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Sampling Locations for Intertidal Biota and Preliminary Observations of Habitats at some British Columbia Estuaries

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C. D. Levings, W. M. Pomeroy and R. Prange

Pacific Environment Institute, West Vancouver, B. C.

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C.D. Levings, W.M. Pomeroy,[1] and R. Prange[1]

Environment Canada
Fisheries and Marine Service
Pacific Environment Institute
West Vancouver, B.C.

[1]Department of Botany
University of British Columbia
Vancouver, B.C.

TABLE OF CONTENTS

ABSTRACT

Sampling locations for intertidal biota and visual observations of habitats are presented for twelve estuaries on the coast of British Columbia, namely: Indian River, Skwawka River (Jervis Inlet), Toba River, Homathko River (Bute Inlet), Klinaklini River (Knight Inlet), Quatse River (Port Hardy), Bella Coola River, Link River (Ocean Falls), Kitimat, Skeena River (partial), Cayeghle and Teeta Creeks (Neroutsos Inlet), and Somass River (Alberni Inlet). The work is an enlargement on CFAV LAYMORE and CSS VECTOR cruise reports. Judging from the taxonomic composition of their dominant fauna and flora, certain estuaries are heavily influenced by freshwater processes, while others are mainly affected by marine events. The effects of industrial development are noted at certain estuaries.

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INTRODUCTION

Information on estuarine biota in British Columbia is of considerable interest because of the potential impact of developing industry on these ecosystems. Because of the scarcity of flat land near tidewater in the province, the deltas created at the heads of some fjords are in demand. The estuarine communities at these deltas may be significant in food chains leading to commercial species such as salmon.

In the past two years, CFAV LAYMORE and CSS VECTOR have been used by the Pacific Environment Institute in studies of a number of the "fjord-head" deltas. The ships were used as bases for beach work and most sampling was completed from rubber boats or by walking on the beaches at low tide. The cruises have been directed toward obtaining data on intertidal estuarine fauna (especially gammarid amphipods, *Anisogammarus* spp.) and flora at undisturbed sites to compare with the disrupted estuary at Squamish, at the head of Howe Sound. Since Howe Sound is a "high-runoff" inlet (Pickard, 1961), we have been especially interested in estuaries with similar characteristics, namely those with relatively large rivers fed by glacial melt water. We have, however, also visited estuaries characterized by small freshwater discharges or with low suspended loads.

The present report provides visual observations and details of sampling locations for the cruises. The detailed information resulting from the work will be presented in future publications and theses.

Summaries of information available on some of the physical aspects of certain estuaries have been presented elsewhere (Marles et al, MS, 1973). These summaries were useful for the Pacific Regional Board Working Group on Estuaries, Environment Canada. Our report is, in part, a submission to assist this Working Group.

It is to be noted that all comments and conclusions in this report are tentative, until numerical data are available.

FORMAT FOR RESULTS

Six estuaries that we have sampled are of interest to the Estuary Working Group, and exact station locations are shown on figures for these sites. These estuaries are: Indian, Homathko, Quatse (Port Hardy), Bella Coola, Kitimat, Skeena (partial) and Somass. Some of us have also worked at the Squamish and Fraser estuaries, and these data are reported elsewhere (Levings, MS, 1973; Lim and Levings, MS, 1973; Levings, 1974; Levings and Coustalin, MS, 1975; Pomeroy and Stockner, MS, 1973; Pomeroy, MS, 1974). Some of our sampling activities are summarized in Table 1 and general locations are shown on the chart of the British Columbia coast in Figure 1.

INDIAN RIVER (Fig. 2)

March 26 1973 (LAYMORE)

Eleven stations were sampled on a transect extending through the center of this delta. The intertidal zone of the delta was characterized by mussels (*Mytilus edulis*) and barnacles (*Balanus glandula*), which indicates the estuary is dominated by marine processes. Sedge (*Carex* sp.) and unattached *Fucus* sp. (rockweed) were observed in the middle and upper intertidal zone, while the lower intertidal area was mainly mud, with patches of sand. Soft-shell clams (*Mya arenaria*) were noted

in moderate abundance, and some were collected for heavy metal analyses (Environmental Protection Service request). Amphipods (*Anisogammarus* sp.) were not abundant on the tide flats, but were taken in vertical hauls at the LAYMORE anchorage. Judging from the composition of the fauna, this estuary is dominated by marine processes.

In situ salinometer measurements were made at a number of stations in the estuary. Surface salinities were low (< 10^{o}/oo) over a wide area at the head of the inlet.

The fauna of the Indian River estuary did not appear to be affected by man's activities at the time of our sampling. Pilings and old dock structures indicate log booming activity in times past, but faunal degradation was not observed in these areas. Log storage activities were underway on the south side of the estuary in deep water, off the tide flats.

SKWAWKA RIVER (JERVIS INLET) (Fig. 3).

FEBRUARY 15 1973 (LAYMORE)

On the west bank of the Skwawka River delta, a large expanse of sand/gravel, covered with mussels (*M. edulis*), barnacles (*Balanus cariosus*), and rockweed (*Fucus* sp.) was observed. An embankment with overhanging sedge rhizomes was noted, but an extensive search along the bank and in the sedge mat did not reveal amphipods in abundance.

Samples were obtained on a transect which extended from the high intertidal zone to the low-tide level of that night. This transect cut through an extensive oyster bed (*Crassostrea gigas*), in which barnacles (*B. cariosus*) and mussels were also noted. Judging from the composition of the fauna, this estuary is dominated by marine processes.

A number of stations were occupied at the inner estuary for temperature

and salinity data. Surface salinities generally ranged from 26 to 30°/oo, except very close to the river mouth, where fresh water was prominent. Three surface plankton tows were also completed at certain inner estuary stations, but amphipods were no obtained in the samples. An oceanographic station was occupied at the LAYMORE anchorage.

TOBA RIVER (Fig. 4).

OCTOBER 5, 6 1972 (VECTOR)

The sedge marsh on the west side of the delta accounted for about one-third of the delta. Barren sand and gravel flats characterized most of the central and east side. The ratio of the area of the sedge marsh to the non-vegetated lower tide flats was less than 1. Shoreline surveys were completed, but the sedge rhizome habitat for amphipods was not common. Few *Anisogammarus* spp. were observed, but isopods (*Gnorimosphaeroma* sp.) were abundant. Horizontal plankton tows were completed at 3 stations over the tide flats at high tide.

Surface salinities at the anchor station were high (25 to 30°/oo) and rapid fluctuations in salinity were observed. A deep-water dock was being constructed near the mouth of the Tahumming River, which also enters the head of Toba Inlet.

August 13, 14 1974 (LAYMORE)

The Toba River was in freshet, and Toba Inlet waters were milky some distance from the head of the fjord. An oceanographic cast was completed near the delta front.

Six intertidal quadrats were completed, all in the western sector of the delta which is, in part, a muddy channel leading to a logging camp. This channel is used for barge transport. Polychaetes and bivalves were

abundant in the muddy sand.

The delta of the Toba River was experiencing considerable sedimentation owing to river freshet. Algal species diversity was low with the following being recorded: *Fucus* spp., *Enteromorpha* sp.,*Ulva* sp., *Vaucheria-Rhizoclonium* mat and *Navicula grevellei*. The former two species were restricted to the sand and mud flats at the delta front while the latter three were found in the upper intertidal areas near the sedge mats.

The macrophyte vegetation consisted of typical B.C. fjord-estuarine species and communities. The dominant species was *Carex lyngbyei*, a sedge, which formed a solid mat that ended abruptly in the higher intertidal. Interspaced among the sedge were other plant species (*Triglochin maritimum* and *Deschampia* sp.) which appeared at higher levels. The *Carex lyngbyei* community seemed to dominate over most of the delta. The standing biomass of this community was approximately 800 to 1000 gm dry weight per square meter.

HOMATHKO RIVER (BUTE INLET) (Fig. 5)

October 3, 4 1972 (VECTOR)

Shoreline surveys were completed on the west side of the delta, but the sedge rhizome habitat was not common. Amphipods (*Anisogammarus* spp.) were observed, but the isopod *Gnorimosphaeroma* sp. was absent. Horizontal plankton tows were completed at 4 inshore stations.

The sandy, lower tide flats were extensive, and trees are close to the high water line. The ratio of the area of the sedge marsh to the non-vegetated lower tide flats was less than 1. The delta of the Southgate River (head of Bute Inlet, west side) was also examined. The sedge marshes at the mouth of this river occupy a small area.

A 24-hour anchor station was completed off the mouth of the Homathko River, and Surface layers were characterized by low salinity and high turbidity.

March 31 1973 (LAYMORE)

On this occasion, observations centered on the Southgate estuary, since Fisheries Operations had indicated that extensive dredging was planned in that area.

Nine quadrats were obtained on a transect from 0.25 m above chart datum (O.D.) to 4.2 O.D. on the Southgate delta (Fig. 3). The sedge rhizome habitat was not observed on this transect, and organisms were generally sparse in the sandy sediments. Some amphipods (*Anisogammarus* spp.) were observed under logs and debris.

Five surface plankton tows were completed at the head of the inlet, and each yielded amphipods (*Anisogammarus confervicolus*) in moderate abundance. Tides were not appropriate for quantitative sampling near the Homathko River but some amphipods and many larval caddis flies (Insecta, Trichoptera) were observed.

August 15, 16 1974 (LAYMORE)

An oceanographic station was completed off the mouth of the Homathko, and a number of in situ salinity and temperature measurements were also made over the intertidal zone. Bute Inlet wax was present. The Homathko River was in freshet, and fresh water was prominent over most of the head of Bute Inlet.

