Northwest and
Alaska
Fisheries Center

National Marine
Fisheries Service

U.S. DEPARTMENT OF COMMERCE

# NWAFC PROCESSED REPORT 83-15

# Incidental Catch of Northern Sea Lions

## During the 1982 and 1983 Walleye Pollock Joint Venture Fishery, Shelikof Strait, Alaska

August 1983

This report does not constitute a publication and is for information only. All data herein are to be considered provisional.

# NOTICE

This document is being made available in .PDF format for the convenience of users; however, the accuracy and correctness of the document can only be certified as was presented in the original hard copy format.

Inaccuracies in the OCR scanning process may influence text searches of the .PDF file. Light or faded ink in the original document may also affect the quality of the scanned document.

# INCIDENTAL CATCH OF NORTHERN SEA LIONS DURING THE 1982 AND 1983 WALLEYE POLLOCK JOINT VENTURE FISHERY, SHELIKOF STRAIT, ALASKA

by

Thomas R. Loughlin and Robert L. DeLong

National Marine Mammal Laboratory
Northwest and Alaska Fisheries Center
National Marine Fisheries Service, NOAA
7600 Sand Point Way N.E., Bldg. 32
Seattle, Washington 98115

August 1983

# INTRODUCTION

Northern (Steller) sea lions (Eumetopias jubatus) have long been blamed for damaging fishing gear and caught fish, often becoming entangled in nets themselves. They have been caught incidentally in the foreign commercial trawl fisheries in the Bering Sea and Gulf of Alaska since about 1954 when those fisheries developed. During the period 1978 - 1981, they were the predominant incidentally caught marine mammal species with a total of 268 observed by U.S. fisheries observers stationed on 10% of the foreign commercial fishing vessels; the total estimated annual take during this period by foreign vessels averaged 724 animals (Loughlin et al. in press a). This estimate does not include those taken by domestic fishermen, including domestic fishermen participating in joint venture fisheries. Many of the incidentally caught sea lions were alive when brought aboard the foreign trawl vessel (up to 34% in 1979) and escaped over the side once released from the net. Joint venture fisheries composed of U.S. trawlers fishing for foreign processors have experienced nearly 100% mortality of sea lions caught in the trawls. The contents of the cod end of the nets are enclosed by being tied-off after haul-back by the domestic crew and they may remain in the water for long periods of time prior to transfer and hoisting aboard the foreign processor.

Even though the mortality rate of sea lions caught in joint venture fisheries was high, the number of animals caught prior to 1982 was low and it is assumed that there was little impact to local sea lion populations up to that time. However, during the 1982 walleye pollock (Theragra chalcogramma) joint venture fishery in Shelikof Strait, near Kodiak

Island, Alaska, trawls were reported with as many as 100 dead sea lions caught in the nets. As the fishery progressed, the number of animals caught increased significantly causing concern over the potential impact of this take on local populations. Subsequently, staff at the National Marine Mammal Laboratory (NMML) and Resource Assessment and Conservation Engineering Division (RACE) of the Northwest and Alaska Fisheries Center (NWAFC), initiated a research program to assess the nature and magnitude of incidental catch of sea lions during the 1983 walleye pollock joint venture fishery. This report presents information collected by U.S. fishery observers stationed on the foreign processors during 1982 and a summary of the 1983 research effort.

## SUMMARY OF THE FISHERY

The Shelikof Strait walleye pollock joint venture fishery began in 1980 when 950 metric tons (t) of walleye pollock were caught by U.S. catcher boats and delivered to South Korean processors (the joint venture fishery took a total of 1,900 t of fish in the entire Gulf of Alaska). The fishery expanded rapidly and 17,000 t were landed in 1981 and again delivered to South Korean processors; 74,136 t were taken in 1982, and 131,390 t in 1983. Japanese, South Korean, and Polish processors were involved in the fishery in 1982; in 1983 only the Japanese and South Korean processors were involved. The fishery developed to take advantage of enormous spawning schools of walleye pollock aggregating in the Shelikof Strait-Simidi Islands region between January and March. Operationally, domestic boats catch the fish using a mid-water trawl. The cod ends containing fish are detached from the trawl net and delivered to foreign vessels for processing. The processors

can accommodate only a limited amount of fish per unit of time; thus the delivery of cod ends to the processor is timed such that a continuous supply of fish is available for processing, 24 hours a day. Each foreign processor is served by 1 to 10 domestic catcher boats, depending on the size of the processor. Sea lions caught in the net are removed aboard the foreign processor but are legally the responsibility of the domestic boat that caught them. The processors produced surimi (a minced fish-meat product), roe, whole fish, and fish meal.

The fishery is expected to expand in both the number of foreign and domestic vessels involved and the amount of fish landed. Two major concerns regarding this expansion are the continued incidental catch of northern sea lions and the amount of waste fish (fish that are caught but not landed).

The problem of waste fish arose because the walleye pollock aggregations are so numerous and dense that often quantities of fish were caught in excess of what the processors could handle and still maintain a good product. The excess fish were discarded prior to transfer of the cod end of the net and may be a major source of food, or even an attractant, to sea lions swimming near the catcher boats. Some catcher boats have installed blow-out panels in the aft part of the trawl to allow the excess fish to be bled off during haul back (Charles W. West, pers. commun.). Most of the excess fish were dead once caught and discarded at the surface.

## SUMMARY OF NORTHERN SEA LION INFORMATION

Adult males grow to 3.0 m in length and over 900 kg in weight; they mature sexually between 5 and 7 years of age and most are able to obtain and defend territories on the breeding colonies between 9 and 13 years of age. Adult females reach 2.0 m and weigh almost 300 kg; they first ovulate at 3 years of age and give birth to a single pup annually. Pups weigh 16 to 23 kg and are 89 to 102 cm long; they are born between late May and early July with a peak in mid-June (Pitcher and Calkins 1981).

Northern sea lions are found in continental shelf waters from the Sea of Japan and northern Honshu Island, northward around the North Pacific Ocean rim to the Okhotsk Sea, Bering Sea, Gulf of Alaska, and southward to the California Channel Islands. The centers of distribution and abundance are the Aleutian Islands and Gulf of Alaska. The world population estimate is between 245,000 and 290,000 animals with from 95,000 to 135,000 in the northern Gulf of Alaska (Calkins and Pitcher 1982; Loughlin et al. in press b).

They eat a variety of fish and cephalopods. In the Gulf of Alaska their most common food items, listed in terms of relative importance, are walleye pollock, Pacific herring (Clupea harengus pallasi), squid, capelin (Mallotus villosus), Pacific salmon (Oncorhynchus spp.), Pacific cod (Gadus macrocephalus), and sculpin (family Cottidae) (Pitcher 1981).

## METHODS

### 1982

There was no directed marine mammal research during the 1982 joint venture fishery, however U.S. fishery observers aboard the foreign processors recorded some incidental catch data. Observer coverage amounted to 37.9% of the processor days in 1982. The observers recorded the number, and in most cases, the sex and length (standard and/or curvilinear) of incidentally caught sea lions. In a few cases upper canine teeth were removed and sent to NMML for aging. The marine mammal data were collected as an aside to the regular duties of the fisheries observer (which are substantial) and thus there was no consistency in the type or amount of data collected. In most cases, it was not possible to match the teeth from sea lions to the measurements for length since no identifying numbers were assigned to the samples. In many instances the number of caught sea lions exceeded 20 animals in one tow and the fishery observers were understandably overwhelmed and only able to collect minimal data.

### 1983

Research in 1983 consisted of four separate but related efforts. These included our intent to test an Acoustic Harrassment Device, placement of a NWAFC gear specialist aboard U.S. trawlers, sampling of sea lions after the netloads of fish were delivered to the processors, and an aerial survey of sea lion haul sites in and around Shelikof Strait.

