DISTRIBUTION AND ABUNDANCE OF SEA OTTERS, STELLER SEA LIONS, AND HARBOR SEALS IN PRINCE WILLIAM SOUND, ALASKA

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ABSTRACT

Helicopter surveys of marine mammals were conducted along the coastline of the Prince William Sound area in June 1973 and March 1974. These surveys, designed to provide general information on abundance and more specific information on distribution, were directed towards sea otters, Steller sea lions and harbor seals. Observations of other marine mammals were recorded incidentally.

In June 1973, 2,015 sea otters were counted and 1,441 were observed in March 1974. The total population was estimated to be about 5,000. Current distribution patterns were determined. It appears the population is still expanding and animals are becoming established in areas of previously unoccupied habitat.

Based on observations of 5,134 animals in June and 4,614 in March numbers of sea lions occupying the area were estimated at 6,500 to 7,500. During June, sea lions were almost exclusively limited to outside waters. Most of the animals were found near the following five rookeries and summer hauling grounds; Cape St. Elias, Seal Rocks, Fish Island, The Needle and Pt. Elrington. Use of these areas continued in March, but limited movement into inside waters also occurred. Three winter hauling grounds, Glacier Island, Perry Island and Point Eleanor, were located in inside waters. Total numbers of sea lions in the Prince William Sound area appeared to be about the same as those observed in 1956-57, but a considerable increase at Seal Rocks and decrease at Fish Island were noted.

During the June survey 5,630 harbor seals were counted and 2,965 were seen in March. Although survey techniques were inadequate for estimating population size it is believed the seal population greatly exceeds the number of animals actually observed. A number of seal haul-outs and concentration areas were located. Some changes in seasonal distribution were noted.

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The project was conducted under the direction and supervision of John Vania.

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Ansel Johnson, research biologist with the USFWS, participated in the March survey and provided data from a boat survey of part of Prince William Sound.

To all of these I express my thanks.

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INTRODUCTION

Current and proposed petrochemical developments in Prince William Sound necessitate increased knowledge of the ecology, distribution and abundance of the area's marine mammal populations. Location of the Trans-Alaska oil pipeline terminus in Valdez will result in construction of oil storage and loading facilities in Port Valdez and heavy oil tanker traffic in the Sound. El Paso Natural Gas Co. has recently announced tentative plans for a trans-Alaska natural gas pipeline with a terminus in Sheep Bay. This would require construction of liquification, storage and loading facilities and tanker traffic would increase. In addition, the Gulf of Alaska is highly regarded as a potential oil and gas source and a lease sale is scheduled for December 1975.

Petrochemical related developments in the area will inevitably result in the contamination of its marine ecosystem. Degradation of marine habitats, whether resulting from chronic low-level contamination or massive spills, may impact marine mammal populations by lowering ecological productivity as well as by direct injury to animals. Baseline abundance data are needed in order to detect and evaluate changes which might occur. Seasonal distribution data are basic to sound recommendations on development in the area, since contingency plans must be based on knowledge of areas important to marine mammal populations.

Depredations of and competition with commercially valuable fisheries by marine mammals in Prince William Sound are problems that can be expected to continue and probably increase in magnitude. Solutions to these problems are incumbent upon a thorough knowledge of the biology of the animals involved.

Widespread public concern for the welfare of marine mammal populations has been demonstrated during recent years. The Marine Mammals Protection Act of 1972 is a misguided manifestation of this concern. The need for accurate and complete information on marine mammal populations became evident during hearings before this Act became law.

This report presents data reflecting our current knowledge of marine mammal distribution and abundance in the Prince William Sound area. Emphasis is placed on sea otters (*Enhydra lutris*), Steller sea lions (*Eumetopias jubata*) and harbor seals (*Phoca vitulina*), but other marine mammal observations are also reported. Much of this information is general in nature, but in many instances sufficient detail is presented to provide direction for the decision making process. Should large-scale oil spills or other environmental contamination occur, the detailed information on marine mammal distribution and concentration areas will indicate priorities for containment and cleanup operations. Major changes in marine mammal use patterns or population numbers should be detectable by repetition of all or parts of the survey and comparison of the results obtained with the baseline data provided in this report.

METHODS

Most of the data presented were collected during two shoreline surveys of the Prince William Sound area from Cape Puget to Cape St. Elias. These surveys, designed to collect information on distribution and abundance of sea otters, sea lions and harbor seals, were conducted from June 24-29, 1973 and from March 5-20, 1974. Surveys were flown with five-place jet turbine helicopters, Jet Rangers (Bell 206A) and Fairchild-Hiller 1100's. Supplemental surveys, using a Cessna 180 and Piper Super Cub (PA-18), were conducted on the Copper River Delta, Controller Bay and Bering River on July 25 and 26, 1973. Port Wells, Passage Canal, Blackstone Bay, Cochrane Bay and Esther Island were surveyed using a 17' Boston Whaler skiff between May 17 and June 8 1973. Portions of Elrington, Evans, LaTouche, Knight, Green, Montague and Hinchinbrook Islands plus Port Gravina, Sheep Bay and Simpson Bay were surveyed from the "M/V Aleutian Tern" between March 15 and 21, 1974.

Helicopter surveys were flown at altitudes of 200-400 feet about 200 yards offshore. The contour of the shoreline was followed and offshore rocks and islets were circled. Airspeed was usually about 70 knots but when concentrations of animals were found, speed was reduced. Two observers and one recorder-observer were in each helicopter. One observer was seated in the front, and the helicopter was always flown so he was on the shoreward side. A recorder-observer was seated directly behind the front seat observer and helped with observations when not recording. The third observer, in the back on the offshore side of the

aircraft, and the pilot also assisted in making observations. All observations were called out to the recorder who was equipped with large-scale nautical charts and notebooks in which all data were recorded. In some instances visual counts were supplemented with photographs to provide a more precise estimate of numbers. A 35mm camera with 50 or 105mm lens and a medium-speed, black and white film (Kodak Plus - X) were used. Such photographs were useful when concentrations of animals, such as sea lion rookeries, large pods of sea otters and large seal hauling areas, were found.

Locations of sea lion rookeries and most hauling grounds were known prior to our surveys. When these areas were approached in the helicopter, the observers prepared themselves to photograph and estimate numbers of sea lions. An initial pass was made approximately 75 yards offshore at an altitude of about 500 feet. Airspeed was reduced to allow photographs to be taken and visual estimates of numbers to be made. The front seat observer estimated numbers while the backseat observer-recorder photographed the animals. After the initial pass, most of the adults had entered the water and the pups were counted. Approach and method of coverage were modified slightly from area to area because of varying topography. Sea lion numbers were later counted from 8 x 10 inch black and white prints.

Fixed-wing aircraft surveys were flown with a single observer-recorder seated directly behind the pilot in the PA-18 or alongside the pilot in the Cessna 180. Airspeed was 70-100 knots and the altitude was

300-700 feet. Data were recorded in a similar fashion to the helicopter surveys. Photographs were used to supplement visual counts.

Boat surveys were conducted at slow speeds (5-7 knots) and followed the contour of the shoreline. Binoculars were used as an aid in sighting and identifying the animals. Data were recorded in a similar manner to the aerial surveys.

SEA OTTER

Historical records indicate that sea otters were fairly abundant in Prince William Sound prior to intensive Russian hunting which began about 1795 (Lensink 1962). It appears that by 1800, however, populations of sea otters in the area had been reduced to very low levels. Continued Russian hunting through 1867 and American exploitation until 1911 prevented their recovery.

Small, remnant groups of animals apparently survived in isolated areas as indicated by Kenyon's (1969) report of two, illegally taken sea otter skins seized by the government at Seward in 1924. Repopulation to current levels undoubtedly was the result of buildup and dispersal of these remnant groups. The general pattern of population recovery and dispersal is fairly evident when Lensink's data derived from historical sources and surveys during 1959 and 1960 are examined along with Department records and results of our surveys (Table 1). Fig. 1 illustrates this

Table 1 Summary of sea otter surveys and sightings, Prince William Sound - Kayak

Area	Pre-1959[a]	1959[b]	1960[b]	1964[c]	1970[c]	1973[d]	1974[d]
Kayak I.	N.S.*	163	122	39	5	7	10
Hawkins I.	1 (1951)	N.S.	N.S.	N.S.	1	4	123
Hinch. I.	150 (1951)	58	48	167	101	367	86
Montague I.	78 (1957)	349	100	42	259	514	206
Green I. area	N.S.	42	101	116	103	135	152
Galena Bay to Fish Bay	N.S.	N.S.	N.S.	N.S.	1	6	2
Fish Bay to Cordova	N.S.	0	N.S.	N.S.	104	199	311
Esther Pass. to Valdez Arm	N.S.	0	N.S.	N.S.	N.S.	24	132
Naked, Storey, Peak I.	N.S.	1 (1959)	0	0	N.S.	159	40
Knight, Eleanor I.	2 (1956)	N.S.	1	3	145	241	77
Port Wells, College, Harr. Fiords, Esther I.	N.S.	N.S.	N.S.	N.S.	N.S.	35	47
Nellie Juan to Passage Canal	N.S.	0	N.S.	N.S.	1	15	51
Bainbridge, Latouche area	64 (1949)	96	149	41	133	309	206

Other Sightings of Interest

1.	Montague I.	Present	1936
2.	Whittier	6	winter 1969-70
3.	Perry I.	5	1968
4.	Falls Bay	4	1968
5.	Dangerous Pass	5	1968
6.	Kayak I.	85-100	1965
		35	1968

* N.S. = not surveyed
a. Lensink (1962) - summary of miscellaneous observation.
b. Lensink (1962) - fixed wing aerial survey.
c. ADF&G - fixed wing aerial survey.
d. ADF&G - helicopter survey.

continuing process of repopulation in the Prince William Sound area. Sizable groups of otters were reported during the late 1940's and early 1950's from the Montague, Hinchinbrook, Latouche, Elrington, and Kayak Island areas. In addition, occassional sightings of one or two animals were made in other areas (Lensink 1962). In the early 1960's distribution remained about the same but numbers appeared to have increased (ADF&G unpublished data). By 1970, Knight and Naked Islands and Port Gravina were well populated and since then otters have moved into Sheep Bay and Orca Inlet. College and Harriman Fiords, the north end of Culross Island, Glacier Island and the Fairmount - Olsen Island area all appear to be newly populated. Additional small groups and single individuals are occasionally seen almost anywhere in Prince William Sound. Sightings are becoming increasingly frequent in the formerly barren, northwestern portion of the Sound.

The process of dispersal appears to be following the two patterns outlined by Kenyon (1969). Movement of large numbers of otters from densely populated areas to adjacent unpopulated habitat appear to have occurred around Knight Island, Naked Island, and the Port Gravina - Sheep Bay area. The second type of dispersal, in which wandering individuals accumulate to form colonies in good habitat a considerable distance from dense populations, has apparently taken place in the Harriman - College Fiord area and around the north end of Culross Island.

Kenyon (1969) presented data indicating that body weight of sea otters decreased considerably when food was a limiting factor. If this holds true Prince William Sound otters are not generally food-limited. Weights from animals captured during transplant operations are some of the highest recorded (ADF&G unpublished data). The severe, periodic "die-offs" which occur at Amchitka Island when populations outstrip food resources (Kenyon 1969) apparently have not yet occurred in Prince William Sound. There are some indications, however, that subadult mortality has steadily increased around Montague Island although all information indicates that population is still growing and new areas are being populated. Areas which appear to be acceptable habitat but are not presently supporting significant sea otter populations include Perry Island, Bligh Island and Galena Bay.

Helicopter surveys are useful in determining and monitoring changes in sea otter distribution. They are of only limited value in determining magnitude and changes in population size however (Schneider 1971). Because numerous factors influence the number of animals seen survey results vary greatly. Distribution of sea otters will affect the number seen. When animals are scattered offshore, many are missed during a shoreline survey. Higher counts will be obtained when otters are found in large pods close to shore as they are less likely to be missed. Kenyon and Spencer (1960) assumed that nearly 25 percent of the otters in the flight path will be submerged and missed during a survey. Estes and Smith (1973) stated that during periods of minimum feeding

activity approximately 30 percent of a population will be underwater at a given instant. In addition, weather conditions, time of day, observer experience and ability and pilot ability all affect survey results.

Survey conditions were superior during the June survey. In March, sun glare and wind were a continual problem reducing the effectiveness of the observers. Otter distribution was also different during the two surveys. Animals were usually found in the same general areas but during March they were much more scattered with some animals far offshore. Few large groups were seen during March in contrast to June when a number of sizable pods were noted. Differences in survey conditions and animal distribution probably account, to a great extent, for the difference in numbers of otters observed on the two surveys. During the June survey 2,015 otters were seen compared to 1,441 in March.

Lensink (1962) estimated the 1960 Prince William Sound - Kayak Island populations at 1,000 - 1,500 based on actual observations of 702 otters during a fixed-wing aircraft survey. Considering recent information on the accuracy of various types of sea otter surveys (Schneider 1971), his estimate was probably ultraconservative, possibly erring by 100 percent. The Alaska Department of Fish and Game (1973) estimated the population at 5,000. This figure seems reasonable in light of the numbers of otters counted on the past two surveys. Comparative shore - helicopter counts on Amchitka Island showed that two to four times as many animals could be counted from shore and even then some are missed (Schneider 1971).

Sea otter numbers around Kayak Island appear to have dropped in recent years. Aerial surveys in 1959 and 1960 accounted for 138 and 122 animals, respectively (Lensink 1962). Six Department surveys between 1964 and 1974 failed to find more than 39 otters although a commercial pilot reported seeing 85-100 in 1965 (Table 1). Reasons for the apparent decline are not known but several possibilities have been advanced. Changes in habitat resulting from the 1964 earthquake might have reduced carrying capacity although some areas in Prince William Sound appeared to experience more severe disturbance without corresponding reductions in numbers. Reports of otters down the coast toward Yakutat have caused speculation of emigration.

Several possible shifts in distribution were detected during the March survey. It is difficult to determine with only two surveys whether these represent; (1) changes in seasonal distribution, (2) range extensions, (3) normal variations within the distribution of groups of otters, or (4) variation resulting from differences in survey conditions, observers, pilots, etc. representing no actual change in distribution.

During the March survey, 115 otters were counted in Orca Inlet where none were seen during the June survey. This is not a recent range extension as we have received reports from the public on this group of otters for several years. The animals were probably present but not seen in June. Because shallow water extends far offshore in this area sea otters could easily be missed in a shoreline survey.

A major shift in distribution appeared to have occurred in the Sheep Bay area where 202 otters were counted in March compared to 5 in June. This is probably a range extension of the group of otters that has been located in the Knowles Head - Port Gravina area for the past 4-5 years.

The Glacier Island - Unakwik Inlet area appeared to have more sea otters in March, when 126 were seen, than during June when only 16 were counted. At the same time nearby Naked Island showed a marked reduction from 159 otters in June to 40 in March. This possibly represents a shift of otters from one area to the other.

The western side of the Sound, from Chenega Island north seemed to have more otters in March than in June. During the winter survey 173 sea otters were counted as compared to 66 in June. Whether this represents a true increase or is the result of variation inherent to the survey technique is not known.

March counts of sea otters at Hinchinbrook, Montague, Green, Knight, Latouche and Bainbridge Islands were down considerably. In June, 1,550 were seen in these areas, compared to only 652 in March. These are all areas with well-established otter populations and it is unlikely that there was an actual reduction in numbers. As previously mentioned, survey conditions and animal distribution during the March survey were not conducive to seeing large numbers of otters. Repetitive

helicopter counts of otters on Amchitka Island, which range from 1,545 to 4,042 (ADF&G unpublished data), illustrate the variations which occur on this type of survey.

Kenyon (1969) reported that in the Aleutian and Shumigans Islands otters regularly haul out on land. They favor rocky points but also utilize sand beaches, spits and islets. Reports of sea otters hauling out in the Prince William Sound area are relatively rare. Edward Klinkhart (ADF&G, Anchorage, AK., pers. comm.) stated that otters were routinely hauling out on Okalee Spit in March 1964. He saw a group of about 51 animals hauled out on the tip of the spit on March 1, 1964. On the same date he reported seeing 52 sea otters hauled out on the spit at the mouth of Boswell Bay. The Department has received a number of other reports of otters hauled out at Boswell Bay so it is apparently not uncommon.

During the June survey only one instance of hauling out was noted. A female and pup were seen hauled out on a floating glacial ice pan in Icy Bay. During March a number of otters were seen hauled out. Ice shelves which formed at the heads of many bays were commonly utilized. Three otters were seen hauled out on snow banks just above the high tide line and one had hauled out on a tidal rock. Sea otter tracks and beds were noted in the snow on several small islets and points.

