

# The Northern Fur Seal



UNITED STATES DEPARTMENT OF THE INTERIOR  
U.S. FISH AND WILDLIFE SERVICE  
BUREAU OF COMMERCIAL FISHERIES



Circular 336



Breeding grounds of the northern fur seals: Robben Island (Kaihyōtō or Tyuleny Island) off Sakhalin; the Commander Islands (Bering Island and Medny or Copper Island) at the Soviet end of the Aleutian chain; and the Pribilof Islands – St. Paul Island, St. George Island, Otter Island, Walrus Island, and Sea Lion Rock.

Cover – The Pribilof Islands in Bering Sea are the homeland of the largest fur seal herd in the world. Here the fur seals come ashore to bear their young on the rocks and sands above tidewater. The story behind the restoration and development of the Alaska fur seal herd is one of adventure and international diplomacy. It is a heartening account of cooperation among nations – an outstanding example of wildlife conservation.

UNITED STATES DEPARTMENT OF THE INTERIOR

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Leslie L. Glasgow, *Assistant Secretary*

*for Fish and Wildlife, Parks, and Marine Resources*

Charles H. Meacham, *Commissioner*, U.S. FISH AND WILDLIFE SERVICE

Philip M. Roedel, *Director*, BUREAU OF COMMERCIAL FISHERIES

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By

RALPH C. BAKER, FORD WILKE,  
and C. HOWARD BALTZO<sup>2</sup>

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States — now and in the future.

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## ABSTRACT

The early history of worldwide fur sealing; the distribution and movement of northern fur seals; and their food, physical characteristics, reproduction, and mortality and disease are discussed. Information is also given on fur seal population, management, and research; sealing on the Pribilof Islands; and processing and sale of fur seal skins.

The northern fur seal was first described by Georg Wilhelm Steller in 1742, and the largest part of the population was found on the Pribilof Islands by Gerassim Pribilof in 1786. The number of fur seals reached its lowest level, about 216,000, in 1911 after periods of mismanagement by Russia and the United States and the attrition from pelagic sealing. The Convention of 1911, signed by Canada, Japan, Russia, and the United States, and the succeeding Convention signed in 1957, gave protection needed for recovery. Populations are now near maximum on the Pribilof Islands and Robben Island and are increasing on the Commander Islands. Seals became reestablished on the Kuril Islands in the 1950's. They reappeared on San Miguel Island, Calif., in 1968.

Fur seals migrate south to waters off southern California and northern Japan. Seals of various origins intermingle at sea and to a lesser degree on land. They remain at sea

from November to May when they begin returning to the rookery islands. The oldest seals return first.

Fur seals feed on anchovy, hake, capelin, herring, Alaska pollock, miscellaneous other fish, and squids. They feed effectively at night.

Their fur is waterproof. Part of it is retained more than one year.

Male seals acquire harems when about 10 years old. Females have their first pups when 5 or 6 years old after a year-long pregnancy. Pups are fed every 5 to 14 days on milk with a fat content of 50 percent. They are able to swim from birth.

Malnutrition, hookworm infection, injuries and bacterial infections kill 5 to 20 percent of the pups on land, depending on population density. Others die at sea, with 15 to 35 percent surviving to age 3.

The number of pups born, number of adult males, survival, pregnancy rates, and mortality are measured annually. Management is aimed at holding the population at its most productive size. Research by the United States is coordinated with that of Canada, Japan, and the U.S.S.R. by the North Pacific Fur Seal Commission.

Fifty to sixty-five thousand young males are harvested annually from June to August. Females are taken if necessary to maintain a specified population size.

<sup>1</sup> A revision of Circular 169 under the same title by Baker, Wilke, and Baltzo, 1963.

<sup>2</sup> Ralph C. Baker, formerly Assistant Director for Resource Development, Bureau of Commercial Fisheries, Washington, D.C. 20240; Ford Wilke, Laboratory Director, Marine Mammal Biological Laboratory, Bureau of Commercial Fisheries, Sand Point Naval Air Station, Seattle, Wash. 98115; and C. Howard Baltzo, formerly Program Director, Pribilof Fur Seal Program, Bureau of Commercial Fisheries, 6116 Arcade Bldg., Seattle, Wash. 98101.

Products from fur seals include furs, animal food, and protein extracts. Canada and Japan each receive 15 percent of the skins and 70 percent of the net proceeds from skins sold by the United States is paid to the State of Alaska.

## EARLY HISTORY OF FUR SEALING

In 1742 Georg Wilhelm Steller drew up the first scientific description of the fur seal after he had survived the wreck of the vessel commanded by Vitus Bering off what is now called Bering Island in the Commander Islands, U.S.S.R. These islands are one of the three principal breeding grounds of the northern fur seal.

In 1783 Gerassim Pribilof, navigator in the service of Imperial Russia, joined the search for other breeding grounds of the North Pacific fur seals. The Russians originally came to this area in search of sea otters, and here they found fur seals as well. Each spring the seals were seen to swim northward through the passes of the Aleutian Islands and disappear into the fog and mist of the Bering Sea. In 1786, 3 years after his search began, Pribilof came upon the islands that now bear his name and found fur seals along the beaches in seemingly uncountable numbers. Almost immediately the teeming rookeries became a source of sealskins for the fur markets of the world, at about the time the 13 colonies on the Atlantic coast of North America were forming a new nation. Today northern fur seals breed on the Pribilof Islands, St. Paul and St. George, in the eastern Bering Sea, the Commander Islands, Bering and Tyleni, in the western Bering Sea, and on Robben Island off Sakhalin. Small colonies have become established in the Kuril Islands between Kamchatka and Hokkaido and on San Miguel Island off California.

Two years before the discovery of the Pribilof Islands, adventurous skippers from New England and Europe had discovered commercial possibilities in the great herds of fur seals along South American coasts, in Antarctica, and off South Africa. Even though the Spaniards expelled British sealers from the Falkland Islands in 1770, the United States'

first experimental cargo of 13,000 pelts from the Southern Hemisphere appears to have been taken at the Falklands in 1784 by the crew of the American vessel *States* from Boston.

In the 50 years that followed, the fur seal rookeries on Islo Alejandro Selkirk (former Mas Afuera), Juan Fernandez, the South Shetlands, Prince Edward, the Antipodes, and many other islands were destroyed as fast as they were discovered. Literally millions of pelts were taken to the Canton market to trade for tea, silks, and other products of China. The populations of fur seals south of the equator were rapidly decimated. Some herds survived, however, and still live off the coasts of South Africa, South America, Australia, New Zealand, the Galapagos Islands, and some of the subantarctic islands.

