

90-20

Sea Urchin Injury -- Assessment Of Impacts of Oil
On Green Sea Urchins, Strongylocentrotus droebachiensis,
in the Kodiak Island Area

Fish/Shellfish Study Number 26

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Executive Summary

A total of 4719 green sea urchins, Strongylocentrotus droebachiensis, were examined from 2 oiled and 4 non-oiled sites around Kodiak Island. Urchins ranged in size and estimated age from 8 mm (0.75 yrs) to 85 mm (6.0+ yrs.). Histological and hydrocarbon tissue samples were collected at 6 sites and await laboratory analysis. A collection of 20-40 urchins will be assembled in the spring of 1990 for larval bioassay analysis. Divers did not observe any subtidal oil.

Objectives

1. To estimate the relative abundance of green sea urchins in oiled and non-oiled areas.
2. To estimate the gonad production of urchins in oiled and non-oiled areas such that differences of + or - 5% can be determined between the two impact levels 95% of the time.
3. To estimate the incidence of abnormalities in ovarian development in urchins in oiled and non-oiled areas such that differences of + or - 5% can be determined between the two impact levels 95% of the time.
4. To estimate recruitment of young urchins, as a percentage of all urchins in the sample area, in oiled and non-oiled areas.
5. To estimate the toxicity of crude oil to urchin larvae.
6. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

METHODS/DATA ANALYSIS

This project is being conducted in two phases, phase 1: field work and phase 2: laboratory work. Objectives 1 through 4; abundance estimates, roe production estimates, ovarian development abnormalities, and recruitment estimates will be conducted wholly or partially in the field while the larval bioassay work (objective 5) and a portion of the ovarian development work will be conducted in a laboratory. The larval bioassays and the ovarian development work will be conducted by an independent contractor.

STUDY SITES

Five oiled and four non-oiled areas of green sea urchin habitat were selected for study in the Chiniak and Uyak Bay areas, Figure 1. Specific site data recorded includes: site name, site orientation (N-NE etc.), latitude, longitude, dominate substrate composition in percent, surface and bottom water temperature and salinity, weather conditions, wave action and oil conditions.

SAMPLE DESIGN

Where conditions permitted, transect lines were established when sufficient numbers of urchins were found by scuba divers. The sites were sampled during (November and December, 1989). Transects were established perpendicular to the water's edge and parallel to each other along the bottom where urchins occurred. Distance between transects was determined on site by the distribution of urchins with a distance of 7-15 meters between transects. Scuba divers surveyed each transect within 1-3 meters on either side of the transect mid-line.

At sites where sufficient numbers of urchins were not available to conduct transect work or conditions limited dive time, adaptations to transect methodology were implemented to sample each site. These changes are described below in the site by site descriptions. Presence of oil, kelp and kelp condition (alive, dead, oiled, unoled) were recorded. A minimum sample of 200 urchins were measured from each transect line and non-transect sites.

Along each transect and at non-transect sites, a random sample of ten urchins were collected, and the diameter, live weight, and roe weight of these animals were measured. A random sample of gonads from 10 urchins at each site was prepared for histological examination for abnormalities. The gonads were preserved in 10% buffered formalin (Dr. Ted Meyers, ADF&G Juneau, pers. comm.). Three randomly selected composite samples of three gonads each were selected from transects or sites in each area for hydrocarbon analysis.

During the spring of 1990, 20-40 live urchins will be shipped to a contractor for laboratory bioassay experiments on toxicity of oil to urchin larvae. The urchins will be transported in a dry condition in ice chests lined with kelp and maintained as close to normal ambient temperature as possible.

In order to assign an age structure to the populations studied, we made the following assumptions based on the limited data available for the Kodiak area: 1) Egg hatch occurs in April in all areas surveyed and 2) growth rates are similar between areas.

Based on unpublished modal size frequency data from observations

of green sea urchin populations in the Chiniak Bay area of Kodiak Is. (collected by E. Munk, NMFS, Kodiak), we estimated the age composition of both Chiniak and Uyak Bay urchin samples.

Gonadal indexes were computed as: average gonad weight / average whole weight x 100. The indexes compare the size of gonads to the average size of whole animals at each site, and are a measure of reproductive activity over time.

DATA ANALYSIS

Survey areas were stratified into those impacted and not impacted by oil. Once the laboratory analyses are complete, statistics on analysis of variance will be computed to assess any differences in hydrocarbon content, incidence of gonad abnormalities, changes in relative abundance and any differences in parameters describing relationships between gonad weight and urchin diameter or gonad weight and total weight. Trend analysis of the relative abundance of young of the year urchins may be used to detect potential recruitment failures associated with oil impact.

STUDY RESULTS

A total of 24 sites within 9 areas of Chiniak and Uyak Bays were explored by scuba divers for the presence of green sea urchins. These sites are depicted on Figures 2-9. Urchins were found at 12 sites (50%). Six sites had sufficient numbers of urchins to sample. Two of these sites, numbers 21 and 23 were identified as light and very lightly oiled. The remaining 10 sites with urchins were identified as non-oiled, Table 1.

A total of 4719 urchins were sampled (1837 in Chiniak, 2882 in Uyak) ranging in size and estimated age from 8 mm (0.75 yr.) to 85 mm (6.0+ yr.). The average size and age at a site varied between 37.7 mm (2.75 yr.) at site 23 in Uyak Bay to 54.1 mm (3.75 yr.) at site 3 in Chiniak Bay. Samples of size distributions at the six sampling sites are shown in Figures 10-15.

Average gonad indices are presented in Table 2. Indices ranged from 16.9 at site 21 to 23.1 at site 3. This difference reflects that the average diameter of urchins at site 3 was 20 mm greater than at site 21. These indices will be more meaningful biologically when a temporal distribution of indices is made available with future studies.

Hydrocarbon and histological urchin tissue samples were collected at 6 sites (2 oiled, 4 unoiled), Table 1, and are being readied for analysis. No definitive data on injuries to urchins from the oil spill is available until the results from the tissue analysis is complete. Divers did not observe any signs of oiling on subtidal marine life or substrates.

Table 1. List of sites, urchins, oil observations and hydrocarbon and histological sampling.

Site number	Urchin observations	* Oil Observations	Samples	
			Hydro.	Histo.
1	urchins	no oil	no	no
2	urchins	no oil	yes	yes
3	urchins	no oil	yes	yes
4	no urchins	no oil	no	no
5	urchins	no oil	no	no
6	no urchins	no oil	no	no
7	urchins	no oil	no	no
8	no urchins	no oil	no	no
9	no urchins	no oil	no	no
10	few urchins	no oil	no	no
11	few urchins	no oil	no	no
12	no urchins	heavy oil	no	no
13	no urchins	heavy oil	no	no
14	no urchins	heavy oil	no	no
15	no urchins	heavy oil	no	no
16	no urchins	heavy oil	no	no
17	no urchins	very light oil	no	no
18	urchins	no oil	yes	yes
19	no urchins	no oil	no	no
20	urchins	no oil	yes	yes
21	urchins	light oil	yes	yes
22	no urchins	very light oil	no	no
23	urchins	very light oil	yes	yes
24	few urchins	no oil	no	no

*oiling data obtained from Kodiak Island Borough map July 21, 1989

Table 2. Urchin measurements from collection sites

	Site #2	Site #3	Site #18	Site #20	Site #21	Site #23
Avg. Test Diameter	49mm	60.6mm	43.7mm	43.1mm	40.3mm	41.7mm
Avg. Live Weight	49.6g	81.7g	39.4g	30.7g	27.7g	29.3g
Avg. Roe Weight	10.3g	18.9g	8.1g	5.5g	4.7g	6.3g
Avg. Gonad Index	20.8	23.1	20.6	17.9	16.9	21.5

STATUS OF INJURY ASSESSMENT

The progress made to date in meeting each of the objectives has been variable. A significant factor affecting objective 1 was the absence of urchins at sites 12-16 adjacent to the heaviest oiled beaches in the study area. Green sea urchins were documented at several locations along these beaches in July and August 1989 by Dames and Moore Biological Consultants (Mark Blakesly, pers. comm.). During our November and December dives we returned to the same sites and found no urchins. Another confounding factor is the presence of sea otters, Enhydra lutris, a predator of urchins, in the Uyak Bay area. We have no estimates of the rate of predation on urchins since the arrival of oil and therefore we cannot discriminate between oil and otter related mortalities at this time. Therefore we cannot discount the possibility that oil contamination caused a decline in abundance of sea urchins between July/August and November/December 1989. It is doubtful that a large increase in sea otter predation occurred over this time interval. While a few otters have been sighted in the Chiniak Bay area their numbers appear to be much lower.

Most of the commercial harvest from Kodiak waters occurs in the vicinity of sites 1-3 in the Chiniak Bay area. Very little commercial activity occurs in the Uyak area. Since commercial divers tend to remove the largest urchins any size comparisons and relative estimates of recruitment between areas becomes skewed. Data on removals are not precise enough to allow us to adjust our samples for the influence of commercial removals. These factors combined make it very difficult to assess oil's impact on the urchin populations through objectives 1, 2 and 4.

The hydrocarbon and histological examination of tissues and the larval bioassay work scheduled for the spring of 1990, should provide the best information on oil-related impacts.

Following is a site by site description of the study area.

