ASSESSMENT OF THE DISTRIBUTION AND ABUNDANCE OF SEA OTTERS ALONG THE KENAI PENINSULA, KAMISHAK BAY AND THE KODIAK ARCHIPELAGO

by

Karl B. Schneider

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I. Abstract

Sea otters are the most vulnerable of all marine mammals to the effects of environmental oil spills. Many populations have not recovered from the period of excessive exploitation during the 18th and 19th centuries. Relatively small oil spills could not only kill large numbers of sea otters but could virtually eliminate small isolated populations or retard range expansion into unpopulated former sea otter habitat. Outer Continental Shelf development currently poses the most significant threat to the complete recovery of sea otters. As sea otters may be a "keystone" species, altered sea otter abundance could have a profound effect on the structure of nearshore communities.

The current distribution and relative abundance of sea otters along the Kenai Peninsula, Kamishak Bay and the Kodiak Archipelago were determined through aerial and boat surveys and miscellaneous observations. These data were compared to previously existing information to determine the history of population growth, present status, probable future trends and to identify critical areas.

The outer Kenai Peninsula coast was repopulated in the 1960's. Most of the available habitat south and east of Port Graham is presently occupied and range expansion into Kachemak Bay and lower Cook Inlet is occurring. Another population has occupied Kamishak Bay for many years and has recently expanded its range southwestward along the Alaska Peninsula. Both of these populations currently occupy, and are expanding into, habitat that lies within or adjacent to the proposed lower Cook Inlet OCS lease area. There is a potential for oil spills to kill large

numbers of sea otters and perhaps seriously retard repopulation of former sea otter habitat in lower Cook Inlet.

The Barren Islands were completely repopulated by sea otters in the 1950's. Although this population may have played a major role in repopulation of the Kenai Peninsula in the 1960's it does not appear to be contributing significantly to the repopulation process at this time. Most of the population occupies a small area and could be vulnerable to relatively small oil spills or other localized impacts.

A remnant population of sea otters survived north of Shuyak Island. This group has increased in numbers and is rapidly expanding its range around both sides of Afognak Island. This expansion is expected to continue until all of Kodiak Island is repopulated. Although this population is likely large enough to survive even major oil spills, repopulation of Kodiak could be seriously retarded by OCS related activities.

Another population of unknown size inhabits the extensive area of shallow water between the southwestern end of Kodiak Island and Chirikof Island. The potential for growth of this population appears high, however, much of its habitat lies within the proposed western Gulf of Alaska OCS lease area. More information on the status of this population is needed.

Several other populations outside of the study area appear threatened by proposed OCS development and should be studied in greater detail.

II. Introduction

Sea otters were reduced to very low numbers by commercial hunting between 1742 and 1911. A number of small nuclear populations did survive, however, and many have steadily grown and expanded their ranges. For the past 20 years the pattern of repopulation of former sea otter habitat has been monitored by the U. S. Fish and Wildlife Service and the Alaska Department of Fish and Game through a series of surveys (Lensink 1960, Kenyon 1969, Schneider unpublished data). In recent years survey techniques have been refined to permit more realistic estimates of abundance, although we are still unable to census sea otters with a high degree of confidence over large areas (Schneider 1971, Estes and Smith 1973).

Most of the repopulation studies focused on the Aleutian Islands where rapid range expansion was taking place. Through a combination of extensive aerial surveys and intensive boat and shore counts it was possible to assess the status and trends of sea otter populations, identify critical areas, predict patterns of range expansion and evaluate the impacts both natural and unnatural catastrophic events.

Sea otter populations in the Gulf of Alaska have generally been smaller and less attention has been devoted to them. The status of these populations has been monitored through a haphazard series of fragmentary surveys and reported sightings. Calkins et al. (1975) summarized most of the pertinent available data. Even though the basic distribution of sea otters was known and some rough estimates of abundance had been made

(A.D.F.& G. 1973) it was clear that the basis for assessment of changes in distribution and abundance was poor.

Concern for the potential effects of the Trans-Alaska oil pipeline terminal, the proposed Trans-Alaska gas pipeline terminal and associated tanker traffic on marine mammals in general and sea otters in particular caused scientists to turn their attention to the Prince William Sound area. The Alaska Department of Fish and Game conducted two helicopter surveys (Pitcher 1975) and cooperated with the U. S. Fish and Wildlife Service in a supportive boat survey. The U. S. Fish and Wildlife Service then initiated more intensive studies adjacent to tanker routes and terminal sites. Proposals for expanded human activities in the marine environment, particularly those associated with OCS development, have increased the need to update information on sea otter distribution and abundance in other areas.

Sea otters are probably the most vulnerable of all marine mammals to the direct effects of oil. Unlike most marine mammals they have no thick blubber layer. They rely on air trapped in their dense fur for conservation of body heat and buoyancy. When clean, this mat of fur is waterproof and the skin over most of the body remains dry. If the fur is soiled it loses its water repellency and insulative qualities. If this is not corrected quickly the animal will die of hypothermia. Although little information is available on the quantities and types of petroleum products necessary to kill a sea otter, it appears that relatively small amounts of both refined fuels and crude oil will cause death (Kenyon 1971

Schneider unpublished data). Kenyon (1969) cited cases where massive kills may have occurred near shipwrecks.

Long-term effects of chronic pollution on all high trophic-level species are possible if one or more of the links in the food chain are affected. Sea otters require very large quantities of food (20 to 25 percent of their own body weight per day) to support their high metabolic rate. The main factor limiting most sea otter populations appears to be food availability.

Sea otters in most areas appear to be relatively sedentary and feed on relatively sessile organisms. Therefore they may be exceptionally sensitive to changes in the food chain and any such effects would tend to be site specific.

All of the sea otter populations bordering the Gulf of Alaska are still recovering from the period of commercial exploitation, and are expanding their range into unpopulated or sparsely populated habitat. The range of some of these populations is extremely limited. Very localized effects of human activity could endanger some of these populations and seriously retard the process of repopulation of former sea otter habitat.

Sea otters exert a profound influence on nearshore plant and animal communities and have been described as a keystone species (Faro 1969, Estes and Palmisano 1974, and others). A knowledge of the history of sea otter occupancy of an area is necessary for studies of changes in those communities.

The objectives of this project were to map the present range of sea otters around the Kenai Peninsula, Kamishak Bay and the Kodiak Archipelago; to determine the relative abundance of sea otters throughout their present range; to determine recent patterns of change in distribution and abundance providing a basis for predicting future changes; and to identify areas critical to the survival and continued growth of sea otter populations. It is anticipated that this information will be useful for making decisions on the regulation of human activities in the marine environment so as to minimize adverse impacts on sea otters. The information should also be useful to ecologists studying changes in nearshore communities.

III. Current State of Knowledge

Calkins et al. (1975) provided the most up to date summary of available information on sea otter distribution and abundance in the study areas prior to the initiation of this project. The following discussion is adapted from that report.

Kenai Peninsula

Prior to 1967, only scattered observations of sea otters had been reported from Cape Puget to Port Graham on the Kenai Peninsula. Lensink (1960) reported a sighting of 15 animals near Elizabeth Island in 1953, and Kenyon (1969) felt that no significant population of otters occupied the area by the mid-1960's. In 1967 large numbers of otters began to be sighted regularly on the southern tip of the Kenai Peninsula

in the area from Koyoktolik Bay to Chugach Bay. On a 1968 survey of this area 400 otters were seen. The apparent movement of large numbers of otters to the southern tip of the Kenai Peninsula, probably from the Barren Islands, and subsequent expansion up the southeast side of the Kenai Peninsula probably occurred in the years 1966 to 1968. At the same time, otters from Prince William Sound probably contributed to the repopulation of the area east of Gore Point.

Our most recent information from surveys conducted in 1970 confirmed there were concentrations of otters on the tip of the Kenai Peninsula with scattered groups along the coast to Cape Puget (Table 1). It is important to realize that data presented in Table 1 originated from a series of surveys conducted by different observers under varying conditions from various fixed-wing aircraft. The large variability between surveys renders them useless for comparative purposes. This information should only be used to indicate the presence of animals and can in no way be extrapolated to give total numbers. Reports from the public in the early 1970's indicated that up to 200 otters were regularly seen in Port Graham and that small numbers were straying into Kachemak Bay. Sightings from north of Kachemak Bay as far as Ninilchik were increasing.

Kamishak Bay

The Kamishak Bay area including Augustine Island, Shaw Island and Cape Douglas has been partially surveyed on numerous occasions. Lensink (1962) reported that approximately 50 otters were seen near Augustine Island in 1948 and that Spencer counted 40 at Augustine Island and one

Table 1. SEA OTTERS COUNTED ON AERIAL SURVEYS OF KENAI PENINSULA
June, 1970 - January, 1971

AREA	JUNE 5 & 9	JULY 15-20	AUG. 14	OCT. 12	NOV. 12	JAN. 12
C. Junken-C. Resurrection	5	30	42	27	10	30
Resurrection Bay	2	2	0	4	2	NS
Aialik Bay	1	20	5	8	0	21
Harris Bay	8	18	7	5	3	* 25
Nuka Bay	106	56	NS	31	28	27
Port Dick	0	11	NS	NS	3	23
Rocky Bay-Port Chatham	121	125	NS	NS	9	26
Koyuktolik Bay-Port Graham	0	0	NS	NS	0	NS
Total	243	262	54	75	55	152

* 38 Sea otters counted from shore and skiff 11/20/70.
NS = No sightings

at Shaw Island in 1957. Lensink counted 52 on Augustine in 1959, but he considered it a poor count. In 1965 Kenyon counted 18 around Augustine Island and 101 in the Shaw Island-Cape Douglas area. In 1969 Alaska Department of Fish and Game biologists tallied 62 and 130 animals in the Augustine Island area on different counts. In 1971 Alaska Department of Fish and Game biologists counted 150 otters between Augustine Island and Tignagvik Point. Also in 1971 Prasil (1971) counted 60 otters between Augustine and Shaw Islands. A 1970 survey by Schneider indicated that this population had expanded its range southwestward to the vicinity of Shakun Island. Prasil (1971) subsequently counted up to 443 sea otters around the Shakun Island and 92 at Douglas Reef on a series of aerial surveys made in 1970 and 1971.

Kodiak Archipelago

Sea otter habitat in the Barren Islands is separated from that in the rest of the Kodiak Archipelago by approximately 15 km of deep water. This probably limits movements between the island groups. Sea otter sightings in the Barren Islands date back to 1931, when two otters were seen near Sud Island. Otters have been observed regularly in the Barren Islands since then. The highest count prior to 1970 was 325 animals seen in 1957 (Lensink 1960). Kenyon (1969) reported seeing 272 otters in the Barren Islands during a 1959 survey and estimated a population of 363 animals.

In June 1970 Schneider flew as the only observer in a Grumman Goose during a survey of the Barren Islands. Offshore coverage was poor

although conditions and visibility were good and a complete count of the Barren Islands was made with a total count of 307.

Portions of the Kodiak-Shuyak-Afognak area, including the Trinity Islands and Chirikof Island, contain good sea otter habitat. Kodiak was an important hunting area during the period of Russian exploitation, but the population was never completely extirpated.

Reports from the Kodiak area are fragmentary and incomplete; no complete surveys have been attempted. We knew that a relatively large population has existed for many years at the north end of the group and a population of unknown size occurred at the south end.

In 1948 Refuge Manager Beals reported three otters off Shuyak Island and in 1951 Chapados and Spencer saw 15 on Sea Otter Island and 67 at Latax Rocks (Lensink 1960). In 1957 Lensink saw 14 in the Trinity Islands and 281 around the Shuyak area. In 1964 E. Klinkhart counted 63 sea otters at Latax rocks, 13 at Seal Island and one at Marmot Island.

Sightings at areas other than the north and south ends included five sighted by James Faro at Uyak Bay and three near the south end of Chirikof sighted by the crew of the MV "Teal." Occasional individuals were reported from Marmot and Chiniak Bays.

The most recent survey information came from Schneider (1970, unpub. report) who saw 18 between Ban Island and Shuyak Strait, 6 in Pernosa Bay, 3 at Marmot Island, 121 in the area of Sea Otter Island, 33 on

the west side of Shuyak Island and 26 in the area of Latax Rocks and Dark Island for a total of 207. On a separate flight six were seen midway between Tugidak and Chirikof Islands. Reports of small numbers and the incidence of beached, dead animals on Tugidak Island indicated that at least moderate number occur there.

Reports since 1970 suggested that range expansion was occurring along both sides of Afognak Island. B. Ballanger sighted 15 south of Marmot Strait and 10 at Outlet Cape in 1975 and reported an increase in sightings near the town of Kodiak. Lensink (1960) estimated the total sea otter population of the Kodiak Archipelago including the Barren Islands at 800-1,500, while Kenyon (1969) indicated that the Kodiak area had not been repopulated to a significant degree with a total estimate of 1,118 otters. Based on more recent information ADF&G (1973) estimated the population at 4,000 sea otters.

IV. Study Area

The study area included the shoreline, all offshore rocks and islets and floating glacial and sea ice pans and adjacent waters less than 80 m in depth in the following areas.

1. The Kenai Peninsula from Cape Puget to the mouth of the Kenai River including the Chugach Islands.

2. The west side of lower Cook Inlet from Tuxedni Bay to Cape Douglas including Augustine Island.

3. The entire Kodiak Archipelago including the Barren Islands, Shuyak Island, Afognak Island, Marmot Island, Kodiak Island, the Trinity Islands and Chirikof Island.

V. Methods of Data Collection

Between 1 October and 7 October 1975 a helicopter survey was made of the Kenai Peninsula and the northern part of the Kodiak Archipelago. A Bell 206B "Jet Ranger" II helicopter (N90217) was flown along the survey trackline at altitudes of 50 to 70 m and an average airspeed of 70 knots (130 km/hr). Both altitude and airspeed were varied according to counting conditions. A forward observer sat in the left front seat and counted animals directly in front and to the left of the helicopter, an offshore observer sat in the right rear seat and counted on the right side, and a recorder sat in the left rear seat and recorded all observations and photographed concentrations of marine mammals. Both the pilot and recorder assisted the observers by pointing out animals. Personnel were Vernon Lofstedt - pilot, Karl Schneider - forward observer, Donald Calkins - recorder, Warren Ballard - right observer on the Kenai P Peninsula, and Kenneth Pitcher - right observer on Afognak Island. This survey required a total of 38.4 hours of flying time including 25.1 hours of actual survey time.

Sea otters were counted visually. Large pods of sea otters were photographed and the number of individuals was determined from projected 35mm slides.

Between 3 February and 11 February 1976 counts of sea otters were made from skiffs along portions of the Kodiak Archipelago. Three observers jointly counted numbers of pups and numbers of adults as the skiff paralleled the shoreline and circled offshore rocks. Binoculars were used to aid counts offshore and to identify pups.

Sightings and partial counts of sea otters were made on the following aerial surveys of sea lions conducted under RU #243.

12 March - 14 March 1976 - covering portions of the Kenai Peninsula and Kodiak Archipelago.

20 May 1976 - covering portions of the Barren Islands.

8 June - 10 June 1976 - covering portions of the Kenai Peninsula, Barren Islands and the Kodiak Archipelago.

The trackline on these surveys normally covered only small portions of sea otter habitat. The observer placement in the aircraft was such that few sea otters could be seen from the left side of the aircraft. Therefore, the number of sea otters counted was generally low.

The trackline was modified to cover selected areas of sea otter habitat more thoroughly when survey conditions were suitable. Emphasis was placed on the fringes of expanding populations and areas that had not been surveyed previously.

The scientific party included:

Karl Schneider - Alaska Department Fish and Game - Principal Investigator and observer 12 - 14 March, 20 May, 8 - 10 June 1976.

Donald Calkins - Alaska Department Fish and Game - Principal Investigator RU #243 and observer 12 - 14 March, 20 May, 8 - 10 June 1976.

Charles Irvine - Alaska Department Fish and Game - Observer - recorder 12 - 14 March 1976.

Roger Aulabaugh - Alaska Department Fish and Game - Observer - recorder 8 - 10 June 1976.

A Grumman Super Widgeon flown by Ken Bunch was used on all of these surveys.

On 1 April, 1976 a systematic survey of Kamishak Bay and portions of Kachemak Bay was made from a Grumman Turbo Goose.

Tracklines were flown over open water in shallow areas believed to support sea otters. The aircraft was flown along east and west tracklines spaced 2 minutes of longitude apart. Navigation was aided by The Global Navigation System (GNS 500). One observer counted sea otters out of each side of the aircraft. A limited track width was not used as the

objective of the survey was to determine distribution and relative abundance rather than to estimate numbers. The effective track width for individual animals was probably no more than 400 m, however.

Survey conditions which influence the sightability of sea otters were classified on all of the above surveys according to the following system.

Code

1 Excellent - surface of water calm, usually a high overcast sky with no sun glare. Sea otters appear dark against a uniformly light gray background of the water's surface. Individuals easily distinguished at a distance.

2 Very good - may be light ripple on water's surface or slightly uneven lighting but still relatively easy to distinguish individuals at a distance.

3 Good - may be light chop, some sun glare or shadows. Individuals at a distance may be difficult to distinguish but individuals nearby and small groups at a distance are readily identified.

4 Fair - usually choppy waves and strong sun glare or dark shadows in part of the survey track. Individuals in kelp beds, in the lee of rocks, or near the observer and most pods readily identified but most individuals and some pods in areas of poor lighting or at a distance difficult to distinguish.

5 Poor - individuals difficult to distinguish unless very close and some pods at a distance may be missed, however, conditions still good enough to give a very rough impression of the distribution of animals.

6 Unacceptable - heavy chop with many whitecaps, lighting poor or large waves breaking on rocks. No surveys should be conducted under these conditions but occasionally a sighting of significance may be made in the course of other activities.

Conditions may vary within a single count area. Therefore, the classification may represent the average conditions encountered.

Tracklines of all the above surveys are presented in the RESULTS section of this report.

Significant sightings made by other biologists from both federal and state agencies were collected. Those made by personnel working on RU #3/4, 229 and 243 were particularly useful.

Pertinent information on past distribution and abundance was extracted from the literature and Alaska Department of Fish and Game files.

VI. Results

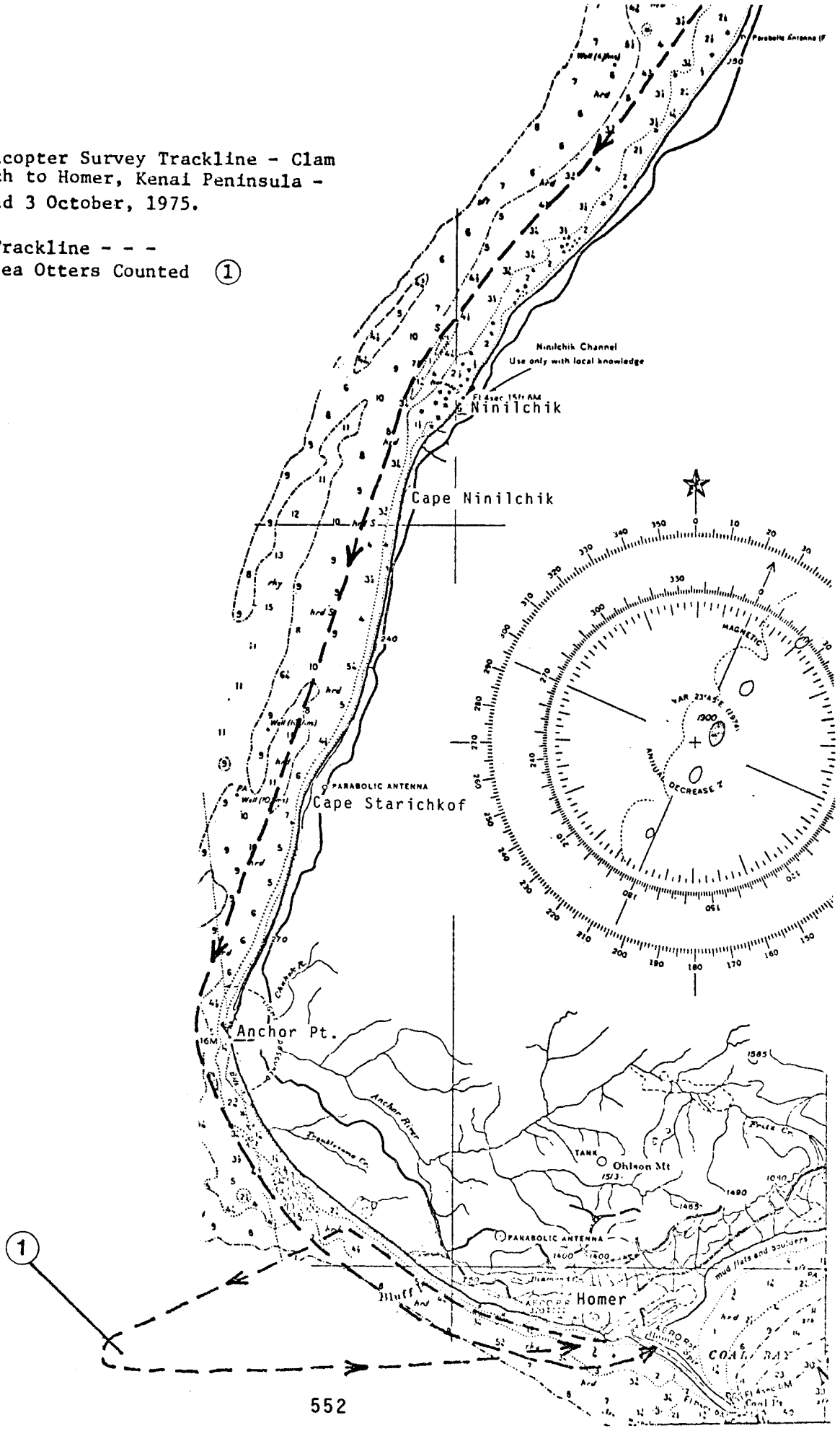
Results of the October helicopter survey are presented in Table 2 and Figs. 1-6, the February boat survey in Table 3 and Figs. 7-8, the March

Table 2. Results of helicopter sea otter survey of portions of the Kenai Peninsula and the Kodiak Archipelago, 1-7 October 1975.

Area	Date	Sea Otters Counted	Survey Conditions	Completeness of Coverage
Kenai Peninsula				
Kenai-Clam Gulch	10/1/75	0	Fair	Incomplete
Clam Gulch-Ninilchik	"	0	"	"
Ninilchik-Anchor Pt.	"	0	"	"
Anchor Pt-Coal Pt.	"	0	"	"
Coal Bay	"	0	Very Good	Complete
Bear Cove	"	5	Good	"
Halibut Cove	"	1	"	"
Tutka-Sadie	"	1	"	"
Seldovia	"	4	"	"
Port Graham	"	16	Fair	"
Port Chatham	"	54	Poor	"
Chugach Bay	10/2/75	66	"	"
Rocky Bay	"	90	Fair	"
Port Dick	"	15	"	"
Nuka Passage	"	32	"	"
West Nuka	"	20	Poor	Incomplete
McCarty Arm	Not Surveyed			
East Arm Nuka	10/3-4/75	26	Poor	Incomplete
Pye Reef-Two Arm	10/4/75	1	"	Complete
Harris Bay	"	92	Very Good	"
Aialik Bay	"	36	"	"
Resurrection Bay	10/4-5/75	29	Fair	Incomplete
Day Harbor	10/5/75	13	"	Complete
Whidbey-Johnstone	"	15	"	"
Puget Bay	"	25	Good	"
Kodiak Archipelago				
Ouzinki	10/6/75	0	Poor	Incomplete
Afognak Bay	"	6	Fair	"
Kazakof Bay	"	0	Poor	"
Duck Bay	"	1	"	"
Izhut Bay (West)	"	1	"	"
Izhut Bay (East)	"	0	"	"
King Cove	10/7/75	16	Fair	"
Marmot I.	"	529	"	Complete
Tonki Cape	"	134	Good	"
Tonki Bay	"	32	"	"
Seal Bay (East)	"	164	"	"
Seal Bay (West)	"	342	"	"
Perenosa Bay (South)	"	290	Excellent	"
Perenosa Bay (North)	"	58	"	"
Shuyak (East)	"	10	Good	"
Sea Otter I.	"	156	Fair	Incomplete
Point Banks	"	9	Very Good	Complete
Shuyak (North)	"	14	"	Incomplete
Latax Rocks	"	59	"	Complete
Shuyak (West)	"	12	"	Incomplete
Shuyak Strait	"	2	"	"
Bluefox Bay	"	81	"	"
Foul Bay	"	61	"	"

Fig. 1 Helicopter Survey Trackline - Clam Gulch to Homer, Kenai Peninsula - 1 and 3 October, 1975.