The exploitation of the Alaska herd at first followed the same destructive methods as those pursued by sealers in the southern seas. Twice during the Russian administration the herd on the Pribilof Islands was threatened by annihilation: first, through failure to restrict the numbers of seals killed, and later by failure to give the females adequate protection. Russia forbade the killing of females after 1834, but according to H. W. Elliott<sup>3</sup> the ruling was not enforced until 1847. Elliott was told about a wall of ice that prevented the females from landing on St. Paul Island and forced them to bring forth their pups in the water or through storm-tossed surf, which killed many of the mothers and most of the pups. The truth about this catastrophe and the condition of the seal population in 1836 cannot be verified. By 1867, when Alaska was purchased, the seal herd was reported to be thriving.

After the purchase of Alaska by the United States, Congress passed legislation to protect the fur seals of the Pribilof Islands from reckless slaughter. A number of independent companies had begun sealing on the islands and had taken about 300,000 skins the first season. To prevent this destruction, an Act of Congress of 27 July 1868 prohibited the killing of fur seals, and on 3 March 1869 the islands

<sup>3</sup> Henry W. Elliott. 1887. The fur-seal industry of the Pribilof group, Alaska. In George Brown Goode, The fisheries and fishery industries of the United States, sec. 5, vol. 2, part 18, pp. 321-393. U.S. Government Printing Office, Washington.

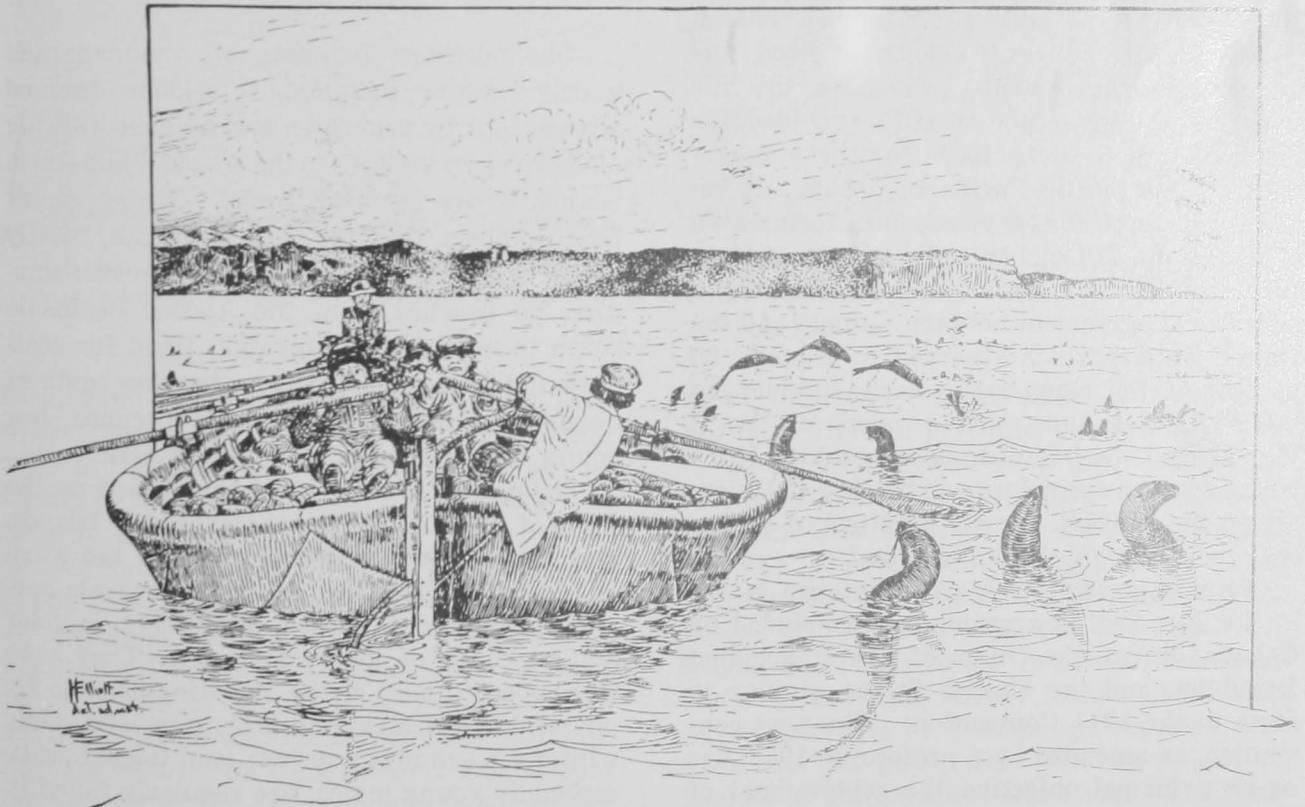
were set aside by the U.S. Government as a special reservation for the protection of the animals. Only local natives were allowed to kill fur seals, and then only for food. A year later the U.S. Treasury Department was authorized to lease exclusive rights to take seals on the islands, with the stipulation that no females were to be taken. Further legislation in 1874 authorized the Secretary of the Treasury to establish catch quotas and open seasons for the lessee.

Fur seals are vulnerable to capture while at sea as well as on land. Pelagic sealing, or taking of fur seals at sea, began to develop on a commercial scale about 1879. As practiced extensively by American, Canadian, and Japanese sealers in the North Pacific, pelagic sealing resulted in the indiscriminate killing of the seals, without regard to age, sex, or the number taken. The pelagic take of sealskins reached a peak of 61,838 in 1894.

In 1870 the Alaska Commercial Company, composed of several sealing competitors who had compromised in 1868 to gain control of the resource, was awarded the United States' first 20-year contract to seal on the Pribilof Islands. Under the first 20-year lease, the Alaska Commercial Company took 1,977,377 sealskins. Under a second 20-year lease (to the North American Commercial Company), only 342,651 sealskins were taken in the period ending in 1909. The leasing system was discontinued in 1910, and since then the Alaska fur seal herd has been under the management of the Federal Government, first by the Secretary of Commerce through the former Bureau of Fisheries and now by the Secretary of the Interior through the Bureau of Commercial Fisheries of the U.S. Fish and Wildlife Service.

