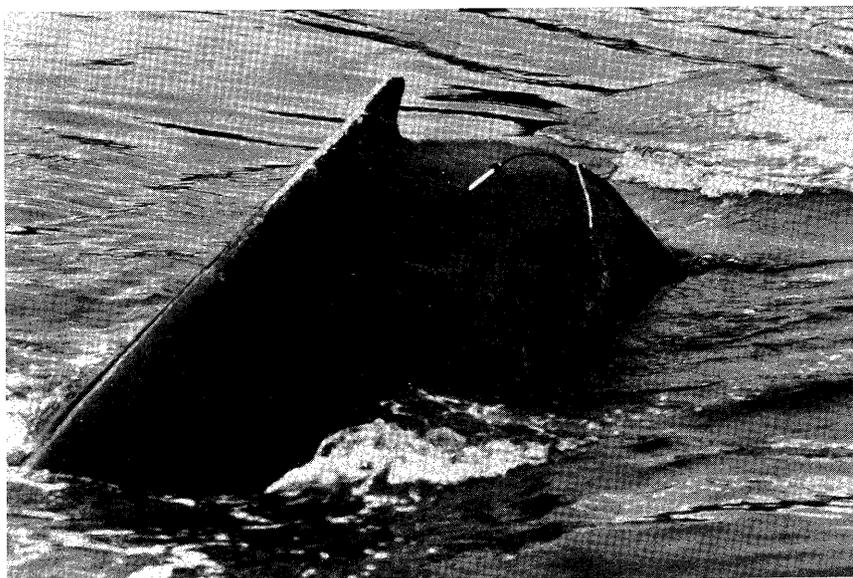


Marine Mammal Research

George Y. Harry, Jr.¹



First successfully tagged and tracked humpback whale.



Northern fur seals.

The Pribilof Islands, home of some 2 million fur seals, were discovered in 1786 by the Russian navigator Gerassim Pribilof, and Russia began exploitation of the seals almost immediately.

During the latter part of the Russian regime, the fur seal management program

allowed the herd to increase and when the United States purchased Alaska in 1867, the population was probably near maximum abundance.

The U.S. government soon recognized that efficient management of fur seals required knowledge about the size and biological characteristics of the herd. An agent of the Treasury Department, Henry Elliott, was dispatched to the

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islands in 1872. Elliott spent several summers in the Pribilofs, estimating the size of the herd, mapping rookeries and hauling grounds, and drawing fur seals and their surroundings. His reports and conclusions, although sometimes controversial, for the first time directed public attention to the fur seals of the Pribilof Islands and their environment. Elliott continued his intense efforts on behalf of the fur seals until his death in 1930, giving his last testimony on the species at the age of 80.

In 1893 the U.S. Commissioner of Fisheries became responsible for fur seal research. This responsibility has remained with the federal fishery agency, through several name changes and up to the present, except for the period 1903-08. During the first 2 years, research was directed by C. H. Townsend, who made an important contribution toward understanding the distribution of fur seals by plotting the location of pelagic catches in the North Pacific Ocean and Bering Sea. Controversy about the effects of pelagic sealing led to agreement between Great Britain and the United States to institute independent scientific investigations. The results of these studies, published in four volumes in 1898, summarized the knowledge of fur seal biology and populations at that time.

During the last two decades of the 19th century and to a limited extent during the first decade of the 20th century, uncontrolled sealing at sea decimated northern fur seal populations. In 1911 a treaty prohibiting pelagic sealing was signed by representatives of the United States, Great Britain (for Canada), Russia, and Japan. In 1914, the Secretary of Commerce appointed George Parker of Harvard University, Wilfred Osgood of the field Museum of

Natural History, and Edward Preble of the Department of the Interior's Bureau of Biological Survey to census the Pribilof herd, to evaluate past influences and current sealing practices on the herd, and to recommend future practices which would lead to its restoration. The report of their scientific findings, published in 1915, emphasized the importance of pup counts as a basis for estimating the rate of increase in the herd. The Bureau of Fisheries largely accepted the recommendations of Osgood, Preble, and Parker, and techniques for gathering routine population data were gradually developed. All data, however, were collected by island administrative personnel. No biologists were assigned to the Pribilof Islands between 1915 and 1939, and almost no biological research was carried out.

Although little formal fur seal research took place before 1939, many important contributions to the natural history of the Pribilofs were made by a schoolteacher, Dr. G. Dallas Hanna, who arrived on St. Paul Island in July 1913 at the age of 26. Dr. Hanna remained on St. Paul Island almost continuously until September 1918 and returned in the summers of 1919 and 1920. Although his principal duties were those of schoolteacher and storekeeper, he also collected specimens, made photographs and assisted with fur seal research. Between 1914 and 1951, he authored 41 publications on the natural history of the Pribilof Islands. After leaving the islands, Dr. Hanna continued his scientific career as geologist, paleontologist, naturalist, and inventor; at the time of his death in 1970, he was curator of geology at the California Academy of Sciences.

In 1940 the Commerce Department's Bureau of Fisheries and the Interior Department's Bureau of Biological

Survey were merged to form the U.S. Fish and Wildlife Service under the Department of the Interior. For the first time, mammalogists and fur seal managers were brought together within one agency. Since 1940 (except for 1942), biologists have been continuously assigned to fur seal studies. As the first Director of the Fish and Wildlife Service, Dr. Ira Gabrielson assumed responsibility for the Pribilof Islands fur seal herd. Gabrielson and others had become skeptical of the "bookkeeping system" developed for estimating the size of the fur seal population, which resulted on paper in a herd size of about 3.5 million animals. This census was not based on biological research because almost none had been carried out since 1915. Gabrielson asked Frank Ashbrook, who was in charge of fur seal investigations for the service, to develop a research plan. Such a plan required firsthand information about the herd; therefore, in June 1940, Ashbrook and Dr. Victor Scheffer of the Bureau of Biological Survey were dispatched to the Pribilof Islands. The 1940 studies marked the beginning of the modern period of fur seal research. Scheffer previously had taken part in the Aleutian expedition aboard the vessel Brown Bear (1936-38), directed by Olaus Murie, and in 1938 had established an office in Seattle at the University of Washington Forestry Building, Anderson Hall. Seattle thus became the headquarters for fur seal research.