Site 1. Date: 11-16-89

Location: Kalsin Bay between Utesistoi and Svitlak Island
Latitude 57 37.7' Longitude 152 21.7'

Physical Characteristics: Bottom substrate was a mixture of sand, gravel, and rock. Larger rocks were covered in corraline algae. Sparse macroalgae observed.

Urchin population: Moderate urchin population seen. Urchins weren't collected due to commercial diver in the area.

Site 2. Date: 11-16-89

Location: Kalsin Bay along SW side of Isthmus Pt.
Latitude 57 37.6' Longitude 152 20.5'

Physical characteristics: (see Appendix 1)

Urchin Population: Moderate urchin population.

Collection methods: Four transects were laid down perpendicular to shore approximately 7 meters apart. A total of 200-300 urchins were collected from 1 meter on either side of the transect midline. The urchins were brought ashore to be measured, then a random sample of 10 urchins from each transect was chosen and live and roe weights taken. Random samples were saved for hydrocarbon and histology analysis.

Site 3. Date: 11-20-89

Location: Kalsin Bay along SW side of Isthmus Pt. (100m from site 2)
Latitude 57 37.5' Longitude 152 23.0'

Physical Characteristics: (see Appendix 2)

Urchin Populations: Moderate urchin population

Collection methods: Same as site 2

Site 4 Date: 11-20-89

Location: Middle Bay along NW side of Broad Pt.
Latitude 57 42.3' Longitude 152 24.4'

Physical Characteristics: Bottom substrate a mixture of pebbles, rocks and boulders with dense beds of macroalgae mainly Laminaria and Alaria. At a depth of 15-20 feet sandy areas were interspersed with above bottom type.

Urchin Populations: No urchins seen

Site 5 Date: 11-27-89

Location: Zaimka Island, East Side
Latitude 57 43.6' Longitude 152 27.9'

Physical Characteristics: Bottom substrate is a mixture of rock, pebble and sand. Scattered areas of dense macroalgae.

Urchin Population: Urchins were found in sparse concentrations under algal cover.

Site 6 Date: 11-27-89

Location: Cliff Point, NW side
Latitude 57 43.5' Longitude 152 28.0'

Physical Characteristics: Sand, silt, bottom.

Urchin Populations: No urchins seen.

Site 7 Date: 11-27-89

Location: Blodgett Island, N & E sides
Latitude 57 43.4' Longitude 152 29.3'

Physical Characteristics: Bottom substrate is pebble, rock, boulder with underlying sand. Large sand, silt areas interspersed occasionally. Moderate cover of macroalgae.

Urchin Population: Moderate urchin population scattered under cover of macroalgae and shell hash. No transects done due to ice cover.

Site 8 Date: 11-27-89

Location: Cliff Point across from Blodgett Island
Latitude 57 43.2' Longitude 152 29.3'

Physical Characteristics: Bottom substrate is rock, pebble, boulder with underlying sand. Occasional sand, silt areas. Moderate cover of macroalgae.

Urchin Population: No urchins seen.

Site 9 Date: 11-22-89

Location: West side of Woody Island
Latitude 58 47.4' Longitude 152 20.5'

Physical Characteristics: Visibility 0-2' not sure of bottom type.

Urchin Population: Unsure due to poor visibility.

Site 10 Date: 11-24-89

Location: Trident Basin between Near and Holiday Island
Latitude 58 47.1' Longitude 152 23.2'

Physical Characteristics: Bottom substrate a mixture of pebbles, rocks, and boulders. Large quantities of macroalgae.

Urchin Populations: A few live urchins and some fresh

cracked urchin tests observed. Sea otter seen in the area.

Site 11 Date: 11-24-89

Location: South Bay of Crooked Island
Latitude 58 46.4' Longitude 152 24.0'

Physical Characteristics: Bottom type a rocky, shell hash.

Urchin Populations: Only a few urchins were observed. Two years previous this area held large quantities of urchins but was commercially harvested.

Site 12 Date: 11-13-89

Location: Spiridon Bay, Hook Point
Latitude 57 41.1' Longitude 153 46.7'

Physical characteristics: On the east side of Hook Point the bottom sediment was sandy, rock rubble covered with a moderate amount of macroalgae. On the west side of Hook Point the bottom sediment varied from boulder reef along the intertidal to rocky, cobble, shell hash offshore. Heavy macroalgae covered the reef grading to moderate offshore, occasional eelgrass beds interspersed.

Urchin Population: Few urchin tests seen, but no live urchins.

Site 13 Date: 11-7-89

Location: Spiridon Bay, Egg Island, NE side
Latitude 57 41.9' Longitude 153 51.4'

Physical Characteristics: Large boulder reefs along upper intertidal, sandy, shell hash offshore. Moderate macroalgae cover.

Urchin Population: Few urchin tests seen, but no live urchins.

Site 14 Date: 11-8-89

Location: Spiridon Bay, NW of Egg Island
Latitude 57 42.3' Longitude 153 52.6'

Physical Characteristics: Bottom Substrate small pebbles with sandy interstices. Light macroalgae cover, mostly Agarum, with some Laminaria. Otter cracked bivalves seen.

Urchin Population: One pale urchin seen.

Site 15 Date: 12-3-89

Location: Spiridon Bay, Egg Island, SW side
Latitude 57 42.0' Longitude 153 51.6'

Physical Characteristics: Bottom substrate is a pebble, rock, boulder reef, with interspersed shell hash. Heavy macroalgae cover of Agarum, Laminaria, Corralina, and Rhodomenia.

Urchin Population: No urchins seen.

Site 16 Date: 12-4-89

Location: Chief Cove and North of Chief Cove
From Latitude 57 43.9' Longitude 153 56.2'
To Latitude 57 42.1' Longitude 153 54.4'

Physical Characteristics: Most of the intertidal area around Prominence mound was solid rocky reef. Moderate Concentrations of macroalgae, mostly Agarum and Laminaria and misc. filamentous reds. Otter cracked shells seen. South towards Chief Point the boulder reef gave way to unconsolidated rock, pebble areas. Rocks were encrusted with corraline algae and clumps of brown and red algae but no large beds seen.

Urchin Population: Few old urchin tests seen, but no live urchins.

Site 17 Date: 12-5-89

Location: Coves across from Harvester Island
Latitude 57 38.3' Longitude 154 0'

Physical Characteristics: Bottom sediment mostly rock, pebble interspersed with large sandy areas. Rocks were encrusted with corraline algae and sporadic clumps of Laminaria and filamentous red algae. Occasional eelgrass beds throughout sandy areas.

Urchin Population: Few urchin tests seen but no live urchins.

Site 18 Date: 11-4-89

Location: Larsen Bay Cannery
Latitude 57 32.0' Longitude 153 59.0'

Physical Characteristics: (see Appendix 3)

Urchin Concentrations: Moderate to heavy concentrations of urchins seen.

Collection Methods: Four transects were laid down perpendicular to shore and approximately 7 meters apart. A total of 200-300 urchins were measured underwater in 1 meter band on either side of the transect mid-line. A random sample of 10 urchins was then collected from each transect for live and roe weights and for hydrocarbon and histology analysis.

Site 19 Date: 11-6-89

Location: Uyak Bay, East side of Amook Island
Latitude 57 28.9' Longitude 153 49.0'

Physical Characteristics: Bottom sediment mostly gravel, silt and shell hash. Sparse macroalgae, mainly Laminaria. Offshore starting at 20' was a rock ledge and boulder terraces to 30'. Dense macroalgae on rocks and boulders.

Urchin Populations: No urchins seen.

Site 20 Date: 11-9-89 & 12-6-89

Location: Amook Island
Latitude 57 31.0' Longitude 153 50.0'

Physical Characteristics: (see Appendix 4)

Urchin Population: Large urchin population

Collection Methods: Transects were done on 12-6-89. They were laid out perpendicular to shore, 15 m apart starting at the low tide mark. In a 4 m band along each transect, 200 to 300 urchins were taken to shore to be measured. A random sample of 10 urchins from each transect was then chosen for live and roe weights. A random sample of urchin for hydrocarbon analysis was previously taken on 11-9-89.

Site 21 Date: 12-5-89

Location: Larsen Bay (head)

Physical Characteristics: (see Appendix 5)

Urchin Population: Moderate urchin population in a narrow band parallel to shore.

Collection Methods: Two transects were laid down parallel to shore. One transect was along the 12 ft. depth contour and the second was along the 16 ft. depth contour. From a 4 m band along transect 1, 200 - 300 urchins were collected, and from a 2 m band along transect 2, 200 - 300 urchins were collected. All urchins were brought to shore

to sample. A random sample was taken for live and roe weights and for hydrocarbon and histological analysis.

Site 22 Date: 12-6-89

Location: Zacher Bay, east of Carlsen Pt.
Latitude 57 34.0' Longitude 153 48.8'

Physical Characteristics: Bottom sediment a mixture of rock, pebbles and sandy silt. Scarce macroalgae was noted but an algal scum covered much of the area.

Urchin Population: A few urchin tests were found but no live urchins.

Site 23 Date: 12-9-89

Location: Cove SW of Alf Island
Latitude 57 23.6' Longitude 153 51.2'

Physical Characteristics: (see Appendix 6)

Urchin Population: A small narrow band of urchins in shallow water parallel to shore.

Collection Methods: All urchins in a 5 by 30 m band parallel to shore were collected and measured on shore. From these urchins, a random sample was taken for live and roe weights and hydrocarbon and histological analysis.

