INSTITUTE OF MARINE SCIENCE
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ENVIRONMENTAL STUDY OF THE MARINE ENVIRONMENT NEAR NOME, ALASKA

D. W. Hood, V. Fisher, D. Nebert, H. Feder, G. J. Mueller, D. Burrell, D. Boisseau, J. J. Goering, G. D. Sharma, D. T. Kresge and S. B. Fison

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SECTION 1. OCEANOGRAPHIC STUDIES

CHAPTER I. INTRODUCTION

D. W. Hood

The expanding use of raw material caused by increasing population and the desire for higher standards of living has created an expanding interest in obtaining greater and more diverse sources of important metals. Technology has provided the means for utilization of ores of lower quality; however, this requires more processing at a greater cost of energy and environmental impact. The diminishing supply of minerals has placed heavy pressure on the mineral industry to seek new sources of raw materials from remote regions of the earth including the ocean floor.

Recovery of minerals from the ocean imposes environmental problems that are new to the extractive industries because of the nature of the marine environment and the use of this resource in providing many other human needs. Preservation of the capacity of the oceans to provide renewable resources on a sustained basis is essential to the existence of man and must be protected from any lasting damage.

Only limited extraction of metals from the ocean has yet occurred although much interest in mining manganese nodules from the deep ocean basin is now developing. Other ventures are largely concerned with mining submarine placer deposits of heavy minerals such as gold and tin from the nearshore environments. The placer deposits have been formed by glacial, stream and beach processes during periods of low sea level and are generally restricted to unconsolidated nearshore and shelf sediments. The mining of off-shore placer deposits in United States waters is presently only occurring in a few areas on a relatively small scale; however, there promises to be expanded activity in the near future. The U. S. Bureau of

Mines of the Department of Interior has begun to define problems which must be overcome in developing the placer deposits for heavy metals.

One of the more attractive areas for placer mining development is the Nome region of Alaska which has been well known as a mineral resource area since the late 19th century. Previous work includes various investigations of the Norton Sound region conducted by the U. S. Geological Survey (Brooks, 1902; Collier et al. 1908; Moffit, 1913). More recent works by Nelson and Hopkins (1969, 1972) have described the bottom sediments of Norton Sound and Chirikov Basin and reflected on the kinds of sediments and biota present. However, detailed studies of the interrelationship of the nearshore sediments, the physical-chemical processes functioning there and the kinds, distribution and significance of the biota living there had not been adequately investigated to determine the possible environmental problems which may arise from the development of a placer mining activity in this region.

The American Smelting and Refining Company has obtained mining leases in the nearshore environment of the beach off Nome which they wish to develop for gold placer mining (Fig. I-1 and see VII-1). The Institute of Marine Science was engaged to undertake a preliminary environmental study of the region. The purpose of this study was to collect baseline data to define the sedimentary, biological and physical-chemical environments in the vicinity of Nome. The investigation included: a determination of the surficial bottom sediments including suspended sediment loads and trace metal content of the sediments; the collection and identification of bottom dwelling organisms; a few estimates of water column primary productivity; the hydrography circulation patterns and oxygen distributions; the nutrient levels and

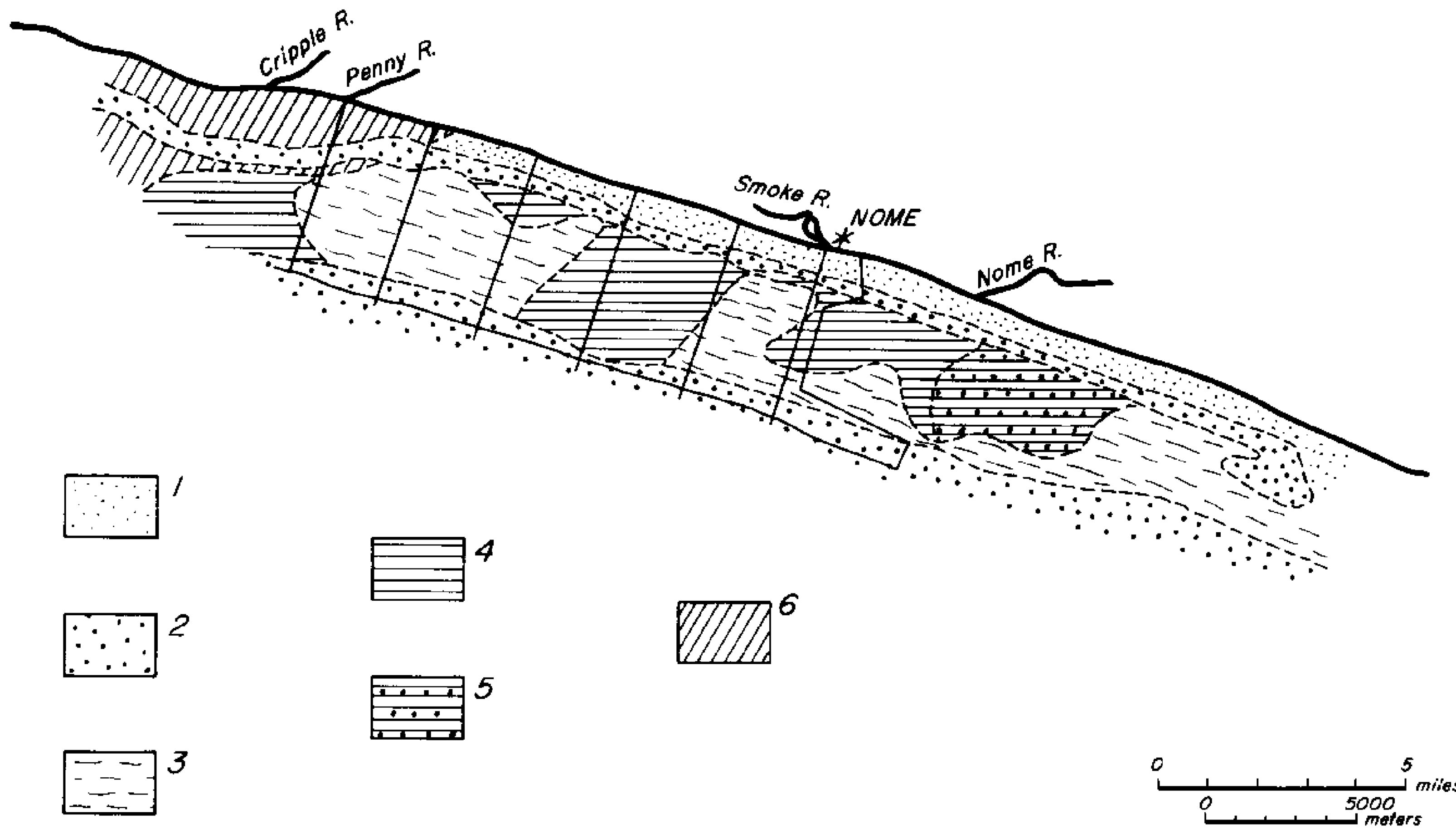

Figure I-1. Nome lease area: 1) Medium sand in zone of effective longshore drift. 2) Relict sandy beach gravel and local patches of recently deposited sand and silt. 3) Recently deposited marine muddy sand generally containing abundant ice rafted and relict gravel debris. 4) Relict gravel and local patches of recently deposited sand and mud resting on gravel drift. 5) Thin relict gravel resting on Nome River outwash. 6) Bedrock locally covered by patches of relict gravel.

trace metal content of the water column; and, the socio-economic status of the town of Nome.

The work was taken on as a cooperative effort between Industry, National Science Foundation which furnished the R/V *ACONA* to the project, and Sea Grant Program at the University of Alaska. Most of the sampling was done from the *ACONA*; however, some biological samples were also collected from the R/V *ALPHA HELIX* and ships of opportunity. The study was carried out as part of a larger study on the oceanography of Norton Sound and the Northern Bering Sea. The data collected on the overall study were incorporated into this report in accordance with the relevance to the environmental assessment of the specific area under lease for placer mining. The stations occupied are shown in Figure I-2.

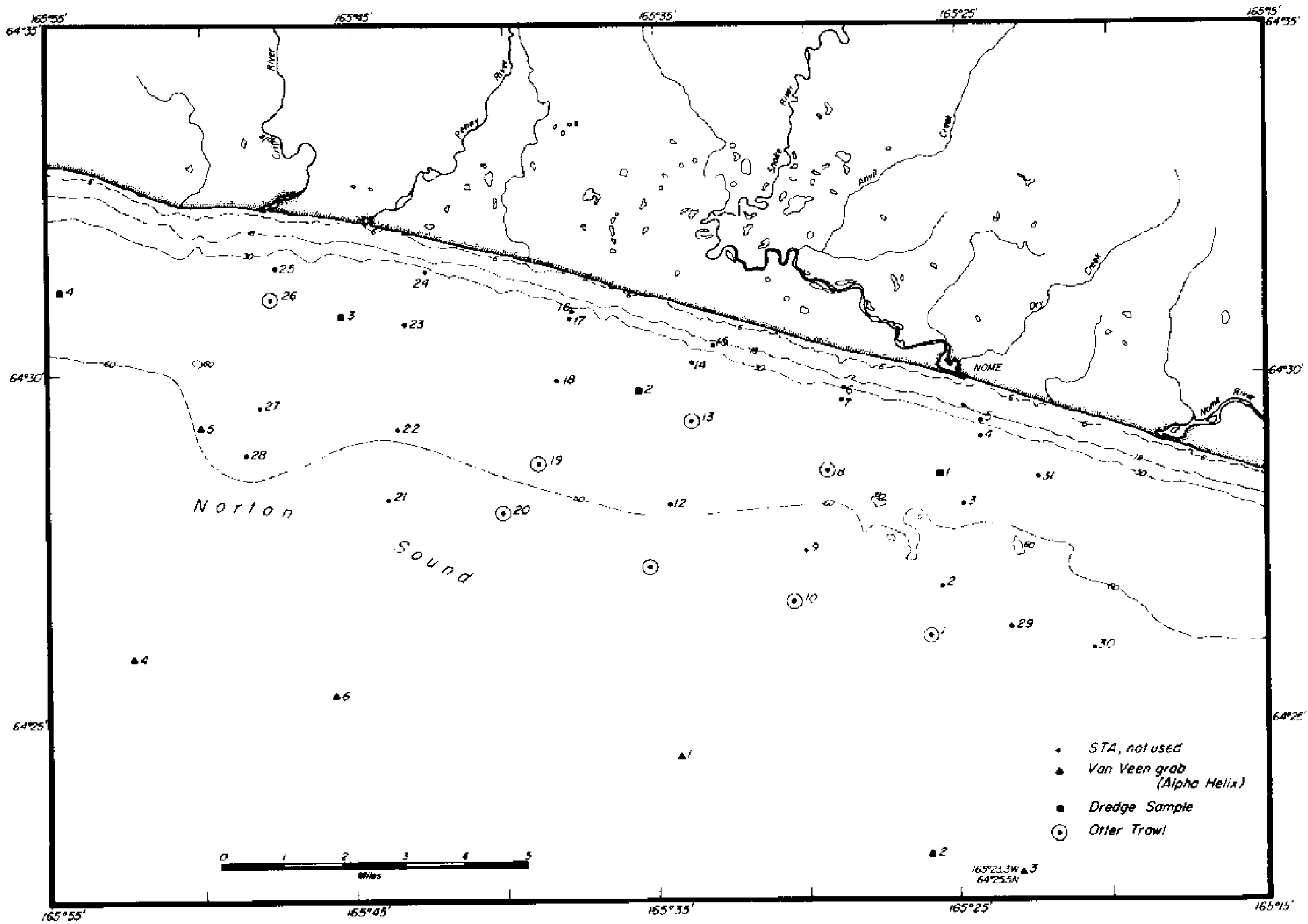

Figure I-2. Nome study sampling stations.

CHAPTER II. IMPACT ASSESSMENT

D. W. Hood and Victor Fisher

The purpose of this summary is to relate the known environmental data to the immediate problems of the environmental impact of a proposed placer mining activity to be carried out by American Smelting and Refining Company at their Nome mineral lease site. It should be understood that the data base for the lease site area is very limited with no seasonal data available. However, based on the available data, a number of questions can now be posed and some answers given:

1. What is the importance of the bottom life in the lease area to the Norton Sound Ecosystem; the local ecosystem. What is the potential damage of the dredging operation to the bottom life?

The major invertebrate biomass found within the lease area consisted of sea stars, sea urchins, sea cucumbers and brittle stars. Other invertebrate organisms of importance were a soft coral, pandalid shrimps and crangonid shrimps. Feeding types in the lease area showed a preponderance of suspension feeders. Polychaetous annelids were important in the mud-sand areas outside the lease site. Deposit feeders were preponderant here. Trawl species taken in the area were similar at all stations and these data compared well with that obtained by others in 1949, 1968 and 1971.

In general, the organisms found in the lease site are typical of those found in well-oxygenated, high energy sandy-gravel-rock sediment regimes, and represent a stable community of organisms. Changes to the community in the restricted lease-site area should have little impact on the total Norton Sound Northern Bering Sea ecosystem.

The organisms of the sand-mud habitat just south of the lease site consist of polychaetous annelids, mollusks and some echinoderms, many of which are food species used by tanner crab and flatfishes. In the food chain tanner crab are frequently used as food by flatfishes. Many of these food organisms are highly dependent on the quality of the sediments since many of them engulf sediment and feed on its contained organic material. It is to be expected that these organisms would be sensitive to substratum changes, and might be affected by the mining activities. Quantitative data on this habitat are now available and changes resulting from mining operations can be monitored. Depletion of these organisms over small areas, such as that projected for the mining operation, will probably have a minor influence on the Norton Sound ecosystem. Local disturbances of the bottom by mining operations would of necessity decimate the organisms of the area mined and those areas immediately adjacent.

2. How long after dredging will bottom life re-establish itself; will the species diversity be changed from that before dredging?

Repopulation of the area will begin once mining operations are terminated. This repopulation will take place as a result of the reproductive activities and immigration of species inhabiting adjacent areas. The length of time required for repopulation cannot be determined at present.

The species that will ultimately repopulate the area after dredging will probably not differ from the initial population composition. This statement is based on the premise that the effect of dredging is not expected to change the environment significantly given sufficient time for recovery. The salinity, temperature, oxygen, pH, depth, light penetration, primary productivity, turbidity and other parameters will remain essentially the same before and after dredging.

3. Will the new topography of the bottom be harmful or beneficial to the dominant organisms utilizing this area?

It is not expected that the new topography of the bottom caused by the placer mining operation will have a long-term effect on the organisms indigenous to the area. As indicated above there appears to be a stable biological community along the northern coast of Norton Sound that will provide sufficient organisms for repopulation.

4. What effect will the sediments from redeposited spoil have on the down current biological community; to what distance from the dredging site will this effect be evidenced?

Placer mining at sea may have important impact on the down stream biological community through deposition of spoils created by beneficiation processes at sea and from chemical interaction of the sediments with the water column. Those materials separated from the ores are normally returned to the sea bed. The location of redeposition depends upon the current and turbulent energy, the size fraction and density of the spoil material. The sedimented material may affect organisms by modification of the biological habitat adversely either through chemical changes arising from beneficiation processes or sediment water interactions or rapid sediment accumulation.

In the Nome area the particle size distribution as well as the gravel-sand-silt-clay distribution (Figs. VII-6 and VII-7) suggest that there are three general types of surface sediments in the lease area: relict-glacial, muddy sand, and mixtures of gravel and sand. The relict-glacial sediments are over 50 percent gravel and have been reworked by transgression and regression to remove most of the clay and silt fraction. Strong long-shore tidal and wind driven currents occur on the coast of Nome with speeds of 0.3 to 2.0 knots being observed.

The coarse materials once dredged will return almost immediately to the bottom even in the presence of strong currents, however the fine material will join the suspended load already existent in this area which was found to have a range of concentration between 1.6 - 6.7 mg/ℓ. The final deposition of suspended sediment derived from the Yukon and (even) the Kuskokwim Rivers is largely in the Chukchi Sea. It is doubtful if the material suspended by the mining operation will cause a great impact on sedimentation processes already existent. Beneficiation of ores by the process involved in the proposed dredging operation will be minimal and will add very limited quantities of man-made materials to the water column through the processes of corrosion, lubrication, engine exhausts and human wastes. Barring an accidental spill of fuel oil, it is not likely that these sources of contaminants will effect the water quality of this relatively high energetic area. It is expected that dredged spoils will resettle, in essentially the same condition as before disturbance, into a stable hydrodynamic condition.

5. Will the turbidity of the water at the dredging site affect the pelagic organisms? Will the effect be more than local?

Submersive sediments of the lease area are distributed in a complex pattern on a regular bathymetry. These sediments consist of gravel and muddy sands. Gravel represents a large deposit which has resulted from marine reworking of glacial till. Repeated reworking by transgressions, regressions, wave and tidal currents, has also formed a thin deposit of sand and muddy sand locally and offshore. The very coarse nature of surficial sediment suggests that present hydraulic energy in the water column is sufficient to remove fine sediments from this region. Furthermore, most sediments are negatively skewed and thus a non-depositional environment for fine sediments. Due to the lack of sufficient mud fraction in the surficial sediments, dredging operations are not expected to produce high turbidity or density layers which would be harmful to the pelagic fauna either generally or locally.

Dredging of the subsurface sediments, however, poses some problems and the effects of disturbing these sediments cannot be evaluated. Glacial tills normally contain mud (clay and silt) in various proportions and at present the particle size distribution of subsurface glacial till is not known. It is unlikely, however, that the relatively small area dredged each year and the large scale movement of water in an easterly direction will lead to a significant change in the pelagic environment.

6. Will the disturbance of sediments on the bottom have an effect upon deposition along the shorelines? If so, will any life be affected; will sediment transport be effected?

Dredging in an area is immediately followed by physical alteration of the bottom and some relocation of sediments. The physical alteration generally includes changes in circulation and the water depth. Dredge material after processing is returned to the sea. The dominant currents then carry these sediments to their new deposition sites.

The texture and the mineralogy of holocene sediments in the lease area suggest that these sediments originate in the beaches and the relict sediments. Reworking and roiling of nearshore sediments is an important mechanism for sediment transport in this area. Because the sediments from beaches are transported offshore and an eastward longshore drift apparently prevails, it is logical to assume the dredged sediments will either be carried offshore or to the east alongshore. The beach along Nome is continually open to wave attack during summer and ice erosion during winter. These processes will inhibit sedimentation along open beaches.

7. Will the stirring of gravels cause release of any harmful chemicals or change the chemistry of the overlying waters?

Dredging of mineralized zone can contribute dispersion and dissolution of potentially toxic elements in the marine environment. Our study in the Nome area, however, indicated a lack of correlation between the regions of heavy mineral concentrations and enrichment of potentially toxic elements. It is, therefore, safe to assume that redistribution of these sediments will not increase the toxicity. Apparently there is some association between clay, organic carbon, and heavy metals content of sediments. The low concentrations of organic carbon in the surficial sediments as well as low concentrations of trace elements (pH, Cd, and Zn) further suggest that stirring of gravel will not alter significantly the chemistry of the overlying waters.

The trace element distribution and deposition should be controlled by contemporary processes. Redistribution of subsurface sediments will undoubtedly add clay fraction into aquatic environment which may adsorb organic carbon as well as trace elements and carry them offshore. On the other hand, dredging may make available nutrient-rich trapped interstitial waters which could increase productivity and benthic fauna proliferation.

8. Will there be dissolved oxygen depletion due to the dredging operation?

A common problem, which arises from dredging operations in the marine coastal environment, is dissolved oxygen depletion. This condition is usually caused by disturbing fine sediments which have become anaerobic through bacterial oxidation of organic matter. The oxygen demand of these sediments during the process of reoxidation causes depletion of dissolved oxygen in the water column.

The sediments in the Nome area are, with minor exception, very coarse in size and relatively oxidized. Disturbing these sediments will cause little oxygen demand of the water column. In addition, the dissolved oxygen concentrations of the waters in Northern Norton Sound are uniformly high.

9. Will the operation interfere with marine transportation in the area?

There is no apparent reason for this operation to interfere with marine shipping except to the extent the actual dredge operation physically occupies space in the area.

10. What are the probable impacts of the mining operation on the economy of the Nome area?

It is expected that the labor force would consist of 80 to 120 people, with an annual payroll between $800,000 and $1,500,000 per year. The addition of this work force would constitute a 6-8% increase in area employment. The employment increase rises to 10-12%, if one assumes that the majority of the mining employees will be male.

Assuming that the management will follow a local hire policy under which about 90% of the employees will be recruited locally, the local employment impact will be very significant. With a labor force participation rate of less than 50% and an unemployment rate of 20%, the impact can be considered quite positive from the community and regional standpoint. Native unemployment, underemployment, and non-participation is particularly unfavorable, and a company program to hire, and as necessary, train local Natives would prove especially beneficial to the population. Based on the experience of other enterprises in northern and western Alaska, it is anticipated that there will be no difficulty in local recruitment of a satisfactory labor force.

Payrolls are expected to add between 10 and 20% to wage and salary earnings in the Nome area. The mining enterprise would constitute the largest private employer in Nome, its payroll approaching the total of the area's construction industry, the largest private industry category in the region.

Given a policy of using local labor, the public service and housing impact of the mining operation would be minimal. The company may, however, find that special provisions will have to be made for housing of management and professional personnel due to lack of excess quality housing in Nome. Existing schools, municipal facilities, utilities, and transport facilities will accommodate any added loads without significant dislocation or added costs to the community that would not be more than offset by increased revenues generated by mining activities.

CHAPTER III. PHYSICAL OCEANOGRAPHY OF NORTON SOUND

David Nebert

INTRODUCTION

Norton Sound is distinguished by its large area and shallow depth (Fig. III-1). It is about 145 km in the north-south dimension, 230 km in the east-west dimension, and averages about 20 m in depth. A further distinguishing feature is that it is ice covered during much of the winter-spring period. Salinities range from less than 20 °/₀₀ in summer surface waters to a maximum of about 34 °/₀₀ in winter. Temperatures range from above 12°C in summer to -1.85°C in winter (essentially the freezing point). Summer water characteristics are influenced by river input, wind transport and mixing, and to a lesser extent, tidal mixing. Winter water characteristics are controlled by thermohaline convection.

Historic hydrographic data for Norton Sound is not available. However, data are available from two winter icebreaker cruises which have stations at the western boundary in the vicinity of 64°N, 166°W. A recent cruise, July 1973, was conducted within Norton Sound and the northern Bering Sea by the Institute of Marine Science (see data in Appendix I). In addition, limited current meter data is available for the Nome area from 6 August to 10 September 1969 (Winchester 1969). Analysis of these data allow a cursory summary of summer and winter oceanographic features in the Norton Sound area.

SUMMER 1973 CONDITIONS: NORTON SOUND

Summer water structure varied widely during July 1973 in Norton Sound. The salinity profiles may be divided into four classes, each

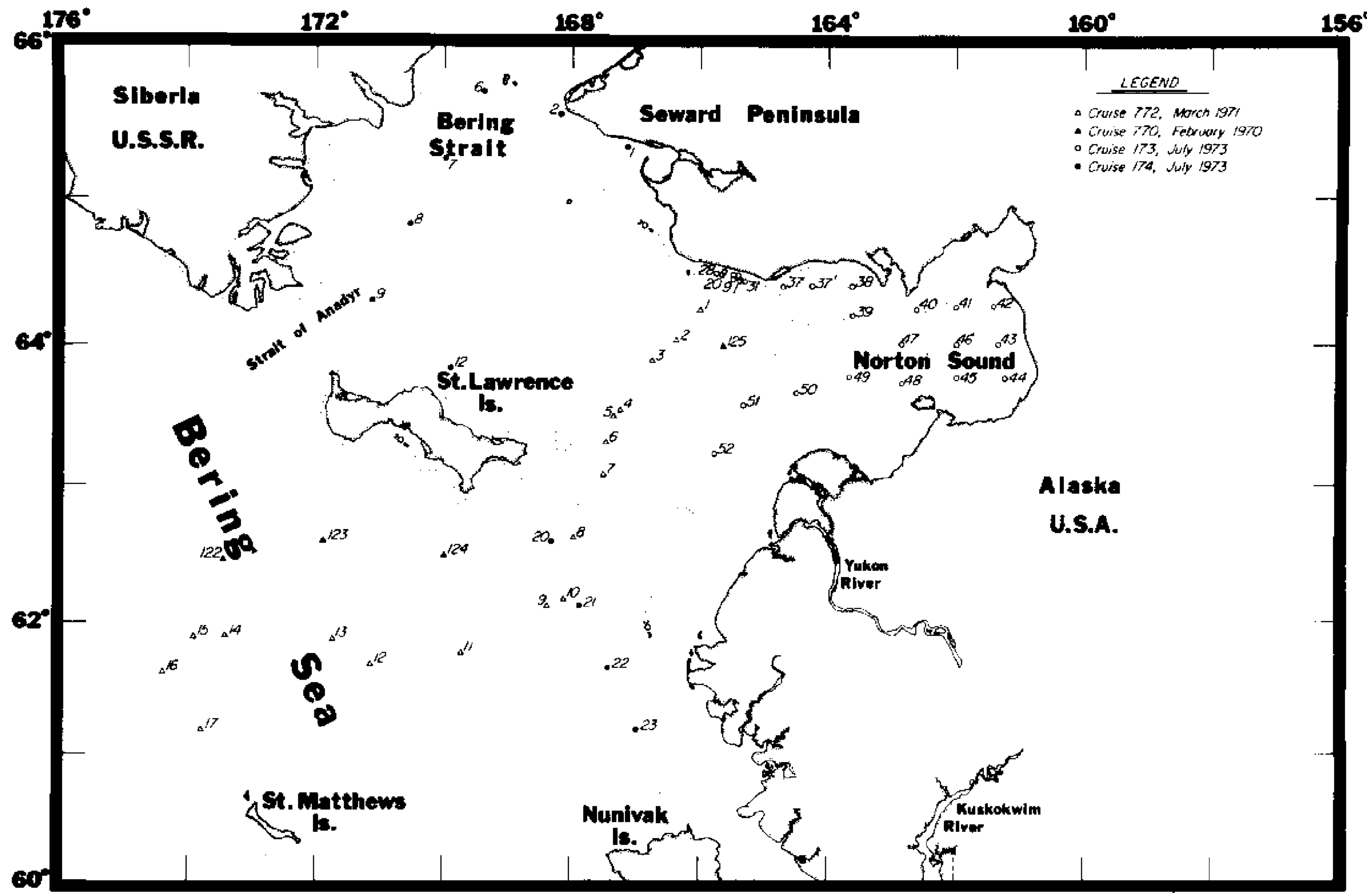

Figure III-1. Physical Oceanography Sampling Stations.

representing a particular area (Fig. III-2). The western salinity structure showed the influence of both saline Bering Sea water and Yukon-Kuskokwim River water. The southwest profiles showed strong river influence with low salinity. The eastern end of Norton Sound had a strong salinity stratification, showing the influence of the Yukon and local run-off on the surface as well as the influence of Bering Sea water at the bottom. The northwest salinity profile was nearly vertical and probably was the result of a mixture of Bering Sea water and Yukon River water. This mixture is discussed in more detail in conjunction with the northern Bering Sea circulation.

The water structure is affected by frequent and sometimes severe summer storms. The winds associated with these storms can influence the circulation in two ways: by generating wind induced surface currents, and by mixing the otherwise stratified water to form a homogeneous water mass that will subsequently be replaced by Bering Sea and Yukon River waters.

Winds that are not strong enough to mix the water column may still induce surface currents that may then be compensated by bottom currents. The predominent winds during the July 73 cruise were from the northeast; this may have aided in bringing the more saline Bering Sea water into the deeper parts of eastern Norton Sound.

Winds capable of mixing the complete water column are probably common since the area is quite shallow (20 m). Such a mixed water mass will be of intermediate density, more dense than the Yukon waters but less dense than the adjacent Bering Sea water. This will probably result in some form of flushing. Because of the temporal and spatial sampling pattern it was not possible to confirm either of these proposed wind-related circulations.

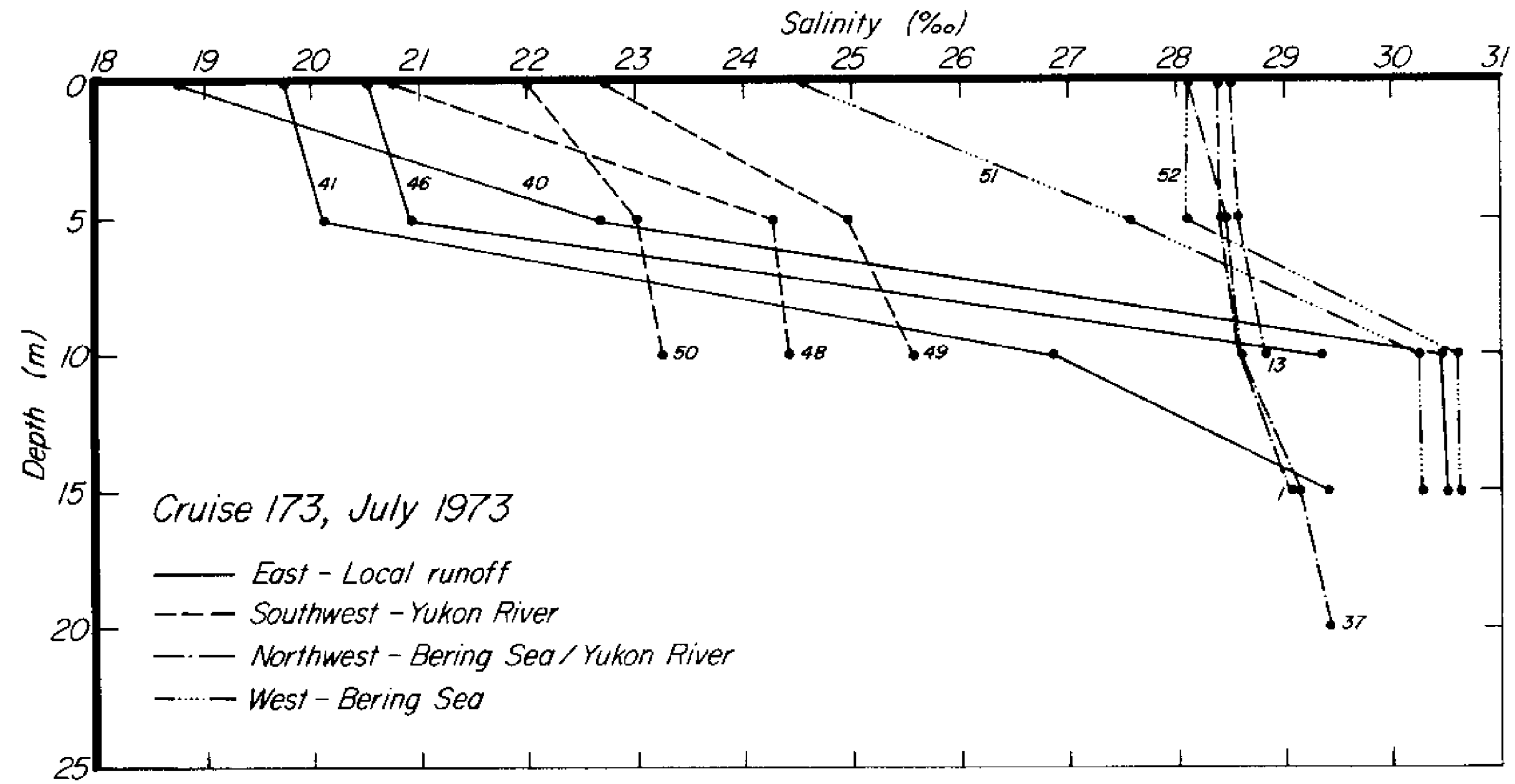

Figure III-2. Salinity profiles for selected stations from Cruise 173, July 1973 showing four types of water structure in Norton Sound.

In fact, the proposed wind-related circulations probably act in conjunction with other factors such as tidal mixing and the Bering Sea circulation.

Significant tidal currents have been observed parallel to the coast at Nome; during the period of observation, 6 August to 10 September, current speeds were 0.3 to 0.5 knots with occasional peaks of 0.8 knots (Winchester 1969). [Current speeds in this location of up to 2 knots have been reported by others (Nelson and Hopkins 1972)]. Current direction alternated with a diurnal tidal frequency from east to west. Tidal currents of this magnitude may be partially responsible for the observed homogeneous waters near Nome. However, tidal mixing is apparently not a significant factor in most of Norton Sound since strong density gradients were found east of Nome as well as throughout the eastern sound.

There are two interesting features of the salinity structure in the eastern half of Norton Sound; the low surface salinity and the high bottom salinity. The low surface salinity may be the result of local run-off, since surface salinities nearer the Yukon River mouth are generally higher. This is reinforced by surface salinities at the eastern boundary of Norton Sound, which are 13 to 19 °/₀₀. The weather station at Unalakleet reports almost 3 inches of rain each July (U. S. Dept. of Commerce 1969-1971) which may contribute enough fresh water run-off to affect the local salinity structure. However, from cruise data it is not possible to tell whether the observed surface layer is generated locally or whether it is locally modified Yukon River water.

The high bottom salinity in eastern Norton Sound was evidence that appreciable lateral advection has occurred. Since it had the same salinity as the adjacent Bering Sea, the exchange rate was either relatively rapid or it was the residual of a previous more saline intrusion. There was no available "source" water found during July which was noticeably more saline than that in the eastern part of Norton Sound, so it is likely that the circulation was dynamic. The data was insufficient to estimate any sort of flushing rate.

Two other related features are the homogeneous water found near Nome (Fig. III-2) and the extremely cold water found at a depth of only 10 m at the western end of Norton Sound (Fig. III-3). These are both related to the circulation of the northern Bering Sea. The water types at both NS-1 and BS-1 are the same, indicating a similar source. From the T-S diagram it is apparent that the NS-1 and BS-1 water could be formed by mixing waters from the Yukon River, NS-48, with waters from BS-23 or from a combination of NS-52 and BS-23. Still another possible source is the combination of NS-48 and BS-12 waters. While there are several possible sources for the NS-1 and BS-1 waters, all data indicates a northward transport at the north end of Norton Sound. The source of the cold NS-51 and NS-52 bottom water may be from the Strait of Anadyr (BS-9) since this was the only other source of below zero water. These features, in combination, tend to support the accepted circulation pattern for the northern Bering Sea (Nelson and Hopkins 1972), that is, a general northward flow through the Strait of Anadyr and between St. Lawrence Island and the Alaskan Peninsula which results in a northward current through the Bering Strait. There appears to be a cyclonic circulation north of St. Lawrence Island which may be responsible for bringing very cold water from the Strait of Anadyr to the western edge of Norton Sound. The use of T-S diagrams to explain surface water mixing is not as dependable as with deep water since surface heat and salt exchange

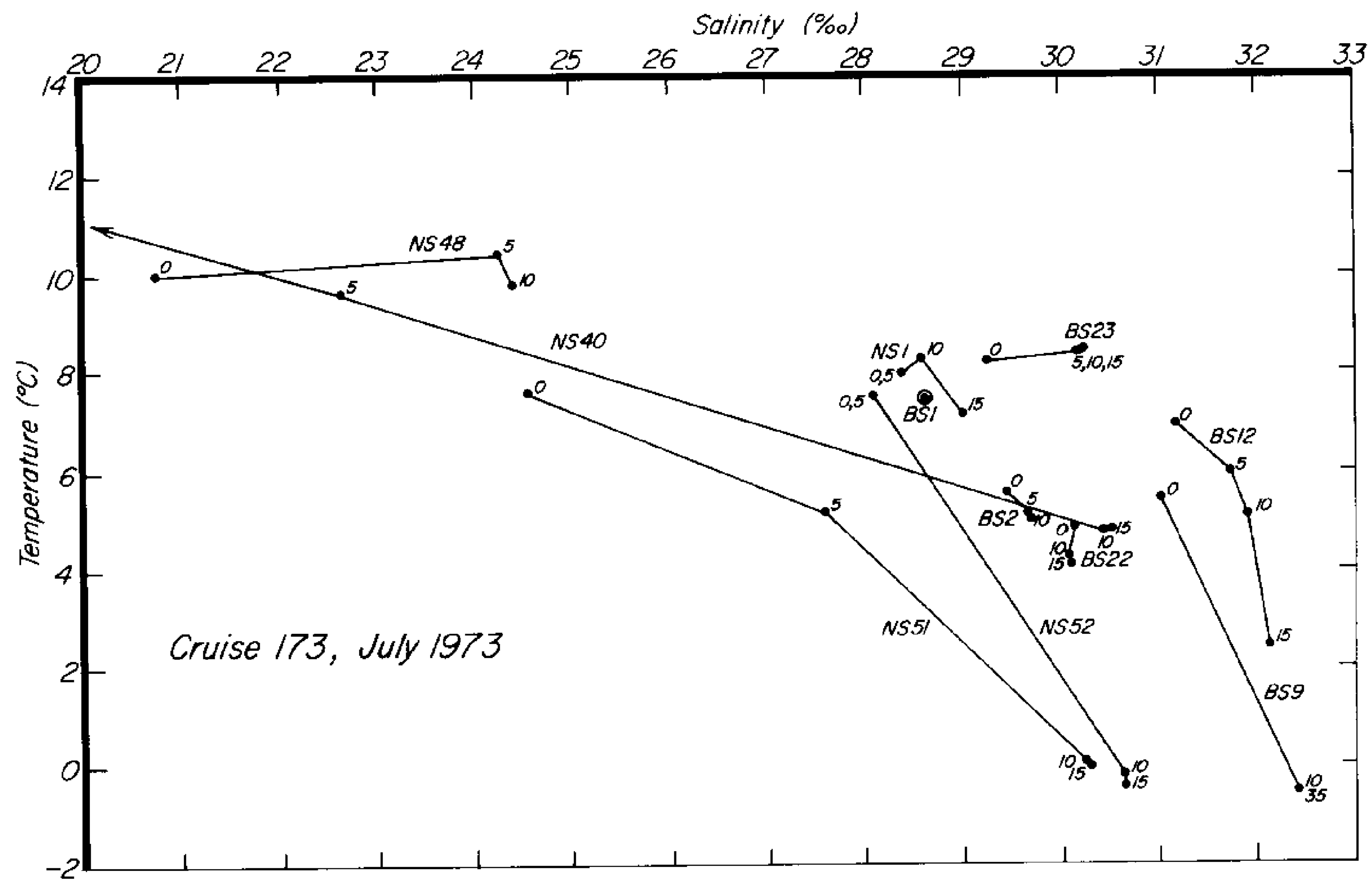

Figure III-3. Temperature-salinity plots for selected stations from Cruise 173, July 1973.

may occur, but it does lend support to the proposed circulation of the northern Bering Sea.

WINTER CONDITIONS: NORTON SOUND

Ship access to Norton Sound and the northern Bering Sea is severely limited in winter and spring by pack ice. However, two winter cruises have been made by icebreaker: one in February 1970 and one in March 1971. In both cases the penetration was to the area 64°N, 166°W, just south of Nome. Other stations were taken south of St. Lawrence Island (Fig. III-1). Salinity and temperature profiles are plotted for selected stations (Figs. III-4 and III-5).

Profiles for February 1970 show temperatures of -1.7 to -1.8°C and salinities of 31.5 to 32.2 °/₀₀ (Fig. III-4). In all cases the water was homogeneous to the bottom. The station nearest Nome was noticeably more saline than the other stations. This may be due to the advection of more saline water from the Strait of Anadyr or may be due to local ice formation. Such local ice formation can be expected to result in more saline (and therefore more dense) water in the shallower shelf areas like Norton Sound. If this does occur, replacement of this dense water can be expected, resulting in a winter circulation. This type of circulation would probably be sluggish in nature; no information is available on rates.

The March 1971 profiles (Fig. III-5) show much denser water, both colder and more saline than the previous year; this is later in the winter season. The winter of 1970-71 was notably more severe than the previous winter (U. S. Dept. of Commerce 1969-1971). There is also more structure in the

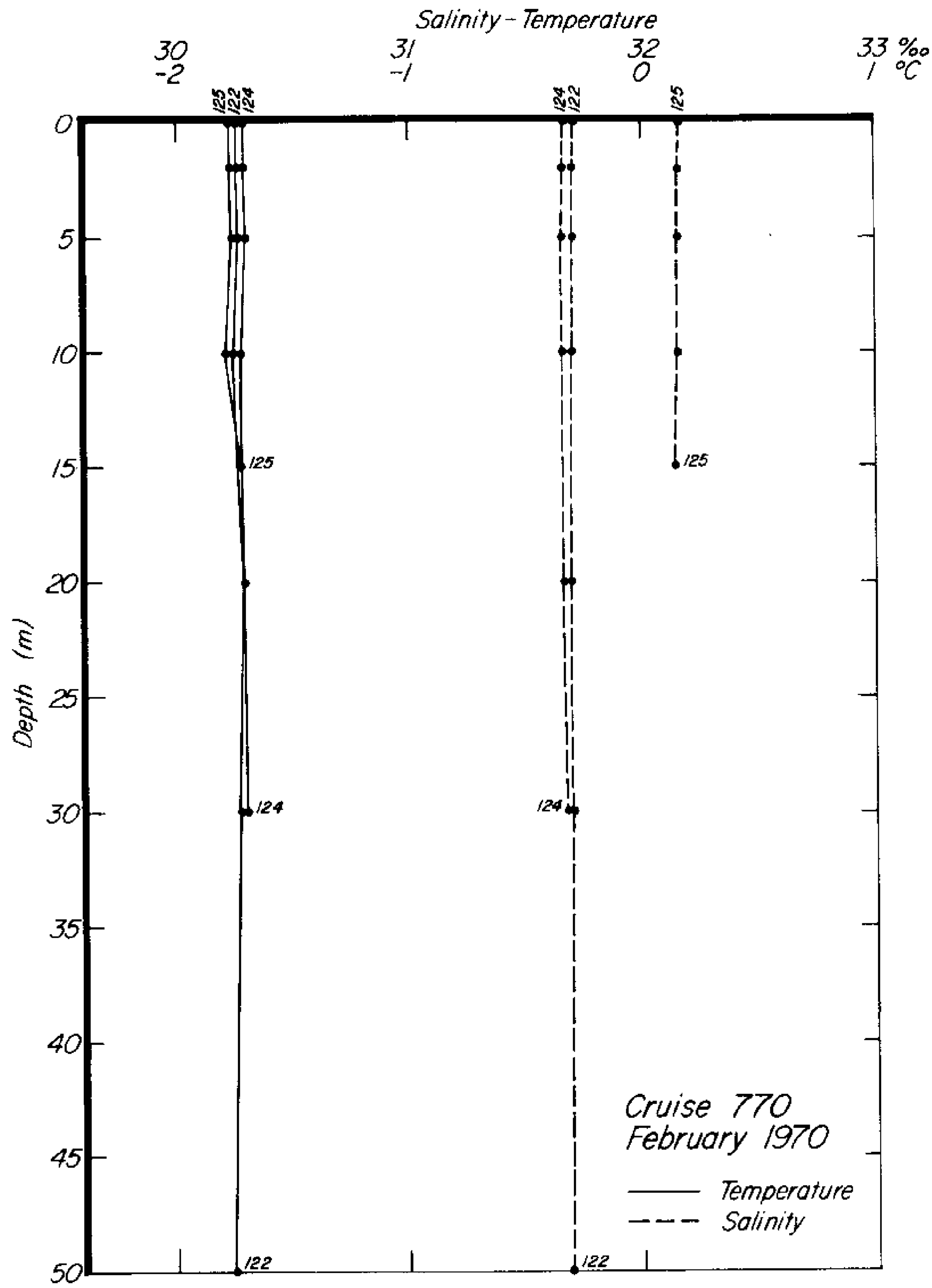

Figure III-4. Salinity and temperature profiles for selected stations from Cruise 770, February 1970.

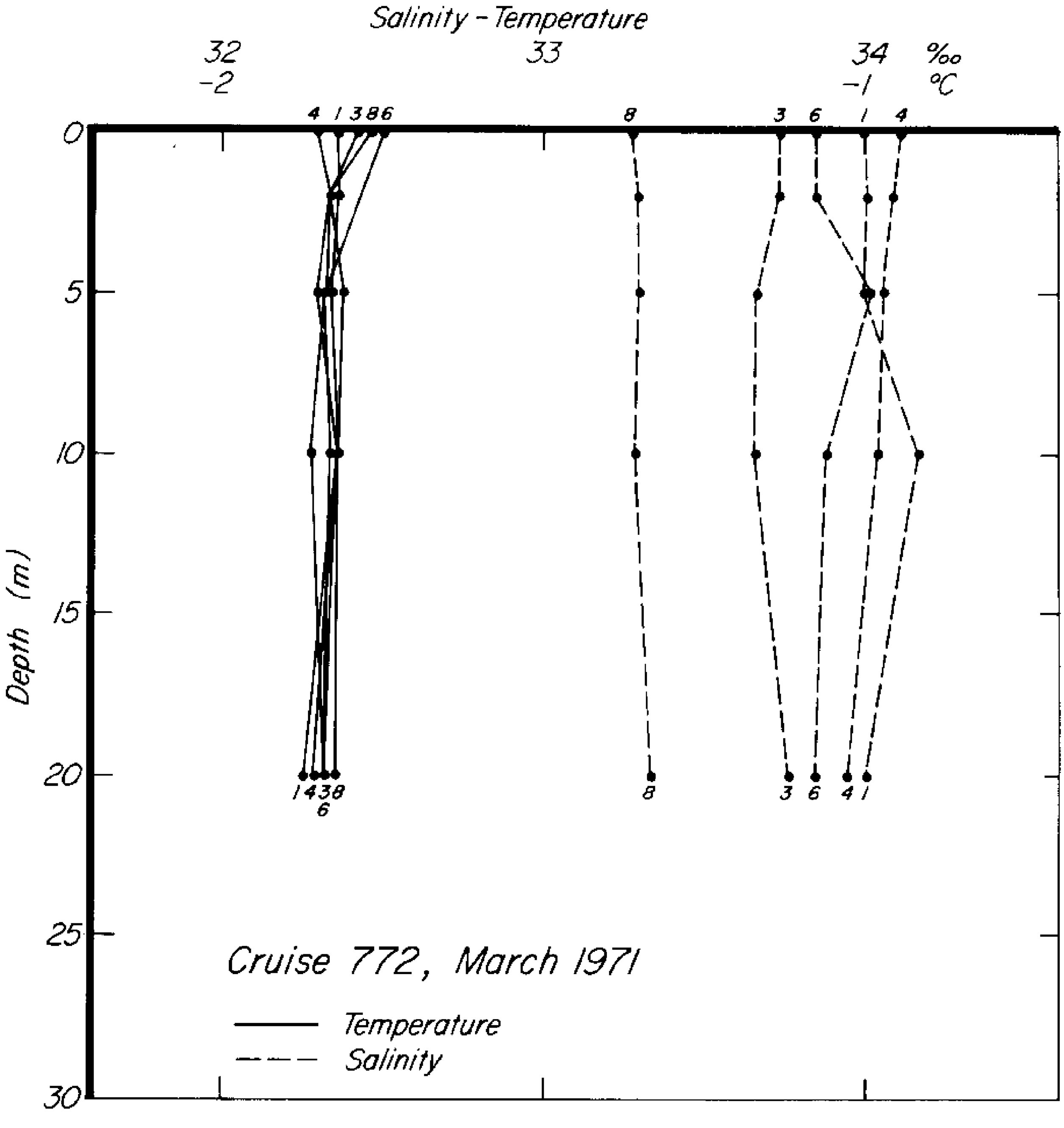

Figure III-5. Salinity and temperature profiles for selected stations from Cruise 772, March 1971.

salinity profiles which cannot be easily explained. These data show the same feature of more saline and colder water to the north.