Trackline - - -
Sea Otters Counted (1)



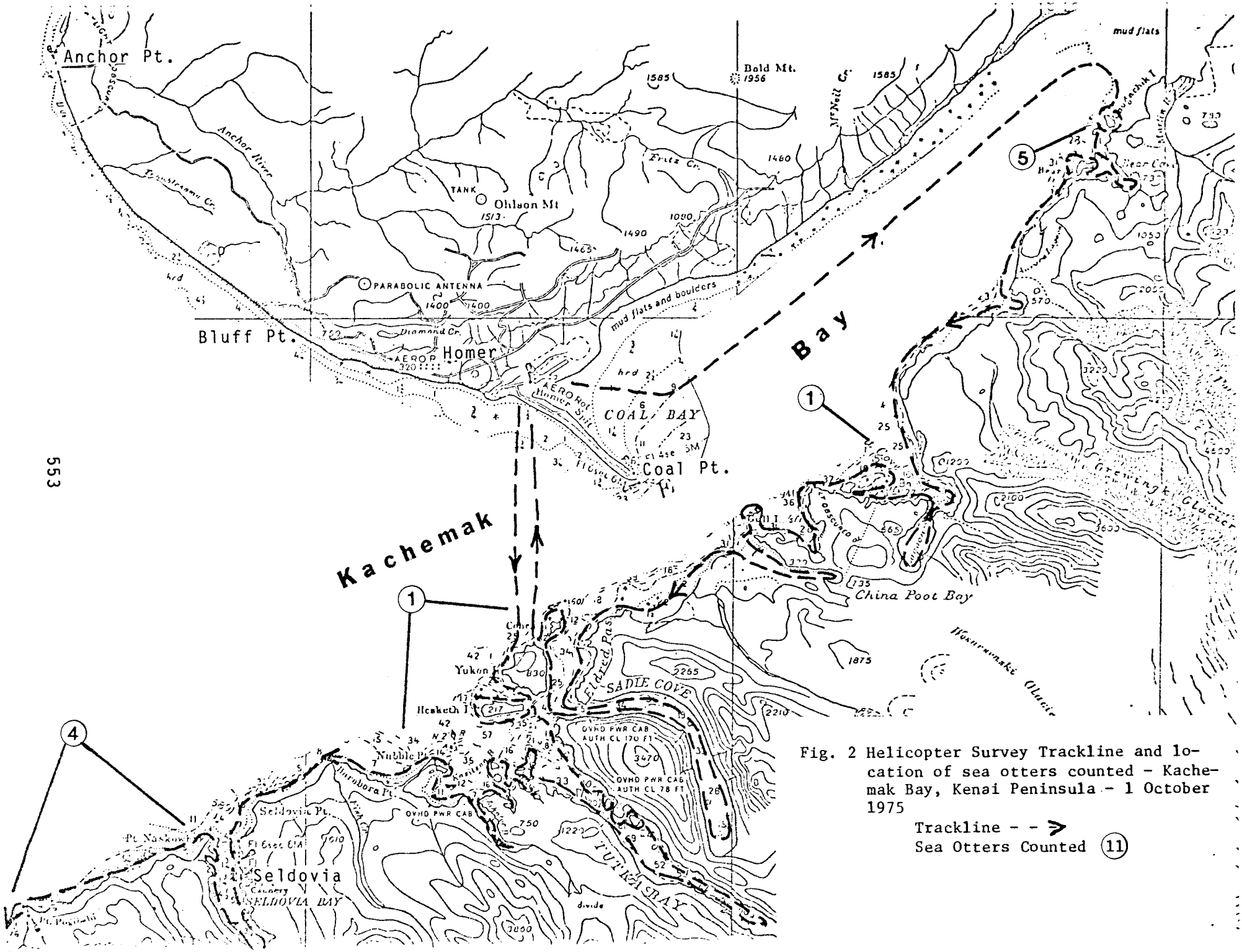


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Fig. 2 Helicopter Survey Trackline and location of sea otters counted - Kachemak Bay, Kenai Peninsula - 1 October 1975

Trackline - - →
Sea Otters Counted (11)

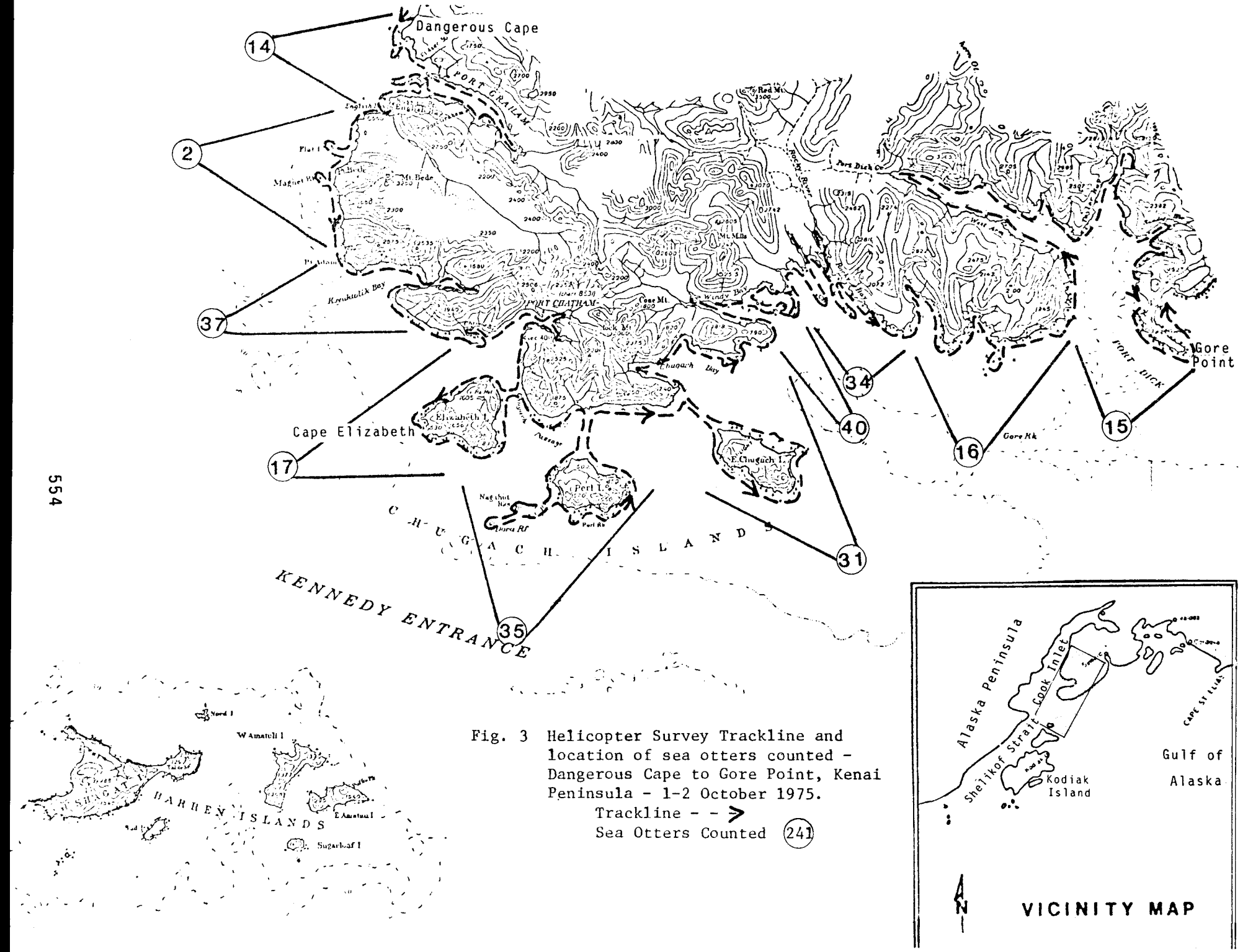
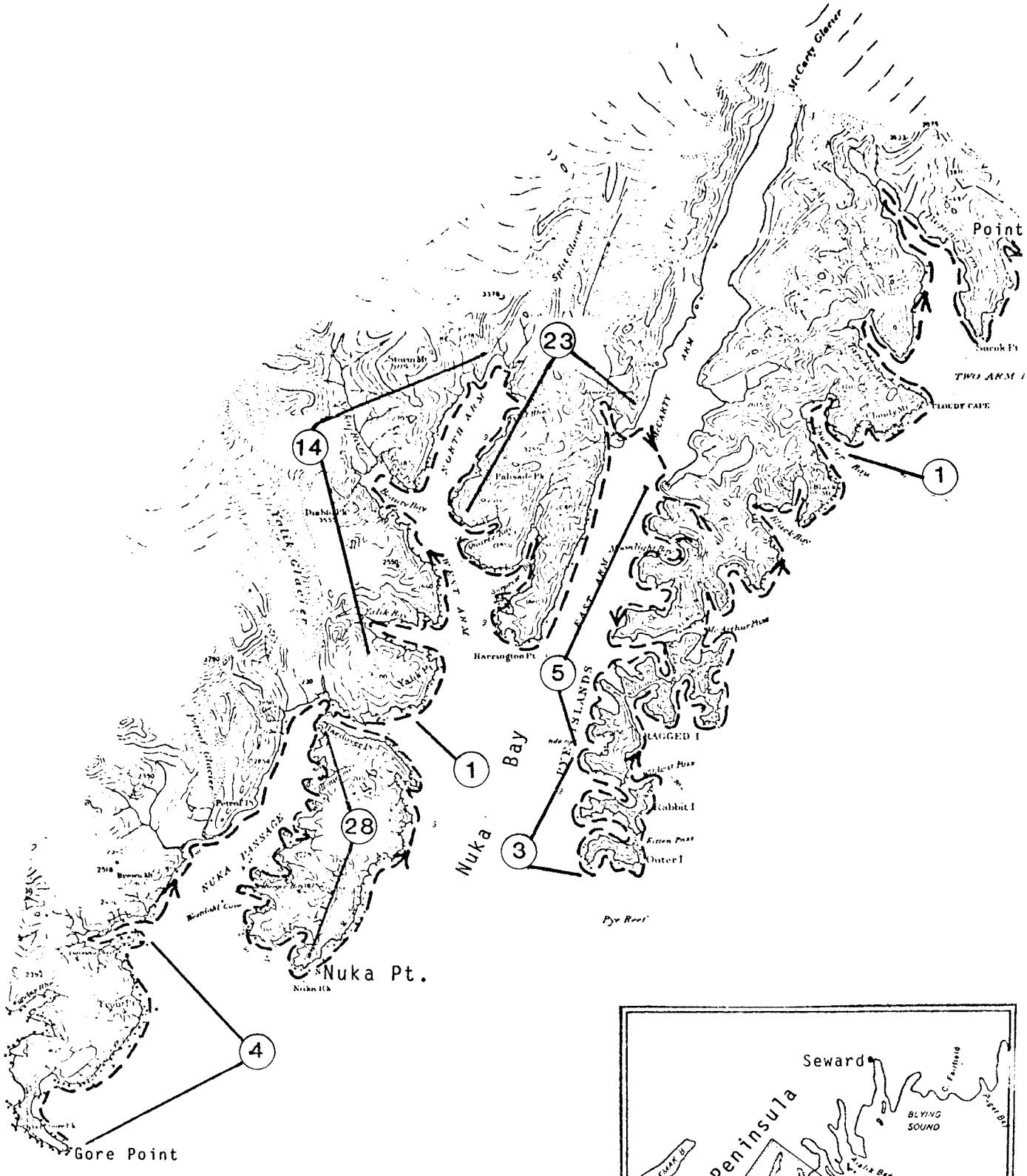


Fig. 3 Helicopter Survey Trackline and location of sea otters counted - Dangerous Cape to Gore Point, Kenai Peninsula - 1-2 October 1975.

Trackline - - >

Sea Otters Counted (241)



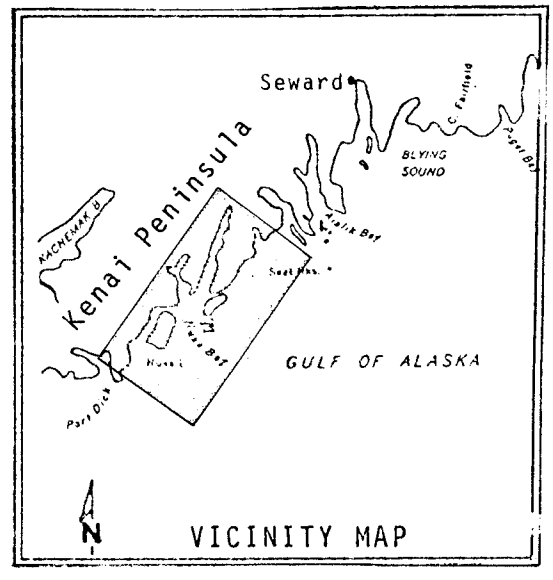
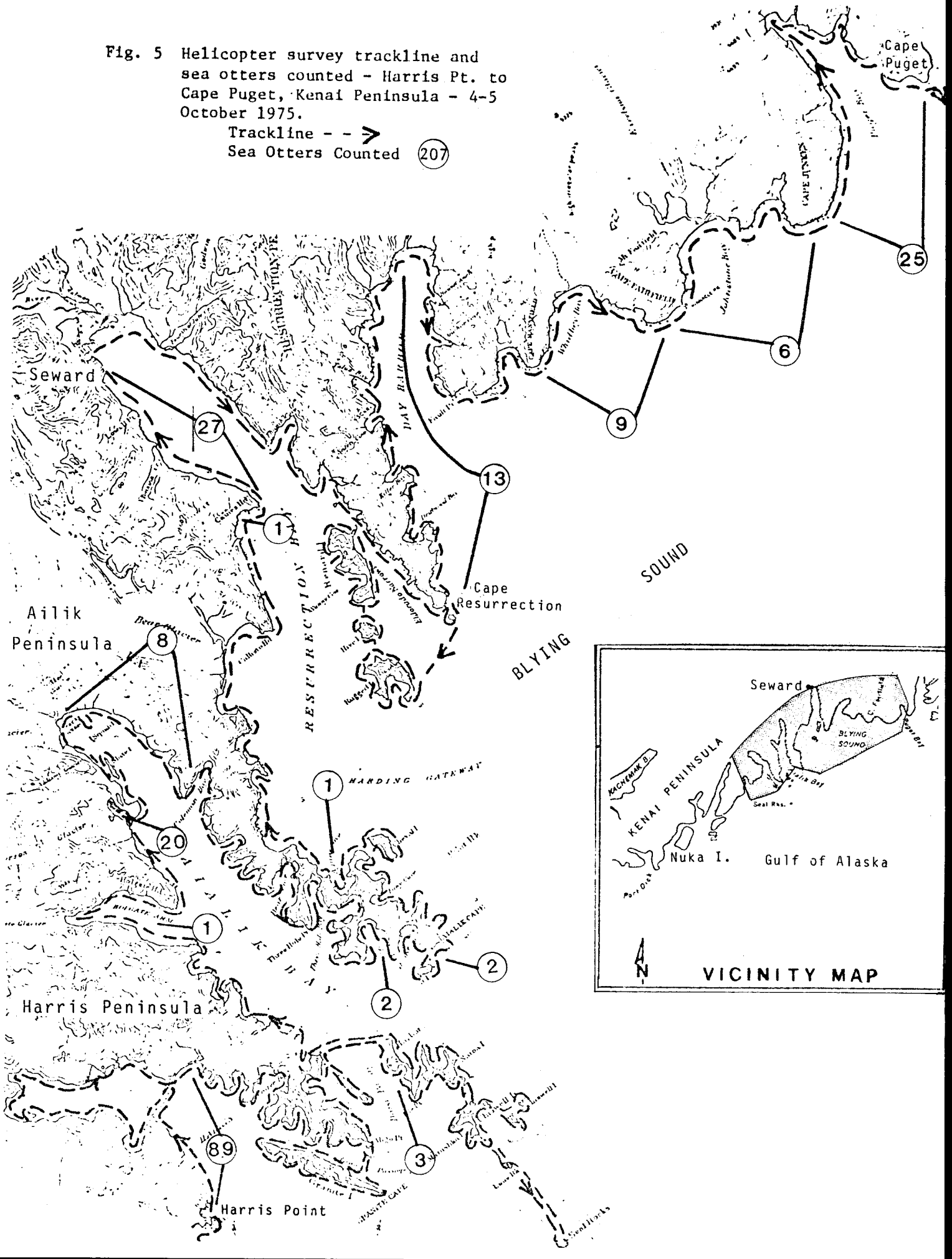


Fig. 4 Helicopter survey trackline and location of sea otters counted - Gore Pt. to Harris Pt., Kenai Peninsula - 2, 3, 4 October 1975.
Trackline - - >
Sea Otters Counted (82)

Fig. 5 Helicopter survey trackline and sea otters counted - Harris Pt. to Cape Puget, Kenai Peninsula - 4-5 October 1975.

Trackline - - →

Sea Otters Counted (207)



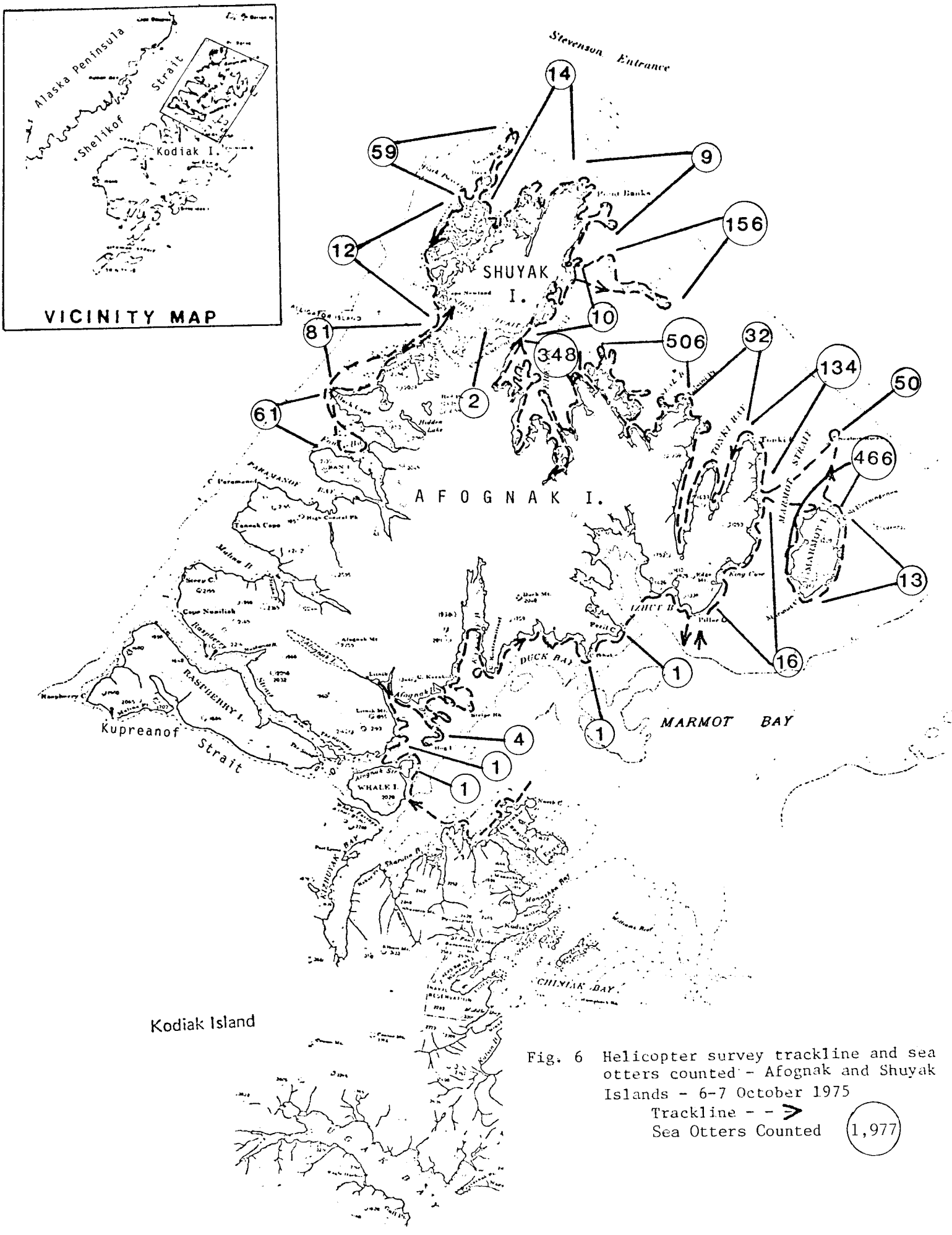


Fig. 6 Helicopter survey trackline and sea otters counted - Afognak and Shuyak Islands - 6-7 October 1975

Trackline - - >

Sea Otters Counted (1,977)

Table 3. Results of boat sea otter survey of portions of the Kodiak Archipelago, 3-11 February 1976.

Area	Date	Sea Otters Counted	Survey Conditions	Completeness of Coverage
Kupreanof Strait	2/3/76	1	Poor	Incomplete
Paramanof Bay	2/4/76	15	Fair	"
Foul Bay	"	60	Poor	"
Bluefox Bay	"	32	Fair	"
Shuyak Strait	"	14	"	"
Shuyak (West)	2/5/76	272	Poor	"
Uganik Passage	2/10/76	37	Excellent	"
Cape Ugat	"	1	Fair	"
Uyak Bay (East)	2/11/76	1	"	"
Uyak Bay (South)	"	0	Very Good	"
Kodiak	2/9/76	0	Fair	"

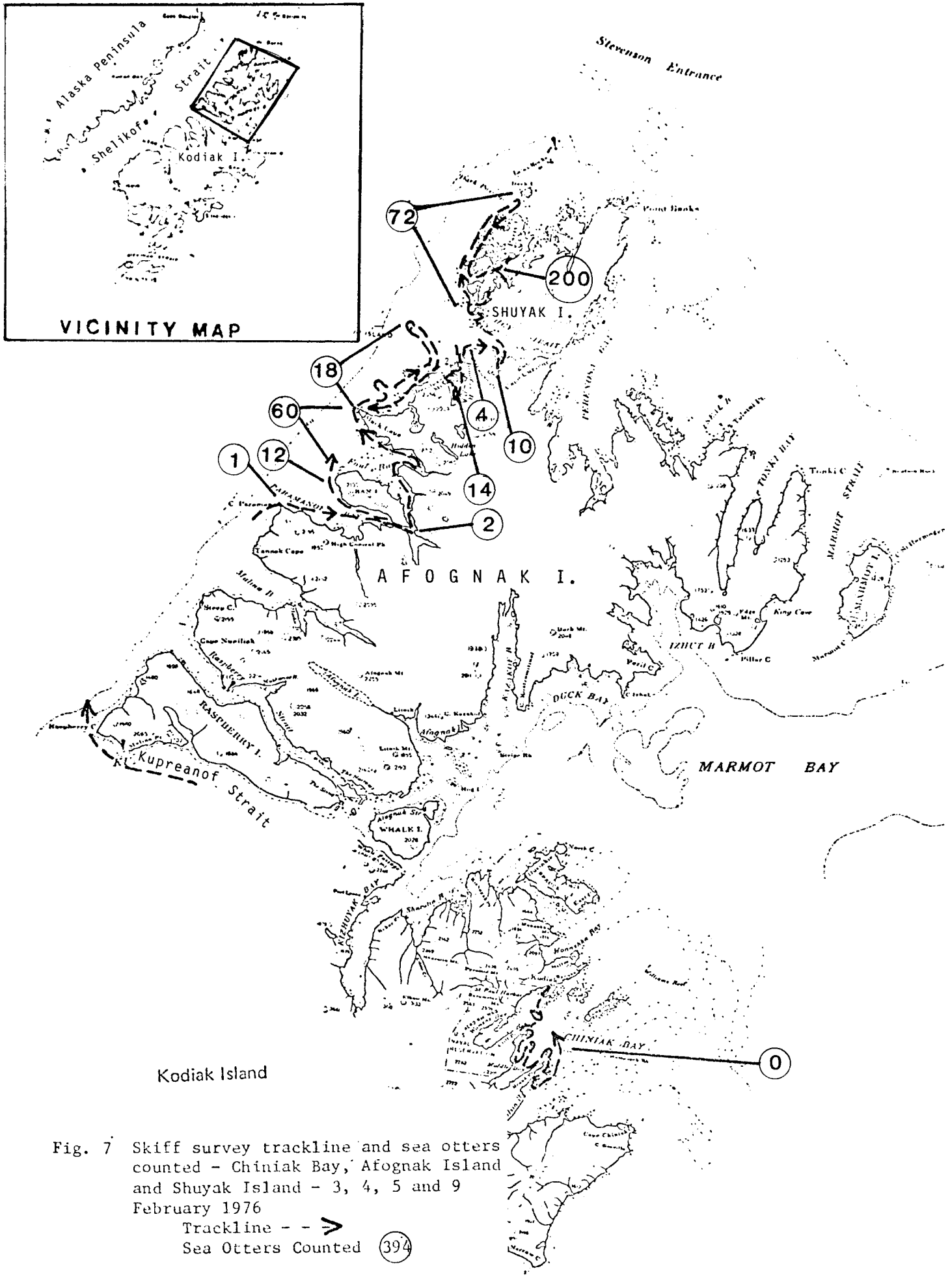
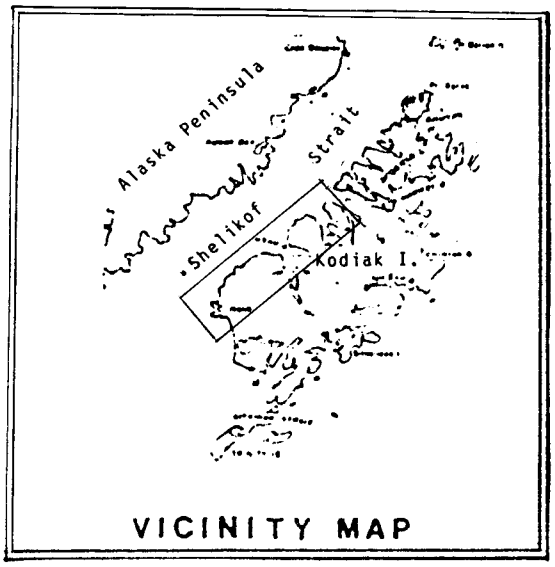


Fig. 7 Skiff survey trackline and sea otters counted - Chiniak Bay, Afognak Island and Shuyak Island - 3, 4, 5 and 9 February 1976

Trackline - - >

Sea Otters Counted (394)



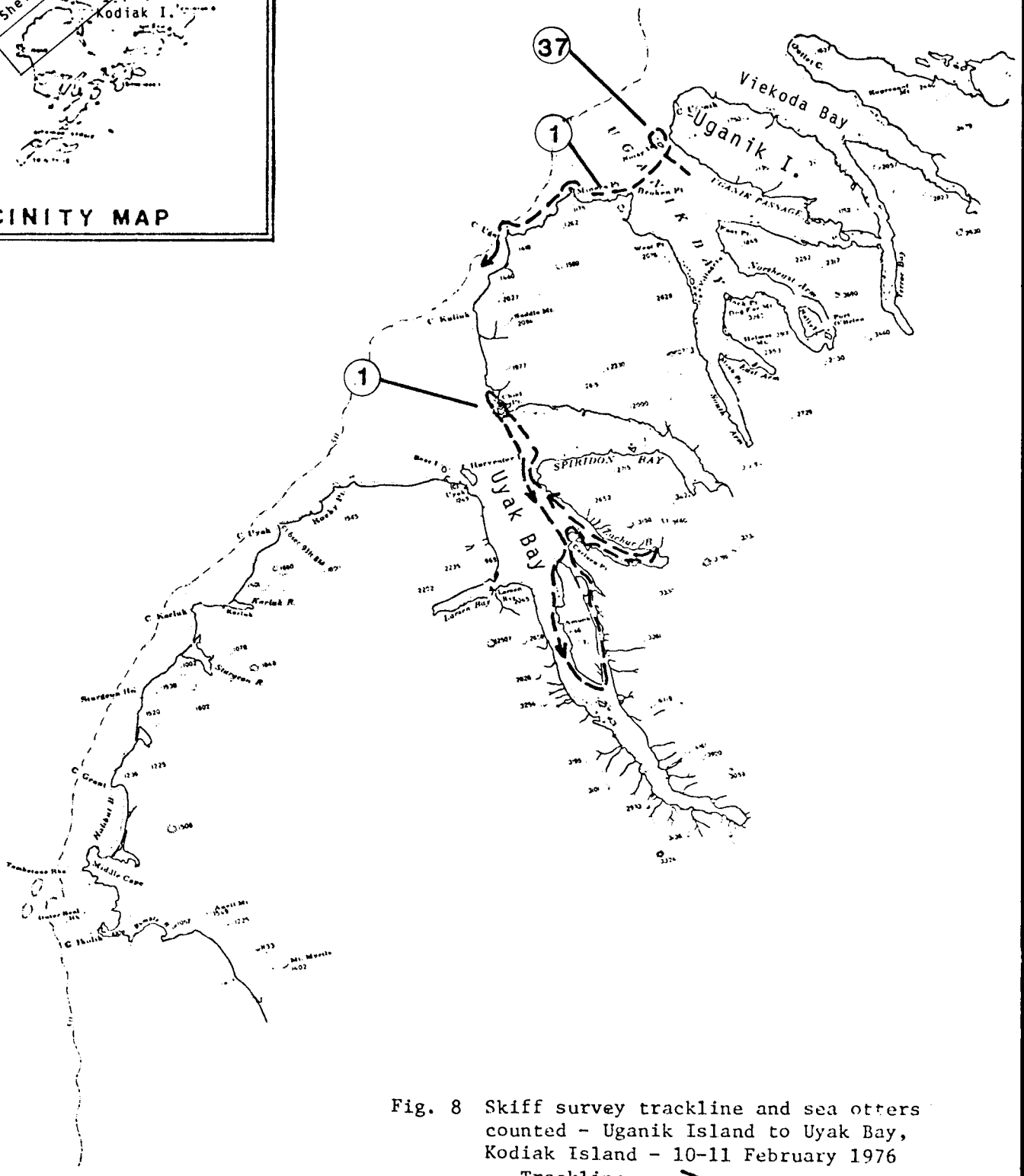


Fig. 8 Skiff survey trackline and sea otters counted - Uganik Island to Uyak Bay, Kodiak Island - 10-11 February 1976
Trackline - - >
Sea Otters Counted (39)

fixed-wing survey in Table 4 and Figs. 9-13, the April aerial strip survey in Table 5 and Figs. 14-15, the May fixed-wing survey in Table 6 and Fig. 16 and the June fixed-wing survey in Table 7 and Figs. 17-21. Survey tracklines are shown in Figs. 1-21. Counts presented in Tables 2-4 and 6-7 are grouped into standardized count areas to facilitate comparison.