Acoustic Harassment Device

An audible device was developed at Oregon State University (OSU) to deter pinnipeds from entering gill nets and we had hoped to have the OSU scientists test its effectiveness in deterring northern sea lions from entering trawl nets. The device emits signals within the hearing range of sea lions at decibel levels which are reportedly sufficiently loud to cause pain, depending on proximity of the animal to the source. Unfortunately, the device did not work when placed in a submersible housing during laboratory tests, and because of other logistical problems, the device was not deployed during the 1983 fishery. We intend to participate in testing the device in 1984.

NWAFC Gear Specialist

A gear specialist from the RACE Division was invited aboard several U.S. catcher boats during the 1983 fishery to gain additional information on the incidental capture of sea lions in mid-water trawls. The observer's goals were: to observe and record details of fishing strategies and techniques, vessel characteristics, trawl construction and performance, and selected environmental observations during fishing operations; to observe any interactions between sea lions and gear or vessels; to record any other sea lion behavior on the fishing grounds; and to solicit and record ideas or observations pertinent to this issue from fishermen or joint venture representatives aboard processor ships. The observer was at sea from 10 March 1983, through 22 March 1983, and made observations from two catcher vessels: the Sunset Bay (10-16 March) and the Neahkanie (16-22 March).

The results from this study are being prepared as a separate report and are not yet available. Inquiries regarding its status should be directed to Charles W. West, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, 7600 Sand Point Way NE, Bldg. 32, Seattle, WA 98115.

Sampling Caught Sea Lions

One additional observer (hereafter marine mammal observer) was placed aboard each of 8 different foreign processors (3 Japanese and 5 Korean) during late March and early April to assist the primary fishery observer in collection of fisheries data, collect biological samples, and make a variety of observations relating to sea lions. Each sea lion brought aboard was checked for brands, tags, or bullet wounds; the curvilinear and standard length and sex were recorded (Fig. 1); the snout behind the second post-canine tooth was removed for subsequent aging of canine tooth dentine layers; the reproductive tract was collected and stored in 10% buffered formalin; the fetus, if present, was measured and sexed; and each stomach was removed and examined for contents by straining the contents through sieves after volumetric measurement. Identifiable fish were noted by species and number and the fork length was measured. Otoliths, other fish parts, and cephalopod beaks were stored in 10% buffered formalin for later identification. A summary of the characteristics of each tow, including marine mammal catch information, was recorded on prepared forms (Fig. 2).

When not taking marine mammal samples, the marine mammal observer noted the occurrence of sea lions in relation to time of day, discarding

of fish by-products by the processor, and distance from shore or known haul-out sites. They also assisted the fishery observers in their duties.

The marine mammal observers were aboard during late March through early April. Our original intent was to place these observers aboard during the entire month of April (when 80% of the sea lions were caught in 1982, see below) but the fishery ended earlier than expected, thus limiting the time that they were aboard. The fishery observers were aboard during the entire joint venture fishery (January to March-April) and they recorded incidentally caught sea lions seen by them during those times when the marine mammal observer was not aboard. Some teeth were collected by the primary fishery observer, but generally only the number, time of day, tow information, and sex (with some exceptions) were recorded.

Aerial Survey

An aerial survey was completed during 6 and 7 April of all known rookeries and haul-out sites in and around Shelikof Strait and Kodiak Island to estimate the number and distribution of northern sea lions potentially affected by the joint venture. The survey was flown in an amphibious "Widgeon" aircraft. Participants included David Withrow (NMML); Donald Calkins, Alaska Department of Fish and Game (ADF&G); and Mark Chihuly (ADF&G). Methods including altitude and air speed were as in Calkins and Pitcher (1982). Estimates were made at the time of the survey and then verified by counts from projected photographs of each site taken during the survey.

# RESULTS

## 1982

The walleye pollock joint venture fishery began in January, peaked in March, and concluded in April. Of the total pollock catch, 5.5% was landed in January, 26.5% in February, 54.0% in March, and 14.0% in April. Of the total fishery observer days allocated to the fishery, 3.6% occurred in January, 13.3% in February, 50.0% in March, and 33.1% in April (Table 1). Fishery observer coverage was 37.9% of the Shelikof fishery. Coverage increased monthly from 17% in January to 64% in April.

The monthly catch of sea lions varied from a low of 4% in February, 16% in March, and 80% in April. Pollock catch and number of observer days of sampling peaked in March, whereas 80% of the sea lions observed in the catch occurred in April. During the joint venture fishery, 528 dead northern sea lions were seen and reported by fishery observers. Assuming observers saw 100% of the sea lions hauled aboard the processor vessels, the 528 dead sea lions extrapolates to 1,393 animals for the entire fishery.

The location of the catcher boats when sea lions were caught is not known; however we plotted the location of the processors, which were usually near the catcher boats, when the animals were hauled aboard. Over 90% of the animals were caught near the central portion of Shelikof Strait over deep water and nearest the central and southern shores of the Alaska Peninsula (Fig. 3).

Of the 528 observed dead sea lions, we obtained length measurements from 294, determination of sex from 174 and teeth for aging from 43.

It was rarely clear whether the standard or curvilinear length was measured so we grouped all the length measurements together (which biased the lengths and ages based on these lengths upward). The lengths of 99 females ranged from 130 to 240 cm with a mean of 194 cm (SD = 22.4); 75 males ranged from 140 to 290 cm with a mean of 200 cm (SD = 28.7); and 120 unsexed animals ranged from 140 to 250 cm with a mean of 204 cm (SD = 21.6) (Fig. 4). Ages based on these lengths were extrapolated from standard length/age data presented by Calkins and Pitcher (1982). For the 99 females we obtained approximate ages ranging from 1 to 17 years old with a mean of 7 years old; for the 75 males the range was from 1 to 18 years old with a mean of 4 years old.

Forty-three canine teeth representing 38 females and 5 males were aged by counting dentine lines. The females ranged in age from 3 to 17 years old with a mean of 7.6 years old, and the males ranged from 3 to 10 years old with a mean of 5.8 years old (Fig. 5).

## 1983

The walleye pollock joint venture fishery began in January, peaked in March, and ended in early April (Table 1). Of the total pollock catch, 2.8% was landed in January, 31.4% in February, 64.0% in March, and 1.8% in April. Of the total fishery observer days allocated to the fishery, 3.9% occurred in January, 33.1% in February, 57.6% in March, and 5.5% in April. Fishery observer coverage for the entire fishery was 76.1%, but varied by month with 50% in January, 89.1% in February, 73.3% in March, and 68.9% in April (Table 1).

The monthly catch of sea lions varied from a low of 4% in January, 47% in February, 45% in March, and 4% in April (Table 1). During the fishery, 169 dead sea lions were observed and reported by fishery observers (Table 2). Assuming that the observers saw 100% of the sea lions hauled aboard the processors, and since observer coverage of the processor days was 76.1%, the 169 extrapolates to 222 sea lions incidentally caught during 1983. Based on preliminary tow data, 3.7% of all tows during 1983 contained sea lions; there were 0.12 sea lions per tow; and 3.3 sea lions were caught in those hauls containing sea lions (Table 2).

Fishing did not progress as far north and east in Shelikof Strait during 1983, thus the catch of sea lions was concentrated further south and west than in 1982. Most incidentally caught animals were taken between Puale Bay and Takli Island over deep water near the Alaska Peninsula and toward the center of the strait (Fig. 3).

Of the 169 dead sea lions, we obtained length measurements from 76 and sex and age from 77. The lengths of 61 females ranged from 157 to 251 cm with a mean of 215 cm (SD = 22.3); 17 males ranged from 194 to 283 cm with a mean of 233 cm (SD = 27.7) (Fig. 6).

Seventy-seven canine teeth representing 62 females and 15 males were aged by counting dentine lines. The females ranged in age from 1 to 15 years old with a mean of 6.5 years old (SD = 3.41); the males ranged in age from 2 to 7 years old with a mean of 4.7 years old (SD = 1.48) (Fig. 7).

