MARINE BIOLOGY AND CIRCULATION INVESTIGATIONS IN SITKA SOUND, ALASKA

A report on the findings and habitat management recommendations resulting from marine and estuarine surveys conducted in Sitka Sound during 1979-1980.

by:

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INTRODUCTION AND PURPOSE

The main objective of this study was to investigate, document, and describe the marine biology and surface circulation of Sitka Sound with particular emphasis upon the developed area of the City of Sitka and its immediate vicinity. This report contains the findings and habitat management recommendations resulting from marine and estuarine surveys conducted in Sitka Sound during 1979 and 1980. The surveys were part of an overall habitat evaluation project conducted under a cooperative agreement between the City and Borough of Sitka and the Alaska Department of Fish and Game, Habitat Protection Section. The purpose of obtaining this information is to assist coastal planners, developers, the City and Borough of Sitka, and the various State and Federal regulatory agencies in carrying out their responsibilities to balance the protection of resources and habitats of the coastal zone with the orderly growth and development of Sitka.

The surveys were performed in three major tasks:

Task 1 Underwater surveys were conducted at various locations along the shoreline of Sitka Sound to gather information on marine plant and animal species including macrophytes, invertebrates, and fish, to determine their biological interrelationships and interdependencies and to document the various coastal environments present along the coast.

Task 2 Intertidal surveys were conducted at various locations along the waterfront to gather information on the species present, the intertidal zonation, and the relative importance of the various intertidal zones to the habitat resources of the Sitka waterfront.

Task 3 A drift bottle study in Sitka Sound was undertaken to assist in the interpretation of the area's surface circulation. Regional and local circulation regimes were inferred from the drift bottle trajectory data; however, the primary intent of the study was to elucidate potential pollution trajectories and problem areas.

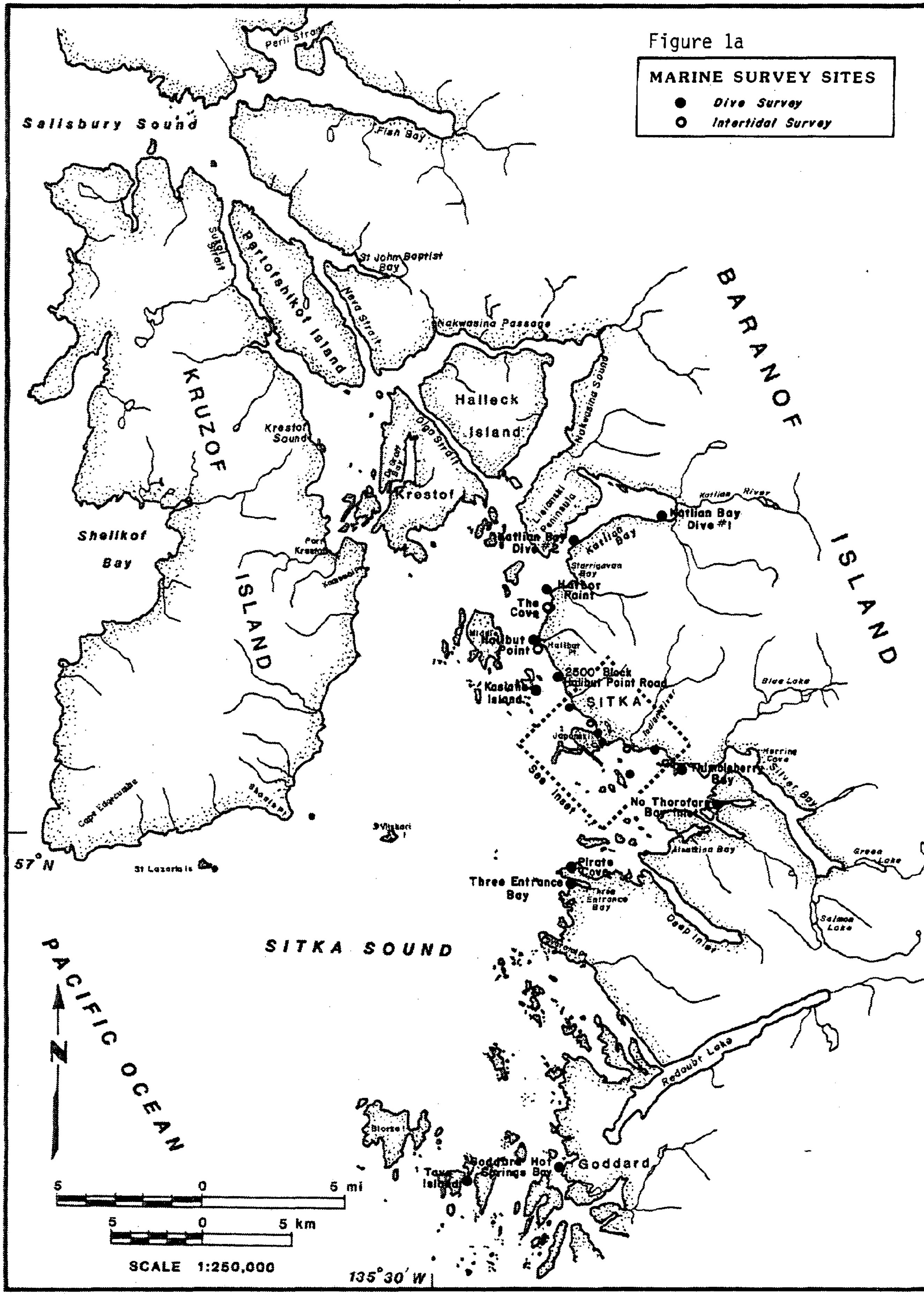
METHODS

Each of the three tasks were accomplished by utilizing standard methods. The method for underwater surveys has been developed and used by the U.S. Fish and Wildlife Service and National Marine Fisheries Service mainly to evaluate log dump and in-water storage sites in Southeast Alaska. The method for intertidal surveys employed a standard qualitative reconnaissance of macro-invertebrate and plant life at various tide levels and life zones. The method for the drift bottle study was developed by the Alaska Department of Fish and Game and has been used for previous circulation investigations in Lower Cook Inlet and the northeast Bering Sea and southeast Chukchi Sea. A description of each method follows:

Underwater Surveys

Scuba dives were made at 17 locations along the coastline of Sitka Sound (Figures 1a and 1b). Sampling was done along a 100 meter (328 feet) surveyor's tape anchored at the mean higher high water (MHHW) tide line and run out perpendicular to the shoreline. At five meter (16.4 feet) intervals along the transect, observations of benthic substrate, water depth, epifauna, epiflora, and fish were recorded. Infauna was sampled by hand digging and wafting. Underwater photos were taken to supplement data collection. Invertebrates and algae which could not be identified in the field

Figure 1a


MARINE SURVEY SITES
Dive Survey
Intertidal Survey
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Krestof Sound
Krestof
Olga Strait
Shelikof Bay
Katlian Bay Dive #1
Katlian Bay Dive #2
Katlian Bay
Harbor Point
The Cove
Halibut Point
2500' Block Halibut Point Road
Kasiana Island
SITKA
Thimbleberry Bay
No Thorofare Bay Inlet
Silver Bay
Pirate Cove
Three Entrance Bay
Deep Inlet
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Goddard
Goddard Hot Springs Bay
Taye Island
57°N
135°30'W
5 0 5 mi
5 0 5 km
SCALE 1:250,000

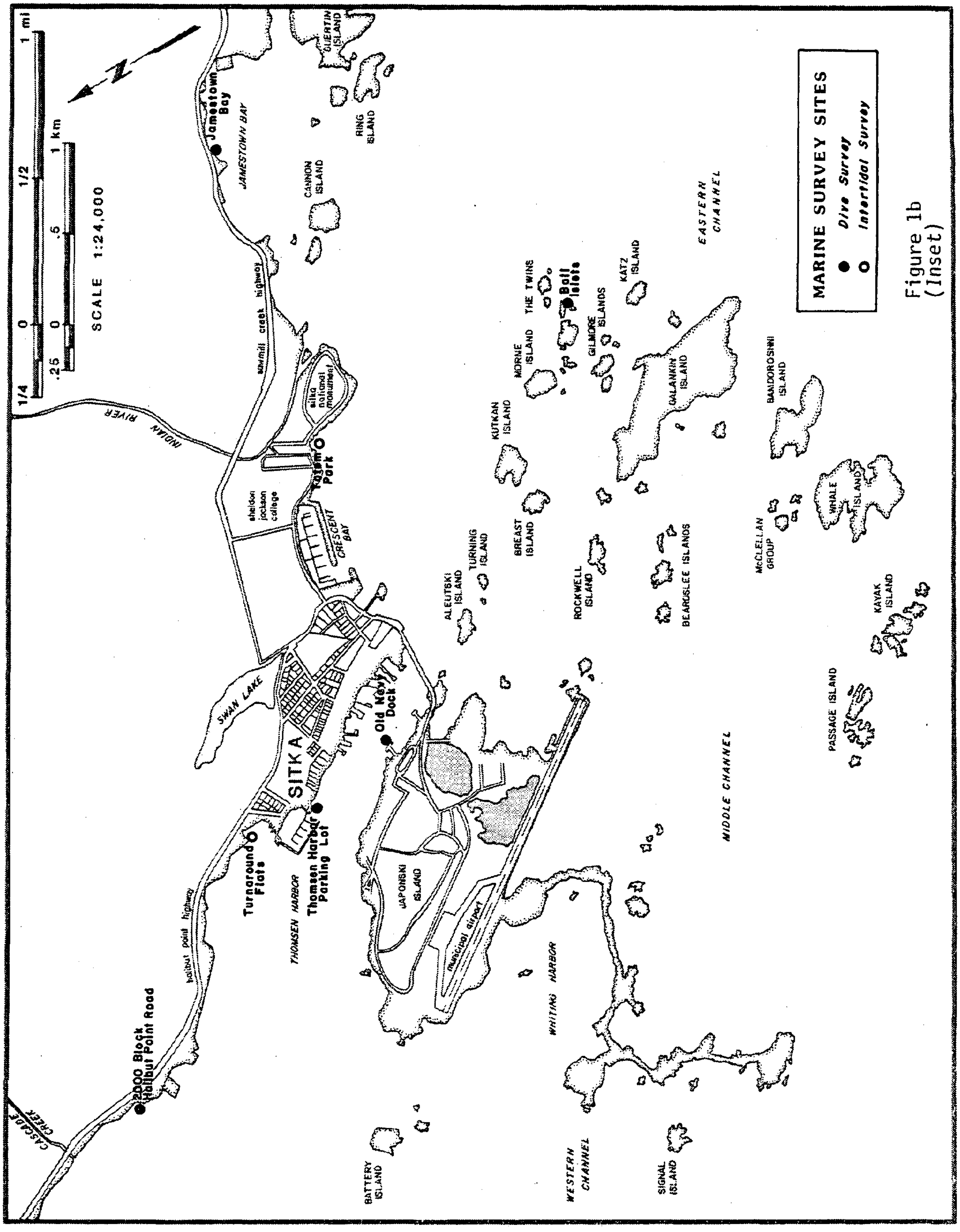


Figure 1b
(Inset)

were collected and preserved in buffered formalin for later laboratory identification. Representative algae specimens were collected, dried, and pressed for permanent reference. All depth readings were taken with an oil-filled depth gauge and later corrected to the reference tidal datum (MHHW) using the Tide Tables (U.S. Department of Commerce, NOAA). For safety reasons, dive surveys did not exceed 80 feet in depth. General reconnaissance of each site area was accomplished as time permitted.

Intertidal Surveys

Intertidal surveys were made at four locations along the roaded waterfront (Figures 1a and 1b). Sampling was accomplished by walking a measured transect tape through the intertidal zone from lower low water (LLW) to higher high water (HHW), to record observations including substrate, elevation, epifauna, infauna, and epiflora within major life zones. Infaunal samples were taken using a shovel and bucket and washed in the field using a one millimeter mesh sieve. Invertebrates and algae which could not be identified in the field were collected and preserved in buffered formalin for later laboratory identification. Elevations were determined by using a surveyor's rod and transit referenced to the mean higher high water tide line. Density estimates for numerically dominant species were made by averaging replicate counts occurring within three random casts of a one-quarter square meter quadrat.

Drift Bottle Study

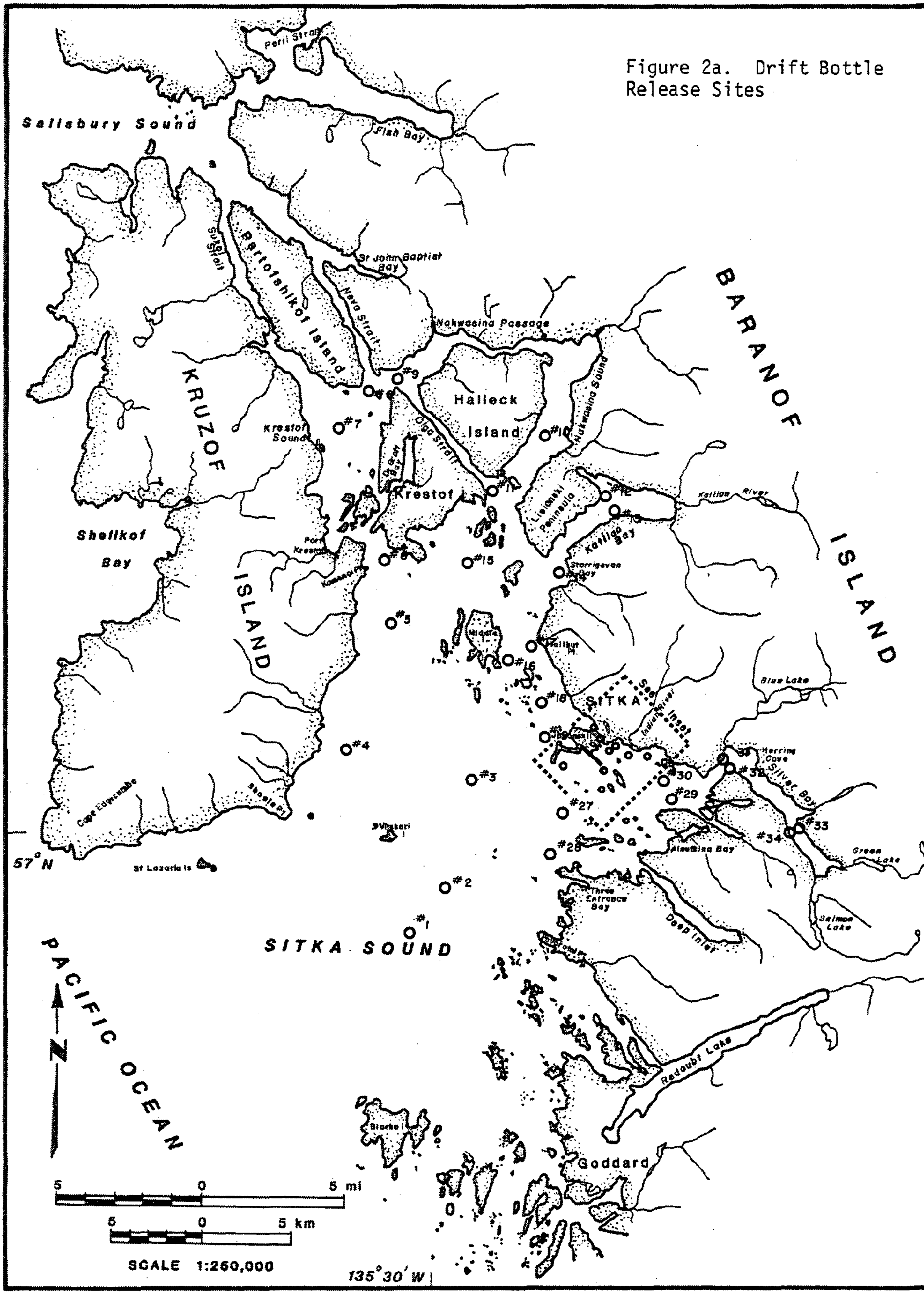
The drift bottles utilized were 4.5 x 1.1 in (11.5 x 2.8 cm) clear plastic centrifuge tubes which were weighted to float vertically with approximately 0.3 in (0.5-1 cm) of the tube exposed above the water surface. The bottles are representative of circulation in roughly the upper four inches (10 cm) of the water column, although the bottles will experience at least some degree of direct wind influence.

Within each bottle are two rolled cards: an individually numbered return postcard and a card explaining the program and clarifying the type of information needed. The outer card has a fluorescent orange face to facilitate sighting of the bottle.

One hundred bottles were released at each of 35 stations within Sitka Sound (Figures 2a and 2b). Station locations were determined by visual fix using a horizontal sextant for all stations except those located close inshore. Positioning accuracy ranged from ± 1/2 mile for the stations farthest offshore to ± a few tens of feet for the inshore stations.

Drift bottle drops of 100 bottles per station were made on September 18, 1979 at all stations except stations 20-24 in the immediate vicinity of Sitka (Figure 2b). At stations 20-24, 25 bottles were released

Figure 2a. Drift Bottle Release Sites



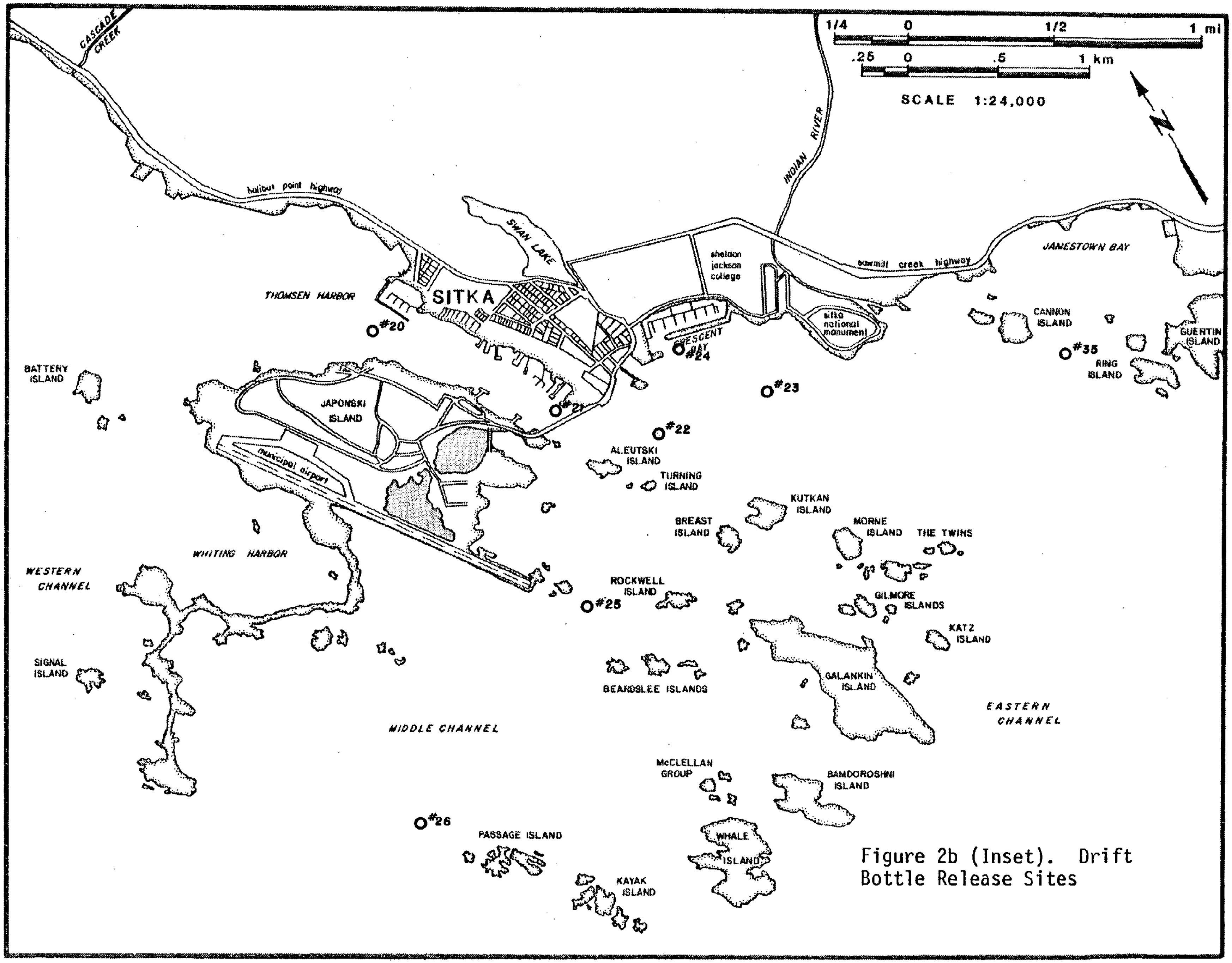


Figure 2b (Inset). Drift Bottle Release Sites

each day during the period of September 18-21, to provide a better representative of the average dispersion and transport occurring in the vicinity of Sitka. Two releases were made during flood tide and two during ebb tide at stations 20-24.

RESULTS AND DISCUSSION

Underwater and Intertidal Surveys

A comprehensive species list of marine plants, invertebrates, and fish observed during underwater and intertidal surveys by location is found in Appendix II. This list represents species that could be observed and identified during one visit to each location. It is by no means an exhaustive species list of Sitka Sound. More intensive year-round sampling would reveal additional species, particularly infaunal polychaete worms, small gastropods, and crustaceans, which were outside the scope of the study.

The results of the underwater and intertidal surveys are presented in Figures 3-19 and Tables 1-4. The text that accompanies the figures and tables gives a brief site discussion and recommended habitat management practices. The figures and tables are organized by geographic location, starting with Katlian Bay in the north and ending with Tava Island in the south.

Appendix I contains a listing of common names for marine flora and fauna with their respective scientific names.

Shore Zone Profiles. Figures 3-19 are shore zone profiles of each of the seventeen underwater survey sites. Each profile is generated by plotting depth readings (corrected to MHHW) at five meter intervals along the transect base line and connecting the points with a smooth curve. In order to fit the profile onto an 8½" X 11" page, the vertical (depth) and horizontal (distance) scales differ by a ratio of 2.5:1. The distance along the transect in the figures are points measured at the ground surface not those at the water surface. Hence, the profiles are not scaled replications of the bottom configuration, but rather are intended to illustrate the relationship between plant and animal communities, substrate, and depth at each station. The flora and fauna shown on the figures represent the major marine life observed during the surveys. Refer to Appendix II for a complete listing of species observed at each site. No attempt was made to scale the individual species drawings within each figure.

SHORE ZONE PROFILES

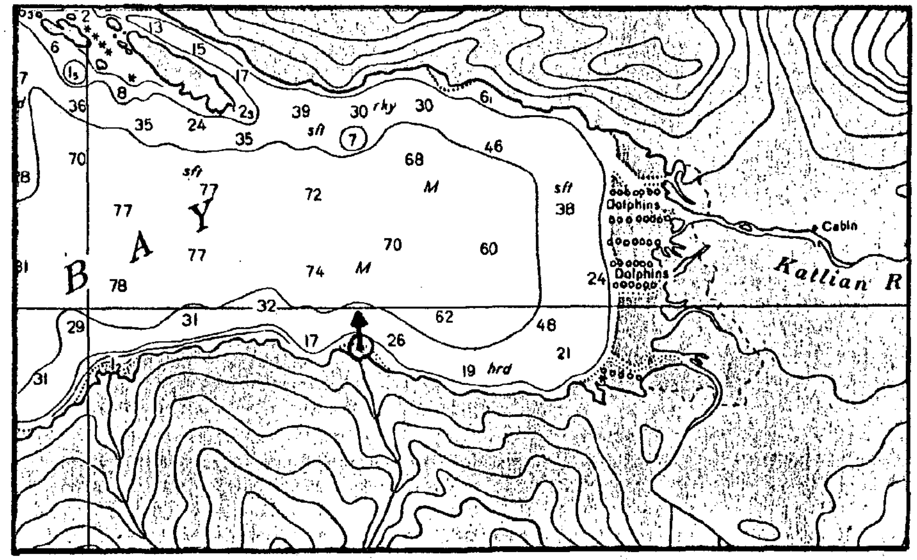
Katlian Bay No. 1

Site Description: The survey was conducted on the face of a small alluvial outwash formed at the mouth of an unnamed creek on the south shore of Katlian Bay. The shoreline sloped gently seaward until reaching the shallow subtidal zone where it dropped off rapidly in a series of alluvial terraces. The intertidal substrate was a mixture of coarse sand and gravel covered with scattered rockweed. Barnacle, periwinkle, mussel, and butter and littleneck clam were the dominant intertidal invertebrates.

At the initial subtidal slopebreak, a narrow fringe of eelgrass predominated. Within the eelgrass zone, Dolly Varden char and tubesnout were observed. The Dolly Varden may have been part of the population that spawns in the South Fork Katlian River, approximately one mile east of this site.

The subtidal slopes were covered with silt and organic detritus, providing a soft, unstable substrate for invertebrates and attached marine plants. Plant material of terrestrial and salt marsh origin, much of which consisted of grasses, sedge, and leaf litter, was abundant. It is probable that the salt marsh at the head of Katlian Bay contributes plant detritus to this site. The small creek also contributes conifer needles and leaf litter. Dominant invertebrates on the soft bottom included numerous large dendroid nudibranchs, brittle star, sea cucumber, sunflower sea star, and burrowing stalked anemone.

The marine community at this site could be classified as a low energy, detritus-based ecosystem. Significant amounts of organic detritus accumulate on the bottom, discouraging the establishment of sessile suspension feeding invertebrates. It is probable that occasional severe storms generate sufficient wave energy to move the detritus down slope.



Management Recommendations: This site provides a feeding area for Dolly Varden char that move along the coast to and from their natal stream. Herring are reported to spawn occasionally in this area, although the paucity of hard subtidal substrates and limited macrophyte growth may limit the preference for herring spawning at this site. Coho salmon are known to rear in the creek and it is probable that low numbers of coho and pink salmon utilize this site for spawning and rearing.

Activities or developments occurring in this area should be designed to maintain passage of fish along the coast. The water quality of the creek and adjacent estuary should be maintained to meet or exceed State water quality standards. Dredging or filling operations should be conducted in a manner that will avoid or minimize disruption of fish returning to spawn in the Katlian River system as well as juvenile salmonids foraging in the nearshore zone. The placement of in-water structures such as piling, which provide a hard, stable surface area for attachment of marine plants and invertebrates would probably enhance the marine habitat diversity at this site. This site may be suitable for temporary log storage; however, further site evaluation by resource agencies is recommended.

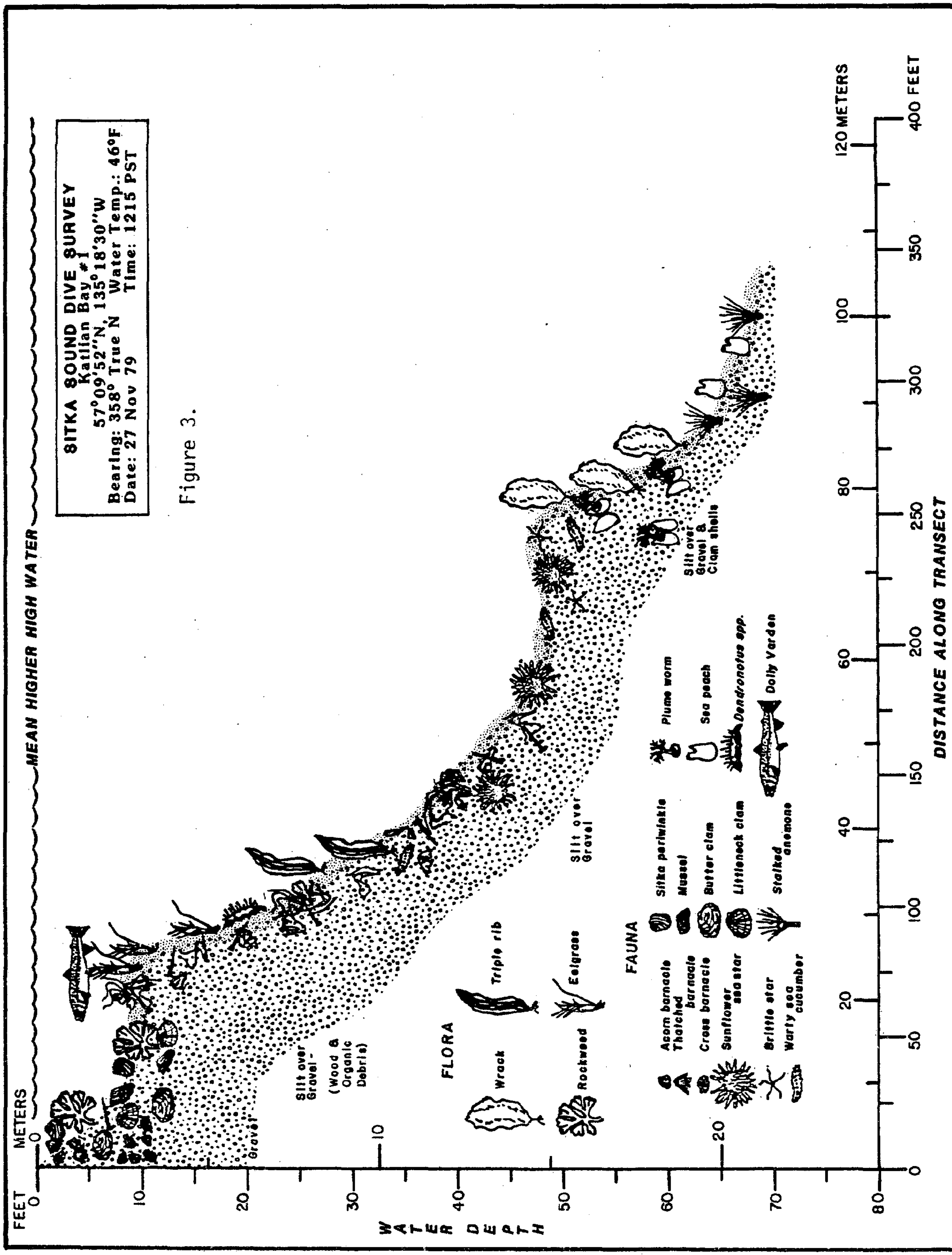

SITKA SOUND DIVE SURVEY
Katlian Bay #1
57°09'52"N, 135°18'30"W
Bearing: 358° True N
Water Temp: 46°F
Date: 27 Nov 79
Time: 1215 PST
MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
DISTANCE ALONG TRANSECT
120 METERS
400 FEET
Gravel
Silt over Gravel - (Wood & Organic Debris)
Silt over Gravel
Silt over Gravel & Clam shells
FLORA
Wrack
Rockweed
Triple rib
Eelgrass
FAUNA
Acorn barnacle
Thatched barnacle
Cross barnacle
Sunflower seastar
Brittle star
Warty sea cucumber
Sitka periwinkle
Mussel
Butter clam
Littleneck clam
Stalked anemone
Plume worm
Sea peach
Dendronotus spp.
Dolly Varden

Figure 3.

Katlian Bay No. 2

Site Description: The survey site was located on the south shore of Katlian Bay approximately one-quarter mile northeast of Mosquito Cove. The shore zone is a steep bedrock and boulder face that characterizes much of the south shore of Katlian Bay.

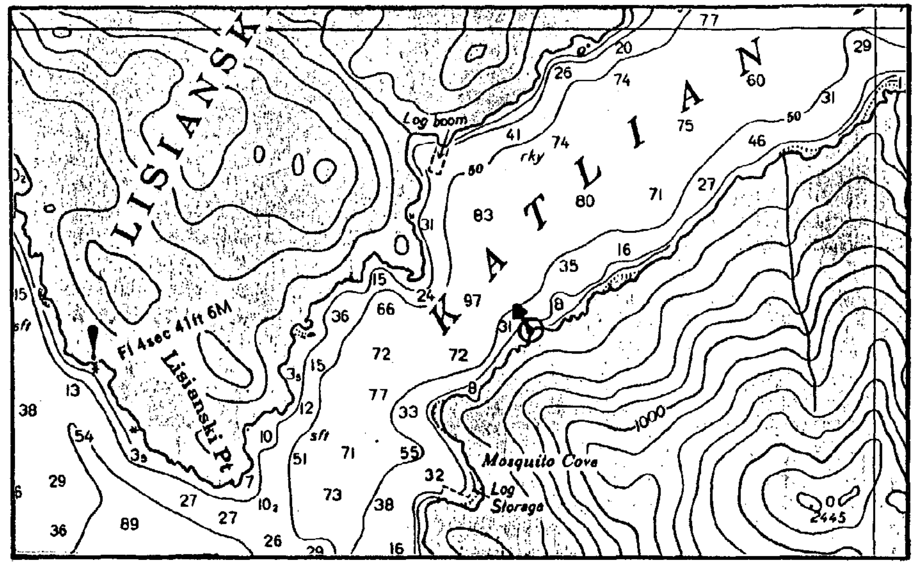
The narrow intertidal shelf was dominated by barnacle, limpet, and rockweed. Subtidally, vegetation included triple rib kelp and wrack. Pink coralline algae encrusted the rock surfaces. Invertebrates in the shallow subtidal zone included gumboot and lined chiton, leather star, burrowing sea cucumber, and the bryozoan, *Microporina borealis*. Fish species included kelp greenling and copper, dusky, and quillback rockfish.

Below 30 feet in depth, the bottom substrate changed to silt, gravel, and shell debris with scattered boulders and bedrock outcrops. Algal growth consisted mainly of encrusting corallines. Rock surfaces supported numerous orange crinoid sea feathers. The soft bottom areas were dominated by horse clam, sea pen, and sunflower sea star.

In contrast to the primarily detritus based marine community at Katlian No. 1, this site had a well developed assemblage of suspension feeding invertebrates that derive their food from plankton. This would indicate that more oceanic conditions and better circulation prevail at this site. The stability afforded by rock substrates favors longer lived organisms and greater species diversity. The area is known to support herring spawning.

Management Recommendations: The steep and rocky topography could make this site difficult for shoreline development.

Future road development along the south shore of Katlian Bay may result in the side casting of rock



and debris, which could adversely change the shoreline ecology. Rock and soil deposited here would temporarily alter the resident flora and fauna. Recolonization of the new substrates would result in a succession of marine communities. It is possible that herring spawning could be disrupted until the area stabilized. We recommend end hauling of road cuts rather than side casting of surplus overburden.

Any significant degradation of water quality through siltation, water temperature changes, oil spills, or toxic discharges would affect sensitive suspension feeders and herring. State water quality standards should be enforced within Katlian Bay for all future developments.

Temporary log storage at this site could reduce algal growth through shading, but would probably have little effect on subtidal suspension feeders. The steep bathymetry and good circulation at this site would minimize the smothering and leachate effects of bark accumulation. Further site evaluation by resource agencies is recommended if log storage is planned.

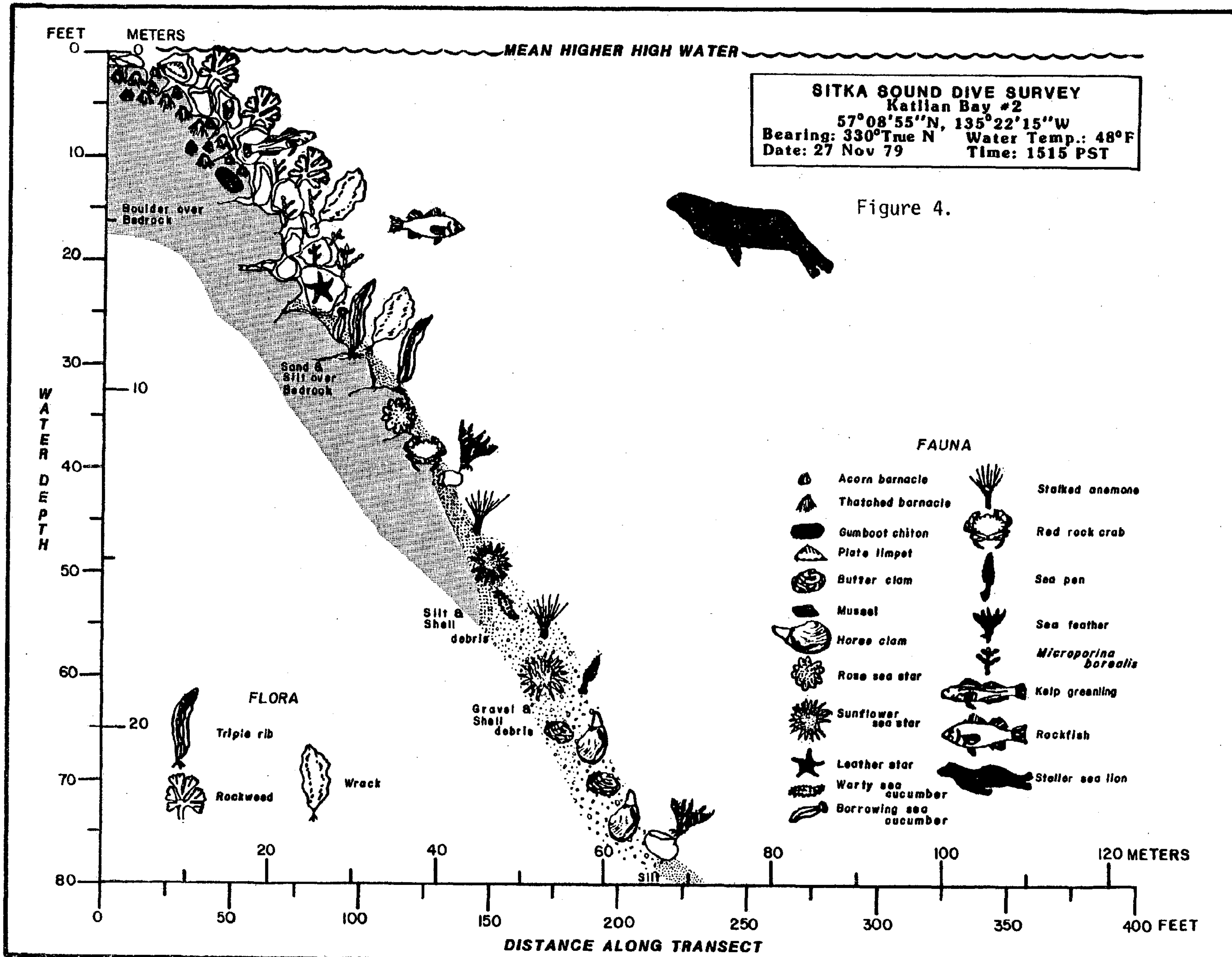

SITKA SOUND DIVE SURVEY
Katlian Bay #2
57°08'55"N, 135°22'15"W
Bearing: 330°True N
Water Temp.: 48°F
Date: 27 Nov 79
Time: 1515 PST
MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
DISTANCE ALONG TRANSECT
120 METERS
400 FEET
Boulder over Bedrock
Sand & Silt over Bedrock
Silt & Shell debris
Gravel & Shell debris
Silt
FLORA
Triple rib
Rockweed
Wrack
FAUNA
Acorn barnacle
Thatched barnacle
Gumboot chiton
Plate limpet
Butter clam
Mussel
Horse clam
Rose sea star
Sunflower sea star
Leather star
Warty sea cucumber
Borrowing sea cucumber
Stalked anemone
Red rock crab
Sea pen
Sea feather
Microporina borealis
Kelp greenling
Rockfish
Steller sea lion

Figure 4.

Harbor Point

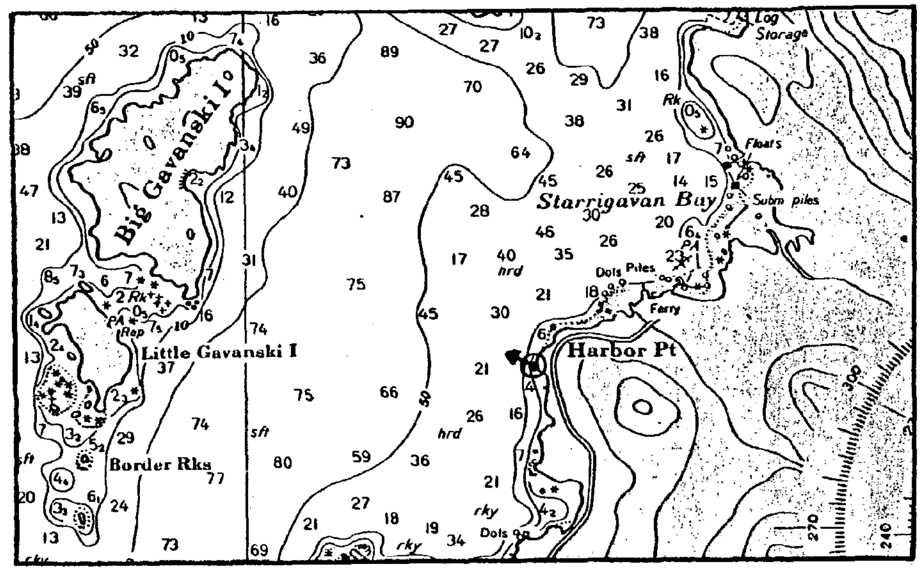
Site Description: The survey was conducted at Harbor Point located approximately one-third mile south of the State ferry terminal. The steep bedrock and boulder shoreline is similar in physical characteristics to Katlian No. 2.

The intertidal zone was a steep face of boulders resting on a bedrock ledge. Rockweed and barnacle were the dominant intertidal cover.

The shallow subtidal zone was a vertical bedrock face interspersed with crevices and ledges. The bryozoan, *Microporina borealis* was the dominant invertebrate. Burrowing sea cucumber and the brittle star, *Ophiopholus aculeata* occupied the rock crevices.

A macrophyte algae zone consisting primarily of sieve kelp and wrack was attached to boulders at the base of the rock wall between the depths of 25 and 45 feet. Octopus, kelp greenling, and dusky, copper, and quillback rockfish occurred here. Below 40 feet, the substrate changed to a mixture of silt, sand, shell debris, and gravel with bedrock outcrops. Invertebrates included butter and horse clam, burrowing stalked anemone, sunflower sea star and sea peach. Sea feather, plume worm, and red sea urchin occurred on rock substrate.

Like Katlian No. 2, the Harbor Point marine community consists of suspension feeding invertebrates and their associated predators. A large percentage of herbivores, notably red sea urchin, were present at Harbor Point due to the more well developed subtidal algae zone. Herring consistently spawn in this area.



Management Recommendations: Habitat sensitivities and management recommendations are similar to Katlian No. 2. Because of gravel dredging operations, the ferry terminal, and industrial marine activities immediately to the north, Harbor Point is susceptible to water quality degradation through siltation and oil spills. If port development expands in this area, sufficient equipment and trained personnel should be made available to effectively contain and clean up spilled oil under all weather conditions. In all future shore development in this area, State water quality standards should be enforced. Additionally, waterfront structures and operations should be designed to maintain fish passage along the coast to Starrigavan Creek as well as maintaining the shore zone for herring spawning. The steep, rocky shoreline and rapid drop off will probably preclude solid fills on tide lands at Harbor Point. Pile supported piers or floating docks, would probably have little effect upon the existing habitat.

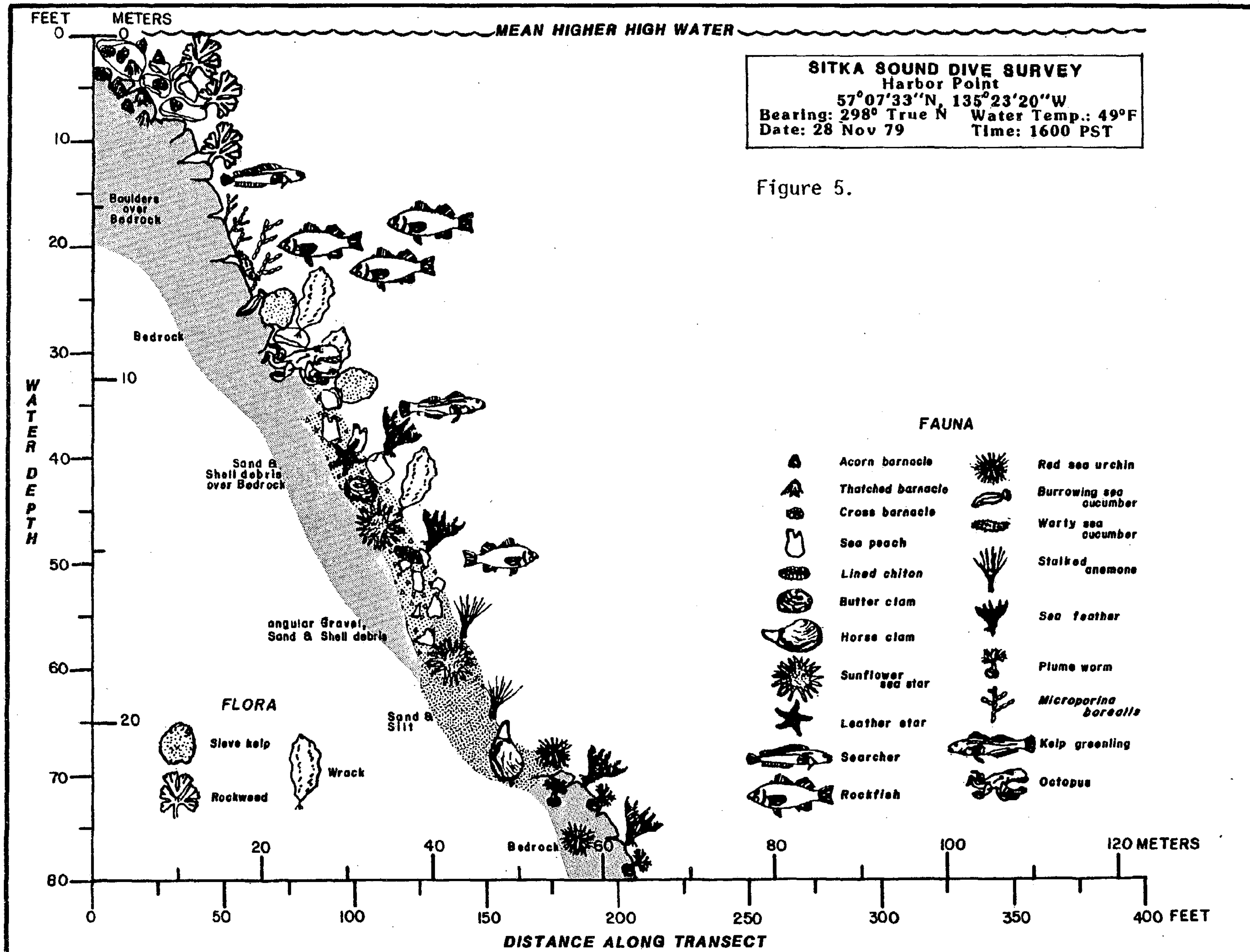

SITKA SOUND DIVE SURVEY
Harbor Point
57°07'33"N, 135°23'20"W
Bearing: 298° True N
Water Temp.: 49°F
Date: 28 Nov 79
Time: 1600 PST
MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
DISTANCE ALONG TRANSECT
Boulders over Bedrock
Bedrock
Sand & Shell debris over Bedrock
angular Gravel, Sand & Shell debris
Sand & Silt
Bedrock
FLORA
Sieve kelp
Rockweed
Wrack
FAUNA
Acorn barnacle
Thatched barnacle
Cross barnacle
Sea peach
Lined chiton
Butter clam
Horse clam
Sunflower sea star
Leather star
Searcher
Rockfish
Red sea urchin
Burrowing sea cucumber
Warty sea cucumber
Stalked anemone
Sea feather
Plume worm
Microporina borealis
Kelp greenling
Octopus
0
10
20
30
40
50
60
70
80
0
10
20
20
40
60
80
100
120 METERS
0
50
100
150
200
250
300
350
400 FEET

Figure 5.

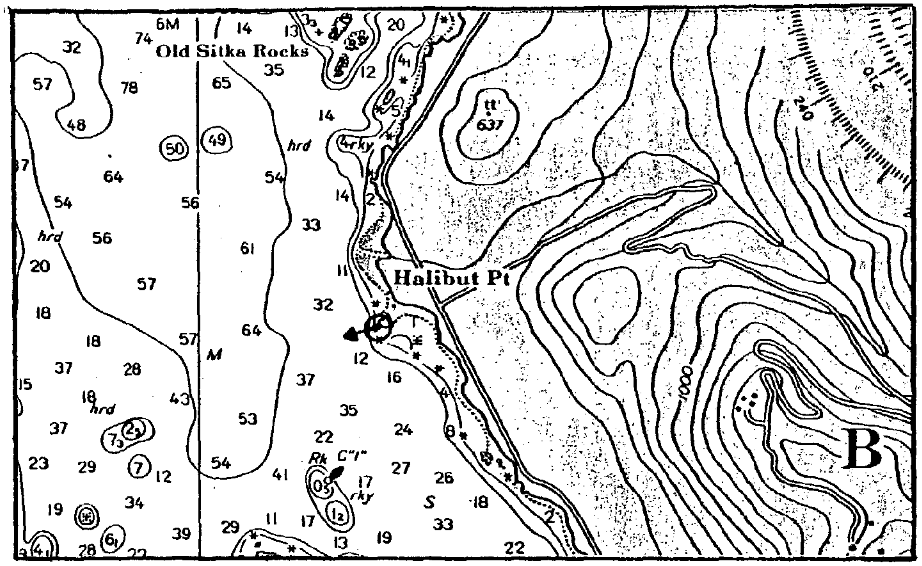
Halibut Point

Site Description: The survey was conducted on the seaward side of a small island located in the southwest corner of the Halibut Point Recreation Center.

The shore zone was a nearly vertical bedrock face that continued approximately 20 feet above and below the water surface. The intertidal zone was dominated by rockweed, barnacle, chiton, and periwinkle. In contrast to Harbor Point, the low intertidal/shallow subtidal zone was vegetated with wing kelp and triple rib kelp. Pink coralline algae encrusted the rock surfaces. Invertebrates included green sea urchin, purple sea star, and green anemone.

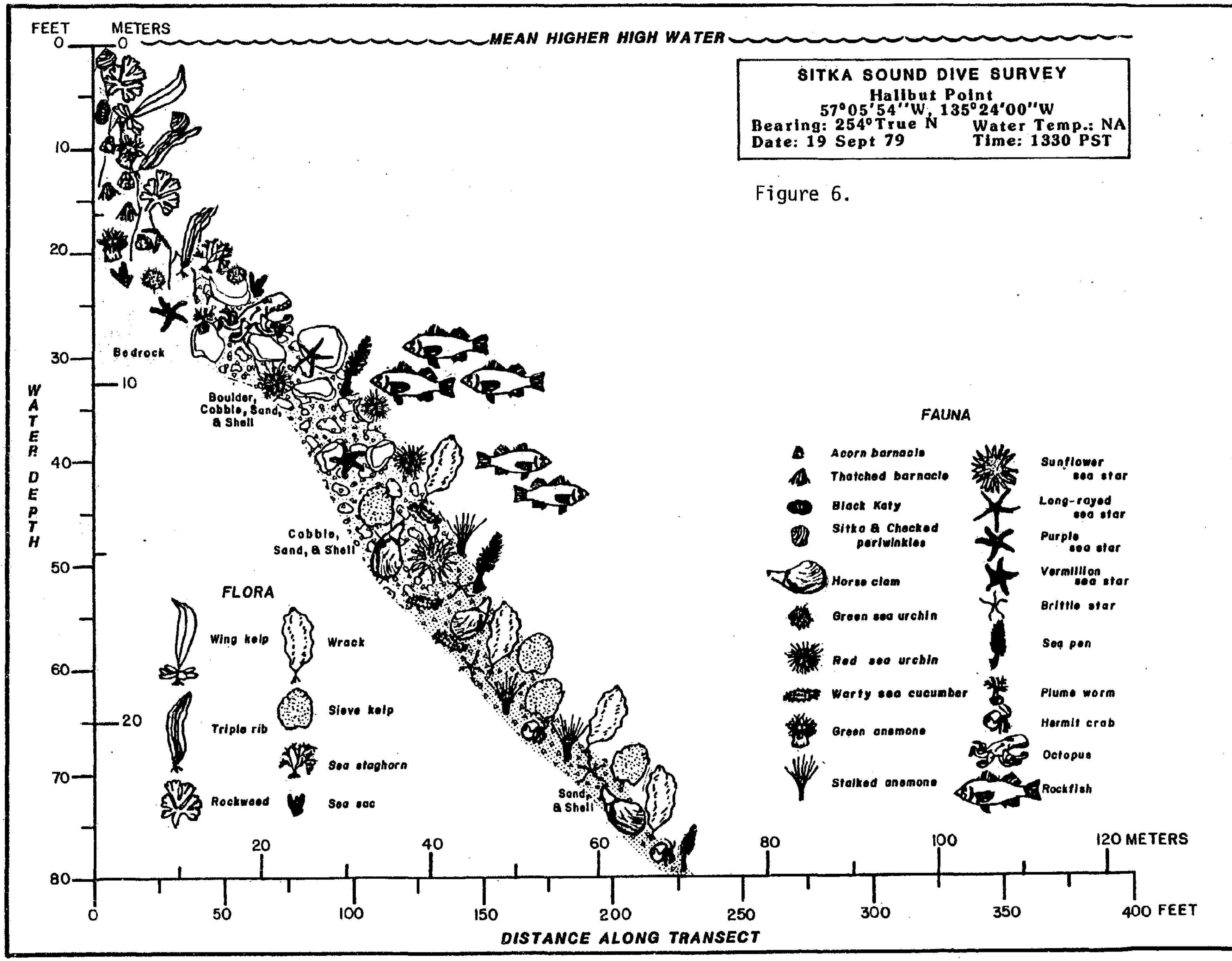
Below 25 feet in depth, the bottom substrate changed to a mixture of boulder, cobble, sand, and shell. Invertebrates included octopus, red sea urchin, plume worm, abalone, sea pen, and several species of sea star. Fish included china, quillback, dusky, and yellowtail rockfish.

At 40 feet in depth an algae zone consisting of sieve kelp and wrack continued downward to the end of the transect at 80 feet. This was one of the deepest Macrophyte zones observed in all of the underwater surveys, indicating perhaps that water clarity at this site is exceptional. Invertebrates included sea pen, brittle star, horse clam, hermit crab, sea cucumber, sunflower sea star, and burrowing stalked anemone. Herring consistently spawn in this area. See Table 2 for additional information on Halibut Point.



Management Recommendations: The Halibut Point site contained a diverse mix of grazers, deposit feeders, suspension feeders, detritivours, and their predators. This site is popular among local scuba divers because it affords easy access from the shore. The Halibut Point shore zone should be managed as a natural recreation and habitat area to provide continued public opportunities for resource harvest, education, and enjoyment. Maintenance of the high water quality in the area should be a primary goal. Sources of potential turbidity pollution such as the gravel pit operation on Granite Creek can be controlled through careful planning and operation of the pit. Any proposed placement of inwater structures or fill should be reviewed for its effect upon herring spawning habitat.

In the event of an oil spill, maximum efforts should be made to protect this area from contamination.


SITKA SOUND DIVE SURVEY
Halibut Point
57°05'54''W, 135°24'00''W
Bearing: 254°True N
Water Temp.: NA
Date: 19 Sept 79
Time: 1330 PST
MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
DISTANCE ALONG TRANSECT
Bedrock
Boulder, Cobble, Sand, & Shell
Cobble, Sand, & Shell
Sand, & Shell
FLORA
Wing kelp
Triple rib
Rockweed
Wrack
Sieve kelp
Sea staghorn
Sea sac
FAUNA
Acorn barnacle
Thatched barnacle
Black Katy
Sitka & Checked periwinkles
Horse clam
Green sea urchin
Red sea urchin
Warty sea cucumber
Green anemone
Stalked anemone
Sunflower sea star
Long-rayed sea star
Purple sea star
Vermillion sea star
Brittle star
Sea pen
Plume worm
Hermit crab
Octopus
Rockfish
Figure 6.

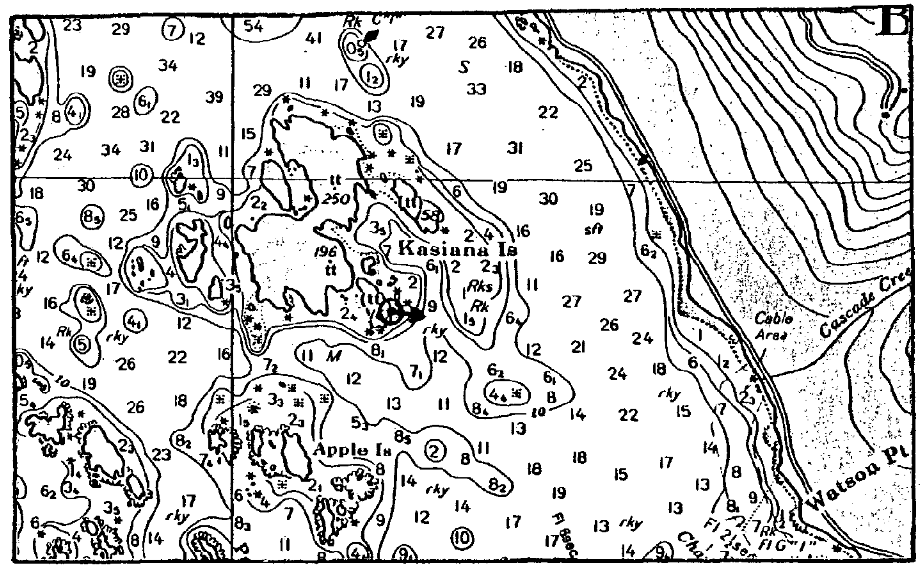
Kasiana Island

Site Description: The survey was located on the southeast island in the Kasiana Islands group. The island lies within a shoal area of numerous rocks, islets, and shallow channels. The shore zones within the area are influenced by wave surge and complex tidal currents.

The intertidal zone was composed of a narrow rock ledge and bedrock wall. Rockweed, sea sac, barnacle, limpet, and purple sea star were the major intertidal organisms.

