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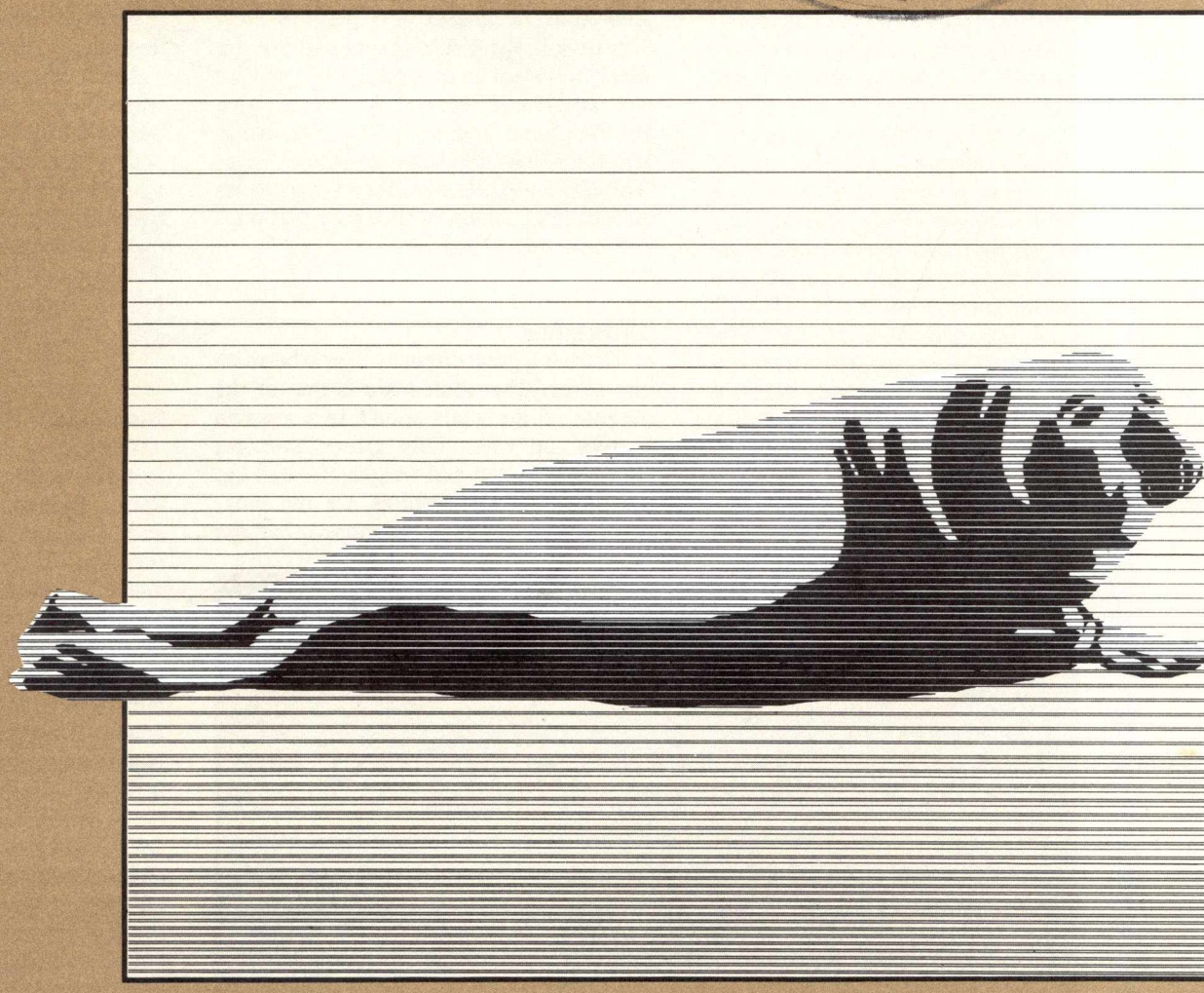


The Grey Seal

Fisheries and Oceans
Pêches et Océans
Canada

The Grey Seal

A.W. Mansfield
Department of Fisheries and Oceans
Arctic Biological Station
Ste-Anne-de-Bellevue, Quebec H9X 3R4

