

ANNUAL REPORT

Contract # 03-5-022-69
Research Unit #243
1 July 1975 - 1 April 1976
Pages: 15

Population assessment, ecology and trophic relationships
of Steller Sea Lions in the Gulf of Alaska

Principal Investigators:

Donald Calkins, Marine Mammals Biologist
Kenneth Pitcher, Marine Mammals Biologist
Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, Alaska 99502

I. Summary

This project is a broadly based investigation into the population status and biology of the Steller sea lion in the Gulf of Alaska. Basic objectives are to provide information on population status, seasonal distribution, movement patterns, population composition and segregation and use of critical habitat. We are also examining food habits and basic trophic relationships. Reproductive biology is being examined in order to provide the parameters necessary for population productivity calculations. Other objectives include collection of data on growth, pathology and environmental contaminant levels.

The project is designed to closely examine the potential impact of development associated with exploration for and development and transport of crude oil and natural gas reserves in the Gulf of Alaska. Delineation of rookeries, hauling grounds, feeding areas and their seasonal use patterns are very necessary as it has been shown that disturbance can modify use and even cause abandonment (Thorsteinson and Lensink 1962, Pike and Maxwell 1958). Population level and productivity should be determined before development in order to evaluate possible effects. Knowledge of the degree of segregation is important so that localized kills or disturbances can be evaluated in terms of importance to the total population. The importance in establishing trophic relations in the Gulf is evident. Activities which reduce basic productivity would eventually reduce the carrying capacity for high level consumers such as sea lions.

Branding activities on Sugarloaf and Marmot Islands were successful in marking 1319 sea lions. Observations made 3 months later indicated that at least some pups remained near the pupping rookeries for that length of time. Distribution surveys were conducted along the Kenai coast and around northern Afognak and Shuyak Islands in October. Six previously unrecorded hauling areas have been identified. To date gadids, particularly Theragra, have been the dominant prey species. Collecting activities have provided further evidence that segregation of sex and age classes probably does occur.

II. Introduction

A. This investigation of Steller sea lions (Eumetopias jubatus) in the Gulf of Alaska is a broadly based undertaking designed to provide basic information about population status, distribution, movement patterns, segregation, use of critical habitat, population composition and dynamics, growth, pathology, food habits and trophic relationships. Achievement of these goals is being accomplished through concurrent subprojects involving: (1) aerial photographic census and distribution surveys; (2) autecological investigations; and (3) a study of food habits and trophic relationships. The project will require four years, however much of the population census work is being completed the first year.

B. Basic objectives of the project are as follows:

To determine numbers and biomass of Steller sea lions in the Gulf of Alaska. To establish sex and age composition of groups of sea lions utilizing the various rookeries and hauling grounds. To determine patterns of animal movement, population identity and population discreteness of sea lions in the Gulf. To determine changes in seasonal distribution.

To investigate population productivity and growth rates of Steller sea lions in the Gulf of Alaska with emphasis on determining; age of sexual maturity, overall reproductive rates, age specific birth rates and duration of reproductive activity.

To determine food habits of Steller sea lions in the Gulf of Alaska with emphasis on variation with season, area and habitat type. An effort will be made to relate food habits with prey abundance and distribution.

To collect information on pathology, environmental contaminant loads and use of critical habitat.

C. Population numbers and seasonal distribution of sea lions should be determined before exploration and development begin. It has been demonstrated that disturbance can cause changes in sea lion distribution and even cause abandonment of an area (Thorsteinson and Lensink 1962, Pike and Maxwell 1958). Information on movement patterns and the composition of groups of animals occupying various locations is important in order to evaluate possible effects should disturbance or kills occur in localized areas.

Baseline data on reproduction and population dynamics should be collected before development begins. These data are necessary so that post development changes can be evaluated.

The sea lion is a dominant high level carnivore in the marine system of the Gulf of Alaska. Oil and gas exploration and development have the potential of greatly affecting basic productivity and the abundance of prey species. Therefore the importance of establishing trophic relationships is evident.

Oil and gas exploration and development could possibly increase levels of various environmental contaminants which are concentrated in top-level consumers such as the sea lion. Baseline levels should be established.