Site 24 Date: 11-6-89

Location: Alf Island, SE cove
Latitude 57 24.6' Longitude 153 49.8'

Physical characteristics: The bottom type was slate shingle with sparse algae composed mostly of Laminaria.

Urchin Population: Lightly, distributed urchins under shingles and amongst blue mussels.

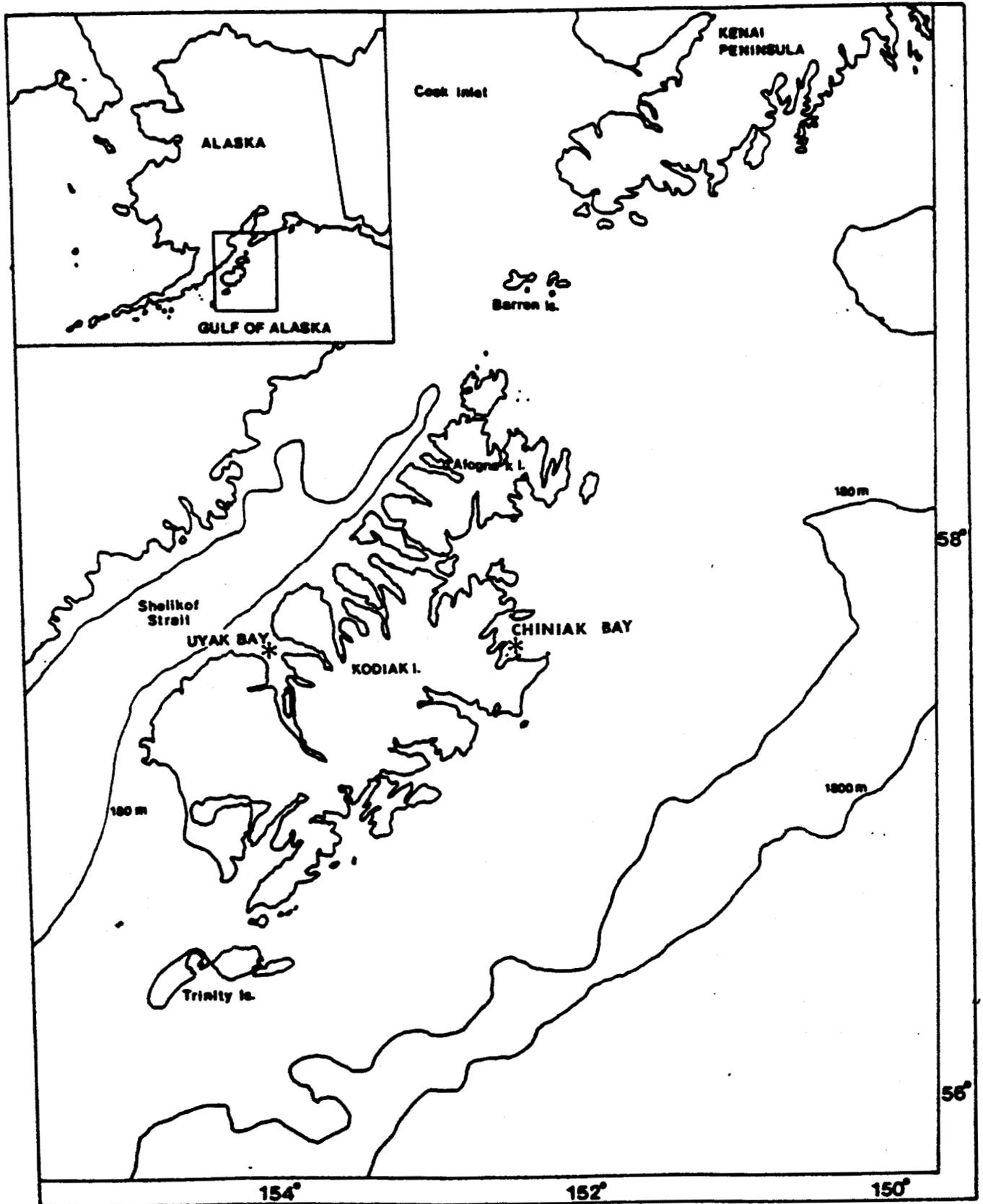


Figure 1. Kodiak Island, Alaska.

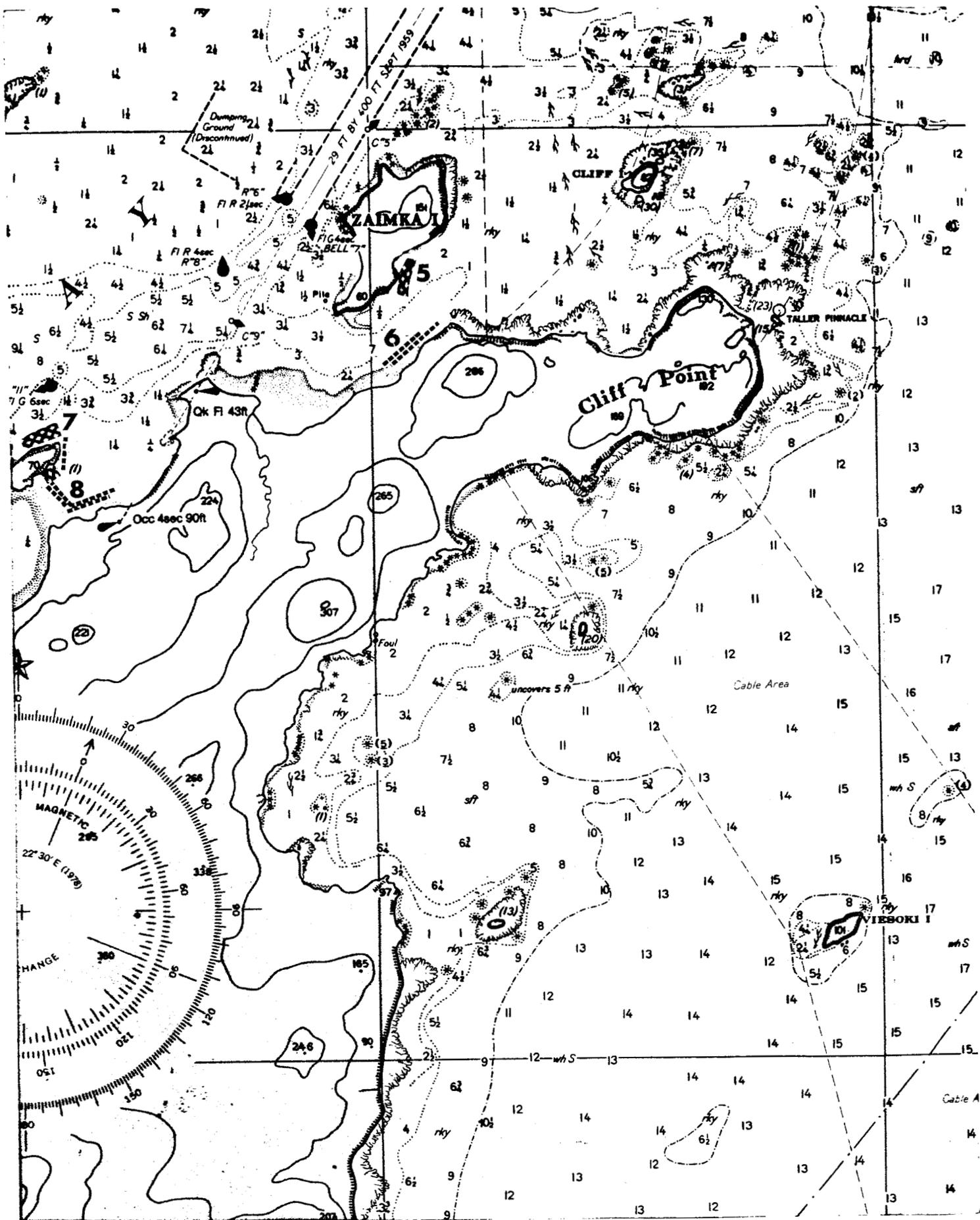


Figure 3. Sites 5-8 in Chiniak Bay Area.