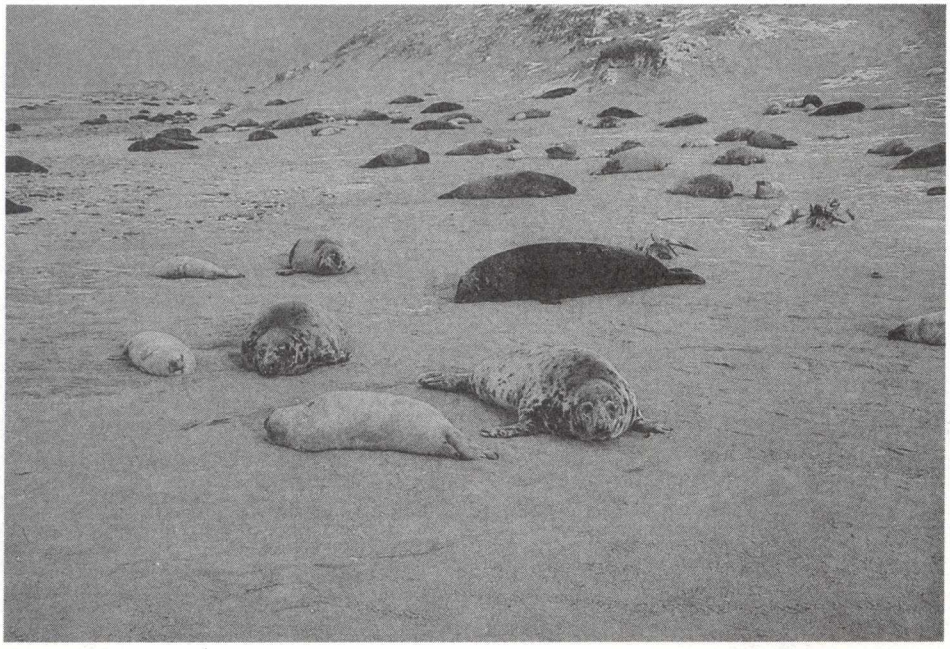
The grey seal, *Halichœrus grypus*, makes its home in northern temperate and sub-arctic waters on both sides of the North Atlantic. It is a gregarious species, forming large concentrations on land or ice during a generally well-defined pupping and mating season.

In the Maritime Provinces, the vernacular English names are grey seal and "horsehead". The latter is applied specifically to the adult male which has a long, curved, horse-like muzzle. Other names are "hopper" in Newfoundland and "hodge" in Labrador. In Québec and parts of New Brunswick, the French names in use are direct translations of the English: *phoque gris* and *tête de cheval*. A curious name used by some English-speaking people in the Magdalen Islands is "cowmore" seal. This evidently refers to *Île Le Corps Mort*, or Deadman Island, where grey seal pups are born every year.

Description

There is a great disparity in size between the sexes. The adult male is one of the largest of the seals found in Canadian waters and when fully grown averages 225 cm in length and weighs 300-350 kg. Its most striking features are the long, arched nose, already mentioned, and the heavy development of the shoulders, the skin of which is thrown into numerous folds, usually much scarred from fighting. The coat colour is dark grey, almost black, with small patches of lighter grey on the flanks. The much smaller adult female averages 200 cm in length and weighs between 150 and 200 kg. The female's nose is rounded like the male's but much shorter and narrower. The coat colour is medium grey on the back, silver on the belly, and usually white on the throat and chest with irregular black splotches. The overall effect is generally much lighter and more mottled than in the male.

The newborn pup has a coat of long silky white fur, usually tinged with greyish-brown on the back and sides. This natal coat is shed after 3 or 4 weeks, exposing a new coat of short stiff hair of a distinctive pattern in each sex. The moulted male pup is dark grey or black in colour with an overlying network of silver grey. The female "moulter" is silver-grey with small scattered dark spots.

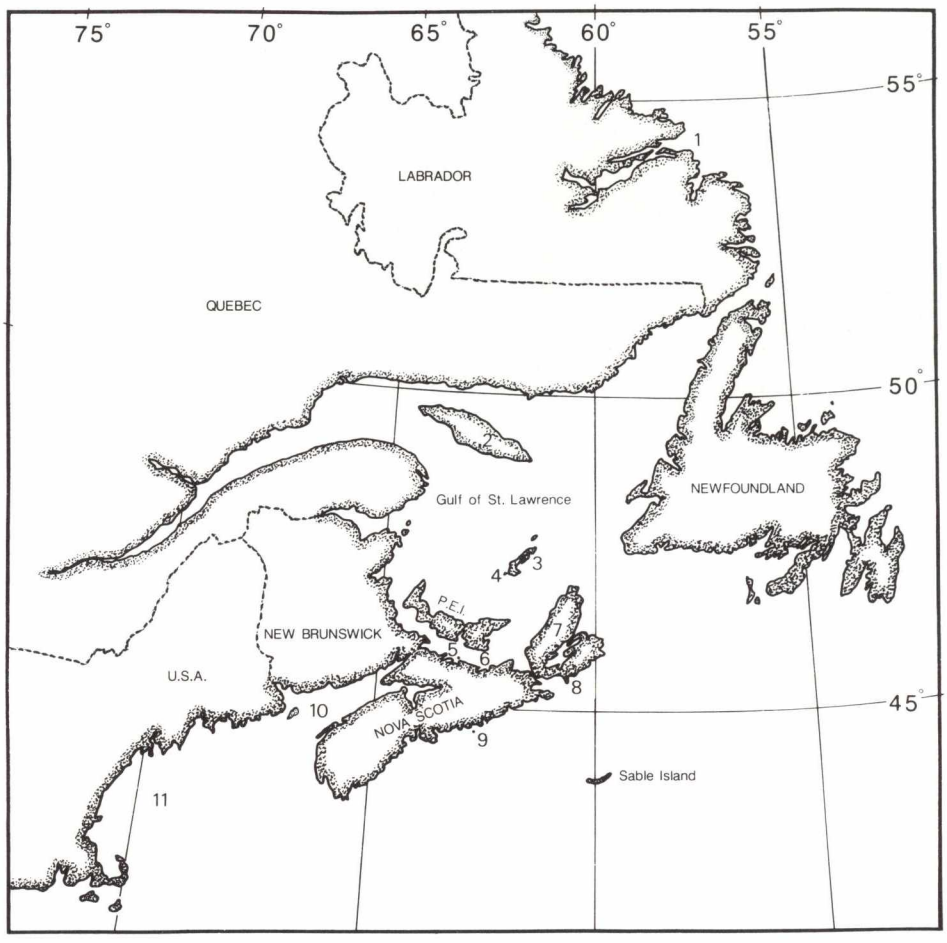


Part of breeding colony on Sable Island. Two adult females and their pups are in the foreground; behind them is a tenured male.