Eight intertidal quadrats were sampled on the delta, which was characterized by coarse, sandy sediments. Few muddy substrates were observed. Bivalves (*Macoma* spp.) were the most prominent organisms observed, and al-

though some sedge rhizome habitat was present, amphipods (*Anisogammarus* spp.) were not abundant.

The following birds were observed in moderate numbers: dunlin, snipe, herring gull, Canada geese and eagles.

Algae were restricted to the upper intertidal areas at the margin of the sedge growth. *Ulva* sp., *Blidingia* sp., and *Pylaiella littoralis* were recorded. Biomass was low and primary production moderate. Considerable export of algae, primarily *Blidingia* sp., was evident.

This area was typical of B.C. fjord estuaries with respect to vascular plant communities. The number of species and communities were more numerous than those recorded on the Toba estuary. The *Carex lyngbyei* community was the most abundant and apparently the most productive, having about the same biomass as at the Toba estuary. On the west side of the delta there was a small community dominated by *Scirpus validus*. *Potentilla pacifica*, *Triglochin maritima* and *Deschanpsia caespitosa* were also quite common in the *C. lyngbyei* community and at higher elevations.

KLINAKLINI RIVER (KNIGHT INLET) (Fig. 6)

December 5, 6 1972 (LAYMORE)

The delta of the Klinaklini was very gently sloping, and the sedge rhizome habitat was not present. The ratio of sedge marsh to lower intertidal mud and sand is close to 1. Eight quadrat samples were obtained on a transect from about 0.2 m O.D. to 4.0 m O.D. in the middle sector of the estuary. Sampling was hampered by ice and snow. A few insect larvae were noted in the samples, but other organisms were not observed. The scarcity of fauna has been confirmed by laboratory sorting of these samples. Amphipods were absent from plankton tows at the oceanographic station.

Large numbers of waterfowl, including Canada geese (app. 100), mallard ducks (app. 500), and whistling swans (app. 12) were observed on the delta. About a dozen harbour seals were also observed in the estuary.

A twenty-four hour oceanographic station was occupied, but a north-east gale hampered operations for the first twelve hours. Surface salinities at the anchor station were high (25 - 30^{o}/oo). The salinity data showed that a "patch" of fresh water drifted by the ship during a lull in the gale.

A deep-water loading dock was present on the east side of the head of the inlet, which services a logging camp inland on the Klinaklini delta. None of these industrial operations appeared to have affected the intertidal zone of this delta.

QUATSE RIVER (PORT HARDY) (Fig. 7)

August 16, 17 1974 (LAYMORE)

The estuary of the Quatse River was dominated by marine processes, and most intertidal organisms were typical of quiet marine bays (e.g. *Thais* spp. (Gastropoda), *Cancer magister* (Decapoda), etc). Amphipods (*Hyale* spp.) were abundant under thick beds of the algae *Spongomorpha* sp. Eight intertidal quadrats were obtained. Sediments appeared to be recently deposited mud and sand from the Quatse River.

An oceanographic station was completed close to the entrance of the estuary. Salinities in the estuary were high (28 to 31^{o}/oo) and low salinity water from the river was barely detectable.

Sediments in the northwest sector of the estuary had recently been disrupted by construction of a boat harbour/breakwater, and there was some evidence of recolonization of the disrupted habitats.

The Quatse estuary is under marine influence, as evidenced by its flora. Large areas of mud flats in the lower and mid-intertidal areas were covered by mats of algae. These consisted primarily of *Spongomorpha* sp., *Pylaiella littoralis*, *Fucus* sp., *Pelvetiopsis* sp., *Rhodomella larix*, and *Ulva* sp. Filamentous diatom growths were recorded from the mid and upper intertidal areas. In the upper intertidal zone, the characteristic salt marsh plants *Salicornia* sp., and *Sueda* were present. *Fucus* spp. and *Pelvetiopsis* sp. were also abundant in this area.

Biomass was extremely high as was primary production. Export studies indicated benthic diatoms and *Spongomorpha* sp. to be the major algal species leaving the estuary. In comparison to other areas, export was relatively high. The Quatse system appears to be very productive, experiencing stable marine conditions for a good part of the year.

LINK RIVER (Ocean Falls Harbour, Cousins Inlet)

Studies at Ocean Falls have been primarily directed toward subtidal benthic communities, but some observations of the intertidal zone have been made.

July 19 to 24 1972 (LAYMORE)

On the north side of the Harbour, from close to the Martin River to the beginning of Ocean Falls townsite, intertidal sediments had recently been disrupted by road construction. Large boulders and rip-rap were observed in this area and few epifaunal organisms were growing on the rocks. Toward the townsite, the shoreline is less steep (under docks) and was characterized by mud-sand substrates. Rockweed (*Fucus* sp.) and mussels (*Mytilus edulis*) were noted in moderate abundance in this area.

On the south side of the Harbour, behind a log storage area, the shoreline was composed of gently sloping rocks, with some gullies of mud and sand. Some paper and wood fibres were noted, as were thick growths of a filamentous algae. Six quadrats were sampled on an intertidal transect in one of the crevices. Rockweed (*Fucus* sp.), mussels (*Mytilus edulis*), and amphipods (*Anisogammarus confervicolus*) and isopods (*Gnorimosphaeroma* sp.) were the dominant macroscopic organisms observed.

A large number of boomsticks, which formerly contained logs for the pulp mill, were examined in Ocean Falls Harbour. According to local residents, the boomsticks had been in place for up to twenty years. An interesting community of algae and animals was observed and sampled on these boomsticks. Among the algae, large numbers of amphipods (*Anisogammarus confervicolus)* and insect larvae (probably Chironomidae) were found. The presence of the insect larvae suggested that freshwater processes are dominant in the upper layers where the boomsticks float.

October 22 to 25 1973 (LAYMORE)

In collaboration with Environmental Protection Service personnel, mussels (*M. edulis*) were collected for zinc analyses. They were collected on both the north and south side of the harbour.

August 18, 19 1974 (LAYMORE)

The diversity of algae at Ocean Falls was quite low. In the areas under the influence of fresh water from the Link River dam, growth was restricted to the log boom and wharf areas. Large amounts of brown filamentous algae (*Pylaiella*) and filamentous diatoms were evident. Amphipods were commonly found in association with the algae, forming interesting communities changing in composition as distance from the dam outflow

increased.

Fucus sp., *Ulva* sp., and a filamentous green alga were located on the banks and rocks in the intertidal zone at about 0.4 km from the mill.

Export measurements indicated organic material as being higher below the fresh water lens from the dam outflow. Export from the log boom communities and rocky acreas appeared low in comparison to delta areas at Bute and Quatse.

Random macrophyte collections were made along the shore in the area of Ocean Falls. Estuarine plants such as *Carex lyngbyei* and *Potentilla pacifica* occur on the small delta created by the Martin River.

BELLA COOLA RIVER (Fig. 8)

October 25, 26 1973 (LAYMORE)

The delta of the Bella Coola River was characterized mainly by sand and cobble substrates, but some mud flats were observed in the eastern sector of the delta. Six quadrat samples were obtained near the middle of the delta, where the sediments are mainly sand and gravel. Sedge meadows (*Carex* sp.) were located in a narrow strip in the upper intertidal zone, and the ratio of marsh to sand flats was less than 1.

Benthic animals were sparse in the intertidal zone, which appeared to be dominated by freshwater processes. *Fucus* sp. (rockweed) was abundant in several areas, and amphipods (*Anisogammarus* spp.) were abundant under rotting logs but not under *Fucus*. Horizonal plankton tows were completed at six stations over the intertidal zone at high tide, but no amphipods were obtained in them. A diatom bloom was in progress, which clogged the plankton net. Copepods and ctenophores were abundant in the tows. Salinities at these stations ranged from 4 to 10^{o}/oo, and temperatures ranged

from 6.4 to 6.9°C.

Log booming, dredging, and wharf construction have disrupted the intertidal habitat on the east side of the estuary.

KITIMAT RIVER (Fig. 9)

August 20, 21 1974 (LAYMORE)

The western sector of the Kitimat delta has been disrupted by construction of an aluminum plant, loading docks, log storage, and a forest products loading dock. The intact portion of the Western sector, adjacent to the forest products dock, was characterized by sand containing large numbers of bivalves (*Macoma* spp.). *Fucus* sp. (rockweed) was observed on debris (logs, stumps) in this area. The middle and eastern sector, where rocks and cobbles composed the sediment, were covered with *Fucus* sp. which harboured dense populations of amphipods, especially *Anisogammarus locustoides*, *Anisogammarus* sp., and *Hyale* sp. Eleven intertidal quadrats were completed.

An oceanographic station was completed near the delta front, and 24-hour observations were also completed while the ship was docked. A number of in situ salinity and temperature measurements were completed, and surface salinities were not lower than 4 - 5 $^{o}/oo$, even though the Kitimat River was not in freshet. An east-west trend in salinities across the delta front was not observed. Very strong up-inlet winds were blowing at the time, which may have "locked" fresh water at the head of the fjord.

Benthic algae was virtually restricted to the upper intertidal areas at the edge of the sedge zone. *Fucus* spp., *Blidingia* sp., and *Ulva* sp. were recorded, with the former being most abundant. In the area adjacent to the river, little growth was evident.

Biomass tended to be high in the restricted area where algae occurred.

Export was the lowest of all areas studied. Since the area is open to strong winds, waves and current action, the substrates experience considerable abrasion and thus are relatively unstable habitats.

The Kitimat estuary has vascular plant vegetation similar to that recorded for Bute Inlet. The pioneer community is again *Eleocharis palustris* followed by a large community dominated by *Carex lyngbyei* with a high standing crop.

