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The Marine Mammals

The marine mammals—whales, dolphins, seals, walruses, sire-nians, and sea otter—include a higher proportion of species that are commercially useful than is found among any other group of animals in the sea.

Some of the marine mammals are enormously valuable. How-ever, their exploitation is severely limited by two factors: (1) the populations are relatively small in numbers and (2) the rate of pro-duction of young is low. The number of young which a female bears in a lifetime does not allow for much loss, certainly not for such prodigious infant mortality as the oviparous fishes suffer. Thus it happens that while most populations of fishes are remark-ably resilient to the effects of fishing, populations of mammals are not. Fishery stocks often continue to yield large catches even though they are being exploited far beyond their level of maximum productivity. It cannot be shown that there are any marine fish populations that have been brought even near to extermination by overfishing. This is not true of the sea mammals. Some popula-tions (of fur seals, for example) have been exterminated. Some entire species, such as the Hawaiian monk seal, have been reduced to the point where their very existence hangs in delicate balance. The history of all the great marine mammal industries is a monoto-nous repetition of the reduction of one species after another to un-profitable levels. Depleted stocks, such as the Alaska fur seal, have been restored only under governmental or international regulation. In some instances restoration has progressed very slowly. This is

true of the sea otter and the northern elephant seal. Fortunately efforts are being made to control whaling. An international convention was established in 1946 to regulate the killing of whales so as to maintain the stocks of these animals at their most productive levels. It is too early in the history of this organization to judge the results of its work.¹

Relatively little is known about fundamental features of the biology of many of these animals, such as their rates of growth and replacement, the routes of their migrations, their food habits, and the identity of the various stocks. The pelagic marine mammals have much to tell us about parts of the sea which they can reach better than we. Thus their oceanic distribution may indicate areas of fertility that also nourish valuable fishery stocks, and thus serve as a guide to exploration for untapped resources (Figures 20 to 23). They are excellent sampling instruments, their stomachs containing specimens which are not ordinarily available to us otherwise. For example, whales caught in the eastern North Pacific contain larger horse mackerel than Japanese fishermen ever catch, and thus reveal the existence of stocks of that species which should be worth exploring.

The study of pelagic mammals as indicators of fertility and of faunae in remote areas and depths is a research field that has hardly been touched. The following pages will review briefly the uses and status of the various groups.

Whales

BALEEN WHALES. These whales are characterized by a peculiar feeding apparatus in their mouths. They have no teeth. Instead, a series of 300 or more horny plates is arranged along each side of the palate, set at right angles to the long axis of the head. The plates hang down into the cavity of the mouth, about a quarter of an inch apart, varying in length with different species, from 20 to 30 inches in some to 10 or 15 feet in others. The substance of which they are composed, called baleen or whalebone, is tough and more or less flexible. The inner margin of each plate is frayed out in a coarse fringe, with the result that the whole assemblage of plates forms a sieve through which mouthfuls of water can be strained to collect plankton and small, schooling fish.

Clumsy though all this may appear, it is an enormously effective fishing apparatus. The smallest species of baleen whale, the pygmy right whale, grows to be 20 feet long; the blue whale, which is the largest of all animals, grows to be 100 feet; all the other baleen

whales reach at least 30 feet when full grown. Not only do they grow large, but they grow fast. The blue whale is particularly spectacular in this respect. At birth it is more than 24 feet long; in two to four years (estimates vary) it is 74 to 77 feet and sexually mature. For a mammal to produce flesh at that rate, and to maintain existence in the sea requires such prodigious concentrations of food as occur only in the most fertile areas. Depending as they do on plankton, the baleen whales feed in surface layers. They are mostly animals of temperate and cold waters (compare Figures 20 and 21). Of the 39,439 baleen whales caught in 1955-56, 80.0 per cent were from the Antarctic.

In the summer these whales tend to concentrate in high latitudes for feeding along coasts or on banks enriched by such processes as upwelling, convection, or divergences of currents. As winter approaches they move toward the equator into warmer water to reproduce and nurture their young.

At least ten species of baleen whales are recognized. These include three right whales, five fin whales (also called rorquals), the humpback, and the California gray whale. They all can yield valuable products, as shown by the fact that the whaling industry has utilized them all at one time or another. Nearly all the baleen whales are subject to conservation regulations under the International Whaling Convention. These regulations, which vary with different species, include catch quotas and minimum size limits. For certain species, total protection is established.

There are probably no underexploited stocks of baleen whales. There are stocks that are going through the slow process of recovering from overexploitation, which some day may be harvested again, and there are those that are now being exploited up to or beyond their level of maximum sustained yield. There are certainly no virgin stocks left. The problem of expanding the production of these animals, should demand warrant it, consists of determining the level of sustained yield in accordance with conservation principles, and then of regulating the industry to that level.