Sea otter observations made by personnel conducting three aerial surveys of birds under RU #3/4 are presented in Figs. 22-28. All three surveys include the area within 400 m of shore along the entire shoreline from Gore Point to the East Foreland. Sea otters offshore were not counted and at times otters inside the survey strip were ignored if many birds were present.

Sightings made in various parts of the Kodiak Archipelago from helicopters and boats by personnel working on RU #229 and 243 in October and November 1976 are presented in Figs. 29-32. These observations often were made under poor conditions and reflect only the presence or absence of sea otters close to shore.

Recent significant sightings from other sources are presented in Table 8.

VII. Discussion

The effectiveness of surveys of the type used in this project can be highly variable. The results should be interpreted carefully with consideration of the survey conditions and the completeness of coverage.

Table 4. Sea Otter sightings made during aerial survey of sea lions around the Kodiak Archipelago, 13-14 March 1976.

Area	Date	Sea Otters Counted	Survey Conditions	Completeness of Coverage
Kodiak Archipelago				
Izhut Bay (East)	3/13/76	0	Fair	Incomplete
Duck Bay	"	6	"	"
Cape Chiniak	"	0	"	"
Kodiak	"	0	"	"
Sequel Pt.	"	1	Good	"
Ugak I.	"	0	Poor	"
Ugak Bay	"	0	"	"
Dangerous Cape	"	0	"	"
Sitkalidak I. (South)	"	0	"	"
Twoheaded I.	"	0	"	"
Aiaktalik I.	"	0	"	"
Sitkinak I. (South)	"	1	Fair	"
Tugidak I. (South)	"	21	Good	"
Tugidak-Chirikof	"	1	"	"
Chirikof	"	10	Very Good	"
Tugidak I. (North)	"	1	Fair	"
Alitak Bay	"	0	"	"
Ayakulik	"	0	"	"
Halibut Bay	3/14/76	1	Good	Complete
Karluk	"	0	"	"
Rocky Point	"	0	"	"
Uyak Bay (West)	"	5	Very Good	Incomplete
Cape Ugat	"	0	Fair	Complete
Uganik Passage	"	12	Poor	Incomplete
Viekoda Bay	"	1	Very Good	Incomplete
Kupreanof Strait	"	20	Good	"
Raspberry Strait	"	20	"	"
Malina Bay	"	31	Fair	"

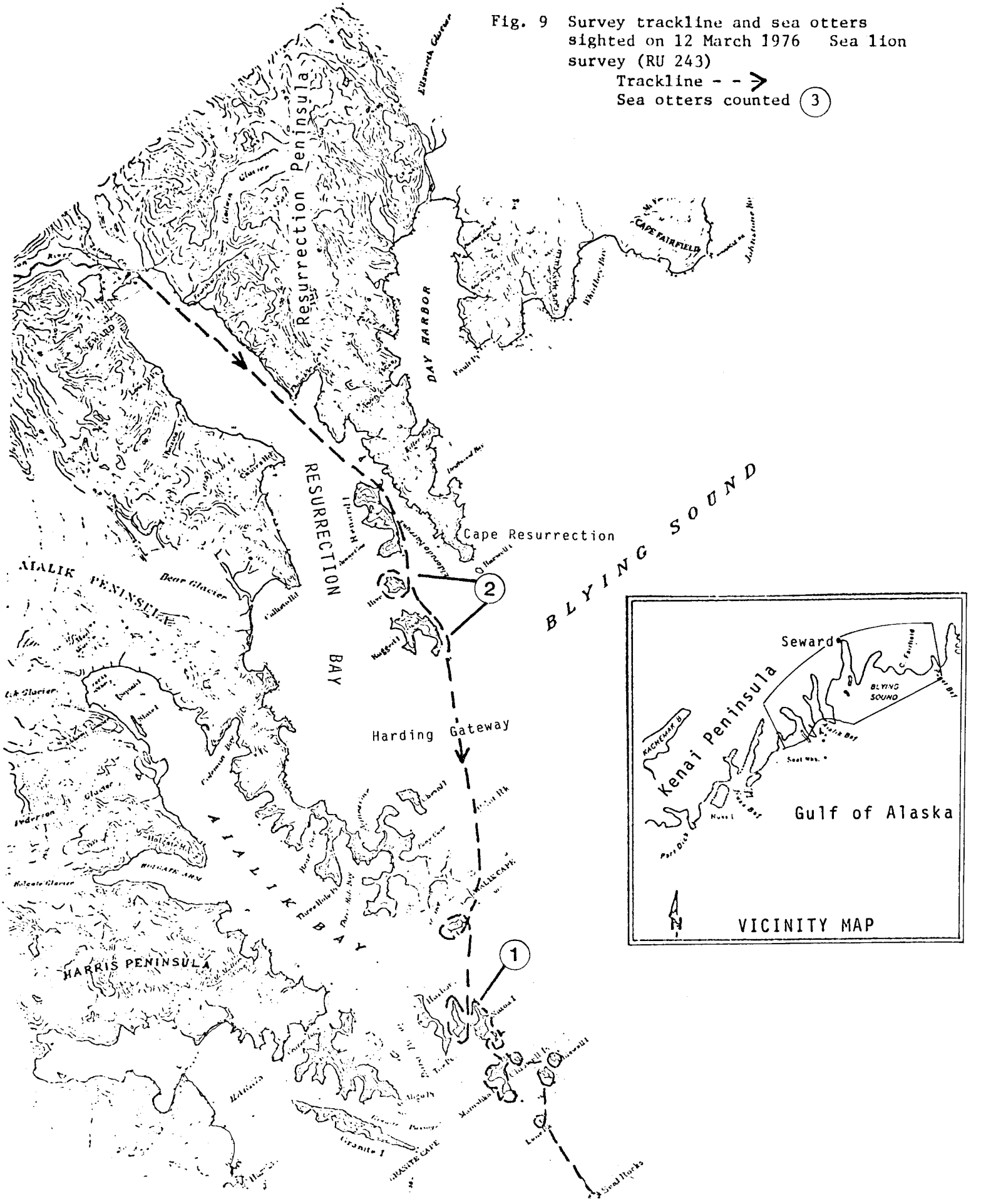


Fig. 9 Survey trackline and sea otters sighted on 12 March 1976 Sea lion survey (RU 243)

Trackline - - →

Sea otters counted (3)

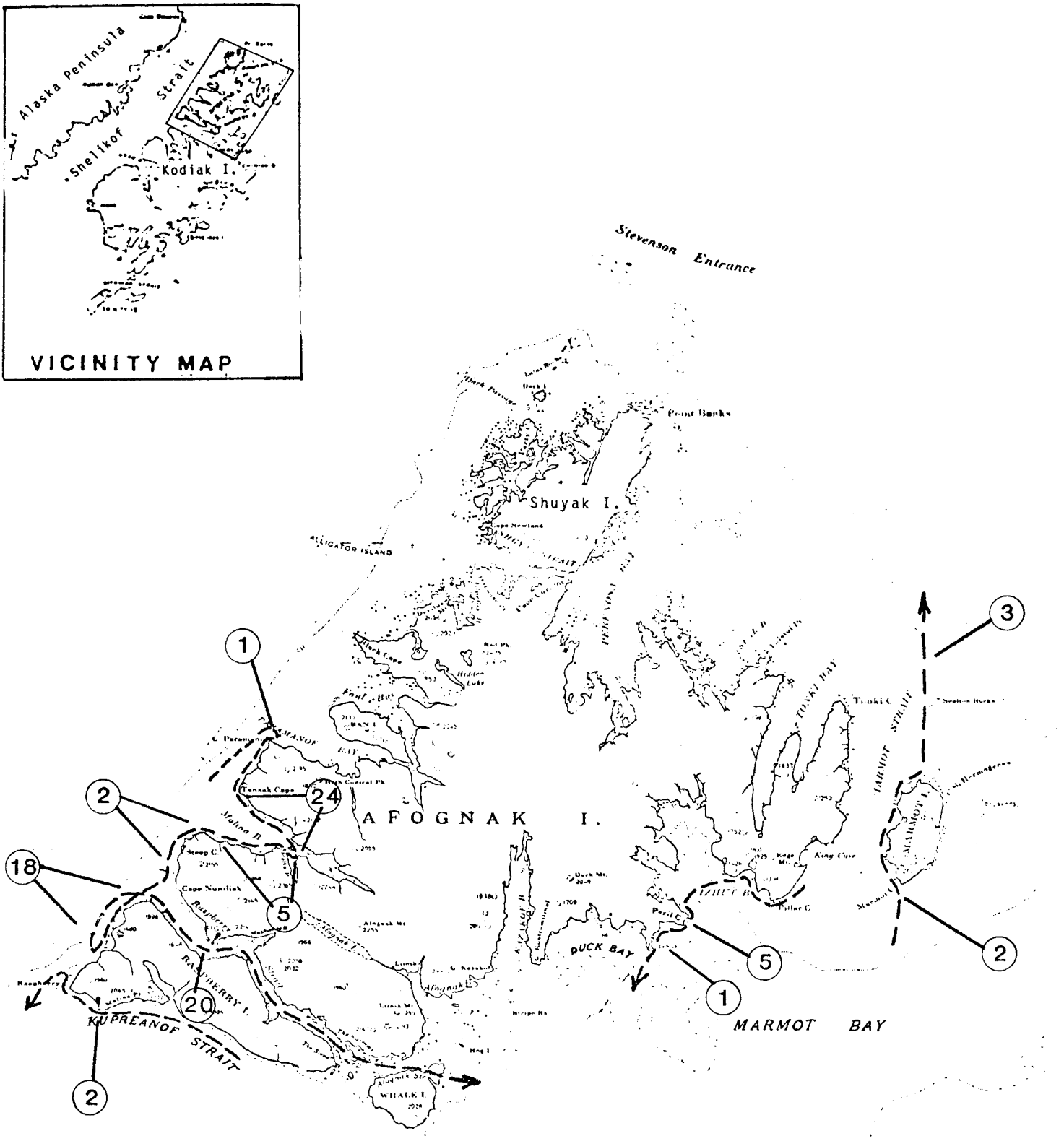


Fig. 10 Survey trackline and sea otters sighted on 13-14 March 1976 Sea lion survey (RU 243)
Trackline - - >
Sea otters counted (83)

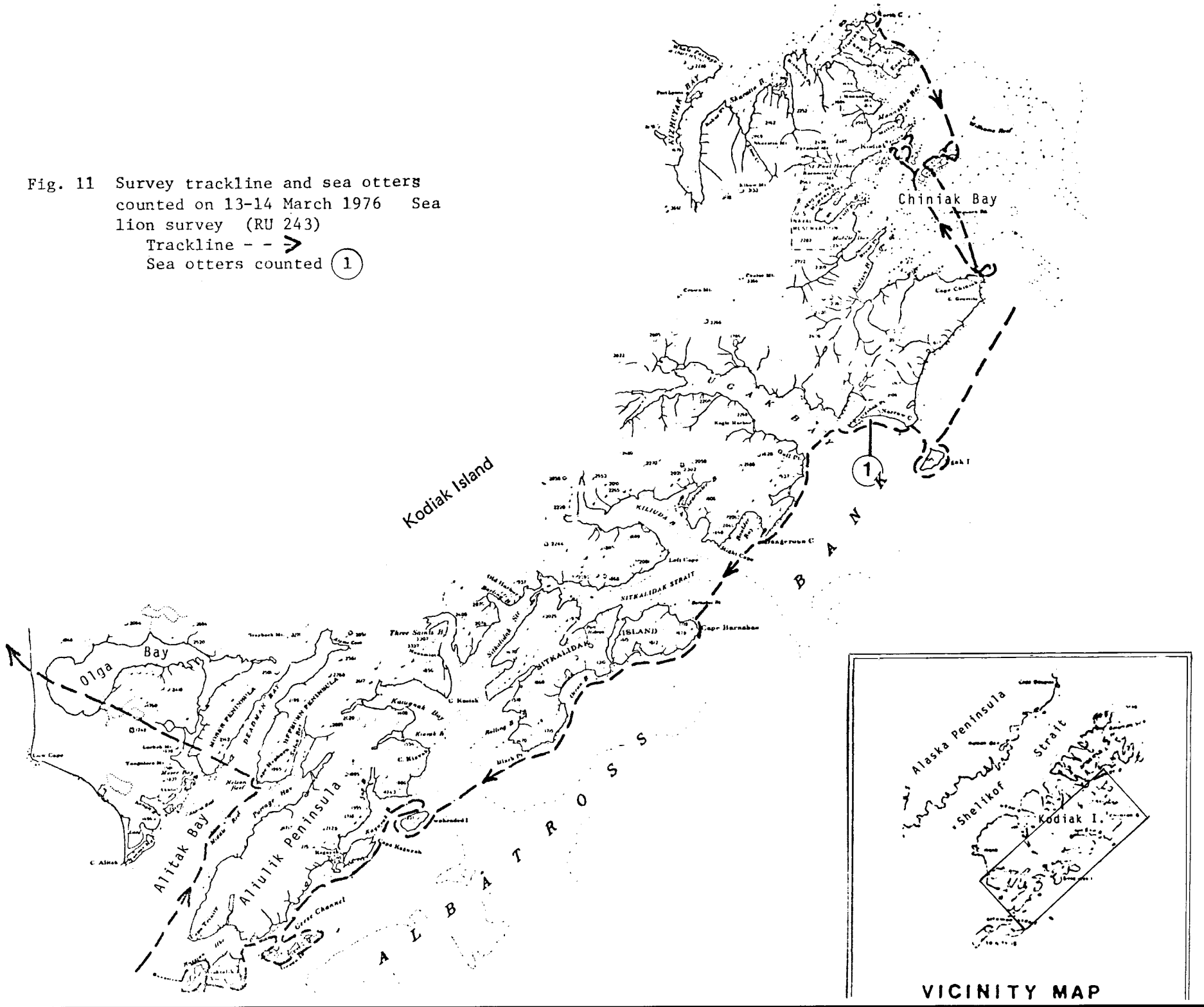
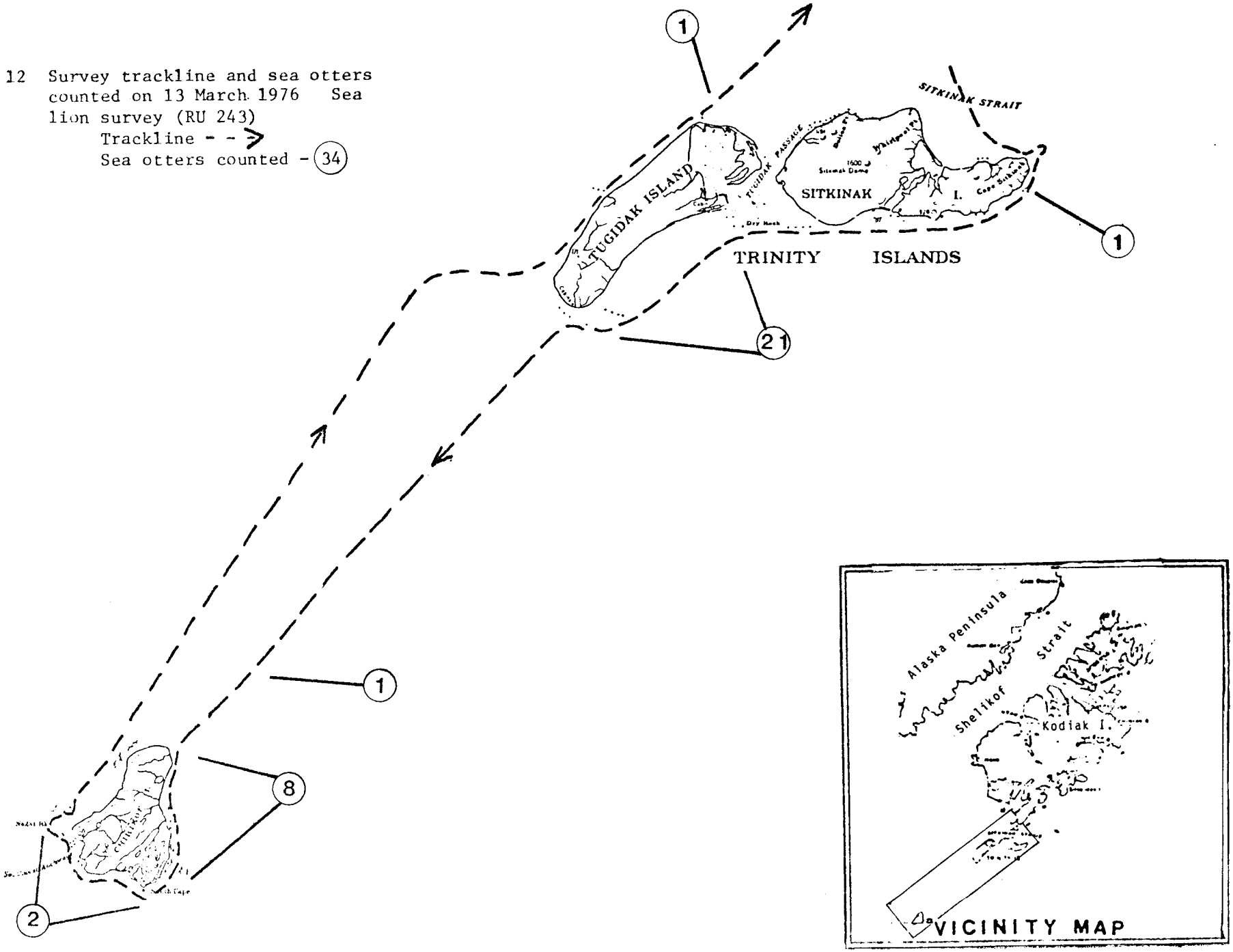


Fig. 11 Survey trackline and sea otters counted on 13-14 March 1976 Sea lion survey (RU 243)
Trackline - - >
Sea otters counted (1)

Fig. 12 Survey trackline and sea otters counted on 13 March 1976 Sea lion survey (RU 243)
Trackline - - →
Sea otters counted - (34)



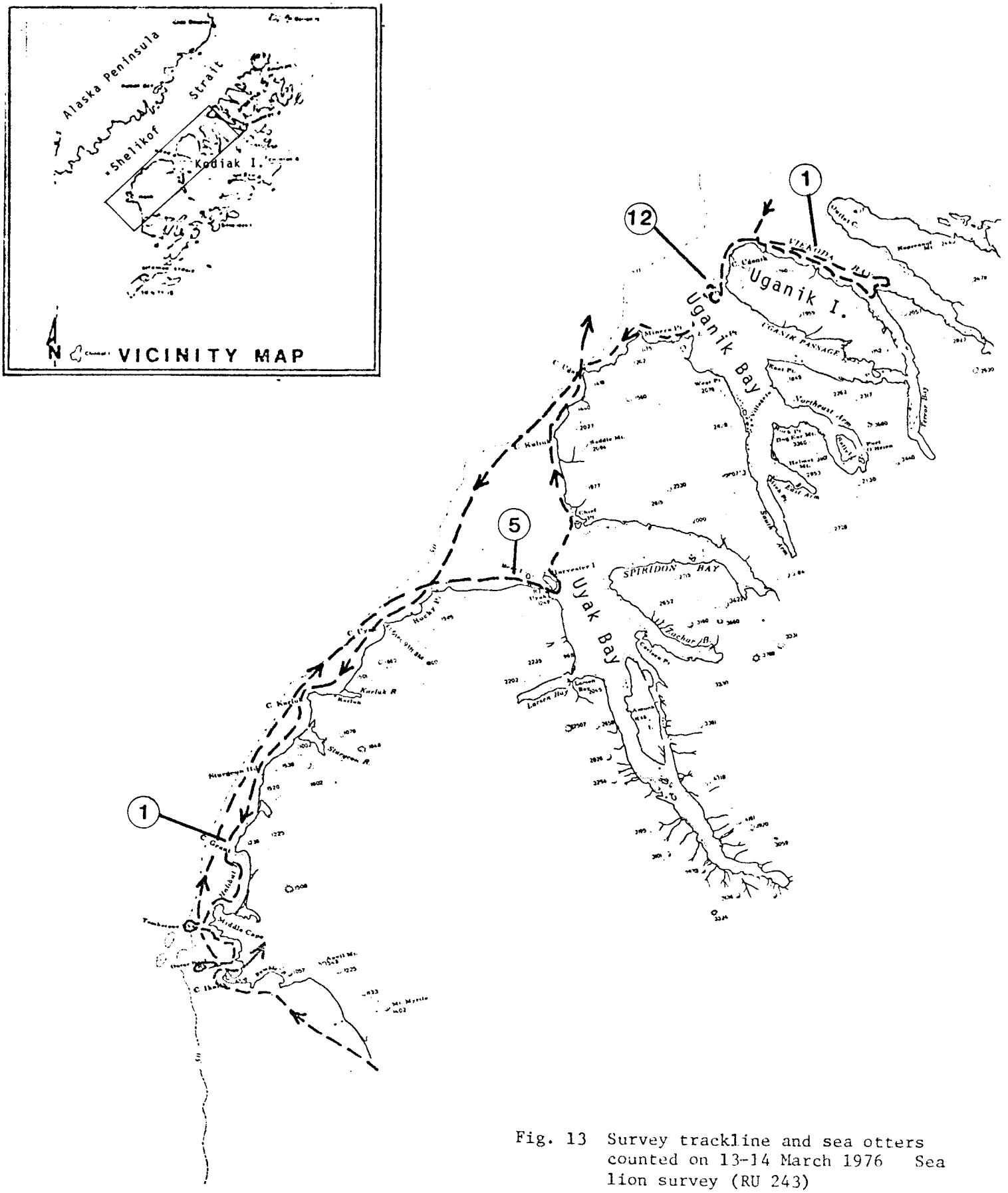


Fig. 13 Survey trackline and sea otters counted on 13-14 March 1976 Sea lion survey (RU 243)
Trackline - - >
Sea otters counted (19)

Table 5. Sea otter sightings made on unlimited-width strip transect survey in Kamishak Bay and Kachemak Bay, 1 April 1976.

Kamishak Bay

Tracklines - Even minutes of latitude extending from the shore of Kamishak Bay to;

153° 00' W Long between 59° 36' N Lat and 59° 20' N Lat
153° 10' " " " 59° 18' " " 59° 08' " "
153° 15' " " " 59° 06' " " " 59° 04' " "

and shoreline from Shaw I. to C. Douglas

Sighting Latitude	Sighting Longitude	Number of Sea Otters Sighted	Survey Conditions
59°32' N	153°22' W	1	Very Good
59 32	153 26	1	"
59 26	153 40	1	"
59 26	153 39	4	"
59 26	153 37	2	"
59 26	153 29	1	"
59 26	153 28	34	"
59 22	153 57	1	"
59 22	154 00	4	"
59 21	153 56	1	"
59 21	153 54	2	"
59 21	153 52	1	"
59 21	153 50	1	"
59 22	153 45	1	"
59 23	153 22	1	"
59 19	153 29	1	"
59 19	153 28	1	"
59 20	153 34	2	"
59 20	154 00	1	"
59 18	154 02	1	"
59 16	154 03	1	"
59 16	154 04	1	Good
59 12	153 57	1	"
59 12	154 04	1	"
59 12	154 07	2	"
58 54	153 18	1	"
58 52	153 18	3	"
58 50	153 19	1	"

Table 5 (Cont.) Sea otter sightings made on unlimited-width strip transect survey in Kamishak Bay and Kachemak Bay, 1 April 1976.