The marine mammal observers examined 17 females 5 of which were pregnant. The fetuses consisted of four females and one male; they had

a mean weight of 9.6 kg and a mean crown-rump length of 70 cm (Table 3).

One objective of the study was to determine northern sea lion food habits while in Shelikof Strait. Stomachs from 19 sea lions examined aboard foreign processors contained principally pollock, either whole or partially digested (Table 4). Some stomachs contained small rocks of varying size, digested fish, and a few otoliths, primarily pollock. Fork lengths of undigested fish had lengths ranging from 34 to 49 cm with a mean of 39.3 cm (SD = 7.1; n = 68). For the sea lions that had measurable pollock in their stomachs, the observer obtained a sample of the fork lengths for pollock caught in the same tow as the sea lions. Fork lengths of 370 of these pollock ranged from 34 to 54 cm with a mean of 40 cm.

We also examined the time of day of the tow when sea lions were caught and the position of the sea lions in the net cod ends. Eighty-one percent of the sea lions were caught between 2000 hours and 0500 hours with most (53%) caught between 2300 hours and 0300 hours (Fig. 8). Only 11% were caught during daylight hours.

The observers recorded the position of the sea lions in the net cod ends to determine if sea lions were caught during net descent, during the tow, or during net ascent. Of 54 sea lions where the position was noted, 35 were near the top of the net, 8 were near the center, none were near the bottom, and 11 were evenly distributed throughout the net. These results suggest that most sea lions were caught during net ascent or while the net was near the surface during haul back.

Numbers of sea lions were estimated at each haul site in the Shelikof Strait area during the aerial survey; counts were made from projected

photographs of each haul site taken during the survey. The estimates made during the flights totalled 18,175 sea lions; the counts from photographs totalled 19,888 sea lions (Table 5). The largest numbers of sea lions were counted at Puale Bay (4,702), Takli Island (1,199), Marmot Island (2,743), Two Headed Island (1,870), Chirikof Island (1,285), Nagai Rocks (1,250), Latax (1,188), and Cape Chiniak (1,138).

## DISCUSSION

The number of sea lions incidentally caught and killed in the 1983 fishery (169 observed, 222 estimated) was a significant reduction from the number caught and killed in 1982 (528 observed, 1,393 estimated). To us, the likely reasons for this reduction are differences in the dates and location of the fishery in each year. During 1982 the joint venture fishery was active through April, when 80% of the sea lions were caught. During 1983 the fishery terminated in early April and was slowing appreciably in late March as foreign processors met their contractual agreements with U.S. fishermen and began leaving the area for other fishing grounds. The location of the fishery also differed each year. During 1982 the vessels fished further east and closer to shore than during 1983. We presume that during 1982 the vessels encountered more sea lions at sea further east and closer to shore than during 1983, and that there are generally more sea lions in the Shelikof Strait area during mid- to late April than during January to March. Results from past surveys by the ADF&G and our survey in early April support this presumption. Apparently sea lions begin moving into the area in greater numbers in late April and May in preparation

for breeding and pupping from late May to July on the nearby rookeries.

Modification in fishing techniques or gear may have caused or contributed to the reduction in the incidental catch of sea lions. Domestic fishermen were quick to recognize potential problems that could arise from continued high incidental catch of sea lions, from both a legal and economic standpoint. We believe that during the 1983 fishery they purposefully avoided, when possible, net sets when large numbers of animals were nearby. The few sets when large numbers of sea lions were caught were when numerous animals were in the vicinity (e.g., one tow with over 20 sea lions caught occurred when more than 100 sea lions were nearby). The installation of blow-out panels may also have reduced the number of sea lions killed by allowing some animals to escape once caught.

Large groups of sea lions at sea usually consist of subadult males and females; adult males sometimes occur in these large groups but are usually found individually. The subadult male and female groups appear to be more audacious, inquisitive, and have a propensity for following fishing vessels to feed on fish discarded during processing or to interfere with the net and other gear during the fishing operation. It is therefore not surprising to find that most sea lions incidentally caught in 1982 and 1983 were subadult males and females; few adult males were caught. Since females become sexually mature at about 4 years of age and reproduce annually (Pitcher and Calkins 1981), females caught in Shelikof Strait were likely to be sexually active members of the population. The males caught in the fishery were not likely to be

sexually active members of the population since male sea lions do not become sexually mature until about 5 years of age and are not able to obtain and defend territories until after 9 years of age.

Neither is it surprising that incidentally caught sea lions were feeding almost exclusively on walleye pollock. They were probably either in the midst of large pollock schools when caught or were caught as they attempted to take caught fish from the nets. We do not have random samples of sea lions from Shelikof Strait to provide a complete food habits study; this was done previously by Pitcher (1981). But the data show that incidentally caught sea lions are actively feeding on pollock during the fishery and a predator/prey relationship exists between the fish caught and the sea lions. This situation is unlike other incidental catch problems, such as tuna-porpoise and salmon-Dall porpoise, where the marine mammal is not an active predator of the fish being taken in the fishery. Therefore, increases or decreases in the number of pollock could interfere with important predator/prey interactions by influencing the number and distribution of northern sea lions.

## SUMMARY

During 1982, 528 dead northern sea lions were seen and reported by U.S. fishery observers. Based on observer coverage, the 528 extrapolates to an estimated 1,393 dead sea lions for 1982. During 1983, 169 dead sea lions were reported and 222 were estimated to have been caught.

The locations and dates of the Shelikof Strait walleye pollock joint venture fishery differed in 1982 and 1983 and are the likely

causes for the reduction in incidentally caught sea lions during 1983.

Immature male and mature and immature females were the predominant age-classes incidentally caught during both years. Mature males were infrequently caught.

Sea lions fed on walleye pollock in Shelikof Strait during the 1983 pollock joint venture. The size of fish consumed by the sea lions was similar to that caught in the trawl nets.

Most sea lions were caught during dark between 2000 hours and 0500 hours; only 11% were caught during daylight hours.

Based on position in the net, it is assumed that the sea lions were caught during net ascent or near the surface during net retrieval.

19,888 sea lions were counted in the Shelikof Strait area during early April, 1983. The estimated number of animals caught (222) in 1983 represents 1.1% of the counted population.

## ACKNOWLEDGEMENTS

We are grateful to R. Brooks, J. Eliason, P. Gearin, A. Gonzalez, G. Joyce, R. Merrick, R. Schlexer, and J. Stein who were the marine mammal observers during the 1983 study. We also wish to thank Russ Nelson, coordinator for the U.S. fishery observer program at the NWAFC, and his staff and fishery observers for their assistance in 1982 and 1983. The 1983 work was funded by the governments of Japan and Korea through the fishery observer fund. The manuscript was improved by comments from D. Calkins, C. Fowler, R. V. Miller, R. Nelson, and D. Rugh. Graphics and editorial assistance were provided by staff at the NWAFC.

## REFERENCES

Calkins, D. G., and K. W. Pitcher. 1982. Population assessment, ecology and trophic relationships of Steller sea lions in the Gulf of Alaska. Unpubl. manuscr., 129p. Alaska Dep. Fish Game, 333 Raspberry Road, Anchorage, AK 99502. (Submitted to U.S. Dep. Commer., Off. Mar. Pollut. Assess., Juneau, Alaska, as Final Rep. 243, Contract 03-5-022-69.)

Loughlin, T. R., L. Consiglieri, R. L. DeLong, and A. T. Actor. in press a. Incidental catch of marine mammals by foreign fishing vessels-1978-1981. Mar. Fish. Rev.

Loughlin, T.R., D.J. Rugh, and C.H. Fiscus. in press b. Northern sea lion distribution and abundance: 1956-1980. J. Wildl. Manage.

