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MORBIDITY AND MORTALITY OF MARINE MAMMALS - BERING SEA

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I. Summary

The objectives of this study are:

1. To determine the normal rate of occurrence (by species, sex, and age) of dead and moribund marine mammals along the eastern shore of the Bering Sea,
2. To determine the causes of death and morbidity of those animals, and
3. To determine the kinds and rates of occurrence of pathological conditions and their causes in the living populations of Bering Sea mammals.

Surveys in 1976 of about 1395 km of the Alaskan coast in the Bristol Bay and Bering Strait regions yielded counts of 107 relatively fresh carcasses of marine mammals. The majority of those necropsied had died from gunshot wounds (as in 1975). Other causes were: malnutrition (1 sea otter); umbillical hernia (1 walrus, 1 harbor porpoise); killer whale predation (1 gray whale); and trauma, possibly also related to killer whale predation (1 larga seal). Carcasses in this and the previous year occurred at the mean rate of about .05/km of beach, except in areas downstream from major hunting sites of the coastal Eskimos and from major hauling grounds of pinnipeds, where their rate of occurrence was about 10 times greater.

In the course of three research cruises in southeastern Bering Sea, 236 other marine mammals were examined. Data from 361 others, examined in connection with various investigations prior to the inception of this project, were summarized from the records of the former Arctic Health

Research Center (USPHS). Taken as a whole, these suggest that about six percent of the living populations of Bering Sea marine mammals have some kind of grossly evident pathological condition, the most common of which seem to be abcessed wounds, mycotic infections of the skin, various kinds of tumors, and liver disease. Serological analysis from the recent series, though still incomplete, suggests the presence of at least two important infectious agents (San Miguel Sea Lion Virus and Leptospira sp.), not otherwise detected in the necropsies. In addition, the helminth parasites of 43 specimens were determined, including discovery of two species new to science.

II. Introduction

A. General nature and scope of study

This study is designed to provide baseline information on the incidence and causes of pathological conditions in marine mammal populations of the Bering Sea that will be useful in evaluating future impacts of petroleum-related activities in that region. Emphasis is placed on surveys of distribution and numbers of beached carcasses of moribund and dead animals, and on necropsy of such specimens and of samples from the living populations for determination of causes of illness and death.

B. Specific objectives

1. to determine the number (by species, sex, and age) and location of stranded marine mammals on samples of the Alaskan Bering Sea coast,

2. to determine the pathological conditions and agents thereof that caused or contributed to the death of those mammals, and Alaskan Bering Sea coast,

3. to determine the causes and rates of occurrence of pathological conditions in living marine mammal populations of the Bering Sea through necropsy of individuals collected non-selectively as regards the purposes of this project.

C. Relevance to Problems of Petroleum Development

Marine mammals are the top level consumers in the Bering Sea trophic system. On that account, to monitor their health and welfare, including the incidence of diseases and other pathological conditions, is to monitor the "health" of the marine ecosystem itself, since they are the ultimate recipients of all changes that take place within the system, from perturbation and pollution to simple physical disturbance. Because they tend to be long-lived, they provide a cumulative historical record of past conditions, e.g., in their overall growth and the growth of certain body parts, such as the tusks of walruses and the vibrissae of seals and sea lions, and in their stores of certain pollutants, such as heavy metals, pesticides, and mineral hydrocarbons. But they are also responsive to short-term changes, in that their nutrition and the nurture and survival of their young are finely tuned to certain environmental requirements that are easily disrupted by man-made changes in the system itself.