III. Current State of Knowledge

A reservoir of general knowledge exists on pinnipeds but specific information on sea lions in the Gulf of Alaska is lacking. With the exception of the Prince William Sound area, population assessment studies have not been carried out in the Gulf since 1956-1958 (Mathisen and Lopp 1963). Changes in seasonal distribution are only partially known. In general, it appears there is considerable movement from exposed summer rookeries to more sheltered wintering areas. There is no information about the proportions or composition of animals involved in such movements, nor the direction, rate or extent of movement. Large scale movements of Steller sea lions in Oregon have been noted by Mate (1973). Bartholomew and Boolootian (1960) suggested that seasonal migratory movements were correlated with age and sex in California. Seasonal movements are known to occur in British Columbia although they are not fully understood (Spalding 1964 and Smith 1972).

Composition of animals using the various rookeries and hauling grounds in the Gulf of Alaska is unknown although some degree of sex and age segregation obviously takes place. Data collected from various sea lion rookeries in Prince William Sound suggested they were not a discrete population but that there might be considerable interchange with other areas, possibly from the large rookeries of the Kenai Peninsula and Kodiak area (Pitcher and Vania 1973).

Adequate information is lacking on reproduction and growth in the Steller sea lion. Data from other species of marine mammals (Sergeant 1966, 1973) suggest that population productivity may be a good indicator of relationship to carrying capacity. Laws (1959) showed that seals with plentiful food supplies grew faster and became sexually mature earlier, thus increasing population productivity. There are some indications that reproductive rates of sea lions in Alaska are lower than in other portions of their range (Brooks 1957, Pike and Maxwell 1958 and Thorsteinson and Lensink 1962).

Previous studies of food habits have been incidental in nature and all were done during summer months. Fiscus and Baines (1966) reported on the stomach contents of four animals taken in the Gulf. Species encountered included: Ammodytes, Mallotus, Sebastes, cottids and cyclopteridae. Imler and Sarber (1947) found Theragra, Oncorhynchus, Platichthys, Microgadus, Hippoglossus atheresthes, Raja and Octopus in seven sea lions collected from the Barren Islands, Chiswell Island and Kodiak. Thorsteinson and Lensink (1962) reported on nine animals which contained food items from Marmot Island. They identified rockfishes, greenlings, sandlances and cephalopods.

IV. Study area

Population assessment activities are being conducted at rookeries and hauling grounds in the Gulf of Alaska from Cape Spencer to Scotch Cap on Unimak Island. Specific sampling areas from which we have collected or plan to collect sea lions include Kayak Island, Middleton Island, Prince William Sound, the Kenai Coast, Barren Islands and the Kodiak area.

V. Sources, Methods and Rationale of Data Collection

Sea lion population data have been collected by three major methods. The first is aerial surveys of sea lion rookeries and hauling areas along the coast of the Gulf of Alaska. Recent procedures for aerial surveys of sea lions have proven quite effective because of the considerable body of information available about sea lion behavior and seasonal and diurnal activities (Orr and Poulter 1967, Sandegren 1970, Mate 1973, Bigg 1973, Fiscus 1969 and Fiscus and Baines 1966). Aerial surveys of hauling areas consist of flying by in either fixed-wing aircraft or helicopters and photographing all hauled out animals with hand held, motor driven 35 mm cameras. The rookeries are approached to within 50 meters at an altitude of approximately 200 meters and overlapping photos are taken. From the developed photos a mosaic is constructed and numbers of animals are counted.

The second method of data collection on sea lion populations consists of visiting selected rookeries for sex and age composition counts and marking pups. The marking system presently in use is that of highly visible hot brands (Smith et al. 1973, Rand 1950, Scheffer 1950, Chittleborough and Ealey 1951). These brands are standard cattle type brands applied to the front shoulder of the sea lion pup. The iron, heated by propane gas, measures approximately 4 cm by 8 cm. Seven rookeries have been selected for branding on the basis of numbers of pups produced. The rookeries where pups are to be branded are Marmot Island which is off the east side of Afognak Island, Sugarloaf Island in the Barren Islands, Outer Island one of the Pye Islands off the eastern Kenai coast, the Chiswell Islands off the eastern Kenai coast, Fish Island in the Wooded Islands off Monague Island in Prince William Sound, Seal Rocks between Montague Island and Hinchinbrook Island in the entrance to Prince William Sound and Pinnacle Rock at Cape St. Elias.

Branding takes place in late June and early July shortly after the pups are born. Gothic style letters are used and are coded to the specific rookeries. Through the use of letter brands applied to different areas on the animal, it is possible to mark pups for several years and still distinguish between age classes and location of birth. Recovery of branded animals is through the collection of individuals and during sex and age composition counts on specific rookeries and hauling areas.