It appears from these reports and observations that sea otters in the Prince William Sound area do not haul out with nearly the frequency

or regularity they do in the Aleutian Islands. This behavior is apparently quite rare in summer but increases in winter months; with ice the favored hauling substrate.

Selected portions of Prince William Sound were surveyed from the 65 foot "M.V. Aleutian Tern" between March 15-20, 1974. The emphasis was on sea otters but notes on seals and sea lions were made. Areas covered included portions of Evans, Elrington and Latouche Islands, Knight and Green Islands, Applegate Rocks, Sheep Bay, Simpson Bay and Port Gravina. The survey technique was described by Schneider (1974).

This repetitive count, using a different counting platform, gives considerable insight into the shortcomings and variability of survey techniques for estimating population size. Data in table 2, a comparative summary of otter sightings in areas surveyed both by boat and helicopter, add support to Schneider's (1971) contention that boat surveys are considerably more efficient than aerial surveys. Schneider stated further that shore counts are higher than boat counts and even then obviously not all animals are counted.

In the Aleutian Islands, sea otters form sexual aggregations which have been studied by several observers; Lensink (1962), Kenyon (1969) and Schneider (1972, 1973). These workers found discrete "female areas" composed of females, pups and some mature males and "male areas" in which numerous subadult males and some older males were found. Numbers

Table 2. Comparison of numbers of sea otters counted in areas surveyed by both helicopter and boat.

rea	Boat	Helicopter	% Difference
Elrington I.	16	14	+ 14%
vans I.	55	33	+ 66%
Latouche I.	51	12	+325%
Knight I.	180	59	+205%
reen I. area	201	152	+ 32%
Port Gravina-Sheep Bay	480	299	+ 61%
impson Bay	0	0	0%
otal	983	569	+ 73%

of males in the female areas varies directly with the number of estrous females. In the Aleutians, male areas are usually found where shallow water extends further offshore than normal, often near an exposed point of land or a pass between islands. Female areas are often points with water sheltered by rocks and islets (Schneider 1973).

If sexual segregation exists in Prince William Sound, it doesn't appear to take the same form as in the Aleutians (Calkins 1972). Some areas seem to have characteristics of female areas but no discrete male areas have been found (Schneider 1973). Habitat is considerably different from the Aleutians and sexual segregation could possibly be expressed in a different way.

Accurate knowledge of segregation and identification of specific areas would be important in event of localized kills of sea otters. It would be impossible to adequately evaluate effects on the population without knowing which segments were involved.

SEA LION

Information available on sea lion populations in the Prince William Sound area prior to our surveys was limited to that derived from census work in 1956 and 1957 by Mathisen and Lopp (1963), population studies on Fish Island (Lewis Island) (Brooks 1956), a behavioral study of sea lions on Fish Island (Sandegren 1970) and incidental observations by Department personnel. These provided fairly good background information for rookeries and summer hauling grounds but were incomplete, particularly during winter months.

Apparently a large proportion of sea lion populations haul out on traditional rookeries and hauling grounds. Rookeries and summer hauling areas are almost exclusively located along the outside coast. Generally, these areas are also used in winter, but in some instances by reduced numbers of animals. In winter, some movement of sea lions into more sheltered, inside waters occurs.

Although breeding females and mature territorial bulls are strongly tied to rookeries, Sandegren (1970) observed considerable movement to and from a rookery. Some territorial bulls went to sea occasionally while others remained on the rookery for over 60 continuous days. Females tended to make periodic trips to sea, probably for feeding purposes, but cows about to give birth, who have just given birth, or are estrous were reluctant to leave the rookery. Peak numbers of animals are usually ashore about midday (Mathisen and Lopp 1963 and Sandegren 1970). Stormy weather, high surf, high tides, disturbance and high solar radiation all appear to cause animals to return to the water. Numbers of animals found hauled out are usually greatest during summer (Mathisen and Lopp 1963). Population estimates based on rookery and hauling ground counts must be considered minimal as some animals will almost certainly be in the water at any given time. The various factors which influence haul'out behavior must be considered when planning a rookery count or when interpreting the results.

Locations of rookeries and hauling grounds and number of sea lions seen during the two surveys are shown in fig. 2.

Sea lions utilize the Cape St. Elias area both summer and winter (Table 3). Mathisen and Lopp (1963) photographed these animals on October 2, 1957 and counted 1,253 adults and 90 pups. During our June 1973 survey we found 1,548 adults and 18 pups, mostly located on the exposed rocks, just south of Pinnacle Rock. The winter survey, on March 6, 1974, was hampered by gusty winds and turbulence resulting in poor quality photos. A minimum of 505 sea lions were present mostly located on a rocky beach on the southwest end of Pinnacle Rock.

Seal Rocks, located in Hinchinbrook Entrance, appear to be the largest breeding rookery and winter hauling ground in the Prince William Sound area at present. In 1956-1957 Mathisen and Lopp (1963) censused the area three times, counting a maximum of 183 sea lions. The Bureau of Land Management took aerial photos in 1966 which showed 864 sea lions. Our June 1973 survey indicated there were 1,733 animals, including 200 pups, while the March 1974 survey revealed 1,750 sea lions. There was a local change of distribution on Seal Rocks from summer to winter. During the summer the central rock-gravel beach served as the rookery area. In March no sea lions were using this area but 200 harbor seals were hauled out on the beach. Numbers of sea lions using the area appear to have increased considerably since the late 1950's.

Sea lion population numbers of Fish Island (also known as Lewis Island), the outermost of the Wooded Islands, are the most extensively documented of any group of sea lions in Prince William Sound (Table 3).

Table 3. Summary of sea lion rookery and hauling ground counts.

Area	Date		Number of sea lions
Cape St. Elias	2 Oct. 1957[a]		= 1,343
	26 June 1973[b]	1,584 ad. +18 pups	= 1,566
	6 March 1974[b]		= 505
Seal Rocks	22 July 1956[a]	162 ad. + 21 pups	= 183
	24 March 1957[a]		= 0
	2 Oct. 1957[a]		= 95
	4 Sept. 1966[c]		= 846
	26 June 1973[b]	1,533 ad. + 200 pups	= 1,733
	5 March 1974[b]		= 1,750
Fish I. (Lewis I.)	22 July 1956[a]	466 ad. + 213 pups	= 679
	Summer 1956[d]	2,400 ad. + 100 pups	= 2,500
	1 Sept. 1956[a]		= 2,556
	14 Dec. 1956[a]		= 1,694
	24 March 1957[a]		= 810
	27 June 1957[a]		= 3,000
	2 Oct. 1957[a]		= 3,762
	27 May 1968[e]	1,500 ad. + 49 pups	= 1,549
	26 June 1973[b]	1,243 ad. + 26 pups	= 1,269
	6 March 1974[b]		= 1,114
The Needle	21 July 1956[a]	179 ad. + 16 pups	= 195
	1 Sept. 1956[a]		= 150
	14 Dec. 1956[a]		= 165
	24 March 1957[a]		= 190
	27 June 1957[a]	179 ad. + 0 pups	= 179
	2 Oct. 1957[a]		= 130
	26 June 1973[b]	234 ad. + 2 pups	= 236
	6 March 1974[b]		= 568
Glacier I.	12 March 1974[b]		= 55
Pt. Eleanor	15 March 1974[b]		= 91
Perry I.	24 March 1957[a]		= 80
	16 March 1974[b]		= 153
Pt. Elrington	21 July 1956[a]	25 ad. + 6 pups	= 31
	1 Sept. 1956[a]		= 0
	14 Dec. 1956[a]		= 550
	24 March 1957[a]		= 200
	29 May 1957[a]		= 300
	27 June 1957[a]		= 250
	2 Oct. 1957[a]		= 353
	27 June 1973[b]	250 ad. + 0 pups	= 250
	15 March 1974[b]		= 339

a. Mathisen and Lopp, 1963
b. Alaska Department of Fish and Game surveys
c. Bureau of Land Management aerial photo - pups not distinguishable
d. Alaska Fisheries Board and Alaska Department of Fisheries, 1956
e. Sandegren, 1970 - using maximum count of adults and total number of pups known born.

It appears that present numbers are considerably less than 1957 levels, possibly by as much as 50 percent, and sea lion distribution has also changed greatly. Sandergren (1970) described extensive changes in the topography of Fish Island resulting from the 1964 earthquake. The rookery area was previously on the north side of the island and is now on the south side. The former rookery is now covered with fallen rock, and the present rookery was formerly free-standing rocks in the ocean. There is a distinct possibility that the change in population size is the result of these tectonic changes in rookery and hauling areas.

The Needle, although utilized by sea lions throughout the year, appears to receive more use during the winter (Table 3). This haul out area is in semi-protected waters and, as our surveys indicate, probably experiences an influx of animals during the winter. The area does not produce significant numbers of pups and during the summer has mostly nonbreeding animals.

No documented records of sea lions hauling out on Glacier I. were available before the March survey. On March 12, 1974, 55 sea lions were photographed on the southeast side of Glacier Island. As no sea lions were seen at this location during the June survey and because it is located in fairly protected waters we concluded that it serves only as a winter hauling ground.

Point Eleanor was documented for the first time as a hauling ground on March 15, 1974 when 91 sea lions were seen hauled out. Local fishermen

and boat operators have been aware of this hauling ground for some time. Use is probably limited to the winter due to its inside waters location.

Perry Island, located on inside waters, appears to be another winter hauling ground. Mathisen and Lopp (1963) found 80 sea lions on March 24, 1957 and we counted 153 lions on March 16, 1974.

Point Elrington, appears to serve as a year-round hauling ground for several hundred animals, but no pupping of significance is known to occur there. Counts vary between 31 and 550 sea lions but are usually between 250 and 350 (Table 3). It appears that more animals use the area in winter than summer.

Danger Island, Knowles Head, Porpoise Rocks and Fox Point have all been reported as minor hauling areas (Mathisen and Lopp 1963 and Alaska Department of Fish and Game 1973). No animals were seen in these areas on either survey and their present use status is unknown.

Total numbers of sea lions counted during the two surveys were similar, 5,134 during the June survey and 4,614 during March, and no difference in winter and summer population size could be detected. Differences in photograph quality and coverage and animal distribution combined with unknown numbers of sea lions at sea prohibit precise estimates of numbers. However, it appears that winter and summer population levels are similar in the Prince William Sound area, a minimal estimate being 6,500-7,500 sea lions.

Distribution of sea lions changed somewhat between the summer and winter surveys. At Cape St. Elias, only 505 sea lions were counted in March compared to 1,566 during June. If this is a true reflection of population size it indicates a winter movement away from Cape St. Elias. Seal Rocks and Lewis Island had similar numbers of sea lions during the two surveys. The Needle and Point Elrington had moderate increases from June to March. Point Eleanor, Perry Island and Glacier Island all inside water areas, were used during the winter only. During the June survey, only 0.07 percent of the sea lions were seen in inside waters compared to 7.3 percent during the March survey. This, plus the fact that the three inside hauling areas were used only during the winter, indicate a small but significant change in seasonal distribution.

Only 246 pups were counted during the June survey. Even though pups are difficult to see and some were undoubtedly overlooked this is very low pup production in relation to the total number of sea lions seen. All of the hauling areas appeared to have a very high proportion of immature animals. Sandegren's (1970) data show a high proportion of nursing subadults in relation to pups produced. These data all suggest that sea lions in the Prince William Sound - Kayak Island area may not be a discrete population but that there may be considerable interchange with other areas, possibly from the larger rookeries of the Kenai Peninsula and Kodiak area.

Total numbers of sea lions counted in the Prince William Sound - Kayak Island area during our surveys are comparable with population data

gathered by Mathisen and Lopp (1963) in 1956 and 1957. There have been two major changes; Seal Rocks has shown a dramatic increase in numbers and Fish Island appears to have declined considerably. Tectonic changes in hauling grounds and rookeries are the apparent cause of these changes in numbers. Both areas uplifted considerably, Fish Island about 11 feet and Seal Rocks about 8 feet (U.S. Geological Survey 1969). The effects, however, were quite different; at Fish Island there was an apparent loss of hauling and breeding areas (for description of changes see Sandegren 1970) while the uplift at Seal Rocks appears to have increased hauling habitat.

The relative stability of the total population over the past 18 years in light of the lack of human exploitation suggests a population at about carrying capacity for the area.

HARBOR SEAL

Detailed information on abundance and distribution of harbor seals in Prince William Sound is not available. Distribution and areas of concentration have been shown in a very general way (ADF&G 1973). Biologists have long noted areas with highly visible concentrations of seals such as Columbia Glacier, the Copper River Delta and Channel Island.

Available survey techniques for harbor seals are not adequate for estimating population size and are marginal for determining distribution.

When seals are underwater they can be seen only under the most favorable conditions i.e. clear, shallow, calm water with good lighting, and even when on the surface, they are difficult to see and most are missed. Seals are most easily seen and accurately counted when hauled out. Various environmental factors apparently affect haul out behavior, with tide probably being most important. It has been our experience that in tidal haul out areas many more seals can be counted at low tide than at high tide. Usually in glacier-fed bays, where seals haul on floating ice pans, the greatest numbers of animals are seen on higher stages of the tide when the floating ice is concentrated near the glaciers (Bishop 1967). There is also some indication that fewer seals haul out during periods of stormy weather than during fair weather. Unfortunately, even when large numbers of seals are hauled out, we have no idea what proportion of the total population we are seeing.

Ideally, a seal survey would only be conducted under optimum conditions; when surface conditions were calm, lighting was good and stage of tide was suitable for the type of haul out area. During these surveys, financial and time constraints prevented restricting the survey to times of optimum conditions. Weather was considered to some degree but stage of tide was disregarded and the results should be considered in this light. Survey conditions during the winter survey were generally poorer than during the June survey. Because of the lower observability of seals under these conditions, winter survey figures were undoubtedly more conservative than summer results.

No estimate of population size can be made from our survey data. Population numbers are undoubtedly far in excess of the 5,630 seen during the June survey and the 2,965 counted during March. Although over 2,600 more seals were counted during the summer survey it would be incorrect to assume that more seals were present. Poorer survey conditions and different distributional patterns make it difficult to compare numbers seen during the two surveys.

The most valuable harbor seal information obtained from the surveys was in regard to distribution, especially locations of concentration areas. The distribution patterns are not complete because of the impreciseness of the survey technique and some concentrations and haul out areas were inevitably missed.

During the summer, the largest concentration of seals was found on the Copper River Delta where 1,349 were counted hauled on sand bars. Controller Bay and the Bering River were other areas where seals used sand bars as a hauling substrate. The Copper River, Miles Lake and Bering River were the only areas where seals were found in fresh water although they have been reported from both Coghill and Miners Lakes (Wallace H. Noerenberg, Fisheries Consultant, Cordova, pers. comm.). Glacial ice pans served as haul outs in Columbia Bay, Unakwik Inlet, College Fiord, Harriman Fiord, Blackstone Bay, Derickson Bay and Nassau Fiord. Offshore rocks and islets served as hauling grounds throughout the area. Concentrations were found at; the Port Chalmers - Stockdale

Harbor area, Seal Island, Applegate Rocks, Channel Island, Little Green Island, Olsen - Fairmount Islands, Naked, Knight, Danger and Evans Islands and Port Bainbridge.

Detectable changes in winter distribution were apparent in several instances. The Copper River Delta, Miles Lake and Bering River, which all had concentrations of seals during the summer, were frozen and devoid of seals during the March survey. The Copper River Delta had the largest single concentration of seals seen during the summer survey. It is unknown where these seals spend the winter months.

Floating ice pans, calved from glaciers, are utilized by seals as haul out platforms. These areas may be especially important for pupping, mainly during the month of June, as large numbers of females with young pups are present. Glaciers are less active in the winter and much less floating ice is present. This probably was the reason for the reduction in numbers of seals seen in these areas during the March survey. During June 499 seals were seen hauled out on glacial ice pans compared to only 93 in March.

The heads of many bays, particularly those with sizable fresh water streams, freeze over during the winter and seals often use these ice shelves as haul outs. Most hauling out is along the ice edge but occasionally holes up to a half mile back from the ice edge are used.

During March considerably fewer seals were counted at some of the rock haul out areas than were seen during the June survey. Notable reductions were seen in the Port Chalmers - Stockdale Harbor area, at Danger, Channel, Little Green and Seal Islands, Bay of Isles and Prince of Wales Passage. Conversely, considerably more seals were seen at Seal Rocks, Montague Point, Jeannie Cove and Port Nellie Juan during the March survey. It is impossible to determine, from the data now available, whether these represented changes in distribution or were a result of timing and conditions during the two surveys.