The Fur Seal Treaty of 1911 was scheduled for renewal in 1941, but unexpectedly in October 1940, Japan gave notice of its intent to withdraw from the treaty the following year. Japan claimed that the Pribilof Islands fur seal herd migrated annually into Japanese waters and consumed vast quantities of food fish. In response

to this claim, staff members of the Fish and Wildlife Service in Washington, D.C., developed a 2-year research plan which would assess damage to the commercial fishery caused by seals, calculate the rate of intermingling of the Asian and the Pribilof Islands fur seals, and determine the food species of fur seals. On 30 June 1941, Congress appropriated \$290,000 for the investigation. Scheffer was made project leader and the following five biologists were assigned to the study: Wilbert M. Chapman, Henry Banner, Kelshaw Bonham, Ford Wilke, and Donald Shipley. Headquarters for this expanded research program remained in Seattle at the University of Washington Forestry Building, Anderson Hall. The Black Douglas was selected as the research vessel, but before research began, Pearl Harbor was attacked and the vessel was taken over by the U.S. Navy.

In the spring of 1942, the Aleutian Islands became an active war theater and all fur seal research came to a halt. Scheffer was able to return to the Pribilof Islands in the summer of 1944 and resume his fur seal research, continued until his retirement in 1969. Scheffer collected specimen material from marked animals of known age, obtained additional information on the age-length relationship, studied the parasites of fur seals, and collected testes as evidence of the age at which spermatogenesis begins.

Research continued at a low level during the war years, but in 1947 plans were made to reactivate the Black Douglas and to undertake pelagic fur seal research. Congress appropriated \$62,500 for this study and biologists William Sholes, Karl Kenyon, and Robert Brown were hired. Headquarters for the expanded fur seal research was in the

Montlake Laboratory, now the Northwest and Alaska Fisheries Center. The Black Douglas made two trips out of Seattle in 1947, the first one was to the Pribilof Islands and back with side trips to Unalaska and Bogoslov Island, and the second was to Attu Island. However, the vessel proved much too large for efficient pelagic seal hunting. In 1948 the Black Douglas left Seattle on her third and last fur seal research cruise. The vessel went to the Pribilof Islands and back to Unalaska, across the North Pacific Ocean to San Francisco, to San Pedro, and finally to Seattle.

Following World War II, land-based research was also increased. In 1947 and subsequent years the pup tagging which was initiated in 1941, was greatly expanded. In 1948, Scheffer and Kenyon took aerial photographs of all rookeries as an experimental censusing technique. An important breakthrough in fur seal research took place in 1948 when Scheffer extracted 36 teeth from a freshly killed animal to photograph dentition. During the process, he noticed faint ridges circling the root of each tooth and hypothesized that each ridge might indicate one year of life. His theory proved to be correct and, as a result, a routine part of the field operations on the Pribilof Islands each year has been a collection of teeth for age determination.

In 1948 a plan was being developed in Tokyo for pelagic research in waters off Japan. The Natural Resources section of the General Headquarters, Supreme Commander for the Allied Powers, undertook to study the natural resources of Japan and to assist in their restoration. A Wildlife Branch was established and Wilke was sent by the U.S. Fish and Wildlife Service to study the migration and feeding habits

of fur seals wintering off Japan. Field operations started in December 1948 on a small Japanese vessel and were resumed with two Japanese biologists in 1950.

Another important event took place in 1949 when it became evident that assistance was needed in statistical design of experiments and population dynamics work. Dr. William Birnbaum, Director of the Laboratory of Statistical Research at the University of Washington and his assistant, Dr. Douglas Chapman, agreed to help work with statistical problems. Chapman became a consultant to the fur seal program in 1950 and has continued in this capacity. With Scheffer and Kenyon, he was instrumental in the 1954 revision of the estimated fur seal population--recalculated to be 1.8 million animals, based on biological observations, instead of 3.6 million.

After U.S. involvement in pelagic research off Japan ended in 1950, Wilke returned to the Seattle office. A major international fur seal study took place in 1952; Wilke and Kenyon, representing the United States, and Fred Taylor and James Manzer, representing Canada, went to Japan joining Fukuzo Nagasaki in studies off Japan. (The Soviet Government was invited to take part in the research operation but declined, although expressing an interest in re-establishing international arrangements for the conservation of fur seals.) Six vessels operated in Japanese waters; Scheffer headed the research team in the waters off the western coast of North America using two vessels. Major results included data on intermingling of fur seals at sea from U.S. and Soviet Islands, pregnancy rates, food of seals, and lengths and weights of 400 fetuses.

In 1953 Scheffer was detailed to Denver, Colorado, for 2 years, followed by 1 year in England. That same year Wilke was placed in charge of fur seal research, remaining in Seattle in charge of marine mammal research until his retirement in 1970.

The period 1953 to 1956 was one of austerity for fur seal research. Wilke, Kenyon, and an administrative assistant were the only staff members during this period. By October 1954 the Montlake Laboratory had become crowded and, as a result, the fur seal investigation was moved to rooms in a converted house in Edmonds, Washington. The house also contained a barber shop and a plumbing shop.

Although fur seal research between 1953 and 1956 was at an ebb, international events were taking place which would lead to greatly expanded research programs. The United States, Soviet Union, Japan, and Canada agreed that a North Pacific Fur Seal Conference should be convened to draft a new treaty. Discussions took place intermittently from 20 November 1955 to 9 February 1957 when the Interim Convention on Conservation of North Pacific Fur Seals was signed in Washington, D.C., on behalf of the four governments. The convention continued the ban on pelagic sealing and called for a cooperative research program to collect and share field data. The interim convention, with some modifications, continues in effect to the present and relies on scientific research to determine the measures necessary to maintain the maximum sustainable productivity of the fur seal resources and to understand the relationship between fur seals and other living marine resources. Since the signing of the convention, the objective of the fur seal research program has been to fulfill the

research requirements stated in the convention.