III. Current state of knowledge

At the inception of this project, there was very little published information on either the rates of occurrence of moribund and dead marine

mammals or the causes thereof in any part of the Alaskan O.C.S. area. Fragmentary reports of mass strandings of walruses (Odobenus rosmarus) on St. Lawrence Island (Schiller, 1954) and the nearby Punuk Islands (Murie, 1936) provided little reliable data on the nature or causes of those incidents. In the first case, from his examination in January 1952 of 17 of the 52 carcasses (mostly adult females) that washed up in October 1951, and from the reports of Eskimos who had examined some of the others, Schiller (1954:209) concluded that they probably had been killed by "a great and sudden external pressure," possibly "by concussion resulting from an (underwater) explosion." However, the reported signs (intestinal prolapse, free blood in the abdomen, and mutilated appendages) could just as easily have been due to putrefactive postmortem changes; none of the known diagnostic signs of implosive damage (as described by Rausch, 1973) was recognized in the animals examined. In the second case, Murie (1936), Collins (1940), and Cahalane (1947) reported that the flattened, hairless condition of the multitudes of walrus carcasses found on the Punuk Island was indicative of their having died from being crushed by the weight of other walruses, stampeded perhaps by the threat of preying killer whales (Orcinus orca). In this instance, also, the reported signs were by no means diagnostic, for the carcasses were not fresh and could easily have attained their condition through long-term putrefaction. Hanna (1920, 1923) reported on eight walrus carcasses examined by him on St. Matthew and the Pribilof islands, noting that "in each case death had been caused by crushing of the body cavity" (1923:213). Kenyon (1961) reported that two Cuvier's beaked whales (Ziphius cavirostris) which stranded on Amchitka Island in the Aleutians had been killed by rifle bullets. Jellison (1953) reported a Stejneger's beaked whale (Mesoplodon stejnegeri) stranded on the Pribilof Islands, and Moore (1963) reported

two others from the Nushagak Peninsula and the Kasilof River, but no pathological information was provided for any of these. There are several other isolated records of occurrence of such unusual or rare specimens, but these provided no real basis for appreciation of the normal abundance of carcasses of the more common species.

In the summer of 1975, personnel of this and one related project surveyed some 2,014 km of the shores of the eastern Bering Sea and Bering Strait (Fay, 1976) and recorded 250 newly stranded marine mammals of nine species, weighing some 1,200 tons (Table 1). These occurred at the rate of from less than .01 to 14 carcasses per km of shoreline, the highest rates being in areas downstream from intensive hunting sites of the coastal Eskimos and in areas where large numbers of animals haul out to rest. As might be expected, the majority of carcasses in those high-rate hunting areas were determined to have died from gunshot wounds. The rate of occurrence in the lighly settled areas or areas with low hunting intensity averaged about .05 carcasses per km, with a range from .01 to .15/km. Most of these had died from natural causes. Some pathological conditions identified at necropsy as having contributed to the death of these animals were: hepatitis, peritonitis, and omphalitis (2 harbor seals), gastric ulcers, hemoendometritis, hepatitis, and interstitial pneumonia (2 sea otters), predation by killer whales (2 gray whales), dental abcess and acute pneumonitis (1 walrus), and dermatomycosis and streptococcal lymphadenitis (1 ringed seal). None of the carcasses were of species known to reside more than a few km from the location where they were found, implying that carcasses of animals that die in more distant areas do not persist at sea long enough to be transported

TABLE 1. Frequency of occurrence of stranded carcasses of marine mammals per kilometer of surveyed shoreline, Bering Sea to Kotzebue Sound, 1975 (Data from Fay, 1975)

Area	Dist. (km)	Numbers of stranded marine mammal carcasses*						
		Whales**	Sea lions	Walrus	Hair seals***	Sea otters	Total	No/km
BRISTOL BAY								
Southern	654.2	10	0	8	12	2	32	.05
Northern	238.1	0	0	15	0	0	15	.06
KUSKOKWIM BAY	113.7	0	1	0	0	0	1	.01
ST. LAWRENCE I.								
Southern	116.2	9	0	6	2	0	17	.15
Northern	151.3	0	0	45	24	0	69	.46
Punuk Is.	0.5	0	0	7	0	0	7	14.00
BERING STRAIT	235.2	7	0	91	13	0	111	.47
KOTZEBUE SOUND	505.2	0	0	1	4	0	5	.01

* Includes only those <four months *in situ*, i.e., stranded after breakup of the pack ice. All areas surveyed in July, except St. Lawrence Island (August).