OTHER MARINE MAMMALS

Dall porpoises (*Phocoenoides dalli*) and harbor porpoises (*Phocoena phocoena*) are common year-round residents of Prince William Sound and numerous sightings were made on both surveys.

Six minke whales (*Balaenoptera acutorostrata*) were seen during the June survey; two near Green Island, one at Bainbridge Island and three just east of Seal Island. In the past, Department biologists have reported this whale as common around the northwestern portion of Montague Island and Passage Canal during summer.

Eight observations of humpback whales (*Megaptera novaeangliae*) were made during the June survey, all in the southwestern portion of the Sound. Three were seen outside of Shelter Bay on Evans Island and five were found around Bainbridge Island. One humpback was seen from a boat near Point Pigot on August 1, 1973.

On June 27, 1973, a group of at least 40 and possibly as many as 100 killer whales (*Orcinus orca*) was seen between Evans and Knight Islands. Three were seen in Bass Harbor at Naked Island, three were observed off the east side of Perry Island and one at Busby Island, all during June. We did not see killer whales during the March survey but have received reliable reports of winter sightings. Larry Haddock (Wildlife Biologist, USFWS, Anch. pers. comm.) reported seeing an estimated 50 killer whales in Knight Island Passage during March 1973. Rick Rosenthal (Biological Consultant, Dames and Moore, Anch., pers. comm.) saw 4 killer whales near Porpoise Rocks about May 8, 1974.

A single adult male northern fur seal (*Callorhinus ursinus*) was seen with 17 immature male sea lions on a rock off the southwest end of Elrington Island on June 27, 1973.

SUMMARY AND CONCLUSIONS

Sea otter distribution was determined for the Prince William Sound area. All areas previously known to support otters continue to do so although numbers appear to be reduced in the Kayak Island area. The population appears to still be expanding and new areas are being populated. Between the two surveys, one major shift appeared to have occurred. Over 200 otters were seen in Sheep Bay in March compared to 5 in June. This appears to be a range extension of the group of sea otters which have been found in the Point Gravina area for the past 4-5 years. More sightings were made in the northwestern portion of the Sound in March than in June. Whether this represents movement of animals into the area

or is the result of a higher proportion of animals being seen in March is unknown. Indications are that the population will continue to expand and disperse, probably at a fairly rapid rate. A gross total population estimate is 5,000 based on results of the two surveys plus information from comparative shore-helicopter counts on Amchitka Island.

Summer distribution of sea lions was found to be almost exclusively limited to five rookeries and hauling grounds located in outside waters. During the winter these same areas were used as hauling grounds but some animals moved into inside waters and used several hauling grounds there. Counts of sea lions totaled 5,134 during June and 4,614 during March. Population size is estimated at 6,500-7,500. Total numbers appear to be about the same as during 1956-57 but an increase was detected at Seal Rocks and a decrease at Fish Island. Pup production was low, only 246 were recorded during the June survey. Large numbers of immature animals were seen. It appears that sea lions in Prince William Sound may not be a discrete population but that animals are moving to the Sound from other areas. A marking and recovery program on rookeries in Prince William Sound, the Kenai Peninsula and Kodiak area should provide needed information on degree of interchange and population discreteness. The 1964 earthquake appears to have changed hauling habitat on both Fish Island and Seal Rocks and there seems to be a corresponding increase of numbers at Seal Rocks and a decrease at Fish Island.

Useful information on harbor seal distribution, concentrations and hauling areas was obtained but cannot be considered complete due to shortcomings of the survey technique. Major summer concentration and haul out areas include: Controller Bay, Copper River Delta, Columbia Bay, Seal Island, Applegate Rocks, Channel Island, Little Green Island, Knight Island, College Fiord, Blackstone Bay, Danger Island and Evans Island. During winter seals were not found on the Copper River Delta or up the Bering River as they were ice covered. There was less use of glacial ice pans as hauling areas (probably because glaciers are less active and much less ice is calved). Seals hauled on ice shelves at the heads of many bays. Other possible changes in seasonal distribution were noted but due to difficulties in surveying seals they may not be valid. No population estimate can be made but it undoubtedly is far in excess of the 5,630 seen in June and the 2,965 counted in March. More precise information on numbers and distribution could be obtained by using skiff surveys under optimum tide and weather conditions. This technique is probably too time-consuming for the entire area but may be worthwhile in areas of special interest.

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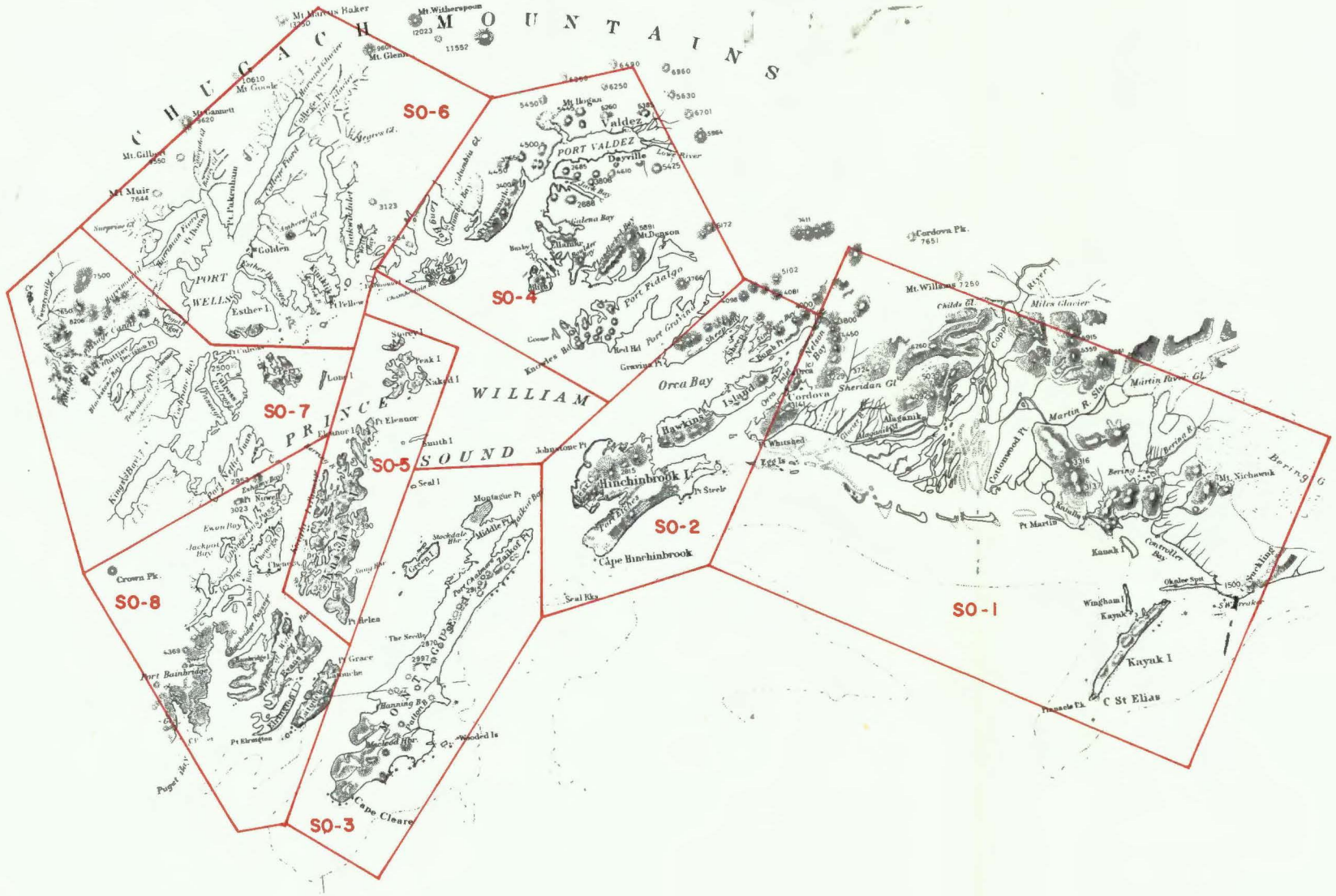
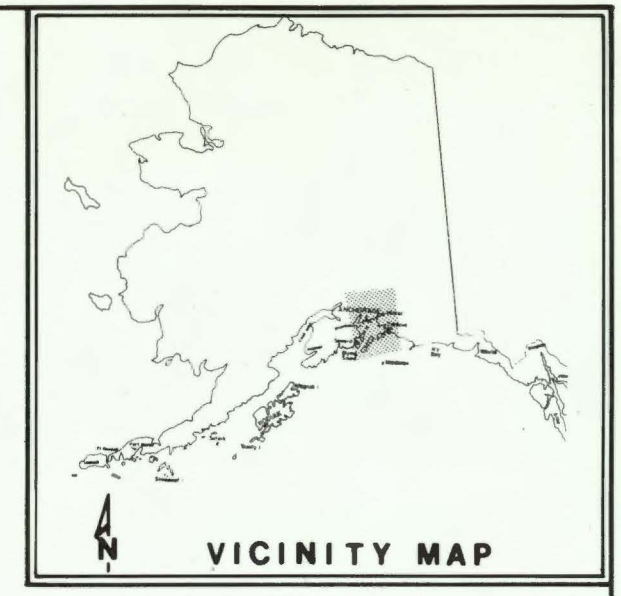
APPENDIX A





LEGEND

50 Fathom Curve

N

Scale - 1: 1,338,270

SEA OTTER
DISTRIBUTION MAPS

PRINCE WILLIAM SOUND
COPPER RIVER DELTA

APPENDIX I

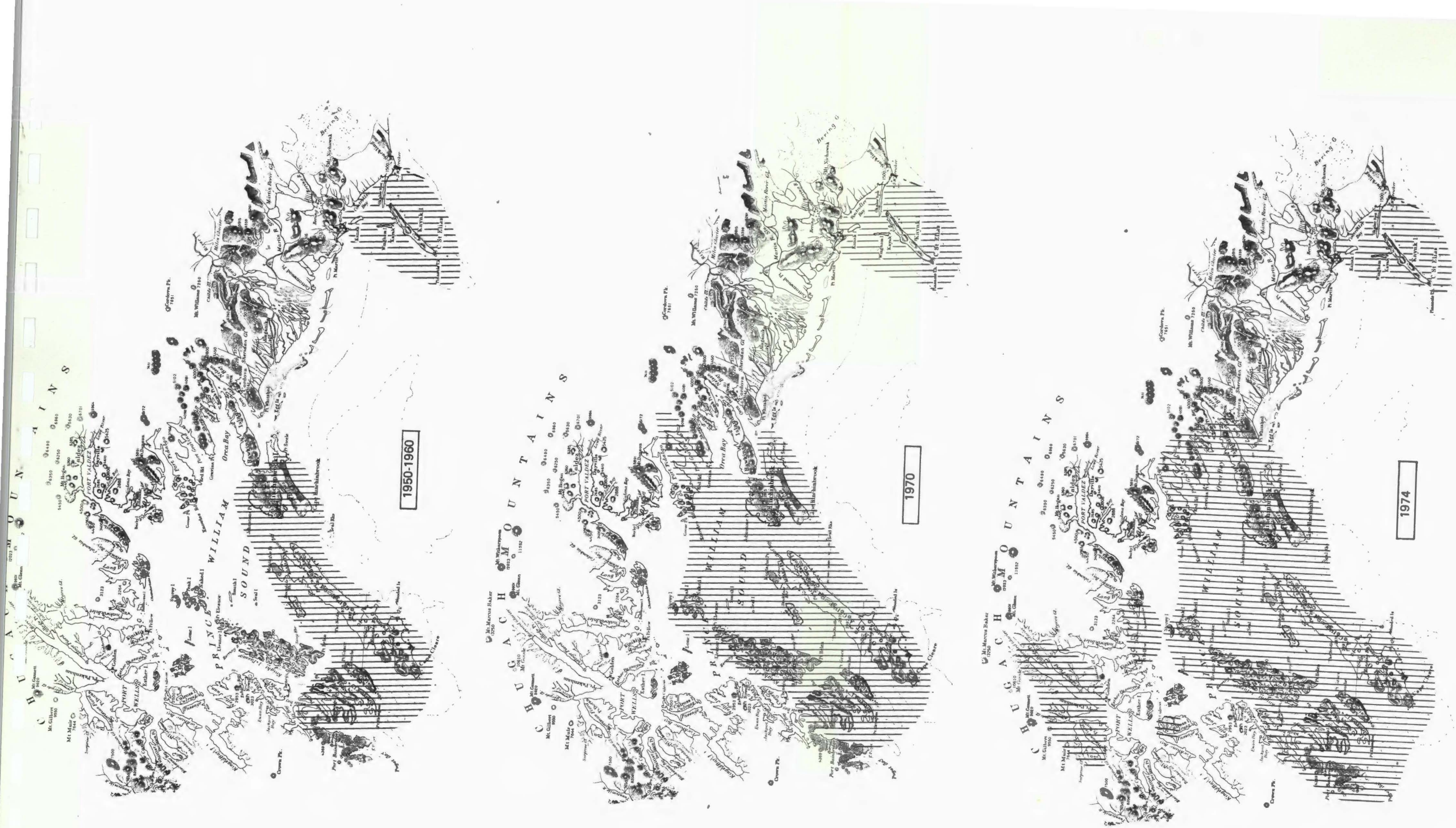
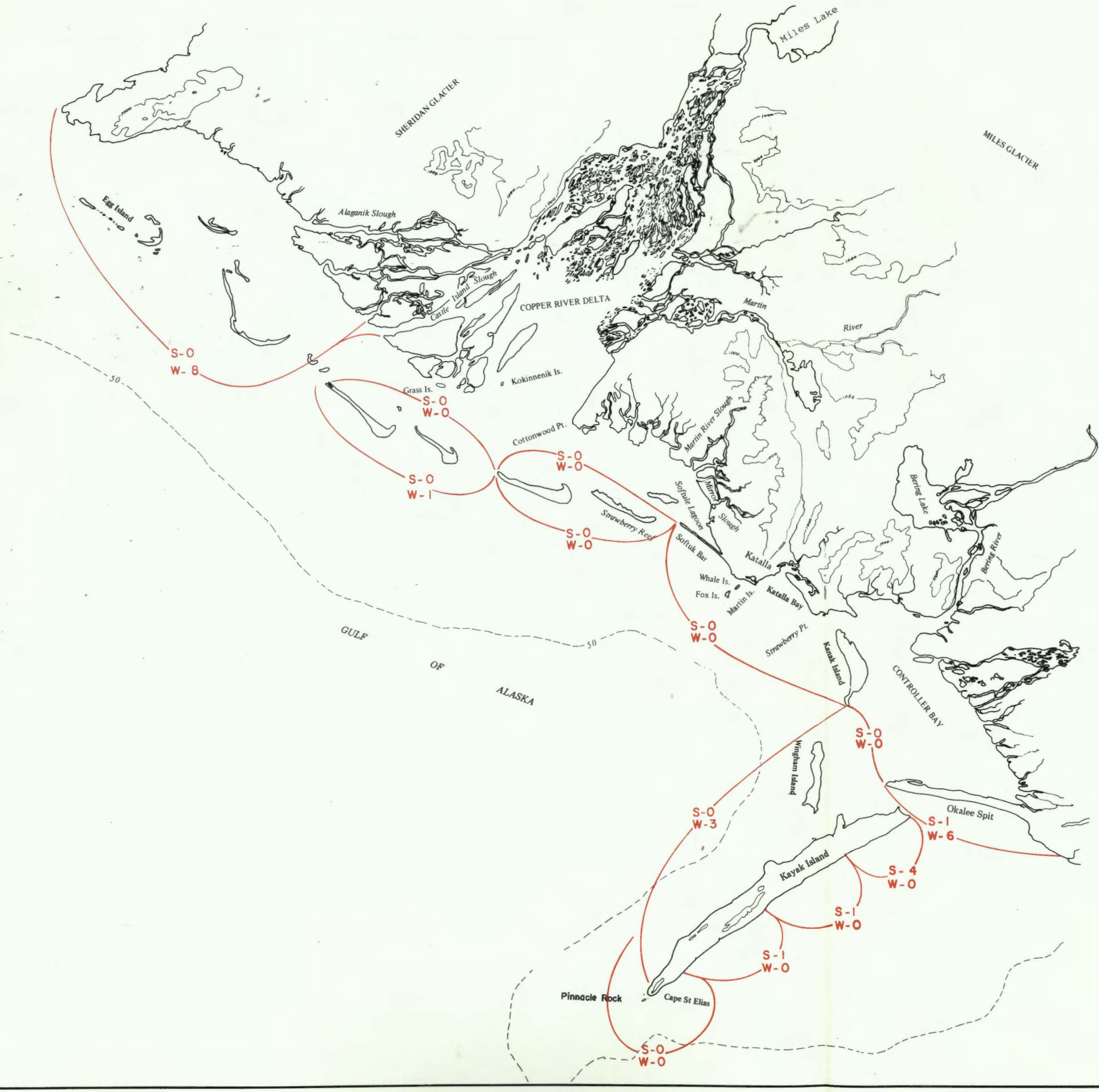