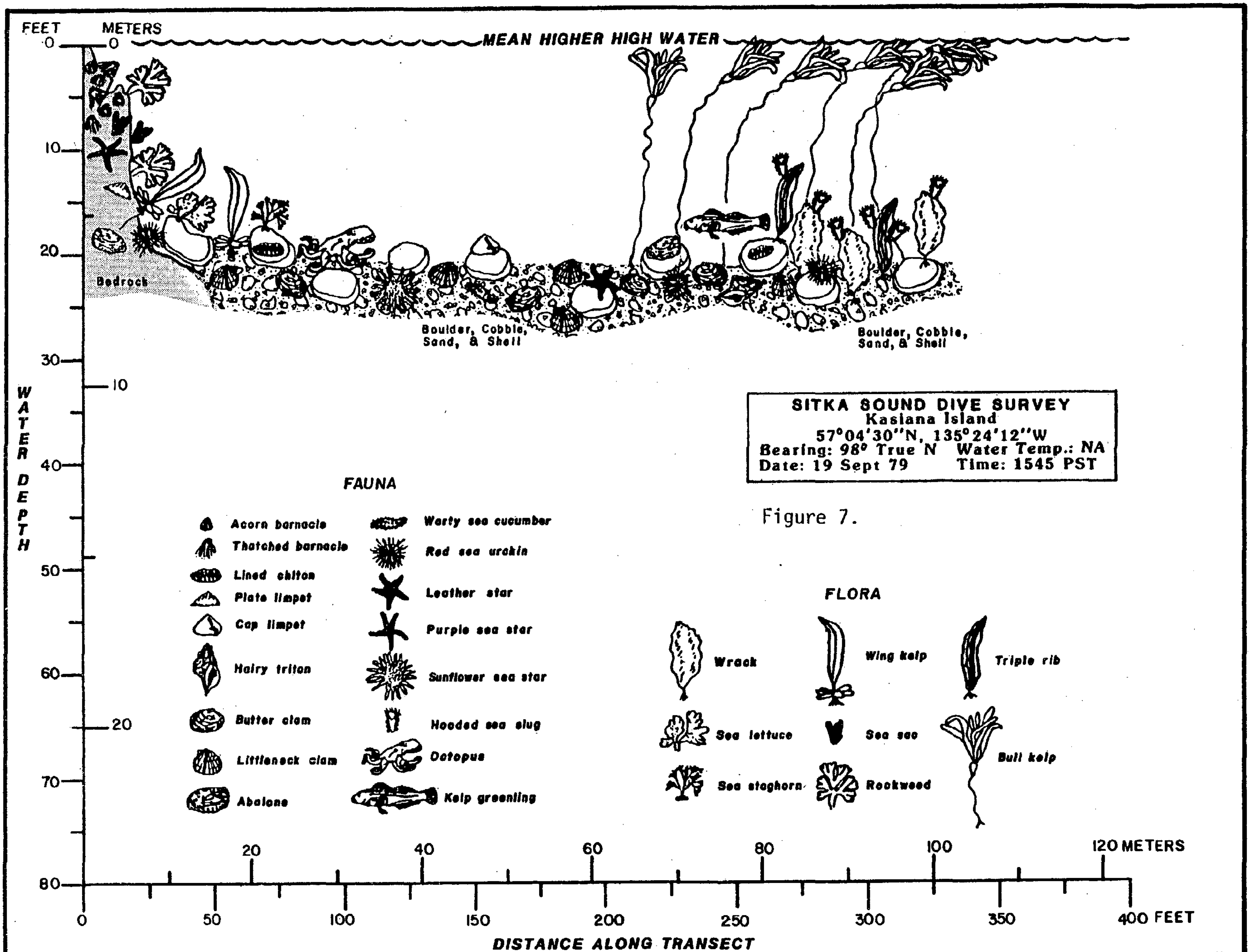
The subtidal zone was composed of a boulder and gravel field interspersed with pockets of sand and shell debris. Subtidal rocks were encrusted with coralline algae. A zone of wing kelp and sea staghorn occurred at the base of the bedrock wall. Abalone, hairy chiton, red sea urchin, cap limpet, and lined chiton were the dominant invertebrate grazers. Octopus, sea cucumber, leather star, and sunflower sea star also occurred. Infauna included littleneck and butter clam.

An algae bed consisting of a canopy of bull kelp with an understory of triple rib kelp and wrack, occurred approximately 200 feet from the shore. Major invertebrates within the kelp bed included red sea urchin, abalone, cap limpet, and lined chiton, all of which are considered grazers. Hooded sea slug, were attached to blades of kelp. Kelp greenling was the only fish species observed. This area is consistently used for herring spawning.



Management Recommendations: The survey site can be characterized as a moderately high energy environment similar to many of the outer coast and inshore islands of Sitka Sound. Although the area is partially protected by islets and shoals, tidal and wave surge mixing is vigorous, particularly during storm conditions. The biota at this site consists primarily of grazers, suspension feeders, and their predators. The algae bed is an important component of the marine community.

The kelp beds and herring spawning habitat at Kasiana Islands should be maintained if developments are planned. Any necessary tideland alteration, dredging, etc., should be timed to avoid the herring spawning season (March-April). In general, shore zone filling is not recommended. Where fills are necessary, only clean rock material should be used and fills should be confined to the upper four feet of the intertidal zone. Piling supported structures are recommended in lieu of solid fills. Upland development on Kasiana Island such as gravel extraction and housing should be monitored for its effect on nearshore water quality, particularly increased turbidity.



FEET
METERS
MEAN HIGHER HIGH WATER
Bedrock
Boulder, Cobble, Sand, & Shell
Boulder, Cobble, Sand, & Shell
WATER DEPTH
0
10
20
30
40
50
60
70
80
0
10
20
SITKA SOUND DIVE SURVEY
Kasiana Island
57°04'30"N, 135°24'12"W
Bearing: 98° True N
Water Temp.: NA
Date: 19 Sept 79
Time: 1545 PST
FAUNA
Acorn barnacle
Thatched barnacle
Lined chiton
Plate limpet
Cap limpet
Hairy triton
Butter clam
Littleneck clam
Abalone
Warty sea cucumber
Red sea urchin
Leather star
Purple sea star
Sunflower sea star
Hooded sea slug
Octopus
Kelp greenling
FLORA
Wrack
Wing kelp
Triple rib
Sea lettuce
Sea sac
Bull kelp
Sea staghorn
Rockweed
20
40
60
80
100
120 METERS
0
50
100
150
200
250
300
350
400 FEET
DISTANCE ALONG TRANSECT

Figure 7.

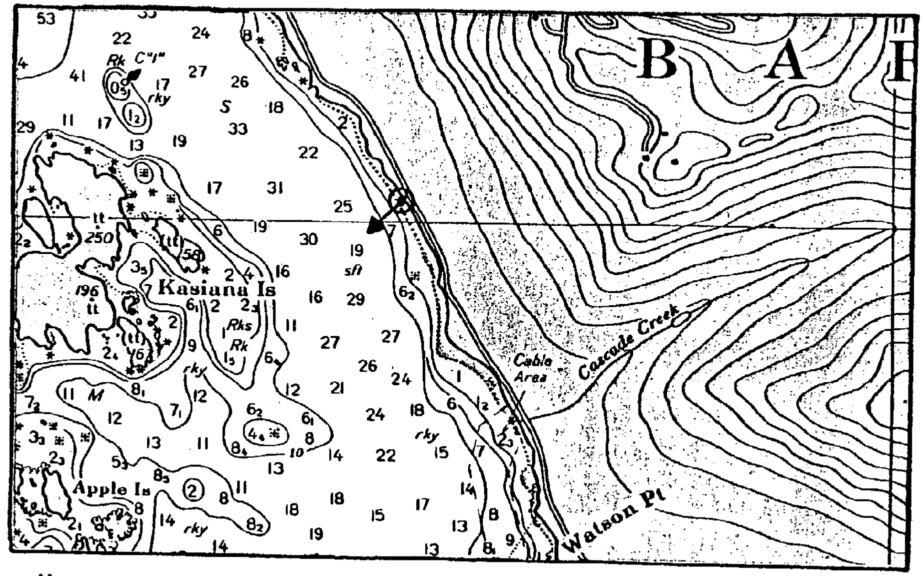
2500 Block, Halibut Point Road

Site Description: The survey was located along the shore adjacent to the 2500 Block of Halibut Point Road. The beach was composed of rounded boulders interspersed with small pockets of cobble, gravel, and sand. The beach appears to receive considerable wave action, particularly ocean generated swell that enters through the Western Channel. During the survey, a two foot swell and beach surge was encountered.

The upper intertidal zone was nearly devoid of attached plants and animals. The instability of the substrates was evident as waves broke on the beach and rocks shifted and ground against each other. The substrate instability was responsible for the paucity of biota found in the upper intertidal zone. The lower intertidal zone contained a scattering of rockweed, barnacle, limpet, and mussel.

Within the shallow subtidal zone, marine life became more abundant. An algae bed consisting of seersucker kelp, rockweed, sea lettuce, and sea staghorn occurred below the tide line. Coralline algae encrusted the rock surfaces. Invertebrates included thatched barnacle, hermit crab, and octopus.

At 25 feet depth, the boulder and cobble substrate ended abruptly, becoming a low gradient slope of gravel, sand, and shell debris. Sieve kelp and wrack were the dominant algae. Epifauna included plume worms, brittle stars and a high density of sunflower sea stars. Butter clams were the dominant infauna and were the principal prey item of the sea stars. A swarm of crustacean larvae, probably pandalid shrimp, were present near the bottom. Numerous rock sole were also noted. Herring consistently spawn in this area.



Management Recommendations: Harsh physical conditions ofwave energy and unstable substrate probably limit the biota in the upper intertidal zone. Successful species in this area, including acorn barnacle, are short-lived and quick to reproduce. The placement of rock fill or revetments above the four foot (MLLW) tide line, would probably have only a temporary impact upon the intertidal habitat of this area.

Developments occurring in the low intertidal and subtidal zone should be reviewed for their effect upon algae beds, herring spawning habitat, and juvenile salmonid feeding and migration. In-water construction activities should be timed to avoid the herring spawning season (March-April).

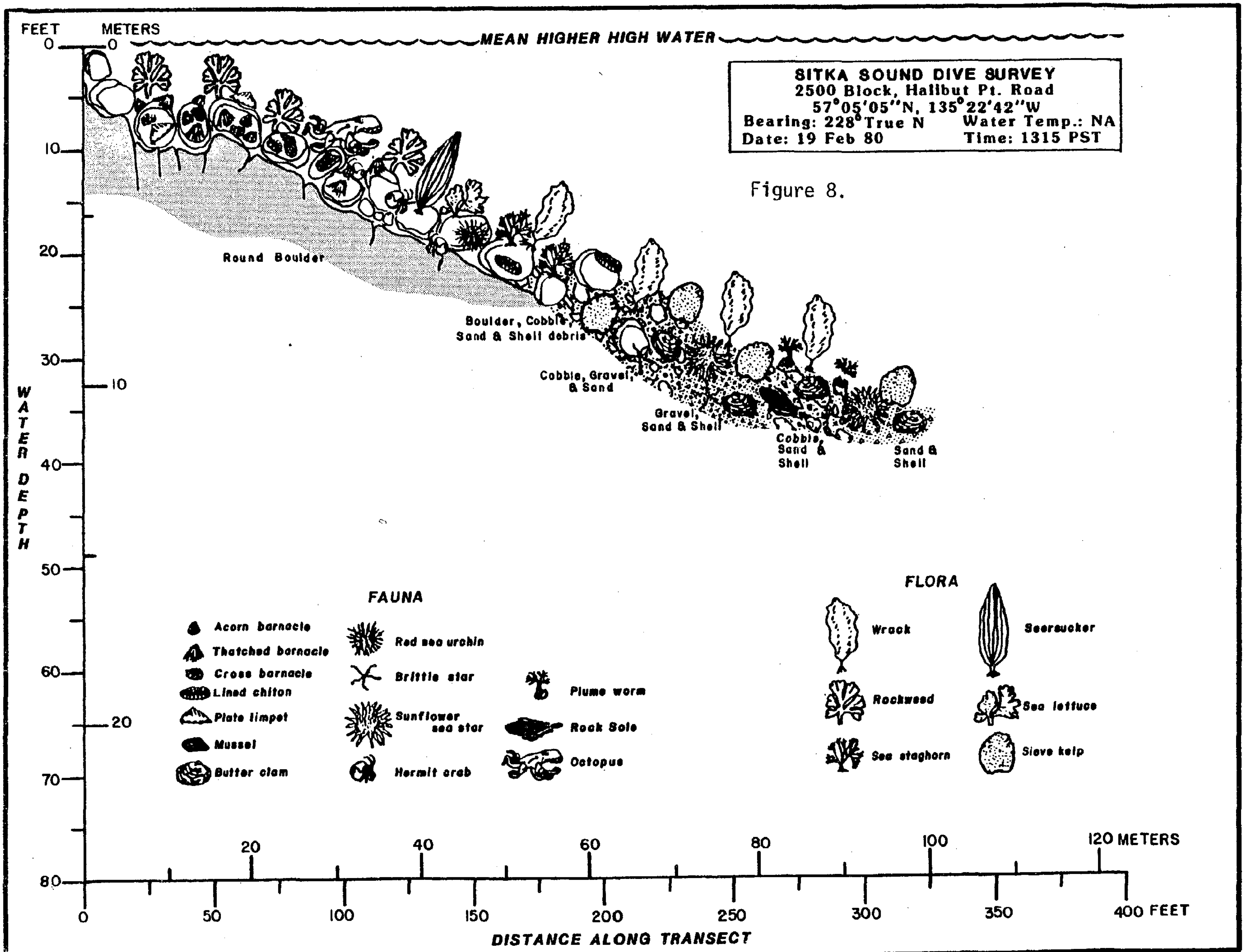

SITKA SOUND DIVE SURVEY
2500 Block, Halibut Pt. Road
57°05'05"N, 135°22'42"W
Bearing: 228° True N
Water Temp.: NA
Date: 19 Feb 80
Time: 1315 PST
MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
Round Boulder
Boulder, Cobble, Sand & Shell debris
Cobble, Gravel, & Sand
Gravel, Sand & Shell
Cobble, Sand & Shell
Sand & Shell
FAUNA
Acorn barnacle
Thatched barnacle
Cross barnacle
Lined chiton
Plate limpet
Mussel
Butter clam
Red sea urchin
Brittle star
Sunflower sea star
Hermit crab
Plume worm
Rock Sole
Octopus
FLORA
Wrack
Rockweed
Sea staghorn
Seersucker
Sea lettuce
Sieve kelp
120 METERS
400 FEET
DISTANCE ALONG TRANSECT

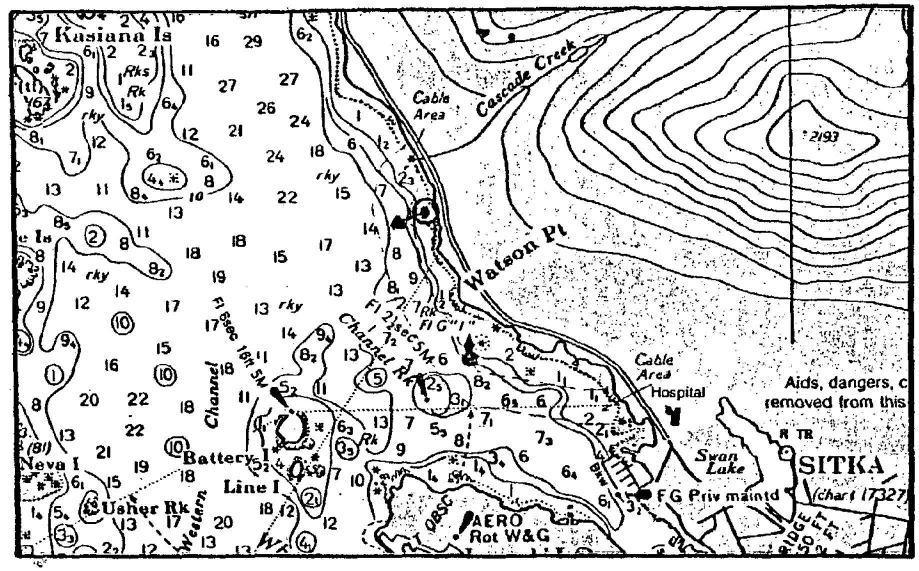
Figure 8.

2000 Block, Halibut Point Road

Site Description: The survey was located along the shore adjacent to the 2000 Block of Halibut Point Road. The shoreline at this site is similar in physical character to the shoreline at 2500 Block, Halibut Point Road with the exception that this site appears to be somewhat more protected from large waves. Both sites generally typify the coast lying between mile 1.7 and mile 3.5 of Halibut Point Road.

The intertidal beach is a boulder and cobble matrix with scattered patches of gravel and sand. Barnacles and plate limpet were the dominant epifauna in the upper intertidal zone. The rockweed zone began at the five foot tide line MLLW and extended into the low intertidal zone to the zero tide line MLLW. Lower intertidal invertebrates included giant barnacle, six-rayed sea star, and red sea urchin.

Three distinct zones of marine plants occurred within the shallow subtidal zone. At -1 feet MLLW, pompom kelp dominated the first zone. At -2 feet wing kelp was dominant and at -3 feet, a narrow fringe of basket grass occurred. Below these zones scattered wing kelp and sea staghorn occurred to -10 feet where sieve kelp became monospecific to the end of the transect. Coralline algae encrusted all subtidal rock surfaces. Invertebrates included plume worm, lined chiton, red sea urchin, striped anemone, abalone, cap limpet, and sea stars. Fishes included copper, dusky, and quillback rockfish and kelp greenling. Herring are known to consistently spawn in this area.



Management Recommendations: This site, like 2500 Block, is influenced by wave energy and substrate instability. Unlike 2500 Block, this site has a well developed macrophyte algae community and greater species diversity. It is probable that this area is somewhat more stable and protected from wave impacts than 2500 Block; however, the flora and fauna are still typical of a high energy rocky shore. Construction of revetments and rock fill should be confined above the six foot MLLW tide line in order to minimize effects upon the low intertidal ecosystem. Coastal access should be addressed in all tideland fills particularly where publicly owned tidelands are involved. If tideland filling or shoreline stabilization is planned for this area, we recommend reserving a minimum strip of 50 feet width for public access along the beach. We also recommend reserving lateral public access to the beach at frequent intervals along Halibut Point Road.

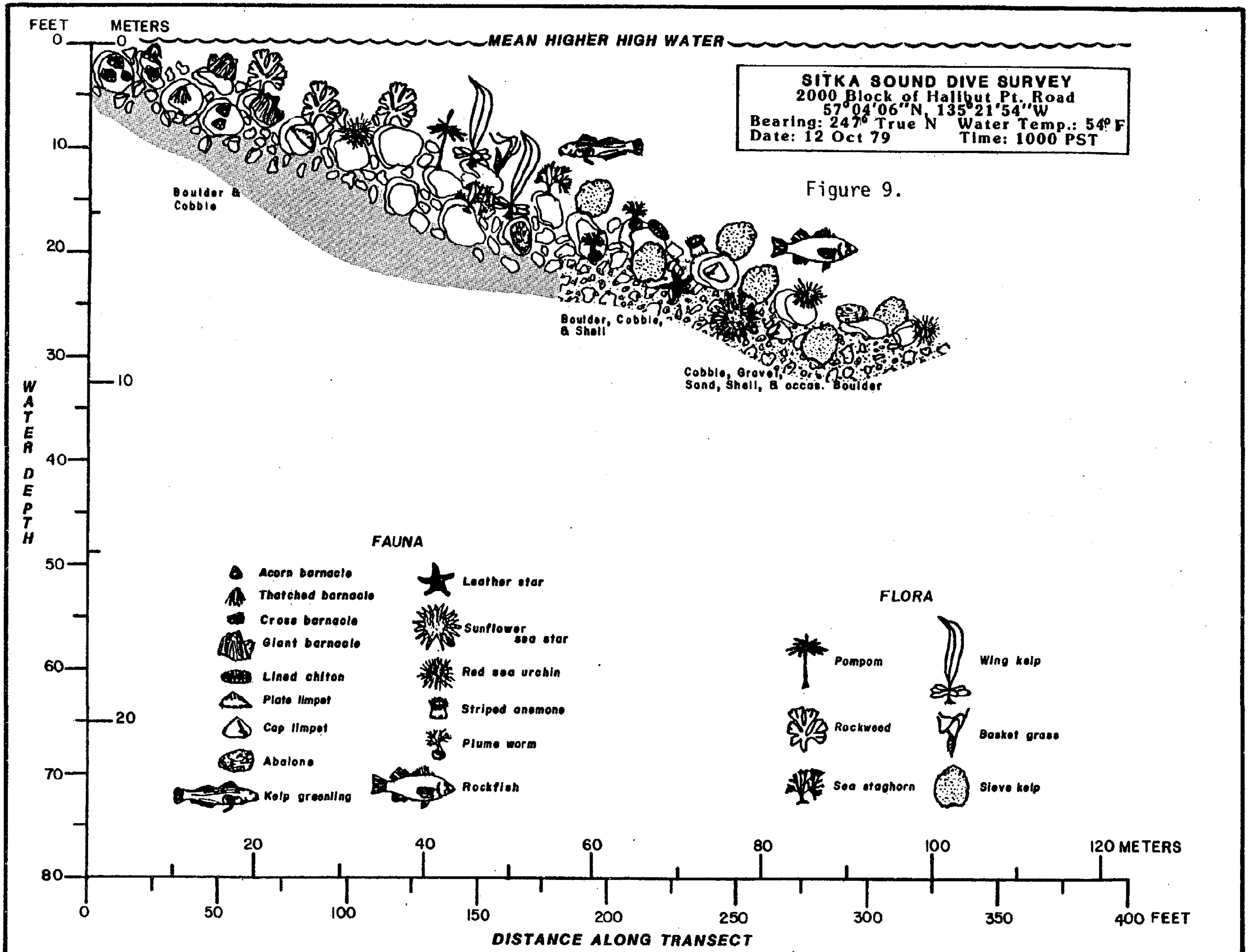

SITKA SOUND DIVE SURVEY
2000 Block of Halibut Pt. Road
57°04'06"N, 135°21'54"W
Bearing: 247° True N
Water Temp.: 54°F
Date: 12 Oct 79
Time: 1000 PST
MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
Boulder & Cobble
Boulder, Cobble, & Shell
Cobble, Gravel, or Sand, Shell, & occas. Boulder
FAUNA
Acorn barnacle
Thatched barnacle
Cross barnacle
Giant barnacle
Lined chiton
Plate limpet
Cap limpet
Abalone
Kelp greenling
Leather star
Sunflower sea star
Red sea urchin
Striped anemone
Plume worm
Rockfish
FLORA
Pompom
Rockweed
Sea staghorn
Wing kelp
Basket grass
Sieve kelp
DISTANCE ALONG TRANSECT
120 METERS
400 FEET

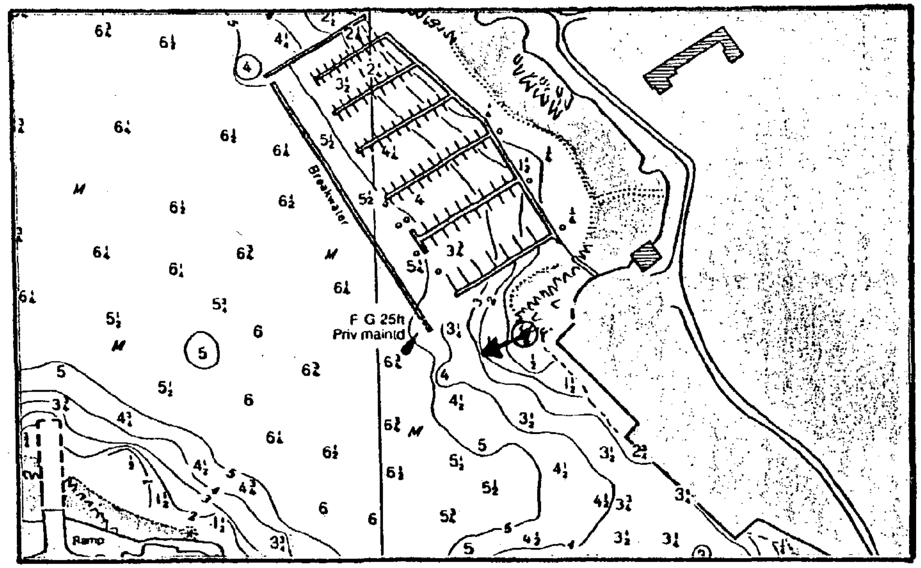
Figure 9.

Thomsen Harbor Parking Lot

Site Description: The survey was located just south of the Thomsen small boat harbor at the base of the parking lot fill. The survey transect extended into Sitka Channel.

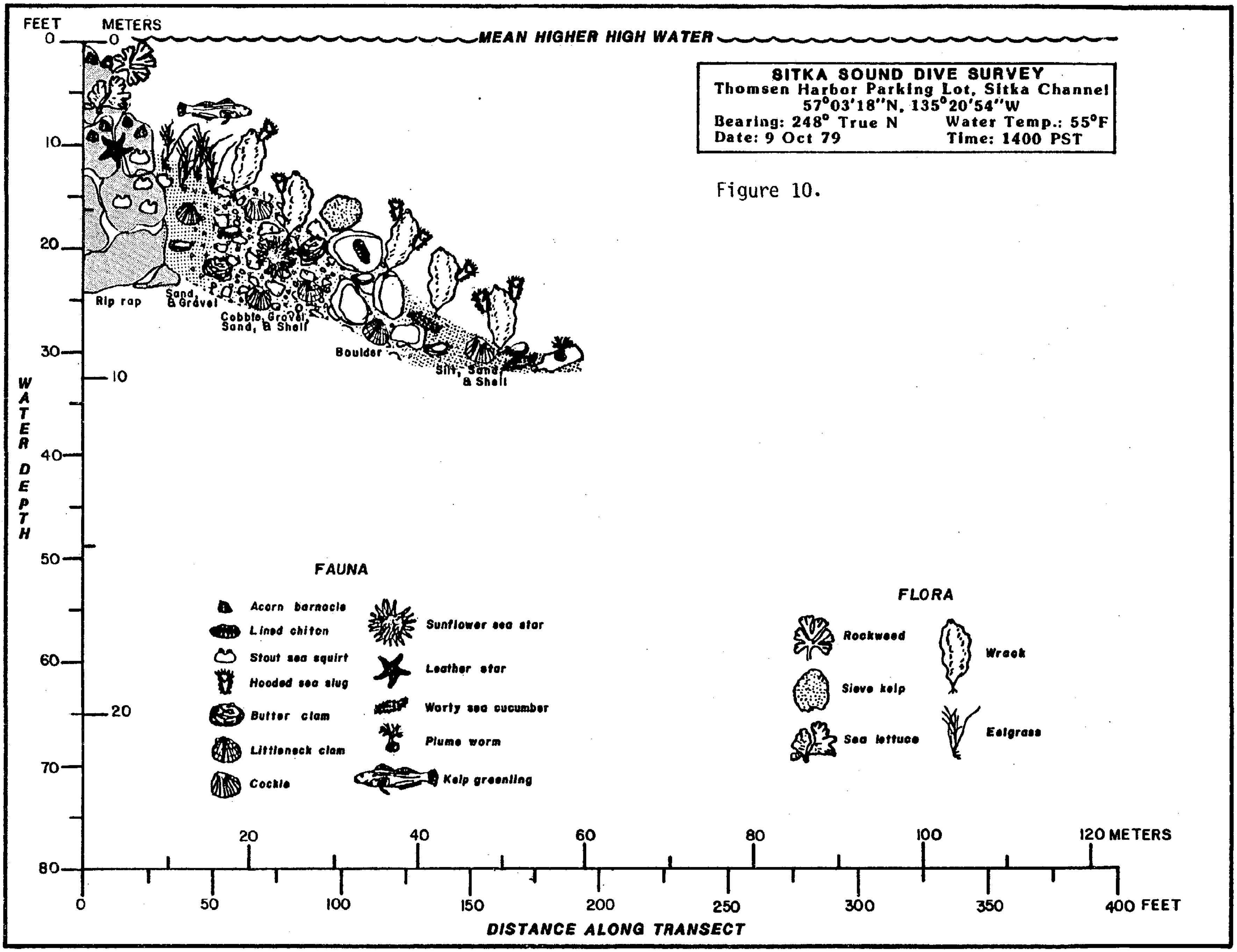
The intertidal zone is a rip-rap fill constructed in 1977 as part of a city port development project. Rockweed and sea lettuce were the dominant algal cover. Acorn barnacle, Sitka periwinkle, and plate limpet were sparsely distributed, intertidal invertebrates.

Subtidally, stout sea squirt, an opportunistic colonizer, was the dominant invertebrate, covering much of the rock surfaces. Thatched barnacle, plate limpet, and leather star were also found. Patches of coralline algae encrusted rocks. The toe of the rip-rap wall occurred at approximately -5 feet MLLW. Here, the substrate changed abruptly to sand and shell debris. A narrow band of eelgrass extended for approximately ten feet before the bottom sloped towards the channel. The bottom was a mixture of sand, gravel, cobble, and shell debris with patches of boulders. Algal cover consisted primarily of wrack, sieve kelp, and *Callophyllis* "type" red algae. The blades of kelp supported hooded sea slug. Epifauna included sea cucumber, lined chiton, plume worm, and sunflower sea star. Infauna included littleneck and butter clam and cockle. Herring spawn consistently to the north on Japonski Island and Seaplane Turnaround Flats; however, herring are not known to spawn at this site, nor anywhere within Sitka Channel.



Management Recommendations: The marine ecosystem at Thomsen Harbor is in transition following the recent waterfront development projects. It is likely that this area also receives chronic pollution from petroleum spills, detergents, seafood wastes, and sewage associated with boats and waterfront activities. Tide and wind driven circulation through Sitka Channel contributes to supporting suspension feeding invertebrates and their associated predators. The circulation contributes to the dilution and "flushing" of pollutants, thus mitigating some of the adverse effects.

Pile supported structures, such as the adjacent Halibut Producer's Co-op, are environmentally superior to solid fills in the Sitka Channel. We recommend that an effective oil spill contingency plan be developed for the Sitka Channel and that sufficient containment and clean-up equipment be stored in Sitka to handle the largest potential petroleum spill on the waterfront.



FEET
METERS
MEAN HIGHER HIGH WATER
SITKA SOUND DIVE SURVEY
Thomsen Harbor Parking Lot, Sitka Channel
57°03'18"N, 135°20'54"W
Bearing: 248° True N
Water Temp.: 55°F
Date: 9 Oct 79
Time: 1400 PST
Rip rap
Sand, & Gravel
Cobble, Gravel, Sand, & Shell
Boulder
Silt, Sand & Shell
WATER DEPTH
FAUNA
Acorn barnacle
Lined chiton
Stout sea squirt
Hooded sea slug
Butter clam
Littleneck clam
Cockle
Sunflower sea star
Leather star
Worty sea cucumber
Plume worm
Kelp greenling
FLORA
Rockweed
Sieve kelp
Sea lettuce
Wrack
Eelgrass
120 METERS
400 FEET
DISTANCE ALONG TRANSECT

Figure 10.

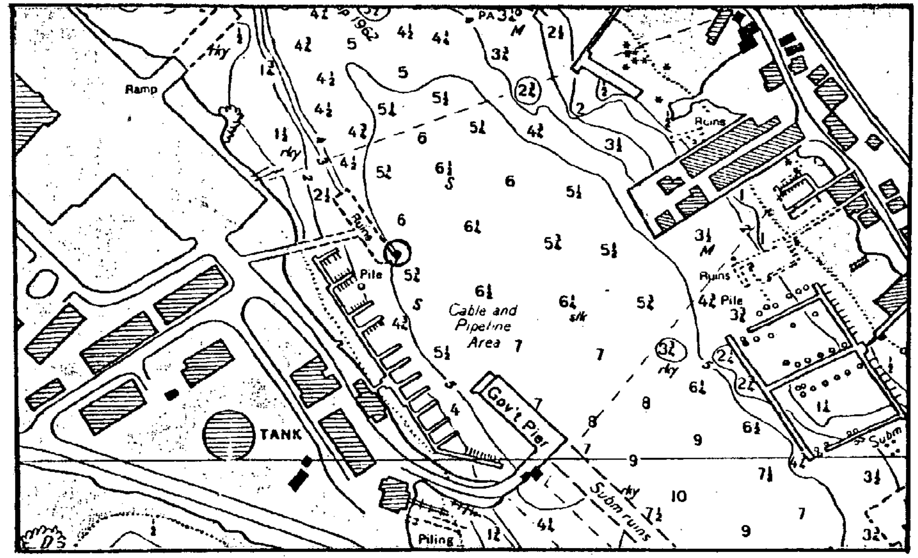
Old Navy Dock

Site Description: The survey was located at the abandoned Old Navy Dock located on the west side of the Sitka Channel. The dock is a creosote-treated, wooden-pile supported structure constructed during the 1940's. It has since fallen into disrepair. Many of the piles are broken off at the mud line or are seriously weakened by boring clams (shipworms). The survey transect included the southeast corner pile and the bottom at the base of the dock.

The intertidal portion of the pile supported barnacle, mussel, and clumps of rockweed. The lower intertidal zone was dominated by leather star and purple sea star, both of which preyed upon the mussels and barnacles.

Subtidally, the flora and fauna showed little apparent zonation. A diverse assemblage of suspension feeding invertebrates including plume worm, sponge, rock scallop, bryozoan, hydrozoan, sea squirt, anemone, brittle star, and shipworm were found. Attached macrophytes included rockweed, sieve kelp, wrack, and several species of red algae. Herbivorous invertebrates included limpet, snail, and green sea urchin. Predators and scavengers included purple, slender, leather, rose, and sunflower sea star; several species of snail; hermit crab; copper rockfish; and kelp greenling. A school of herring was also present.

The bottom substrate at the base of the dock consisted of mix of sand, silt, and shell debris. Manmade debris, such as tires, cans, bottles, wire, and pipe, littered the area. Scattered clumps of eelgrass were the principal macrophyte present. Epifauna included burrowing stalked anemone and sunflower sea star. The infauna included bent-nosed clams. A length of ten inch pipe and a tire provided cover for an octopus and searcher.



Management Recommendations: The rich growth of suspension feeding invertebrates indicates that this site has good water circulation. At the time of the survey, an estimated one-quarter knot current set northwest through the site. The marine community is a diverse and complex assemblage of suspension feeders, herbivores, predators, and scavengers. This site provides an example of creating additional marine habitat through the utilization of piling supported structures.

We recommend the utilization of piling in lieu of solid tideland fills for new waterfront construction in the Sitka Channel. The use of concrete and steel piling eliminates problems associated with boring clams, rot, and fire. Piling supported piers will maintain and often enhance feeding and rearing areas for herring, salmon, bottom fish, and forage fish, while solid fills generally eliminate shore zone habitat. A fishing pier constructed near this area, perhaps with an artificial "reef" at its base would attract sport fish species for recreational and subsistence use by the public.

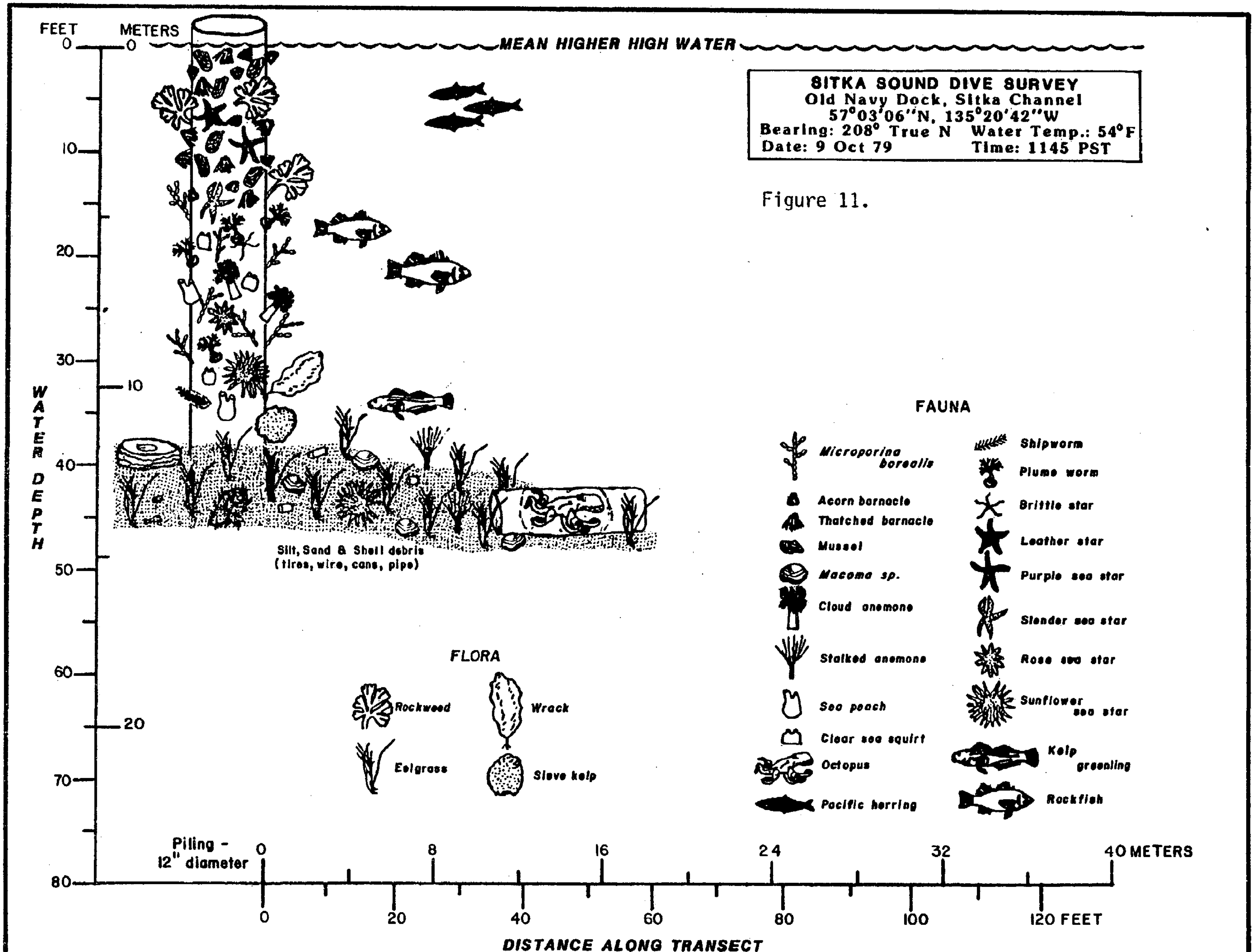

SITKA SOUND DIVE SURVEY
Old Navy Dock, Sitka Channel
57°03'06"N, 135°20'42"W
Bearing: 208° True N Water Temp.: 54°F
Date: 9 Oct 79 Time: 1145 PST
MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
Silt, Sand & Shell debris (tires, wire, cans, pipe)
FLORA
Rockweed
Wrack
Eelgrass
Sieve kelp
FAUNA
Microporina borealis
Acorn barnacle
Thatched barnacle
Mussel
Macoma sp.
Cloud anemone
Stalked anemone
Sea peach
Clear sea squirt
Octopus
Pacific herring
Shipworm
Plume worm
Brittle star
Leather star
Purple sea star
Slender sea star
Rose sea star
Sunflower sea star
Kelp greenling
Rockfish
Piling - 12" diameter
0
8
16
24
32
40 METERS
0
20
40
60
80
100
120 FEET
DISTANCE ALONG TRANSECT

Figure 11.

Jamestown Bay

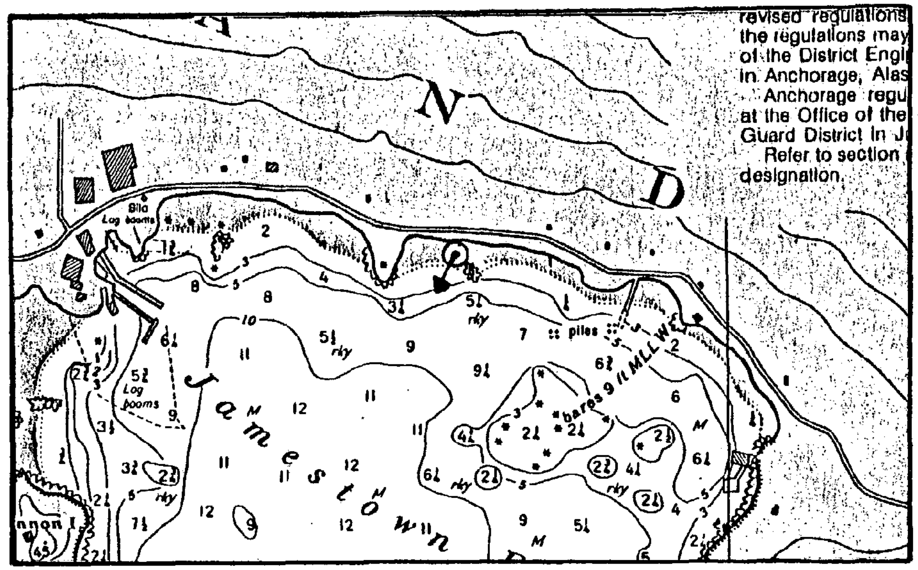
Site Description: The survey was located approximately mid-way along the shoreline in Jamestown Bay. Jamestown Bay is a semi-protected embayment that receives moderate wave activity and swell during strong westerly storms. The beach at the survey site was composed of boulders, cobbles, and gravel.

Macrophyte algae were sparse in the upper intertidal zone. Invertebrates included acorn and thatched barnacle and plate limpet. The lower intertidal zone was covered with rockweed. Mussel, lined chiton, periwinkle, and blue top snail were the dominant invertebrates.

A sharp transition in substrate occurred at the lower tide line. The boulder and cobble substrate in the intertidal zone abruptly changed to gravel and sand, then graded towards finer materials with depth.

In the shallow subtidal zone, a narrow band of eelgrass occupied the sand and silt substrate. Invertebrates within the eelgrass bed included sea cucumber and hermit crab. A school of juvenile herring occurred along the fringe of the eelgrass bed.

Below the eelgrass bed, algae growth consisted of scattered wrack and sieve kelp. Seersucker kelp was dominant below 20 feet in depth. Epifauna was sparse. A sunken log riddled with shipworm burrows provided substrate for plumeworm and sea peach. Sunflower sea star preyed upon bent nosed and truncated clams which were the dominant infauna in the silt and organic detritus bottom. Below 35 feet in depth, no macrophytes were found. Burrowing anemone, brittle star, hermit crab, and scattered plume worm were the dominant invertebrates. Most plants and animals were coated with fine silt. Herring are no longer reported to spawn in Jamestown Bay.



Management Recommendations: Jamestown Bay lacked the species diversity found elsewhere along the Sitka waterfront and appeared to be under stress from siltation. Industrial operations along the west shore including a sawmill, marine ways, and concrete batch plant, as well as recent gravel dredging operations, have caused local siltation problems. Upland land use practices, including the large clearcut above Jamestown Bay, cause soil erosion and increased runoff that may have also contributed to the siltation of the marine environment in Jamestown Bay. The Bay also receives a portion of the sulphite waste liquor plume from the pulpmill, causing a discoloration of the surface water. The discoloration coupled with increased turbidity from shoreland development practices, may have a limiting effect upon subtidal macrophyte growth that we observed.

We recommend that the City in cooperation with ADEC, attempt to improve the water quality of the Bay, or at least prevent any further deterioration. We recommend floating and pier supported structures rather than solid tideland fills for the waterfront development. The shoreline, seaward of the road, should be reserved for water-dependent uses.

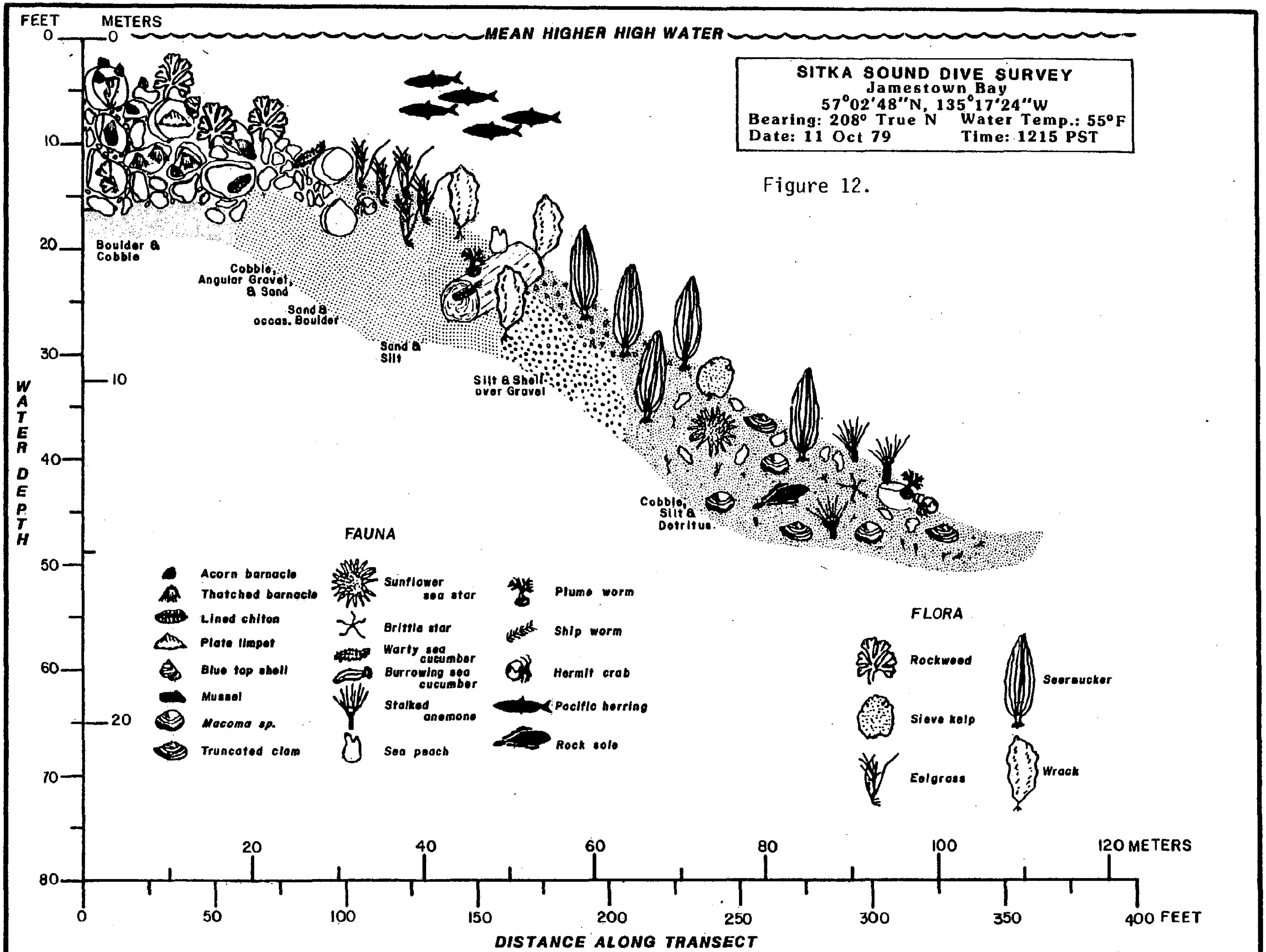

SITKA SOUND DIVE SURVEY
Jamestown Bay
57°02'48"N, 135°17'24"W
Bearing: 208° True N
Water Temp.: 55°F
Date: 11 Oct 79
Time: 1215 PST
MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
Boulder & Cobble
Cobble, Angular Gravel, & Sand
Sand & occas. Boulder
Sand & Silt
Silt & Shell over Gravel
Cobble, Silt & Detritus
FAUNA
Acorn barnacle
Thatched barnacle
Lined chiton
Plate limpet
Blue top shell
Mussel
Macoma sp.
Truncated clam
Sunflower sea star
Brittle star
Warty sea cucumber
Burrowing sea cucumber
Stalked anemone
Sea peach
Plume worm
Ship worm
Hermit crab
Pacific herring
Rock sole
FLORA
Rockweed
Sieve kelp
Eelgrass
Seersucker
Wrack
120 METERS
400 FEET
DISTANCE ALONG TRANSECT

Figure 12.

Thimbleberry Bay

Site Description: The survey was located in the northeast corner of Thimbleberry Bay. The transect ran from the shoreline, through a silt basin, towards a rocky outcrop in the bay. The shoreline in Thimbleberry Bay is characteristically rocky and fairly protected from westerly winds, ocean swells, and waves by Marshall and Harris islands.

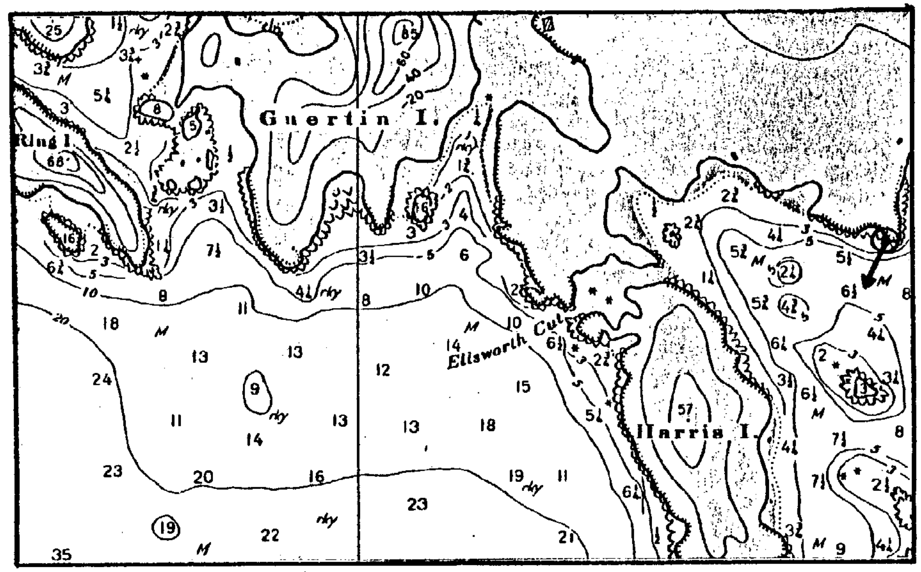
The intertidal zone was a steep bedrock and boulder beach. Rockweed, barnacle, and shield limpet were found in the upper intertidal zone. The lower intertidal invertebrates included barnacle, shield limpet, plate limpet, green sea urchin, purple shore crab, lined chiton, and mussel.

Algae in the low intertidal and shallow subtidal zones included rockweed and encrusting and foliose corallines. Wrack, sieve kelp, and cup and saucer were dominant subtidal algae. No algae were found below the 35 foot depth contour.

The bottom sloped steeply away from the shoreline to approximately 45 feet depth, where it opened into a basin that then sloped upwards towards an exposed rock outcrop. Benthic substrates changed rapidly with depth and slope. Predominant rock substrate changed to sand at approximately 30 foot depth and then graded towards fine silt with increasing depth.

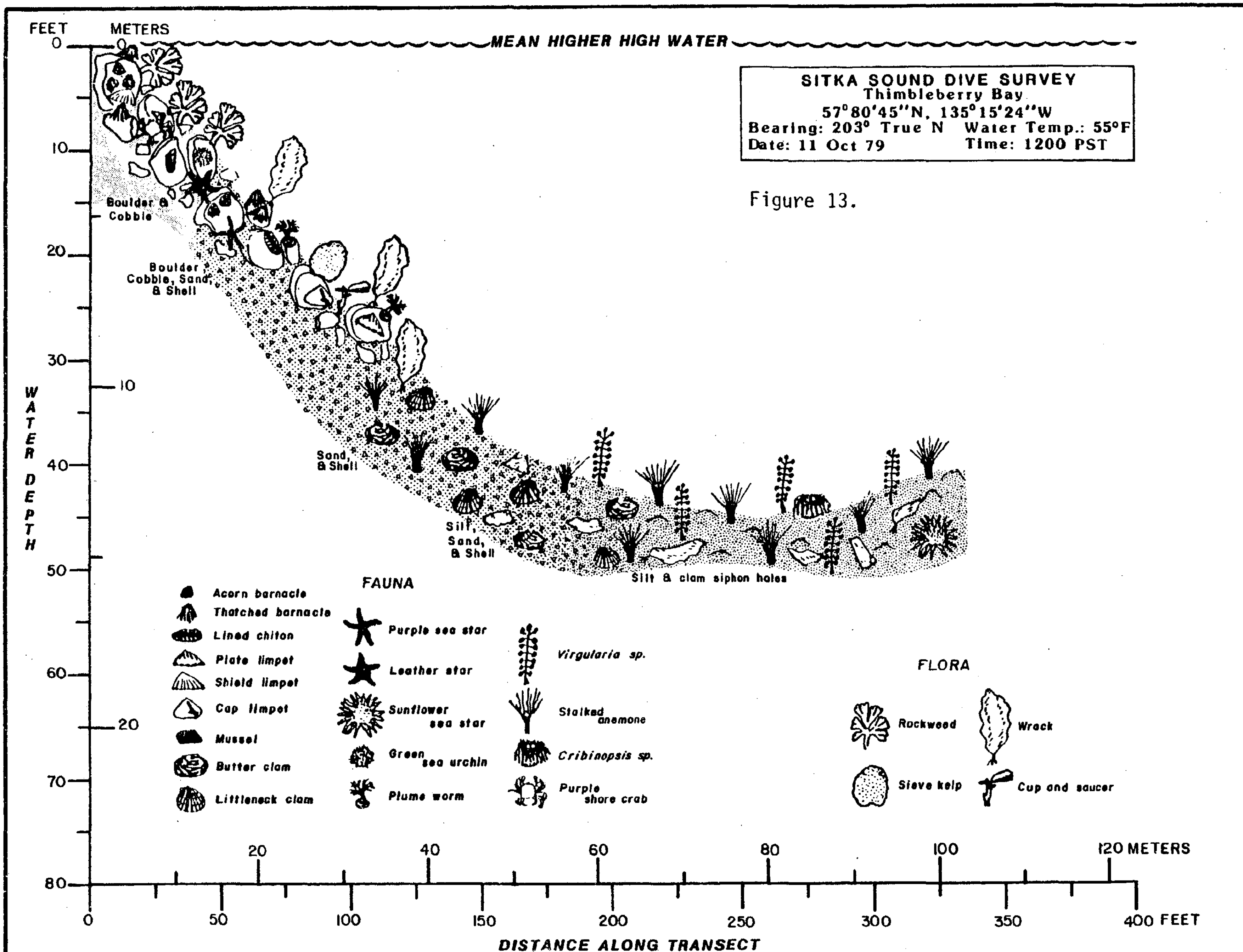
Invertebrates on rock substrates included plume worm, cap limpet, lined chiton, purple sea star, and leather star. Soft bottom invertebrates included butter clam, littleneck clam, burrowing stalked anemone, and the sea pen, *Virgularia*. Sunflower sea star and vermillion sea star preyed upon clams and sea pens. Herring are no longer known to spawn in the area.

Management Recommendations: Thimbleberry Bay has a marine ecosystem that appears to be more diverse and



rich than the adjacent Jamestown Bay. The shorelands are used primarily for low density residential and much of the shoreline remains undeveloped. This pattern of development has been compatible with the habitat values of the area. There was no evidence at this site of the siltation problems experienced in Jamestown Bay; although, pulp waste liquor discolors the surface waters and may limit subtidal algae growth and herring spawning.

We recommend that future developments in Thimbleberry Bay be designed to maintain intertidal surface area, algae beds, and water quality. Tideland filling should be discouraged. Small piling supported pier structures and floats should have minimal impact. Coastal access along beaches should be protected or enhanced when waterfront developments are planned. The mouths of Thimbleberry Creek and Blueberry Lane Creek are both anadromous fish streams, and should be buffered from encroachments and water quality degradation. A minimum 25 feet setback from the high water stream bank is recommended. No large quantities of petroleum products should be stored over water because a large spill within the confines of the Bay could have a serious impact.



FEET
METERS
MEAN HIGHER HIGH WATER
SITKA SOUND DIVE SURVEY
Thimbleberry Bay
57°80'45"N, 135°15'24"W
Bearing: 203° True N Water Temp.: 55°F
Date: 11 Oct 79 Time: 1200 PST
Boulder & Cobble
Boulder Cobble, Sand, & Shell
Sand, & Shell
Silt, Sand, & Shell
Silt & clam siphon holes
WATER DEPTH
FAUNA
Acorn barnacle
Thatched barnacle
Lined chiton
Plate limpet
Shield limpet
Cap limpet
Mussel
Butter clam
Littleneck clam
Purple sea star
Leather star
Sunflower sea star
Green sea urchin
Plume worm
Virgularia sp.
Stalked anemone
Cribinopsis sp.
Purple shore crab
FLORA
Rockweed
Wrack
Sieve kelp
Cup and saucer
0
10
20
30
40
50
60
70
80
0
10
20
0
20
40
60
80
100
120 METERS
0
50
100
150
200
250
300
350
400 FEET
DISTANCE ALONG TRANSECT

Figure 13.

Ball Islets

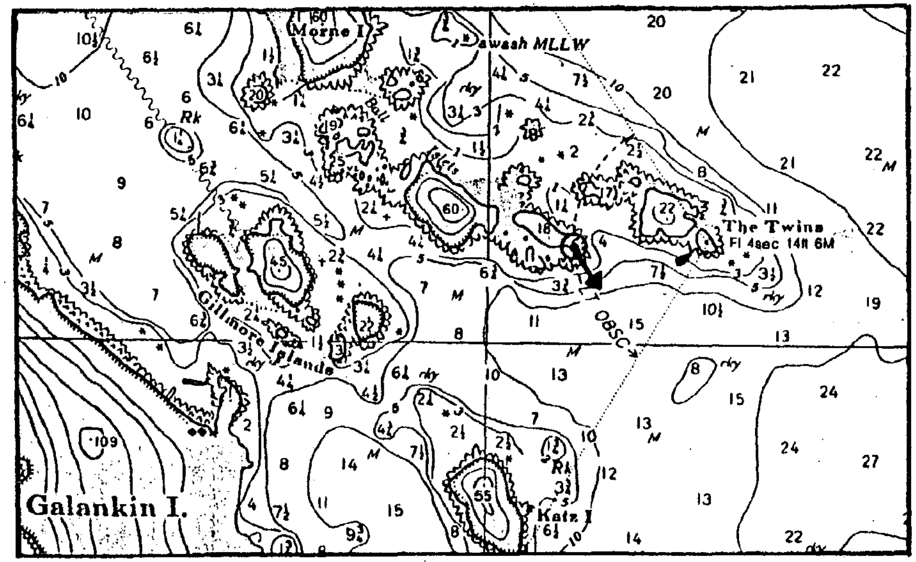
Site Description: The survey was located at the easternmost islet within the Ball Islets group. The islet is one of many similar rocky outcrops located along the southern Sitka waterfront between Eastern and Middle channels.

The intertidal zone was a bedrock shelf that extended seaward for approximately 45 meters (150 feet) and then dropped off rapidly along a steep subtidal slope.

Intertidal algae included rockweed in the upper zone and sea lettuce, sea staghorn, and wrack in the lower zone. Invertebrates included acorn and thatched barnacle, shield and plate limpet, lined chiton, and purple sea star.