** All gray whales (*Eschrichtius robustus*), except one minke whale (*Balaenoptera acutorostrata*) in southern Bristol Bay.

*** All harbor seals (*Phoca richardsi*) in Bristol Bay, and mainly ringed seals (*P. hispida*) elsewhere.

great distances, though surface air and water currents my be favorable for such passage.

Some of the best and most useful information on morbidity-mortality rates and the causes thereof in Bering Sea marine mammals have been obtained in connection with intensive studies of the northern fur seal (Callorhinus ursinus) populations on the Pribilof Islands and of sea otter (Enhydra lutris) populations at Amchitka Island. Of some 700,000 to 1,000,000 fur seal pups born each year on the Pribilofs, about 75 percent die by age five years, mainly from natural causes (Roppell, et al., 1963, 1965). While predation by killer whales and sharks is certainly an important factor in this mortality, its extent is unknown (Baker, et al., 1963). Other contributing factors are: intraspecific strife (Johnson, 1968), parasitism (Neiland, 1961; Keyes, 1965; Dunlap, et al., 1976), and toxins (Keyes, 1965). Still other conditions, e.g., renal fibrosarcoma (Brown, et al., 1975), and agents of disease, e.g., Leptospira sp. (Smith, et al., 1974), Sarcocystis (Brown, et al., 1974a), viruses of the psittacosis group (Eddie, et al., 1966), and vesicular exanthema viruses (Prato, et al., 1974; Smith, et al., 1975, 1976; Madin, et al., 1976) have been recognized and, especially the latter, are now believed to play an important role in die-offs at sea. The mortality of pups on the rookeries has been studied in greatest detail. Of the 40 to 120 thousand pups that die each year on the Pribilof rookeries (Roppell, et al., 1965), the most frequent primary cause of death is malnutrition (37.6%; Keyes, 1965), followed closely by trauma (17.4%: Ibid.), hookworm infections (12%: Ibid.; Lyons, 1963; Brown, et al., 1974b), bacterial invasion of open wounds (11%: Keyes, 1965), and gastrointestinal problems (4.6%: Ibid.; Jellison and Milner, 1958).

Kenyon (1969) has indicated that there is a substantial mortality of sea otters in the Aleutian Islands in winter and early spring and that this involves mainly the youngest age classes and more often the males than the females. The ultimate cause of death, in most cases, is malnutrition, which seems to be the result most often of dental problems coupled with severe weather as a deterrant to normal feeding. Gastro-intestinal conditions, associated with helminthic infestations (especially Phocanema decipiens) and bacterial agents (Clostridium spp.) seem to be common contributors. A liver disease of unknown etiology and various other conditions that occurred infrequently were judged to be relatively unimportant in the pristine wilderness environment but might become more important under more stressful circumstances of environmental pertrub-ation. One such condition is contamination of the fur by foreign matter, causing it to lose its water-repellency. When this occurs, according to Kenyon, "the insulating blanket of air among the dense fur fibers is lost, the animal is chilled, and soon dies."

The information on causes and rates of morbidity and mortality in other species of Bering Sea marine mammals is extremely spotty at this time. A thorough review of all sources, based mainly on a bibliography compiled by this project (Quart. Rep. 31 Dec 76), is in preparation for submittal at a later time.

IV. Study Area

The basic study area is the shelf of the eastern Bering Sea and Bering Strait, from Unimak Pass north to Kotzebue Sound. The shoreline of

that area, including the islands, is more than 5,000 km, of which we have selected about 20 percent for annual stranding surveys, with other parts surveyed on an opportunistic basis. The regular survey areas are (1) the southern shore of Bristol Bay from Naknek to Bechevin Bay, (2) the coast of St. Lawrence Island, and (3) from Bering Strait to Point Hope. These were selected because of their accessibility and their juxtaposition to proposed lease areas and centers of abundance of major marine mammal populations. Necropsy of specimens taken in connection with other OCSEAP projects is undertaken on an opportunistic basis anywhere within the basic study area and in other areas to which the same migrant populations journey in the course of the year (e.g., eastern Chukchi and western Beaufort Seas).