Distribution

The grey seal occurs along the coasts of eastern Canada, the northeastern United States, Iceland, the British Isles, western and northern Norway, the White Sea (USSR), and the Baltic (primarily Sweden and Finland). In Canada it is found as a summer resident in scattered localities throughout the Maritime Provinces and in the Gulf of St. Lawrence. It is particularly numerous at Sable Island and Anticosti Island. It occurs much less frequently in Newfoundland and southern Labrador and is rarely found north of Hamilton Inlet. At the southern end of its range it occurs in small numbers in the lower Bay of Fundy and the Gulf of Maine and occasionally as far south as Nantucket Island and the coasts of New Jersey and Virginia.

Known breeding colonies occur off the east coast of Nova Scotia at Sable Island, the Basque Islands and Camp Island. In the Gulf of St. Lawrence small breeding colonies occur at Amet Island in Northumberland Strait and at Deadman Island just off the southwestern point of the Magdalen Islands, but the largest group breeds on newly formed ice in the eastern part of Northumberland Strait and along the western shore of Cape Breton Island.



Place names mentioned in the text.
1, Hamilton Inlet; 2, Anticosti I.; 3, Magdalen Is.; 4, Deadman I.,; 5, Amet I.; 6, Northumberland Strait; 7, Cape Breton Island; 8, Basque Is.; 9, Camp I.; 10, Bay of Fundy; 11, Gulf of Maine.

In March and April there is a dispersal away from the breeding colonies, particularly by young seals of the year. In spite of their initial wanderings, most seals that survive to adulthood return to their place of birth to breed.

Life History

The grey seal is especially gregarious during the breeding and moulting seasons. At Sable Island, the first pregnant females arrive just before Christmas and usually give birth within a day of coming ashore. The pupping season is at its peak in mid-January and is virtually over by the end of the first week in February. Birth takes place fairly quickly and the newborn pup begins suckling within a few hours. The foetal membranes and umbilical cord are usually ruptured by the movements of the mother as the pup is born, and the placenta is expelled shortly after. Both the placenta and foetal membranes are consumed by attendant gulls which squabble noisily for this abundant food supply. These birds are essentially scavengers, but they will attack and kill pups that have become separated from their mothers, especially when they grow weak from starvation. At the breeding colonies close to the mainland, and especially on the ice in the Gulf of St. Lawrence, bald eagles and ravens are also commonly seen when births are occurring.

Newborn pups measure about 110 cm in length and weigh 17 kg on average. During the nursing period, which lasts 15 to 20 days, they grow very rapidly, the females attaining a weight of about 50 kg and the males about 60 kg at weaning. The average daily gain in weight is about 2 kg, all of which is derived from the mother's concentrated milk which contains over 50 % fat. Since the nursing mother fasts while the pup is feeding, her decrease in weight is even more striking than the pup's increase. She may lose up to 65 kg in weight by the time the pup is weaned, which represents about 85 % of her energy reserves.

Both mother and pup generally remain close to the birth site. The females form small groups, each keeping a small but discrete area around herself which she defends vigorously against all intruders. Adult males take up positions close to the groups of females, and the more dominant males establish tenure by challenging rival males with open-mouthed threats, usually accompanied by long quavering calls, aptly described as hooting. If status remains in dispute vigorous fights can ensue. Each male tries to bite the neck or flippers of the other and dominate it by pinning it down. The vanquished male usually turns tail and flees, while the winner of the encounter rolls over several times, usually towards the nearest female.

Male aggressiveness increases quickly towards the end of the nursing period when the females become receptive to mating. There is no evidence of oestrous behaviour, but when the female is ready she submits to the male with little struggle. Once successful mating has occurred, which may involve several copulations, the female leaves the breeding colony. She may be

Newly moulted female pup.

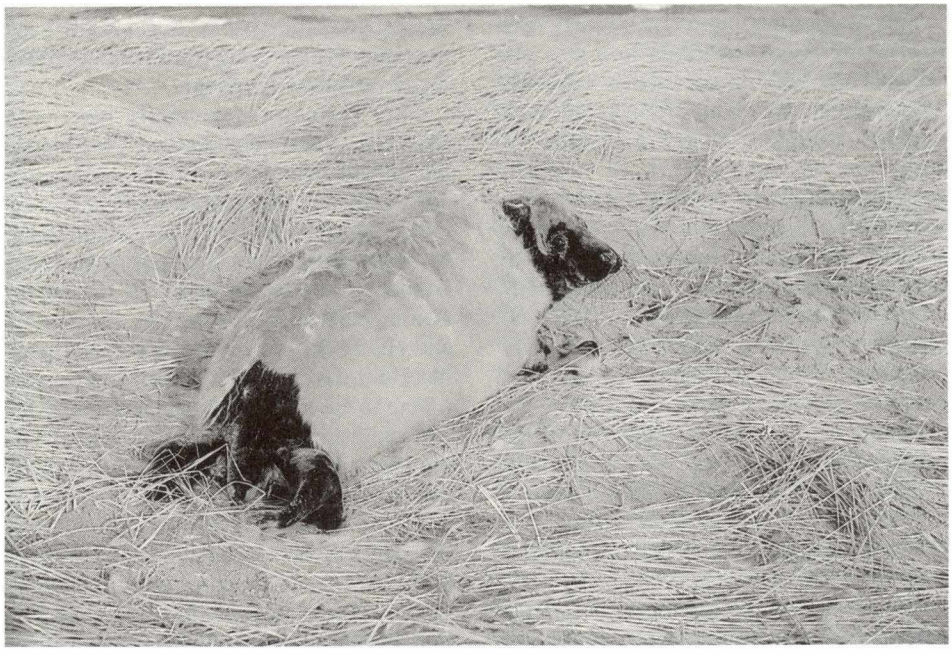
Newly moulted male pup.