SUMMARY

Norton Sound is a shallow subarctic embayment within which the water properties and circulation are affected primarily by winds, fresh water input, thermohaline convection and the character of marine source water from the Bering Sea. Wind mixing may extend to the bottom. Wind transport may also drive significant currents. The T-S correlations suggest a northward transport of water past the west end of Norton Sound, an inward flow of Bering Sea water along the bottom of the sound, and modification of the near surface water by river input. Data were insufficient to estimate flow rates for these waters. During the winter, thermohaline convection, due to cooling and diminution of fresh water input, mixed the water throughout the water column. Some observed high salinity water may have been due to either exclusion of salt during ice formation or to advection of saline waters from the western Bering Sea. The available data are inadequate to make definitive statements concerning circulation in Norton Sound.

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CHAPTER IV. BIOLOGICAL STUDIES

H. M. Feder and G. J. Mueller

INTRODUCTION

Offshore mining operations of necessity disturb the marine sediments in the region of excavation as well as in areas affected by sediment transported from the disturbed region. Simultaneously, such industrial activities will disturb the habitats of the animals living in the sediments. The presence or absence of particular benthic species as determined by the general nature of the substrate is well documented (see Hedgpeth, 1957 for general discussions on the nature of marine benthic habitats). Specifically, the close relationships of benthic faunal assemblages to particular sediment characteristics have been shown for some areas (Jones 1950; Lie 1968; Sanders 1956, 1968). Furthermore, the ability of pelagic larval forms of benthic species to select or reject a particular substratum on the basis of specific sediment properties has been determined experimentally (Jaegersten 1940; Wilson 1952, 1953). Thus, it seems apparent that changes in the substrate will be reflected by changes in resident fauna. However, the nature of such faunal changes can only be comprehended if the biota is investigated over a reasonable time base prior to and after disturbance of the particular area. Changes can then be measured by way of analysis of species diversity and dominance patterns (see Pearson 1970, 1971 and Rosenberg 1972, 1973 for use of such an approach for monitoring areas affected by industrial activity).

Benthic organisms, particularly infauna and sessile epifauna, are useful as indicator species for a disturbed area because they tend to remain in one place, typically react to long-range environmental changes and, by their presence, reflect the nature of the substratum. In contrast, planktonic organisms only briefly retain their position in the water column in a particular area, typically respond to short-range environmental changes, and are renewed constantly by way of water currents from adjacent areas. Thus, planktonic forms as a result of their transitory nature in the water column would give an erroneous impression of health of an area otherwise seriously disturbed, and are not as useful as indicator species in a monitoring program.

OBJECTIVES

The present investigation was designed to provide preliminary, background biological information for the mineral lease area and regions adjacent to the lease area - the latter regions are to serve as bases for comparison once mining activities begin. The study, necessarily limited in time and scope, considered only infaunal and sessile epifaunal benthic species, although some mobile epifaunal and nektobenthic species were taken by the sampling gear.

The sampling procedures and a literature survey contributed to the following goals:

1. Identification and general distribution of the major infaunal and epifaunal benthic macrofauna in the lease area and in adjacent areas outside of the lease area.
2. The relative abundance and biomass of the major infaunal and epifaunal benthic macrofauna in the lease area and in adjacent areas outside the lease area.

3. Identification, general distribution and relative abundance of major macrofaunal species collected in years previous to the present investigation.

METHODS

Time and logistics permitted only a limited number of sites to be sampled within the lease by way of the R/V *ACONA* in July. The character of the bottom precluded use of a quantitative sampler within the lease area, and the gear selected for the study was a small otter trawl with a 12-foot opening. Seven stations were sampled with the otter trawl. Single ten-minute drags were made over six of the stations; three replicate drags were made on one of the stations (Fig. I-2). All material was sorted on deck and preserved in 10% formalin. Species identifications, counts of individuals and biomass determinations were made at the Marine Sorting Center, University of Alaska, Fairbanks.

Five quantitative stations were occupied from the R/V *ALPHA HELIX* on 15 August and 7 September 1973 at the southern edge of the lease site by Sam Stoker. Selection of the area to be sampled was based on its suitability for use with 0.1 M^2 van Veen Grab (the sampling gear chosen for quantitative studies). The region sampled was as close to the lease area as operation of the grab dictated. Five replicate samples were taken at each station. All material was washed on a 1.0 mm screen on board and the biological specimens collected in this manner preserved in 10% formalin. Species identifications, counts and biomass determinations were made at the Marine Sorting Center in Fairbanks.

Four qualitative samples (approximately 10-minute drags with a small dredge) collected by G. J. Mueller in the lease area and in the vicinity of the lease area on 22-24 July, 1971 were processed in the course of the present investigation. All material was identified at the Marine Sorting Center. All stations for which data are available are given in Table IV-1.

Data from two additional sources, previously collected, were compiled and assessed for comparison with collections made in the present investigation. The two other collections were:

1. An exploratory fishing survey made in the Nome area in June and July 1949 by the U. S. Fish and Wildlife Service (Ellson et al., 1950).
2. An experimental shrimp-trawling operation in the Nome area by M. F. Geiger and R. Baxter (1968, unpublished data).

RESULTS

Isolation of 62 invertebrate and 18 fish species was made from the trawl samples collected on the lease area in July 1973. Comparison of this data with drags made in July 1971 indicates that only 3 different species were collected at this time (see Tables IV-2 and IV-3). Examination of the trawl data of Geiger and Baxter from 1968 (unpublished data) shows that small tanner or snow crabs (*Chionocoetes opilio*) occasionally frequent the area and that two additional species of brachyuran crabs also may occur (see Appendix Table II-1).

Invertebrates (83 species) were isolated from the van Veen grab samples collected from the area immediately outside the lease area in August 1973 (see Fig. I-2, Table IV-4, and Tables IV-5 through IV-34).*

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*Note: continuation of text on page 66 and of discussion on page 82.

TABLE IV-1. Stations sampled during the cruise of the R/V ACONA and R/V ALPHA HELIX in July and August 1973 and Stations sampled from the M/V VIRGINIA CITY in July 1971. See Figure I-2 for station locations.

Station	Type of Station	Latitude	Longitude	Depth	Bottom	Date
1	Trawl	64°26.2'N	165°25.9'W	22 meters	Clay-gravel-rock	20 July 1973
8	Trawl	64°27.4'N	165°30.0'W	20 "	"	20 July 1973
10	Trawl	64°26.7'N	165°30.4'W	22 "	"	20 July 1973
11	Trawl	64°27.2'N	165°35.2'W	23 "	"	20 July 1973
13	Trawl	64°29.3'N	165°30.4'W	14 "	"	20 July 1973
19	Trawl	64°28.7'N	165°38.8'W	20 "	"	20 July 1973
20	Trawl	64°28.0'N	165°40.0'W	23 "	"	20 July 1973
26	Trawl	64°31.1'N	165°47.7'W	13 "	"	20 July 1973
AH-01	Grab*	64°24.5'N	165°34.5'W	32 "	Mud-sand-gravel	15 Aug. 1973
AH-02	Grab*	64°23.0'N	165°25.5'W	34 "	"	15 Aug. 1973
AH-03	Grab*	64°25.5'N	165°23.3'W	22 "	"	15 Aug. 1973
AH-04	Grab*	64°26.7'N	165°52.0'W	22 "	"	7 Sept. 1973
AH-05	Grab*	64°29.0'N	165°50.3'W	16 "	"	7 Sept. 1973
AH-06	Grab*	64°25.5'N	165°45.3'W	30 "	"	7 Sept. 1973
GJM 1	Dredge	64°28.5'N	165°25.0'W	18-30"	Gravel-rock	22 July 1971
GJM 2	Dredge	64°28.5'N	165°35.0'W	22 "	"	22 July 1971
GJM 3	Dredge	64°30.5'N	165°45.0'W	14-24"	"	22 July 1971
GJM 4	Dredge	64°30.0'N	165°58.0'W	22 "	"	22 July 1971

* Quantitative samples taken outside the lease area. See Figure I-2 for location of van Veen grab (Alpha Helix) Stations 1-6.

TABLE IV-2. A list of Species Collected on the Lease Site by trawl.

TAXON			COMMON NAME
Phylum Porifera		species 1	sponge
		species 2	sponge
		species 3	sponge
Phylum Cnidaria	Class Hydrozoa	mixed species	hydroid
		Tubularia sp. 1	hydroid
	Class Anthozoa	Actinaria Species 1	sea anenome
		Eunephthya rubiformis	soft coral
Phylum Ectoprocta		*Alcyonidium disciforme*	moss animal
		Carbasea carbasea	moss animal
		Flustrella sp. 1	moss animal
		Rhamphostromella sp. 1	moss animal
		Species 1	moss animal
Phylum Mollusca	Class Gastropoda	*Capulacmaea radiata*	snail
		Natica sp. 1	snail
		Trichotropsis bicarinata	snail
		Species 1	snail
	Subclass Opisthobranchiata	Species 1	snail
	Class Pelecypoda	*Astarte borealis*	clam
		Hiatella arctica	clam
		Musculus niger	clam
	Class Cephalopoda	egg case	squid
Phylum Sipunculida		Species 1	peanut worm
Phylum Annelida	Class Polychaeta		
	Family Polynoidae	*Arctonoe vittata*	bristle worm
		Eunoe oerstedi	bristle worm

TABLE IV-2 (continued)

TAXON			COMMON NAME
		Harmothoe extenuata	bristle worm
		Species 1	bristle worm
		Species 2	bristle worm
		Species 3	bristle worm
	Family Sabellidae	*Pseudopotamilla reniformis*	
Phylum Arthropoda	Class Pycnogonida	*Tanystylum duospinum*	sea spider
	Class Crustacea		
	Subclass Cirripedia	*Balanus* sp. 1	barnacle
		Balanus sp. 2	barnacle
	Subclass Malacostraca		
	Order Isopoda	*Pleuroprion* sp. 1	pillbug
	Order Amphipoda	Species 1	
	Order Decapoda		
	Suborder Natantia	*Argis crassa*	shrimp
		Argis lar	shrimp
		Crangon dalli	shrimp
		Crangon septemspinosa	shrimp
		Pandalus hypsinotus	shrimp
		Pandalus goniurus	shrimp
		Sclerocrangon borealis	shrimp
		Spirontocaris groenlandica	shrimp
	Suborder Anomura	*Pagurus splendescens*	hermit crab
		Haplogaster grebnitzki	
		Paralithodes camtschatica	king crab
	Suborder Brachyura	*Hyas coarcticus aleuticus*	spider crab
Phylum Echinodermata			
	Class Asteroidea	*Asterias amurensis*	sea star
		Crossaster papposus	sea star
		Evasterias sp.	sea star
		Henricia sp.	sea star
		Leptasterias sp.	sea star
		Species 1	sea star
		Species 2	sea star

TABLE IV-2 (continued)

TAXON			COMMON NAME
		Species 3	sea star
		Species 4	sea star
	Class Ophiuroidea	*Gorgonocephalis caryi*	brittle star
		Amphiodia craterodermata	brittle star
	Class Echinoidea	*Strongylocentrotus drobachiensis*	sea urchin
	Class Holothuroidea	*Psolus* sp.	sea cucumber
Phylum Chordata			
Subphylum Tunicata		*Molgula* sp.	sea squirt
		Boltenia ovifera	sea squirt
		Species 1	sea squirt
Subphylum Vertebrata			
	Superclass Pisces		
	Family Petromyzontidae	*Entosphenus tridentatus*	pacific lamprey
	Family Godridae	*Eleginus gracilis*	saffron cod
	Family Stichaeidae	*Chirolophis decoratum*	warbonnet
		Chirolophis snyderi	warbonnet
		Eumesogrammus praecisus	4-lined snake blenny
		Lumpenus maculatus	snake blenny
	Family Cottidae	*Enophrys claviger*	sculpin
		Enophrys lucasi	lister sculpin
		Eurymen gyrinus	sculpin
		Gymnocanthus galeatus	arctic sculpin
		Microcottus sellaris	bright belly sculpin
		Myoxocephalus joak	plain sculpin
		Myoxocephalus verracosus	warty sculpin
		Nautichthys pribilovius	eyeshade sculpin
	Family Pholidae	*Pholis dolichogaster*	striped gunnel
	Family Agonidae	*Agonus acipenserinus*	sturgeon poacher
	Family Liparidae	*Liparis cyclopus*	ribbon snailfish
	Family Pleuronectidae	*Limanda aspera*	yellow fin sole

TABLE IV-3. A list of species collected by dredge off Nome on July 22-24, 1971. Species not on grab and trawl study of 1973 are marked with an asterisk.

Drag #1

Alcyonidium disciforme

Hemithiris psittacea
Henricia sp. 1
Asterias amurensis
Crossaster papposus
Leptasterias
Gorgonocephalis caryi
Psolus sp. 1
Strongylocentrotus drobachiensis
Eunephtya rubiformis
Molgula sp. 1
Argis lar
Crangon dalli
Pagurus splendescens
Pandalus hypsinotus
Sclerocrangon borealis
Astarte borealis
Natica sp. 1
*Lyonsia norvegica
Chone infundibuliformes
Harmothoe imbricata
Yoldia hyperborea
Turritella sp. 1
Serripes groenlandicus

Drag #2

Alcyonidium disciforme
Asterias amurensis
Crossaster papposus
Gorgonocephalus caryi
Psolus sp. 1
Strongylocentrotus drobachiensis
Eunephtya rubiformis
Tunicata type 1
Argis lar
Crangon dalli
Pagurus splendescens
Pandalus hypsinotus
Sclerocrangon borealis
Astarte borealis
Natica sp. 1
*Lyonsia norvegica
*Pandora sp.
Yoldia hyperborea
Trichotropsis bicarinata
Margarites helicina
Turritella sp. 1
Balanus sp. 1
Cucumaria caligera
Hyas coarctatus aleuticus
Amphiodia craterodermata
*Ophiuroid sp. 1
Sternaspis scutata
Myriochele heeri
Terebellides stroemi
Sabella crassicornis
*Velutina sp. 1
Serripes groenlandicus

TABLE IV-3 (continued)

Drag #3

Asterias amurensis
Crossaster papposus
Gorgonocephalus caryi
Psolus sp. 1
Strongylocentrotus drobachiensis
Eunephtya rubiformis
Tunicata type 1
Argis lar
Crangon dalli
Pagurus splendescens
Pandalus hypsinotus
Sclerocrangon borealis
Natica sp. 1
Yoldia hyperborea
Macoma brota
Margarites helicina
Gastropod sp. 1
Turritella sp. 1
Cucumaria calcigera
Hyas coarctatus aleuticus
Amphiodia craterodermata
*Ophiuroid sp. 1
Sternaspis scutata
Myriochele heeri
Pseudopotamilla reniformis
Sabella crassicornis
Praxillella praetermissa
Euchone analis
**Velutina* sp.
Serripes groenlandicus

Drag #4

Eunephthya rubiformis
Alcyonidium disciforme
Ectoprocta sp. 1
Rhamphostromella sp. 1
Hemithiris psittacea

Henricia sp. 1
Crossaster sp. 1
Leptasterias sp. 1
Gorgonocephalis caryi
Psolus sp. 1
Strongylocentrotus drobachiensis
Molgula sp. 1
Boltenia ovifera
Argis lar
Argis crassa
Pagurus splendescens
Pandalus hypsinotus
Sclerocrangon borealis
**Velutina* sp. 1
Yoldia hyperborea
Natica sp. 1
Trichotropsis bicarinatata
Macoma brota
Serripes groenlandicus
Haplogaster grebnitzki
Amphiodia craterodermata
Turritella sp. 1
Harmothoe extenuata
Anaitides maculata
Sternaspis scutata
Praxillella praetermissa
Myriochele heeri
Sabella maculata

TABLE IV-4. A list of species collected adjacent to the lease site by 0.1 m^2 van Veen grab.

TAXON			COMMON NAME
Phylum Coelenterata			
	Class Hydrozoa	mixed species	
	Class Anthozoa	Eunephthya rubiformis	soft coral
Phylum Nemertea		mixed species	ribbon worm
Phylum Ectoprocta		Carbasea carbasea	moss animal
		Rhamphostromella sp. 1	moss animal
		encrusting forms (mixed species)	moss animal
Phylum Brachiopoda		Hemithiris psittacea	lamp shell
Phylum Mollusca	Class Amphineura	Lophyrochiton albus	chiton
	Class Gastropoda	Cylichna sp.	snail
		Margarites helicinus	snail
		Natica sp. 1	snail
		Tachyrhynchus sp. 1	snail
		Trichotropsis borealis	snail
		Turritella sp. 1	snail
		gastropod sp. 1	snail
	Class Pelecypoda	Astarte borealis	clam
		Clinocardium ciliatum	clam
		Macoma brota	clam
		Macoma calcarea	clam
		Musculus niger	clam
		Nucula tenuis	clam
		Orobitella compressa	clam
		Serripes groenlandicus	clam
		Thyasira flexuosa	clam
		Yoldia hyperborea	clam

TABLE IV-4 (continued)

TAXON				COMMON NAME
Phylum Sipunculida			Unknown sp. 1	peanut worm
Phylum Annelida	Class Polychaeta			bristle worm
		Family Polynoidae	*Arctonoe vittata*	bristle worm
			Harmothoe imbricata	bristle worm
			sp. 1	bristle worm
			sp. 2	bristle worm
		Family Phyllodocidae	*Eteone longa*	bristle worm
		Family Syllidae	*Syllis oerstedi*	bristle worm
			sp. 1	bristle worm
			Typosyllis fasciata	bristle worm
		Family Nereidae	*Ceratonereis pancidentuta*	bristle worm
			Nereis sp. 1	bristle worm
		Family Nephtyidae	*Nephthys* sp. 1	bristle worm
		Family Goniadidae	*Glycinde wireni*	bristle worm
		Family Lumbrineridae	*Lumbrineris fragilis*	bristle worm
		Family Orbiniidae	*Haploscoloplos elongatus*	bristle worm
		Family Spionidae	Spionid sp. 1	bristle worm
		Family Magelonidae	*Magelona pacifica*	bristle worm
		Family Cirratulidae	*Tharyx multifilis*?	bristle worm
		Family Flabelligeridae	*Bradia inhibilis*	bristle worm
		Family Scalibregmidae	*Scalibregma inflatum*	bristle worm
		Family Opheliidae	*Ophelia limacina*	bristle worm
		Family Sternaspidae	*Sternaspis scutata*	bristle worm
		Family Capitellidae	*Heteromastus filiformis*	bristle worm
		Family Maldanidae	Maldanid sp. 1	bristle worm
			Praxillella gracilis	bristle worm
			Praxillella praetomissa	bristle worm
		Family Oweniidae	*Myriochele heeri*	bristle worm
			Owenia fusiformis	bristle worm
		Family Pectinariidae	*Cistenides granulata*	bristle worm

TABLE IV-4 (continued)

TAXON		COMMON NAME	
	Family Ampharetidae	*Ampharete acutifrons*	bristle worm
		Ampharete reducta	bristle worm
	Family Terebellidae	*Polycirrus medusa*	bristle worm
		Proclea emmi	bristle worm
		Species 1	bristle worm
	Family Trichobranchidae	*Terebellides stroemi*	bristle worm
	Family Sabellidae	*Chone infundibuliformis*	bristle worm
		Euchone analis	bristle worm
		Myxicola infundibulum	bristle worm
		Pseudopotamilla reniformis	bristle worm
		Sabella maculata	bristle worm
		Sabella crassicornis	bristle worm
Phylum Arthropoda	Class Pycnogonida	Sp. 1	sea spider
	Subclass Malocostraca		
	Order Cumacea	*Diastylis goodsiri*	
		Species 1	
	Order Isopoda	*Pleuroprion* sp. 1	pillbug
	Order Amphipoda	Amphipod sp. 1	
Phylum Echinodermata	*Asterias amurensis*	sea star	
	Class Asteroidea	*Evasteris* sp.	sea star
	Class Ophiuroidea	*Amphiodia craterodermata*	brittle star
		Gorgonocephalus caryi	basket star
		Ophiura sarsi	
	Class Echinoidea	*Strongylocentrotus drobachiensis*	sea urchin
	Class Holothuroidea	*Cucumaria calcigera*	sea cucumber
		Cucumaria sp.	sea cucumber
		Psolus sp.	sea cucumber
		Holothuroid sp. 1	sea cucumber
Phylum Chordata			
Subphylum Tunicata		*Boltenia ovifera*	sea squirt
		Molgula sp.	sea squirt

TABLE IV-5. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the Species collected by Grab at Station AH-01, Grab No. 1.

Taxon	Population Density	Total Wet Weight in grams
Nemertean	Fragment	.03
Margarites helicinus	7	.04
Turritella sp.	3	.66
Astarte borealis	2	.36
Serripes groenlandicus	1	.49
Yoldia hyperborea	2	1.50
Polynoidae sp. 1	Fragment	.01
Eteone longa	1	.01
Glycinde wireni	3	.01
Haploscoloplos panamensis	7	.05
Magelona pacifica	4	.11
Tharyx multifidis?	1	.01
Sternaspis scutata	2	.24
Heteromastus filiformis	1	.01
Myriochele heeri	TMTC	.96
Cistenides granulata	1	.22
Pycnogonida	1	.01
Cumacean sp. 1	3	.01
Amphipod sp. 1	2	.28
Amphiodia craterodermata	36	.99
Cucumaria sp.	1	10.46

TABLE IV-6. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-01, Grab No. 2.

Taxon	Population Density	Total Wet Weight in grams
Hydroid	Colony	.54
Eunephthya rubiformis	2	1.695
Nemertea sp.	Fragment	.04
Turritella sp.	5	1.66
Astarte borealis	2	28.44
Macoma brota	1	5.71
Modiolis niger	2	.27
Yoldia hyperborea	4	4.06
Arctonoe vittata	Fragment	.01
Lumbrineris fragilis	2	.30
Sternaspis scutata	2	.15
Praxillella praetomissa	2	.184
Myriochele heeri	2	.08
Terebellides stroemi	4	.41
Pseudopotamella reniformis	1	.128
Cumacean sp. 1	1	.02
Pleuroprion sp.	3	.10
Amphipod sp. 1	3	.14
Amphiodia craterodermata	43	8.67
Gorgonocephalus caryi	3	.092

TABLE IV-7. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-01, Grab No. 3.

Taxon	Population Density	Total Wet Weight in grams
Cylichna sp.	1	.04
Margarites helicinus	1	.04
Turritella sp.	3	1.27
Gastropod unk. sp. 1	2	.91
Macoma calcarea	1	7.53
Orbitella compressa	1	.03
Yoldia hyperborea	4	3.16
Polynoidae sp. 1	1	.23
Lumbrineris fragilis	2	.16
Tharyx multifilis?	1	.02
Scalibregma inflatum	1	2.8
Praxillella praetomissa	4	.35
Cistenides granulata	1	.17
Ampharete acutifrons	1	.03
Terebellidae sp. 1	Fragments	.14
Terebellides stroemi	2	.13
Amphiodia craterodermata	36	1.59
Ophiura sarsi	1	.08

TABLE IV-8. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-01, Grab No. 4.

Taxon	Population Density	Total Wet Weight in grams
Cylichna sp.	1	.03
Margarites helicinus	1	.02
Tachyrhynchus sp.	2	.203
Turritella sp.	4	1.46
Astarte borealis	2	.32
Clinocardium ciliatum	1	2.92
Macoma calcarea	1	1.76
Musculus niger	1	.02
Serripes groenlandicus	1	.21
Thyasira flexuosa	1	.04
Yoldia hyperborea	3	2.48
Polynoidae	1	.02
Lumbrineris fragilis	1	.08
Magelona pacifica	1	.02
Praxillella praetomissa	2	.12
Myriochele heeri	6	.05
Cistenides granulata	1	.09
Terebellides stroemi	1	.08
Cumacean sp. 1	1	.02
Amphipod	7	.02
Amphiodia craterodermata	34	1.66

TABLE IV-9. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-01, Grab No. 5.

Taxon	Population Density	Total Wet Weight in grams
Eunephthya rubiformis	1	.92
Turritella sp.	1	.07
Gastropod unk. sp. 1	1	.35
Astarte borealis	2	.72
Clinocardium ciliatum	1	3.88
Macoma brota	1	9.74
Musculus niger	1	.33
Yoldia hyperborea	1	.55
Polynoid sp. 1	1	.15
Haploscoloplos elongatus	1	.01
Magelona pacifica	1	.02
Bradia inhibilis	2	.85
Praxillella praetomissa	2	.94
Maldanid sp. 1	1	.07
Myriochele heeri	1	.01
Cistenides granulata	1	.18
Amphipod	3	.07
Amphiodia craterodermata	12	.33

TABLE IV-10. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-02, Grab No. 1.

Taxon	Population Density	Total Wet Weight in grams
Tachyrhynchus sp.	1	.11
Turritella sp.	4	1.32
Macoma brota	4	.54
Orbitella compressa	1	Too Small to Weigh
Yoldia hyperborea	1	.51
Magelona pacifica	1	.02
Praxillella gracilis	1	.90
P. praetomissa	3 Fragments	.17
Myriochele heeri	2	.03
Proclea emmi	2	.16
Amphipoda	2	.07
Amphiodia craterodermata	43	1.43
Cucumaria calcigera	1	.16

TABLE IV-11. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-02, Grab No. 2.

Taxon	Population Density	Total Wet Weight in grams
Nemertea sp.	Fragment	.01
Turritella sp.	8	1.58
Macoma brota	1	13.07
Serripes groenlandicus	1	.17
Thyasira flexuosa	1	.07
Yoldia hyperborea	2	2.25
Sipunculid sp. 1	1	.51
Lumbrineris fragilis	1	.55
Magelona pacifica	1	.01
Praxillella praetomissa	2	.11
Ampharete acutifrons	1	.06
Amphiodia craterodermata	51	2.01

TABLE IV-12. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-02, Grab No. 3.

Taxon	Population Density	Total Wet Weight in grams
Nemertea sp.	2	.05
Turritella sp.	5	1.41
Macoma brota	1	10.76
Nucula tenuis	1	.06
Serripes groenlandicus	1	.34
Yoldia hyperborea	2	1.81
Lumbrineris fragilis	1	.08
Magelona pacifica	1	.01
Bradia inhibilis	?	.19
Heteromastus filiformis	F	Too Small to Weigh
Praxillella praetomissa	3	.26
Myriochele heeri	1	Too Small to Weigh
Terebellides stroemi	5	.27
Amphipoda	3	.08
Amphiodia craterodermata	74	3.22

TABLE IV-13. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-02, Grab No. 4.

Taxon	Population Density	Total Wet Weight in grams
Turritella sp.	4	1.39
Gastropod unk. sp. 1	1	.02
Macoma brota	1	.43
Yoldia hyperborea	2	3.77
Lumbrineris fragilis	4	.79
Praxillella praetomissa	Fragments	.13
Myriochele heeri	1	.01
Cistenides granulata	1	.17
Terebellides stroemi	2	.09
Amphipoda sp. 1	1	.03
Amphiodia craterodermata	21	1.1
Cucumaria calcigera	1	.16

TABLE IV-14. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-02, Grab No. 5.

Taxon	Population Density	Total Wet Weight in grams
Nemertea sp.	Fragments	1.34
Turritella sp.	4	1.38
Macoma brota	2	18.63
Serripes groenlandicus	1	.77
Yoldia hyperborea	2	.77
Sipunculid sp. 1	2	7.26
Harmothoe imbricata	1	.06
Praxillella praetomissa	1	.16
Myriochele heeri	2	.03
Terebellides stroemi	1	.06
Amphipoda sp. 1	4	.32
Amphiodia craterodermata	8.1	4.92
Cucumaria calcigera	1	.12

TABLE IV-15. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-04, Grab No. 1.

Taxon	Population Density	Total Wet Weight in grams
Eunephthya rubiformis	1	.65
Carbasea carbasea	3	.73
Natica sp.	2	.27
Serripes groenlandicus	1	23.1
Yoldia hyperborea	4	.81
Harmothoe imbricata	1	.10
Polynoidae sp. 1	1	.79
Ceratonereis paucidentata	1	.03
Lumbrineris fragilis	1	.07
Scalibregma inflatum	1	.24
Haploscoloplos elongatus	1	.13
Cistenides granulata	4	.65
Polycirrus medusa	2	.27
Terebellides stroemi	3	.11
Pseudopotamilla reniformis	F	.30
Sabella maculata	3	.96
Sabella crassicornis	2	.27
Cummacean sp. 1	1	.04
Amphipoda	4	.13
Amphiodia craterodermata	21	.54
Holothuroid sp. 1	2	.20

TABLE IV-16. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-04, Grab No. 2.

Taxon	Population Density	Total Wet Weight in grams
Cistenides granulata	2	.43
Ampharete acutifrons	1	.10
Ampharete reducta	1	.04
Terebellides stroemi	3	.18
Sabella maculata	1	.17
Diastylis goodsiri	1	.07
Amphipoda	1	.16
Amphiodia craterodermata	19	.58
Holothuroid sp. 1	7	.55
Astarte borealis	5	1.78
Serripes groenlandicus	1	.04
Yoldia hyperborea	5	2.12
Arctonoe vittata	2	.07
Syllis oerstedi	1	.01
Ceratonereis paucidentata	2	.05
Glycinde wireni	1	.02
Lumbrineris fragilis	1	.06
Scalibregma inflatum	2	.60
Haploscoloplos elongatus	4	.14

TABLE IV-17. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-04, Grab No. 3.

Taxon	Population Density	Total Wet Weight in grams
Hydroid	1	.107
Gastropoda sp. 1	1	.03
Astarte borealis	2	1.18
Yoldia hyperborea	15	5.24
Arctonoe vittata	Fragments	.01
Syllis oerstedi	1	.01
Ceratonereis paucidentata	1	.14
Magelona pacifica	1	.01
Tharyx multifilis	1	.04
Scalibregma inflatum	1	.21
Heteromastus filiformis	2	.02
Haploscoloplos elongatus	3	.14
Cistenides granulata	1	.16
Ampharete acutifrons	3	.12
Terebellides stroemi	2	.25
Chone infundibuliformis	1	.80
Myxicola infundibulum	2	1.78
Sabella maculata	1	.25
Cumacea sp. 1	1	.02
Amphipoda	1	.17
Amphiodia craterodermata		
Gorgonocephalus caryi	3	.47
Holothuroid sp. 1	2	.36

TABLE IV-18. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-03, Grab No. 4.

Taxon	Population Density	Total Wet Weight in grams
Eunephthya rubiformis	1	18.51
Carbasea carbasea	?	.67
Natica sp.	1	.12
Yoldia hyperborea	16	2.71
Polynoidae sp. 1	1	.23
Lumbrineris fragilis	2	.14
Scalabregma inflatum	2	.32
Haploscoloplos elongatus	1	.06
Praxillella gracilis	1	.08
Myriochele heeri	2	
Cistenides granulata	3	.45
Terebellides stroemi	4	.04
Sabella maculata	4	.77
Sabella crassicornis	3	.60
Pycnogonida sp. 1	1	.04
Pleuroprion sp. 1	2	.06
Amphipoda	2	.07
Amphiodia craterodermata	12	.33
Strongylocentrotus drobachiensis	1	.15

TABLE IV-19. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-03, Grab No. 5.

Taxon	Population Density	Total Wet Weight in grams
Ectoprocta sp. 1	1	.39
Astarte borealis	5	.83
Serripes groenlandicus	1	.05
Yoldia hyperborea	6	2.13
Polynoid sp. 1	1	.20
Lumbrineris fragilis	4	.13
Magelona pacifica	1	.04
Scalibregma inflatum	2	.35
Haploscoloplos elongatus	1	.06
Praxillella praeteromissa	1	.13
Terebellides stroemi	3	.13
Euchone analis	1	.03
Cumacean sp. 1	2	.03
Amphipoda	2	.14
Amphiodia craterodermata	24	.67

TABLE IV-20. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-04, Grab No. 1.

Taxon	Population Density	Total Wet Weight in grams
Astarte borealis	2	.86
Macoma brota	1	.30
Yoldia hyperborea	11	3.37
Syllis oerstedi	1	.01
Myriochele heeri	2	.02
Cistinides granulata	4	.60
Terebellides stroemi	2	.06
Euchone analis	1	.03
Cumacean sp. 1	1	.02
Amphiodia craterodermata	1	.03
Molgula sp.	1	.98

TABLE IV-21. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-04, Grab No. 2.

Taxon	Population Density	Total Wet Weight in grams
Astarte borealis	1	.05
Yoldia hyperborea	4	.97
Spionid sp. 1	1	.04
Cistenides granulata	3	.84
Terebellides stroemi	1	.07
Amphiodia craterodermata	1	.02
Molgula sp.	3	10.52

TABLE IV-22. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-04, Grab No. 3.

Taxon	Population Density	Total Wet Weight in grams
Yoldia hyperborea	3	.73
Syllid sp. 1	1	.02
Lumbrineris fragilis	1	.11
Haploscoloplos elongatus	1	.05
Spionid sp. 1	1	.02
Cistenides granulata	3	.04
Amphipoda	2	.06
Amphiodia craterodermata	7	.23
Psolus sp.	2	32.21
Molgula sp.	1	1.18

TABLE IV-23. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-04, Grab No. 4.

Taxon	Population Density	Total Wet Weight in grams
Yoldia hyperborea	4	1.89
Myriochele heeri	1	101.0
Cistenides granulata	9	1.63
Euchone analis	1	.02
Amphipoda sp. 1	6	.23
Amphiodia craterodermata	6	.12
Cucumaria sp. 1	1	103.0

TABLE IV-24. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-04, Grab No. 5.

Taxon	Population Density	Total Wet Weight in grams
Clinocardium ciliatum	1	2.09
Musculus niger	1	.15
Yoldia hyperborea	6	.82
Typosyllis fasciata	1	.07
Lumbrineris fragilis	1	.07
Cistenides granulata	3	.53
Ampharete acutifrons	1	.07
Amphipoda sp. 1	3	.17
Amphiodia craterodermata	3	.06
Holothuroid sp. 1	1	.03
Molgula sp.	1	6.33
Boltenia ovifera	1	6.59

TABLE IV-25. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-05, Grab No. 1.

Taxon	Population Density	Total Wet Weight in grams
Eunephthya rubiformis	1	.13
Astarte borealis	1	.55
Yoldia hyperborea	1	.06
Nereis sp. 1	1	.07
Ceratonereis paucidentata	1	.01
Cistenides granulata	1	.09
Ampharete acutifrons	1	.02
Chone infundibuliformis	1	.66
Euchone analis	1	.02
Sabella maculata	1	.11
Sabella crassicornis	1	.11
Amphiodia craterodermata	7	.29
Evasterias sp. 1	1	1.74
Cucumaria calcigera	1	.06

TABLE IV-26. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-05, Grab No. 2.

Taxon	Population Density	Total Wet Weight in grams
Eunephthya rubiformis	1	3.39
Astarte borealis	2	1.05
Syllis oerstedi	1	.01
Lumbrineris fragilis	1	.08
Myriochele heeri	2	.01
Cistenides granulata	1	.55
Amphiodia craterodermata	33	1.03

TABLE IV-27. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-05, Grab No. 3.

Taxon	Population Density	Total Wet Weight in grams
Ophelia limacina	1	.12
Amphiodia craterodermata	10	.19
Cucumaria calcigera	1	.16

TABLE IV-28. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-05, Grab No. 4.

Taxon	Population Density	Total Wet Weight in grams
Hydroids	6	.05
Lophyrochiton albus	1	.02
Myriochele heeri	1	.01
Scalibregma inflatum	1	.04
Amphiodia craterodermata	53	.81
Strongylocentrotus drobachiensis	1	21.61

TABLE IV-29. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-05, Grab No. 5.

Taxon	Population Density	Total Wet Weight in grams
Astarte borealis	1	.50
Amphiodia craterodermata	24	.68

TABLE IV-30. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-06, Grab No. 1.

Taxon	Population Density	Total Wet Weight in grams
Hydroids	6	.01
Lophyrochiton albus	1	.02
Natica sp.	1	.09
Astarte borealis	2	4.8
Nucula tenuis	1	.20
Yoldia hyperborea	11	6.9
Glycinde wireni	1	.01
Lumbrineris fragilis	1	.10
Magelona pacifica	1	.01
Praxillella praetomissa	1	.06
Cistenides granulata	5	.58
Cumacean sp. 1	1	.01
Amphipod sp. 1	2	.44
Amphiodia craterodermata	12	.14

TABLE IV-31. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-06, Grab No. 2.

Taxon	Population Density	Total Wet Weight in grams
Hydroids unk. spp.	2	.01
Carbasea carbasea	1	.10
Encrusting Ectoprocta	1	Too small to weigh
Hemithiris psittacea	1	.03
Astarte borealis	1	4.39
Macoma brota	1	.06
Musculus niger	1	.19
Thyasira flexuosa	1	.03
Yoldia hyperborea	11	7.8
Lumbrineris fragilis	2	.05
Polynoidae	Fragment	.02
Pleuroprion sp.	3	.06
Amphiodia craterodermata	34	.64

TABLE IV-32. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-06, Grab No. 3.

Taxon	Population Density	Total Wet Weight in grams
Hydroids	7	.02
Eunephthya rubiformis	1	.78
Nemertea	Fragments	.15
Encrusting ectoproct sp. 1	1	Too small to weigh
Lophyrochiton albus	1	.02
Margarites helicinus	4	.12
Trichotropsis bicaniculata	1	.01
Astarte borealis	10	1.58
Macoma brota	1	.36
Macoma calcarea	1	.11
Thyasira flexuosa	1	.04
Yoldia hyperborea	5	2.8
Syllis oerstedi	1	.01
Ceratonereis paucidentata	2	.08
Nepthys sp. 1	1	1.127
Lumbrineris fragilis	3	.41
Magelona pacifica	1	Too small to weigh
Myriochele heeri	1	.01
Cistenides granulata	3	.60
Cumacean	1	.09
Amphiodia craterodermata	39	1.60
Cucumaria calcigera	5	1.82

TABLE IV-33. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-06, Grab No. 4.

Taxon	Population Density	Total Wet Weight in grams
Hydroid	1	.01
Nemertea	Fragment	.02
Margarites helicinus	1	.03
Astarte borealis	1	.03
Macoma brota	4	1.11
Yoldia hyperborea	7	4.3
Glycinde wireni	1	.01
Lumbrineris fragilis	4	.48
Scalibregma inflatum	1	.01
Cistenides granulata	9	1.16
Amphiodia craterodermata	26	.42
Amphipoda	2	.18

TABLE IV-34. The Population Density and biomass (wet formalin weight inclusive of shell weight) of the species collected by Grab at Station AH-06, Grab No. 5.

Taxon	Population Density	Total Wet Weight in grams
Eunephthya rubiformis	2	6.0
Diastylis goodsiri	1	.08
Serripes groenlandicus	1	4.67
Yoldia hyperborea	5	2.3
Glycinde wireni	1	.01
Lumbrineris fragilis	Fragment	.15
Cistenides granulata	2	.61
Amphiodia craterodermata	5	.05
Gorgonocephalus caryi	1	.07
Molgula sp.	1	8.80

The species collected in July and August 1973 were representatives of 10 separate phyla. The fishes in the trawl collections were principally sculpins (Family Cottidae); the only flatfishes collected were the yellowfin sole (*Limanda aspera*). Other species of flatfish occur in the general area of the lease site as shown by Geiger and Baxter (unpublished data) and Ellson et al. (1950). None of the flatfishes appear to be abundant.

Of the invertebrates taken from sandy-gravel-rock bottom in the lease area, members of the phylum Echinodermata (sea stars, sea urchins, sea cucumbers, brittle stars) were the most common and contributed the greatest invertebrate biomass to the area. Representative species of other invertebrate groups were also common (e.g., the soft coral, *Eunephthya* and some species of shrimps such as the coonstripe shrimp, *Pandalus hypsinotus*, and gray shrimps - species of the family Crangonidae). Polychaetous annelids appeared to assume a greater importance in the mud-sand areas outside the lease site, but one species of echinoderm, *Amphiodia craterodermata*, still represented a dominant form in all of the grab samples.

Assessment of invertebrate feeding types in the lease area showed a preponderance of suspension feeders, scavengers and predators with relatively few deposit feeders (Table IV-35). An increase in deposit feeders with a decrease in scavengers were noted in the grab samples taken in the mud-sand area outside of the lease site (Table IV-36).

Species taken by trawl within the lease site were similar at all stations sampled (Tables IV-37 through IV-45). In addition, species reported from areas east and west of the lease site in 1949, 1968 and 1971 as well as within the lease site were similar to those taken by the authors in 1973 (see Tables IV-1, IV-2 and IV-3; Appendix Tables II-1 and II-2 from others).

TABLE IV-35. Feeding methods* used by invertebrate species collected at the 8 trawl stations on the American Mining and Smelting Company Lease Site (see Fig. I-2 and Table IV-1 for locations and depths). Phylum: P = Porifera, C = Coelenterata, B = Bryozoa; S = Sipunculoidea, E = Echinodermata, Ct = Chordata tunicata

Species	Phylum	Deposit Feeder	Suspension Feeder	Scavenger	Predator	Unknown
Sponges (3 species)	P		X			
Actinaria	C				X	
Hydroid sp. 1 (mixed species)	C				X	
Tubularia sp. 1	C				X	
Eunephthya rubiformis	C				X	
Alcyonidium discoforme	B		X			
Carbacea carbacea	B		X			
Flustrella sp.	B		X			
Rhamphostromella sp. 1	B		X			
Ectoprocta sp. 1	B		X			
Sipunculid unk. sp. 1	S	X				
Polynoidae (3 species)	P			X		
Arctonoe vittata	P			X		
Harmothoe extenuata	P			X		
Pseudopotamilla reniformis	P		X			
Eunoe oerstedi	P			X		
Astarte borealis	M		X			
Hiatella arctica	M		X			
Musculus niger	M		X			
Gastropod unk. sp. 1	M					X
Nudibranch sp. 1	M					X
Natica sp. 1	M				X	
Capulacmaea radiata	M	X?				
Trichotropsis bicarinata	M	X?				
Sclerocrangon borealis	A			X		
Argis crassa	A			X		
Argis lar	A			X		

*(See Feder *et al.*, 1973, for data sources for feeding methods; others based on interpretations by the authors of this report.)

TABLE IV-35 (continued)

E = Echinodermata, CT = Chordata Tunicata

Species	Phylum	Deposit Feeder	Suspension Feeder	Scavenger	Predator	Unknown
Crangon dalli	A			X		
Crangon septemspinosa	A			X		
Haplogaster grebnitzki	A			X		
Hyas coarctatus aleuticus	A			X		
Pagurus splendescens	A			X		
Pandalus hypsinotus	A				X	
Pandalus goniurus	A				X	
Spirontocaris groenlandicum	A			X		
Pleuroprion sp. 1	A			X		
Amphipod sp. 1	A			X		
Paralithodes camtschatica	A				X	
Balanus spp. (2 spp.)	A		X			
Tanystylum duospinum	AP				X	
Asterias amurensis	E				X	
Crossaster papposus	E				X	
Evasterias sp.	E				X	
Leptasterias sp.	E				X	
Asteroidea (4 species)	E				X?	
Henricia sp.	E		X			
Amphiodia craterodermata	E		X			
Gorgonocephalus caryi	E				X	
Psolus sp.	E		X?			
Strongylocentrotus drobachiensis	E			X		
Tunicata sp. 1	CT		X			
Molgula sp.	CT		X			
Boltenia ovifera	CT		X			
Total		3	20	17	19	2
% of Total		4.9%	32.8%	27.9%	31.1%	3.3%

TABLE IV-36. Feeding methods* used by invertebrate species collected at 5 grab stations adjacent to the lease area (see Fig. I-2 and Table IV-1 for locations and depths). C = Coelenterata; N = Nemertinea, S = Sipunculoidea, B = Bryozoa, L = Brachiopoda, P = Polychaetous annelids.

Species	Phylum	Deposit Feeder	Suspension Feeder	Scavenger	Herbivore	Predator	Unknown
Hydroid (mixed species)	C					X	
Eunephthya rubiformis	C					X	
Nemertean (mixed species)	N					X	
Sipunculida	S	X					
Carbasea carbasea	B		X				
Rhamphostromella sp. 1	B		X				
Encrusting Ectoprocta (mixed species)	B		X				
Hemithiris psittacea	L		X				
Ampharete reducta	P	X					
Ampharete acutifrons	P	X					
Cistenides granulata	P	X					
Euchone analis	P		X				
Lumbrineris fragilis	P	X					
Magelona pacifica	P	X					
Myriochele heeri	P		X				
Owenia fusiformis	P		X				
Proclea emmi	P	X					
Praxillella gracilis	P	X					
Praxillella praetomissa	P	X					
Syllis oerstedi	P					X	
Typosyllis fasciata	P					X	
Syllid sp. 1	P					X	
Terebellides stroemi	P	X					
Sternaspis scutata	P	X					
Pseudopotamilla reniformis	P		X				

*(See Feder et al., 1973, for data sources for feeding methods; others, not documented, are based on interpretations by the authors of this report.)

TABLE IV-36 (continued)

P = Polychaetous annelids, M = Mollusca, A = Crustacea, Py = Pycnogonida, E = Echinodermata

Species	Phylum	Deposit Feeder	Suspension Feeder	Scavenger	Herbivore	Predator	Unknown
Scalibregma inflatum	P	X					
Terebellid sp. 1	P	X					
Tharyx multifilis?	P	X					
Bradia inhibilis	P	X					
Maldanid sp. 1	P	X					
Haploscoloplos elongatus	P	X					
Polynoid (2 species)	P			X			
Arctonoe vittata	P			X			
Harmothoe imbricata	P			X			
Heteromastus filiformis	P	X					
Sabella maculata	P		X				
Sabella crassicornis	P		X				
Polycirrus medusa	P	X					
Ceratonereis paucidentata	P					X?	
Glycinde wireni	P						X
Myxicola infundibulum	P		X				
Chone intundibuliformis	P		X				
Spionid sp. 1	P	X					
Nereid sp. 1	P					X	
Ophelia limacina	P	X					
Nephthys sp. 1	P					X	
Eteone longa	P					X	
Lophyrochiton albus	M	X?					
Gastropoda sp. 1	M						X
Natica sp.	M					X	
Tachyrhynchus sp. 1	M						X
Margarites helicinus	M	X?					
Turritella sp.	M						X
Trichotropsis bicarinata	M						X
Cylichna sp. 1	M					X	

TABLE IV-36 (continued)

M = Mollusca, A = Crustacea, Py = Pycnogonida, E = Echinodermata

Species	Phylum	Deposit Feeder	Suspension Feeder	Scavenger	Herbivore	Predator	Unknown
Clinocardium ciliatum	M		X				
Astarte borealis	M		X				
Macoma brota	M	X					
Macoma calcarea	M	X					
Musculus niger	M		X				
Nucula tenuis	M	X					
Orobitella compressa	M		X				
Serripes groenlandicus	M		X				
Thyasira flexuosa	M		X				
Yoldia hyperborea	M	X					
Cumacean sp. 1	A	X					
Diastylis goodsiri	A	X					
Amphipod unk. sp. 1	A			X			
Pleuroprion sp.	A			X			
Pycnogonid sp. 1	Py					X	
Amphiodia craterodermata	E		X				
Ophiura sarsi	E	X					
Gorgonocephalus caryi	E					X	
Asterias amurensis	E					X	
Evasterias sp.	E					X	
Holothuroidea sp. 1	E	X					
Psolus sp.	E		X?				
Cucumaria calcigera	E		X				
Cucumaria sp.	E		X				
Strongylocentrotus drobachiensis	E			X			
Boltenia ovifera	E		X				
Molgula sp.	E		X				
Total		31	24	7		16	5
% of Total		37.3	28.9	7.8		19.3	6.0%

TABLE IV-37. The Population Density and biomass (wet formalin weight inclusive of shell weight) of species collected by trawl at Station 9.