Figure 1 **Historical Sea Otter Distribution Prince William Sound Area 1950 to 1974**



LEGEND

50 Fathom Curve

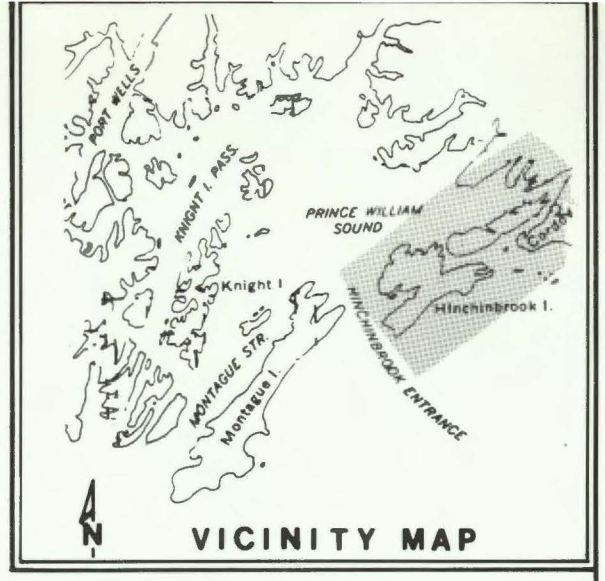
Sea Otter Surveys
S = June 1973
W = March 1974
Number Counted
S = 7
W = 18

N

SCALE - 1: 350,000

KAYAK ISLAND
COPPER RIVER AREA

SO-1



LEGEND

50 Fathom Curve

Sea Otter Surveys

S = ' June 1973

W = March 1974

Number Counted

S = 377

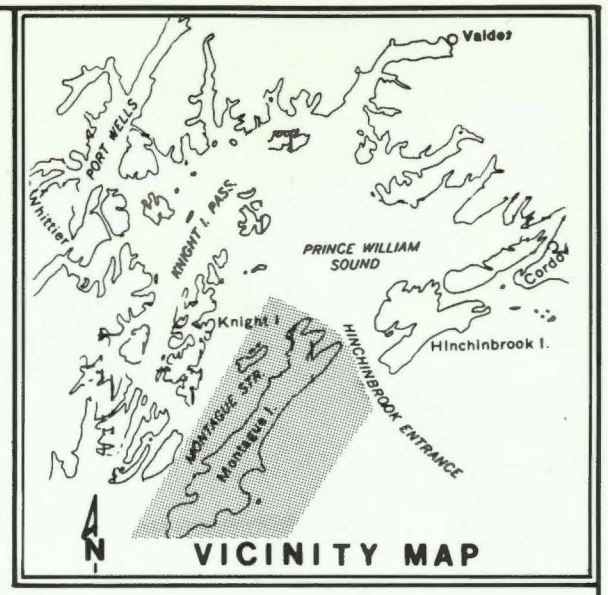
W = 403

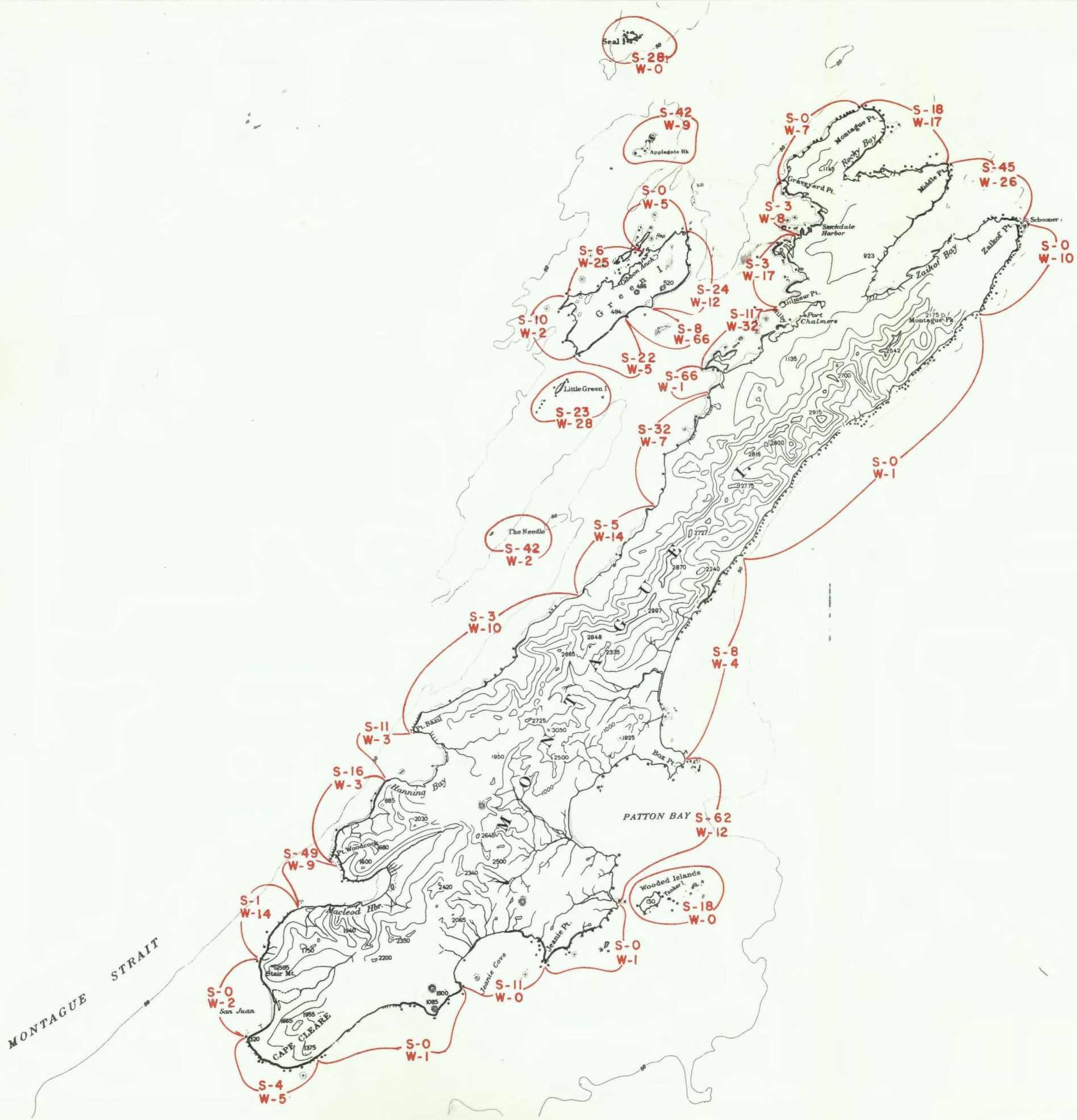
N

SCALE - 1: 270,000

HINCHINBROOK HAWKINS ISLANDS AREA

SO-2





LEGEND

50 Fathom Curve

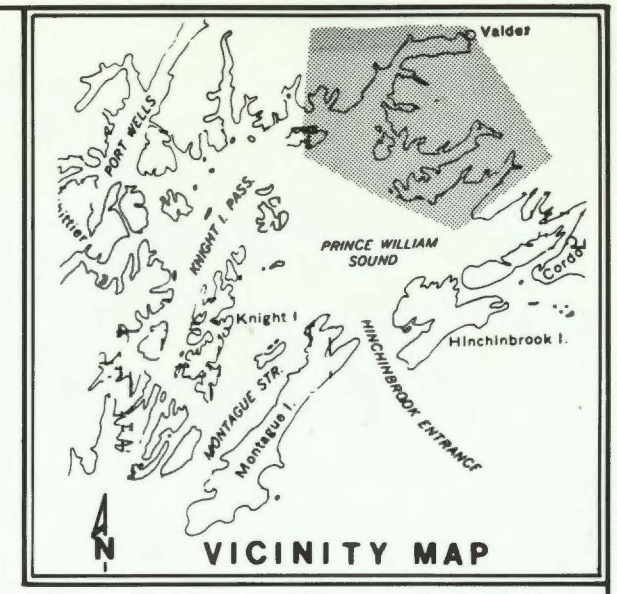
Sea Otter Surveys
S = June 1973
W = March 1974
Number Counted
S = 677
W = 358

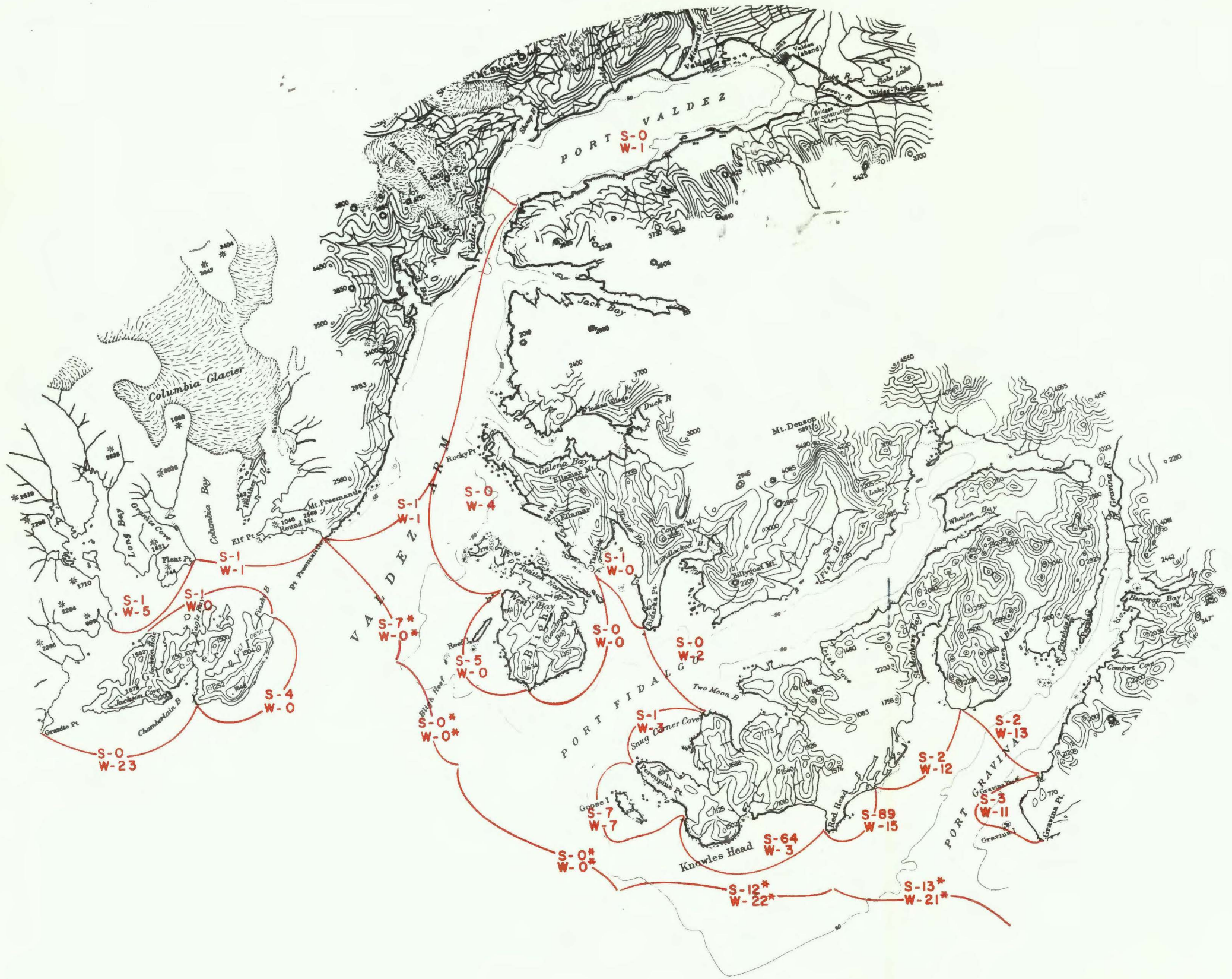
N

SCALE - 1: 270,000

MONTAGUE ISLAND AREA

SO-3





LEGEND

50 Fathom Curve

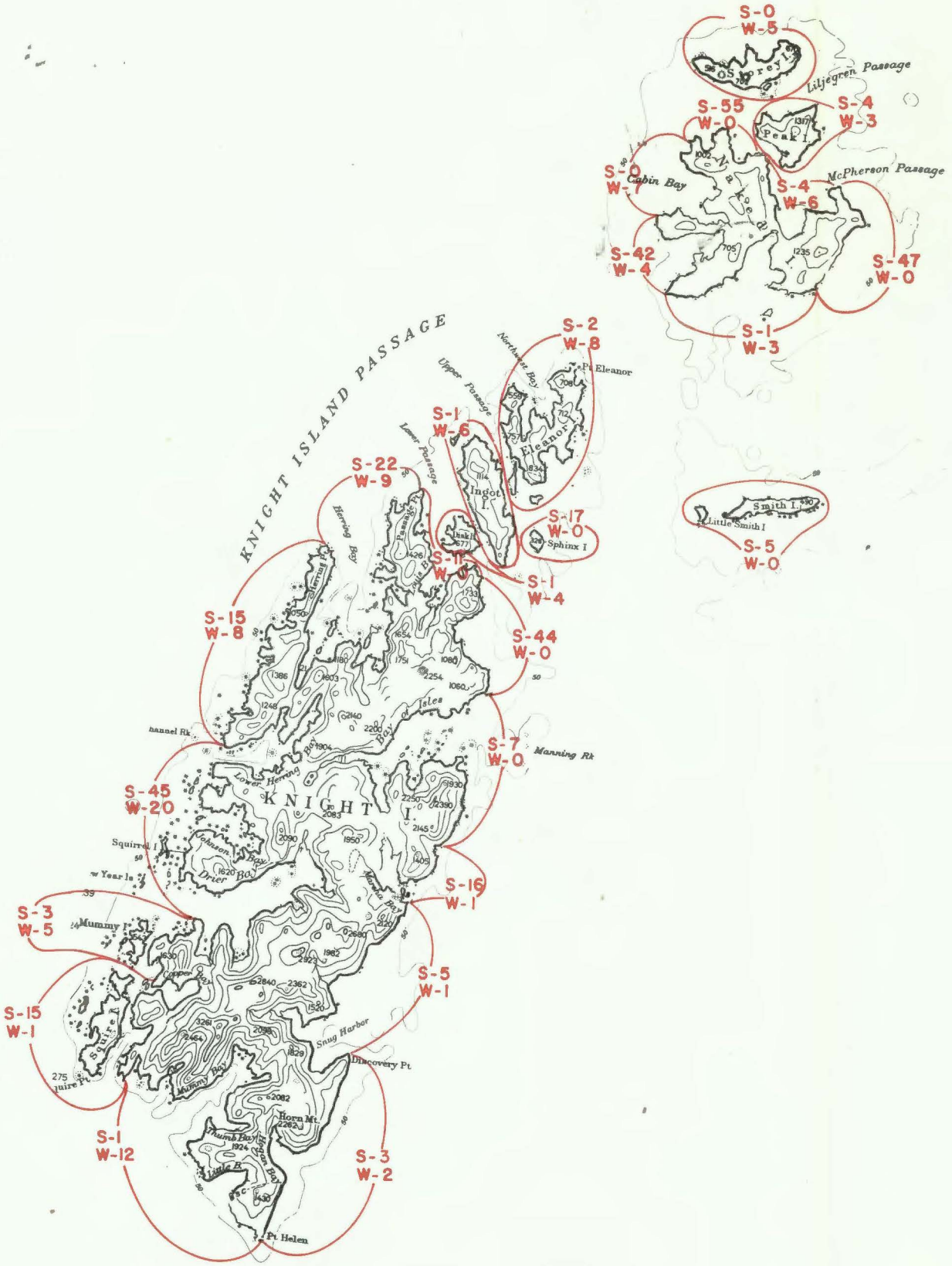
Sea Otter Surveys
S = June 1973
W = March 1974
Number Counted
S = 214
W = 144
* Offshore Flightline