V. Sources, Methods, and Rationale of Data Collection

Stranding data are collected about one month after the breakup of sea ice in the vicinity of the regular survey areas. Data from earlier and later surveys have indicated that this is the optimal timing for obtaining near-maximal counts and for access to the greatest number of specimens in relatively fresh condition. For the Alaska Peninsula, this means initiation by late May to mid-June; for St. Lawrence Island, by late June to mid-July; and for the Bering Strait area, by mid- to late July. With allowance for weather, about two to three weeks of work are required in each area.

Each survey is conducted by a 2-man team, including one senior scientist and one technician. In the Alaska Peninsula and Bering

Strait areas, the mode of transportation for the team is a Supercub aircraft with extra-large balloon tires for beach landings; on St. Lawrence Island, a combination of all-terrain vehicles and small boats is utilized. In the areas covered via aircraft, the survey is begun with a complete coverage of the sampling area (preferably, all in one day), noting the kinds of carcasses and moribund animals and marking the location of each on suitably large-scale aerial charts. Thereafter, the team works out from various camps along the way, landing near each carcass and examining it in accordance with the procedures outlined in the project manual for postmortem examination (See Annual Report, R.U. #194 31 March 76). At St. Lawrence Island, the modes of transportation necessitate that the survey of numbers and locations is conducted simultaneously with the examinations.

Necropsy of specimens taken in conjunction with other projects (i.e., OCSEAP, R.U. #230,232) is performed as soon as possible after death of the animal and in accordance with procedures outlined in the project manual. The primary objective of this is to obtain adequate samples of each species with which to describe the normal rates of occurrence of pathogens and pathological conditions in their populations, and to obtain materials for comparison with those from the stranded carcasses, whose condition is seldom satisfactory for isolation of pathogens or acquisition of high quality histopathological samples.

Histopathological and other materials collected during the necropsies are transported back to the home base (University of Alaska-Fairbanks) at the end of the field work period for processing, analysis and, as

necessary, distribution to various specialists for further study. These comprise mainly of (1) samples for serological, heavy metals, and hydrocarbon analysis, (2) bones and teeth for identification and age determination, (3) preserved tissues for histopathological examination, (4) microbiological isolates, and (5) photographs for identification.

VI. Results

Stranding Surveys

The survey of beach dead animals in 1976 covered a total of 1,395 km of shoreline in three areas: southern Bristol Bay, Bering Strait, and Kotzebue Sound (Table 2). The St. Lawrence Island area was not surveyed, due to inability to obtain permission from the local Native corporations in a timely fashion for conduct of the work. In the areas covered, a total of 107 carcasses of 9 species were found, with a total estimated weight of about 218 tons. As in the previous year, these were about ten times more numerous in the area downstream from a major hunting "ground" of the Bering Strait Eskimos than in the rest of the areas surveyed. Again it seemed that the usual rate of occurrence outside those high-intensity hunting areas was about .05 carcasses per km of shoreline. Also, as in 1975, none of the carcasses were of species known to reside more than a few km from the locality in which they were found.

The necropsy results from 21 of the 44 carcasses examined are summarized in Table 3. The cause of death in the remainder was not determined with certainty.

TABLE 2. Frequency of occurrence of stranded carcasses of marine mammals per kilometer of surveyed shoreline, Bering Sea and Bering Strait, 1976.