Kachemak Bay

Tracklines - Even minutes of latitude extending from the shore of The Kenai Peninsula to 152° 10' W Long between 59° 34' N. Lat and 59° 48' N Lat.

Sighting Latitude	Sighting Longitude	Number of Sea Otters Sighted	Survey Conditions
59°34' N	151°30' W	1	Very Good
59 34	151 33	1	"
59 34	152 03	4	"
59 34	152 05	1	"
59 36	151 59	1	"
59 36	151 45	1	"
59 36	151 34	1	"
59 38	151 51	1	"
59 38	151 54	1	"
59 38	151 56	1	"
59 38	151 57	1	"
59 38	152 02	1	"
59 38	152 06	1	"
59 40	152 04	1	"
59 40	151 57	1	"
59 40	151 55	2	"
59 40	151 52	5	"
59 40	151 48	2	"
59 40	151 47	2	"
59 42	151 50	4	"
59 42	151 45	1	"
59 42	151 58	3	"
59 42	151 59	2	"
59 42	152 01	1	"
59 44	152 06	2	"
59 44	152 03	1	"
59 46	152 06	3	"
59 48	152 06	1	"
59 48	151 59	1	"
59 48	151 58	1	"

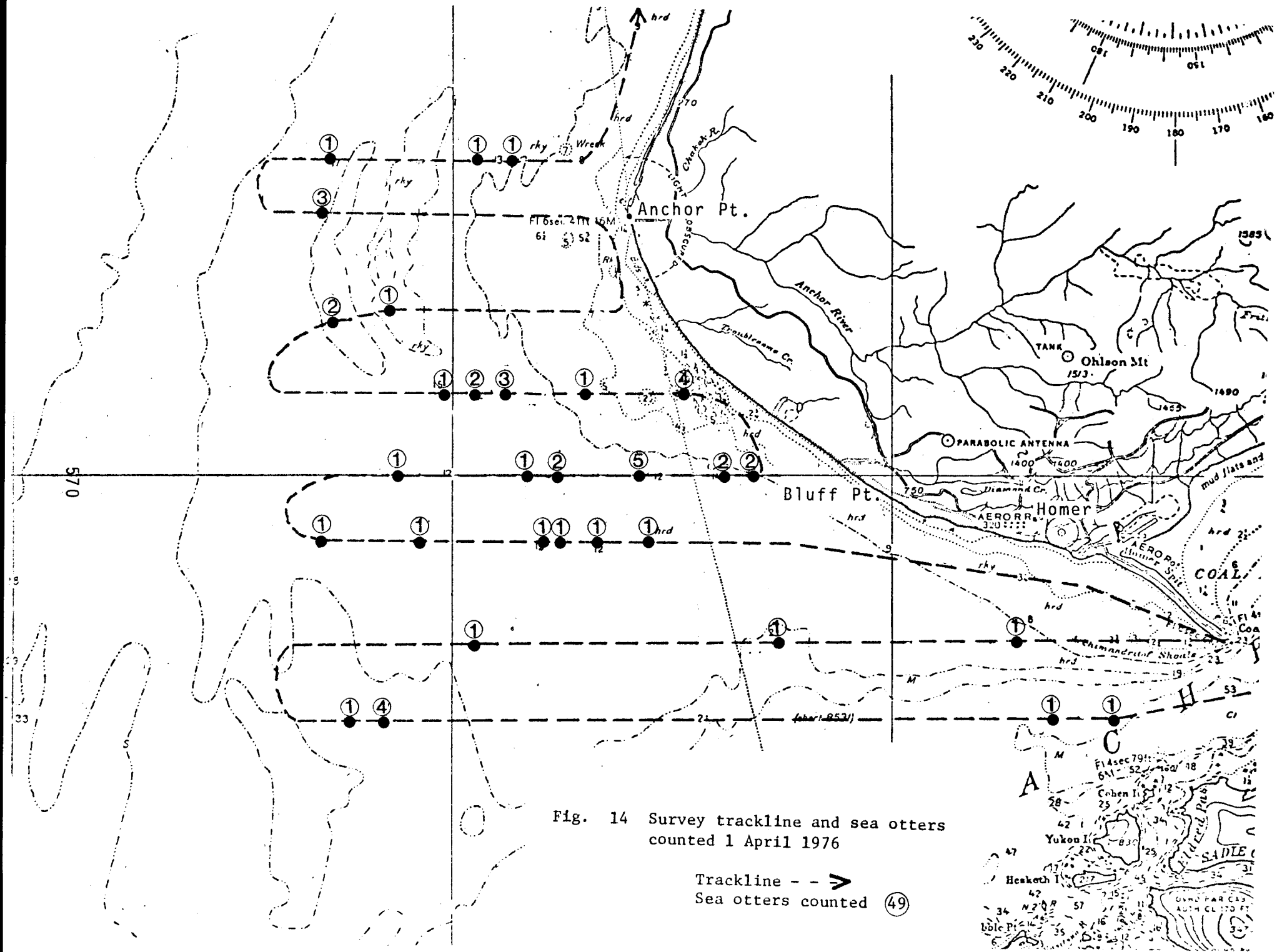


Fig. 14 Survey trackline and sea otters counted 1 April 1976

Trackline - - >
Sea otters counted (49)

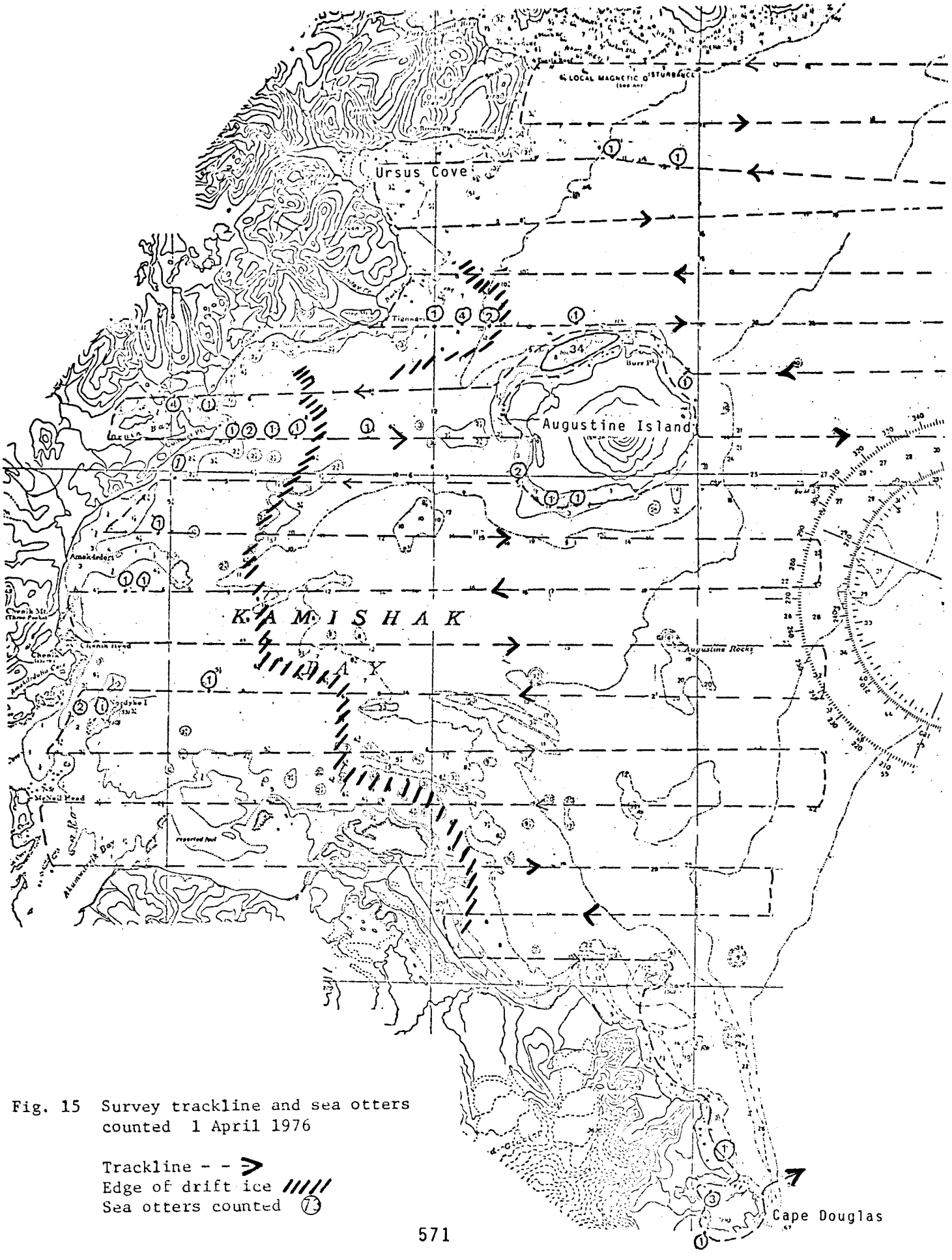


Fig. 15 Survey trackline and sea otters counted 1 April 1976

Trackline - - >
Edge of drift ice ////
Sea otters counted (7)

Table 6. Sea otter sightings made during aerial survey of sea lions around the Barren Islands, 20 May 1976.

Area	Date	Sea Otters Counted	Survey Conditions	Completeness of Coverage
West Amatuli I.	5/20/76	8	Poor	Incomplete
N. side Ushagat I.	"	10	"	"
S. side Ushagat I.	"	40	"	"
Sud I.	"	33	"	"
Carl I.	"	60	"	"

Table 7. Sea otter sightings made during aerial survey of sea lions around the Kodiak Archipelago including the Barren Islands, 10 June 1976.

Area	Date	Sea Otters Counted	Survey Conditions	Completeness of Coverage
Kodiak Island				
Low Cape	6/10/76	2	Fair	Incomplete
Kodiak	"	1	Excellent	"
Barren Islands				
Sugarloaf Island	"	1	Fair	Complete
E Amatuli I.	"	0	"	"
W. Amatuli I.	"	2	"	"
Nord I.	"	0	"	"
N. side Ushagat I.	"	8	"	"
S. side Ushagat I.	"	35	"	"
Sud I.	"	15	"	"
Carl I.	"	50	"	Incomplete

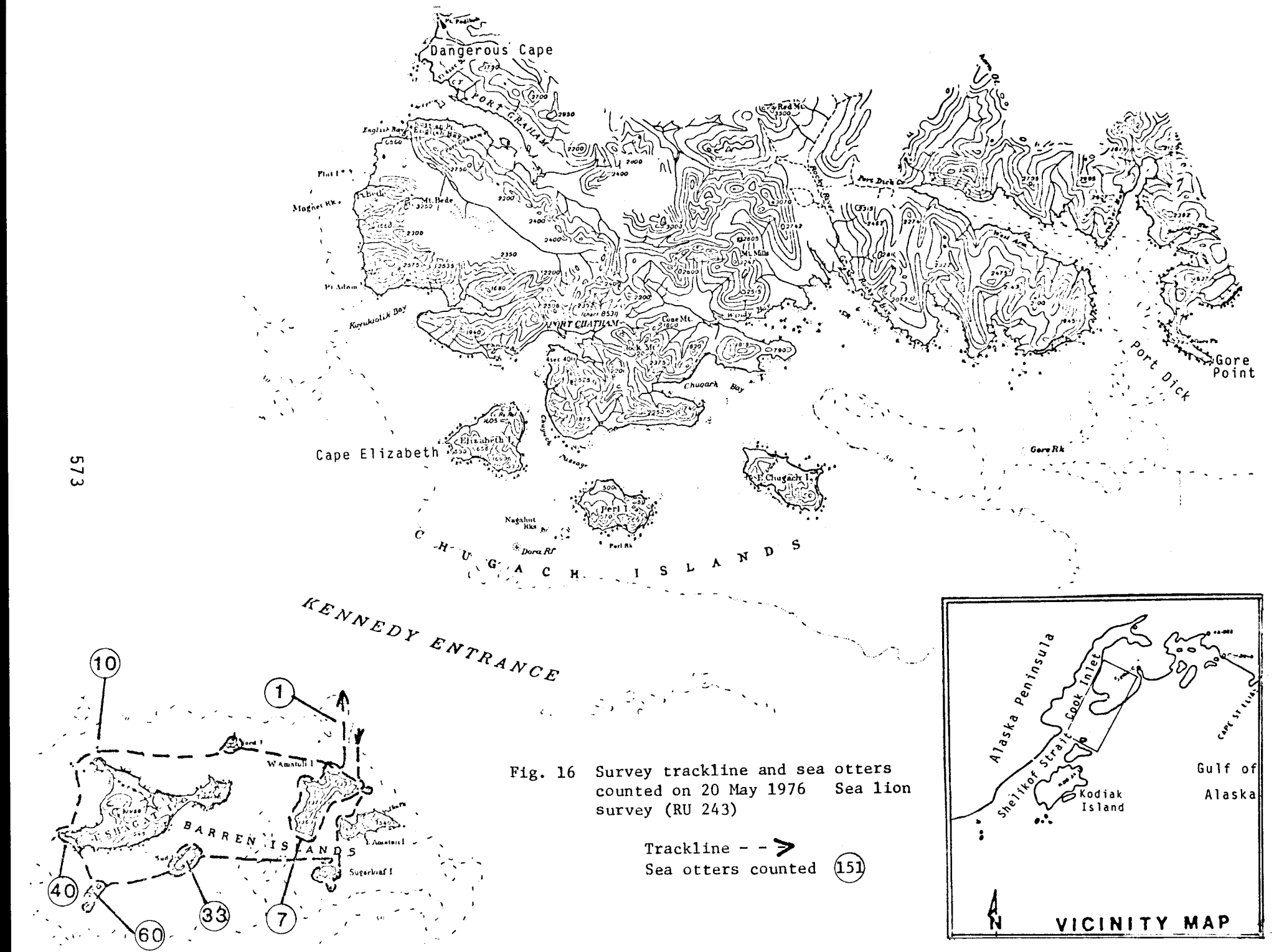


Fig. 16 Survey trackline and sea otters counted on 20 May 1976 Sea lion survey (RU 243)

Trackline - - →

Sea otters counted (151)

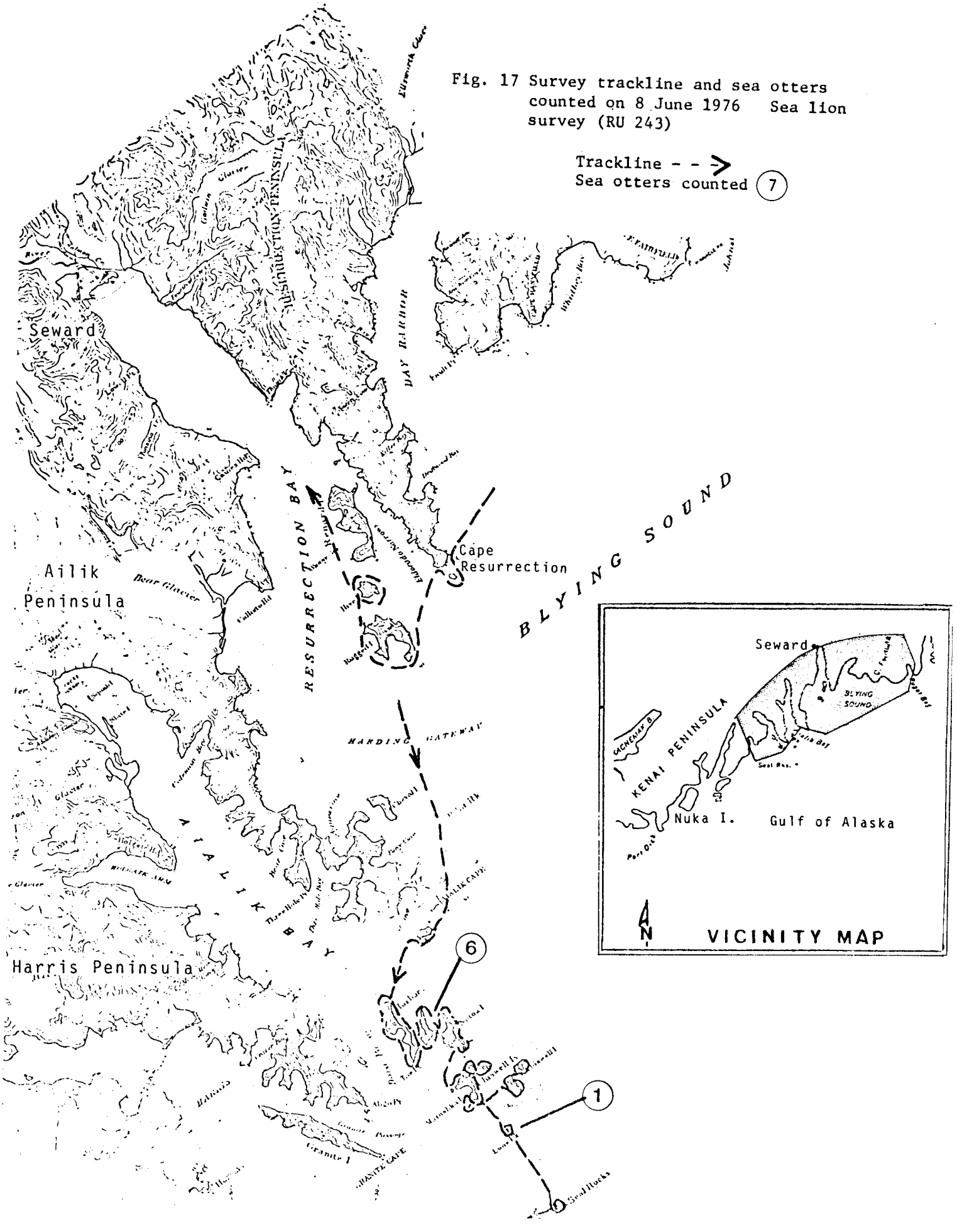


Fig. 17 Survey trackline and sea otters counted on 8 June 1976 Sea lion survey (RU 243)

Trackline - - →
Sea otters counted (7)

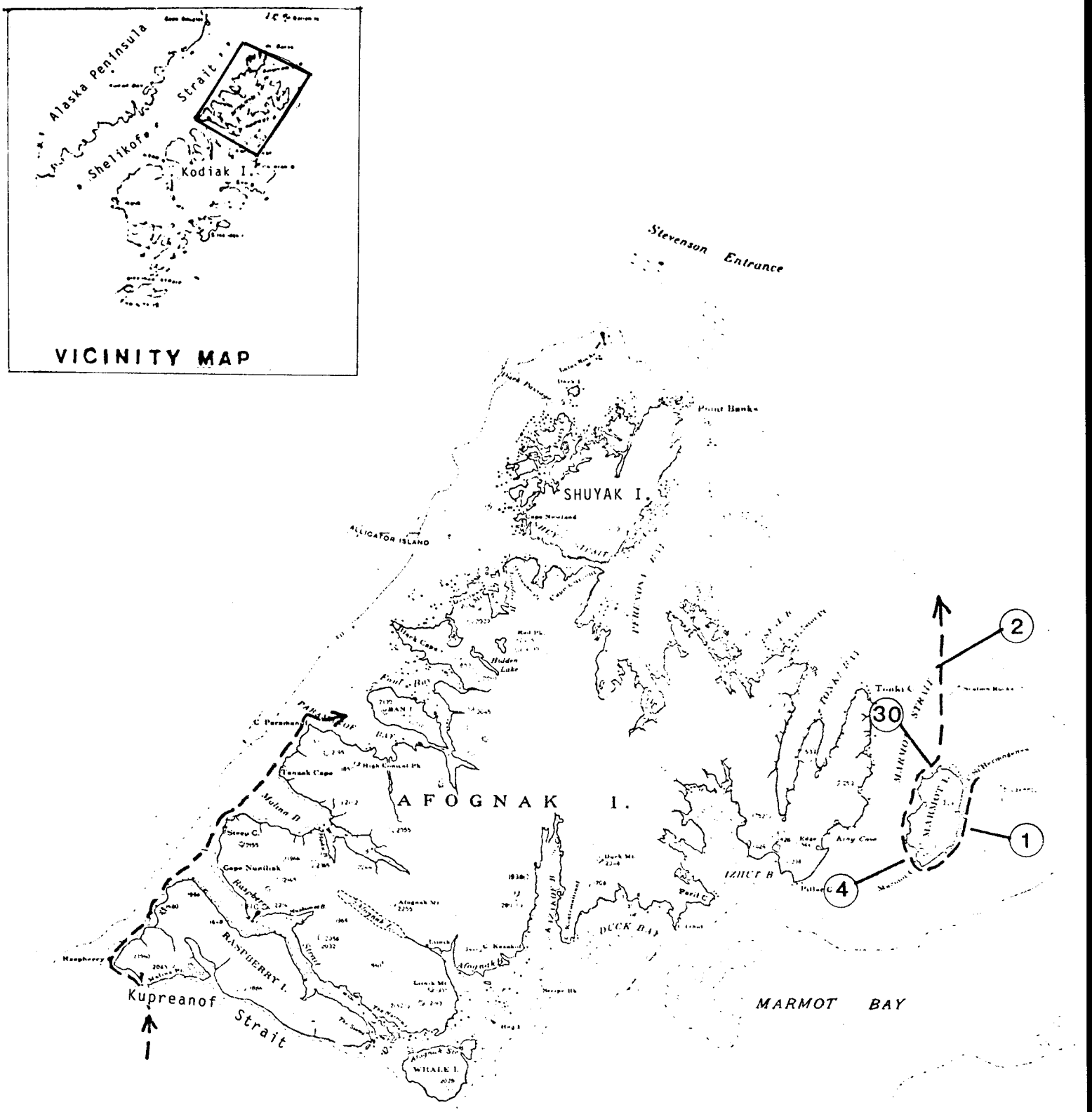
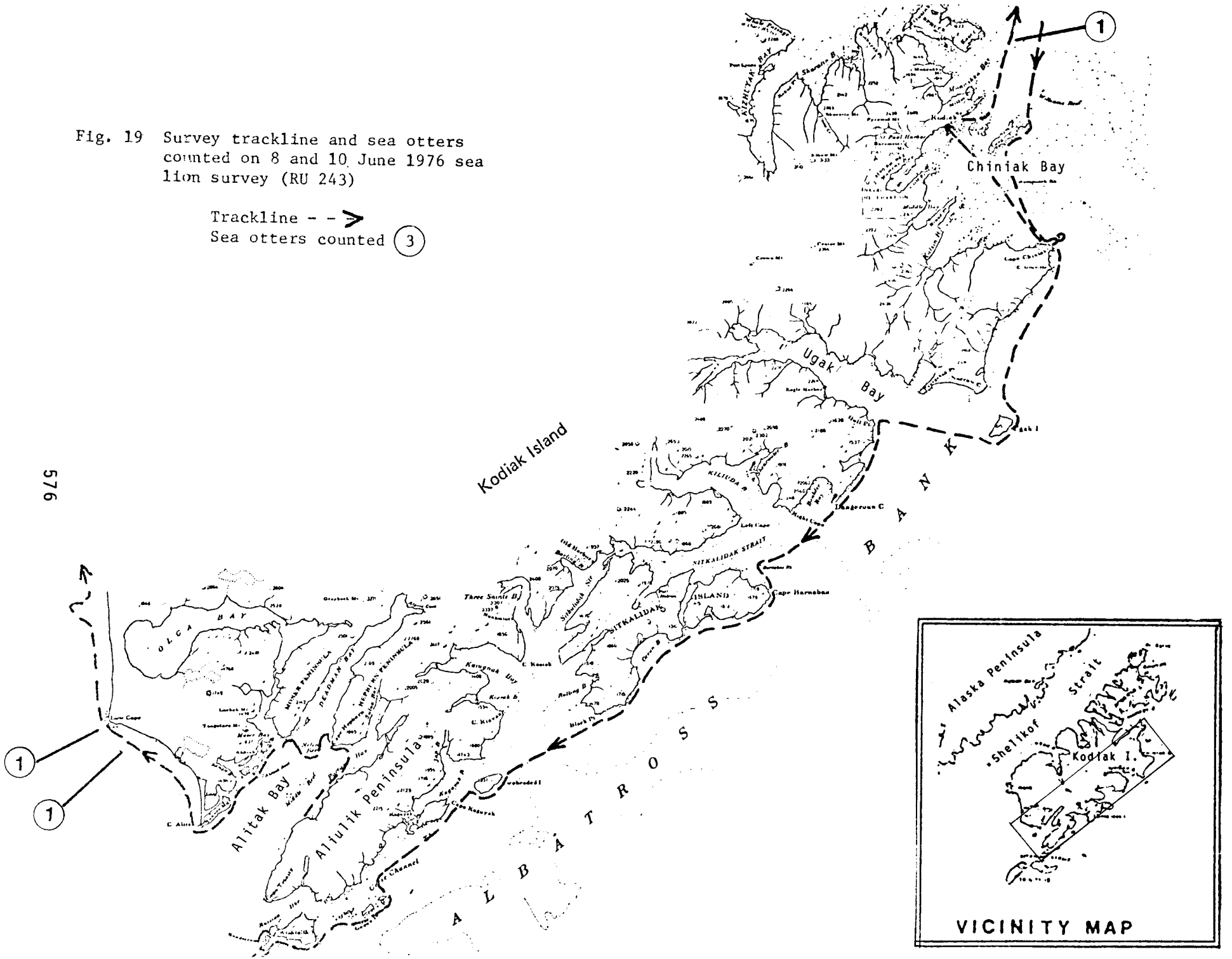


Fig. 18 Survey trackline and sea otters counted on 8 and 10 June 1976 sea lion survey (RU 243)