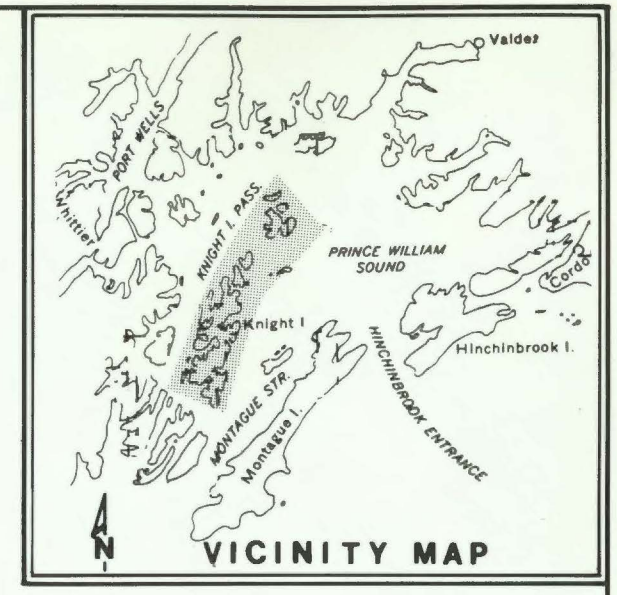
N

SCALE - 1: 270,000

VALDEZ ARM
PORT GRAVINA AREA

SO-4





LEGEND

50 — 50 Fathom Curve

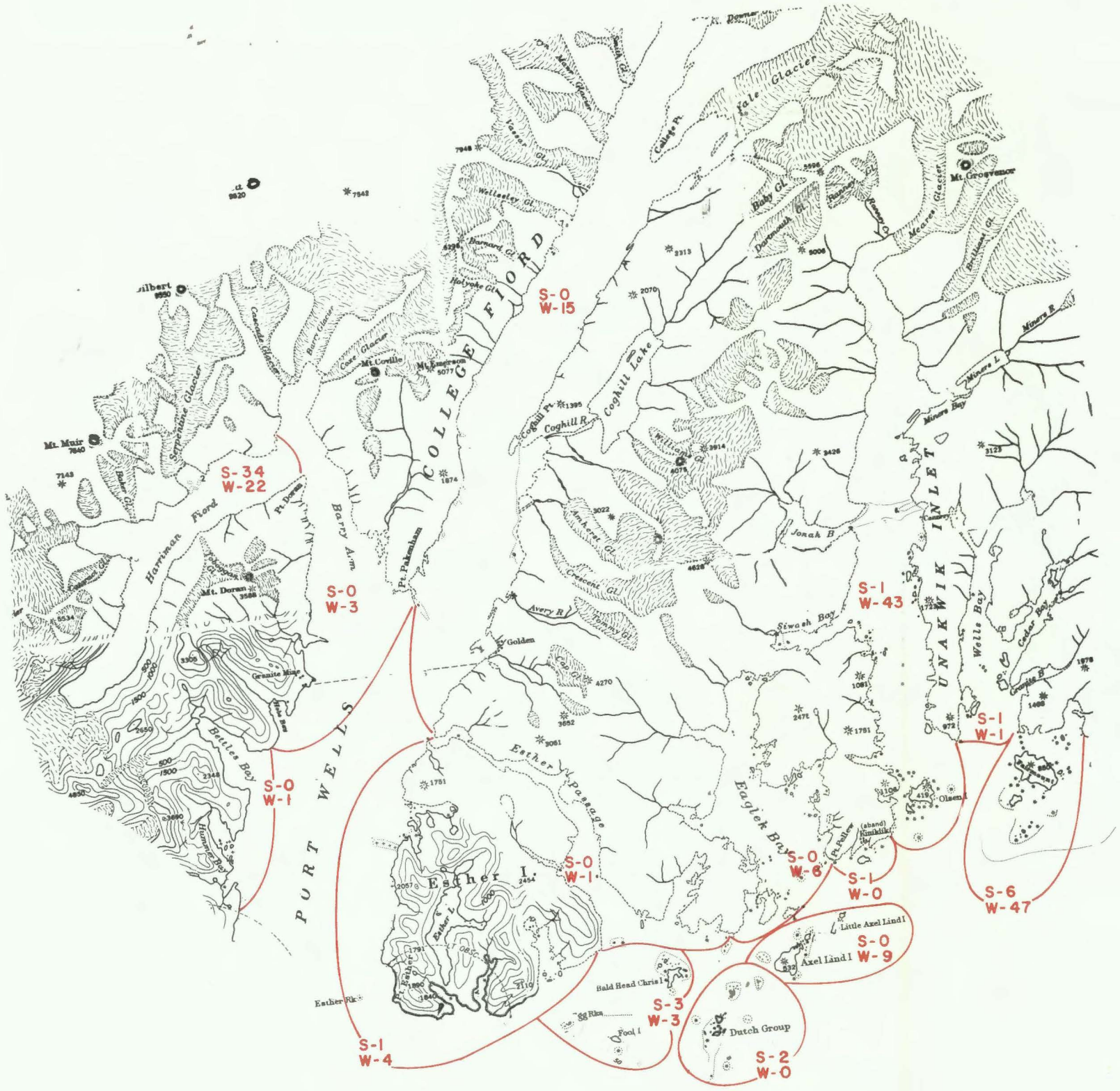
Sea Otter Surveys
S = June 1973
W = March 1974
Number Counted
S = 366
W = 105

N

SCALE - 1: 270,000

KNIGHT ISLAND AREA

SO-5



LEGEND

50 Fathom Curve

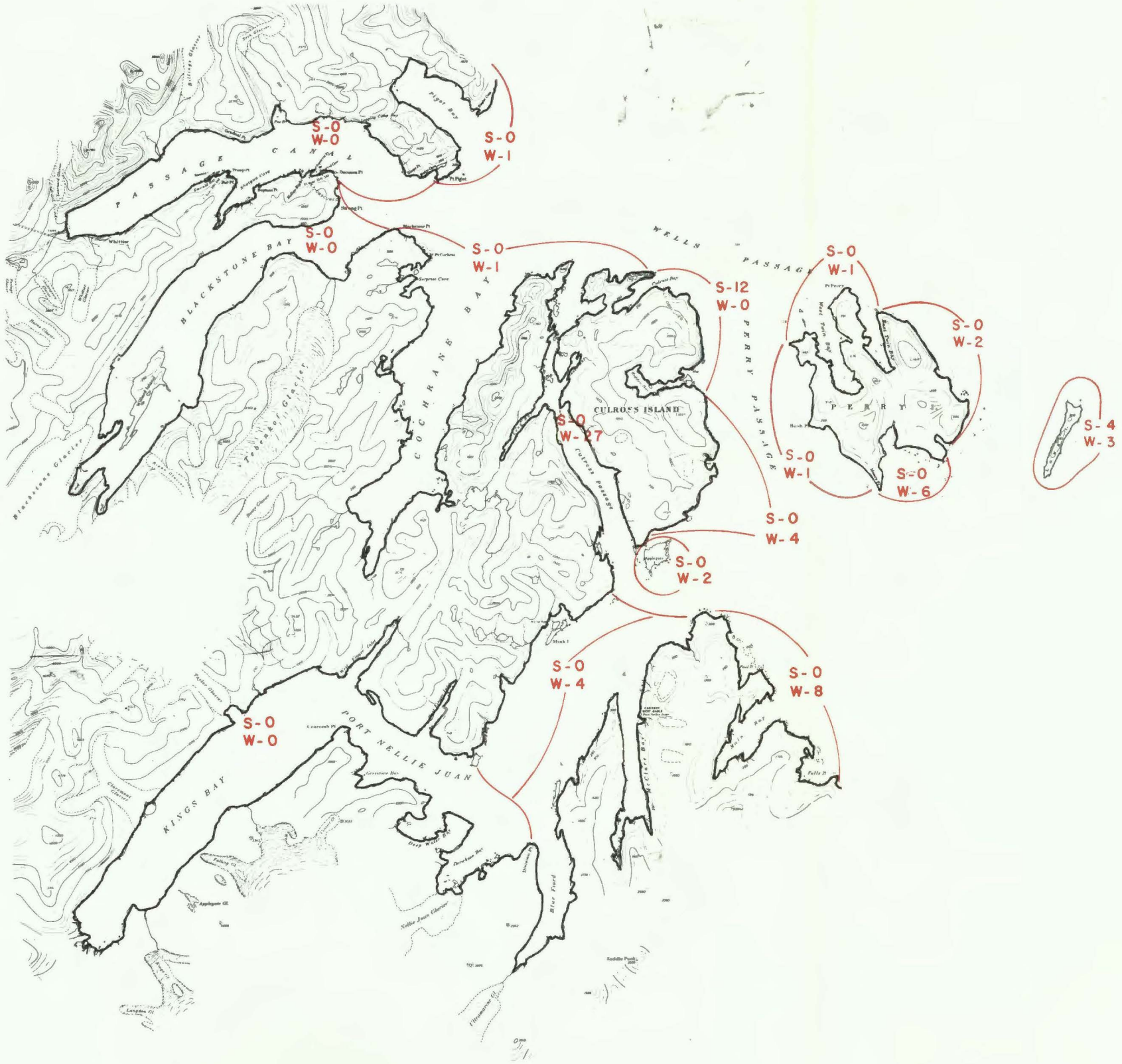
Sea Otter Surveys
S = June 1973
W = March 1974
Number Counted
S = 49
W = 155

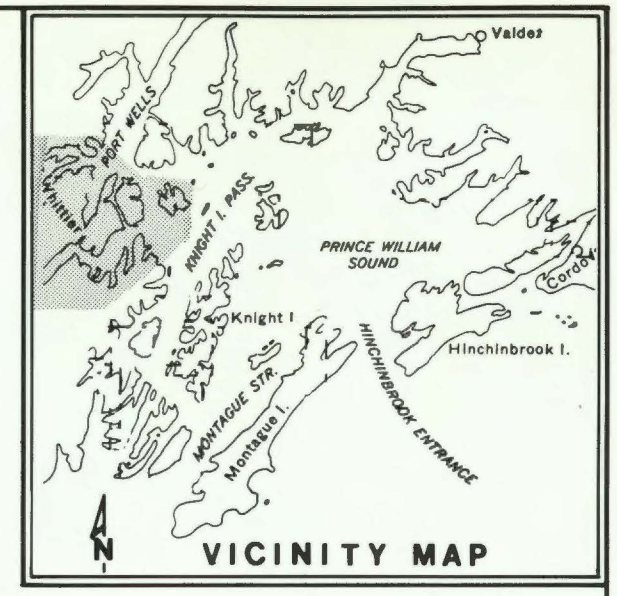
N

SCALE - 1: 270,000

PORT WELLS
UNAKWIK AREA BAY PASSAGE

SO-6





LEGEND

50 Fathom Curve

Sea Otter Surveys

S = June 1973

W = March 1974

Number Counted

S = 16

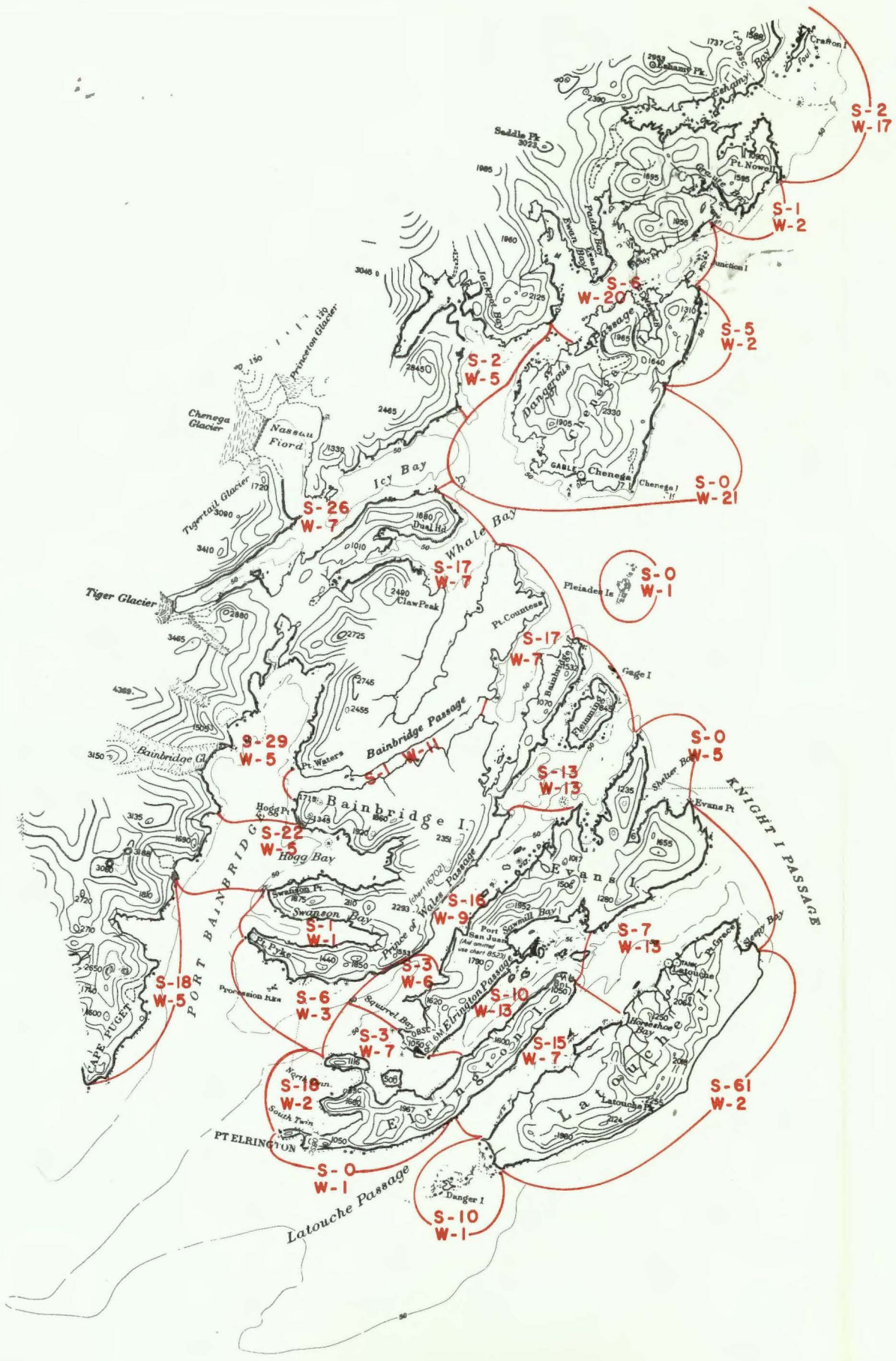
W = 60

N

SCALE - 1: 270,000

WELLS PASSAGE
PORT NELLIE JUAN AREA

SO-7



LEGEND

----- 50 ----- 50 Fathom Curve

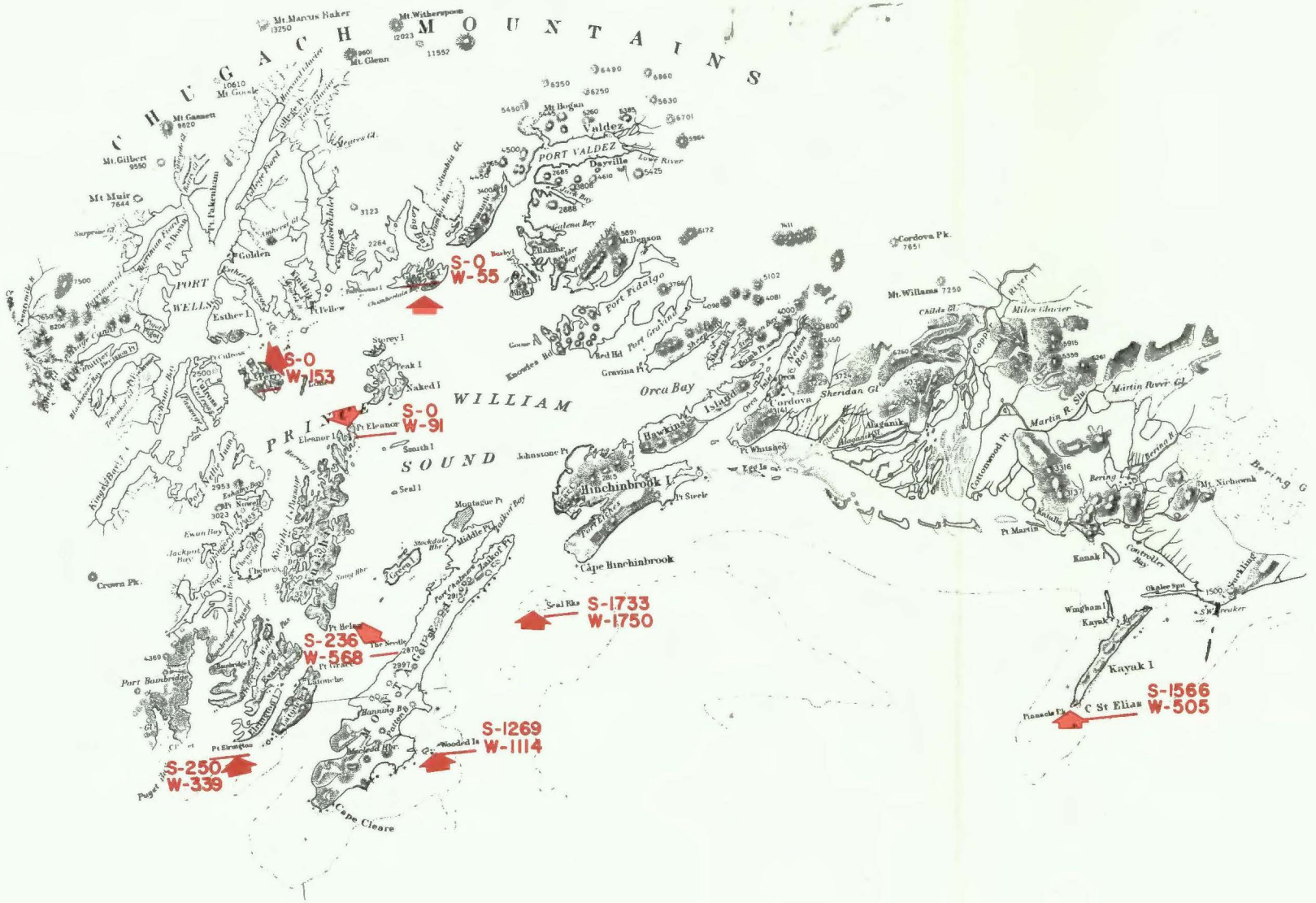
Sea Otter Surveys
S = June 1973
W = March 1974
Number Counted
S = 309
W = 198