Pitcher, K.W. 1981. Prey of the Steller sea lion, Eumetopias jubatus, in the Gulf of Alaska. Fish. Bull., U.S. 79:467-472.

Pitcher, K.W., and D.G. Calkins. 1981. Reproductive biology of Steller sea lions in the Gulf of Alaska. J. Mammal. 62:599-605.

Table 1. Monthly summary of the pollock catch, incidentally caught sea lions observed, and observer coverage in the 1982 and 1983 Shelikof Strait walleye pollock joint venture.

| | Year | Jan. | Feb. | Mar. | Apr. | Total |
|---|---|---|---|---|---|---|
| Estimated pollock catch (t) | 1982 | 4,052 | 19,623 | 40,000 | 10,461 | 74,136 |
| | 1983 | 3,614 | 41,292 | 84,092 | 2,392 | 131,390 |
| Pollock catch (%) | 1982 | 5.5 | 26.5 | 54.0 | 14.0 | 100 |
| | 1983 | 2.8 | 31.4 | 64.0 | 1.8 | 100 |
| Incidentally caught sea lions observed (%) | 1982 | --- | 4.0 | 16.0 | 80.0 | 100 |
| | 1983 | 4.0 | 47.0 | 45.0 | 4.0 | 100 |
| Observer coverage of total processor days (%) | 1982 | 17.0 | 22.0 | 38.0 | 64.0 | 37.9 |
| | 1983 | 50.0 | 89.1 | 73.3 | 68.9 | 76.1 |
| Percent of total observer days allocated (%) | 1982 | 3.6 | 13.3 | 50.0 | 33.1 | 100 |
| | 1983 | 3.9 | 33.1 | 57.6 | 5.5 | 100 |

Table 2. Name of foreign processor, number of sea lions delivered to the processor, and number of tows containing sea lions delivered to processors in the 1983 Shelikof Strait walleye pollock joint venture.

| Ship | Dates marine mammal observer a/ on board | Number of dead sea lions b/ delivered | Number of dead seen by marine mammal observer | Tows with sea lions | Total number tows |
|---|---|---|---|---|---|
| Akebono Maru #72 | 22-30 Mar. | 102 | 10 | 25 | 319 |
| Tenyo Maru #3 | 22-31 Mar. | 21 | 1 | 8 | 376 |
| Zuiyo Maru | 22-31 Mar. | 1 | 0 | 1 | ? |
| O Yang Ho | 22-31 Mar. | 1 | 0 | 1 | 140 |
| Cheog Yang Ho | 22 Mar.-1 Apr. | 2 | 0 | 2 | 100 |
| Gae Cheog Ho | 23 Mar.-9 Apr. | 32 | 2 | 7 | 276 |
| Kyung Yang Ho | 23 Mar.-8 Apr. | 5 | 1 | 4 | 121 |
| #7 Sangwon | 23 Mar.-6 Apr. | 5 | 5 | 4 | 41 |
| | Totals | 169 | 19 | 52 | 1,373 |

a/ The fishery observer was on board the entire time the vessel was in Shelikof Strait (except for #7 Sangwon where the fishery observer and marine mammal observer boarded together).

b/ The foreign vessels did not catch the sea lions; they were caught by domestic boats and delivered to the foreign vessel during net transfer.

Table 3. Pregnant female age and length, and fetus sex, weight, and length for northern sea lions incidentally caught during the 1983 Shelikof Strait pollock joint venture.

| | FEMALE | | FETUS | | |
|---|---|---|---|---|---|
| ID No. | Standard length (cm) | Age (yrs) | Sex | Crown-rump length (cm) | Weight (kg) |
| 83-201 | 231.1 | 10 | M | 69.0 | 8.2 |
| 83-202 | 215.9 | 7 | F | 68.5 | 10.6 |
| 83-203 | 233.6 | 15 | F | 71.1 | 9.1 |
| 83-205 | 220.9 | 5 | F | 73.6 | 10.5 |
| 83-207 | 213.3 | 6 | F | 66.0 | 9.6 |

Table 4. Stomach contents of 19 northern sea lions examined aboard foreign processors in Shelikof Strait, Alaska, during 1983.

| Sea lion number | Misc. contents | Number of walleye pollock | Walleye pollock fork length (cm) Range | Mean | Total stomach contents volume (ml) |
|---|---|---|---|---|---|
| 83-001 | 1 rock | 2 | a/ | | 3,250 |
| 83-200 | fish bones | 5 | 40-43 | 41.8 | 2,500 |
| 83-201 | | 2 | a/ | | 500 |
| 83-202 | fish bones | 6 | a/ | | 3,800 |
| 83-203 | | 5 | 38-48 | 41 | 3,450 |
| 83-204 | fish bones, 1 rock | 1 | a/ | | 300 |
| 83-205 | | 1 | 38 | -- | 700 |
| 83-206 | | 3 | 35-43 | 39 | 1,300 |
| 83-207 | fish bones | 13 | 35-49 b/ | ? | 5,300 |
| 83-208 | | 1 | 39 | -- | 400 |
| 83-209 | 1 rock | 4 | 35-43 | 38 | 1,900 |
| 83-600 | | 22 | 34-46 | 40.5 | 6,200 |
| 83-601 | fish bones, 3 rocks | ? | a/ | | 1,750 |
| 83-602 | digested fish | 3 | a/ | | 1,675 |
| 83-603 | digested fish, 1 rock | 6 | 35-44 | 38 | 2,950 |
| 83-604 | fish bones, 1 rock | 8 | 36-49 | 41.5 | 5,325 |
| 83-800 | fish bones, 2 rocks | ? | a/ | | 1,500 |
| 83-801 | fish bones | 4 | a/ | | 3,250 |
| 83-1000 | | 5+ | a/ | | 7,400 |
| | Total | 91 | 34-49 | | 53,450 |
| | $\bar{X}$ | | | 39.3 | 2,813 |
| | SD | | | 7.1 | 2,056 |

a/ Fish were too digested to measure fork length.

b/ Approximations.

Table 5. Number of sea lions counted from photographs taken during an aerial survey of Shelikof Strait and adjacent areas during 6 and 7 April 1983.

| Location | Number | Time of day | Date |
|---|---|---|---|
| Simidi Islands | 636 | 1445 | April 6 |
| Chirikof Island | 1,285 | 1511 | " |
| Nagai Islands | 1,250 | 1517 | " |
| Ugiashak Island | 286 | 1603 | " |
| Rock of Ugiashak Island | 61 | 1606 | " |
| Dry Bay | 174 | 1650 | " |
| Puale Bay | 4,702 | 1700 | " |
| Takli Island | 1,199 | 1023 | April 7 |
| Cape Kuliak | 106 | 1033 | " |
| Cape Ugat | 356 | 1100 | " |
| Latax Rocks | 1,188 | 1131 | " |
| Sugarloaf Island | 239 | 1145 | " |
| Sea Otter Island | 177 | 1157 | " |
| Sea Lion Rocks | 508 | 1205 | " |
| Marmot Island | 2,743 | 1210 | " |
| Long Island | 328 | 1226 | " |
| Cape Chiniak | 1,138 | 1341 | " |
| Ugak Island | 202 | 1352 | " |
| Gull Point | 185 | 1400 | " |
| Cape Barnabas | 694 | 1410 | " |

Table 5. Number of sea lions counted from photographs taken during an aerial survey of Shelikof Strait and adjacent areas during 6 and 7 April 1983. (continued)

| Location | Number | Time of day | Date |
|---|---|---|---|
| Twoheaded Island | 1,870 | 1428 | April 7 |
| Cape Sitkinak | 247 | 1440 | " |
| Cape Ikolik | 239 | 1511 | " |
| Steep Cape | 25 | 1111 | " |
| Tonki Cape | 50 | 1203 | " |
| Total | 19,888 | | |