Carl Abegglen and Alton Roppel joined the permanent research staff in 1956, and during the same year, a new laboratory was occupied on St. Paul Island. The following winter, research headquarters was moved from Edmonds, Washington, to Navy buildings on the Sand Point Naval Air Station, Seattle, and remained there until part of the Navy property was transferred to the National Oceanic and Atmospheric Administration (NOAA) in 1976. After NOAA took possession of the property, the south end of hangar 32 was converted for marine mammal research headquarters. Now under construction at the NOAA Sand Point facility is a new building which will include the National Marine Mammal Laboratory.

In the early 1950s, biologists concerned with the Pribilof Islands fur seals were aware that the herd had ceased to grow and came to the conclusion that the herd should be reduced in size, by killing female fur seals, in order to increase productivity. The commercial harvest of female fur seals began in 1956 and continued through 1968 although, from 1963 to 1968, only females in excess of those needed to maintain herd size were harvested.

In 1957, Karl Niggol joined the staff and was involved in pelagic research until he left the laboratory in 1962. Clifford Fiscus joined the pelagic research team in 1958 and became its leader after Niggol left. In 1958 staff biologists chartered two halibut schooners and one purse seiner for studies of the abundance, distribution, and feeding habits of seals off the western coast of North America. Pelagic studies from chartered vessels, in cooperation with Canadian

scientists, continued each year through 1974. At that time, the decision was made to interrupt sea work and analyze the vast amount of data which had been collected. The analysis and publication of pelagic data continues in cooperation with Canadian scientists. Ocean research was resumed in the fall of 1980; the objectives included monitoring the arrival of the various year classes of seals in southbound migration in southeastern Alaskan waters.

In 1956 the U.S. Fish and Wildlife Service was divided into two parts; the Bureaus of Commercial Fisheries (BCF) and Sport Fisheries and Wildlife (BSFW). The federal responsibility for pinnipeds and cetaceans was given to BCF while the responsibility for sea otters, manatees, and walrus was assigned to the BSFW. This artificial division of responsibility had little effect on BCF's marine mammal research because almost no research had been done on those species which became BSFW's responsibility.

At about the same time that BCF was established as part of the Fish and Wildlife Service, a sea otter research program was started under Karl Kenyon. Since this species became the responsibility of the Bureau of Sport Fisheries and Wildlife, Kenyon transferred to that Bureau. His office remained with the fur seal group in Edmonds and he transferred to Sand Point when the Marine Mammal Biological Laboratory moved there in 1957. Kenyon's program contributed to administrative funds of the marine mammal laboratory until he retired in 1973. At that time, the Seattle program of the Fish and Wildlife Service was transferred to Alaska and Ancel Johnson replaced Kenyon as project leader.

When Kenyon transferred to BSFW in 1956, Alton Roppel replaced him in BCF, and the entire scientific fur seal staff consisted of Wilke and Roppel. Later that year, Carl Abegglen was hired as project leader for investigations on the Pribilof Islands and held this position until his transfer to Washington, D.C., in 1962. Roppel replaced Abegglen as project leader and did field research on the Pribilof Islands every year from 1956 through 1980 when he announced his retirement effective in January 1982.

An important provision of the Fur Seal Convention allowed for cooperative research and exchange of scientists. As a result, in 1958 Gordon Pike and Fukuzo Nagasaki visited St. Paul Island as official observers for Canada and Japan, respectively. Many similar exchanges have occurred to the present, often involving active, cooperative research among scientists of the various countries. For example, the first Soviet observers visited the Pribilof Islands in 1960. That same year Scheffer visited the Soviet fur seal rookery on Robben Island off the southern coast of Sakhalin Island; in 1963 Wilke, and in 1975 Harry, visited the same island. Wilke, Roppel, Niggol, and Kenyon observed fur seal research on the Commander Islands in 1961 and Fiscus and Johnson visited there in 1968. In 1958 George Tanonaka (on loan from High Seas Salmon Studies) participated in Japanese ocean research off Hokkaido, and in 1965 and 1967 Hiroshi Kajimura, who had joined the staff in 1963, participated in the Japanese research program off Honshu and Hokkaido.

Chapman continued his fur seal population studies in the 1950s and based on 8 years of tag returns from 1950 to 1957, in 1958 he reported on population estimates of Pribilof

Islands fur seal pups. He found unresolved discrepancies in his data and concluded that new studies of the estimation procedure were needed. He felt that factors such as tag-induced mortality may have been causing bias in the annual estimates of abundance. Chapman's analysis led to the development of a new method for making population estimates. Pups are now marked by shearing fur from the top of the head and population estimates are made in August, rather than marking pups with metal tags and making population estimates from recoveries in the harvest several years later.

By the summer of 1960 Chapman had been providing advice to the laboratory regarding statistical procedures and population analyses for almost a decade. That year he visited the Pribilofs to familiarize himself with the research operations. It also had become apparent that the laboratory needed a fulltime biometrician, and in 1961 Ancel Johnson was added to the staff in this capacity. Chapman and Johnson cooperated on fur seal statistical and population problems until Johnson transferred to the Bureau of Sport Fisheries and Wildlife, Department of the Interior, in 1973.

Dr. Mark Keyes joined the laboratory as a veterinarian in July 1962 and visited the Pribilofs that summer. He returned to the islands each summer until 1981 when limitations were placed on travel. Dr. Keyes' assignment was to discover the causes of fur seal mortality, determine the relative importance of the various factors causing death, assess the effects of metal tags on fur seals, and study hook worm and other parasites. A principal assignment for Dr. Keyes from 1967 to 1971 was to initiate and monitor, in conjunction with Northwest Regional Office personnel, contract studies to develop

more humane harvesting and killing methods. The conclusion from these studies was that the killing method could not be improved with extant knowledge, although several changes in the procedure for herding fur seals to the harvest areas were recommended and put into effect.