Early pelagic sealing had a devastating effect upon the fur seal herd. Almost a million skins were taken on the high seas from

"Fur seals sporting around the baidar — Natives of St. Paul lightening off the bundled sealskins to the shores from the Village Cove." A sketch by Henry W. Elliott, who visited the Pribilofs for the Treasury Department and the Smithsonian Institution in 1872, shortly after the purchase of the Islands from Russia. The baidar, or bidarra, was made of sea lion skins. Canvas-covered bidarrahs are still used in ship-to-shore ferrying.





1879 to 1909, and many of the seals shot or speared in the open sea were not recovered. The effect on the Alaska herd was disastrous, because females made up 60 to 80 percent of the pelagic catch. In 1912, when the first complete census was taken by David Starr Jordan and George A. Clark, 215,900 seals were counted or estimated on the Pribilof Islands. Although scientists believe this estimate was too low, the Pribilof herd had undoubtedly been reduced severely, and the smaller herds off the Pacific Asian coast were faced with extinction.

After extended diplomatic negotiations and a long series of ineffectual bilateral agreements, the United States, Great Britain (for Canada), Japan, and Russia concluded a Convention on 7 July 1911, for the protection of the fur seals of the North Pacific. Pelagic sealing was prohibited except by aborigines with primitive weapons. Each country with fur seal rookeries agreed to share 30 percent of its annual take of sealskins—Canada and Japan each to receive 15 percent of the sealskins from the Pribilof Islands and the 15 percent of those from the Commander Islands; and Canada, Russia, and the United States each to receive 10 percent of the pelts from Robben Island.

Worldwide political events affected the international agreements protecting the fur seals. The Convention of 1911 provided for the first time a sound basis for the management of the North Pacific fur seals. It remained in force for 30 years, until terminated by Japan on 23 October 1941. From 1942 to 1957 the Pribilof herd was protected by a provisional agreement between Canada and the United States, which reserved to Canada 20 percent of the skins taken each summer on the Pribilof Islands. As a result of World War II, control of Robben Island and the Kuril Islands passed from Japan to the Soviet Union, giving the U.S.S.R. complete control of all fur seal rookeries off the Asian coast.

On 9 February 1957, a new interim North Pacific Fur Seal Convention was concluded by Canada, Japan, the Union of Soviet Socialist Republics, and the United States, similar in form to the 1911 Convention. The new convention, as amended by a protocol in 1963, has as its principal objective the achievement of

maximum sustainable yields of fur seals in the North Pacific. It provides for a Fur Seal Commission comprised of representatives of the four Governments to coordinate research and management for the northern fur seal. It also provides that Canada and Japan each shall receive 15 percent of the sealskins taken commercially by the United States and the U.S.S.R.

The Fur Seal Act of 1966 (Public Law 89-702) puts into effect domestically the international Convention. It provides for the conservation and protection of the fur seal and sea otter and for the administration of the Pribilof Islands.

Under international protection and rational management, the Alaska fur seal herd has increased from the low point of about 216,000 animals in 1912 to its present level of over 1¼ million animals. From 1940 to 1967 the herd has provided an average 59,758 male sealskins. Since 1958, over 738,000 seals have been harvested or taken for research under management policies approved by the North Pacific Fur Seal Commission.

## DISTRIBUTION AND MOVEMENTS OF SEALS

The northern fur seal, an abundant and widely ranging mammal, is seldom observed alive except by fishermen and seamen working offshore or by visitors to the Alaskan and Asian islands where the seals breed. Every winter beachcombers find fur seal carcasses, mostly young seals that were pups the previous summer, on beaches from the Alaska Peninsula south to northern California. Dead fur seals have not been reported from beaches south of northern California, probably because few young fur seals migrate south of here.

Originally the fur seals that breed on the Pribilof Islands, on the Commander Islands, and on Robben Island and some of the Kuril Islands were described as three separate species because of supposed differences in color and in shape of head and neck. They have since been found to be indistinguishable by physical appearance and measurements; their wintering grounds overlap; and tagged seals, especially young males, are regularly found in



In late June this 9-year-old bull fur seal is approaching the age when he will compete actively for territory on a rookery. Probably the territory he seeks will be near the spot where he was born.

small numbers on rookery islands other than where born. The recently reestablished colonies in the Kuril Islands and on San Miguel Island, Calif., contain animals from Asian and Alaskan rookeries. Therefore, the fur seals of the North Pacific are now considered to belong to a single species, *Callorhinus ursinus*.

Migratory routes extend over vast areas of the Pacific. Except as stragglers, few fur seals range north of the Pribilof Islands. They migrate south to the Channel Islands off Santa Barbara, Calif. In the west they range from the vicinity of the Commander Islands to the

seas southwest of Kinkazan Peninsula on northern Honshu and into the Sea of Japan.

Northern fur seals now breed on the following islands: St. Paul and St. George Islands and Sea Lion Rock of the Pribilof group in Alaska; Copper and Bering Islands of the Commander group off Kamchatka; Robben Island, off Sakhalin; Nizkaya, Visokaya, Khitraya, and Tchiornaya Rocks in the Kuril Islands; and San Miguel Island, Calif. The Soviet Institute of Oceanology reported that seals, but no pups, were seen on the Kuril Islands of Paramushir and Urup. Fur seals



Summer on a typical fur seal rookery—Kitovi Rookery on St. Paul Island. Characteristically, the females return each summer to the rookeries where they were born. In May and June come the harem bulls or beachmasters; later the females.

13 JUNE. — By mid-June most of the harem bulls have established stations and await the arrival of the females.



28 JUNE. — By late June, the first females arrive, and harems begin to form.



The pups are born soon after the females come ashore. The pups grow stronger, they wander over the rookery and eventually gather in groups or pods, while their mothers spend much time at sea searching for food.



3 AUGUST. — In late July or early August the harems begin to break up.



8 JULY. — In early July the harem groups remain closely knit.



of the Kuril Islands were nearly exterminated by sealers in the 1890's; in 1955 and 1956, however, Soviet investigations revealed their presence once again, though in small numbers. About 80 percent of the northern fur seals live and breed on the Pribilof Islands.

International research reveals intermixing between fur seals of the eastern and the western Pacific. From research on the intermixing of seals from American and Asian islands, scientists believe that 20 to 30 percent of the seals found off the coast of Japan in winter and spring come from the Pribilof Islands. Seal-tagging studies by the United States and the Soviet Union indicate that male seals from the Commander Islands make up about 1 percent of the annual commercial kill of seals on the Pribilof Islands and that the Pribilof Islands contribute 10 to 25 percent of the seals harvested each year on the Commander Islands.