followed by the male that mated with her, but usually the more dominant males remain behind. The most successful breeding males are likely to remain ashore for as long as 60 days. If the female is unaccompanied by a dominant male on her way to the sea, she is invariably harrassed by subordinate males which attempt further copulation.

By mid February most adults have left the breeding colonies. The pups remain on shore for several weeks after weaning while they complete their moult. They huddle together in small groups and seek shelter from the wind in hollows, or behind stranded logs and other bulky beach litter. During this time they fast and may lose up to 25 % of their body weight. However, they remain strong and aggressive, and can inflict painful bites and scratches if handled incautiously.

The preceding description of the grey seal's life history refers particularly to the land-breeding colony at Sable Island where most studies have been carried out. As one might expect, the ice-breeding seals in the Gulf of St. Lawrence show some differences in behaviour as a result of the instability of their sea-ice habitat, but otherwise they appear to be indistinguishable from the land-breeding seals. Pups are born during the same breeding season from late December to early February but they occur in widely scattered groups. When the sea ice breaks up, under the influence of gale-force winds, the females with their young evidently drift out of the Gulf on ice floes, but whether or not this is a major cause of pup mortality is not known. Adult females appear to look after their young as assiduously as the land-breeding females, though they do enter the water during the nursing period, as evidenced by the holes that they keep open in the ice and the presence of food in several stomachs sampled. Only a small proportion of adults on the ice are males, which are usually old, dominant animals.

When the young seals finally leave their birth place they undertake extensive wanderings. Young-of-the-year from Sable Island have been taken on the coast of Nova Scotia in early May where they have been feeding on mackerel and herring as they migrate inshore. Others have been found as far north as southern Labrador and as far south as Virginia in the United States, as well as from many points in the Gulf of St. Lawrence. Young-of-the-year from the Gulf of St. Lawrence also disperse widely. Two of our more interesting records are of tagged young recaptured on Sable Island in May and July and killed later at Amet Island in July and September, respectively, of the same year.



Male pup beginning to moult white coat.

One-day-old pup.

Grey seals gain little weight in their first year, though they increase in length by 20 to 40 cm. Since most do not moult again in their first year, their pelage becomes faded brown in colour by year's end, which makes them easily recognizable among groups of non-breeding animals. Older animals begin their moult in early May and most finish by early June. There does not appear to be a prolonged haul-out at this time.

Once she leaves the breeding colony, the adult female begins feeding in order to replace the blubber and other tissues lost during lactation and to provide a food source for the next pup. Strangely enough, there is no visible sign of the new life developing within her until the end of May or early June. After successful mating, the fertilized egg takes about 10 days to develop into a minute ball of cells, the *blastocyst*, which then remains inactive in the uterus for 3–4 months before finally becoming attached to the uterine wall. Following attachment, or *implantation*, the embryo develops in the normal mammalian manner. The whole cycle, which occupies an exact year, is an important phenomenon in the life histories of many other seals. Usually a single pup is born, but occasionally twin foetuses have been taken from dead animals. Whether a female can successfully rear two pups is open to question.

By the time the next breeding season occurs male and female grey seals have acquired an impressive layer of blubber which can reach a thickness of 7 cm in females and as much as 9 cm in the largest males. They obtain this energy store, which may amount to as much as 40 % of the overall body weight, by feeding on a wide variety of bottom-living fishes such as cod, flounders, skates, haddock and lumpfish, and on pelagic species such as herring, mackerel and capelin during their inshore migrations. Salmon and smelt may be preyed on in river estuaries, but these species do not figure prominently in the diet. The little bottom-living sand lance and the pelagic saury and silver hake appear to play an important part in the summer diet of seals feeding around Sable Island and on the offshore fishing banks. Invertebrates such as squids, crabs and shrimps are occasionally eaten, but lobsters apparently only rarely. Grey seals have been reported to open lobster traps, but some fishermen acknowledge that the seals are probably after the bait rather than the lobsters.