SHELIKOF STRAIT INCIDENTAL MORTALITY STUDY
SPECIMEN DATA RECORD

Species name: _____ (1 2) Observer: _____

Foreign vessel name: _____ (3 4 5) (6 7 8 9)

Entry # (same as Form 10b): (10 11 12) Specimen tag #: (13 14 15 16 17 18 19)

Capture date: (mo./day/yr.) (20 21 22 23 24 25) Capture time: (26 27 28 29)

# Hours specimen on deck to end of dissection: (30 31)

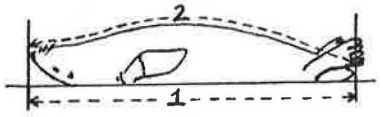
Location (Lat./Long./E-W): (32 33 34 35 36 37 38 39 40 41)

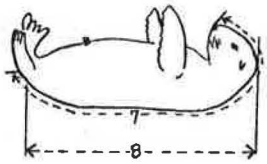
Sex: (1=male;2=female) (42)

(1) Standard length (cm): (43 44 45 46 47) (2) Curvilinear length (cm): (48 49 50 51 52)

Weight (kg): (one decimal, zero or number) (53 54 55 56 57)

Core temperature observation: (1=hot/steaming;2=lukewarm;3=cold) (58)




Fetus present?: (1=yes;2=no) (59) Fetus sex: (1=male;2=female) (60) Fetus weight (gm): (61 62 63 64 65 66 67)

(7) Fetus- Nose-tail length (cm): (68 69 70 71 72) (8) Fetus- Crown-rump length (cm): (73 74 75 76 77 78)

---

Specimen parts saved (circle each taken):

Teeth Reproductive-tract Stomach Intestine

Photos taken? _____ Roll # _____ Frame(s) # _____

Distinguishing marks/characteristics of specimen:

(a) Brand present (circle yes or no): Yes No
(if so, describe)
_____

(b) Flipper tag on specimen (circle yes or no): Yes No
(if so, describe)
_____

(c) Bullet wounds, etc. (describe): _____

_____

General comments (use back if necessary):

Figure 1. Blank data form used to record information on individual sea lions incidentally caught during the 1983 Shelikof Strait walleye pollock joint venture fishery.

VESSEL NAME: ______________________  OBSERVER: ______________________

| NUMBER | CODE | YEAR |
|---|---|---|
| 11 12 13 | 14 15 16 17 | 18 19 |
| | | |

FORM 10-b MARINE MAMMAL INCIDENTAL CATCH DATA
SHELIKOF STRAIT STUDY

USE FORM 10-a, "REMARKS ON MARINE MAMMALS" ON THE REVERSE SIDE OF THIS FORM FOR ADDITIONAL COMMENTS REGARDING THE INCIDENTAL TAKE OF MARINE MAMMALS

PAGE ______ OF ______

Total no. hauls made while observer aboard ______

| ENTRY NUMBER | DATE | | HAUL NUMBER | TIME NET HAUL OFF BOTTOM | CATCHER BOAT VESSEL CODE | MARINE MAMMAL SPECIES NAME (If none observed, write in none) | SPECIES CODE | | NUMBER ANIMALS IN CATCH | | | | | LATITUDE | E/W | (1) LONGITUDE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MO | DAY | | | | | | | TOTAL CAUGHT SEEN BY OBS. | NUMBER ALIVE AND RELEASED | NUMBER KILLED BY CREW | NUMBER DEAD IN CATCH | NUMBER DECOMPOSED | | | | |
| 8 9 10 | 20 21 | 22 23 | 24 25 26 | 27 28 29 30 | 31 32 33 | | 41 42 43 | 44 45 | 46 47 48 | 49 50 | 51 52 | 53 54 55 | 56 57 | 58 59 60 61 | 62 | 63 64 65 66 | 67 68 |
| 8 9 10 | 20 21 | 22 23 | 24 25 26 | 27 28 29 30 | 31 32 33 | | 41 42 43 | 44 45 | 46 47 48 | 49 50 | 51 52 | 53 54 55 | 56 57 | 58 59 60 61 | 62 | 63 64 65 66 | 67 68 |

Figure 2. Blank data form used to record information on each tow for incidentally caught sea lions during the 1983 Shelikof Strait walleye pollock joint venture fishery.

FORM 10-a REMARKS ON MARINE MAMMALS IN THE CATCH

Instructions: Describe problems encountered in observations, identification, specimens collected percentage of haul observed, discrepancies in reports, etc. Be complete in describing observations of dead or living animals. Entry number is the same number entered on the other side (Form 10-b).

| ENTRY NO. | DATE (MO/DAY/YR) | HAUL NO. | POSITION IN HAUL | NAME OF CATCHER BOAT | REMARKS |
|---|---|---|---|---|---|
| | | | | | |

Figure 2. Continued.

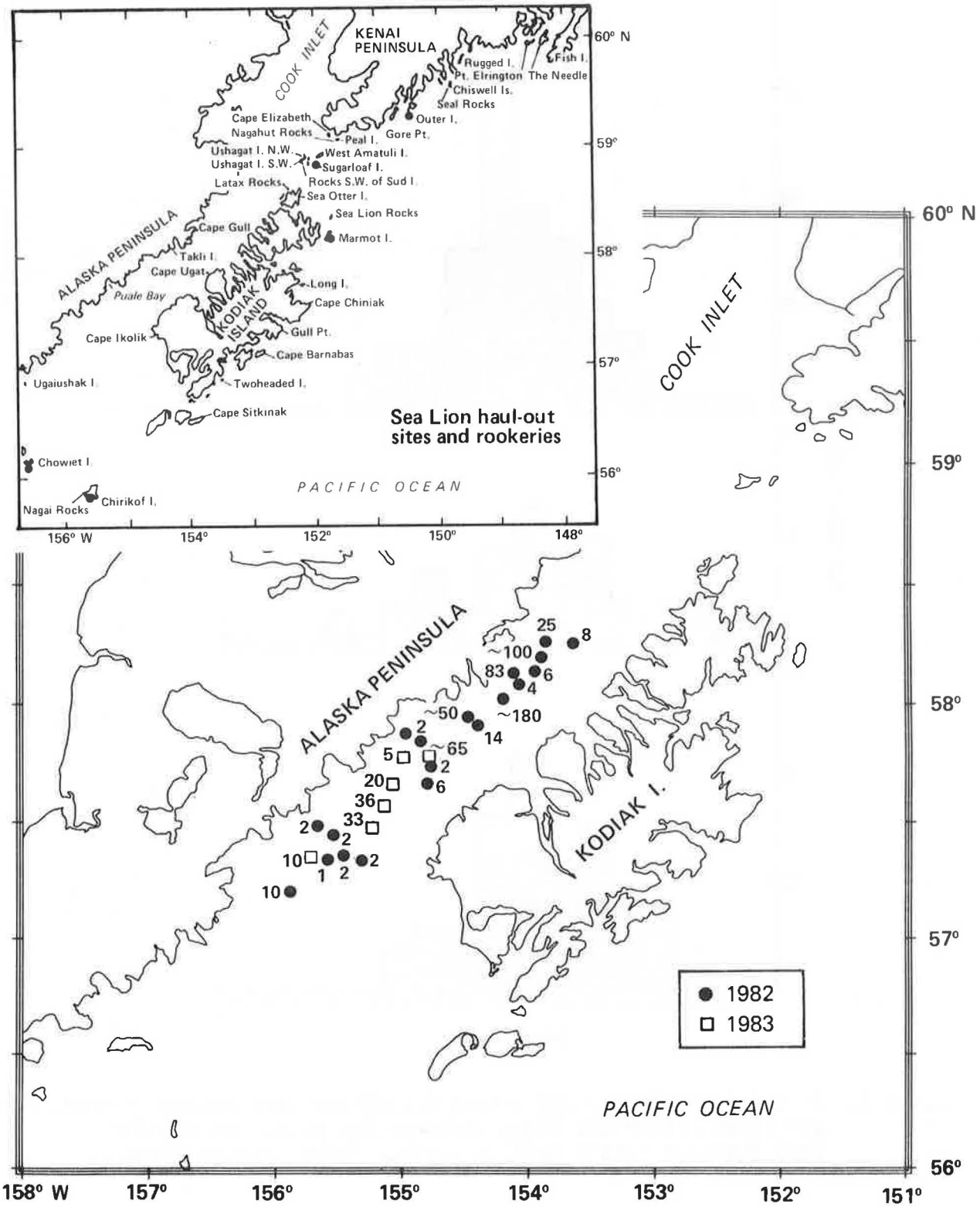



Figure 3. The location and number of northern sea lions observed dead during the 1982 and 1983 Shelikof Strait walleye pollock joint venture fishery. Inset shows the location of northern sea lion rookeries (solid circles) and haul-out sites in the area (modified from Calkins and Pitcher 1982).