Unless sick or injured, fur seals rarely land from the time they leave their rookery islands in the fall until they return the following spring, summer, or fall. Exceptions are on Samalga Island near the west end of Umnak Island and Año Nuevo Island and at least one of the Channel Islands of California. Seals, believed to be young males, were seen hauled out on a reef at Samalga Island; a male came ashore on Año Nuevo Island in 1962, and two landed in 1967. A pup born on the coast of Washington in July 1959 was one of very few known to be born away from the rookery islands until the existence of a small colony of breeding seals on San Miguel Island was verified by University of California investigators in July 1968. This discovery raises the question of whether the fur seals that were exterminated from islands off California were *Calloporhinus*, the northern fur seals, or *Arctocephalus* which is now restricted to the southern hemisphere except for a small population at Guadalupe Island.

Seals are usually seen 10 to 90 statute miles (16-145 km.) offshore and are frequently most abundant between 30 and 70 miles (48 and 113 km.). Pelagic sealers gave names to the ocean areas where fur seals concentrated. The important locations off North America are the Farallon Grounds extending from Point Conception to Point Arena off California, the

Vancouver Grounds reaching from south of the Columbia River to the north end of Vancouver Island, the Fairweather Grounds reaching from Sitka to Middleton Island, and the Pribilof Grounds in the eastern Bering Sea. Seals also congregate on Portlock Bank off Kodiak Island and near the Sanak Islands.

Most people living along coastal areas of the western United States, particularly California, are unaware that many thousands of fur seals feed and rest for several winter months on the nearby ocean.

The top speed of fur seals in water is not accurately known. For short distances they can keep ahead of a ship moving at 8.7 to 13.1 knots (16.1-24.1 km. per hour). They can be overtaken if chased persistently by a ship with a speed of only 7.8 knots (14.5 km. per hour).

On the ocean surface the seals are often seen asleep, floating on their side or back, with all four flippers folded or with one or more rigidly stretched into the air; however, on the island rookeries, activity continues unabated day and night.

In the open ocean seals may occur singly or in small groups. Food will often attract concentrations of 6 to 20 seals. Several such groups may be in view at one time. A loose grouping of up to 100 has been observed. The density of seals on wintering grounds is extremely variable, ranging from none to over 70 per square mile (27 per square km.).

Seals range through waters with surface temperatures of 30° to 59° F. (-1° to 15° C.). They are most abundant in waters with surface temperatures of 47° to 54° F. (8° to 12° C.). What seems to be a preference for water of certain temperature may actually be a response to availability of food.

Bull seals winter principally in Alaskan waters. They have been seen most frequently in the Gulf of Alaska.

The fur seals arrive at the Pribilof Islands in a progression of ages, with the older males and females arriving before the younger ones. Bull seals begin landing at their breeding rookeries on the Pribilof Islands in late April and increasing numbers appear until the middle of June. The oldest bulls arrive first, and others follow in order of age. The oldest and earliest females appear in June. Occasional

yearlings have appeared ashore as early as late July, but most of them land in October and early November and remain only 2 or 3 weeks before going to sea again. The small proportion of yearlings that come ashore includes more males than females.

The location and composition of the rookeries change as fall approaches. During autumn, most of the animals ashore appear to prefer areas farther up on the beaches than during the summer. Seals make their main exodus from the breeding grounds during November even while some yearlings may be still arriving.

The bulk of the commercial kill, made up of 3- and 4-year-old males, arrives in late June, July, and early August, while the other young age groups arrive later. The midpoint for arrivals of 4-year-old males is 13-18 July and for 3-year-old males 20-28 July. Few 4-year-old females arrive before August, but they become numerous by mid-August. Two- and three-year-old females arrive still later, and apparently only a small percentage of the yearling females come out on land.

## FOOD

Fur seals feed particularly on small, schooling fish such as anchovy, capelin, and herring but will feed on whatever species are available. Squid is a mainstay of their diet almost everywhere. Anchovy, hake, squid, saury, and rockfish are principal foods off California and Oregon. Off Washington, herring, rockfish, and anchovy are leading foods. Herring and wall-eye pollock are important off Southeastern Alaska. Capelin and sand lance are part of the seals' diet in the Gulf of Alaska, the Aleutian Islands passes, and the Bering Sea. Salmon occurred in 239 of the 9,580 stomachs containing food, collected from 1958 to 1966 in the northeast Pacific. Fifty-four species of fish and 9 species of squid were found in seal stomachs collected off North America from 1958 to 1966.

At sea, seals feed primarily at night because some of the important food species rise to the upper water layers during darkness. Where food is available during the day, seals feed then also.