TOOTHED WHALES. The toothed whales have teeth and no baleen. In some species the teeth are fully formed in both jaws; in others they occur only in the lower jaw; in still others they are vestigial and do not show. There are many species in this suborder of whales, including the sperm whales, the bottlenose and beaked whales, all the porpoises and dolphins, and the narwhal. The pygmy sperm whale grows to be about 10 or 12 feet long. It is a poorly known species and although widely distributed, is generally considered rare. It has no commercial value and is not likely to

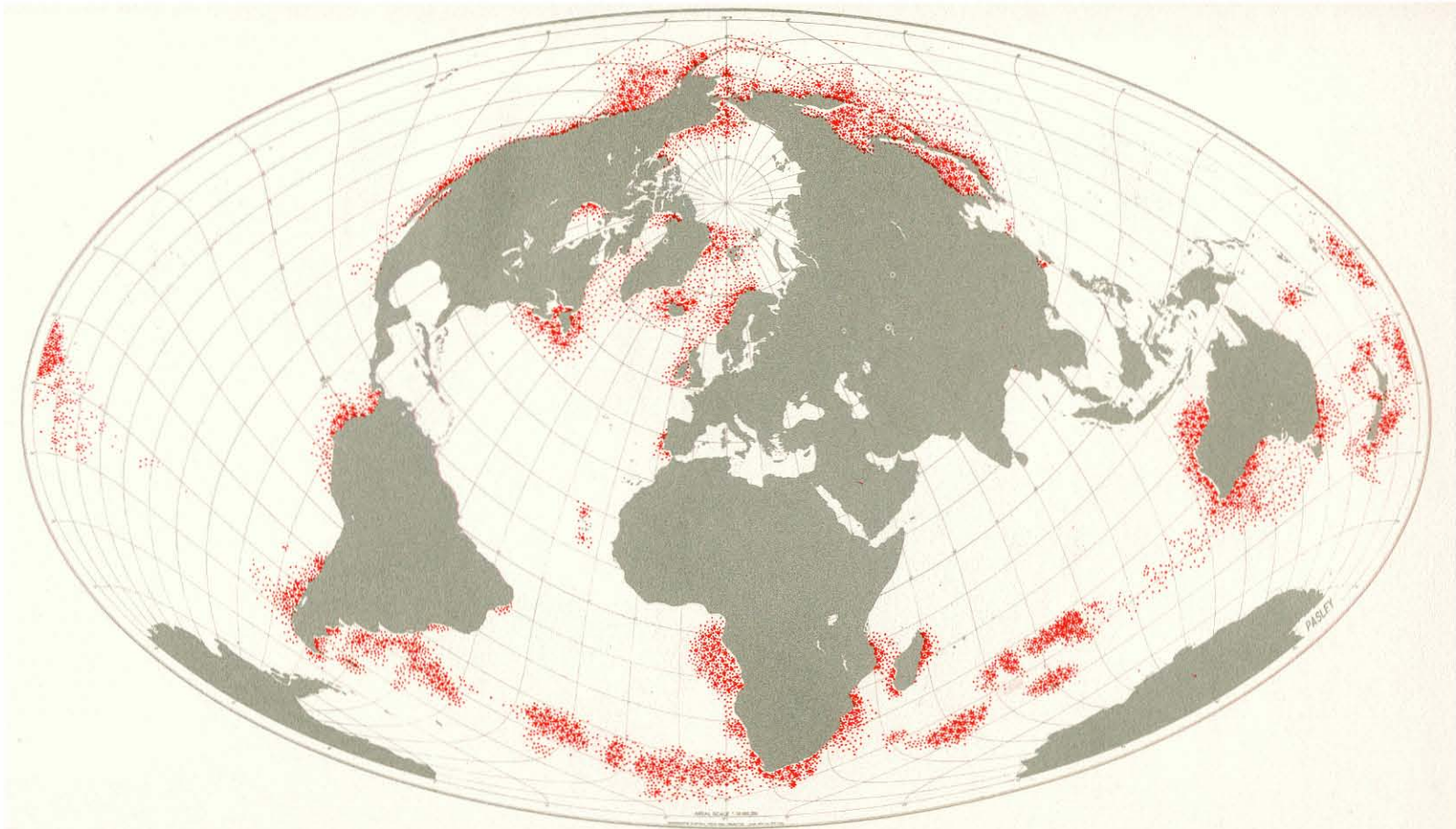


FIG. 20. Baleen whale grounds: summer. Compiled from log records of whaling vessels and from supplementary data supplied by Raymond Gilmore. The larger dots show where several catches were made.