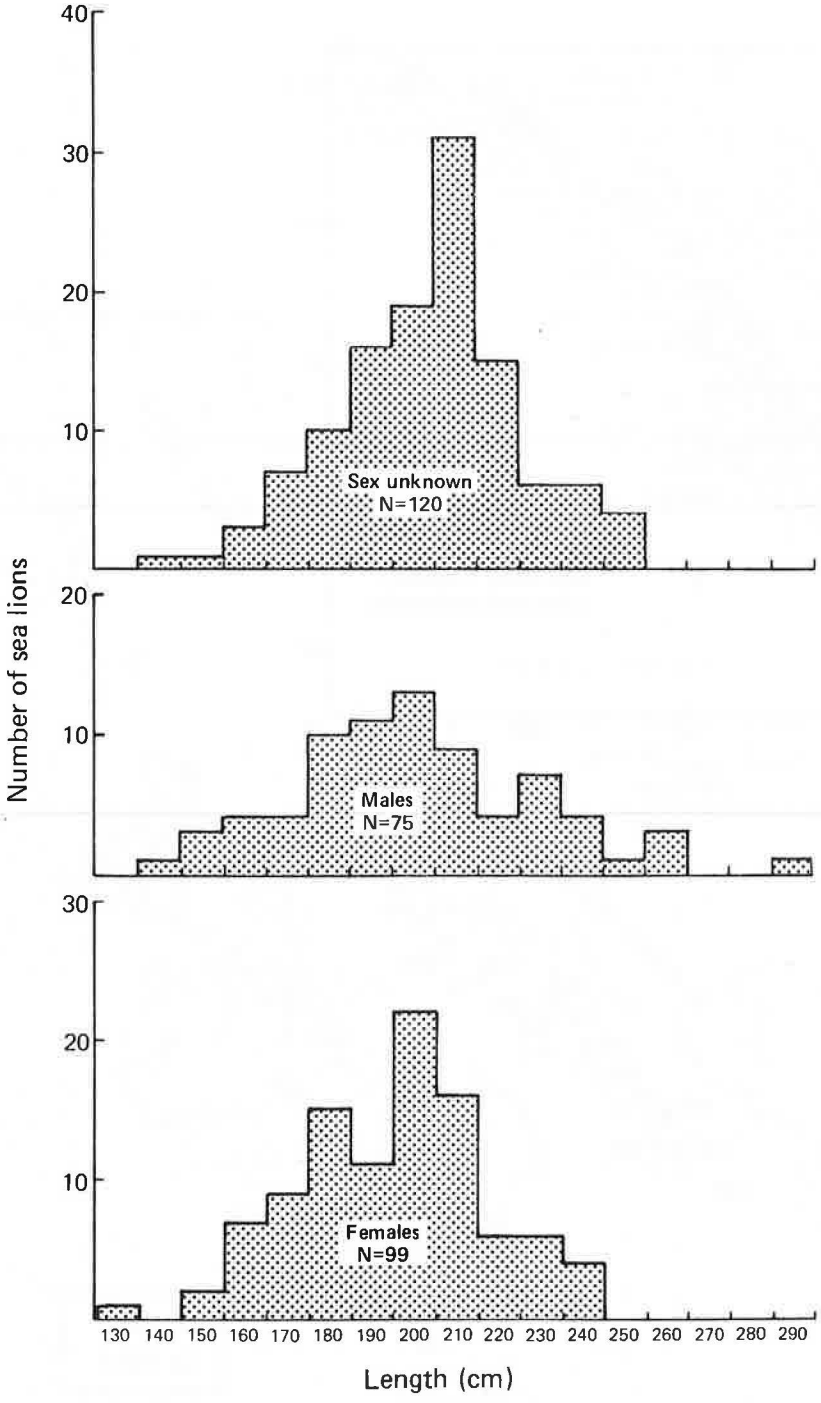



Figure 4. Length (curvilinear and standard combined) and number of male, female, and unidentified sea lions incidentally caught during the 1982 Shelikof Strait walleye pollock joint venture fishery.

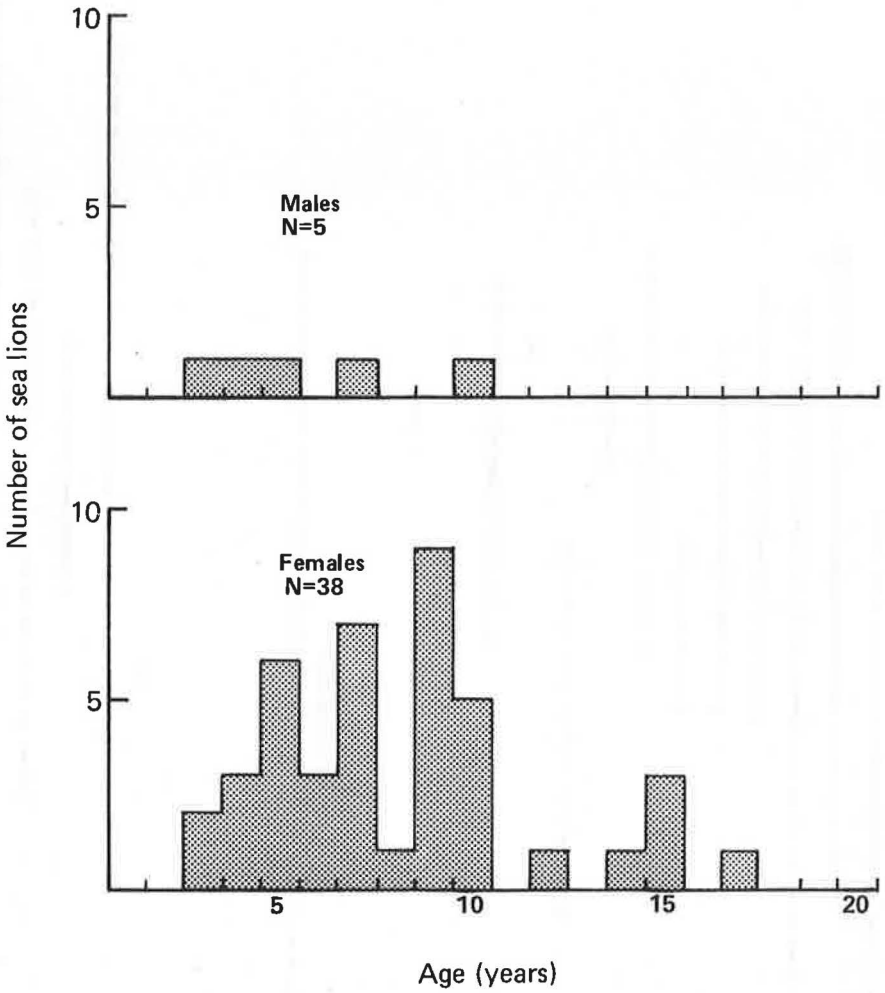



Figure 5. Age-class distribution for male and female sea lions incidentally caught during the 1982 Shelikof Strait walleye pollock joint venture fishery.