In November 1963 Kajimura joined the laboratory to assist in pelagic research. Kajimura has remained with the pelagic investigation since that time and in 1973 became project leader when Fiscus transferred to other responsibilities at the laboratory.

From the late 1950s until 1970, pelagic and land research continued at a steady pace with a fairly constant number of personnel. Chapman continued his fur seal population studies and in 1964 published a critical study of population estimates. Wilke was Laboratory Director during this period and also the U.S. member of the Standing Scientific Committee of the North Pacific Fur Seal Commission. Richard Bauer entered on duty in 1962 to assist Roppel in studies on the islands after Abegglen transferred to Washington, D.C. Bauer spent one field season on St. Paul Island before transferring to the U.S. Forest Service. He was replaced by Raymond Anas, who was on the staff from 1964 to 1971. Thomas O'Brien and Gary Baines worked with pelagic investigation for a short time. Patrick Kozloff started as a temporary employee in the summer of 1964 and upon his graduation from the University of Alaska in 1969, became a permanent member of the staff under Roppel.

Until 1968 the only known breeding area of the northern fur seal in the eastern Pacific region was the Pribilof Islands. That year a small, breeding colony of this species was discovered

on San Miguel Island off the coast of southern California, the island is also home for five other pinniped species. This discovery presented the opportunity to examine population structure as the colony increased in size. A University of California graduate student, Robert DeLong, was assigned to the project and became a permanent member of the biological staff in 1974. At that time, another graduate student, George Antonelis, became DeLong's assistant at San Miguel Island and in 1980 he was appointed to the permanent staff. This fur seal colony continues to increase in numbers, studies of the competition between northern fur seals and the California sea lion which use the same breeding sites and pupping areas continue, as do studies of reproductive success and of food and feeding habits. Interrelationships among pinniped species utilizing San Miguel Island shores and waters is also a continuing study.

CETACEAN STUDIES BEFORE 1970

Although much of the early federal marine mammal research was on fur seals, there was also some interest in cetaceans, especially the large whales. Dr. Remington Kellogg, who was associated with the Smithsonian Institution's National Museum for nearly 50 years and was Director from 1948 to 1962, attended the First International Conference on Whales and Whaling in 1930, sponsored by the League of Nations. In 1949 the International Whaling Commission was established, and for its first 18 years, Kellogg was the U.S. representative to the Commission. He resigned in 1966 at the age of 73.

In 1946 Dr. Raymond Gilmore joined the Fish and Wildlife Service with headquarters at the National Museum, Washington, D.C. One of his first duties was to prepare background information for the meeting the same year which resulted in the International Convention for the Regulation of Whaling. He also carried out field studies at the maritime industries whaling station on Humboldt Bay in northern California from 1947 until the operation closed in 1951, and visited the whaling station at Coal Harbor, Vancouver Island, B.C. Headquarters for Gilmore remained at the National Museum until 1952 when he moved to the Fish and Wildlife Service Laboratory at Stanford University.

While stationed on the west coast, Gilmore concentrated his research on gray whales, but he also collected biological data from whales landed at the Del Monte Fishing Company's whaling station on San Francisco Bay. In 1954 the laboratory at Stanford University was transferred to Scripps Institution of Oceanography at La Jolla, California, where Gilmore continued his studies of gray whale biology and numbers. In 1958 the Fish and Wildlife Service decided to concentrate marine mammal research at the Seattle laboratory, and during that summer Gilmore was stationed in Seattle where he completed a manuscript on his gray whale research. In September 1958 Gilmore resigned from the Fish and Wildlife Service and returned to San Diego, where he still works with gray whales and other marine mammals at the San Diego Natural History Museum as Research Associate in Marine Mammals.

Gilmore was replaced by Dale Rice, who transferred from the Denver Wildlife Research Laboratory, Bureau of Sport Fisheries and Wildlife, in November 1958. Allen Wolman joined the staff in

1965 to assist with cetacean studies. At the time Rice began whale studies, two whaling stations were in operation on San Francisco Bay at Richmond, California--one by the Del Monte Fishing Company and the other by Golden Gate Fishing Company. Much of Rice's program involved examination of whales brought into these shore stations, and this whale research continued until 1971 when the large commercial species were declared endangered and the last remaining U.S. whaling station, Del Monte's, was closed. Other parts of the whale research program involved tagging animals from chartered catcher boats, observing living whales from vessels and from shore, and analyzing catch statistics. In addition to the commercial species taken at these whaling stations, gray whales were taken under special permit. An annual census of the southward migration of the gray whales was conducted near Monterey, California, beginning in 1967-68. A monograph on the life history and ecology of the gray whale was published by Rice and Wolman in 1971. Rice also spent April and May of 1961 and 1962 in Eskimo whaling camps near Point Hope and Barrow, Alaska, studying bowhead whales.

Because of the inclusion of whale research, the marine mammal program in Seattle in 1960 was designated as the Marine Mammal Biological Laboratory. At about the same time, responsibility for marine mammal research was delegated to the regional office in Seattle from headquarters in Washington, D.C.

Scientists from the Marine Mammal Biological Laboratory began active participation in meetings of the International Whaling Commission (IWC) in 1960. At the suggestion of U.S. Commissioner Kellogg, the North Pacific Working Group was formed, consisting of

one biologist from each of the four nations concerned: Canada, Japan, United States, and USSR. The working group was instructed to coordinate and review past and future research efforts in the North Pacific Ocean and to advise the Commission on necessary management plans. Rice was the U.S. member of this working group and attended annual meetings of the Commission. The IWC North Pacific Working Group identified the need for an expanded whale marking effort and, as a result, every year from the winter of 1962-63 to 1968-69, laboratory personnel tagged whales off the North Pacific Coast. The objective was to determine which breeding stocks contributed to the populations that were exploited on the various summer grounds.