Trackline - - >
Sea otters counted (37)

Fig. 19 Survey trackline and sea otters counted on 8 and 10 June 1976 sea lion survey (RU 243)

Trackline - - →
Sea otters counted (3)



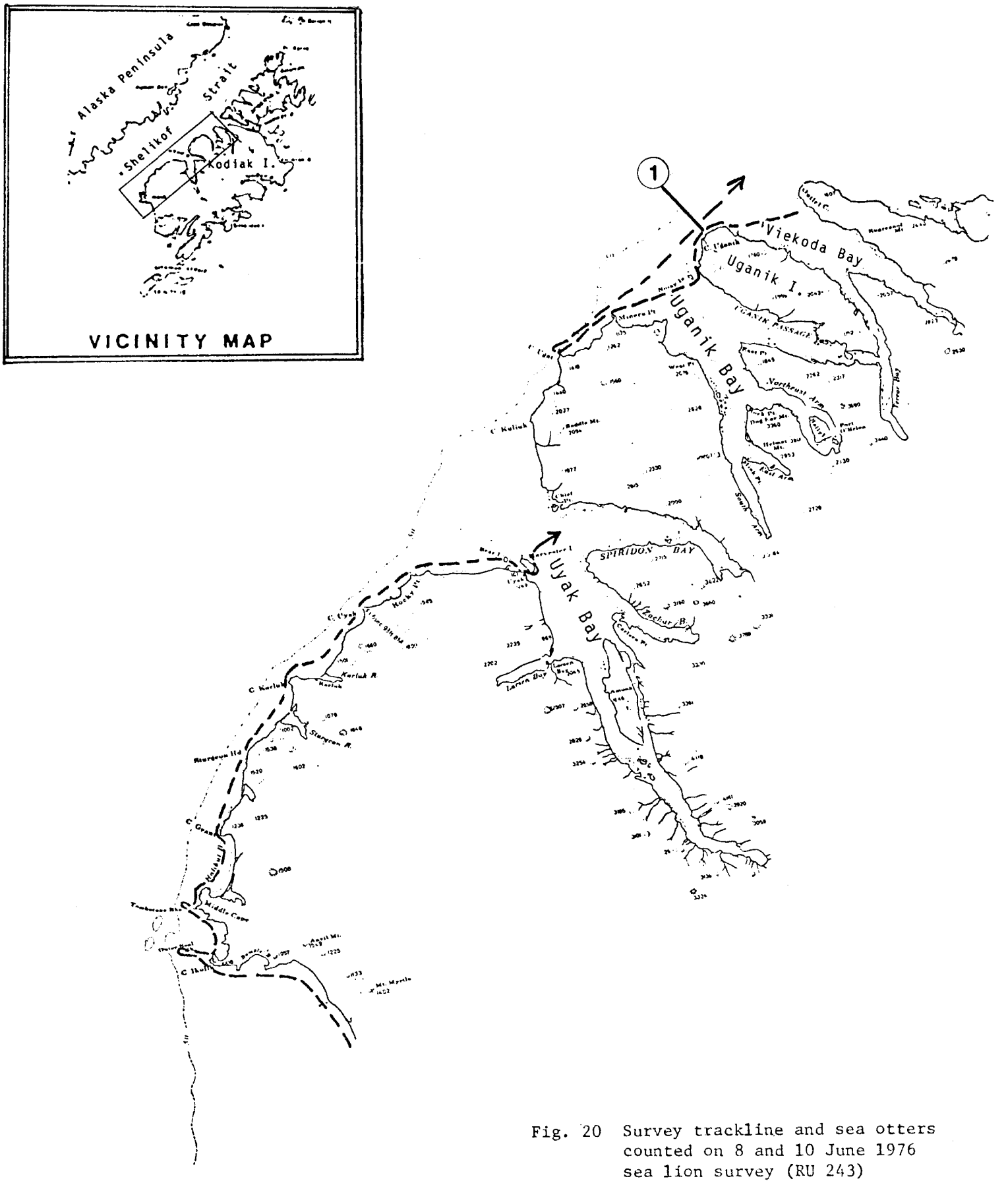


Fig. 20 Survey trackline and sea otters counted on 8 and 10 June 1976 sea lion survey (RU 243)

Trackline - - >
Sea otters counted (1)

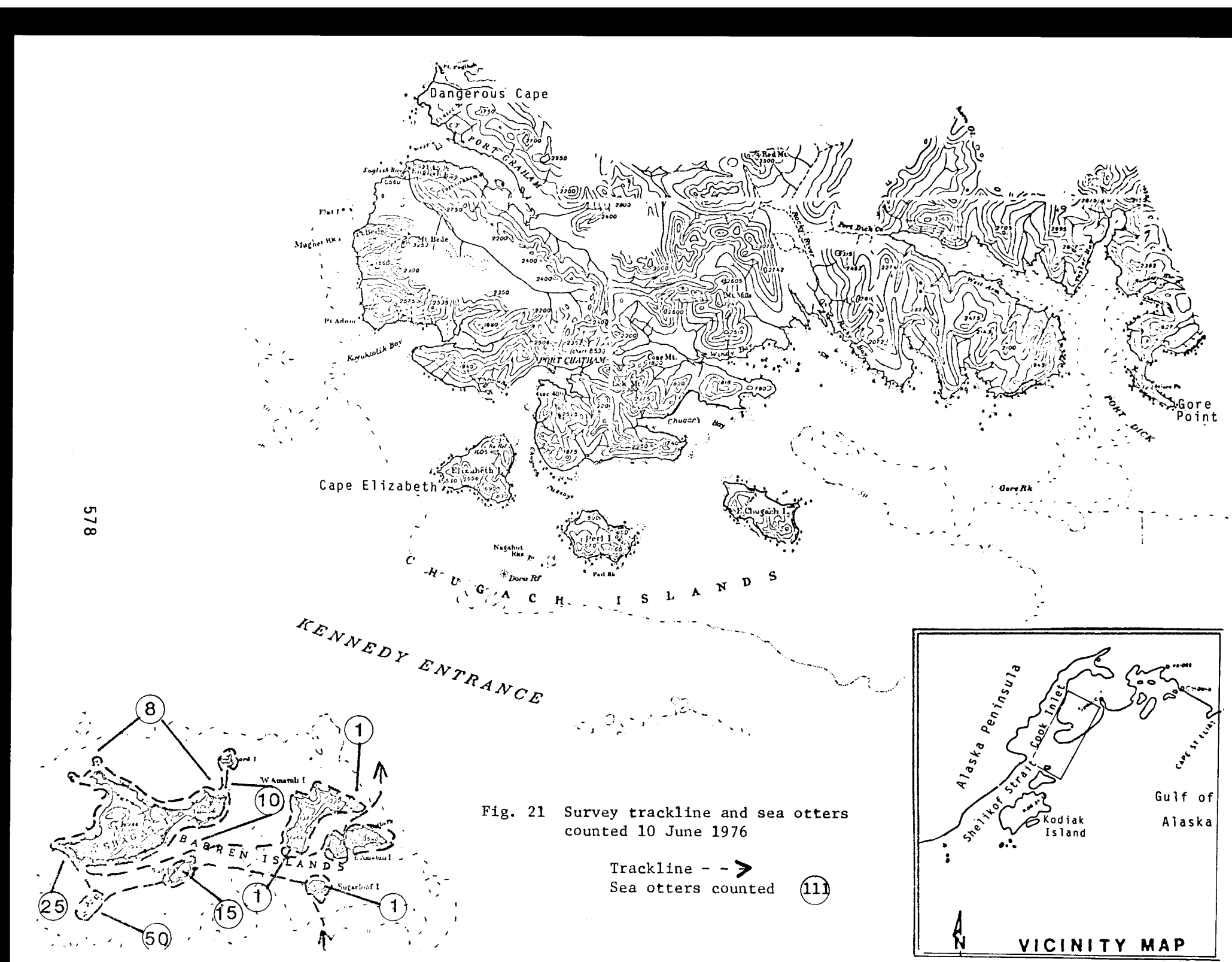


Fig. 21 Survey trackline and sea otters counted 10 June 1976

Trackline - - >
Sea otters counted (111)

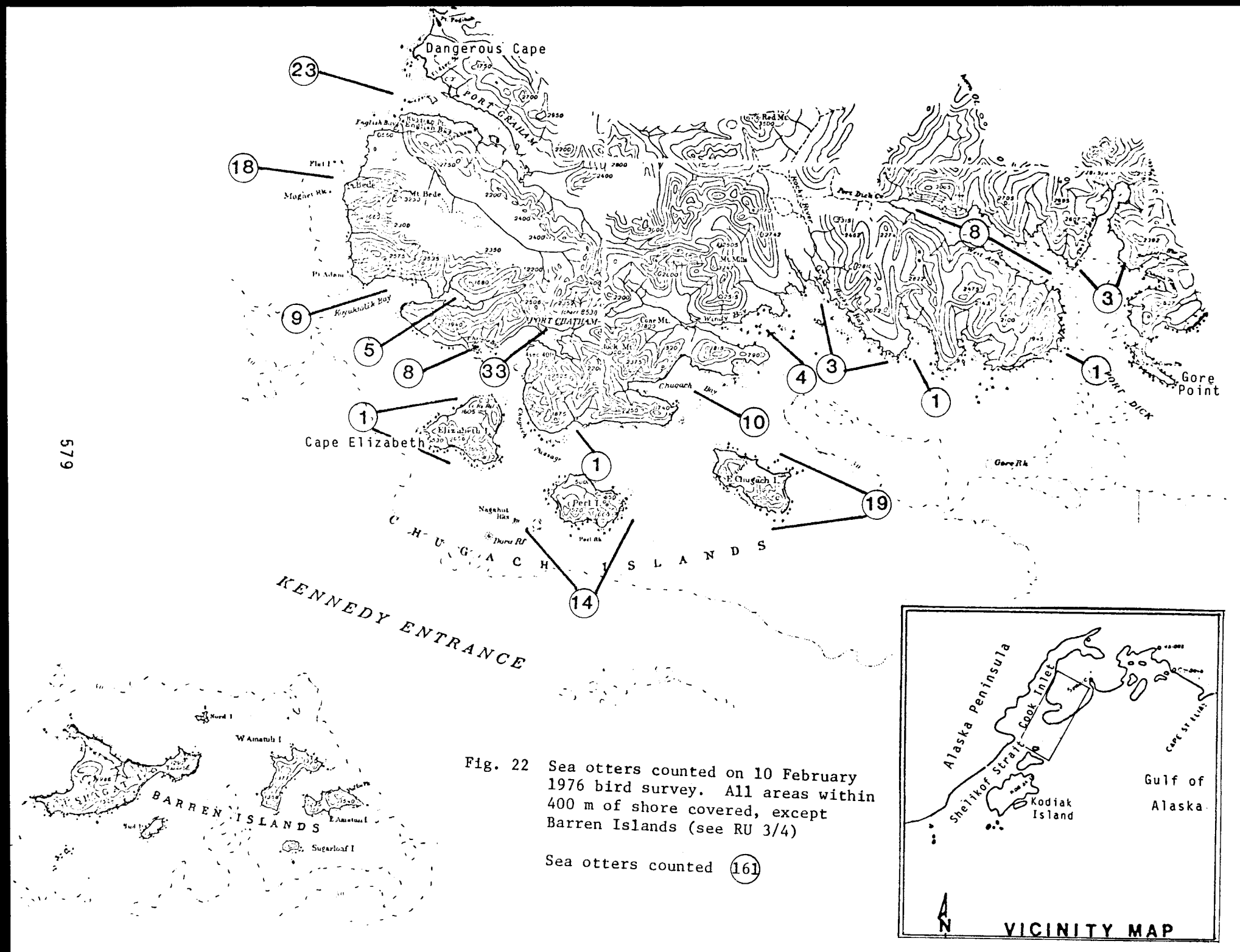


Fig. 22 Sea otters counted on 10 February 1976 bird survey. All areas within 400 m of shore covered, except Barren Islands (see RU 3/4)

Sea otters counted (161)

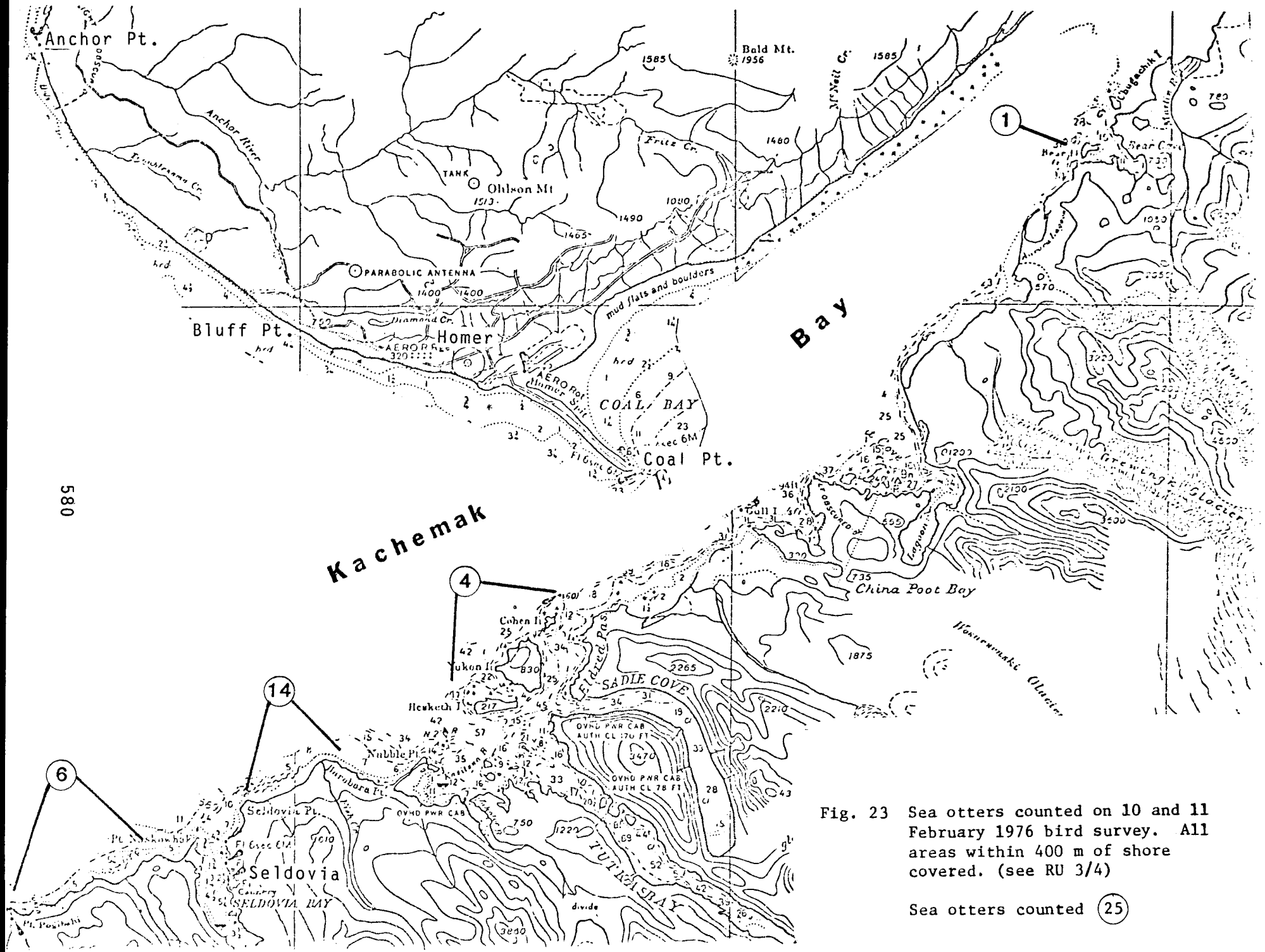


Fig. 23 Sea otters counted on 10 and 11 February 1976 bird survey. All areas within 400 m of shore covered. (see RU 3/4)

Sea otters counted (25)

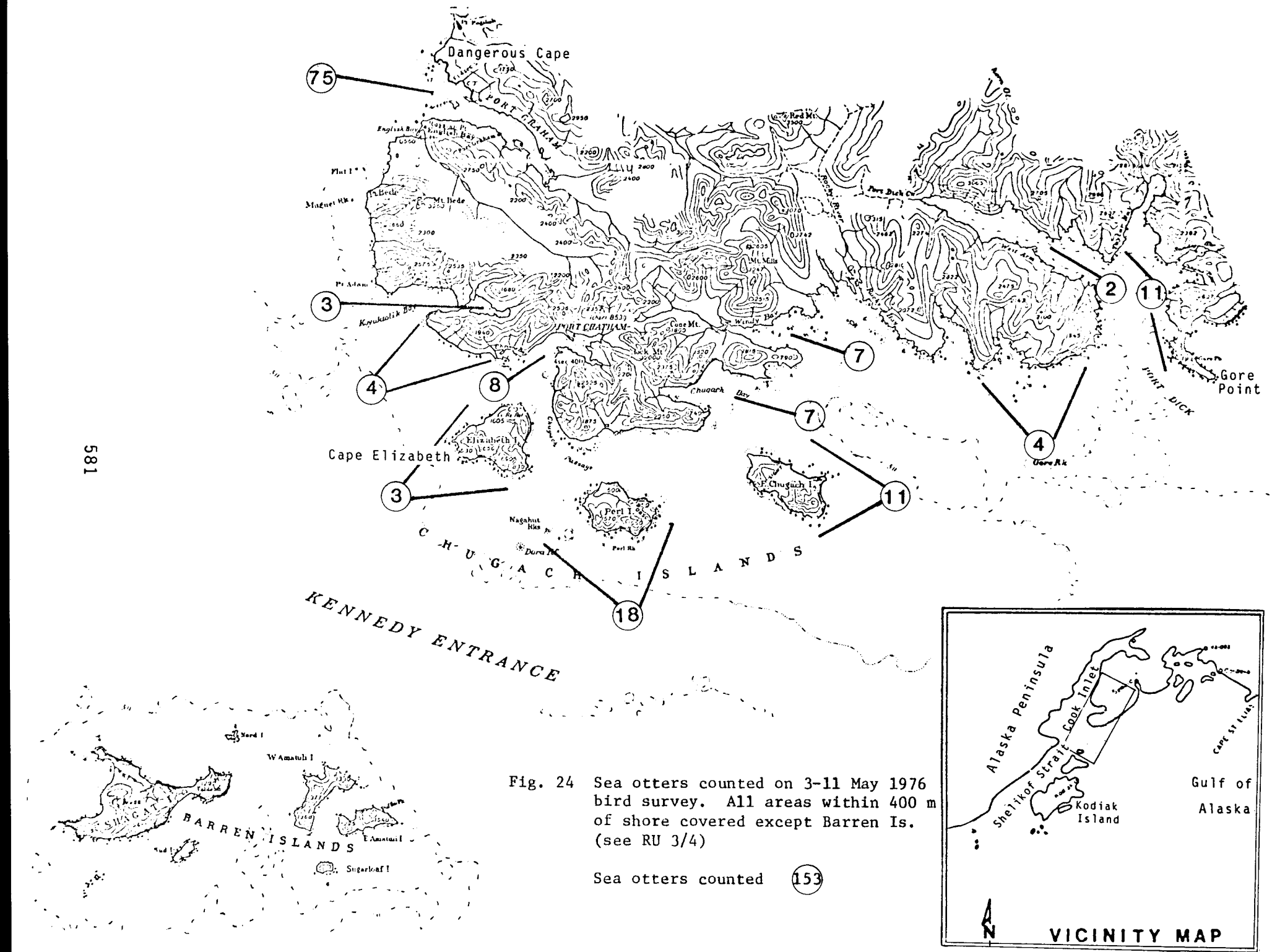
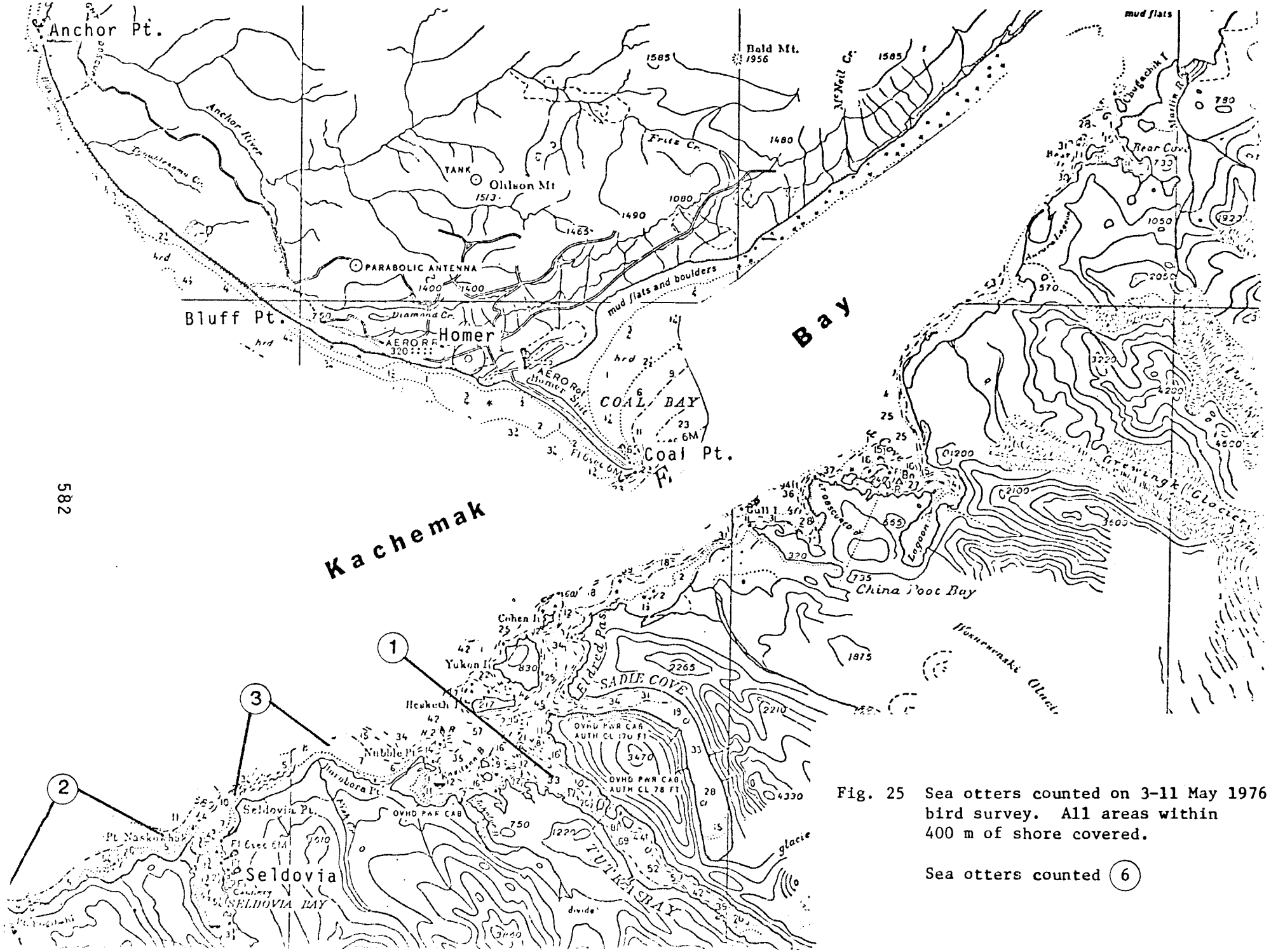


Fig. 24 Sea otters counted on 3-11 May 1976 bird survey. All areas within 400 m of shore covered except Barren Is. (see RU 3/4)

Sea otters counted (153)



582

Fig. 25 Sea otters counted on 3-11 May 1976 bird survey. All areas within 400 m of shore covered.

Sea otters counted (6)

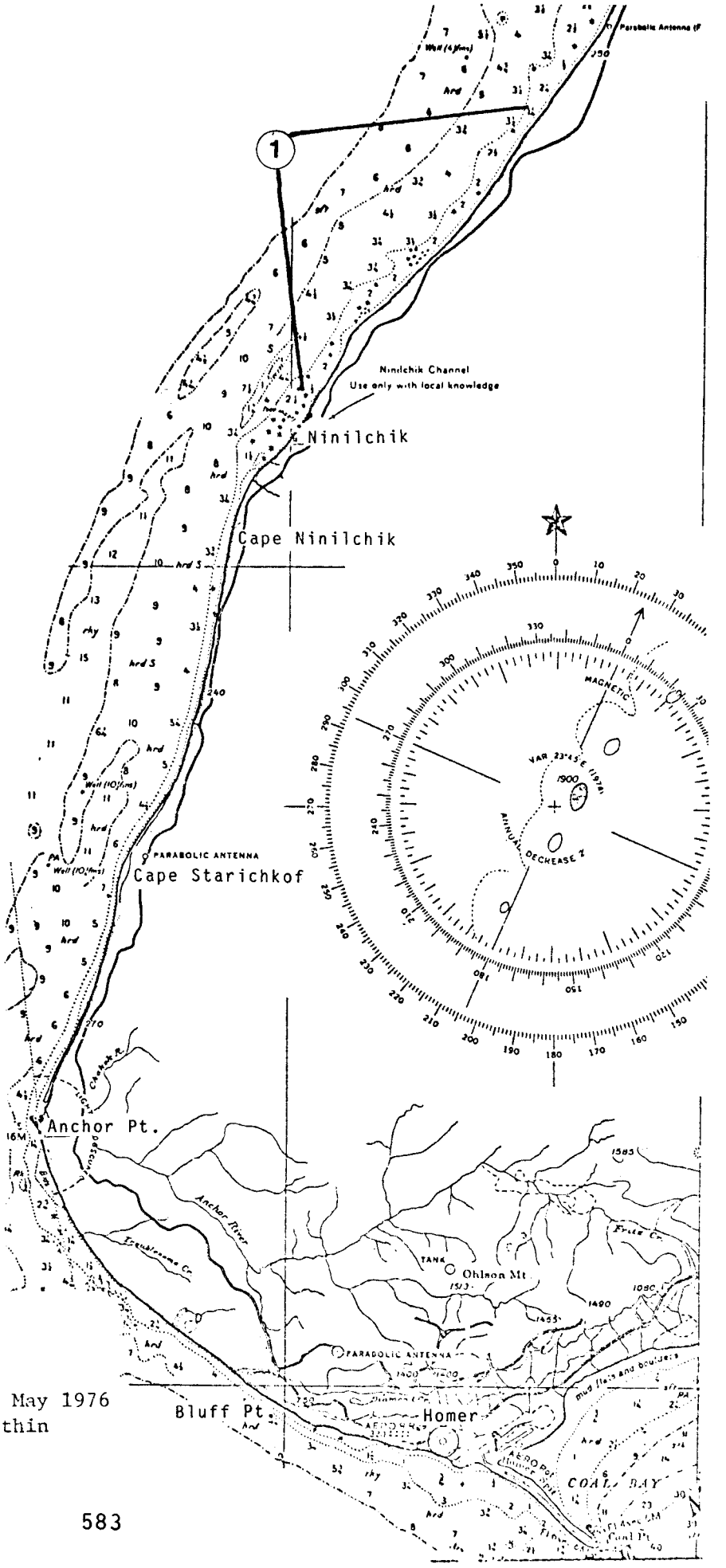


Fig. 26 Sea otters counted on 3-11 May 1976 bird survey. All areas within 400 m of shore covered.