The third method of collecting information on sea lion populations has been through observations made while aboard vessels engaged in collecting sea lions and harbor seals. Crews of these vessels generally have contributed local knowledge about sea lion populations.

Data on growth, development, condition, reproduction, food habits, pathology and environmental contaminant loads are being obtained from the analysis of specimen materials from collected sea lions. These animals are being collected systematically from different areas throughout the year. This is being done to detect variations in food habits and body condition with season, area and habitat type.

Weights and standard measurements are taken from each collected animal including: total weight, blubber weight, standard length, curvilinear length, axillary girth, and blubber thickness (Scheffer 1967). These data are being collected to establish growth rates and assist in making calculations of biomass.

The ovaries and uterus are taken from each female and preserved in formalin. Standard laboratory techniques for reproductive analysis are used through which the presence or absence of a conceptus in the uterus is determined and a partial reproductive history is reconstructed by examination of ovarian structures. These data are necessary for determination of ages of sexual maturity and age specific birth rates which are basic parameters required for population productivity calculations.

Testes and epididymides from each male sea lion are collected and preserved. A microscopic examination is made of epididymal fluid to determine whether sperm are present or not. This is necessary for determination of age of sexual maturity and periods of seasonal potency in males.

Age determinations are being made for each animal. This is done by decalcifying a tooth from each animal, using a microtome to produce thin sections, staining the thin sections with hematoxylin and counting the annual growth rings with the aid of a microscope (Johnson and Lucier 1975). Age determinations are necessary for assessment of growth rates and to determine population structure and productivity.

Stomach contents from each animal were preserved in formalin, weights and volumes were determined for all contents. Identifications of prey species were made by examination of recognizable individuals and skeletal materials of diagnostic value. Frequency of occurrence of prey species was then determined.

Intestinal contents from each sea lion were strained through mesh sieves to recover fish otoliths. Otoliths, which are diagnostic to species, were compared to a reference collection and identified (Fitch and Brownell 1968). Tissue samples are being collected and frozen so that baseline levels of heavy metals, pesticide residues and hydrocarbons eventually can be determined.

VI. Results

One survey was completed in October 1975 in conjunction with RU 240. This survey covered the sea lion rookeries along the Kenai Peninsula and Kodiak Island (Figs. 1 and 2). The rookeries surveyed and visual estimates of sea lions are shown in Table 1.

Table 1. Sea lion rookeries surveyed October 1975.

Rookery	Visual est.	Rookery	Visual est.
Cape Puget	0	Nuka Point	0
Cape Junken	0	Gore Point	2
Barwell Island	0	East Chugach Island	0
Hive Island	0	Perl Island	70
Rugged Island	0	Sugarloaf Island	4588
Chat Island	0	Nagahut Rocks	1
Chiswell Island	3251	Cape Elizabeth	69
Seal Rocks (Kenai)	155	Flat Island	0
Outer Island	6300	Latax Rocks	625
Tonki Cape	0		
Sealion Rocks	625		
Marmot Island	7995		
Sea Otter Island	290*		

* Not previously identified as a sea lion hauling area.

The next scheduled survey is in progress at this time and will be reported on at a later date. This survey is designed to cover all the sea lion haul outs in the entire study area and will provide information on winter distribution and haul out use.

Through our surveys, collecting activities and interviews with vessel crews, the following previously unreported haul-outs have been located:

1. Sea Otter Island (off Afognak I.)
2. Steep Cape (S.W. side of Afognak I.)
3. Raspberry Island (Shelikof Strait)
4. Raspberry Island (Kupreanof Strait)
5. Noisy Island (on S.W. side of Uganik I.)
6. Uganik Island (on N.W. side)

Sea lion branding was accomplished at Sugarloaf Island and Marmot Island in July 1975. The pups were branded with an X at Sugarloaf and an O at Marmot. A total of 1319 pups were branded; 373 males and 346 females at Sugarloaf and 320 males and 280 females at Marmot.

To date 8 sea lions have been collected; 18 from Prince William Sound, five from Kodiak and 3 from the Kenai Coast. Preliminary food habit analyses have been completed from the Prince William Sound animals (Table 2). Gadids were the dominant food items composing 72 percent of the total occurrences. Theragra was the major species making 48 percent

Figure 1. Sea lion rookeries and hauling areas along the Kenai Coast.