Area	Dist. (km)	Numbers of carcases (<4 months since death)					
		Whales	Walrus	Hair seals	Sea otters	Total	No/km
BRISTOL BAY							
Southern part	654.2	4*	8	18	1	31	.05
BERING STRAIT	235.2	2**	47	15	0	64	.27
KOTZEBUE SOUND	505.2	1***	10	1	0	12	.02

* Includes 3 gray whales, 1 minke whale

** One gray whale and 1 harbor porpoise (Phocoena phocoena)

*** One belukha (Delphinapterus leucas)

TABLE 3. Major pathological findings in beach dead marine mammal carcasses necropsied in 1976.

Field No.	Species	Major findings	Diagnosis
CETACEA			
503-7	Eschrichtius robustus	Throat, tongue, mandible torn away; remainder severely lacerated.	Killed and eaten by killer whales
503-3	Phocoena phocoena	Blubber very thin, yellow; hernia of umbilicus with gut loop extruded and strangulated, both ends of loop intussuscepted.	Constrictive blockage of GI tract; malnutrition.
PINNIPEDIA			
102-3	Odobenus rosmarus	Umbillical hernia with partial extrusion of uterus containing full-term foetus.	Trauma (?)
502-3	" "	Skull fractured by bullet	Gunshot
502-8	" "	Same	"
503-14	" "	Same	"
503-1	" "	Bullet hole associated with cerebral hemorrhage.	"
503-5	" "	Same	"
502-9	" "	Several bullet holes in neck, associated with severe hemorrhage.	"
502-7	" "	Bullet hole in neck, associated with hemorrhage	"
503-4	" "	Same	"
503-6	" "	Same	"
503-8	" "	Same	"
503-13	" "	Severe hemorrhage in neck, with fractured vertebrae	"
502-2	Erignathus barbatus	Skull fractured by bullet	"
101-8	Phoca largha	Subpleural hemorrhage and lung congestion; microabcesses in liver (unrelated).	Trauma (possibly due to killer whales)

TABLE 3 Continued

Field No.	Species	Major findings	Diagnosis
503-9	Phoca largha	Massive hemorrhage of neck, with fractured cervical vertebrae	Gunshot
502-5	Phoca hispida	Skull fractured by bullet	"
502-6	" "	Same	"
503-12	" "	Same	"
SEA OTTER			
103-1	Enhydra lutris	Emaciated; gut empty; bladder full; rupture of right cornea	Malnutrition, possibly secondary to eye injury.

Necropsy of Specimens from Other Projects

In the course of three research cruises in the southeastern Bering Sea (ZRS Zagoriany, 15 March-4 May; OSS Surveyor, Legs I & II, 14 March-1 May), project personnel examined 236 marine mammals collected primarily for purposes other than those of this study. Each of these was taken non-selectively, as regards their health and general physical condition. The numbers examined per species were:

6 Steller sea lions (Eumetopias jubatus)

158 Walruses (Odobenus rosmarus)

3 Bearded seals (Erignathus barbatus)

39 Larga or spotted seals (Phoca largha)

2 Harbor seals (Phoca richardsi)

28 Ribbon seals (Phoca fasciata)

Blood serum samples from 110 of these were forwarded to the Naval Biomedical Research Laboratory (Oakland, California) for serum antibody screening, the results of which are not yet completely in hand. Preliminarily, it seems that the five sea lions sampled (but none of the other species) had antibodies for two of the five known serotypes of San Miguel Sea Lion Virus (SMSV) with titers to 1:160. It is probable that there will also be a high proportion of reactors to Leptospira antigen in several species. Each of these pathogens is suspected of having had a severe impact on marine mammal populations in the western United States (including the Alaska fur seal) in recent years, as well as being important agents of disease in domestic animals and, in the case of the latter, man.

Blubber samples from 71 specimens for hydrocarbon analysis and organ samples from 24 for heavy metals analysis also were collected and are being processed at this time in connection with other OCSEAP projects (R.U. #162/275).

Major pathological findings in these specimens are summarized in Table 4. In addition, the helmith parasites of 43 specimens were determined (including discovery of two species new to science); data from these were summarized in tabular form in a recent Quarterly Report (R.U. #194, 31 Dec 76).