Sea otters counted (1)

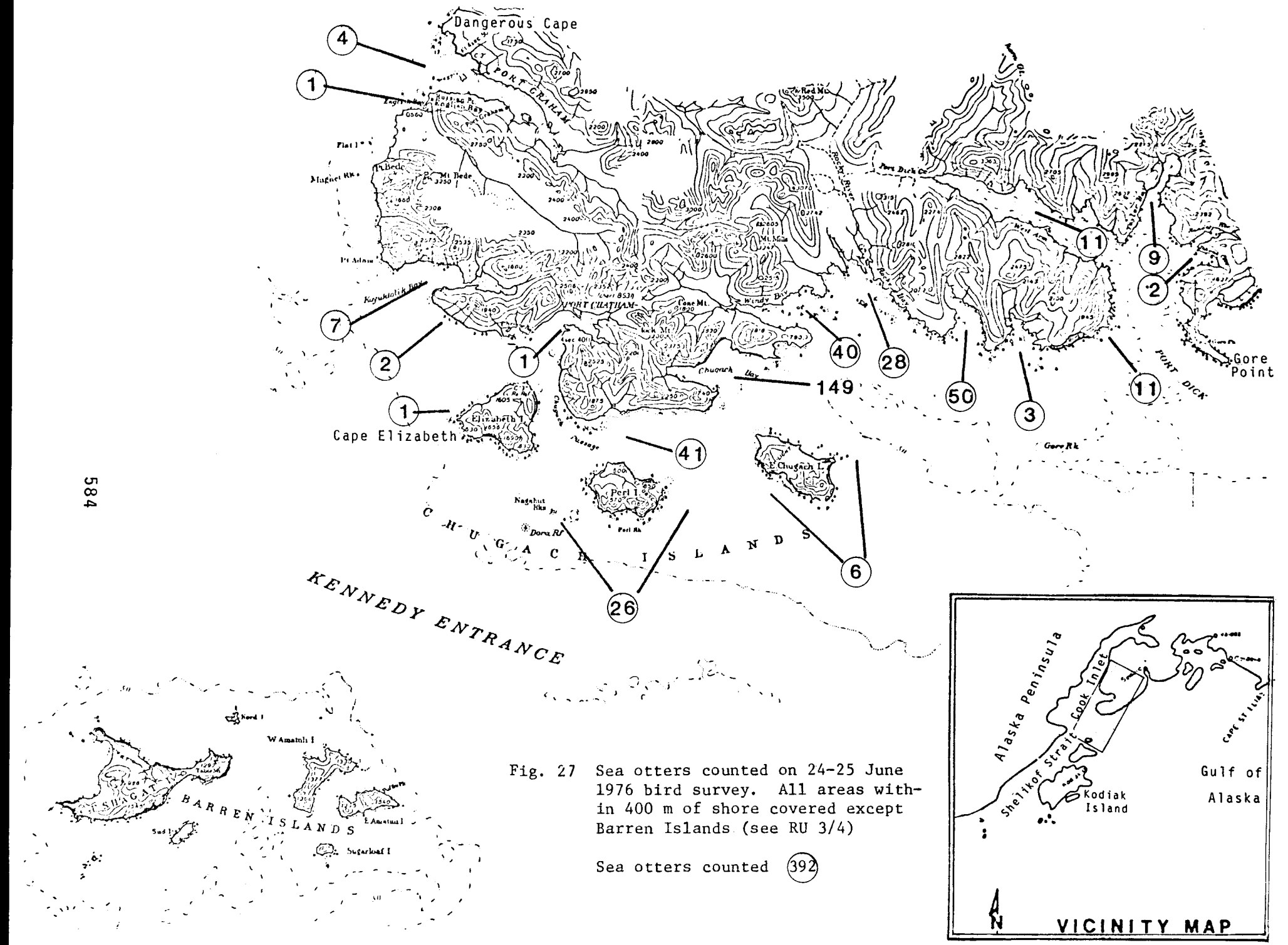
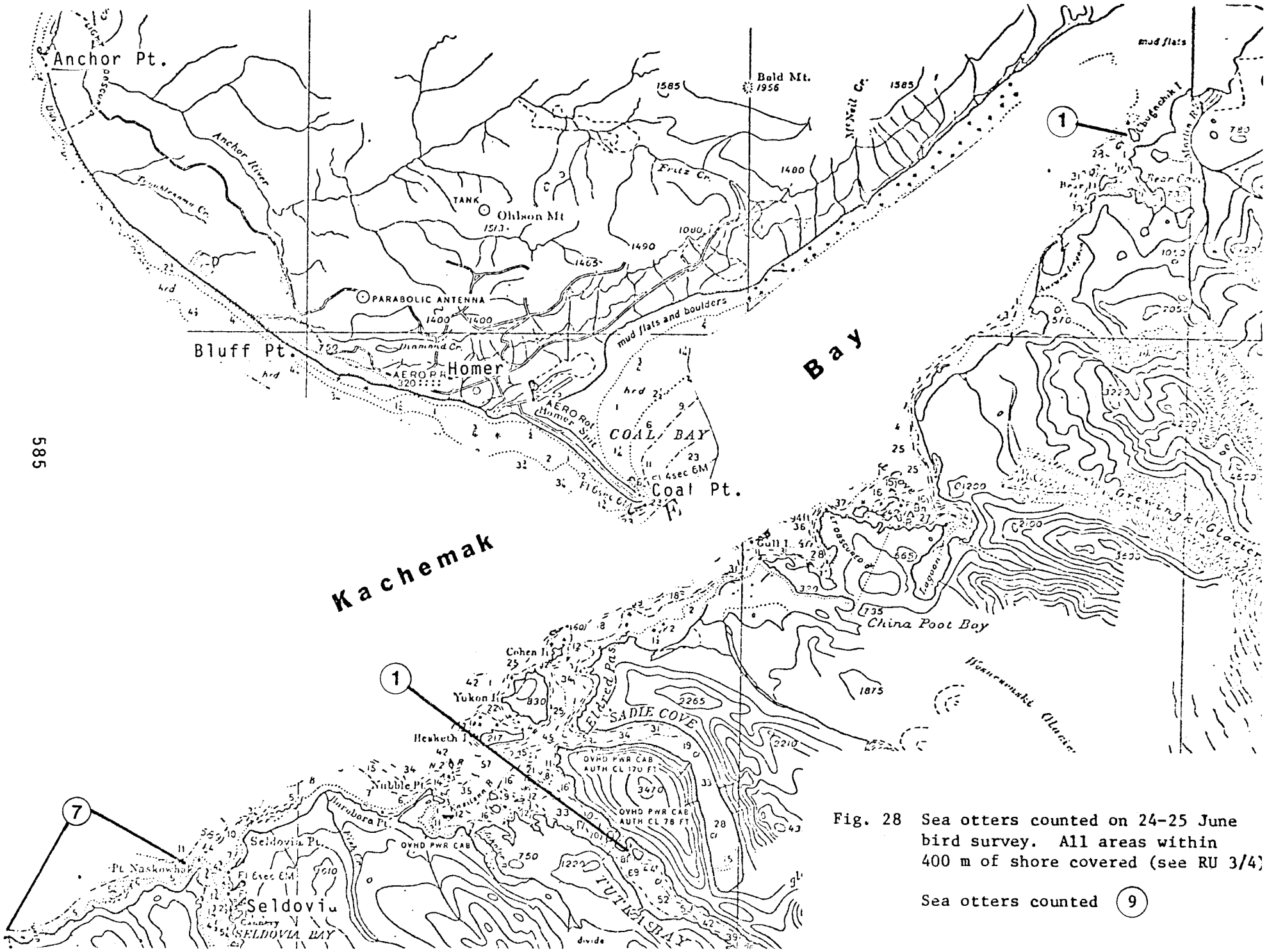


Fig. 27 Sea otters counted on 24-25 June 1976 bird survey. All areas within 400 m of shore covered except Barren Islands (see RU 3/4)

Sea otters counted (392)



585

Fig. 28 Sea otters counted on 24-25 June bird survey. All areas within 400 m of shore covered (see RU 3/4)

Sea otters counted (9)

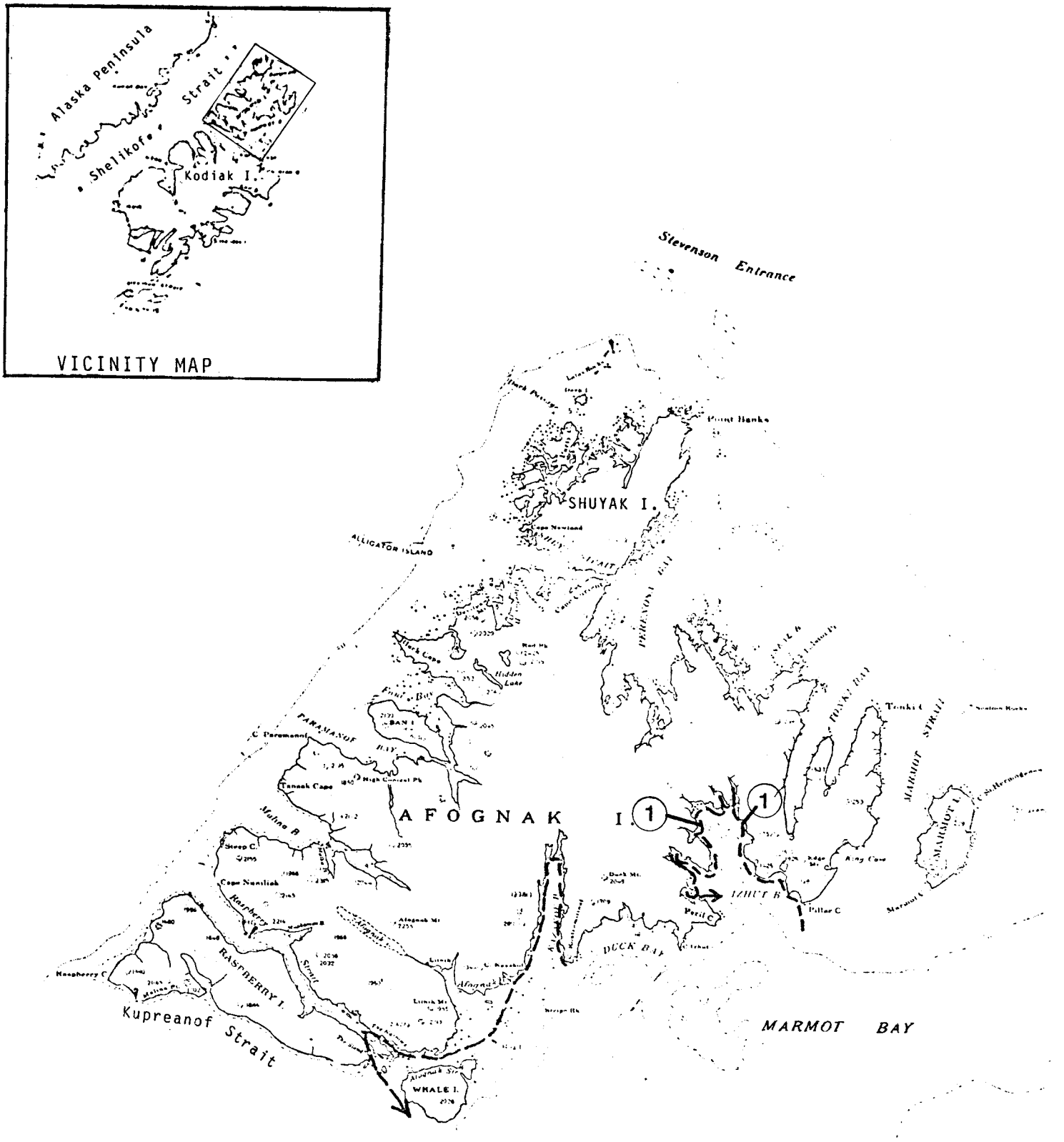
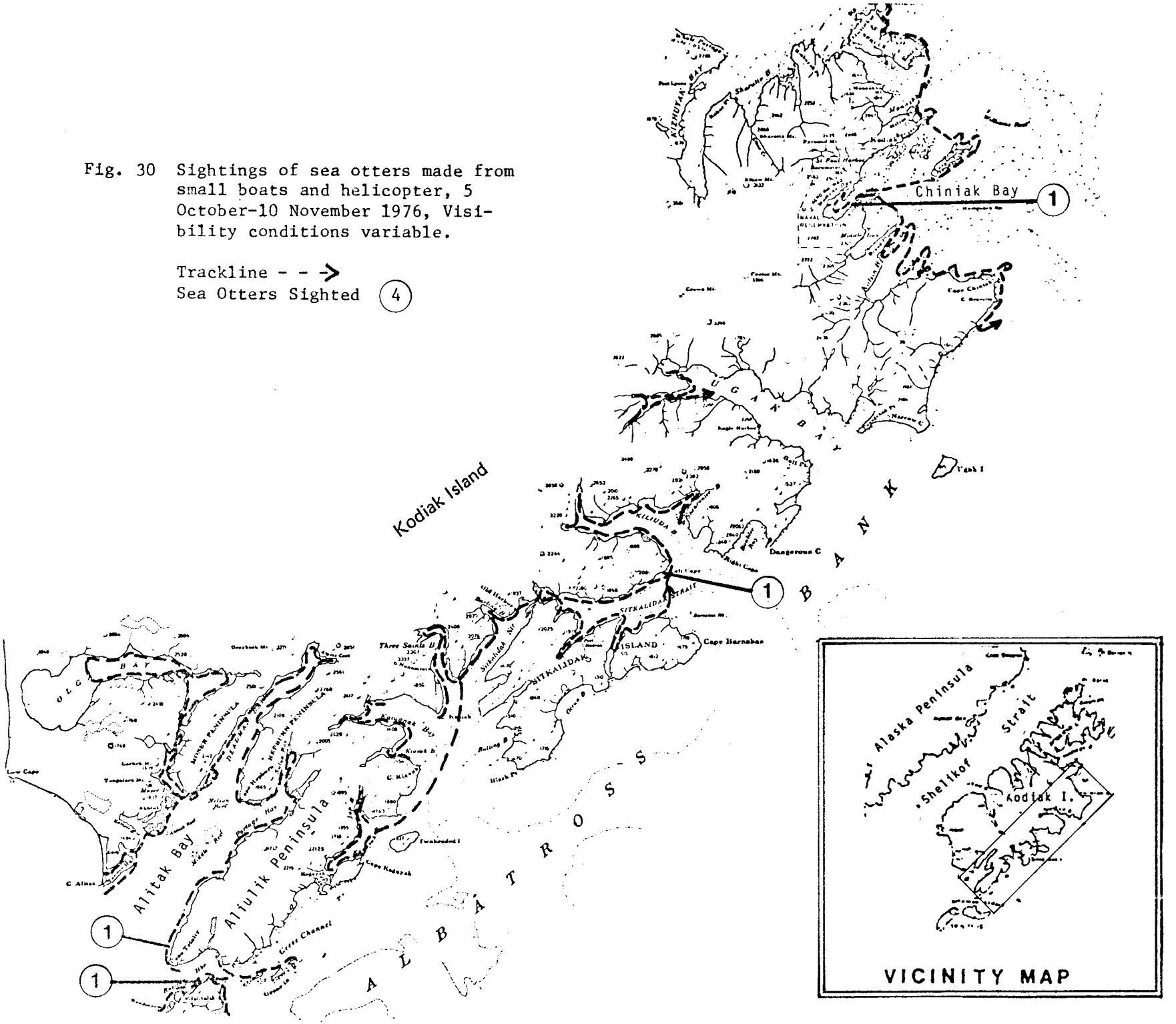


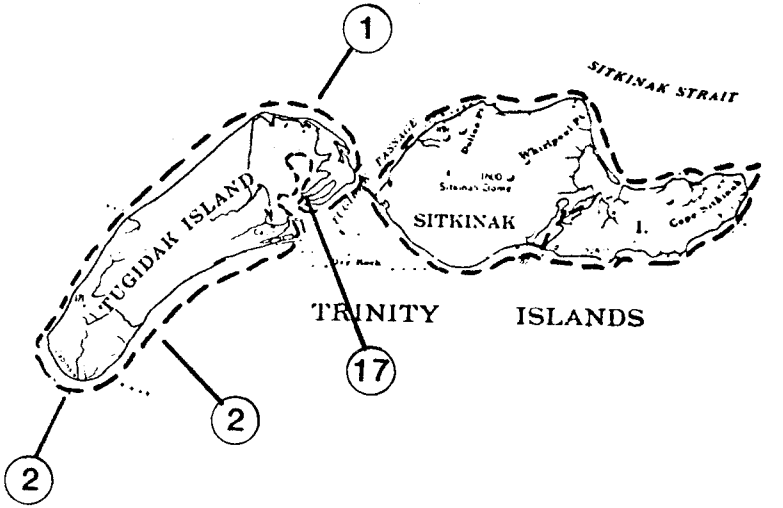
Fig. 29 Sightings of sea otters made from small boats October 1976. Visibility conditions variable.

Trackline - - →
Sea Otters Sighted (2)

Fig. 30 Sightings of sea otters made from small boats and helicopter, 5 October-10 November 1976, Visibility conditions variable.

Trackline - - →
Sea Otters Sighted (4)





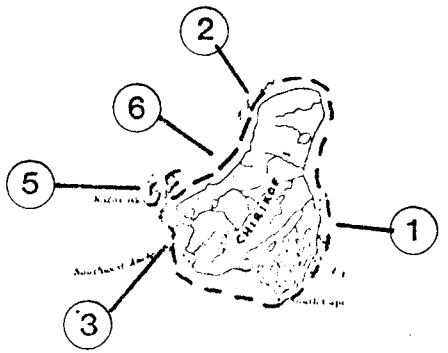
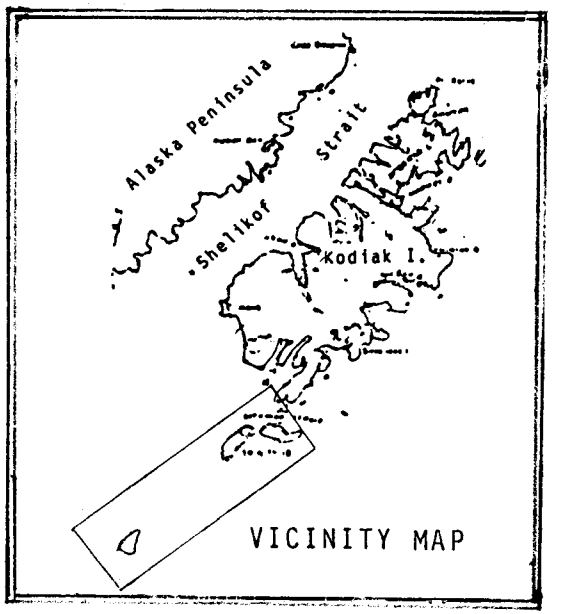


Fig. 31 Sightings of sea otters made from helicopter, 8-9 October 1976. Visibility conditions poor.

Sea Otters Sighted (39)



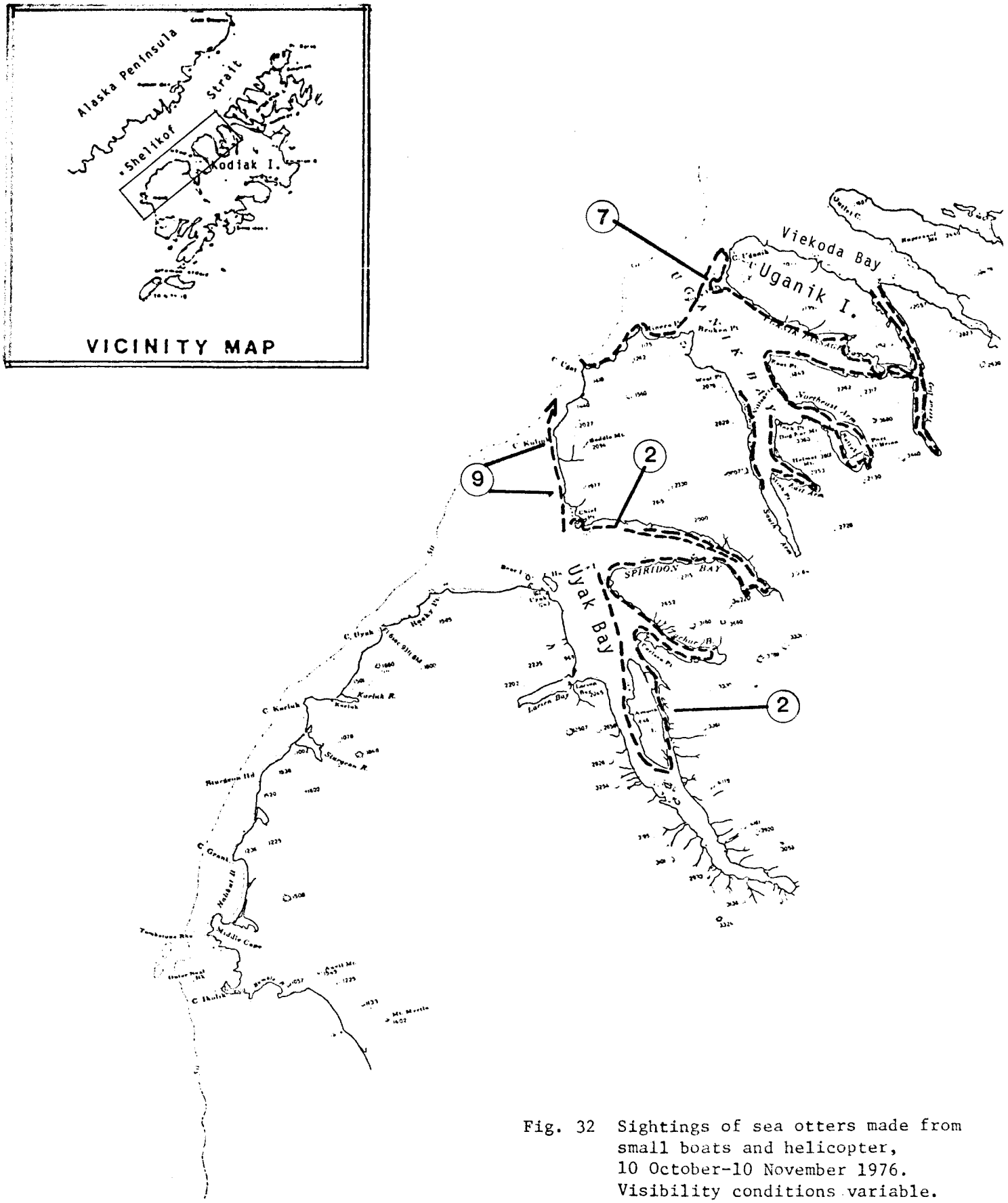


Fig. 32 Sightings of sea otters made from small boats and helicopter, 10 October-10 November 1976. Visibility conditions variable.

Trackline - - →
Sea Otters Sighted (20)

Table 8. Recent significant sightings of sea otters.

Location	Date	Number of Sea Otters	Observer
Kachemak Bay			
Bear Cove	Spring 1973	1	M. McBride
Peterson Bay	Spring 1973	1	M. McBride
Glacier Spit	1 June 1975	1	Bill McDermitt
Sadie Cove	4 May 1975	2	Merle Wolford
Tutka Bay	April-May 1975 (daily)	1	T. Kronin
Homer Spit	Spring-Summer 1976 (died Aug. 1976)	1	Numerous
26.7 Naut. Mi. Transect Homer Spit west along 59°35'54" N Lat.	30 March 1976	30	D. Erickson
Yukon Island	17 March 1976	2	Ballard & Erickson
Bluff Point	13 March 1976	27	Ballard
Outer Kenai Coast			
Quartz Bay (Nuka Bay)	2 May 1975	50	S. Linderman
Chugach Passage	1 April 1975	"Hundreds"	T. Edwards
Port Graham	13 June 1975	40-50	K. Kyle
Harris Bay	31 August 1976	100	P. Arneson
East Arm Nuka Bay	31 August 1976	5	P. Arneson
West Arm Nuka Bay	31 August 1976	45	P. Arneson
Kamishak Bay & Cook Inlet			
Augustine Island	5 March 1976	50 hauled out	Ballard-Erickson
59°26'N 152°52'W	10 May 1976	1	Erickson
59°28'N 152°00'W	10 May 1976	1	Erickson
59°29'N 152°22'W	30 Sept 1976	2	Erickson & Kurhajec
Kalgin Island	9 June 1975	2	USFWS-Briggs
Kodiak			
Malina Pt. Raspberry I.	Spring 1975	20	"A Pilot"(B. Ballenger)
South of Marmot Strait	July 1975	25	B. Ballenger
Raspberry Strait	1975	1	B. Ballenger
Spruce Cape	"frequently" 1975	1-2	G. Hadju
Outlet Cape	22 April 1975	10	B. Ballenger
Gull Point	28 February 1976	2	P. Arneson
Foul Bay	22 March 1976	48	P. Arneson
Kupreanof Strait	22 March 1976	1	P. Arneson
Deadman Bay	5 March 1976	2	P. Arneson
Tugidak I.(Northwest side)	30 June 1976	1 dead	B. and P. Johnson
Tugidak	8 July 1976	1 dead	B. and P. Johnson
Tugidak	10 July 1976	1 dead	B. and P. Johnson
Tugidak	23 July 1976	1 dead	B. and P. Johnson
Tugidak	25 July 1976	1	B. and P. Johnson
Tugidak	29 July 1976	2 (1 pup)	B. and P. Johnson
Tugidak	1 August 1976	1 dead	B. and P. Johnson

Table 8 (Cont'd.) Recent significant sightings of sea otters.