While we have a reasonable idea of the various prey species forming the grey seal's diet, we are less certain of the amount of food consumed daily or annually. Examination of full stomachs containing freshly ingested food shows that a grey seal can consume between 3 and 5 % of its body

weight at one time, but we are still not sure how many meals are eaten in a day and whether the seal always fills its stomach. The number of meals is likely to vary widely, depending on the availability of food and the proportion of energy-producing fat that it contains, but it appears to be once or less per day on average. This rate of feeding is suggested by recent experimental studies on captive animals which have provided estimates of the total energy required for maintenance of body condition. When allowance is made for essential growth, it appears that the average grey seal, which weighs about 135 kg, requires between 2 and 3 % of its body weight in food per day. However, it must be borne in mind that these figures are based on a regular diet of high energy food such as herring. For seals living in the wild, which consume significant quantities of fish with lower energy contents, these figures need to be substantially increased.

Economics

There is a scarcity of information about the use of grey seals by the aboriginal peoples of eastern Canada, particularly those living in the Gulf of St. Lawrence, but there are written records to show that grey seals played an important part in the lives of the early settlers from Europe. As long ago as 1672, Nicholas Denys described the hunt for young grey seals on the Seal Islands in southern Nova Scotia, and mentioned that as many as 800 had been killed in a single day. There is also an account by Charlevoix, published in 1744, which describes the seal hunt in the Gulf of St. Lawrence and the importance of seals to the early inhabitants of eastern Canada. Although the harp seal was probably the most widely taken species, grey seals must have been particularly important in those localities where the young were born on islands or ice within a reasonable distance of shore.

Three important items were furnished by young seals: meat, oil and skins. The meat, including the heart and liver, were valuable and welcome additions to the diet. The oil, rendered from the blubber, was used for cooking when fresh, and could be burned in lamps or used for currying leather when old and rancid. The skins were used for making muffs and probably hats when furred, but were generally used as leather for covering trunks and for making waterproof footwear.

Grey seals are now rarely used as a resource. A few inhabitants of the Magdalen Islands take one or two hundred pups each year from Deadman's Island (Île Le Corps Mort); other seals are hunted in the St. Lawrence estuary and around Anticosti Island by a few residents of the North Shore, particularly from Les Escoumins and Havre St. Pierre. However, the seals have become of great economic importance owing to the effects they have on fisheries and the fishing industry. Their most visible effect is on inshore fishing operations which use large numbers of simple gill nets and small numbers of larger and more complicated trap nets to catch herring, mackerel, pollock, cod, lumpfish and salmon. Grey seals are remarkably adept at removing entrapped fish, or leaving them partially eaten in the nets so that they are unfit for human consumption. Occasionally, so much damage may be caused to both the gear and the fish that fishing is no longer practicable.

The lobster fishery, which provides the majority of inshore fishermen with their greatest source of income, also suffers some depredation from grey seals, as well as from the smaller and much less numerous harbour seals. Since lobsters do not appear to play a significant part in the grey seals' diet, it seems likely that the seals are more interested in the bait in the trap. They push in the head of the trap or scratch and chew at the closure buttons until the door floats open, and then consume the bait. This leads to losses of lobsters from the trap and effectively deters other lobsters from entering the trap until it is set again.

It is hard to quantify the effects of seals on inshore fisheries, but from a survey carried out in 1983 it has been estimated that the damage to fishing gear alone in Nova Scotia could be a million dollars or more per year. Most of the damage can be attributed to grey seals which are larger and far more numerous than harbour seals.

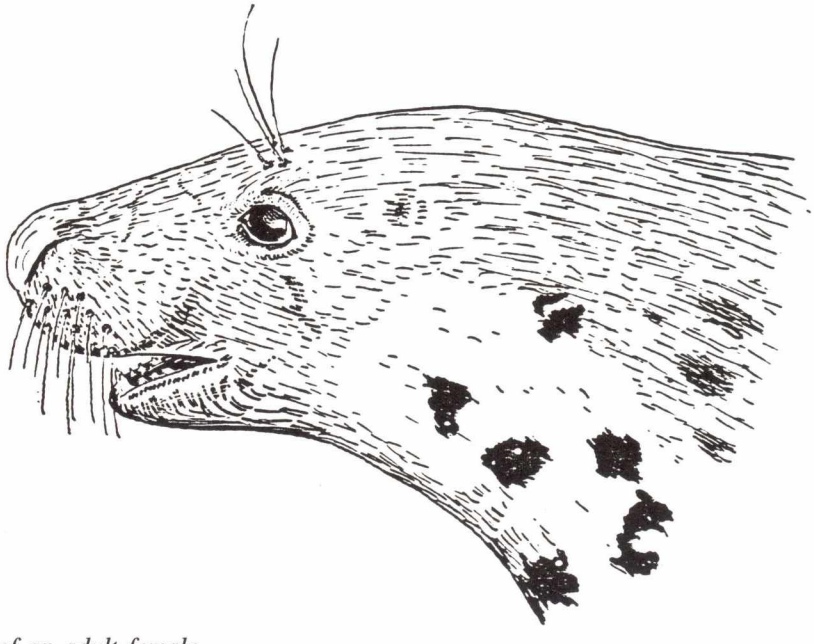
At the present time we are unable to estimate with confidence the proportion of commercially important fish consumed by grey seals. We had originally believed that herring, cod, flounders and skates formed about half of the diet, but our recent observations suggest that capelin, sand lance,

silver hake and saury may overshadow these in importance. Clearly we must improve our data on feeding before we will be able to provide any more meaningful estimates of grey seal predation on fish stocks.