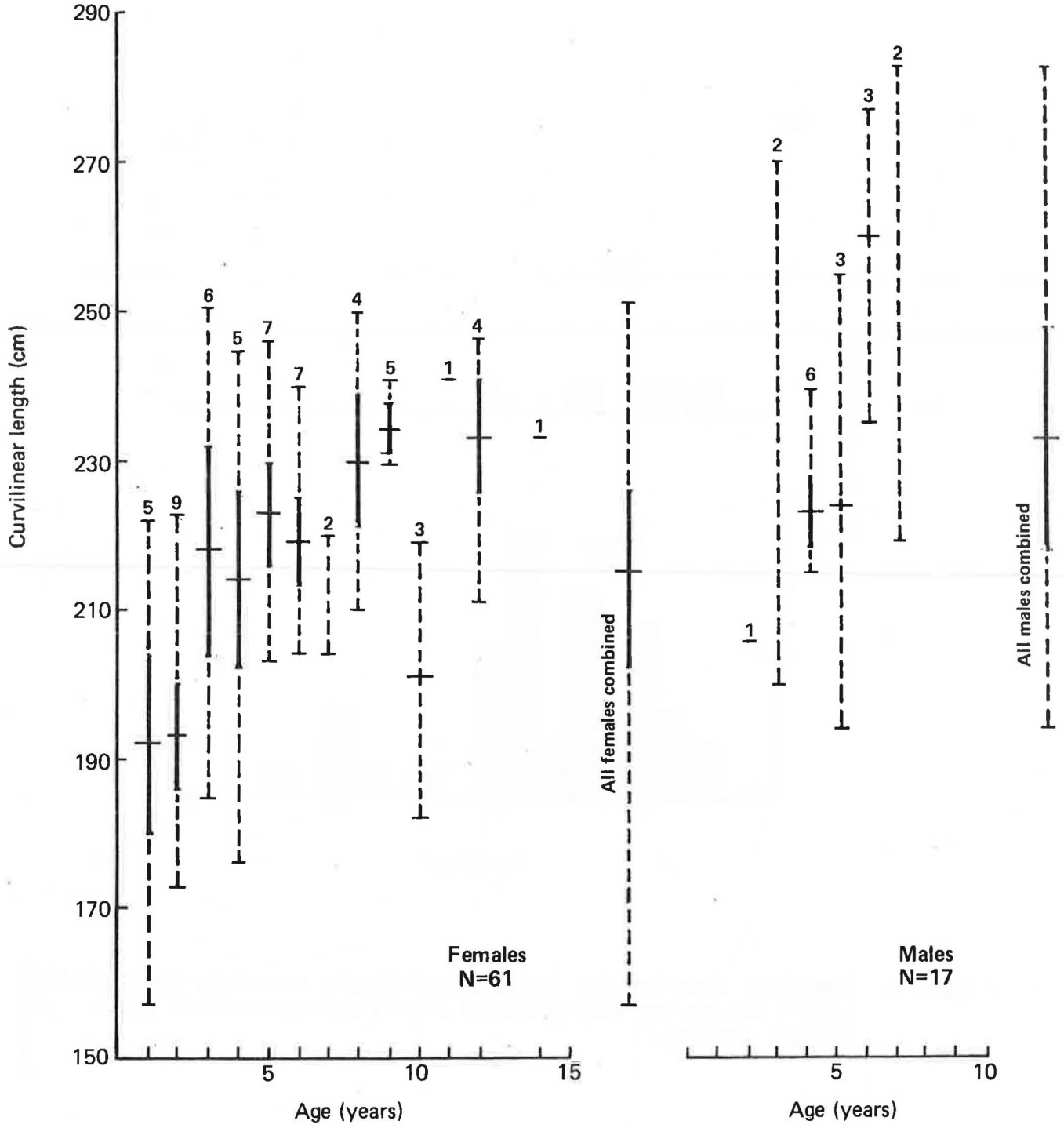



Figure 6. Age and curvilinear length for male and female sea lions incidentally caught during the 1983 Shelikof Strait walleye pollock joint venture fishery. Range (dotted lines), standard deviation (solid line), mean (horizontal line), and sample size are shown.

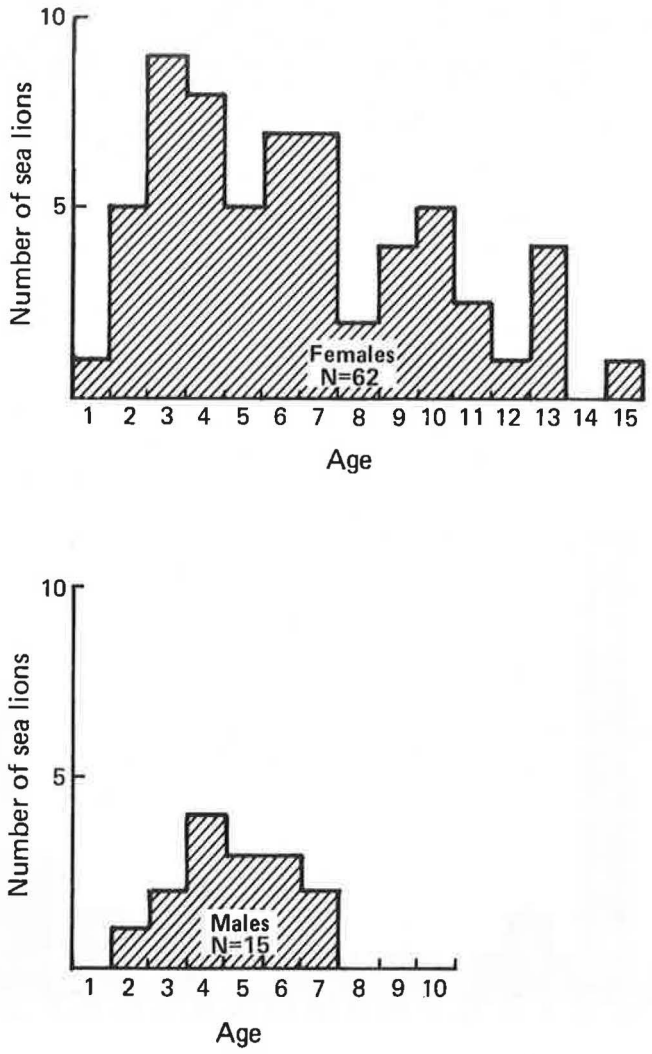



Figure 7. Age-class distribution for male and female sea lions incidentally caught during the 1983 Shelikof Strait walleye pollock joint venture fishery.