The laboratory program and staff remained stable until 1969, when the decision was made in Washington, D.C., headquarters to transfer whale research to the Fishery-Oceanography Center at La Jolla, California. Rice was transferred with the program in January 1970. Wolman stayed in Seattle and became a member of the fur seal pelagic research program.

PERIOD OF AUSTERITY

From 1970 to 1973, the only research funded at the Marine Mammal Biological Laboratory was for fur seals. The total laboratory budget for this period was less than \$300,000 which allowed only routine monitoring of the herd at sea and on the islands. In the spring of 1970 Wilke retired as Laboratory Director and Roppel became Acting Director. In addition to Roppel six permanent biologists were on the staff during the summer field season, down

from nine in 1969. They were Patrick Kozloff, Dr. Mark Keyes, Ancel Johnson, Clifford Fiscus, Hiroshi Kajimura, and Allen Wolman. In the fall of 1970 Dr. George Harry transferred from his position as Director of the federal Great Lakes Fisheries Laboratory (at Ann Arbor, Michigan) to become Director of the Marine Mammal Biological Laboratory; concurrently, he became the U.S. member of the North Pacific Fur Seal Commission's Standing Scientific Committee.

When in 1970 the Bureau of Commercial Fisheries became the National Marine Fisheries Service under a new agency, the National Oceanic and Atmospheric Administration, the Marine Mammal Biological Laboratory became a division of the Northwest Fisheries Center, with Dr. Harry as Division Director. Headquarters remained at Sand Point.

Although 1970 to 1973 was a period of austerity for marine mammal research, events were taking place in Washington, D.C., which would lead to a greatly accelerated program. In 1971 and 1972, hearings were held before the U.S. Congress with the objective of enacting federal legislation for the conservation of marine mammals. Congress passed the Marine Mammal Protection Act in 1972, making the conservation of marine mammals a federal responsibility. The Act declared a moratorium on the taking and importing of marine mammals and marine mammal products with certain exceptions. The Act further states that marine mammals should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem; the primary objective of their management should be to maintain the health and stability of the marine ecosystem.

EXPANDED RESEARCH

Because it seemed likely that federal funding would become available for marine mammal research, the Marine Mammal Division staff in 1971 prepared research plans to develop information needed for conservation of those marine mammals of U.S. concern and prepared status reports on these species.

Additional money for marine mammal research first became available in the summer of 1973; about \$87,000 was appropriated for whale research. As a result, in August 1973, Rice was transferred back to the Marine Mammal Division from the Southwest Fisheries Center and Wolman again was assigned to cetacean research. Another \$38,000 was made available for pinnipeds other than fur seals and \$116,000 for expanded fur seal research. The total research budget almost doubled from approximately \$300,000 in 1972 to about \$550,000. To provide scientists for these new programs, Willman Marquette, James Johnson, Robert Lander, and Gerald Sanger were transferred from other divisions of the Northwest and Alaska Fisheries Center; Dr. Roger Gentry came aboard as a new federal employee.

Because of rapid expansion of the Marine Mammal Division, Dr. W. Bruce McAlister was appointed Deputy Director in 1974, transferring from his position as Deputy Director of the Marine Fish and Shellfish Division. In addition to his duties as Deputy Director, Dr. McAlister initiated a study of the interaction of marine mammals and fish of commercial importance in the eastern Bering Sea and Aleutian Island area. In 1976 Michael Perez joined the staff to assist Dr. McAlister with these studies. Dr. McAlister resigned as Deputy Director in 1978 but remained at

the Laboratory as a part-time employee until 1981 when Dr. Thomas Loughlin transferred from NMFS headquarters to take over the research Dr. McAlister had been carrying out.

The increase in funds for fur seal research was prompted by the finding that the herd had not responded with the expected increase in productivity after the reduction in herd numbers between 1956 and 1963. In 1972 laboratory scientists proposed a major field experiment involving suspension of the commercial harvest for pelts at St. George Island. By eliminating harvest, the herd would be expected to change in age/sex composition and size, to approximate as closely as possible the "pristine" condition that had existed before 200 years of harvesting began. Direct comparison of this herd against the continuously harvested St. Paul Island herd, only 40 miles away, would reveal man's effects on the processes that control herd size. Intensive research on behavior, physiology, and pathology were intended to show the mechanisms by which the herd changed toward a non-harvest equilibrium.

Despite some reluctance on the part of Japan, the research plan was approved at the 1972 meeting of the Fur Seal Commission with the understanding that the ban on the St. George Island commercial harvest would not be permanent. Ancel Johnson was named supervisor of intensified land studies, except for disease work, but soon after, he left the laboratory; Dr. Roger Gentry became project leader in 1974, a position he still holds.

The results of this experiment to date are as unexpected as were the results of the 1956-63 herd reduction program. The number of male fur seals has increased as a result of not being

harvested but females and pups have decreased. The mechanism by which male and female population levels may be interrelated is still unknown. Biologists are attempting to acquire knowledge about this relationship by increasing their efforts to measure feeding behavior of males and females at sea and by estimating the energetic requirements of seals of all ages and both sexes.

The Alaska Native Claims Settlement Act gave title to most of the land and buildings on St. Paul Island to the Tanagusix Corporation, an Aleut group. As a result, and because of a need for more facilities, new quarters for NMFS management and research staff were constructed on the lagoon about 1/2 mile from town. These quarters were occupied in 1975, although several staff houses on St. Paul were retained for school teachers and, during the summer, NMFS cooperative researchers. The main research laboratory remained in the basement of the community store until the new, combination NMFS office and research laboratory was occupied in 1977.

