on behalf of the Union, including:
 - coordination of a programme of activities for the conservation of biological diversity within the framework of the IUCN Conservation Programme.
 - promotion of the maintenance of biological diversity by monitoring the status of species and populations of conservation concern.
 - development and review of conservation action plans and priorities for species and their populations.
 - promotion of implementation of species-oriented conservation action plans and response to related issues.
 - provision of guidelines, advice and policy recommendations to government, other agencies and organisations with respect to conservation and management of species and their populations.
 - periodic evaluation of the status of species and biological diversity conservation initiatives.
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IUCN -The World Conservation Union

Founded in 1948, The World Conservation Union brings together States, government agencies and a diverse range of non-governmental organizations in a unique world partnership: over 800 members in all, spread across some 125 countries.

As a Union, IUCN seeks to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. A central secretariat coordinates the IUCN Programme and serves the Union membership, representing their views on the world stage and providing them with the strategies, services, scientific knowledge and technical support they need to achieve their goals. Through its six Commissions, IUCN draws together over 6,000 expert volunteers in project teams and action groups, focusing in particular on species and biodiversity conservation and the management of habitats and natural resources. The Union has helped many countries to prepare National Conservation Strategies, and demonstrates the application of its knowledge through field projects it supervises. Operations are increasingly decentralized and are carried forward by an expanding network of regional and country offices, located principally in developing countries.

The World Conservation Union builds on the strengths of its members, networks and partners to enhance their capacity and to support global alliances to safeguard natural resources at local, regional and global levels.

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