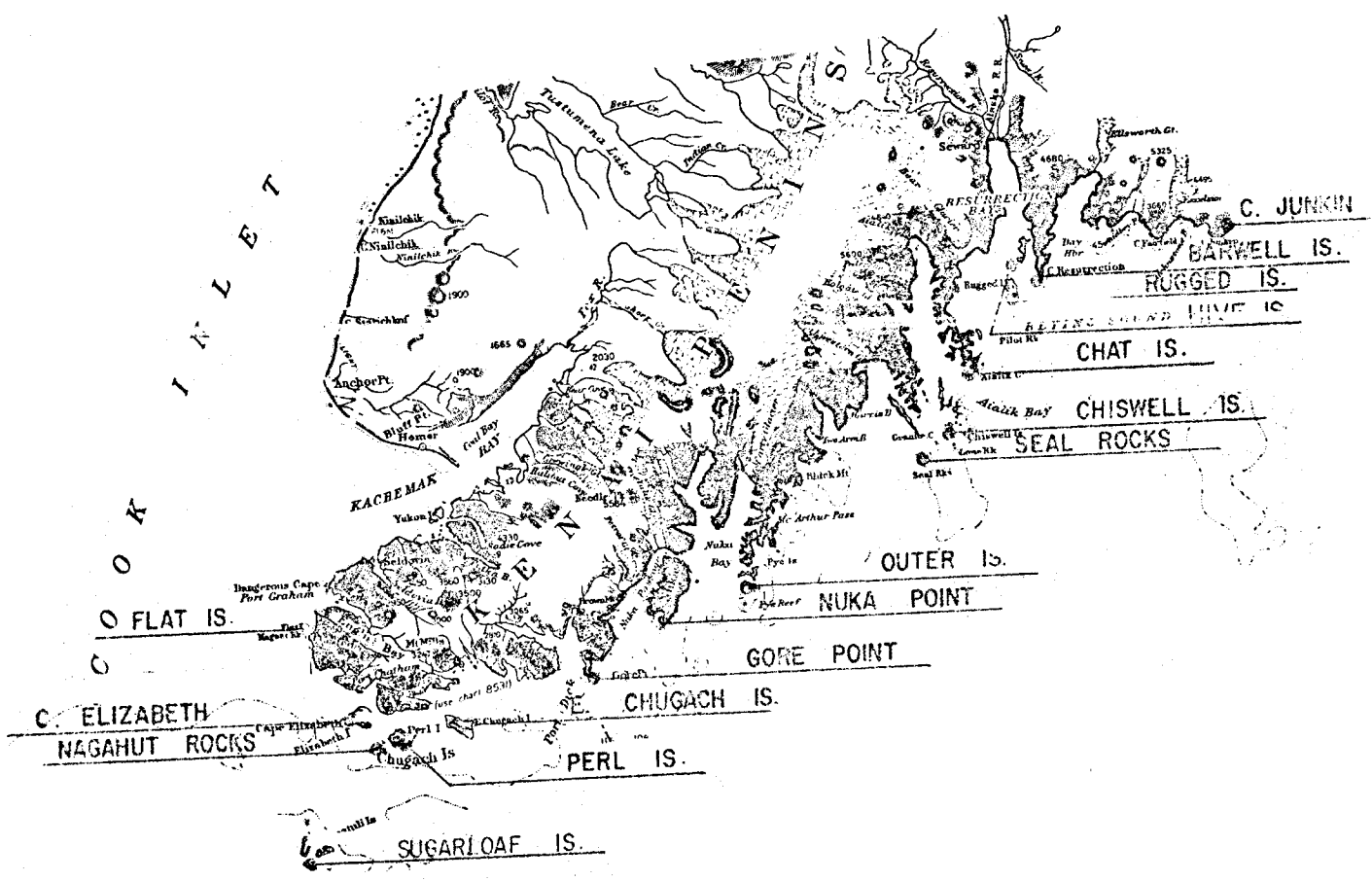