A compilation of data relative to frequency of occurrence of pathological conditions in Bering Sea marine mammals was begun, drawing from the files of the former Arctic Health Research Center's Zoonotic Disease Section (with which the principal investigator was formerly connected). The results to date, combined with those from the work of this project, are shown in Table 5. These data, from 597 necropsies of 10 species, suggest that about six percent of animals taken non-selectively have some kind of grossly evident pathological condition. Of these, the most common seem to be abcessed wounds, mycotic infections of the skin, various kinds of tumors, and fibrosis of the bile ducts. Numerous other records of specimens of pathological interest that were drawn from samples of unknown size also are being reviewed and will be reported at a later time.

VII. Discussion

The marine mammals of the Bering Sea are mainly transient, some of them residing there in summer and spending the winter farther to the south,

TABLE 4. Major pathological findings in marine mammals collected in connection with other projects, 1976

Field No.	Species	Major findings
Z-102	Odobenus rosmarus	Dermatomycotic lesions over most of the body, circular to oval, some raised and with sloughing of hair and cornified layer.
Z-103	" "	Same, but restricted to ventral surface and flippers.
Z-115	" "	Cystic ovary filled with caseous material; other normal.
Z-122	" "	18 x 21 cm arterial aneurism in dorso-lateral aspect of spleen; contents mixed whole and necrotic blood.
Z-14	" "	Abcessed puncture wound in neck; abcess 20 cm in diameter, 2 cm thick, subcutaneous, no drainage.
SUV-30	Phoca largha	Splenomegaly (13 x 32 cm; 0.7 kg).
Z-211	" "	Fibrosis of liver margins.
Z-175	" "	Healing perforative gastric ulcers.
Z-221	" "	Healing ulcerative skin lesions on belly.
SUV-23	Phoca fasciata	Fibrosis of liver margins.
SUV-28	" "	Splenomegaly (0.9 kg); dermatomycosis with extensive hair loss, epidermal hyperkeratosis.
Z-194	" "	Dermatomycosis, patchy hair loss.
Z-226	" "	Healing crescentic lacerations on back and flank, largest 25 cm long, 3 cm deep.
Z-228	" "	Fistulated wound in left rear flipper; tarsal-metatarsal area edematous.

TABLE 5. Preliminary summary of available data on rates of occurrence of gross pathological conditions in Bering Sea marine mammals necropsied from 1950 to 1976.*

Species	Number examined		% pathological	Types of conditions
	Total	Pathological		
Eschrichtius robustus	2	0	-	-
Delphinapterus leucas	6	1	-	Middle ear inflammation (1)
Phocoena phocoena	2	0	-	-
Eumetopias jubatus	16	1	6	Focal necrosis of kidney (1)
Odobenus rosmarus	276	15	6	Subcutaneous abcess (2); acute dermatomycosis (2); dental pulpitis (1); malnutrition (1); biliary fibrosis (2); renal calculi (1); splenic aneurism (1); cystic ovaries (1); uterine tumor (2); epithelial fibropapilloma (2)
Erignathus barbatus	89	6	7	Biliary fibrosis (3); acute dermatomycosis (1); trauma (1 evidently wounded by bear or killer whale); old gunshot wound (1)
Phoca largha	102	7	7	Old bullet wound? (1); splenomegaly (2); ulcerative skin lesions (1); gastric ulcer (1); malnutrition (2)
Phoca richardsi	22	1	4.5	Lacerations and splenomegaly (1)
Phoca hispida	40	1	2.5	Consolidative pneumonia (1)
Phoca fasciata	42	3	7	Subcutaneous abcess (1); acute dermatomycosis (2)

* Data from the files of the former Arctic Health Research Center (USDHEW, Public Health Service), Fairbanks, and from work performed under this project. All specimens were taken non-selectively. Data from beach dead animals are not included.