The shelf break occurred at approximately the lower tide level with a steep bedrock face extending down to approximately the 30 foot depth level. Kelp and other macro algae were conspicuously absent from the subtidal zone. Normally these plants occur at least to 40-50 feet depth in Sitka Sound. Invertebrate life was primarily suspension feeders, including plume worm and rock jingle. Herbivores were poorly represented subtidally, which would be expected with the paucity of algae.

At the base of the bedrock face, the benthic substrate changed to a mixture of sand and shell debris with scattered boulders and bedrock outcrops. Silt became an increasing component of the substrate with depth. Soft bottom invertebrates included sea pen, burrowing stalked anemone, and brittle star. Predators included octopus, searcher, and rose star. Herring are no longer known to spawn in this area.



Management Recommendations: The marine community at this site was dominated by suspension feeders and their predators. The absence of a subtidal marine algae community with associated herbivores may be the result of the chronic layer of sulphite waste liquor, which acts as a screen to sunlight and inhibits plant growth at normal depths. During the survey, the surface layer was discolored with sulfite liquor to a depth of approximately 15 feet. A sharp transition to clear water occurred below this depth. Further study of the water quality and algae communities within this area may be warranted, particularly to determine how widespread the effects are and if rehabilitation of algae communities and herring spawning areas are feasible and practical.

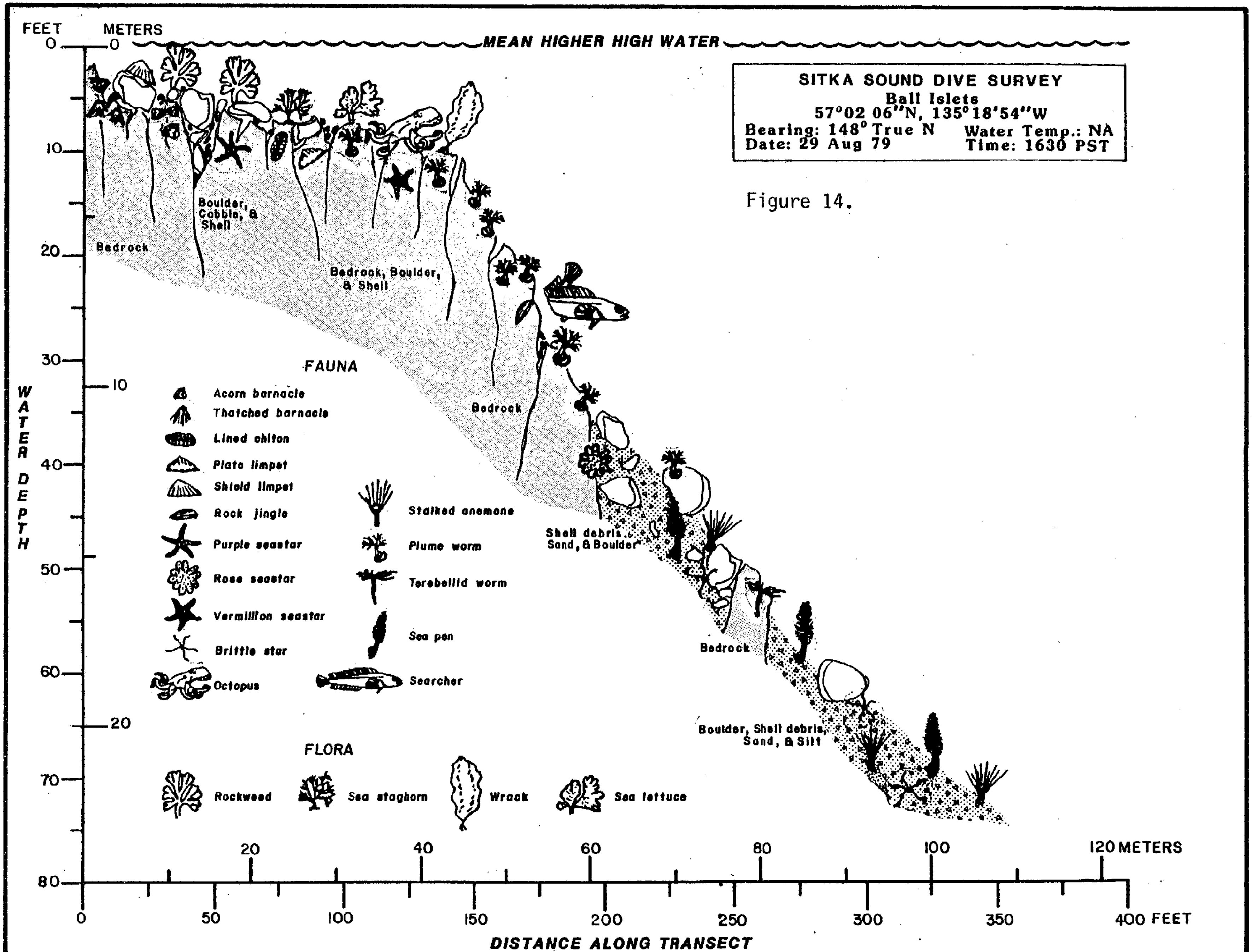

SITKA SOUND DIVE SURVEY
Ball Islets
57°02 06"N, 135°18'54"W
Bearing: 148° True N
Water Temp.: NA
Date: 29 Aug 79
Time: 1630 PST
MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
DISTANCE ALONG TRANSECT
0 10 20 30 40 50 60 70 80
0 10 20
0 50 100 150 200 250 300 350 400 FEET
20 40 60 80 100 120 METERS
Bedrock
Boulder, Cobble, & Shell
Bedrock, Boulder, & Shell
Bedrock
Shell debris, Sand, & Boulder
Bedrock
Boulder, Shell debris, Sand, & Silt
FAUNA
Acorn barnacle
Thatched barnacle
Lined chiton
Plate limpet
Shield limpet
Rock jingle
Purple seastar
Rose seastar
Vermillion seastar
Brittle star
Octopus
Stalked anemone
Plume worm
Terebellid worm
Sea pen
Searcher
FLORA
Rockweed
Sea staghorn
Wrack
Sea lettuce

Figure 14.

No Thorofare Bay Inlet

Site Description: The survey was located approximately 100 yards southwest of the entrance to No Thorofare Bay. The entrance to the Bay is through a narrow rock channel that can only be safely navigated during high, slack water. Approximately 1,000 acre feet of water pass through the entrance channel during an average six hour tidal cycle. Tidal velocities in the channel exceed five knots and standing waves several feet high are not uncommon.

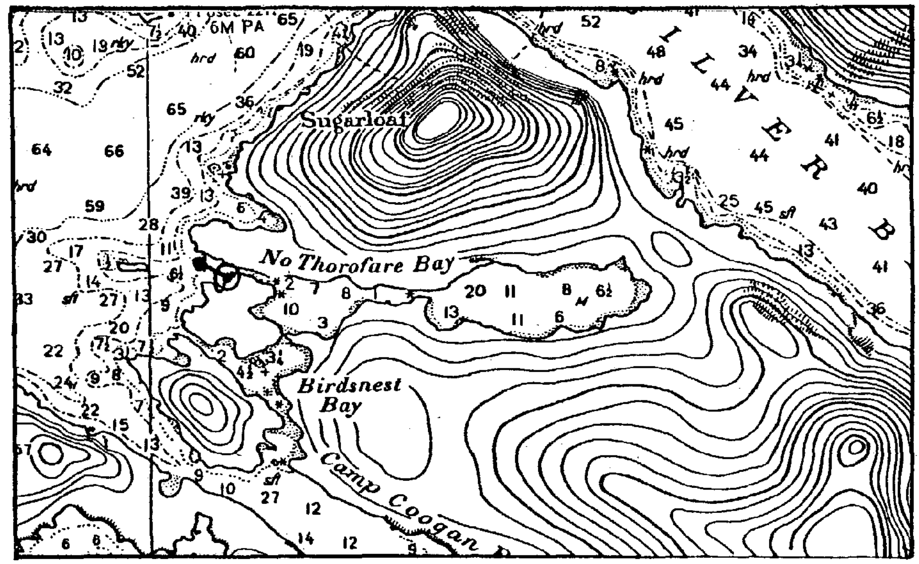
The shoreline was rocky and heavily wooded. A shallow subtidal boulder and bedrock ledge extended into the inlet for approximately 60 feet before sloping downward along a steep talus face. At approximately 45 foot depth the slope gradient lessened and the substrate changed to fine materials with an increasing silt component towards depth.

Algae within the intertidal zone included rockweed, the encrusting red alga *Hildenbrandia/Petrocelis*, and the red alga, *Odonthalia*. Intertidal invertebrates included periwinkle, barnacle, limpet, mussel, and the drill snail, *Thais*.

The low intertidal and shallow subtidal zones were densely covered with wrack and the brown alga, *Desmarestia*. Coralline algae encrusted rock surfaces. Invertebrates included red sea urchin and burrowing sea cucumber.

Algae cover on the subtidal talus slope consisted mainly of scattered wrack and encrusting corallines. Major invertebrates included burrowing sea cucumber, cloud anemone, and plume worm. Other invertebrates included rock jingle, cap limpet, lined chiton, and sea peach.

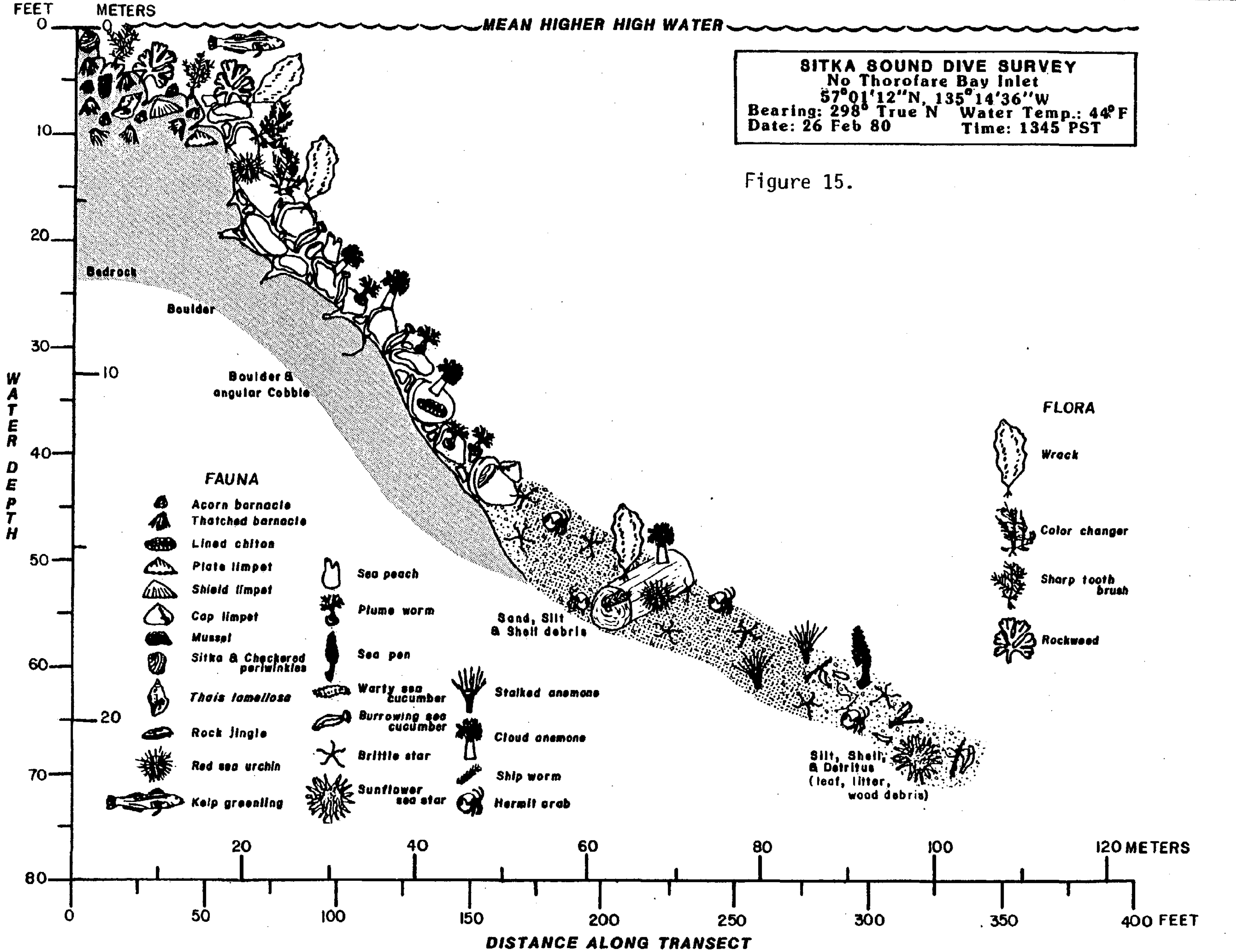
The soft bottom slope was devoid of macrophytes with the exception of a clump of wrack attached to a sunken



log. The dominant soft bottom epifauna were brittle star and hermit crab. Sea cucumber, burrowing stalked anemone, sea pen, and sunflower sea star were also found. A thick mat of organic detritus consisting of leaves, needles, and wood fiber occurred at the lower end of the transect.

This site is a known herring spawning area.

Management Recommendations: The marine ecosystem at this site is dominated by suspension feeders that are nourished by the large volumes of plankton carried in and out of No Thorofare Bay by tidal currents. The area has a diverse and rich assemblage of epifauna that should be protected for essential habitat use, scientific study, and recreation. Impacts that could affect this area include: 1) any chronic degradation of water quality, including increased turbidity or oil pollution; 2) smothering of bottom life with bark debris, silt, or dredge spoils; 3) dredging or blasting to deepen or widen the channel, which would destroy the existing marine community; and 4) intensive harvesting of marine flora and fauna, which could result in the destruction of delicate, rare, or long-lived species.



SITKA SOUND DIVE SURVEY
No Thorofare Bay Inlet
57°01'12"N, 135°14'36"W
Bearing: 298° True N
Water Temp.: 44°F
Date: 26 Feb 80
Time: 1345 PST
MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
DISTANCE ALONG TRANSECT
120 METERS
400 FEET
Bedrock
Boulder
Boulder & angular Cobble
Sand, Silt & Shell debris
Silt, Shell, & Detritus (leaf, litter, wood debris)
FAUNA
Acorn barnacle
Thatched barnacle
Lined chiton
Plate limpet
Shield limpet
Cap limpet
Mussel
Sitka & Checkered periwinkles
Thais lamellosa
Rock jingle
Red sea urchin
Kelp greenling
Sea peach
Plume worm
Sea pen
Warty sea cucumber
Burrowing sea cucumber
Brittle star
Sunflower sea star
Stalked anemone
Cloud anemone
Ship worm
Hermit crab
FLORA
Wrack
Color changer
Sharp tooth brush
Rockweed

Figure 15.

Pirate Cove

Site Description: The survey was located on the seaward side of a narrow isthmus forming the western boundary of Pirate Cove. The site itself was in a shallow unnamed cove facing the open waters of Sitka Sound. Minimal protection from the sea results from the islet, rocks, and kelp beds located at the mouth of the cove.

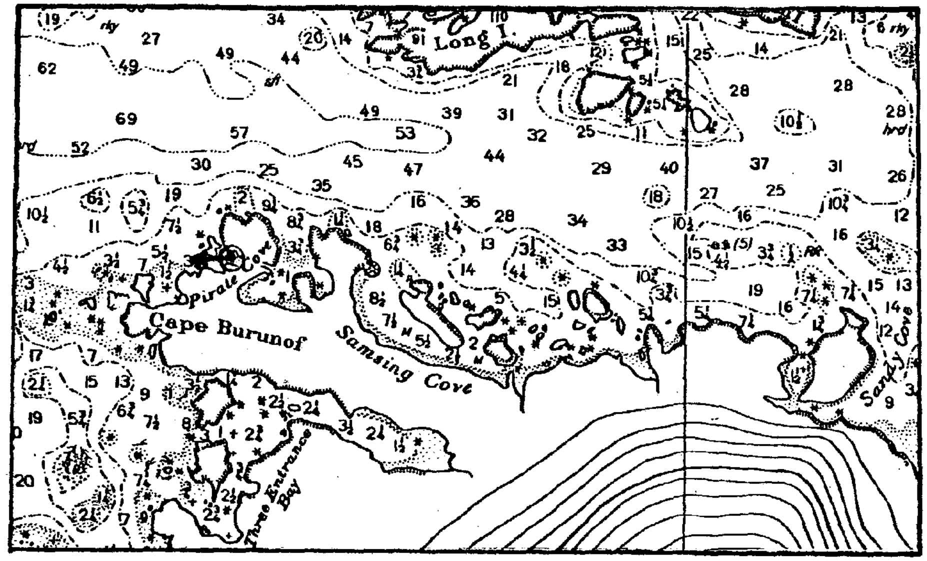
The survey encompassed the bedrock and boulder shoreline and a shallow cobble and gravel pavement extending seaward toward the mouth of the cove.

Intertidal algae was dominated by rockweed. Invertebrates included acorn and thatched barnacle, plate limpet, mussel, and purple sea star.

Subtidally the dominant algae were rockweed and color changer in the shallowest zones and a slightly deeper algae bed consisting of a mixed canopy of bull kelp and giant kelp with an understory of wrack and sea sac. Sandy patches supported eelgrass. Subtidal epifauna were generally sparse, perhaps reflecting the harsh conditions of wave exposure, unstable substrate, and the winter timing of our survey.

Invertebrates included lined chiton; abalone; sunflower sea star; and green, striped, and *Anthopleura elegantissima* anemone. Infauna included horse clam and butter clam.

A large swarm of crustacean larvae, probably pandalid shrimp, were present in the water column at the time of the survey. The only fish species observed was kelp greenling. Herring are known to consistently spawn in this area.



Management Recommendations: The site was characterized as a semi-protected cove lying on the exposed outer coast. The high energy, unstable conditions present at this site favor plant and animal assemblages that can withstand moderate to severe wave energy and shifting substrates. Important habitat uses of this area include herring spawning and crustacean larval rearing.

Impacts resulting from oil spills, chronic pollution, or tideland filling could be expected to reduce habitat uses. Reducing wave energy and stabilizing substrates would probably enhance the species diversity and richness of the area.

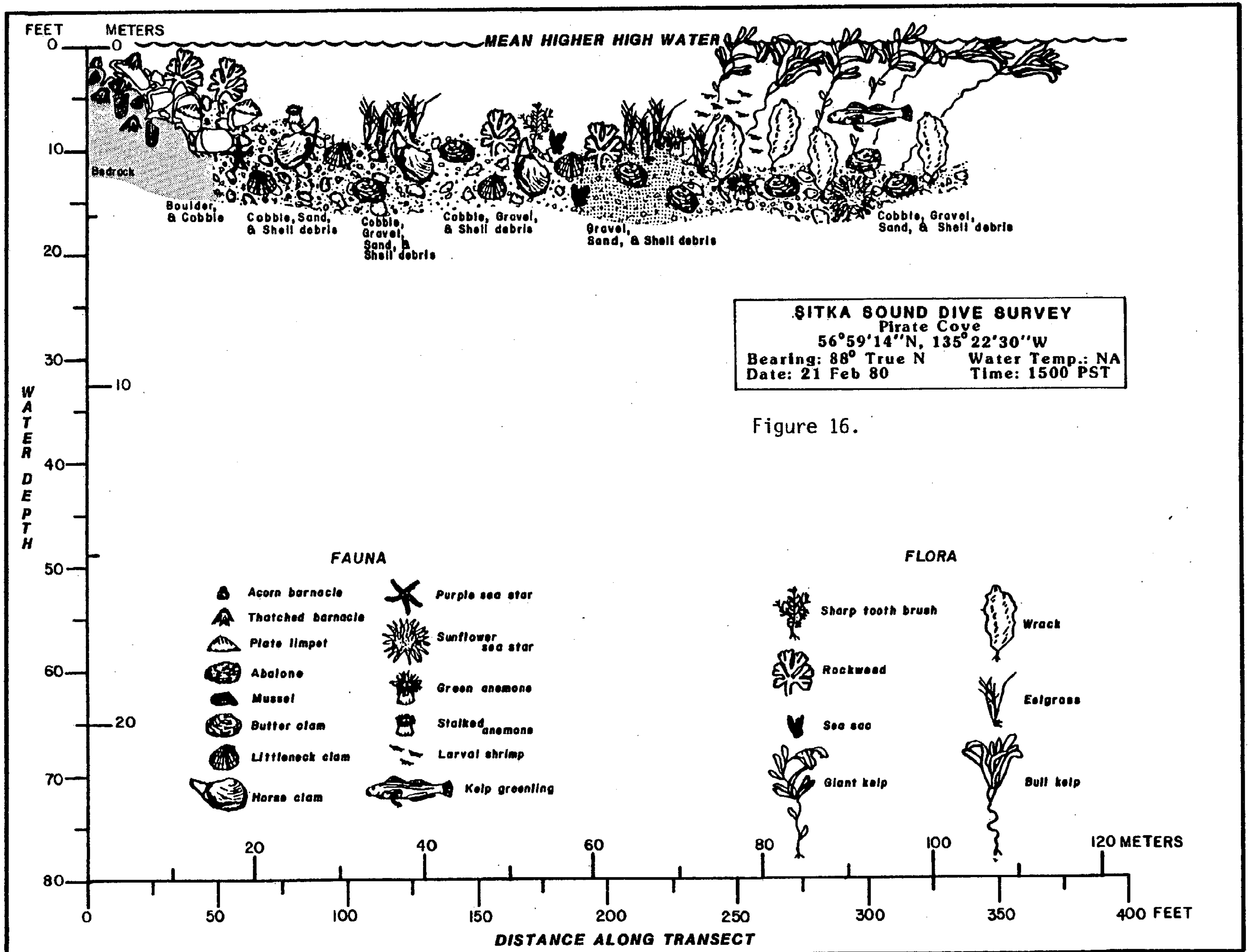

SITKA SOUND DIVE SURVEY
Pirate Cove
56°59'14''N, 135°22'30''W
Bearing: 88° True N
Water Temp.: NA
Date: 21 Feb 80
Time: 1500 PST
MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
DISTANCE ALONG TRANSECT
Bedrock
Boulder, & Cobble
Cobble, Sand, & Shell debris
Cobble, Gravel, Sand, & Shell debris
Cobble, Gravel, & Shell debris
Gravel, Sand, & Shell debris
Cobble, Gravel, Sand, & Shell debris
FAUNA
Acorn barnacle
Thatched barnacle
Plate limpet
Abalone
Mussel
Butter clam
Littleneck clam
Horse clam
Purple sea star
Sunflower sea star
Green anemone
Stalked anemone
Larval shrimp
Kelp greenling
FLORA
Sharp tooth brush
Rockweed
Sea sac
Giant kelp
Wrack
Eelgrass
Bull kelp
0
10
20
30
40
50
60
70
80
0
10
20
0
50
100
150
200
250
300
350
400 FEET
20
40
60
80
100
120 METERS

Figure 16.

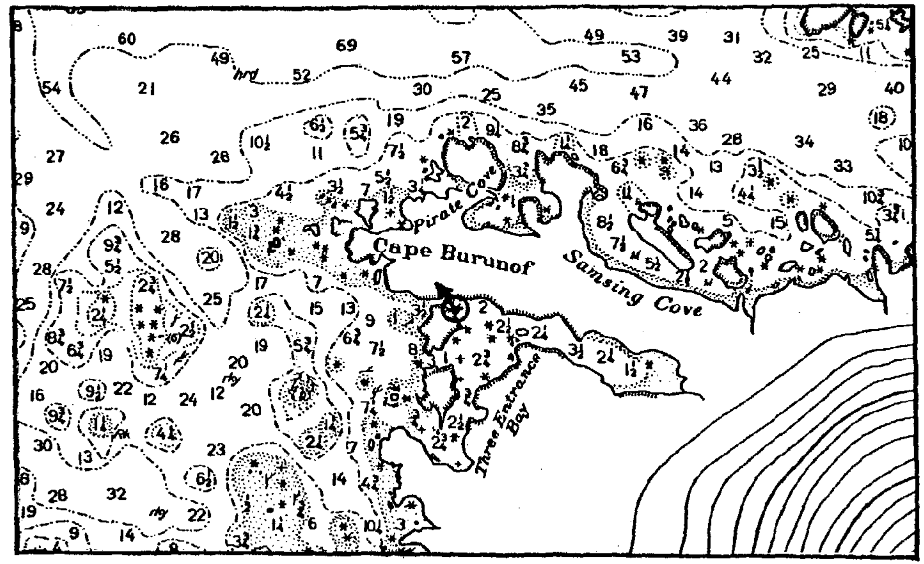
Three Entrance Bay, North Entrance

Site Description: The survey was located across the north entrance to Three Entrance Bay. The site was a relatively shallow channel bordered by vertical bedrock walls on both sides. Unlike No Thorofare Bay, tidal currents between Sitka Sound and Three Entrance Bay are dissipated through three channels. Current velocities at this site were on the order of one to two knots.

Rockweed covered the intertidal walls on both sides of the channel. Intertidal invertebrates included acorn and thatched barnacle, plate limpet, mussel, lined chiton, black katy, and green sea urchin. Subtidal invertebrates included keyhole limpet, red sea urchin, burrowing sea cucumber, lined chiton, cap limpet, and gumboot chiton. On the south side of the channel the rock wall ended abruptly in a sand and gravel bed while on the north side, the base of the wall consisted of boulders and cobble. The transition zone between the course and fine substrates occurred midway in the channel, hence the marine communities on either side were markedly different.

Within the fine substrate zone, eelgrass was the dominant macrophyte. Sunflower sea star preyed upon horse clams and red sea urchin grazed upon the eelgrass. Kelp greenling occurred within the eelgrass bed.

The coarse substrate zone supported a greater diversity of epifauna. Suspension feeders included green, striped, and cloud anemone; burrowing sea cucumber; and several species of sea squirts and sponges. Grazers included abalone, cap limpet, red sea urchin, and lined chiton. Predators and scavengers included hermit crabs and sunflower sea stars. The stinging jelly fish, *Cyanea capillata* was also present. Algae attached to hard substrates included sieve kelp, wrack, color changer, triple rib kelp, and bull kelp. Subtidal rock surfaces were encrusted with coralline



algae. Herring are known to consistently spawn in the area.

Management Recommendations: Three Entrance Bay was found to have a rich marine invertebrate community dominated by suspension feeders, herbivores, and their predators. The diversity of substrates and marine plants contributes to the complexity of the marine habitat at this site. The Bay also experiences vigorous mixing with the waters of Sitka Sound and hence benefits from plankton production and upwelling along the coast.

Because of its importance for scientific and habitat resources, recreation, and herring spawning, we recommend that Three Entrance Bay be managed as a protected habitat area for recreation, scientific research, education, and fish and shellfish production. The use of this area for log storage, float homes, dredging, tideland filling, seafood processing, and shoreline development is not recommended. This area should also be considered as a priority site for protection in the event of an oil spill.

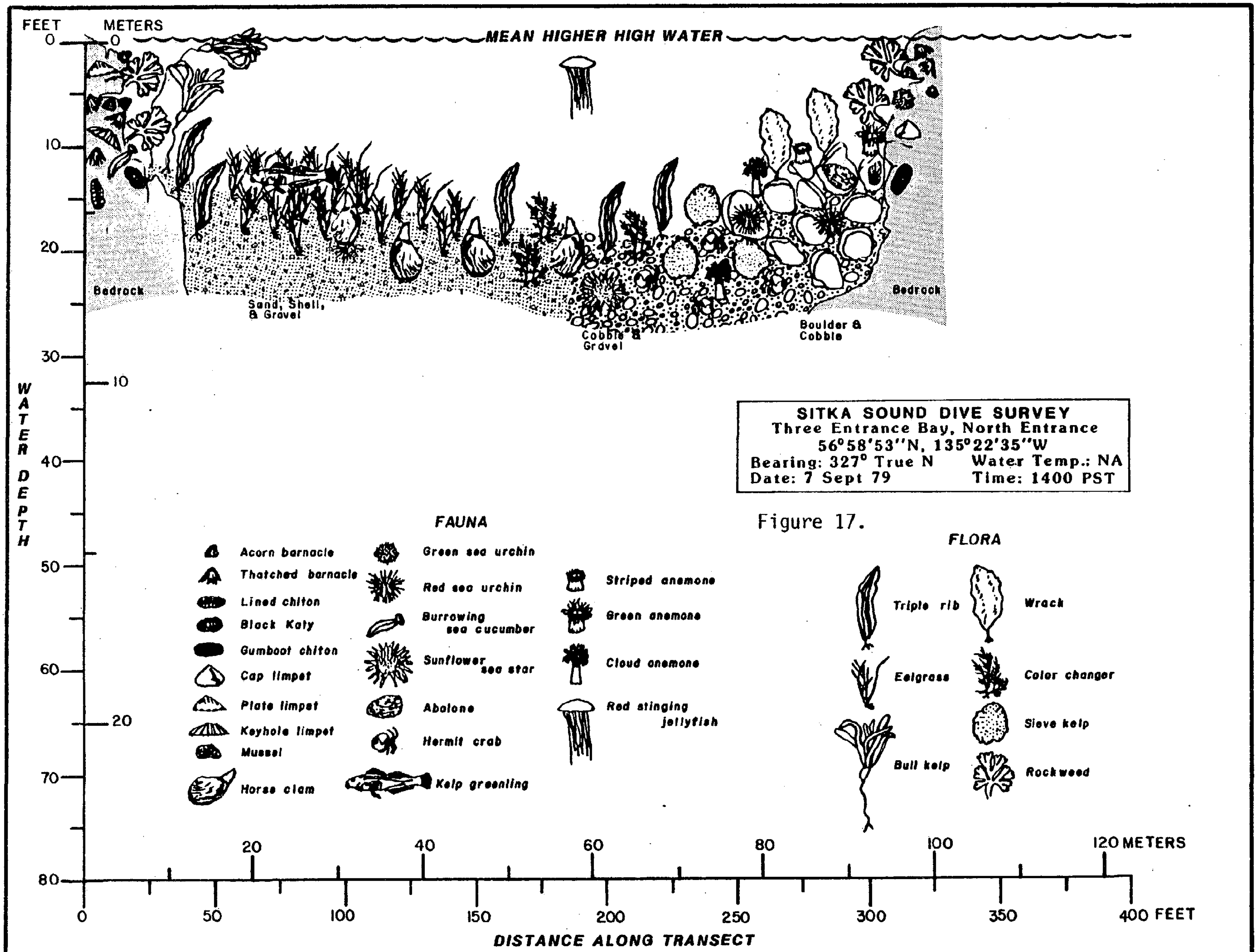

FEET
METERS
MEAN HIGHER HIGH WATER
Bedrock
Sand, Shell, & Gravel
Cobble & Gravel
Boulder & Cobble
Bedrock
WATER DEPTH
0
10
20
30
40
50
60
70
80
SITKA SOUND DIVE SURVEY
Three Entrance Bay, North Entrance
56°58'53"N, 135°22'35"W
Bearing: 327° True N
Water Temp.: NA
Date: 7 Sept 79
Time: 1400 PST
FAUNA
Acorn barnacle
Thatched barnacle
Lined chiton
Black Katy
Gumboot chiton
Cap limpet
Plate limpet
Keyhole limpet
Mussel
Horse clam
Green sea urchin
Red sea urchin
Burrowing sea cucumber
Sunflower sea star
Abalone
Hermit crab
Kelp greenling
Striped anemone
Green anemone
Cloud anemone
Red stinging jellyfish
FLORA
Triple rib
Eelgrass
Bull kelp
Wrack
Color changer
Sieve kelp
Rockweed
20
40
60
80
100
120 METERS
0
50
100
150
200
250
300
350
400 FEET
DISTANCE ALONG TRANSECT

Figure 17.

Goddard Hot Springs Bay

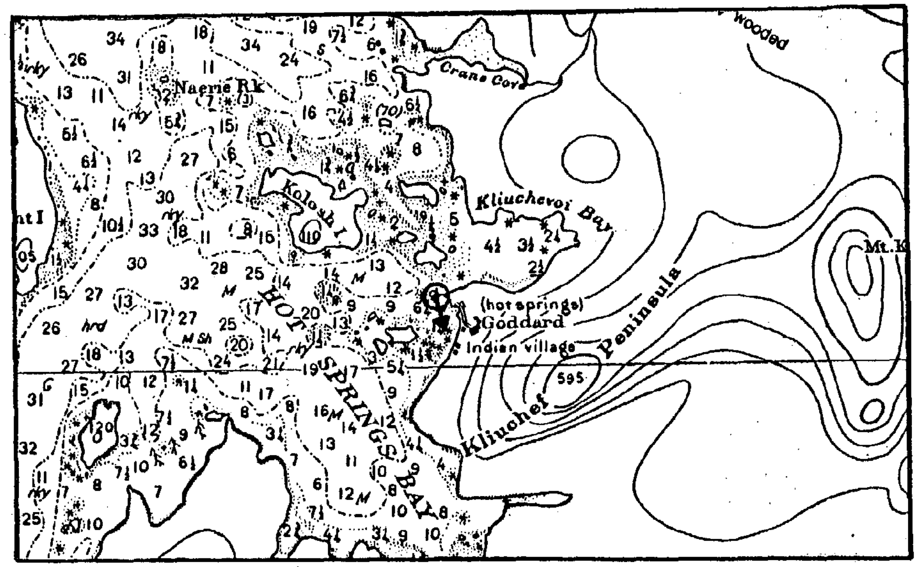
Site Description: The survey was located in the cove utilized as an anchorage for the Goddard Hot Springs. The transect ran from a small wooded islet on the north boundary of the cove towards a rock exposed at low tide. A small trickle of hot spring water discharged onto tidelands in the vicinity of the survey; however, this was not found to have a noticeable effect upon marine life along the transect.

The profile of the bottom was a gentle slope extending from the shore towards the rock outcrop. Substrates in the intertidal and shallow subtidal zones were predominantly boulders and bedrock. The floor of the cove was a fine mixture of sand, silt, and shell debris with occasional scattered cobble and small boulders.

Intertidal algae were dominated by rockweed and sea sac. Invertebrates included barnacle, limpet, and chiton. Algae attached to subtidal rocks included rockweed, color changer, wrack, and seersucker kelp. Coralline algae encrusted rock surfaces.

Invertebrates on subtidal rocks included lined chiton, black katy, red sea urchin, purple sea star, drill snail, octopus, and hermit crab. Soft bottom infauna were dominated by cockle, butter, and horse clam. Epifauna included sea cucumber and sunflower sea star. The hooded sea slug, *Melibe* was abundantly attached to subtidal algae and eelgrass. A large school of two to three year old herring was also observed during the survey. Herring are known to consistently spawn in the area.

Management Recommendations: The marine ecosystem within Goddard Hot Springs Bay is generally a quiet, low energy environment. The site would be particularly sensitive to local water pollution resulting from increased turbidity, untreated sewage discharge, or oil spills, as it is likely that these pollutants



would persist and produce toxic effects upon the invertebrates and fish found here. The lands surrounding this area are in State, Borough, and private ownership. Because of the attractiveness of the area, it is likely that Goddard will be developed in subdivided lots, dock facilities, a lodge, and other recreation-oriented developments. The area has also been suggested for inclusion in the State marine park system.

Care should be taken to avoid degrading marine water quality through oil spills, erosion from shoreland development, waste disposal, and dredging operations. Tideland filling should be discouraged. The siting of waterfront developments should be preceeded by additional on-site inspections to insure that sensitive habitats, including herring spawning areas, clam beds, and marine plant communities, are identified and protected. Because of rock outcrops within the cove area, as well as an extensive eelgrass bed and sensitive habitat, it is not recommended that the Cove area be cleared or deepened for additional boat anchorage. A suitable site for expanded moorage facilities is located in the adjacent Kliuchevoi Bay.

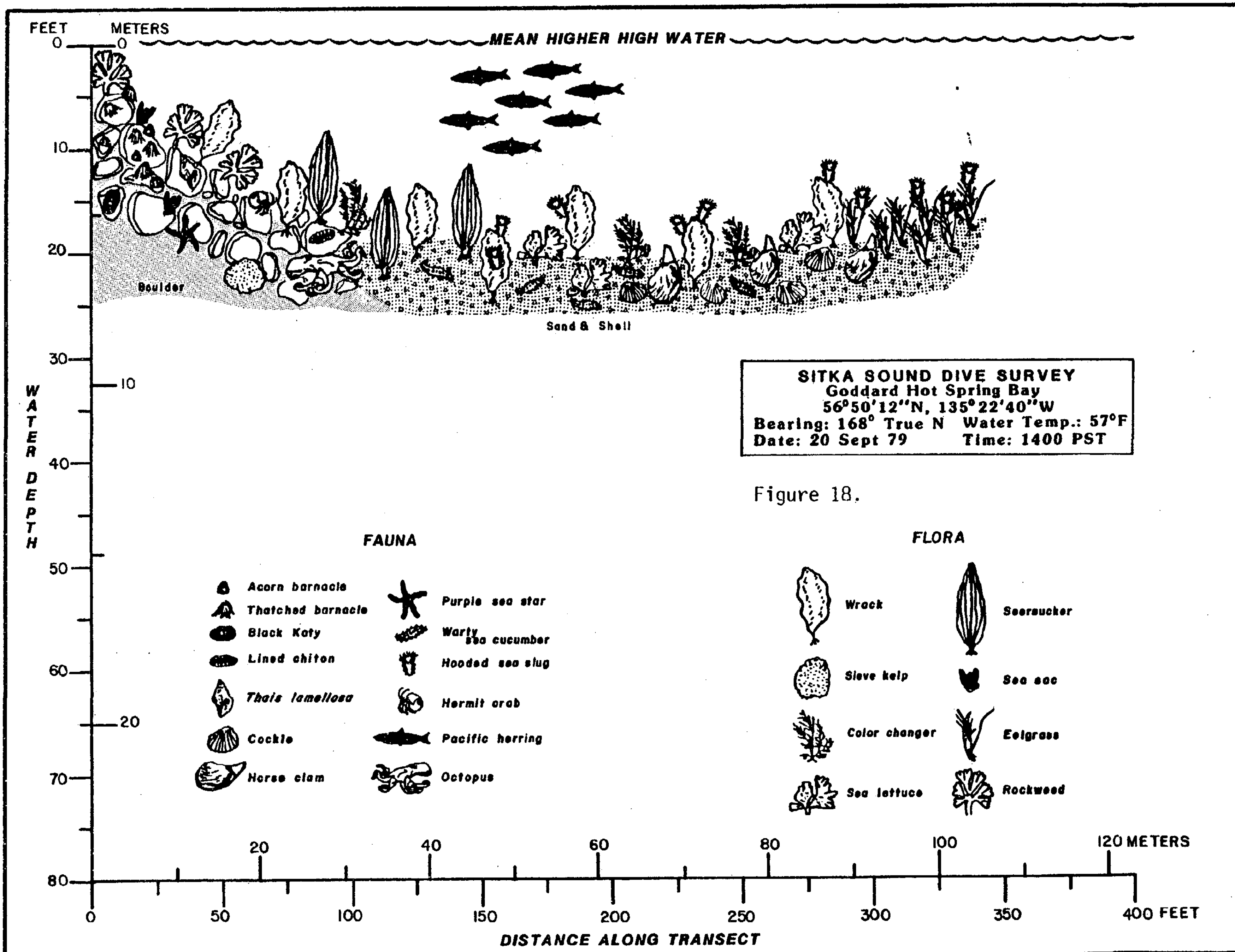

MEAN HIGHER HIGH WATER
FEET
METERS
WATER DEPTH
0
10
20
30
40
50
60
70
80
Boulder
Sand & Shell
SITKA SOUND DIVE SURVEY
Goddard Hot Spring Bay
56°50'12"N, 135°22'40"W
Bearing: 168° True N Water Temp.: 57°F
Date: 20 Sept 79 Time: 1400 PST
FAUNA
Acorn barnacle
Thatched barnacle
Black Katy
Lined chiton
Thais lamellosa
Cockle
Horse clam
Purple sea star
Warty sea cucumber
Hooded sea slug
Hermit crab
Pacific herring
Octopus
FLORA
Wrack
Sieve kelp
Color changer
Sea lettuce
Seersucker
Sea sac
Eelgrass
Rockweed
120 METERS
400 FEET
DISTANCE ALONG TRANSECT

Figure 18.

Tava Island

Site Description: The survey was conducted on the northeast shore of Tava Island, located approximately three nautical miles west of Goddard. The site was a rocky shoreline with a thick fringe of floating kelp lying offshore.

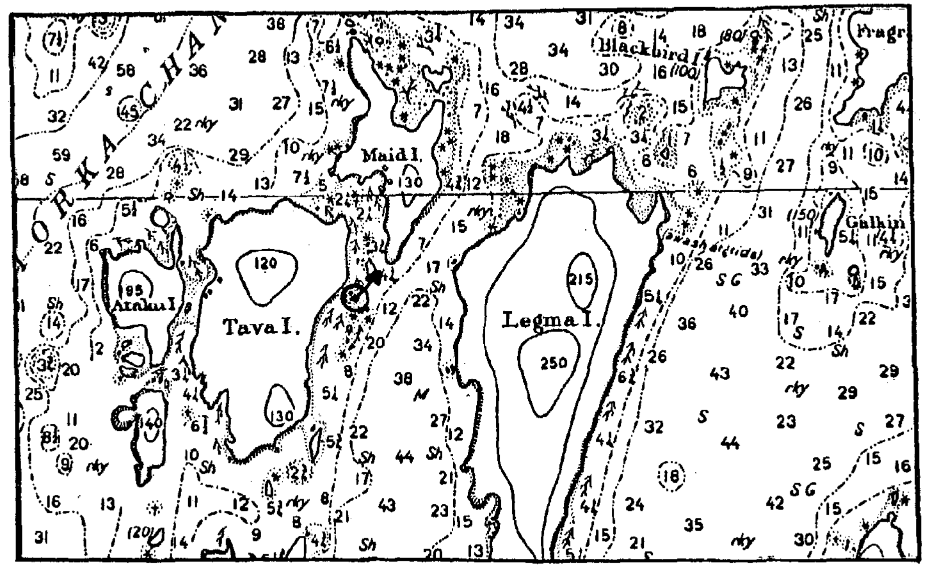
The shore zone substrate included a boulder and bedrock intertidal and shallow subtidal zone followed by a sandy plain interspersed with scattered rock and gravel pockets.

Intertidal algae included a mix of rockweed, sea sac, sea lettuce, and sharp tooth brush. Intertidal and shallow subtidal invertebrates included acorn and thatched barnacle, lined chiton, red sea urchin, and the bryozoan, *Microporina borealis*.

Algae on subtidal rock surfaces were dominated by giant kelp, which formed a floating canopy over most of the survey transect. Understory algae included triple rib kelp, wrack, color changer, sharp tooth brush, sea sac, and encrusting and foliose corallines. Grazers on the algae included red sea urchin, abalone, lined, mossy, and gumboot chiton, and cap limpet. Infauna included horse, littleneck, and butter clam, burrowing sea cucumber, the cone worm *Pectinaria*, and various infaunal polychaetes. Predators included octopus, hairy triton, rockfish, and sculpin.

Fish species inhabiting the kelp bed included yellowtail, quillback, china and black rockfish, tubesnout, kelp greenling, and juvenile rockfish. A harbor seal was also observed.

Management Recommendations: Tava Island, like all of the outer coast islands, provides a considerable amount of exposed and semi-protected shoreline where marine plant and animal assemblages are strongly influenced by oceanic conditions. The luxuriant kelp



beds in this area are the result of nutrient rich waters that are upwelled along the coast. The kelp beds themselves convert nutrients and sunlight into plant tissue, which in turn supports the rich diversity of grazing invertebrates and associated food webs. Kelp beds also create macro-habitats that support herring spawning, juvenile fish rearing, and shellfish nursery areas.

Kelp harvesting of giant kelp *(Macrocystis)* may occur in this area in the future. Depletion of kelp beds through over-harvest or water pollution, would result in adverse changes to coastal habitats that would directly affect important fish and shellfish resources. We recommend that any future kelp harvesting operations be carefully monitored to insure that kelp resources and kelp habitats are maintained or enhanced. A reduction of red sea urchin, the principal invertebrate grazer on kelp, would probably enhance kelp beds and should be considered in conjunction with kelp management. Reduction of red sea urchins could be accomplished through transplants of natural predators such as sea otter and hairy triton or by establishing an urchin fishery.

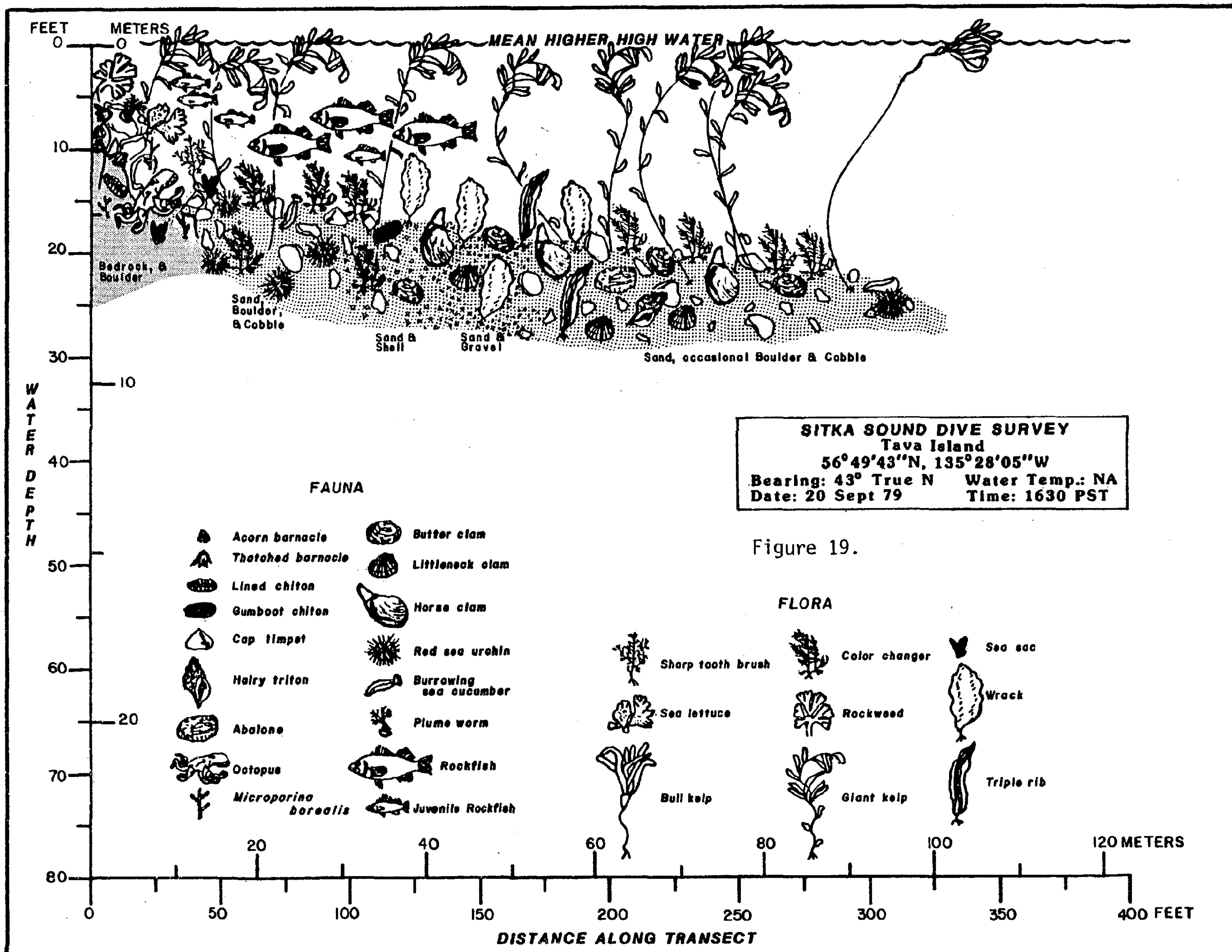

FEET
METERS
MEAN HIGHER HIGH WATER
Bedrock, & Boulder
Sand, Boulder, & Cobble
Sand & Shell
Sand & Gravel
Sand, occasional Boulder & Cobble
WATER DEPTH
0
10
20
30
40
50
60
70
80
SITKA SOUND DIVE SURVEY
Tava Island
56°49'43"N, 135°28'05"W
Bearing: 43° True N
Water Temp.: NA
Date: 20 Sept 79
Time: 1630 PST
FAUNA
Acorn barnacle
Thatched barnacle
Lined chiton
Gumboot chiton
Cap limpet
Hairy triton
Abalone
Octopus
Microporina borealis
Butter clam
Littleneck clam
Horse clam
Red sea urchin
Burrowing sea cucumber
Plume worm
Rockfish
Juvenile Rockfish
FLORA
Sharp tooth brush
Sea lettuce
Bull kelp
Color changer
Rockweed
Giant kelp
Sea sac
Wrack
Triple rib
20
40
60
80
100
120 METERS
0
50
100
150
200
250
300
350
400 FEET
DISTANCE ALONG TRANSECT

Figure 19.

Intertidal Survey Tables. Tables 1-4 contain the results of intertidal surveys at four locations along the Sitka waterfront. Data within each table are grouped into major biotic assemblages which in turn determine the basic intertidal zones including upper, mid, and lower intertidal zones. The biotic assemblages are influenced in large part by physical parameters such as tidal elevation and substrate. This information is given in the tables as well as the linear distance along the transect which gives the approximate width of each zone.

The tables are accompanied by a set of habitat management recommendations and a site map for each of the locations surveyed.

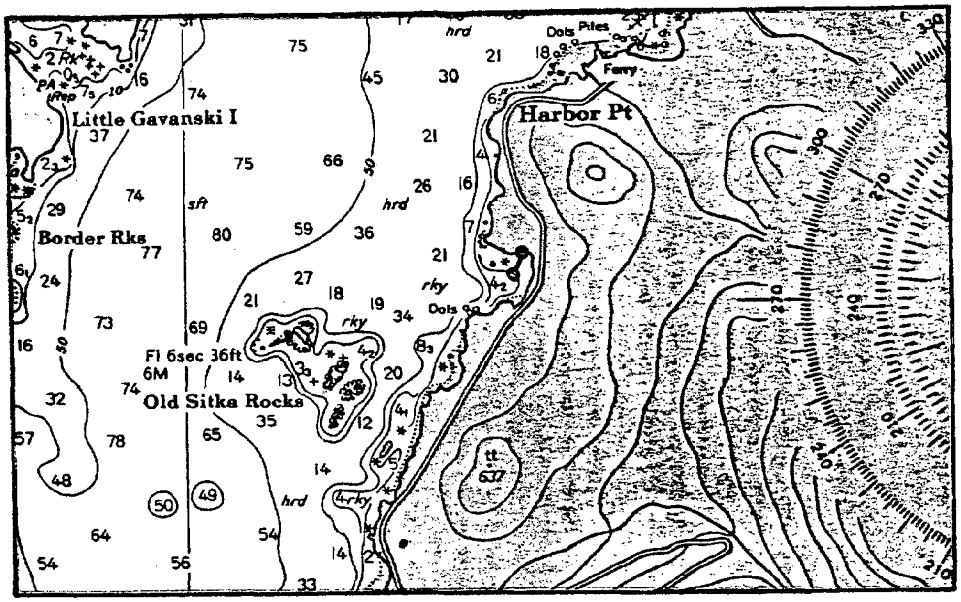
INTERTIDAL SURVEY TABLES

Table 1.

SITKA SOUND INTERTIDAL SURVEY
The Cove
57°07'08"N Latitude, 135°23'15"W Longitude
Date: May 15, 1980 Time: 0800 PST

Elevation above MLLW (feet)	Distance along Transect (meters)	Substrate	Biota and Comments
9.7 to 7.7	0 to 32	small angular boulders with patches of gravel	The upper intertidal zone is a sparsely vegetated boulder patch interspersed with gravel pockets. Algae included scattered rockweed and the red alga, *Gloiopeltis furcata*. A beach seepage area was vegetated with patches of green link confetti. Invertebrates on boulders included three herbivores; plate limpet, shield limpet, and Sitka periwinkle. The predominant barnacles in the upper intertidal zone were acorn barnacle and cross barnacle. Gravel pockets contained scattered mussel, Sitka periwinkle, and a mixed distribution of acorn barnacle and thatched barnacle. Red shore crab, beach hopper, and the limpet, *Notoacmea persona* occurred beneath boulders.
7.6 to 5.7	33 to 40	angular cobble with patches of sand and gravel	The mid-intertidal zone macrophytes included rockweed, sea lettuce, and the filimentous green sea rope, *Spongomorpha* sp. Plants, invertebrates, and rocks were covered with a slick, brown diatom coating. Herbivores occurred in low numbers. The paucity of grazers in the mid-intertidal zone may explain the relatively unchecked growth of diatoms. Similar situations have occurred in marine areas impacted by toxic chemical spills, such as petroleum products, or high strength detergents. It is possible that the intertidal biota has been affected by bilge cleaning or petroleum spills from the nearby container barge facility and/or small boat harbor. Large numbers of the spindle snail, *Searlesia dira* were found. *Searlesia* is a predator on small gastropods and barnacles. Other predators included six-rayed sea star; slender star; and drill snail, *Thais lamellosa*. Infauna included littleneck clam and several unidentified species of polychaete worm. Red shore crab, beach hopper, and hermit crab were found under rocks.
5.6	41	sand and gravel	The transition zone from the mid-intertidal cobble to the low intertidal mud and sand was moderately covered with sea lettuce and a foliose red alga, *Polysiphonia*, to which were attached numerous caprellid amphipods. Dominant infauna included the polychaete worm, *Owenia fusiformis*; littleneck clam; the soft shell clam, *Macoma inquinata*; and sipunculid peanut worm.
5.5 to -2.8	42 to 61	soft sand and silt with scattered cobbles	The low intertidal zone was an eelgrass bed with scattered wrack and seersucker kelp. Eelgrass densities ranged from 576 plants per square meter. Eelgrass lengths ranged from 40 cm to 60 cm with an average length of 55 cm. Infauna was dominated by littleneck clam, soft shell clam, and *Owenia* worms. Other infauna included unidentified polychaete and oligochaete worms and the predatory nemertean worm, *Paranemertes peregrina*. Within the eelgrass bed were a school of pink salmon smolts; the spider crab, *Pugettia gracilis*; and sunflower sea star.

THE COVE



Management Recommendations: The Cove is a quiet estuarine embayment with a mix of commercial, industrial, and residential development. Important habitat uses of the area include herring spawning and overwintering, juvenile salmon rearing, waterbird feeding and resting, clam beds, and occasional feeding by sea lions, harbor seals, and harbor porpoise.

At the survey site, we found a relatively depauperate upper intertidal zone (from 9.9 to 5.6 MLLW) and a fairly rich and productive lower intertidal zone. The paucity of epifauna, particularly of grazing invertebrates, and the profuse bloom of benthic diatoms in the upper and mid-intertidal zones suggested that the normal ecological balance was upset in this area. This may have been due to local water quality degradation such as petroleum spills or bilge pumping; however, this could not be determined by this study.

We recommend that future activities and developments in this area be planned and operated to minimize degradation of water quality. Operations within the boat harbor and container barge facility should avoid spillage of fuels, bilge cleaners, or other toxic chemicals into the water. Bilge pumping should be avoided in the Cove.

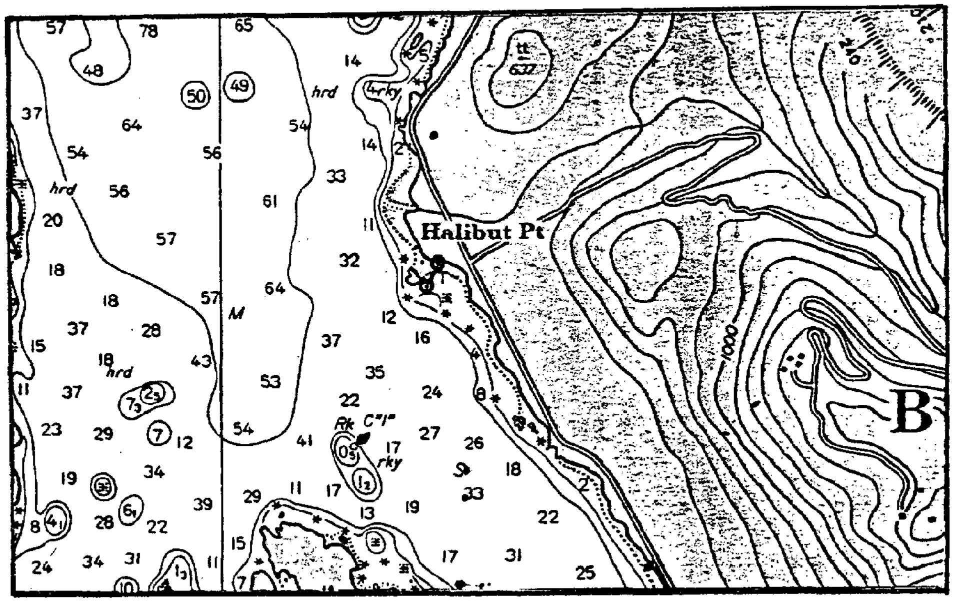
If tideland filling is necessary we recommend that fills be restricted to the upper intertidal zone (above 6 ft MLLW tide line) to minimize the loss of lower productive intertidal habitats, including eelgrass beds, herring spawning areas, bird feeding areas, salmon rearing areas, and worm and clam beds. Below 6.0 ft MLLW pile supported piers are permissable. Floating finger piers should not ground at any tide stage. Public access to and along beaches should be maintained.

Table 2.