Taxon	Population Density	Total Wet Weight in grams
Porifera	Fragment	10.4
Hydroid	Colonial	20.0
Carbasea carbasea	Colonial	0.9
Hiatella arctica	2	1.6
Astarte borealis	3	6.9
Eunoe oerstedi	1 + Fragments	5.8
Polynoid unk. sp. 1	1	3.2
Polynoid unk. sp. 2	1	0.4
Balanus sp. 1	2	50.1
Balanus sp. 2	38	4.9
Argis crassa	2	3.8
Argis lar	2	4.3
Crangon dalli	1	0.7
Pagurus splendescens	3	17.5
Pandalus hypsinotus	35 + Fragments	143.4
Pandalus goniurus	1	0.5
Spirontocaris groenlandica	1	0.5
Sclerocrangon borealis	5	30.0
Haplogaster grebnitzki	3	20.7
Hyas coarctatus aleuticus	1	2.3
Asterias amurensis	6	221.0
Crossaster papposus	4	29.0
Evasterias sp.	1	44.7
Leptasterias sp.	2	72.2
Asteroid sp. 1	1	4.0
Strongylocentrotus drobachiensis	19	216.8
Psolus sp.	8	400.0
Echinoderm material	Fragment	112.6
Tunicata sp. 1	5	192.7
Tunicata sp. 2	2	19.5
Chirolophis decoratus	1	11.4
Enophrys lucasi	2	39.3
Nautichthys pribilovius	2	4.5
Limanda aspera	1	6.4

TABLE IV-38. The Population Density and biomas s (wet formalin weight inclusive of shell weight) of species collected by trawl at Station 11.

Taxon	Population Density	Total Wet Weight in grams
Eunephthya rubiformis	2	47.8
Flustrella sp.	Colonial	10.5
Rhamphostromella	Colonial	48.1
Hiatella arctica	1	4.5
Crangon dalli	1	1.6
Pandalus hypsinotus	4	19.5
Pandalus goniurus	1	0.3
Sclerocrangon borealis	3	11.1
Asterias amurensis	26	65.7
Crossaster papposus	1	14.4
Henricia sp. 1	1	1.3
Asteroid sp. 1	1	1.7
sp. 2	6	10.2
sp. 3	7	19.3
Gorgonocephalus caryi	1	0.9
Strongylocentrotus drobachiensis	44	846.5
Psolus sp.	2	10.3
Gymnocanthus galeatus	4	86.5

TABLE IV-39. The Population Density and biomass (wet formalin weight inclusive of shell weight) of species collected by trawl at Station 12.

Taxon	Population Density	Total Wet Weight in grams
Tubularia sp.	1	3.4
Hydroids	Colonial	16.3
Eunephthya rubiformis	1	0.9
Carbasea carbasea	Colonial	31.9
Flustrella sp.	Colonial	55.2
Hiatella arctica	1	0.2
unknown gastropod	3	3.9
Eunoe oerstedi	3	2.2
Argis crassa	7	10.2
Crangon septemspinosa	2	5.0
Pandalus hypsinotus	5	14.6
Asterias amurensis	10	25.0
Leptasterias sp.	1	24.0
Asteroid no. 1	1	6.7
Brittle star unknown sp.	2	3.4
Gorgonocephalus caryi	1	145.3
Strongylocentrotus drobachiensis	12	230.6
Psolus sp.	1	36.6
Tunicata sp. 1	1	69.9
Microcottus sellaris	1	6.7

TABLE IV-40. The Population Density and biomass (wet formalin weight inclusive of shell weight) of species collected by trawl at Station 14.

Taxon	Population Density	Total Wet Weight in grams
Porifera	1	3.0
unknown hydroids	Colonial	5.4
Eunephthya rubiformis	5	26.0
Carbasea carbasea	Colonial	3.8
Flustrella sp.	Colonial	37.3
Rhamphostromella sp.	Colonial	2.6
Crangon dalli	2	0.5
Pandalus hypsinotus	4	7.9
Pandalus goniurus	2	0.5
Sclerocrangon borealis		
Hyas coarctatus aleuticus		3
Asterias amurensis	67	613.8
Crossaster papposus	6	49.6
Henricia sp.	1	0.7
Leptasterias	Fragments	320.2
Asteroid sp. 1	6	17.8
sp. 4	3	314.5
Brittle star	1	0.9
Strongylocentrolus drobachiensis	53	379.9
Echinoderm material	Fragments	512.4
Tunicata sp. 1	1	2.1
Chirolophis snyderi	2	16.2
Eleginus gracilis	3	139.0
Gymnocanthus galeatus	5	156.0
Lumpenus maculatus	1	14.2
Microcottus sellaris	2	14.8

TABLE IV-41. The Population Density and biomass (wet formalin weight inclusive of shell weight) of species collected by trawl at Station 15.

Taxon	Population Density	Total Wet Weight in grams
Hydroids	Colonial	1.1
Actinaria	3	150.2
Eunephthya rubiformis	Colonial	39.7
Carbasea carbasea	Colonial	51.4
Flustrella sp.	Colonial	81.5
Rhamphostromella sp.	Colonial	51.5
Musculus niger	5	28.5
Unknown polychaeta	15	14.4
Sabella maculata	5	2.9
Unknown pycnogonid	1	0.3
Crangon septemspinosa	1	1.2
Pagurus splendescens	1	2.5
Pandalus hypsinotus	1	1.8
Sclerocrangon borealis	2	1.2
Paralithodes camtschatica	1	7.0
Asterias amurensis	12	87.5
Leptasterias sp.	Fragments	233.3
Strongylocentrotus drobachiensis	8	199.4
Psolus sp.	1	6.9
Echinoderm material	Fragments	43.4
Tunicata sp. 1	20	200.
sp. 2	10	134.6
Eleginus gracilis	2	41.8
Enophrys clarigen	1	27.3
Enophrys lucasi	1	14.1
Gymnocanthus galeatus	8	195.8
Myoxocephalus verrucosus	1	48.6
Limanda aspera	8	57.2

TABLE IV-42. The Population Density and biomass (wet formalin weight inclusive of shell weight) of species collected by trawl at Station 18.

Taxon	Population Density	Total Wet Weight in grams
Porifera	1	8.0
Hydroids unk. sp.	Colonial	4.1
Eunephthya rubiformis	6	130.9
Alcyonidium discoforme	82	936
Carbasea carbasea	Colonial	122.7
Flustrella sp.	Colonial	9.7
Rhamphostromella sp.	Colonial	23.5
Ectoprocta unk. sp.	Colonial	Too small to weigh
Capulacmea radiata	1	3.0
Musculus niger	1	0.7
Gastropod unk. sp.	1	2.3
Cephalopod egg case	1	1.1
Sipunculid unk. sp.	1	2.1
Polynoid sp. a	1	1.3
Polynoid sp. b	1	0.6
Pseudopotamilla reniformis	16	13.9
Balanus sp. 2	28	55.0
Tanystylum duospinum	1	Too small to weigh
Argis crassa	7	3.8
Argis lar	4	31.8
Crangon septemspinosa	7	31.6
Pagurus splendescens	5	2.1
Pandalus hypsinotus	8	27.0
Pandalus goniurus	6	10.7
Sclerocrangon borealis	7	53.6
Hyas coarctatus aleuticus	1	27.1
Asterias amurensis	137	562.4
Crossaster papposus	13	128.1
Evasterias sp.	2	111.0
Henricia sp.	5	4.9
Leptasterias sp.	12	1,471.2
Asteroid sp. 1	14	95.0
sp. 2	18	85.2
sp. 3	21	86.7
sp. 4	3	392.1
Gorgonocephalus caryi	3	87.2
Strongylocentrotus drobachiensis	22	621.3
Psolus sp.	2	43.7
Echinoderm material		62.8

TABLE IV-42 (continued)

Taxon	Population Density	Total Wet Weight in grams
Compound ascidians	3 colonies	1.9
Tunicata sp. 1	7	277.0
Tunicata sp. 2	9	80.4
Eleginus gracilis	5	136.1
Enophrys lucasi	1	56.3
Eumesogrammus praecisus	1	14.2
Gymnocanthus galeatus	5	191.5
Microcottus sellaris	3	44.1
Myoxocephalus verrucosus	3	67.8
Nautichthys pribilovius	3	4.6
Pholis dolichogaster	1	33.4
Agonus acipenserinus	1	9.1

TABLE IV-43. The Population Density and biomass (wet formalin weight inclusive of shell weight) of species collected by trawl at Station 19, Trawl No. 2.

Taxon	Population Density	Total Wet Weight in grams
Eunephthya rubiformis	2	5.3
Carbasea carbasea	Colonial	3.3
Flustrella sp.	Colonial	1.1
Rhamphostromella sp.	Colonial	57.0
unknown sipunculid	1	0.2
Arctonoe vittata	1	70.1
Eunoe oerstedi	2	0.7
Harmothoe extenuata	1	0.3
Balanus sp. No. 2	12	1.3
Argis crassa	9	23.7
Pagurus splendescens	3	19.2
Pandalus hypsinotus	11	51.8
Spirontocaris groenlandica	1	9.9
Asterias amurensis	49	681.6
Crossaster papposus	12	69.2
Henricia sp.	1	0.4
Leptasterias sp.	9	821.7
Asteroid sp. 1	13	31.8
Asteroid sp. 2	9	34.9
Asteroid sp. 5	1	21.5
Strongylocentrotus drobachiensis	42	1,758.0
Psolus sp.	5	213.6
Enophrys lucasi	1	23.9
Gymnocanthus galeatus	3	81.7
Microcottus sellaris	5	38.8

TABLE IV-44. The Population Density and biomass (wet formalin weight inclusive of shell weight) of species collected by trawl at Station 19, Trawl No. 12.

Taxon	Population Density	Total Wet Weight in grams
unknown sponge	Fragments	11.1
hydroids	Colonial	7.0
Actinaria	1	29.6
Carbasea carbasea	Colonial	34.5
Flustrella sp.	Colonial	253.9
Rhamphostromella sp.	Colonial	325.4
Hiatella arctica	1	3.0
Trichotropis bicarinata	1	4.3
Astarte borealis	1	1.4
Harmothoe extenuata	1	0.4
Balanus sp. 1	4	354.4
sp. 2	3	3.5
Crangon dalli	2	6.3
Crangon septemspinosa	1	0.7
Pagurus splendescens	6	11.3
Pandalus hypsinotus	18	45.0
Pandalus goniurus	32	12.1
Spirontocaris groenlandica	1	4.5
Sclerocrangon borealis	16	62.7
Hyas coarctatus aleuticus	3	28.7
Asterias amurensis	23	586.7
Crossaster papposus	9	45.0
Henricia sp.	1	1.4
Leptasterias sp.	13	373.3
Asteroid sp. 1	1	7.3
sp. 2		1.5
Strongylocentrotus drobachiensis	187	2,345.5
Psolus sp.	1 + Fragments	163.0
Echinoderm material	Fragments	225.5
Tunicata sp. 2	3	35.3
Eurymen gyrinus	2	68.2
Gymnocanthus galeatus	5	151.8
Microcottus selleris	1	5.5
Myoxocephalus verracosus	1	50.1
Nautichthys pribilovius	2	5.0

TABLE IV-45. The Population Density and biomass (wet formalin weight inclusive of shell weight) of species collected by trawl at Station 19, Trawl No. 3.

Taxon	Population Density	Total Wet Weight in grams
Sponge-rough	1	2.5
smooth	4	2.5
Hydroids	Colonial	5.1
Eunephthya rubiformis	9	78.2
Carbasea carbasea	Colonial	15.7
Rhamphostromella sp.	Colonial	29.8
Astarte borealis	1	1.2
Cryptonatica sp.	1	2.5
Nudibranch sp. 1	1	0.8
Eunoe oerstedi	2	2.2
Harmothoe extenuata	1	0.4
Balanus sp. 1	2	129.6
Balanus sp. 2	1	1.2
Argis crassa	11	27.7
Crangon septemspinosa	3	5.5
Pagurus splendescens	8	12.3
Pandalus hypsinotus	8	32.6
Hyas coarctatus aleutiens	1	1.7
Strongylocentrotus drobachiensis	73	
Tunicata sp. 2	1	4.0
Entosphenus tridentatus	1	65.1
Eleginus gracilis	1	61.5
Gymnocanthus galeatus	2	84.2
Myoxocephalus joak	1	2.1
Nautichthys pribilovius	2	12.5
Liparis cyclopus	1	10.8

DISCUSSION

Most of the species collected in this investigation are known; also similar species have been reported for other regions of the northeastern Bering Sea shelf by Soviet investigations (Neyman, 1960). The presence of known species is fortunate, making possible broad biological interpretations of the changes in the biota in the lease area and immediate vicinity when mining operations begin.

The species collected within the lease site (a similar aggregate of species have been collected in and near the lease site since 1969) are forms typical of a sandy-gravel-rock, well oxygenated, high energy area. The assemblages of species present appear to be representative of a stable and apparently mature community of organisms (see Rosenberg, 1972 for a discussion of community formation and stability).

The broad spectrum of trawl and drag stations occupied over the lease site in both space and time (collections made in 1949, 1968, 1971, 1973) gives a good, qualitative basis for a continuing assessment of the region during the period of mining activity. In addition, trawl station data from other similar sand-gravel-rock areas near the lease site, demonstrate the similarity in species composition and general abundance along coastal regions near Nome. Thus, adequate control sites will be available to permit comparisons of disturbed with undisturbed areas.

An understanding of the sand-mud community just south of the lease site (Fig I-1; Table IV-1) is important since organisms of this region are the only ones near the site that can be sampled quantitatively. Organisms here are highly dependent on sediment for their general activities with many species actually engulfing the sediment for feeding purposes (see Tables IV-35 and IV-36 for a tabulation of feeding types): these species will be sensitive to changes in their substratum. The magnitude of biological change taking place in these mud-sand areas during mining activities in the closely adjacent areas should be determinable via monitoring activities. A reduction of certain species can be expected by way of increased environmental stresses and possibly by way of an influx of predators from highly disturbed adjacent areas where prey organisms may have been depleted. Organisms present in sand-mud areas are typically important food species (e.g., polychaetous annelids, mollusks, some echinoderms) for bottom-feeding organisms of potential fisheries importance (e.g., tanner or snow crab, flatfishes), but depletion of such food species over small areas such as the projected lease site will probably not be important. However, extensive mining activities along great coastal extents will have importance and such activities should be carefully monitored if avoidance of such activities is impractical.

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CHAPTER V. CHEMICAL OCEANOGRAPHY

D. W. Hood and David Burrell

INTRODUCTION

Marine chemical environments do, on occasion, change when the environment is placed under impact, particularly from the addition of chemicals or severe changes in the sediment regime.

The near steady state conditions established at the water-sediment interface are interrupted with activities (such as dredging) that disturb the sea floor (Ketchum, 1972). New chemical reactions are brought into play on newly exposed sediment. For example, when reduced sediments are dredged, the release of sulfides may induce a decrease in the oxygen concentration to a low enough level to threaten marine life. Further, the oxidative process can change the solubility relations of the heavy metals, and concentrations could reach toxic levels.

Trace pollutant metals introduced into the marine environment are overwhelmingly retained on solid phases, and few processes act to solubilize these elements. Nevertheless, there have been a few reported occurrences of coastal increases in the soluble contents which may presumably be attributed to industrial or urban contamination. The best documented example of this has been local perturbations of Cu, Pb, Cd and Zn distributions in coastal embayments of industrialized areas in Europe (Abdullah *et al.*, 1972). It seems likely that local increases of this type must be related to organo-metallic complexation such as might be reasonably expected in highly populated areas. However, so few studies of this type have been attempted that it is unwise to generalize.

OBJECTIVES

Because of the justified current concern over heavy metal pollution in both fresh and marine waters it is strongly advisable to determine baseline contents prior to any industrial perturbation, and this has been attempted here. Dissolved and particulate organic carbon (DOC and POC) values have also been determined as essential background data. Any disturbance of the components of the natural carbon cycle by dredging operations would be of considerable importance.

Both organic matter (dissolved organic carbon-DOC, particulate organic carbon-POC) and pH values can reflect alterations in gross chemical features of a marine system (Ketchum, 1972).

Because of the justified current concern over heavy metal pollution in both fish and marine waters, and the possible disturbance of the carbon cycle by dredging operations, an attempt was made to ascertain baseline contents of heavy metals, DOC, POC and pH prior to any industrial perturbation.

METHODS

Trace metals. Samples from the ASRC Lease area were collected ship-board in a metal-free sampler and stored in acid rinsed 250 ml poly bottles. Concentrated HCl (0.5 ml) was added to each bottle to prevent loss of the analyte metals by sorption on the container surfaces.

The analysis technique employed (Burrell, Williamson and Lee, 1973) necessitates chelation and extraction of the trace metals at seawater pH. It was necessary, therefore, to initially buffer the above samples to this pH range. The complete pre-analysis treatment was as follows:

i) 10 ml aliquots of each sample were pipetted into 15 ml capacity glass centrifuge tubes fitted with teflon-lined caps. Each tube had been washed with a 0.1% solution in dithizone in chloroform prior to use.

ii) To bring each sample to pH 8.2, 10 drops of approximately 1.0 M tris buffer and 5 drops of 4.5% KOH solution were added to the tubes.

iii) 1.0 ml of the 0.1% dithizone in chloroform reagent was added. The tubes were mechanically shaken for 10 minutes, the upper aqueous layer was decanted and replicate 3 μl aliquots of the organic phase were atomized in a Varian Model 63 carbon rod for each test element. Samples for zinc analysis were diluted x4 with chloroform.

For each analytical run, one sample bottle was treated to produce a standard addition working curve. Different concentrations of each metal (chosen to conform with the expected concentration range) were added to each of three 10 ml aliquots. These standards were then extracted as given above.

Two additional tubes containing 10 ml of seawater were buffered as described. 0.02 ml concentrated HCl, 10 drops of tris buffer and 5 drops of KOH solution were then added in addition. The absorption difference observed constituted the signal blank for these reagents. A further analysis of the dithizone solution was also needed. The following example illustrates the required absorbance peak height readings for one arbitrary cadmium determination:

a.	Seawater	-10.7 average peak height units
b.	SW + 0.1 ppb Cd	-21.2
c.	SW + 0.2 ppb Cd	-25.8
d.	SW + 0.3 ppb Cd	-40.2
e.	Dithizone blank	- 0.8
f.	SW + additional reagents	-11.9
g.	acid/buffer reagent blank	-(f + e) - a

Organic Carbon Analysis. Water samples for organic carbon analysis were collected and filtered through two 47-mm glass fiber filters (which had been heated to 475°C for at least 4 hours) in a glass Millipore filter holder. For DOC determinations, 5 ml of the filtrate were added to a 10 ml glass ampoule which had been baked at 575°C for 4 or more hours. For POC analyses, each filter was rolled and inserted in an ampoule within which 5 ml of the filtrate was added. Approximately, 0.1 g $K_2S_2O_8$ and 0.25 ml 3%-H_3PO_4 were added to each ampoule. After flushing for 5 minutes with purified oxygen the ampoules were sealed using a special ampoule sealer.

DOC samples were prepared in at least triplicate; and POC in duplicate or triplicate.

The organic carbon content of the sealed ampoules was measured by heating the ampoule (to 175°C for 24 hours) to oxidize the organic carbon and then measuring the resultant CO_2 by passing it through an infrared gas analyzer. CO_2-free nitrogen was used as a carrier gas from the ampoule crusher to the CO_2 analyzer. The recorded peak area was proportional to the amount of CO_2.

The DOC and POC calibration curves were prepared from standard dextrose solutions.

Reagent blanks were determined by making triplicate measurements on different amounts (usually 1, 2, 3, 4, and 5 ml) of low carbon sea water. The amounts of carbon obtained were plotted against ml of sample and the curve extrapolated to zero.

For POC analysis, the filter blank problem was solved by filtering the sample through two filters placed in a single filter holder. The POC value of the sample was then obtained by subtracting the value of carbon on the bottom filter from the top filter value.

pH. Values for pH were determined on all samples collected on the ASRC lease area as well as Norton Sound. Determinations were carried out with a Coleman pH meter using a single glass-calomel electrode. Standardization was made against both Beckman and Mallinkrodt pH 7.0 standard buffer solutions maintained at the same temperature as the samples.

The samples were collected in sampling bottles similar to those used for oxygen and were stored in a water bath having the same temperature as sea surface water. Analyses were made within one hour from collection by dipping the electron probe deep into the sample bottle so as to minimize artefacts arising from gas exchange.

RESULTS

Data obtained for trace metals are summarized in Table V-1, for organic carbon content in Table V-2, and for pH values in Table V-3.

DISCUSSION

The trace metal data fall in the usual range for open seawater samples. Particulate organic samples are similarly "normal" but the dissolved organic data are somewhat higher than those recorded by Loder for the southern Bering Sea and the Chukchi Sea.

It is not considered likely that marine dredging operations will have a measurable perturbation on these parameters. Release of fine-grained sediment

TABLE V-1

TRACE METAL CONCENTRATIONS IN NORTON SOUND

STATION	DEPTH	bottle #	Pb(ppb)	Cd(ppb)	Cu(ppb)	Zn(ppb)
		<				
NS - 3	0	41	<.1	.06	0.9	21.6
	10	42	<.1	.05	0.8	12.3
	15	43	.2	.12	1.1	42.3
NS - 2	0	44	<.1	.04	0.8	3.8
	10	45	<.1	.06	0.9	3.3
	15	46	<.1	.05	0.9	3.3
NS - 12	0	50	.3	.05	0.6	7.8
	10	51	.1	.10	0.5	5.2
	15	52	<.1	.08	0.9	16.7
NS - 27	0	56	.1	.04	0.4	11.1
	10	57	<.1	.14	0.8	5.8
	15	58	<.1	.04	0.8	7.8
NS - 26	0	59	.2	.09	1.1	8.0
	10	60	<.1	.06	1.0	10.7
NS - 28	0	61	.2	.28	0.9	5.2
detection limit $\left(\frac{\text{2x baseline}}{\text{units per ppb}}\right)$			.1	.006	.1	.1

NOTES:

1. Nonseparation of suspended particulate material; i.e., the results are for extractable soluble species plus that metal extracted from the varying particulate fraction present.
2. Analytical error. No precision limits for the latter have been included since this is likely to be considerably smaller than that due to the pre-analysis

TABLE V-2

CONCENTRATION OF DISSOLVED AND PARTICULATE ORGANIC MATTER IN WATER SAMPLES COLLECTED NEAR NOME, ALASKA.

STATION	DEPTH (m)	VOLUME (mL)	DISSOLVED ORGANIC CARBON (mg C/ℓ)	PARTICULATE ORGANIC CARBON (μg C/ℓ)
NS-1A	10	1000	2.55	--
NS-1B	10	1000	-	--
NS-13	10	1000	2.36	119
NS-3	10	1000	2.18	197
NS-26	10	500	2.30	176
NS-28	0	500	2.68	130
"	10	1000	2.00	90
"	17	1000	2.47	185

TABLE V-3

pH DATA, NORTON SOUND, JULY 1973, ACONA 173

STATION	NAME	BOTTLE	DEPTH	pH
173-052	NS-1	100	0	7.850
		50	1.5	7.915
		25	3.5	7.900
		10	6.0	7.908
		1	12.0	7.850
173-053	NS-13	3049	0	8.073
		3051	1.5	7.990
		3052	3.5	7.932
		3058	6.0	7.965
		3060	12.0	7.940
173-054	NS-3	3052	0	7.760
		3053	10	7.765
		3054	15	7.755
173-055	NS-2	3048	0	7.800
		3049	10	7.768
		3050	20	7.745
173-056	NS-9	3057	0	7.816
		3058	10	7.792
		3059	20	7.744
173-057	NS-12	3048	0	7.793
		3049	10	7.786
		3050	19	7.744
173-058	NS-22	3052	0	7.887
		3053	10	7.880
		3054	15	7.845
173-059	NS-27	3048	0	7.809
		3049	10	7.805
		3050	15	7.779
173-060	NS-26	3051	0	7.805
		3052	10	7.832

TABLE V-3 (continued)

STATION	NAME	BOTTLE	DEPTH	pH
173-061	NS-28	961	0	7.845
		962	10	7.791
		963	15	7.785
173-062	NS-21	964	0	7.842
		965	10	7.782
		966	20	7.779
173-063	NS-20	967	0	7.810
		968	10	7.815
		969	20	7.785
173-064	NS-11	3051	0	7.866
		3052	10	7.842
		3053	20	7.776
173-065	NS-10	961	0	7.895
		962	10	7.842
		963	20	7.816
173-070	NS-40	966	0	7.970
		970	0.5	7.925
		971	1.0	7.900
		972	2.5	7.900
		973	5.0	7.865
173-072	NS-42	3055	0	7.875
		3057	0.5	7.900
		3058	1.0	7.905
		3059	2.5	7.905
		3060	5.0	7.905
173-073	NS-43	3058	0	7.882
		3059	5	7.892
		3060	10	7.870
173-074	NS-44	3054	0	7.900
		3055	5	7.850
		3057	10	7.890
173-075	NS-45	3058	0	7.920
		3059	5	7.932
		3060	10	7.905
173-076	NS-46	3054	--	--
		3055	5	7.935
		3057	10	7.935

TABLE V-3 (continued)

STATION	NAME	BOTTLE	DEPTH	pH
173-080	NS-50	3048	0	7.940
		3049	5	7.900
		3050	10	7.905
173-081	NS-51	3048	0	7.885
		3049	5	7.895
		3050	10	7.870
		3054	15	7.770
173-082	NS-52	3057	0	8.030
		3058	5	8.030
		3059	10	7.950
		3060	15	7.940

into the water column might cause very localized scavaging of metals but this would be undetectable in this open system. Similarly any effect on the organic carbon regime, due perhaps to exposure of anoxic sediment, would be of minute consequence.

The pH values noted are within the normal limits found in coastal areas of northern latitude during summer months.

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CHAPTER VI. PRODUCTIVITY AND NUTRIENT CYCLING

David Boisseau and J. J. Goering

INTRODUCTION

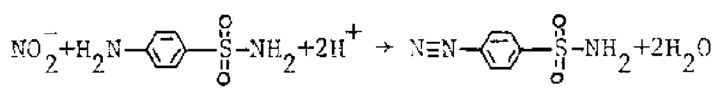
Shallow, nearshore Bering Sea waters support extensive growth of phytoplankton, the prime producers of organic matter in the sea, because light and abundant inorganic and organic nutrients are usually more available here than in deeper offshore areas. This is often attributed to freshwater runoff or to coastal upwelling supplying nutrients. The effects of nutrient supply by nutrient regeneration in the bottom sediments, however, have not been extensively studied. The sea bottom in shallow water is undoubtedly an important nutrient source, and it is a tightly coupled component of an interdependent nearshore ecosystem.

OBJECTIVES

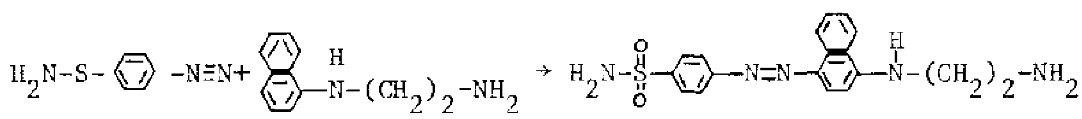
Because primary production is critical to all life in the sea, a baseline study of marine primary production and nutrient cycling in the vicinity of Nome, a proposed site of extensive mining activity, has been started with funds provided by American Smelting Co. The objective of primary production studies is to evaluate the capacity of an ecosystem to build up, at the expense of external energy (both radiant and chemical), primary organic compounds of high energy potential for further transformation and flow to higher trophic levels.

METHODS

Nitrite. Nitrite at pH∿1 was diazotiaed with sulfanilamide for nitrogen determination by the method of Bendschneider and Robinson (1952):



The product of this reaction was subsequently coupled with N-(1-naphthyl) ethylenediamine to yield a highly colored diazo dye.



The linear function of nitrite concentration to the optical density of this dye was measured at 530 nm for 0.01-3.0 μM concentrations of nitrite within a precision range of about 10 percent.

The following reagents were used in the automated procedure of Strickland and Parsons (1968):

Sulfanilamide: 10 g in 1 liter of 10% v/v HCl

N-(1-naphthyl)ethylenediamine dihydrochloride: 1 g in 1 liter distilled water

Nitrate. Nitrate was reduced to nitrite with cadmium-mercury amalgam and determined by means of the nitrite procedure. A wash of 10% w/v ammonium chloride was used to prevent buildup of reduction-inhibiting cadmium hydroxide on the surfaces of the amalgam.

$$Cd^\circ + Hg^{2+} \rightarrow Cd^{2+} + Hg^\circ$$

$$Cd^{2+} + NO_3^- + H_2O \rightarrow NO_2^- + Cd(OH)_2\downarrow$$

$$nCl^- + Cd(OH)_2\downarrow \rightarrow Cd(Cl)_n$$

The sample was diluted on the manifold to provide linear detection of nitrate in the 0.1 to 20-μM range.

The reduction was carried out in a 0.8 X 15-cm glass column containing mercury-cadmium amalgam, prepared by treating 40 to 60-mesh cadmium filings with 2% w/v mercuric chloride at a reduction efficiency of about 95 percent.

The automated method used in this study, developed at the Institute of Marine Science (Fairbanks) by D. M. Schell in 1967, has a precision of about 10 percent.

Ammonia. Ammonia was determined by automated analysis, modified Koroleff method (Slawyk and MacIsaac 1972).

Phosphate. Phosphate was determined by its reaction with ammonium polymolybdate under strongly acidic conditions to form a phospho-molybdate complex, which was reduced by ascorbic acid to a *heteropoly-blue*. Small quantities of potassium antimonyl-tartrate were added to enhance color development.

This automated procedure, taken from Strickland and Parsons (1968), is an adaptation of the Murphy and Riley manual method (1962). The following reagents were used:

34 g ammonium polymolybdate and 0.25 g potassium antimonyl tartrate in 4 liters 10% v/v H_2SO_4

4 g ascorbic acid in 100 ml acetone and 100 ml distilled water

A working ascorbic acid solution consisting of 20 ml of the above solution in 100 ml distilled water (prepared daily)

Maximum absorbance of the *heteropoly-blue* complex was at 880 nm and linear response for phosphate ranging in concentration from 0.1 to 10 μM was obtained at this wave length by use of silicon photo-cells at a precision of about 10 percent.

Soluble silica. Soluble silica, like phosphate, was determined as a colored molybdate complex formed in acidic media from the reaction of orthosilicic acid and ammonium polymolybdate. This complex was reduced by stannous chloride to the *heteropoly-blue* form, with tartaric acid used to inhibit phosphate and arsenate interference. The following reagents were used in this automated procedure (Strickland and Parsons 1968):

Stock molybdate: 200 g ammonium paramolybdate in 4 liters distilled water

Working molybdate: 80 ml stock molybdate in 120 ml 10% v/v hydrochloric acid

Tartaric acid: 400 g tartaric acid in 3.8 liters distilled water

Stock reductant: 40 g stannous chloride dissolved in 50 ml 50% v/v hydrochloric acid

Working reductant: 2.5 ml stock reductant in 100 ml 10% v/v hydrochloric acid (prepared daily)

Linear response was obtained from the silico-molybdate complex at 700 nm, although this was not the region of maximum response. Samples were diluted with distilled water on the manifold to give linear response for soluble silica concentrations from 1-120 μM at a precision of about 10 percent.

Measurements of chlorophyll and phaeo-pigments. Seawater samples were collected with a 5-liter PVC Niskin bottle (General Oceanics, Inc., Model 1010) from light depths corresponding to various levels of surface incident solar radiation (100, 50, 25, 10 and 1 percent) and were transferred into 4-liter polyethylene sample bottles. One milliliter of a $MgCO_3$ suspension was added to each bottle, and the contents were then filtered through a fine glass fiber filter (Gelman Type A). The filter containing the particulate matter was folded in half, inserted into a glassine envelope and kept frozen in the dark until extraction could be carried out.

In the laboratory the filters were added to 7 ml of spectrophotometric-grade acetone and vigorously agitated with a microspatula attached to an electric motor until the filters were completely pulverized. The tubes were next placed in a refrigerator for 20 hours, removed and allowed to come to room temperature, then centrifuged at 3000 rpm for 15 min. The clear supernatant liquid was pipetted into a 10-cm spectrophotometric cell and analyzed in a Perkin-Elmer Model 202 scanning spectrophotometer. Absorbance was recorded for each sample over the wavelength range 350–750 nm.

Chlorophyll *a*. Chlorophyll *a* was calculated from the following expression (Strickland and Parsons 1968):

$$\text{mg Chl } \underline{a}/\text{m}^3 = \frac{[11.6\ E_{665} - 1.31\ E_{645} - 0.14\ E_{630}]v}{V \times \ell}$$

where E is the corrected extinction value at 665 nm, 645 nm and 630 nm.

ℓ = path length of spectrophotometric cell (cm)

V = volume of seawater filtered (liters)

The computation of integrated values for chlorophyll *a* in the euphotic zone was based on the summation of trapezoids, opposed to the subjective approach of drawing a curve. Points representing concentrations of chlorophyll *a* or phaeo-pigments were plotted against depth and the points connected from surface (100 percent light) to depth (1 percent light). The points were connected also to corresponding depths on the Z axis, and the areas of the four resulting trapezoids were summed. This method of integration was used also to compute particulate nitrogen values and carbon-14 and nitrogen-15 uptake rates in the euphotic zone.

Measurements of primary production by the ^{14}C method. Five each of light and dark 125-ml reagent bottles were filled with seawater from the five selected light depths (100,50,25,10 and 1 percent). Two milliliters of seawater were removed from each bottle, and 1 ml of a $^{14}C\text{-}HCO_3^-$ solution (5 μc) was added. The 10 reagent bottles from each station were incubated for 4 hours in a deck incubator in neutral-density, light-screened pyrex glass tubes which approximated the light intensities at the depths samples. Seawater flowed continuously through the deck incubator, keeping samples at approximate sea surface temperatures.

After incubation, the filters were placed in liquid scintillation vials containing 15 ml "Aquasol" liquid scintillation fluor and 2 ml distilled water and returned to the laboratory for counting. The filters were counted on a Beckman β-Mate II liquid scintillation counter.

The rate of carbon uptake (primary productivity) was calculated according to Strickland and Parsons (1968):

$$\text{mg C/m}^3\text{-hr} = \frac{(R_s - R_b) \times W \times 1.05}{R \times N}$$

where

R_s = normalized counting rate of sample planchette

R_b = normalized counting rate of blank

R = normalized counting rate of $^{14}C\text{-}HCO_3^-$ solution added (ampoule contents)

N = number of hours the sample was exposed to light

W = $12{,}000 \times A \times F_t$

A = total carbonate alkalinity

F_t = factor which converts carbonate alkalinity to total carbon dioxide

The primary productivity beneath a square meter of sea surface was computed by the same method as described for chlorophyll *a*.

RESULTS

Primary Productivity: In July 1973, a two-day survey of the primary productivity and nutrient regime in the shallow nearshore Bering Sea waters off Nome, Alaska, was conducted on R/V *ACONA* cruise 173. The results of this study are presented in Fig. VI-1 and Tables VI-1,2 and 3.

The daily rate of primary productivity, as measured by the ^{14}C technique, is given in Table VI-1. The rate, 490 mg C/m^2/day is similar to the rates that have been observed in other Bering Sea shelf waters at this time of year. McRoy et al. (1972) have made several measurements of summer primary productivity near the Aleutians and the southeastern Bering Sea. The rates varied widely, primarily a result of different locations and light conditions. The range of measurements was 18 to 867 mg C/m^2/day with an average value of 243 MgC/m^2/day (a value based on more than 20 stations). This value compares well with all reported estimates of Bering Sea rates for summer.

The summer standing crop of phytoplankton near Nome, as evidenced by their chlorophyll content (Table VI-2), also appears to be similar to values reported for other Bering Sea shelf waters. The summer standing stock of phytoplankton near the Aleutians and the southeastern Bering range from 0.2 to 9.9 mg Chl a/m^3 with an average of 1.88 (McRoy et al., 1972).

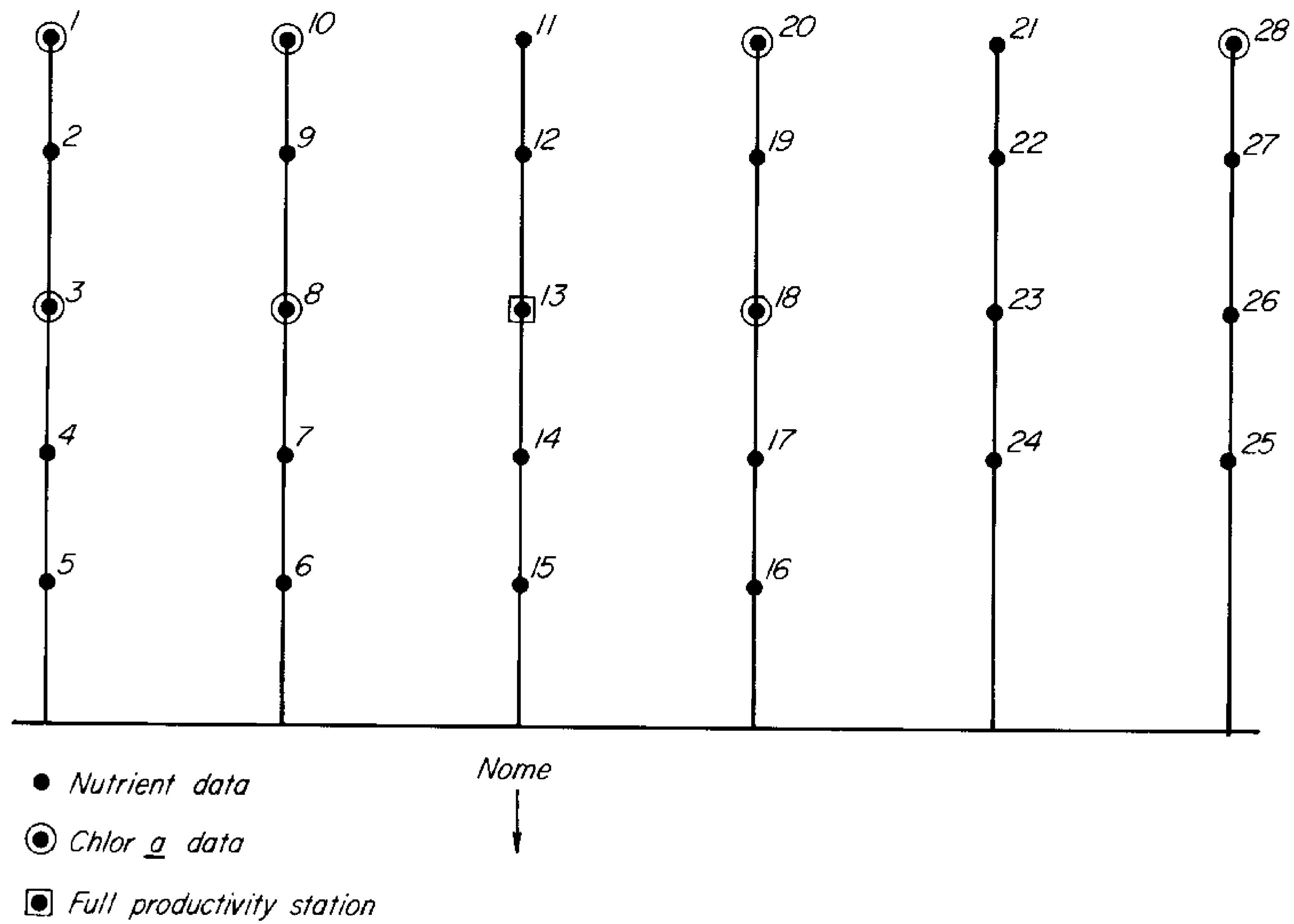


Figure VI-1. R/V *ACONA* Nome station grid in the Bering Sea near Nome.

TABLE VI-1. Primary productivity in the Bering Sea near Nome.

C^{14} uptake data		ACONA 173 July 1973		
Station	Depth	$mgC/m^3/hr$	$mgC/m^2/hr$	mgC/m^2-day
NS-13				
100%	0	4.40	40.83	498.96
50%	1.5	7.42		
25%	3.5	4.56		
10%	6.0	2.89		
1%	12.0	0.67		
AC 173-070	64°14.6 N; 163°36.5 W			
NS-40*				
50%	0	7.42	38.55	462.62
50%	0.5	10.46		
50%	1.0	11.07		
50%	2.5	9.53		
50%	5.0	1.07		
AC 173-072	64°16.0 N; 161°26.0 W			
NS-42				
100%	0	6.01	23.60	283.14
50%	0.5	7.85		
25%	1.0	6.50		
10%	2.5	5.49		
1%	5.0	0.55		
AC 173-080	63°40.0 N; 164°30.0 W			
NS-50				
100%	0	3.60	19.89	238.68
50%	1.0	4.22		
25%	2.5	3.91		
10%	4.0	2.44		
1%	8.0	0.12		

*Represents a light versus depth experiment
A sample taken at the 50% light level (0.5 m) and incubated at 100%, 50%, 25%, 10% and 1% light levels.

TABLE VI-2. Chlorophyll concentrations in the Bering Sea near Nome.

Chlor *a* data	ACONA 173 July 1973		
Station	Depth	mg/m^3	mg/m^2
NS-1			
100%	0	0.97	12.38
50%	1.5	1.02	
25%	3.5	1.04	
10%	6.0	0.98	
1%	12.0	1.12	
NS-3	0	0.91	
NS-8	0	1.17	13.15
	5	1.01	
	10	0.72	
	15	0.63	
NS-10	0	0.81	11.25
	5	0.84	
	10	0.80	
	15	0.41	
NS-13	0	0.83	9.44
50%	1.5	1.01	
25%	3.5	0.80	
10%	6.0	0.79	
1%	12.0	0.63	
NS-18	0	1.38	10.95
	5	1.08	
	10	0.84	
NS-20	0	0.85	10.17
	5	0.80	
	10	0.56	
	15	0.50	
NS-28	0	0.81	12.72
	5	0.75	
	10	1.08	
	15	0.62	

TABLE VI-3. Nutrient content in the Bering Sea near Nome.

Nutrients		ACONA 173 Nome Grid		Bering Sea July 1973	
Station	Depth	NO_2+NO_3-N	$Si(OH)_4$-Si	NH_3-N	PO_4-P
NS-1	0	0.05	22.56	0.26	0.28
	1.5	0.05	20.25	0.26	0.22
	3.5	0.08	22.56	0.23	0.22
	6.0	0.10	22.75	0.23	0.25
	12.0	0.13	21.37	1.25	0.22
NS-8	0	0.25	24.37	0.73	0.12
	5	0.18	22.75	0.15	0.32
	10	0.23	19.19	0.81	0.30
	15	0.18	16.06	2.97	0.30
NS-10	0	0.10	22.00	3.37*	0.12
	5	0.10	16.87	0.47	0.10
	10	0.15	21.94	0.15	0.28
	15	0.58	21.06	0.76	0.12
NS-13	0	0.05	27.92	0.40	0.28
	1.5	0.02	21.94	0.89	0.25
	3.5	*2.28	25.45	1.11	0.47
	6.0	0.02	23.90	0.22	0.41
	12.0	0.02	23.38	6.33	0.53
NS-18	0	0.0	26.06	0.99	0.02
	5	0.01	23.50	0.23	0.15
	10	0.06	23.12	0.29	0.32
NS-20	0	0.10	22.50	0.50	0.22
	5	0.18	22.56	0.29	0.22
	10	0.15	19.94	0.35	0.30
	15	0.25	22.81	0.41	0.38
NS-28	0	0.20	22.81	0.23	0.22
	5	0.10	22.81	3.44*	0.18
	10	0.13	22.56	0.44	0.30
	15	0.23	20.56	0.47	0.22

*Represents doubtful values recorded from the Technicon autoanalyzer.

Nutrient Cycling: Nitrogen is often implicated as the chemical species limiting plant growth in coastal waters. It likewise appears to limit summer phytoplankton growth off Nome as evidenced by the low concentrations of nitrate and ammonia in the euphotic zone (Table VI-3). Phosphorus and silicic acid concentrations appear to be sufficient to support abundant phytoplankton growth.

The high surface (0m) silicic acid content in the western part of the sampling grid undoubtedly results from Yukon River input. The occasional high levels of ammonia in deep water probably reflects the importance of the sea bed as a nutrient regenerator.

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CHAPTER VII. GEOLOGICAL OCEANOGRAPHY NEAR NOME

G. D. Sharma

INTRODUCTION

Nome, Alaska, became famous after the discovery of placer gold deposits during the late nineteenth century. Gold which was previously mined along the beaches, extended to onshore buried beaches during 1904-1906. During mid-twentieth century the ore concentration became too low to provide profitable mining in this region.

Shortage of gold reserves in the U.S. treasury and the higher world market price have revived interest for gold mining in the offshore areas. The renewed interest in this region in 1968 was expressed by a systematic geological investigation by the U.S. Geological Survey (Hopkins, 1968; Hopkins, et al., 1968; Nelson and Hopkins, 1968; Nelson et al., 1969; Scholl and Hopkins, 1969; Silberman and Hopkins, 1969; Greene, 1970; Tagg and Greene, 1970; Sheth, 1971; Nelson and Hopkins, 1972) and the University of Washington (McManus et al., 1969; Venkatarathnam, 1969; Grim and McManus, 1970; McManus and Smyth, 1970). These studies were primarily designed for gold exploration and included examination of about 500 bottom samples and 51 core samples from Chirikov Basin and Norton Sound.

The purpose of this investigation is to delineate the sedimentary environment of the offshore region lying between Nome River and Cripple River. A study of bottom topography, grain size distribution, suspended load distribution and heavy mineral concentrations is included to determine the sediment source and the dynamics of sediment transport in the region. Sediment properties including grain size, organic carbon and selected heavy metal distribution will be related to the benthic species diversification and concentrations. An attempt is made to determine the sediment transport in suspension by integrating the suspended load distribution, clay minerals distribution and the hydrographic data.

OCEANOGRAPHIC SETTING

The area of investigation is located in Norton Sound along the shore of the Seward Peninsula. The region extends approximately 5 miles offshore to a depth of about 75 feet and is bounded by Nome River on the east and Cripple River on the west (Figs. VII-1 and I-2).

The water depth increases rapidly to 40 feet within less than 1 mile from shore. The bottom slopes gradually between 30 and 60 feet. Little influence on bathymetry is exerted by rivers draining into the region.

The climate is wet. Shorefast or moving ice cover prevails for 6-7 months during the year. Summer storms generally ravage the entire shallow regions of Norton Sound. Strong coastal bottom currents reaching speeds up to 100 cm/sec have been reported in the vicinity of Nome (Nelson and Hopkins, 1972). These currents are intermittent and flow both eastward and westward along the coast. Normally the tidal current dominates in this region.