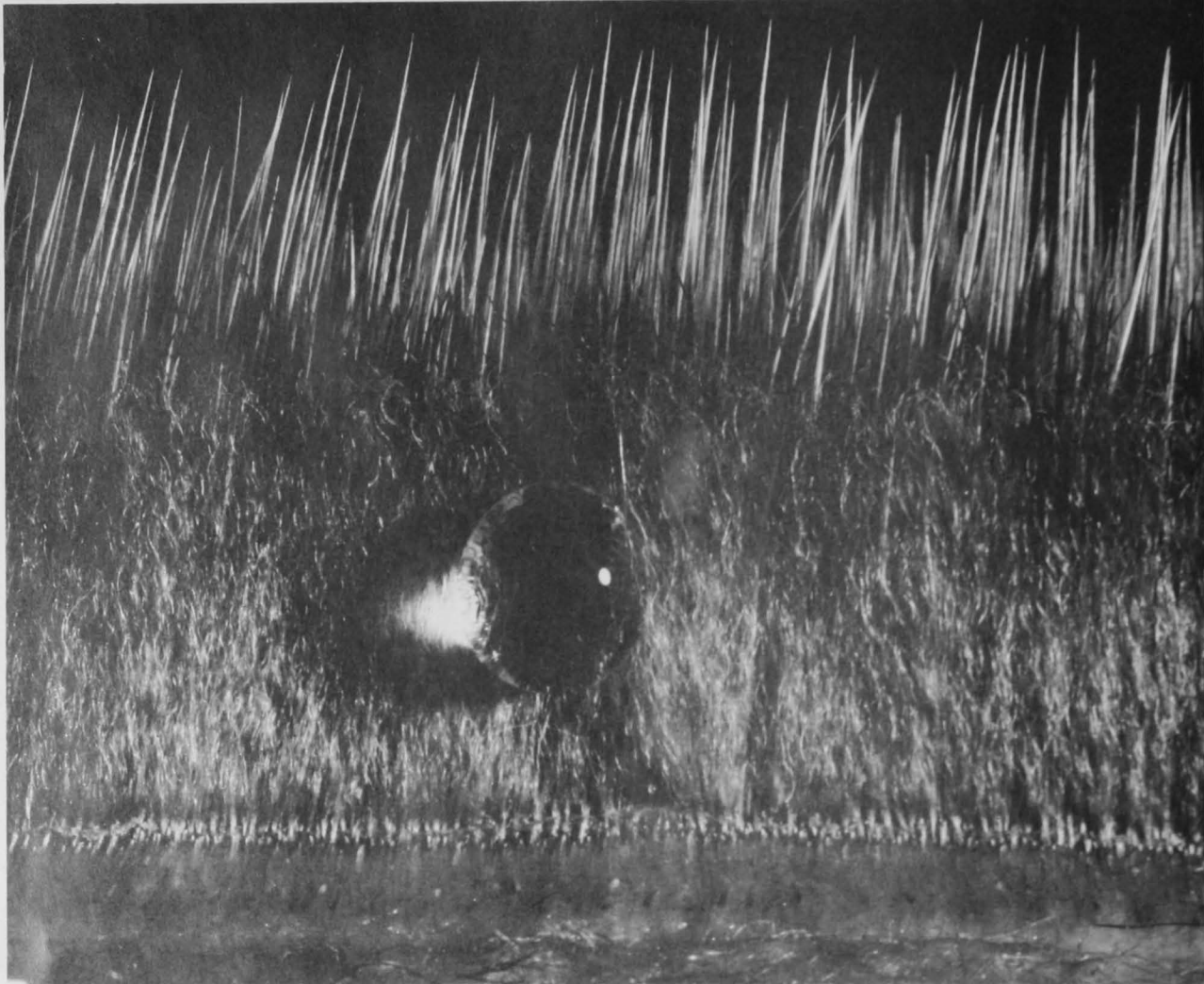
## PHYSICAL CHARACTERISTICS

The fur seal's physical features are adapted to meet its needs. The fur seal has unusually large flippers compared with other seals and sea lions. The large bare flipper area is useful for cooling, especially on land, since dense fur effectively insulates other parts of the body. The fur, which has over 300,000 hairs per square inch, is so impermeable to water that the skin remains dry even when the seal rubs or scratches itself in the water. Molt is incomplete because some of the hairs remain fixed in the skin more than 1 year. Body temperature is about 100° F. (38° C.). Overheating from unusual exertion or sunshine when on land causes obvious discomfort. Body temperatures above 107° F. (42° C.) cause heat prostration and usually death.

Other features help the seal to survive. The eyes are relatively large, and the seal can see at night. The nostrils can be closed, and the external ears are small, tightly rolled cylinders with a narrow, waxy orifice that prevents the entrance of water. A fish or squid held by the 36 teeth has no chance of escape. The lower incisors fit into a notch in the upper incisors and the upper molar and premolar teeth interlock with the lower, so the seal has a highly efficient bite.

The questions "How heavy is a fur seal and how long is it?" have many answers. A 10- to 12-pound (4.5- to 5.4-kg.) newborn pup that survives eventually becomes either a mature female weighing 95 to 110 pounds (43.1-49.9 kg.) or a bull weighing from 400 to over 600 pounds (181.4-272.2 kg.). Three-year-old males as selected for the commercial kill average 62 pounds (28.1 kg.), and 4-year-old males 78 pounds (35.4 kg.). The size difference between male and female is apparent even before birth. In early May unborn males are about an inch (2.5 cm.) longer and one-half pound (2 kg.) heavier than females. At birth, an average male is 26 inches (66 cm.) long and a female an inch (2.5 cm.) shorter. A large adult female measures 56 inches (142 cm.) from the tip of its nose to tip of tail, and a bull 84 inches (213 cm.).

The color of a seal's fur reflects the seal's age and its activities. While at sea the females and young males are gray. After a few days



The pelage of fur seals effectively prevents the animals from becoming wet. The photograph demonstrates the water-repellent nature of the underfur in a section freshly cut from a yearling seal. Magnification is 4 times.

ashore they turn yellow-brown from staining by the mud and excrement on the rookeries. Although cleaned somewhat during trips to sea, the pelage is not restored to its original color until molt occurs. Pups are black when born but become gray in September. Males over 6 years old are predominantly brownish-black, but they vary greatly and may also be dark gray and reddish brown. An adult male develops a short bushy mane on his shoulders and neck.

## REPRODUCTION

Motivated by a strong homing instinct, bulls usually return to the rookery of their birth

to establish a territory which they will defend, whether or not they are joined by females. One or more female seals occupying a territory with a bull constitutes a harem. Harems vary in size from 1 to over 100 females; the average is about 40. Location influences the size of a bull's territory and his harem, and the rapidity with which he will acquire females. Generally, locations near the water attract the most females but there are many exceptions. Locations that appear almost identical to the human eye either may be crowded with seals or completely unused. Females seek a location rather than a specific male. The most vigorous efforts of a bull are not sufficient to keep a female that is determined to leave.

Adult male seals spend only a few years of their lives as masters of a harem. Adult males remain on their territories an average of 50 days. They are seldom able to acquire a harem until they are 10 years old. About one-third of the males with harems are replaced each year. The active harem life of most males, then, is for 3 or 4 years when they are 10 to 14 years old.

Biologists of the Bureau of Commercial Fisheries have made age determinations for seals up to 26 years old. Tagged seals 21 years old were recovered in 1962. The maximum life span is believed to be about 30 years. Most fur seals have their first pup when 4 to 6 years old. In the prime of their reproductive life, when they are 8 to 13 years old, nearly 90 per-

cent of the females are pregnant each year. Thereafter, the pregnancy rate gradually decreases. At age 20, 50 percent or more become pregnant. Some 60 percent of the females in the Pribilof herd that are 4 years old or older bear young.