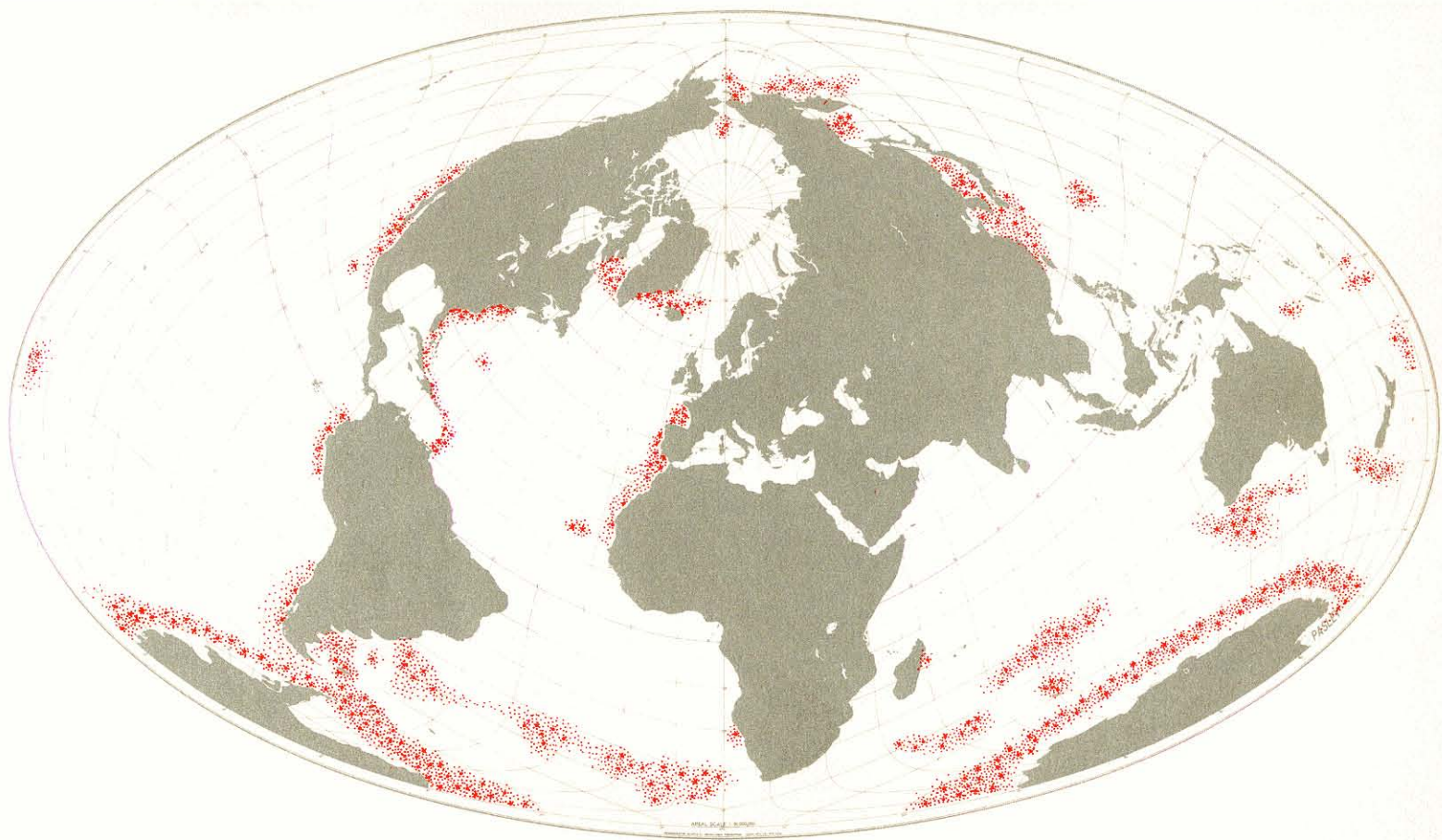


FIG. 21. Baleen whale grounds: winter. Compiled from log records of whaling vessels and from supplementary data supplied by Raymond Gilmore. The larger dots show where several catches were made.