GEOLOGIC SETTING

Southern Seward Peninsula is largely underlain by metamorphosed sedimentary rocks intruded by dikes and sills of granite, diorite and

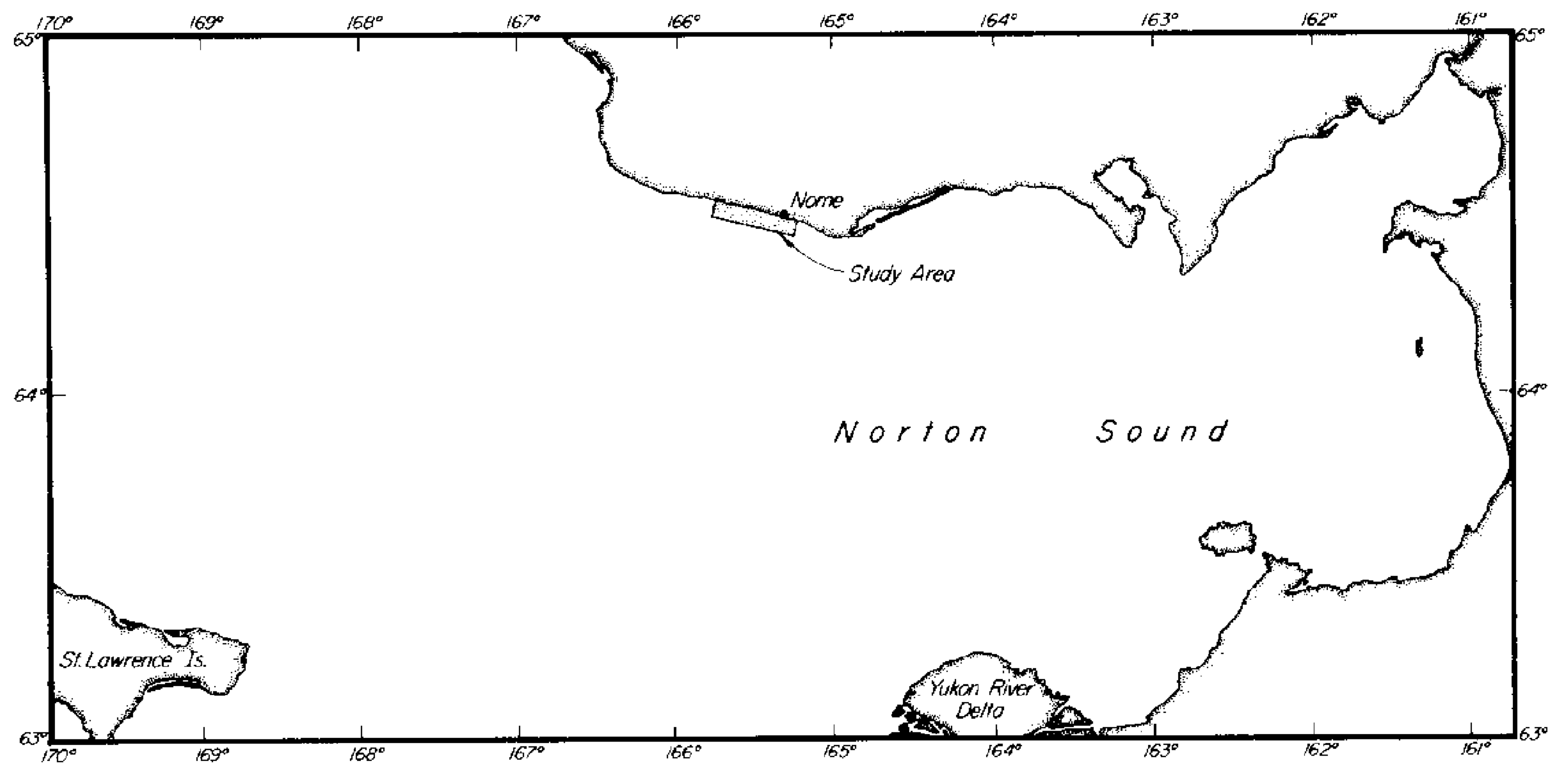

Fig. VII-1. Index map showing the location of the study area.

diabase (Moffit, 1913). The bedrock (Nome Group) lies just below the sea bottom off the Cripple River while eastward it is covered by thicker marine deposits of late Tertiary and Quaternary age (Nelson and Hopkins, 1972). These marine sediments, interstratified with glacial deposits, are covered with modern beach sediments, alluvium, colluvium, wind blown silt and peat deposited during Halocene time. The coastal plain near Nome was glaciated at least twice and glaciers extended several miles southward from the present shoreline. The early glaciation occurred during Pleistocene and last during Illinoian time. Four major marine units represent different sea level stands and are locally known as Pliocene beach, Submarine beach, Third beach and Second beach (Nelson and Hopkins, 1972). The contemporary beach in the vicinity of Nome is narrow, less than 200 feet wide, bordered by 10-20 feet high wave-eroded cliffs capped by tundra.

METHODS OF STUDY

Bottom surficial sediments from 31 stations were obtained during July 1973 using a modified van Veen grab sampler (Appendix III; Table 1). Duplicate samples for analysis comparison were obtained from two stations.

Water samples from the surface and various depths were obtained by Niskin bottle casts. The salinity measurements were made onboard ship using a Bissett Berman Model 6230N inductive salinometer and temperatures were read from immersion thermometers.

The station depths were routinely recorded onboard ship by use of a Ross Precision Depth Recorder.

Laboratory processing of samples included sedimentological and chemical analysis, determination of organic carbon, X-ray diffraction analysis and measurements of suspended sediment load. Sedimentological analyses were carried out according to the methods of Folk (1961). Sediment samples were treated with H_2O_2 to remove organics. Sand and gravel fractionated by wet sieving were dry sieved, and pipette analyses were run on the silt and clay fraction. Sediment grain size parameters were computed using formulae described by Folk (1961).

For organic carbon determination sediments were finely ground, treated with HCl and dried at 40°C. The carbonate-free samples were powdered, dried, and 50-100 mg of sample was weighed and placed into a porcelain boat for combustion analysis. The samples were combusted with oxygen at 800°C, and the total CO_2 evolved was measured using a Beckman Model 315B Infrared Analyzer by a modified method of Menzel and Vaccaro (1964). The sample was placed in a 38.1 cm quartz combustion tube (10-mm ID, 12 mm OD). The combustion tube was packed with 18 cm of wire-form reagent cupric oxide (Baker No. 1820), placed 5 cm from the exit end and held in place with quartz wool. The combustion tube with sample was then placed in its holder and moved into a hot oven so that just the cupric oxide was heated. The tube was flushed with oxygen at 4 lbs/in^2 at 100 ml/min for 3 minutes while the cupric oxide was heated to 800°C. Gases from the collection bulb were removed by pulling a vacuum of 51 mm Hg. The sample was then moved into the furnace and was heated to 800°C along with cupric oxide while the tube was flushed with oxygen. The combustion of the sample lasted about 3 minutes and the vacuum in the chamber dropped to about 13 mm Hg. The pressure in the collection chamber was equilibrated to atmospheric pressure by allowing CO_2 free air to enter the chamber. The gas evolved from the sample was then circulated through the IR analyzer and the concentration was read on a microampere. This measurement was read against a calibration curve to determine the organic carbon in the sample.

The concentration distribution of selected heavy metals in sediments was determined by using a cold digestion method and atomic absorption spectrophotometry. The samples were treated with H_2O_2 overnight at 60°C, finely ground with an agate mortar and pestle, and dried at 60°C. One half gram of the dry sample was weighed in a platinum crucible and allowed to react with concentrated HF for 24 hours on a water bath. The dry sample was then removed and 0.5 ml of concentrated perchloric acid was added and allowed to fume at 250°C until the samples were completely oxidized. A few ml concentrated HF was again added to the sample and was placed on a water bath for further reaction. Finally the residue was dissolved in concentrated HCl and diluted to 50 ml with 30% HCl solution. Heavy metals concentrations in the samples were determined by using a Perkin Elmer 303 atomic absorption spectrophotometer.

X-ray diffraction analysis were performed on $< 4\ \mu$ and $< 2\ \mu$ sediment sample fractions using a Norelco X-Ray Diffractometer. Clay mineralogy and relative amounts of clay minerals were determined by identification of peaks and relative peak heights of X-ray diffractograms.

Millipore (47-mm) filter papers (HAWP 04700, HA 0.45-μ Millipore) were used to determine the suspended load in water samples. The filter papers were prewashed in 50°C distilled water for 15 minutes, rinsed in distilled water at room temperature and allowed to dry in a desiccator. The filter papers were then transferred into an enclosed weighing chamber with desiccant and allowed to dry for 24 hours. The weights of filter papers were determined using a sealed microbalance. Before weighing, 10 filter papers were randomly selected out of each stock to be used as control filters. The control filters were weighed first and then periodically reweighed. A total of ten weighings were made on each control filter by this procedure. The numerical average of the weights obtained for each filter was accepted as the true weight of that filter. A thorium oxide, "alpha particle" source was used during all weighings to minimize electrostatic charges. Filter papers were sealed in petri dishes and numbered for use. On board ship, 2 liters of water samples were filtered through a preweighed paper and washed with 25 ml distilled water. Filters with the suspended matter and the control filters for all batches were desiccated and weighed as described. Variations in filter weights due to humidity and balance conditions were corrected using changes in control filter weights. A statistical analysis made on control filters over the entire process of sample weighing indicated an error of $\pm$ 0.2 mg.

RESULTS

Bottom Sediments

The bottom sediments near Nome consist of sandy gravels and gravelly sands (Fig. VII-2). In general, near beach sediments are gravel which become finer offshore. The gravel deposits form an irregular belt which

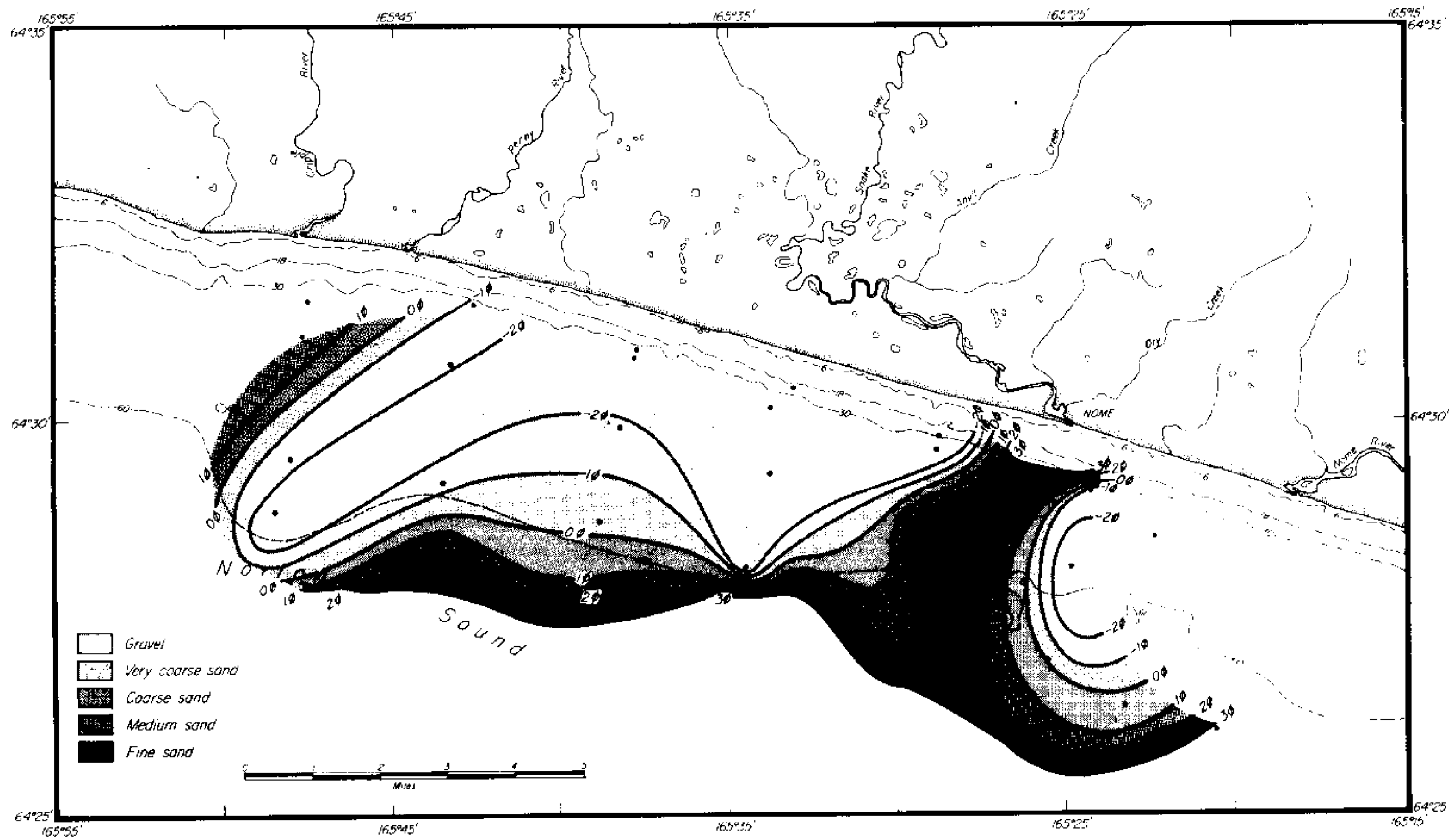

Fig. VII-2. Mean size (M_2) variation of surficial sediments.

extends parallel to the shore. The gravel belt is cut by finer sediments in the vicinities of the Snake River and Penny River. A patch of sand was observed in the gravel deposit. With the exception of fine sand at the mouth of Snake River the coarser sediments are poorly to very poorly sorted and gravelly sands are extremely poorly sorted (Fig. VII-3 and Appendix III: Table 2). The gravel sediments are near-symmetrical to coarse-skewed while the finer sediments are fine-skewed to strongly fine skewed (Fig. VII-4). The sediment distribution varies from platykurtic to very leptokurtic (Fig. VII-5).

The particle size distributions (Fig. VII-6) as well as the gravel-sand-silt clay distribution (Fig. VII-7 and Appendix III; Table 3) suggest that there are three general types of surface sediments--relict gravel, muddy sand, and mixture of gravel and sand. Relict-glacial sediments consists of more than 50 percent gravel. These sediments have been reworked by transgression and regression and fine (clay and silt) sediments have been winnowed from them. The strong currents which removed the fine sediments also prevent deposition of contemporary sediments on them. Nearshore relict-gravel grades offshore into sand and muddy sands. These sediments consist of Holocene sediments and fines winnowed from relict-gravel sediments. Sands are prevalent near the river mouths and as bars along the beaches. The mixed sediments consist of sediments derived from relict gravel and the Holocene sands.

Heavy minerals (> Sp. gr. 2.90) were separated using sink or float method in bromoform from sand-sized fractions 1.5-2.0 ϕ (0.25-0.35 mm) and 2.5-3.0 ϕ (0.125-0.177 mm) in order to interpret mineralogical changes to delineate source areas, depositional environment and modes of sediment transport. The heavy mineral concentrations in these sediments increase with a decrease in sediment grain size (Figs. VII-8 and VII-9, Tables VII-1 and VII-2). Heavies

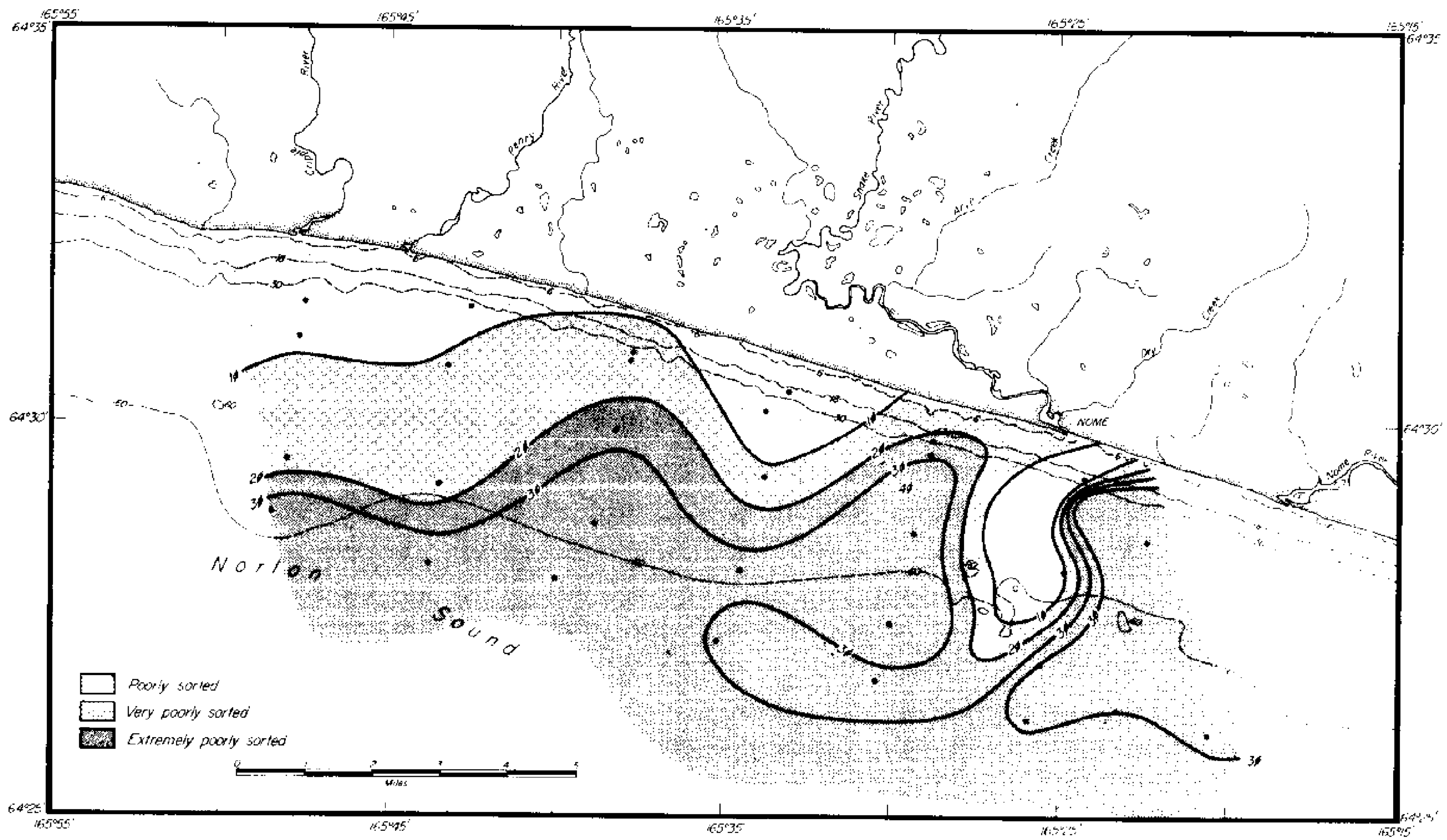

Fig. VII-3. Sorting (σ_I) in surficial bottom sediments.

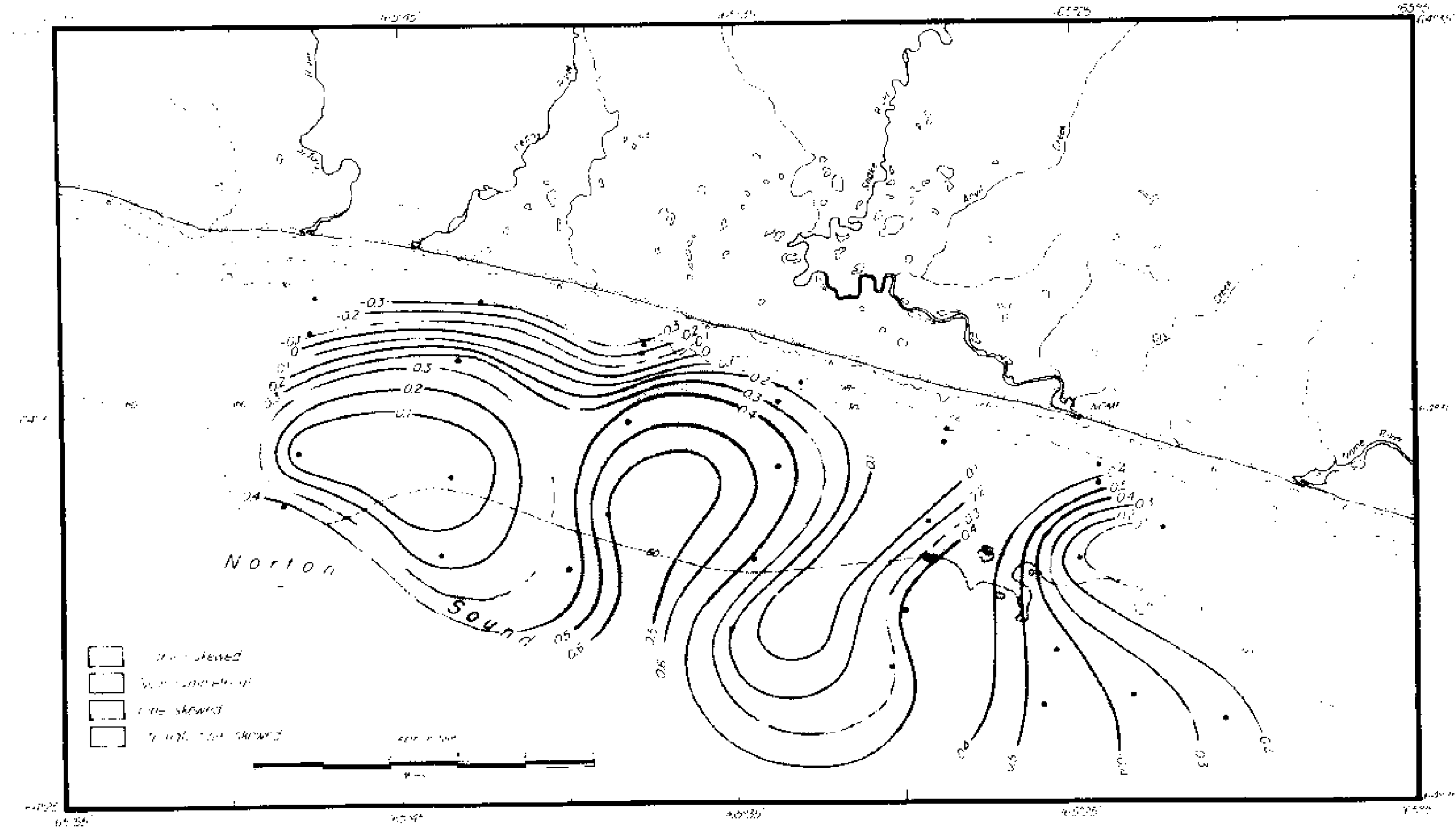

Fig. VII-4. Skewness (SK_I) of surficial bottom sediments.

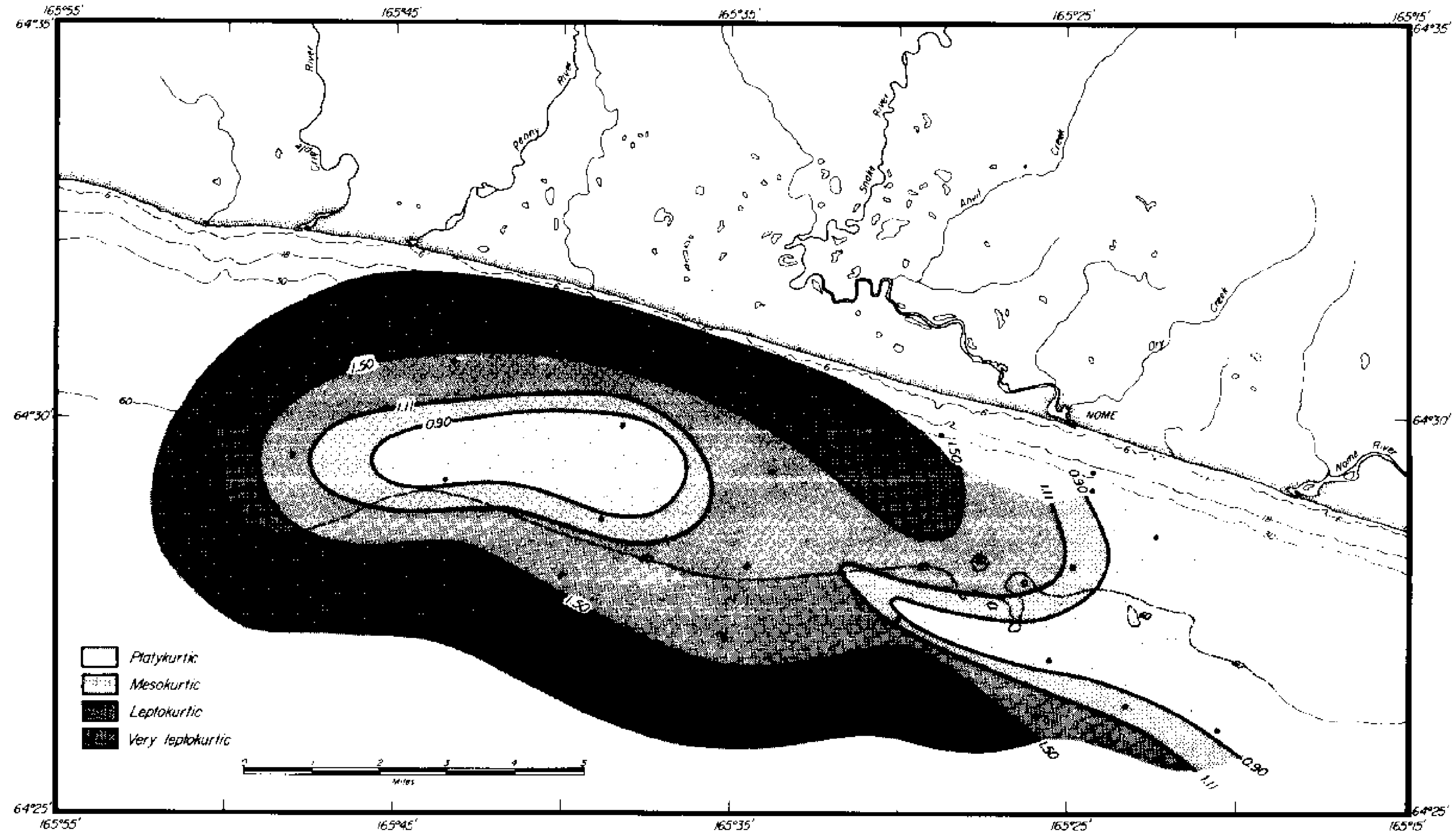

Fig. VII-5. Kurtosis (K_G) of surficial bottom sediments.

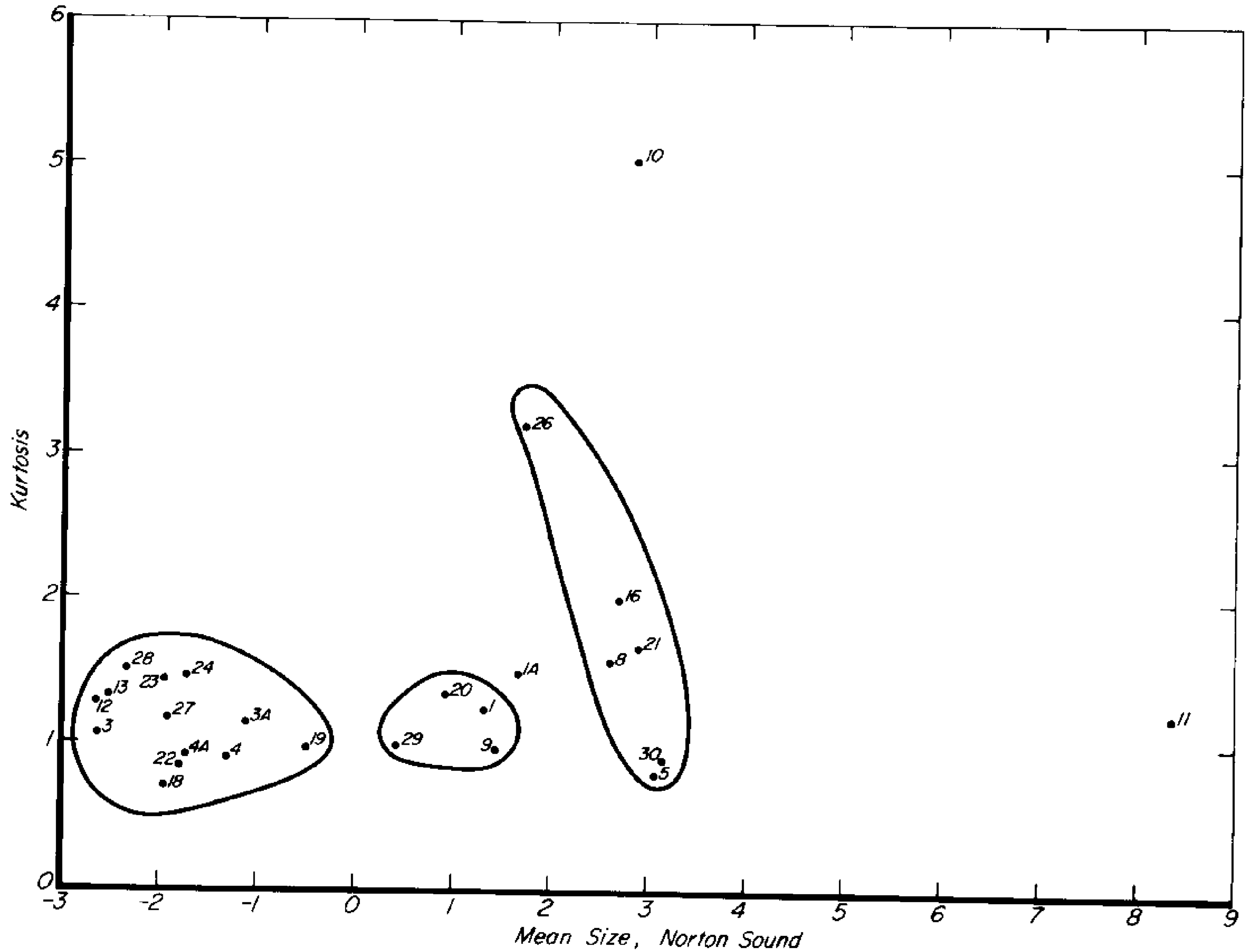

Fig. VII-6. Mean size versus Kurtosis for surficial bottom sediments.

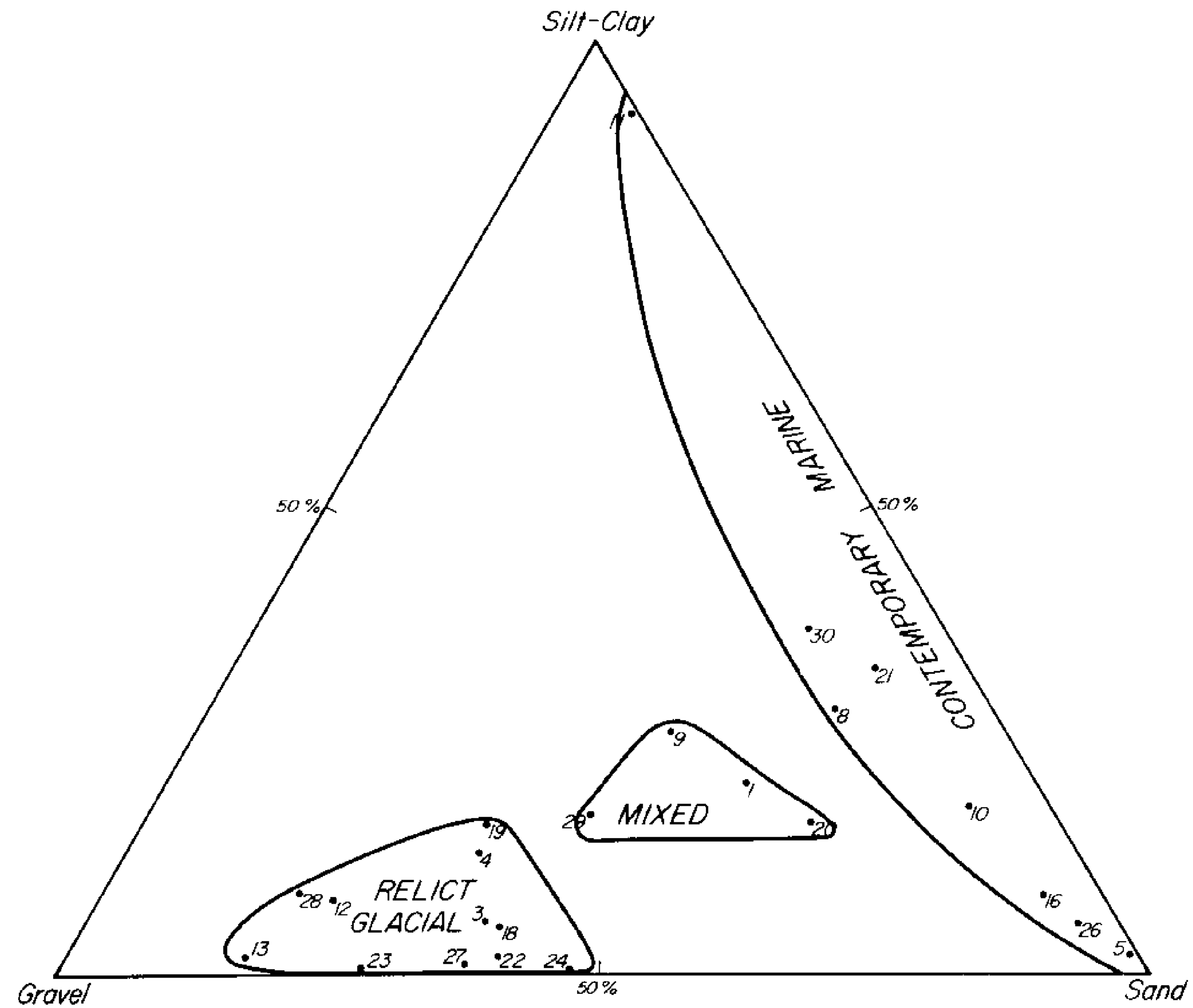

Fig. VII-7. Gravel, sand, silt-clay contents in surficial bottom sediments.

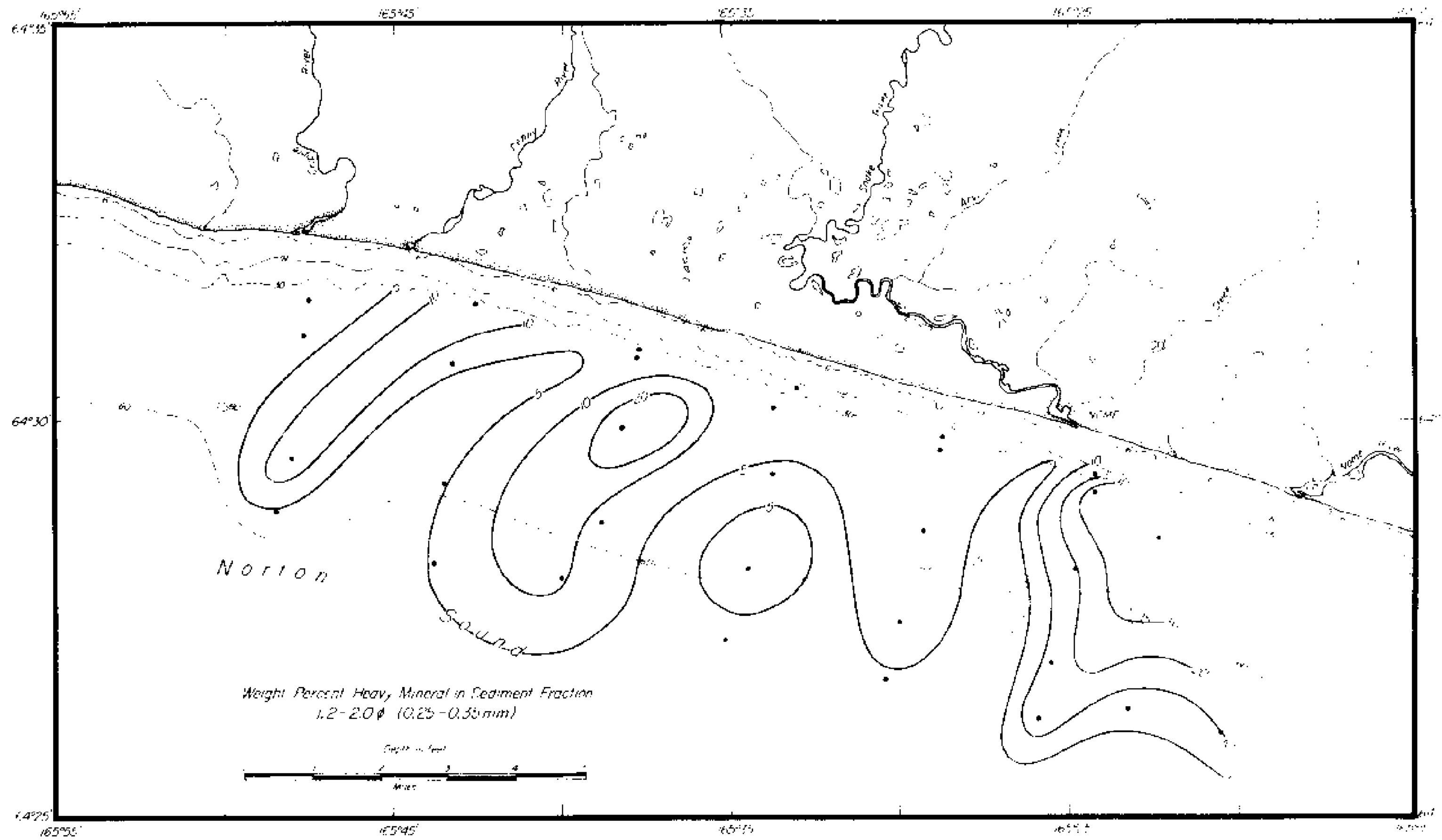

Fig. VII-8. Weight percent heavy mineral concentrations in sediment fraction 1.5 - 2.0 ϕ (0.25 - 0.35 mm).

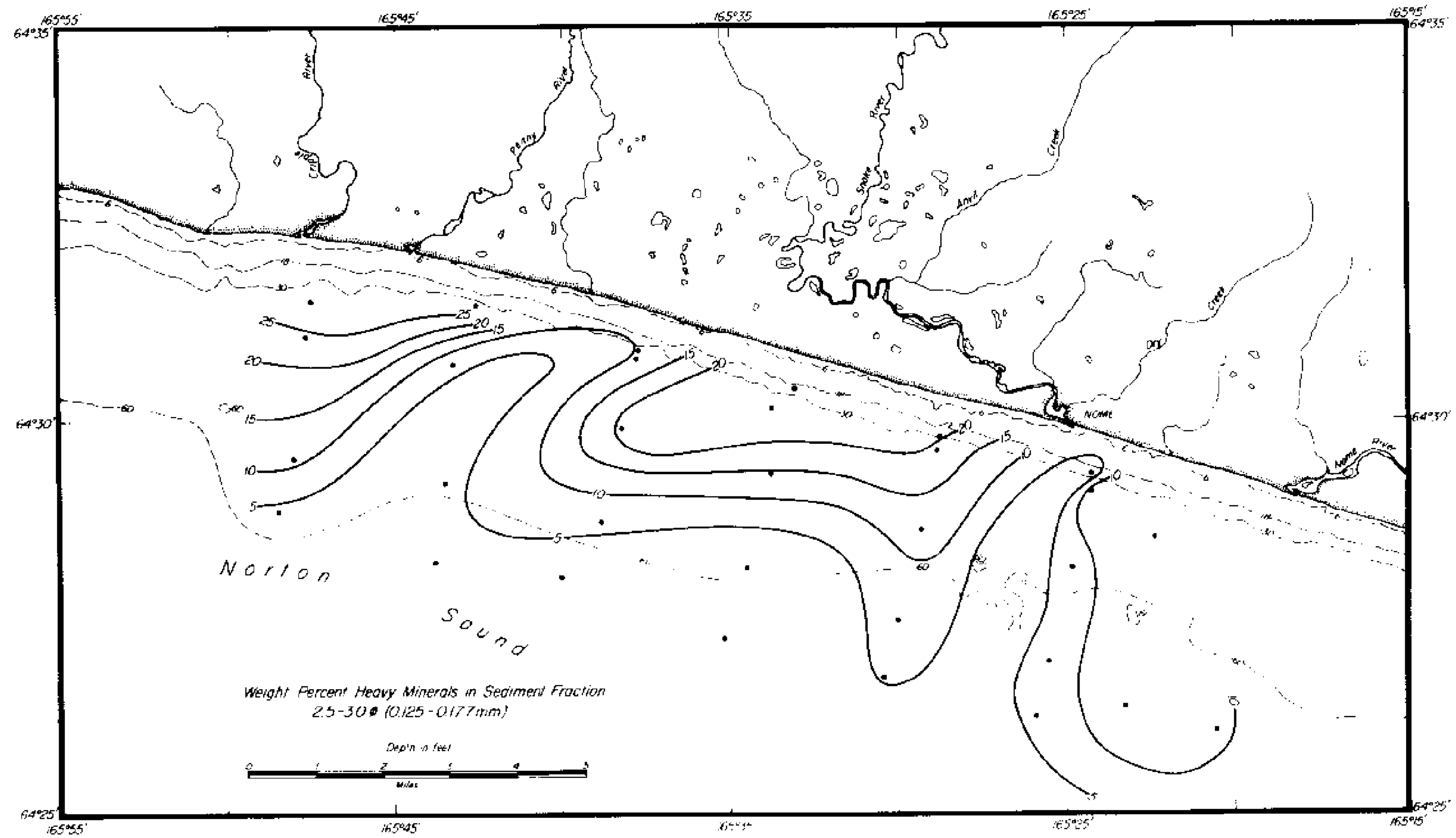

Fig. VII-9. Weight percent heavy mineral concentrations in sediment fraction 2.5 - 3.0 φ (0.125 - 0.177 mm).

TABLE VII-1

Weight percent heavy mineral concentrations in sediment fraction 1.5 - 2.00 ϕ (0.25 - 0.35 mm).

Sample Number	Wt. % of 1.5-2.0 ϕ in sample	Wt. % of heavy minerals in 1.5-2.0 ϕ fraction	Wt. % of light minerals in 1.5-2.0 ϕ fraction	Wt. % 1.5-2.0 ϕ fraction heavy minerals in sample	Wt. % 1.5-2.0 ϕ fraction light minerals in sample
NS-1	3.6	11.1	88.9	0.40	3.20
NS-3	2.5	18.96	81.04	0.47	2.03
NS-4	4.5	35.56	64.44	1.60	2.90
NS-5	0.5	18.32	81.68	0.09	0.41
NS-8	7.34	6.74	98.26	0.49	6.85
NS-9	2.0	7.09	92.91	0.14	1.85
NS-10	11.8	4.21	95.79	0.50	11.30
NS-11	0.6	4.30	95.70	0.03	0.57
NS-12	0.6	7.42	92.58	0.04	0.55
NS-13	0.7	4.11	95.89	0.03	0.67
NS-16	9.8	2.22	97.78	0.22	9.58
NS-18	7.1	28.90	71.10	2.05	5.05
NS-19	1.88	4.18	95.82	0.08	1.80
NS-20	2.6	10.52	89.48	0.27	2.33
NS-21	5.0	5.44	94.56	0.27	4.73
NS-23	2.08	5.58	94.42	0.12	1.96
NS-24	0.12	14.08	85.92	0.02	0.10
NS-26	45.9	1.48	98.52	0.68	45.22
NS-27	1.4	11.24	88.76	0.16	1.24
NS-28	1.37	4.88	95.12	0.07	1.30
NS-29	6.45	7.37	92.63	0.47	5.97
NS-30	5.87	10.30	89.70	0.60	5.26

TABLE VII-2

Weight percent heavy mineral concentrations in sediment fraction 2.5 - 3.0 ϕ (0.125 - 0.177 mm).

Sample Number	Wt. % of 2.5-3.0 ϕ in sample	Wt. % of heavy minerals in 2.5-3.0 ϕ fraction	Wt. % of light minerals in s.5-3.0 ϕ fraction	Wt. % 2.5-3.0 ϕ fraction heavy minerals in sample	Wt. % 2.5-3.0 ϕ fraction light minerals in sample
NS-1	5.3	6.06	93.93	0.32	4.98
NS-3	4.4	7.64	92.35	0.34	4.06
NS-4	4.88	10.85	89.14	0.53	4.35
NS-5	39.8	3.04	96.95	1.21	38.58
NS-8	17.8	10.51	89.48	1.87	15.93
NS-9	9.5	5.84	94.15	0.55	8.94
NS-10	29.7	5.03	94.96	1.49	28.20
NS-11	3.2	2.98	97.01	0.09	3.10
NS-12	1.5	1.97	98.02	0.03	1.47
NS-13	0.15	14.02	85.97	0.02	0.13
NS-16	27.7	10.11	89.88	2.80	24.89
NS-18	1.4	22.91	77.08	0.32	1.08
NS-19	6.07	5.49	94.54	0.33	5.74
NS-20	1.28	3.1	96.89	0.04	1.24
NS-21	24.76	4.11	95.88	1.02	23.74
NS-23	0.5	6.94	93.05	0.03	0.46
NS-24	0.13	28.66	71.33	0.04	0.09
NS-26	3.41	24.09	75.90	0.82	2.59
NS-27	0.6	11.08	88.91	0.07	0.53
NS-28	3.9	3.64	96.35	0.14	3.76
NS-29	5.5	14.07	85.92	0.77	4.73
NS-30	8.35	11.63	88.36	0.97	7.38

generally tend to accumulate in coarser sediments which are related to relict-glacial sediments. The abrupt decrease of heavies in sands near the Snake River mouth and offshore sand suggests that high concentrations of heavies in coarser sediments are due to winnowing of light minerals during several transgressions and regressions. The distribution of percentage heavy minerals is correlative to the mean size distribution of surficial sediments.

The clay minerals in > 2 μ sediment fraction consisted of chlorite, illite and quartz. The ratio of peak heights of chlorite and illite when compared with quartz indicated predominance of chlorite over illite.

The organic carbon in sediments varied from 0.4 to 1.57 percent by weight (Fig. VII-10, Table VII-3). An increase in the clay fraction (material composed of particles < 4 μ in size) was accompanied by an increase in the organic carbon in the sediment (Fig. VII-11).

The distribution and variation in suspended load in waters offshore Nome were measured during 19-21 July 1973. The measurement of suspended load was accompanied by measurements of salinity and temperature (Figs. VII-12 - VII-14). The combined collection of these related data is considered pertinent to understanding the effects of tidal, geostrophic and other current movements on sediment transport and deposition.

The suspended load in surface water varied from 1.6-6.7 mg/ℓ. Higher concentrations were observed in nearshore waters while offshore the suspended load decreased rapidly (Fig. VII-15 and Appendix III; Table 4). The suspended load distribution in waters generally follow the bathymetry of the region. The sediment in suspension increases with increase in water depth. Near-bottom water contains as much as 17 mg/ℓ in suspension. A gradual and consistent increase in suspended load with depth was observed in regions west of Snake River. Near the

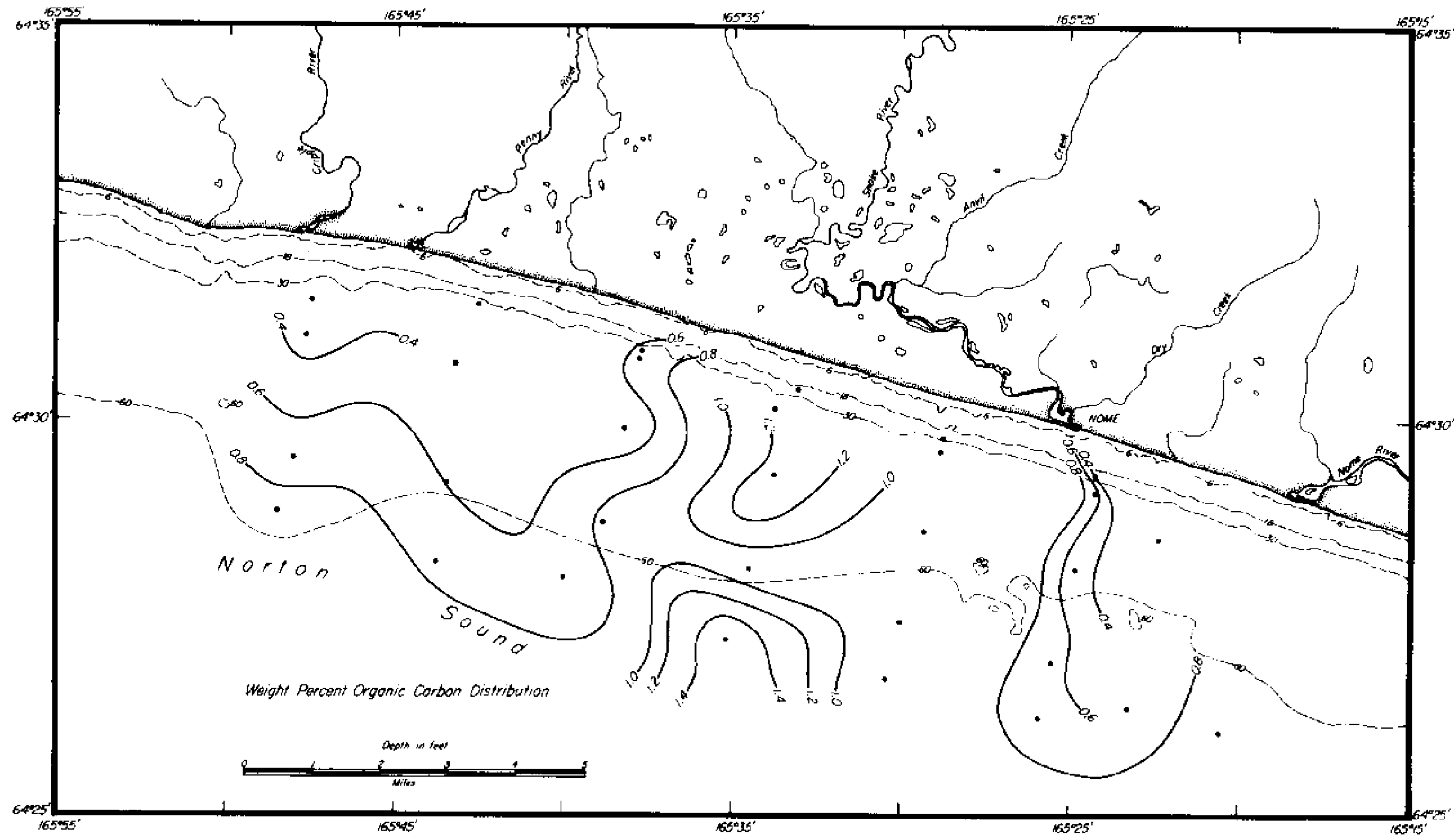

Fig. VII-10. Weight percent organic carbon distribution in surficial sediments.