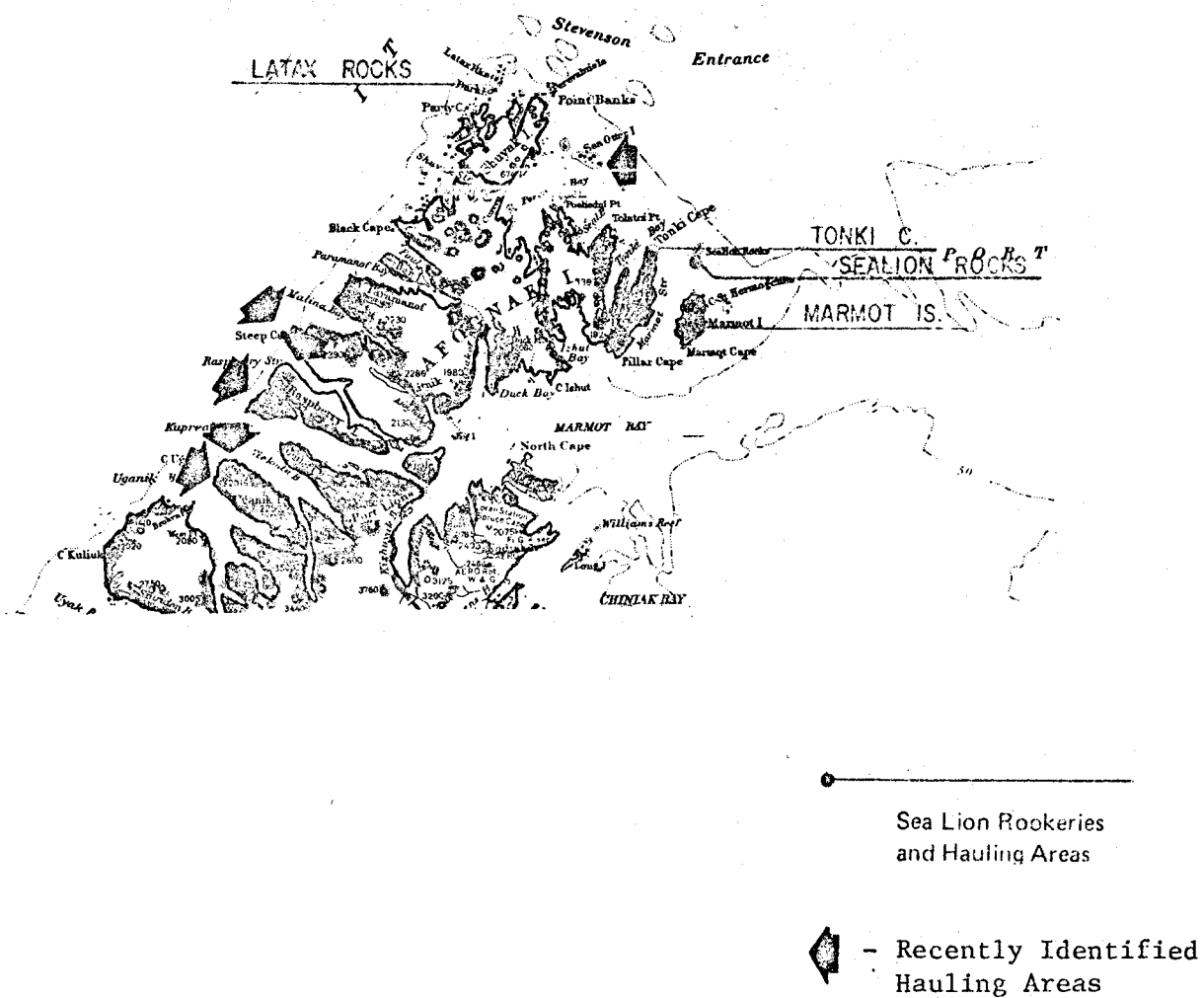