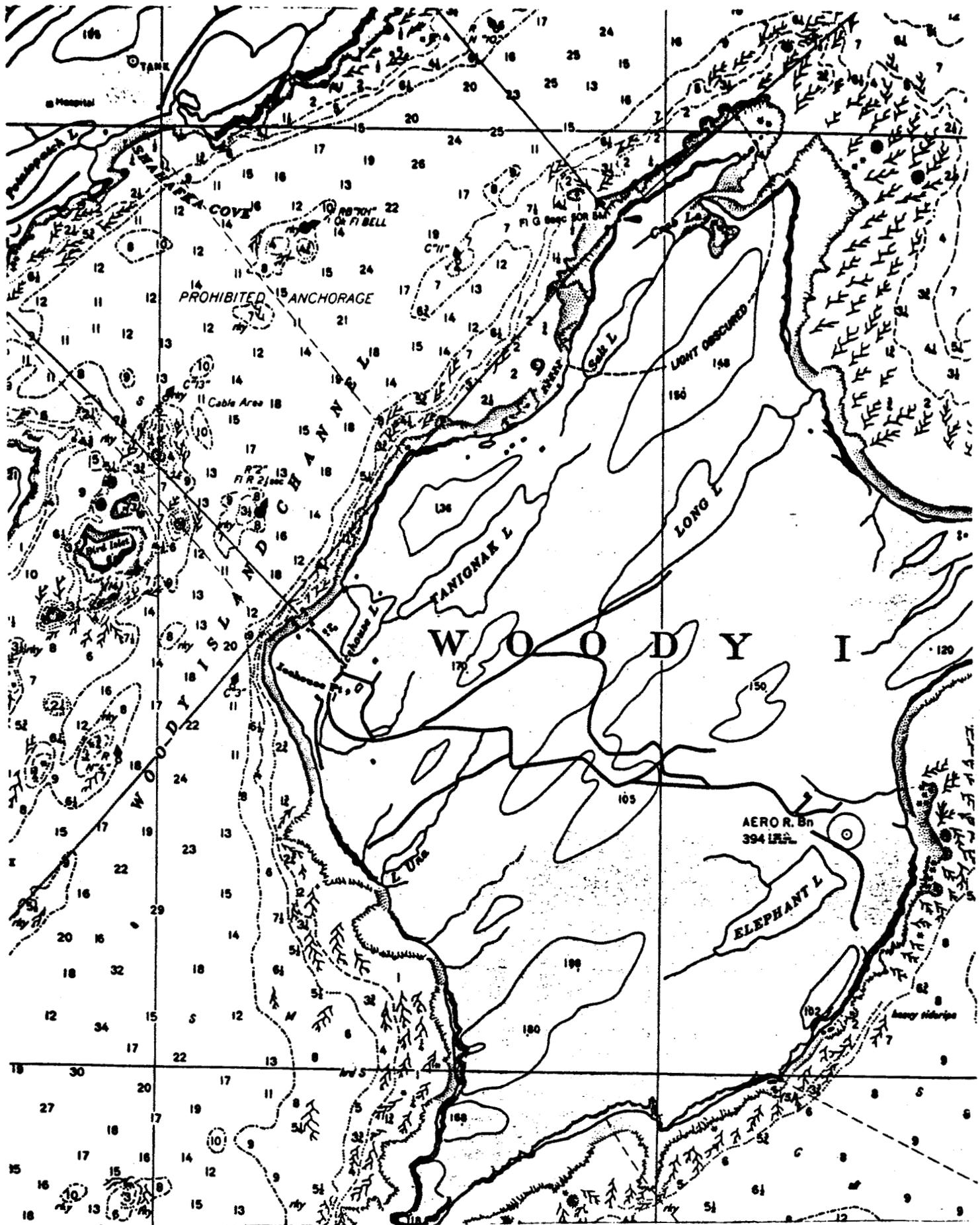


Figure 4. Site 9 in Chiniak Bay Area.

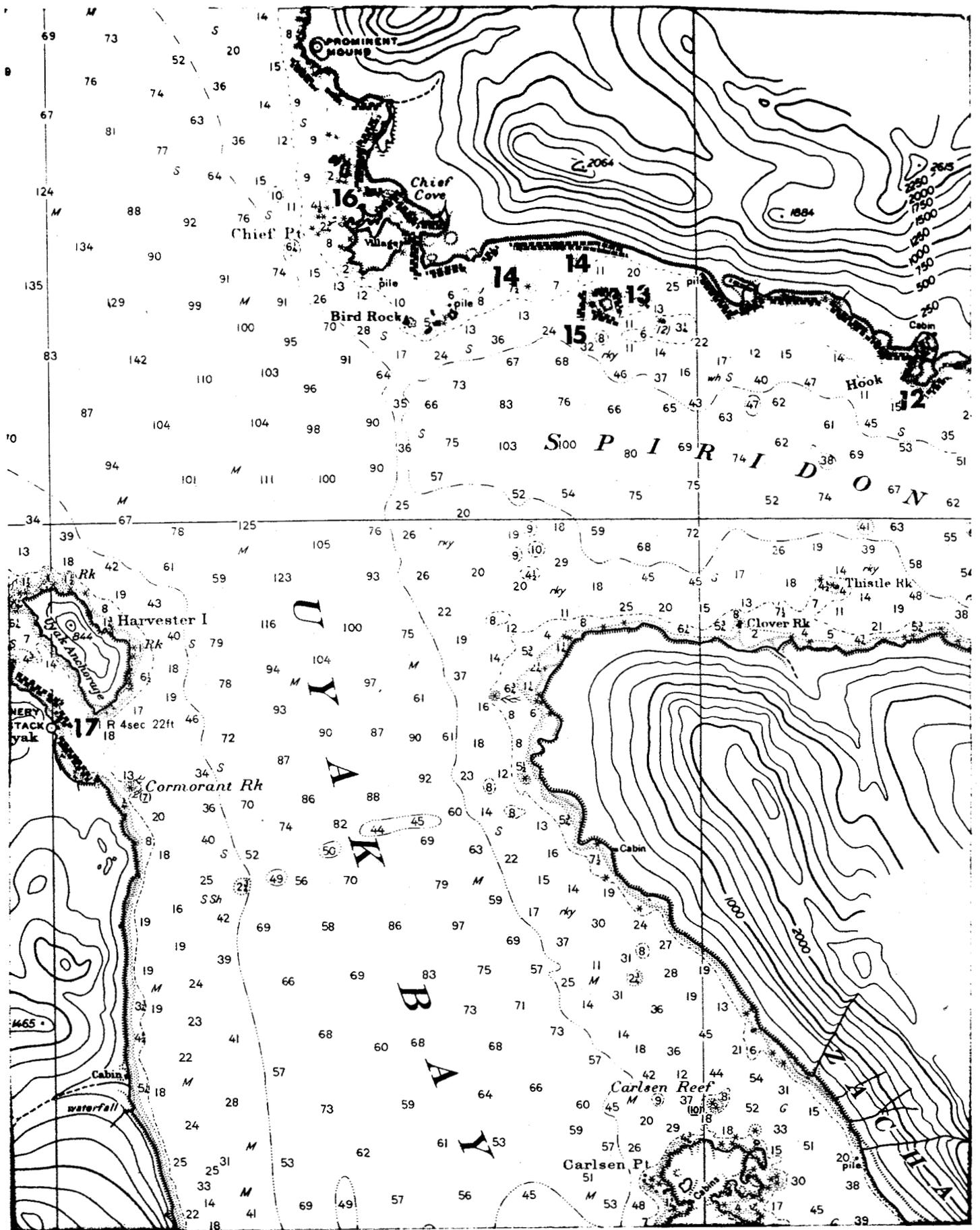


Figure 6. Sites 12-17 in Uyak Bay Area.

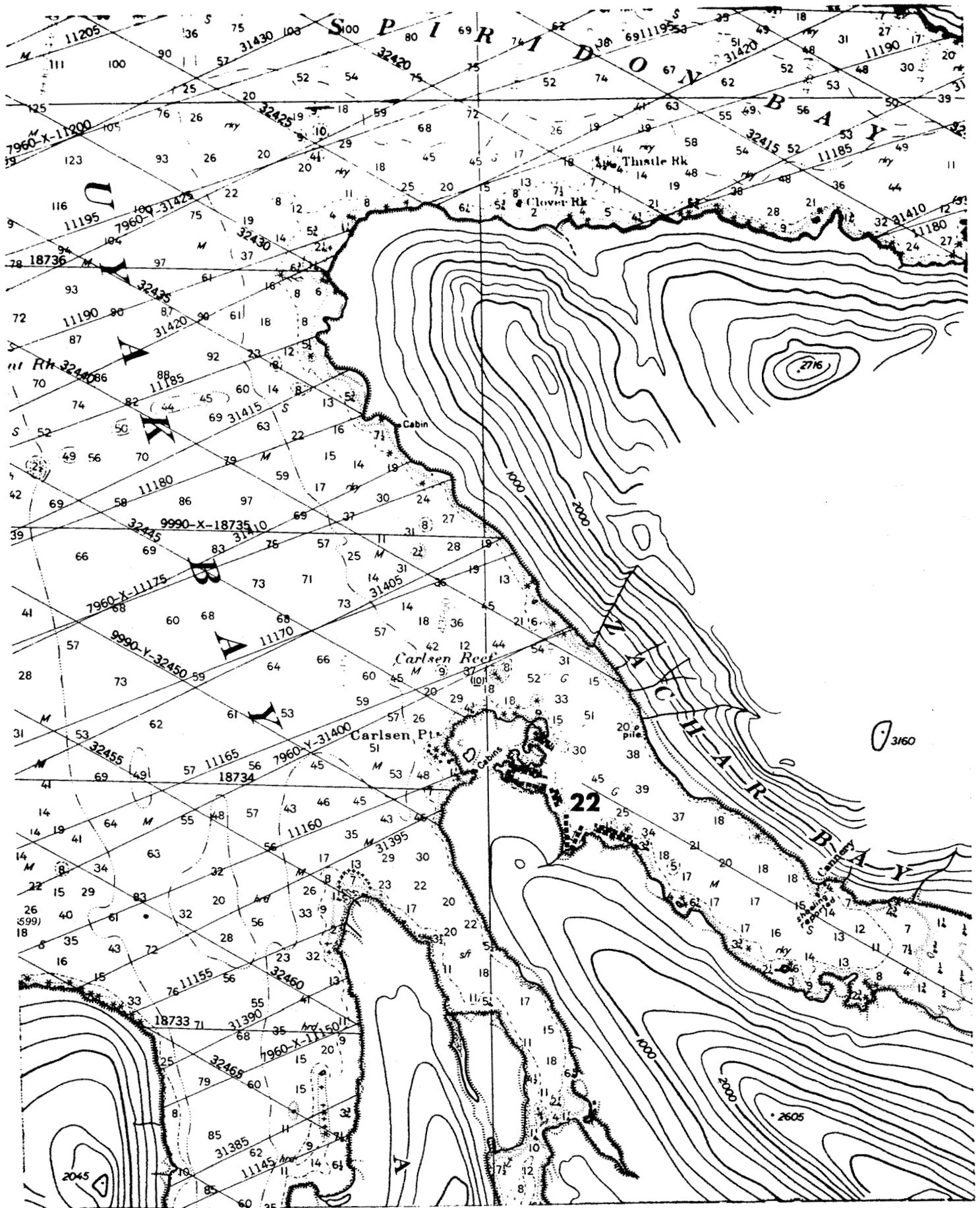


Figure 8. Site 22 in Uyak Bay Area.