In summer, 1974, juvenile salmonids were sampled at the Kitimat estuary by biologists working for a private consulting firm (Howard Paish and Associates). These biologists report that young salmon were feeding extensively on the intertidal amphipods we observed.

WATERS ADJOINING PORPOISE HARBOUR, PRINCE RUPERT

(partially Skeena Estuary, Fig. 10)

August 22 to 24 1974 (LAYMORE)

Studies at this area were directed toward an examination of the effect of pulp mill effluent on intertidal amphipods. Since the habitats we sampled are influenced to some degree by the discharge of the Skeena River, our activities are reported herein.

On the west side of Ridley Island, adjacent to Chatham Sound, six intertidal quadrats were completed in the vicinity of the sulfite liquor outfall. Intertidal organisms were totally absent on the beach adjacent to the effluent pipeline, except in the high intertidal zone where a few amphipods (F. Talitridae) were observed. At stations on Bishop Rock, less than 0.4 km from the outfall, "normal" littoral communities (including *Balanus cariosus; Littorina sitkana, Anisogammarus* sp. etc.) were observed.

An oceanographic station was completed from the LAYMORE anchorage.

Porpoise Harbour and adjoining shores of Wainwright Basin, on the west side of Ridley Island, were also examined. Fifteen quadrat samples were obtained.

On a small islet at the northwest corner of Porpoise Harbour, intertidal animals were very abundant. The small islet is exposed to air only on lower tides. Organisms observed in large numbers included amphipods (*Anisogammarus*, primarily *Locustoides*), polychaetes (F. Polynoidae), isopods (*Lygia* sp.), gastropods (*Littorina* sp.) and decapod crabs (F. Paguridae). Where the effluent discharge line leaves the water on the east shore of Ridley Island, freshwater organisms (insect larvae) were noted, suggesting that leakage of effluent from the line may be frequent.

In the southwest sector of Wainwright Basin, adjacent to the sulfate waste discharge, oligochaetes probably (F. Enchytraeidae) were the only intertidal organisms observed. These worms were incredibly abundant under slate slabs on the beach. Amphipods (*Anisogammarus* spp. and *Hyale* spp.) were present under algae and wood debris at stations further distant.

Algal growth in the area of the sulfite liquor outfall (west side Ridley Island) was very restricted. *Enteromorpha* sp. was recorded on logs in the upper intertidal but growth in other areas was lacking. At Bishop Rock good growths of *Fucus* sp., *Enteromorpha* sp., *Rhodamella* sp., *Ulva* sp., and *Gigartina* sp., were noted.

Benthic algae in Porpoise Hourbour were typical of natural marine communities of sheltered bays. The dominant species were *Fucus* spp., *Odonthalia floccosa*, *Laurencia* sp., *Enteromorpha* sp., *Ulva* sp., filamentous and mud diatom communties. In the area where the outflow pipe leaves the water and goes onto land, large growths of green algae were recorded. *Enteromorpha intestinalis*, *Enteromorpha* sp., *Ulva lactuca*, and very well

developed algal mats of *Vaucheria* and *Rhizoclonium* plus blue-green algae were most common. This would suggest leakages of fresh water, leaving the area in a brackish state.

Algal growth in Wainwright Basin, where the sulfate waste outfall is located, was very restricted. In the immediate area of the discharge, blue-green algae and bacterial growths were noted on the rocks. Growth at the opposite end of the basin was primarily *Enteromorpha intestinalis*, very abundant in upper intertidal areas suggesting freshwater input. In the same area there were large amounts of purple sulfur bacteria growing on the surface of the mud. Growth of algae in protected bays consisted of moderate amounts of *E. intestinalis*, *Ulva* sp., and *Fucus* spp.

NEROUTSOS INLET (Fig. 11)

August 26, 27 1974 (LAYMORE)

Studies at Neroutsos were also directed toward pulp mill pollution and amphipods. However, the estuaries of two small creeks were examined in the course of our work at Neroutsos, and the observations are related to the main theme of this report.

Twelve intertidal quadrats were obtained on the beaches at Neroutsos. The intertidal communities along the southern half of the inlet were remarkable. The shoreline fauna was bizarre, dominated by oligochaetes (probably F. Enchytraeidae), nemerteans, small nudibranchs (*Alderia modesta;* Mollusca, Opisthobranchia), arachnids (Acarina, Pseudoscorpionida), and a wide variety of winged, adult insects.

The estuary of Teeta Creek (about halfway up Neroutsos Inlet on the west shore) was characterized by thick algal mats with dense populations of nudibranchs, oligochaetes, and horseflies. Sediments were mainly mud,

with coarse sand in the creek bed.

Intertidal communities at the estuary of Cayeghle Creek, at the head of the inlet, were also bizarre. Pseudoscorpions, insects, oligochaetes, and dipteran flies were the dominant fauna. After considerable searching one polychaete (F. Nereidae) and a few isopods (some *Gnorimosphaeroma* spp.) were also observed. Sediments were mainly sand adjacent to the creek mouth but were muddy in the eastern sector of this stream's delta.

Three oceanographic stations were occupied in the southern portion of the inlet, and oxygen values were very low (< 2 mg L^{-1}) in surface layers. In situ salinity observations were made at the head of the inlet, off Cayeghle Creek, and surface salinities were generally high (25 to 32^{o}/oo). A small patch of low salinity water was detected near the mouth of the creek.

Growths of intertidal benthic algae at the head of the inlet were extremely heavy. The dominant algae was *Entermorpha intestinalis,* which was especially heavy where creeks entered. Growth of *Rhodomela larix, Ulva* sp., and *Fucus* spp. were evident along the *Entermorpha* on the seaward side of the pulp mill at Port Alice. Both in the area of the mill and towards the delta of Cayeghle Creek, *E. intestinalis,* algal mats of *Vaucheria, Rhizoclonium* and filamentous blue-green algae predominated. Purple sulfur bacteria were also evident. Green algae accounted for approximately 95% of the alga biomass in the Neroutsos Inlet area.

Primary production was high and export from the delta quite low. In general, the inlet appears very productive and in fact showed the highest algal biomass of any area studied on the cruise, possibly due to nutrient enrichment (ammonia) from the pulp mill.

SOMASS RIVER (ALBERNI INLET) (Fig.12)

August 28, 29 1974 (LAYMORE)

Ten intertidal quadrats were obtained between Sproat Narrows and Alberni. "Typical" intertidal biota such as barnacles were sparse at most sample sites, and mussels were not observed at any location. Amphipods (*Anisogammarus* spp.) appeared to increase in abundance toward the head of the inlet. These organisms were noted in large numbers among algae (*Spongomorpha* sp.) on logs near the mouth of China Creek.

Intertidal animals on the mud/sand flats at the mouth of the Somass River were sparse. Amphipods were present in moderate abundance under wood debris, but bivalves and polychaetes were noticeably absent. Amphipods were also moderately abundant in algae (diatoms) growning on log debris on the north side of the estuary.

Alberni Inlet was generally low in benthic algal growth. The area around China Creek had reasonably heavy growths of *Spongomorpha* sp. on logs plus some *Fucus* sp. and *Enteromorpha* sp. on the sandy beach.

Growth on the Somass River Delta at the head of the inlet was extremely sparse in most places, consisting of *Enteromorpha* sp. on rocks. A sand/mud bar in front of the dock area showed relatively heavy growths of algal mats (*Rhizoclonium* sp., and blue-green filaments). Its presence seemed out of context for the generally barren delta and may be related to an outfall from the dock area.

Marsh vegetation on the delta was primarily grasses and *Eleocharis* sp.

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Table 1. Summary of sampling activities at 12 B.C. estuaries, October 1972 to August 1974

Estuary	Sampling Dates	Number of Quadrats for Fauna	Leveling[1]	Outer[2] Estuary Hydrography	Inner[3] Estuary Hydrography
Indian	March 26 1973	11	no	yes	yes
Skwawka (Jervis Inlet)	February 15 1973	8	no	yes	yes
Toba	October 5,6 1972 August 13,14 1974	6	yes	yes	yes
Homathko (Bute Inlet)	October 3,4 1972 March 31 1973 August 15,16 1974	13	yes	yes	yes
Klinaklini (Knight Inlet)	December 5,6 1972	8	no	yes	no
Quatse (Port Hardy)	August 16,17 1974	8	yes	yes	yes
Bella Coola	October 25,26 1973	6	no	yes	yes
Link (Ocean Falls)	July 19-24 1972 August 18,19 1974	6	no	yes	yes

Table 1. Continued

Kitimat	August 20,21	1974	11	yes	yes	yes
Skeena (Partial)	August 22-24	1974	21	yes	yes	no
Cayeghle, Teeta (Neroutsos Inlet)	August 26,27	1974	6	yes	yes	yes
Somass (Alberni Inlet)	August 28,29	1974	6	yes	no	no

1. Sampling locations located in vertical and horizontal plane using an engineer's transit.
2. Water column profiles from ship at anchor seaward of the "drop-off" of the delta.
3. Observations made at high tide from a rubber boat over the tide flats.