With the transfer of Johnson to the Bureau of Sport Fisheries and Wildlife, it became apparent that a replacement was needed to provide statistical and biometric assistance to the fur seal project; Robert Lander assumed these responsibilities. One of Lander's major accomplishments was to tabulate and publish the vast amount of fur seal population data which had been collected on land, with the exception of the tagging data and, in cooperation with Canadian scientists, the pelagic data of the United States and Canada. Lander was also active in preparing U.S. position papers for the annual meetings of the Fur Seal Commission. He retired in January 1981.

Because of Lander's pending retirement, Dr. Charles Fowler, from Utah State University, was hired in 1979 to assume responsibility for fur seal population studies. In 1980, Dr. Fowler was placed in charge of all fur seal research.

KILLER WHALE STUDIES

In the early 1970s there was considerable public objection to the capture of live killer whales in Puget Sound for public display in oceanaria. After passage of the Marine Mammal Protection Act in 1972, a permit from the National Marine Fisheries Service was needed to capture killer whales. Before such a permit could be issued, it was necessary to know how many killer whales could be taken, if any, without adversely affecting the stock. The Marine Mammal Division began a cooperative program with the Washington Department of Game and with Canadian scientists to determine the number of killer whales in the coastal waters of the United States and Canada and to determine migration routes of the whales. Canadian scientists developed a system of identifying individual whales from physical characteristics such as scars and marks on the dorsal fin, and most individuals in whale pods resident to waters of the United States and Canada can now be identified. Although the National Marine Fisheries Service issued a permit for the capture of several killer whales, none was ever taken and no attempts have been made to capture killer whales in U.S. waters since 1975.

BOWHEAD WHALE RESEARCH

Another cetacean problem surfacing in the early 1970s involved the killing of bowhead whales by Alaskan Eskimos for subsistence purposes. This take had greatly increased over previous years and there were also indications of a rise in the number of whales wounded but not landed. The Marine Mammal Division had been aware of this problem, but until 1974 no research funds were available to study bowhead whales. Fortunately, Dr. Floyd Durham of the University of Southern California had been gathering biological and statistical information from Eskimos and Eskimo whaling camps during the preceding decade. In spring 1973, the Marine Mammal Division let a contract of a few thousand dollars to the University of Southern California for Dr. Durham to conduct field studies at Point Hope whaling camps. The Naval Arctic Research Laboratory in Barrow provided support for this study and allowed use of a small cabin at Point Hope. In April 1973 Dr. Durham and Dr. Harry arrived at Point Hope in subzero weather, tunneled through the snow into the cabin which was to be research headquarters, and in the dark of night, and with the help of the local schoolteacher, succeeded in starting the oil heating stove. Thus began a bowhead research program which greatly expanded over the next 5 years.

For the 1974 whaling season, \$14,000 was allocated to bowhead whale field research and Marquette at Point Hope, and Fiscus at Barrow, gathered information during the spring whaling season. Fiscus returned to Barrow in the fall of 1974 to participate in an aerial survey of bowheads during the fall migration. Marquette subsequently returned to arctic Alaska each year through 1980 on bowhead research. The

bowhead research project remained at a low level in 1975, but the U.S. Bureau of Land Management's OCSEAP provided additional funds for the 1976 and 1977 seasons.

Fiscus was made OCSEAP project leader in 1975, and in the fall of that year, Dr. Howard Braham joined this program. After approximately 1 year, Braham became leader of the project when Fiscus was designated supervisor of all pinniped research including fur seals, a position he held until his retirement in 1980. In 1976 and 1977, Bruce Krogman and David Rugh, respectively, were added to the OCSEAP project and they became permanent staff members in 1978. Aerial surveys were started in 1976 primarily to determine the numbers and distribution of bowhead whales in offshore waters. Camps were established on the ice at the edge of open-water leads near Barrow to census whales as they migrated to summer feeding areas. Very few whales were sighted from the air that could not be counted from camps on the shore ice. Additional National Marine Fisheries Service funding became available for the 1978 spring season and the bowhead whale program was further expanded. For example, one experiment conducted by James Johnson involved recording bowhead whale vocalizations to determine if whales were passing the ice camps undetected. Bowhead sounds were identified, but the technique was not successful in enumerating whales.

In 1981, a considerable portion of the bowhead whale field program was contracted to the Alaska Eskimo Whaling Commission. The 1982 bowhead field work of the National Marine Mammal Laboratory will be much reduced because of a decline in funding.

OCSEAP contracted with the Marine Mammal Division not only for bowhead

whale research but also for information on distribution and abundance of marine mammals in the Gulf of Alaska and in the Bering and southern Chukchi Seas. The desired information was obtained from 1975 to 1977 through a combination of aerial and ship surveys and observations on land.

Additional OCSEAP funding was made available to the National Marine Mammal Laboratory in 1980 to investigate gray whale feeding locations in the northern Bering Sea, to make a survey of the abundance and distribution of endangered species in the Gulf of Alaska, and to compile and analyze data obtained from NOAA vessels and other ships in areas of OCSEAP concern. These were one-year contracts which have been completed.

HUMPBACK WHALE RESEARCH

In the early 1970s the regional office of the U.S. Forest Service in Juneau agreed to record sightings of marine mammals made by naturalists aboard the Alaska ferry system in southeastern Alaska and Prince William Sound. Forest Service naturalists recorded concentrations of humpback whales in the Frederick Sound area. The first aerial survey for humpback whales from Juneau, south into Frederick Sound, was made by Dr. Harry and Dr. Tadayoshi Ichihara of the Japanese Far Seas Fisheries Research Laboratory in August 1973. Humpback whales were sighted in Stephens Passage and were abundant in Frederick Sound.

The first cruise to obtain information on distribution and abundance of humpback whales in southeastern Alaska took place in August 1975 aboard the Murre II, a vessel attached to the Auke

Bay Laboratory. This and subsequent vessel trips were made in cooperation with Charles Jurasz aboard his vessel, the Ginjur.