Fur seal pups are nursed on land during the first 3 or 4 months of life. Most fur seal pups are born during the first 3 weeks of July. Females give birth to one pup, usually a day after first coming ashore on the rookery. Five days later they are impregnated, usually in a single mating, and sometime in the following week make a trip to sea to feed. Feeding excursions may last 5 to 14 days, but average 8 days. Females nurse only their own offspring, which they recognize by a combination of

Fur seal pups sleeping on the sand near Tolstoi Rookery, St. Paul Island, in late July. These pups, which are less than a month old, are resting during one of the 5- to 14-day intervals between nursings.





location, sound, and smell. The pup must obtain enough of the rich milk, containing about 50 percent fat, to survive between the widely spaced feedings. During the nursing period the pup's stomach occupies most of the body cavity. Little food other than milk is taken by the pup before it leaves the island in the fall at weaned age of 3 or 4 months. By the time the young are ready to leave the rookery in November, the larger ones weigh over 30 pounds (14 kg.). Nursing ends abruptly when the female leaves the islands to migrate southward. The pups must then begin to find their own food in the form of fish and squids. After several months at sea they may not have gained, or may even have lost weight, but their contours are more nearly those of an adult.

A much-repeated misstatement is that young fur seals are taught to swim. The pups can swim from the moment of their birth, and none ever receives lessons from its mother. In early August most pups begin to spend some

time in the water. At first they swim rather awkwardly with head high out of the water but they soon gain skill and endurance.

During the first day or two after birth of her pup, the female attempts to protect it and sometimes carries it in her mouth. Thereafter, the female flees from an intruder without making any attempt to protect her pup. A pup that falls into a crevice in rocks dies because the mother is unable to retrieve it.

## MORTALITY AND DISEASE

When the Pribilof herd was small, less than 5 percent of the pups died on land, but when the herd was at its peak in the 1950's the proportion that died ~~decreased~~<sup>increased</sup> and varied from year to year. In the worst years 20 percent or more of the pups died. Now, with the herd reduced, mortality of pups has decreased. It has ranged from 5 to 12 percent since 1963.

Hookworm infection and malnutrition were leading causes of death in fur seal pups when



Each year a few brown, yellow, almost white, or piebald seal pups are born. Light colored adults are occasionally seen, but true albinos rarely survive.

the population was high. Other known causes were injuries, congenital defects, and bacterial infections. Hookworm infection has now apparently declined with the decrease in population size. Although it ranked second as a cause of death in 1967 and consistently is among the three leading causes, hookworm infection may now kill an appreciably smaller fraction of the pups than it did in the 1950's. Malnutrition, infections, and injuries continue to be important causes of death.

The relative importance of the causes of mortality for the entire population is extremely difficult to determine because of problems in sampling and identification of the cause of death.

Biologists assume that many of the pups that starve do so because their nursing mothers are killed at sea. Rejection of pups is common among harbor seals, however, and may also contribute to losses from starvation in fur seals.

Hookworm infection in the fur seal has been extensively studied. Hookworms occur in the tissues of seals of all ages. The parasites are apparently able to penetrate the skin, at least on bare surfaces such as the flippers. Pups are infected through nursing, and the parasite attaches principally to the small intestine. Bloodsucking by the worm causes severe anemia. By fall, the intestinal infection disappears, but hookworms are retained in the blubber, mammary tissue, and perhaps other tissues. There is no evidence that adult worms from the intestines move into the blubber. Larval worms that penetrate the skin hatch from eggs passing from the intestines of pups. Reasons for variation in mortality on land from year to year are not clear, but one cause may be variation in the effect of weather on the number and infectivity of hookworm larvae. High mortality of pups on land is correlated with low survival to age 3 even though mortality on land may be only 20 percent of the total loss. This fact suggests that in years of high mortality among pups on land, many surviving pups are weakened and are unable to withstand the rigors of ocean life.

Little is known about the causes of death at sea. The killer whale and great white shark eat seals. Parasites probably also kill seals. Emaciated young seals that drift ashore in winter suggest that violent weather and in-

ability to obtain adequate food are the greatest hazards during the first year at sea. At this time the pups make a sudden transition from nursing to finding their own food in the cold, stormy, winter ocean. Many perish. As high as 85 percent of some year classes may be lost by the time they are 3 years old. Recently the many scraps of synthetic netting thrown overboard by fishermen have become a hazard to seals. A seal will put its head through looplike objects it finds floating in the sea. Large pieces of netting impede a seal so that it is unable to feed. Small pieces are a hindrance but do the most damage by cutting through the skin and underlying fat and muscle causing infection, crippling, and death. Once the meshes have worked into a snug position deep in the dense fur the seal can never rid itself of the net. When one animal has died and disintegrated away from a net, another can be enmeshed.

## POPULATION

Several methods have been used to estimate the size of the fur seal populations. When the Convention of 1911 first gave international protection to fur seals, the Pribilof herd had about 200,000 animals, which could be counted with reasonable success. After 1934, only bulls were counted because crowding and constant interchange of animals on the rookeries made a meaningful count impossible. Until 1948, the Bureau of Fisheries estimated the size of the herd annually on the basis of calculated geometric rates of increase established just after the turn of the century. The calculated and actual increase corresponded well until the mid-1930's, but by 1947 the method was discontinued because no basis existed for calculating the increase rate, with useful accuracy, for a population that was near the peak of the growth potential. The estimate of the number of pups born in 1967 was 385,000. The total Pribilof herd was about 1,400,000 in early August 1967.

The seals on all other North Pacific islands (Commanders, Robben, Kurils) total 300,000 in late summer. The herd on the Commander Islands has a rate of increase similar to the rate demonstrated by the herd on the Pribilof Islands when it was growing rapidly. The

population on Robben Island is giving some indication of approaching its upper limit—death rate among pups is increasing. Seals on the Western Pacific islands have a higher reproduction rate among young females than those on the Pribilof Islands. The change in growth rate as these herds "mature" will be followed with interest by students of animal population dynamics.

Satisfactory management requires some measure of changes in various segments of the population. These measurements include number of pups born, survival of year classes, number of bulls, pregnancy rates, and mortality at various ages. Biologists supervised the tagging and marking of over 600,000 seal pups between 1947 and 1966. Currently, each year about 12,500 pups and 3,000 1- to 3-year-old seals are tagged and 10,000 pups are marked temporarily by shearing a patch of fur from the top of the head. By combining (1) information from tag recoveries, (2) age classification of the kill through counts of growth rings on teeth, (3) pregnancy rates, and (4) pup mortality counts, Bureau of Commercial Fisheries biologists estimate the number of pups born. An improved method of estimation uses the mark ratio resulting from random, temporary marking of pups; the number of pups marked; and the number of dead pups. The results are checked for accuracy by making complete counts on small rookeries.