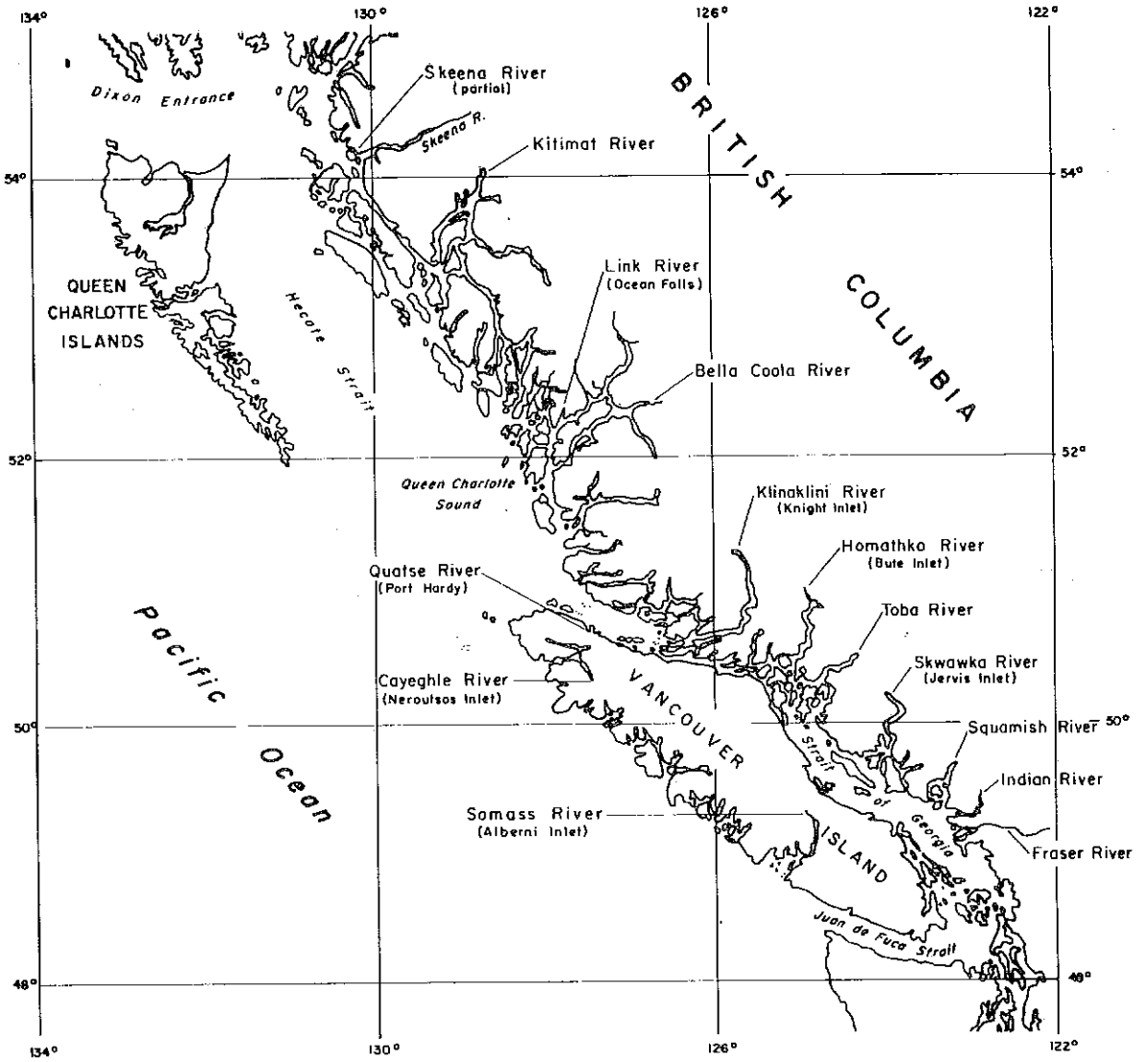

Figure 1. Chart of the British Columbia coast showing general locations of the estuaries examined, October 1972 to August 1974.

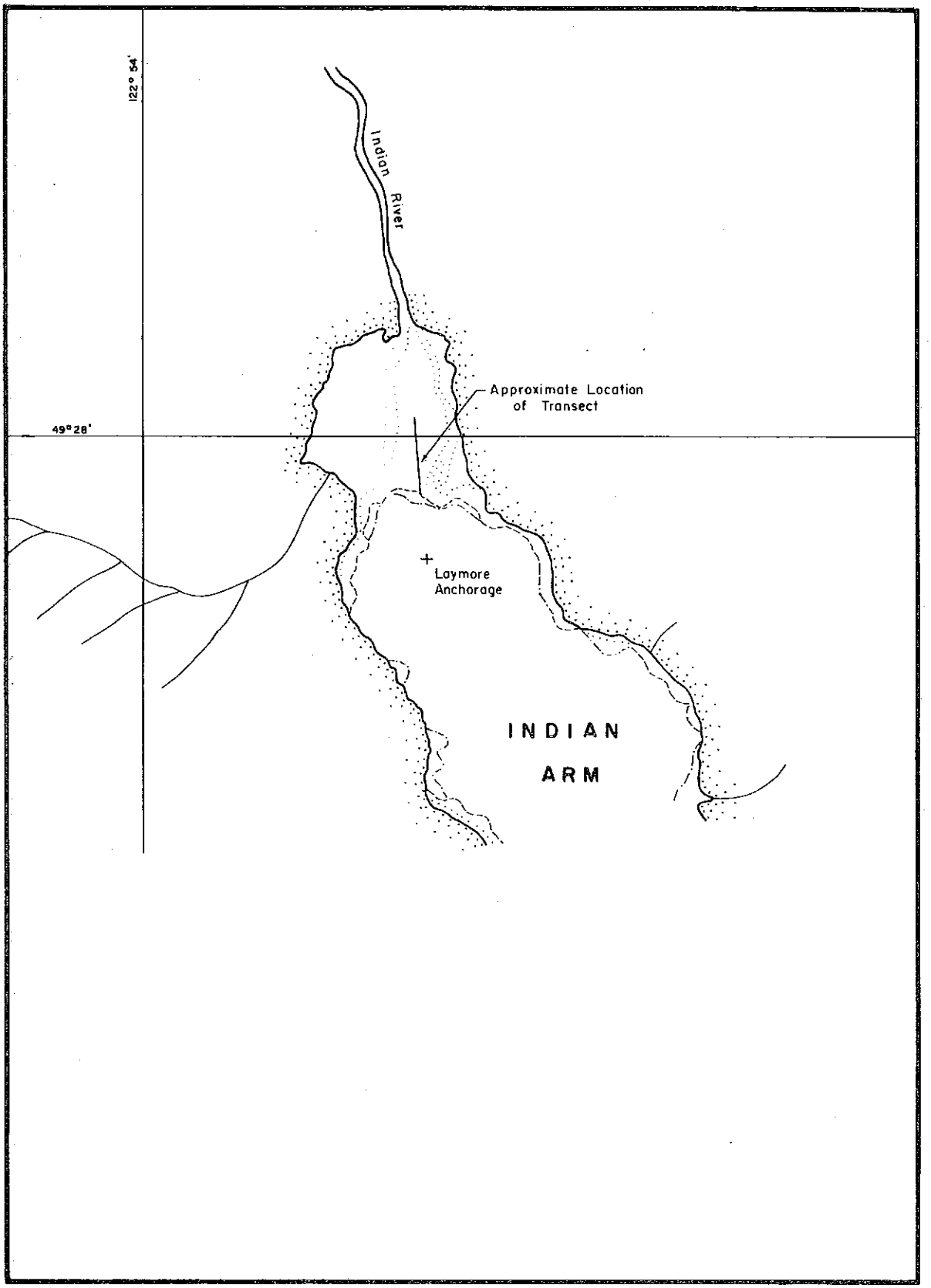

Figure 2. Chart of the Indian River estuary (from Canadian Hydrographic Chart No. 3435) showing sampling locations for intertidal biota (March 26 1973).