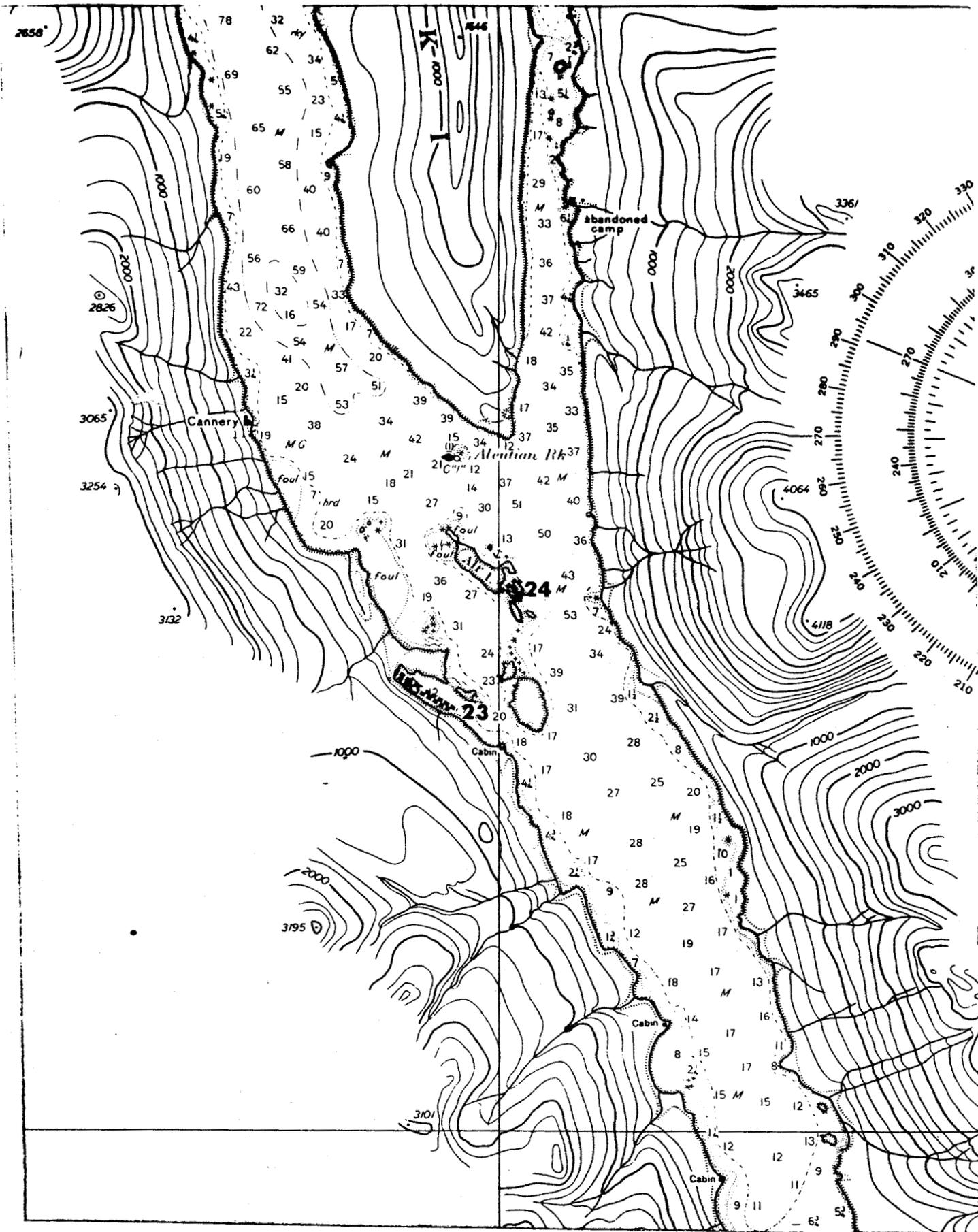


Figure 9. Sites 23-24 in Uyak Bay Area.

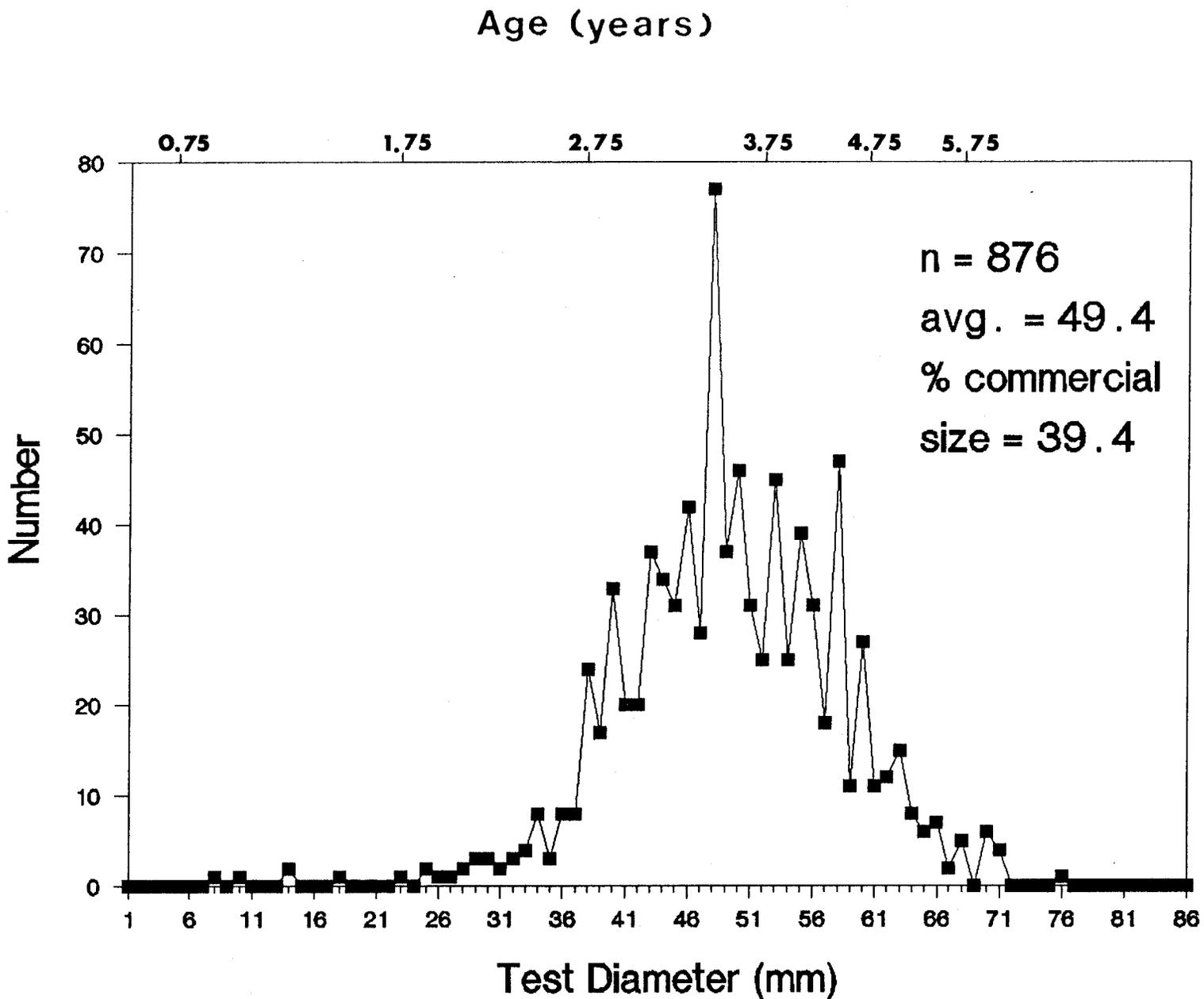


Figure 10. Site 2 green sea urchin test width frequency histogram.