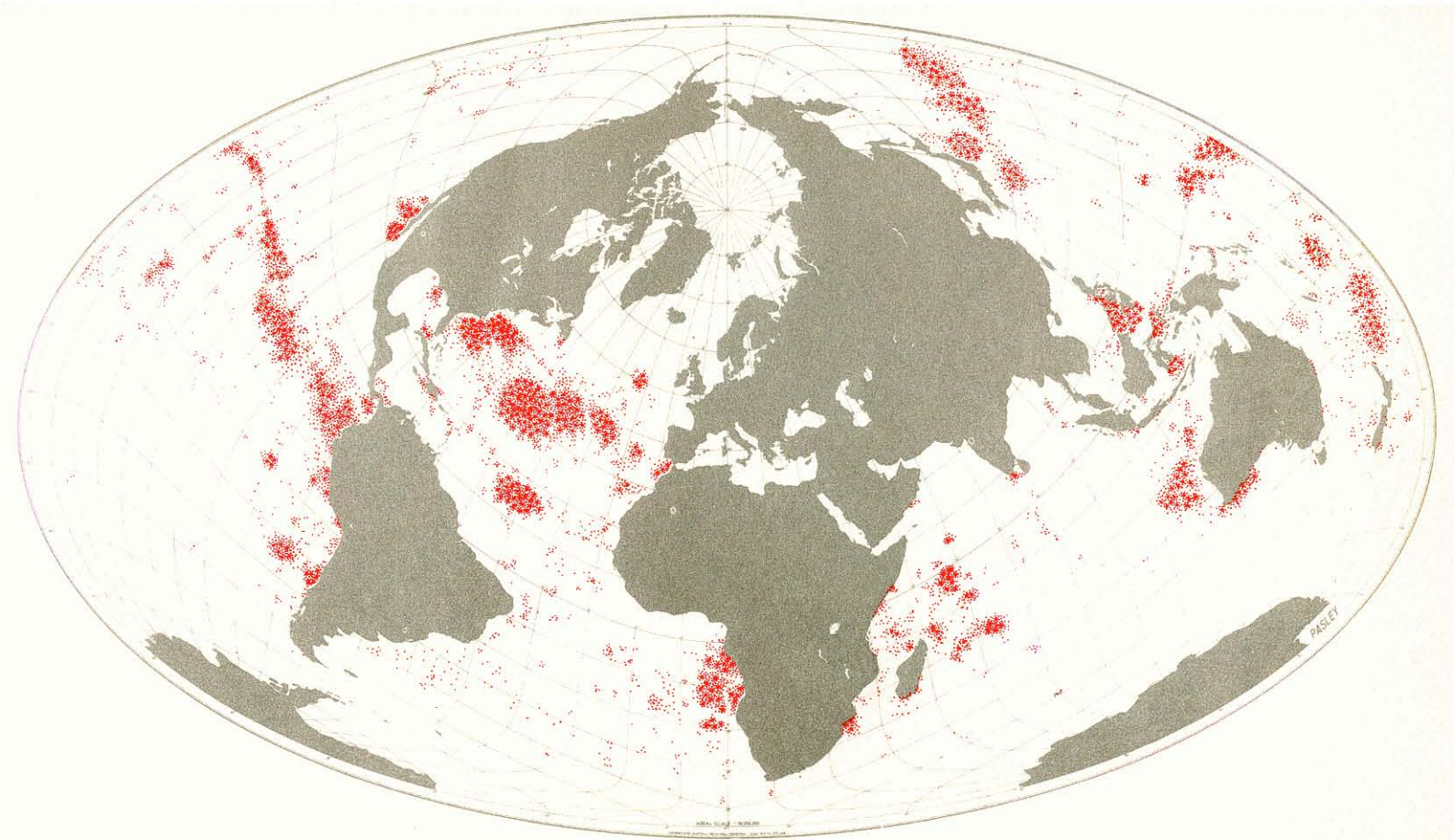


FIG. 22. Sperm whale grounds: April–September. Compiled from log records of whaling vessels and from supplementary data supplied by Raymond Gilmore. The larger dots show where several catches were made.