Figure 2. Sea lion rookeries and hauling areas - Northern Kodiak and Afognak Area.



of the total. In this report we will only look at frequency of occurrence, however, data are being collected on weights, volumes and number of individuals and will be presented in the final report. Of particular interest is one animal which had stomach contents (exclusively Theragra) totaling 7.9 percent of its body weight.

Table 2. Frequency of occurrence of sea lion food items.

Food Items	Number of Occurrences	Percentage of Occurrences
Gadidae (Total)	18	72%
<u>Theragra</u>	12	48%
<u>Gadus</u>	4	16%
<u>Eleginus</u>	2	8%
Clupeidae (Total)	2	8%
<u>Clupea</u>	2	8%
Pleuronectidae (Total)	2	8%
<u>Platicthys</u>	1	4%
unid. pleuronectid	1	4%
Cephalopoda (Total)	3	12%

Work is still underway to develop a satisfactory technique for age determination of Steller sea lions, however tentative ages have been assigned to 15 of the sea lions collected in Prince William Sound. Weights and measurements are also presented in Table 3. Not enough data are available to construct growth curves or develop seasonal condition patterns.

Reproductive analyses have been completed on the four females from Prince William Sound (Table 4). SL-1-75, tentatively aged at 3-4 years, was pregnant apparently for the first time. No evidence of a previous pregnancy or ovulation were found. SL-2-75, tentative age 9 years, was pregnant and lactating. SL-3-75, aged at 7 years, was pregnant but not lactating. Each appeared to have produced a minimum of one previous pup. Cord-1-75 has not been aged but is either an 8-month-old pup or a yearling. It was nulliparous, and showed no follicular activity.

Table 3. Age, growth and condition data from collected sea lions.

Number	Sex	Age	Weight	Standard Length	Blubber Thickness
SL-5-76	MM	-	70.0 Kg	168.5 cm	1.4 cm
PWS-5-75	MM	-	77.3 Kg	164.0 cm	1.3 cm
PWS-6-75	MM	-	69.5 Kg	172.0 cm	1.5 cm
SL-4-76	MM	-	160.0 Kg	187.0 cm	3.0 cm
SL-4-75	MM	2-3	175.0 Kg	197.0 cm	2.4 cm
SL-12-75	MM	2-3	200.0 Kg	202.0 cm	2.5 cm
SL-7-75	MM	3-4	205.0 Kg	195.0 cm	2.8 cm
SL-14-75	MM	3-4	230.0 Kg	205.0 cm	5.0 cm
SL-13-75	MM	3-4	240.0 Kg	218.0 cm	3.0 cm
SL-5-75	MM	4+	255.0 Kg	207.0 cm	3.0 cm
SL-10-75	MM	3-4	260.0 Kg	222.0 cm	2.6 cm
SL-9-75	MM	3-4	305.0 Kg	227.0 cm	2.9 cm
SL-8-75	MM	2-4	320.0 Kg	-	3.2 cm
SL-6-75	MM	3	334.0 Kg	226.0 cm	4.0 cm
SL-11-75	MM	3-4	370.0 Kg	-	3.5 cm
SL-15-75	MM	5	375.0 Kg	249.0 cm	3.0 cm
SL-1-75	FF	3-4	210.0 Kg	-	2.4 cm
SL-3-76	FF	-	215.0 Kg	217.5 cm	3.0 cm
SL-2-75	FF	9+	255.0 Kg	-	3.5 cm
SL-1-76	FF	-	258.0 Kg	228.0 cm	3.0 cm
SL-3-75	FF	7+	280.0 Kg	229.5 cm	4.9 cm
SL-2-76	FF	-	315.0 Kg	227.0 cm	4.5 cm

Table 4. Reproductive status of four female sea lions collected from April 1975 to December 1975.

Number	Tentative Age	Pregnant Yes-No	Status	Comments
Cord-1-75	8 mos.-or 20 mos.	No	Nulliparous	No follicular activity
SL-1-75	3-4 yrs.	Yes	Primiparous	No corpus albicans, or placental scars, 2.2g fetus
SL-2-75	9 yrs.	Yes	Multiparous	Lactating, 23.g fetus
SL-3-75	7 yrs.	Yes	Multiparous	Not lactating, 14.4 g fetus, possible corpus albicans

C. Tissue samples

Various tissue samples have been taken from each sea lion collected under this program. Liver, muscle, blubber and kidney samples have been taken for heavy metals, hydrocarbon and pesticide analyses, liver, kidney and whole blood have been taken for blood chemistry studies and sera have been preserved for pathology studies.

VII. & VIII. Discussion and Conclusions

It is important to recognize that although this report is written to meet the annual report requirements, the project has not been in progress for the full year. Funding of this project did not begin until July 1, 1975 for a total working period of seven months. Much has been accomplished in this short period although the bulk of the work is yet to come. As has already been mentioned, the winter survey is now in progress and is expected to be completed by mid-March. A summer survey of all the rookeries and hauling areas in the Gulf is planned for mid-June. In late June and early July extensive branding is planned for the seven rookeries. Collecting trips are scheduled for March, April and May.

It is difficult to draw any conclusions from the data collected at this time. No complete surveys have been flown and the recovery phase of the branding program has not yet started. Some interesting points have been noted and will be discussed here.