Humpback whales are found in southeastern Alaska waters primarily in summer; during winter, the species is found in the Hawaiian Islands waters and off the west coast of Mexico. In an attempt to find the migration route of the southeastern Alaska humpback whales, marine mammal scientists implanted experimental radio tags in their blubber. These tags were developed under the supervision of Dr. Carleton Ray of the Johns Hopkins University, and William Schevill and William Watkins of the Woods Hole Oceanographic Institution. The radio-transmitting tags were fired from a modified 12-gauge shotgun. Under the direction of Dr. Michael Tillman, humpback whales were tagged from chartered vessels in Frederick Sound and vicinity in 1976 and 1977. A cooperative radio-tagging effort under the direction of James Johnson, Marine Mammal Division; William Watkins, Woods Hole Oceanographic Institution; and Douglas Wartzok, the Johns Hopkins University, was also undertaken in Prince William Sound in 1978. However, these tags did not remain in the whale blubber long enough to provide information on migration routes, and no further radio-tagging was carried out by Marine Mammal Division scientists until 1980. At that time, the Marine Mammal Tagging Office, under the direction of Larry Hobbs, was transferred to Seattle from Washington, D.C. During 1980 under an OCSEAP contract, further radio-tagging experiments were undertaken with bowhead whales.

The humpback whales, which winter in the Hawaiian Islands and give birth to their young, became a great public

attraction in the early 1970s, and some biologists feared that harassment might cause a decrease in the number of surviving calves. Little information was available on the number and distribution of humpback whales in the Hawaiian Islands. In order to estimate population size and obtain information on distribution, the Marine Mammal Division chartered vessels to count humpback whales around the main Hawaiian Islands during the winters of 1976 to 1979. The greatest concentration of whales was found on Penguin Bank southwest of Molokai, and the total number of whales was estimated to be about 650. This project was carried out by Dale Rice and Allen Wolman.

The cooperative program with the U.S. Forest Service for collecting information on marine mammal sightings from naturalists aboard Alaska State ferries led to a similar program with other vessels operating in waters of the North Pacific Ocean. Paul Sund, stationed at the NMFS Tiburon, California Laboratory, was assigned to establish a system to obtain oceanographic and biological information from vessels of opportunity. Sund set up a system by which vessels, especially NOAA research vessels, reported marine mammal sightings to the Marine Mammal Division for computer storage. In 1975, a NOAA Corps officer, Lt. jg Roger Mercer, was assigned to the Marine Mammal Division and supervised this project. Lt. Mercer was replaced in 1978 by Lt. Lewis Consiglieri. The sighting data have been of great value in providing information about the distribution of marine mammals. For example, the data have been useful in determining which marine mammals might be affected by development of petroleum resources in the waters off Alaska.

WHALE POPULATION DYNAMICS

The major concern of the International Whaling Commission (IWC) is to make certain that the stocks of commercially exploited whales remain in healthy condition. Management of whale stocks requires an adequate knowledge of the population dynamics of the various stocks; however, the Marine Mammal Division did not have an expert on whale population dynamics. Therefore, in 1974 Dr. Tillman of the Northwest and Alaska Fisheries Center's Division of Marine Fish and Shellfish was assigned half-time to the Marine Mammal Division to carry out whale stock assessment studies. Dr. Tillman attended the IWC meeting in 1974 for the first time and has been a U.S. member of the Scientific Committee every year since then. He became a full-time member of the Marine Mammal Division staff in 1975 and was assigned as program leader for all cetacean studies. In 1978 Jeffrey Breiwick joined Dr. Tillman in whale stock assessment research. Following the resignation of Dr. McAlister as Deputy Director in 1978, Dr. Tillman was appointed to this position while continuing his whale population studies; he is currently vice chairman of the IWC Scientific Committee.

In 1976 responsibility for U.S. participation in the IWC observer program was transferred from NMFS headquarters in Washington, D.C., and Larry Tsunoda and Eugene Nitta, observers at Japanese land-based whaling stations, joined the permanent staff. In 1978 Merrill Goshu replaced Nitta, who transferred to the NMFS Southwest Regional Office.

U.S.-MEXICO COOPERATIVE GRAY WHALE DYNAMICS

A research agreement was signed in 1978 between representatives from the Instituto Nacional de Pesca, Departamento de Pesca, Mexico City, and the Marine Mammal Division to conduct a 5-year research program on gray whales in their winter grounds in Baja California. Breeding ecology in the calving lagoons, as well as spatial and temporal distribution inside and outside the lagoons was emphasized.

In 1979 and 1980 research teams from PESCA and the NMFS joined to study gray whales in Laguna Ojo de Liebre and adjacent waters. In 1980 an aerial survey was also made to determine the distribution and relative abundance of gray whales along the west coast of Baja California. In 1981, scientists from PESCA continued the research in Laguna Ojo de Liebre, documenting the movements of whales into and out of the lagoon and making a population estimate of those whales using the lagoon. Concurrently, scientists were conducting coastal and offshore systematic surveys using a boat and an aircraft simultaneously to estimate the size of the population which occurs outside the lagoons and throughout Baja California. These studies are expected to provide the kind of information needed to make sound management decisions.

OTHER PINNIPED SPECIES

The northern elephant seal, once abundant along the Pacific coast from Cape Lazaro, Baja California, to central California, was nearly wiped out by excessive commercial harvesting

in the 19th century. At the turn of the century, the population of this species was about 100 animals; however, the elephant seal has made a remarkable recovery. By the mid-1970s, it was once again abundant and had reoccupied much of its breeding range as far north as the Farallon Islands, California. In 1977 the Marine Mammal Division, through a contract with the University of California, summarized information about the status of this species. The elephant seal report was important in reaching the decision that the species should not be classified under provisions of the Endangered Species Act of 1973. The principal California breeding area is on San Miguel Island, where laboratory biologists have been carrying out population studies since 1972.