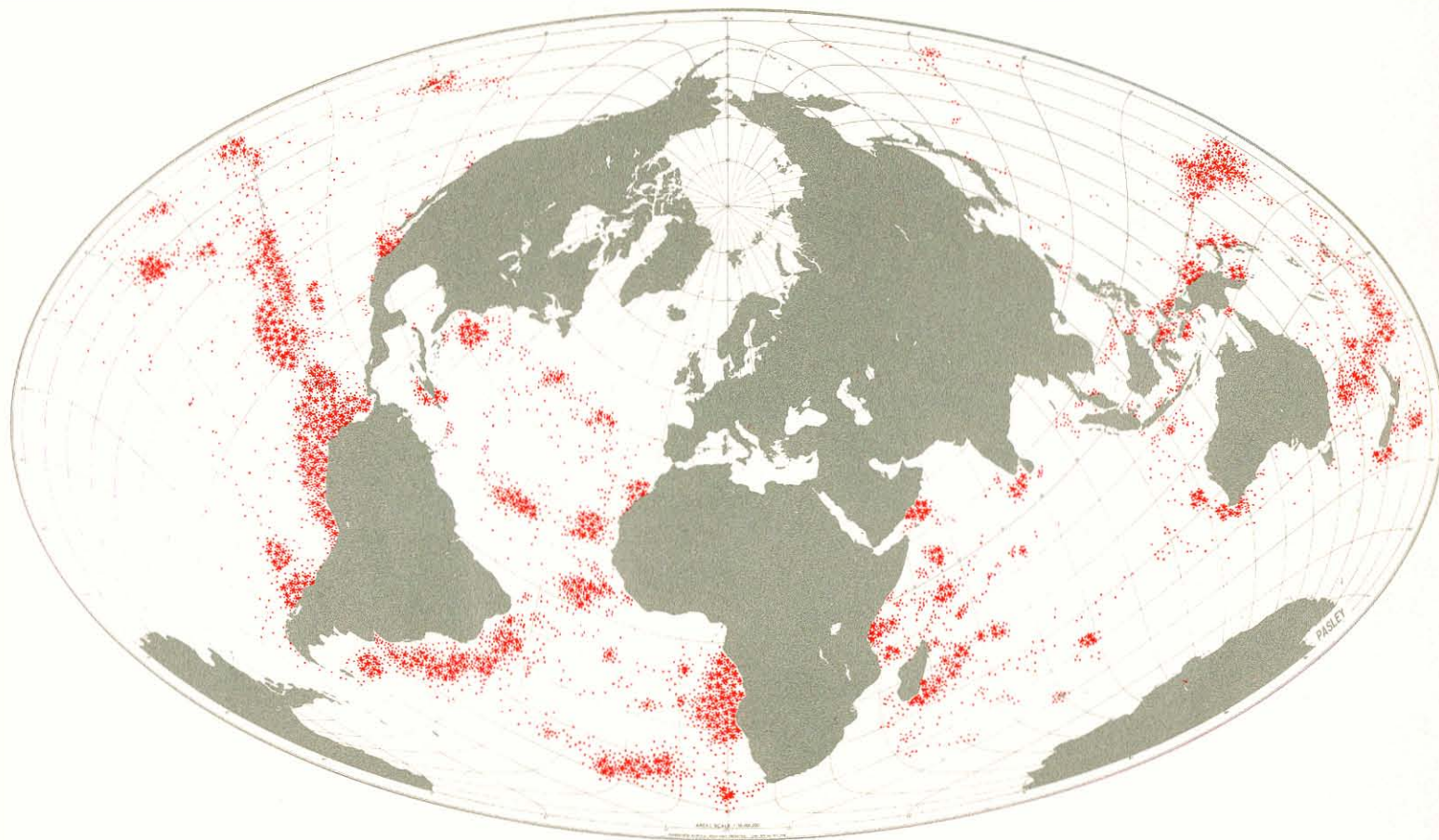


FIG. 23. Sperm whale grounds: October–March. Compiled from log records of whaling vessels and from supplementary data supplied by Raymond Gilmore. The larger dots show where several catches were made.

have any in the future. The sperm whale of commerce, which grows to be 60 feet long or more, occurs all over the world in polar regions as well as in the tropics. Mostly, however, it is a species of warm latitudes, evidently concentrating in areas enriched by hydrographic processes.

The sperm whale is a deep-water animal, able to go down almost half a mile. It evidently feeds at great depths. Its food consists largely of giant squids which inhabit ecological systems that must be very rich to attract and support such large animals. Unfortunately, our knowledge of faunal composition or of the mechanisms maintaining the fertility of these systems is almost a blank.

The oils of the sperm whale are waxy. This is especially true of the spermaceti, which is a clear colorless oil contained in a cavity of the head. Spermaceti solidifies in the air to form a white wax. It is used in cosmetics and for a variety of industrial purposes, including the manufacture of candles and as a dressing for fabrics. Another product of much interest, because of its erstwhile great value, is ambergris, a concretion formed in the intestine of sperm whales. Since ambergris can now be synthesized, the natural product may no longer bring great fortune to its finders.

The sperm whales were the most valuable of whales during most of the eighteenth century and the first half of the nineteenth, when they were intensively pursued all over the world, mostly by Americans. Sperm whaling became reduced almost to the point of extinction in the last half of the nineteenth century, partly as a consequence of depletion of the whales, and partly because of the replacement of whale oil by mineral oil for illumination. Sperm whales are being hunted again, now chiefly by catcher boats working from great factory ships in the Antarctic, on the west coast of South America, off Japan and the Bonin Islands, and in various other areas. Hand whalers take several hundred animals throughout the year in the neighborhood of the Azores. For 1955-56, the Food and Agriculture Organization statistics reported 18,625 sperm whales caught, which was more than 32 per cent of the total catch of all whales. It seems unlikely that the sperm whale is underexploited now; if anything, the contrary is true (Figures 22 and 23).

The bottlenose or beaked whales, of which there are several species, range at full length from 15 to 40 feet. As is true of the sperm whale, they feed in deep water on cuttlefish and squids. The oils derived from them are waxy, and the head contains a spermaceti organ. The whales of this family are not now particularly hunted. The Atlantic bottlenose was taken extensively during the last part of the nineteenth century. A few, probably

less than a hundred a year, of Baird's beaked whale are now taken in the North Pacific by Japanese and Russian whalers. Of the other species of beaked whales (*Mesoplodon*), specimens are occasionally captured and used. For the most part, however, they are poorly known, and though widely distributed, are rarely seen. They seem not to concentrate in any particular area, and there is no reason to think they are a potential resource of much value.

The protein content of lean whale meat is about 20 per cent. The 1950 catch, which consisted of 23,623 "blue whale units," contained something like 325,000 metric tons of meat which is the equivalent of the yield from 1,800,000 average weight steers.² However, the demand for whale meat is limited. Furthermore whales are hunted for their oil, and although meal is also manufactured on the factory ships and in the shore stations (82,100 metric tons in 1955-56), large quantities of offal are still thrown back into the sea as waste product. In the season of 1955-56, 72,000 metric tons of meat were landed. However, there are many technological problems that must be solved before it can be profitable to whaling companies to prepare meat in an attractive form, carry it to the home port in excellent condition, and market it in competition with beef, mutton, pork, and fish. Whaling companies are quite alert to this problem. Indeed, they have invested large sums in research work to develop new by-products, but so far with no remarkable achievement.

Porpoises

One family of marine mammals (the Delphinidae), contains the numerous species of dolphins and porpoises, as well as the narwhal, white whale, pilot whale, killer whale, and false killer whale. They differ from the baleen whales in lacking baleen, and from the sperm whales, bottlenose, and beaked whales in lacking a spermaceti organ. Most of them have functional teeth in both jaws. The various species vary greatly in form and range in full size from about 5 to 25 feet. They occur all over the world from arctic to antarctic latitudes and in many diverse environments from rivers to the high seas.