On the October collecting trip, 14 sea lions were collected in Prince William Sound. Of these 14, eight were collected in the area of Port Bainbridge in one day; these 8 were all subadult males and were taken from several large groups of sea lions, all of which appeared to be males. This brings up some interesting questions about sexual segregation in sea lions. We have known for some time that sexual segregation does occur, particularly at some of the haul out areas, but in most cases it is not known to what degree this occurs. It is also unknown how age specific this segregation is. Large oil spills or disturbances could have far reaching effects on sea lion populations if they were concentrated on specific sex and age classes of the population.

Several hauling areas have been located which were previously unreported in the literature. All of these are on the north end of the Kodiak Archipelago. Inclusion of these areas in the literature is essential if consideration is to be given to protecting them from oil and gas development related disturbance.

Of the tissue and blood samples collected to date, analysis has only begun on those taken for blood chemistry studies. These studies are directed towards population identity and discreteness.

The most important finding to date in the food habits studies is the dominance of gadids, Theragra in particular. None of the

previous workers in the Gulf (Fiscus and Baines 1966, Imler and Sarber 1947 and Thorsteinson and Lensink 1962) reported gadids as common food items. It is important to continue sampling to see if the present pattern continues in other areas and seasons of the year.

Not enough progress has been made in the reproductive work to draw any firm conclusions. One finding of particular interest is a 3-4 year old primiparous female which provides some insight into age of sexual maturity. Virtually no information is presented in the literature on age of sexual maturity, frequency of breeding, pregnancy rates or duration of reproductive activity. Mathisen et al. (1962) reported females between the ages of 9 and 22 years were breeding in the Shumagin Islands. Thorsteinson and Lensink (1962) working on Marmot Island found that 160 harem bulls between 6 and 17 years were potent. These animals were collected between 27 May and 15 July. They felt that all males were sexually mature by 6 or 7 years of age.

IX. Needs for further study

In addition to the activities planned for the remainder of the contract period it is essential that we gather more information on the specifics of sex and age classes using the different rookeries and hauling areas and the extent of segregation. In the future it will be necessary to execute activities primarily designed to locate branded animals away from the rookeries where they were branded.

Collecting of sea lions should continue until a sample sufficiently large to determine foods habits by season, area and habitat type is obtained. This same sample should provide enough reproductive material to establish the basic parameters necessary for population productivity calculations.

Consideration should be given to developing a radio-tracking technique for sea lions. Once developed the technique would rapidly provide badly needed information on movements, seasonal distribution, feeding areas and habitat utilization.

Investigations into the life histories of important prey species should be undertaken. Particular emphasis should be given to potential effects of oil and gas exploration and development on these species.

Studies should be initiated to determine what makes a particular haul out or rookery more desirable than other similar locations. It is important that we better understand the extent and limitations of areas critical to sea lions.

X. Summary of fourth quarter activities

A. Field and laboratory activities

1. Field Activities

- a. 28 Oct.-4 Nov. 1975. M.V. "Montague" (ADF&G) Prince William Sound
- b. 3 - 13 Feb. 1976, M.V. "Resolution" (ADF&G) Kodiak, Afognak, Shuyak
- c. 1 - 15 March 1975 - Winter distribution surveys charter aircraft.
- d. 16 - 23 March 1976 - M.V. "Big Valley" (charter) Kenai Coast.

2. Scientific party

- a. Karl Schneider - ADF&G - PI #243
- b. Don Calkins - ADF&G - PI #243, Co PI #229
- c. Kenneth Pitcher - ADF&G - PI #229, Co. PI #243
- d. Various employees - ADF&G - Field and laboratory assistants.

3. Methods - see section V. Annual report.

4. Sample Localities

- a. Prince William Sound
- b. Kenai Peninsula - outside coast
- c. Northern Kodiak, Afognak and Shuyak Islands

5. Data collected and analyzed

- a. During the Oct. - Nov. 1975 cruise, 14 sea lions were collected in southwestern Prince William Sound. The Feb. 1976 cruise in the Kodiak area produced five additional animals. The March trip along the Kenai coast produced 8 sea lions.
- b. Preliminary identifications were made of the food items from the animals collected in Prince William Sound.
- c. Reproductive analyses were completed for the female sea lions collected in Prince William Sound.
- d. Preliminary ages were assigned to 15 of the sea lions.