TABLE VII-3
Organic Carbon in Sediments Near Nome

Station #	weight percent non-carbonate carbon
1	0.660
3	0.542
4	0.666
5	0.364
8	0.893
9	0.900
10	0.829
11	1.568
12	0.904
13	1.355
16	0.611
17	0.777
18	0.423
19	0.837
20	0.694
21	0.786
26	0.356
28	0.704
29	0.868
30	0.855

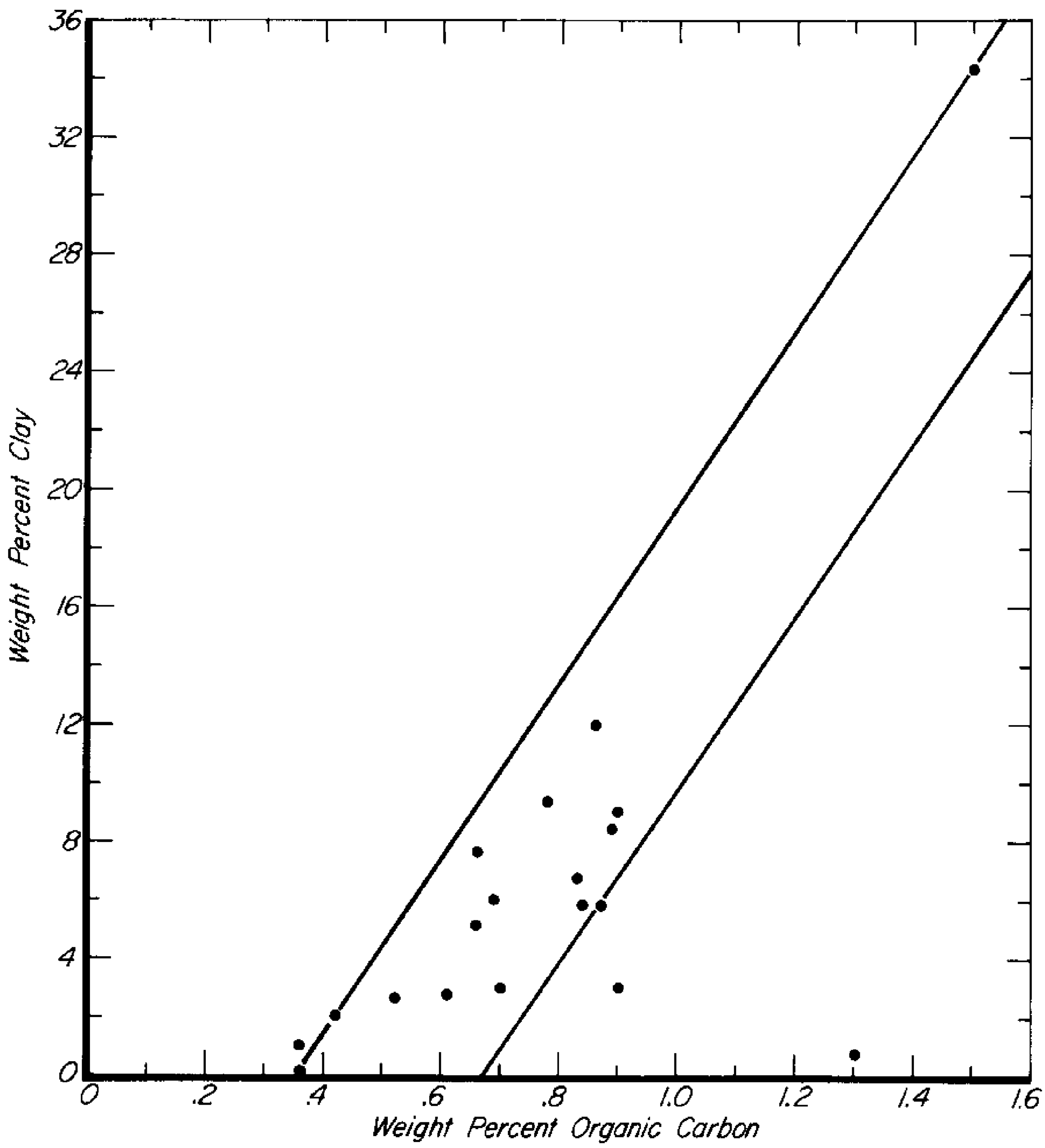

Fig. VII-11. Weight percent organic carbon versus weight percent clay (<4μ) for surficial bottom sediments.

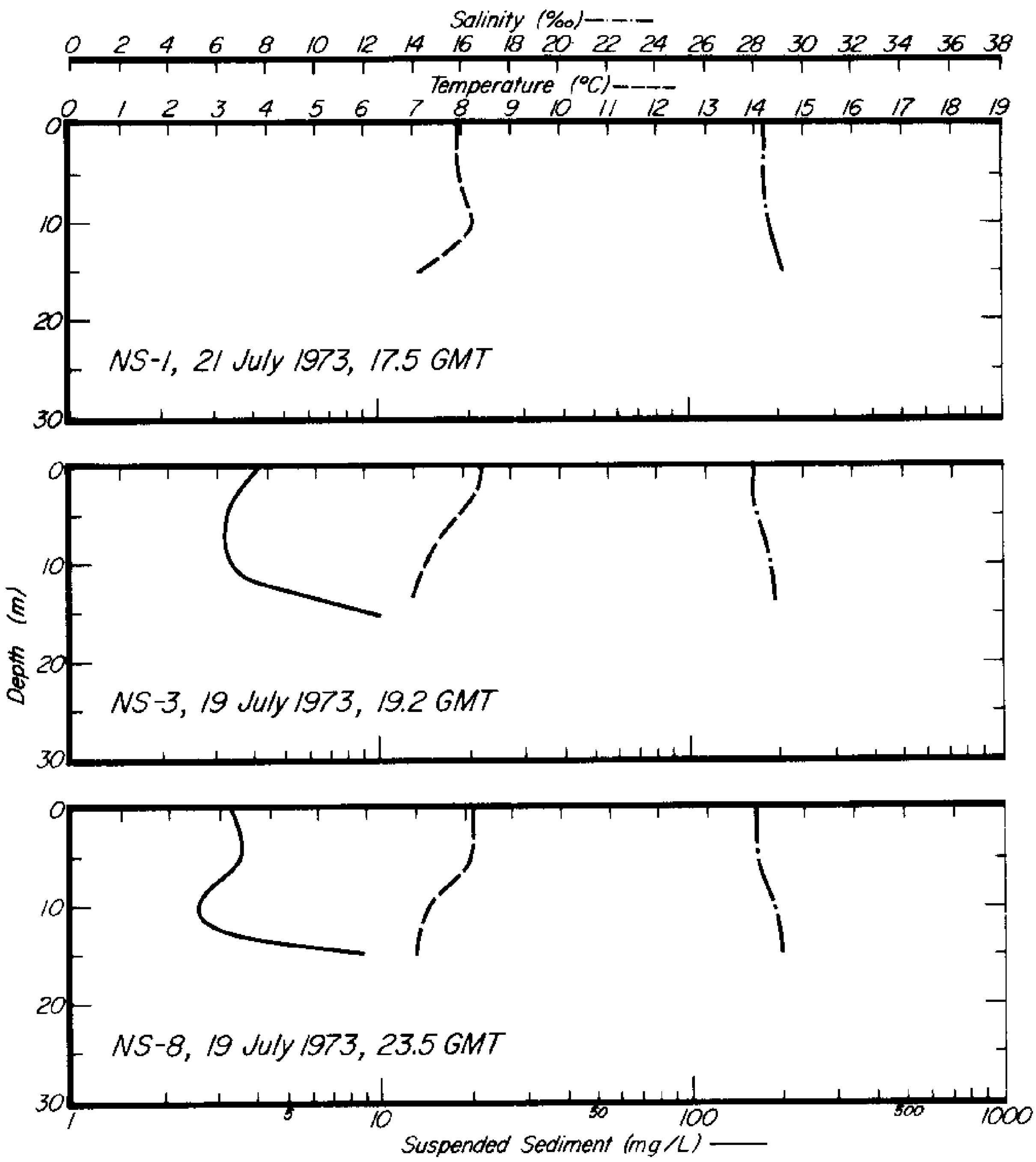

Fig. VII-12. Depth profiles of suspended sediment load, salinity and temperature in waters off Nome.

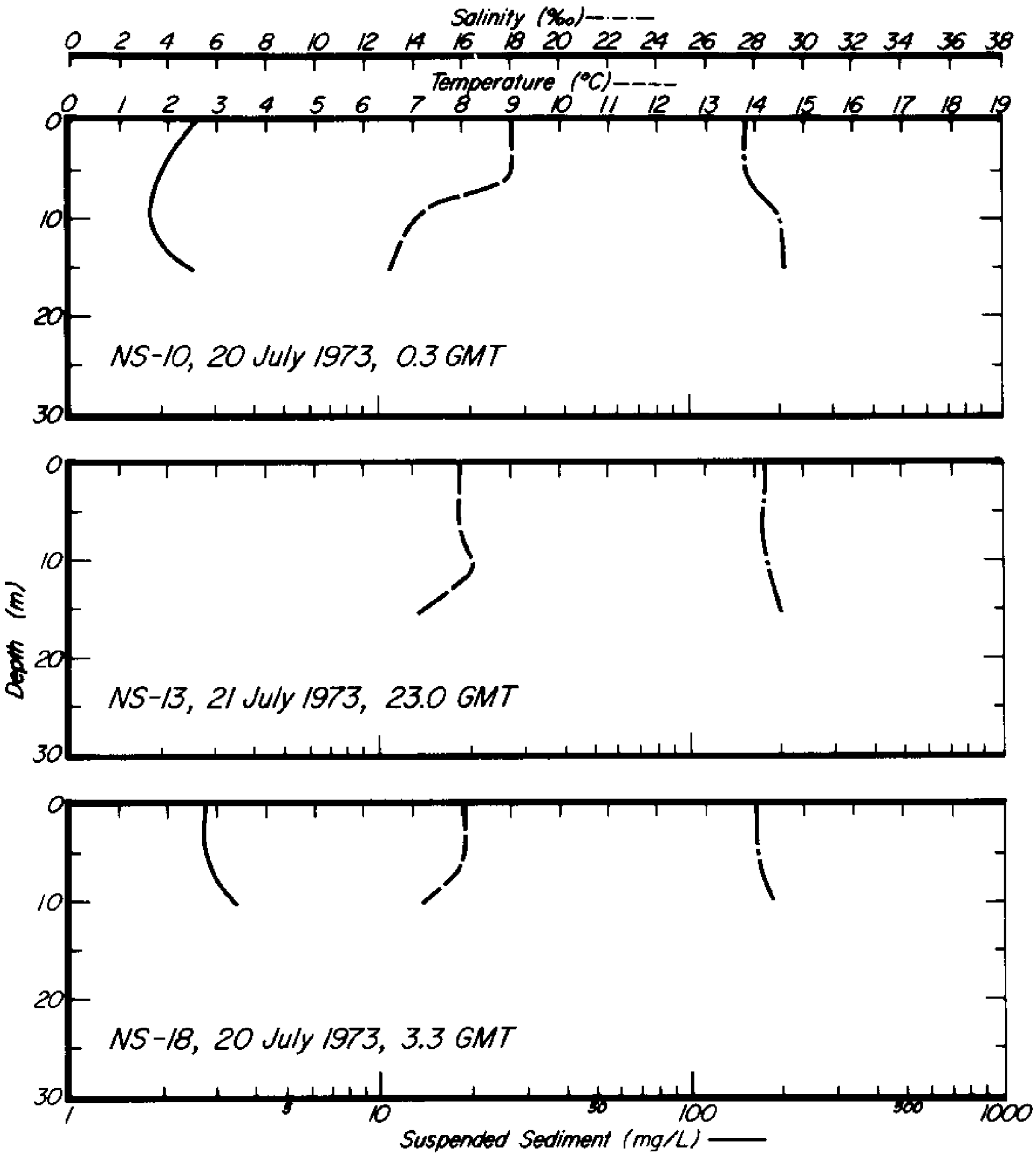

Fig. VII-13. Depth profiles of suspended sediment load, salinity and temperature in waters off Nome.

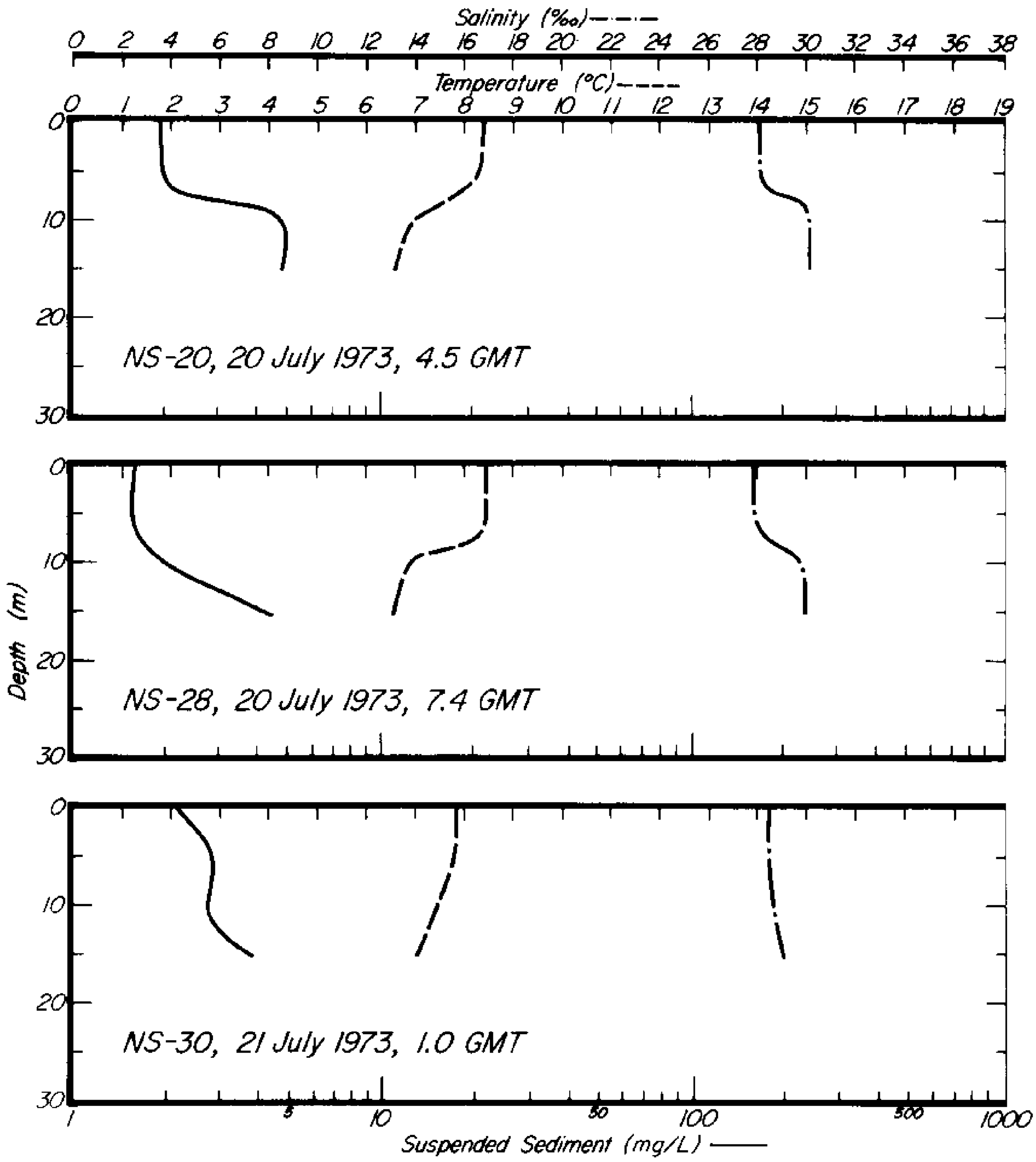

Fig. VII-14. Depth profiles of suspended sediment load, salinity and temperature in waters off Nome.

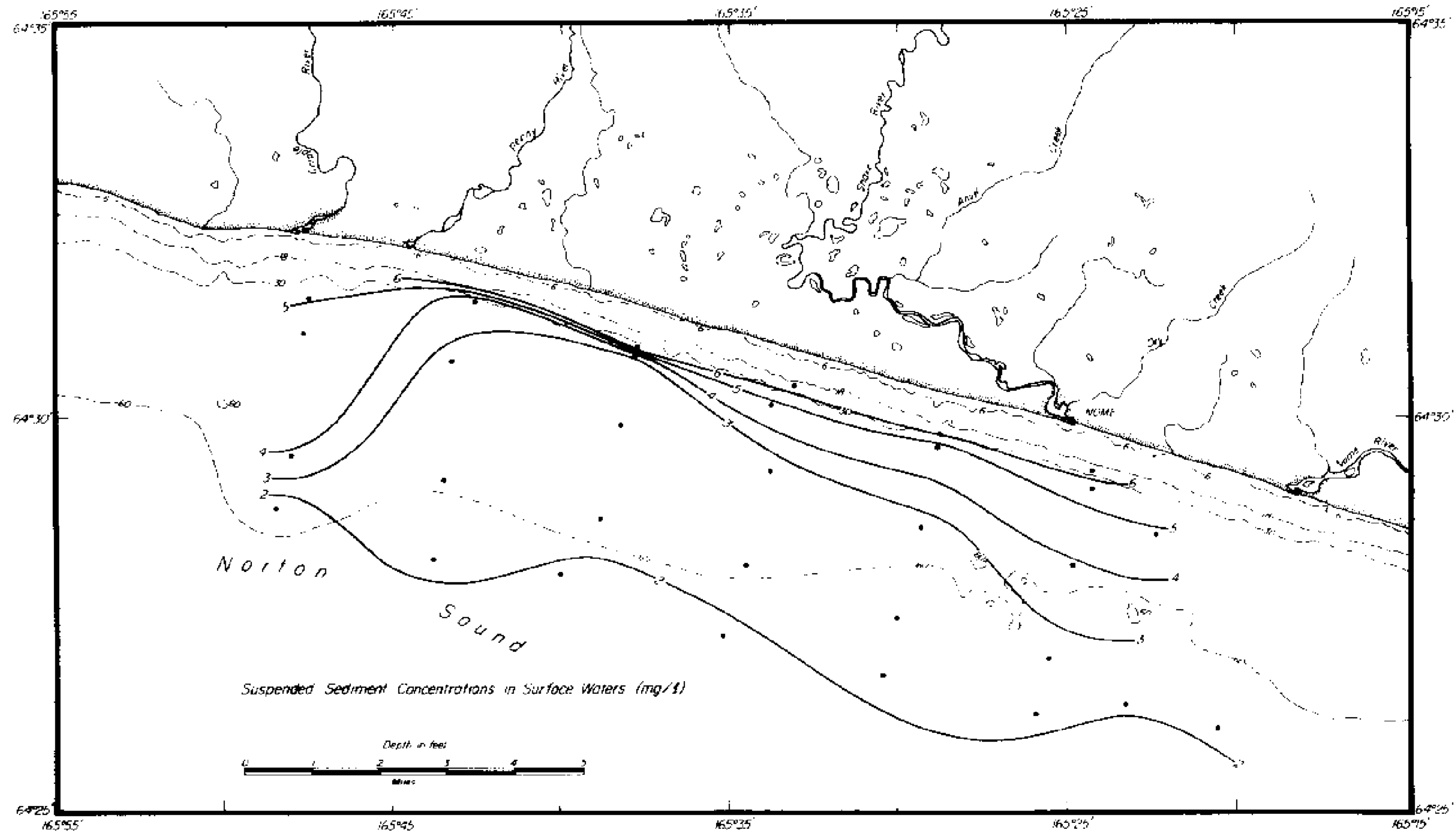

Fig. VII-15. Suspended sediment load distribution in surface waters.

mouth of the Snake River, however, pockets of water with lesser amounts of suspended sediment appear to intrude at intermediate depths (Fig. VII-16). No significant variations in suspended load parallel to the shore were observed. Snake River, in particular, does not appear to form extensive plume carrying sediments offshore in suspension.

The distribution of copper, cadmium and zinc in surficial sediments from the offshore region of Nome is given in Table VII-4. Copper in sediments varies from 7 to 32 ppm, cadmium from 1.0 to 10.5 ppm and zinc from 37 to > 400 ppm. The concentrations of these elements are not related to heavy mineral concentration in sediments, rather they show general relationships with clay and organic carbon distributions in sediments.

DISCUSSION

The nearshore sediments in the vicinity of Nome consist of Pleistocene relict sediments. These sediments contain material of ancient beach, deltaic and glacial deposits. The relict sediments are mainly gravel which are found in an irregular belt which is parallel to the shore. The gravel belt is cut by tongues of Holocene sand, silt and clay.

The sources for the sediments of the study area lie in the beach which consists of coarse gravel to fine sand and the adjacent drainage regions of the rivers, in particular the Snake River. These rivers carry sand which is generally deposited near their mouth. Important sources for sand also lie in relict gravel. These glacial deposits are continually reworked and winnowed thus forming a gravel lag deposit and contributing sand, silt and clay to offshore deposits. Winnowing and

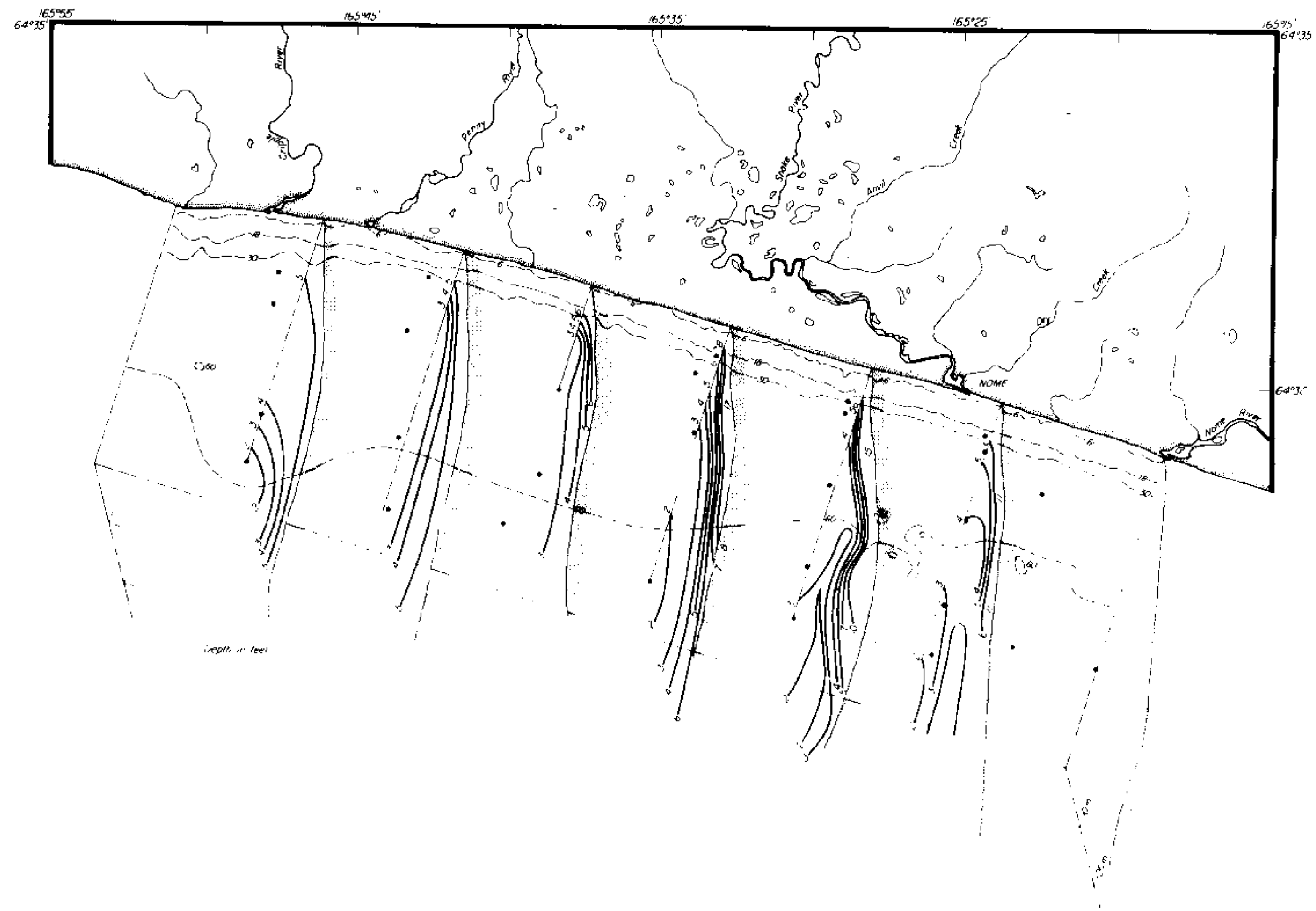

Fig. VII-16. Vertical and spatial distribution of sediments in suspension in waters off Nome.

TABLE VII-4

Concentrations (ppm) of cadmium, copper, zinc and lead in surficial sediments.

Sample No.	Cadmium	Copper	Zinc	Lead
NS-1	11	10	130	Not detectable
NS-3	11	10	38	"
NS-4	7.7	12	58	"
NS-5	7.7	10	37	"
NS-8	6.5	18	55	"
NS-9	5.1	13	48	"
NS-10	5.1	10	62	"
NS-11	7.7	60	170	"
NS-12	1.05	11	52	"
NS-13	4.0	8	160	"
NS-16	4.0	10	67	"
NS-18	4.0	10	42	"
NS-19	4.0	11	55	"
NS-20	4.0	12	45	"
NS-21	1.0	19	42	"
NS-26	5.0	11	45	"
NS-28	4.0	11	40	"
NS-29	7.5	19	50	"
NS-30	4.0	27	>400	"

reworking of bottom sediments is well demonstrated by high concentrations of suspended sediments in near bottom waters. The reworking and roiling of sediments in the nearshore area is an important mechanism for sediment transport and distribution.

The processes controlling sediment distribution are wind, waves, currents and to some extent ice. The prevailing winds in the Nome region are from the north and northwest. During storms, however, the wind may blow from south or southwest. Winds in general carry beach sands from west to east.

During summer months waves up to 50-75 cm are common in the region and these waves attack the shore with average angle of 27°. Waves formed during severe storms probably roil sediments extensively and mass movement of sediments occurs during these episodes. The wave direction during storms is commonly north or northwest and wave attack is perpendicular to the coast.

The combination of prevailing winds and the angle of wave incident to the shore results in a littoral current. The effect of the littoral current is a net sediment transport to the east. Eastward longshore drift has been revealed by the movement of trash from garbage dumps near Nome (Greene 1970). Active sedimentation on the west side of Nome River jetties and erosion on the east further suggest eastward movement of nearshore sediments.

The environment of deposition in offshore region of Nome is characteristic of moderately high energy environment. The sediments are actively reworked by frequent storm waves. The effects of these storms is not known at present.

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SECTION 2. NOME SOCIOECONOMIC STUDY

D. T. Kresge and S. R. Fison

CHAPTER VIII. INTRODUCTION AND SUMMARY

Although the community itself is not large, the city of Nome is undoubtedly one of the places in Alaska most likely to be recognized by outsiders. The fame, or noteriety, acquired during the gold rush era has persisted but the Nome of today bears little resemblance to the turn-of-the-century mining town described in history books. Indeed, mining is no longer a significant part of the Nome scene; the last major gold dredging operation shut down over a decade ago. The purpose of this report is to outline the general socioeconomic characteristics of the present city of Nome.

An excellent description of the location and setting of Nome was given in the 1968 Nome Comprehensive Development Plan:

> "The city of Nome is located in Northwest Alaska on the south coast of the Seward Peninsula, facing across Norton Sound and the Bering Sea towards St. Lawrence Island and Siberia. Unlike most of Northwest Alaska's communities which developed because of their convenience to hunting or fishing grounds or to sources of fuel, Nome was founded because of gold strikes here at the turn of the century. . . .
>
> In relation to Alaska's major population centers, Nome is remote. The city lies approximately 535 miles northwest of Anchorage and 520 miles west of Fairbanks, while Kotzebue, the nearest regional center, is 180 miles to the northeast. Because of its remoteness from the major population centers of the state, Nome has become a base of operation for government agencies serving the needs of Northwest Alaska, particularly those involved in transportation and communications activities and those concerned with assisting the Eskimo people of this region.
>
> The Seward Peninsula is the westernmost point of the North American mainland and, in shape, resembles an arrowhead, the point of which extends to within 48 miles of the Siberian coast. Geologically, the Seward Peninsula is very old and it has also been heavily glaciated. However, since the ice age some uplifting has taken place to form narrow coastal plains, except along the northern

coast of the Peninsula where these plains are more extensive. Permafrost underlies the entire Peninsula and is up to 600 feet deep in some locations.

The city of Nome is situated on the southern coast of the Seward Peninsula at the edge of a gently rising coastal plain which ranges between 3 and 5 miles in width in this area and rises from sea level to an altitutde of about 200 feet near the base of Anvil Mountain, approximately 4 1/2 miles north of downtown Nome. Anvil Mountain, a broad dome-shaped feature, attains an altitude of 1,134 feet. . . The foothills of the rugged and much higher Kigluaik Mountains are about 35 miles north of the city. The coastal plain itself is covered by tundra and is poorly drained, with numerous small lakes and ponds dotting the surface. In their courses across this plain, the Snake, Penny and Nome Rivers have cut channels from 30 to 50 feet deep, with a number of tributary streams and short, intermittent streams which drain directly into the ocean incising the plain to shallower depths.

In recent years, the economy and population of Nome has remained essentially static. Since the mid-1960's, there have been very limited gains in employment opportunities in Nome, particularly in the private sector. The growth which has occurred has been entirely in state and local government employment. Between 1965 and 1972, state and local government accounted for the entire increase in employment in the Nome area. In 1972, state and local government provided 40 percent of the employment in Nome; the government sector as a whole provided 58 percent of total employment. The government sector accounted for an even higher proportion (63 percent) of total payrolls. This was due to the relatively high wages paid by government and the relatively high proportion of year-round employment in government.

Since the closing of the gold dredging operation in 1962, the private sector has generally accounted for substantially less than half of total employment in Nome. Equally important, many of the private jobs tend to be highly seasonal. Nearly a third of all workers and 45 percent of Native workers were employed for less than 13 weeks. The seasonality is particularly pronounced in the contract construction, transportation, and trade sectors. The activity connected with tourism is presumably responsible for much of the seasonal variation in transportation and trade. It is interesting to note that the recent growth in the number of tourists going to Nome seems to have had little impact on the economic activity in Nome. The tours to Nome are short and somewhat self-contained (the airlines also own the major hotels.) A large increase in the number of tourists generates only a modest increase in employment and income for local residents. Apart from erratic year-to-year fluctuations, none of the private industries have shown sustained growth during the past five or ten years.

The lack of employment opportunities has led to high unemployment rates and low labor force participation rates among the Native population. At the time of the 1970 census, over 20 percent of the Native labor force was unemployed. Furthermore, less than 40 percent of the Native population over 16 years old was even in the labor force. Thus, of the Natives over 16 years old, only 30 percent were employed in 1970. Clearly, the Nome labor market is characterized by large amounts of unemployment and underemployment when compared to the labor supply potentially available.

Income in Nome is considerably lower than the statewide averages. Although the average income for white families in Nome is above the state average, the mean income for Natives was only $6,800 in 1969. That was

$1,300 below the average for Native families throughout the state and was less than half of the average income for all families in Alaska. The low income could be attributed to the limited employment opportunities and to the seasonal nature of the jobs that were available. Although wages and salaries provided most of the income for Natives, about a third of the families also received some form of public assistance income. Among those families receiving public assistance income, the average amount received per family was roughly $1,200. Thus, this was an important source of income for those who qualified for it. In the aggregate, however, public assistance provided only 6 percent of the total income for Native families in Nome.

The problem of low incomes is made worse by the extremely high cost of living in Nome. Food prices are 30 to 40 percent higher than in Fairbanks or Anchorage. The cost of housing is at least that much higher. A major factor driving up the cost of living in Nome is, of course, transportation costs. Nome is in a remote location, the volume of goods being shipped is small, and harbor facilities are poor. In general, freight charges to Nome from Seattle are 50 to 100 percent higher than the charges to Anchorage. Also, during a major portion of the year, cargo can only be brought in by air.

The lack of employment opportunities, low incomes, and high cost of living have caused a substantial number of Natives to migrate from Nome to other parts of the state. It is estimated that between 1960 and 1970, about 400 Natives migrated from the city of Nome and 1,100 migrated from the Nome Census Division. That migration represents nearly one-fourth of the 1960 population. It can be seen from the age-sex distribution of the Native population that young people, after completing school, were leaving the Nome area. This out-migration is further evidence that the potential labor supply in Nome is much larger than indicated by current employment levels. If employment opportunities were available, the labor supply could be expanded quickly through increased participation rates and lower migration.

The average level of educational attainment in Nome is generally quite low, but is rising rapidly. As would be expected, the improvement is particularly marked among the younger segment of the population. Over half of the Natives between the ages of 18 and 24 are high school graduates. That is comparable to the proportion for the U.S. population as a whole. Furthermore, among the school-age population in Nome (7 to 17 years old), over 99 percent are enrolled in school so the educational attainment should if anything rise further.

In addition to the educational facilities, the public services available in Nome include water and sewer, electricity, telephone, and medical services. For the most part, these facilities are reasonably adequate for a remote community of the size of Nome. However, the water and sewer system provides quite limited coverage (about one-fourth of the homes) and the system is approaching design capacity.

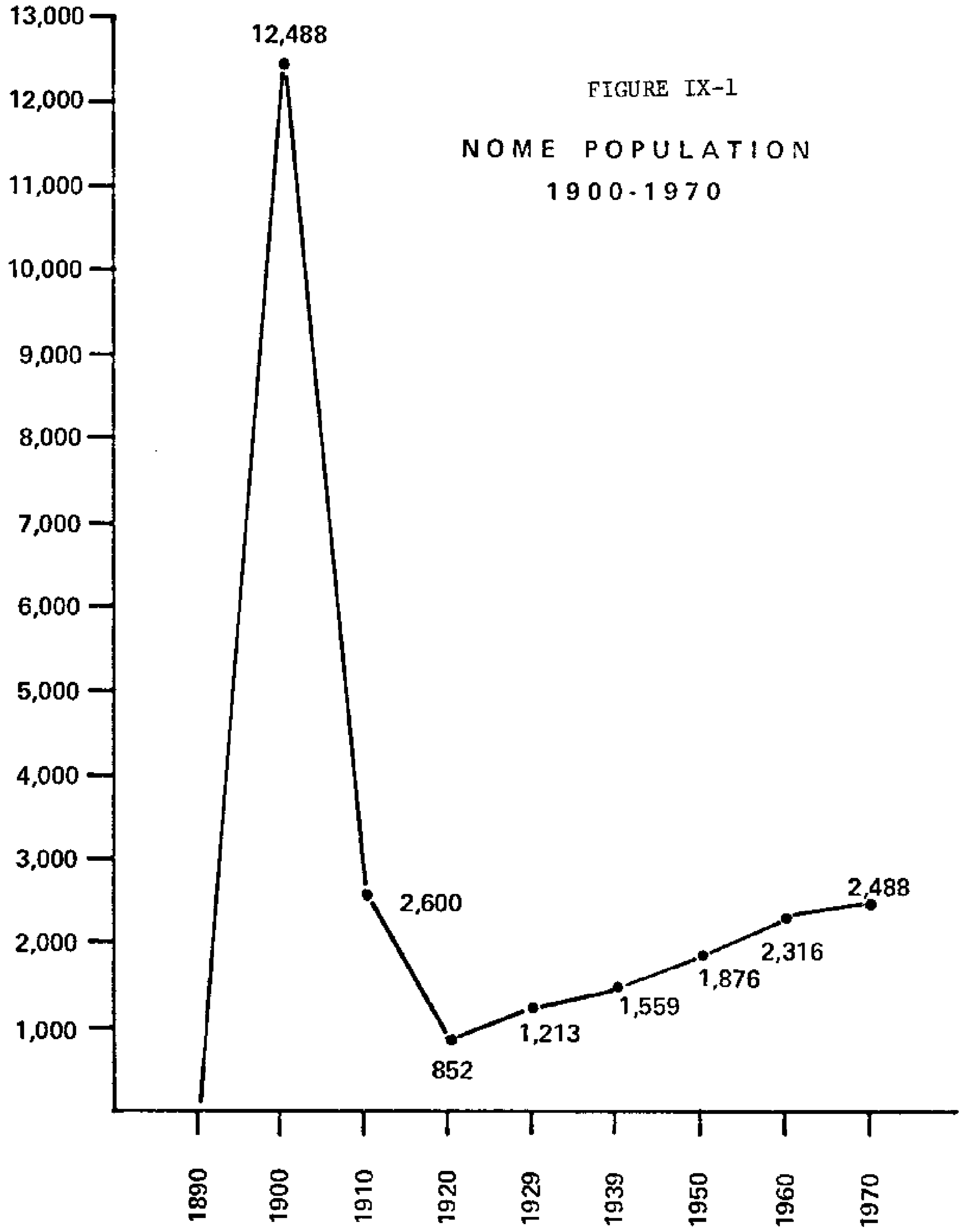
Probably the most serious problem concerning living conditions in Nome is the severe lack of adequate housing. This could be critical if there were to be an expansion in employment which in turn caused an increase in population. The housing stock in Nome is generally in poor condition, lacking facilities, and overcrowded. Recent surveys have estimated that 60 to 80 percent of the housing in Nome is substandard, and a large share of the substandard housing is dilapidated beyond repair. Clearly, in the event of any expansion, this would be an area of urgent social concern.

CHAPTER IX. POPULATION AND EDUCATION

HISTORICAL PATTERNS OF POPULATION CHANGE

Prior to the discovery of gold in 1898, there was no settlement at Nome. However, the stampede of gold seekers which poured into the area after the first strike soon made Nome the largest city in Alaska. The 1900 Census estimated that Nome had 12,488 residents (see Figure IX-1) but it is likely that many of the uncounted thousands camped along the area's beaches and creeks would have brought the total to about 20,000. Gold activity in Nome continued at a fairly high level during the next decade, but the big strikes were over and most of Nome's residents left as quickly as they had arrived. By 1910 the city's population had dropped to 2,600. Between 1910 and 1920 mining activity declined drastically, World War I intervened, and many residents died during a 1918 influenza epidemic. By 1920 Nome had only 852 residents.

Following the gold rush "boom and bust," Nome's population began a slow, steady increase. A large scale gold dredging operation was established in 1922 and there was some migration of Natives into Nome from the surrounding areas. Between 1920 and 1960, the population of Nome increased by 2 to 3 percent a year. The military activity in Nome during World War II was very temporary and, unlike the situation in much of Alaska, there was no spurt in employment and population between 1940 and 1950. From 1940 to 1960, the population of Nome increased by just 50 percent while the population of the state more than tripled. In terms of annual rates of increase, Nome was growing at 2 percent and the state was growing at nearly 6 percent.



Source: U.S. Department of Commerce, Bureau of the Census.

RECENT POPULATION PATTERNS

From 1960 to 1970, Nome's growth slowed still further. Population increased only 7 percent over the decade, less than one percent a year. The lack of growth can be attributed to several key factors: the closing of gold dredging operations in 1962, a declining birth rate, and the migration of Natives to other regions of Alaska. Unfortunately, the population data for the city of Nome do not provide details concerning the components of population change. However, data for the Nome Census Division can be used to derive more detailed information. The city of Nome contains 43 percent of the population of the census division and it is reasonable to assume that the characteristics of the census division are representative of the city as well.

During the 1960's, the total population of the Nome Census Division declined by 5.6 percent but the drop was due solely to shifts in military personnel (see Table IX-1.) The civilian population remained virtually constant while the number of military personnel was cut from 504 in 1960 to 151 in 1970. Over the decade there was a substantial amount of migration from the Nome region. With the civilian population staying constant, the out-migration fully offset the natural increase due to births and deaths within the region.

As shown in Table IX-1, about 80 percent of the residents of the Nome Census Division are nonwhites. In 1970, over 98 percent of the "nonwhites" were Natives and virtually all of these were Eskimos. Throughout this report, the term Native or Eskimo is used synonomously with nonwhite when referring to the Nome Census Division or the city of Nome. Between 1960 and 1970, both the Native and the white populations declined in the Nome Census Division.

TABLE IX-1

POPULATION GROWTH 1960 - 1970

NOME CENSUS DIVISION

	1960 Census			1970 Census			% of Change of Total
	Male	Female	Total	Male	Female	Total	1960 - 1970
Total Population	3,440	2,651	6,091	3,071	2,678	5,749	- 5.6
Civilian	2,936	2,651	5,587	2,920	2,678	5,598	0.2
Military	504	--	504	151	--	151	-70.0
White	1,043	414	1,457	689	516	1,205	-17.3
Nonwhite	2,397	2,237	4,634	2,382	2,162	4,544	- 1.9
Negro	61	7	68	23	4	27	-60.3
Indian	5	4	9	9	10	19	- 1.1** (Indian, Aleut, Eskimo, Other)
Aleut				2	2	4	
Eskimo				2,321	2,127	4,448	
Other	2,331*	2,226*	4,557	27	19	46	

Sources: U.S. Department of Commerce, Bureau of the Census, 1963, Table 28; Babb, 1972, Table 5; U.S. Department of Commerce, Bureau of the Census, 1971b, Table 121.

* In 1960 Census Aleut and Eskimo are included in "other" category.

** Represents approximate change in Native Population

Clearly there was migration of both groups from the Nome region, although much of the white migration was attributable to movements of military personnel.

The data in Table IX-2 provide some approximate estimates of natural increase and migration as sources of population change. The estimated natural increase in the civilian Native population was 1,036 persons while the net change in civilian Native population was a reduction of 55 persons. Thus, there was a net out-migration of nearly 1,100 persons. Most of the change in the white population was due to shifts in military personnel. There was a small out-migration of white civilians and there was a net increase of 66 in the civilian white population.

Table IX-2 also contains estimates of the rates of natural increase for 1960, 1970 and average rates over the decade. For all population groups shown, there is a sharp drop in the rate of natural increase between 1960 and 1970. This is due to the reduction in the birthrate during that period. This phenomenon occurred throughout the country and is generally attributed to several factors. There were improvements in birth control methods, programs to provide information on family planning, and a general change in social attitudes regarding family planning. In the Nome Census Division the annual rate of natural increase was cut nearly in half, falling from 3.02 percent in 1960 to 1.52 percent in 1970. Among whites the rate of natural increase dropped from 1.10 percent to 0.65 percent. The drop for the nonwhite population was even more dramatic-- 3.45 in 1960 compared to 1.72 in 1970. Further evidence confirming the drop in birthrates is provided by the fertility ratios in Table IX-3. A fertility ratio is the number of children under five years old per 1,000 women of child-

TABLE IX-2

COMPONENTS OF POPULATION CHANGE 1960-1970

NOME CENSUS DIVISION

	All Races			White			Non-white		
	1960	1970	Change 1960-70	1960	1970	Change 1960-70	1960	1970	Change 1960-70
Population	6,091	5,749	- 342	1,457	1,205	- 252	4,634	4,544	- 90
Military Personnel[1]	504	151	- 353	454	136	- 318	50	15	- 35
Civilian Population	5,587	5,598	+ 11	1,003	1,069	+ 66	4,584	4,529	- 55
Births	218	134	1,608	23	14	176	195	120	1,432
Deaths	49	49	484	12	7	88	37	42	396
Natural increase	169	85	1,124	11	7	88	158	78	1,036
Rate of natural increase (Total Population)	2.77	1.48	1.90[2]	0.75	0.58	0.66[2]	3.41	1.72	2.26[2]
Rate of natural increase (Civilian Population)	3.02	1.52	2.01[3]	1.10	0.65	0.85[3]	3.45	1.72	2.27[3]
Migration			- 1,466			- 340			- 1,126
Civilian Migration			- 1,113			- 22			- 1,091

Sources: U.S. Department of Commerce, Bureau of the Census, 1963, Table 27; U.S. Department of Commerce, Bureau of the Cenus, 1971b, Table 121; Alaska Department of Health and Social Services.

[1] Calculated assuming that 90 percent of military personnel are white. That is the average proportion for the state during the 1960-1970 period.

[2] Calculated using the average of the 1960 and 1970 population figures.

[3] Calculated using the average of the 1960 and 1970 civilian population figures.

TABLE IX-3

FERTILITY RATIOS* BY RACE

NOME CENSUS DIVISION 1960 AND 1970

	ALASKA			NOME CENSUS DIVISION			CITY OF NOME			TOTAL U.S. (IN THOUSANDS)
	TOTAL	WHITE	NON-WHITE	TOTAL	WHITE	NON-WHITE	TOTAL	WHITE	NON-WHITE	
1960										
Children under 5	34,193	24,602	9,591	1,007	110	897	NA	NA	NA	20,321
Women 15-49	49,407	38,660	10,747	1,110	198	912	NA	NA	NA	41,601
Fertility ratio	692	636	892	907	556	984	NA	NA	NA	488
1970										
Children under 5	32,075	23,825	8,250	671	113	558	297	90	207	17,119
Women 15-49	72,512	58,503	14,009	1,190	258	932	548	215	333	48,624
Fertility ratio	442	407	589	564	438	599	542	419	622	352

*Children under 5 years per 1,000 women 15-49 years old

Sources: Rogers, 1963, Vol. II, Table 43; U.S. Department of Commerce, Bureau of the Census, 1963, Table 27; U.S. Department of Commerce, Bureau of the Census, 1971c, Table 85, Evans, 1973, page 42; Babb, 1972, page 39.

bearing age, which is taken to be all women between 15 and 49 years old.[1] By including data for Alaska and for the U.S., Table IX-3 shows that the decline in the birthrate was indeed widespread. The fertility ratio for Natives in the Nome Census Division fell from 984 in 1960 to 599 in 1970, a decline of nearly 40 percent. Although the fertility ratio for whites declined more moderately, about 20 percent, it was still appreciably lower than the ratio for Natives.

The data in Table IX-4 were computed by assuming that the rates of natural increase for whites and Natives in the city of Nome were the same as those measured in the Nome Census Division. With this assumption, the observed net population change can be divided into the changes due to natural increase and due to migration. Between 1960 and 1970, over 400 Natives are estimated to have migrated from the city of Nome, causing a net decline of 43 in the Native population. That is in sharp contrast to the white population which increased by 215 persons, with most of the gain due to in-migration.

The population movements during the period from 1960 to 1970 were drastically different from those observed from 1950 to 1960. During the earlier period, the population grew at an average rate of about 2 percent a year. This growth was the net result of the natural increase and in-migration of Natives accompanied by a substantial out-migration of whites. The pattern from 1960 to 1970 was just the opposite with out-migration of Natives and in-migration of whites.