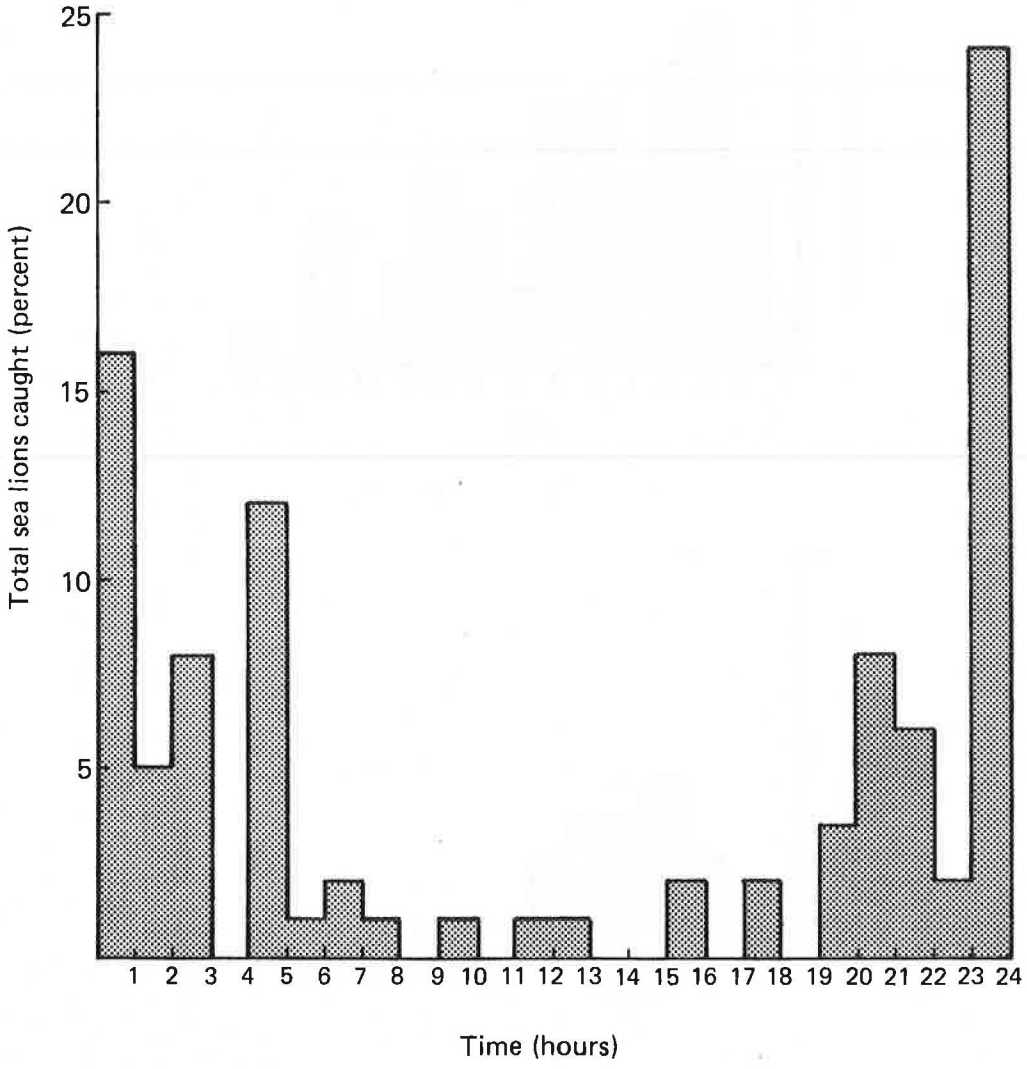



Figure 8. Percentage of total number of sea lions caught in the 1983 Shelikof Strait walleye pollock joint venture fishery during each hour of the day.

## APPENDIX I. Observations of Northern Sea Lions

The following paragraphs are edited excerpts from reports by the marine mammal observers. They are presented as examples of the interaction between sea lions, the catcher boats, and the foreign processors.

Report by R. Merrick:

I observed northern sea lions near the ship on 33 occasions, with frequency and group size varying with the time of day. Between 0000 and 0800 I had the fewest observations (8), but the largest average group size (17). Between 0800 and 1800, I had 10 observations but an average group size of less than 5. Most sightings were in the evening (1800-2400), with 15 observations, and an average group size of 11. Groups typically included only adult females and subadults, with adult males definitely seen only three times. Twenty-three of these observations involved feeding behavior at either the ship's garbage chutes (only undersized pollock and nontarget species were discharged) or off the stern ramp as a cod end was transferred. Twenty-five percent of the cod end transfers attracted sea lions. However, animals did not attack the cod ends, rather they were feeding on the fish extruded through the net. Only once did I see sea lions contact the net, and this was to pull partially extruded fish from the net. More typically, the animals simply followed the net in. No animals attempted to come up the stern ramp. Holes were rarely seen in the cod ends, and when they were seen, it was difficult to determine their origin.

Animals were observed more frequently at the garbage chutes than at the cod ends (14 vs. 9). As I observed virtually all cod end transfers, and a relatively small proportion of the time I observed that garbage being

dumped, it would appear that the garbage chutes are a more important attractant for sea lions than the cod ends, at least on vessels like the Cheog Yang Ho.

Report by P Gearin:

One net haul was observed on a catcher boat while I was being transported to the Japanese processor. The net was set at 1940 hours and hauled-back at 2120 hours. During the net set and tow, no sea lions were observed around the vessel. When the cod end reached the surface, however, a large number of sea lions were observed around the cod end. As the cod end was winched closer to the vessel, sea lions followed it to the stern ramp and were observed to be actively feeding. When the cod end was about 25 m from the vessel and floating at the surface, there were sea lions all around it and the water appeared to be boiling by their furious feeding activity. I estimated there were at least 75-100 sea lions in the vicinity of the cod end. The sea lions appeared to be attacking the cod end since many animals were observed pulling fish directly from the net or seizing fish which had fallen out.

The sea lions continued to follow behind the vessel even after the cod end was winched part way up the stern ramp. When the cod end was transferred to the processor, the sea lions broke off from the catcher boat and followed the cod end to the processor's stern ramp, continuing to feed off fish extruding from the floating cod end. After the cod end was winched up the stern ramp and clear of the water, the group of sea lions, by this time numbering about 50 animals, followed along 5 m off starboard for 5-10 minutes before dispersing.

While I was on the Akebono Maru, sea lions were observed during all hours of the day and night. They were most often sighted in distinct compact

groups of between 5 to 25 animals. Sea lions were observed on many occasions following along behind the processor and feeding on pollock effluent pumped out of the stern. Also, during the course of the day as the vessel moved slowly through the water, groups of sea lions were often sighted approaching the vessel from a distance. If the foreign vessel was processing at the time, the sea lions would follow along behind, feeding on effluent. If the vessel was not processing, the sea lions would approach from the stern and then follow along off port or starboard for several minutes. If there was no effluent to feed on, the sea lions would not follow the vessel for very long but would break away en masse or in small groups and leave the vicinity.

Large numbers of sea lions were most consistently observed during cod end deliveries, day or night. Sea lions were seen during the 15 cod end deliveries which I observed. During daylight hours when the catcher boats were visible from a distance, sea lions could often be sighted following along behind the vessel, eating fish falling from the cod end. When the cod end was transferred to the processor, the sea lions often followed it all the way to the stern ramp, remaining until the cod end was clear of the water before dispersing.

APPENDIX II. Vessels in the Fishery

The following is a list of the vessels involved in the Shelikof Strait walleye pollock joint venture fishery during 1983 including the names of the vessels and their products.

| Processor | Nationality | Product | Domestic catcher boats |
|---|---|---|---|
| Tenyo Maru | Japanese | surimi | Alert |
| | | | California Horizon |
| | | | Half Moon Bay |
| | | | Margaret Lynn |
| | | | Neahkanie |
| | | | Nord Fjord |
| | | | Sunset Bay |
| | | | Vanguard |
| Zuiyo Maru | Japanese | surimi and fish meal | same as for Tenyo Maru |
| Akebono Maru #72 | Japanese | surimi | Oceanic |
| | | | Great Pacific |
| Cheog Yang Ho | Korean | roe, fish meal, and whole fish | Ambition |
| | | | Front Line |
| | | | Lady Blue |
| | | | Mary Lou |
| | | | Nelle Belle |
| | | | Paragon II |
| | | | Pelagos |
| | | | Pioneer |

| Processor | Nationality | Product | Domestic catcher boat |
|---|---|---|---|
| Gae Cheog Ho | Korean | roe, fish meal, and whole fish | same as for Cheog Yang Ho |
| Kyung Yang Ho | Korean | Whole fish and fish meal | same as for Cheog Yang Ho, plus: Half Moon Bay Victory |
| O Yang Ho | Korean | surimi, fish meal | Barbara Lee Hazel Lorraine |
| #7 Sangwon | Korean | roe, whole fish | Centurian |