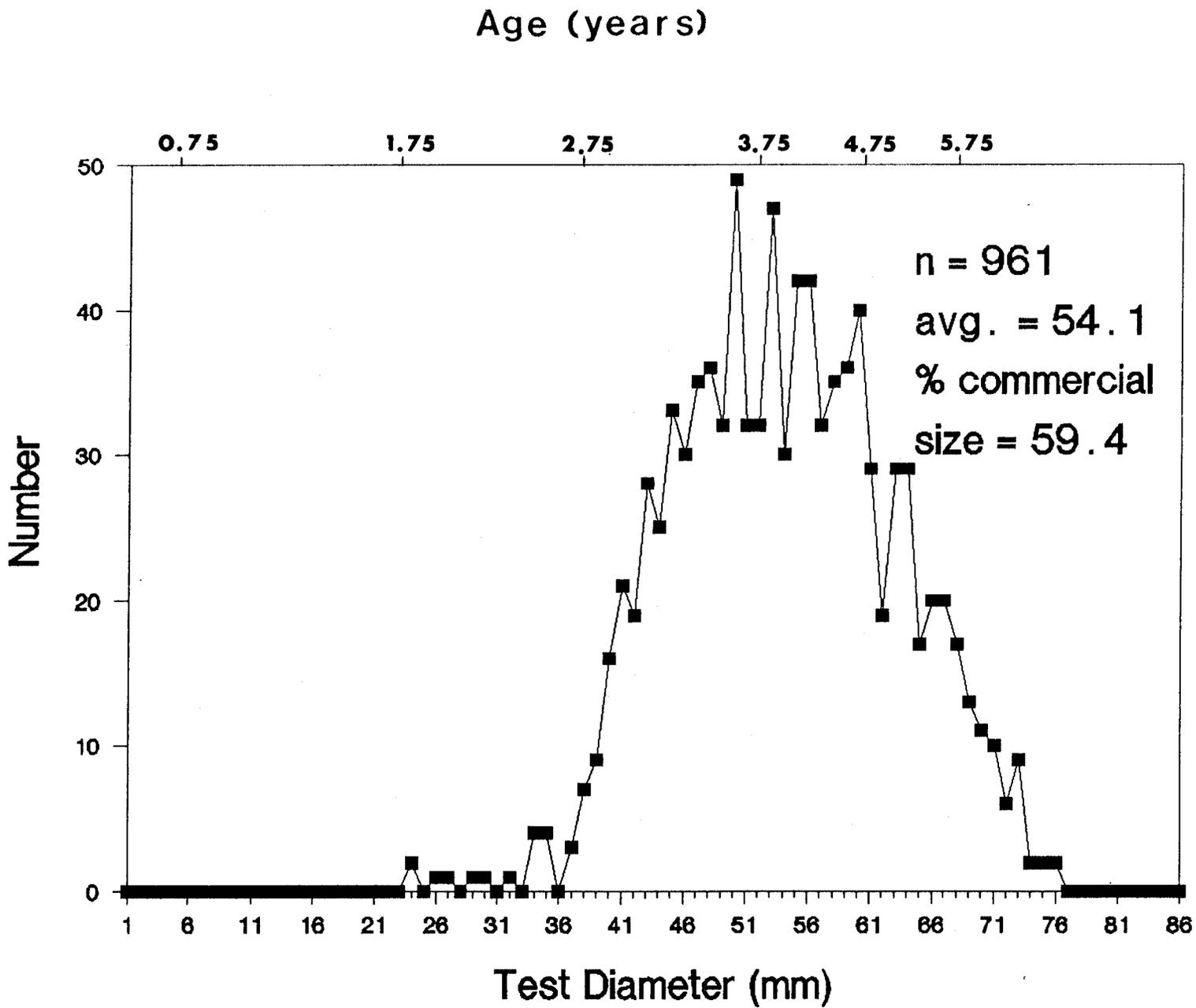


Figure 11. Site 3 green sea urchin test width frequency histogram.

Age (years)

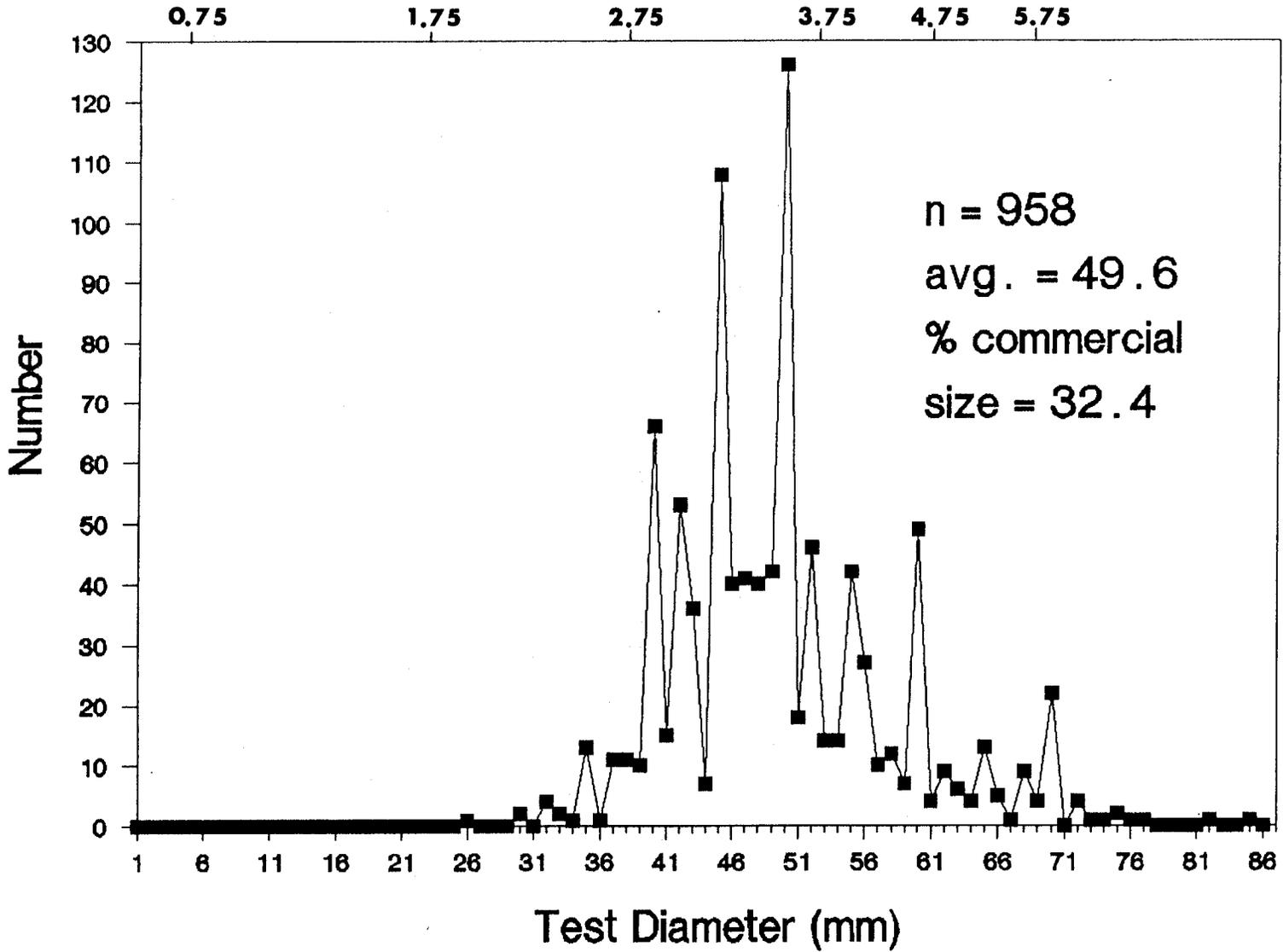


Figure 12. Site 18 green sea urchin test width frequency histogram.