N

SCALE - 1: 270,000

LATOUCHE - BAINBRIDGE AREA

SO-8



LEGEND

50 Fathom Curve

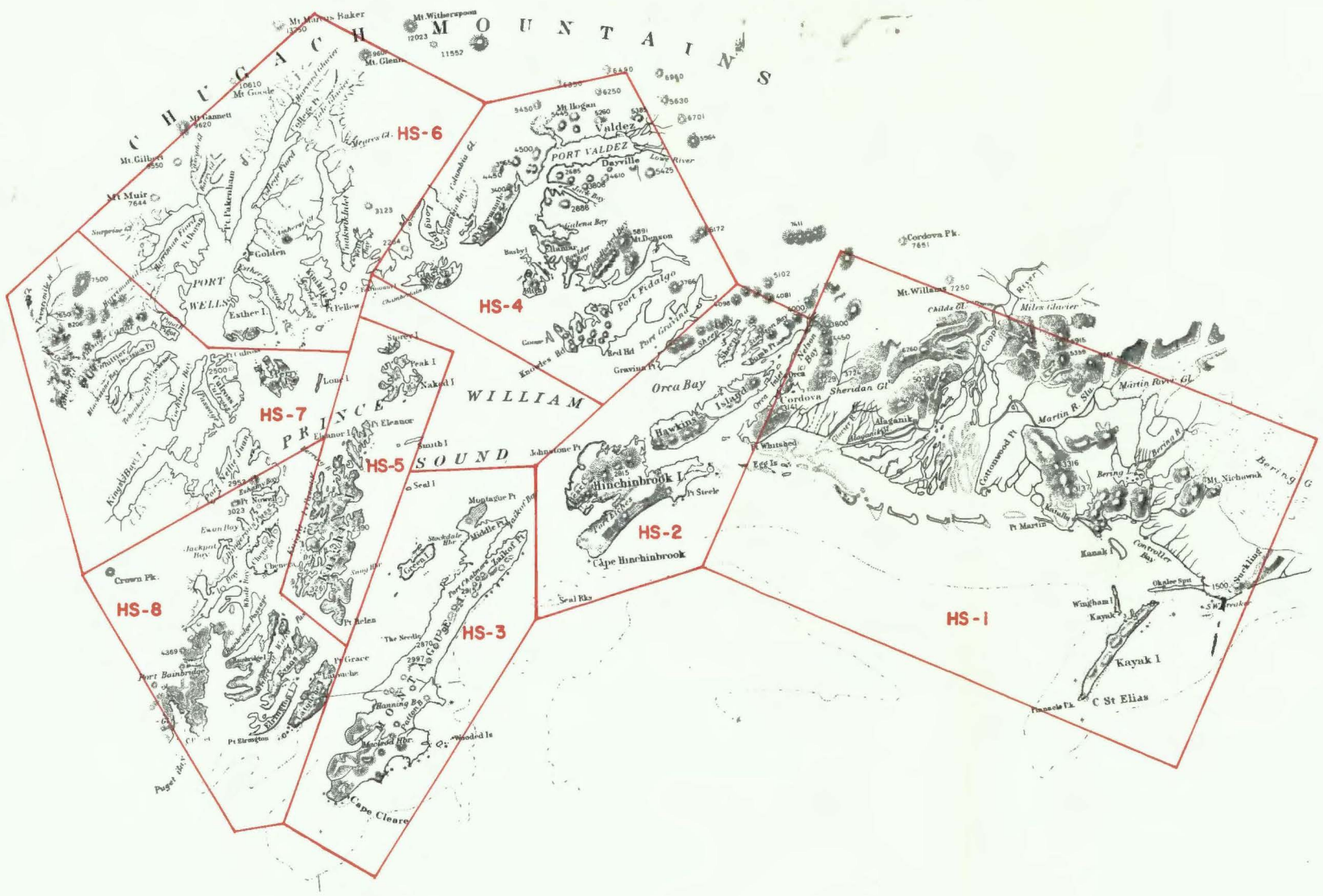
Steller Sea Lion Rookery and Hauling Ground Surveys:
S= June 1973
W= March 1974

N

Scale - 1: 1,338,270

FIGURE 2 — Sea Lion rookeries and hauling grounds, Prince William Sound Area, 1973-1974

PRINCE WILLIAM SOUND
COPPER RIVER DELTA



LEGEND

50 Fathom Curve

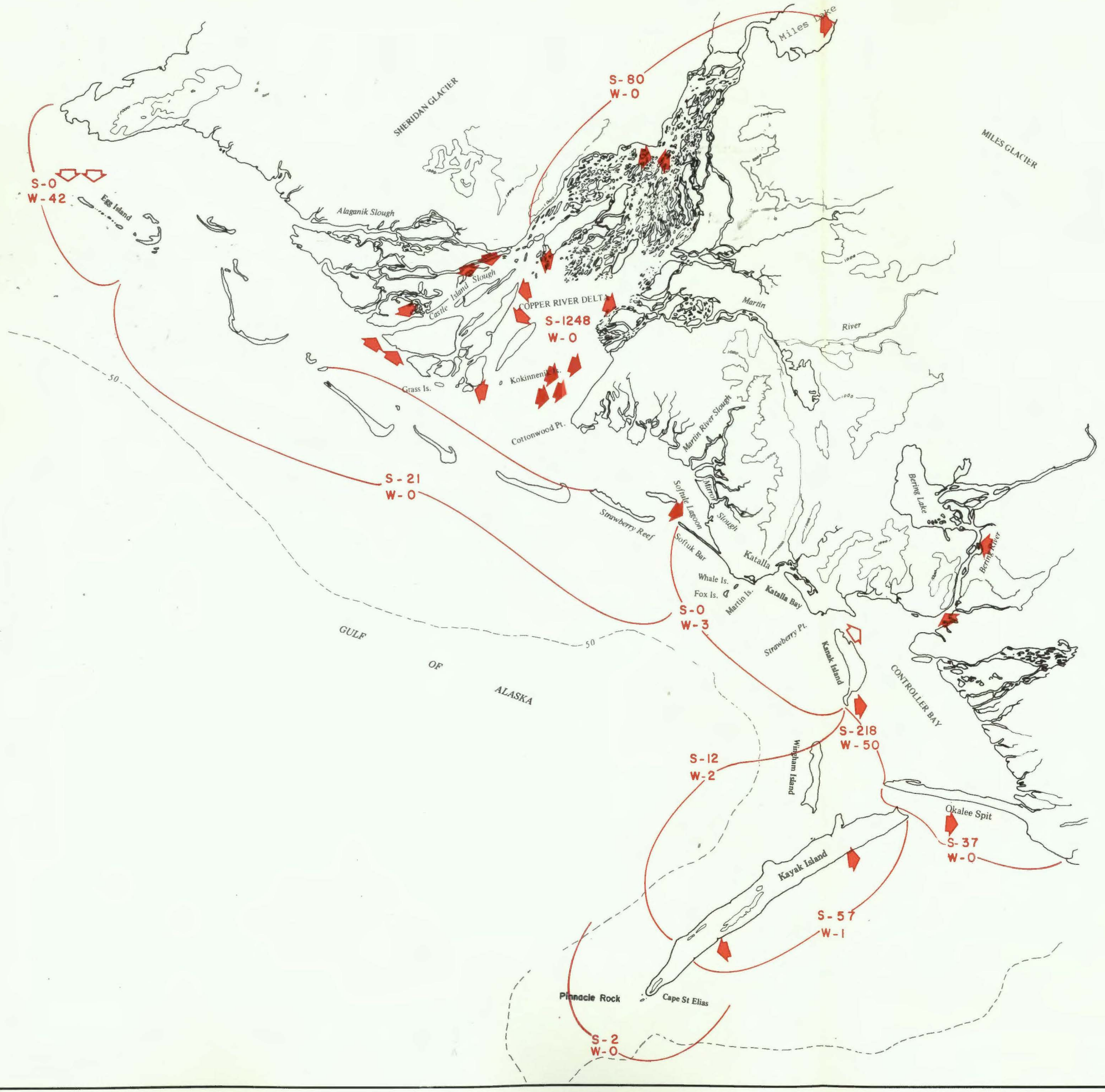
N

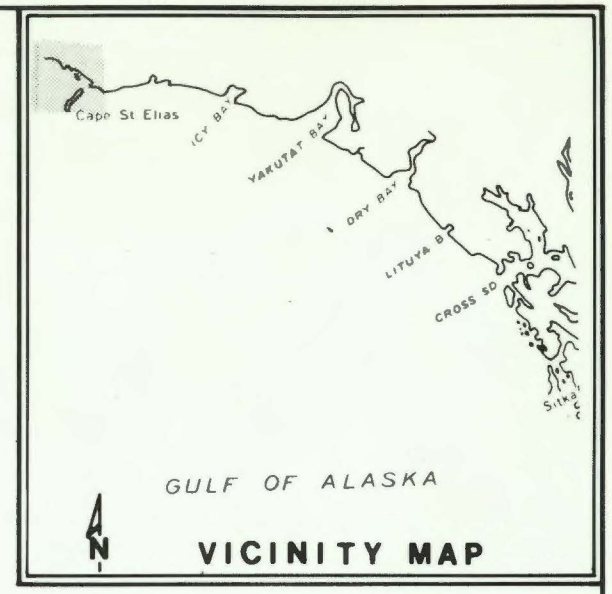
Scale - 1: 1,338,270

HARBOR SEAL
DISTRIBUTION MAPS

PRINCE WILLIAM SOUND
COPPER RIVER DELTA

APPENDIX II





LEGEND

50 Fathom Curve

Harbor Seal Surveys

S = June 1973
W = March 1974
= Land haul out area - Five or more seals observed
= Ice haul out area - Five or more seals observed