Several species are quite unutilized. A few do have commercial value in some areas. These animals are at the head of the food chain, the top dogs of the sea, as anyone who has ever seen a herd of porpoises attacking a school of mackerel can attest. They are not rare animals, yet almost nothing is known about how they figure in the marine economy. How abundant are they? How do they affect the abundance of food fishes? No one knows. Few biologists have the opportunity to study dolphins and porpoises in-

tensely. Consequently, the natural history of these animals is only partially known at best. There is little if any exact information on the seasons, places, and frequency of reproduction, or on the rate of growth and mortality. Hence, there is no basis of judging how much of a harvest the stocks of these animals could sustain. The flesh varies in quality from one species to another. In some it is dark and soft, almost liver-like in texture; in others it is tough. In some it is agreeable to eat; in others it has an unpleasant odor. Evidently the meat must be treated in some way to make it attractive and palatable. To devise such a treatment would require technological research. One obstacle to developing porpoise fishing is that fishermen of all lands look on these beautiful creatures with affection. They have woven all sorts of myths and superstitions about them. Porpoises are their companions and guides. How could anyone harm one?

The common porpoise (*Delphinus delphis*), a cosmopolitan species, is fished commercially around Japan and in the Black Sea, where in some years more than 20,000 are caught. Elsewhere it is not actively pursued, though it is taken occasionally with nets on the coast of Europe. It formerly had some value in an American fishery, but is no longer in demand in the United States. Its blubber oil is of a glyceridic type. The oil from the head and jaw contains isovaleric acid and has some value as a lubricant. The flesh is edible.

The bottlenose dolphin was the object of a United States fishery at Cape Hatteras during the nineteenth century. It was valued for blubber oil, jaw oil, and to some extent for meat. Now it is taken only occasionally by local fishermen in various parts of the world.

The pilot whale, also called blackfish or pothead, is probably the most important species of the dolphin family in the world. As is true of other members of the family, small herds become stranded on beaches from time to time and perish. People use the oil and even meat of the carcasses in some places where these accidents occur. The oil has special value for lubricating watches and other fine instruments. In Greenland and around the Faroe, Orkney, and Shetland Islands, fishermen unite to drive pilot whales ashore whenever they appear. In Japan, small whaling boats take them, along with other species, on the high seas.

The white whale (or beluga) is an arctic species of porpoise which is hunted rather extensively by people of some northern countries, notably Norway (around Spitsbergen and in the North Atlantic), Canada (Gulf of St. Lawrence and Hudson Bay), Russia (White Sea, Kara Sea, and Sea of Okhotsk), and Greenland. A few

thousand pilot whales are caught annually in Newfoundland, most of them by being driven ashore. A few are harpooned. The white whale is particularly important in the Eskimo economy, being used as food by men and sledge dogs. The meat is palatable and nutritious. The blubber oil is also useful for food and for illumination. Moreover, the oil of the head and jaws is rich in isovaleric acid and is therefore valuable as a lubricant for fine instruments. The leather makes an excellent product, being waterproof and having remarkable toughness and elasticity. It is used for making boots and bootlaces.

The killer whale is a cosmopolitan member of the dolphin family. It is probably the most voracious of all animals, preying on fishes, walrus, seals, other dolphins and porpoises, and whales of all sizes. A few are taken commercially in Japan and probably also in other parts of the world. Although numerous in total numbers, the killer probably does not congregate anywhere in large enough numbers to induce the development of a special fishery.

The narwhal, a species of the arctic seas, is remarkable for its single long, twisted tusk. In western Greenland and northeast Baffin Island sudden freezes trap them (as well as white whales and other species) in bays, whence they cannot escape. Then Eskimos kill them, save the meat for food, the hide for leather, and the tusk for sale to white traders. The blubber oil is said to be of superior quality.

The Sirenians

These form an order of aquatic mammals which include the manatees and dugongs. They have a face which a nearsighted observer *might* take to be human. The females have a single pair of teats on the breast, hence these animals are thought to be the prototypes of the mermaids of antiquity. Though superficially resembling the whales in many respects, the two groups are anatomically different and unrelated. The sirenians live in shallow seas, bays, estuaries and rivers. They subsist wholly on algae and other submerged aquatic plants. They are sluggish, inoffensive animals, not very intelligent, and apparently at the end of their line of evolution. The naturalist Georg Steller, accompanying the navigator Vitus Bering, found large herds of one sirenian on the Commander Islands in 1741. This was the northern sea cow. These animals were as much as 20 or 30 feet long, weighed up to 8,000 pounds. The meat and fat were said to be superlatively palatable, and northern expeditions used the animals for food. So vulnerable was this species

to overexploitation, that it became extinct 27 years after its discovery.

The dugong is another sirenian, which inhabits the Indo-West-Pacific region from East Africa, around the Red Sea to Australia, New Guinea, and the Ryukyu Islands. Once these animals occurred in large herds of several hundred individuals, and were so fearless that they would allow themselves to be touched with the hand. They are no longer either so abundant or so trustful. Their flesh and oil are said to be excellent. They are fished locally in various places though not extensively. The problem with these animals is not how to increase exploitation but how to preserve the species.

Manatees, of which there are at least three species, occur in rivers and on the coasts of both sides of the Atlantic in tropical zones. They were heavily exploited during the nineteenth century for their oil and hides, perhaps also for their flesh, which was described, too, as being of fine quality. Consequently their numbers became seriously reduced. There seems to be no important fishery for them now, nor any prospect of one.