As well as providing potential competition to fishermen grey seals also affect the fishing industry by impairing the quality of the fish that the industry processes. Like most fish-eating animals, seals are infested with many gut parasites, some of which are of direct importance to man. In Atlantic Canada, seals are final hosts to several species of nematode worms. The most important is the sealworm or codworm *Pseudoterranova* (formerly *Porrocaecum* or *Phocanema*) *decipiens* which is found in large numbers in the grey seal, in relatively small numbers in the harbour seal, and only rarely in the harp seal. The eggs of *P. decipiens* are shed from the seal's gut into the water where they hatch as tiny larvae. These find their way through one or two small crustacean hosts to the gut of fishes, of which the cod is the most important species commercially. Once inside the fish host, the larvae burrow through the stomach wall into the muscles, where they coil up inside a protective sheath. The lifecycle of the parasite is completed when the fish is eaten by a seal. Once inside the seal's stomach the worms mature and the females begin producing large quantities of eggs.

The presence of sealworms in fish is of major concern to the fishing industry, which spends considerable effort and money in detecting and removing sealworms from infected fillets. The costs involved, and the losses from downgrading and discarding heavily infected fish were estimated by the Royal Commission on Seals and the Sealing Industry in Canada to amount to at least $30,000,000 for Atlantic Canada in 1984.

The grey seal is by far the most important final host of the sealworm, and one would expect the level of infestation of groundfish to be correlated with the numbers of grey seals in some way. While we cannot express this relationship in quantitative terms, we do know that there has been a marked increase in the severity of the sealworm problem on the Scotian Shelf, in the Gulf of St. Lawrence and off southern Newfoundland in recent years. Candling of fillets from some of the offshore areas is now required where it was not needed before. It is significant that the areas most severely affected are those close to Sable Island where the grey seal population is expanding rapidly.



Head of an adult female.

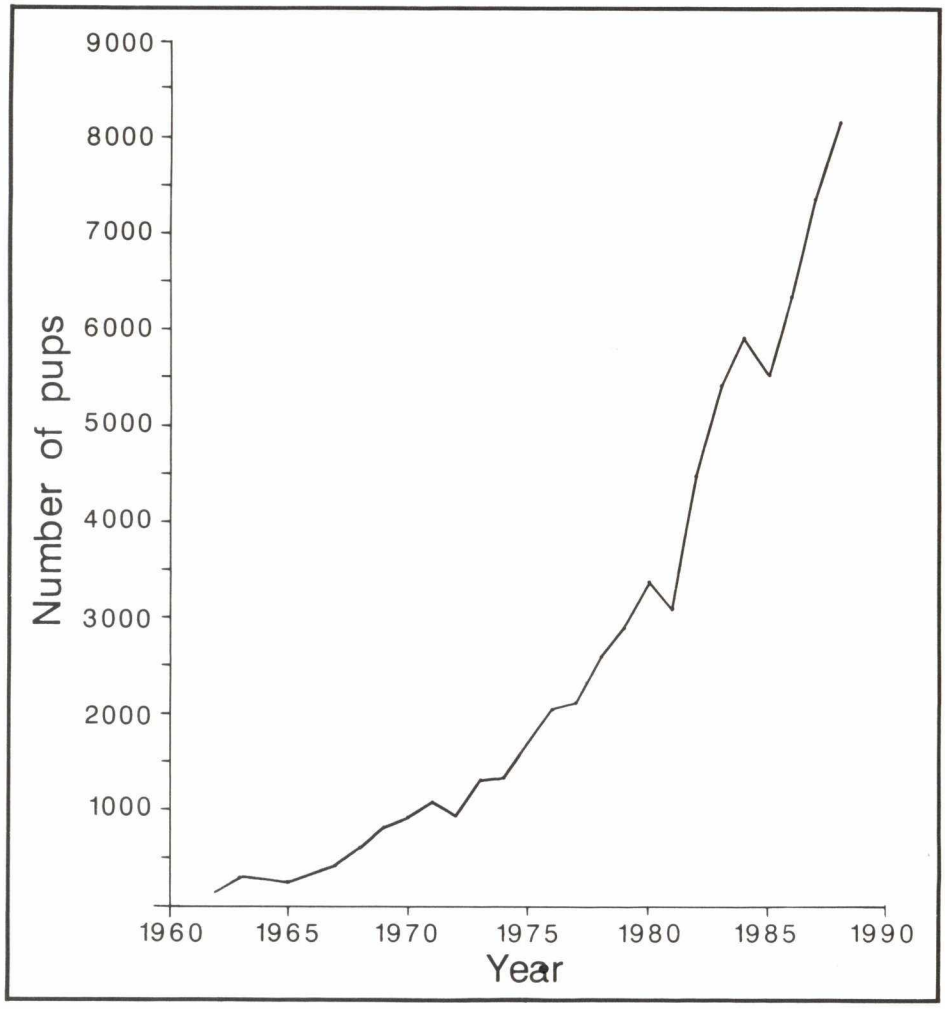
Research

Population Status

Although the presence of the grey seal in eastern Canada was first reliably recorded in 1870, it was not until 1949 that it was shown to be a well-established species with large herds breeding at several localities. In that year the Department of Fisheries changed the system of bounty payment for control of harbour seals. Previously, payment of the bounty had been made upon presentation of the snout (nose and whiskers) as evidence of kill, but because of fraudulent submission of the snouts of other animals, the regulations were changed so as to require the lower jaw for payment. The jaw was chosen since the teeth of seals are sufficiently different so that the various species can be readily distinguished. Once the new system was in place it became apparent that jaws of grey seals were being submitted, as well as those of harbour seals. Many of the grey

seal jaws, particularly from Northumberland Strait and eastern Nova Scotia, were of newborn young, indicating the presence of breeding colonies in these areas.