The Guadalupe fur seal was believed to be extinct as a result of commercial exploitation in the 19th century. In 1926, however, a few animals were discovered by fishermen on Guadalupe Island. Since that time, recovery of the species has been very slow and the breeding range has not spread to other areas. Little information was available about these fur seals in the mid-1970s so the Marine Mammal Division contracted with the University of Washington for a 2-year study. In cooperation with Mexican authorities, a graduate student from Mexico, Luis Fleischer, carried out field studies on Guadalupe Island for two seasons. Fleischer concluded in his 1978 master's thesis that the Guadalupe fur seal population numbered about 1,000 animals.

Enroute to Japan in 1972 for a meeting of the Fur Seal Commission, Dr. Harry stopped in Honolulu to confer with Palmer Sekora, Superintendent of the Fish and Wildlife Service's Hawaiian Island National Wildlife Refuge, about

the status of Hawaiian monk seals which reside in the northwestern Hawaiian Islands. Both biologists were concerned that the small population of monk seals was threatened by increasing human activity especially since the species was not protected by an endangered species designation. Following these discussions, action was started to add the Hawaiian monk seal to the endangered species list, and in 1976 it was so designated.

In 1975 the Marine Mammal Division, in cooperation with the Fish and Wildlife Service, initiated planning on a research program to obtain information about the number, biology, and critical habitat of Hawaiian monk seals. Fiscus and DeLong took part in cruises to the northwestern Hawaiian Islands in 1976, 1977, and 1978 to census monk seals. In 1978 an additional trip was made to Laysan Island in an attempt to determine the cause of a sudden die-off of monk seals. In 1980 the feeding behavior of monk seals was investigated at Lisianski Island. This study included personnel from the National Marine Mammal Laboratory, Southwest Fisheries Center of the National Marine Fisheries Service, and Scripps Institution of Oceanography. The information obtained is being used to formulate a plan with the objective of increasing the number of Hawaiian monk seals. In 1979, the monk seal research program was transferred from the National Marine Mammal Laboratory to the Southwest Fisheries Center.

U.S.-SOVIET COOPERATION

In the Bering and Chukchi seas, U.S. and Soviet nationals harvest what may be intermingling stocks of ice seals and walrus. On the U.S. side, the

harvest is principally by Alaskan Eskimos for subsistence uses. Exchange of research information about these species benefits both countries. For this reason, informal meetings of scientists from the United States and the USSR took place in conjunction with annual meetings of the Fur Seal Commission in the early 1970s. Cooperation in marine mammal research was formalized when the presidents of the United States and the Soviet Union on 23 May 1972, signed an agreement for cooperation in the field of environmental conservation. In January 1973, a subgroup of experts on marine mammals met in Moscow to discuss problems of conservation management and research of marine mammal populations. Dr. R. V. Miller, research specialist on marine mammals in the NMFS Washington, D.C., office, was designated coordinator for the U.S. delegation and Dr. Harry became a member of the U.S. Steering Committee. The first meeting of the marine mammal subgroup in the United States was held in Washington, D.C., in December 1973; representatives from the Marine Mammal Division included Dr. Harry, Fiscus, and Ancel Johnson. No U.S. funding has been allocated specifically for cooperative USA/USSR research, but nevertheless the program has been very successful in developing cooperative marine mammal research projects of interest to both countries. Meetings to develop research plans are held at approximately 18-month intervals, alternating between the two countries. Harvest data on marine mammals of the Bering and Chukchi seas and titles of marine mammal publications with copies of important publications from each country are exchanged. Soviet scientists have taken part in research activities of the National Marine Mammal Laboratory in the North Pacific Ocean and Arctic waters. Scientists from the National Marine Mammal

Laboratory have joined Soviet scientists for bowhead whale research aboard Soviet vessels.

DALL'S PORPOISE

The Marine Mammal Protection Act of 1972 requires that permits be issued to any foreign vessels which incidentally take marine mammals during commercial fishing operations within the U.S. 200-mile zone. Japanese salmon gillnet fishermen operating within this zone incidentally take Dall's porpoises and therefore are subject to provisions of the Act. The Marine Mammal Division began a 3-year study involving Japanese and U.S. scientists in 1978; Dr. Linda Jones, formerly on the staff of the Marine Mammal Commission, was selected as project leader. The objective of the program was to assess the impact of the Japanese gillnet fishery on Dall's porpoise stocks and to determine methods of reducing the mortality of porpoises captured in the nets. The program has been carried out aboard Japanese research and commercial fishing vessels, and in 1981 the period of research was extended. Information has been obtained on Dall's porpoise population size, life history, and food. Studies are now under way to develop methods of preventing porpoises from becoming entangled in the gillnets.

COLUMBIA RIVER ESTUARINE MARINE MAMMALS-FISHERIES INTERACTIONS

At a workshop sponsored by the Marine Mammal Commission in 1977, the Columbia River and adjacent waters were recommended as an area for study of

marine mammal-fisheries interactions. A research program was developed by the states of Oregon and Washington and funds were provided by the National Marine Mammal Laboratory and the Columbia River Estuary Data Development Program. The research was contracted to the Washington Department of Game. The first report has been completed. It provides information on the numbers of harbor seals taken in the Columbia River gillnet fishery and detected by aerial surveys, as well as information from tagging and sampling of harbor seals for biological data. The program is planned to continue through 1982. DeLong has responsibility for this program.

NATIONAL MARINE MAMMAL LABORATORY

In recognition of the expanded research role of the Marine Mammal Division, in 1979 the Division was designated as the National Marine Mammal Laboratory, remaining as a part of the Northwest and Alaska Fisheries Center. In the same year Dr. Harry announced his retirement effective January 1980, and Dr. Tillman was appointed Laboratory Director. Dr. R. V. Miller was transferred from the Washington office to replace Dr. Tillman as Deputy Director. The Laboratory is now divided into three major research areas: Cetacean Program under Dr. Braham, Fur Seal Program under Dr. Fowler, and Marine Mammal Fishery Interactions Program under DeLong.

The Laboratory is now well established as an important component in the study of ocean ecosystems.

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