while others reside there in winter and spend the summer farther to the north. As a whole, about 3 million individuals utilize this area on an approximately half-time basis. In their peregrinations, they are exposed to a wide variety of environmental conditions and contacts with other species and populations, some as far south as Baja California and Japan, or as far north as the Beaufort and East Siberian Seas. The results of our investigations thus far indicate that about six percent of those individuals at any given time shows grossly evident signs of having been affected by diseases or injuries, and it is becoming evident that many more had been exposed to other infectious agents. It is probable that some of those agents and the conditions that they cause would have led or contributed to the demise of the animals. Indeed, it is probable that at least 5 to 10 percent of the marine mammals utilizing the Bering Sea dies there each year, many of them from the same kinds of diseases and injuries as we have recognized.

Carcasses of some of those dead and dying animals come ashore on the beaches of the eastern Bering Sea throughout the ice-free period, June to October or November, evidently at a mean rate of about .05 to .1/km/yr. However, in a few localities where large numbers of animals are wounded by subsistence-hunting Eskimos or where large numbers haul out to rest, the rate of stranding tends to be about 10 times as great. Along the approximately 5,000 km of shoreline, then, it is reasonable to expect some 250 to 500 carcasses in any given year, with the greatest concentrations in the areas downstream from intensive hunting sites or major hauling grounds.

The findings thus far, in both the stranded and non-stranded specimens, suggest that, apart from bullet wounds, predator-induced trauma, malnutrition, and various infectious agents of disease are the main causes of morbidity and mortality in Bering Sea marine mammal populations, at present. The most common infectious conditions and agents seem to be (a) mycotic infections in the skin, (b) streptococcal infections leading to focal necrosis of the liver, (c) wound infections probably by strains of both Streptococcus and Staphylococcus, and (d) tentatively, leptospirosis and vesicular viral disease (SMSV). It is easily conceivable that the potential variety of additional stresses brought to bear by oil development in the Bering Sea could have a synergistic effect on many of these.

VIII. Conclusions (tentative)

1. Dead and moribund marine mammals are deposited on the shores of the eastern Bering Sea at the rate of about .05/km/yr, except in areas close to major hunting sites and major haulout sites, where the rate locally is about 10 times as great.
2. About 6 percent of individuals in the living populations of Bering Sea marine mammals have grossly evident signs of pathological conditions, many of which could eventually lead to or contribute to the death of the animal.
3. Many other individuals show clinical signs of exposure to infectious diseases, but the rates of occurrence of these are not yet certainly known.

IX. Needs for Further Study

1. Stranding Surveys:

The results thus far suggest that the rate of occurrence of stranded marine mammal carcasses is relatively constant and varies more with juxtaposition to major hunting sites and hauling grounds than with year-to-year differences in environmental conditions. Adequate confirmation of this is needed in areas other than those regularly surveyed, i.e., we feel that it would be particularly useful to undertake at least one greatly expanded survey of the eastern shore of the Bering Sea, from Unimak Pass to Bering Strait, covering at least half of that area, in order to compare predicted (on the basis of present findings) with observed stranding rates. This could also greatly enlarge our present sample of diagnosed causes of death. Ideally, the survey should be undertaken via helicopter capable of carrying a 2-man team of experienced observers/examiners. Alternatively, the present system of survey via Supercub aircraft could be utilized, but the number of carcasses available for necropsy would be much less, due to greater limitations for beach landings in some areas.

2. Necropsy of Non-Selective Samples:

As can be seen from Table 5, the samples from several species are still insignificantly small and need to be expanded. Present efforts (FY '77) will contribute to their expansion, but every effort should be made to expand them further, as long as specimens are available

from other projects. Additional data, particularly from species of Phoca, from Eumetopias jubatus, and from the cetaceans, will be needed, inasmuch as these are large populations of major economic importance that regularly frequent the proposed lease areas.