The reduction in birthrates in recent years and the changes in migration patterns have altered the age-sex distributions of both the Native and white

TABLE IX-4

COMPONENTS OF POPULATION CHANGE 1950 - 1970
CITY OF NOME

	All Races					White					Non-white				
	1950	1960	1970	Change 1950-60	Change 1960-70	1950	1960	1970	Change 1950-60	Change 1960-70	1950	1960	1970	Change 1950-60	Change 1960-70
Population	1,876	2,316	2,488	+440	+172	945	705	920	-240	+215	931	1,611	1,568	+680	- 43
Natural Increase				+529	+430				+ 91	+ 69				+438	+361
Rate of natural increase (Civilian Population)*				2.52	1.80				1.10	-.85				3.45	2.27
Migration				- 89	-258				-331	+146				+242	-404

*Assuming that the rates of natural increase for civilian whites and non-whites in the Nome Census Division (Table 2-2) also apply to the city of Nome. It is also assumed that the rates of natural increase for 1960 apply to the entire period from 1950 to 1960.

Sources: U.S. Department of Commerce, Census of the Bureau, 1963, Table; Evans, 1973, page 42.

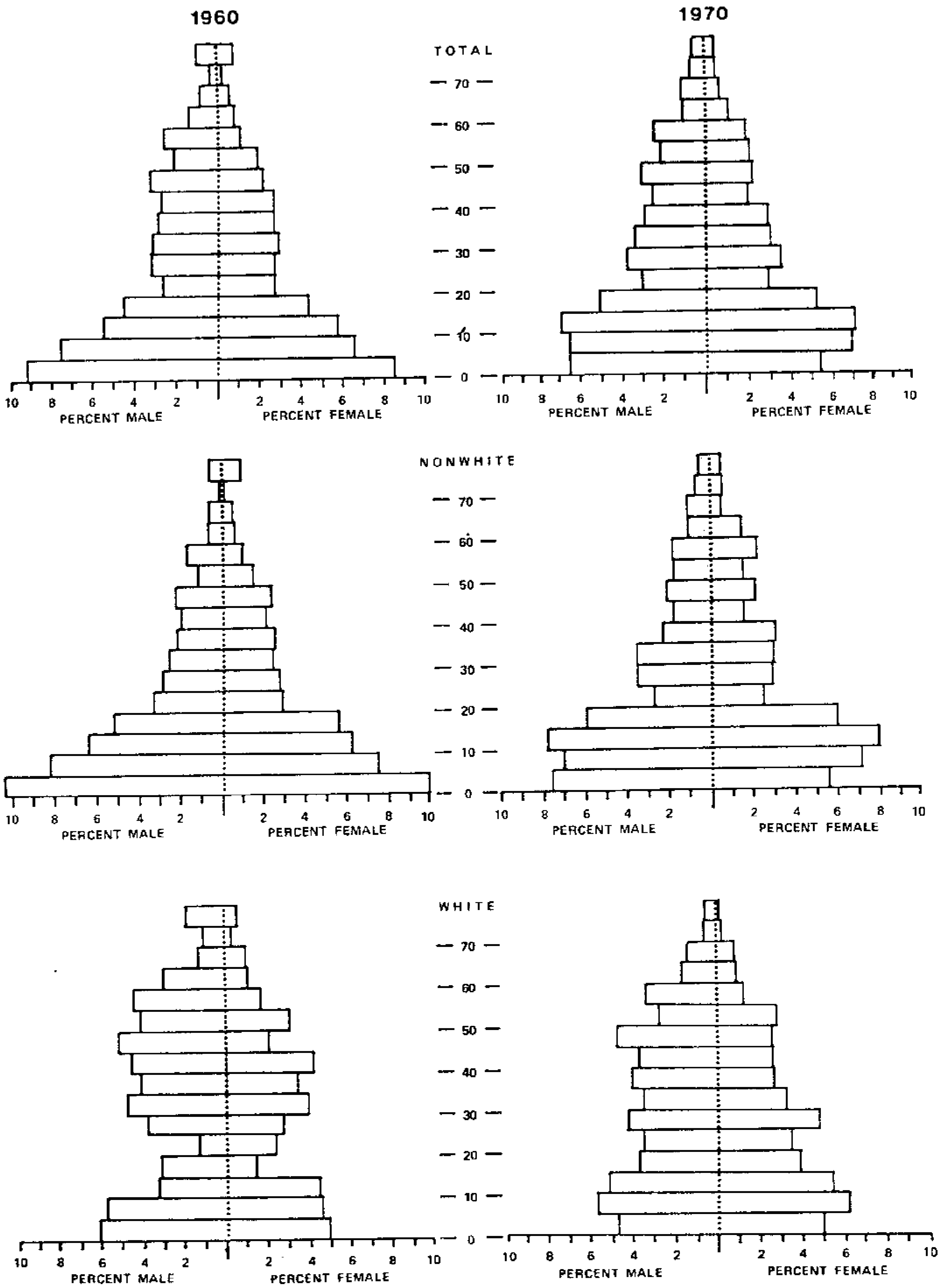
populations in Nome. The age-sex pyramids Figure IX-2 show the composition of the population in 1960 and 1970. The technique used to construct such pyramids is described by Rogers:

> The principal analytical tool for the purposes of revealing variations in the age-sex profiles is the population pyramid. Their construction is relatively simple. Age groups are placed on the vertical scale, starting at the bottom with the youngest age group and passing successively to the higher ones. On the horizontal scale are plotted the percentages that each age group constitutes of the entire population, with the portion of the percentage composed of males on the left and the portion made up of females on the right. Building from bottom to top of those bars, which represent percentages of males and females in each age category gives rise to the age-sex pyramid. The pyramid itself represents 100 percent of the total population.[2]

Perhaps the most striking change illustrated by Figure IX-2 is the decline in the Native birthrate as shown by the pronounced shrinking of the base of the pyramid between 1960 and 1970. The migration of Natives from the Nome area after completion of their schooling is reflected in the sharp constriction of the pyramid in the age groups above 20 years old. The pyramids indicate that out-migration is particularly significant in the 20 to 25-year age class. Among the white population in Nome, the age-sex distribution has become much more regular between 1960 and 1970. The differences in birthrates and migration patterns tend to make the Native population, on the average, younger than the white population. In 1970, 56 percent of the Native population was less than 20 years old while only 37 percent of the white population was under 20.

FIGURE IX-2

CITY OF NOME – POPULATION PROFILES



Source: U.S. Department of Commerce, Bureau of the Census, 1963 and 1973.

SCHOOL FACILITIES AND ENROLLMENTS

The Nome School District is the only city operated school system in Northwest Alaska. In the remainder of the region schools are administered by the State Operated Schools, Bureau of Indian Affairs, or various religious organizations. The 1973-74 school year budget for the Nome School District was about $2 million. Of that total, only about 2 percent was derived from local sources while 98 percent of the funding came from state and federal sources.[3]

Nome's elementary and junior high school students are housed in the main school located in the center of town. Part of the building dates from 1935, a wing was added in 1958, and a large new addition opened in January 1974. Nome's present high school is located about four miles outside of tow . The facility was originally built in 1962 to serve as a skill center. In the mid-1960's it became the Beltz Regional Vocational High School administered by the State Operated Schools system. Students from Native villages throughout Northwest Alaska attended the school and lived in the adjacent dormitory. In the fall of 1972, the Beltz High School and the Nome City High School merged under the administration of the Nome City School District. Both village and town students began to attend the Beltz facility. At the end of the 1972-73 term the dormitory was closed. In the fall of 1973, there were 90 students from outlying villages attending the Nome-Beltz high school. Of these, 24 were housed in a cottage-style living arrangement in the former quarters of the state teachers and the remaining village students lived with Nome families under the State Boarding Home Program.[4] In addition to the traditional high school curriculum the Nome-Beltz High School offers vocational courses in electronics, woodworking, mechanics, metal fabrication, and business skills.

Despite the fact that Nome's population has remained nearly constant, school enrollments have risen substantially since about 1960 (see Table IX-5 and Figure IX-3.) This was due, in part, to increases in the proportion of younger children going to school and to students remaining in school through the higher grades. The rise in enrollments was also attributable to the introduction of new programs designed specifically to meet the needs of the residents of the area.

Elementary school enrollments (grades 1 through 8) have shown no clear trend and have averaged about 550 students from 1960 to 1973. Reflecting the change in birthrates, the elementary school enrollment did reach a peak of 600 in the mid-1960's and then declined to 500 in the early 1970's. In contrast, the high school enrollment has grown substantially since 1960. Because of the merger with the Beltz school in 1972, it is difficult to make comparisons after that date. However, between 1960 and 1969, high school enrollment rose from 93 to a peak of 190. That represents an average annual increase of 8 percent, obviously much more rapid than the growth in population. After 1969, high school enrollment (excluding the 90 students from outlying villages) declined slightly to its present level of about 180.

The total enrollment in the Nome school system has been raised in recent years by the initiation of special education and kindergarten programs. Special education classes were first offered in 1968; 30 to 40 students have been enrolled recently. A kindergarten program was started in 1970. The

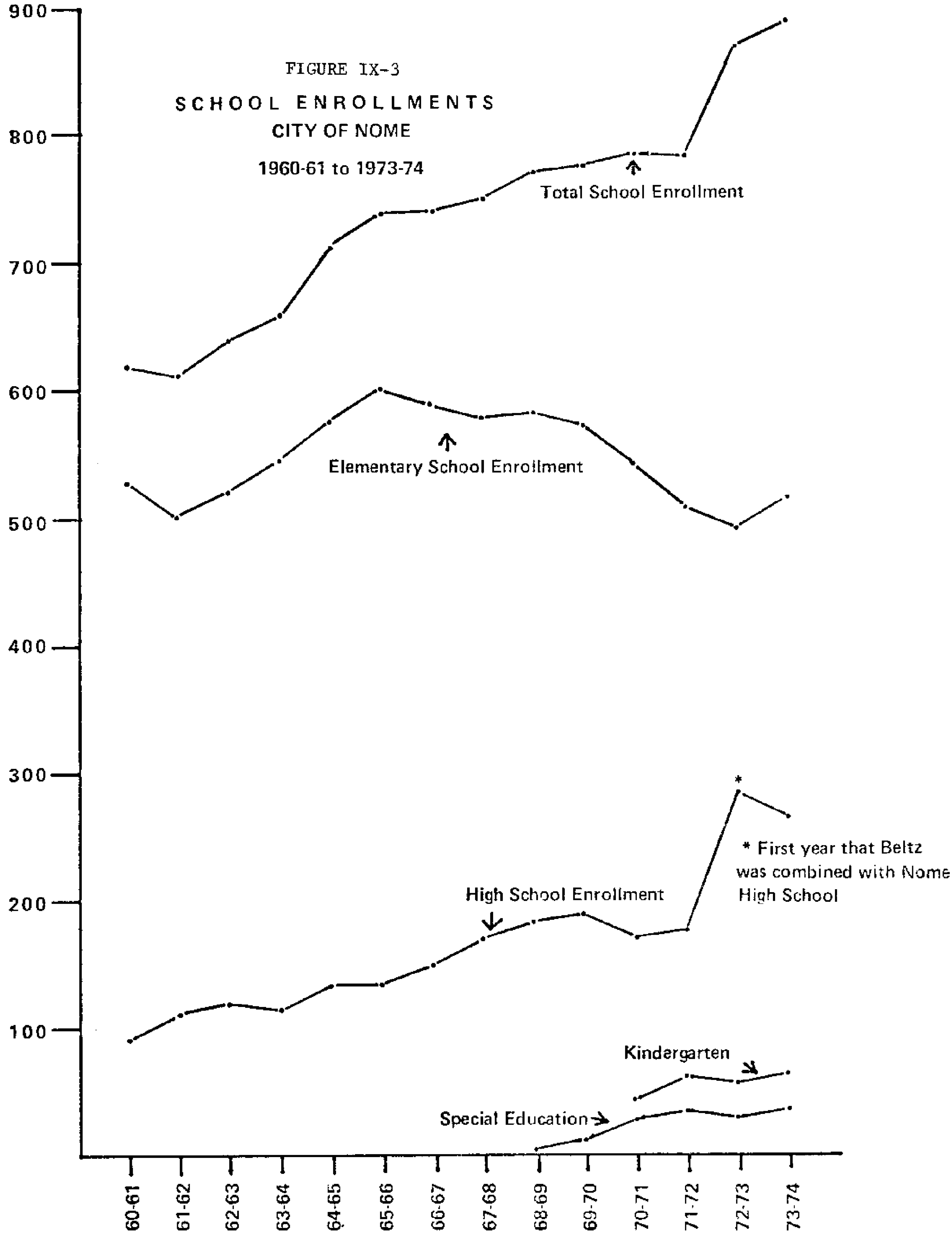
TABLE IX-5

SCHOOL ENROLLMENTS

CITY OF NOME 19.4-55 to 1973-74

	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974
Kindergarten	-	-	-	-	-	-	-	-	-	-	45	62	59	66
Elementary (1-8)	528	500	520	545	576	602	588	580	583	573	541	508	494	518
Special Education	-	-	-	-	-	-	-	-	5	16	28	37	30	38
High School	93	111	120	115	134	137	152	168	185	190	170	178	284	267
TOTAL	621	611	640	660	710	739	740	748	773	779	784	785	867	889

Source: Alaska. Department of Education.



Source: Sullivan, 1970.

need for such a program had been clearly identified in the 1968 Nome Comprehensive Plan:

> A high percentage of Nome's school children are of Eskimo origin. Some of these children enter the school unable to speak English, while a larger group is bilingual but seldom uses English outside the school classroom. Because of these language barriers and because no kindergarten classes are offered, approximately 25 percent of the elementary students take 2 to 3 years to get through the first grade and a great deal of individual instruction is required.[5]

According to the superintendent of schools the Nome School District is attempting to put greater emphasis on early childhood education. Students who have attended kindergarten, but who are not ready to enter the first grade study a modified primary curriculum with emphasis on reading skills. These students receive personal attention from teachers trained in remediation.[6]

EDUCATIONAL ATTAINMENT

In general, the educational attainment in the Nome Census Division can be characterized as being quite low but rapidly improving. The median school years completed in the Nome Census Division in 1970 was only 8.7 for males and 7.8 for females, as compared to 12.5 and 12.4 for the state as a whole (see Table IX-6.) The proportion of high school graduates was 30.5 percent in Nome, less than half the statewide proportion of 66.6 percent. As shown in Table IX-6, the low educational attainment is characteristic only of the Native population of Nome. Among Natives in Nome over 25 years old, only 11.5 percent were high school graduates; that is an extremely low proportion relative to whites and relative to Natives throughout the rest of the state. Nearly 80 percent of the Nome Native population over 25 years old had completed no more than 8 years

TABLE IX-6

EDUCATIONAL ATTAINMENT
NOME CENSUS DIVISION

Years of School Completed	NOME CENSUS DIVISION						ALASKA						U.S.	
	TOTAL		WHITE		NONWHITE		TOTAL		WHITE		NONWHITE		TOTAL	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
MALES, 25 years old and over	1,299	100.0	372	100.0	927	100.0	73,963	100.0	61,189	100.0	12,774	100.0	51,869,770	100.0
No school years completed	55	4.2	0	-	55	5.9	1,774	2.4	267	0.4	1,507	11.8	852,851	1.6
Elementary: 1-4 years	186	14.3	0	-	186	20.1	2,612	3.5	435	0.7	2,177	17.0	2,299,323	4.4
5-6 years	169	13.0	10	2.7	159	17.2	2,180	2.9	656	1.2	1,524	11.9	3,082,912	5.9
7 years	106	8.2	0	-	106	11.4	1,883	2.5	1,024	1.7	859	6.7	2,392,567	4.6
8 years	204	15.7	31	8.3	173	18.7	5,653	7.6	4,378	7.2	1,275	10.0	6,708,041	12.9
High School: 1-3 years	176	13.5	43	11.6	133	14.3	10,858	14.9	9,116	14.9	1,742	13.6	9,633,537	18.6
4 years	189	14.5	112	30.1	77	8.3	26,684	36.1	24,258	39.6	2,426	19.0	14,365,218	27.7
College: 1-3 years	96	7.4	69	18.5	27	2.9	10,829	14.6	9,994	16.3	835	6.5	5,526,759	10.7
4 years	39	3.0	36	9.7	3	3.2	5,612	7.6	5,359	8.8	253	2.0	3,518,159	6.8
5 years or more	79	6.1	71	19.1	8	8.6	5,878	7.9	5,702	9.3	176	1.4	3,490,403	6.7
High School Graduates	403	31.0	288	77.4	115	12.4		66.3	45,313	74.1	12,774	28.9		51.9
Median School Years Completed		8.7						12.5						12.1
FEMALES, 25 years old and over	1,039	100.0	249	100.0	790	100.0	60,985	100.0	49,717	100.0	11,268	100.0	58,029,589	100.0
No school years completed	60	5.8	0	-	60	7.6	1,565	2.6	177	0.3	1,388	12.3	914,902	1.6
Elementary: 1-4 years	182	17.5	0	-	182	23.0	2,009	3.3	197	0.4	1,812	16.1	1,972,238	3.4
5-6 years	196	18.9	0	-	196	24.8	1,944	3.2	456	0.9	1,488	13.2	3,134,180	5.4
7 years	97	9.3	0	-	97	12.3	1,248	2.0	486	1.0	762	6.8	2,423,053	4.2
8 years	143	13.8	0	-	143	18.1	3,974	6.5	2,570	5.2	1,404	12.5	7,307,323	12.6
High School: 1-3 years	51	4.9	22	8.8	29	3.7	9,294	15.2	7,676	15.4	1,618	14.4	11,652,385	20.1
4 years	123	11.8	69	27.7	54	6.8	24,136	39.6	22,285	44.8	1,851	16.4	19,792,833	34.1
College: 1-3 years	84	8.1	67	26.9	17	2.2	9,223	15.1	8,604	17.3	619	5.5	6,123,971	10.6
4 years	76	7.3	64	25.7	12	1.5	4,872	8.0	4,622	9.3	250	2.2	3,139,445	5.4
5 years or more	27	2.6	27	10.8	0	-	2,720	4.5	2,644	5.3	76	0.7	1,569,259	2.7
High School Graduates	310	29.8	227	91.2	83	10.5		67.1	38,115	76.7	11,268	24.8		52.8
Median School Years Completed		7.8						12.4						12.1
TOTAL, 25 years old and over	2,338	100.0	621	100.0	1,717	100.0	134,948	100.0	110,906	100.0	24,042	100.0	109,899,359	100.0
No school years completed	115	4.9	0	-	115	6.8	3,339	2.5	444	0.4	2,895	12.0	1,767,753	1.6
Elementary: 1-4 years	368	15.7	0	-	368	21.4	4,621	3.4	632	0.6	3,989	16.6	4,271,561	3.9
5-6 years	365	15.6	10	1.6	355	20.7	4,124	3.1	1,112	1.0	3,012	12.5	6,217,092	5.7
7 years	203	8.7	0	-	203	11.8	3,131	2.3	1,510	1.4	1,621	6.7	4,815,620	4.4
8 years	347	14.8	31	5.0	316	18.4	9,627	7.1	6,948	6.3	2,679	11.1	14,015,364	12.6
High School: 1-3 years	227	9.7	65	10.5	162	9.4	20,152	14.9	16,792	15.1	3,360	14.0	21,285,922	19.4
4 years	312	13.3	181	29.1	131	7.6	50,820	37.6	46,543	42.0	4,277	17.8	34,158,051	31.1
College: 1-3 years	180	7.7	136	21.9	44	2.6	20,052	14.9	18,598	16.8	1,454	6.0	11,650,730	10.6
4 years	115	4.9	100	16.1	15	0.9	10,484	7.8	9,981	9.0	503	2.1	6,657,604	6.1
5 years or more	106	4.5	98	15.8	8	0.5	8,598	6.4	8,346	7.5	252	1.0	5,059,662	4.6
High School Graduates	713	30.5	515	82.9	198	11.5		66.6		75.3		26.9		52.4

Sources: U.S. Department of Commerce, Census of the Bureau, 1973; U.S. Department of Commerce, Census of the Bureau, 1971c, Table 88.

of schooling and 7 percent had no schooling at all.

Having observed that the average level of educational attainment is low in the Nome region, it is important to go on to note that rapid improvements are being made in this area. The proportion of high school graduates has risen from 1.5 percent in 1960 to 11.5 percent in 1970 for the Native population over 25 years old. The improvement shown by this measure really understates the rising educational level within the younger segment of the population. Among Native males between the ages of 20 and 49, nearly one-third were high school graduates in 1970. The proportion of high school graduates among Native females between the ages of 15 and 44 was 17 percent.[7] For Natives between the ages of 18 and 24, and excluding those still enrolled in school, high school graduates made up fully 54 percent of the population in Nome.[8] That proportion is comparable to the percentage of high school graduates in the U.S. population as a whole. Thus, it would appear that the Natives in Nome have in recent years made significant progress in raising the level of educational attainment. Furthermore, the data on school enrollments indicate that this progress is likely to continue. In 1970, over 99 percent of the residents of Nome between the ages of 7 and 17 were enrolled in school.

CHAPTER IX

Footnotes

1. See Rogers, 1963 pp. 104-107 for a discussion of this concept.

2. Rogers, 1963 pp. 64-65.

3. Taylor, 1973

4. Taylor, 1973

5. Alaska. State Housing Authority, 1968 pp. 128-129.

6. Taylor, 1973

7. U.S. Department of Commerce, Bureau of the Census, 1971b and 1973.

8. U.S. Department of Commerce, Bureau of the Census, 1973.

CHAPTER X. EMPLOYMENT AND WAGES

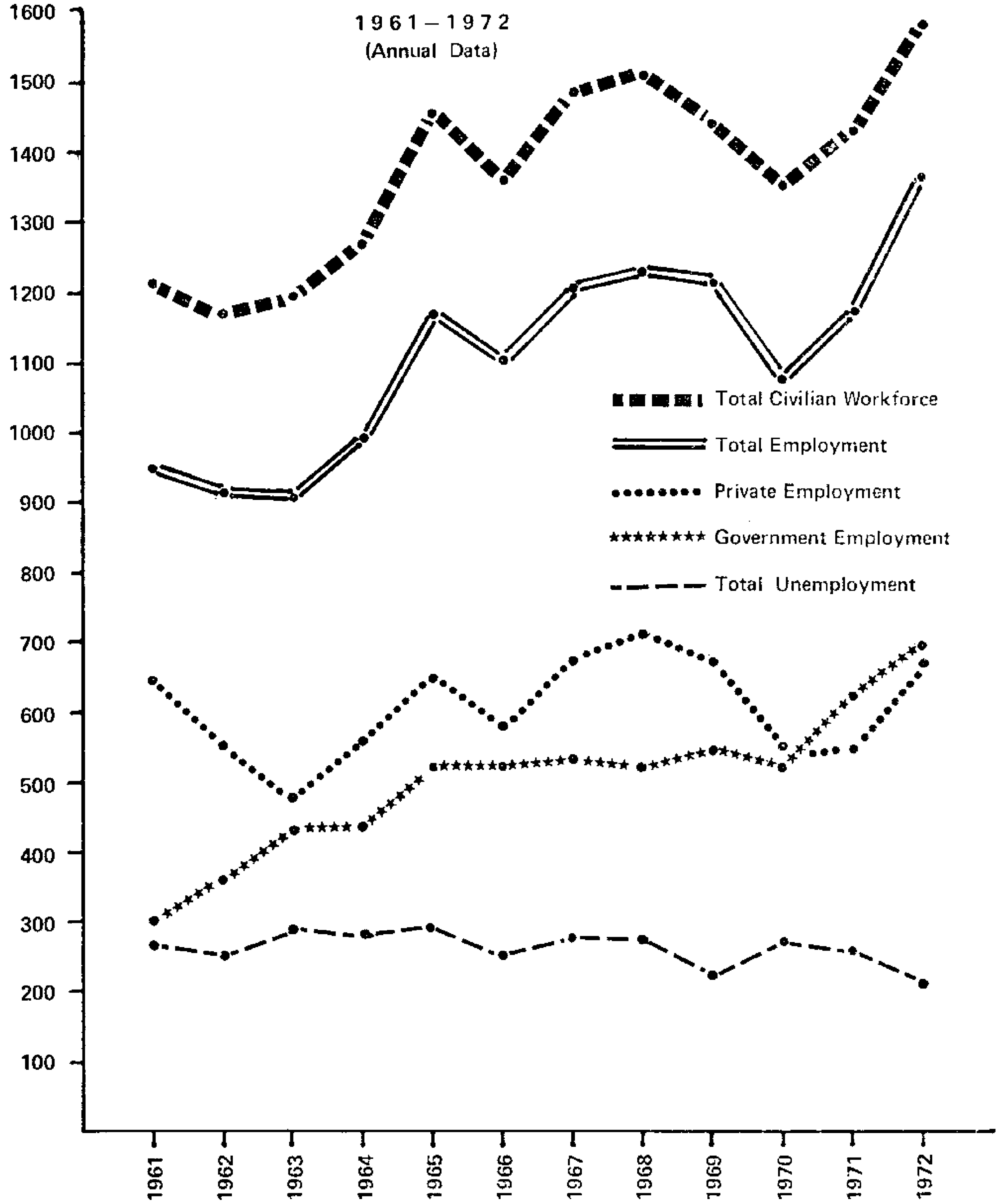
LABOR FORCE

The size of the labor force in any region is determined jointly by the characteristics of the local population and by the availability of employment opportunities. It is obvious that in the long-run there has to be a close relationship between the size of the population base and the size of the labor force. However, this relationship is not necessarily constant over time nor is it the same for all regions. In particular, there can be large differences in the observed participation rates, i.e., in the proportions of the population that choose to seek employment. One of the key factors determining the participation rate is the availability of employment opportunities. When jobs are easy to find, more people decide to seek employment thus causing an increase in the participation rate and in the labor force.

In Nome, the workforce has fluctuated widely in the shortrun but, over the longer run, has shown a gradual upward trend (see Figure X-1.) The civilian workforce in the Nome Census Division averaged about 27 percent higher in the 1971-72 period than in the 1961-62 period. The data in Table X-1 show that the 1970 labor force participation rate in Nome was much lower than the statewide average, 48 percent as compared to 62 percent. The participation rate for Natives was only 38 percent in total; 45 percent for males and 31 percent for females. Those rates are much lower than the participation rates for whites but are only moderately lower than the statewide participation rates for Natives.

FIGURE X-1

WORKFORCE & EMPLOYMENT
NOME LABOR MARKET AREA
1961–1972
(Annual Data)



Source: Alaska, Department of Labor, Workforce Estimates.

TABLE X-1

LABOR FORCE AND EMPLOYMENT

NOME CENSUS DIVISION 1970

	NOME			ALASKA		
	TOTAL	WHITE	NON-WHITE	TOTAL	WHITE	NON-WHITE
Total Civilian Population, 16 years old and over	3,065	674	2,391	159,702	128,367	31,335
Civilian labor force	1,466	556	910	98,296	84,960	13,336
Percent of total (participation rate)	47.8	82.5	38.1	61.5	66.2	42.6
Employed	1,236	523	713	89,236	78,231	11,005
Unemployed	230	33	197	9,060	6,729	2,331
Percent of civilian labor force	15.7	5.9	21.6	9.2	7.9	17.5
Male, 16 years old and over	1,620	363	1,257	76,547	61,363	15,184
Civilian labor force	891	330	561	60,293	52,490	7,803
Percent of total (participation rate)	50.3	90.9	44.6	78.8	85.5	51.4
Employed	696	304	392	54,114	47,931	6,183
Unemployed	195	26	169	6,179	4,559	1,620
Percent of civilian labor force	21.9	7.9	30.1	10.2	8.7	20.8
Female, 16 years old and over	1,445	311	1,134	83,155	67,004	16,151
Civilian labor force	575	226	349	38,003	32,470	5,533
Percent of total (participation rate)	39.8	72.7	30.8	45.7	48.5	34.3
Employed	540	219	321	35,122	30,300	4,822
Unemployed	35	7	28	2,881	2,170	711
Percent of civilian labor force	6.5	3.1	8.0	7.6	6.7	12.9

Source: U.S. Department of Commerce, Census of the Bureau, 1973.

The rate of unemployment among Natives is extremely high in the Nome area. At the time of the 1970 census, the Native unemployment rate was estimated to be 22 percent and the rate for all workers was 16 percent (see Table X-1.) The comparable rates for the state were 17 percent for nonwhites and 9 percent overall. According to the Alaska workforce estimates, the average unemployment rate throughout 1970 was 20 percent in the Nome area and was 9 percent for the state. The high rate of unemployment in Nome is undoubtedly a key factor causing the low participation rates. The lack of employment opportunities has caused people to drop out of the labor force. In addition, the high unemployment among Natives is an important factor contributing to the observed migration of Natives from the Nome area.

SEASONAL VARIATION IN EMPLOYMENT

In tracing the movements over time, the pattern of employment in the Nome area has substantial seasonal fluctuations. Figure X-2 shows the movement in the average annual employment and the monthly variations around the average. The graph also illustrates how closely the seasonal movements in the workforce, due to changes in participation rates, match the movements in employment. However, the movements do not match exactly, as demonstrated by the seasonal variation in unemployment shown at the bottom of the figure.

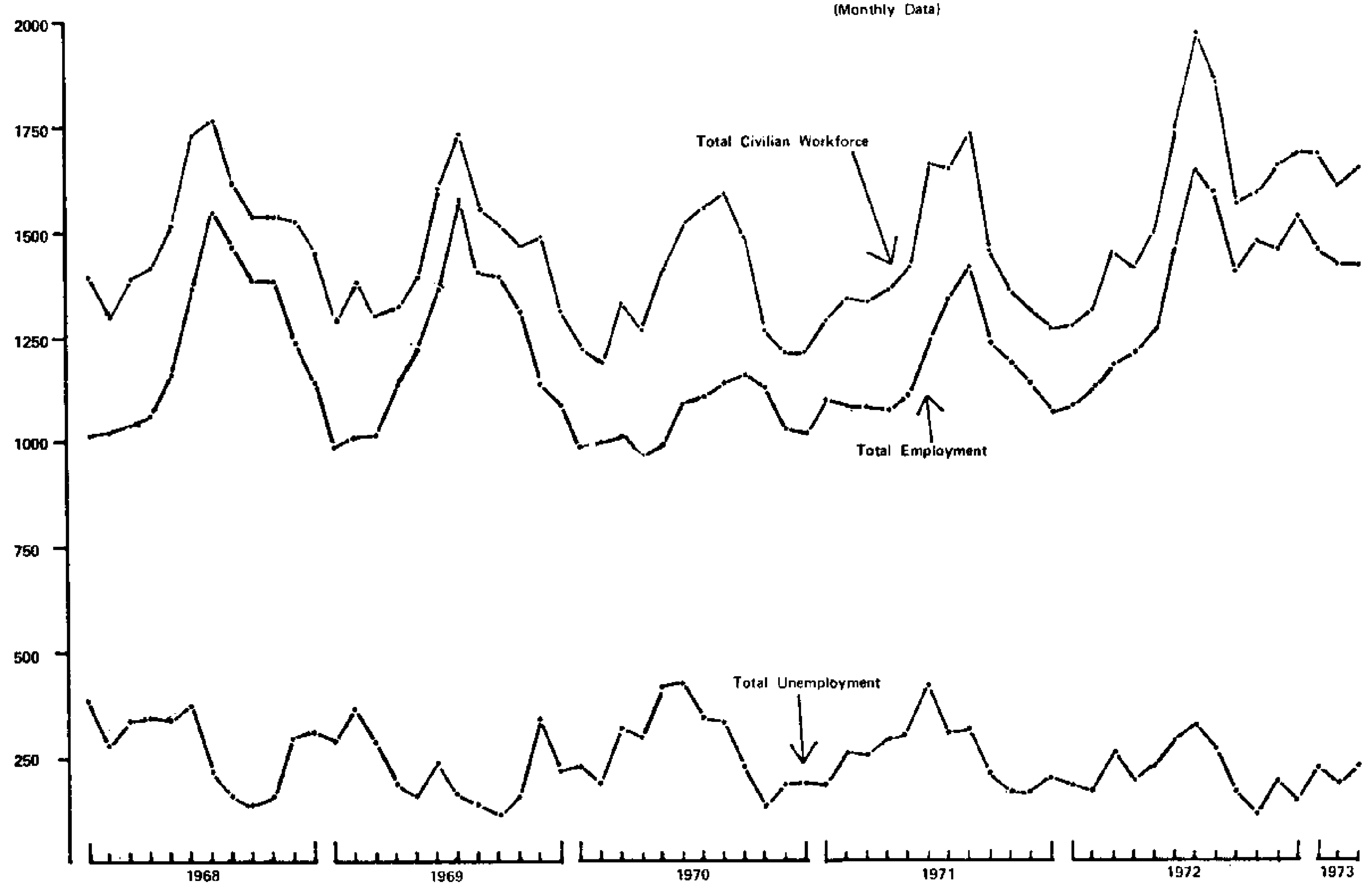
The construction, transportation, and trade industries are the main sources of the summer peak in employment. As shown in Table X-2, the peak employment in each of these industries is substantially higher than the annual average employment. For the period from 1969 to 1972, the peak em-

FIGURE X-2

WORKFORCE AND EMPLOYMENT

NOME LABOR MARKET AREA 1968-73

(Monthly Data)



Source: Alaska, Department of Labor, Workforce Estimates.

TABLE X-2

Employment By Industry

Nome Census Division 1961-1972

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Total Employment	948	915	907	991	1171	1105	1209	1234	1219	1078	1175	1373
Private Employment	647	555	477	557	648	581	674	713	672	552	551	674
Nonagricultural Wage & Salary Emp.	825	813	820	882	1000	950	1046	1072	1060	938	1025	1213
Peak Month*	(1125)	(1112)	(1024)	(1190)	(1478)	(1159)	(1373)	(1346)	(1367)	(1097)	(1248)	(1468)
Contract Construction	76	47	53	80	94	30	73	101	78	39	38	74
Peak Month*	(283)	(110)	(117)	(216)	(259)	(74)	(216)	(182)	(142)	(89)	(89)	(147)
Transportation, Communication and Public Utilities	96	101	99	113	105	107	119	116	106	115	110	123
Peak Month*	(174)	(181)	(169)	(300)	(192)	(206)	(201)	(190)	(192)	(178)	(131)	(150)
Wholesale and Retail Trade	167	156	139	143	132	133	141	152	168	128	129	141
Peak Month*	(313)	(302)	(205)	(232)	(174)	(174)	(185)	(216)	(299)	(160)	(169)	(167)
Services	88	78	75	88	116	130	147	141	124	94	84	138
Peak Month*	(94)	(85)	(79)	(99)	(137)	(148)	(200)	(161)	(145)	(120)	(95)	(160)
Government	301	360	430	434	523	524	535	521	547	526	624	699
Peak Month*	(342)	(391)	(484)	(495)	(778)	(628)	(636)	(569)	(612)	(567)	(725)	(886)
Federal	NA	NA	NA	241	232	244	235	238	244	187	223	214
Peak Month*	NA	NA	NA	(258)	(247)	(263)	(253)	(257)	(254)	(313)	(238)	(231)
State and Local	NA	NA	NA	192	291	280	300	283	303	339	401	485
Peak Month*	NA	NA	NA	(242)	(537)	(385)	(394)	(344)	(361)	(395)	(493)	(665)
Other	97	71	24	24	30	26	31	41	37	36	40	38

Industrial Distribution of Annual Average Nonagricultural Wage & Salary Employment (Percent)

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Contract Construction	9.2	5.8	6.5	9.1	9.4	3.2	7.0	9.4	7.4	4.2	3.7	6.1
Transportation, Communication and Public Utilities	11.6	12.4	12.1	12.8	10.5	11.3	11.4	10.8	10.0	12.3	10.7	10.1
Wholesale and Retail Trade	20.2	19.2	17.0	16.2	13.2	14.0	13.5	14.2	15.8	13.6	12.6	11.6
Services	10.7	9.6	9.1	10.0	11.6	13.7	14.1	13.2	11.7	10.0	8.2	11.4
Government	36.5	44.3	52.4	49.2	52.3	55.2	51.1	48.6	51.6	56.1	60.9	57.6
Federal	NA	NA	NA	27.4	23.2	25.7	22.4	22.2	23.0	19.9	21.8	17.6
State and Local	NA	NA	NA	21.8	29.1	29.5	28.7	26.4	28.6	36.2	39.1	40.0
Other	11.8	8.7	2.9	2.7	3.0	2.7	2.9	3.8	3.5	3.8	3.9	3.1

*Employment in the peak month of each year is shown in parentheses below the annual average of monthly employment.

Source; Alaska. Department of Labor, Division of Employment Security, Alaska Workforce Estimates.

ployment in contract construction was over twice the annual average employment; in transportation and trade the peak was 40 percent higher than the annual average. Total employment in the Nome area had a seasonal peak which was 22 percent higher than the annual average from 1969 to 1972; the seasonal peak in the state as a whole was 12 percent higher than the annual average. It should be noted that the difference between the seasonal peak and the seasonal low point would be roughly twice as large as the differences cited above. Thus, in Nome the seasonal variation typically produces nearly a 45 percent difference between the high and low points in employment each year.

Because of the seasonality in the economy, a large proportion of the Nome labor force is employed for only a fraction of the year. During 1969, only 40 percent of the employees in the Nome area were employed for 40 weeks or more and one-third of the employees worked less than 13 weeks during the year (see Table X-3.) Among the Natives employed in Nome, 25 percent worked year-round (40 weeks or more) while 45 percent worked less than 13 weeks. Clearly, on an annual basis, only a fraction of the available labor force is being utilized in the Nome area.

EMPLOYMENT

Employment in each of the major industries in the Nome areas is shown in Table X-2. The discussion below outlines the factors which have produced the observed development of each sector.

Government: The government sector has historically been one of the most important in Alaska's economy. In Nome, the government is clearly the dominant

TABLE X-3
WORKERS BY WEEKS WORKED
NOME CENSUS DIVISION 1969

	NOME						ALASKA					
	Total		White		Nonwhite		Total		White		Nonwhite	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percen
Males, 16 years and over												
by weeks worked in 1969	1,549		491		1,058		99,721		83,957		15,764	
40-52 weeks	682	44.0	391	79.6	291	27.5	75,249	75.5	67,992	81.0	7,257	46.0
14-39 weeks	392	25.3	75	15.3	317	30.0	15,219	15.3	11,591	13.8	3,628	23.0
13 weeks or less	475	30.7	25	5.1	450	42.5	9,253	9.3	4,374	5.2	4,879	31.0
Did Not Work in 1969	222		14		208		7,556		4,988		2,568	
Females, 16 years and over												
by weeks worked in 1969	789		257		532		49,307		41,104		8,203	
40-52 weeks	261	33.1	158	61.5	103	19.4	24,023	48.7	21,337	51.9	2,686	32.7
14-39 weeks	238	30.2	70	27.2	168	31.6	14,637	29.7	12,165	29.6	2,472	30.1
13 weeks or less	290	36.7	29	11.3	261	49.1	10,647	21.6	7,602	18.5	3,045	37.1
Did Not Work in 1969	656		54		602		34,543		26,527		8,016	
Total, 16 years and over												
by weeks worked in 1969	2,338		748		1,590		149,028		125,061		23,967	
40-52 weeks	943	40.3	549	73.4	394	24.8	99,272	66.6	89,329	71.4	9,943	41.5
14-39 weeks	630	26.9	145	19.4	485	30.5	29,856	20.0	23,756	19.0	6,100	25.5
13 weeks or less	765	32.7	54	7.2	711	44.7	19,900	13.4	11,976	9.6	7,924	33.1
Did Not Work in 1969	878		68		810		42,099		31,515		10,584	

Source: U.S. Department of Commerce, Bureau of the Census, 1973.

sector in the regional economy. Since the closing of gold dredging operations in 1962, the combined federal and state and local government employment has consistently accounted for more than half of the total employment in the Nome Census Division. Government employment has risen from 300 persons in 1961 to 700 in 1972.

As shown in Figure X-1, since 1961 the government sector has been the sole source of long-run growth in Nome economic activity. Government employment increased rapidly from 1961 to 1965, remained constant through 1970, and then expanded again in 1971 and 1972. This recent growth was due almost entirely to employment in state and local government; that sector increased employment by 43 percent between 1970 and 1972. In contrast to government employment, the private sector in Nome has fluctuated widely but has shown no sustained growth from 1961 to 1972. Employment at the end of the period was the same as at the start.

Table X-4 shows the monthly government employment by agency for the Nome Census Division in 1972. Information for the city of Nome alone was not available, but as the regional center most of the region's government employment is concentrated in the city. In 1972, federal workers made up 30 percent of total government employment in the Nome area. Over half of the federal employment was with the Department of the Interior, which in Nome is largely the Bureau of Indian Affairs. State employees constituted somewhat over half of total government employment. The major state agencies involved were Community and Regional Affairs, Governor's Office, State Operated Schools, Department of Highways, and Department of Education. Local government

TABLE X-4

1972 GOVERNMENT EMPLOYMENT IN THE NOME CENSUS DIVISION

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average
TOTAL	700	733	736	680	659	708	809	783	593	708	784	871	730
Federal Government	224	223	229	209	213	192	189	199	213	225	231	221	214
Transportation	36	35	35	35	35	35	35	34	30	29	29	27	33
Health Education and Welfare	2	2	2	2	2	2	2	2	2	10	11	12	4
Air Force	28	27	26	12	13	15	14	17	17	23	23	19	20
Interior	119	119	122	123	123	101	101	107	121	125	126	122	117
Commerce	15	17	17	13	15	15	15	18	19	16	18	17	16
U.S. Postal Service	24	23	27	24	25	24	22	21	24	22	24	24	24
State Government*	339	362	368	338	308	391	498	467	280	378	448	532	392
Governor's Office/Community and Regional Affairs	133	147	137	117	88	162	302	266	53	126	195	274	167
Law	2	2	2	2	2	2	2	2	2	2	2	2	2
Revenue	2	2	2	2	2	2	2	2	2	2	2	2	2
Education	33	31	32	31	30	29	21	27	55	76	75	86	44
Health & Social Services	21	23	23	24	26	25	26	26	25	25	25	26	25
Labor	3	3	3	3	3	3	3	3	3	3	3	3	3
Military Affairs	1	1	1	1	1	1	3	3	6	5	5	6	3
Fish & Game	5	6	6	5	8	8	5	5	5	5	4	4	6
Public Safety	8	8	8	9	9	9	9	9	9	7	8	8	8
Public Works	16	16	30	14	12	18	14	13	12	13	8	9	15
Highways	39	40	41	41	41	54	62	65	67	55	51	47	50
State Operated School	64	71	71	77	74	66	37	34	29	46	58	53	57
Legislative Affairs	1	1	1	1	1	1	1	1	1	1	1	1	1
Court System	11	11	11	11	11	11	11	11	11	12	11	11	11
Local Government	137	148	139	133	138	125	122	117	100	105	105	118	124
School District	94	106	97	94	97	85	88	87	70	70	68	75	86
City Government	43	42	42	39	41	40	34	30	30	35	37	43	38

*Not adjusted to remove Neighborhood Youth Corps workers still in school.

Source: Alaska. Department of Labor.

employment was 17 percent of the total. Nearly 70 percent of the local government positions were with Nome's city schools and the others were in city government.

Mining: Nome is most often remembered as a gold mining town but, since the gold dredge was shut down in 1962, the mining sector has generated very little employment in Nome. Mining has been included in the "other" category in Table X-2. In 1972, 20 to 25 persons were employed in mining during the summer months. In terms of annual averages, the employment in mining would be even lower.

Contract Construction: Employment in contract construction has varied erratically with no discernable trend. During 1972 an average of 74 persons were employed in construction, about the same as the average over the entire 1961-1972 period. Employment in the construction industry in Nome varies widely, both seasonally and from year to year. The seasonal peak in construction employment is generally two to three times as large as the annual average employment. Between 1961 and 1972, the annual average employment in the construction industry ranged from a high of 101 in 1968 to a low of 30 in 1966.

Transportation, Communications, and Public Utilities: Employment in this sector in Nome has been quite stable over time. There may have been a very slight increase in average employment during the past ten years. There is significant seasonal variation, though much less than in construction.

Trade: The trade sector has also been rather stable with, if any trend, a slight decline in employment between 1961 and 1972. In the early part of the period, the trade sector had very large seasonal fluctuations but since the mid-1960's the seasonality has been considerably reduced.

Services: Of the private industries in Nome, the service sector has displayed the least seasonal fluctuation. However, the average employment in the industry has moved erratically over time. Employment rose rapidly between 1963 and 1967 to reach a peak of 147. It fell to just 84 in 1971 and then jumped to 138 in 1972.

WAGES AND SALARIES

Wages and salaries paid by all industries in the Nome area totaled $11.5 million in 1972 (see Table X-5). Payrolls have increased by 90 percent since 1964, an average annual rate of increase of 8.3 percent. Most of the increase in earnings is attributable to the government sector where payrolls have risen from $2.8 million in 1964 to $7.2 million in 1972. In contrast, wages and salaries paid by the private sector have increased by just $1.0 million, from $3.3 million in 1964 to $4.3 million in 1972. Thus, between 1964 and 1972, the government sector has accounted for over 80 percent of the increase in payrolls in the Nome area. As also shown in Table 3-5, the growth in government payrolls has been quite steady while private payrolls have fluctuated widely over the period.

The annual earnings per employee in the Nome area are shown in Table X-6. The figures in that table were computed by dividing the annual payroll in each industry by the number of persons employed by that industry during the month of peak employment. Because of the seasonality in the Nome economy, it would have produced very misleading results to have divided by the average annual employment rather than peak employment. For example, in the construction

TABLE X-5

ANNUAL PAYROLL BY INDUSTRY

Nome Census Division 1961-1972

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
ALL INDUSTRIES	3,894,289*	3,789,004*	4,028,335*	6,075,378	6,762,510	6,161,131	7,086,558	8,162,040	8,059,182	7,582,235	9,365,595	11,520.382
PRIVATE INDUSTRIES				3,294,774	3,634,545	2,558,181	3,230,885	4,191,158	3,682,381	2,654,548	3,163,964	4,304,185
Contract Construction	960,060	673,525	1,012,056	1,455,188	1,648,633	451,496	967,182	1,775,096	1,239,968	507,782	601,934	1,277,902
Transportation, Communication & Public Utilities	542,210	608,528	606,491	719,246	703,379	732,233	861,063	782,192	798,756	819,659	937,037	1,008,199
Wholesale and Retail Trade	624,069	601,637	585,540	584,495	538,363	526,972	526,354	635,114	825,954	734,898	820,785	877,073
Services	178,962*	181,801*	149,275*	363,275	556,277	584,992	660,834	696,840	571,201	372,496	449,635	842,764
Government	NA	NA	NA	2,780,604	3,127,965	3,602,950	3,855,673	3,970,882	4,376,801	4,927,687	6,201,631	7,216,197
Federal	NA	NA	NA	1,589,365	1,503,160	1,687,064	1,755,778	1,712,658	1,853,881	1,685,243	1,985,489	2,516,202
State and Local	NA	NA	NA	1,191,239	1,624,796	1,915,886	2,099,895	2,258,224	2,522,920	3,242,444	4,216,142	4,699,995
Other	NA	NA	NA	172,570	187,875	262,488	179,452	301,916	246,502	219,713	354,573	298,247

*Data not comparable to later years because of changes in the coverage of the services and government sectors.

Source: Alaska. Department of Labor, Division of Employment Security. Statistical Quarterly.

industry using average employment in the calculation would produce an estimate of annual earnings per employee of $17,269 in 1972. Clearly, the typical construction worker in Nome did not earn over $17,000 in 1972. Because most workers earned most of their income during the summer months, the use of peak employment provides a more accurate measure of annual earnings per employee.