Location	Date	Number of Sea Otters	Observer
Tugidak	9 August 1976	3 (1 pup)	B. and P. Johnson
Tugidak	27 August 1976	1 dead	B. and P. Johnson
Tugidak	31 August 1976	1	B. and P. Johnson
Tugidak	13 September 1976	1	B. and P. Johnson
Marmot Bay			
58°08'N, 152°01' W	22 May 1976	2	USFWS-Bartonek
58°09'N, 152°00' W	16 July 1975	1	USFWS-Cline
58°07'N, 152°00' W	16 July 1975	2	USFWS-Cline

The probability of sighting a sea otter is influenced by the speed and altitude of the platform, distance from the trackline, lighting conditions, sea state, activity of the animal, group size and presence of birds, other marine mammals, kelp etc. Experience indicates that many otters are missed even under ideal conditions and ideal conditions rarely occur along Alaska's coast. Some success has been achieved in attempts to census sea otters through intensive use of combinations of air and ground counts over small areas and at considerable cost. These indicate that there may be 1.5 to 4 times as many sea otters as are seen from a helicopter and perhaps 4 to 10 times as many as seen from a fixed wing aircraft, but it has never been possible to measure all variables. Therefore, the counts presented in this report should not be considered total counts. They indicate distribution and relative abundance and permit only rough estimates of population size.

KENAI PENINSULA

A summary of significant counts of sea otters around the Kenai Peninsula is presented in Table 9. All counts are arranged by standardized count areas to facilitate comparison. Locations are the approximate midpoints of each count area. These counts were conducted by different individuals using different survey platforms under varying conditions of visibility. All possible sea otter habitat was rarely covered. Changes in numbers seen in each count area are often due to differences in surveys rather than actual changes in numbers of sea otters present. When considered with reports from residents of the area and biologists frequently visiting the area certain patterns are evident, however.

Table 9. Summary of significant counts of sea otters around the Kenai Peninsula.

Area	Location Latitude	Location Longitude	1951-* 1953	1967-* 1968	1970-** 1971	Oct 1975 Helicopter Survey	Feb 1976 Bird Survey	Apr 1976 Strip Census	May 1976 Bird Survey	June 1976 Bird Survey	Jun-*** July 1976 Boat Survey	Aug 1976 Mapping Flight
Puget Bay	59° 58' N	148° 31' W	No significant population	Few sightings	NS	25						
Whidbey-Johnstone	59° 55'	148° 50'			22	15						
Day Harbor	59° 58'	149° 10'			8	13						
Resurrection Bay	59° 58'	149° 23'			2	29					9	
Aialik Bay	59° 45'	149° 42'			20	36					36	
Harris Bay	59° 43'	149° 53'			38	92					72	100
Pye Reef-Two Arm	59° 30'	150° 14'			1	1					16	
East Arm-Nuka	59° 27'	150° 25'			85	26					35	5
McCarty Arm	59° 38'	150° 18'			8	NS						
West Nuka	59° 28'	150° 34'			41	20					127	45
Nuka Passage	59° 20'	150° 48'			10	32					56	2
Port Dick	59° 14'	151° 03'	1		23	15	12		13	33	134	
Rocky Bay	59° 12'	151° 20'			4	90	8		11	121		
Chugach Bay	59° 10'	151° 35'			76	66	44		36	222	260	
Port Chatham	59° 12'	151° 50'	15	400+	50	54	56		18	11		
Port Graham	59° 22'	151° 55'			0	16	41		75	5		
Seldovia	59° 27'	151° 44'		Few sightings		4	20		5	7		
Tutka-Sadie	59° 30'	151° 30'				1	4		1	1		
Halibut Cove	59° 36'	151° 15'				1	0		0	0		
Bear Cove	59° 43'	151° 06'				5	1		0	1		
Coal Bay	59° 42'	151° 14'				0	0		0	0		
Coal Pt-Anchor Pt	59° 40'	151° 45'			Few sightings	0	0	400 est.	0	0		
Anchor Pt-Ninilchik	59° 55'	151° 47'				0	0	0	0	0		
Ninilchik-Clam Gulch	60° 09'	151° 30'				0	0	0	1	0		
Clam Gulch-Kenai	60° 22'	151° 20'	No significant population			0	0	0	0	0		

* From Lensink (1962)

** Composite of highest counts from several surveys

*** Bailey (1976)

NS = None seen

History

Sea otters probably were eliminated from the Kenai Peninsula by the early 1900's. It appears that remnant populations may have survived in southwestern Prince William Sound, the northern Kodiak Archipelago and Kamishak Bay. Small numbers were occasionally reported between the Chugach Islands and Cape Puget in the 1950's and early 1960's but Kenyon (1969) concluded that no significant population occurred in the area. Reports increased steadily through the mid-1960's and in 1967 several hundred and perhaps over 1,000 abruptly appeared in the vicinity of Port Graham and Chugach Bay. This concentration diminished over the next few years, perhaps as the result of dispersal to the east.

By 1970 sea otters were distributed in small numbers along the entire peninsula from Cape Puget to Port Graham. Rare sightings occurred in Kachemak Bay. It appeared that repopulation was the result of range expansion by the Prince William Sound population and large scale immigration from another area, perhaps the Barren Islands. Between 1970 and early 1975 no major changes were reported although sightings in Kachemak Bay increased and sea otters became a common sight near Seward.

Present Status

Survey conditions around the Kenai Peninsula during October 1975 helicopter survey were less than ideal. The percentage of sea otters recorded was probably in the lower range for helicopter surveys. There may be three or more times as many as counted. Results of the June 1976 bird survey,

Bailey's (1976) boat counts and other sightings (Tables 8 and 9) tend to support this view. The survey did delineate the distribution of the population and provide good information on the relative abundance of sea otters occupying various parts of the area. These were the primary objectives of the survey. Bailey's (1976) boat counts (Table 9) probably provide the best information on distribution and abundance within the area he covered. The technique he employed would tend to give more uniform results in areas where extensive offshore shallow areas do not exist. His counts should still be considered minimal especially in the area west of Gore Point.

The October helicopter survey and recent sightings indicate that the distribution of sea otters along the outer Kenai coast is essentially the same as in 1970. Some range expansion into Kachemak Bay has occurred. The distribution and relative densities of sea otters between Port Graham and Cape Puget generally seem to conform to the distribution of suitable habitat. This indicates that no major range expansion is occurring in that area and it is unlikely that significant changes will occur in the future, although densities may increase. Sea otters appear established in the area from Port Graham to Seldovia but their densities are low. Scattered otters occur along the entire south side of Kachemak Bay but no groups of breeding animals have become established there.

There have been occasional sightings of sea otters near Homer and as far north as Deep Creek since the late 1960's. These appeared to be stray animals and were usually old males. In 1975 there was an increase in sightings of sea otters in offshore areas west of the area between Homer

and Anchor Point indicating recent range expansion. The 1 April 1976 strip transect survey confirmed that a substantial number of sea otters were dispersed over a large area. A reliable population estimate is not possible from these data, however, it would appear that over 400 sea otters occupy the area surveyed and their numbers are increasing. No pups have been reported in this area suggesting that this group is composed of sexually inactive animals probably mostly "surplus" males. Such animals are usually the first colonizers of vacant habitat. Their numbers increase through immigration from adjacent areas of high density rather than through reproduction in the recently populated area. It may take several years for a significant level of reproduction to develop in this area.

The survey did not cover all of the presently occupied habitat as sea otters were seen near the ends of the tracklines and on both the first and last tracklines. General observations indicate that there are few north of Anchor Point, however. The first recent observation of a sea otter north of Ninilchik was made in May 1976 (Fig. 26). An unusual characteristic of this population is its offshore distribution which is similar to that found north of Unimak Island and the Alaska Peninsula (see RU 241).

Future

Kenyon (1969) described a common pattern of range expansion for sea otters. Concentrations often build up at the fringes of a population then abruptly disperse into adjacent habitat only when competition for food arises. This abrupt movement is often preceded by an increase in

the occurrence of stray transient animals. This pattern appears to be occurring in the lower Cook Inlet-Kachemak Bay area today. High densities built up in the area between Rocky Bay and Port Graham in the late 1960's and early 1970's. Stray animals in Kachemak Bay increased then an abrupt shift to the area northwest of Homer occurred. At the same time there appears to have been a decrease near Port Graham where frequent unconfirmed reports of over 200 were received in the early 1970's. Some immigration from Kamishak Bay might also have occurred. This pattern of range expansion should continue for several years. We can expect continued movement of animals from the outer Kenai Peninsula into Kachemak Bay and northward up Cook Inlet.

Kachemak Bay, particularly the south side, should eventually support relatively high sea otter densities. Opportunities for the general public to view sea otters in Alaska are extremely limited. Kachemak Bay will probably eventually be the most accessible sea otter viewing area in Alaska. Therefore, the importance of the bay and the sea otter population that will repopulate it is increased.

The potential for range expansion north of Kachemak Bay is less certain. Sea otters are capable of feeding in waters 80 m deep and in rare cases more than 100 m deep although most normally remain in water 60 m deep or less. Therefore, potential sea otter habitat extends across Cook Inlet and this population may become contiguous with that in Kamishak Bay. Food availability and perhaps the occurrence of sea ice will probably determine the eventual northern limit of this population. At this time it is difficult to predict what the northern limit will be. A recent sighting near Kalgin Island (Table 8) suggests that at least stray

individuals may eventually occur throughout lower Cook Inlet.

Critical Areas

The potential for adverse impacts of OCS development on sea otters inhabiting the waters around the Kenai Peninsula appears high. Presently occupied or potential sea otter habitat lies in and adjacent to proposed lease areas and sites for onshore activities. Oil spills, in particular, could greatly reduce sea otter numbers and retard the process of repopulation of former habitat. Impacts in some areas would have greater detrimental effects than those in other areas.

Densities of sea otters between Gore point and Cape Puget are low. The area consists of deep, steep-sided fiords. Waters of suitable depths for sea otter foraging are limited to a narrow band along the shores and a few scattered submerged glacial moraines and shallow lagoons. The observed distribution of sea otters generally coincided with the distribution of shallow water. Most concentrations were inside the major bays. Very few sea otters were seen near exposed capes. Areas with a direct southeast exposure to the Gulf of Alaska are generally precipitous and wave scoured and offer little habitat for sea otters.

The combination of topography of the area and distribution of sea otters would probably limit the impact of offshore oil spills in this area. Sea otters east of Gore Point are probably contributing less to repopulation of new areas than those west of Gore Point. If a short-term impact such

as an oil spill reduced sea otter numbers east of Gore Point, recovery could be rapid provided the relatively dense populations in Prince William Sound and west of Gore Point remained unaffected. Perhaps the greatest loss in human terms would be a loss of opportunity to view sea otters should a reduction occur in Resurrection Bay.

The situation west of Gore Point is quite different. Concentrations of sea otters near the fringes of expanding populations appear to be important to the repopulation process. Animals toward the center of the population probably contribute less to repopulation than those near the fringes. From this standpoint the area from Port Graham to Rocky Bay may be critical. A reduction in sea otter densities in that area could seriously retard repopulation of Kachemak Bay and Lower Cook Inlet. Kachemak Bay and all waters of lower Cook Inlet less than 60 m deep, at least as far north as Ninilchik, should also be considered critical because of their potential as sea otter habitat.

KAMISHAK BAY

History

The history of sea otters in Kamishak Bay is vague. Most surveys of the area have included only the shoreline of Augustine Island and perhaps Shaw Island and Cape Douglas. Occasional sightings of large numbers offshore and dramatic fluctuations in shoreline counts suggested that considerable movement occurred and that much of the occupied habitat lay outside of the area surveyed. The 1 April 1976 survey was the first

attempt to locate sea otters in all potential habitat in Kamishak Bay. Table 10 presents the most significant counts made in Kamishak Bay and adjacent areas. These counts were made under variable conditions and should be compared with caution.

It appears that a small remnant population of sea otters remained in Kamishak Bay in the early 1900's. This population, centered around Augustine Island, probably grew throughout the 1940's and 1950's although no growth is evident in the counts. By 1965 some range expansion to the south had occurred. Counts made between 1969 and 1971 indicated that there may have been an increase in numbers around Augustine Island and the waters immediatedly to the north and west and that there had been a substantial movement around Cape Douglas to the vicinity of Shakun Rocks. The relatively high numbers seen by Prasil (1971) southwest of Cape Douglas suggest that the population within Kamishak Bay proper had reached a much higher level in the early 1960's than indicated by the counts.

Most likely, densities in the bay increased steadily through the 1960's then stabilized or declined slightly as animals emigrated to the southwest and possibly to the east across Cook Inlet. There is also a possibility that periodic oil spills influenced numbers although no direct evidence of oil related mortality is available from that area.

Present Status

The available information indicates that the range of the population extends from northern Kamishak Bay to Cape Nukshak. Otters may occur

Table 10. Summary of significant counts of sea otters in Kamishak Bay and adjacent waters.

	1948[1]	1957[1]	1959[1]	1965[2]	1969	1970	1970-71[3]	1971	Apr 1976[4]	Jun 1976
North of Chinitna Pt	Reports									
Augustine I. shoreline	50	40	52	18	132			24	40	
Chinitna Pt-Douglas R. (including offshore areas)	Reports						60	100-150	28	
Douglas R-C. Douglas		1		71		0			5	
C. Douglas-Kiukpalik I.		0	0	30		0	92			
Kiukpalik I.-C. Chiniak		0	0	0		71	443			
C. Chiniak-C. Nukshak		0	0	0		0	0			
C. Nukshak-C. Kubugakli		0	0	1		0	0			0
C. Kubugakli-C. Unalishagvak		0	0	0		7				35

1 Lensink (1962)
2 Kenyon (1969)
3 Highest counts from Prasil (1971)
4 Partial coverage, see fig. 15

throughout the shallow waters of Kamishak Bay and often range far from shore. The distribution observed on 1 April 1976 (Fig. 15) seemed to be influenced by the distribution of sea ice. Many sea otters were associated with patches of drift ice and 17 were hauled out on ice. The sea otters appear to be relatively mobile in this area and major shifts may occur periodically. Concentrations usually occur around Augustine Island, particularly the north side; in the waters west of Augustine Island; around Shaw Island and Cape Douglas; at Douglas Reef; and at Shakun Rocks. Observed numbers in each of these areas have fluctuated widely, however.

Sea otters inhabiting the Alaska Peninsula coast between Cape Douglas and Cape Chiniak should be considered part of the Kamishak population. Those sighted near Puale Bay in 1970 and 1976 are probably at the extreme fringe of the large population that is centered near Kujulik and Amber Bays. Therefore, the Kamishak population and the Kujulik population are expanding their ranges toward each other and should eventually become contiguous. A superficial survey of the area between Cape Nukshak and Puale Bay in June 1976 indicated that little expansion of range has occurred since 1970 but the pattern of range expansion is clear.

Although a reliable population estimate cannot be derived from data collected on 1 April 1976, crude estimates indicate that there might be between 500 and 1,000 sea otters in Kamishak Bay. The number southwest of Cape Douglas probably equals or exceeds that number.

Future

The population should continue to expand its range to the southwest. Eventually some range expansion to the north should occur. The range of this population could become continuous with that of the Kenai Peninsula. Recent sightings in the middle of lower Cook Inlet (Table 8) indicate that some interchange already occurs. At this time it is not possible to predict how far up Cook Inlet either population will expand.

Critical Areas

At the present time the area around Augustine Island and northern Kamishak Bay should be considered most critical to the process of repopulation of former sea otter range. The concentration inhabiting the Shakun Rocks area is also expected to contribute significantly to the repopulation of vacant habitat and is highly vulnerable. However, the presence of the large and rapidly expanding Kujulik Bay population to the southwest makes survival and growth of the Shakun Rocks group less critical.

KODIAK ARCHIPELAGO

Three separate population centers of sea otters exist in the Kodiak Archipelago. These are: (1) the Barren Islands, (2) Shuyak-Afognak and (3) Trinity Islands-Chirikof Island. Each will be discussed separately.

1. Barren Islands

History

Significant counts of sea otters made in the Barren Islands are presented in Table 11. These counts were made under different conditions and may not be directly comparable.

No real change in numbers is apparent after 1957. All of the lower counts including those made in 1976 were made under poor conditions or were incomplete. The difference between the 1951 and 1957 counts is not easy to explain. Either a substantial nucleus population was present in 1951 but was missed on the survey, or a group emigrated from the Shuyak Island area. In either case the island group was fully repopulated by 1957. Lensink (1962) speculated that regular movements occurred between Shuyak and the Barren Islands. The fluctuations in counts which lead him to suggest this were more likely caused by scattering of animals offshore but some major movements may have occurred.

The group of several hundred sea otters that appeared on the Kenai Peninsula in 1967 may have come from the Barren Islands. If this is the case there may have been substantial fluctuations in the number of sea otters occupying the Barren Islands that are not evident in the counts.

Present Status

At the present time this population can be considered at or near the carrying capacity of the habitat. Densities are highest in the shallow

Table 11. Summary of significant counts of sea otters around the Barren Islands.

Area	Latitude	Longitude	1951*	1957*	1957*	1959*	1964	1966	1970	1974**	1975**	May 1976	June 1976
Sugarloaf I.	58° 53' N	152° 02' W							0		6		1
E. Amatuli I.	58° 55'	151° 59'							0		5		0
W. Amatuli I.	58° 56'	152° 03'							2		21	8	2
Nord I.	58° 58'	152° 09'							0		12		0
N. side Ushagat	58° 57'	152° 15'							75	] 150	21	10	8
S. side Ushagat	58° 54'	152° 15'							1	]	20	40	35
Sud I.	58° 54'	152° 13'						] 150+	29	120	71	33	15
Carl I.	58° 53'	152° 19'						]	200		70	60	50
Total			0	325	234	272	81		307		226	151	111

* Lensink 1962

** Bailey 1975

waters south of Ushagat Island including those around Carl Island and Sud Island. Low densities are usually found throughout the remainder of the island group. This distribution has been evident in most counts and probably reflects the quality of the habitat.

Future

Little change is expected in the status of sea otters in the Barren Islands. Numbers may fluctuate but the distribution should remain similar to that observed in recent years. Occasionally sea otters might immigrate to the Kenai Peninsula or Shuyak Island but such movements will be difficult to detect. The Barren Island population is no longer playing an important role in the process of repopulation of vacant sea otter habitat.

Critical Areas

Complete elimination of the Barren Island population would have relatively little impact on other areas. Therefore, consideration of critical areas can only be based on survival of the population as a separate entity. Perhaps two-thirds of the population regularly inhabits the relatively small area around the south side of Ushagat Island, Carl Island and Sud Island. Most reproductive activity probably occurs there. Therefore, this area is critical to the survival of the Barren Island population.

Because that area is small, the population is highly vulnerable and could be severely reduced by a minor oil spill. Repopulation of the

Barren Island group would eventually occur through immigration from the Kenai Peninsula or Shuyak Island, but this could take many years.

2. Shuyak-Afognak

History

Significant counts of sea otters around the area between Shuyak Island and Chirikof Island are summarized in Table 12.

A remnant population survived in the vicinity of Latax Rocks and Sea Otter Island. By the 1950's this population was well established and appeared to be growing rapidly, expanding its range to Afognak Island in the vicinity of Seal Bay.

Little change was evident in the 1960's. The range of the population remained the same although stray individuals were seen around Kodiak Island. No increase in numbers was evident. There may be several reasons for this apparent lack of growth. First, sea otter populations often increase in numbers without expanding their range for several years. Traditional survey techniques are not always sensitive enough to detect increases in densities. Counts made during the 1960's were incomplete and often not directed specifically at sea otters. Second, immigration to the Barren Islands and eventually to the Kenai Peninsula may have occurred. This would explain the lack of a major reduction of the Barren Island population when several hundred sea otters appeared on the Kenai Peninsula in the mid-1960's. Third, oil, probably from tanker

Table 12. Summary of significant counts of sea otters around the Kodiak Archipelago

			1951*	1957*	1957*	1958*	1959*	1964	1966	Sightings 1964-1971	1970	Sightings 1975	Heli-copter 1975	Boat 1976	Air March 1976	Misc 1976
Cape Chiniak	57° 38'N	152° 15'W								1					0	
Kodiak	57° 45'	152° 20'								2		Few		0	0	1,1
Spruce I.	57° 55'	152° 23'											0			
Ouzinki	57° 57'	152° 30'														
Sharatin Bay	57° 53'	152° 41'														
Kizhuyak Bay	57° 49'	152° 52'														
Whale Passage	57° 56'	152° 50'										1				
Afognak Bay	58° 02'	152° 43'											6			
Kazakof Bay	58° 08'	152° 35'											0			
Duck Bay	58° 07'	152° 27'											1		6	
Izhut Bay (West)	58° 11'	152° 17'										Few	1			1
Izhut Bay (East)	58° 11'	152° 12'											0		0	1
King Cove	58° 12'	152° 00'											16			
Marmot I.	58° 13'	151° 50'						1			3	25	529			
Tonki Cape	58° 21'	151° 59'								3			134			
Tonki Bay	58° 18	152° 08'											32			
Seal Bay (East)	58° 22'	152° 10'											164			
Seal Bay (West)	58° 23'	152° 16'						13		Many			342			
Perenosa Bay (South)	58° 22'	152° 25'									2		290			
Perenosa Bay (North)	58° 27'	152° 28'									4		58			
Shuyak (East)	58° 31'	152° 23'		5	12	581	365						10			
Sea Otter I.	58° 31'	152° 12'	15		75				150+		121		156			
Point Banks	56° 38'	152° 19'			75				100+				9			
Shuyak (North)	58° 36'	152° 28'		89	119								14			
Latax Rocks	58° 40'	152° 31'	67					63			26		59			
Shuyak (West)	58° 34'	152° 39'									33		12	272		
Shuyak Strait	58° 29'	152° 35'									0		2	14		
Bluefox Bay	58° 27'	152° 44'									18		81	32		
Foul Bay	58° 21'	152° 30'											61	60		48
Paramanof Bay	58° 18'	152° 56'												15		
Kaliua Bay	58° 13'	153° 05'													31	3
Raspberry Strait	58° 06'	153° 06'													20	
Kupreanof Strait	57° 59'	153° 10'										10, 20		1	20	1
Viekoda Bay	57° 54'	153° 14'													1	
Uganik Passage	57° 51'	153° 24'												37	12	7
Uganik Bay	57° 48'	153° 30'														
Cape Ugat	57° 52'	153° 51'												1	0	9
Uyak Bay (East)	57° 39'	153° 50'												1		2
Uyak Bay (South)	57° 25'	153° 50'								5				0		2
Uyak Bay (West)	57° 36'	153° 58'													5	

Table 12 (Cont.) Summary of significant counts of sea otters around the Kodiak Archipelago

			1951*	1957*	1957*	1958*	1959*	1964	1966	Sightings 1964-1971	1970	Sightings 1975	Heli-copter 1975	Boat 1976	Air March 1976	Misc 1975
Rocky Point	57° 40'N	154° 12'W														
Karluk	57° 35'	154° 30'													0	
Halibut Bay	57° 25'	154° 43'													0	
Ayakulik	57° 10'	154° 35'													1	
Low Cape	56° 55'	154° 20'													0	
Alitak Bay	56° 55'	154° 05'														2
Deadman Bay	57° 04'	153° 57'													0	1
Olga Bay	57° 08'	154° 15'														2
Tugidak I. (North)	56° 55'	154° 35'	0	0												
Tugidak I. (South)	56° 25'	154° 35'	0	0						Beach Deads Annually					1	1
Sitkinak I. (South)	56° 30'	154° 10'	0	0	15					Present					21	21
Sitkinak I. (North)	56° 38'	154° 05'	0	0											1	
Tugidak-Chirikof	56° 00'	155° 30'														
Chirikof I.	55° 50'	155° 40'	0							6					1	
Aiaktalik I.	56° 43'	154° 00'								4					10	17
Twoheaded I.	56° 53'	153° 37'													0	1
Three Saints Bay	57° 06'	153° 28'								1					0	
Sitkalidak I. (West)	57° 04'	153° 25'														
Sitkalidak I. (South)	57° 05'	153° 05'														
Sitkalidak I. (North)	57° 12'	153° 05'													0	
Kiliuda Bay	57° 19'	153° 00'														1
Dangerous Cape	57° 19'	152° 38'														
Ugak Bay	57° 27'	152° 40'													0	2
Ugak Island	57° 23'	152° 15'													1	
Sequel Point	57° 31'	152° 15'													0	
															0	

* Lensink (1962)

ballast, has periodically killed many sea birds in this area. Some mortality of sea otters might have occurred.

The 1970 survey and increased sightings around Afognak Island and northern Kodiak Island indicated that range expansion along the northern and western sides of Afognak Island had finally started. The 1975 and 1976 surveys indicate that the rate of range expansion has accelerated and that the size of the population has, in fact, increased substantially.

The population has gone through the classic pattern of growth described by Kenyon (1969). It remained concentrated in a small area, built to high densities, then abruptly expanded its range into adjacent vacant habitat. Whether expansion to the south was retarded by immigration to the north or by mortality from oil spills is uncertain. The population has overcome whatever limiting influences that might have existed and has entered a period of rapid range expansion.