Seals

Whales, porpoises, and sirenians spend all of their time in the water. There is another order of marine mammals, which includes the hair seals and the fur seals, the Pinnepedia, which must go ashore or onto the ice to reproduce. These are the eared seals, the walruses, and true seals. They are carnivores.

EARED SEALS. The eared seals are distinguished from other members of this order by the presence of external ears. In addition, like the walruses, their hind flippers are turned forward under the body in the direction of the head.

There are at least five species of sea lions, two in the Northern Hemisphere and three in the Southern. They feed in the water on fish, mollusks, crustaceans, and sea birds. In summer they resort to favorite rocky places and islets where they gather in colonies of harems and reproduce. Although their pelage is worthless as fur, they have been taken commercially in the past for their oil and hides and "trimmings." The "trimmings," that is, genitalia and gall bladder, were sold to the Chinese people, who valued them for medicinal purposes. Sea lions are quickly vulnerable to undirected exploitation but they can recover with adequate protection. For example, it was estimated that in 1872 there were 27,000 to 33,000 Steller sea lions on the Pribilof Islands. By 1923 there were only

a few hundred left.³ In 1955 there were 5,000. In all of Alaska there were about 40,000 in 1955, in British Columbia 10,000, in Washington 500, in Oregon 1,000, and in California 3,000. There has been much controversy about sea lions. They do eat fish, as well as squids, octopus, crabs, and other things, and they congregate where their prey is plentiful. They also occasionally damage fishing gear. Fishermen therefore frequently urge that their numbers be reduced.

This is not something to do unscientifically, however. How populations of sea lions affect the ecology of their environment should be the subject of special research. This implies a good deal more than examining the contents of a few stomachs to see what they eat. Another question for research is how different annual rates of slaughter affect the abundance of colonies. There is also a need for technological research to determine how to get the greatest value from carcasses of slaughtered sea lions.

There are some five species of fur seals, three in the Southern Hemisphere and two in the Northern. The pelage of these animals, which is soft with a thick under-fur, provides commercial sealskin. In late spring fur seals gather in certain favored places, form colonies of harems, and reproduce. A harem consists of one bull and from 10 to 100 cows. As winter approaches, the northern fur seal deserts its breeding grounds, returns to the sea and journeys far in the direction of the equator. Specimens marked on the Pribilof Islands with flipper tags have been found later swimming 2,000 miles south off the American coast. Other have been found off the northern islands of Japan. The fur seals of the Southern Hemisphere are for the most part nonmigratory.

Wherever exploitation of fur seals has gone unregulated it has resulted in serious depletion of the resource. Thus the Guadalupe fur seal, which occurred on the small islands off the coast of southern California and northern Lower California, was almost exterminated late in the nineteenth century. Indeed, it was thought that they were extinct until a small colony was found on Guadalupe Island in 1928. A few are now living and there is hope that under careful protection this resource might eventually be restored. That this is possible is attested by the history of the northern fur seal, which was almost exterminated by unregulated sealing and subsequently restored to become again a profitable resource. This species breeds on the Pribilof, Commander and Kurile islands in the Bering Sea and on Robben Island in the Sea of Okhotsk. There were over a million animals on the Pribilof Islands when the United States purchased Alaska in 1867. During the next 43 years an in-

tense pelagic fishery, as well as shore sealing on the breeding grounds, threatened to exterminate these herds. Where the harvest had been 165,000 in 1868, it fell to 17,000 by 1900. In 1910 the United States Government took over the Pribilof seal herds. Since then, the annual slaughter has been carried on only by Aleut residents of the islands, working under the supervision of Fish and Wildlife Service agents. The seals are sold at public auction, and the net proceeds go to the national treasury. The flesh of the carcasses is rendered into oil and meal. The meal is used for animal feeds, the oil for various industrial purposes. Under this carefully directed harvesting the herd has grown to number about 1,500,000.

Pelagic sealing was outlawed in 1911 by the Pacific Sealing Convention, to which the United States, Great Britain, Japan, and Russia were parties. To compensate for their refraining from pelagic sealing, the treaty allotted to Great Britain and Japan 15 per cent of the annual harvest of skins taken from the Pribilofs. Russia was a signatory to the treaty only in the interest of the seal herds in the Western Pacific. In 1941 Japan abrogated the treaty, whereupon the United States and Canada made a provisional agreement to protect the fur-seal resource until a new treaty could be negotiated.

The fur seals of South America, South Africa, New Zealand, and Australia also once were abundant and valuable. They were severely depleted by sealing many years ago. Some rookeries never recovered, but others have improved enough under government supervision to be again commercially valuable. Around 20,000 pelts come annually from South Africa and about 1,000 from Uruguay. It would be useful to study these populations to see how they could be restored to profitable levels.