As calculated in Table X-6, the annual earnings per employee in Nome increased from about $5,100 in 1964 to $7,850 in 1972. That is a gain of 53 percent or an average rate of increase of 5.5 percent per year. Calculated by the same method, average earnings in Alaska in 1972 were $10,350. Thus, annual earnings in Nome were about 25 percent lower than the statewide average.

Government: In the past few years, the payrolls in state and local government have accounted for about two-thirds of the total government payrolls in Nome. The 1972 payrolls were $4.7 million for state and local government and $2.5 million for federal government. State and local government payrolls have nearly quadrupled since 1964 while federal payrolls have increased by 60 percent (see Table X-5.)

Prior to 1968, annual earnings per employee were substantially lower for state and local employees than for federal employees (see Table X-6.) From 1968 to 1971, annual earnings for the two groups were almost equal. Then, in 1972, average earnings for federal employees jumped sharply while average earnings for state and local employees declined substantially. Average earnings for federal employees in Nome rose by $2,550 in 1972, that is larger than the cumulative increase over the preceding seven years. The 1972 decline in average earnings for state and local employees was not due

TABLE X-6

ANNUAL EARNINGS PER EMPLOYEE*

Nome Census Division 1961-1972

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
TOTAL	3462**	3407**	3934**	5105	4575	5316	5161	6064	5896	6912	7504	7848
Contract Construction	4034	6123	8650	6737	6365	6101	4478	9753	8732	5705	6763	8693
Transportation, Communication, and Public Utilities	3116	3362	3589	2397	3664	3555	4284	4117	4160	4605	7152	6721
Wholesale and Retail Trade	1994	1992	2856	2519	3094	3029	3040	2940	2762	4593	4857	5252
Services	1904**	2139**	1890**	3669	4060	3953	3304	4328	3939	3104	4733	5267
Total Government	NA	NA	NA	5617	4021	5737	6062	6979	7151	8691	8554	8145
Federal	NA	NA	NA	6160	6086	6415	6940	6664	7299	7912	8342	10893
State and Local	NA	NA	NA	4922	3025	4976	5330	6564	6989	8209	8552	7068

**Data not comparable to later years because of changes in the coverage of the services and government sectors.

*Computed by dividing annual payroll in each industry by the peak monthly employment in that industry.

Source: Alaska. Department of Labor, Division of Employment Security. Alaska Workforce Estimates.

to a reduction in wage rates but to a change in the composition of employment. As shown in Table X-4, certain state programs implemented in 1972 involved the hiring of large numbers of temporary and/or part-time employees. Thus, there was an unusually large increase in state employment relative to the amount of wages generated. Since most federal employees are full-time workers, average earnings in the two government sectors are not directly comparable in 1972.

In general, annual wages in the government sector in Nome have been consistently higher than those in private industries. The only significant exception to this is the construction industry where wages have frequently been higher than in government. Annual earnings in the other private industries have been considerably lower than in government.

Contract Construction: The total payroll in contract construction in Nome was $1.3 million in 1972; about 11 percent of total payrolls and 30 percent of private payrolls (see Table X-5.) On the average, a construction worker earned about $8,700 in 1972 (see Table X-6.) In addition to large seasonal fluctuations, the construction industry is subject to abrupt year-to-year changes in the level of activity. Between 1961 and 1972 employment, payrolls, and annual wages have varied erratically in contract construction. Because of this, it is difficult to make comparisons over time but, in general, the size of the construction industry in Nome seems to have remained fairly constant.

Transportation, Communications, and Public Utilities: Payrolls in this industry were $1.0 million in 1972; about 9 percent of total Nome payrolls and 23 percent of private payrolls. Transportation payrolls have been increasing at about the same rate as the other private industries in Nome. With employment showing little growth, most of the increase in payrolls was due to gains in annual earnings per employee. Annual wages in 1972 were $6,700 in transportation, communications, and public utilities.

Trade: The combined wholesale and retail trade sector had payrolls of $0.9 million in 1972. Annual earnings per employee in 1972 were $5,200, a relatively low figure but more than double the earnings in 1964. Part of the increase in earnings is attributable to the reduction in seasonality in recent years. The summer peak in employment has been spread out somewhat and annual earnings have been raised by increasing the number of months that the average worker is employed.

Services: Annual earnings per employee in the service sector were $5,200 in 1972, the same as earnings in trade. Employment and total payroll were slightly lower in services than in trade. Payrolls in services were $0.8 million in 1972, about 20 percent of the total private payrolls in Nome.

Other: This is a residual category which includes mining; manufacturing; finance, insurance, and real estate; and miscellaneous industries. Each of these industries is so small that it is not reported separately. In 1972, the "other" category as a whole accounted for only 2.6 percent of the payrolls in the Nome region.

CHAPTER XI. INCOME AND COST OF LIVING

DISTRIBUTION OF INCOME

The 1970 Census estimated that median family income in the Nome census division for 1969 was $7,340 (see Table XI-1), about 41 percent below the median family income for the state as a whole. The mean income in Nome was $9,253, about one-third lower than the state average. About 23 percent of the Nome area families fell within the intermediate income ranges ($5,000-9,999), a figure which is almost the same as the statewide average. However, 38 percent of Nome's families had incomes less than $5,000, while in Alaska only 14 percent fell within this range. Conversely, 62 percent of the families in Alaska had incomes of at least $10,000; in the Nome division this level of income was attained by only 39 percent of the families.

The incomes of white families in the Nome area more closely resembled the statewide pattern with a relatively high proportion (76 percent) having incomes $10,000 and above. The mean income for white families in Nome was somewhat higher than for white families in the rest of the state. In contrast, nearly half of the Native (nonwhite) families had incomes less than $5,000--a statistic high even in comparison to the statewide nonwhite population. More than a fourth of the Nome Native families had incomes below $3,000. The proportion of Native families in the higher income brackets was correspondingly low. Mean income for Native families in Nome was $6,824. That was less than half of the state average for all families and $1,300 below the state average for nonwhite families.

TABLE XI-1

INCOME OF FAMILIES

NOME CENSUS DIVISION 1969

	NOME Total Number	NOME Total Percent		NOME White Number	NOME White Percent		NOME Non-White Number	NOME Non-White Percent		ALASKA Total Percent		ALASKA White Percent		ALASKA Non-White Percent	
All Families	1,010	100.0		282	100.0		728	100.0		100.0		100.0		100.0	
Less than $1,000	47	4.7		4	1.4		43	5.9		2.2		1.6		5.6	
$1,000 - 1,999	88	8.7		4	1.4		84	11.5		2.3		1.4		7.5	
2,000 - 2,999	72	7.1	38.1	5	1.8	12.4	67	9.2	48.1	2.7	14.1	1.7	9.9	8.3	37.7
3,000 - 3,999	71	7.0		0	-		71	9.8		3.2		2.2		8.6	
4,000 - 4,999	107	10.6		22	7.8		85	11.7		3.7		3.0		7.7	
5,000 - 5,999	65	6.4		11	3.9		54	7.4		5.0		4.3		8.8	
6,000 - 6,999	38	3.8		5	1.8		33	4.5		4.9		4.6		6.8	
7,000 - 7,999	50	5.0	23.1	0	-	11.7	50	6.9	27.5	4.6	23.6	4.5	22.4	5.2	30.1
8,000 - 8,999	45	4.5		5	1.8		40	5.5		4.8		4.7		4.9	
9,000 - 9,999	35	3.5		12	4.3		23	3.2		4.3		4.3		4.4	
10,000 - 14,999	216	21.4		102	36.2		114	15.7		24.6		25.5		19.2	
15,000 - 24,999	143	14.2	38.8	83	29.4	75.9	60	8.2	24.5	28.2	62.4	31.3	67.7	11.0	32.1
25,000 or more	33	3.3		29	10.3		4	0.5		9.6		10.9		1.9	
Median Income	$7,340			NA			NA			$12,443		$13,464		NA	
Mean Income	$9,253			$15,529			$6,824			$13,856		$14,874		$8,166	

Source: U.S. Department of Commerce, Bureau of the Census, 1973.

SOURCES OF INCOME

The income data in Table XI-2 show that by far the most important sources of family income in the Nome region is wages and salaries. Ninety-seven percent of the families had some wage or salary income; wages and salaries provided 92.5 percent of all family income in the region. In 1969, the mean family income from wages and salaries was roughly $8,800; it was $15,000 for whites and $6,300 for Natives.

Far fewer families receive income from the other sources shown in Table XI-2. However, for those families that do receive non-wage income the amount of money involved can be quite significant. For example, only 10 percent of the families had self-employment income in 1969 but each family involved earned over $1,000 from that source. Similarly, 11 percent of the families received social security payments which averaged $900 per family. A relatively high proportion of Native families received social security payments but the average income from this source was much less than for whites. That reflects the fact that social security payments are based in part on past earning.

According to the 1970 census, about one-fourth of the Nome area families received public assistance or public welfare income in the preceding year (see Table XI-2.) This is a much higher proportion than in the state as a whole. Of those families in Nome receiving assistance, 95 percent were Native. Nearly one-third of the Native families in Nome received some public assistance income. That too is a high proportion in comparison to 21 percent

TABLE XI-2

SOURCES OF INCOME 1969

NOME CENSUS DIVISION

	NOME									ALASKA					
	Total			White			Nonwhite			Total		White			
	Number	(Families) Percent	Mean Family Income	Number	(Families) Percent	Mean Family Income	Number	(Families) Percent	Mean Family Income	Number	(Families) Percent	Number	(Families) Percent	Number	(Families) Percent
Total Families	1,010	100.0	$9,253	282	100.0	$15,529	728	100.0	$6,824	66,670	100.0	56,552	100.0	10,118	100.0
Wage and Salary	980	97.0	8,821	282	100.0	15,042	698	95.9	6,308	63,187	94.8	53,898	95.3	9,289	91.8
Self-Employment	101	10.0	1,076	34	12.1	1,066	67	9.2	1,090	9,922	14.9	8,642	15.3	1,280	12.7
Social Security or Railroad Retirement	110	10.9	909	17	6.0	1,232	93	12.8	849	3,665	5.5	2,493	4.4	1,172	11.6
Public Assistance or Welfare Payments	243	24.1	1,189	11	3.9	577	232	31.9	1,220	3,237	4.9	1,137	2.0	2,100	20.8
All Other Income	189	18.7	1,076	64	22.7	1,148	125	17.2	1,040	18,357	27.5	16,594	29.3	1,763	17.4

Source: U.S. Department of Commerce, Bureau of the Census, 1973.

for Native families throughout the state. For those families receiving public assistance income in 1969, the average amount received by a Native family in Nome was $1,220. In the aggregate, public assistance provided just 3 percent of total family income in the Nome Census Division. Among Native families, it provided less than 6 percent of total family income.

State public assistance, Bureau of Indian Affairs general assistance, and Food Stamps are the three major forms of public assistance available to Nome area residents. The State public assistance programs include payments for old age assistance, aid to the blind, aid to the disabled and aid to families with dependent children. Table XI-3 shows the number of cases and dollar payments in each category for October 1970 through October 1973. In October 1973, the total amount of state public assistance in the Nome area was $70,029. Approximately 40 percent of this total ($28,064) was received by persons living in the city of Nome. Comparable statistics are not available for years prior to 1970 because regulations for receiving assistance under these programs were changed in that year. Between 1970 and 1973 the number of Nome area residents receiving state assistance decreased slightly from 425 to 393 and the amount of dollar payments dropped from $81,994 to $70,029. The Department of Health and Social Services does not provide data on yearly total assistance, but if the October 1973 figure is typical, it can be inferred that the programs distributed more than $840,000 to Nome area residents in 1973. Bureau of Indian Affairs general assistance is available only to Natives. In 1972, these outlays in the Nome area totaled $150,000 with payments to 295 cases.[1] The Food Stamp Bonus Coupon program receives funding

TABLE XI-3

PUBLIC ASSISTANCE

NOME October 1970, 1971, 1972, 1973

	Number of Cases in October					Dollar Payments in October				
	OAA	AB	AD	AFDC	TOTAL	OAA	AB	AD	AFDC	TOTAL
NOME DISTRICT										
1970	127	21	75	202	425	$17,980	$3,313	$11,986	$48,715	$81,994
1971	156	14	83	231	484	20,599	2,441	13,612	50,918	87,570
1972	131	12	78	199	420	17,423	1,972	13,651	42,595	75,641
1973	126	9	71	187	393	16,988	1,383	12,129	39,529	70,029
CITY OF NOME										
1970	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1971	54	2	30	82	168	7,089	370	4,842	17,639	29,940
1972	57	3	31	84	175	7,085	404	4,925	15,579	27,993
1973	52	4	30	84	170	6,581	566	4,645	16,272	28,064

Source: Alaska. Department of Health and Social Services, "October Report."

OAA - Old Age Assistance
AB - Aid to Blind
AD - Aid to Disabled
AFDC - Aid to Dependent Children Programs

from the U.S. Department of Agriculture, but is administered by the state. Administration of this program for area recipients is handled through the Nome office of the Division of Family and Children's Services. Between November of 1972 and October of 1973 an average of 832 persons (169 households) in the Nome area received food stamps. During this same period an average of 312 persons (76 households) in the city of Nome received food stamps (see Table XI-4.) The bonus value of the coupons averaged roughly $77 per household per month. The food stamp regulations were recently changed to allow their use for the purchase of nonfood items to be used in subsistence hunting and fishing. However, stamps cannot be used for the purchase of guns or ammunition.

COST OF LIVING

The Quarterly Report on Alaska Food Prices[2] is the only regularly reported data series which provides direct information on the cost of living in Nome relative to other areas. The report is based on a "market basket" of 45 food items which are surveyed nationwide by the U.S. Department of Agriculture (see Table XI-5.) The cost of this market basket is used to calculate food price ratios between Seattle and selected Alaska communities. These ratios for Nome, Anchorage, Fairbanks, and Juneau from 1957-1973 are shown in Table XI-6. Prior to 1960, food prices in Alaska were based almost exclusively on a city's proximity to the port of Seattle. Thus, in the late 1950's, Southeastern Alaska communities such as Juneau had the lowest food prices in the state. As the state grew during the 1960's, prices rose much less rapidly

TABLE XI-4

PARTICIPATION IN THE FOOD STAMP PROGRAM
NOVEMBER 1972 - OCTOBER 1973
CITY OF NOME

CITY OF NOME DATE	NUMBER OF PARTICIPANTS	NUMBER OF HOUSEHOLD PARTICIPATING	DOLLAR VALUE OF COUPONS	COST TO RECIPIENTS	BONUS VALU OF COUPONS
October 1973	319	71	$10,562	$5,095	$ 5,457
September	291	72	9,374	4,106	5,268
August	305	73	9,724	4,467	5,257
July	297	70	9,709	4,329	5,380
June	308	80	9,077	4,179	4,898
May	293	79	9,429	4,218	5,212
April	305	78	17,800	4,684	13,116
March	314	73	9,724	5,036	4,688
February	307	75	9,300	4,371	4,929
January	346	82	10,912	5,328	5,584
December 1972	322	79	9,939	4,772	5,167
November	337	81	9,993	4,548	5,445
MONTHLY AVERAGES	312	76	$10,462	$4,594	$ 5,868

Source: Alaska. Department of Health and Social Services, 1973.

TABLE XI-5

AVERAGE RETAIL PRICES OF 45 FOOD ITEMS IN SELECTED ALASKA CITIES

SEPTEMBER 1973

Food Item	Unit	Juneau	Kodiak	Anchrg.	Fair-banks	Bethel	Nome	Nome Anch. ratio
Flour	10 lb.	1.98	2.19	1.75	1.90	2.45	2.56	146
Rice	28 oz.	1.24	1.40	1.19	1.10	1.39	1.53	128
Corn Flakes	18 oz.	.58	.64	.50	.61	.70	.75	150
Bread, white	1 1/2 lb.	.61	.62	.62	.64	.83	.92	148
Round steak	1 lb.	1.95	1.94	2.06	2.28	2.71	2.72	132
Chuck roast	1 lb.	1.26	1.29	1.08	1.26	1.63	1.77	164
Hamburger	1 lb.	1.19	1.29	1.18	1.42	1.67	1.54	131
Pork chops	1 lb.	1.92	1.88	1.85	1.83	2.19	2.12	115
Bacon	1 lb.	1.90	1.94	1.81	1.89	2.01	1.93	107
Wieners	1 lb.	1.47	1.42	1.27	1.23	1.94	1.73	136
Frying chicken	1 lb.	1.23	1.17	.98	1.22	1.31	1.44	147
Tuna fish	6 1/2 oz.	.60	.66	.56	.63	.69	.79	141
Milk, fresh	1/2 gal.	.99	1.12	.99	1.08	1.49	1.79	181
Ice cream	1/2 gal.	1.30	1.39	1.12	1.30	2.14	1.97	176
Butter	1 lb.	1.17	1.23	.95	1.13	1.48	1.35	142
Milk, evap.	14 1/2 oz.	.27	.32	.26	.28	.32	.35	135
Milk, powdered	12 qt.	2.66	2.53	2.48	2.09	2.95	3.62	146
Eggs, fresh	1 doz.	.99	1.14	1.14	1.06	1.43	1.39	122
Orange juice, frozen .	12 oz.	.59	.74	.76	.79	.99	1.02	134
Apples	1 lb.	.50	.54	.52	.51	.74	.76	146
Bananas	1 lb.	.35	.49	.33	.38	.51	.62	188
Oranges	1 lb.	.36	.42	.36	.39	.43	.59	164
Potatoes	1 lb.	.16	.15	.18	.21	.32	.37	206
Onions	1 lb.	.23	.20	.35	.37	.49	.48	137
Carrots	1 lb.	.38	.38	.38	.41	.51	.59	155
Lettuce	1 lb.	.52	.46	.48	.46	.71	.73	152
Cabbage	1 lb.	.33	.35	.31	.32	.46	.39	126
Tomatoes, fresh	1 lb.	.72	.72	.56	.76	1.01	.95	170
Grapefruit juice . . .	46 oz.	.78	.90	.76	.82	1.05	1.11	146
Tomato juice	46 oz.	.61	.68	.61	.67	.99	1.04	170
Pears	No. 2 1/2 can	.71	.78	.73	.58	.85	.94	129
Peaches	No. 2 1/2 can	.68	.88	.56	.58	.73	.80	143
Fruit cocktail	303 can	.42	.50	.43	.45	.55	.55	128
Corn	303 can	.32	.37	.32	.38	.47	.50	156
Tomatoes, canned . . .	303 can	.40	.40	.36	.41	.41	.52	144
Baby foods	4 1/2-5oz.	.16	.18	.15	.21	.23	.20	133
Coffee	3 lb.	3.31	3.92	3.35	3.64	4.35	4.08	122
Salad or cooking oil .	48 oz.	1.58	1.94	1.38	1.48	2.17	2.05	149
Margarine	1 lb.	.50	.60	.42	.56	.54	.43	102
Mayonnaise	1 qt.	1.09	1.26	.90	1.04	1.50	1.40	156
Cola drink	6 pack	1.11	1.32	1.17	1.28	1.79	1.70	145
Beans, dried	2 lb.	.62	.76	.75	.69	.81	.70	93
Sugar	10 lb.	1.92	2.34	1.72	1.84	2.85	2.74	159
Tomato soup	10 1/2 oz.	.20	.26	.20	.20	.28	.32	160
Cr. of mushroom soup	10 1/2 oz.	.24	.25	.23	.23	.34	.35	152
TOTAL*		42.10	45.96	40.06	42.61	55.41	56.20	
TOTAL**		30.45	32.49	29.00	31.87	40.67	41.01	
% of Seattle**, ***		121	129	116	127	162	163	
Total, March 1973**		27.91	30.91	27.12	29.83	40.90	38.89	
Total, June 1972**		25.35	28.57	25.04	27.48	39.23	36.58	

* New revised food list
** Old food list
*** Based on August, 1973 U.S. Department of Labor, BLS "Retail Food Prices by Cities."

Source: Alaska, University. Institute of Agricultural Sciences, 1973.

TABLE XI-6

FOOD PRICES IN SELECTED ALASKA CITIES

AS PERCENT OF SEATTLE

1957-1963

	NOME	ANCHORAGE	FAIRBANKS	JUNEAU
1957	170[1]	136	154	123
1958	167[2]	136	149	121
1959	168	133	148	123
1960	168	130	149	121
1961	159[3]	129	143	118
1962	163	128	140	119
1963	163	128	143	119
1964	165	128	141	120
1965	NA	NA	NA	NA
1966[4]	167	128	140	124
1967	177	132	144	127
1968	174	127	141	126
1969	172	125	140	127
1970	174	120	138	119
1971	178	124	136	121
1972	177	121	129	121
1973[5]	167	119	129	121

[1]Data available only for third and fourth quarters
[2]Data available only for first and fourth quarters
[3]Data available only for first, third, and fourth quarters
[4]Data available only for fourth quarter
[5]Based on first, second, and third quarters only.

Source: Alaska, University. Institute of Agricultural Sciences, 1973.

in Anchorage and Fairbanks than in Seattle. As the size of the market expanded in Alaska's urban centers, it led to increased competition among retail grocers, larger volume buying and more efficient merchandising. In contrast to Anchorage and Fairbanks, Nome has experienced little growth and there are no large, competitive grocery chains in the area. In September of 1973 food prices in Nome were 40 percent higher than in Anchorage and 32 percent higher than in Fairbanks. In recent months the food prices in Nome have not risen as rapidly as prices in Seattle and the relative index has fallen sharply (see Table XI-6.) However, it would be premature to conclude that this represents a permanent narrowing of the gap. It is quite possible that Nome is exhibiting a delayed response to the rapid inflation in the Lower 48.

In addition to the data on food prices, there is one other recent piece of information concerning the cost of living in the city of Nome. In 1972 the Alaska Division of Personnel conducted a survey in various parts of Alaska to determine the costs of housing and food for State personnel.[3] The survey measured food and beverage purchase (exclusive of alcoholic beverages, tobacco, and nonfood products) and made adjustments for special diets, hunting, fishing, gardening or maintenance of livestock. Housing expenditures included rent, mortgage payments, utilities, taxes and insurance. The survey concluded that State employee food expenditures in Nome averaged about $3,400 per household, 15 percent higher than the Anchorage figure and 7 percent above the statewide average (see Table XI-7.) Average annual housing expenditures of $3,118 per household in Nome were 16 percent lower than in Anchorage and 13 percent below the state average. But, the houses in Nome tended to be much smaller than average so housing costs per square foot were found to be 22 percent higher

TABLE XI-7

COSTS OF FOOD AND HOUSING FOR STATE EMPLOYEES 1972

NOME

	NOME		NOME/STATEWIDE RATIO		ANCHORAGE RATIO		STATEWIDE		ANCHORAGE	
	Household	Person	Household	Person	Household	Person	Household	Person	Household	Person
Average Annual Food Expenditures	$3,406	$902	107	92	115	93	$3,185	$978	2,960	$971
Average Annual Housing Expenditures	$3,118	$825	86	74	84	67	$3,605	1,109	3,724	1,223
Average Housing Cost Per Square Foot	$4.33	---	122	--	136	--	$3.54	---	$3.19	---

Source: Alaska. Department of Administration, 1972.

than statewide and 36 percent higher than Anchorage. Furthermore, the condition of housing in Nome was found to be lower than in Anchorage so the 36 percent is actually an underestimate of the true differential in the cost of housing. Based on the study's findings, the Division of Personnel recommended that Nome employees should receive 5 1/2 salary steps above Anchorage; that would amount to a 20 to 25 percent cost of living adjustment for state employees in Nome.[4]

CHAPTER XI

Footnotes

1. U.S. Department of the Interior, Bureau of Indian Affairs, 1972.
2. Alaska, University. 1973
3. Alaska. Department of Administration, 1972.
4. Alaska. Department of Administration, 1971.

CHAPTER XII. HOUSING, PUBLIC SERVICES, AND TRANSPORTATION

HOUSING

A 1968 survey by the Alaska State Housing Authority (ASHA) concluded that housing in Nome was commonly overcrowded, dilapidated and in short supply.[1] A majority of the homes were built around the turn of the century (1900-1906). Over the years homes destroyed by storms, floods, and fires were rarely rebuilt. Until very recently most of the post-Gold Rush housing units were poorly constructed shacks or converted military quonset huts. Of 720 dwellings, 549 (76 percent) were considered "inadequate and/or substandard and beyond repair."[2] Nome's Comprehensive Development Plan, also completed in 1968, discussed the roots of the city's housing problems:

> Some of Nome's housing units are old; however, the major factors contributing to blighted housing conditions in this community are not age but inadequate original construction and overcrowding within the structures themselves. Many of the city's housing units were constructed from makeshift materials such as packing crates and scrap lumber, while others which may have approached being substandard housing in the past have, as a result of constant overcrowding within units, a lack of maintenance and a lack of sanitary facilities, deteriorated to the point where they provide only a minimum of safety and comfort to their occupants.[3]

In 1969 the Alaska State Housing Authority attempted to remedy Nome's housing problems by requesting 200 units of low rent housing through the Department of Housing and Urban Development.[4] HUD evaluated the request, but determined on the basis of an in-house marketing study (not made available) that it could only justify the construction of 50 units. Convinced of the need for more than 50 units, the city of Nome and the

Rural Alaska Community Action Agency conducted another survey in late 1969. That survey found that 84 percent of the houses in Nome were dilapidated or substandard and concluded that 200 units of low rent housing were "fully justified."[5] HUD's decision stuck nonetheless, and in 1970, 50 units of low rent housing were built. These new units eased, but fell far short of solving Nome's housing problems. Other new housing in Nome was provided by 12 units financed through the Farmer's Home Administration and about 20 homes were built with private financing.[6]

The most recent survey of Nome housing was made during the 1970 Census (see Table XII-1.) The Census estimated that Nome had 833 housing units of which 802 were year-round units and 31 were only seasonally occupied. Of the year-round units, 304 were owner occupied, 322 were renter occupied, and 207 were vacant. Only 107 of the vacant units were available for sale or rent. The vacant units also included the 50 new low-income housing units which were not yet occupied because utilities had not been connected.[7]

The 1970 census of housing reported that over two-thirds of Nome's housing lacked some or all plumbing facilities (see Table XII-1.) The comparable statistic for Alaska was 16.5 percent and for the U.S. it was 6.5 percent. Even in the rest of rural Alaska, only 30 percent of the housing units lacked plumbing facilities. In addition, over half of the homes in Nome lacked kitchen facilities. That proportion too was much higher than in other parts of Alaska.

The 1968 ASHA study noted that the housing units in Nome were smaller than average and had more occupants per room than average. This was verified

TABLE XII-1
Housing Characteristics
City of Nome 1970

	Nome Number	Nome Percent	Alaska Percent	Alaska Rural Percent	U.S. Percent
Total Housing Units	833	100.0	100.0	100.0	100.0
Year round units	802	96.3	97.4	95.2	98.5
Seasonal units	31	3.7	2.6	4.8	1.5
Owner occupied	304	36.5	45.0	56.0	58.1
Renter occupied	322	38.7	44.5	29.3	34.3
Vacant, for sale or rent	107	12.8	4.0	4.5	7.6
Other vacant	100	12.0	6.5	10.2	
Plumbing Facilities					
All facilities	249	31.0	83.5	89.7	93.1
Lacking one or more	553	69.0	16.5	30.3	6.9
Flush Toilet					
For exclusive use of household	280	34.9	85.3	72.7	95.2
Also used by another household	21	2.6	1.1	0.9	0.9
None	501	62.5	13.6	22.5	3.9
Kitchen Facilities					
Complete	397	49.5	85.7	72.9	95.6
Not complete	405	50.4	14.4	27.1	4.4
Rooms (year round units)					
1 room	168	20.9	9.2	13.5	1.8
2 rooms	138	17.2	10.6	11.7	3.5
3 rooms	150	18.7	14.8	13.4	11.0
4 rooms	136	17.0	22.4	20.9	20.8
5 rooms	105	13.1	20.9	19.7	25.1
6 rooms	61	7.6	11.6	10.8	20.1
7 rooms	22	2.7	5.6	5.5	9.5
8 rooms or more	22	2.7	4.9	4.7	8.2
Persons					
All occupied units	626	100.0	100.0	100.0	100.0
1 person	120	19.2	13.7	12.9	17.6
2 persons	127	20.3	24.7	22.2	29.6
3 persons	77	12.3	17.3	16.0	17.2
4 persons	77	12.3	17.1	16.5	15.4
5 persons	64	10.2	12.1	13.0	9.8
6 persons	53	8.5	7.1	8.3	5.3
7 persons	39	6.2	4.5	5.9	2.7
8 persons or more	69	11.0	3.6	5.4	2.4
Perons per room					
All occupied units	626	100.0	100.0	100.0	100.0
1.00 or less	390	62.3	81.0	73.9	91.8
1.01 - 1.50	86	13.7	10.0	11.3	6.0
1.51 or more	150	24.0	9.0	14.9	2.2

Source: U.S. Department of Commerce, Bureau of the Census, 1971a, Tables 32, 33; U.S. Department of Commerce, Bureau of the Census, 1973, U.S. Department of Commerce, Bureau of the Census, 1972, Tables 1-4, 39.

in the 1970 census which reported that nearly a fourth of the housing units in Nome had more than 1.5 persons per room. Statewide only 9 percent of the units were that crowded and nationally the proportion was 2 percent.

PUBLIC SERVICES

Water and Sewer: Nome is one of the few communities in Northwest Alaska which provides central water and sewer services. The present system, completed in 1965, has overcome permafrost problems by encasing the water and sewer lines in a utilidor.[8] The water is chlorinated before it enters the system, and the sewerage is treated before the effluent is discharged into Norton Sound. A storage tank at the water treatment plant contains about two days supply of water which can be fed directly into the fire hydrants in case of an emergency. In addition the downtown area has a back-up system of salt water for emergency use in fire fighting. In comparison to other communities in Northwest Alaska, Nome's water and sewer system is very impressive, but there are still problems. The 1968 Comprehensive Development plan noted:

> . . . the major deficiency of Nome's water and sewer service is its inadequate area coverage. At present, only about half of the most densely developed area of town has access to the system and, because the hook-up charge of about $2,000 is more than many Nome residents can afford or is in some cases greater than the value of the structures to be served, a high proportion of residences which are accessible to the system are not connected to it and are served instead by private water truck and honeybucket operators.[9]

In 1972, the Overall Economic Development Plan for Nome reported that the only major extension of the water and sewer system since 1968 had been the construction of a utilidor to serve the new 50-unit low rental housing units. The plan went on to note that the existing sewage treatment plant is approaching full capacity utilization.[10] In the future, this could be a deterrent to the construction of new housing.

Electricity: The city of Nome has provided electric power services to the community since 1956 when it purchased the system from a private company.[11] All of the city's power is diesel generated. All houses in the city are supplied with electricity. Consumption of electric power in Nome has been increasing quite rapidly; from 3 million kilowatt hours in 1961 to 5 million in 1966 and 6.7 million in 1970.[12] The addition of several large power users including William E. Beltz Regional High School, three hotels, and the 50 low-cost housing units accounts for much of the increase. The closing of the United States Smelting, Refining and Mining Company's facilities in 1962 had little effect since the company had generated its own power.

Telephone: The General Telephone Company of Alaska serves the city of Nome. Long distance telephone service, as in the rest of Alaska, is provided by the RCA Corporation. Nome residents can dial direct to other Alaskan cities, as well as the other states. The 1968 Comprehensive Development Plan said of Nome's telephone system: "The level of service provided is excellent and, except for the periodic replacement of cables, few improvements are deemed necessary over the next 20 years."[13]

Medical Facilities: Nome has a 30-bed hospital which is operated by the Methodist Board of Missions.[14] The hospital serves the entire Seward Peninsula region and has a surgery, delivery room, emergency room, and outpatient clinic. It also has a dental clinic and an office for the Nome Public Health nurse. The available medical personnel consist of a resident doctor, a Public Health dentist and nurse, and five staff nurses. The U. S. Public Health Service has contracted the hospital to provide care to Native patients from the region.

TRANSPORTATION

Northwest Alaska is isolated from the state's population centers and is not accessible by Alaska's highway, railroad or marine highway systems. The region lacks deep water ports and it is necessary to lighter most sea cargo to shore. The shipping season lasts only from June to September due to sea ice conditions. Because of these problems, air transportation plays a key role in the transport system. The general lack of easy access combined with a relatively low volume of freight and passenger traffic make transportation costs very high.

Transportation Facilities: The Nome airport, originally built by the U. S. Army during World War II, is the transportation hub for the Seward Peninsula and other Northwest Alaska communities. The airport has a 6,000-foot paved, lighted runway and is equipped with navigational facilities. Airport facilities include a Federal Aviation Agency installation, weather services, aircraft hangars, aircraft repair, freight warehousing, fueling facilities and a passenger terminal.[15]

Three gravel roadways lead from Nome to the Seward Peninsula villages of Teller (72 miles), Taylor (87 miles), and Council (68 miles). These highways are generally open only about four months a year and even then are difficult in places for conventional vehicles. Other overland routes in the Seward Peninsula area are provided by a system of winter trails which are traveled by snow machines. In addition to these highways and trails there are about 100 miles of local service roads in and around the city of Nome.[16] According to the State Highway Department, construction and/or upgrading of highways, roads, and trails leading from Nome during the next five years will be on a small scale. Anticipated projects are outlined in Table XII-2.

TABLE XII-2

Proposed Highway, Local Service Road, and Trail Construction

Nome 1974-1977

Date	Project Location	Project Description	Estimated Total Cost
1974	Nome-Kotzebue area	Stake winter trails in various locations	NA
1977	Nome-Council Road	Safety Sound Bridge, Mile 21 to Mile 22. New construction of one bridge and approaches 1.0 miles.	$1,885,000
Proposed in 5-year plan	Nome-Council Road	Nome River to Safety Sound. Mile 4 to mile 21. 21.	NA
Proposed in 5-year plan	Nome-Taylor Highway	Banner north. Mile 13 to mile 26.	NA
Proposed in 5-year plan	Nome-Taylor Highway	Kougarok mile 26 to mile 36.	NA
Proposed in 5-year plan	Teller-Lost River Road	Brevig Mission to Lost River Development City	NA

Source: Alaska. Department of Highways, 1972.

Harbor facilities in the Northwest region are severely limited due to the complete lack of deep water ports. At Nome, deep draft vessels must unload their cargo offshore and then have it lightered via small barges or boats to the city. The 1972 Overall Economic Development Plan for Nome noted the problems with the present harbor:

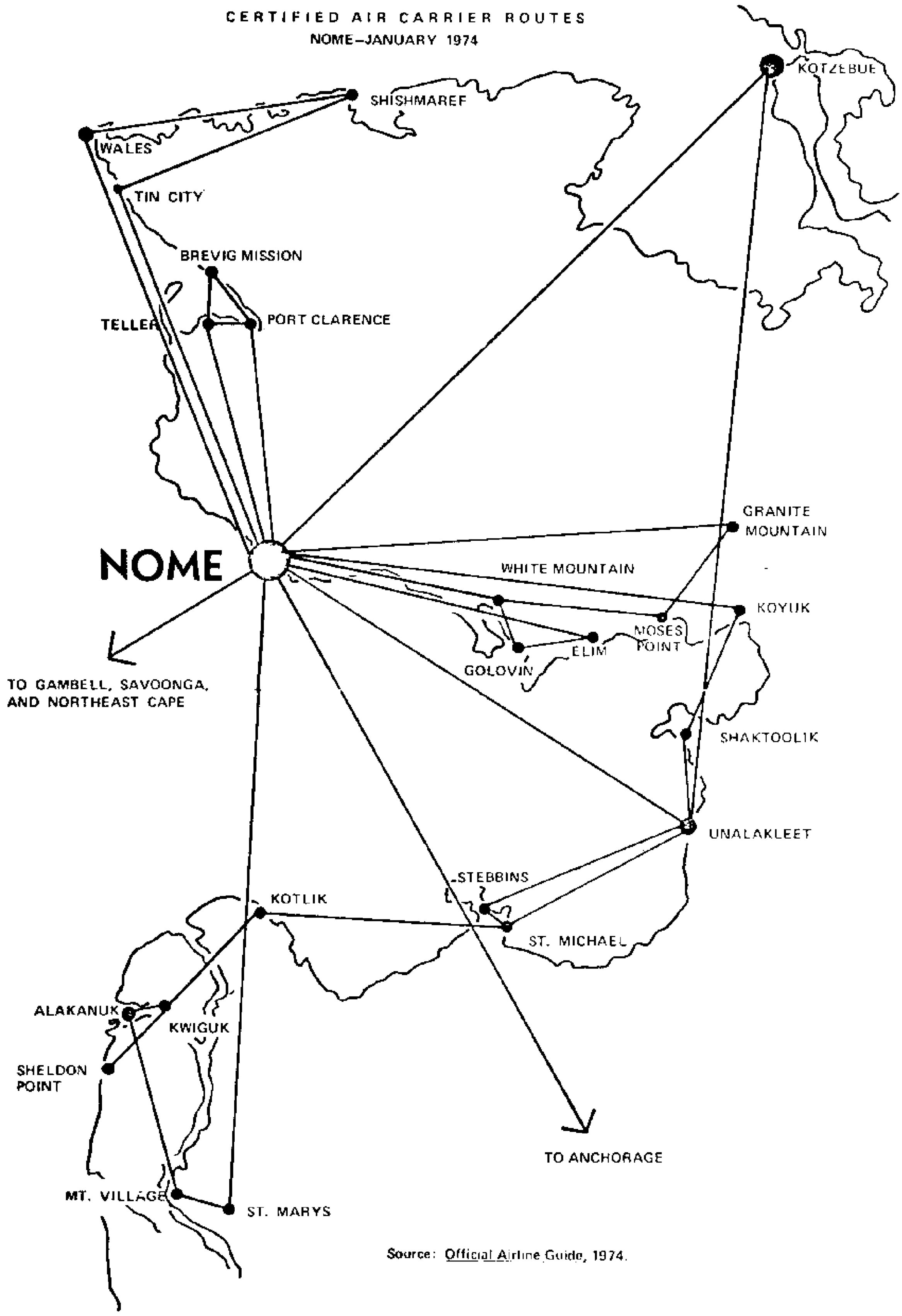
> The port facility is highly inadequate, having a dockside depth of only eight feel and a width of 75 feet. Two jetties extend seaward from the mouth of the Snake River 240 feet and 400 feet, and there is a sharp bend leading into the turning basin. The mouth of the basin is subject to silting and has to be dredged regularly. Only lighters can be unloaded; neither sea-going barges nor deep water hulls can be accommodated. Ships must lie offshore a mile or more and lighter off their cargo; a process often interrupted by storms or high winds.[17]

Transportation Services: Virtually all of the passenger traffic into and out of Nome and the surrounding villages is carried by air. Wien Airlines provides Nome with daily jet service to Kotzebue, Fairbanks and Anchorage, as well as connecting flights to the villages in the area. Additional flights are provided by three air-taxi services based in Nome. Scheduled air routes for the Nome area are shown on Map XII-1. Total enplanements at Nome rose from 8,251 in 1962 to 14,937 in 1971, an increase of 81 per cent for the period (see Table XII-3.)

The bulk of the air freight and U. S. mail coming into the Seward Peninsula area is routed through the Nome airport. The amount of air cargo transported through Nome has fluctuated widely from year to year; it dropped from 629 tons in 1962 to 569 tons in 1971 (see Table XII-3). Of the 1971 air cargo total, 16 per cent was mail and 84 per cent was air freight. Freight service by sea to Nome is restricted to the summer months. Total cargo figures for 1962-1971 are shown in Table XII-4. In 1973 a total of seven

MAP XII-1

CERTIFIED AIR CARRIER ROUTES
NOME–JANUARY 1974



Source: Official Airline Guide, 1974.

TABLE XII-3

Airport Activity Statistics - Certificated Air Route Carriers
Nome, Selected Years

Fiscal Year	Enplanements	Freight (tons)	Mail (tons)	Total Cargo (tons)
1962	8,251	282	347	629
1963	7,921	348	420	768
1965	6,563	222	263	485
1966	8,550	286	253	539
1971	14,937	477	92	569
Change 1962-1971	+81.0%	+69.1%	-73.5%	-9.5%

Source: U.S. Department of Transportation

TABLE XII-4

Waterborne Commerce

Freight Traffic Moving Through the Port of Nome 1962-1971

Year	Tons* of Freight Received, Shipped or Transferred
1962	42,224
1963	46,330
1964	51,720
1965	28,197
1966	47,047
1967	45,347
1968	41,221
1969	26,272
1970	20,951
1971	21,931

*Short tons

Source: U.S. Army Corps of Engineers, 1961-1971.

barges brought cargo to Nome.[18] The Bureau of Indian Affairs freighter, "Northstar III," serves many Northwest Alaska villages, but has not brought freight into Nome since 1969. In 1973, nearly 5,000 tons of sea freighted cargo came into Nome. In addition to the cargo barges, a Standard Oil tanker stops in Nome twice a year. About 5.3 million gallons of fuel and other petroleum products were transported to Nome in 1973. Of the total fuel and cargo coming to Nome, about 1,200 tons were transported to the villages in the area.[19]

Transportation Costs: One-way commercial airline passenger fares to Nome from Anchorage, Fairbanks, Juneau and Seattle are shown in Table XII-5. In general, the passenger cost per mile tends to be higher in Alaska than for comparable distances in the contiguous United States due to the lower traffic volume and higher operation and maintenance costs in Alaska. Table XII-6 compares air freight rates for general commodities and selected items between Seattle and Anchorage with the uniform rate charged for all items shipped between Seattle and Nome. Until recently Nome had special commodity rates, but with the advent of the fuel shortage these rates were eliminated.[20] Nome air freight costs from Seattle range from 48 to 94 percent higher than rates from Seattle to Anchorage.

Sea freight rates from Seattle to Nome are also substantially higher than rates to Anchorage. The major difference is attributable to the difference in the volume of goods shipped. The rates to Anchorage per hundred weight shown in Table XII-7 are based on a 30,000 pound shipment size. Shipments of this size are common to Anchorage, but Nome does not approach this level of volume buying. Other factors which make Nome's sea freight rates much higher than Anchorage are the lighterage costs and difficult shipping conditions. The

TABLE XII-5

Comparison of Commercial Air Fares

Route	Tourist One-Way Fare (tax included)	Distance (miles)	Cost per mile (cents)
Nome-Juneau	$137	1,099	12.5
Nome-Anchorage	81	535	15.1
Nome-Kotzebue	36	185	19.5
Nome-Fairbanks	69	492	14.0
Nome-Seattle	187	1,962	9.5
Anchorage-Juneau	68	578	11.8
Anchorage-Fairbanks	43	263	16.3
Anchorage-Seattle	109	1,438	7.6

Source: Official Airline Guide, January, 1974.

TABLE XII-6

Comparative General and Specific Commodity Air Freight Rates

From Seattle	Cost per hundred pounds To Anchorage	To Nome	Nome/Anchorage ratio
General Commodities	$23.75	$35.15	148
Meat and Poultry	20.65	35.15	170
Milk	18.15	35.15	194
Eggs	18.15	35.15	194
Vegetables	20.65	35.15	170
Household Goods	23.75	35.15	148
Personal Effects	23.75	35.15	148

Source: Alaska Airlines, 1974.

TABLE XII-7

Comparative Sea Freight Rates from Seattle
Commercial Carriers

Nome, Anchorage 1973

Commodity Shipped from Seattle	To Nome			To Anchorage	Nome/Anchorage Cost ratio
	Shipping +	Lighterage =	Total		
Automobiles	$12.90	$3.34	$16.24	$9.08	179
Canned goods	4.81	.83	5.64	4.13	137
Dairy products	12.85	1.90	14.75	5.70	259
Eggs	5.21	1.90	7.11	4.52	157
Frozen Foods	8.54	1.90	10.44	5.11	204
Fruit	6.04	1.82	7.86	5.70	138
Mobile Homes	17.62	3.87	21.49	18.59	116
Plywood	4.40	1.07	5.47	2.21	248
Potatoes	4.10	.84	4.94	2.56	193

Sources: Howard, 1974; Barstow, 1974.

Note - Anchorage hundred weight costs are based on an average 30,000 pound weight break.

lighterage costs add 12 to 26 per cent to the shipping charges. Costs of shipping some commodities between Seattle and Nome are compared to Seattle-Anchorage rates in Table XII-7. Improvements in harbor facilities at Nome could reduce or eliminate lighterage costs, but would have little effect on other factors contributing to higher shipping costs to Nome.