During the early 1950s, the small breeding colony at Amet Island in Northumberland Strait was studied. Further information on grey seal distribution was not obtained until the early 1960s when the colony at Sable Island was first visited and surveys of the ice-breeding seals in the southern Gulf of St. Lawrence were carried out. Since that time there has been a small but continuous effort by the Department to estimate the numbers of grey seals in eastern Canada and to document their seasonal distribution and movements. This has been a relatively simple task for the island-breeding seals but very difficult and costly for the ice-breeding seals, which bear their pups on newly formed ice that is subject to rapid break-up and dispersal during winter storms. Thus, while we have been able to count most of the pups born at Sable Island for the past 25 years, our counts of pups born in the southern Gulf of St. Lawrence have always fallen far short of what our tagging experiments indicate are there.



Pup production at Sable Island, 1962–88.

The tags, similar to those applied to the ears of cattle for identification, are affixed to the web of the hind flipper and remain in place for at least a year before any substantial losses occur. Returns from these tagging experiments, which mostly come from seals killed for the bounty, have shown us that young seals travel extensively throughout the waters of eastern Canada. The returns have also enabled us to estimate the number of seals born in the Gulf, particularly in the years 1984–1986 when we were able to mark between one and two thousand pups each year on the ice. Our best estimate for the pup production in those years is from about 5 000 to 11 000. By contrast, pup production at Sable Island is known reasonably accurately for the same years: 5 856 in 1984, 5 506 in 1985, and 6 301 in 1986.

A remarkable feature of pup production at Sable Island is that it has been rising consistently over the past 25 years at the very high rate of 12.6% per year, from several hundred in the early 1960s to over 8 200 in 1988. For the reasons already given it has not been possible to estimate the annual rate of increase in Gulf pup production and, therefore, the total population with any accuracy.

The reasons for this continuing increase in numbers are obscure. One possible explanation is that the change in the bounty system in 1949 brought about a reduction in hunting as fishermen realized that they would no longer be paid for the grey seals they killed. Before this, up to several hundred seals, mostly pups, had been killed each year at the breeding colonies on Amet Island and in the vicinity of Grand Manan Island, and many young-of-the-year were also taken along the east coast of Nova Scotia, especially near the breeding colony at Camp Island. However, the colony at Sable Island was never subject to any regular killing in the present century.

A second possibility is that construction of the causeway across the Strait of Canso

in 1955 increased the stability of ice in George Bay to the north, allowing the breeding colony in Northumberland Strait to expand.

A third possibility is that predation by sharks, which is an evident cause of mortality in seals at Sable Island, was much reduced in the 1960s and 1970s as a consequence of an intensive fishery for sharks and the large-scale by-catch of these predators in the pelagic longline fishery for swordfish.

The number of pups produced annually can be used to estimate the total number of seals in the population. To do this we need to know the relative frequency of seals in each annual age class and the age-specific reproductive rates of the females. This information is obtained from collections of jaws and reproductive tracts.

Thin sections of canine teeth are used to determine the age of individual animals. The cementum, which surrounds the tooth and holds it firmly within its socket, is laid down in well-marked annual zones which can be counted under a microscope. This method has been verified for at least the first 10 years of life from animals of known age. The reproductive condition of the females can be readily determined by the presence or absence of an embryo or fœtus in the uterus, except in the period before *implantation* occurs.

The bounty system has supplied us with large samples of jaws for age analysis, and additional jaws and reproductive tracts have been obtained from fishermen trained as collectors. The mathematical model constructed from the data obtained from these samples shows us that pups form 17 % of the total population; that is, the total population is about 6 times the pup production. When projected forward to 1987, the model provides a best estimate of the total population somewhere within the range 85 000 to 115 000 seals of all ages.

Other information pertinent to our population studies has been obtained by branding moulted pups with permanent marks. This has been especially important at Sable Island. When these pups become mature and enter the breeding colony as adults, they can be easily identified during ground censuses. The numbers counted then provide us with minimum estimates of the survival of particular year classes. Those animals bearing individually numbered marks also help considerably in furthering our understanding of seal behaviour, especially during the breeding season.

Food and Feeding

All of our information on the types of food consumed has come from fresh and preserved stomach samples from seals shot or captured in nets. We now have a good idea of what grey seals eat, but we still need better information on their seasonal feeding habits over as wide an area as possible and on the seasonal energy content of the more frequently eaten food species. If we can also determine the energy requirements of free-living seals, which is now becoming feasible, we will be able to obtain good estimates of the consumption of particular food species.