WALRUSES. These occur in arctic regions of both the Atlantic and the Pacific. They gather in herds, usually in the neighborhood of shores or masses of floating ice. Though the males are promiscuous they do not form definite harems as do the sea lions and fur seals. They migrate, for the most part, by riding on ice floes. Thus in the northeastern Pacific they move south to Bristol Bay in the winter, north to Point Barrow in the summer. They feed mainly on thick-shelled bivalve mollusks, but also swallow large quantities of seaweed, whether for nourishment or not no one knows. Walruses have been severely overexploited for oil, hides and ivory. They are now variously protected. In Alaska, for instance, they may be killed only by Eskimos, who kill about 1,300 animals each year, use the flesh and fat as food for themselves and their sled dogs, and carve the tusks into curios.⁴ In Siberia the natives are said to have a one

day open season, allowing each man to kill enough for his winter's use.

It does not seem likely that even with the most careful regulation, a walrus fishery could come to be of great importance. Probably the most that could be expected is that the resource might be made to hold its own.

TRUE SEALS. The true seals are distinguished by the lack of an external ear and by the characteristics of the hind limbs, which do not point forward as they do in the fur seals and sea lions, but permanently backward. There are perhaps twenty species of true seals in the world. They occur generally along the shores of temperate and cold countries, mostly in the Northern Hemisphere. Only the monk seals live in warm latitudes. There are three populations (perhaps distinct species) of these and all of them are "relicts" close to extinction. Only four or five species live in the Southern Hemisphere, all of them in or near the Antarctic. They vary in habits from one species to another. Some species (such as the bearded seal) are more or less solitary; others (like the crested seal) live in small groups or family parties; still others (the elephant seal, for example) form very large herds. They may migrate seasonally, like the harp seal, which lives in arctic waters in summer and travels long distances southward in winter; or they may spend all their lives about a single locality, as is the habit of the ringed seal of the North Pacific. Their food habits also vary. The harbor seal, for example, eats fish, sometimes valuable species such as salmon. This particular seal often raids fishermen's nets and damages the gear as well as the catches. The ringed seal, on the other hand, pursues and eats principally small, free swimming crustaceans and mollusks and some small fishes.

Several species of true seals are important in the economy of indigenous peoples of the far north, who use their meat for food, their blubber for illumination, their skins for boot soles, boot coverings, dog traces, harpoon lines, and so forth. The products of seals, principally leather and oil, have value elsewhere in the world too, and vessels put out from various countries of Europe, North America, and the Orient to hunt seals. Sealing industries are not nearly so productive as they once were, largely because several of the most valuable species were brought almost to the point of extermination. This is what happened in the last century to the northern elephant seal, the largest of all pinnipeds, which was once the principal quarry of sealers in the North Pacific. Fortunately the species was not quite wiped out and, thanks to protection by the governments of Mexico and of the United States, it is now slowly coming back.

The chief sealing grounds today in the Arctic and North Atlantic Oceans are western Greenland, the Newfoundland district, the Seas around Jan Mayen, Novaya Zemlya, the Kara Sea, and the White Sea.

The principal species sought now is the harp seal of North Atlantic regions. The number of these animals killed annually on the "front" in the North Atlantic (i.e., east of Newfoundland and Labrador), varies between about 150,000 and 355,000. In 1952, the killed of pups and adults, in round numbers, was as follows: ⁵

<i>Country</i>	<i>Number of Animals</i>
Canada	85,000
Norway	113,000
France	7,000
Total	205,000

Probably only the seal herds of the Antarctic could be regarded as underexploited, and they are too remote to merit sending out special sealing expeditions. The chief problem concerning the seals of the Northern Hemisphere is not how to expand their utilization, but how to set the rate of annual harvest in accord with conservation principles.

SEA OTTERS. This marine mammal is native to coasts of the North Pacific from central Lower California to the western tip of the Aleutians and to Japan on the Asian side. It is rather small as marine animals go, not exceeding 4 or 5 feet including the tail, which is about a quarter the total length. It is remarkable for its beautiful pelage, which consists of dense, fine, deep underfur. These animals spend most of their time at sea, not generally within sight of land. They feed on mollusks, sea urchins, and crustaceans, as well as on various other invertebrates and fishes. They mate during summer in the sea or on shore rocks, give birth to their young in spring and early summer on the floating kelp fronds or on rocks by the sea.

Sea otters were originally numerous enough to support a modest-sized continuing fur trade. Unfortunately that was before the idea of conservation had become established, and the herds of these animals were slaughtered faster than their rate of replacement. During this period, sea otter was the most valuable of all furs. In 1891, the average price was \$275 a skin, and it is said that some skins brought as much as \$2,500!

The history of the sea otter trade is the same wherever they occurred. Hunters killed 5,000 animals on St. Paul Island in the Pribilofs in 1787, 1,000 animals in 1788. Within six years there

were evidently none left. In Cook Inlet, 3,000 skins were taken the first year, 2,000 the second, 800 the third, 600 the fourth, and in 1812, less than 100.⁶ This species was saved from extermination by absolute protection as provided under a 1911 treaty between the United States, Great Britain, Japan, and Russia. It is a violation of United States federal law to possess a sea otter pelt without a permit. During the past forty-five years the species has been slowly re-establishing itself so that there are now thousands of them scattered among the islands of the Aleutian chain and of the Alaska Peninsula, and even one colony as far south as central California. If sea otters were again taken commercially, the rate of cropping would have to be very prudently controlled if the resource were to remain productive.