SITKA SOUND INTERTIDAL SURVEY
Halibut Point
57°05'57"N Latitude, 135°23'55"W Longitude
Date: May 16, 1980 Time: 0900 PST

Elevation above MLLW (feet)	Distance along Transect (meters)	Substrate	Biota and Comments
10.0 to 6.7	0 to 13	3-6 inches of gravel over sand	The upper intertidal zone consisted of a berm of drift algae, composed of rockweed and eelgrass. No living macrophytes were present in the upper intertidal zone. Dried herring eggs were noted on both drift rockweed and drift eelgrass. Invertebrates included beach hopper oligochaete worms, periwinkle, green shore crab, and pill bug isopods.
6.6 to 6.5	14 to 16	cobble and coarse gravel	The substrate transition zone was dominated by a large mass of periwinkle at the base of cobbles. A sparse covering of cross barnacle occurred.
6.4 to 3.4	17 to 48	mixed cobble, gravel, and sand	The mid-intertidal zone had three different substrate types. The mixed cobble/gravel/sand type had a sparse algal covering of rockweed and green sea rope. Thatched barnacle occurred in scattered clumps on rocks. The predatory snail, *Thais emarginata*, was common. The dominant herbivores were plate limpet, shield limpet, two species of periwinkle, *Littorina sitkana* and *L. scutulata*, and the polychaete worm, *Nereis vexillosa*. A sparse infauna consisting primarily of littleneck clam, butter clam, and several polychaete worms were found in this substrate type. The undersides of rocks revealed numerous hermit crabs, shore crabs, and beach hoppers. The compound ascidian, *Distaplia occidentalis* also occurred beneath rocks.
	49 to 56	sandy patch with scattered gravel and cobble	In the sandy substrate type, algae were patchy, consisting primarily of green link confetti and scattered triple rib kelp. The dominant herbivore on rocks was shield limpet. Thatched barnacle was sparsely distributed on rocks. Spindle shell snail (*Searleasia dira*), a predator on barnacles, worms, and periwinkles was relatively abundant in this area. Other predators and scavengers included six-rayed sea star; hermit crab; the snail, *Amphissa columbinana*; purple shore crab; and red shore crab. Infauna included soft shell clam (*Macoma inquinata*), littleneck clam, and cockle.
	57 to 80	gravel and sand with scattered cobble	The gravel and sand substrate type had a lush algal cover of green link confetti, green sea rope, and sea lettuce interspersed with patches of the foliose red alga, *Polysiphonia* sp.; rockweed; laver (*Porphyra* sp.); and triple rib kelp. Green sea urchin was the dominant herbivore. Slender, purple, and six-rayed sea star; drill snail; and spindle snail were dominant predators. Infauna included butter clam, littleneck clam, soft shell clam, and sipunculid peanut worm.
3.3 to -2.6	81 to 94	cobble with pockets of sand and gravel	The lower intertidal zone included a transition area from the predominant green algae zone to the predominant brown algae zone. A mixture of brown and red algae prevailed with no apparent dominance. Species included triple rib kelp, whip tube, sharp tooth brush, green sea rope, sea lettuce, sea sac, and *Polysiphonia* sp. Invertebrate herbivores included plate limpet, shield limpet, lined chiton, mossy chiton, and green sea urchin. Invertebrate predators included leafy hornmouth snail (*Ceratostoma foliatum*), blood star six-rayed sea star, spindle shell snail, and the large nemertean worm, *Paranemertes peregrina*. Thatched barnacle were scattered on rocks as were numerous small hermit crab, many of which occupied the shell of the snail, *Bittium eschrichtii*. Infauna was dominated by butter clam. Littleneck clam and soft shelled clam were also found. Other infauna included *Bittium eschrichtii* and unidentified polychaete worms. At the lowest part of intertidal, the brown algae zone was dominated by wrack and triple rib kelp with an understory of sharp tooth brush, sea sac, sea lettuce, color changer, whip tube, laver, and *Polysiphonia* sp. Rock substrates were encrusted with the pink coralline algae *Lithothamnion/Lithophyllum*, *Corallina vancouveriensis*, and *Bossiella plumosa*. Plate limpet, cap limpet, lined chiton, green sea urchin, and blue top snail were the dominant invertebrate grazers. Sunflower sea star, leather star, blood star, and spindle snails were the dominant invertebrate predators. Sesile suspension feeding invertebrates included plume worm, and rock jingle. Brittle star, burrowing sea cucumber, hermit crab, red shore crab, and *Bittium eschrichtii* were found amoung rocks and gravel. Infauna included butter clam, peanut worm, littleneck clam, and the polychaete, *Nereis vexillosa*.

HALIBUT POINT



Management Recommendations: Halibut Point contains a semi-protected gravel, sand, and cobble beach located at the mouth of Granite Creek. Important habitat uses of this area include herring spawning, salmon spawning and rearing, bald eagle feeding, waterbird feeding and resting, as well as clam beds, abalone, and demersal fish.

We recommend that Halibut Point be managed to maintain or enhance the habitat for fish and wildlife production and utilization. The importance of this area is already recognized as it lies within the Halibut Point State Park. Our findings and recommendations are as follows: 1) activities that would cause degradation of water quality; specifically increased turbidity, oil pollution, sewage contamination, or toxic waste disposal are considered adverse and should be avoided; 2) tideland filling that decreases the wetted surface area is considered adverse and should be avoided; 3) gravel dredging within clam beds, marine plant communities, and salmon spawning areas is considered adverse and should be avoided; and 4) vehicle traffic on tidelands, particularly that occurring below the 6 ft MLLW tide line is considered adverse to clam beds and other marine life and should be avoided.

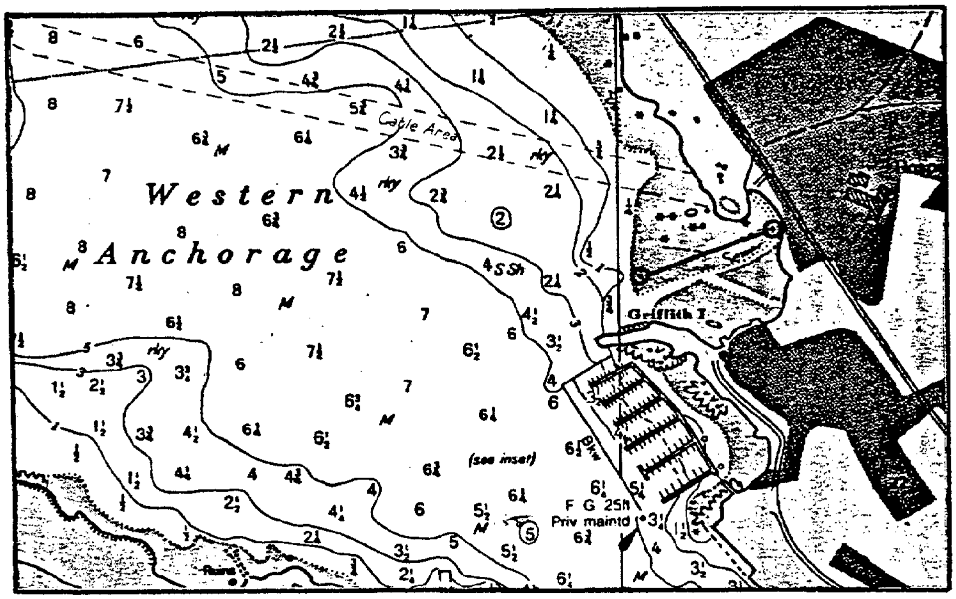
We recommend that this area continue to be managed for public recreation use and habitat including clamming, fishing, beachwalking, picnicking, scuba diving, and education.

Table 3.

SITKA SOUND INTERTIDAL SURVEY
Old Seaplane Turnaround Flats
$57^{o}03'33"$N Latitude, $135^{o}20'50"$W Latitude
Date: May 13, 1980 Time: 0700 PST

Elevation above MLLW (feet)	Distance along Transect (meters)	Substrate	Biota and Comments
9.9 to 6.6	0	rip-rap boulders	Diatom coating on rock surfaces, no invertebrates found.
6.6 to 5.3	1 to 30	sand with boulders	The upper intertidal area had a sparse distribution of the pink clam, *Macoma balthica*. A few periwinkles also occurred.
7.8 to 5.3	31 to 64	boulder and bedrock with scattered sand pockets	A rocky outcrop spanned the upper and mid-intertidal zones. The entire area was heavily polluted by an adjacent untreated sewage outfall that discharged onto the intertidal flats. Rockweed was the dominant algal covering. Patches of the red alga, *Gloiopeltis furcata* occurred in sand pockets. Sharp tooth brush occurred in tidepools. Thatched and acorn barnacles, periwinkles, plate limpet, and shield limpet were the dominant invertebrates. Butter clam occurred in sand substrate.
5.2 to 2.2	65 to 78	sand and silt	This mid-intertidal area included a worm mat dominated by the polychaete, *Owenia fusiformis* and sipunculid peanut worms. Scattered patches of eelgrass also occurred.
	79 to 83	sand and gravel	This mid-intertidal area supported a mussel bed and scattered thatched and acorn barnacle. No infauna were found.
	84 to 89	gravel	This area included the mid-intertidal streambed of Turnaround Creek. A few scattered mussels occurred along the channel banks.
	90 to 107	small cobble and sand	This mid-intertidal area included a mussel bed. The densities ranged from eight to twelve mussels per quarter square meter. Thatched, acorn, and cross barnacle were also found. Infauna included butter clam and cockle.
	108 to 114	silty sand	This mid-intertidal area included a worm mat dominated by the polychaete, *Owenia*. Scattered eelgrass also occurred. Marbled godwit were observed feeding on the worm mat.
	115 to	concrete with joints filled with silty sand	This area included the mid-intertidal portion of the concrete seaplane ramp. Algae included sea sac, sharp tooth brush, whip tube, and sea lettuce. Invertebrates included mossy chiton and hermit crabs. Invertebrates found in slab joints included the anemone, *Anthopleura artemisia*, peanut worm, butter clam, cockle, and the polychaete, *Nereis vexillosa*.
1.9 to -1.8	136 to 187	silty sand	The lower intertidal zone was soft mud substrate supporting a dense eelgrass bed. Densities of eelgrass averaged 172-300 plants per square meter. The length of eelgrass leaves ranged from 50 to 105 cm with an average length of 75 cm. Eelgrass leaves were covered with herring eggs. This area is known to consistently support herring spawning. Invertebrate life was dominated by the polychaete, *Owenia*. Densities of *Owenia* tubes averaged 8,000 per square meter. Other polychaete worms included *Nereis vexillosa* and *Pectinaria granulata*. Infaunal clams including butter, littleneck, pink, and the soft shelled clam, *Macoma inquinata* were abundant. Other invertebrates found included isopod, gammarid amphipod, and peanut worm. Numerous juvenile flat fish were found in the mud. A narrow band of wrack occurred at the end of the transect.

OLD SEAPLANE TURNAROUND FLATS



Management Recommendations: Old Seaplane Turnaround Flats is a quiet mud embayment located north of Thomsen Harbor. The habitat uses of this area included herring spawning, juvenile salmon rearing, extensive eelgrass beds, high densities of infaunal worms, clams, and a productive waterbird feeding and resting area.

The intertidal zone consisted of a relatively non-productive upper area and highly productive lower area. The transition zone between high intertidal and low intertidal occurred between 5.3 and 3.9 MLLW. Species and habitats occurring below 5 feet MLLW would be highly sensitive to tideland filling, dredging, oil spills, and toxic waste disposal. Untreated domestic sewage is discharged from an outfall approximately at the 5 feet MLLW tide level. The effects of this discharge could not be quantified in this survey; however, we did not observe that the effluent had a significant biological effect upon the marine life of the area. Ravens, crows, gulls, and ducks were observed to be attracted to the outfall. The rocks and tidal flats adjacent to the outfall supported a normal diversity and abundance of intertidal invertebrates and macrophytes. It is probable that clams and mussels in the area were contaminated and unfit for human consumption. Depuration of these bivalves should occur rapidly after the sewer is connected to a central treatment facility scheduled in 1981.

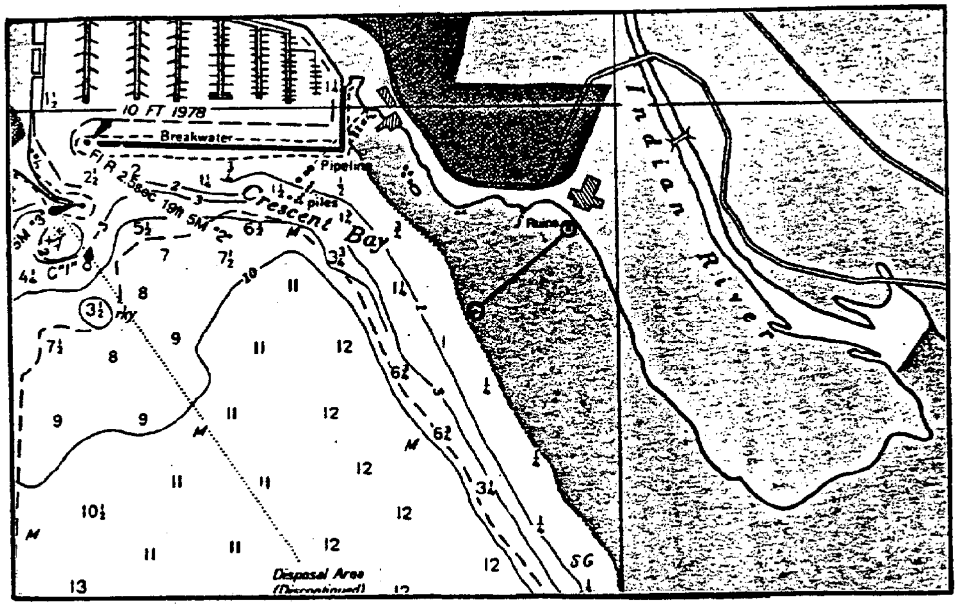
Our primary management recommendation for this area is to protect the lower tideflat habitat from permanent loss or degradation. The following activities or developments are considered adverse to this habitat: 1) solid tideland fills below the 5 foot MLLW tideline; 2) vehicular traffic outside of the existing seaplane ramp; 3) acute or persistent oiling of the area; 4) any significant changes in nearshore current patterns or littoral drift, which would cause sediment scour, concentration of pollutants, or decreased mixing with adjacent waters; and 5) dredging that results in the permanent removal of eelgrass beds, infaunal worm mats and clam beds, or that creates conditions unfavorable for their growth and propagation.

Table 4.

SITKA SOUND INTERTIDAL SURVEY
Totem Park
57°02'56"N Latitude, 135°20'50"W Longitude
Date: May 14, 1980 Time: 0730 PST

Elevation above MLLW (feet)	Distance along Transect (meters)	Substrate	Biota and Comments
10.0 to 6.8	0 to 16	gravel with cobble and drift logs	The upper intertidal zone was an unvegetated gravel slope. Lines of drift algae and wood fiber supported high concentrations of beach hopper, *(Gammarid amphipod)*. A mixed flock of dunlin and western sandpiper was observed feeding on beach hoppers in the tidelines.
6.7 to 5.1	16 to 17	gravel and cobble	This mid-intertidal area included the upper fringe of a brackish tidepool. Algae included rockweed, color changer, and wrack.
5.0	18 to 44	gravel, sand, and mud with organic bark and needle detritus	This mid-intertidal area included a brackish tidepool fed by beach seeps. Macrophytes included sea lettuce, green sea rope, link confetti, color changer, sharp tooth brush, and eelgrass. Plant and substrate surfaces were coated with brown diatoms. Invertebrates were dominated by herbivores including shield limpet and periwinkle. Beach hopper and tidepool sculpin occurred in the water. Infauna was dominated by the polychaete worm, *Owenia fusiformis*.
5.0	45 to 60	gravel mixed with silty mud	This mid-intertidal area included a discontinuous tidepool. Eelgrass and sea lettuce were the dominant macrophytes. Invertebrates included mussel in scattered clumps and dense patches of *Owenia*. Short-billed dowitcher were observed feeding in this area.
5.0	61 to 79	gravel, cobble, and sand	This mid-intertidal area contained shallow tide pools. Macrophytes included eelgrass, rockweed, and the brown alga, *Leathesia difformis*. Epifauna included shield limpet, mussel, periwinkle, and isopod. Invertebrates found under rocks included the snail, *Homalopoma* sp. and the compound ascidian, *Aplidium californicum*. Infauna included butter clam and cone worm.
4.7	80 to 100	gravel and sand	This mid-intertidal area included a shallow tidepool that resembled a former gravel scrape. Macrophytes included rockweed, sharp tooth brush, and green sea rope. Most of the surface area was occupied by a dense mussel bed. The density of mussels ranged from 320 to 480 per square meter. No infauna was found.
4.6 to 3.8	101 to 153	gravel mixed with sand and cobble	This mid-intertidal area was a flat gravel pavement vegetated with clumps of rockweed. Epifauna included thatched and acorn barnacle, shield limpet, periwinkle, and patches of mussel. Pill bug isopod were abundant beneath rocks. No infauna was found.
3.7 to 3.4	154 to 172	cobble and sand with small boulders	The transition area algae between the high and mid-intertidal zones included rockweed, sea lettuce, and sea sac. Epifauna included thatched barnacle, shield limpet, mussel, and drill snail *(Thais* sp.*)*. Beneath rocks, pill bug isopods were abundant. Compound ascidian and *Thais* eggs were also found. No infauna was found in the hard, clayey subsoil.
3.3 to 2.4	173 to 188	sand and gravel	The low intertidal zone macrophytes included eelgrass, rockweed, wrack, sea lettuce, sharp tooth brush, color changer, green sea rope, and the red alga, *Callophyllis* sp. Infauna was dominated by small (1-2 cm) butter clam and cone worm.
2.3 to 1.5	189 to 202	cobble and gravel	This low intertidal area was sparsely vegetated. Algae included sharp tooth brush, wrack, rockweed, whip tube, and encrusting coralline algae. The dominant epifauna were the herbivores: plate limpet and green sea urchin. Serpulid plume worms also occurred. Infauna included the polychaete, *Owenia* and butter, littleneck, and horse clam.
1.4 to 0	203 to 208	cobble and gravel	This low intertidal area was dominated by sharp tooth brush with scattered clumps of sea lettuce, color changer, and *Callophyllis*. Other epifauna included purple sea star and red shore crab. Infauna was dominated by littleneck clam. Other infauna included cockle, butter clam, *Owenia*, and brittle star *(Ophiopholus aculeata)*.
0 to -2.7	209 to 214	cobble and gravel	The lowest intertidal zone was dominated by large brown algae including wrack, triple rib kelp, and seersucker kelp. Other algae included color changer, sharp tooth brush, green sea rope, *Callophyllis*, and corallines. Epifauna were dominated by herbivores including plate, shield, and cap limpet; lined chiton; green sea urchin; and juvenile abalone. Predatory invertebrates included purple sea star, leather star, and blood star. Other epifauna included red shore crab, rock jingle, plume worm, and amphipod. Infauna included littleneck clam, brittle star, terebellid polychaete, and other unidentified polychaete worms.

TOTEM PARK



Management Recommendations: Totem Park contains a semi-protected gravel, cobble, and sand beach lying north of the outlet of Indian River. The adjacent uplands are managed by the National Park Service. Important habitat uses of the tidelands include clam beds, pink salmon spawning and rearing, waterbird feeding and resting, bald eagle feeding, and dense low intertidal algae beds.

We recommend that the tidelands found in this area be managed for fish and wildlife propagation and harvest, recreation, and educational enjoyment. These goals are compatible with the existing National Park management.

Activities considered adverse to the habitat include: 1) any significant water quality degradation including increased turbidity and oil spills; 2) gravel dredging that destroys salmon spawning areas, clam beds, mussel beds, infaunal worm mats, and marine plant communities; 3) vehicular traffic on tidelands; and 4) any significant alteration of nearshore currents and littoral drift that would serve to concentrate pollutants, or reduce mixing with adjacent marine waters.

Drift Bottle Study

A drift bottle study in Sitka Sound was initiated on September 18, 1979 to assist in interpretation of the area's circulation, specifically with regard to pollutant trajectories. Four hundred-seventeen bottles were ultimately recovered of the 3,500 released, for a recovery rate of approximately 12%. Appendix III contains the recovery data for individual stations.

Circulation Mechanisms and Terminology. Drift bottle trajectories are largely determined by the combined effects of three major transport mechanisms: tidal currents, net circulation, and winds. Tidal currents are a major factor in producing rapid dispersion over relatively small distances; however, the oscillatory tidal currents will not necessarily result in a net transport since a drift bottle that is transported several miles on a flood tide may be returned to its point of origin on the ebb tide. Much of the apparent complexity of the observed drift bottle trajectories within approximately 3-6 miles of their drop location is the result of tidal currents. For example, if a drift bottle is dropped at high tide its initial transport is determined largely by the ebb tide direction; whereas, if it is dropped at low tide its initial transport may be in the opposite direction.

The long range, longer period circulation is considered as the net circulation. Figure 20 shows a comparison of the oscillatory tidal currents versus the net circulation for Kachemak Bay (Cook Inlet).

Actual drift trajectories were plotted using radar-tracked drogues. The flood and ebb of the tide during each tidal cycle typically produces an elliptical orbit that is distorted in the direction of the net circulation.

Winds can have a major influence on the local circulation and drift bottle trajectories. However, wind and weather were exceptionally calm during, and for about one week following the drift bottle drops, and it is doubtful if wind exerted any significant influence on drift trajectories during the first week. As discussed later, however, storm winds probably exerted a major influence on drift trajectories later in the study.

Regional Circulation in Sitka Sound. The regional circulation within Sitka Sound is integrally related to the offshore circulation in the Gulf of Alaska. Coastal waters of the northward flowing Alaska Current (Figure 21) enter Sitka Sound from the south and exit around Cape Edgecumbe.

Within Sitka Sound the net surface circulation inferred from the drift bottle recoveries represents the most reasonable surface

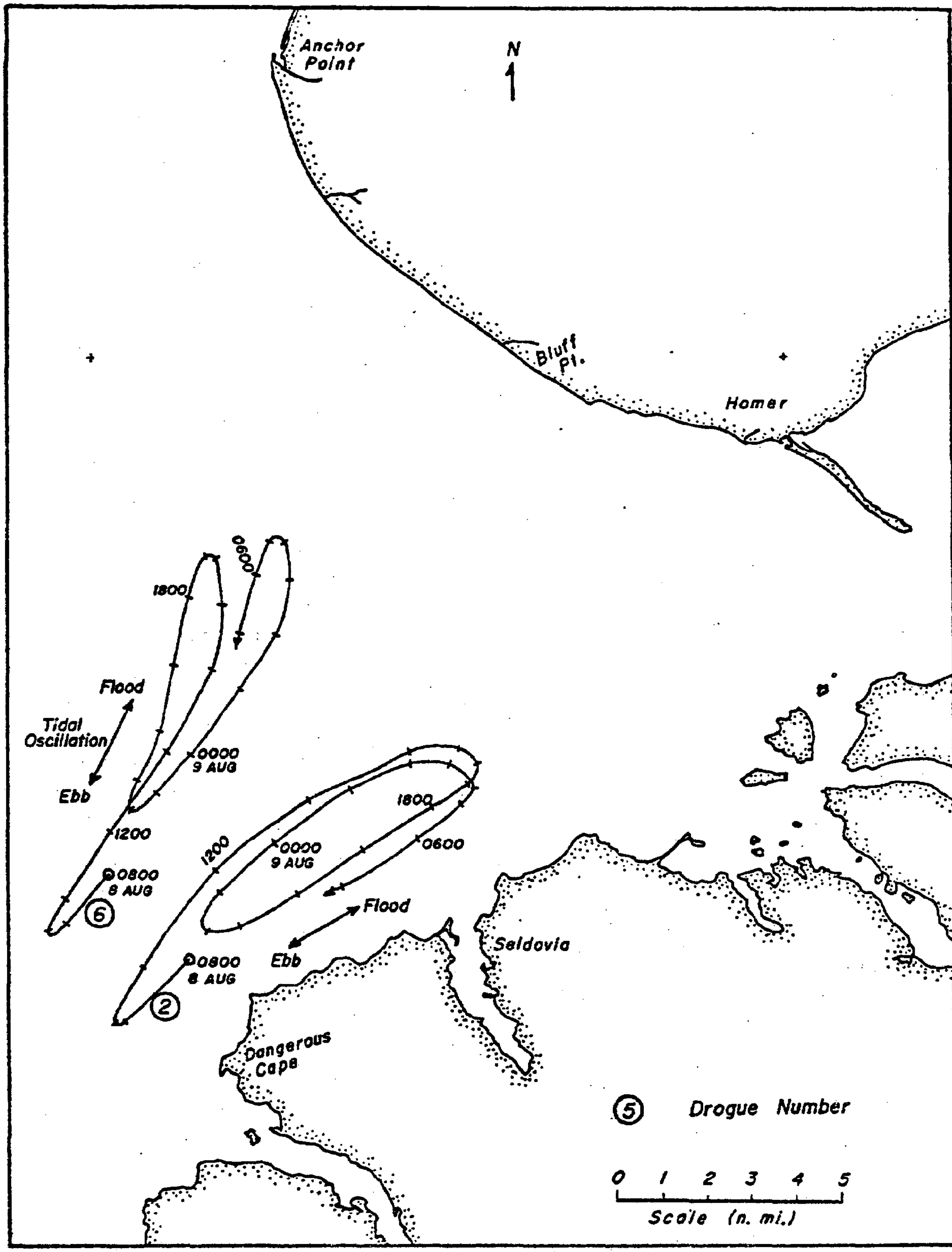


Figure 20. Comparison of Oscillatory Tidal Currents versus Net Circulation for Kachemak Bay

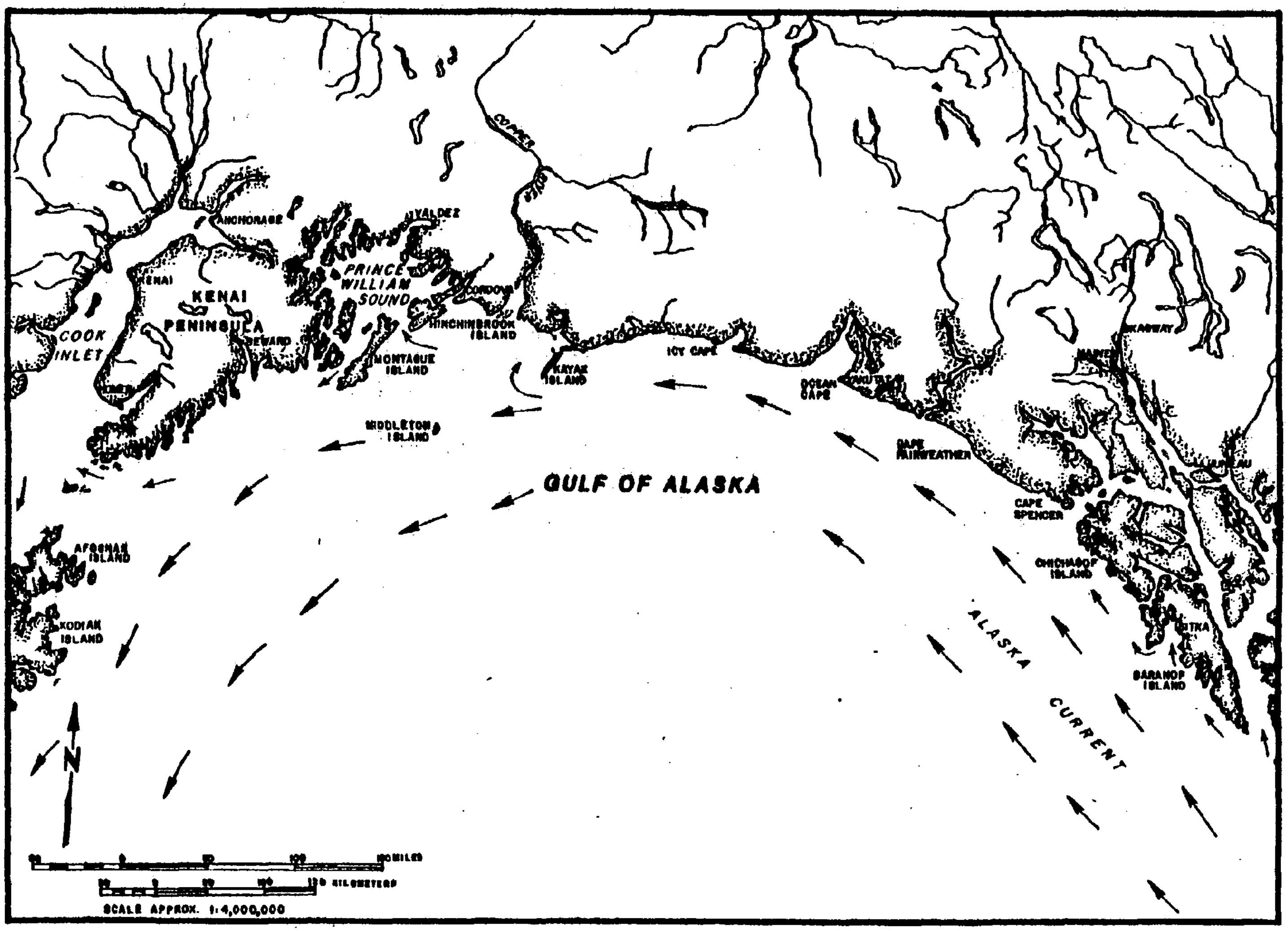


Figure 21. Offshore Circulation in the Gulf of Alaska (Alaska Current)

transport mechanism that will account for the observed distribution of all drift bottle recoveries (Figure 22). A cyclonic (counter-clockwise rotating) gyre in the outer Sound is suggested by the drift bottle trajectories from drop station 1, located 3.5 miles south of Vitskari Island (Appendix III). The complete absence of station 1 bottle recoveries from the Sound north of station 1 indicated most bottles from station 1 were probably transported directly westward into the Gulf of Alaska. One station 1 bottle was carried south to Biorka Island. Southwestward and westward transport along the southeast coast of Kruzof Island is also shown by bottle trajectories from stations 3, 5, 7, 12, 15, 17, 19, 25, 27, 28, and 29 (Appendix III). The distribution of bottle recoveries from these latter stations indicates that many of the drift bottles released in the central Sound were probably carried as far north as Hayward Strait before experiencing southwestward transport along the southeast coast of Kruzof Island. It is also entirely possible that a second gyre exists in the inner Sound north of Vitskari Island. An analogous gyre system was documented in Kachemak Bay using radar-tracked drogues. As was also observed in Kachemak Bay, it is important to note that the size and shape, and possibly even the existence, of a gyre system in Sitka Sound may vary depending on the magnitude of the tides (spring versus neap), seasonal wind differences, volume of freshwater runoff, and other factors. At least some temporal and spatial variation of a gyre or gyre system is to be expected.

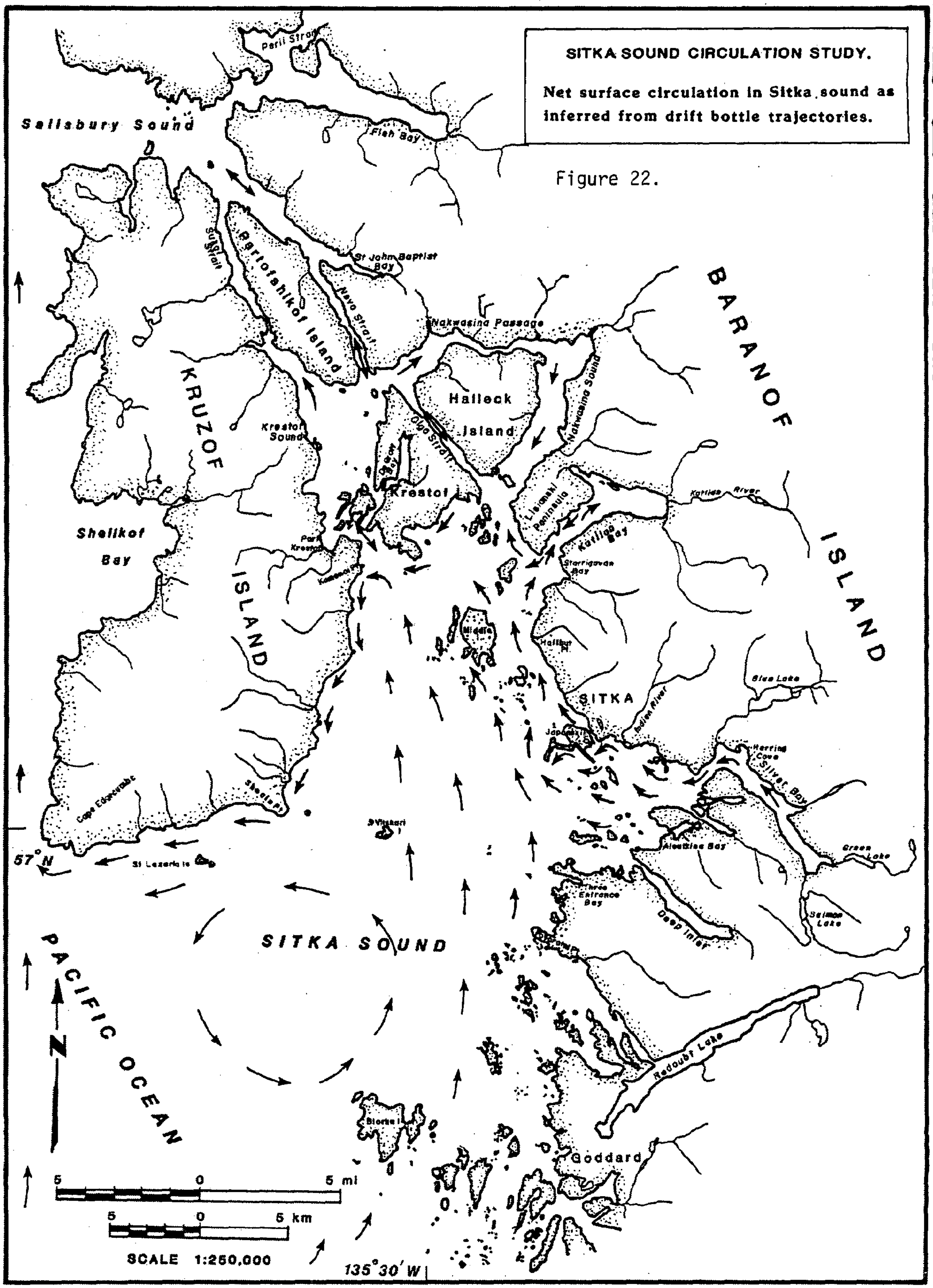

SITKA SOUND CIRCULATION STUDY.
Net surface circulation in Sitka sound as inferred from drift bottle trajectories.
Peril Strait
Salisbury Sound
Fish Bay
St John Baptist Bay
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Krestof Sound
Olga Strait
Krestof
Shelikof Bay
Katlian Bay
Starrigavan Bay
Middle I.
SITKA
Blue Lake
Herring Cove
Silver Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
Cape Edgecumbe
St Lazaria Is
57° N
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000
135°30' W

Figure 22.

Along the eastern and northern shores of the Sound and in the straits and passages to the north of the Sound, the influence of the oscillatory tidal currents is evident in the multi-directional transport of bottles observed within a few miles of each drop site. Small local eddies generated by tidal currents, particularly in the nearshore region, are common and greatly increase the initial dispersion of drift bottles in the vicinity of drop sites.

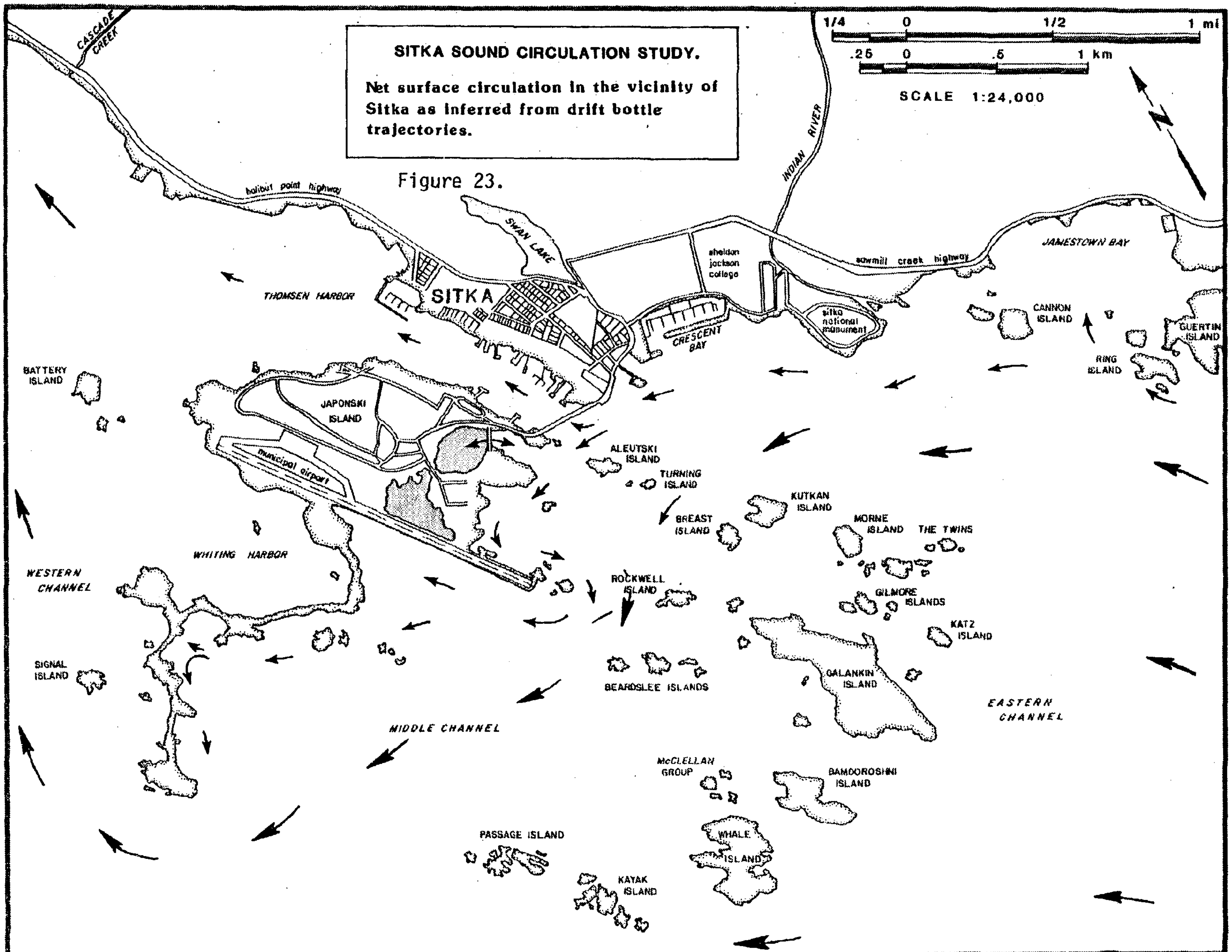
Net circulation along the eastern coast is northward. Transport into embayments, such as Katlian Bay (drop #18, Appendix III), also occurs. As the northward flowing current reaches the northern extent of Sitka Sound, drift card trajectories indicate the majority of transport turns to the west towards Hayward Strait and Kruzof Island. There appears to be little if any northward flow into Nakwasina Sound, and only very limited northward flow into Olga Strait and Hayward Strait. The lack of signficant northward flow out of northern Sitka Sound is suggested by the almost total absence of recoveries in Neva Strait, St. John-Baptist Bay, and Salisbury Sound. The appearance of bottles from Sitka Sound in Krestof Sound and Olga Strait is apparently due to tidal current transport from northern Sitka Sound into Hayward and Olga Straits with subsequent dispersal within Krestof Sound. The single bottle recovery in eastern Salisbury Sound (mouth of Fish Bay) could be the result of northward transport through Neva Strait, or could be due to eastward transport of the bottle into Salisbury Sound following transport of the bottle up the west coast of Kruzof Island by the Alaska Current.

The distribution of recoveries from bottles dropped within Krestof Sound suggests a possible anti-cyclonic (clockwise rotating) circulation within Krestof Sound.

Based upon the number and origin of the drift bottles recovered along the southeastern coast of Kruzof Island, most Sitka Sound surface waters exit the Sound by this route. A significant, but unknown proportion of the southwestward transport along southeastern Kruzof Island may be recirculated into Sitka Sound, especially if a well-defined cyclonic (CCW) gyre exists in the outer Sound as shown in Figure 22.

Local Circulation in the Vicinity of Sitka. The regional net circulation (Figure 22) in the vicinity of Sitka was shown to be northwestward parallel to the coast. Circulation in the immediate vicinity of Sitka, however, is altered significantly by Japonski and other local islands. The local circulation inferred from the drift bottle trajectories is shown in Figure 23.

Drift bottle drops at each of the stations in the immediate vicinity of Sitka were made over a four day period (September 18-21, 1979) and included drops during both flood and ebb tides at each



SITKA SOUND CIRCULATION STUDY.

Net surface circulation in the vicinity of Sitka as inferred from drift bottle trajectories.

Figure 23.

drop station. Eastward dispersion of as much as three miles from the drop sites was observed; this distance is the approximate maximum transport that could be expected during the ebb tide that sets southeast through Sitka Waterfront Channel.

Bottles dropped in the vicinity of the eastern entrance to the Sitka Waterfront Channel appeared to generally bypass the harbor and were transported in a net westward direction towards the runway. A large number of bottles were recovered along the south shore of Japonski Island, including seven inside of Mt. Edgecumbe Lagoon; whereas none were found on the north shore of the island. The data indicates that Japonski Island diverts most of the net northwestward flowing coastal current to the west around the seaward tip (Makhnati Island) and that very little, if any, of the surface water passing the east entrance to the Sitka Waterfront Channel actually enters the channel. The strong onshore transport of surface waters that was observed along the south shore of Japonski Island occurred despite the exceptionally calm weather observed during, and for several days following, the bottle drops. During normal wind conditions, the prevailing southeasterly winds would serve to increase the onshore transport that was observed here during a period of calm weather.

The total absence of bottle recoveries along the north shore of Japonski Island suggests offshore (north or northwestward) transport of surface waters along the entire north coast of the island,

and this further suggests coastal upwelling along the north shore in order to maintain mass balance.

SUMMARY AND CONCLUSIONS

The rich variety and abundance of marine life found in Sitka Sound is due in large measure to the high quality and diversity of habitats found along the coast. The nearshore marine plant and animal communities form the basis of a food chain that supports most of the species of commercial, recreational, and subsistence importance.

The intertidal and shallow subtidal habitats are limited in Sitka Sound because of the steep topography of the area. Estuarine tidal flats are generally restricted to the mouths of streams or are located in small coves where sediments collect. Estuarine tidal flats were found to be generally more productive than the steep rocky shorelines, hence special efforts should be made to protect these areas from unneccessary destruction.

The surveys examined numerous types of shorelines and habitats along the waterfront. In terms of overall species diversity and richness, Katlian No. 2, Harbor Point, Halibut Point, Old Seaplane Turnaround Flats, Old Navy Dock, Totem Park, Thimbleberry Bay, No Thorofare Bay Inlet, Three Entrance Bay, and Tava Island were areas of particular significance.

Man's impact upon the marine environment of Sitka Sound is a difficult and highly subjective task to evaluate. The lack of comprehensive baseline data and monitoring of long term changes in habitat productivity is a major obstacle to assessing whether development has had a net beneficial or negative effect on the productivity of the marine environment. During the course of this study several observations were made that may give some indication of the nature of the impacts.

Pulp Mill. The construction and operation of the Alaska Lumber and Pulp Company mill in Silver Bay has had several noticeable effects on the marine environment of Silver Bay and the waterfront south of Japonski Island.

Our drift bottle study and other observations indicate that sulfite waste liquor (SWL) effluent drifts in a northwest direction out of Silver Bay. The SWL plume is noticeable in surface water from Japonski Island to Sawmill Bay and includes Jamestown Bay, Thimbleberry Bay, and Ball Islets. While no acute toxic effects of this plume were observed, we did note that macrophyte growth is limited south of the causeway on otherwise suitable subtidal substrates, particularly at the Ball Islets underwater survey site. The paucity of marine plant communities in this area may be the result of a shading effect that the SWL imparts to surface water, thus inhibiting light transmission to depths that would otherwise support plant growth. Further documentation of water quality including light transmission and spectral attenuation and assessment of algae communities are needed to further assess this situation. It is known that very little of the shoreline from Silver Bay to the south side of Japonski Island is utilized for herring spawning

(Figure 24). These shorelines are similar in physical appearance and characteristics to shorelines on the north and south that support heavy spawning by herring. Silver Bay and other shorelines south of Japonski Island including Jamestown Bay historically supported herring spawning prior to the start-up of the pulp mill (Skud, 1959). Whether the lack of herring spawning is due to chemical constituents in the water, the paucity of subtidal marine algae, the unpredictable year to year patterns of herring spawning, or subtle biological and physical characteristics of the area is not known. It is probable that it involves a combination of several or all of the above factors. Efforts to rehabilitate herring spawning habitat in these areas may be successful as the requirements for spawning habitat become better known and further improvements to water quality are made.

Drift Logs. Drift logs, most of which originate from the transport and storage of timber from the forest to the mill, are a noticeable feature of many of the beaches in Sitka Sound. As these logs, some weighing several tons, move around on beaches, they exert a tremendous ecological force on the populations of plants and animals inhabitating the intertidal and shallow subtidal zones. Prior to the advent of large scale timbering along the Pacific Coast, drift logs had very little influence on intertidal ecology. Now drift logs affect beaches from California to the Aleutian Islands.

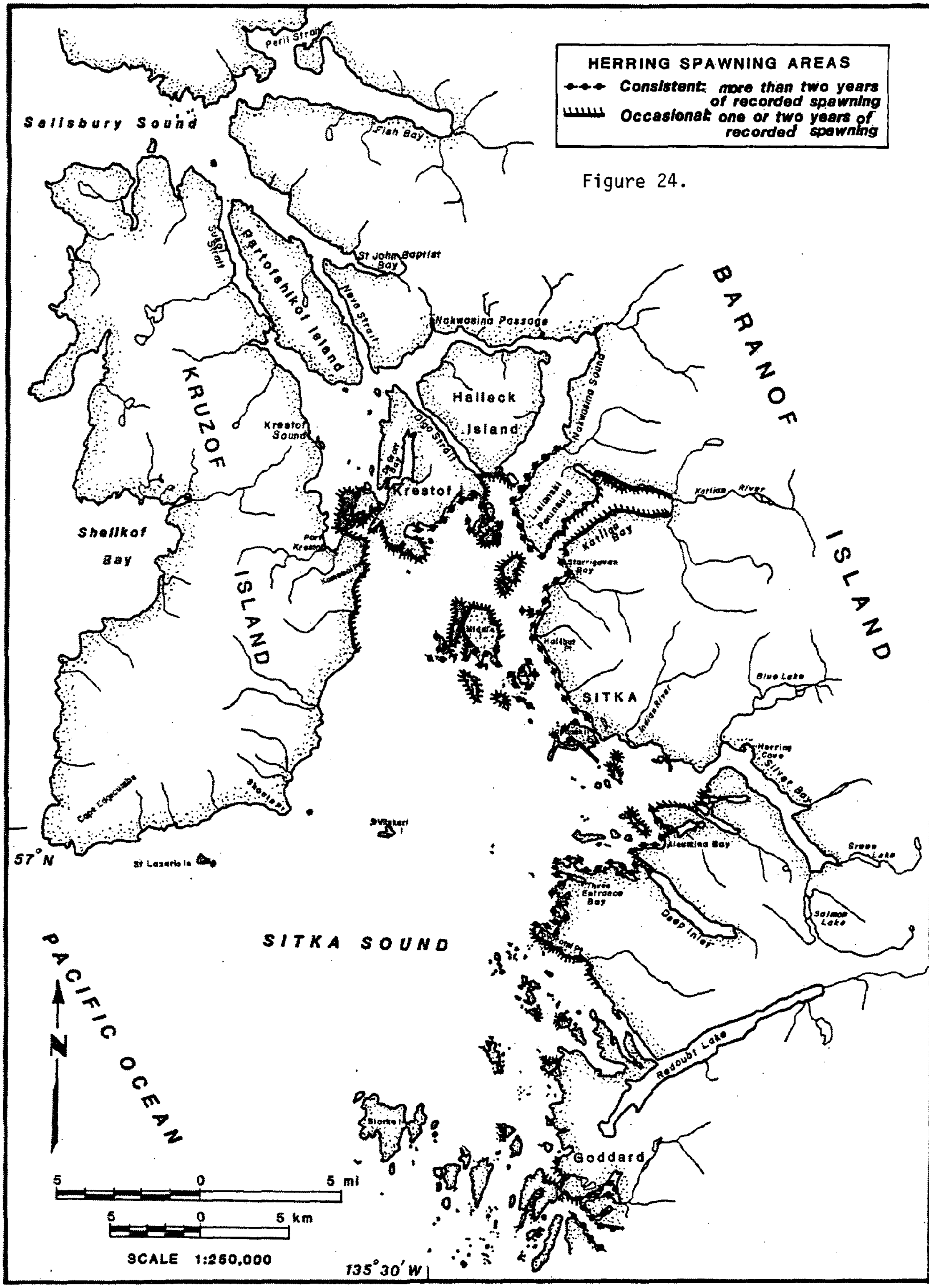

HERRING SPAWNING AREAS
Consistent: more than two years of recorded spawning
Occasional: one or two years of recorded spawning
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Neva Strait
Nakwasina Passage
Partofshikof Island
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Halleck Island
Olga Strait
Nakwasina Sound
Krestof
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
Middle I.
Halibut Pt.
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Deep Inlet
Redoubt Lake
St Lazaria Is
57° N
SITKA SOUND
PACIFIC OCEAN
N
Goddard
SCALE 1:250,000
135°30′ W
5 0 5 mi
5 0 5 km

Figure 24.

Whether drift logs have an adverse impact in the total marine ecosystem has not yet been determined. Intertidal biota by its very nature is adapted to the dynamic conditions found within the intertidal zone. Life history strategies of many intertidal invertebrates are based upon rapid growth, early maturity, and massive reproduction. These factors all tend to minimize the long term damage that any short term event, such as a log impacting a beach, will have on the population of any one species. Some ecological theories suggest that drift logs increase habitat diversity by increasing the number of "ecological niches" where new species can colonize. Our investigations of beaches having large accumulations of drift logs in Sitka Sound noted numerous examples where rock surfaces were scraped clean of macro-invertebrate and plant life. Closer inspection would often reveal cracks, crevices, and other cryptic locations that supported barnacles, limpets, snails, and mussels. It is likely that the impacts of drift logs in these areas actually have had a net negative effect upon intertidal ecology because the frequency of impacts is great enough to eliminate the beach as a viable habitat for any desirable species. We support efforts to remove drift logs from the beaches of Sitka Sound and recommend in favor of log transportation systems, such as barging and upland storage, that minimize the loss of wood fiber from the forest to the mill.

Waterfront Fills. The demand for useable waterfront land in Sitka has resulted in the filling of over one hundred acres of former tidelands along the waterfront. As mentioned previously, intertidal habitat in Sitka Sound should be considered a limited resource because of the steep topography. The filling of tidelands generally results in a reduction of the wetted surface area. In certain environments, such as high energy, unstable beaches, this may have little net biological effect. In other areas, such as clam beds, salmon rearing areas, herring spawning areas, eelgrass beds, and worm flats, the results can be the reduction or elimination of a desirable and limited habitat type. An additional impact occurs when tideland fills force juvenile salmonids (mostly pink and chum smolts) out of relatively protected shallows into deeper water where they become prey to a host of offshore species including sculpins and rockfish (Mulvihill et al., 1980). Most of the Sitka shore zone was found to contain important habitat. Judicious use of fill can create new habitats, such as the attraction of fish to a breakwater. However, the indiscriminate filling of tidelands for the purpose of creating additional waterfront land will reduce the amount of productive shallows along the coast with the resulting loss of habitat diversity and nearshore productivity.

The Sitka waterfront area is ideally suited to the use of piling supported structures for water dependent uses. Concrete and steel piling are structurally sound, fire safe, and permit the continued use of waterfront habitats by invertebrates, fish, and wildlife. Piling structures often create additional habitat and enhance local fish populations in the process. We recommend that the City and Borough of Sitka adopt a policy favoring the use of piling supported and floating structures for waterfront development. The policy should discourage solid fills in tidelands unless no feasible and prudent alternative is available. Where solid fills are in the public interest, it may be necessary to construct a breach in the low intertidal - shallow subtidal area to protect juvenile salmonid migration.

Sewage Disposal. Domestic sewage is currently discharged untreated into the ocean through numerous shallow water and intertidal outfalls. In all of our surveys we were not able to detect any detrimental effect upon the marine habitat of the area from the discharge of domestic sewage. Certain bird species, such as gulls, ravens, crows, and ducks, were attracted to outfall locations, particularly during the winter months.

The centralized sewage collection and treatment facility scheduled for completion in 1983 will improve the aesthetics and public health aspects of waterfront beaches. The facility proposes to intercept existing ocean outfalls and discharge primary treated effluent through a single 24" diffuser outfall located in 85 ft of water south of the airport runway. Requests for funding of this project and waiver of secondary treatment are currently pending with EPA (CBS, 1979). Among the potential benefits of this project will be the improvement of nearshore water quality in the vicinity of existing outfalls. This will improve aesthetics along the waterfront and may allow for the future consumption of shellfish, including hardshell clams and mussels, from currently contaminated areas. We cannot find any appreciable benefit to the fish and wildlife habitat of the area by requiring secondary treatment over primary treatment at this time because of Sitka's low volume of effluents and the relatively innocuous nature of primary treated domestic sewage within the mixing zone as proposed. Secondary treatment may be required in the future depending upon changes in the volume or nature of the effluent. The facility is designed to accept secondary treatment should this become necessary.

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APPENDIX I

ALPHABETICAL LISTING OF COMMON NAMES WITH THEIR RESPECTIVE SCIENTIFIC NAMES SHOWN IN FIGURES 3-19 AND TABLES 1-4

APPENDIX I
ALPHABETICAL LISTING OF COMMON NAMES WITH THEIR RESPECTIVE SCIENTIFIC NAMES SHOWN IN FIGURES 3-19 AND TABLES 1-4

Common Name	Scientific Name(s)
FLORA	
Basket grass	*Phyllospadix scouleri*
Bull kelp	*Nereocystis leutkeana*
Color changer	*Desmarestia viridis*
Cup and saucer	*Constantinea simplex*
	C. subulifera
Eelgrass	*Zostera marina*
Giant kelp	*Macrocystis integrifolia*
Green link confetti	*Enteromorpha intestinalis*
Laver	*Porphyra* sp.
Pompom	*Pterygophora californica*
Rockweed	*Fucus distichus*
Sea lettuce	*Ulva* sp.
	Monostroma sp.
Sea rope	*Spongomorpha* sp.
Sea sac	*Halosaccion glandiforme*
Sea staghorn	*Codium fragile*
Seersucker	*Costaria costata*
Sharp tooth brush	*Odonthalia* sp.
Sieve kelp	*Agarum cribrosum*
	A. fimbriatum
Triple rib kelp	*Cymathere triplicata*
Whip tube	*Scytosiphon lomentaria*
Wing kelp	*Alaria* sp.
Wrack	*Laminaria* sp.