LITERATURE CITED

- Bartholomew, G. A. and R. A. Boalootian. 1960. Numbers and population structure of the pinnipeds of the California Channel Islands. *J. Mamm.* 41(3):366-375.
- Bigg, M. A. 1973. Census of California sea lions of southern Vancouver Island, British Columbia. *J. Mamm.* 54(1):285-287.
- Brooks, J. W. 1957. Annual report No. 9. Alaska Dept. of Fish and Game.
- Chittleborough, R. G. and E. H. M. Ealey. 1951. Seal marking at Heard Island, 1949. Interim Reports of Australian Natl. Antarctic Res. Expeditions. Issued by the Antarctic Division, Dept. of External Affairs, Melbourne, Oct. 1951.
- Fiscus, C. H. 1969. Steller sea lions at Ugamak Island, Aleutian Islands Alaska. Dept. of Interior, Marine Mammal Laboratory. Unpublished report.
- _____ and G. A. Baines. 1966. Food and feeding behavior of Steller and California sea lions. *J. Mamm.* 47(2):195-200.
- Fitch, J. and R. Brownell. 1968. Fish otoliths in cetacean stomachs and their importance in interpreting feeding habits. *J. Fish. Res. Bd. Canada.* 25(12)
- Imler, R. H. and H. R. Sarber. 1947. Harbor seals and sea lions in Alaska. USFW Serv. Spec. Rep. 28, 22p.
- Johnson, A. and C. Lucier, 1975. Hematoxylin hot bath staining technique for aging by counts of tooth cementum annuli. Alaska Dept. of Fish and Game. Unpubl. report. 29pp.
- Laws, R. M. 1959. Accelerated growth in seals with special reference to the Phocidae. *Norwegian Whaling Gaz.* 9:425-452.
- Mate, B. R. 1973. Population kinetics and related ecology of the northern sea lion, Eumetopias jubatus, and the California sea lion, Zalophus Californianus, along the Oregon coast. PhD. thesis. Univ. Oregon. Dept. Bio. 93pp.
- Mathisen, O. A., R. J. Bade and R. J. Lopp. 1962. Breeding habits, growth and stomach contents of the Steller sea lion in Alaska. *J. Mamm.* 43(4):469-477.
- _____ and R. J. Lopp. 1963. Photographic census of the Steller sea lion herds in Alaska, 1956-58. USFW Serv. Sp. Scientific Rep. Fisheries No. 424.
- Orr, R. T. and T. G. Poulter. 1967. Some observations on reproduction, growth and social behavior in the Steller sea lion. *Proc. Calif Acad. of Sciences* 35(10):193-226.

- Pike, G. C., and B. E. Maxwell. 1958. The abundance and distribution of the northern sea lion (Eumetopias jubata) on the coast of British Columbia. J. Fish. Res. Bd. Canada. 15:5-17.
- Pitcher, K. W. and J. S. Vania. 1973. Distribution and abundance of sea otters, sea lions and harbor seals in Prince William Sound, Alaska. Summer 1973, a preliminary report. Alaska Dept. Fish and Game. Anchorage, Alaska. mimeo.
- Rand, R. W. 1950. Branding in field-work on seals. J. Wild. Man. 14(2).
- Sandegren, F. E. 1970. Breeding and maternal behavior of the Steller sea lion (Eumetopias jubata) in Alaska. MSc. Thesis. Univ. Alaska, College, Alaska 138pp.
- Scheffer, V. B. 1950. Experiments in the marking of seals and sea lions. U. S. Dept. of Interior. Fish and Wildlife Service. Spec. Sci. Report No.4.
- _____. 1967. Standard measurements of seals. J. Mamm. 48(3).
- Sergeant, D. E. 1966. Reproductive rates of harp seals (Pagophilus groenlandicus). J. Fish Res. Brd. Canada. 23(5).
- _____. 1973. Feeding, growth and productivity of northwest Atlantic harp seals (Pagophilus groenlandicus). J. Fish. Res. Brd. Canada. 30(1):17-29.
- Smith, I. D. 1972. Sea lions wintering along the outer coast of Vancouver Island. J. Fish. Res. Brd. Canada 29(12):1764-1766.
- Smith, T. G., B. Beck and G. A. Sleno. 1973. Capture, handling and branding of ringed seals. J. Wildl. Mgmt. 37(4):579-583.
- Spalding, D. J. 1964. Comparative feeding habits of the fur seal, sea lion and harbor seal. Fish. Res. Brd. Canada, Bull. 146 52pp.
- Thorsteinson, F. V. and C. J. Lensink. 1962. Biological observation of Steller sea lions taken during an experimental harvest. J. Mamm. 26(4):353-359.

100 for CRD J
Kodeal

Volume 1. Marine Mammals

Principal Investigators' Reports
for the Year Ending March 1976

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