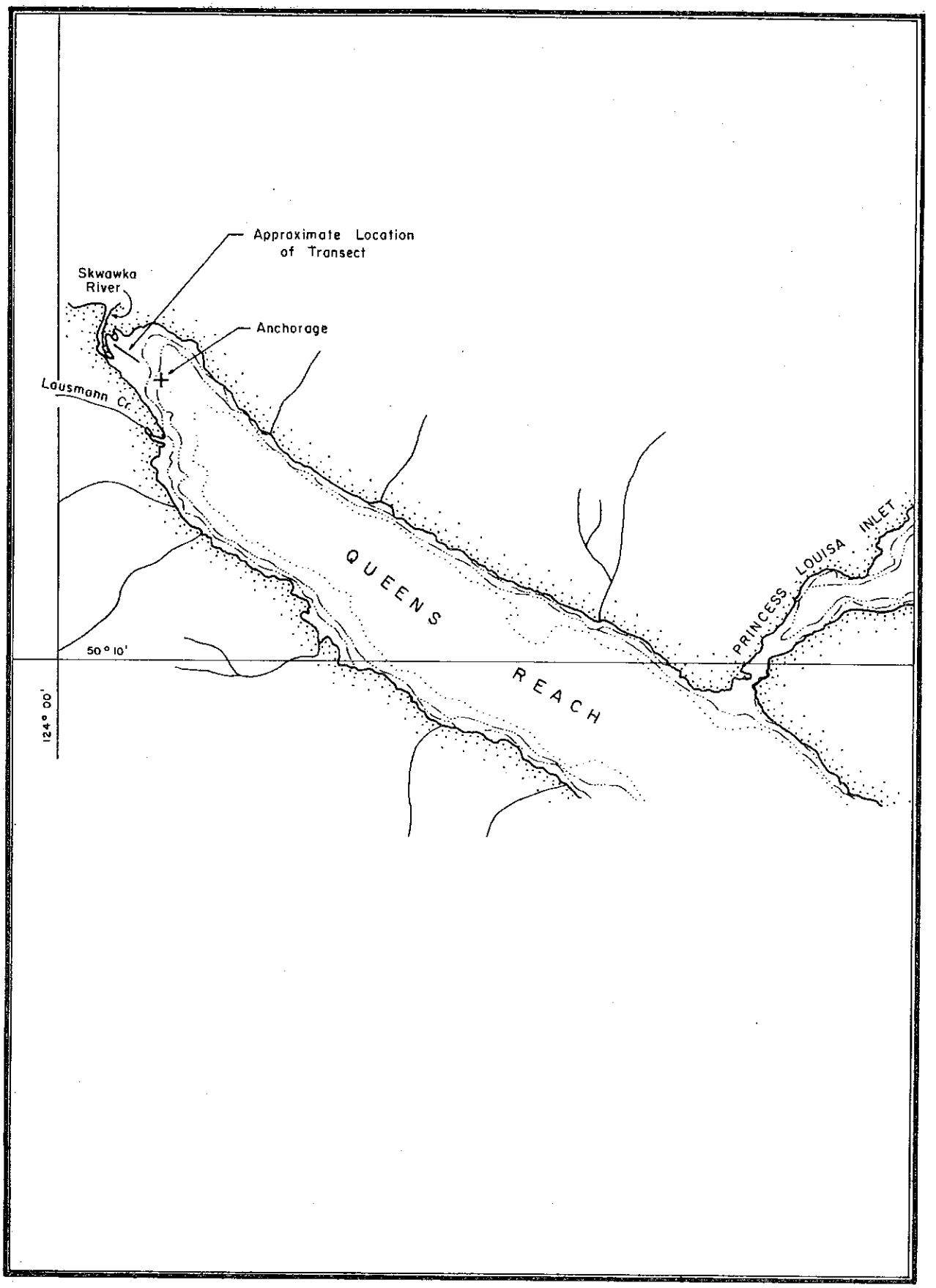

Figure 3. Chart of the head of Jervis Inlet (from Canadian Hydrographic Chart No. 3589) showing location of intertidal sampling (February 15 1973).

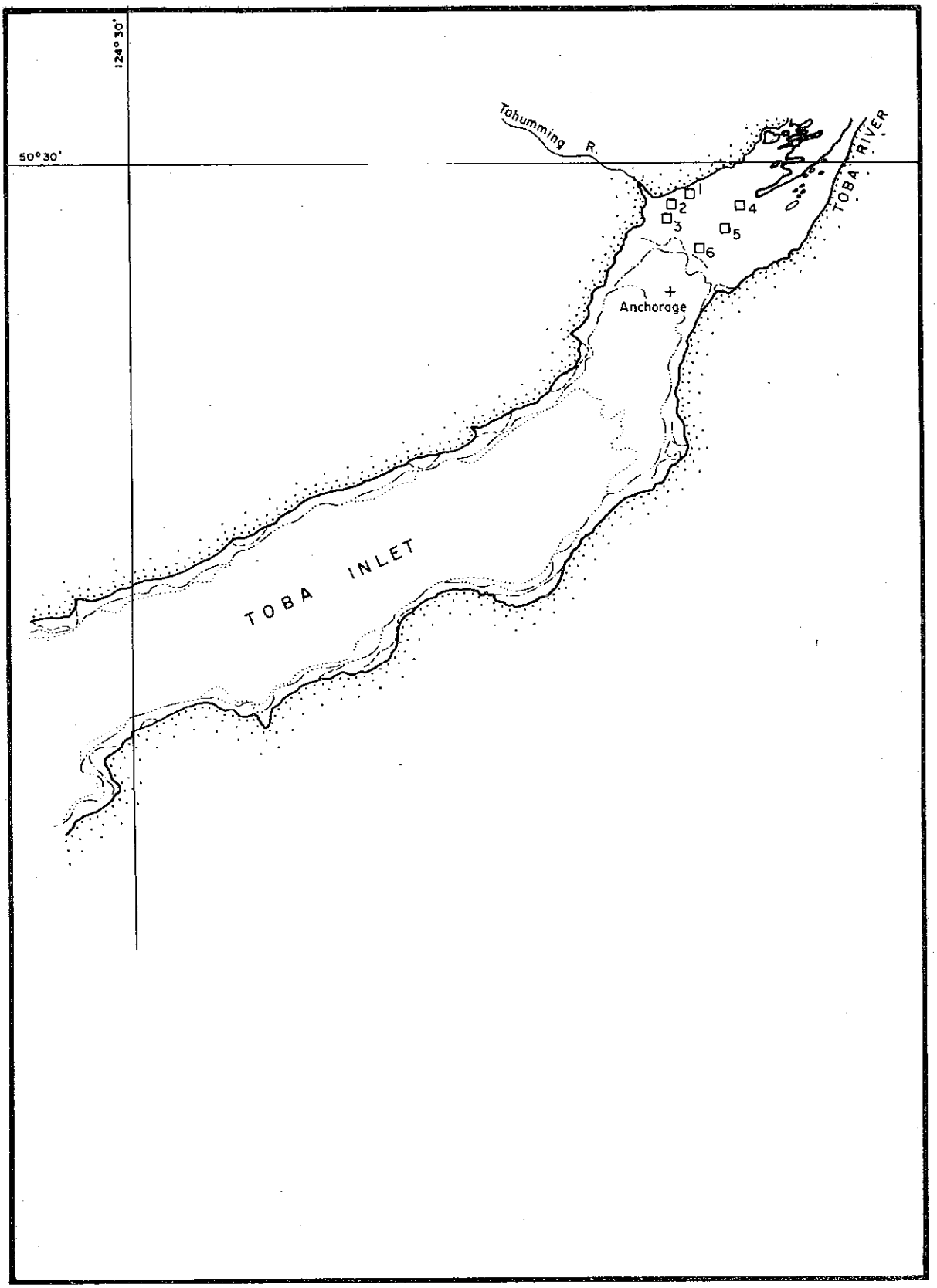

Figure 4. Chart of the Toba River estuary (from Canadian Hydrographic Chart No. 3594) showing location at intertidal sampling (October 5, 6 1972 and August 13, 14 1974).

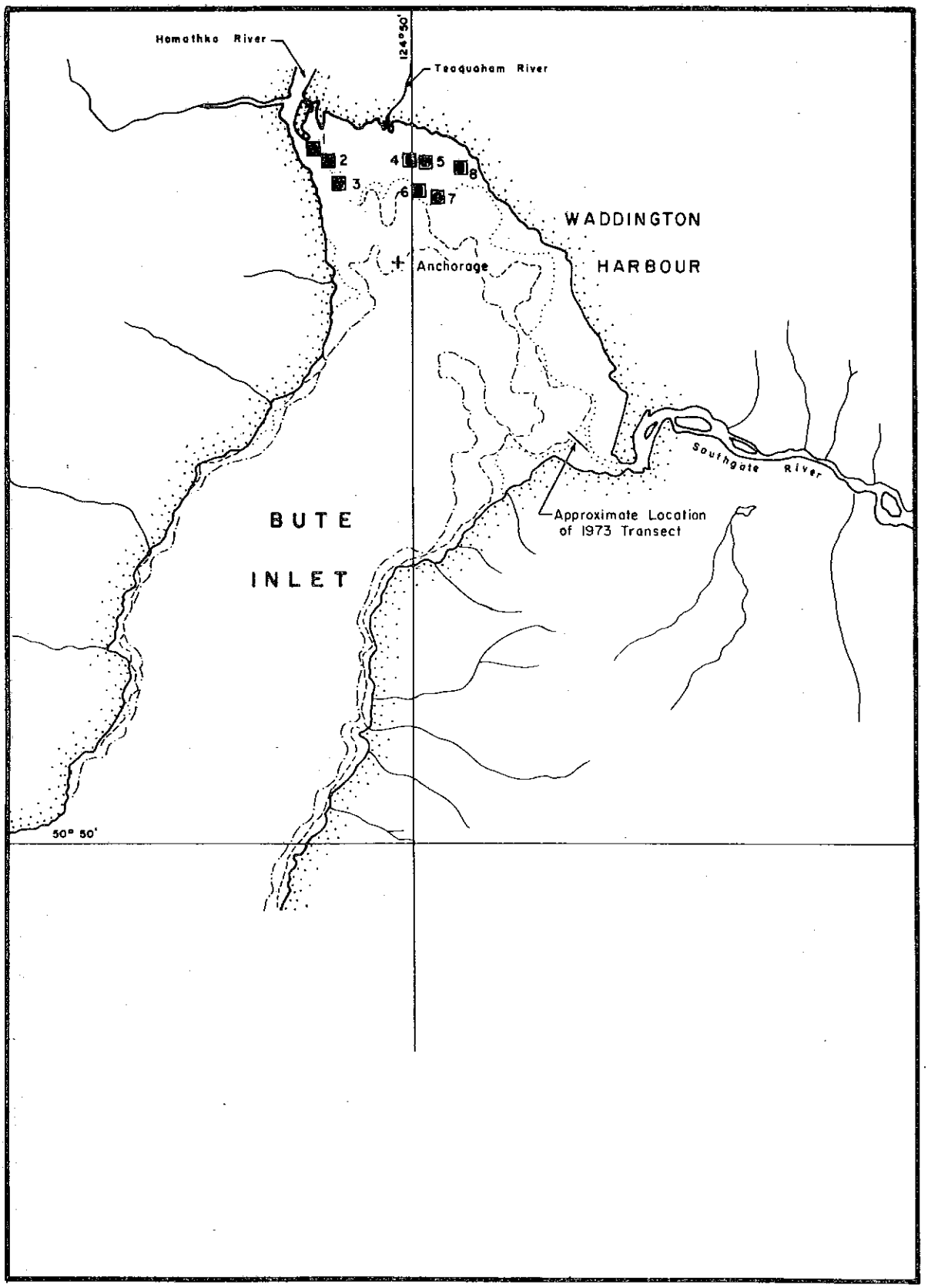

Figure 5. Chart of the head of Bute Inlet (from Canadian Hydrographic Chart No. 3524) showing sampling locations for intertidal biota. Biological observations on October 3, 4 1972 and August 15, 16 1974 were made near the Homathko estuary (solid squares). The transect on March 31 1973 was in the vicinity of the Southgate estuary.