Common Name	Scientific Name(s)
FAUNA	
Abalone	*Haliotis kamatschatkana*
Acorn barnacle	*Balanus glandula*
Bent nose clam	*Macoma nasuta*
Black katy (black chiton)	*Katherina tunicata*
Blood star	*Henricia leviuscula*
Blue top shell	*Calliostoma* spp.
Brittle star	*Ophiopholus aculeata*
	Ophiura sp.
Burrowing sea cucumber	*Cucumaria miniata*
Butter clam	*Saxidomus giganteus*
Cap limpet	*Acmea mitra*
Checkered periwinkle	*Littorina scutulata*
Clear sea squirt	*Corella willmeriana*
Cloud anemone	*Metridium senile*
Cockle	*Clinocardium* spp.
Coho salmon	*Oncorhynchus kisutch*
**Cribinopsis* sp. (sea anemone)	*Cribinopsis* sp.
Cross barnacle	*Chthamalus dalli*
**Dendronotus* sp. (sea slug)	*Dendronotus* sp.
Dolly Varden	*Salvelinus malma*
Dungeness crab	*Cancer magister*
Giant barnacle	*Balanus nubilus*
Green anemone	*Anthopleura xanthogrammica*

Green sea urchin	*Strongylocentrotus droebachiensis*
Green shore crab	*Hemigrapsus oregonensis*
Gumboot chiton	*Cryptochiton stelleri*
Hairy triton	*Fusitriton oregonensis*
Hermit crab	Pagurideae
Hooded sea slug	*Melibe leonina*
Horse clam	*Tresus capax*
Kelp greenling	*Hexagrammos decagrammus*
Keyhole limpet	*Diadora aspera*
Leather star	*Dermasterias imbricata*
Lined chiton	*Tonicella lineata*
Littleneck clam	*Protothaca staminea*
Long-rayed sea star	*Orthasterias koehleri*
**Macoma* sp. (clam)	*Macoma* sp.
**Microporina borealis* (bryozoan)	*Microporina borealis*
Mossy chiton	*Mopalia* spp.
Mussel	*Mytilis edulis*
Octopus	*Octopus defleini*
Pacific herring	*Clupea harengus pallasi*
Peanut worm	Sipuncula
Pill bug isopod	*Gnorimoshpaeroma oregonense*
Pink clam	*Macoma balthica*
Pink salmon	*Oncorhynchus gorbuscha*
Plate limpet	*Notoacmea scutum*
Plume worm	*Serpula vermicularis*

Purple sea star	*Pisaster ochraceus*
Purple shore crab	*Hemigrapsus nudus*
Red rock crab	*Cancer productis*
Red shore crab	*Cancer oregonensis*
Red sea urchin	*Strongylocentrotus franciscanus*
Rockfish	*Sebastes* spp.
Black	*S. melanops*
China	*S. nebulosus*
Copper	*S. caurinus*
Dusky	*S. ciliatus*
Quillback	*S. maliger*
Yellowtail	*S. flavidus*
Rock jingle	*Pododesmus cepio*
Rock sole	*Lepidopsetta bilineata*
Rose sea star	*Crossaster papposus*
Sea feather (crinoid)	*Florometra serratissima*
Sea peach	*Halocynthia aurantium*
Sea pen	*Ptilosarcus gurneyi*
Searcher	*Bathymaster signatus*
Shield limpet	*Collisella pelta*
Shipworm	*Bankia setacea*
Sitka periwinkle	*Littorina sitkana*
Six-rayed sea star	*Leptasterias hexactis*
Slender sea star	*Evasterias troschelii*
Spindle snail	*Searlesia dira*

Stalked anemone	*Pachycerianthus fimbriatus*
Steller sea lion	*Eumetopias jubatus*
Stout sea squirt	*Cnemidocarpa finmarkiensis*
Striped anemone	*Tealia crassicornis*
Terebellid worm	Terrebellidae
**Thais lamellosa* (drill snail)	*Thais lamellosa*
Thatched barnacle	*Balanus cariosus*
Truncated clam	*Mya truncata*
Tubesnout	*Aulorhynchus flavidus*
Vermillion sea star	*Mediaster aequalis*
**Virgularia* sp. (sea pen)	*Virgularia* sp.
Warty sea cucumber	*Parastichopus californicus*

*Common name not known

APPENDIX II

COMPREHENSIVE LISTING OF MARINE PLANTS AND ANIMALS OBSERVED DURING UNDERWATER AND INTERTIDAL SURVEYS

	KATLIAN NO. 1	KATLIAN NO. 2	HARBOR POINT	THE COVE (INTERTIDAL ONLY)	HALIBUT POINT	HALIBUT POINT (INTERTIDAL ONLY)	KASIANA ISLAND	2500 BLOCK HALIBUT POINT ROAD	2000 BLOCK HALIBUT POINT ROAD	TURNAROUND FLATS (INTERTIDAL ONLY)	THOMSEN HARBOR PARKING LOT	OLD NAVY DOCK	TOTEM PARK (INTERTIDAL ONLY)	JAMESTOWN BAY	THIMBLEBERRY BAY	BALL ISLETS	NO THOROFARE BAY INLET	PIRATE COVE	THREE ENTRANCE BAY	GODDARD HOT SPRINGS BAY	TAVA ISLAND
Chlorophyceae																					
Codium fragile					●		●	●	●			●				●		●	●		●
Codium setchellii																	●	●	●		●
Derbesia marina																●					
Enteromorpha intestinalis						●							●								
Felt like green algae (unid.)																●					
Filimentous green algae (unid.)															●	●				●	
Spongomorpha sp.				●		●							●								
Ulva/Monostroma				●		●	●	●		●	●		●	●	●	●	●	●	●	●	●
Urospora sp.																	●				
Phaeophyceae																					
Agarum cribrosum					●				●		●	●		●	●				●	●	
Agarum fimbriatum			●					●													
Alaria sp.					●		●		●								●	●			
Costaria costata				●				●					●	●						●	●
Cymathere triplicata	●	●			●	●	●						●						●		●
Desmarestia viridis						●							●				●		●	●	●
Fucus distichus	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Laminaria sp.	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
Leathesia difformis													●							●	●
Macrocystis integrifolia																		●			●
Nereocystis luetkeana							●											●	●		●
Pleurophycus gardneri																	●				
Pterygophora californica									●								●				
Ralfsea pacifica															●						
Scytosiphon lomentaria						●				●			●								
Angiospermae																					
Phyllospadix scouleri									●									●			
Zostera marina	●			●		●				●	●	●	●	●				●	●	●	

Rhodophyceae	KATLIAN NO. 1	KATLIAN NO. 2	HARBOR POINT	THE COVE (INTERTIDAL ONLY)	HALIBUT POINT	HALIBUT POINT (INTERTIDAL ONLY)	KASIANA ISLAND	2500 BLOCK HALIBUT POINT ROAD	2000 BLOCK HALIBUT POINT ROAD	TURNAROUND FLATS (INTERTIDAL ONLY)	THOMSEN HARBOR PARKING LOT	OLD NAVY DOCK	TOTEM PARK (INTERTIDAL ONLY)	JAMESTOWN BAY	THIMBLEBERRY BAY	BALL ISLETS	NO THOROFARE BAY INLET	PIRATE COVE	THREE ENTRANCE BAY	GODDARD HOT SPRINGS BAY	TAVA ISLAND
Agardhiella tenera																				●	
Bossiella plumosa						●	●														
Bossiella sp.			●					●			●				●			●			●
Botryoglossum ? ruprechtianum																					●
Callophyllis cristata																	●				
Callophyllis ? sp.		●	●									●	●	●	●				●	●	
Constantinea spp.													●		●			●		●	
Corallina ? sp.					●			●			●				●	●			●	●	
Corallina vancouveriensis						●	●		●					●	●		●				
Delesseria decipiens																	●	●		●	
Foliose red algae (unid.)							●					●								●	
Gelidium ? robustum								●			●										
Gigartina sp.							●											●		●	
Gloiopeltis furcata				●						●											
Halosaccion glandiforme					●	●				●	●		●		●			●	●	●	●
Hildenbrandia/Petrocelis					●												●	●			
Iridaea ? sp.							●	●													●
Lithothamnium/Lithophyllum		●	●		●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●
Membranoptera ? sp.								●									●				
Odonthalia sp.			●			●		●	●	●			●				●	●			●
Palmaria ? (Rhodymenia) palmata							●					●									●
Platysiphonia sp.								●													
Plocamium ? cartilagineum								●													
Plocamium sp.							●														
Polyneura latissima																	●				
Polysiphonia ? sp.				●		●											●		●		
Porphyra sp.					●	●														●	
Pterosiphonia ? dendroidea							●								●			●			
Ptilota ? (Neoptilota) sp.								●	●					●							●
Rhodymenia pertusa																	●				
Rhodymenia ? sp.		●						●			●			●			●				
Scagelia ? occidentale							●														

	KATLIAN NO. 1	KATLIAN NO. 2	HARBOR POINT	THE COVE (INTERTIDAL ONLY)	HALIBUT POINT	HALIBUT POINT (INTERTIDAL ONLY)	KASIANA ISLAND	2500 BLOCK HALIBUT POINT ROAD	2000 BLOCK HALIBUT POINT ROAD	TURNAROUND FLATS (INTERTIDAL ONLY)	THOMSEN HARBOR PARKING LOT	OLD NAVY DOCK	TOTEM PARK (INTERTIDAL ONLY)	JAMESTOWN BAY	THIMBLEBERRY BAY	BALL ISLETS	NO THOROFARE BAY INLET	PIRATE COVE	THREE ENTRANCE BAY	GODDARD HOT SPRINGS BAY	TAVA ISLAND
Porifera																					
Cliona celata									●								●		●	●	
Halichondria sp.					●							●					●				
Haliclona sp.		●	●						●								●		●		●
Mycale adhaerens											●										
Ophilitaspongia pennata			●																●		
Cnidaria																					
Abietinaria sp.												●				●	●				●
Anthopleura ? artemisia										●											
Anthopleura elegantissima																		●			
Anthopleura xanthogrammica					●												●	●	●		
Aquorea aquorea																					●
Balanophyllia elegans		●																			
Cribinopsis sp.												●			●						
Cyanea capillata																			●		
Florometra serratissima		●	●																		
Garveia sp.																	●				
Gersemia rubiformis																			●		
Hydroid (unid.)												●							●		●
Hydromedusa (unid.)																			●		
Metridium senile					●							●					●	●	●		
Obelia longissima	●											●									
Obelia sp.		●	●																		
Pachycerianthus fimbriatus	●		●		●			●				●		●	●	●					
Ptilosarcus gurneyi		●			●												●				
Ptilosarcus ? sp.																●					
Scyphozoans (unid.)					●																
Tealia coriacea																			●		●
Tealia crassicornis									●									●	●		
Tealia sp.							●														
Virgularia sp.															●						

	KATLIAN NO. 1	KATLIAN NO. 2	HARBOR POINT	THE COVE (INTERTIDAL ONLY)	HALIBUT POINT	HALIBUT POINT (INTERTIDAL ONLY)	KASIANA ISLAND	2500 BLOCK HALIBUT POINT ROAD	2000 BLOCK HALIBUT POINT ROAD	TURNAROUND FLATS (INTERTIDAL ONLY)	THOMSEN HARBOR PARKING LOT	OLD NAVY DOCK	TOTEM PARK (INTERTIDAL ONLY)	JAMESTOWN BAY	THIMBLEBERRY BAY	BALL ISLETS	NO THOROFARE BAY INLET	PIRATE COVE	THREE ENTRANCE BAY	GODDARD HOT SPRINGS BAY	TAVA ISLAND
Nemertea																					
Paranemertes ? peregrina				●		●															
Mollusca																					
Acmea mitra			●			●	●	●	●			●	●		●	●	●	●	●		●
Amphissa columbiana						●									●	●					
Anisodoris nobilis																	●			●	
Archidoris montereyensis									●										●		
Archidoris odhneri												●						●			●
Bankia setacea												●		●			●				
Bittium eschrichtii						●															●
Bittium sp.			●								●							●			
Calliostoma ligatum			●		●	●	●					●					●	●	●	●	●
Calliostoma sp.		●							●			●		●	●		●			●	●
Ceratostoma foliatum						●						●								●	
Chlamys hastata hericia	●				●						●	●					●				
Chlamys rubida			●									●					●				
Chlamys sp.		●																			
Clinocardium californiense																				●	
Clinocardium nuttallii																					●
Clinocardium sp.	●	●				●		●		●	●		●								
Collisella digitalis								●										●			
Collisella pelta			●	●		●		●		●			●		●	●	●		●		
Cryptochiton stelleri		●																●	●		
Dendronotus ? dalli	●																				
Dendronotus sp.	●	●										●					●				
Diaulula sandiegensis												●									
Diodora aspera					●													●	●		
Dirona albolineata																				●	
Eolid nudibranch (unid.)												●									
Fusitriton oregonensis							●											●			
Haliotis kamtschatkana			●		●		●		●				●					●	●	●	●
Hermissenda crassicornis	●											●					●		●	●	
Hinnites giganteus (multirugosus)												●					●	●		●	

Mollusca (cont.)

	KATLIAN NO. 1	KATLIAN NO. 2	HARBOR POINT	THE COVE (INTERTIDAL ONLY)	HALIBUT POINT	HALIBUT POINT (INTERTIDAL ONLY)	KASIANA ISLAND	2500 BLOCK HALIBUT POINT ROAD	2000 BLOCK HALIBUT POINT ROAD	TURNAROUND FLATS (INTERTIDAL ONLY)	THOMSEN HARBOR PARKING LOT	OLD NAVY DOCK	TOTEM PARK (INTERTIDAL ONLY)	JAMESTOWN BAY	THIMBLEBERRY BAY	BALL ISLETS	NO THOROFARE BAY INLET	PIRATE COVE	THREE ENTRANCE BAY	GODDARD HOT SPRINGS BAY	TAVA ISLAND
Homalopoma luridum													●					●			
Humilaria kennerlyi		●															●				
Katherina tunicata		●							●								●		●	●	
Lacuna sp.	●						●	●	●		●									●	●
Lirularia sp.							●														
Littorina scutulata					●	●															
Littorina sitkana	●	●	●	●	●	●			●	●	●		●			●	●	●			
Macoma balthica										●											
Macoma inquinata				●		●				●											
Macoma iris																				●	
Macoma nasuta	●											●									
Macoma sp.														●							
Margarites ? inflatulus			●																		
Margarites pupillus			●		●				●							●			●		●
Melibe leonina							●				●									●	
Mitrella sp.					●																
Mopalia ciliata																	●				
Mopalia lignosa		●																			
Mopalia muscosa																					●
Mopalia sp.						●				●						●			●	●	●
Mya ? arenaria						●															
Mya truncata		●							●					●			●				
Mytilus edulis	●	●		●				●	●	●		●	●	●	●		●	●	●		
Nassarius mendicus		●			●						●										
Natica clausa																	●				●
Neptunea sp.					●																
Notoacmea fenestrata									●												
Notoacmea ? persona				●											●	●					
Notoacmea scutum	●	●		●	●	●	●	●	●	●	●		●	●	●	●	●	●	●		●
Ocenebra lurida			●																		
Octopus dofleini			●		●		●	●	●			●				●				●	●
Oenopota ? sp.		●																			

Mollusca (cont.)

	Katlian No. 1	Katlian No. 2	Harbor Point	The Cove (Intertidal Only)	Halibut Point	Halibut Point (Intertidal Only)	Kasiana Island	2500 Block Halibut Point Road	2000 Block Halibut Point Road	Turnaround Flats (Intertidal Only)	Thomsen Harbor Parking Lot	Old Navy Dock	Totem Park (Intertidal Only)	Jamestown Bay	Thimbleberry Bay	Ball Islets	No Thorofare Bay Inlet	Pirate Cove	Three Entrance Bay	Goddard Hot Springs Bay	Tava Island
Pododesmus cepio (macroschisma)			●		●	●		●	●		●	●	●			●	●	●		●	
Protothaca staminea	●			●		●	●	●	●	●	●		●	●			●	●		●	●
Puncturella cucullata												●									
Puncturella ? multistriata			●																		
Rostanga pulchra			●																●		
Saxidomus giganteus	●	●				●	●	●	●	●	●		●				●	●			●
Searlesia dira				●		●			●						●			●	●	●	
Tegula brunnea							●														
Tegula sp.									●									●			
Thais emarginata						●			●								●				
Thais lamellosa		●						●												●	
Thais sp.													●								
Tonicella insignis															●						
Tonicella lineata		●	●		●	●	●	●	●		●	●	●		●	●	●	●	●		●
Tresus capax		●	●						●				●				●	●	●	●	●
Trichotropis cancellata		●	●						●			●				●	●				
Tritonia festiva																	●				
Annelida																					
Dodecaceria fewkesi																					●
Eudistylia vancouveri																	●				
Nereis brandti																				●	
Nereis vexillosa						●				●											
Oligochaeta (unid.)				●		●															
Owenia fusiformis				●						●			●								
Pectinaria (Cistenides) granulata										●			●			●					
Polychaeta (unid.)				●		●															
Sabellid polychaete (unid.)		●						●						●							
Schizobranchia insignis											●	●							●		
Serpula vermicularis	●	●					●	●	●		●	●			●	●	●		●	●	●
Serpulid polychaete (unid.)		●				●							●	●	●						
Spirorbis sp.	●	●	●					●	●		●	●		●	●	●	●	●		●	●
Terrebellid polychaete (unid.)											●	●	●			●			●		●

	KATLIAN NO. 1	KATLIAN NO. 2	HARBOR POINT	THE COVE (INTERTIDAL ONLY)	HALIBUT POINT	HALIBUT POINT (INTERTIDAL ONLY)	KASIANA ISLAND	2500 BLOCK HALIBUT POINT ROAD	2000 BLOCK HALIBUT POINT ROAD	TURNAROUND FLATS (INTERTIDAL ONLY)	THOMSEN HARBOR PARKING LOT	OLD NAVY DOCK	TOTEM PARK (INTERTIDAL ONLY)	JAMESTOWN BAY	THIMBLEBERRY BAY	BALL ISLETS	NO THOROFARE BAY INLET	PIRATE COVE	THREE ENTRANCE BAY	GODDARD HOT SPRINGS BAY	TAVA ISLAND
Arthropoda																					
Balanus cariosus	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Balanus glandula	●	●		●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Balanus nubilus			●						●								●		●		
Caprellid amphipod (unid.)	●			●																	
Capitellid amphipod (unid.)																				●	
Cancer oregonensis				●		●							●								
Cancer productus		●																		●	
Chthamalus dalli	●		●	●		●		●	●	●	●							●			
Discorsopagurus schmitti																●					
Elassochirus sp.												●									
Gammarid amphipod (unid.)				●		●				●			●			●					
Gnorimosphaeroma oregonense						●							●								
Hemigrapsus nudus						●										●					
Hemigrapsus ? oregonensis						●															
Hyas lyratus																	●				
Isopoda (unid.)										●			●								
Oregonia gracilis	●								●												
Pandalid shrimp (unid.)															●						
Pandalus danae												●									
Pandalus platyceros																	●				
Paralithodes camtschatica (juvenile)																				●	
Pugettia gracilis				●																	
Pugettia productus																					●
Pagurid (unid.)		●	●	●		●	●	●	●	●	●		●	●		●	●	●	●	●	●
Pycnogonid (unid.)		●																			
Rhinolithodes wosnessenskii												●									
Shrimp larvae (unid.)								●										●			
Telmessus cheiragonus																		●	●		
Sipuncula																					
Sipuncula (unid.)				●		●				●											

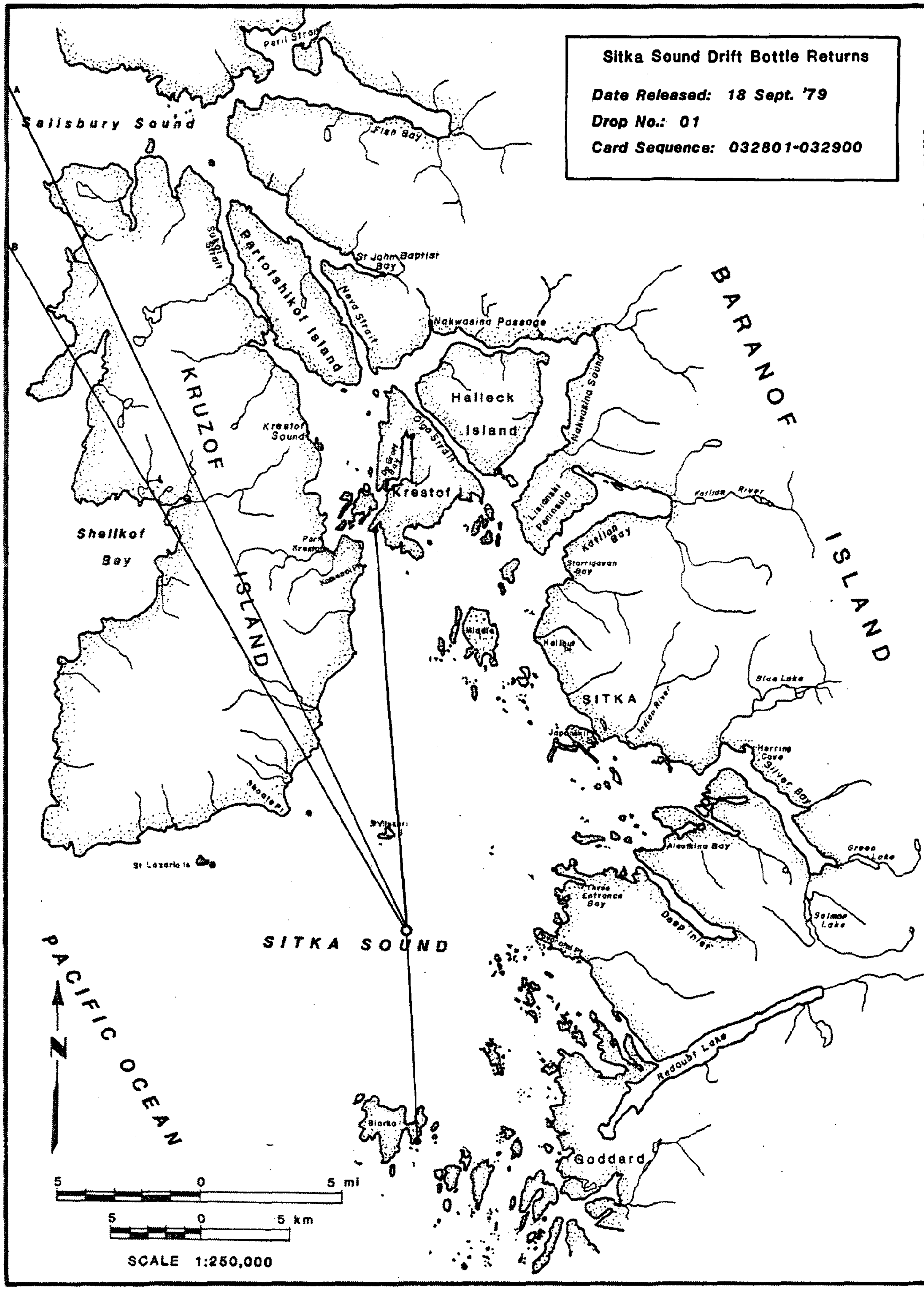
	KATLIAN NO. 1	KATLIAN NO. 2	HARBOR POINT	THE COVE (INTERTIDAL ONLY)	HALIBUT POINT	HALIBUT POINT (INTERTIDAL ONLY)	KASIANA ISLAND	2500 BLOCK HALIBUT POINT ROAD	2000 BLOCK HALIBUT POINT ROAD	TURNAROUND FLATS (INTERTIDAL ONLY)	THOMSEN HARBOR PARKING LOT	OLD NAVY DOCK	TOTEM PARK (INTERTIDAL ONLY)	JAMESTOWN BAY	THIMBLEBERRY BAY	BALL ISLETS	NO THOROFARE BAY INLET	PIRATE COVE	THREE ENTRANCE BAY	GODDARD HOT SPRINGS BAY	TAVA ISLAND
Bryozoa																					
Bryozoan (unid.)																				●	
Bugula sp.		●	●									●			●		●				
Dendrobeania lichenoides			●									●			●		●				
Heteropora sp.		●	●						●							●			●		●
Membranipora membranacea		●					●		●		●	●			●					●	●
Microporina borealis		●	●									●				●					●
Brachiopoda																					
Terebratalia transversa												●					●				
Echinodermata																					
Crossaster papposus		●						●				●						●	●		
Cucumaria miniata		●	●			●											●	●	●		
Dermasterias imbricata		●				●	●		●		●	●	●		●			●	●	●	
Evasterias troschelii	●			●		●						●					●		●	●	
Eupentacta sp.									●												
Henricia leviuscula						●	●		●			●	●	●	●			●	●		●
Leptasterias hexactis				●		●			●												
Mediaster aequalis			●				●	●			●	●		●	●	●	●		●		●
Ophiopholis aculeata		●	●			●						●	●			●	●		●	●	●
Ophiura sp.	●	●			●	●		●						●		●	●			●	
Orthasterias koehleri							●		●			●					●		●	●	
Parastichopus californicus	●		●		●		●					●		●			●	●	●	●	
Pisaster brevispinus							●												●		
Pisaster ochraceus					●	●	●		●			●	●		●		●	●	●	●	
Psolus chitonoides			●												●		●				
Pycnopodia helianthoides	●		●	●	●	●		●				●		●	●		●	●	●	●	●
Solaster dawsoni																	●			●	
Solaster stimpsoni							●		●									●	●		
Solaster sp.												●									
Strongylocentrotus droebachiensis					●	●						●	●		●	●	●	●	●	●	●
Strongylocentrotus franciscanus			●		●		●	●	●			●					●	●	●	●	●
Stylasterias forreri			●		●																

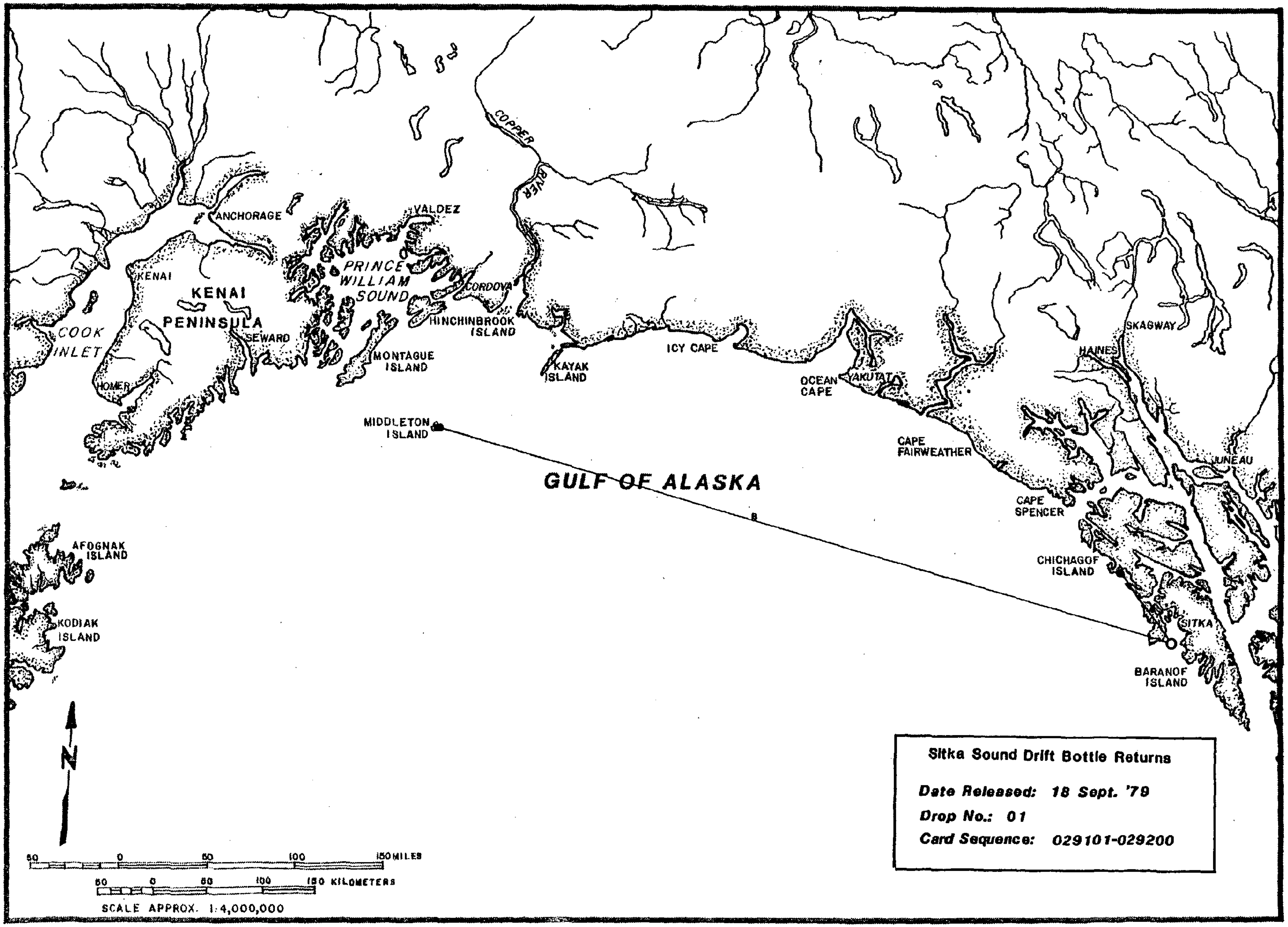
Urochordata	KATLIAN NO. 1	KATLIAN NO. 2	HARBOR POINT	THE COVE (INTERTIDAL ONLY)	HALIBUT POINT	HALIBUT POINT (INTERTIDAL ONLY)	KASIANA ISLAND	2500 BLOCK HALIBUT POINT ROAD	2000 BLOCK HALIBUT POINT ROAD	TURNAROUND FLATS (INTERTIDAL ONLY)	THOMSEN HARBOR PARKING LOT	OLD NAVY DOCK	TOTEM PARK (INTERTIDAL ONLY)	JAMESTOWN BAY	THIMBLEBERRY BAY	BALL ISLETS	NO THOROFARE BAY INLET	PIRATE COVE	THREE ENTRANCE BAY	GODDARD HOT SPRINGS BAY	TAVA ISLAND
Aplidium californicum												●	●								
Boltenia villosa			●								●	●			●					●	
Chelyosoma productum												●									
Cnemidocarpa finmarkiensis			●						●		●	●						●		●	●
Corella willmeriana			●									●		●							●
Didemnum albidum		●																			
Distaplia occidentalis						●														●	
Halocynthia aurantium	●	●	●						●			●		●			●				
Halocynthia igaboja																	●				
Metandrocarpa taylori																					●

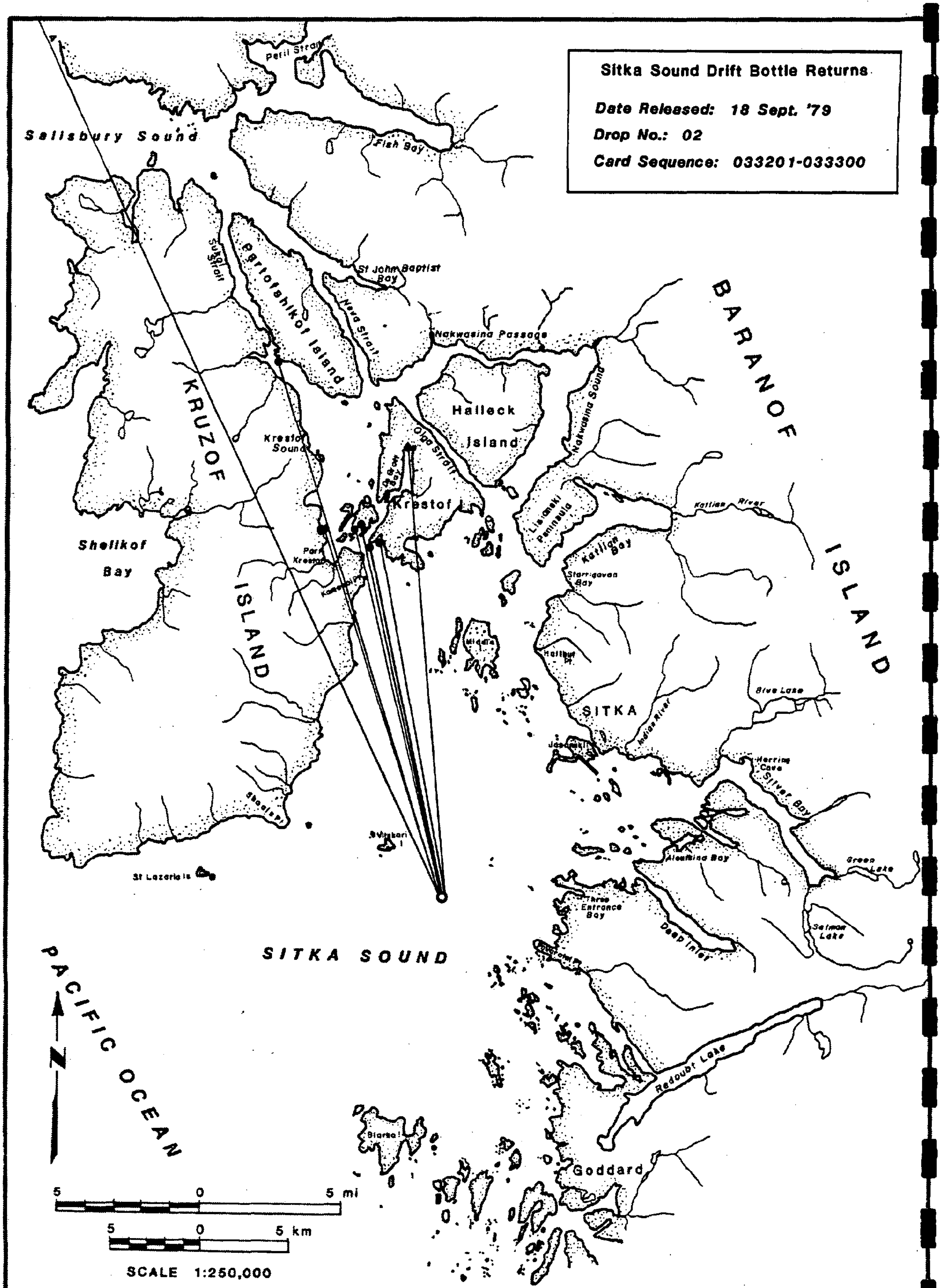
Fish	KATLIAN NO. 1	KATLIAN NO. 2	HARBOR POINT	THE COVE (INTERTIDAL ONLY)	HALIBUT POINT	HALIBUT POINT (INTERTIDAL ONLY)	KASIANA ISLAND	2500 BLOCK HALIBUT POINT ROAD	2000 BLOCK HALIBUT POINT ROAD	TURNAROUND FLATS (INTERTIDAL ONLY)	THOMSEN HARBOR PARKING LOT	OLD NAVY DOCK	TOTEM PARK (INTERTIDAL ONLY)	JAMESTOWN BAY	THIMBLEBERRY BAY	BALL ISLETS	NO THOROFARE BAY INLET	PIRATE COVE	THREE ENTRANCE BAY	GODDARD HOT SPRINGS BAY	TAVA ISLAND
Anarrhichthys ocellatus			●											●							
Aulorhynchus flavidus	●											●									●
Bathymaster signatus			●									●				●					
Chirolophis decoratus																	●		●		
Clupea harengus pallasi												●		●						●	
Clupea harengus pallasi (eggs only)						●				●											
Coryphopterus nicholsi															●						
Hemilepidotus hemilepidotus									●			●									●
Hexagrammos decagrammus	●	●	●		●		●	●	●		●	●		●	●	●	●	●	●	●	●
Hexagrammos stelleri																				●	
Jordania zonope																			●		
Lepidopsetta bilineata								●						●							
Lepidopsetta ? bilineata (juveniles)										●											
Nautichthys oculofasciatus																					●
Oligocottus masculosus													●						●		
Oncorhynchus gorbuscha (smolts)				●																	
Oxylebius pictus		●																			
Salvelinus malma	●																				
Sebastes caurinus		●	●						●			●					●			●	
Sebastes ciliatus		●	●		●				●												
Sebastes flavidus					●																●
Sebastes maliger		●	●		●				●			●							●	●	●
Sebastes melanops																				●	●
Sebastes nebulosus					●															●	●
Sebastes ? sp. (unid. juveniles)	●													●							

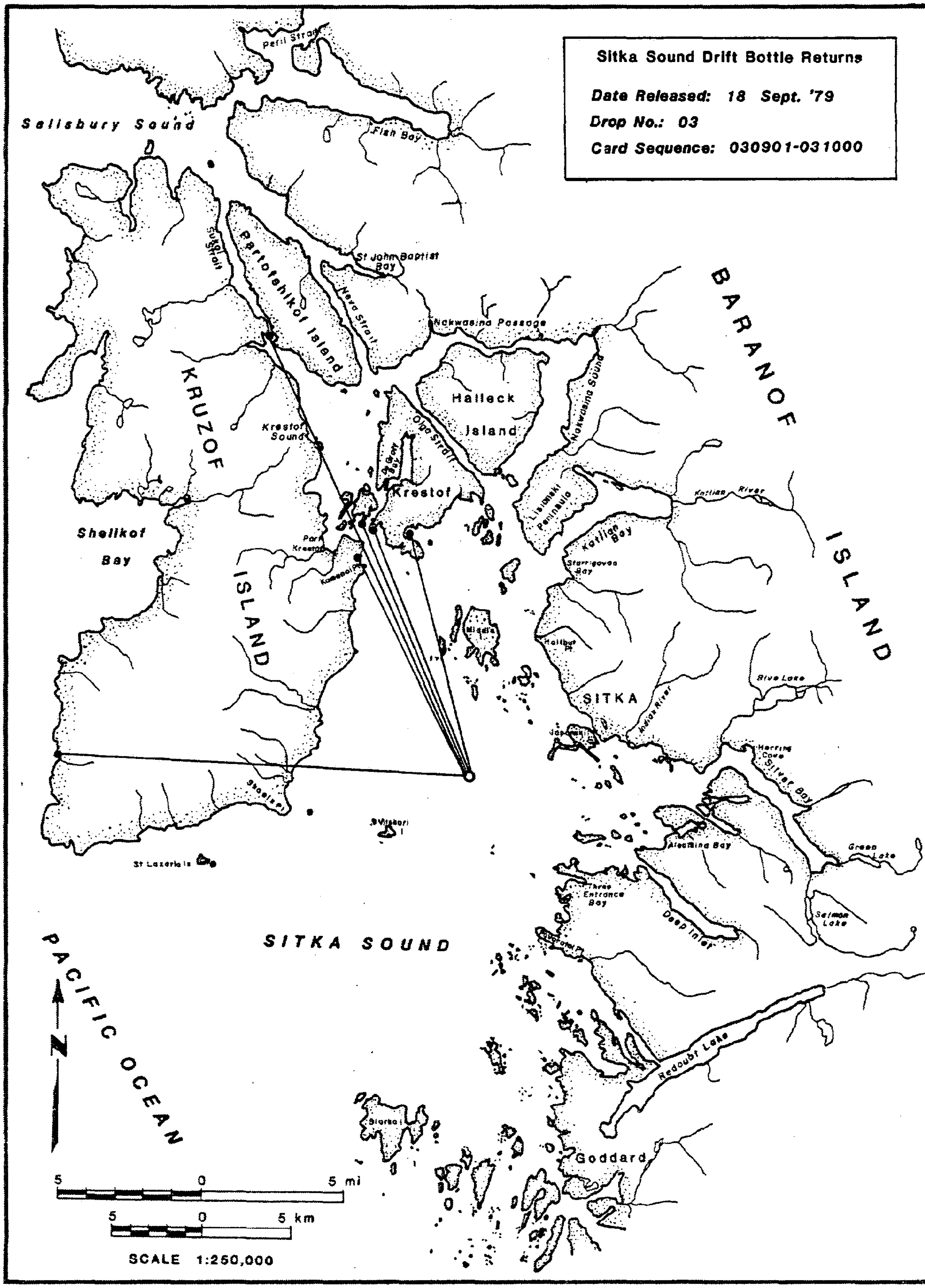
APPENDIX III

DRIFT BOTTLE RETURN DATA

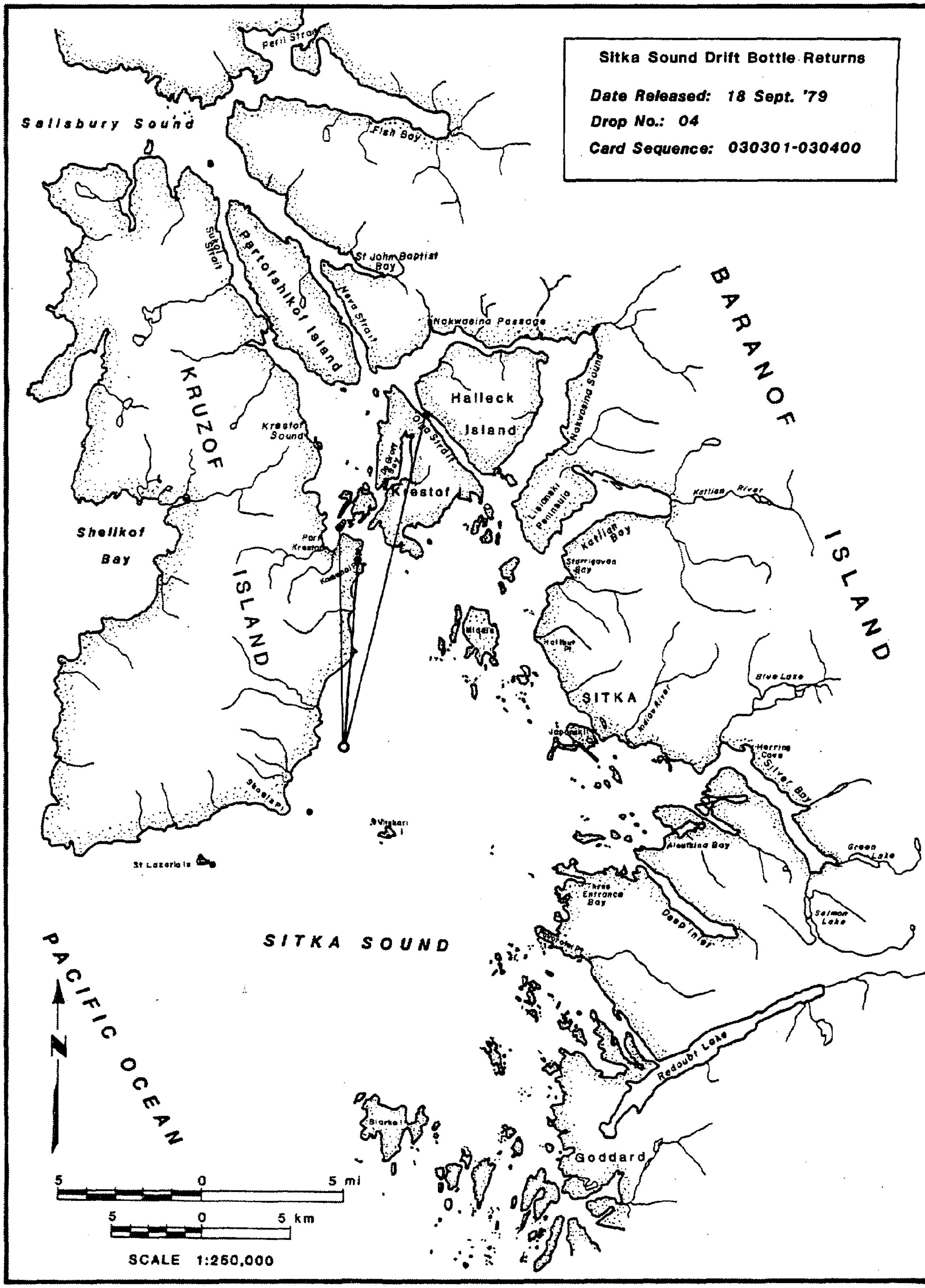

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 01
Card Sequence: 032801-032900
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Krestof Sound
Olga Strait
Krestof I.
Nakwasina Sound
Lisianski Peninsula
Katlian Bay
Katlian River
Starrigavan Bay
Shelikof Bay
Middle
Halibut Pt.
SITKA
Indian River
Blue Lake
Japonski
Herring Cove
Silver Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
SITKA SOUND
St Lazaria Is
PACIFIC OCEAN
N
Redoubt Lake
Biorka
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000
A
B

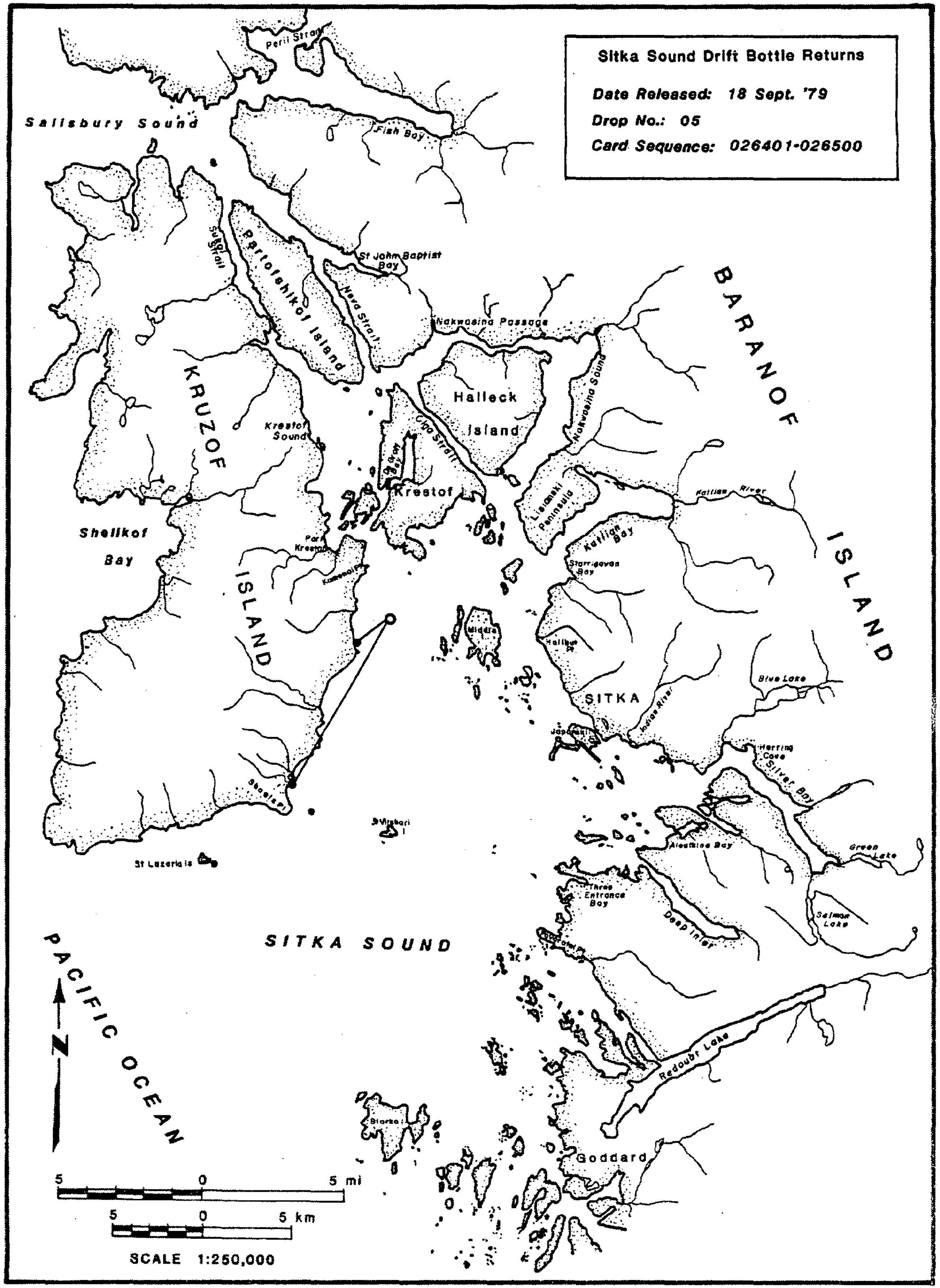

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 01
Card Sequence: 029101-029200
GULF OF ALASKA
ANCHORAGE
KENAI
KENAI PENINSULA
COOK INLET
HOMER
SEWARD
PRINCE WILLIAM SOUND
VALDEZ
CORDOVA
HINCHINBROOK ISLAND
MONTAGUE ISLAND
MIDDLETON ISLAND
COPPER RIVER
KAYAK ISLAND
ICY CAPE
OCEAN CAPE
YAKUTAT
CAPE FAIRWEATHER
CAPE SPENCER
CHICHAGOF ISLAND
SITKA
BARANOF ISLAND
HAINES
SKAGWAY
JUNEAU
AFOGNAK ISLAND
KODIAK ISLAND
N
50 0 50 100 150 MILES
50 0 50 100 150 KILOMETERS
SCALE APPROX. 1:4,000,000

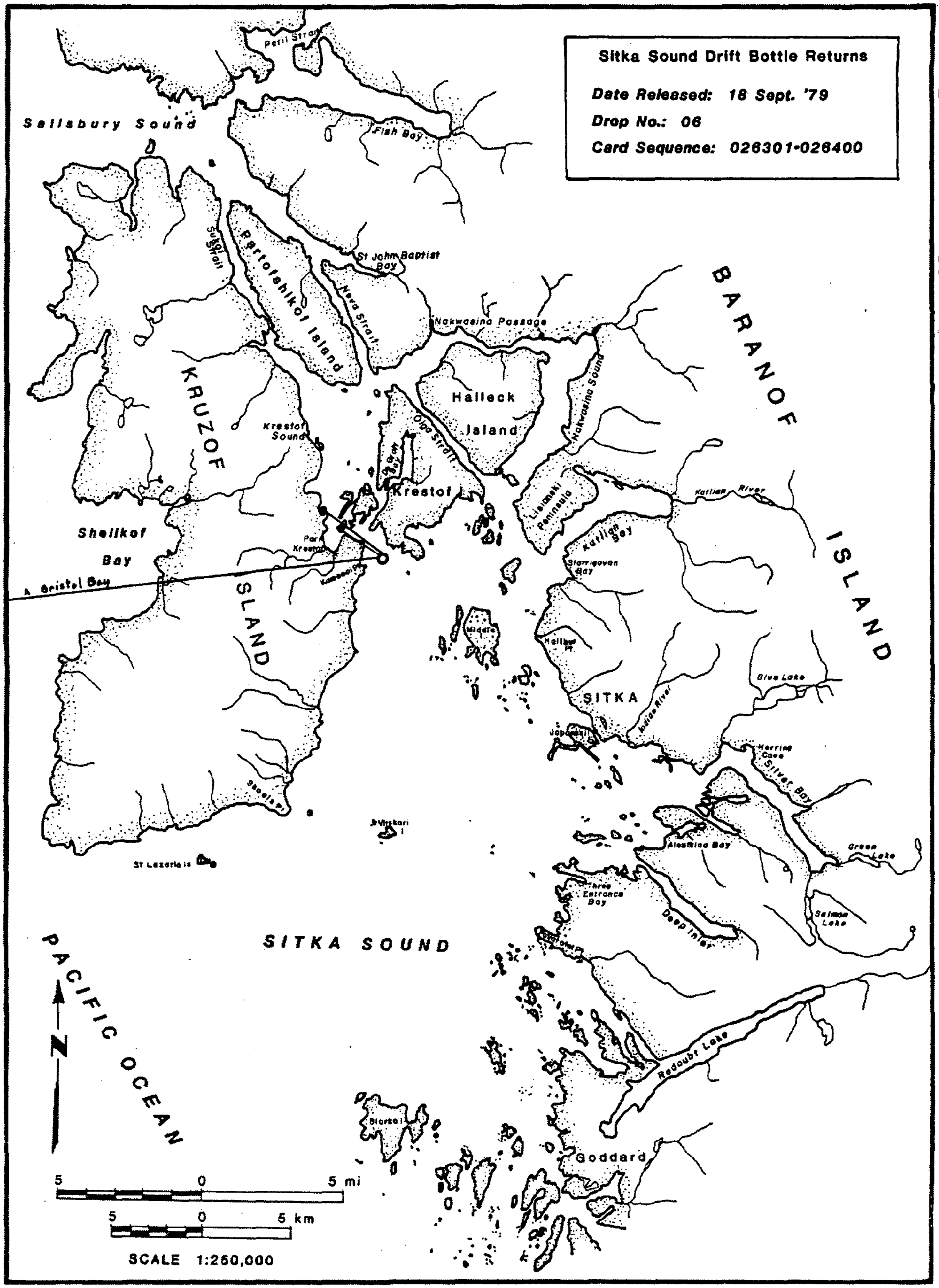

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 02
Card Sequence: 033201-033300
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Nakwasina Passage
Neva Strait
Sukoi Strait
Partofshikof Island
Halleck Island
Olga Strait
Nakwasina Sound
KRUZOF ISLAND
BARANOF ISLAND
Krestof Sound
Krestof I.
Shelikof Bay
Katlian River
Katlian Bay
Starrigavan Bay
Middle
Halibut Pt.
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Three Entrance Bay
Deep Inlet
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

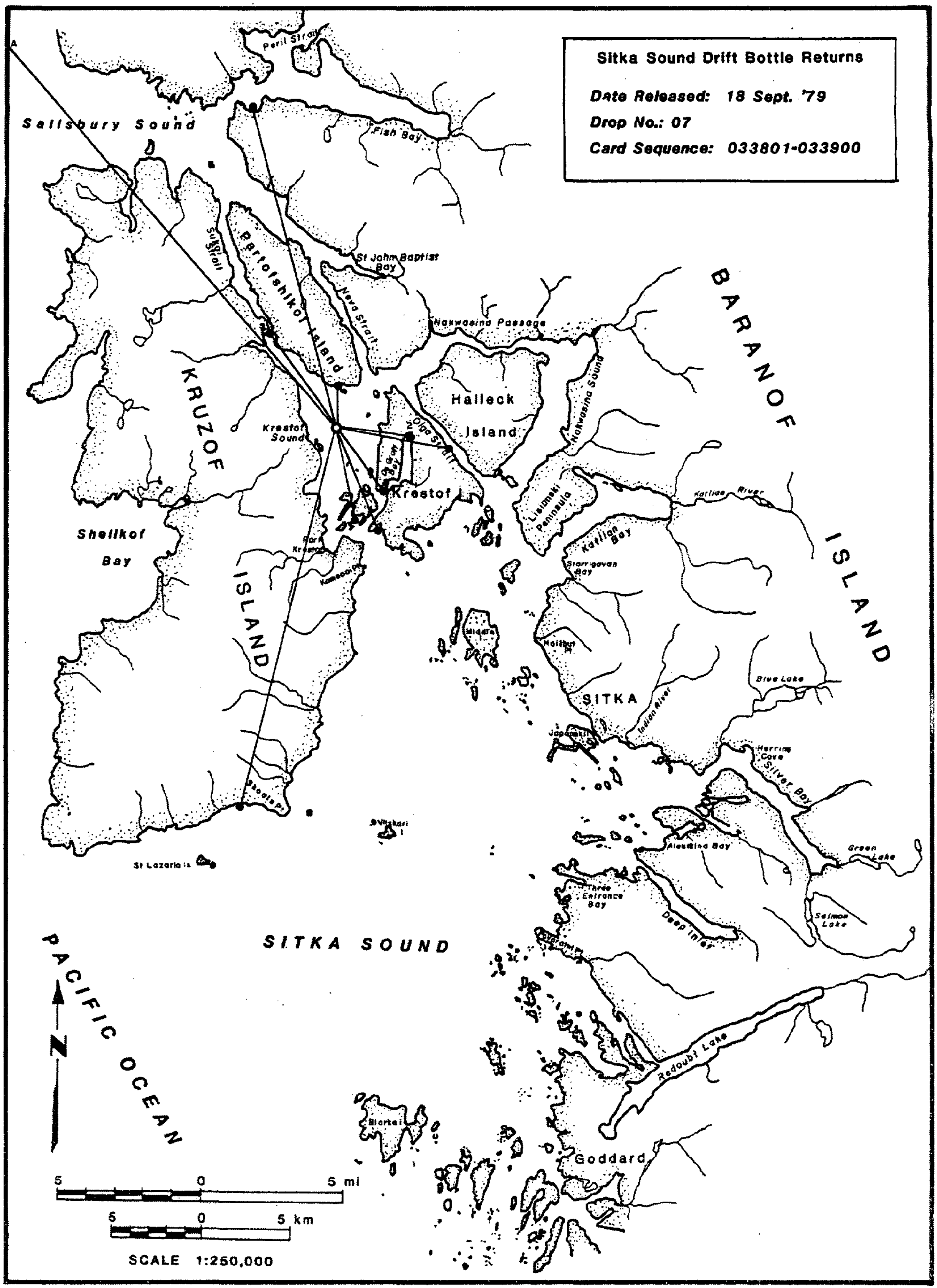


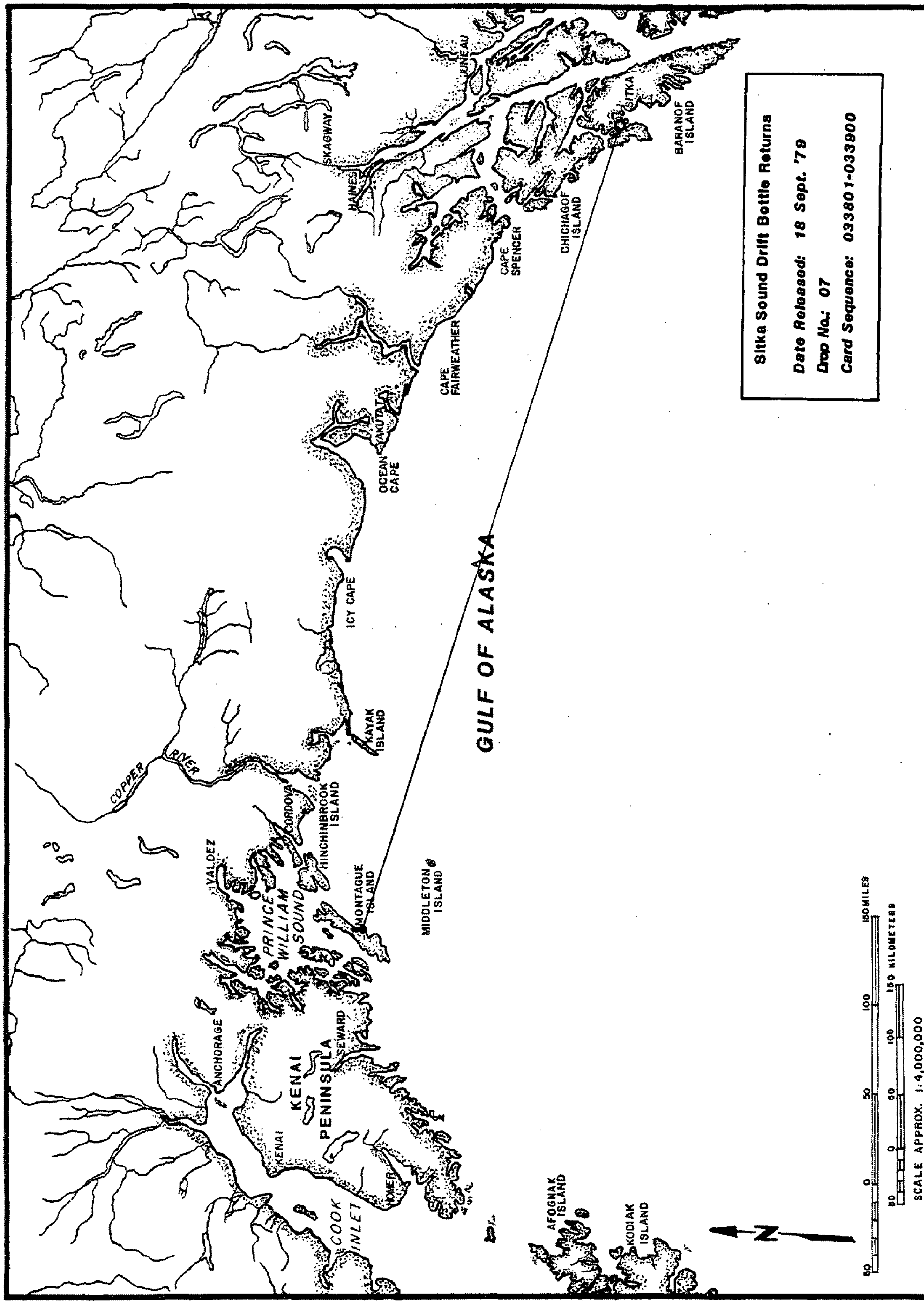
Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 03
Card Sequence: 030901-031000
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Krestof
Krestof Sound
Shelikof Bay
SITKA
SITKA SOUND
PACIFIC OCEAN
Goddard
Redoubt Lake
Deep Inlet
Silver Bay
Blue Lake
Green Lake
Salmon Lake
Herring Cove
Three Entrance Bay
St Lazaria Is
5 0 5 mi
5 0 5 km
SCALE 1:250,000