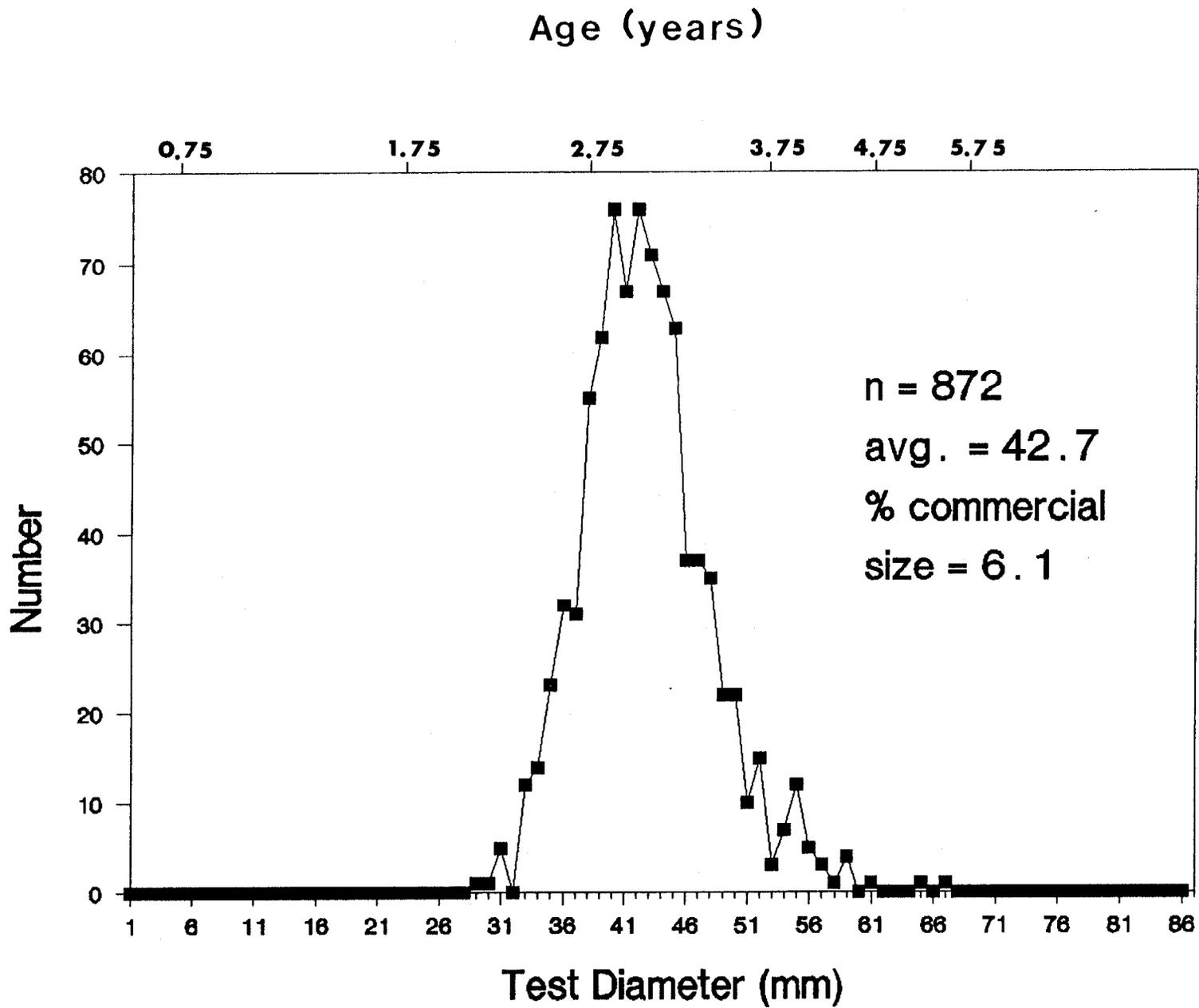


Figure 13. Site 20 green sea urchin test width frequency histogram.

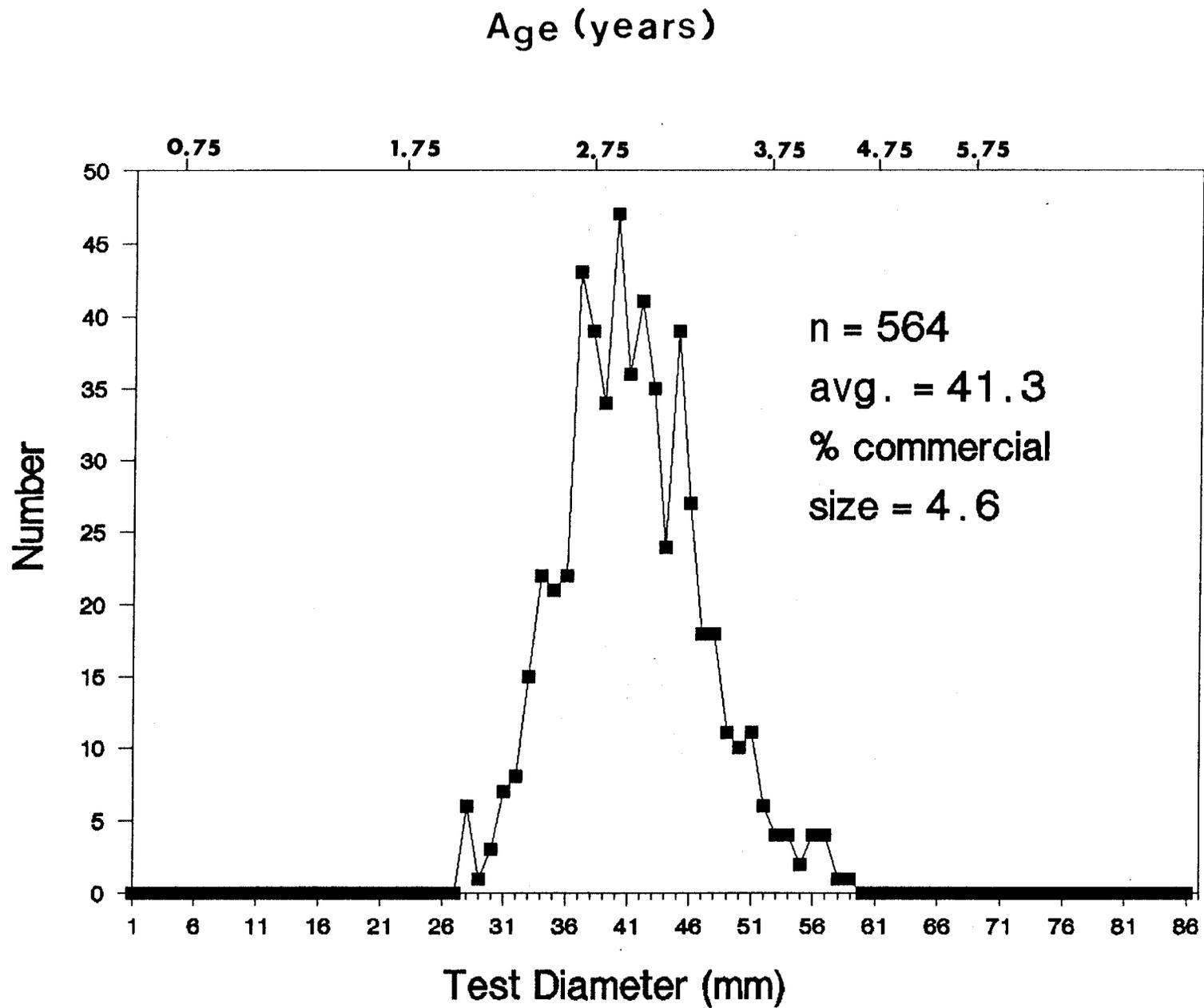


Figure 14. Site 21 green sea urchin test width frequency histogram.

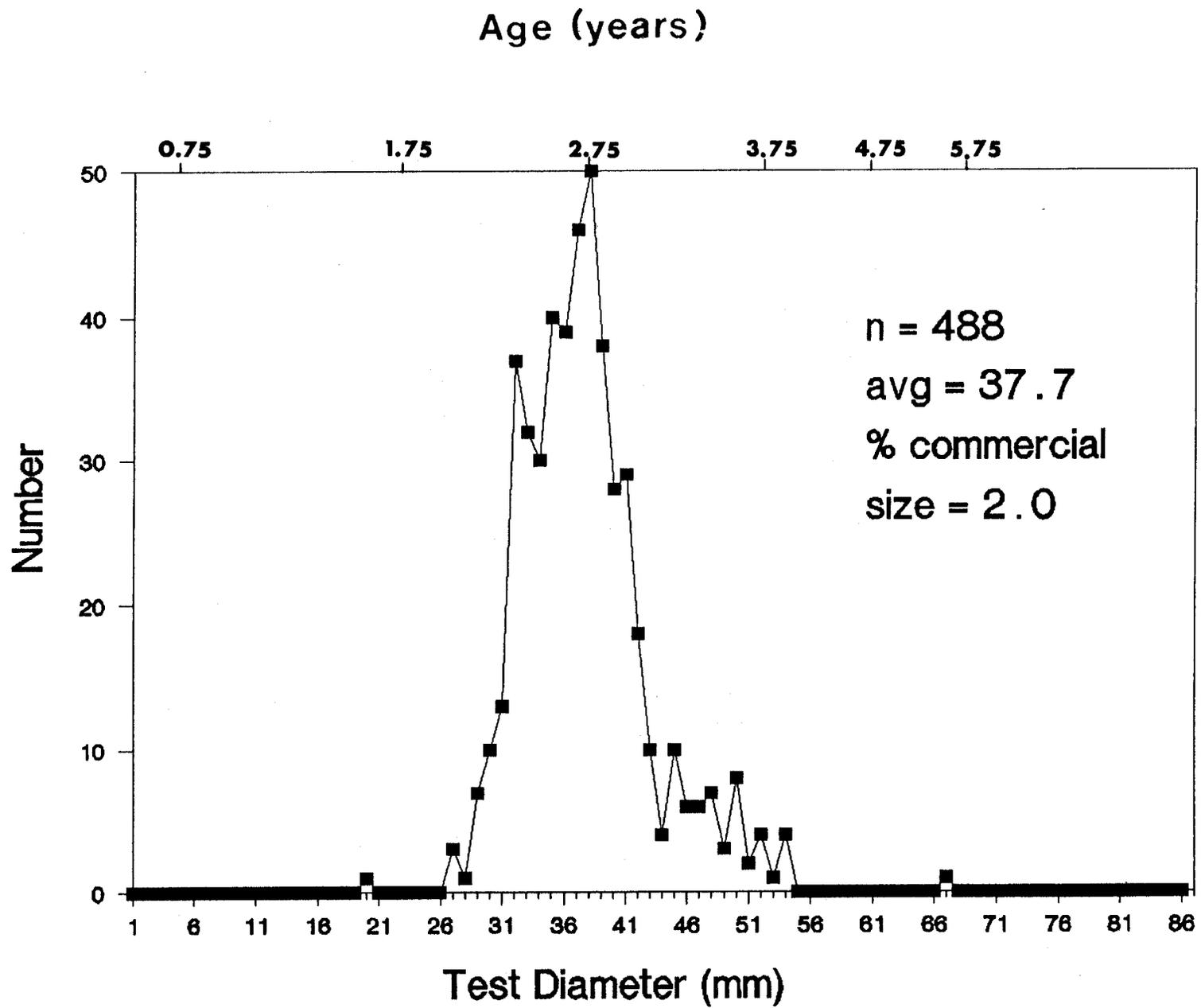


Figure 15. Site 23 green sea urchin test width frequency histogram.