Scientific Names of Fishes Eaten by Grey Seals

American plaice	*Hippoglossoides platessoides*
Capelin	*Mallotus villosus*
Atlantic cod	*Gadus morhua*
Flounders	Pleuronectidae
Haddock	*Melanogrammus aeglefinus*
Atlantic herring	*Clupea harengus harengus*
Lumpfish	*Cyclopterus lumpus*
Atlantic mackerel	*Scomber scombrus*
Pollock	*Pollachius virens*
Atlantic salmon	*Salmo salar*
Atlantic sand lance	*Ammodytes americanus*
Atlantic saury	*Scomberesox saurus*
Silver hake	*Merluccius bilinearis*
Skates	Rajidae
Rainbow smelt	*Osmerus mordax*

Parasites

Infestation of groundfish by the sealworm, *P. decipiens*, is a continuing major problem for the fishing industry. The grey seal is the root of the problem since it is by far the most important final host or vector of the parasite, but the exact relationship between seal numbers and infestation rates of groundfish has still not been determined. One important study presently being carried out is attempting to define this relationship by repeated sampling of a particular species of groundfish, the

American plaice, at selected locations throughout eastern Canada, from Labrador to Georges Bank. The American plaice was selected as an indicator of sealworm distribution and abundance because, in contrast to cod, it is relatively small and sedentary in habit, it can be easily caught and handled, and virtually all of the sealworms that might infest a particular fish are confined to the two easily removed fillets. The samples so far obtained have shown a dramatic increase in abundance of the parasite in groundfish from southern Newfoundland, the Gulf of St. Lawrence and the Breton and Scotian Shelves (the shallow fishing banks to the east of Cape Breton Island and Nova Scotia) over the last 30 years. As previously mentioned, the increase on the Scotian Shelf is particularly significant in view of the rapidly escalating population of grey seals at Sable Island.

Continuation of the monitoring program on plaice and other important grey seal prey forms part of a research program that is attempting to define the relationship between grey seals and sealworm more closely, but much more information on the population dynamics and ecology of the parasite and its intermediate and final hosts will be necessary before a realistic model of the system can be devised.

To this end, a two-part international workshop was held in April 1987 and June 1988 to review available data and to begin the first attempt at modelling the system. Significant gaps in our knowledge were identified and have been used to form the basis of recommendations for future research. The results of the workshop will be published in late 1989.

Support for future research has been substantially increased following the initiation of a 5-year program by the Department of Fisheries and Oceans in collaboration with the fishing industry and several universities. The program will seek to improve our understanding of the interactions between grey seals and fisheries, particularly the impact of fish consumption on commercial catches, and the relationship between seal abundance and parasite infestation rates in groundfish. The program will also investigate the possibility of controlling the abundance of parasites in seals by the use of vermicides (worm-killing drugs) and controlling reproduction, especially in female seals, by the use of anti-fertility drugs.

Management

Seals have no doubt been responsible for disrupting inshore fisheries in eastern Canada for as long as fishermen have been using nets. In order to compensate fishermen for killing seals damaging their nets and catches, a bounty was instituted in 1927. This was directed towards the harbour seal, although grey seals were unintentionally included until 1949. In that year, as noted previously, the evidence required for a bounty claim was changed from submission of the snout to submission of the lower jaw, so that it was now possible to distinguish reliably between the two species. The bounty was restricted to the harbour seal from 1949 until 1976, when this species was given protection as a result of a marked decline in the population. However the bounty was retained and applied instead to the grey seal, which was now considered to be the more important seal predator on inshore fish stocks. During the period 1976-1983, nearly 5 800 bounties were claimed, an average of about 720 per year. However, owing to losses from wounding and sinking, the number of seals killed may have been much higher.

Currently the Department of Fisheries and Oceans pays a bounty of $25 for submission of the jaw of a young grey seal-of-the-year and $50 for the jaw of an older grey seal. One restriction under the Sealing Regulations is that, with certain exceptions, grey seals may be killed only from 1 March to 31 December. This regulation was put in place to prevent unregulated killing of pups on the breeding grounds. The Department also began a culling program in 1967 in an attempt to reduce the overall grey seal population, or at least slow down its growth. The program was terminated in 1983, by which time over 17 000 grey seals had been killed, an average of about 1 000 per year. The culling was restricted to the Gulf of St. Lawrence and to the small colonies at the Basque Islands and Camp Island.

The culling program eventually caused a marked reduction in pup production of the small colonies at the Basque Islands and Camp Island but had much less effect on the population of seals in the Gulf which

An adult female, her suckling pup, and an adult male.

appears to have increased by two to three times in the last 20 years. Culling was not undertaken in the Gulf in 1984 so that as many pups as possible could be tagged. The success of this tagging experiment led to further tagging experiments in 1985 and 1986. Culling was suspended in both these years and remains in abeyance at the present time.

In 1986 the Royal Commission on Seals and the Sealing Industry released its report on Seals and Sealing in Canada. The Commission's recommendations concerning seal research were reviewed by the Fisheries and Oceans Research Advisory Council (FORAC), a body of scientists, fishermen and fishing industry representatives set up in 1979 to provide advice to the Minister of Fisheries and Oceans. In its report, released by the Minister in January 1988, FORAC recommended against a multi-year cull of grey seals, and suggested further research on alternative ways of controlling the increasing grey seal population and its effects on fish stocks. The research program described earlier is a response to FORAC's suggestions. Over the past several years the Department of Fisheries and Oceans has also funded a number of research projects aimed at improving the technology of parasite detection and removal.

Further reading

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