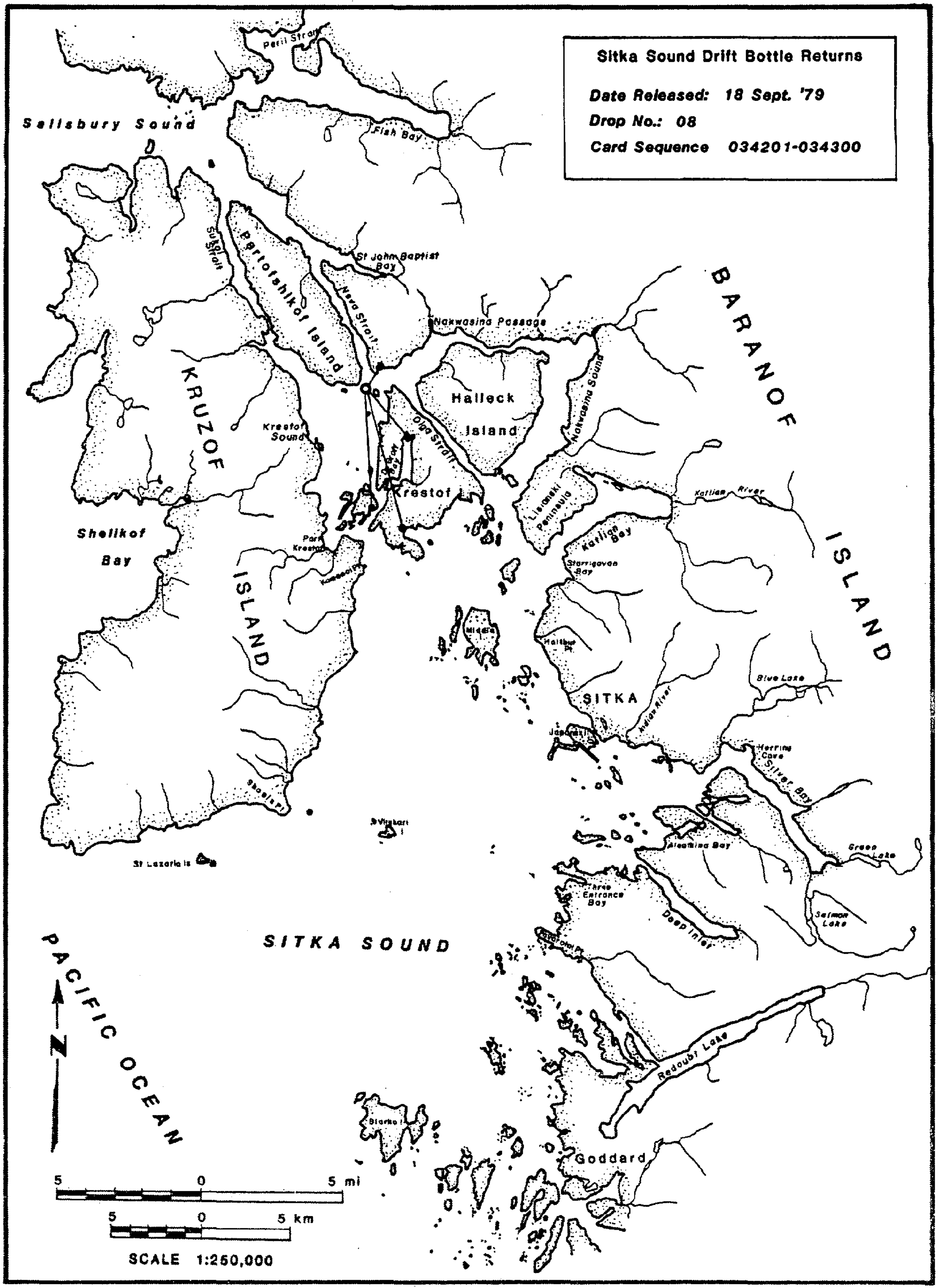

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 04
Card Sequence: 030301-030400
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Halleck Island
Olga Strait
Krestof
Shelikof Bay
Nakwasina Sound
Katlian River
Katlian Bay
Starrigavan Bay
Halibut Pt
SITKA
Indian River
Blue Lake
Japonski I
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Three Entrance Bay
Deep Inlet
Redoubt Lake
Goddard
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

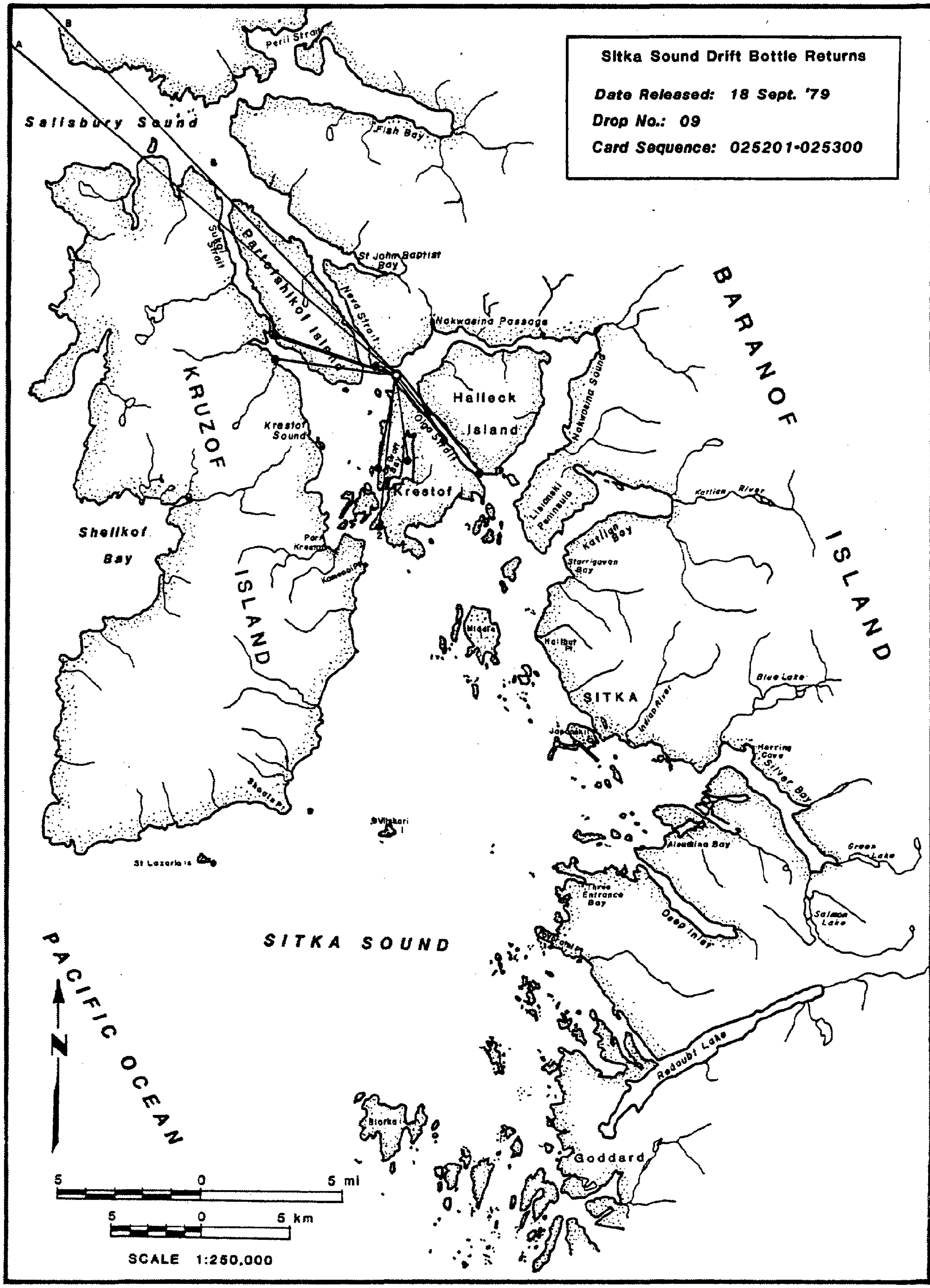

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 05
Card Sequence: 026401-026500
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Halleck Island
Nakwasina Sound
Krestof
Shelikof Bay
Kalinin Bay
Starrigavan Bay
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
Redoubt Lake
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
N
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

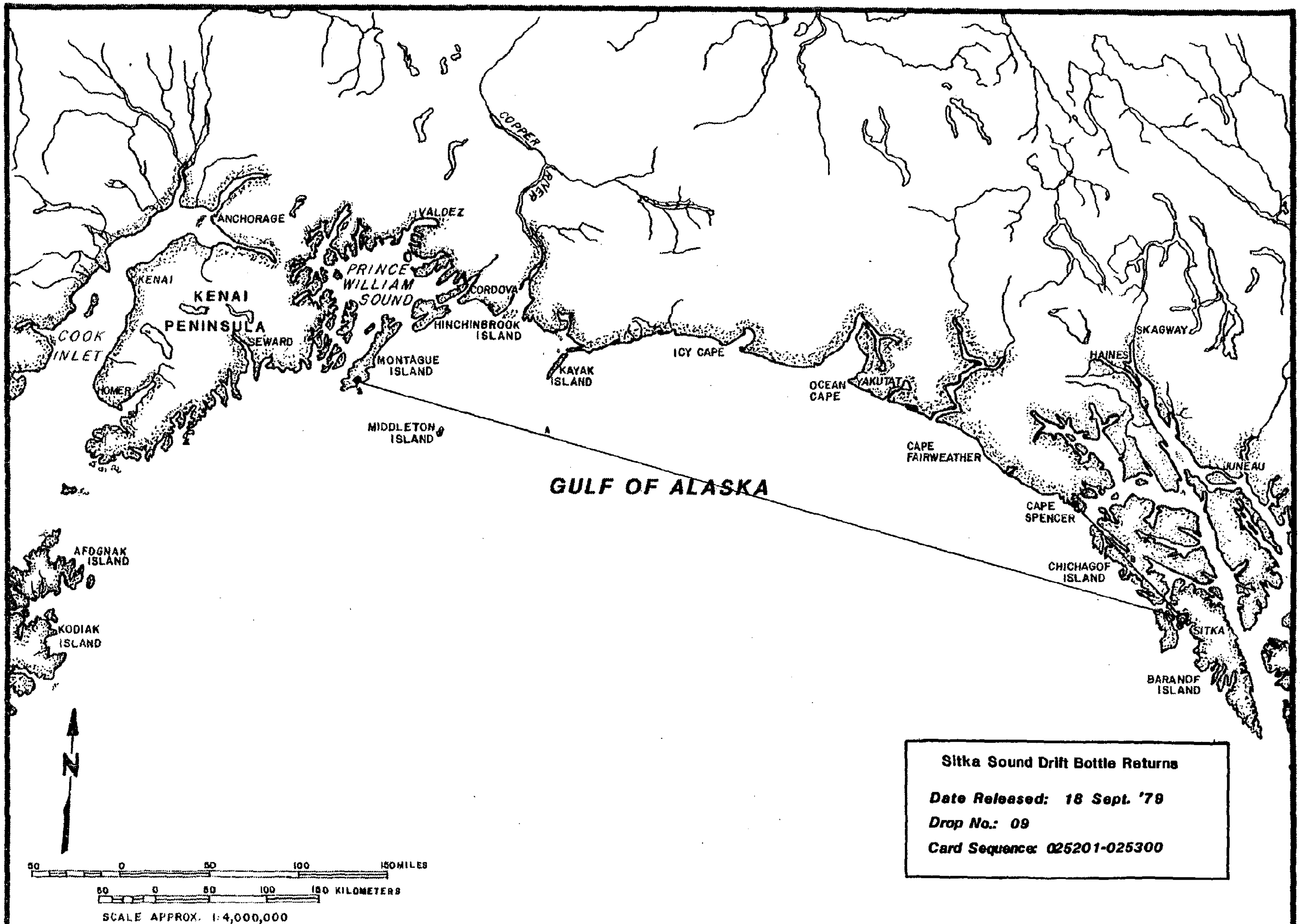

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 06
Card Sequence: 026301-026400
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Nakwasina Sound
Krestof Sound
Olga Strait
Krestof
Shelikof Bay
Bristol Bay
Katlian River
Katlian Bay
Starrigavan Bay
SITKA
Blue Lake
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Deep Inlet
Three Entrance Bay
SITKA SOUND
PACIFIC OCEAN
St Lazaria Is
Redoubt Lake
Goddard
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

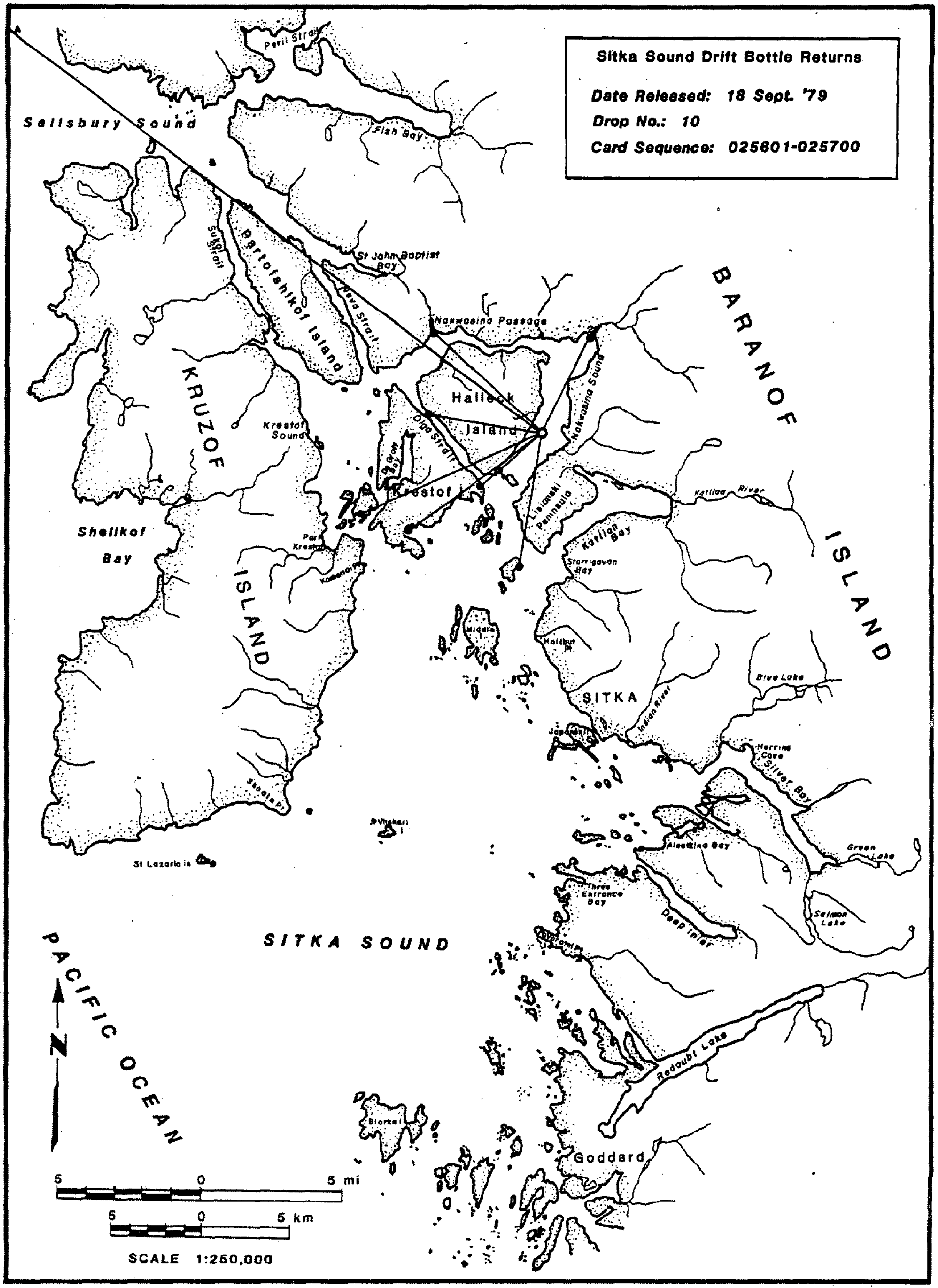

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 07
Card Sequence: 033801-033900
Peril Strait
Salisbury Sound
Fish Bay
St John Baptist Bay
Sukoi Strait
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Nakwasina Sound
Krestof Sound
Olga Strait
Krestof I
Lisianski Peninsula
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
Port Krestof
Kamenoi Pt
Middle I
Halibut Pt
SITKA
Indian River
Blue Lake
Japonski I
Herring Cove
Silver Bay
Shoals Pt
Vitskari I
St Lazaria Is
Aleutkina Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Biorka I
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

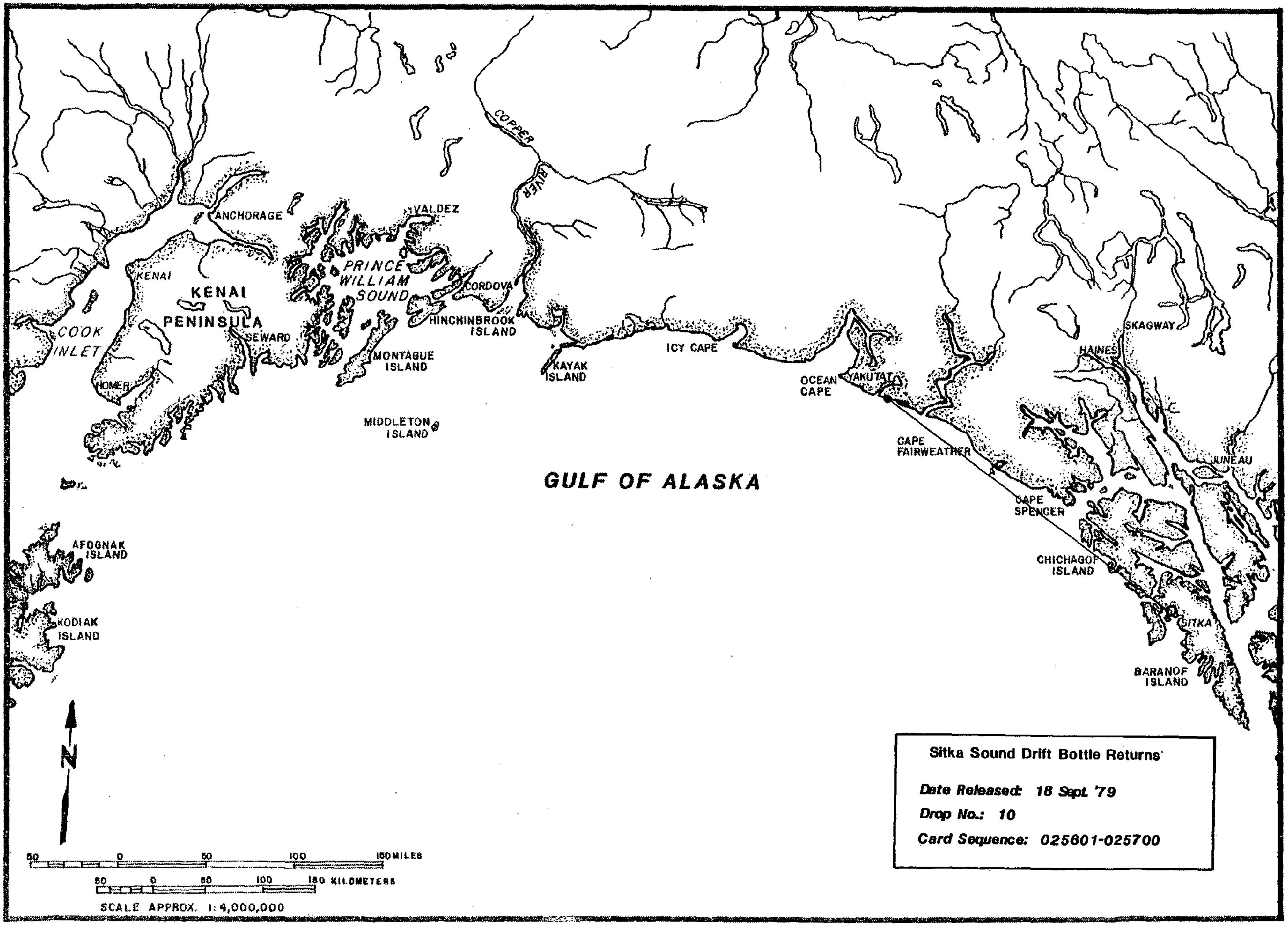

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 07
Card Sequence: 033801-033900
GULF OF ALASKA
JUNEAU
SKAGWAY
HAINES
SITKA
BARANOF ISLAND
CHICHAGOF ISLAND
CAPE SPENCER
CAPE FAIRWEATHER
YAKUTAT
OCEAN CAPE
ICY CAPE
KAYAK ISLAND
COPPER RIVER
CORDOVA
HINCHINBROOK ISLAND
VALDEZ
PRINCE WILLIAM SOUND
MONTAGUE ISLAND
MIDDLETON ISLAND
ANCHORAGE
SEWARD
KENAI PENINSULA
KENAI
HOMER
COOK INLET
AFOGNAK ISLAND
KODIAK ISLAND
N
150 MILES
150 KILOMETERS
SCALE APPROX. 1:4,000,000


Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 08
Card Sequence 034201-034300
Salisbury Sound
Peril Strait
Fish Bay
Partofshikof Island
St John Baptist Bay
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Halleck Island
Nakwasina Sound
Olga Strait
Krestof I.
Shelikof Bay
Port Krestof
Katlian Bay
Katlian River
Starrigavan Bay
Halibut Pt.
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Aleutkina Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

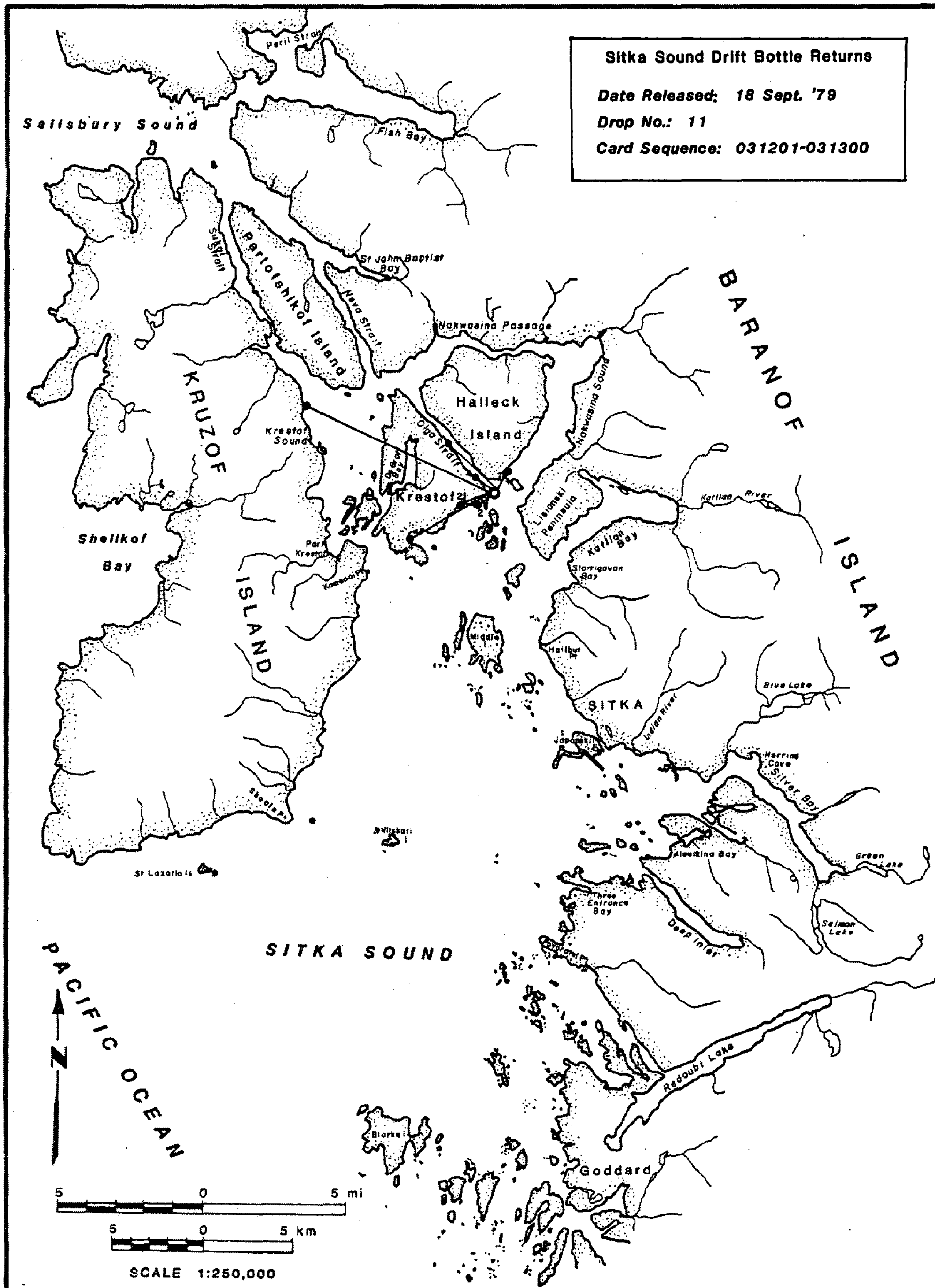

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 09
Card Sequence: 025201-025300
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Neva Strait
Partofshikof Island
Sukoi Strait
Nakwasina Passage
Halleck Island
Olga Strait
Nakwasina Sound
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Krestof I.
Shelikof Bay
Katlian River
Katlian Bay
Starrigavan Bay
Lisianski Peninsula
Middle
Halibut Pt.
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Aleutkina Bay
Green Lake
Salmon Lake
Three Entrance Bay
Deep Inlet
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Goddard
Biorka I
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

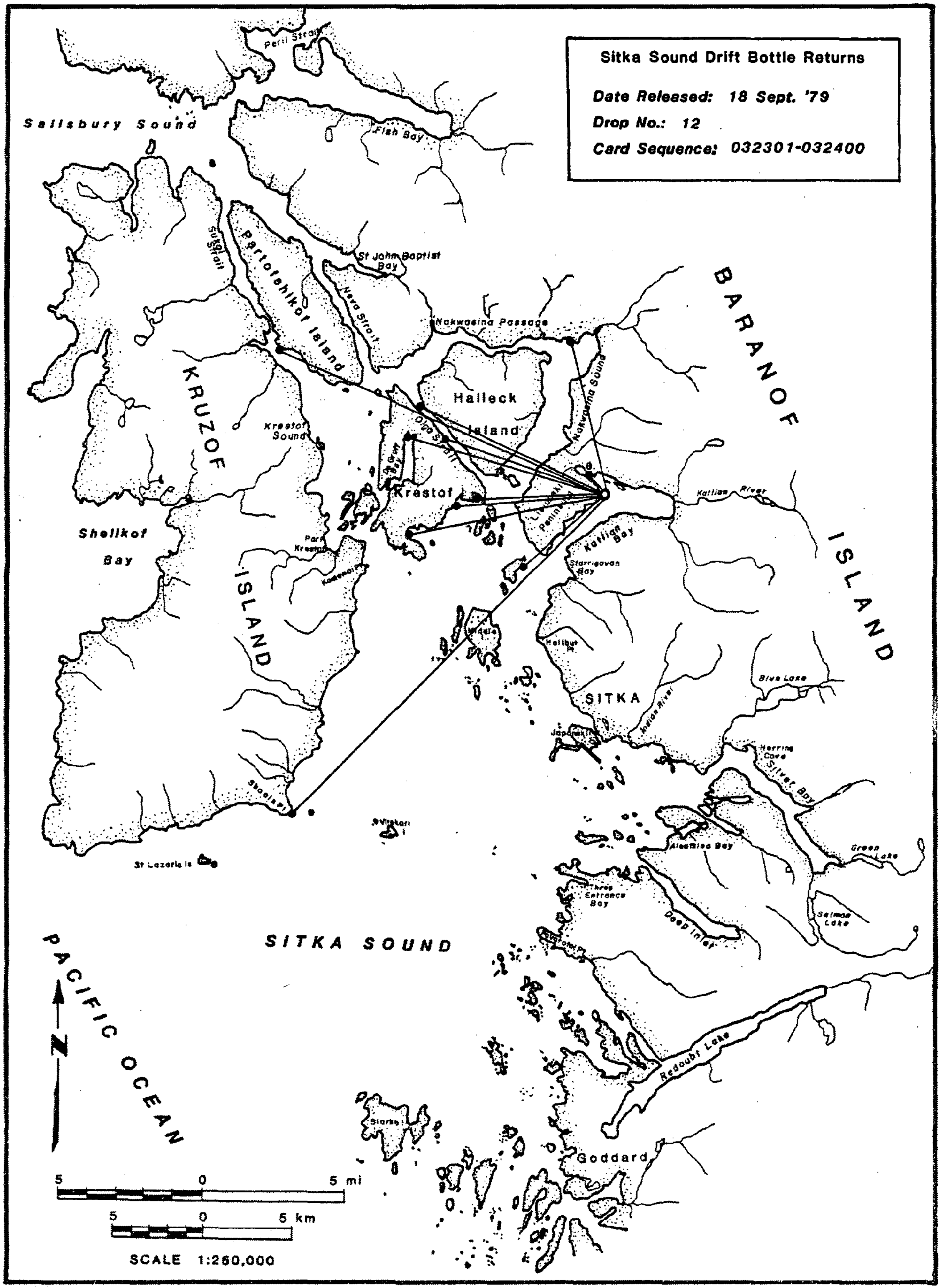

ANCHORAGE
VALDEZ
COPPER RIVER
PRINCE WILLIAM SOUND
CORDOVA
KENAI
KENAI PENINSULA
COOK INLET
SEWARD
HOMER
HINCHINBROOK ISLAND
MONTAGUE ISLAND
MIDDLETON ISLAND
KAYAK ISLAND
ICY CAPE
OCEAN CAPE
YAKUTAT
CAPE FAIRWEATHER
SKAGWAY
HAINES
JUNEAU
CAPE SPENCER
CHICHAGOF ISLAND
SITKA
BARANOF ISLAND
AFOGNAK ISLAND
KODIAK ISLAND
GULF OF ALASKA
N
50 0 50 100 150 MILES
50 0 50 100 150 KILOMETERS
SCALE APPROX. 1:4,000,000
Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 09
Card Sequence: 025201-025300

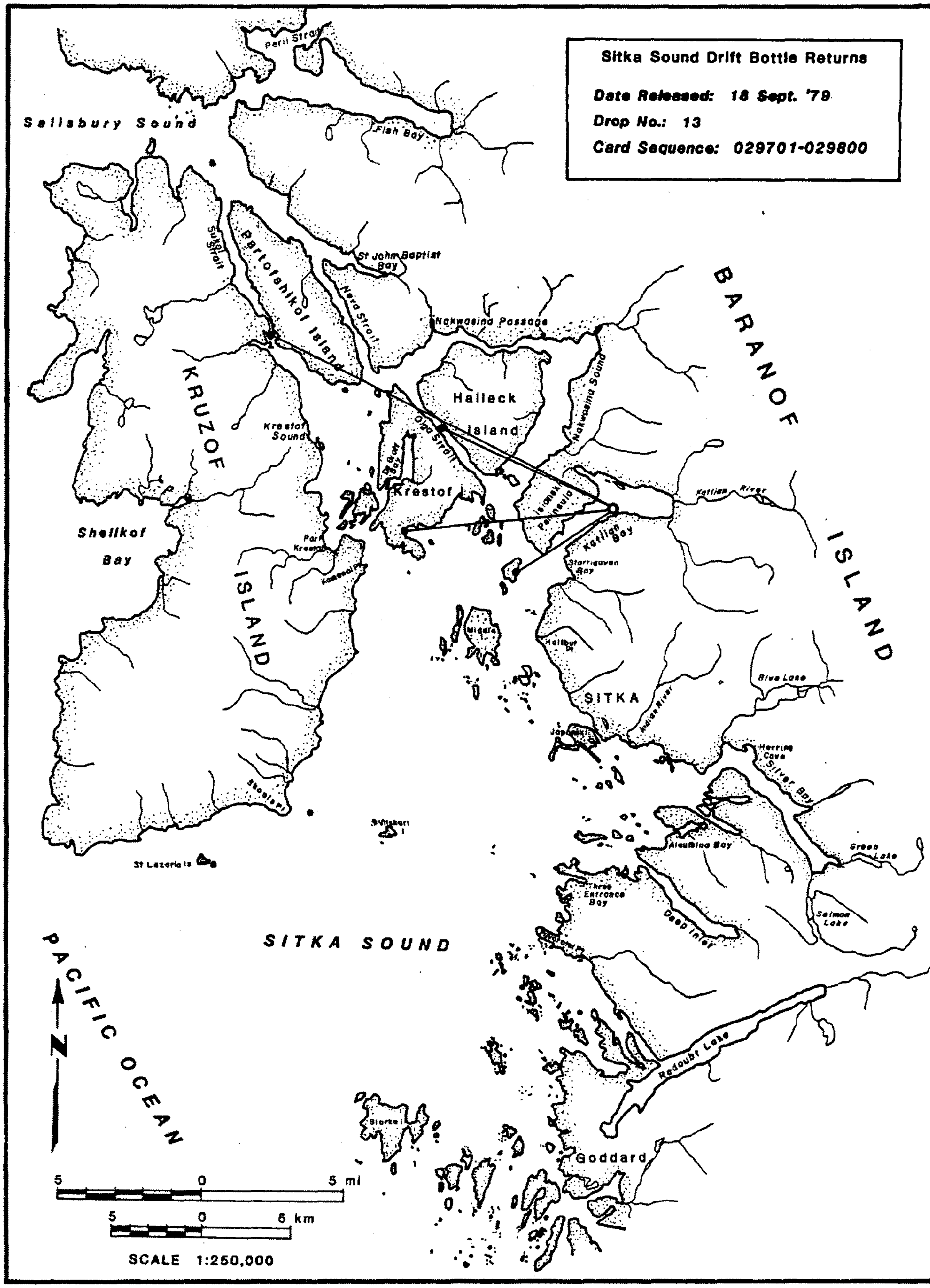

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 10
Card Sequence: 025601-025700
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Sukoi Inlet
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Halleck Island
Olga Strait
Krestof
Nakwasina Sound
Lisianski Peninsula
Shelikof Bay
Katlian River
Katlian Bay
Starrigavan Bay
Middle I
Halibut Pt.
SITKA
Indian River
Blue Lake
Japonski I
Herring Cove
Silver Bay
Alsegtino Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Biorka I
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

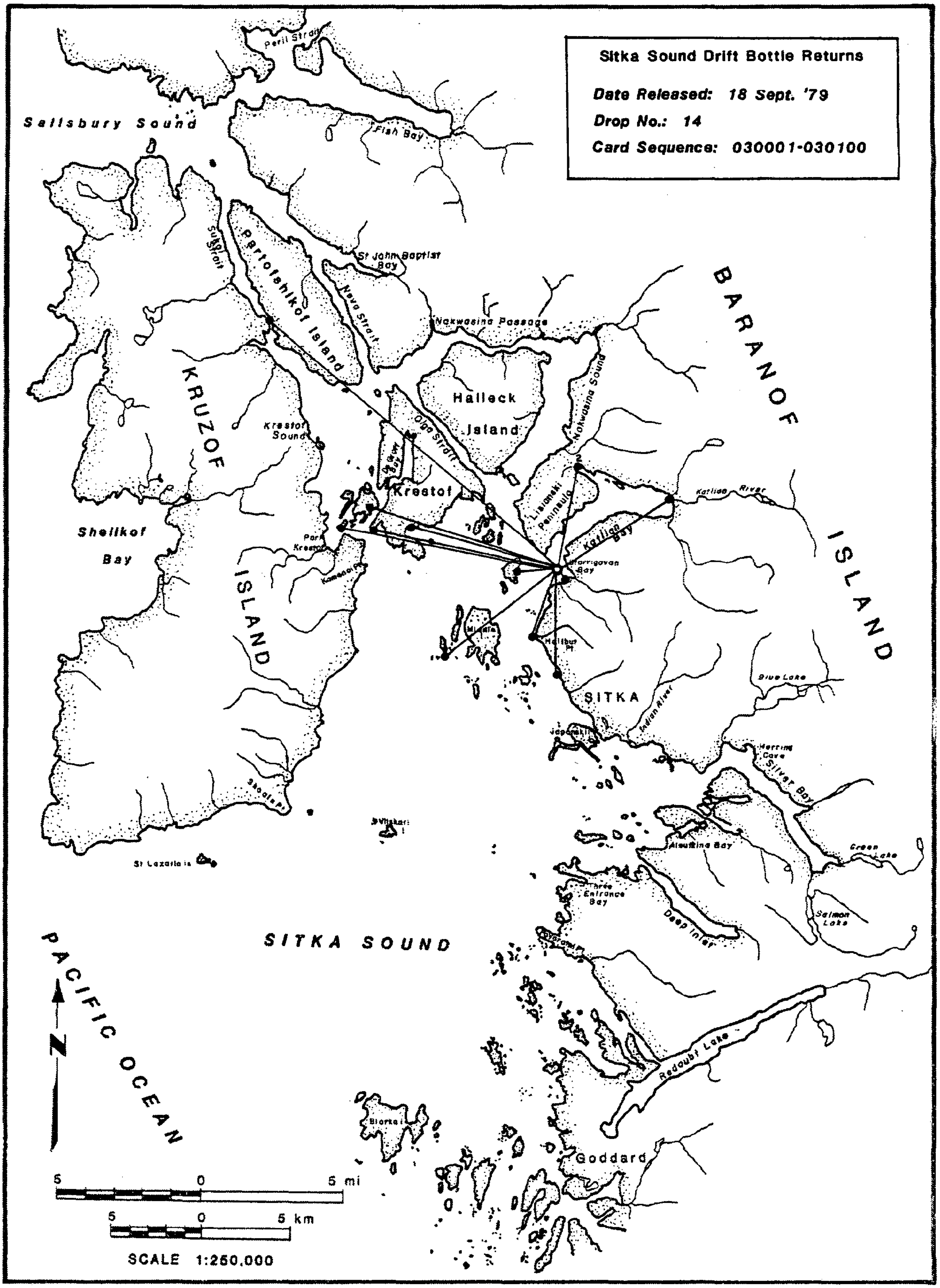


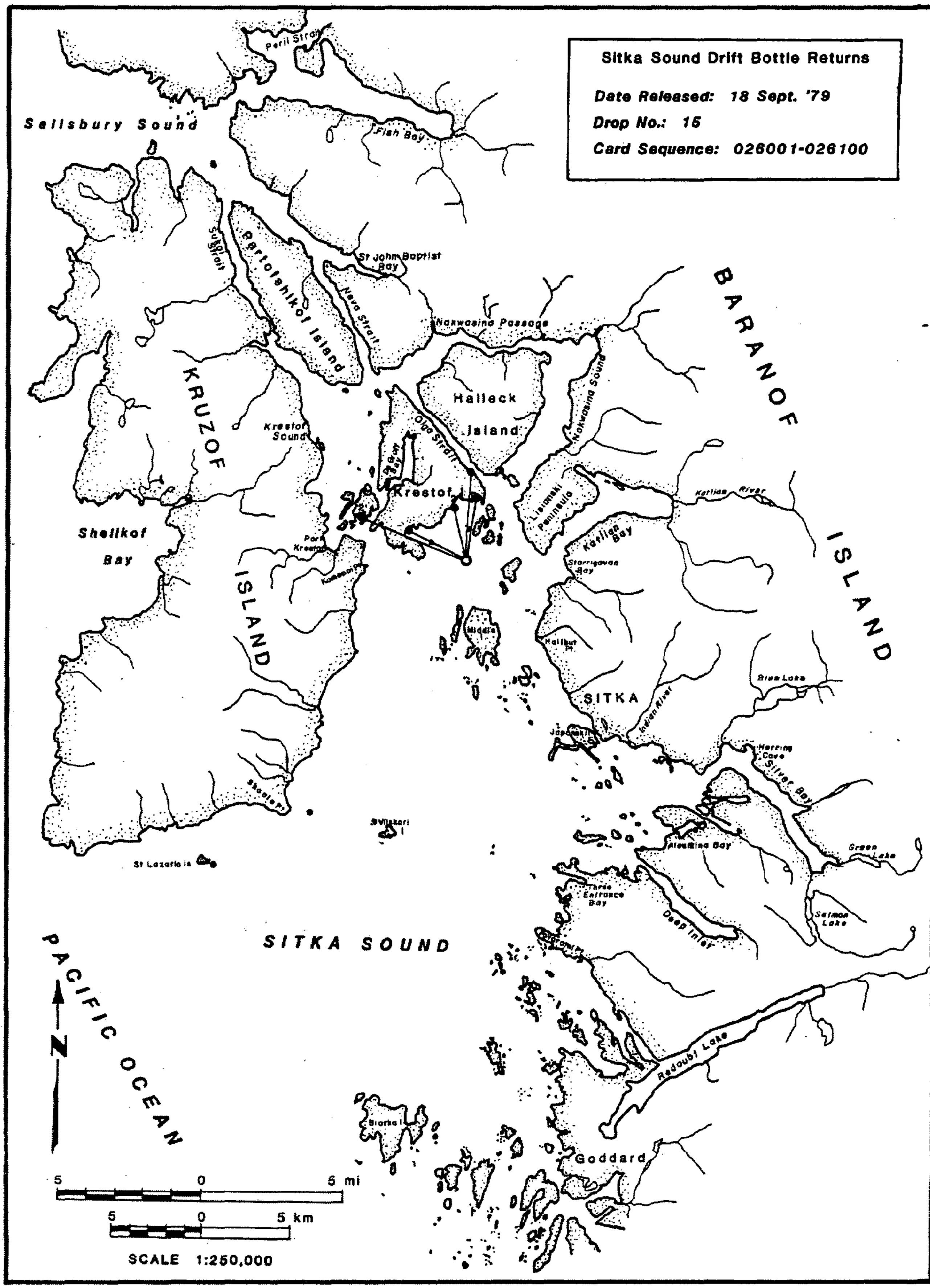
Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 10
Card Sequence: 025601-025700
GULF OF ALASKA
ANCHORAGE
VALDEZ
PRINCE WILLIAM SOUND
CORDOVA
HINCHINBROOK ISLAND
MONTAGUE ISLAND
MIDDLETON ISLAND
KENAI
KENAI PENINSULA
SEWARD
HOMER
COOK INLET
AFOGNAK ISLAND
KODIAK ISLAND
COPPER RIVER
KAYAK ISLAND
ICY CAPE
OCEAN CAPE
YAKUTAT
CAPE FAIRWEATHER
CAPE SPENCER
CHICHAGOF ISLAND
SITKA
BARANOF ISLAND
JUNEAU
HAINES
SKAGWAY
N
50 0 50 100 150 MILES
50 0 50 100 150 KILOMETERS
SCALE APPROX. 1:4,000,000


Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 11
Card Sequence: 031201-031300
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Neva Strait
Nakwasina Passage
Halleck Island
Nakwasina Sound
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Olga Strait
Krestof
Shelikof Bay
Port Krestof
Katlian River
Katlian Bay
Starrigavan Bay
Middle
Halibut Pt
SITKA
Indian River
Blue Lake
Japonski
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Deep Inlet
Three Entrance Bay
Redoubt Lake
Goddard
Biorka
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

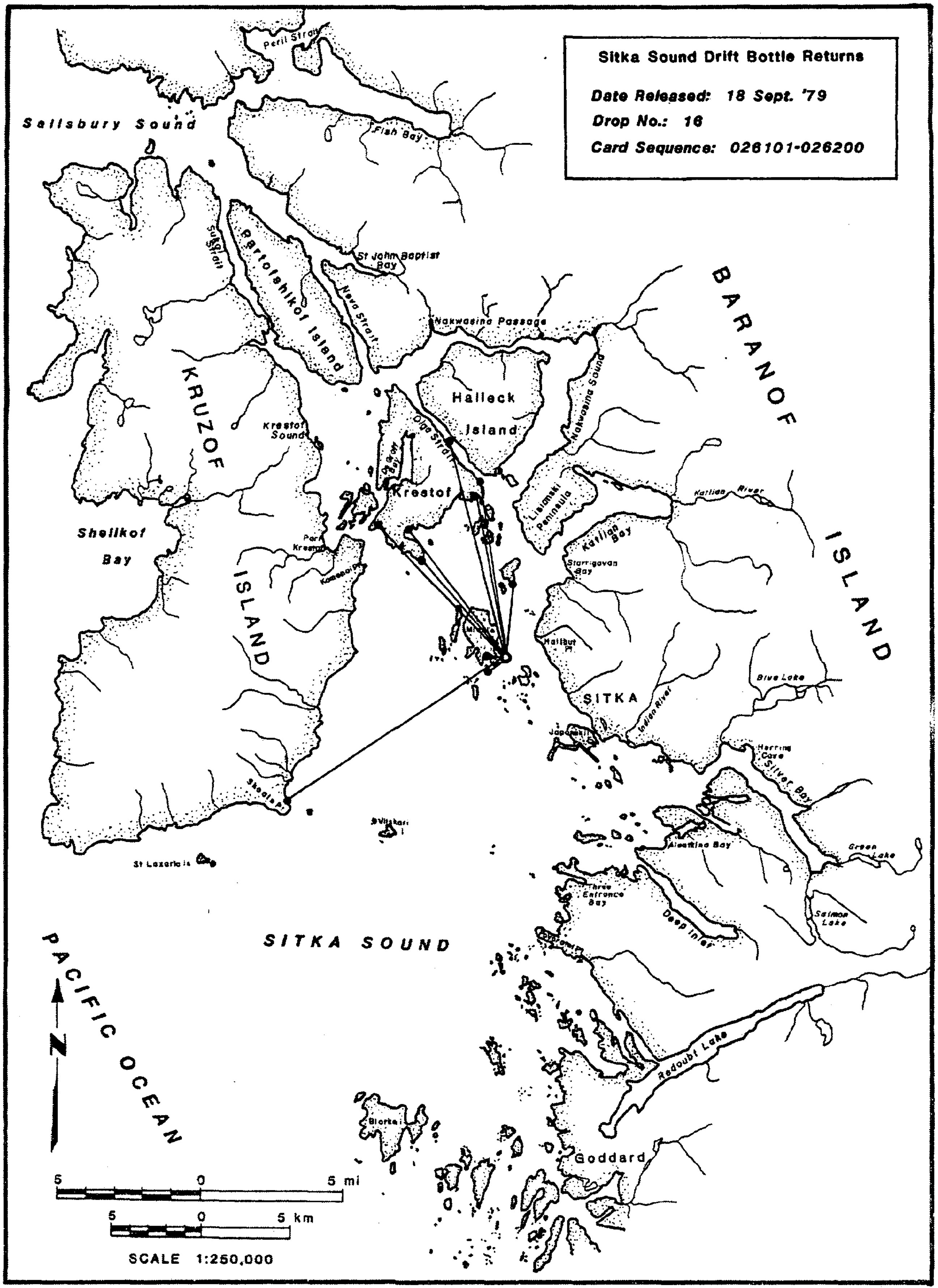

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 12
Card Sequence: 032301-032400
Salisbury Sound
Fish Bay
Sukoi Islets
Partofshikof Island
St John Baptist Bay
Neva Strait
Nakwasina Passage
BARANOF
ISLAND
KRUZOF
ISLAND
Halleck Island
Krestof Sound
Olga Strait
Krestof
Nakwasina Sound
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
Port Krestof
Middle I
Halibut Pt
SITKA
Indian River
Blue Lake
Japonski I
Herring Cove
Silver Bay
Shoals Pt
Vitskari I
St Lazaria Is
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

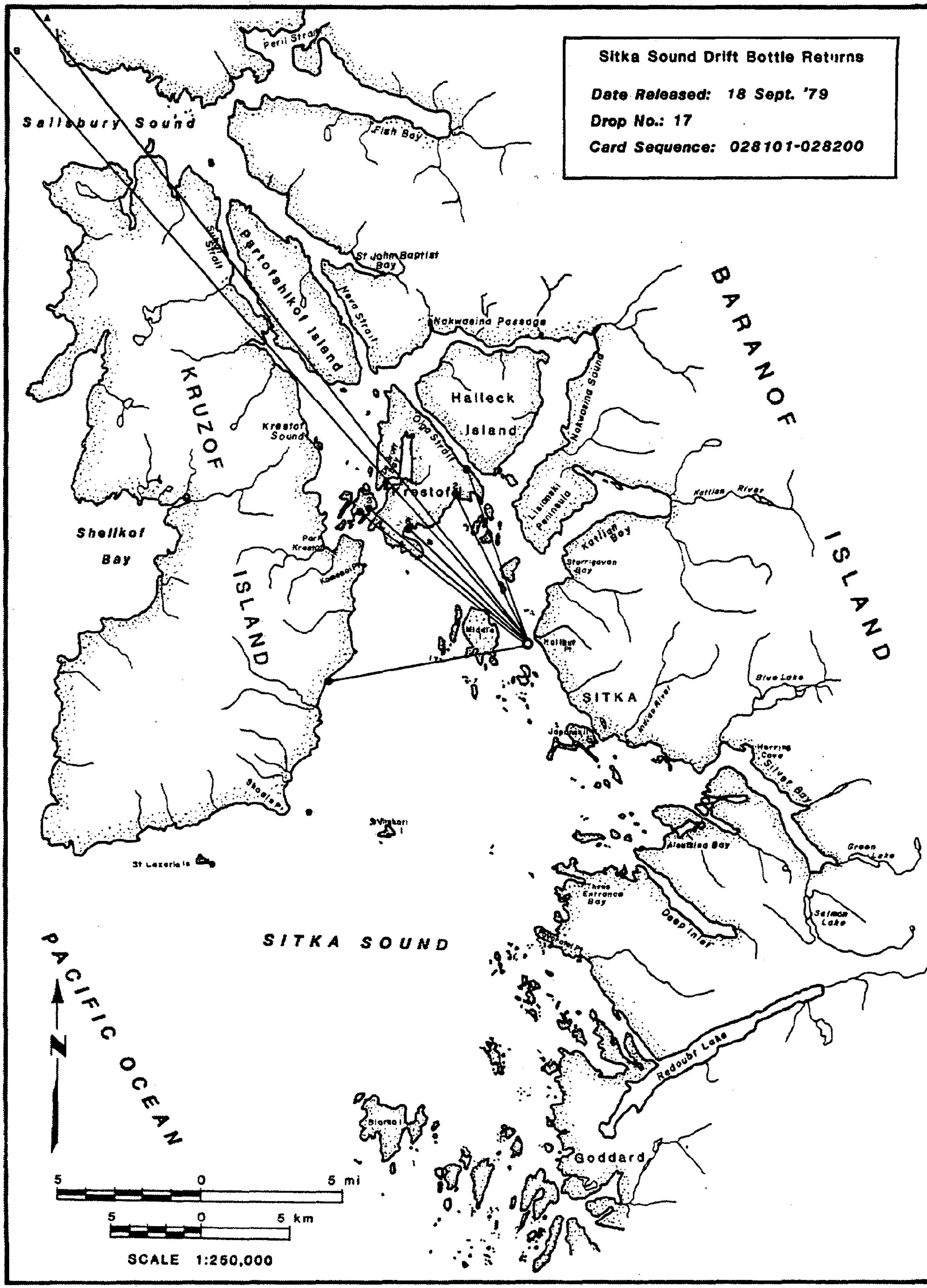

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 13
Card Sequence: 029701-029800
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Sukoi Strait
Partofshikof Island
Neva Strait
Nakwasina Passage
Nakwasina Sound
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Krestof Sound
Olga Strait
Krestof I.
Shelikof Bay
Katlian Bay
Katlian River
Starrigavan Bay
Middle I.
Halibut Pt.
SITKA
Blue Lake
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Three Entrance Bay
Deep Inlet
Redoubt Lake
Goddard
SITKA SOUND
PACIFIC OCEAN
St Lazaria Is
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

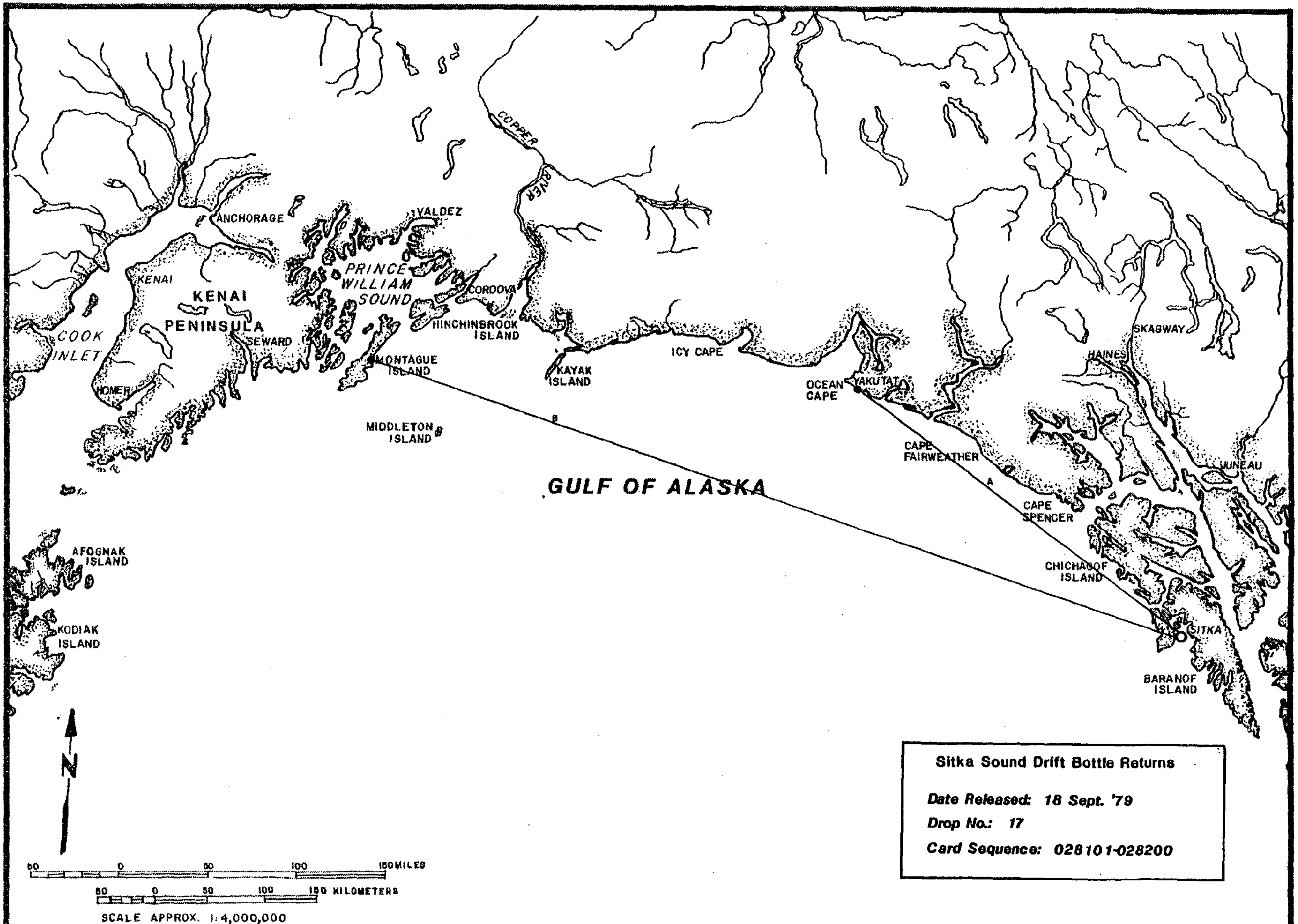

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 14
Card Sequence: 030001-030100
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Olga Strait
Krestof Sound
Krestof
Nakwasina Sound
Katlian River
Katlian Bay
Harrigan Bay
Shelikof Bay
Halibut Pt.
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Three Entrance Bay
Deep Inlet
Redoubt Lake
SITKA SOUND
PACIFIC OCEAN
N
Goddard
St Lazaria Is
5
0
5 mi
5
0
5 km
SCALE 1:250,000

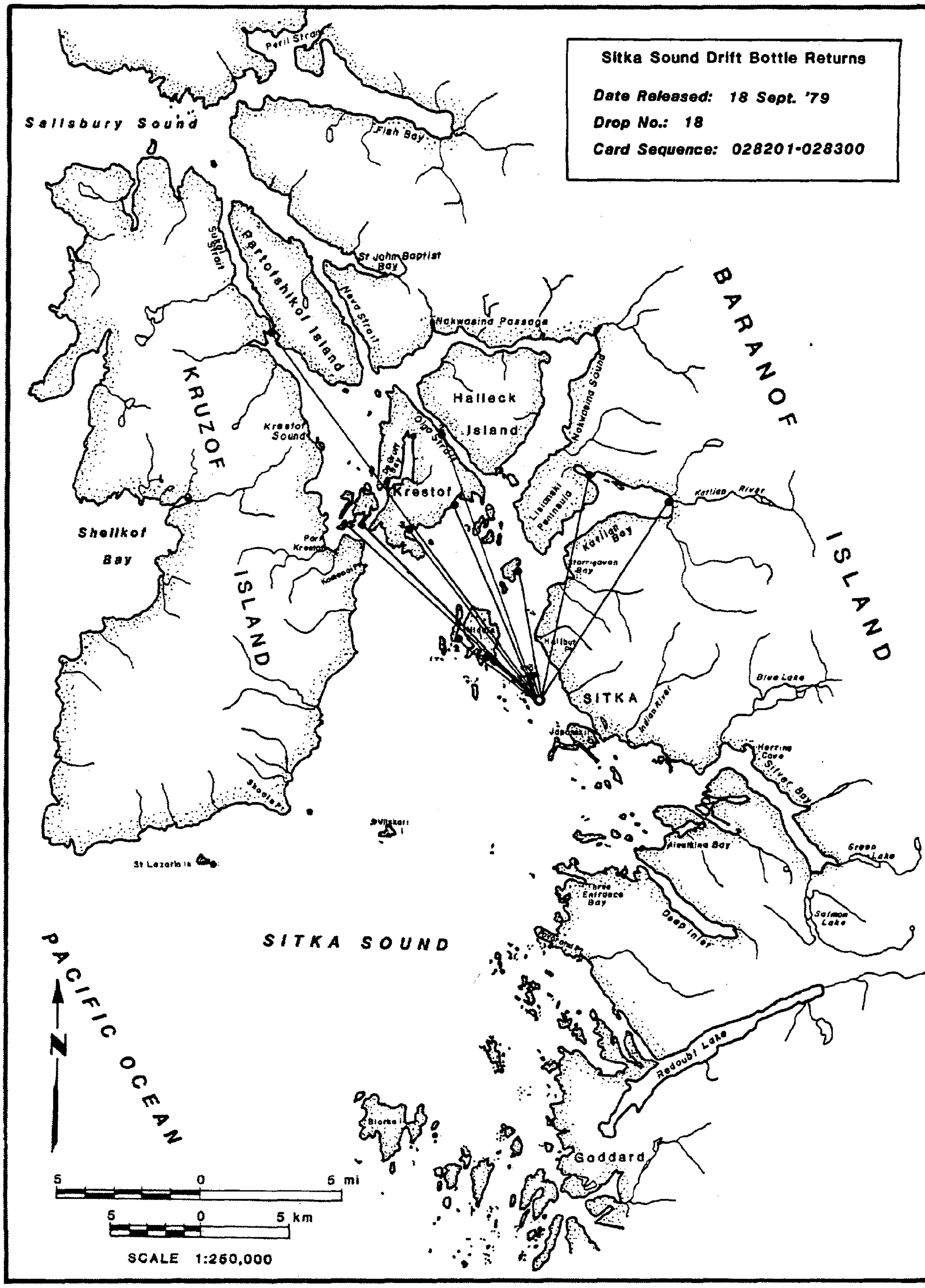


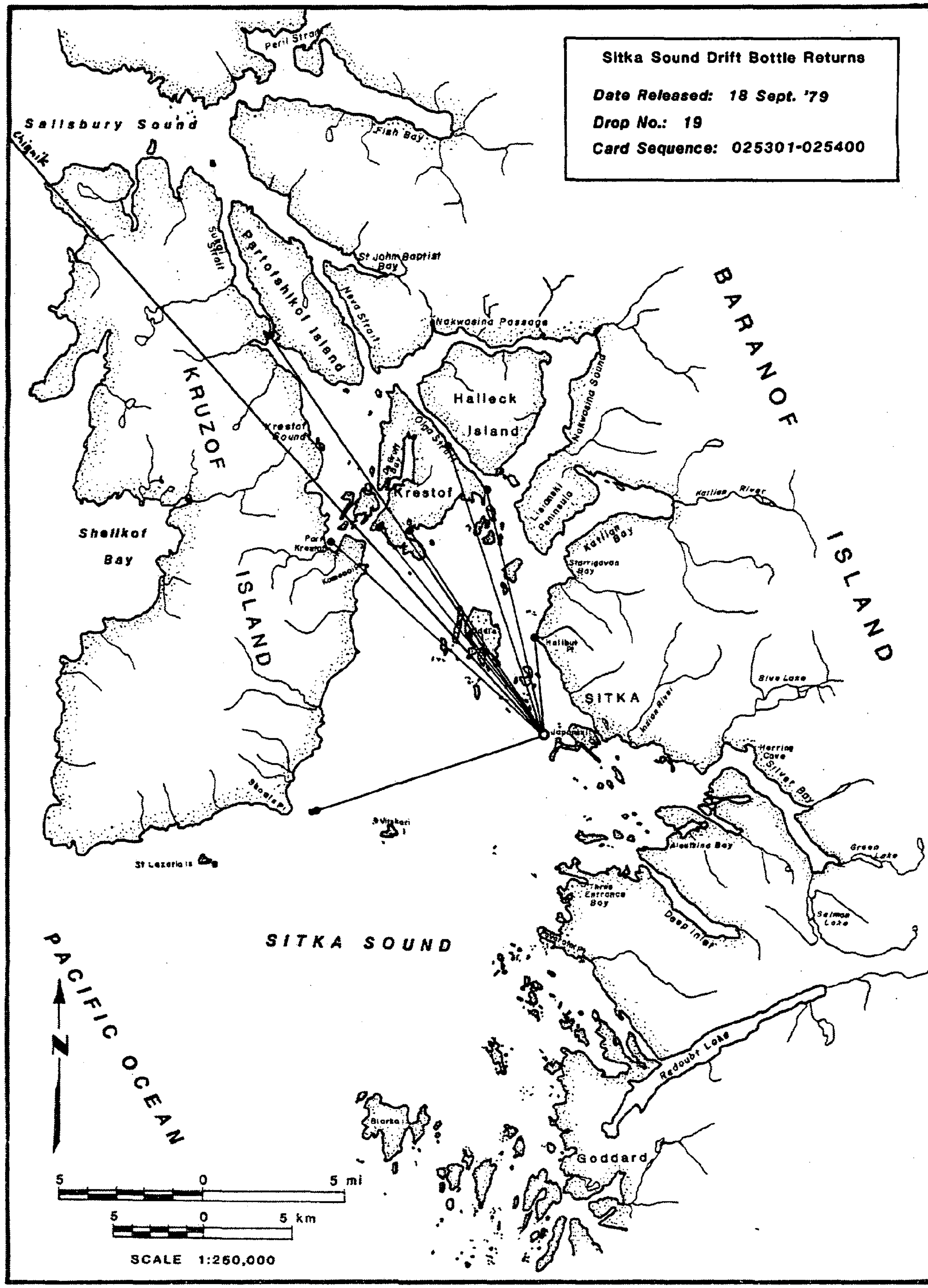
Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 15
Card Sequence: 026001-026100
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Halleck Island
Olga Strait
Krestof I.
Nakwasina Sound
Katlian River
Katlian Bay
Shelikof Bay
Port Krestof
Middle I
Halibut Pt
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Green Lake
Aleutkina Bay
Three Entrance Bay
Deep Inlet
Salmon Lake
Shoals Pt
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Biorka I
Goddard
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000


Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 16
Card Sequence: 026101-026200
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Neva Strait
Nakwasina Passage
Partofshikof Island
KRUZOF
ISLAND
Krestof Sound
Shelikof Bay
Port Krestof
Halleck Island
Olga Strait
Krestof
Nakwasina Sound
Lisianski Peninsula
Katlian Bay
Katlian River
Starrigavan Bay
Halibut Pt
BARANOF
ISLAND
SITKA
Indian River
Blue Lake
Japonski I
Herring Cove
Silver Bay
Shoals Pt
Vitskari I
St Lazaria Is
Aleutkina Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Biorka I
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

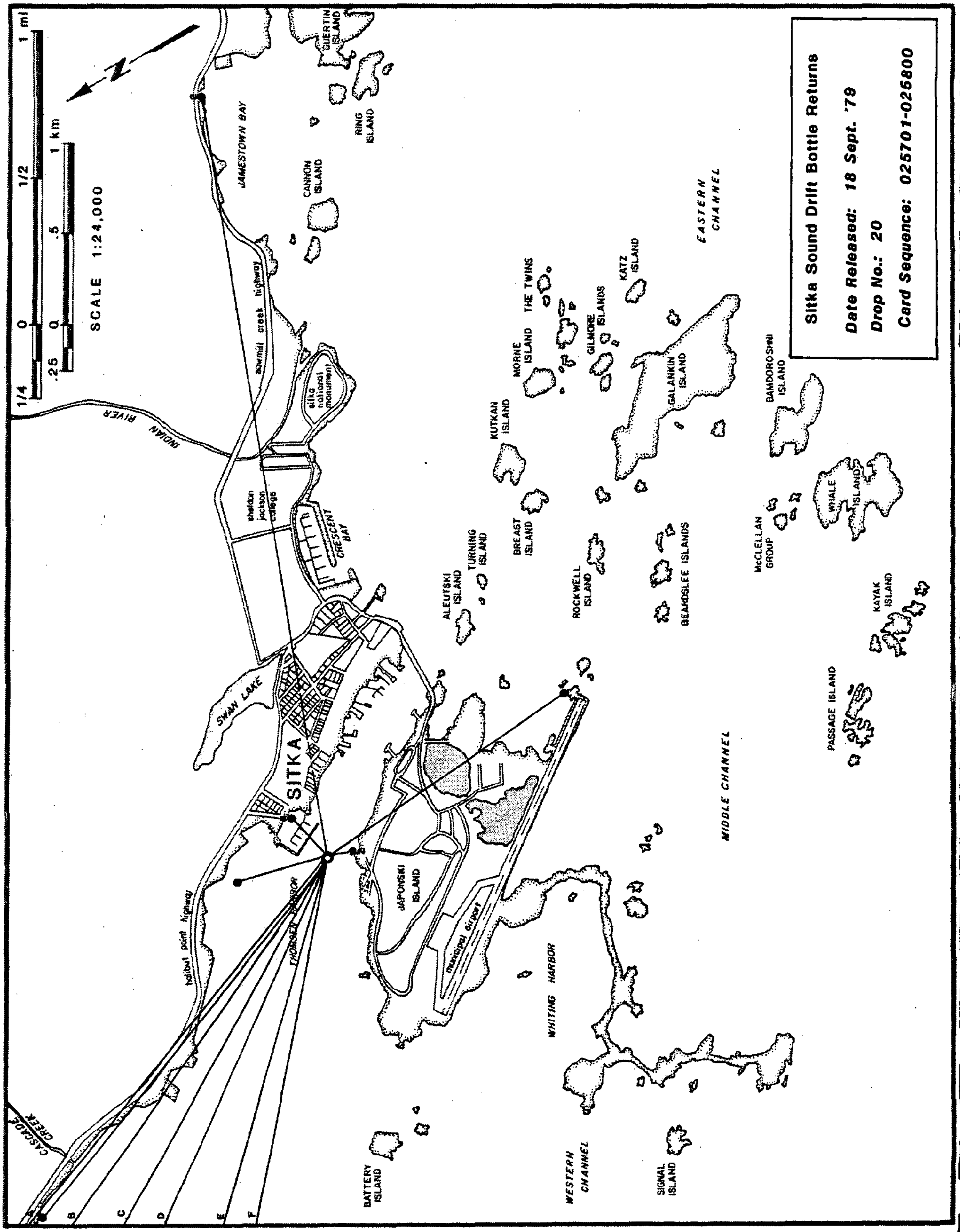

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 17
Card Sequence: 028101-028200
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Nakwasina Sound
Krestof Sound
Olga Strait
Krestof I
Shelikof Bay
Lisianski Peninsula
Katlian Bay
Katlian River
Starrigavan Bay
Middle I
Halibut Pt
SITKA
Blue Lake
Indian River
Japonski I
Herring Cove
Silver Bay
St Lazaria Is
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Goddard
Biorka I
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

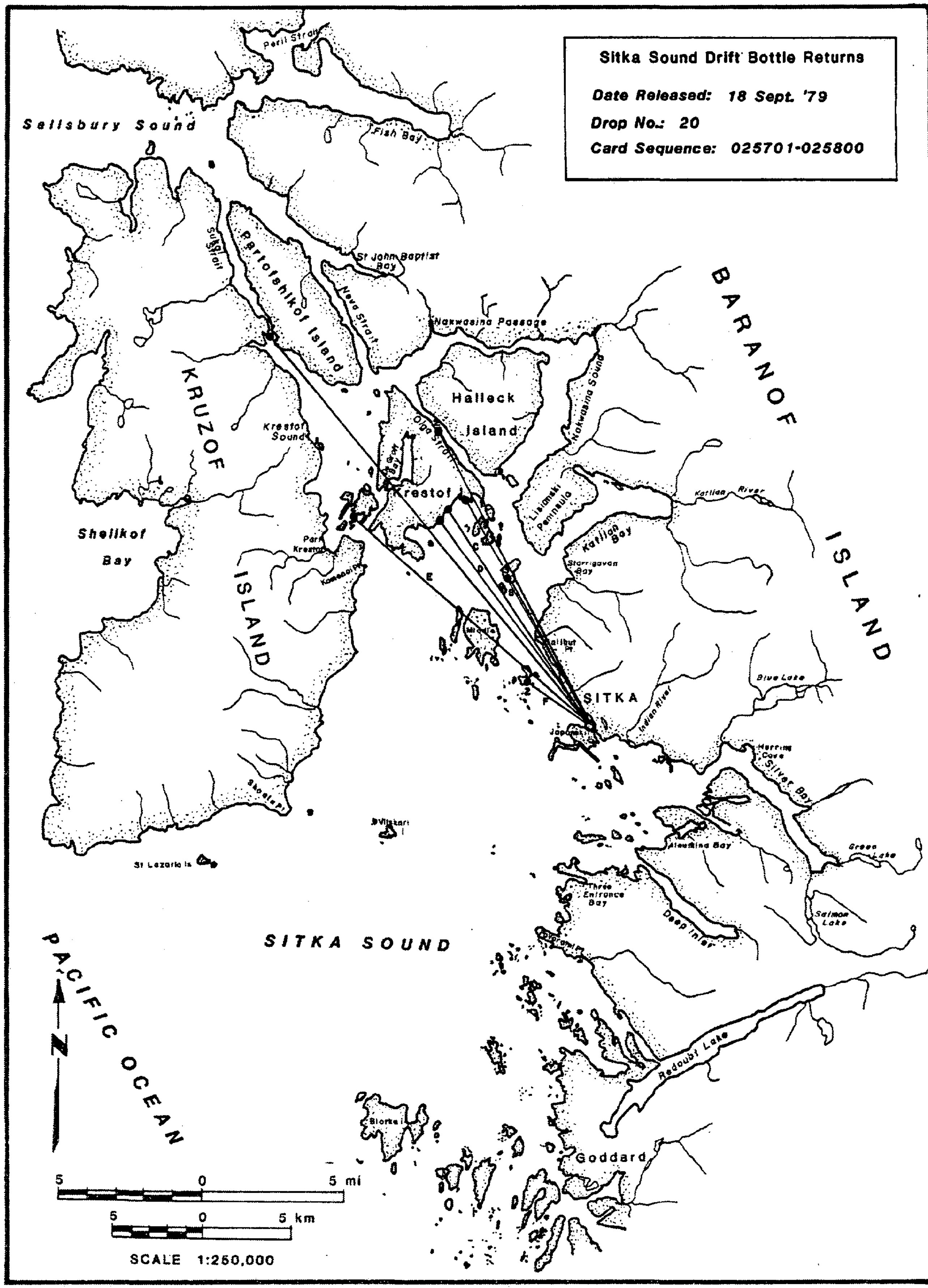

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 17
Card Sequence: 028101-028200
COOK INLET
KENAI
KENAI PENINSULA
ANCHORAGE
HOMER
SEWARD
PRINCE WILLIAM SOUND
VALDEZ
CORDOVA
HINCHINBROOK ISLAND
MONTAGUE ISLAND
MIDDLETON ISLAND
COPPER RIVER
KAYAK ISLAND
ICY CAPE
OCEAN CAPE
YAKUTAT
CAPE FAIRWEATHER
CAPE SPENCER
CHICHAGOF ISLAND
SITKA
BARANOF ISLAND
HAINES
SKAGWAY
JUNEAU
AFOGNAK ISLAND
KODIAK ISLAND
GULF OF ALASKA
A
B
N
50 0 50 100 150 MILES
50 0 50 100 150 KILOMETERS
SCALE APPROX. 1:4,000,000

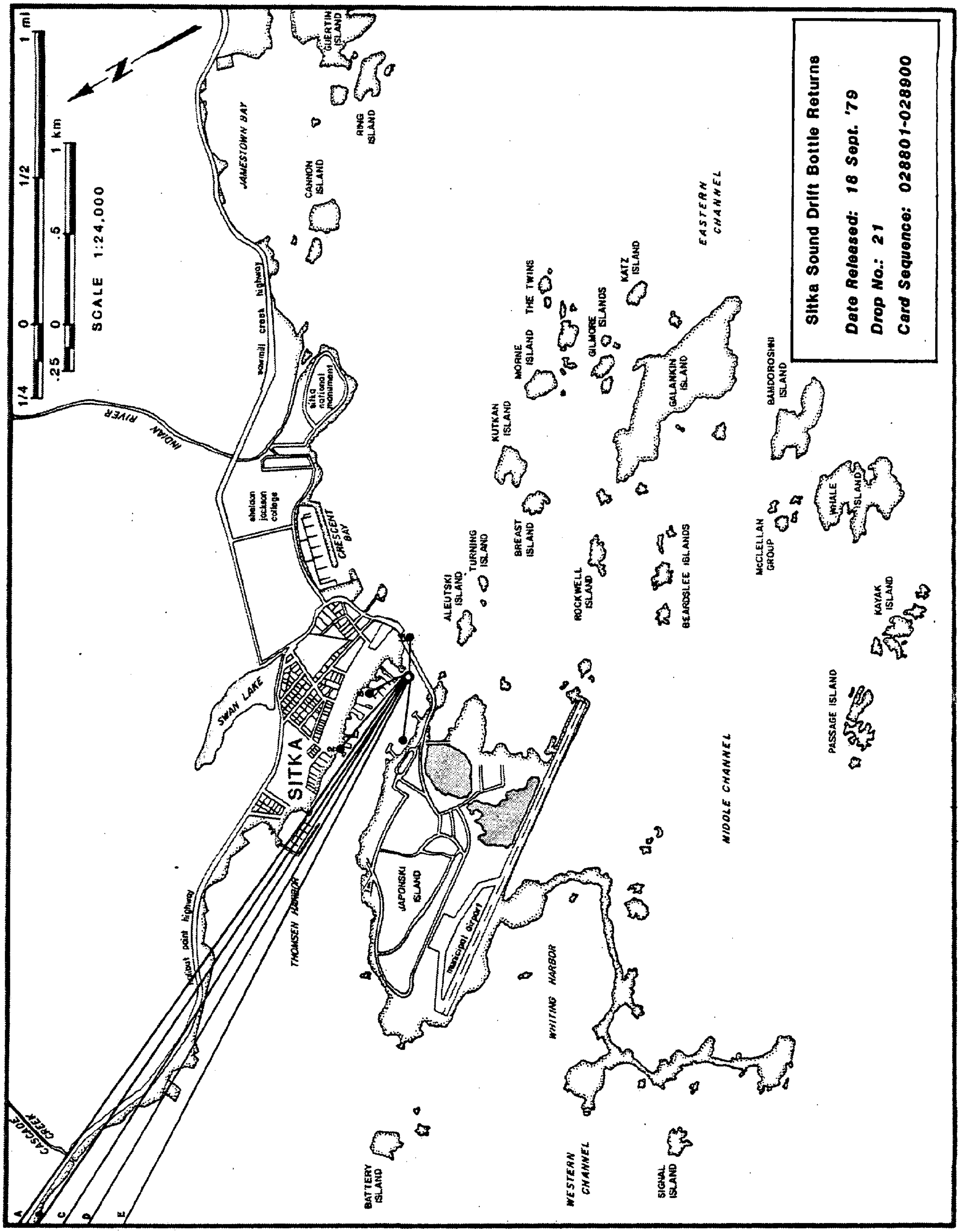

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 18
Card Sequence: 028201-028300
Salisbury Sound
Fish Bay
Sukoi Strait
Partofshikof Island
St John Baptist Bay
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Krestof Sound
Olga Strait
Krestof
Nakwasina Sound
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
Port Krestof
Halibut Pt
SITKA
Blue Lake
Indian River
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Deep Inlet
Three Entrance Bay
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Goddard
Biorka I
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000



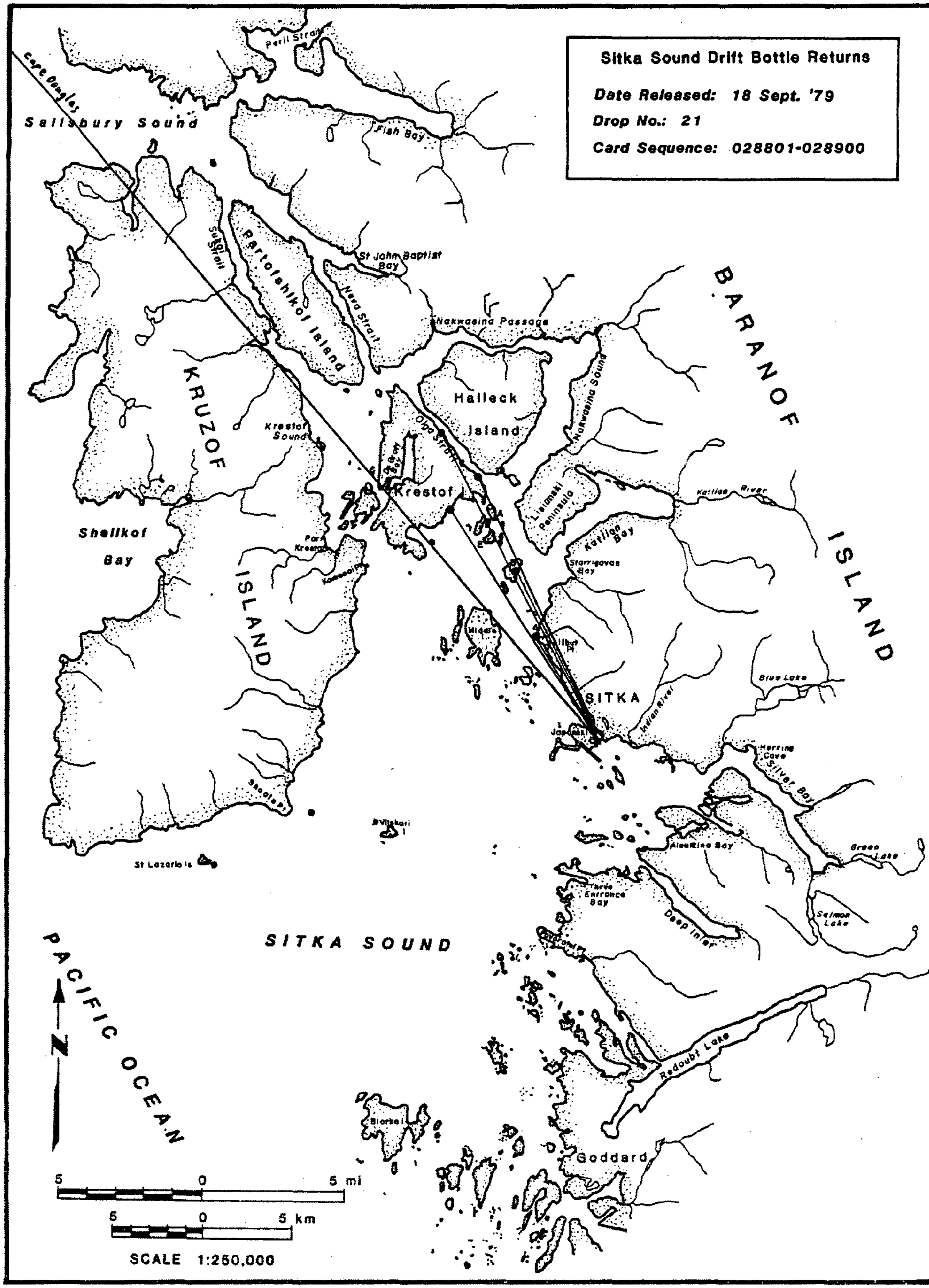
Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 19
Card Sequence: 025301-025400
Sallsbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Krestof
Krestof Sound
Shelikof Bay
SITKA
SITKA SOUND
PACIFIC OCEAN
Goddard
Redoubt Lake
Deep Inlet
Silver Bay
Green Lake
Salmon Lake
Blue Lake
Halibut Pt.
Starrigavan Bay
Katlian Bay
Katlian River
Indian River
Herring Cove
Three Entrance Bay
St Lazaria Is
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

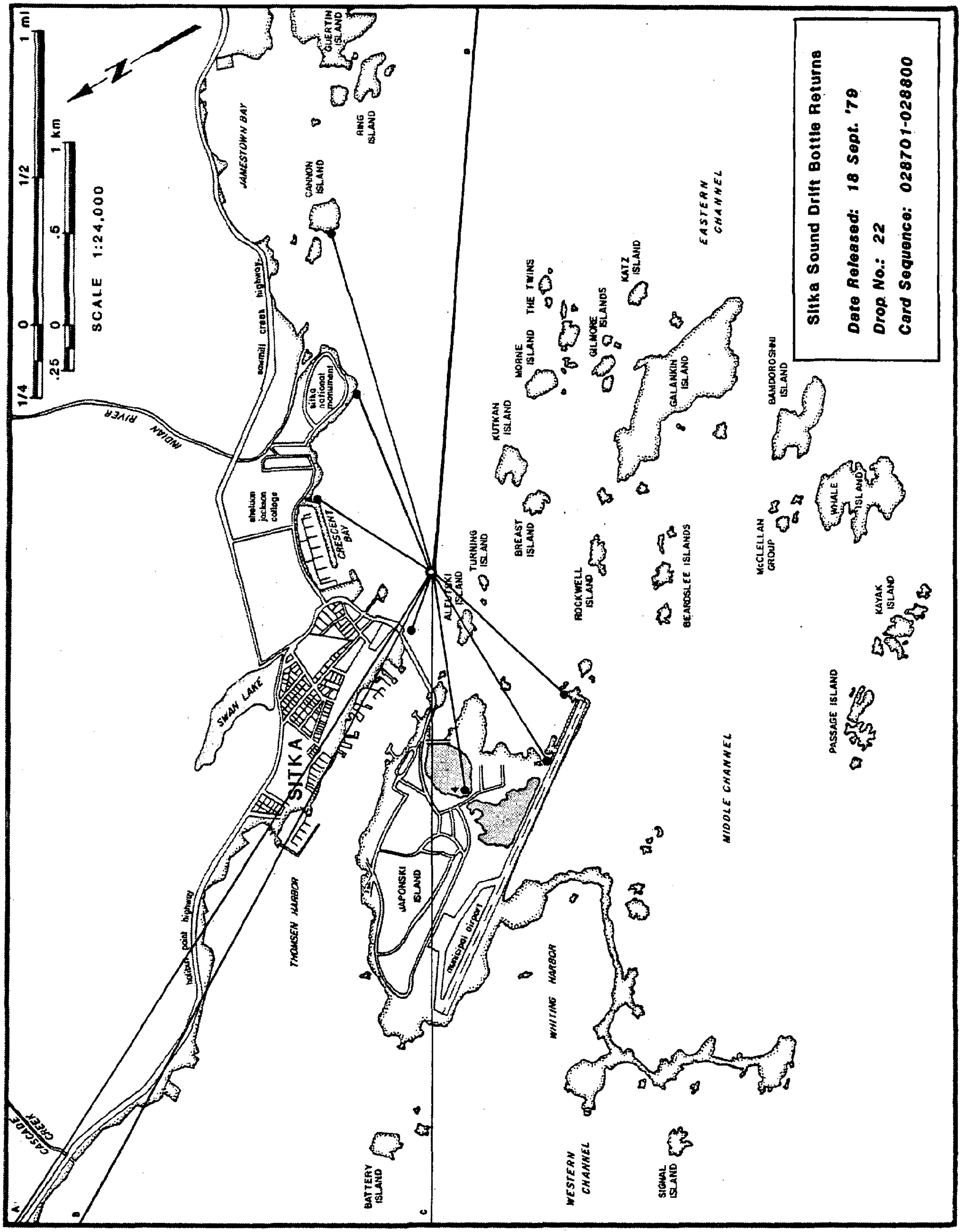

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 20
Card Sequence: 025701-025800
SCALE 1:24,000
1/4 0 1/2 1 mi
.25 0 .5 1 km
N
SITKA
SWAN LAKE
JAMESTOWN BAY
CANNON ISLAND
RING ISLAND
GUERTIN ISLAND
EASTERN CHANNEL
KATZ ISLAND
THE TWINS
GILMORE ISLANDS
MORNE ISLAND
GALANKIN ISLAND
BAMDOROSHNI ISLAND
KUTKAN ISLAND
BREAST ISLAND
TURNING ISLAND
ALEUTSKI ISLAND
ROCKWELL ISLAND
BEARDSLEE ISLANDS
McCLELLAN GROUP
WHALE ISLAND
KAYAK ISLAND
PASSAGE ISLAND
MIDDLE CHANNEL
JAPONSKI ISLAND
WHITING HARBOR
THOMSEN HARBOR
halibut point highway
sawmill creek highway
INDIAN RIVER
sitka national monument
sheldon jackson college
CRESCENT BAY
CASCADE CREEK
WESTERN CHANNEL
BATTERY ISLAND
SIGNAL ISLAND
A
B
C
D
E
F

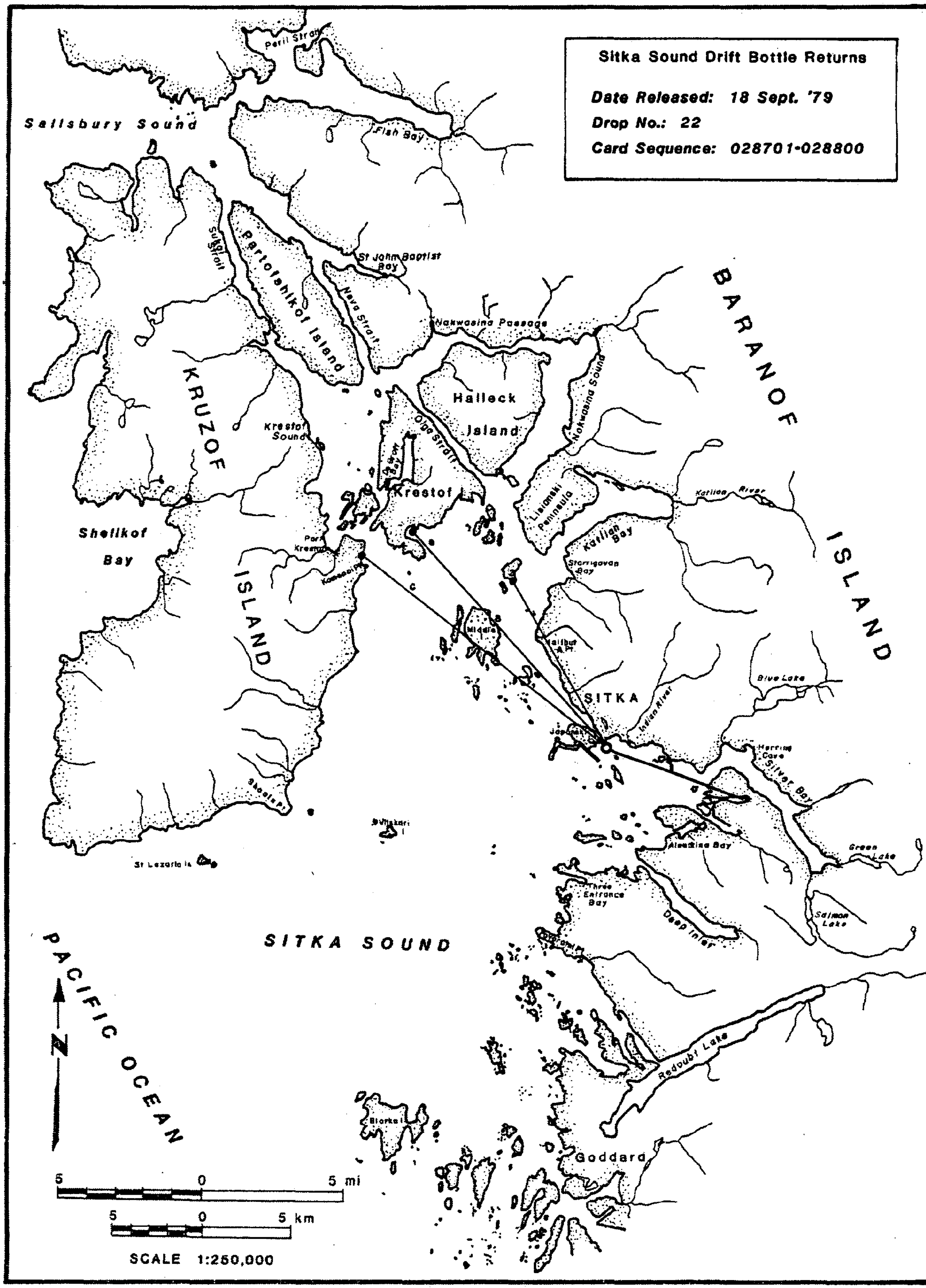

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 20
Card Sequence: 025701-025800
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Krestof Sound
Krestof I.
Olga Strait
Shelikof Bay
Katlian Bay
Katlian River
Starrigavan Bay
Halibut Pt.
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Three Entrance Bay
Deep Inlet
Redoubt Lake
Goddard
St Lazaria Is.
SITKA SOUND
PACIFIC OCEAN
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

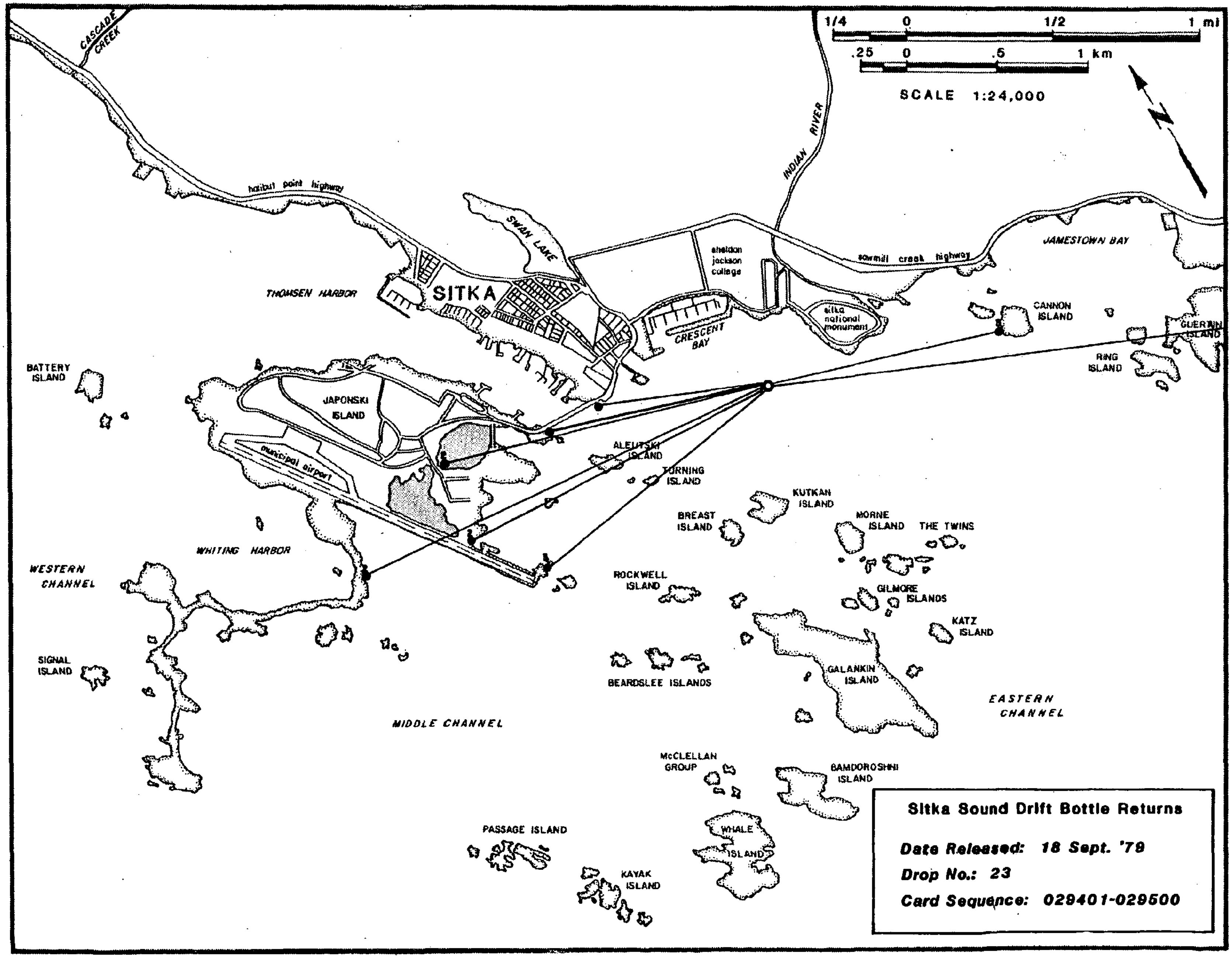


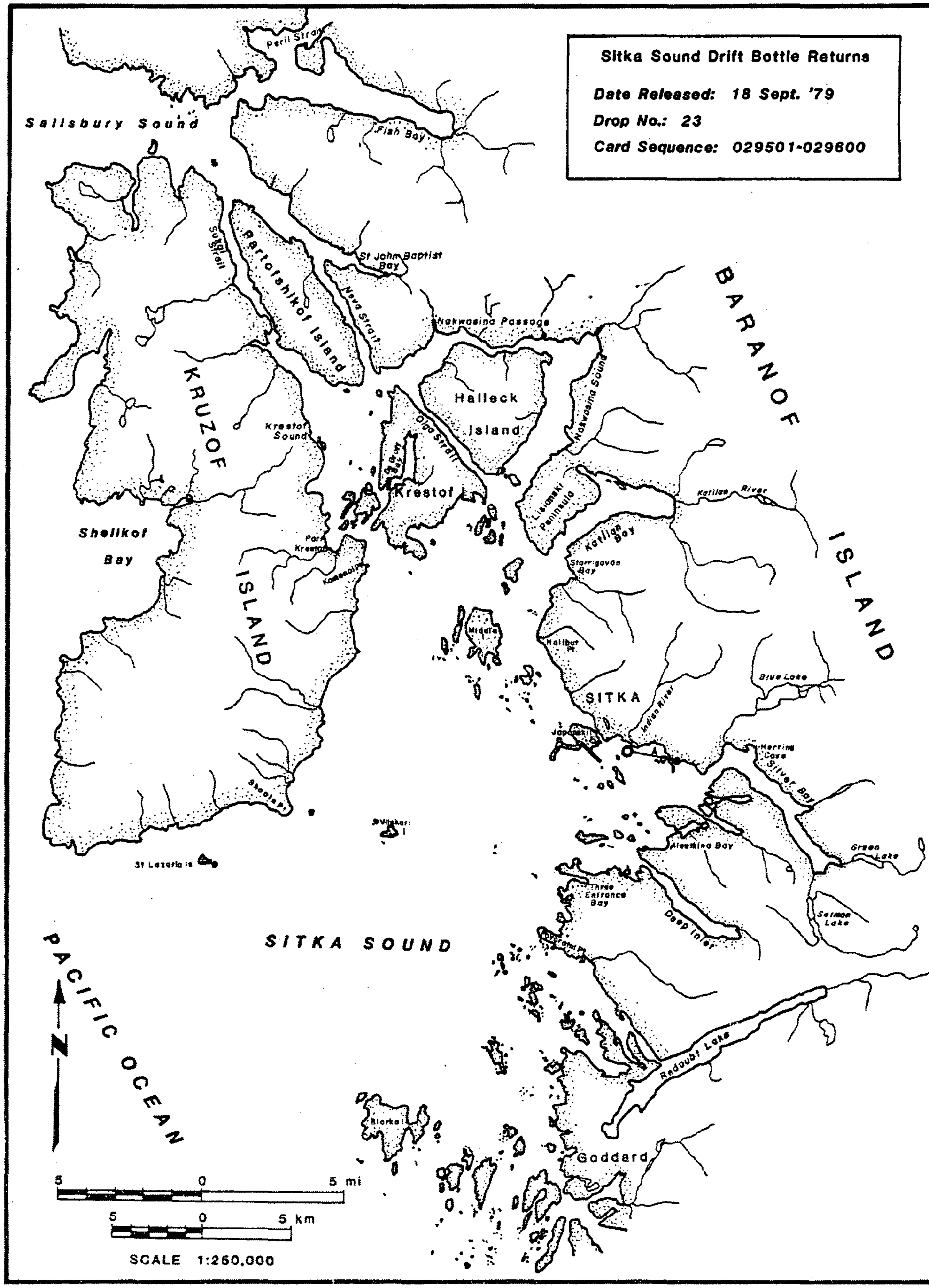
Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 21
Card Sequence: 028801-028900
SCALE 1:24,000
1/4
.25
0
0
.5
1/2
1 km
1 mi
N
JAMESTOWN BAY
GUERTIN ISLAND
RING ISLAND
CANNON ISLAND
EASTERN CHANNEL
KATZ ISLAND
THE TWINS
GILMORE ISLANDS
MORNE ISLAND
KUTKAN ISLAND
GALANKIN ISLAND
SAMDOROSHNI ISLAND
sawmill creek highway
sitka national monument
INDIAN RIVER
sheldon jackson college
CRESCENT BAY
BREAST ISLAND
TURNING ISLAND
ALEUTSKI ISLAND
ROCKWELL ISLAND
BEARDSLEE ISLANDS
McCLELLAN GROUP
WHALE ISLAND
KAYAK ISLAND
SWAN LAKE
SITKA
PASSAGE ISLAND
MIDDLE CHANNEL
JAPONSKI ISLAND
municipal airport
halibut point highway
THOMSEN HARBOR
WHITING HARBOR
CASCADE CREEK
BATTERY ISLAND
WESTERN CHANNEL
SIGNAL ISLAND
A
C
D
E

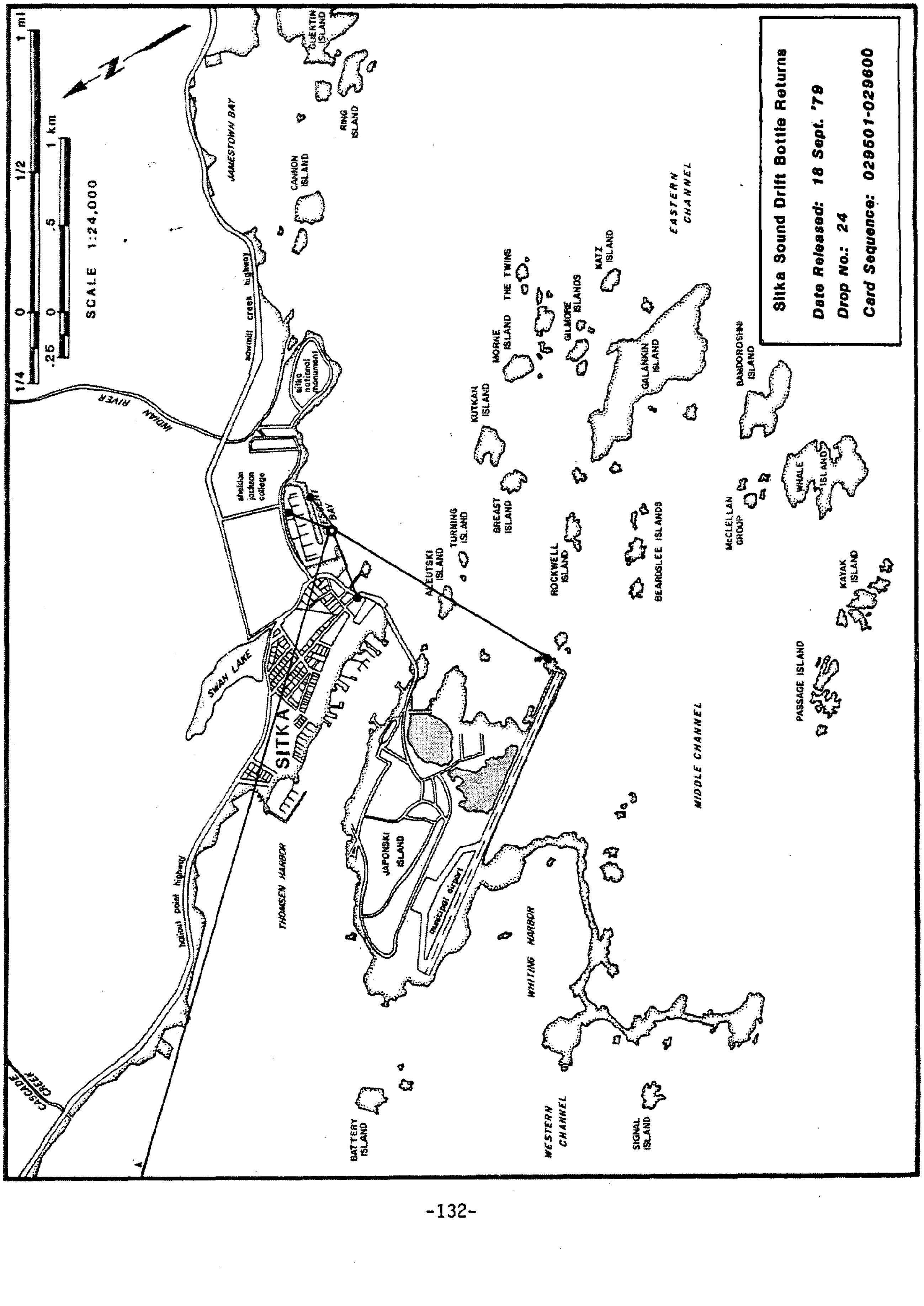

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 21
Card Sequence: 028801-028900
Salisbury Sound
Cape Douglas
Peril Strait
Fish Bay
St John Baptist Bay
Sukoi Strait
Partofshikof Island
Neva Strait
Nakwasina Passage
Halleck Island
Nakwasina Sound
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Olga Strait
Krestof
Lisianski Peninsula
Katlian Bay
Katlian River
Starrigavan Bay
Shelikof Bay
Port Krestof
Middle I
SITKA
Japonski I
Indian River
Blue Lake
Herring Cove
Silver Bay
Aleutkina Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
Shoals Pt
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Goddard
Biorka I
5 0 5 mi
5 0 5 km
SCALE 1:250,000

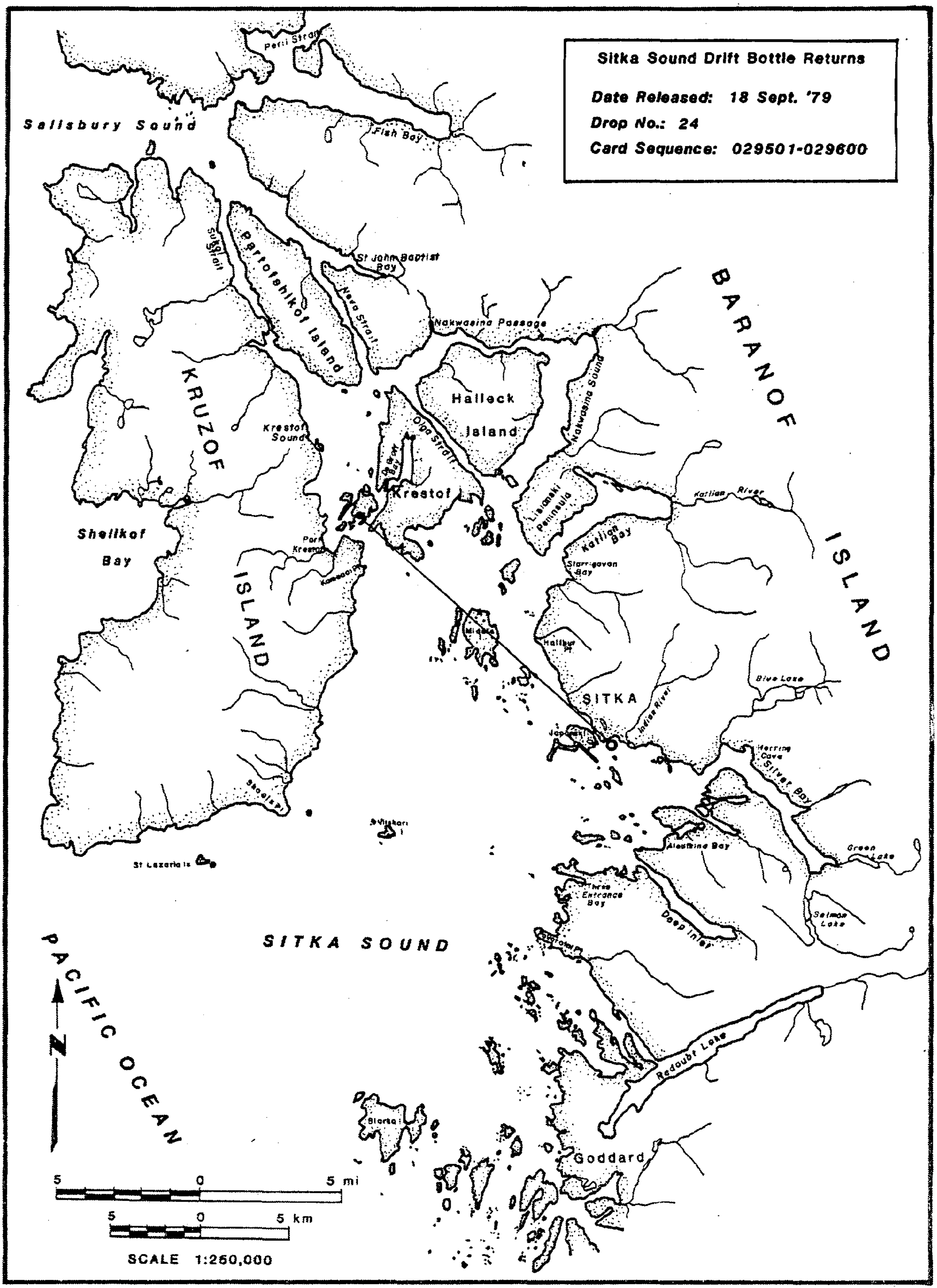

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 22
Card Sequence: 028701-028800
SCALE 1:24,000
1/4
1/2
1 mi
.25
0
.5
1 km
N
SITKA
SWAN LAKE
JAMESTOWN BAY
CANNON ISLAND
RING ISLAND
GUERTIN ISLAND
INDIAN RIVER
sawmill creek highway
sitka national monument
sheldon jackson college
CRESCENT BAY
TURNING ISLAND
ALEUTSKI ISLAND
KUTKAN ISLAND
MORNE ISLAND
THE TWINS
GILMORE ISLANDS
KATZ ISLAND
GALANKIN ISLAND
EASTERN CHANNEL
BAMDOROSHNI ISLAND
WHALE ISLAND
McCLELLAN GROUP
KAYAK ISLAND
PASSAGE ISLAND
BREAST ISLAND
ROCKWELL ISLAND
BEARDSLEE ISLANDS
MIDDLE CHANNEL
JAPONSKI ISLAND
municipal airport
THOMSEN HARBOR
halibut point highway
WHITING HARBOR
CASCADE CREEK
BATTERY ISLAND
WESTERN CHANNEL
SIGNAL ISLAND

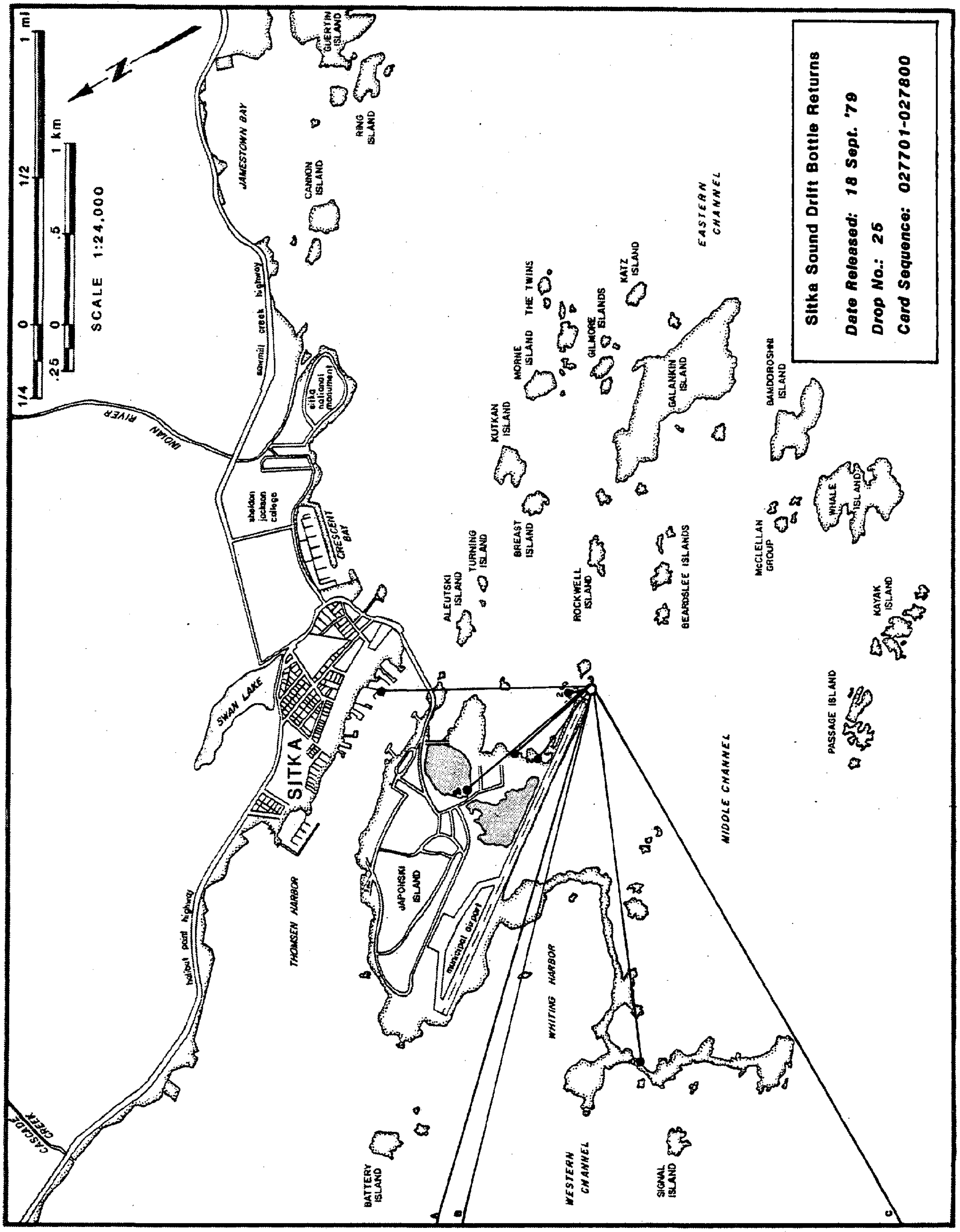

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 22
Card Sequence: 028701-028800
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
Nakwasina Sound
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Krestof Sound
Olga Strait
Krestof I.
Shelikof Bay
Katlian River
Katlian Bay
Starrigavan Bay
Middle I.
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Deep Inlet
Three Entrance Bay
St Lazaria Is.
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Goddard
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000


Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 23
Card Sequence: 029401-029500
SCALE 1:24,000
1/4 0 1/2 1 mi
.25 0 .5 1 km
N
SITKA
SWAN LAKE
THOMSEN HARBOR
halibut point highway
CASCADE CREEK
INDIAN RIVER
sheldon jackson college
CRESCENT BAY
sitka national monument
sawmill creek highway
JAMESTOWN BAY
CANNON ISLAND
GUERTIN ISLAND
RING ISLAND
JAPONSKI ISLAND
municipal airport
ALEUTSKI ISLAND
TURNING ISLAND
BATTERY ISLAND
WHITING HARBOR
WESTERN CHANNEL
SIGNAL ISLAND
MIDDLE CHANNEL
KUTKAN ISLAND
BREAST ISLAND
MORNE ISLAND
THE TWINS
ROCKWELL ISLAND
GILMORE ISLANDS
KATZ ISLAND
BEARDSLEE ISLANDS
GALANKIN ISLAND
EASTERN CHANNEL
McCLELLAN GROUP
BAMDOROSHNI ISLAND
PASSAGE ISLAND
WHALE ISLAND
KAYAK ISLAND

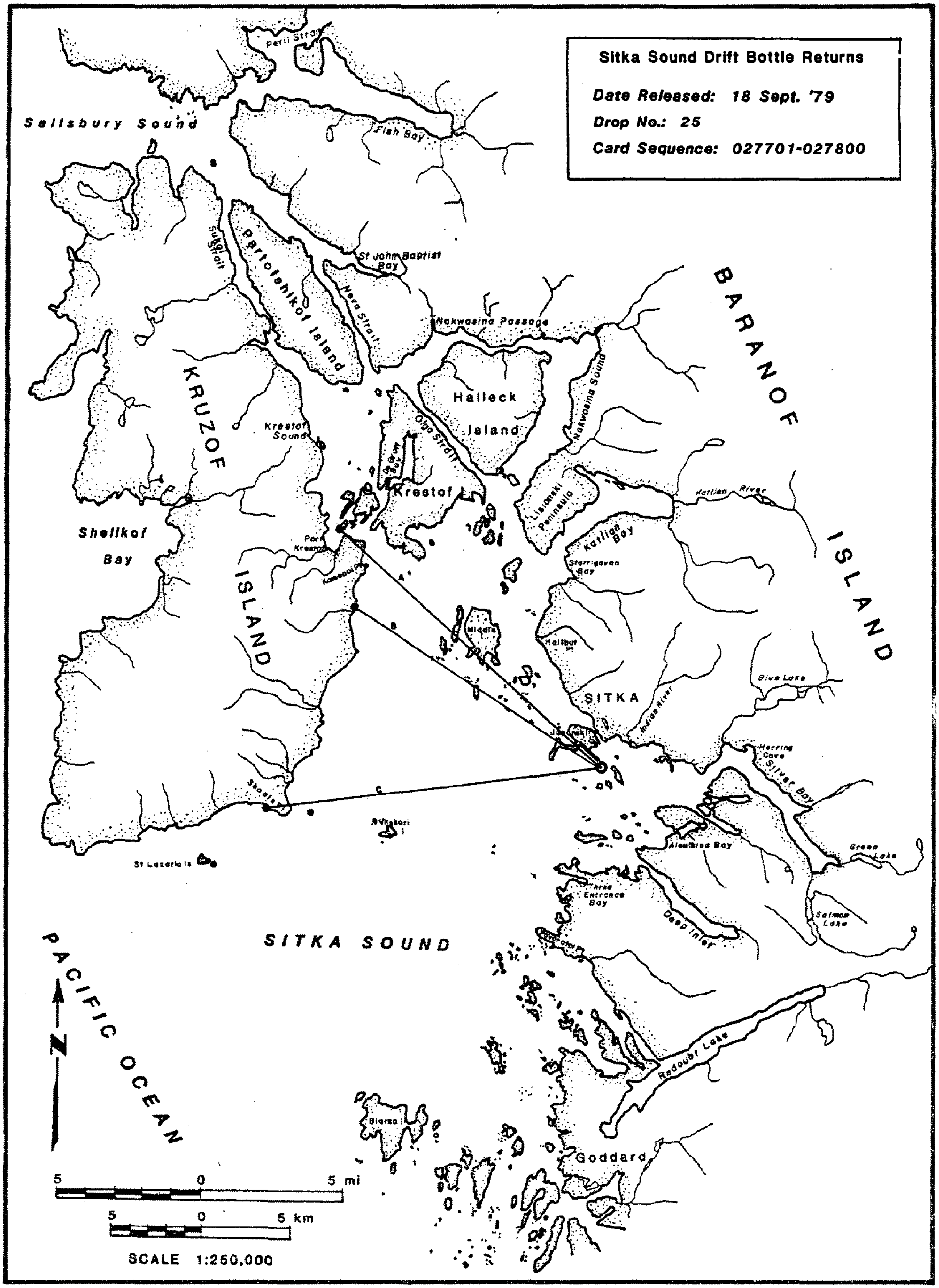

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 23
Card Sequence: 029501-029600
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Neva Strait
Sukoi Strait
Partofshikof Island
Nakwasina Passage
Halleck Island
Nakwasina Sound
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Olga Strait
Krestof
Lisianski Peninsula
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
Middle
Halibut Pt.
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
SITKA SOUND
St Lazaria Is
PACIFIC OCEAN
N
Redoubt Lake
Biorka I
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