Number Counted

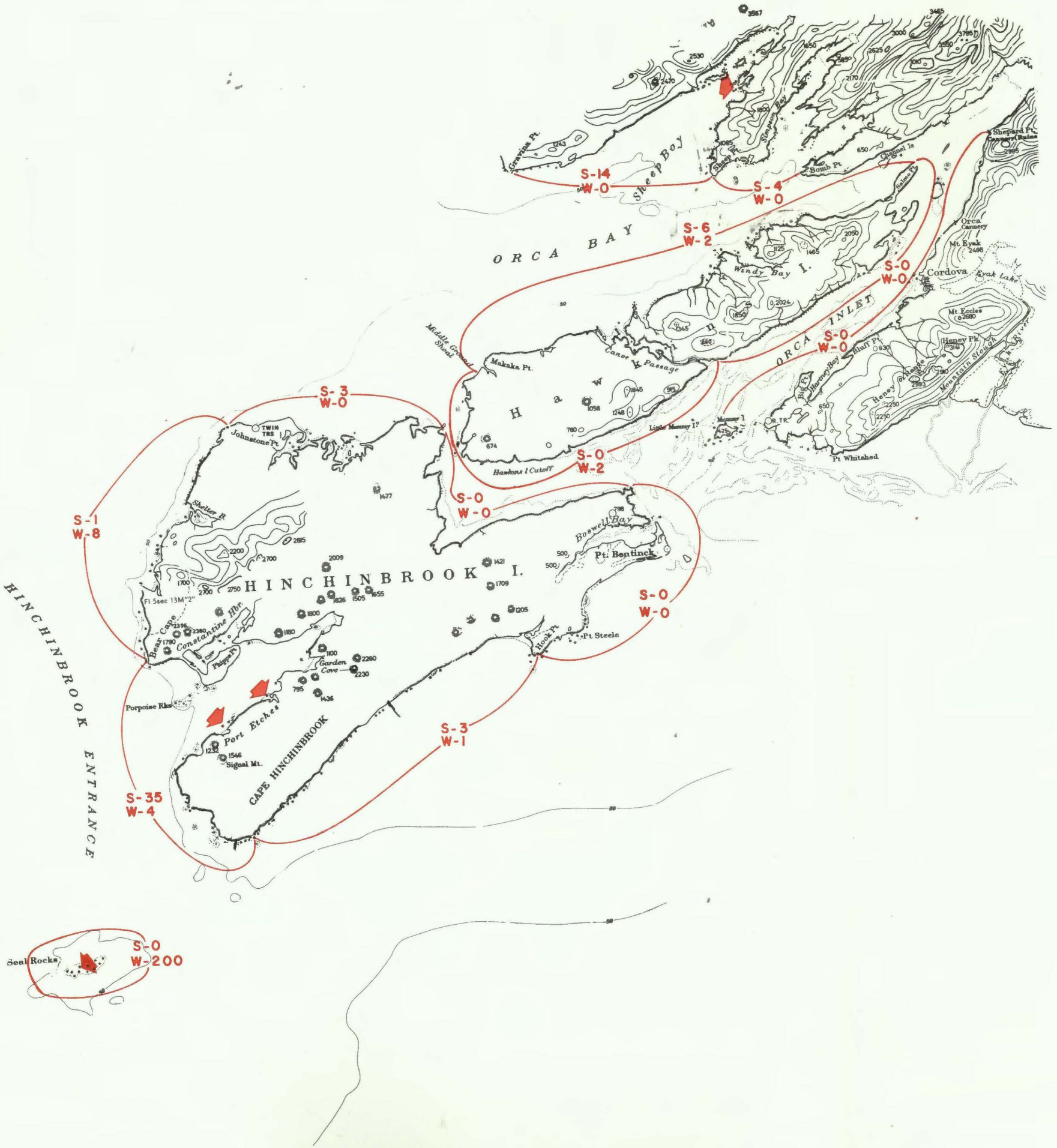
S = 1675
W = 98

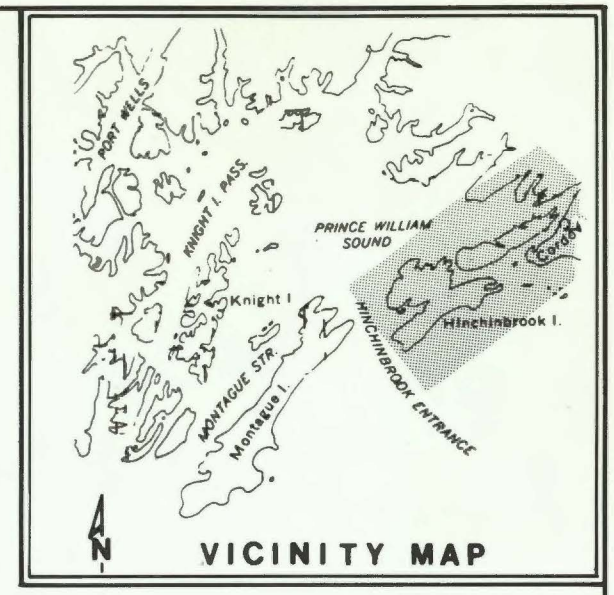
N

SCALE - 1: 350,000

KAYAK ISLAND
COPPER RIVER AREA

HS - 1





LEGEND

50 Fathom Curve

Harbor Seal Surveys

S = June 1973

W = March 1974

= Land haul out area - Five or more seals observed

= Ice haul out area - Five or more seals observed

Number Counted

S = 66

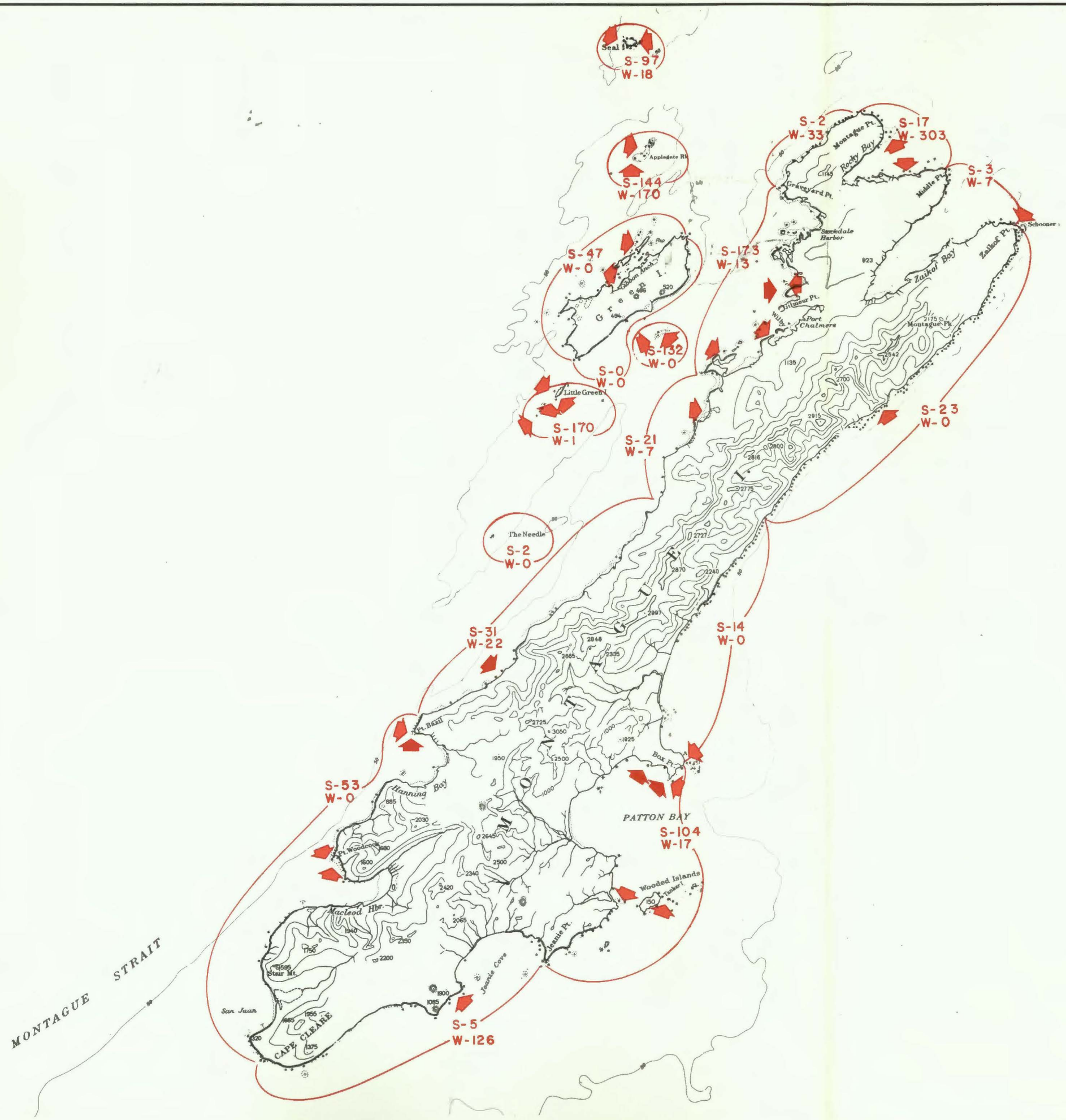
W = 217

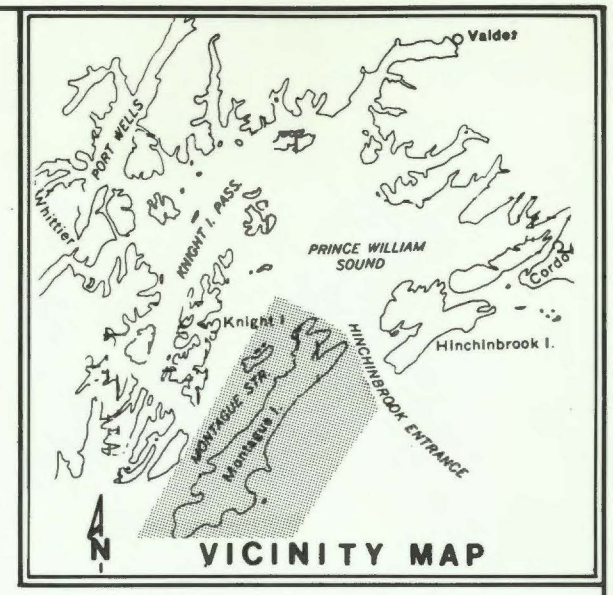
N

SCALE - 1: 270,000

HINCHINBROOK HAWKINS ISLANDS AREA

HS-2





LEGEND

50 Fathom Curve

Harbor Seal Surveys

S = June 1973

W = March 1974

= Land haul out area - Five or more seals observed

= Ice haul out area - Five or more seals observed

Number Counted

S = 1038

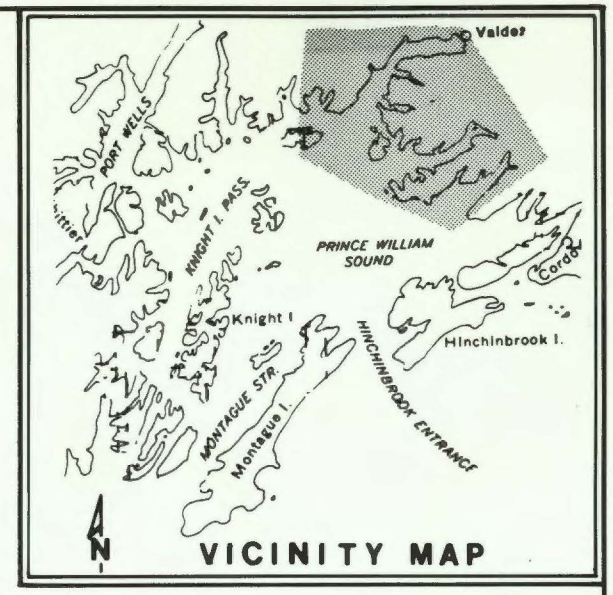
W = 717

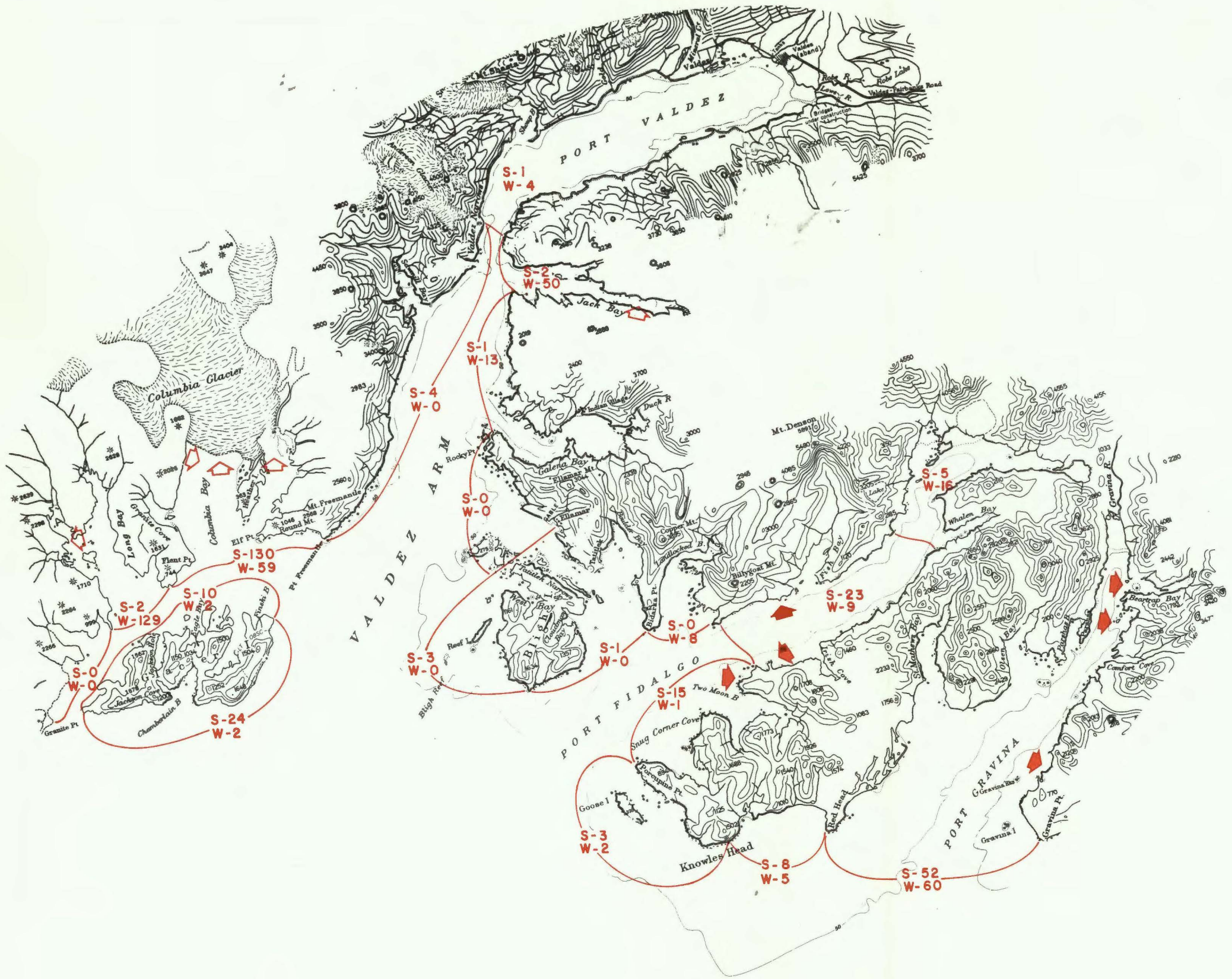
N

SCALE - 1: 270,000

MONTAGUE ISLAND AREA

HS-3





LEGEND

50 Fathom Curve

Harbor Seal Surveys

S = June 1973

W = March 1974

= Land haul out area - Five or more seals observed

= Ice haul out area - Five or more seals observed

Number Counted

S = 284

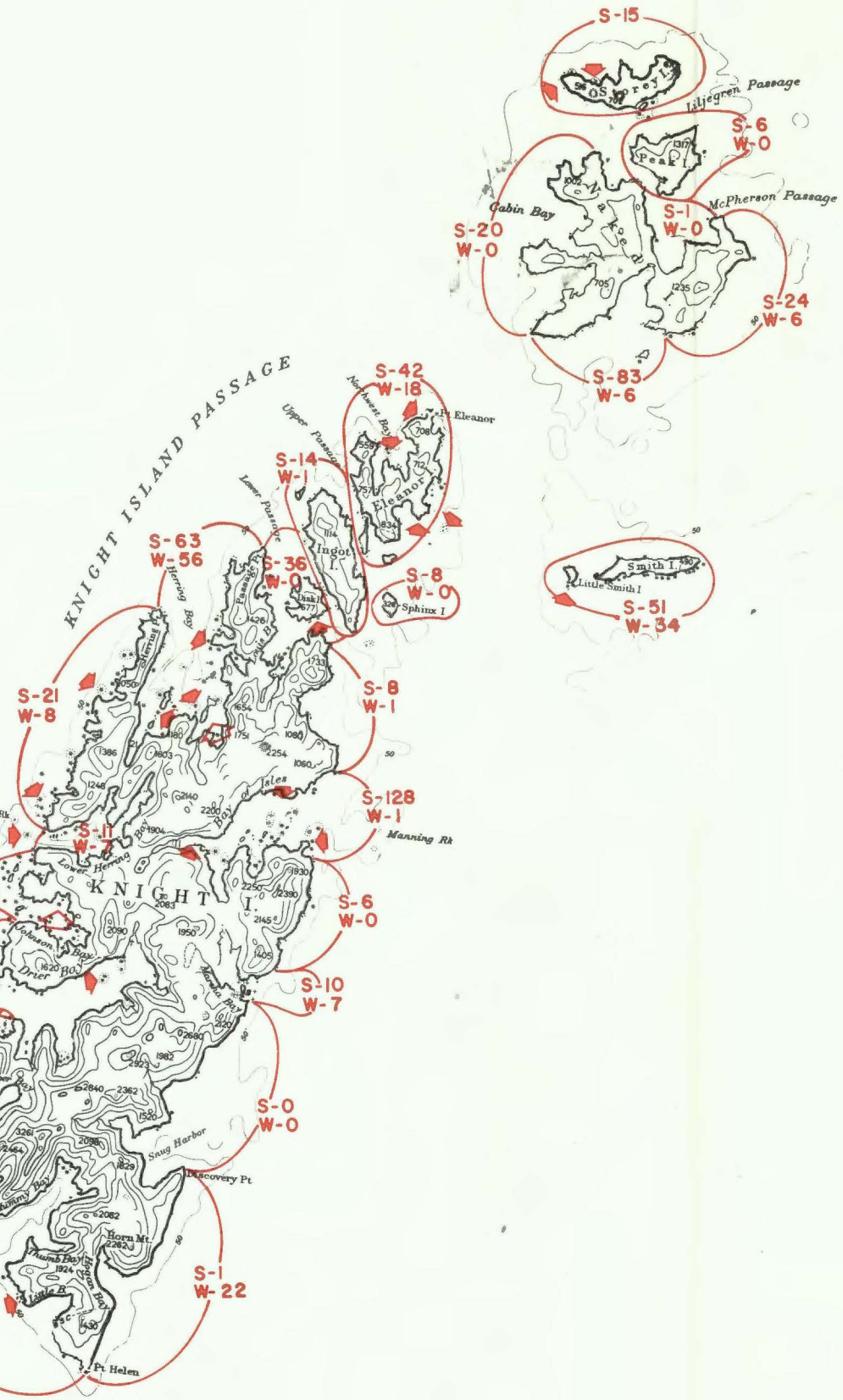
W = 360

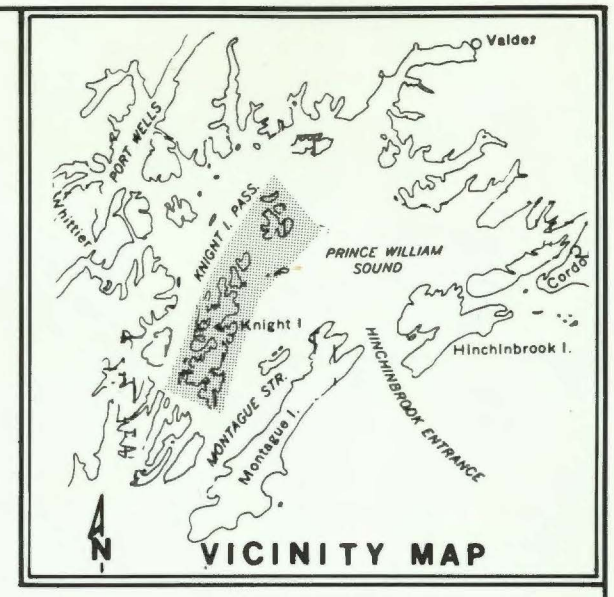
N

SCALE - 1: 270,000

VALDEZ ARM
PORT GRAVINA AREA

HS-4





LEGEND

50 Fathom Curve

Harbor Seal Surveys