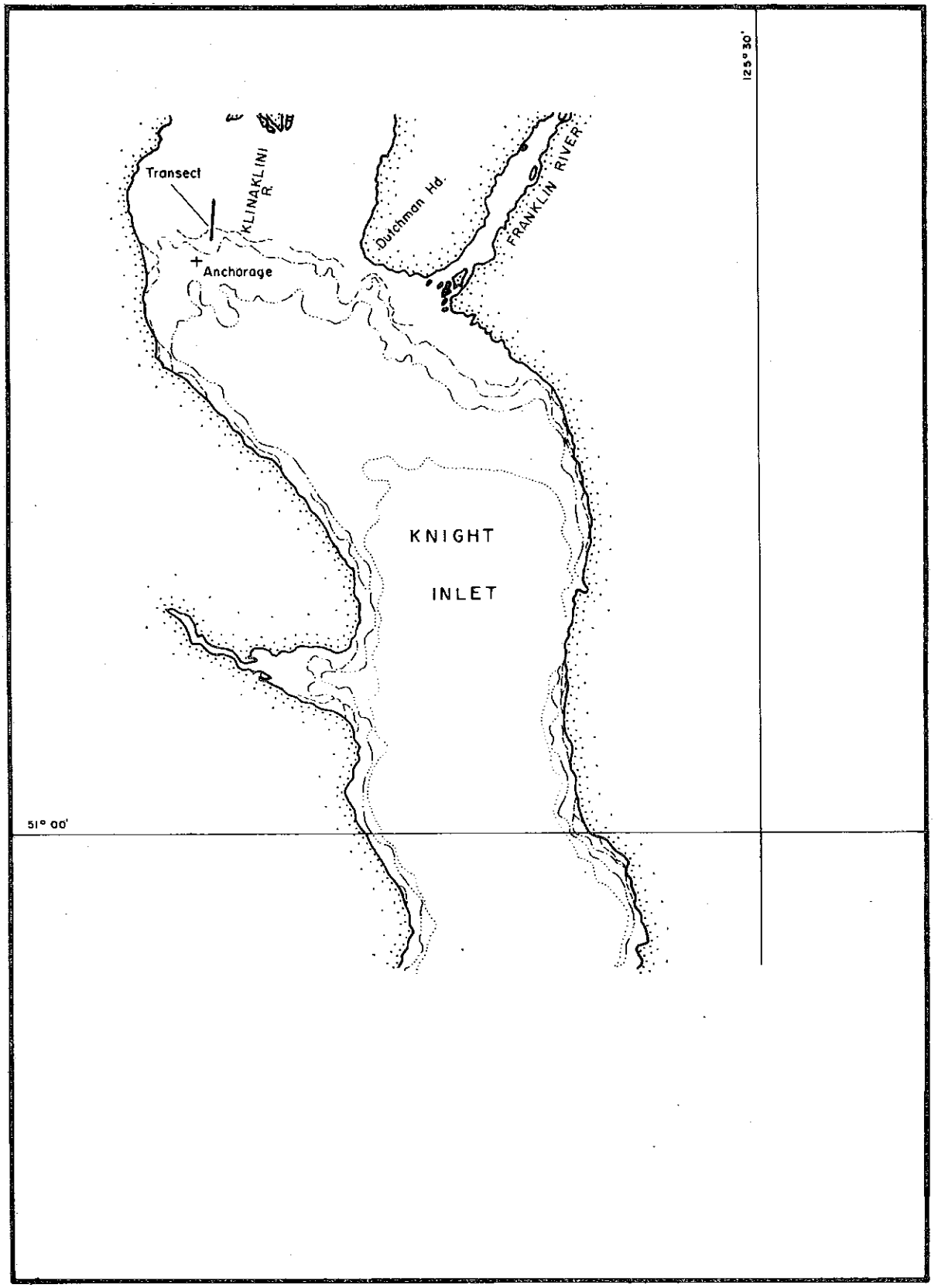

Figure 6. Chart of the head of Knight Inlet (from Canadian Hydrographic Chart No. 3578) showing locations from intertidal sampling (December 5, 6 1972).

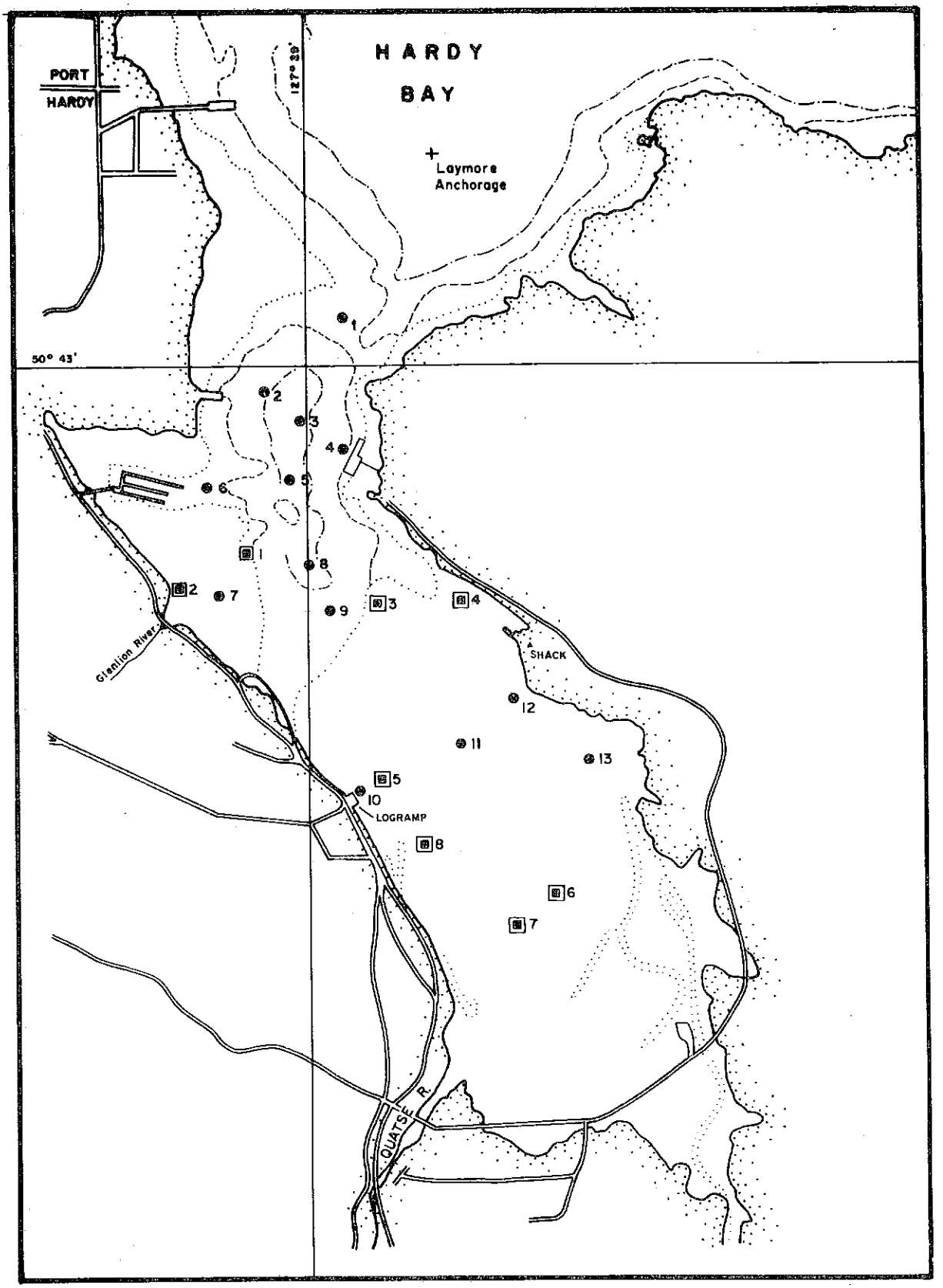

Figure 7. Chart of the Port Hardy area (from Canadian Hydrographic Chart No. 3572) showing sampling locations in the vicinity of the Quatse River estuary (August 16, 17 1974). Solid squares represent quadrat stations and solid circles stations for in situ salinity and temperature observations.