Present Status

Survey conditions were generally good around the north side of Afognak and Shuyak Islands during the October 1975 helicopter survey. Many sea otters were resting in pods increasing their sightability. The percentage of sea otters seen was probably much higher than that seen around the Kenai Peninsula at the same time. We were forced to terminate the helicopter survey before we could clearly delineate the southwestern fringe of the population. The February 1976 skiff survey and March 1976 aerial survey corrected this one flaw and provided some information on

shifts in distribution and sex segregation. Although Kodiak Island was not systematically surveyed most of its shoreline was visited during 1976. The data collected provide an excellent picture of the present distribution of the population (Figs. 6, 7, 8, 10 and 13).

The primary range of the population currently extends from Shuyak Island south to Raspberry Island on the west side of the archipelago and to Marmot Island on the east side. The area between Ban Island and Marmot Island supports sea otter densities comparable to those anywhere in the world. High proportions of females with pups were observed throughout this area. Most of the groups south of Malina Bay and Marmot Strait are probably composed of reproductively inactive animals. Scattered individuals and occasional small groups occur along the entire coast of Kodiak Island. Those between Uganik Bay and Low Cape on the northwest side and between Cape Chiniak and Two Headed Island on the southeast side probably do not represent established groups.

This distribution is typical of rapidly expanding populations, a central area of high density with well defined boundaries or "fronts" of expansion, occasional groups of nonbreeding animals ahead of the "fronts" in areas of good habitat and occasional stray animals far ahead of the "fronts." The "front" on the western side of the archipelago is less well defined than that on the eastern side, probably because areas of high quality habitat on the west side of Kodiak Island are widely separated encouraging greater dispersal.

Future

Range expansion southward along both sides of the archipelago should continue at a rapid rate over the next few years. This will be most noticeable in Marmot and Chiniak Bays which appear to contain large areas of suitable sea otter habitat. The timing of this expansion is difficult to predict but it seems reasonable to expect moderate to high densities to build up in those areas in the next 5 to 10 years. Abrupt movements of several hundred animals from Marmot Strait to such areas as Hog Island, Williams Reef and Cape Chiniak could occur at any time.

Eventually the population should become continuous with the Trinity Island population. Potential sea otter habitat on the northwest side of Kodiak Island north of Cape Ikolik appears limited and should require less time to become fully repopulated than the remainder of the island. We can expect a relatively sparse distribution of sea otters with a few small concentrations in areas such as the Noisy Islands, Chief Point and Harvester Island. The area south of Cape Ikolik is discussed under the Trinity Island population.

The southeast side of Kodiak Island has a number of large shallow areas that will probably support large numbers of sea otters. The number of stray individuals and small groups in the area should increase over the next few years. Eventually large numbers of sea otters should move into the area, primarily from the north but also from the Trinity Islands. It may take many years for sea otters to reach carrying capacity throughout the entire area.

Critical Areas

Virtually all reproduction in the Shuyak-Afognak population presently occurs around Shuyak Island and the northern half of Afognak Island. Rapid repopulation of Kodiak Island depends on maintenance of a high rate of reproduction in this area. Even when Kodiak Island is fully repopulated the area should remain one of the most important pieces of sea otter habitat in southcentral Alaska.

Marmot and Chiniak Bays will also be critical to the process of repopulation of the extensive areas of potential habitat along the east side of Kodiak Island for many years.

Many areas southwest of Cape Chiniak will become critical in the future. Quality of the habitat in that area should be maintained even though short-term impacts would have little effect until Chiniak Bay becomes densely populated.

3. Trinity Islands-Chirikof Island

History

An extensive area of almost 10,000 km^2 of water shallow enough to support sea otters lies between Kodiak Island and Chirikof Island. Small numbers were present in the Trinity Island area in the 1950's although no significant population could be found (Lensink 1962). This group probably represented a remnant population but could have formed from animals straying from

Shuyak Island. During the 1960's sightings around the Trinity Islands and Chirikof Island increased (Table 12). Beached, dead animals were found on Tugidak Island each year by seal biologists but live otters were rarely seen from shore. In 1971 a survey of the area between Tugidak Island and Chirikof Island was attempted but poor conditions and fog interfered. Six sea otters were seen midway between Tugidak and Chirikof Islands. This suggested that the range of the population was extensive and that the population was larger than suspected.

Present Status

No funds were available to survey this area under this research unit and the area remains to be properly surveyed. The observations made during activities funded under RU 243 (Figs. 11, 12, 19, 30 and 31) provide some information on distribution of the population.

There appears to be a concentration of sea otters south of Tugidak and Sitkinak Islands. Potential sea otter habitat extends over 20 km from shore in this area. A much larger area of potential sea otter habitat exists north of the Trinity Islands. Although only occasional sightings have been made in this area, the incidence of beached, dead animals on the northwest shore of Tugidak Island (Table 8) indicates that significant numbers occur there. These animals probably tend to remain well offshore and are missed on nearshore surveys.

Another concentration occurs near Chirikof Island. Again there is a large area of potential habitat offshore and there may be many more sea

otters than indicated by the limited observations presented in this report. The potential sea otter habitat around Chirikof is continuous with that around the Trinity Islands. Sea otters have been seen between the islands indicating some use of this area. Densities appear lower there than they are closer to the islands, however.

Alitak Bay was reasonably well surveyed during 1976. Occasional stray sea otters occur there but no established groups were found. Similarly, densities around the Aliulik Peninsula are low even though habitat there appears excellent. This suggests that densities around the Trinity Islands and Chirikof Island are below carrying capacity and there has been little incentive for major range expansion.

The number of sightings in the area and along the south shore of Kodiak has increased steadily, however, indicating steady population growth.

Future

This population can be expected to grow for many years. Eventually the entire area within the 80 m depth contour may support moderate to high densities. The population should expand its range into Alitak Bay and northward along both sides of Kodiak Island until its range becomes continuous with that of the northern Kodiak population. Some interchange of stray animals may have already occurred.

Critical Areas

Until more information is available, all waters less than 80 m deep southwest of Kodiak should be considered critical to this population.

VIII. Conclusions

The outer Kenai Peninsula was repopulated by sea otters emigrating from Prince William Sound and perhaps the Barren Islands. The present population is contiguous with that in Prince William Sound. All of the habitat south and east of Port Graham is presently occupied. The population is currently expanding its range into Kachemak Bay and lower Cook Inlet. The potential for significant impacts of oil and gas development on sea otters appears greatest in the area between Rocky Bay and Ninilchik.

A separate population inhabits Kamishak Bay. This population has grown and expanded its range southwestward along the Alaska Peninsula. Potential sea otter habitat in Kamishak Bay is contiguous with habitat on the Kenai Peninsula. The two populations may become continuous and it is possible that some exchange is occurring at present. Both populations should expand northward until some factor such as food availability or seasonal sea ice limits further expansion.

The Barren Islands population appears to be near carrying capacity. Little change is expected in the future.

The Shuyak-Afognak population of sea otters is rapidly expanding its range on both sides of the Kodiak Archipelago. Densities around Kodiak Island remain low but should increase dramatically as sea otters emigrate from Afognak Island. The population appears large enough to survive a major oil spill; however, such an event could seriously retard repopulation of Kodiak Island.

A separate population occupies the shallow waters between Kodiak and Chirikof Islands. This population appears to be well established and growing, however, data on distribution and abundance are inadequate.

The present distribution of sea otters in the study area and patterns of range expansion are shown in Figs. 33 and 34.

Several areas appear to be critical to the survival of healthy sea otter populations or to the process of repopulation of former sea otter habitat. These areas are shown in Figs. 35 and 36.

As sea otters expand their range into new areas significant changes in nearshore communities can be expected. Many areas currently supporting high densities of sea otters are probably rapidly changing. The history of sea otter occupancy of an area should be considered by individuals attempting to understand those communities.

IX. Needs for Further Study

Coverage of most of the study area was adequate to meet the objectives of the study. The main deficiency was in the area around the south end

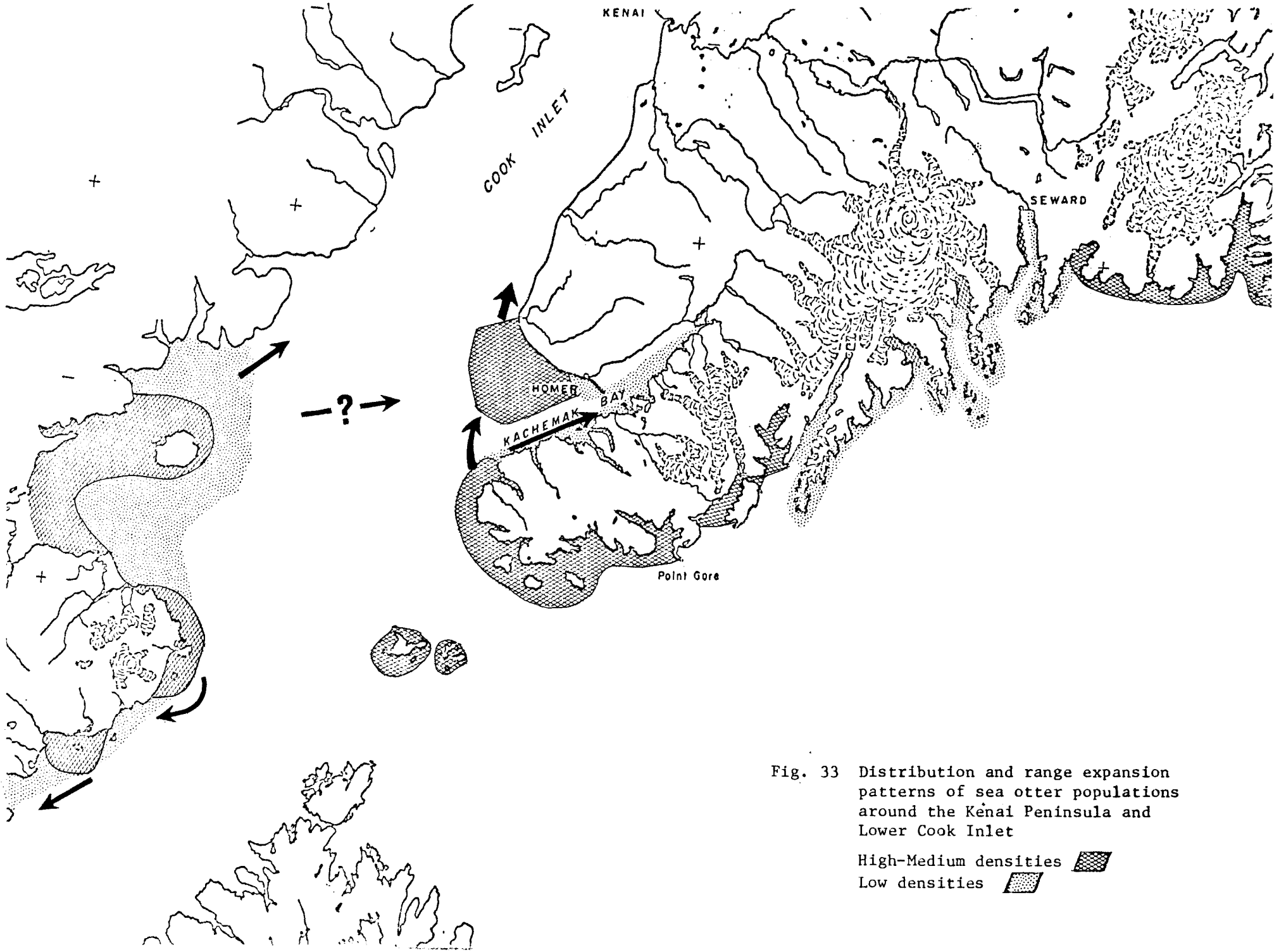


Fig. 33 Distribution and range expansion patterns of sea otter populations around the Kenai Peninsula and Lower Cook Inlet

High-Medium densities

Low densities

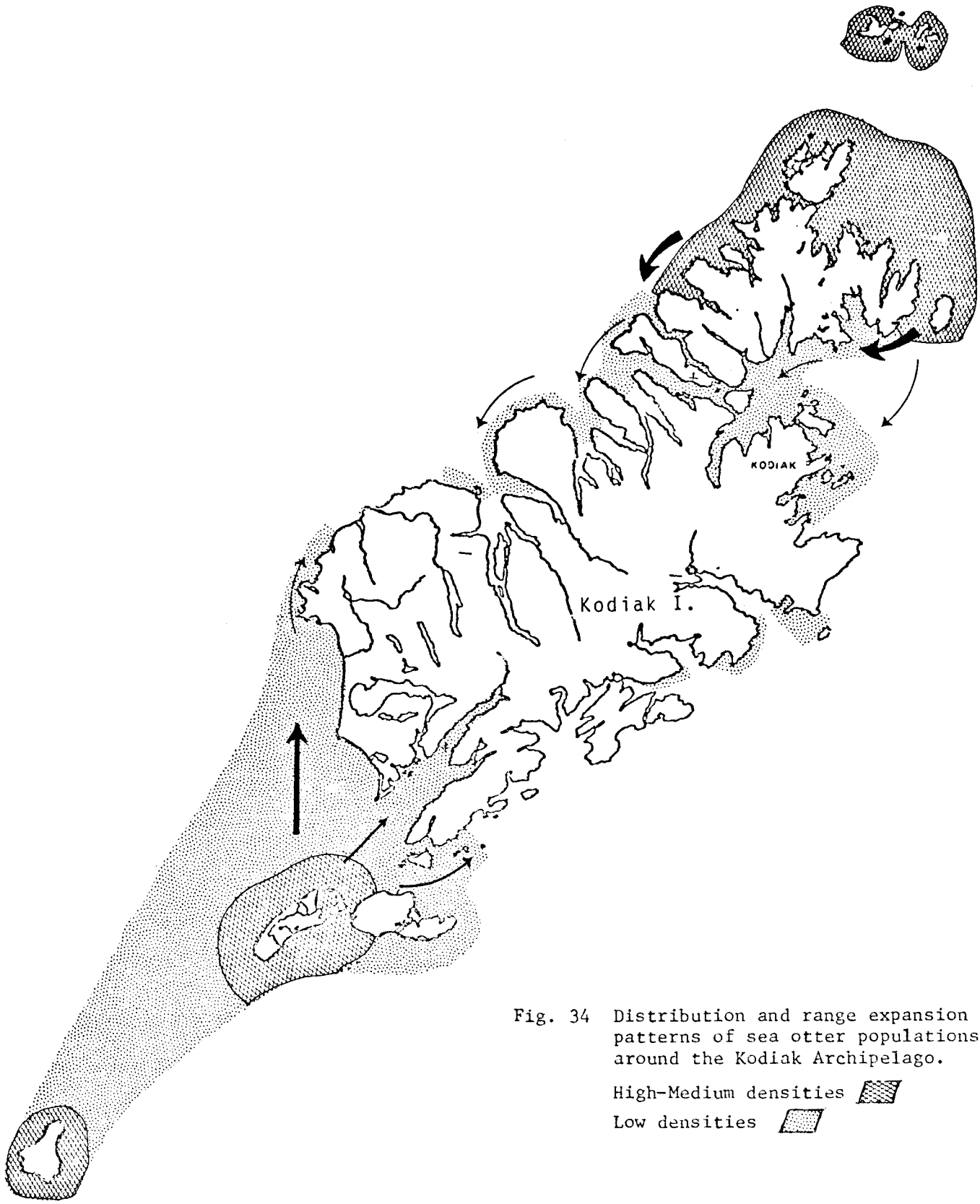


Fig. 34 Distribution and range expansion patterns of sea otter populations around the Kodiak Archipelago.

High-Medium densities

Low densities

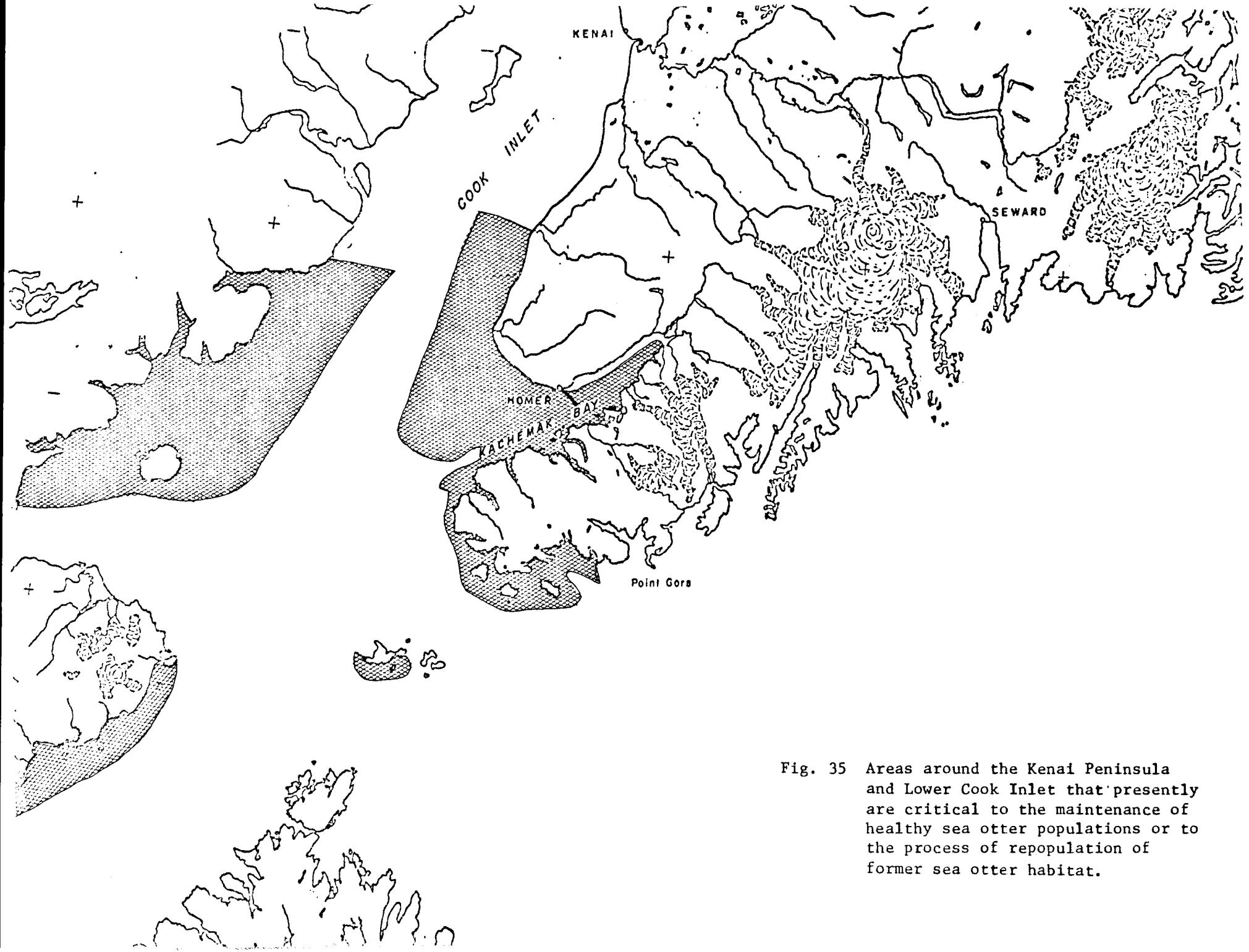


Fig. 35 Areas around the Kenai Peninsula and Lower Cook Inlet that presently are critical to the maintenance of healthy sea otter populations or to the process of repopulation of former sea otter habitat.

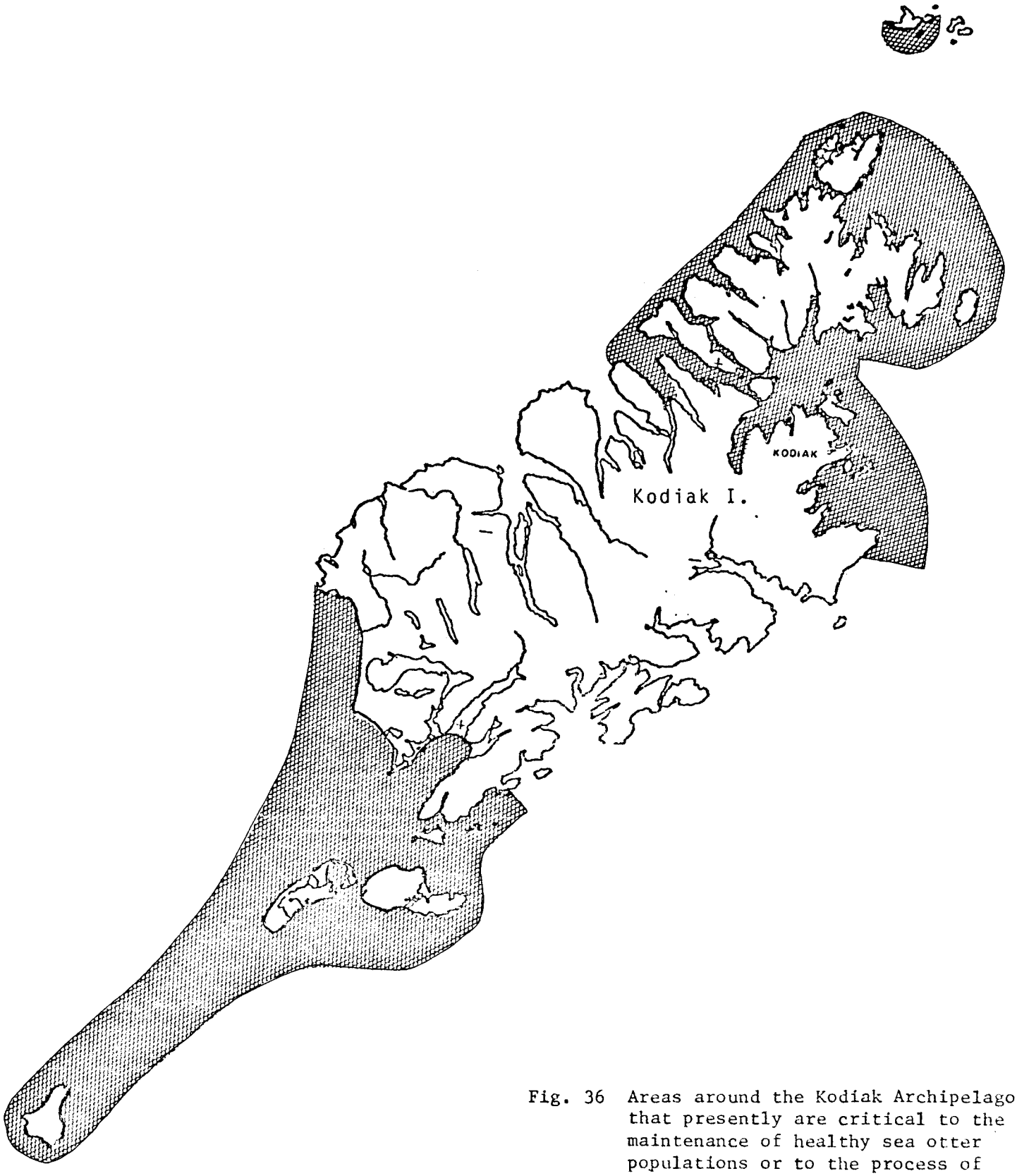


Fig. 36 Areas around the Kodiak Archipelago that presently are critical to the maintenance of healthy sea otter populations or to the process of repopulation of former sea otter habitat.

of Kodiak Island, the Trinity Islands and Chirikof Island. Shoreline surveys were not adequate in extensive shallow areas where sea otters may be scattered over hundreds of square miles. Over 9,000 km^2 of potential sea otter habitat exists southwest of Kodiak Island. Much of this lies within the proposed western Gulf of Alaska lease area. The limited observations available indicate that sea otters already inhabit much of this area. This area should be able to support several thousand sea otters. A systematic survey of the entire area should be conducted to determine the present status of the population and to delineate areas of concentrations.

Changes in sea otter distribution and abundance throughout the remainder of the study area should be monitored. This could be done in conjunction with other activities at no additional operational cost for a few years. It might be necessary to survey selected areas where range expansion is rapid in 3 to 4 years.

There are several areas of concern outside of the study area. These include:

1. Northeast Gulf of Alaska coast - The outer coast of the northeast Gulf of Alaska has generally been considered to be devoid of sea otters. Earlier surveys indicate substantial numbers south of Hinchinbrook Island and small numbers around Kayak Island (Pitcher 1975). In 1966, 10 were transplanted to Yakutat Bay. Recent observations indicate that increasing numbers of sea otters are occurring around the Copper River Delta and that small groups now occur at Icy Bay and along the outer

coast between Yakutat and Cape Fairweather. This suggests that natural repopulation of this extensive area has begun. Little of this area has been surveyed for sea otters. If the status of these groups is as tenuous as believed, it would take little to stop the repopulation of the gulf coast. The status of sea otters should be determined before extensive offshore drilling, or onshore site construction occurs. The role of the Hinchinbrook Island population should be assessed before areas west of Kayak Island are leased.

2. Southern Alaska Peninsula - Several sea otter populations occur along the south side of the Alaska Peninsula including the Semidi Islands, Shumagin Islands, Sanak Island and the Sandman Reefs. Some of these populations could be impacted by OCS development although they are more removed from proposed lease areas. Most of these populations have not been surveyed since 1970. The status of each could be determined by reviewing existing data and making additional observations during work on other research units.

3. Fox and Krenitzin Islands - The Fox and Krenitzin Islands contain large areas of vacant, former sea otter habitat. There are currently four distinct populations of sea otters and a few other small groups and scattered individuals in the area. Some of these populations have verged on extinction for many years but have recently started to grow rapidly. All are concentrated within a few km^2 and all are adjacent to the proposed Aleutian Shelf lease area. A very small oil spill could eliminate any one of these populations. Reasonably good information exists on these populations, the most recent gathered under RU #67 in

1975. This information should be summarized and additional information could be gathered during the course of other activities at little additional cost.

4. Pribilof Islands - Sea otters were once common in the Pribilof Islands but were completely exterminated. Several transplants have been made in attempts to re-establish the population. Recent surveys by National Marine Fisheries Service biologists indicate very small numbers surviving there. However, all surveys have been made during summer while fur seals were present complicating identification of sea otters. A survey, probably by boat, should be conducted while fur seals are absent. Also the possibility of larger numbers existing in shallow offshore areas should be investigated.

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