X. Summary of 4th Quarter Operations

A. Ship or Laboratory Activities

1. Ship or field trip schedule

a. 15 March - 8 April OSS Surveyor, Leg II - Bering Sea

b. 11 April - 1 May OSS Surveyor, Leg III - Bering Sea

c. 19 May - 12 June OSS Discoverer, Bering Sea

d. 15-30 June Alaska Peninsula Stranding Survey

2. Scientific party

a. Surveyor Leg II: Associate investigator R. A. Dieterich and biological technician L. M. Shults, Institutes of Arctic Biology and Marine Science, University of Alaska, Fairbanks.

b. Surveyor Leg III: Principal investigator F. H. Fay and biological technician L. M. Shults, Institutes of Arctic Biology and Marine Science, University of Alaska, Fairbanks.

c. Discoverer: Principal investigator F. H. Fay and biological technician L. M. Shults, Institutes of Arctic Biology and Marine Science, University of Alaska, Fairbanks.

d. Alaska Peninsula: Associate investigator R. A. Dieterich and field assistant (to be named), Institute of Arctic Biology, University of Alaska, Fairbanks.

3. Methods

a. Surveyor II, III; Discoverer: Necropsy of specimens taken non-selectively in conjunction with field work of other OCSEAP projects (R.U. #230,232, 248).

b. Alaska Peninsula: Aerial survey of numbers, kinds, and locations of stranded carcasses in southern Bristol Bay, with necropsy of as many as possible.

4. Sample localities

a. Surveyor II, III: Ice Front, from 165° to 174°W, and within 40 helocopter miles of 72-hr oceanographic stations in the Front at 165°, 170°, and 174°W.

b. Discoverer: In vicinity of the central "Ice Remnant" (approximately 174°W, 62°N).

c. Alaska Peninsula: Southern shore of Bristol Bay, from Naknek to Bechevin Bay.

5. Data to be collected or analyzed

a. Surveyor II, III and Discoverer: Tissue samples for histopathological study; helminthological, bacteriological, viral, and mycological isolates; serum and blubber samples.

b. Alaska Peninsula: As above, plus survey data on numbers, kinds, locations, and causes of death of stranded carcasses.

6. Milestone chart

All milestones were attained in a timely fashion, with the following exceptions:

a. Mass strandings or fall '75 survey: - There were no mass strandings other than those surveyed in the course of the regular surveys. A fall survey was not feasible because of early freezeup and foul weather.

b. Collections from icebreaker: - Not feasible as planned; icebreaker unavailable for winter work.

c. Delivery of final report: - Project was continued in FY '77, rather than terminated.

B. Problems encountered/recommended changes

None.

C. Estimate of funds expended

See attached.

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OCS COORDINATION OFFICE

University of Alaska

ENVIRONMENTAL DATA SUBMISSION SCHEDULE

DATE: March 31, 1977

CONTRACT NUMBER: 03-5-022-56 T/O NUMBER: 8 R.U. NUMBER: 194

PRINCIPAL INVESTIGATOR: Dr. F. H. Fay

Submission dates are estimated only and will be updated, if necessary, each quarter. Data batches refer to data as identified in the data management plan.

Cruise/Field Operation	Collection Dates		Estimated Submission Dates[1]
	From	To	Batch 1
Alaska Peninsula	7/23/75	7/24/75	submitted
Kotzebue Sound	7/17/75	7/20/75	submitted
Kotzebue Sound	7/22/75	7/24/75	submitted
St. Lawrence Is.	8/8/75	8/22/75	submitted
Alaska Peninsula	Summer 1976		submitted
Kotzebue Sound	Summer 1976		submitted
	All FY '76 data have been submitted		

Note: 1 Data Management Plan has been approved by M. Pelto; we await approval by the Contract Officer.

Environmental Assessment of the Alaskan Continental Shelf

Annual Reports of Principal Investigators for the year ending March 1977

Volume I. Receptors — Mammals

Outer Continental Shelf Environmental Assessment Program

Boulder, Colorado

March 1977

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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