S = June 1973

W = March 1974

= Land haul out area - Five or more seals observed

= Ice haul out area - Five or more seals observed

Number Counted

S = 653

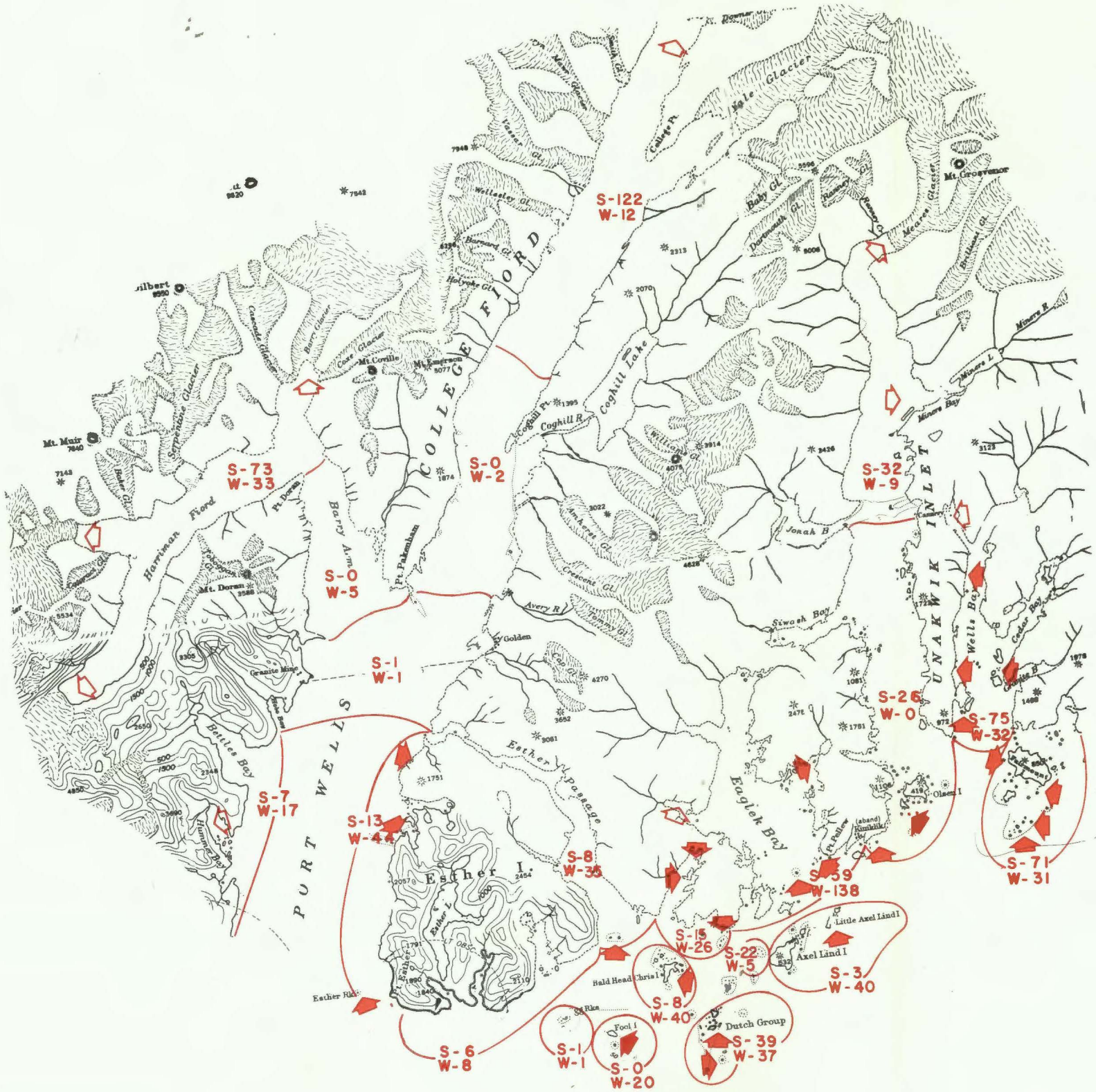
W = 282

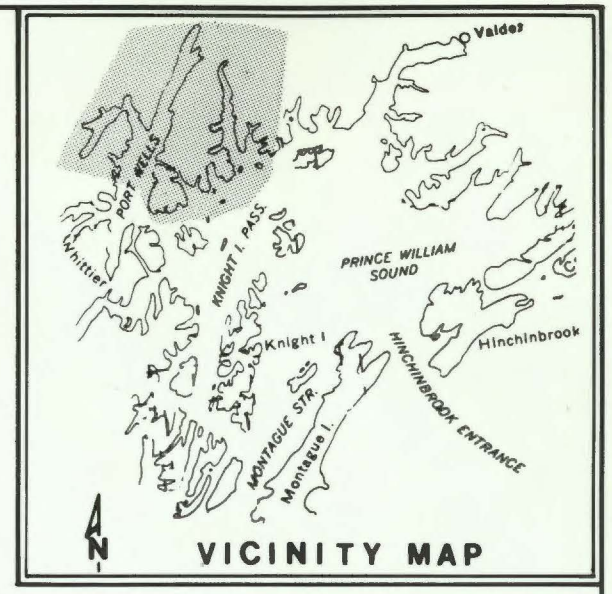
N

SCALE - 1: 270,000

KNIGHT ISLAND AREA

HS-5





LEGEND

50 Fathom Curve

Harbor Seal Surveys

S = June 1973

W = March 1974

= Land haul out area - Five or more seals observed

= Ice haul out area - Five or more seals observed

Number Counted

S = 581

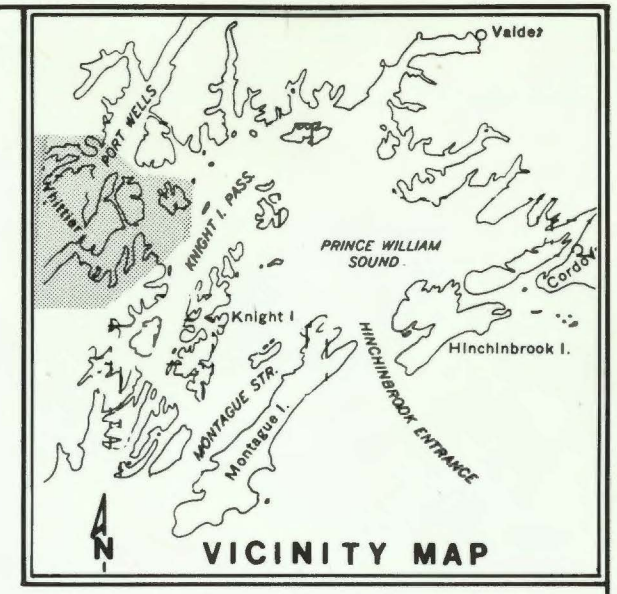
W = 536

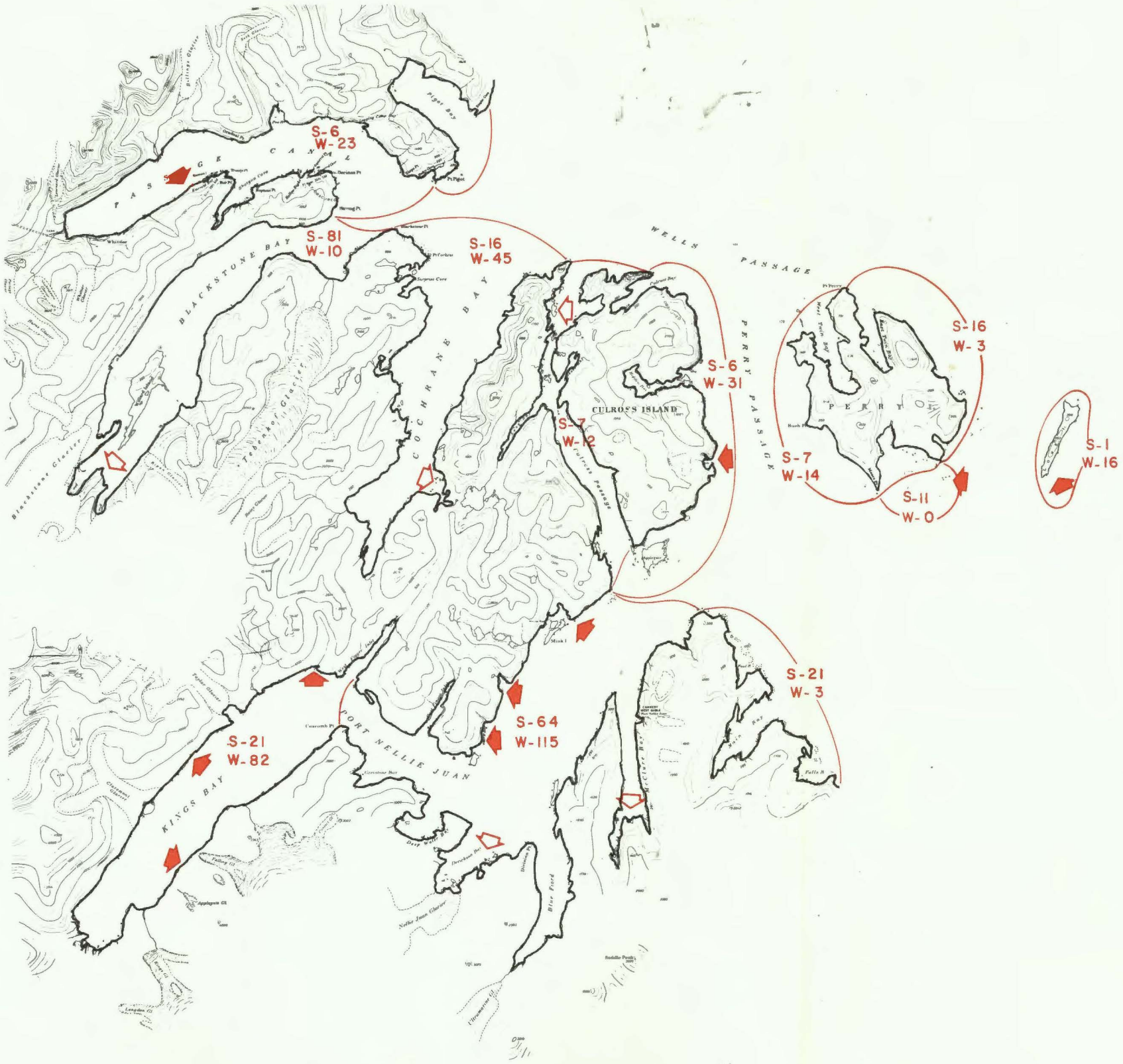
N

SCALE - 1: 270,000

PORT WELLS
UNAKWIK AREA BAY PASSAGE

HS-6





LEGEND

50 Fathom Curve

Harbor Seal Survey's

S = June 1973

W = March 1974

= Land haul out area - Five or more seals observed

= Ice haul out area - Five or more seals observed

Number Counted

S = 257

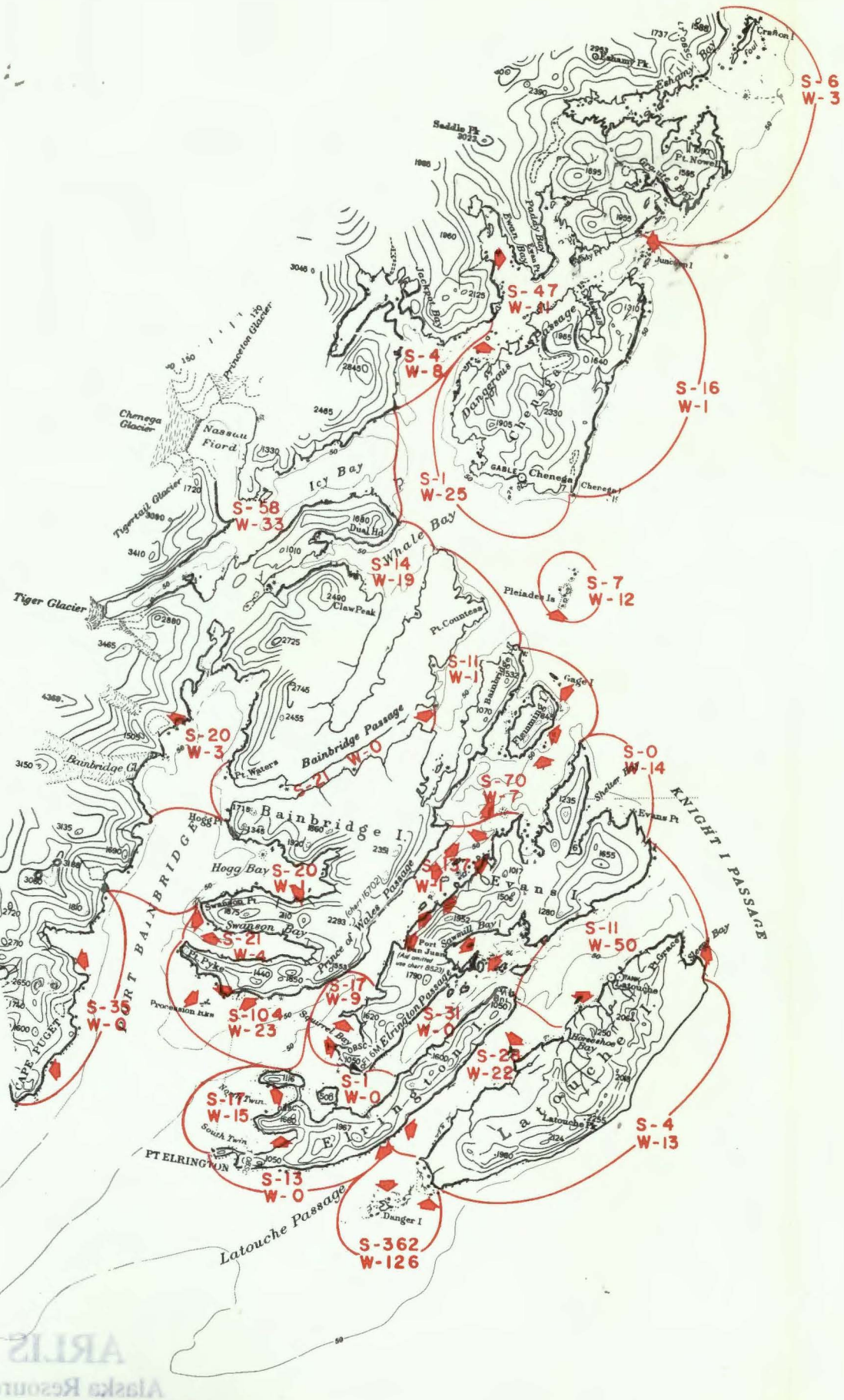
W = 354

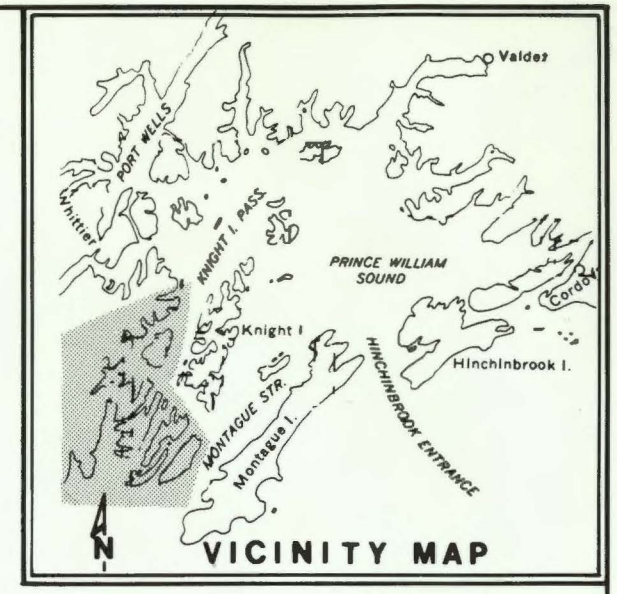
N

SCALE - 1: 270,000

WELLS PASSAGE
PORT NELLIE JUAN AREA

HS-7





LEGEND

50 Fathom Curve

Harbor Seal Surveys

S = June 1973

W = March 1974

= Land haul out area - Five or more seals observed

= Ice haul out area - Five or more seals observed

Number Counted

S = 1076

W = 401

N

SCALE - 1: 270,000

LATOUCHE - BAINBRIDGE AREA

HS-8