**ADF&G URCHIN OIL PROJECT SITE
DESCRIPTION FIELD FORM**

Site Name: Kalsin Bay - Site #2 **Date:** 11-16-89
Latitude: 57° 37.55' **Longitude:** 152° 20.5'
Recorder: Byersdorfer

<u>Code</u>	<u>Description</u>
Waves <u>3</u>	<u>Wavelets</u>
Weather <u>2</u>	<u>Partly cloudy</u>

Air Temp 3.7°C **Surface Sea Temp** 3.0°C **Surface Salinity** 28.5‰/∞

	<u>i</u>	<u>Code</u>	<u>Description</u>
Adjacent Beach Substrate	<u>40</u>	<u>5,6</u>	<u>Pebble, rock fragments</u>
	<u>40</u>	<u>8</u>	<u>Rock</u>
	<u>20</u>	<u>4</u>	<u>Granule</u>

Beach Slope 7% **Beach Orientation (e.g. N-NW)** NW-SE

1. S. Temp.	<u>2.8°C</u>	<u> </u>	<u> </u>
2. B. Temp.	<u>1.7°C</u>	<u> </u>	<u> </u>
3. Depth	<u>7'</u>	<u> </u>	<u> </u>
4. S. Salinity	<u>18.5‰/∞</u>	<u> </u>	<u> </u>
5. B. Salinity	<u>29‰/∞</u>	<u> </u>	<u> </u>
6. Visibility	<u>7-10</u>	<u> </u>	<u> </u>

Transect Length (meters): Transect #1,2,3 were 33.5m
#4 = 26.8m

Substrate (%):	<u>50</u>	Description:	<u>Sand, granule</u>
	<u>40</u>		<u>Pebbles</u>
	<u>10</u>		<u>Rock fragments, rocks, shell hash</u>

**ADP&G URCHIN OIL PROJECT SITE
DESCRIPTION FIELD FORM**

Site Name: Kalsin Bay - Site #3 **Date:** 11/20/89
Latitude: 57° 37.45 **Longitude:** 152° 23.0'
Recorder: Byersdorfer

	<u>Code</u>	<u>Description</u>
Waves	<u>1</u>	<u>Glassy</u>
Weather	<u>1</u>	<u>Clear</u>

Air Temp 0°C **Surface Sea Temp** 2.2°C **Surface Salinity** 28 ‰

	<u>‡</u>	<u>Code</u>	<u>Description</u>
Adjacent Beach Substrate	<u>40</u>	<u>4, 5</u>	<u>Granule, pebble</u>
	<u>60</u>	<u>6, 8</u>	<u>Rock, rock fragments</u>
	_____	_____	_____

Beach Slope 8° **Beach Orientation (e.g. N-NW)** NW-SE

1. S. Temp.	<u>2.2°C</u>	_____	_____
2. B. Temp.	<u>2.9°C</u>	_____	_____
3. Depth	<u>7-10'</u>	_____	_____
4. S. Salinity	<u>28 ‰</u>	_____	_____
5. B. Salinity	<u>28.5 ‰</u>	_____	_____
6. Visibility	<u>15-20</u>	_____	_____

Transect Length (meters): Transect #1 = 58m; Transect #2,3 = 33m;
Transect #4 = 91m

Substrate (‡):	<u>10</u>	Description:	<u>Mud, silt</u>
	<u>10</u>		<u>Sand</u>
	<u>70</u>		<u>Rock fragments</u>
	<u>10</u>		<u>ROCKS</u>

**ADFG URCHIN OIL PROJECT SITE
DESCRIPTION FIELD FORM**

Site Name: Larsen Bay Cannery-Site #18 **Date:** 11/05/89
Latitude: 57° 32.0' **Longitude:** 153° 59.0'
Recorder: Byersdorfer

	<u>Code</u>	<u>Description</u>
Waves	<u>4</u>	<u>Slight 2-4'</u>
Weather	<u>2</u>	<u>Partly cloudy</u>

Air Temp 4.72°C **Surface Sea Temp** 5.83°C **Surface Salinity** 29°/oo

	<u>1</u>	<u>Code</u>	<u>Description</u>
Adjacent Beach Substrate	<u>10</u>	<u>4</u>	<u>Granule</u>
	<u>45</u>	<u>5</u>	<u>Pebble</u>
	<u>43</u>	<u>6</u>	<u>Rock fragments</u>
	<u>2</u>	<u>8</u>	<u>Rock</u>

Beach Slope 7° **Beach Orientation (e.g. N-NW)** N-S

- | | | | |
|-----------------------|-----------------|-------------------|-------------------|
| 1. S. Temp. | <u>6°C</u> | <u> </u> | <u> </u> |
| 2. B. Temp. | <u>6°C</u> | <u> </u> | <u> </u> |
| 3. Depth | <u>12'</u> | <u> </u> | <u> </u> |
| 4. S. Salinity | <u>29°/oo</u> | <u> </u> | <u> </u> |
| 5. B. Salinity | <u>29.5°/oo</u> | <u> </u> | <u> </u> |
| 6. Visibility | <u>20'</u> | <u> </u> | <u> </u> |

Transect Length (meters): Transect #1 = 15m; Transect #2 = 6m;
Transects 3,4 = 10m

Substrate (%):	<u>1%</u>	Description:	<u>Sand</u>
	<u>27%</u>		<u>Granule</u>
	<u>80%</u>		<u>Pebble</u>
	<u>>1%</u>		<u>Rock fragments</u>

**ADP&G URCHIN OIL PROJECT SITE
DESCRIPTION FIELD FORM**

Site Name: Larsen Bay-Head - Site #21 **Date:** 12/05/89
Latitude: 57° 31.7' **Longitude:** 154° 6'
Recorder: Byersdorfer

	<u>Code</u>	<u>Description</u>
Waves	<u>4</u>	<u>Slight</u>
Weather	<u>5-6</u>	<u>Showers - squalls</u>

Air Temp 7.2°C **Surface Sea Temp** 4.5°C **Surface Salinity** 28°/oo

	<u>‡</u>	<u>Code</u>	<u>Description</u>
Adjacent Beach Substrate	<u>5</u>	<u>5</u>	<u>Pebble</u>
	<u>23</u>	<u>6</u>	<u>Rock fragments</u>
	<u>30</u>	<u>7</u>	<u>Cobble</u>
	<u>40</u>	<u>8</u>	<u>Rockle</u>
	<u>2</u>	<u>9</u>	<u>Boulder</u>
Beach Slope <u>10°</u>	Beach Orientation (e.g. N-NW) <u>W-E</u>		

1. S. Temp.	<u>4.5°C</u>	<u> </u>	<u> </u>
2. B. Temp.	<u>4°C</u>	<u> </u>	<u> </u>
3. Depth	<u>12-16'</u>	<u> </u>	<u> </u>
4. S. Salinity	<u>28°/oo</u>	<u> </u>	<u> </u>
5. B. Salinity	<u>29.5°/oo</u>	<u> </u>	<u> </u>
6. Visibility	<u>5'</u>	<u> </u>	<u> </u>

Transect Length (meters): Transect #1=18m; Transect #2=56m

Substrate (‡):	<u>90</u>	Description:	<u>Mud</u>
	<u>10</u>		<u>Pebble, rock</u>
	<u> </u>		<u> </u>
	<u> </u>		<u> </u>

**ADP&G URCHIN OIL PROJECT SITE
DESCRIPTION FIELD FORM**

Site Name: Cove SW of Alf Is.-Site #23 **Date:** 12/09/89
Latitude: 57° 23.65' **Longitude:** 153° 51.2'
Recorder: Byersdorfer

Code	Description
Waves <u>3</u>	<u>Wavelets</u>
Weather <u>8</u>	<u>Rain</u>

Air Temp 6.1°C **Surface Sea Temp** 4°C **Surface Salinity** 28‰

	‡	Code	Description
Adjacent Beach Substrate	<u>15</u>	<u>6</u>	<u>Rock fragments</u>
	<u>25</u>	<u>7</u>	<u>Cobble</u>
	<u>35</u>	<u>8</u>	<u>Rock</u>
	<u>25</u>	<u>9</u>	<u>Boulder</u>

Beach Slope 35° **Beach Orientation (e.g. N-NW)** NW-SE

1. S. Temp.	<u>4°</u>	<u> </u>	<u> </u>
2. B. Temp.	<u>5°</u>	<u> </u>	<u> </u>
3. Depth	<u>5-17'</u>	<u> </u>	<u> </u>
4. S. Salinity	<u>28‰</u>	<u> </u>	<u> </u>
5. B. Salinity	<u>29.5‰</u>	<u> </u>	<u> </u>
6. Visibility	<u>15'</u>	<u> </u>	<u> </u>

Transect Length (meters): All urchins in the small 5x30m band parallel to shore were collected

Substrate (‡):	<u>5</u>	Description:	<u>Rock</u>
	<u>40</u>		<u>Cobble shingle</u>
	<u>40</u>		<u>Rock fragments</u>
	<u>15</u>		<u>Pebble</u>

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