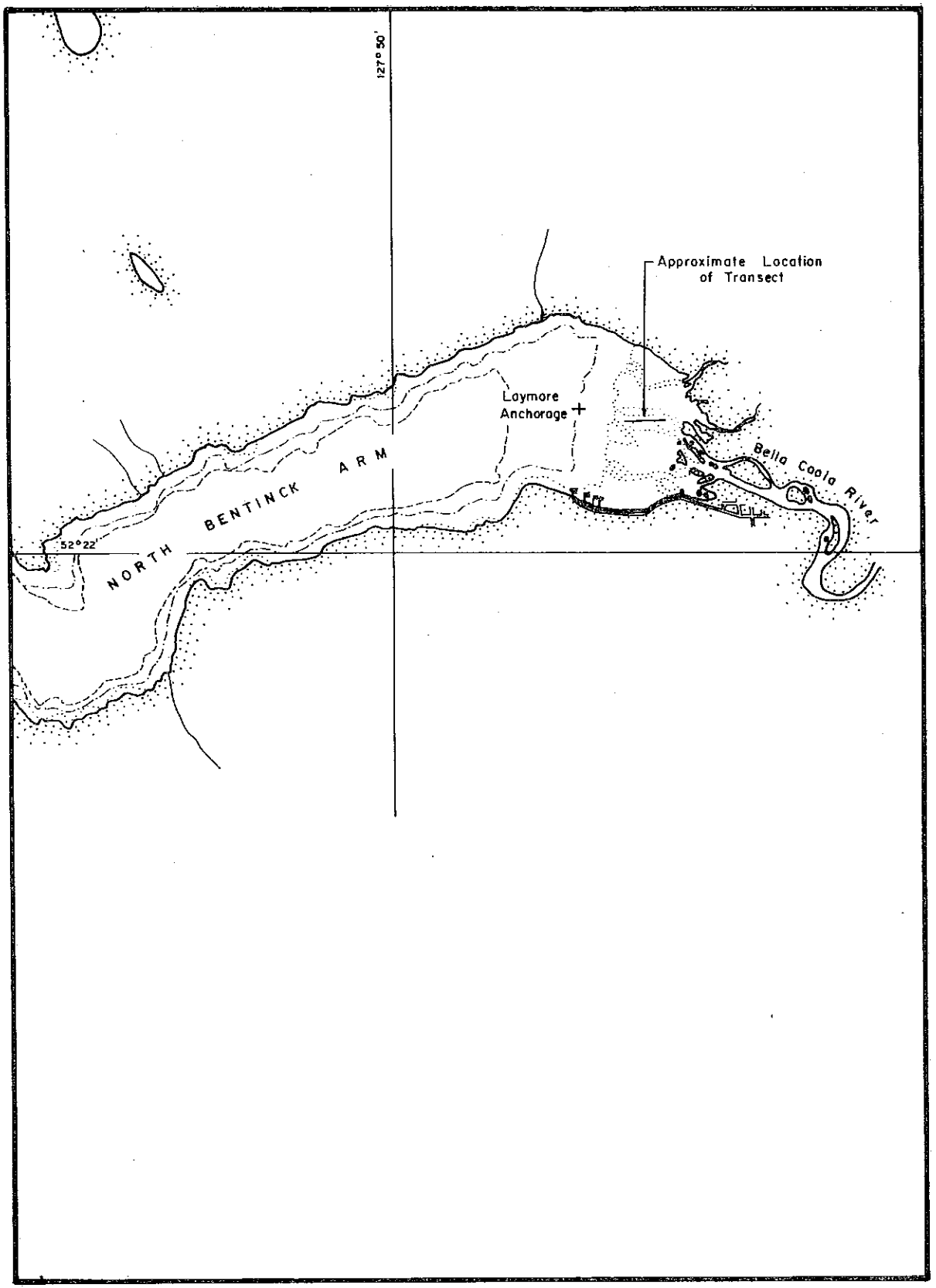

Figure 8. Chart of the Bella Coola River estuary (from Canadian Hydrographic Chart No. 3730) showing location of intertidal sampling (October 25, 26 1973).

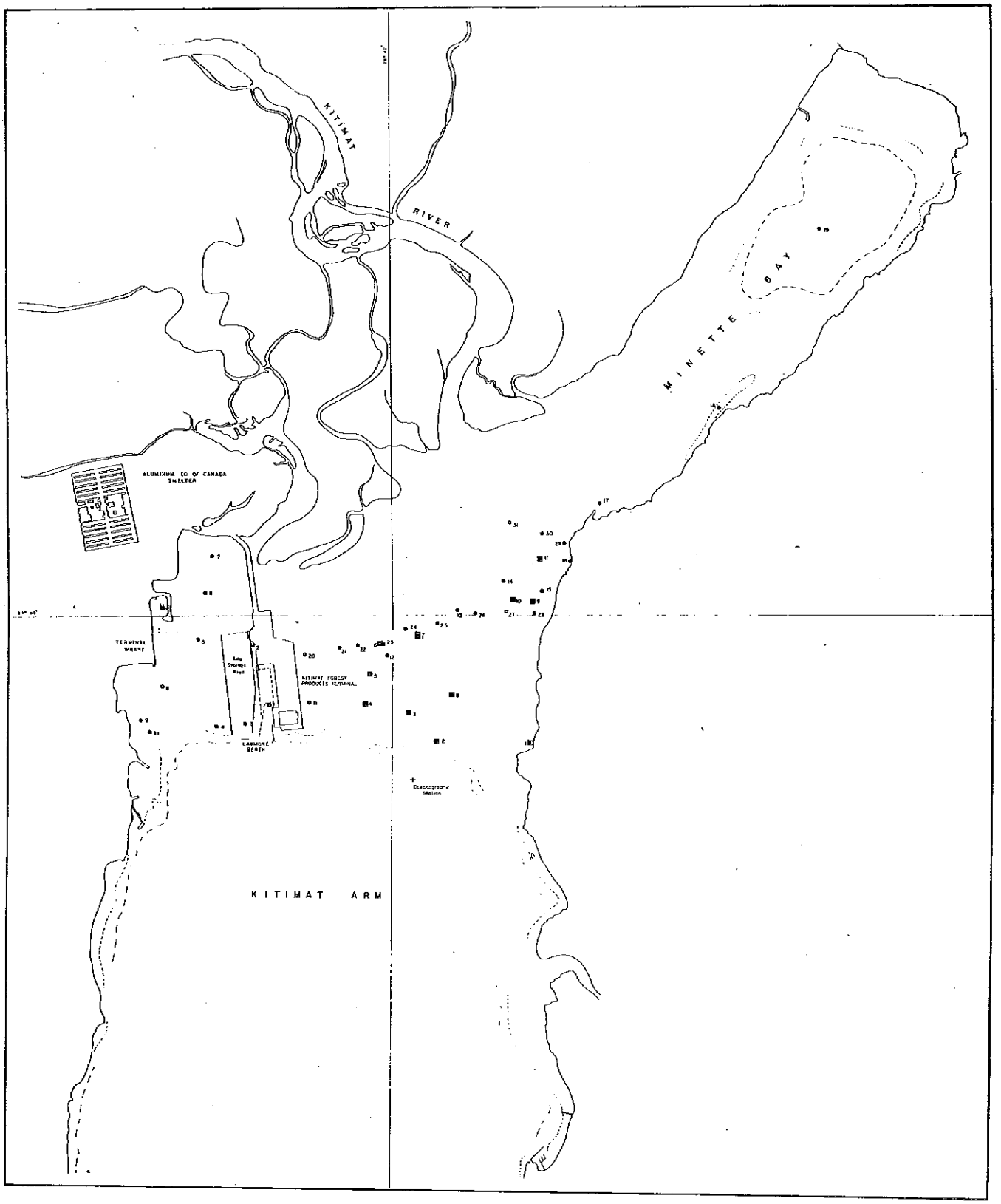

Figure 9. Chart of the Kitimat River estuary (from Canadian Hydrographic Chart No. 3736) showing sampling locations (August 20, 21 1974). Solid squares represent quadrat stations and solid circles stations for in situ salinity and temperature observations.