## MANAGEMENT

Fur seal habits are such that a program of wise utilization is readily devised; however, the success of the program depends on international cooperation because the seals live much of the time outside territorial waters. In Alaska, with few exceptions, fur seals come ashore only on the Pribilof Islands, always about the same date each year. Because seals are highly polygamous and the sexes are born in equal numbers, it is possible to take many males without adversely affecting the productivity of the herd. The young males, whose pelts are most valuable, habitually haul out on the islands apart from the breeding animals in the harems, so they are easily obtained.

Seal measurements guide biologists in selecting seals to harvest. Harvesting of the

seals is limited for the most part to the 3- and 4-year-old males. In 1918, the U.S. Government determined age-length relation from measurements of seals of known age, branded as pups in 1912. Until recently this age-length relation has served as the basis for selecting animals that are to be harvested commercially. The kills are now classified into age categories by counting the annular ridges on canine teeth from a 20- to 30-percent sample. Also the overlap of lengths between ages is better understood through extensive recent measurements of tagged seals.

The number of seals killed each year has varied for a number of reasons. From 1912 to 1917, seals were killed only by the residents of the Pribilof Islands to use as food. Commercial killing for skins was resumed in 1918 after the 7-year cessation. From 1918 to 1922 harvests of seals were high in relation to population size because of the accumulation of males. The kill declined after the excess males were removed, but thereafter steadily increased until 1940. From 1940 to 1955 it averaged about 66,000 males annually. Since then, the kill of males has varied from a high of 96,000 in 1956 to a low of 30,000 in 1959. Part of the difference between these extremes resulted from an extended season in 1956 which made available a larger proportion of the 3-year-old group, but recent fluctuations are caused primarily by variations in year class survival.

In managing the fur seal herd, the Federal Government has adhered to a policy of taking pelts from seals considered surplus to breeding requirements. From 1923 to 1932 a minimum yearly breeding reserve of several thousand bachelors was provided by marking them with a brand or by shearing a patch of fur, then permitting them to return to the sea. This precaution may not have been necessary but it ensured that the number of males escaping the kill would be adequate.

From 1932 to 1955, a sufficient breeding stock was assured by limiting the killing season each year to a period from about the middle of June to the end of July. Only the male seal 41 to 45 inches (104-114 cm.) long were taken as they appeared in the daily drives on the islands during the sealing season. From one half to two-thirds of the animals in this group



The scene on Tolstoi Rookery, St. Paul Island, in late July illustrates the fact that mid-July a large part of the nursing females are feeding in the sea and therefore many more pups than females are on the rookeries.

are 3 years old, and most of the remainder are 4 years old; a small number of 2- and 5-year-old males are included. The proportion of 3- and 4-year-old animals taken depends on the relative survival of year classes.

In recent years Bureau of Commercial Fisheries managers have adjusted the sealing season to the number of young males that are available and to some extent to the age and size of seals that they wish to harvest. Early seasons produce a larger proportion of 4-year-old seals and later seasons a larger proportion of 3-year-old seals, because the older ones arrive earlier. The season for male seals now begins in late June and ends on 31 July. Close cropping of 3-year-old seals during a late season leaves relatively few 4-year-old males

to be taken early in the following year. Forecasts of year class strength made before the 3-year-old seals appear in the kill are still in the process of development. The forecasts are based largely on averages. They give usefully accurate information in an average year but have not been satisfactory on a very strong or weak year class.

Biologists consider the number of males that have been escaping the kill more than adequate, and, as a result, the upper size limit of harvestable male seals has been increased recently. This change permits closer cropping by taking animals that would have been rejected solely because of size under the former limit even though they had skins of good quality.

The number of harem bulls and the kill of males failed to increase after 1940, and this failure caused biologists to conclude by 1952 that the herd had reached, or was near, its peak of development. One major factor, in theory, that precludes further possible growth of the herd is the limited food supply available to the nursing females in the summer and to the pups during their first months at sea in the fall.

With the herd at its peak, the production of pups was high, but survival to age 3 was much more variable than when the herd was smaller and growing rapidly. At the present reduced level where about 380,000 pups are born annually, the return of seals at age 3 and older is relatively stable. Study of the fragmentary data on the relation of the number of pups born to the number of 3-year-old males returning suggests that maximum sustainable yield can be obtained from a seal herd that produces 400,000 to 500,000 pups each year. Since the exact size required to produce maximum sustainable yield is uncertain, the productive capacity of the herd is being tested at different population sizes to find the calculated optimum level.

To adjust the size of the seal herd to the estimated level of maximum sustained yield and to hold it at a constant level long enough to determine productivity, female seals must be taken. At present the number that will be taken is based on the size of year classes. More are taken from a large year class than from a relatively weak year class. Females, being smaller than males, are taken first when at least a year older; therefore, the number to be taken can be determined from the kill of males.

Female seals do not appear on the hauling grounds of the young males or the margins of rookeries until August; therefore, most females are not taken until after the harvest of males is concluded. Females on hauling grounds are principally (1) young animals, (2) those not pregnant during the previous year, or (3) those whose pups have died. Female seals most numerous on hauling grounds in middle and late August are 3 to 6 years old. Their skins are more valuable than those of older females because they have fewer scars

and do not lose fur from the belly in the course of fur processing.

Females can be roughly separated into three age groups by the color of their whiskers. Dark-whiskered females are rarely over 4 years old, those with mixed dark and white whiskers are 4 to 6 years old, and those with white whiskers are usually 7 years or older. Thus the commercially valuable, young, female seal may be readily selected because of a fortunate combination of location, time, and physical appearance.

Both sexes of fur seals on the Pribilof Island will continue to be harvested. Bureau scientists estimated that from 10,000 to 20,000 surplus females should be harvested annually when the herd is brought to the level of maximum sustained yield. Now females 3 to 6 years old are preferred, both because they furnish the best quality of female skins and because they are the most available. The U.S.S.R. takes only males on Robben Island and the Commander Islands but may take females in the future if the Asian herds reach their optimum size.

## RESEARCH

On their respective islands the United States and the U.S.S.R. carry on research programs that emphasize population dynamics. Tagging, tag recovery, kill records by age and sex, and studies of mortality and reproduction are all essential for understanding fur seal populations. In addition, research on growth, pelage, and other anatomical features, behavior, and parasitism and other infections are underway or completed. As knowledge of population dynamics accumulates, the probability increases that we can successfully forecast year class survival and the resulting harvest.