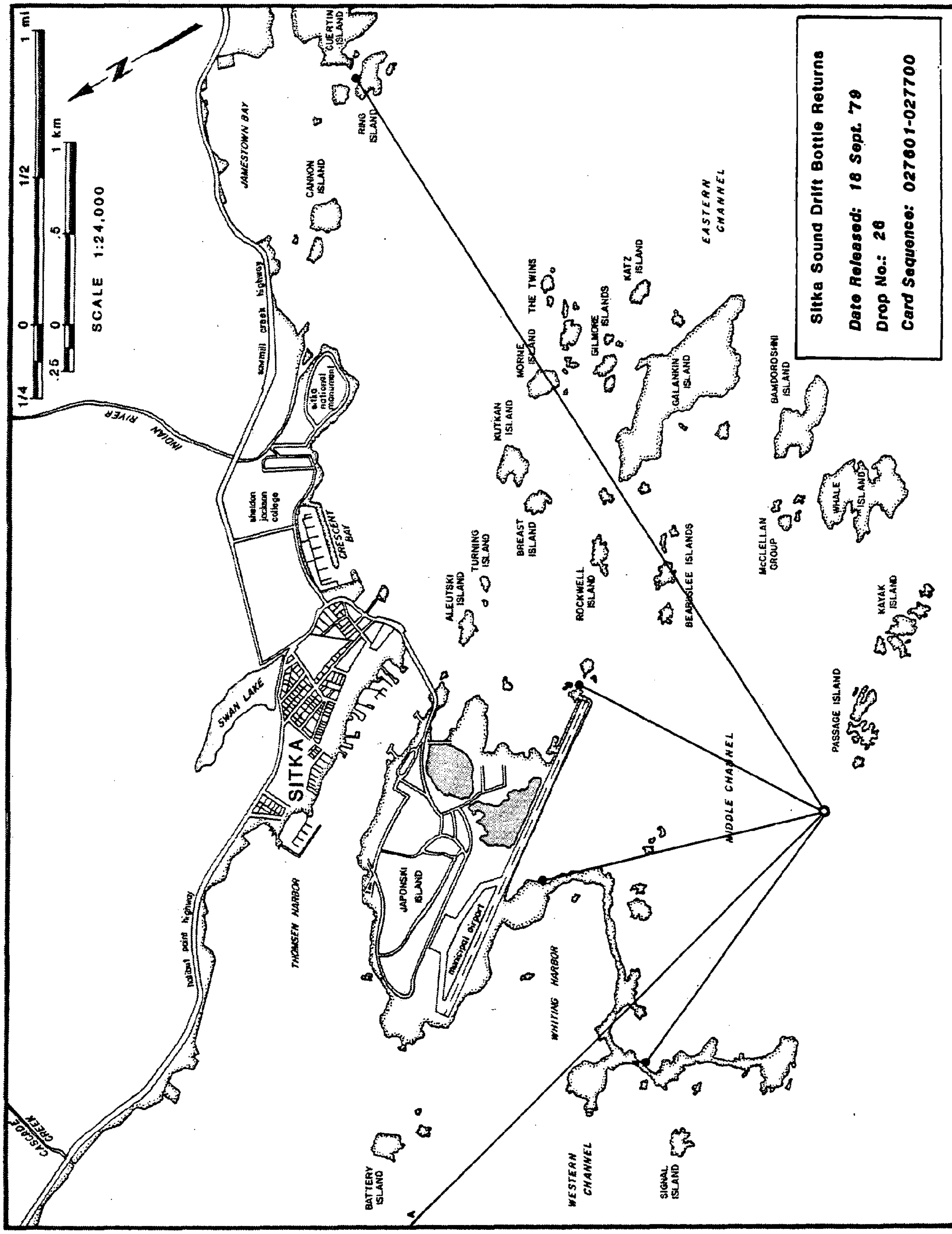

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 24
Card Sequence: 029501-029600
SCALE 1:24,000
1/4 .25 0 0 .5 1/2 1 km 1 mi
N
SITKA
SWAN LAKE
INDIAN RIVER
JAMESTOWN BAY
sawmill creek highway
halibut point highway
sitka national monument
sheldon jackson college
CRESCENT BAY
THOMSEN HARBOR
JAPONSKI ISLAND
municipal airport
WHITING HARBOR
WESTERN CHANNEL
MIDDLE CHANNEL
EASTERN CHANNEL
CASCADE CREEK
BATTERY ISLAND
SIGNAL ISLAND
PASSAGE ISLAND
KAYAK ISLAND
WHALE ISLAND
McCLELLAN GROUP
BEARDSLEE ISLANDS
ROCKWELL ISLAND
BREAST ISLAND
TURNING ISLAND
ALEUTSKI ISLAND
KUTKAN ISLAND
MORNE ISLAND
THE TWINS
GILMORE ISLANDS
KATZ ISLAND
GALANKIN ISLAND
BAMDOROSHNI ISLAND
CANNON ISLAND
RING ISLAND
GUERTIN ISLAND

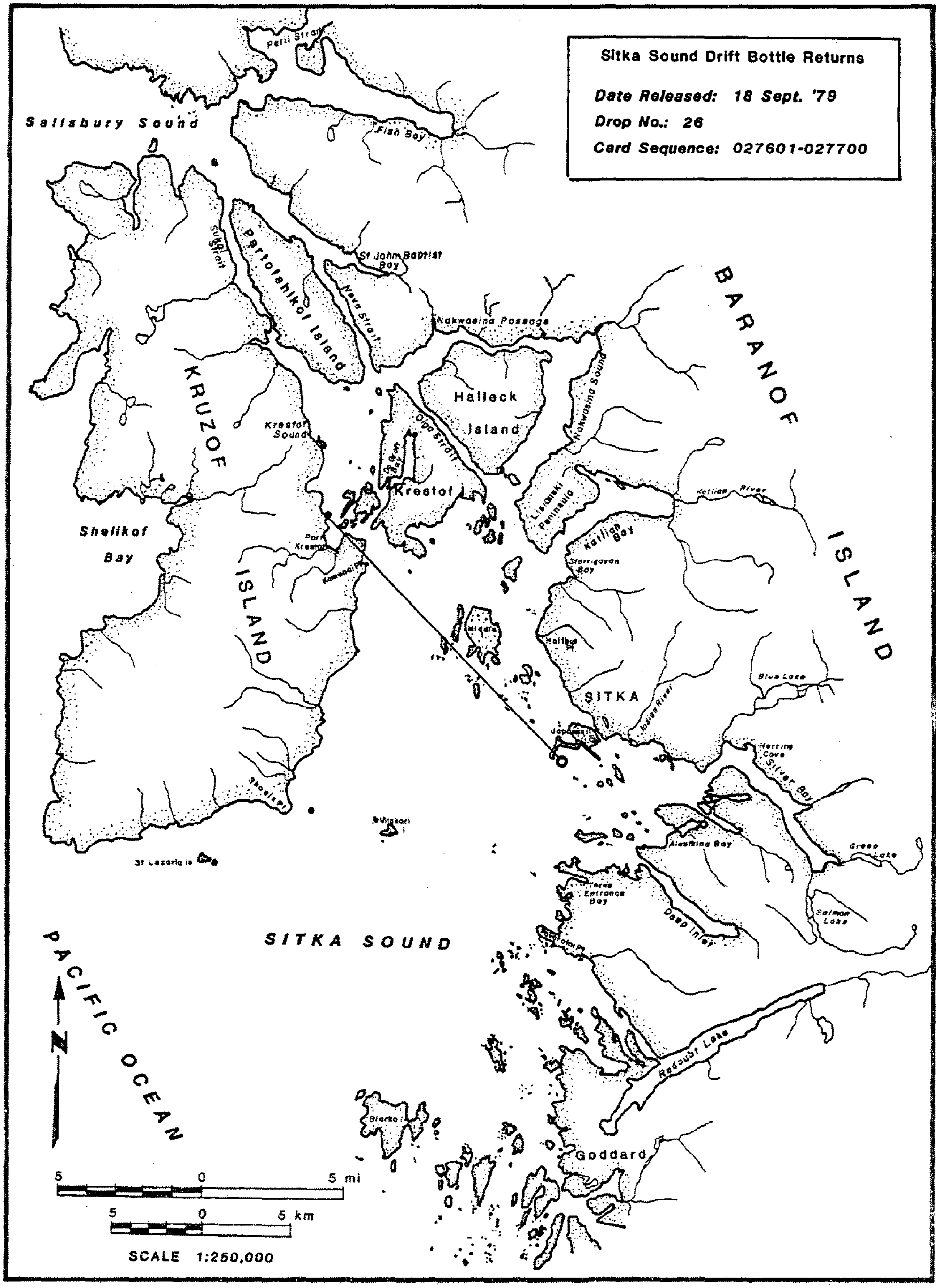

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 24
Card Sequence: 029501-029600
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Nakwasina Sound
Krestof Sound
Olga Strait
Krestof
Lisianski Peninsula
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
Port Krestof
Halibut Pt.
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
Redoubt Lake
Goddard
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

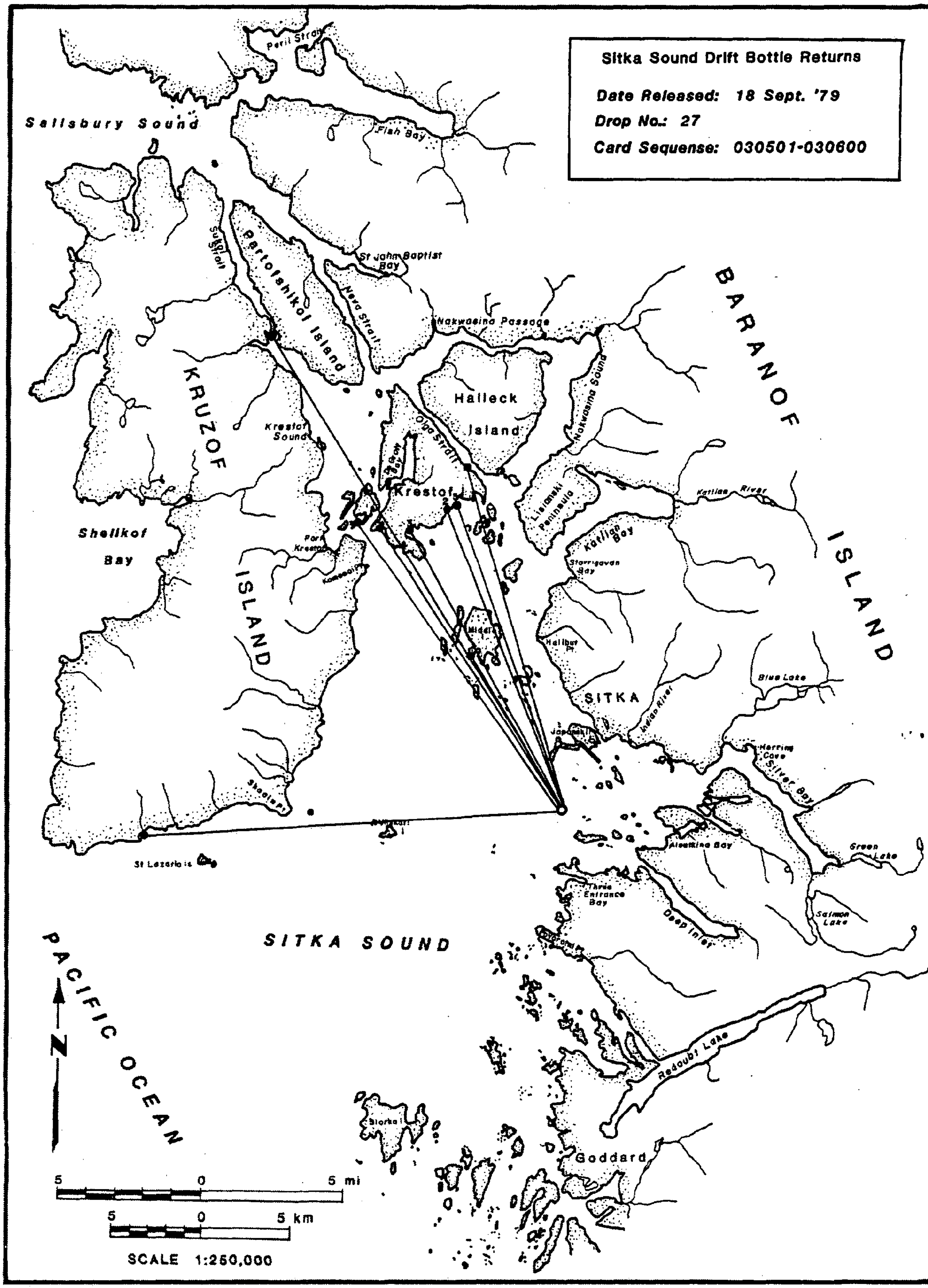


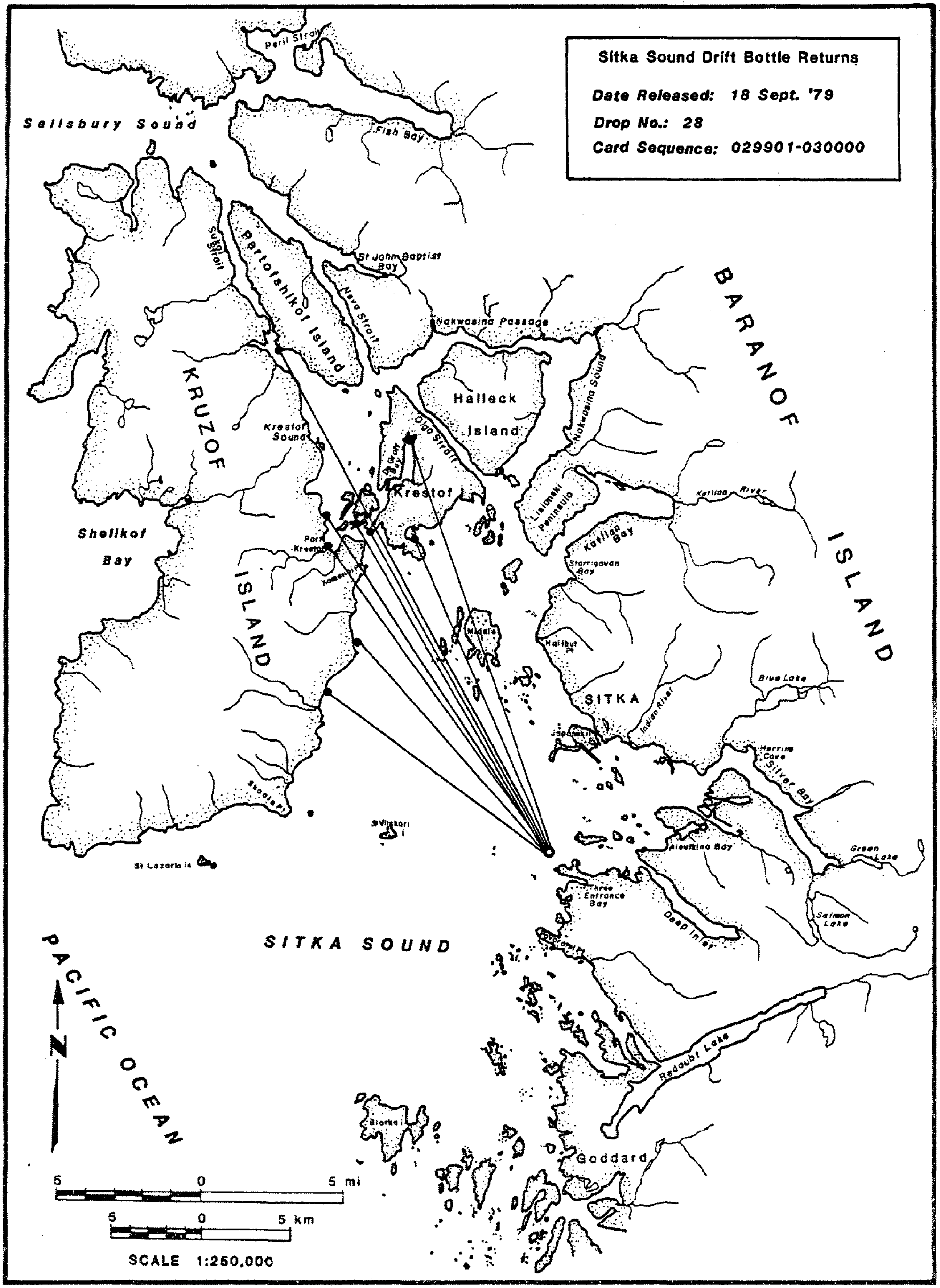
Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 25
Card Sequence: 027701-027800
SCALE 1:24,000
1/4
0
1/2
1 mi
.25
0
.5
1 km
N
JAMESTOWN BAY
GUERTIN ISLAND
RING ISLAND
CANNON ISLAND
EASTERN CHANNEL
KATZ ISLAND
THE TWINS
GILMORE ISLANDS
MORNE ISLAND
GALANKIN ISLAND
BAMDOROSHNI ISLAND
KUTKAN ISLAND
WHALE ISLAND
McCLELLAN GROUP
BREAST ISLAND
TURNING ISLAND
ALEUTSKI ISLAND
ROCKWELL ISLAND
BEARDSLEE ISLANDS
KAYAK ISLAND
PASSAGE ISLAND
MIDDLE CHANNEL
INDIAN RIVER
sawmill creek highway
sitka national monument
sheldon jackson college
CRESCENT BAY
SWAN LAKE
SITKA
JAPONSKI ISLAND
municipal airport
THOMSEN HARBOR
WHITING HARBOR
halibut point highway
CASCADE CREEK
BATTERY ISLAND
WESTERN CHANNEL
SIGNAL ISLAND
A
B
C


Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 25
Card Sequence: 027701-027800
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
Sukoi Strait
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Nakwasina Sound
Olga Strait
Krestof Sound
Krestof I
Lisianski Peninsula
Katlian Bay
Katlian River
Shelikof Bay
Port Krestof
Starrigavan Bay
Middle I
Halibut Pt
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Shoals Pt
Vitskari I
St Lazaria Is
Aleutkina Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Biorka I
Goddard
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

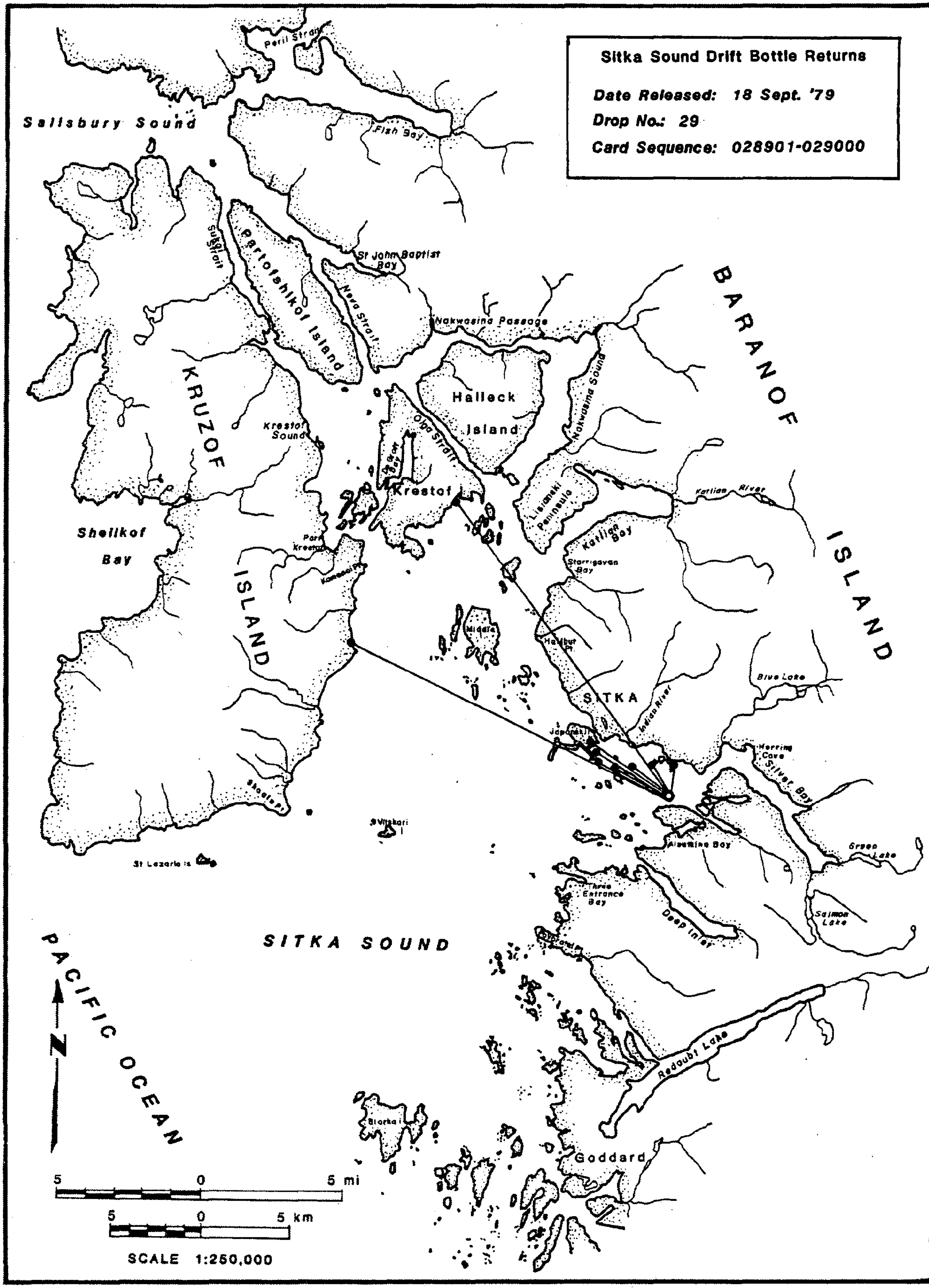

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 26
Card Sequence: 027601-027700
SCALE 1:24,000
1/4 0 1/2 1 mi
.25 0 .5 1 km
N
SITKA
JAMESTOWN BAY
CANNON ISLAND
RING ISLAND
GUERTIN ISLAND
EASTERN CHANNEL
KATZ ISLAND
THE TWINS
GILMORE ISLANDS
MORNE ISLAND
GALANKIN ISLAND
BAMDOROSHNI ISLAND
KUTKAN ISLAND
WHALE ISLAND
McCLELLAN GROUP
BREAST ISLAND
TURNING ISLAND
ALEUTSKI ISLAND
ROCKWELL ISLAND
BEARDSLEE ISLANDS
KAYAK ISLAND
PASSAGE ISLAND
MIDDLE CHANNEL
sawmill creek highway
sitka national monument
INDIAN RIVER
sheldon jackson college
CRESCENT BAY
SWAN LAKE
JAPONSKI ISLAND
THOMSEN HARBOR
halibut point highway
WHITING HARBOR
municipal airport
CASCADE CREEK
BATTERY ISLAND
WESTERN CHANNEL
SIGNAL ISLAND

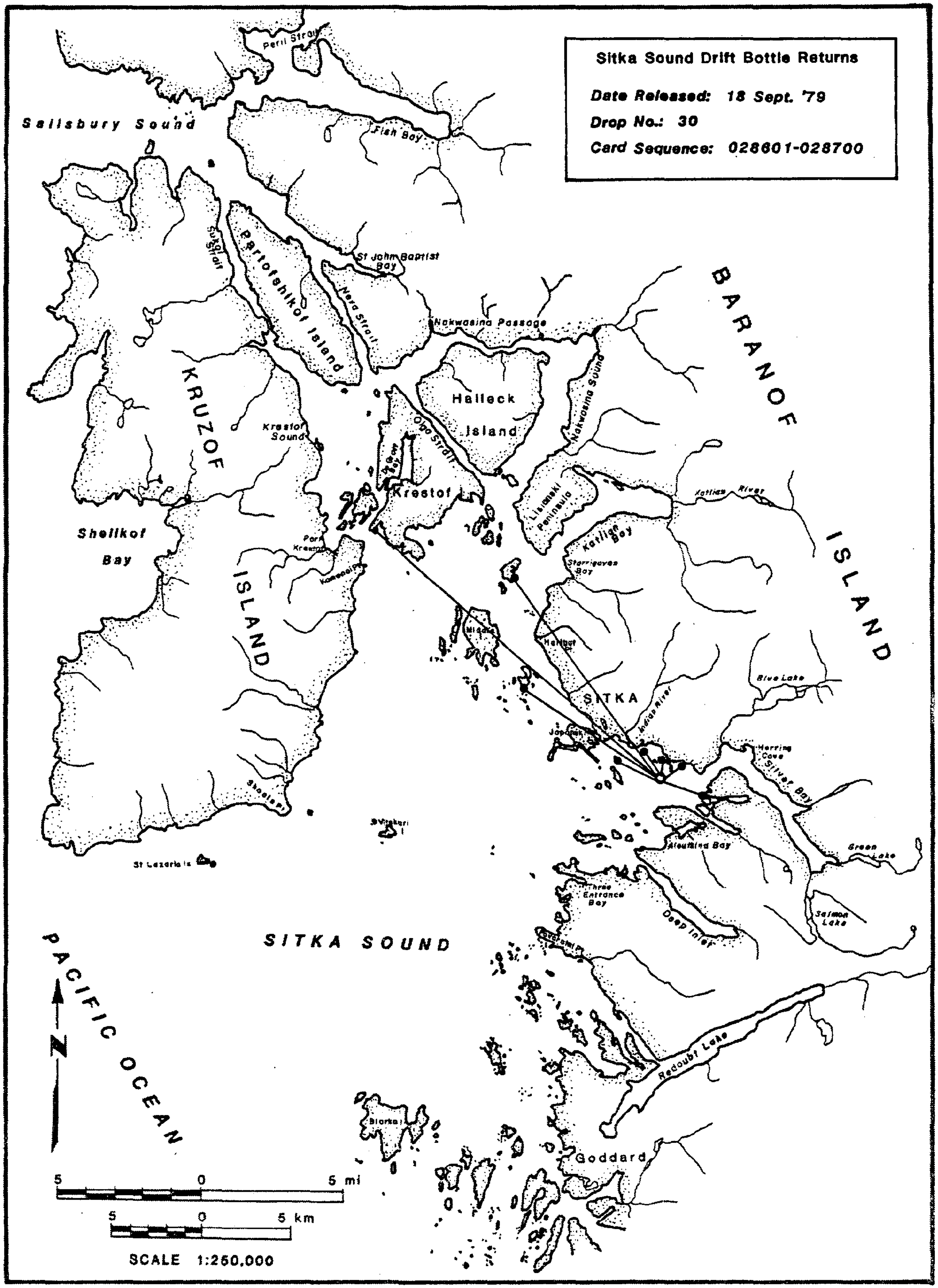

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 26
Card Sequence: 027601-027700
Salisbury Sound
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF
ISLAND
KRUZOF
ISLAND
Krestof Sound
Halleck Island
Olga Strait
Krestof I.
Nakwasina Sound
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
Port Krestof
Middle I.
Halibut Pt.
SITKA
Indian River
Blue Lake
Herring Cove
Silver Bay
Japonski I.
St Lazaria Is
Aleutkina Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

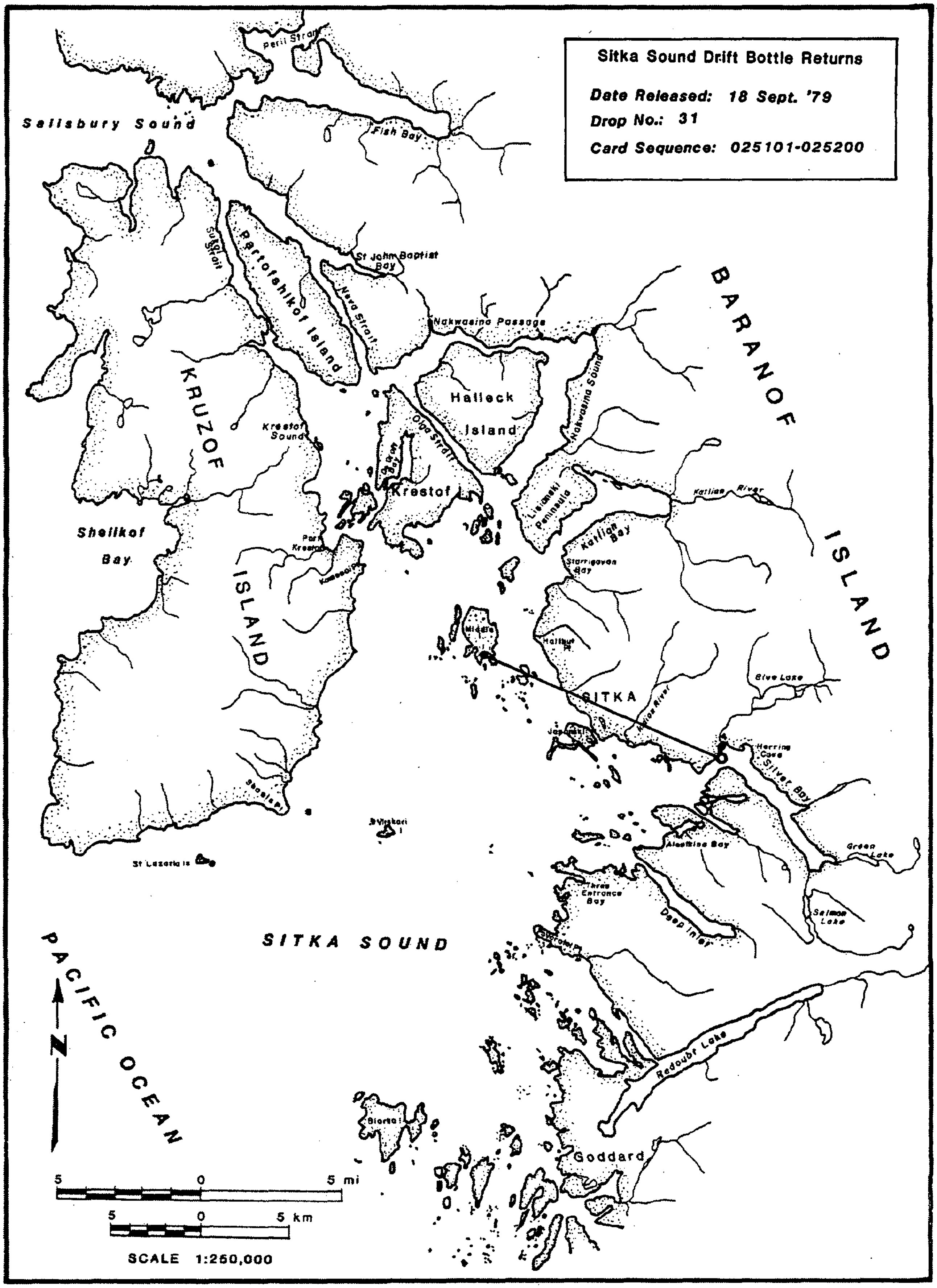

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 27
Card Sequense: 030501-030600
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Neva Strait
Partofshikof Island
Nakwasina Passage
Halleck Island
Nakwasina Sound
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Olga Strait
Krestof I.
Shelikof Bay
Port Krestof
Katlian River
Katlian Bay
Starrigavan Bay
Halibut Pt.
SITKA
Indian River
Blue Lake
Japonski I.
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Three Entrance Bay
Deep Inlet
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

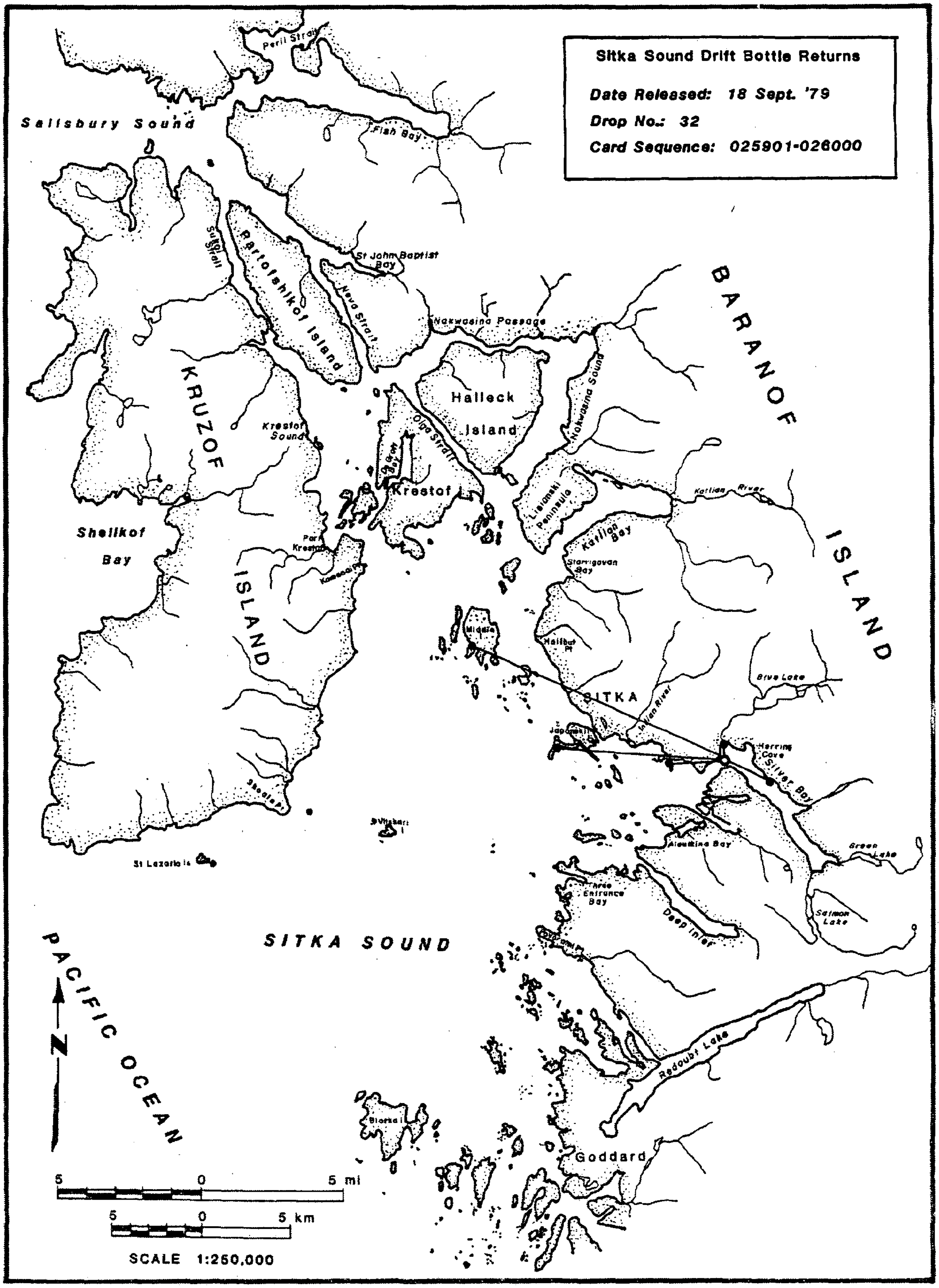


Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 28
Card Sequence: 029901-030000
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Sukoi Strait
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Halleck Island
Olga Strait
Krestof
Nakwasina Sound
Lisianski Peninsula
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
Halibut Pt
SITKA
Indian River
Blue Lake
Japonski I
Herring Cove
Silver Bay
Aleutkina Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Biorka I
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

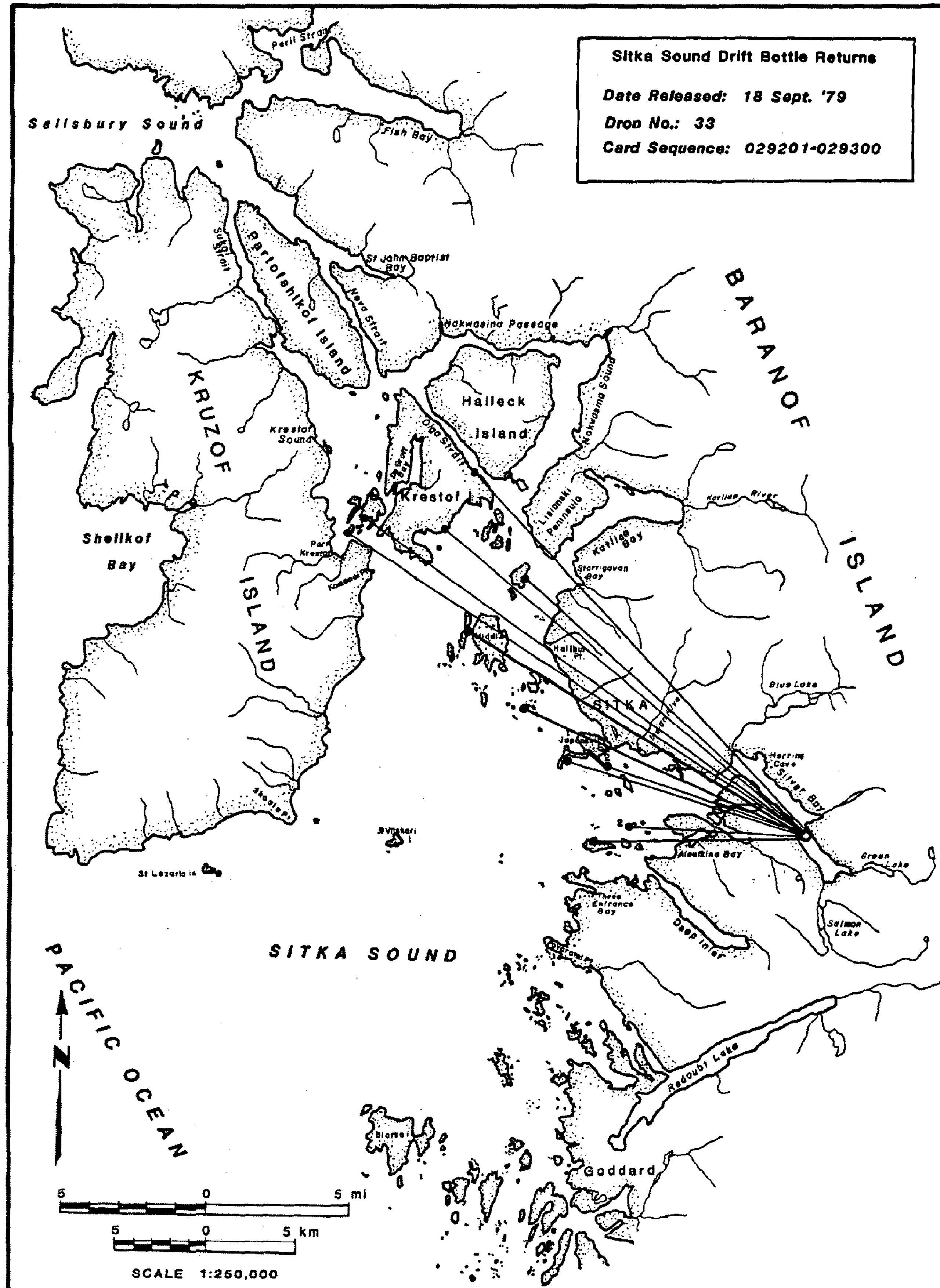

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 29
Card Sequence: 028901-029000
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
Nakwasina Sound
Halleck Island
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Olga Strait
Krestof
Shelikof Bay
Katlian Bay
Katlian River
Starrigavan Bay
Middle
SITKA
Indian River
Blue Lake
Japonski I
Herring Cove
Silver Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Goddard
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

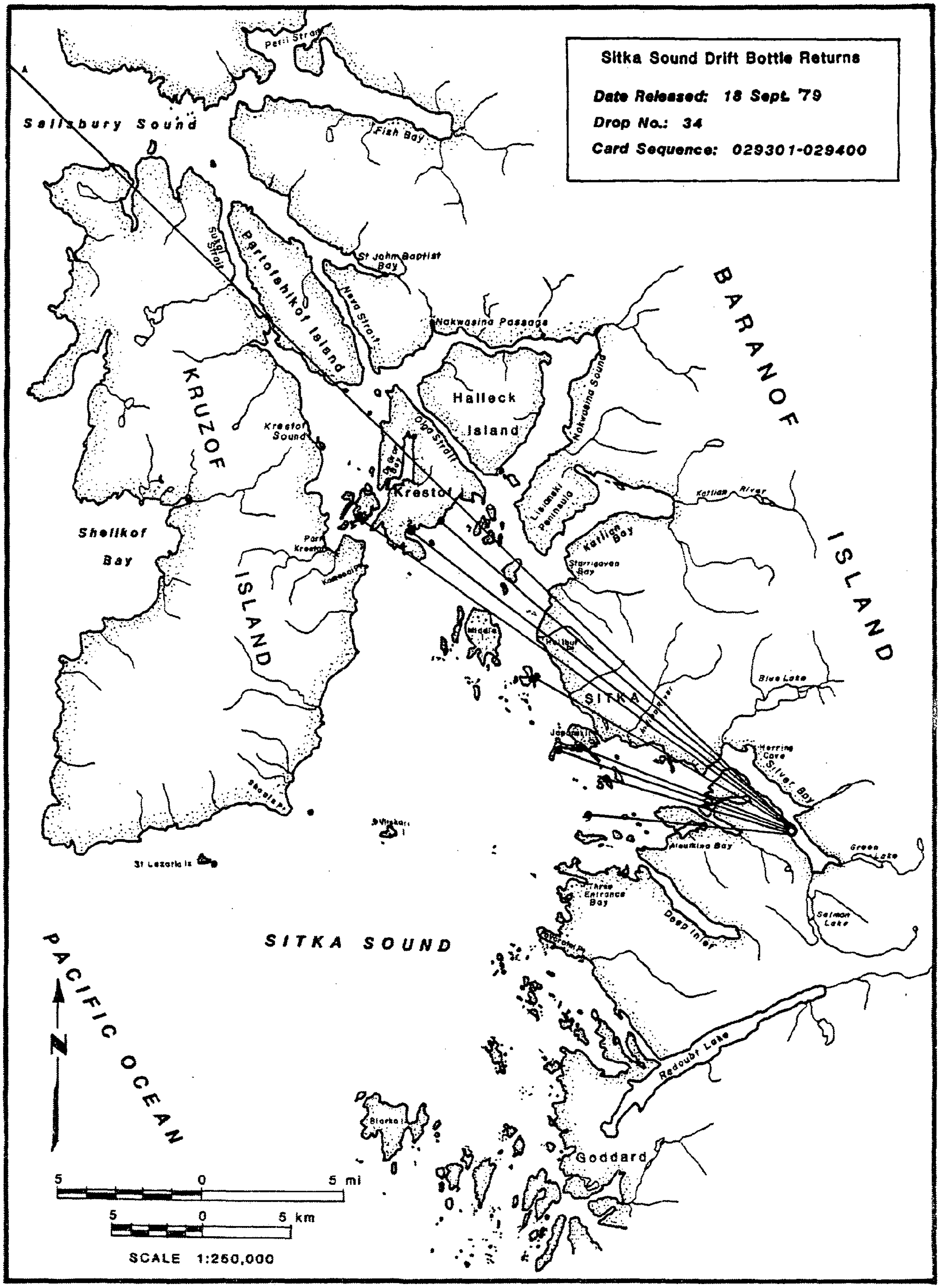

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 30
Card Sequence: 028601-028700
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Neva Strait
Nakwasina Passage
KRUZOF
ISLAND
Krestof Sound
Halleck Island
Olga Strait
Krestof
Nakwasina Sound
BARANOF
ISLAND
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
SITKA
Blue Lake
Indian River
Herring Cove
Silver Bay
Green Lake
Salmon Lake
Three Entrance Bay
Deep Inlet
Redoubt Lake
Goddard
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

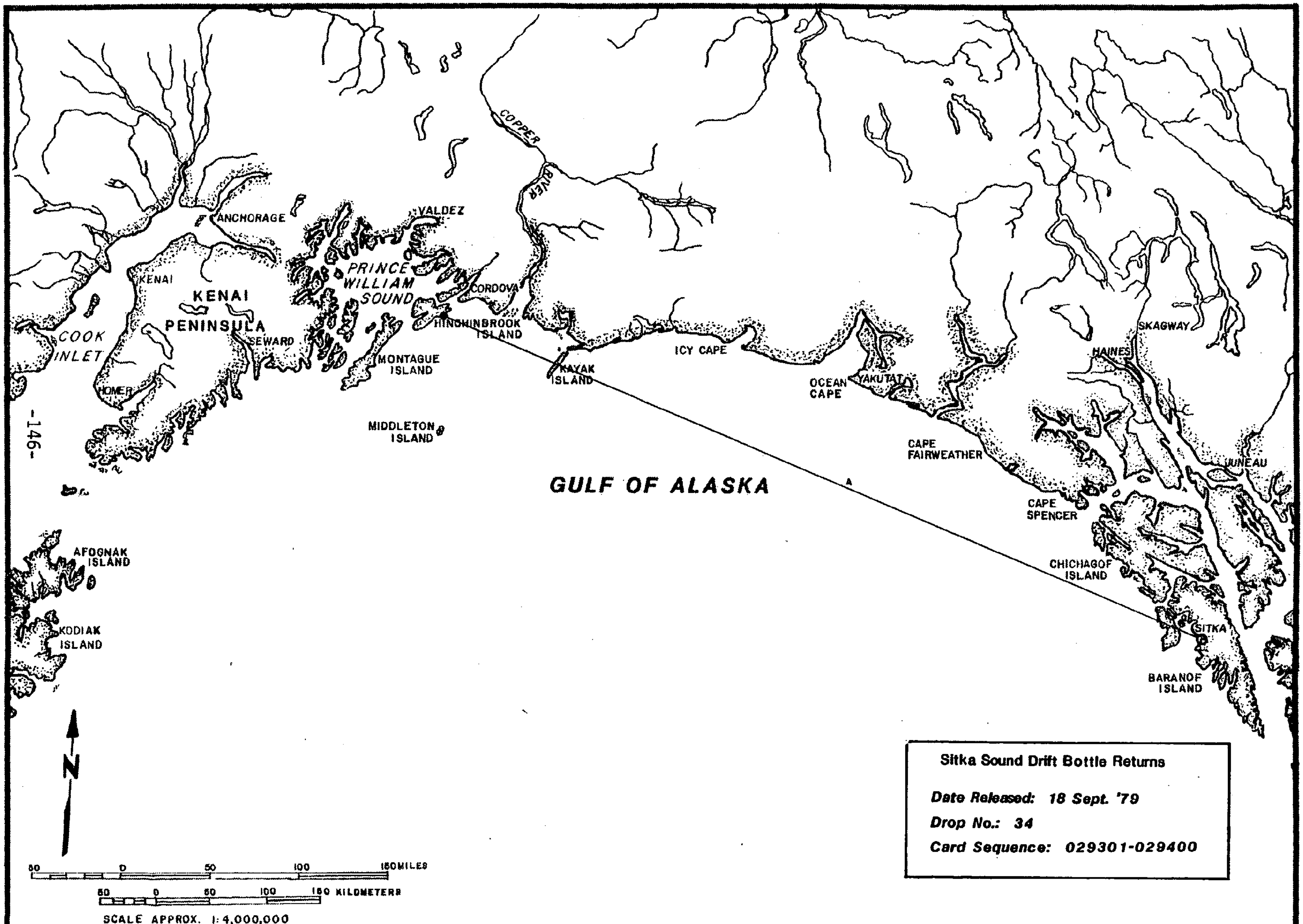

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 31
Card Sequence: 025101-025200
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Nakwasina Passage
Neva Strait
Rakofsky Island
KRUZOF
ISLAND
BARANOF
ISLAND
Halleck Island
Olga Strait
Nakwasina Sound
Krestof Sound
Krestof
Shelikof Bay
Katlian River
Katlian Bay
Starrigavan Bay
Port Krestof
SITKA
Herring Cove
Silver Bay
Blue Lake
Green Lake
Salmon Lake
Deep Inlet
Three Entrance Bay
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Goddard
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000

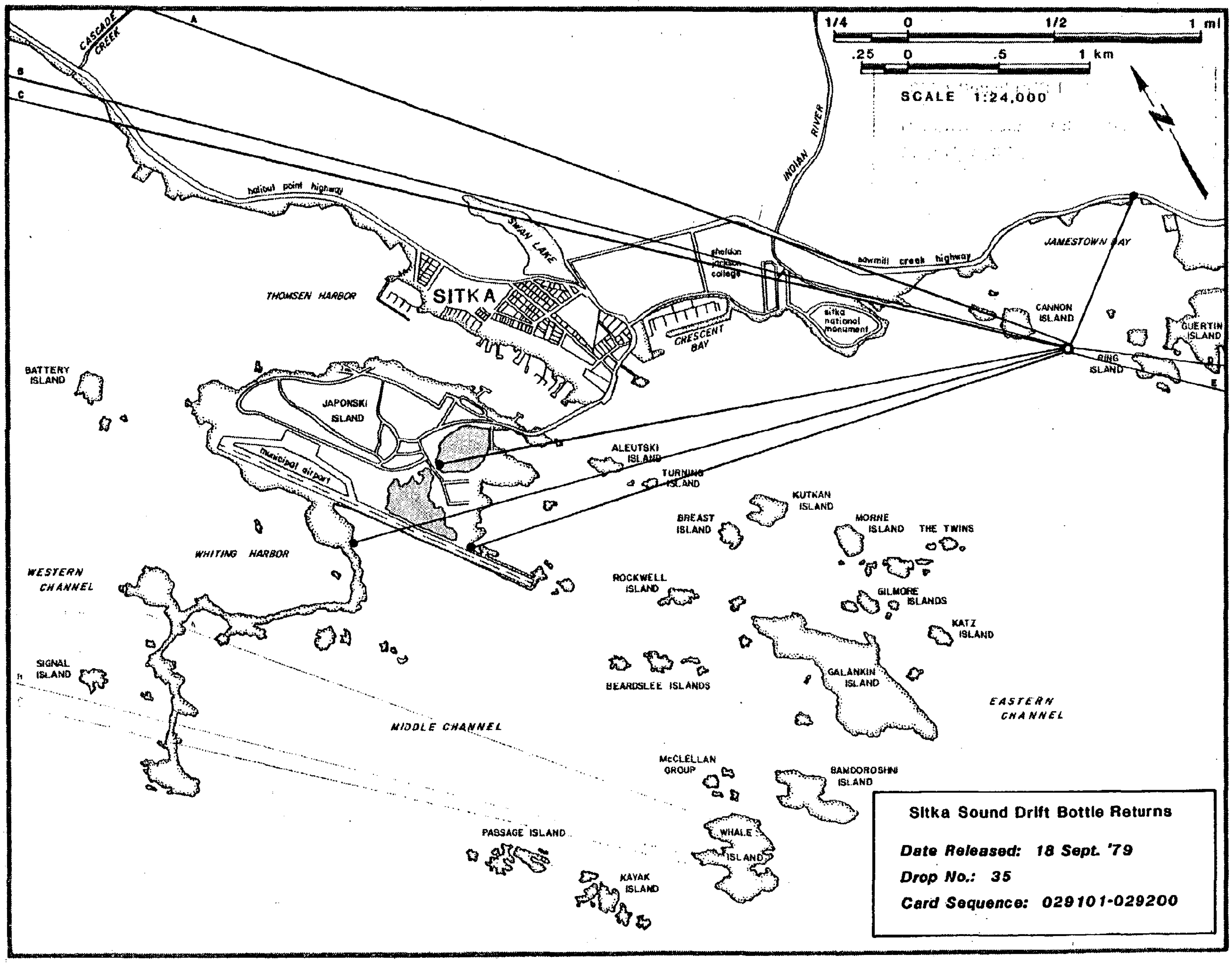


Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 32
Card Sequence: 025901-026000
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Neva Strait
Partofshikof Island
Nakwasina Passage
Nakwasina Sound
Halleck Island
BARANOF ISLAND
KRUZOF ISLAND
Krestof Sound
Olga Strait
Krestof I.
Lisianski Peninsula
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
Port Krestof
Middle I
Halibut Pt
SITKA
Indian River
Blue Lake
Japonski I
Herring Cove
Silver Bay
Aleutkina Bay
Green Lake
St Lazaria Is
Three Entrance Bay
Deep Inlet
Salmon Lake
SITKA SOUND
PACIFIC OCEAN
N
Redoubt Lake
Biorka I
Goddard
5 0 5 mi
5 0 5 km
SCALE 1:250,000

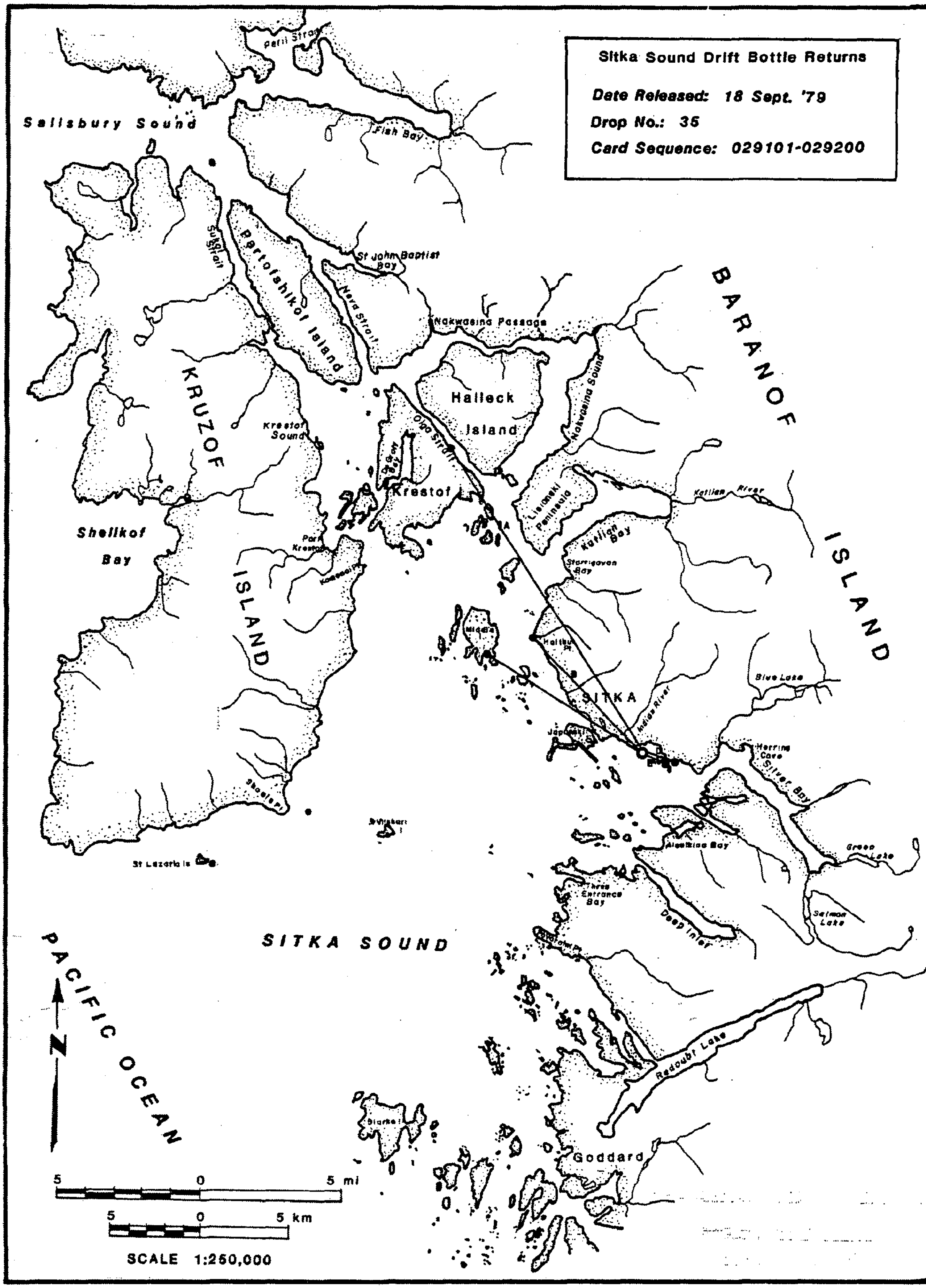

Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 33
Card Sequence: 029201-029300
Salisbury Sound
Peril Strait
Fish Bay
St John Baptist Bay
Neva Strait
Partofshikof Island
Nakwasina Passage
BARANOF
ISLAND
KRUZOF
ISLAND
Halleck Island
Olga Strait
Krestof Sound
Krestof I.
Nakwasina Sound
Lisianski Peninsula
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
Port Krestof
Halibut Pt.
SITKA
Blue Lake
Herring Cove
Silver Bay
Aleutkina Bay
Green Lake
Salmon Lake
Three Entrance Bay
Deep Inlet
St Lazaria Is
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Goddard
N
5 0 5 mi
5 0 5 km
SCALE 1:250,000


Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 34
Card Sequence: 029301-029400
Salisbury Sound
Fish Bay
St John Baptist Bay
Partofshikof Island
Neva Strait
Nakwasina Passage
BARANOF
ISLAND
Halleck Island
Nakwasina Sound
KRUZOF
ISLAND
Krestof Sound
Olga Strait
Krestof
Lisianski Peninsula
Katlian River
Katlian Bay
Starrigavan Bay
Shelikof Bay
Port Krestof
SITKA
Blue Lake
Herring Cove
Silver Bay
Aleutkina Bay
Green Lake
Three Entrance Bay
Deep Inlet
Salmon Lake
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Goddard
St Lazaria Is
5 0 5 mi
5 0 5 km
SCALE 1:250,000


Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 34
Card Sequence: 029301-029400
GULF OF ALASKA
ANCHORAGE
VALDEZ
KENAI
KENAI PENINSULA
PRINCE WILLIAM SOUND
CORDOVA
COPPER RIVER
HINCHINBROOK ISLAND
SEWARD
COOK INLET
HOMER
MONTAGUE ISLAND
KAYAK ISLAND
ICY CAPE
OCEAN CAPE
YAKUTAT
SKAGWAY
HAINES
JUNEAU
MIDDLETON ISLAND
CAPE FAIRWEATHER
CAPE SPENCER
CHICHAGOF ISLAND
SITKA
BARANOF ISLAND
AFOGNAK ISLAND
KODIAK ISLAND
N
50 0 50 100 150 MILES
50 0 50 100 150 KILOMETERS
SCALE APPROX. 1:4,000,000



Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 35
Card Sequence: 029101-029200
SCALE 1:24,000
1/4 0 1/2 1 mi
.25 0 .5 1 km
N
SITKA
CASCADE CREEK
halibut point highway
sawmill creek highway
SWAN LAKE
INDIAN RIVER
sheldon jackson college
sitka national monument
CRESCENT BAY
THOMSEN HARBOR
JAMESTOWN BAY
CANNON ISLAND
GUERTIN ISLAND
RING ISLAND
JAPONSKI ISLAND
municipal airport
BATTERY ISLAND
ALEUTSKI ISLAND
TURNING ISLAND
KUTKAN ISLAND
BREAST ISLAND
MORNE ISLAND
THE TWINS
WHITING HARBOR
WESTERN CHANNEL
ROCKWELL ISLAND
GILMORE ISLANDS
KATZ ISLAND
SIGNAL ISLAND
BEARDSLEE ISLANDS
GALANKIN ISLAND
EASTERN CHANNEL
MIDDLE CHANNEL
McCLELLAN GROUP
BAMDOROSHNI ISLAND
WHALE ISLAND
PASSAGE ISLAND
KAYAK ISLAND


Sitka Sound Drift Bottle Returns
Date Released: 18 Sept. '79
Drop No.: 35
Card Sequence: 029101-029200
Salisbury Sound
Fish Bay
St John Baptist Bay
Nakwasina Passage
BARANOF ISLAND
KRUZOF ISLAND
Halleck Island
Krestof Sound
Krestof I.
Shelikof Bay
Katlian Bay
SITKA
Blue Lake
Silver Bay
Deep Inlet
SITKA SOUND
PACIFIC OCEAN
Redoubt Lake
Goddard
St Lazaria Is
5 0 5 mi
5 0 5 km
SCALE 1:250,000