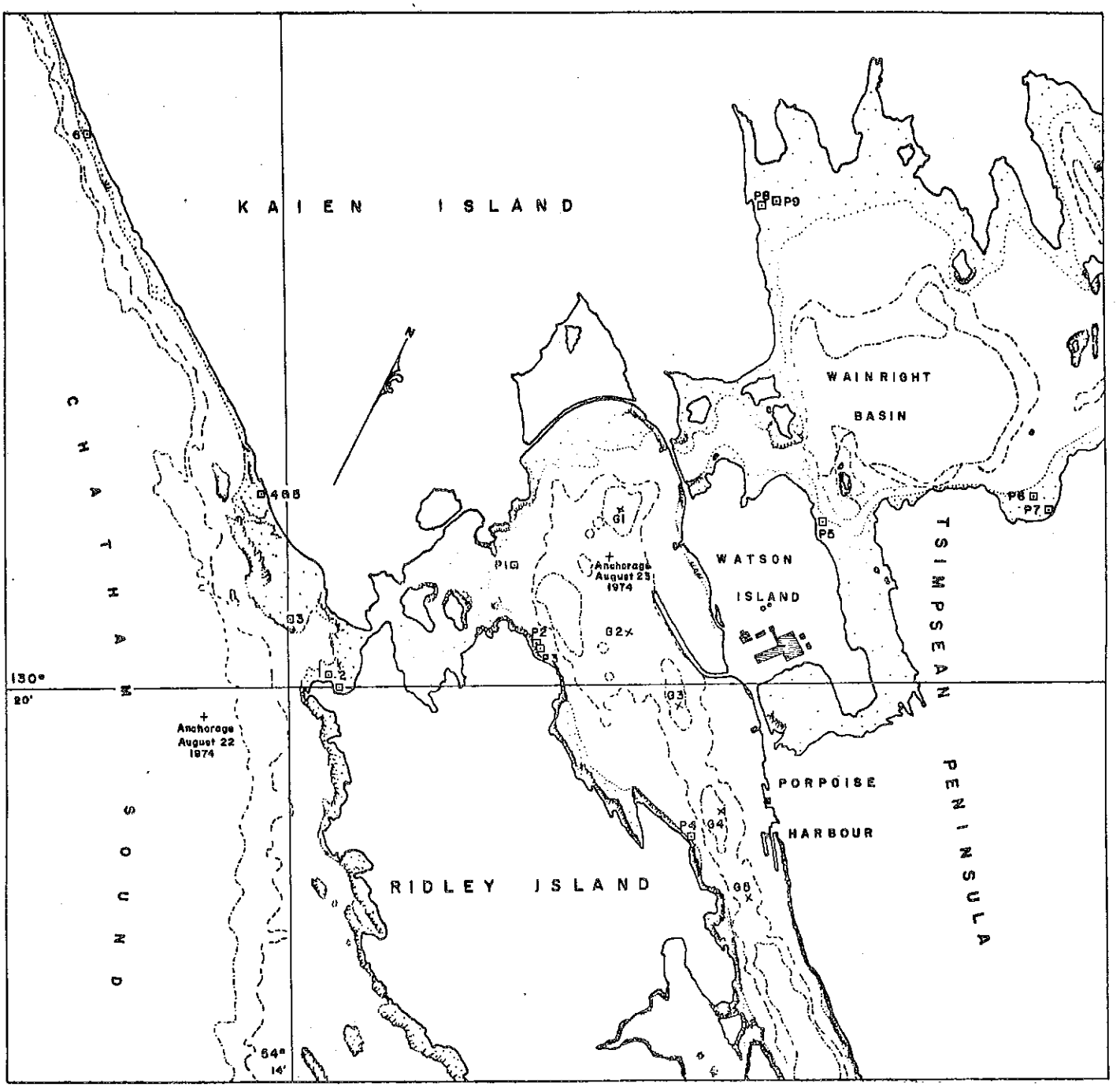

Figure 10. Chart of Porpoise Harbour and vicinity (adjacent to Skeena River estuary; from Canadian Hyrdrographic Chart No. 3702) showing sampling locations for intertidal biota (August 22 to 24 1974). Quadrat stations are indicated by squares.

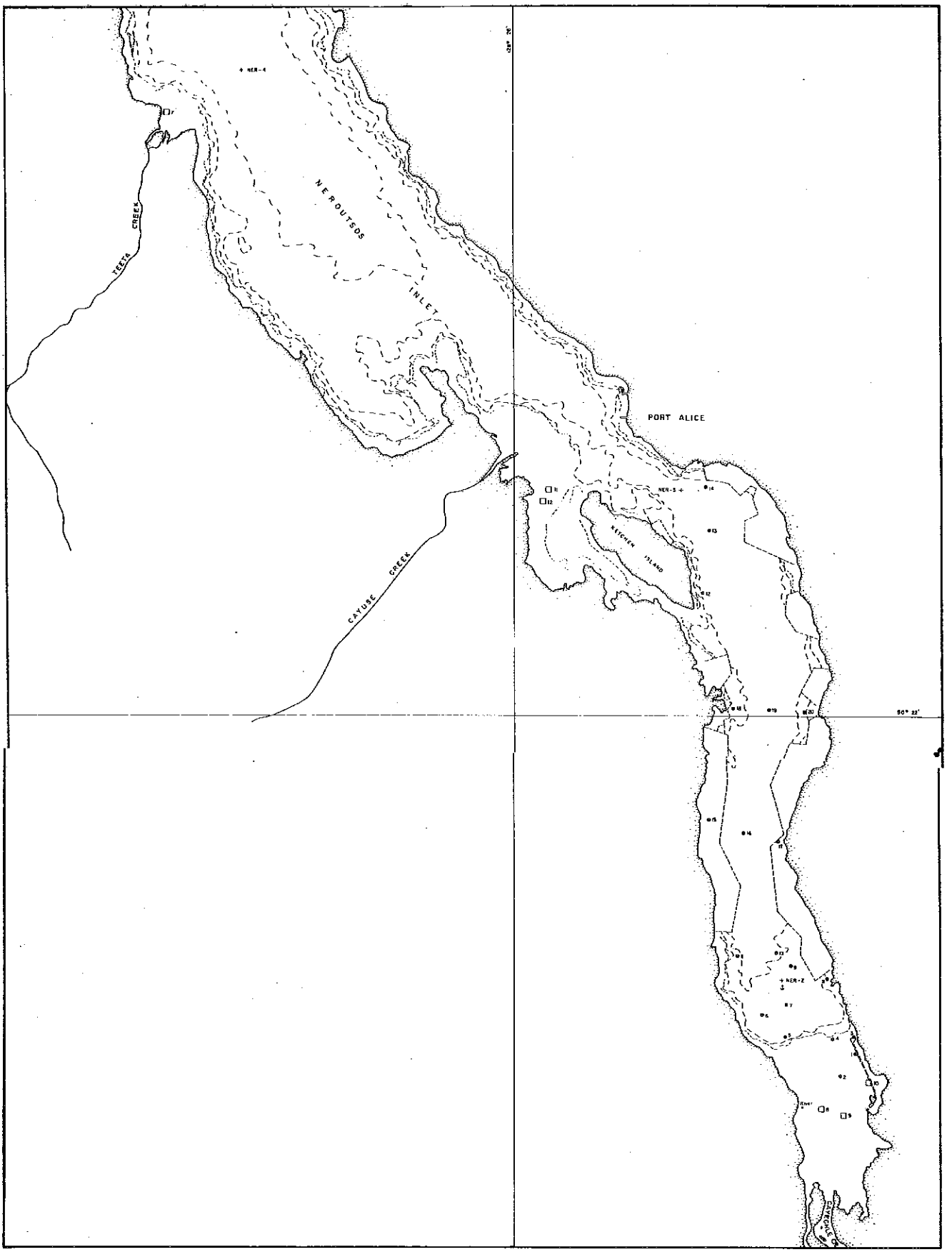

Figure 11. Chart of Neroutsos Inlet (from Canadian Hydrographic Chart No. showing sampling locations (August 26, 27 1974). Solid circles represent stations for <u>in situ</u> salinity and temperature observations.

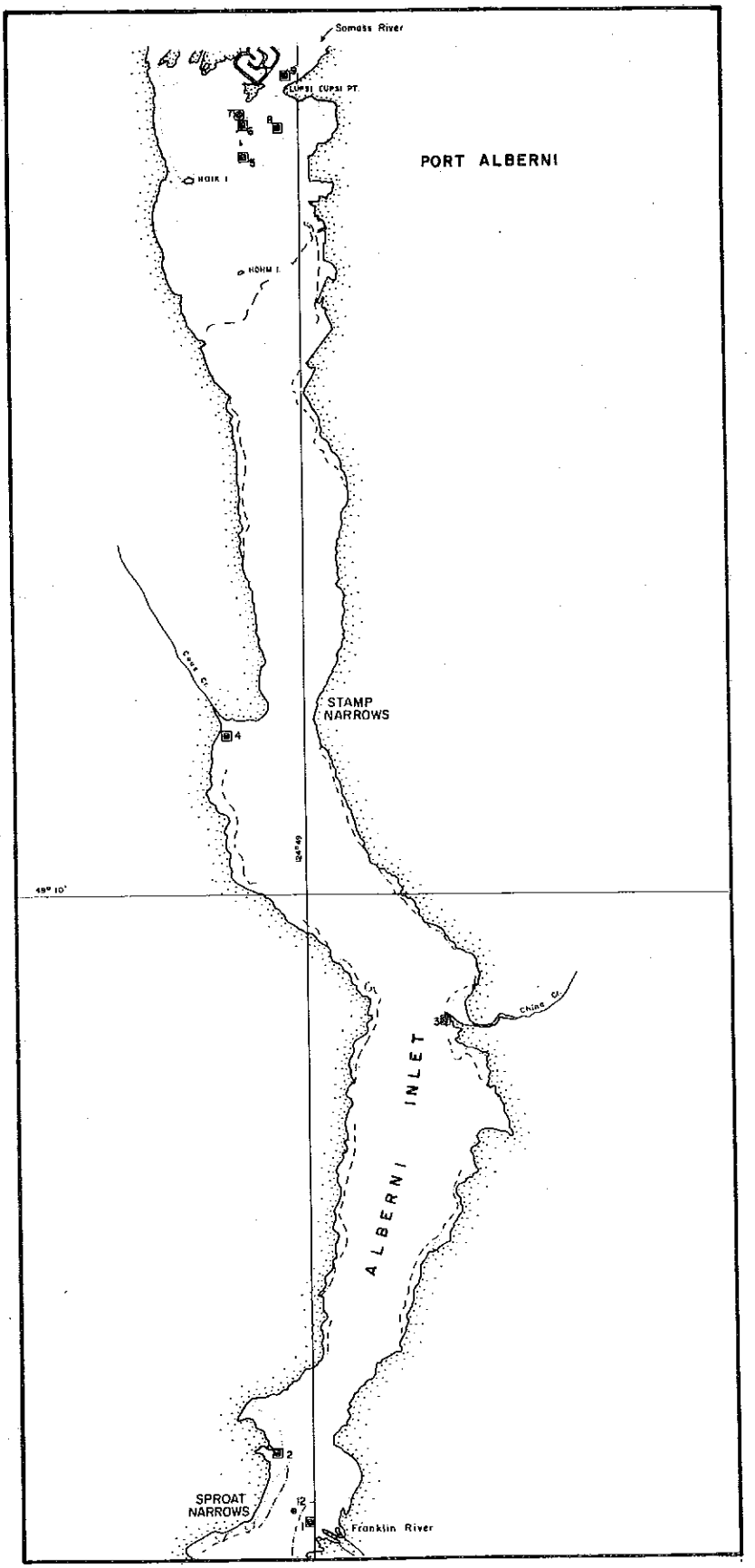

Figure 12. Chart of Alberni Inlet (from Canadian Hydrographic Chart No. 3609) showing sampling locations for intertidal biota (August 28, 29 1974). Squares indicate locations of quadrat stations.