Canada, Japan, the U.S.S.R., and the United States cooperate in a widespread investigation of the ocean life of fur seals. The distribution, ocean abundance, food habits, and intermingling of seals of different origins are studied. Most of the investigations aid management; in addition, certain broad principles of animal populations are being tested and zoological knowledge of marine mammals is being increased.

Many seals are now held and studied in captivity. Studies are expanding on specialized aspects of seal biology. Scientists not employed by the Federal Government are expanding their specialized studies on seals.

## SEALING ON THE PRIBILOF ISLANDS

The harem or rookery areas and adjacent hauling grounds of the bachelors and idle bulls are at widely separated points along the southern and eastern beaches of St. Paul Island and along the northern and western shores of St. George Island. Owing, in part at least, to the high bluffs of St. George Island, only about

20 percent of the Pribilof seals frequent the limited beach areas of that island.

Most of the Pribilof seals congregate on the shores of St. Paul Island, 40 miles (64 km.) to the north; a few thousand haul out on Sea Lion Rock, off the southern tip of St. Paul Island. Visits to the various hauling grounds are scheduled so that the number of seals in the daily kill will be as uniform as possible.

The labor required in the taking of sealskins and the year-round maintenance of two Government stations on the islands is supplied by the native Aleut inhabitants who are employees of the Bureau of Commercial Fisheries. During the summer the local labor supply is supplemented by Aleut workmen from the Aleutian



When hauled out on land, fur seals are easily cut off from the sea and driven to nearby fields. Because of their insulating fur, they must be driven slowly and for moderate distances to avoid heat prostration.

Islands and native students from elsewhere in Alaska.

The roundup of seals on the Pribilof Islands is a simple operation. On a typical day in the St. Paul Island sealing season, a crew of 35 Aleut sealers proceeds in trucks from the village to the hauling ground. Leaving their trucks, the sealers cautiously work their way upwind along the beach between the bachelor seals and the water. When the line of escape to the sea has been cut off, it is an easy matter to surround several hundred seals and drive them slowly inland a short distance to the grass-covered killing field. One or two Aleut boys provide the only guard necessary to prevent a stampede of the animals back to the beach and the open sea. The sealing crew is well trained, and clubbers are adept at selecting animals of commercial value. The work is efficiently organized and carefully supervised. One small group of seals after another is separated from the main group. Seals judged to be less than 41 inches (104 cm.), or to have poor quality furs are permitted to return to the beach. With minimum restraint, selected animals are quickly and humanely dispatched with a blow on their fragile skulls from a hardwood pole. The time required to kill a group of 6 to 10 seals and release rejected ones averages 2 to 3 seconds per animal killed. Any system that required more movement and handling of the seals would cause greater stress for the seals and be more dangerous for the workmen.

In a matter of seconds, the Aleut sealers strip each sealskin from the carcass. From dead seal to cured but unprocessed sealskin is a routine operation. The day's collection of skins is transported by trucks to the village curing plant. Here they are thoroughly soaked in cold sea water, "blubbered," and brine-cured. A mixture of salt and boric-acid powder is applied to the skin side of each cured and drained pelt to dehydrate it and prevent bacterial action and fungous growth as the pelts are packed in barrels for shipment to the mainland, where they are held in cold storage until processed.

Seal carcasses are suitable for making meat meal, oil, or animal food. On St. Paul Island from 1918 to 1961, most of the carcasses and the blubber removed from the skins were con-

verted to meal and oil in a byproducts plant operated by the Government. About 350 tons of meal and 40,000 gallons of oil were produced each season and sold to the highest bidder at Seattle, Wash. The meal was used as a protein supplement in animal feeds, and oil was used in soap making and tanning. The byproducts plant became uneconomical after 1961 and was discontinued. Experimentation revealed, however, that seal meat, bones, and organs are an excellent source of protein for ranch mink. All carcasses on St. Paul Island are now ground, sacked, and frozen. The limited St. George production, which was never large enough to justify a reduction operation, is being used as a source of a special protein.

### PROCESSING AND SALE OF FUR SEAL SKINS

All U.S.-owned skins are processed and sold by private companies serving as agents for the Government. About 100 different operations by highly skilled workmen are involved in converting Pribilof Islands sealskins into the beautiful, soft, supple furs sold to the fur trade at public auctions. Contractors for sealskin processing are selected through competitive procedures.

Sealskins are greatly changed in appearance during processing. The first major step in the processing of sealskins is the removal of the coarse guard hair that overlies the dense, soft underfur. The pelts are thoroughly washed and subjected to moist heat to loosen the guard hair so that it can be extracted by scraping. After the unhairing process, the pelts are tanned and dyed. U.S. Government sealskins have been dyed principally in four colors: (1) black, (2) rich dark brown, (3) neutral brown with overtones of bluish gray, and (4) midnight gray with highlights of silver and a subtle blue cast. Recently, bleaching has been successfully done and fur of a light color is being produced. Closely sheared pelts that are not unhairied have been introduced to the market as a new type of fur suited to more informal garments. Six to eight skins are required to make a coat.

Pelts of northern fur seals have consistently brought the highest price of all sealskins on the world market. The world human popu-



Skins that have been washed, cleaned of blubber, cured in a saturated salt solution, and drained are rubbed with salt and boric-acid powder, rolled, and tightly packed in barrels for shipment.

lation is increasing rapidly, but only moderate increases in the supply of sealskin can be expected—a situation that should strengthen the market for fur seal garments.

Over 2 million sealskins from surplus males have been taken by the Government since restoration of the herd was begun 50 years ago. Net profit to the Federal Treasury from the U.S. share of these skins has exceeded \$25 million. Part of the money from the sale of skins is made available by Congress to the Bureau of Commercial Fisheries to defray expenses of administering the Pribilof Islands and the fur seal industry; 70 percent of the net proceeds are given to Alaska under terms of its statehood Act.

The future of the Alaska fur seal herd seems assured as long as the nations of the world continue to work together in the solution of problems peculiar to such migratory wildlife populations. An epilogue for the Alaska fur seal story is found in the words of G. C. L. Bertram, an English biologist, after his 1943 visit to the Pribilof Islands: "One can give no higher praise than sincerely to hope that planning and agreement for the future may be as beneficent and rational as have been the administration and conservation of the herd during the last forty years."<sup>4</sup>

<sup>4</sup> G. C. L. Bertram. 1950. Pribilof fur seals. *Arctic, J. Arctic Inst. America* 3(2): 75-85.





The village of St. Paul on the south cape of St



veral seal rookeries, including Reef, the largest.

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