CHAPTER XII

Footnotes

1. ASHA, 1969, p. 2.
2. ASHA, 1969, p. 3.
3. ASHA, 1968, p. 103.
4. RurAL CAP, 1969, p. 1.
5. RurAL CAP, 1969, p. 2.
6. ASHA, 1972, p. 19.
7. ASHA, 1972, p. 19.
8. ASHA, 1968, pp. 121-144.
9. ASHA, 1968, p. 140
10. ASHA, 1972, p. 26.
11. ASHA, 1968, p. 43
12. ASHA, 1968, p. 43 and Alaska Dept. of Economic Development, N.O.
13. ASHA, 1968, p. 144
14. ASHA, pp. 125-126.
15. ASHA, 1972, p. 17.
16. ASHA, 1968, p. 49.
17. ASHA, 1972, p. 17.
18. Howard, 1974.
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APPENDIX I. PHYSICAL OCEANOGRAPHIC DATA - NORTON SOUND AND BERING SEA

APPENDIX I

PHYSICAL OCEANOGRAPHIC DATA - NORTON SOUND AND BERING SEA

ACONA Cruise 173, Station 2 19/7/73 19.2 Hours GMT (NS-3)

Latitude = 64 28.1 N Longitude = 165 24.8 W Sonic Depth = 18 M

Weather Data:
Wind direction 265-274 degr
Sea direction 265-274 degr
Temperatures - dry = 7.2 C
wet = 6.5 C
Weather = layered clouds
Barometric pressure = 1010.1 mb

Wind speed = 23 knots
Sea height - 2.0 meters
Cloud type = stratus
Cloud amount = 10/10
Visibility code = 4-10 km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	8.42A	27.920	21.71	6.61
3	8.34C	27.977	21.77	6.45
8	7.53B	28.515	22.30	6.55
13	7.14A	28.856	22.61	6.51

ACONA Cruise 173, Station 7 19/7/73 23.5 Hours GMT (NS-8)

Latitude = 64 28.6 N Longitude = 165 29.3 W Sonic Depth = 20 M

Weather Data:
Wind direction 275-284 degr
Sea direction 275-284 degr
Temperatures - dry = 7.8 C
wet = 7.3 C
Weather = layered clouds
Barometric pressure = 1012.6 mb

Wind speed = 25 knots
Sea height = 2.0 meters
Cloud type = stratus
Cloud amount = 10/10
Visibility code = 4-10 km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	8.25C	28.019	21.81	6.45
5	8.27B	28.017	21.81	6.51
10	7.38A	28.682	22.45	6.53
15	7.11B	28.893	22.65	6.67

ACONA Cruise 173, Station 9 20/7/73 0.3 Hours GMT (NS-10)

Latitude = 64 26.7 N Longitude = 165 30.4 W Sonic Depth = 21 M

Weather Data:
Wind direction 245-254 degr
Sea direction 245-254 degr
Temperatures - dry C
wet C
Weather = layered clouds
Barometric pressure = 1010.8 mb
Wind speed = 24 knots
Sea height = 2.0 meters
Cloud type = stratus
Cloud amount = 10/10
Visibility code = 4-10 km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	9.05A	27.571	21.35	6.77
5	9.05A	27.578	21.36	6.72
10	7.00C	28.957	22.71	6.55
15	6.55A	29.112	22.89	6.52

ACONA Cruise 173, Station 17 20/7/73 3.3 Hours GMT (NS-18)

Latitude = 64 29.9 N Longitude = 165 38.2 W Sonic Depth = 14 M

Weather Data:
Wind direction 275-284 degr
Sea direction 275-284 degr
Temperatures - dry C
wet C
Weather = layered clouds
Barometric pressure = 1012.3 mb
Wind speed = 20 knots
Sea height = 2.0 meters
Cloud type = stratus
Cloud amount = 10/10
Visibility code = 4-10 km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	8.08B	28.090	21.89	6.65
5	8.09A	28.090	21.89	6.62
10	7.22C	28.719	22.50	6.51

ACONA Cruise 173, Station 19 20/7/73 4.5 Hours GMT (NS-20)

Latitude = 64 28.0 N Longitude = 165 40.0 W Sonic Depth = 22 M

Weather Data:
Wind direction 265-274 degr Wind speed = 17 knots
Sea direction 255-264 degr Sea height = 2.0 meters
Temperatures - dry = 7.8 C Cloud type = stratus
wet = 7.2 C Cloud amount = 10/10
Weather = layered clouds Visibility code = 4-10 km
Barometric pressure = 1012.0 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	8.45A	28.013	21.78	6.81
5	8.39A	28.049	21.82	6.75
10	7.03B	28.940	22.69	6.58
15	6.68S	29.029	22.79	6.49

ACONA Cruise 173, Station 27 20/7/73 7.4 Hours GMT (NS-28)

Latitude = 64 28.8 N Longitude = 165 48.5 W Sonic depth = 18 M

Weather Data:
Wind direction 255-264 degr Wind speed = 16 knots
Sea direction 255-264 degr Sea height = 2.0 meters
Temperatures - dry C Cloud type = stratus
wet C Cloud amount = 10/10
Weather = layered clouds Visibility code = 4-10 km
Barometric pressure = 1012.2 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	8.55A	27.986	21.75	6.77
5	8.53B	28.011	21.77	6.73
10	6.96A	28.897	22.67	6.86
15	6.64B	29.003	22.79	6.54

ACONA Cruise 173, Station 37 21/7/73 1.0 Hours GMT (NS-30)

Latitude = 64 26.0 N Longitude = 165 20.5 W Sonic Depth = 21 M

Weather Data:
Wind direction 255-264 degr Wind speed = 16 knots
Sea direction 255-264 degr Sea height = 2.0 meters
Temperatures - dry = 7.0 C Cloud Type = stratus
wet = 6.4 C Cloud amount = 10/10
Weather = layered clouds Visibility code = 4-10 km
Barometric pressure = 1012.3 mg

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	7.90C	28.422	22.18	6.60
5	7.88A	28.420	22.18	6.64
10	7.48A	28.651	22.41	6.52
15	7.05A	29.041	22.77	6.27

ACONA Cruise 173, Station 52 21/7/73 17.5 Hours GMT (NS-1)

Latitude = 64 26.2 N Longitude = 165 25.9 W Sonic Depth = 22 M

Weather Data:
Wind direction 225-234 degr Wind speed = 9 knots
Sea direction 225-234 degr Sea height = 2.0 meters
Temperatures - dry = 6.1 C Cloud type = stratus
wet = 5.4 C Cloud amount = 10/10
Weather = layered clouds Visibility code = 10-20 km
Barometric pressure = 1009.8 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	7.99A	28.394	22.14	6.73
5	7.99C	28.412	22.16	6.80
10	8.29A	28.584	22.25	6.70
15	7.16B	29.070	22.78	6.44

ACONA Cruise 173, Station 53 21/7/73 23.0 Hours GMT (NS-13)

Latitude = 64 29.3 N Longitude = 165 30.4 W Sonic Depth = 14 M

Weather Data:
Wind direction 245-254 degr Wind speed = 14 knots
Sea direction 245-254 degr Sea height = 1.5 meters
Temperatures - dry = 6.9 C Cloud type = stratus
wet = 6.2 C Cloud amount = 10/10
Weather = layered clouds Visibility code = 10-20 km
Barometric pressure = 1009.2 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	7.69A	28.501	22.27	6.81
5	7.59B	28.564	22.33	6.80
10	7.17A	28.832	22.59	6.51

ACONA Cruise 173, Station 66 22/7/73 9.2 Hours GMT (NS-36)

Latitude = 64 24.3 N Longitude = 164 42.3 W Sonic Depth = 27 M

Weather Data:
Wind direction 225-234 degr Wind speed = 8 knots
Sea direction 225-234 degr Sea height = 1.0 meters
Temperatures - dry = 8.2 C Cloud type =
wet = 8.0 C Cloud amount =
Weather = fog, haze Visibility code = 2-4 km
Barometric pressure = 1008.4 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	7.54B	28.101	21.97	6.74
5	8.48A	28.457	22.12	6.76
10	8.14A	28.588	22.27	6.50
15	7.68B	29.135	22.76	6.23
20	6.08A	29.406	23.17	6.20

ACONA Cruise 173, Station 67 22/7/73 10.8 Hours GMT (NS-37)

Latitude = 64 24.3 N Longitude = 164 14.5 W Sonic Depth = 16 M

Weather Data:
Wind direction 225-234 degr Wind speed = 9 knots
Sea direction 225-234 degr Sea height = 1.0 meters
Temperatures - dry = 8.6 C Cloud type =
wet = 8.5 C Cloud amount =
Weather = fog, haze Visibility code = 2-4 km
Barometric pressure = 1008.4 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	9.92B	25.140	19.33	6.74
5	9.09D	26.763	20.72	6.72
10	7.21A	29.536	23.14	6.30
15	6.94B	29.640	23.25	6.24

ACONA Cruise 173, Station 68 22/7/73 12.9 Hours GMT (NS-38)

Latitude = 64 24.3 N Longitude = 163 38.0 W Sonic Depth = 18 M

Weather Data:
Wind direction 225-234 degr Wind speed = 10 knots
Sea direction 225-234 degr Sea height = 1.0 meters
Temperatures - dry = 9.0 C Cloud type =
wet = 9.0 C Cloud amount =
Weather = fog, haze Visibility code = 2-4 km
Barometric pressure = 1008.2 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	10.17B	22.198	17.02	6.83
5	5.27B	29.499	23.34	6.04
10	5.19A	29.626	23.44	6.06
15	5.18A	29.632	23.45	5.99

ACONA Cruise 73, Station 69 22/7/73 14.8 Hours GMT (NS-39)

Latitude = 64 12.2 N Longitude = 163 38.0 W Sonic Depth = 18 M

Weather Data:
Wind direction 235-244 degr Wind speed = 12 knots
Sea direction 235-244 degr Sea height = 1.0 meters
Temperatures - dry = 9.5 C Cloud type =
wet = 9.3 C Cloud amount =
Weather = fog, haze Visibility code = 2-4 km
Barometric pressure = 1008.2 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	10.38S	21.329	16.31	6.81
5	10.19S	21.361	16.36	6.84
10	5.37A	30.025	23.74	6.21
15	5.42A	30.064	23.77	6.21

ACONA Cruise 173, Station 70 22/7/73 18.0 Hours GMT (NS-40)

Latitude = 64 14.6 N Longitude = 163 36.5 W Sonic Depth = 18 M

Weather Data:
Wind direction 215-224 degr Wind speed = 10 knots
Sea direction degr Sea height = 1.0 meters
Temperatures - dry = C Cloud type = stratus
wet = C Cloud amount = 10/10
Weather = layered clouds Visibility code = 4-10 km
Barometric pressure = 1008.3 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	11.96	18.744	14.08	6.57
5	9.62S	22.654	17.45	6.54
10	4.81S	30.442	24.13	5.93
15	4.86S	30.513	24.18	5.90

ACONA Cruise 173, Station 71   22/7/73 20.5 Hours GMT   (NS-41)

Latitude = 64 15.8 N   Longitude = 162 1.0 W   Sonic Depth = 18 M

Weather Data:
Wind direction 175-184 degr   Wind speed = 7 knots
Sea direction 215-224 degr   Sea height = 0.5 meters
Temperatures - dry = C   Cloud type = stratus
wet = C   Cloud amount = 10/10
Weather = layered clouds   Visibility code = 20-50 km
Barometric pressure = 1008.0 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t
0	11.94	19.719	14.83
5	11.88	20.100	15.13
10	7.67S	26.852	20.98
15	5.20S	29.387	23.25

ACONA Cruise 173, Station 72   22/7/73 22.7 Hours GMT   (NS-42)

Latitude = 64 16.0 N   Longitude = 161 26.0 W   Sonic Depth = 11 M

Weather Data:
Wind direction 245-254 degr   Wind speed = 5 knots
Sea direction 245-254 degr   Sea height = 0.5 meters
Temperatures - dry = C   Cloud type = stratus
wet = C   Cloud amount = 10/10
Weather = layered clouds   Visibility code = 20-50 km
Barometric pressure = 1008.0 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t
0	12.48	19.112	14.28
5	12.29	19.097	14.30
8	.	19.113	.
10	12.26S	20.197	15.15

ACONA Cruise 173, Station 73 23/7/73 2.2 Hours GMT (NS-43)

Latitude = 64 0.0 N Longitude = 161 19.9 W Sonic Depth = 12 M

Weather Data:
Wind direction 315-324 degr Wind speed = 8 knots
Sea direction 315-324 degr Sea height = meters
Temperatures - dry = C Cloud type = stratus
wet = C Cloud amount = 10/10
Weather = layered clouds Visibility code = 20-50 km
Barometric pressure = 1007.9 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t
0	13.24	17.787	13.13
5	12.36	19.098	14.28
10		20.730	

ACONA Cruise 173, Station 74 23/7/73 3.2 Hours GMT (NS-44)

Latitude = 63 46.0 N Longitude = 161 14.2 W Sonic Depth = 12 M

Weather Data:
Wind direction 25-34 degr Wind speed = 5 knots
Sea direction 25-34 degr Sea height = 0.2 meters
Temperatures - dry = C Cloud type = stratus
wet = C Cloud amount = 10/10
Weather = layered clouds Visibility code = 20-50 km
Barometric pressure =.1007.5 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t
0	12.96A	13.562	9.94
5	11.55A	16.462	12.38
10	12.09A	18.125	13.58

ACONA Cruise 173, Station 75   23/7/73 5.9 Hours GMT   (NS-45)

Latitude = 63 46.0 N   Longitude = 162 0.0 W   Sonic Depth = 16 M

Weather Data:
Wind direction degr   Wind speed = 0 knots
Sea direction degr   Sea height = 0.0 meters
Temperatures - dry = 12.1 C   Cloud type = stratus
wet = 11.1 C   Cloud amount = 10/10
Weather = layered clouds   Visibility code = 50 + km
Barometric pressure = 1007.2 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	11.99A	21.109	15.89	6.52
5	.	21.321	.	6.49
10	10.87S	23.303	18.04	6.28

ACONA Cruise 173, Station 76   23/7/73 7.7 Hours GMT   (NS-46)

Latitutde = 64 0.0 N   Longitude = 162 0.0 W   Sonic Depth = 15 M

Weather Data:
Wind direction 225-234 degr   Wind speed = 3 knots
Sea direction degr   Sea height = 0.0 meters
Temperatures - dry = 11.8 C   Cloud type = stratus
wet = 11.0 C   Cloud amount = 10/10
Weather = layered clouds   Visibility code = 50 + km
Barometric pressure = 1007.0 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	12.03A	20.522	15.44	6.47
5	11.25B	20.901	15.85	6.63
10	6.70A	29.336	23.05	5.30

ACONA Cruise 173, Station 77 23/7/73 10.3 Hours GMT (NS-47)

Latitude = 64 0.0 N Longitude = 162 41.5 W Sonic Depth = 16 M

Weather Data:
Wind direction degr Wind speed = 0 knots
Sea direction degr Sea height = 0.0 meters
Temperatures - dry = 11.7 C Cloud type = stratus
wet = 11.1 C Cloud amount = 10/10
Weather = layered coulds Visibility code = 50 + km
Barometric pressure = 1007.2 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	11.25A	20.524	15.56	6.55
5	10.44A	21.900	16.74	6.52
10	6.45B	29.645	23.31	5.94

ACONA Cruise 173, Station 78 23/7/73 12.3 Hours GMT (NS-48)

Latitude = 63 44.0 N Longitude = 162 51.0 W Sonic Depth = 15 M

Weather Data:
Wind direction 185-194 degr Wind speed = 10 knots
Sea direction 185-194 degr Sea height = 0.2 meters
Temperatures - dry = 11.3 C Cloud type = stratus
wet = 10.8 C Cloud amount = 10/10
Weather = layered clouds Visibility code = 50 + km
Barometric pressure = 1006.9 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	9.99C	20.738	15.91	7.06
5	10.44A	24.260	18.57	7.04
10	9.79B	24.412	18.79	6.42

ACONA Cruise 173, Station 79 23/7/73 15.2 Hours GMT (NS-49)

Latitude = 63 44.0 N Longitude = 162 51.0 W Sonic Depth = 12 M

Weather Data:
Wind direction 175-184 degr
Sea direction degr
Temperatures - dry = 9.8 C
wet = 9.5 C
Weather = layered clouds
Barometric pressure = 1006.9 mb
Wind speed = 5 knots
Sea height = 0.0 meters
Cloud type = stratus
Cloud amount = 10/10
Visibility code = 50 + km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	8.23B	22.702	17.66	7.24
5	7.75A	24.946	19.48	6.84
10	8.01B	25.564	19.93	6.85

ACONA Cruise 173, Station 80 23/7/73 19.2 Hours GMT (NS-50)

Latitude = 63 40.0 N Longitude = 164 30.0 W Sonic Depth = 12 M

Weather Data:
Wind direction 145-154 degr
Sea direction 145-154 degr
Temperatures - dry C
wet C
Weather = layered clouds
Barometric pressure = 1006.5 mb
Wind speed = 12 knots
Sea height = 0.5 meters
Cloud type = stratus
Cloud amount = 10/10
Visibility code = 50 + km

Observed Data:

Depth	Temp.	Sal.	Sig-t
0	8.26B	22.008	17.12
5	7.39B	22.994	17.99
10	7.08B	23.242	18.22

ACONA Cruise 173, Station 81 23/7/73 23.7 Hours GMT (NS-51)

Latitude = 63 34.1 N Longitude = 165 20.0 W Sonic Depth = 18 M

Weather Data:
Wind direction 155-164 degr
Sea direction 155-164 degr
Temperatures - dry = C
wet = C
Weather = layered clouds
Barometric pressure = 1007.3 mb
Wind speed = 10 knots
Sea height = 1.0 meters
Cloud type = stratus
Cloud amount = 10/10
Visibility code = 50 + km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	7.64S	24.533	19.17	7.30
5	5.20S	27.555	21.81	7.72
10	.01S	30.253	24.31	8.73
15	-.03S	30.272	24.33	8.72

ACONA Cruise 173, Station 82 24/7/73 0.7 Hours GMT (NS-52)

Latitude = 63 14.0 N Longitude = 165 47.5 W Sonic Depth = 19 M

Weather Data:
Wind direction 195-204 degr
Sea direction 195-204 degr
Temperatures - dry = C
wet = C
Weather = layered clouds
Barometric pressure = 1007.5 mb
Wind speed = 23 knots
Sea height = 2.0 meters
Cloud type = stratus
Cloud amount = 10/10
Visibility code = 20-50 km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	7.50B	28.105	21.98	7.26
5	7.50C	28.086	21.97	7.21
10	-.22S	30.600	24.59	8.82
15	-.45A	30.631	24.63	8.84

ACONA Cruise 174, Station 1 27/7/73 6.9 Hours GMT (BS-1)

Latitude = 65 21.4 N Longitude = 167 10.0 W Sonic Depth = 18 M

Weather Data:
Wind direction 175-184 degr Wind speed = 1t knots
Sea direction 175-184 degr Sea height = 1.0 meters
Temperatures - dry = 7.8 C Cloud type = altostratus
wet = 7.0 C Cloud amount = 10/10
Weather = layered clouds Visibility code = 50 + km
Barometric pressure = 1010.2 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	7.49B	28.637	22.40	6.79
5	7.49C	28.608	22.38	6.81
10	7.50A	28.613	22.38	6.84
15	7.51A	.	. 0	6.80

ACONA Cruise 174, Station 2 27/7/73 10.0 Hours GMT (BS-2)

Latitude = 65 34.3 N Longitude = 168 10.0 W Sonic Depth = 33 M

Weather Data:
Wind direction 175-184 degr Wind speed = 22 knots
Sea direction 175-184 degr Sea height = 1.5 meters
Temperatures - dry = 6.1 C Cloud type = altostratus
wet = 5.7 C Cloud amount = 10/10
Weather = partly cloudy Visibility code = 10-20 km
Barometric pressure = 1010.5 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	6.56A	.	. 0	6.90
10	5.55A	29.451	23.27	7.18
20	5.16A	29.658	23.47	7.31
30	5.04A	29.713	23.53	7.34

ACONA Cruise 174, Station 3 27/7/73 13.3 Hours GMT (BS-3)

Latitude = 66 3.1 N Longitude = 168 30.0 W Sonic Depth = 51 M

Weather Data:
Wind direction 175-184 degr
Sea direction 175-184 degr
Temperatures - dry = 4.4 C
wet = 4.1 C
Weather = partly cloudy
Barometric pressure = 1008.9 mb

Wind speed = 25 knots
Sea height = 2.0 meters
Cloud type = altostratus
Cloud amount = 9/10
Visibility code = 10-20 km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	1.74C	32.186	25.77	8.61
10	1.74A	32.190	25.78	8.64
20	1.73B	.	. 0	8.67
30	1.67A	32.217	25.80	8.73
45	1.60A	32.234	25.82	8.72

ACONA Cruise 174, Station 4 27/7/73 17.9 Hours GMT (BS-4)

Latitude = 66 42.5 N Longitude = 168 30.0 W Sonic Depth = 40 M

Weather Data:
Wind direction 185-194 degr
Sea direction 185-194 degr
Temperatures - dry = 5.0 C
wet = 4.4 C
Weather = layered clouds
Barometric pressure = 1007.8 mb

Wind speed = 20 knots
Sea height = 2.0 meters
Cloud type = altocumulus
Cloud amount = 10/10
Visibility code = 20-50 km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	2.52B	32.135	25.68	8.40
10	2.45B	.	. 0	8.40
20	2.42B	32.153	25.70	8.44
30	1.89A	32.243	25.81	8.68

ACONA Cruise 174, Station 5 28/7/73 5.1 Hours GMT (BS-5)

Latitude = 66 10.7 N Longitude = 169 0.0 W Sonic Depth = 51 M

Weather Data:
Wind direction 175-184 degr Wind speed = 20 knots
Sea direction 185-194 degr Sea height = 2.0 meters
Temperatures - dry = 3.8 C Cloud type =
wet = 3.7 C Cloud amount =
Weather = fog, haze Visibility code = 4-10 km
Barometric pressure = 1008.5 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	2.97B	32.604	26.01	9.29
10	2.70C	32.613	26.04	9.20
20	1.29A	32.70b	26.22	8.31
30	1.25A	32.715	26.23	8.20
45	1.26C	32.709	26.22	8.20

ACONA Cruise 174, Station 6 28/7/73 10.0 Hours GMT (BS-6)

Latitude = 65 43.0 N Longitude = 169 24.8 W Sonic Depth = 44 M

Weather Data:
Wind direction 165-174 degr Wind speed = 11 knots
Sea direction 165-174 degr Sea height = 1.0 meters
Temperatures - dry = 2.8 C Cloud type =
wet = 2.6 C Cloud amount =
Weather = fog, haze Visibility code = 1-2 km
Barometric pressure = 1008.7 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	1.23B	32.702	26.22	7.92
10	1.10A	32.693	26.22	7.80
20	1.06A	32.692	26.22	7.70
30	.99A	32.685	26.22	7.71
40	.98A	32.683	26.22	7.70

ACONA Cruise 174, Station 7 — 28/7/73 14.4 Hours GMT — (BS-7)

Latitude = 65 16.5 N   Longitude = 169 59.0 W   Sonic Depth = 41 M

Weather Data:
- Wind direction 175-184 degr — Wind speed = 10 knots
- Sea direction 175-184 degr — Sea height = 1.0 meters
- Temperatures - dry = 3.2 C — Cloud type =
- wet = 3.0 C — Cloud amount =
- Weather = fog, haze — Visibility code = 1-2 km
- Barometric pressure = 1007.9 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	1.52A	32.859	26.33	8.35
10	1.41A	32.838	26.32	8.28
20	.94B	32.843	26.35	7.68
30	.84A	32.850	26.36	7.60

ACONA Cruise 174, Station 8 — 28/7/73 18.3 Hours GMT — (BS-8)

Latitude = 64 50.0 N   Longitude = 170 32.0 W   Sonic Depth = 44 M

Weather Data:
- Wind direction degr — Wind speed = 0 knots
- Sea direction 215-224 degr — Sea height = 0.5 meters
- Temperatures - dry = C — Cloud type =
- wet = C — Cloud amount =
- Weather = fog, haze — Visibility code = 1-2 km
- Barometric pressure = 1007.0 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	1.21B	32.739	26.25	7.84
10	1.16B	32.790	26.29	7.82
20	.54A	32.851	26.38	7.60
30	.49A	32.881	26.40	7.35
40	.43A	32.915	26.43	6.77

ACONA Cruise 174, Station 9 29/7/73 0.2 Hours GMT (BS-9)

Latitude = 64 18.5 N Longitude = 171 8.0 W Sonic Depth = 41 M

Weather Data:
Wind direction 185-194 degr
Sea direction 185-194 degr
Temperatures - dry = C
wet = C
Weather = fog, haze
Barometric pressure = 1006.6 mb

Wind speed = 10 knots
Sea height = 0.5 meters
Cloud type =
Cloud amount =
Visibility code = 2-4 km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	5.50A	31.022	24.51	8.14
10	-.50D	32.416	26.07	8.12
20	-.55B	32.412	26.07	8.11
30	-.55A	32.441	26.09	8.08
35	-.55A	32.453	26.10	8.10

ACONA Cruise 174, Station 12 29/7/73 18.5 Hours GMT (BS-12)

Latitude = 63 50.6 N Longitude = 169 54.3 W Sonic Depth = 36 M

Weather Data:
Wind direction 175-184 degr
Sea direction 175-184 degr
Temperatures - dry = 5.8 C
wet = 5.0 C
Weather = layered clouds
Barometric pressure = 1006.4 mb

Wind speed = 9 knots
Sea height = 0.3 meters
Cloud types = stratus
Cloud amount = 10/10
Visibility code = 20-50 km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	7.02B	31.348	24.59	7.40
10	6.00A	31.765	25.04	7.45
20	5.11B	31.915	25.26	7.27
30	2.41A	32.129	25.68	7.33

ACONA Cruise 174, Station 22 30/7/73 17.4 Hours GMT (BS-12)

Latitude = 65 50.9 N Longitude = 169 54.8 W Sonic Depth = 36 M

Weather Data:

Wind direction 155-164 degr	Wind speed = 9 knots
Sea direction 155-164 degr	Sea height = 0.5 meters
Temperatures - dry = 7.6 C	Cloud type = stratocum.
wet = 6.8 C	Cloud amount = 10/10
Weather = layered clouds	Visibility code = 20-50 km
Barometric pressure = 1006.2 mb	

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	7.42C	31.042	24.29	7.24
10	6.29B	31.709	24.96	7.33
20	6.03B	31.774	25.04	7.33
30	4.98B	31.853	25.23	7.59

ACONA Cruise 174, Station 29 31/7/73 20.5 Hours GMT (BS-20)

Latitude = 62 35.5 N Longitude = 168 19.5 W Sonic Depth = 31 M

Weather Data:

Wind direction 205-214 degr	Wind speed = 17 knots
Sea direction 205-214 degr	Sea height = 1.0 meters
Temperatures - dry = 7.1 C	Cloud type = stratocum.
wet = 6.3 C	Cloud amount = 10/10
Weather = layered clouds	Visibility code = 20-50 km
Barometric pressure = 1013.0 mb	

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	6.54C	31.622	24.86	7.17
10	6.53A	31.620	24.86	7.16
20	1.78A	32.157	25.75	7.69
25	1.76A	32.158	25.75	7.70

ACONA Cruise 174, Station 30   1/8/73 0.2 Hours GMT   (BS-21)

Latitude = 62 8.1 N   Longitude = 167 53.0 W   Sonic Depth = 25 M

Weather Data:
Wind direction 225-234 degr
Sea direction 225-234 degr
Temperatures - dry = C
wet = C
Weather = layered clouds
Barometric pressure = 1014.9 mb
Wind speed = 11 knots
Sea height = 1.0 meters
Cloud type = stratocum.
Cloud amount = 10/10
Visibility code = 4-10 km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	6.58B	30.798	24.21	7.24
5	6.51B	30.818	24.23	7.18
10	3.42C	30.949	24.66	7.99
15	2.08A	30.979	24.78	8.32
20	2.07B	31.022	24.82	8.33

ACONA Cruise 174, Station 31   1/8/73 4.2 Hours GMT   (BS-22)

Latitude = 61 40.0 N   Longitude = 167 26.0 W   Sonic Depth = 22 M

Weather Data:
Wind direction 195-204 degr
Sea direction 225-234 degr
Temperatures - dry = 6.1 C
wet = 6.0 C
Weather = layered clouds
Barometric pressure = 1016.4 mb
Wind speed = 4 knots
Sea height = 0.7 meters
Cloud type = stratocum.
Cloud amount = 10/10
Visibility code = 10-20 km

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	4.89B	30.150	23.89	7.70
5	4.31A	30.077	23.98	7.65
15	4.07A	30.097	23.93	7.58

ACONA Cruise 174, Station 32 1/8/73 8.5 Hours GMT (BS-23)

Latitude = 61 11.5 N Longitude = 166 59.5 W Sonic Depth = 19 M

Weather Data:
Wind direction 215-224 degr Wind speed = 9 knots
Sea direction 245-254 degr Sea height = 0.5 meters
Temperatures - dry = 6.3 C Cloud type =
wet = 6.3 C Cloud amount =
Weather = fog, haze Visibility code = .5-1 km
Barometric pressur = 1016.7 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	8.26B	29.258	22.78	6.84
5	8.41A	30.180	23.48	6.67
10	8.46A	30.211	23.50	6.59
15	8.49A	30.229	23.51	6.60

ACONA Cruise 174, Station 33 1/8/73 12.1 Hours GMT (BS-24)

Latitude = 60 44.3 N Longitude = 166 33.5 W Sonic Depth = 19 M

Weather Data:
Wind direction 205-214 degr Wind speed = 6 knots
Sea direction 205-214 degr Sea height = 0.2 meters
Temperatures - dry = 7.1 C Cloud type =
wet = 6.7 C Could amount =
Weather = fog, haze Visibility code = .2-.5 km
Barometric pressure = 1017.5 mb

Observed Data:

Depth	Temp.	Sal.	Sig-t	Oxy
0	8.44B	30.879	24.02	6.79
5	8.44A	30.878	24.02	6.77
10	8.44A	30.890	24.03	6.74
15	8.45A	30.883	24.02	6.74

APPENDIX II. BIOLOGICAL DATA

APPENDIX II-TABLE 1. Log of experimental shrimp trawling offshore Nome, September 1-4, 1968.*

Drag No.	Date	General Area	Depth (feet)	Type of Bottom	Duration of Drag (minutes)	Catch
1	9/2/68	Cape Nome 10 mi. east	116	Gray mud, some gravel	25	1 coonstripe shrimp (Pandalus hypsinotus) 3 humpy shrimp (P. goniurus "few gray shrimp" (unknown species) (Crangonidae) many starfish many basket starfish (Gorgonocephalus caryi)
2	9/2/68	Cape Nome	112	Gray and black mud	30	32 coonstripe shrimp "many gray shrimp" (Crangonidae) 200 hermit crabs (genus Pagurus) 1 "lemon" sole (unknown species) 60 small codfish (unknown species but probably saffron cod)
3	9/2/68	Cape Nome	68	Gravel	20	many starfish
4	9/2/68	Cape Nome	98	Gray mud and gravel	30	many starfish
5	9/2/68	Cape Nome	78	Rock	-	trawl hung up on rocks
6	9/1/68	1 1/2 mi. south of Nome	50	Rock	-	trawl hung up on rocks
7	9/1/68	2 mi. south of Nome	65	Rock	-	trawl hung up on rocks few starfish 1 barnacle clump 2 "gray shrimp"

*From Geiger and Baxter, 1968.

APPENDIX II-TABLE 1. (continued)

Drag No.	Date	General Area	Depth (feet)	Type of Bottom	Duration of Drag (minutes)	Catch
8	9/1/68	2 1/2 mi. south of Nome	76-83	Rock	-	trawl hung up on rocks
9	9/4/68	4 miles south of Nome	90	Gray mud, rock and some gravel	20	31 sea urchins (*Strongylocentrotus drobachiensis*) 7 basket stars 303 starfish (10 different species) 31 *Eunephytha rubiformis* (Anthozoa) 8 *Sipunculida* (tube-like organisms attached to rocks 48 sea anemones 61 tunicates (2 species) 1 *Pycnogonid* ("sea spider") Crabs: 2 *Telmessus cheiragonus* (small brachyuran crab) 5 *Chionoecetes opilio* (small brachyuran crab) 6 *Hyas coarctatus* (small brachyuran crab) 35 hermit crabs 5 *Oregonia gracilis* (small brachyuran crab) Shrimps: 24 coonstripe shrimp (small size) 4 humpy shrimp (small size) 135 Crangonid shrimp (2 species) 11 Hippolytid shrimp (2 species) Fishes: 10 sculpins (4 species) 1 flounder (unknown species) 2 unidentified fish 3 sea poachers (unknown species)

APPENDIX II-TABLE 1. (continued)

Drag No.	Date	General Area	Depth (feet)	Type of Bottom	Duration of Drag (minutes)	Catch
9						Mollusks: 3 *Trichotropis bicarinata* 2 *Astarte* sp. 4 *Musculus discorus* 3 *Clinocardium ciliatum* 2 *C. fucanum* 1 *Yoldia* sp. 5 *Beringiana kencottii*
10	9/3/68	Midway between Nome and Sledge Island	70	Gravel	15	37 sea urchins 60 starfish (9 species) 25 *Eunephthya rubiformis* (Anthozoa) 1 sea anemone 74 Nudibranchs (2 species) Crabs: 1 *Oregonia gracilis* (small brachyuran crab) 6 hermit crabs Shrimps: 2 coonstripe shrimp (small) 42 humpy shrimp (very small size) 2 Hippolytid shrimps (2 species) 50 Crangonid shrimps (2 species) Fishes: 2 flounder (unidentified species) 15 sculpins (3 species) 5 cod (believe to be saffron cod) few sea poachers 3 unidentified small fishes

APPENDIX II-TABLE 1. (continued)

Drag No.	Date	General Area	Depth (feet)	Type of Bottom	Duration of Drag (minutes)	Catch
11	9/3/68	3 miles east of Sledge	106	Gray mud and gravel	20	5 sea urchins 24 starfish (5 species) 96 *Eunephytha rubiformis* (Anthozoa) 1 sea anemone 8 tunicates 46 basket stars several large barnacle clusters Crabs: 1 small male king crab (37.2 mm carapace length) *Paralithodes camtschatica* 4 *Oregonia gracilis* (small brachyuran crab) 86 hermit crabs 5 *Hyas coarctatus* (small brachyuran crab) 37 *Chionoecetes opilio* (small brachyuran crab) Shrimp: 18 coonstripe shrimp (small) 14 humpy shrimp (very small) 45 Hippolytid shrimp (2 species) 37 Crangonid shrimp (3 species) Fishes: 5 sculpin 4 small cod few sea poacher several small unidentified fishes Mollusks: 1 *Astarte* sp. 4 *Serripes groenlandicus* 1 *Velutina velutina*
		3 miles outside Leare Stream				

APPENDIX II-TABLE 1. (continued)

Drag No.	Date	General Area	Depth (feet)	Type of Bottom	Duration of Drag (minutes)	Catch
12	9/3/68	2 miles east of Sledge Island	115	Gray mud and gravel	25	18 sea urchins 35 starfish (9 species) 9 Eunephytha rubiformis (Anthozoa) 4 sea anemones 3 tunicates 119 basket stars 4 Nudibranchs Crabs: 7 Hyas coarctatus (small brachyuran crab) 3 Chionoecetes opilio (small brachyuran crab) 4 Oregonia gracilis (small brachyuran crab) Shrimps: 64 coonstripe shrimp (small size) 3 humpy shrimp (small size) 61 Crangonid shrimp (3 species) 17 Hippolytid shrimp (2 species) Fishes: 1 flounder (unidentified species) few sculpins (2 species) 1 sea poacher few small cod few snailfish few other small fishes (unidentified species) Mollusks: Beringinia kencottii Trichotropis bicarinata Clinocardium ciliatum Yoldia "myalis"

APPENDIX II-TABLE 1. (continued)

Drag No.	Date	General Area	Depth (feet)	Type of Bottom	Duration of Drag (minutes)	Catch
13	9/3/68	Midway between Sledge Island and mainland	60	Rock	-	trawl hung up on rocks few starfish

APPENDIX II - TABLE 2. Abstract of Table 5 from Fishery Leaflet 369 (Fish and Wildlife Service)

	Area III. Nome - Norton Sound				
Drag No.	13	14	15	16	17
Lat. N.	63°46'	63°47'	63°51'	63°48'	63°50'
Long. W.	167°58'	167°28'	166°28'	165°55'	165°02'
Start[a]	1650	2030	0120	0535	0950
Stop[a]	1750	2130	0220	0640	1050
Elapsed time in minutes	60	60	60	65	60
Speed, Knots	3.8	3.5	3.5	3.5	3.8
Course, Magnetic	S	SW	SE	SE	ESE
Catch (individuals)					
Shellfish					
King Crabs, P.o. males	0	0	0	1	1
" " P.o. females	0	0	0	0	0
" " P.p. males	0	0	1	0	0
" " P.p. females	0	0	0	0	0
Tanner crabs, est.	500	100	10	0	10
Korean horse crabs	0	0	0	0	0
Shrimp	100	12	6	200	12
Flatfish (% marketable)					
Halibut	0	0	0	0	0
Rock "Sole"	1 (0%)	0	0	0	0
Lemon "Sole"	0	0	1 (100%)	4 (0%)	2 (0%)
Starry Flounder	0	1 (100%)	0	0	0
Flathead "Sole"	0	0	0	0	0
Yellowfin "Sole"	0	0	0	5 (0%)	25 (0%)
Arrow-toothed flounder	0	0	0	0	0
Est. Gross Wt. (lbs.)	0	2	2	3	4
Other fish					
Proifio Cod (% marketable)	0	0	0	0	0
Northern tomcod	0	0	0	6	200
Arctic Cod	15	0	0	3	0
Herring	0	0	0	0	0
Pollock	0	0	0	0	0
Capelin	6	20	6	0	0
Est. Gross Wt. (lbs.)	10	2	1	3	50

[a]Time is 160 Meridan

APPENDIX II - TABLE 2. (continued)

	Area III. Nome - Norton Sound				
Drag No.	18	19	20	21	22
Lat. N.	63°53'	63°55'	64°09'	64°11'	64°23.3'
Long. W.	164°08'	163°25'	162°04'	163°30'	164°55.6'
Start[a]	1410	1830	2300	0330	1105
Stop[a]	1515	1930	2400	0430	1205
Elapsed time in minutes	65	60	60	60	60
Speed, Knots	3.5	3.5	3.5	3.5	4.0
Course, Magnetic	NE	E	ESE	NW	SWS
Catch (individuals)					
Shellfish					
King Crabs, *P.o.* males	2	5	1	1	0
" " *P.o.* females	0	3	0	0	0
" " *P.p.* males	0	0	0	0	0
" " *P.p.* females	0	0	0	0	2
Tanner crabs, est.	10	6	0	0	0
Korean horse crabs	2	2	0	1	10
Shrimp	0	3	6	10	50
Flatfish (% marketable)					
Halibut	0	0	0	0	0
Rock "Sole"	0	0	0	0	0
Lemon "Sole"	10 (10%)	20 (0%)	0	2 (0%)	0
Starry Flounder	2 (100%)	0	0	0	1 (0%)
Flathead "Sole"	0	0	0	0	0
Yellowfin "Sole"	50 (2%)	12 (0%)	7 (0%)	3 (0%)	5 (0%)
Arrow-toothed flounder	0	0	0	0	0
Est. Gross Wt. (lbs.)	15	3	1	1	1
Other fish					
Proifio Cod (% marketable)	0	0	0	0	0
Northern tomcod	30	50	40	10	20
Arctic Cod	0	0	0	0	0
Herring	0	0	1	0	0
Pollock	0	0	0	0	0
Capelin	0	0	0	0	2
Est. Gross Wt. (lbs.)	10	20	20	5	10

[a]Time is 160 Meridan

APPENDIX II - TABLE 2. (continued)

	Area III. Nome - Norton Sound				
Drag No.	23[b]	24	25	26	27
Lat. N.	64°23'	64°23'	64°18'	64°80'	63°30'
Long. W.	165°54'	167°48'	166°52'	165°56'	166°20'
Start[a]	2000	0235	0700	1030	1420
Stop[a]	2100	0320	0800	1130	1520
Elapsed time in minutes	60	45	60	60	60
Speed, Knots	3.5	3.5	3.7	3.5	3.5
Course, Magnetic	WSW	ESE	E	ESE	SW
Catch (individuals)					
King Crabs, _P.o._ males	0	0	0	5	5
" " _P.o._ females	0	0	0	0	0
" " _P.p._ males	0	0	0	0	0
" " _P.p._ females	0	3	0	0	0
Tanner crabs, est.	0	20	0	25	10
Korean horse crabs	0	0	0	0	0
Shrimp	1	0	24	20	0
Flatfish (% marketable)					
Halibut	0	0	0	0	0
Rock "Sole"	0	0	0	0	0
Lemon "Sole"	0	0	2(0%)	25(0%)	7(0%)
Starry Flounder	0	0	3(100%)	5(100%)	4(100%)
Flathead "Sole"	0	0	0	0	0
Yellowfin "Sole"	0	1(0%)	12(0%)	20(0%)	12(0%)
Arrow-toothed flounder	0	0	0	0	0
Est. Gross Wt. (lbs.)	0	0	12	15	15
Other fish					
Proifio Cod (% marketable)	0	0	0	0	0
Northern tomcod	0	0	2	2	0
Arctic Cod	0	0	3	0	0
Herring	0	0	0	0	0
Pollock	0	0	0	0	0
Capelin	0	0	10	12	12
Est. Gross Wt. (lbs.)	0	0	5	2	1

[a]time is 160 Meridan

[b]bad tear

APPENDIX II - TABLE 2. (continued)

Area III. Nome - Norton Sound

Drag No.	28	29	30	31	32
Lat. N.	63°22'	63°85'	62°47'	62°31'	62°16'
Long. W.	167°23'	167°14'	168°11'	167°50'	168°06'
Start[a]	0035	0330	0800	1020	1320
Stop[a]	0135	0430	0900	1120	1420
Elapsed time in minutes	60	60	60	60	60
Speed, Knots	3.5	3.5	3.5	3.8	3.5
Course, Magnetic	ESE	E	SE	S	ESE
Catch (individuals)					
King Crabs, P.o. males	0	0	0	0	0
" " P.o. females	0	0	0	0	0
" " P.p. males	0	0	0	0	0
" " P.p. females	0	0	0	0	0
Tanner crabs, est.	20	20	20	0	0
Korean horse crabs	0	0	0	0	0
Shrimp	3000	100	6	0	0
Flatfish (% marketable)					
Halibut	0	0	0	0	0
Rock "Sole"	0	0	9(100%)	13(100%)	10(100%)
Lemon "Sole"	10(0%)	5(0%)	20(10%)	10(50%)	100(75%)
Starry Flounder	1(100%)	0	2(100%)	1(100%)	0
Flathead "Sole"	0	0	0	0	0
Yellowfin "Sole"	30(0%)	100(0%)	30(10%)	25(10%)	200(5%)
Arrow-toothed flounder	0	0	0	0	0
Est. Gross Wt. (lbs.)	10	20	50	45	150
Other fish					
Proifio Cod (% marketable)	0	1(100%)	6(100%)	0	14(100%)
Northern tomcod	0	0	0	0	0
Arctic Cod	40	25	0	3	0
Herring	0	0	0	0	0
Pollock	0	0	0	0	0
Capelin	4	10	Some	Many	Many
Est. Gross Wt. (lbs.)	20	25	65	2	200

[a] time is 160 Meridan

APPENDIX II - TABLE 2. (continued)

Area IV. Norton Sound to Nunivak Island

Drag No.	33	34	35	36	37
Lat. N.	62°81'	61°46'	61°34'	61°22'	61°10'
Long. W.	167°28'	168°42'	168°56'	169°32'	170°26'
Start[a]	1640	2210	0015	0435	0830
Stop[a]	1740	2310	0120	0535	0930
Elapsed time in minutes	60	60	65	60	60
Speed, Knots	4.0	4.2	4.2	4.2	4.2
Course, Magnetic	S	SE	S	ESE	ESE
Catch (individuals)					
King Crabs, *P.o.* males	0	0	0	0	0
" " *P.o.* females	0	0	0	0	0
" " *P.p.* males	0	0	0	0	0
" " *P.p.* females	0	0	0	0	0
Tanner crabs, est.	5	30	25	40	12
Korean horse crabs	0	0	0	0	0
Shrimp	0	0	5	0	0
Flatfish (% marketable)					
Halibut	0	2(0%)	6(0%)	3(33%)	0
Rock "Sole"	0	0	4(100%)	10(80%)	1(0%)
Lemon "Sole"	30(15%)	30(80%)	40(50%)	25(75%)	107(95%)
Starry Flounder	3(100%)	1(100%)	1(100%)	0	0
Flathead "Sole"	0	0	0	0	0
Yellowfin "Sole"	200(3%)	35(60%)	120(40%)	100(10%)	10(60%)
Arrow-toothed flounder	0	0	0	0	0
Est. Gross Wt. (lbs.)	100	150	200	150	300
Other fish					
Proifio Cod (% marketable)	4(100%)	37(100%)	24(100%)	20(100%)	10(100%)
Northern tomcod	0	0	0	0	0
Arctic Cod	5	0	0	0	0
Herring	0	0	0	0	0
Pollock	0	0	0	0	0
Capelin	Some	Some	Some	Some	Many
Est. Gross Wt. (lbs.)	50	600	300	250	130

[a]time is 160 Meridan

APPENDIX III. GEOLOGICAL OCEANOGRAPHY NEAR NOME

APPENDIX III-Table 1. Sediment samples collected in Norton Sound.

Station	Latitude N	Longitude W	Depth (m)	Bottom	Suspended Surface	Suspended depth	pH
NS-1	64°26.2'	165°25.9'	27	x			x
NS-2	26.9'	25.5'	21				x
NS-3	28.1'	24.8'	18	x	x	x	
NS-4	29.1'	24.2'	13	x	x	x	x
NS-5	29.35'	34.2'	8	x			
NS-6	29.8'	28.7'	7	x	x		
NS-7	29.6'	28.8'	12	x	x	x	
NS-8	28.6'	29.3'	20	x	x	x	
NS-9	27.4'	30.0'	23	x	x		x
NS-10	26.7'	30.4'	21	x	x	x	
NS-11	27.2'	35.2'	23	x	x	x	x
NS-12	28.1'	34.5'	20	x	x		x
NS-13	29.3'	30.4'	14	x	x		x
NS-14	30.15'	33.7'	12	x	x	x	
NS-15	30.4'	33.05'	9	x	x		
NS-16	30.9'	37.7'	11	x	x		
NS-17	30.8'	37.7'	12	x	x		
NS-18	29.9'	38.2'	14	x	x	x	
NS-19	28.7'	38.8'	20	x	x		
NS-20	28.0'	40.0'	22	x	x	x	x
NS-21	28.2'	43.8'	24	x	x		x
NS-22	29.2'	43.5'	20	x	x		x
NS-23	30.7'	43.3'	16	x	x		x
NS-24	31.5'	42.5'	13	x	x		
NS-25	31.5'	47.5'	9		x		
NS-26	31.1'	47.7'	16.5	x	x		x
NS-27	29.5'	48.0'	18	x	x		x
NS-28	28.8'	48.5'	18	x	x	x	x
NS-29	26.3'	23.2'	20	x	x		
NS-30	26.0'	20.5'	21	x	x	x	
NS-31	28.5'	22.3'	11	x	x		

APPENDIX III-Table 2. Mean size, standard deviation, skewness and kurtosis of grab sediments from the vicinity of Nome.

Station	Mean size (Mz)		Standard Deviation (σ_I)		Skewness (SK_I)		Kurtosis (K_G)	
NS-1	1.33	Med. Sand	4.05	Ext. poorly sorted	0.45	V. pos. skewed	1.23	Leptokurtic
NS-3	-2.62	C. gravel	0.90	Mod. sorted	0.13	pos. skewed	1.07	Mesokurtic
NS-4	-1.31	Med. gravel	3.99	V. poorly sorted	0.55	V. pos. skewed	0.89	Platykurtic
NS-5	3.06	V. F. sand	0.38	Well sorted	0.06	Nearly symmetrical	0.79	Platykurtic
NS-8	2.60	F. sand	4.00	V. poorly sorted	0.13	Pos. skewed	1.56	V. Leptokurtic
NS-9	1.44	Med. Sand	4.47	Ext. poorly sorted	0.46	V. pos. skewed	0.96	Mesokurtic
NS-10	2.82	F. Sand	2.73	V. poorly sorted	0.27	Pos. skewed	5.03	Ext. Leptokurtic
NS-11	8.36	C. Clay	2.97	V. poorly sorted	0.17	Pos. skewed	1.21	Leptokurtic
NS-12	-2.67	C. gravel	3.21	V. poorly sorted	0.39	V. pos. skewed	1.28	Leptokurtic
NS-13	-2.51	C. gravel	1.13	poorly sorted	0.45	V. pos. skewed	1.31	Leptokurtic
NS-16	2.67	F. sand	1.35	poorly sorted	-0.28	Neg. skewed	1.99	V. Leptokurtic
NS-18	-1.95	Med. gravel	2.88	V. poorly sorted	0.46	V. pos. skewed	0.71	Platykurtic
NS-19	-0.53	F. gravel	3.70	V. poorly sorted	0.61	V. pos. skewed	0.98	Mesokurtic
NS-20	0.93	C. sand	3.53	V. poorly sorted	0.35	V. pos. skewed	1.34	Leptokurtic
NS-21	2.87	F. sand	3.93	V. poorly sorted	0.12	Pos. skewed	1.65	V. Leptokurtic
NS-22	-1.80	Med. gravel	1.26	poorly sorted	0.06	Nearly symmetrical	0.85	Platykurtic
NS-23	-1.95	Med. gravel	1.22	poorly sorted	0.39	V. pos. skewed	1.43	Leptokurtic
NS-24	-1.72	Med. gravel	0.83	Mod. sorted	-0.37	V. neg. skewed	1.46	Leptokurtic
NS-26	1.70	Med. sand	0.90	Mod. sorted	-0.13	Neg. skewed	3.02	Ext. Leptokurtic
NS-27	-1.92	Med. gravel	1.49	Poorly sorted	0.08	Nearly symmetrical	1.17	Leptokurtic
NS-28	-2.35	C. gravel	3.80	V. poorly sorted	0.44	V. pos. skewed	1.49	Leptokurtic
NS-29	0.43	C. sand	3.97	V. poorly sorted	0.33	V. pos. skewed	1.00	Mesokurtic
NS-30	3.14	V. fine sand	4.44	Ext. poorly sorted	0.27	Pos. skewed	0.89	Platykurtic

APPENDIX III-Table 3. Weight percent of gravel, sand, silt and clay in grab samples from the vicinity of Nome.

Station	Gravel (7-1φ)	Sand (-1 to 4φ)	Silt (4 to 8 φ)	Clay (< 8 φ)
NS-1	26.5	53.2	12.7	7.6
NS-3	57.9	36.5	3.0	2.6
NS-4	54.9	32.3	7.69	5.1
NS-5	0	97.2	1.8	1.0
NS-8	14.2	57.5	19.9	8.4
NS-9	30.6	43.6	17.0	9.0
NS-10	7.2	74.94	11.17	6.7
NS-11	0.2	7.13	58.38	34.29
NS-12	70.7	21.7	4.73	2.91
NS-13	81.7	16.53	1.00	.8
NS-16	5.2	86.1	6.0	2.7
NS-18	56.7	38.1	3.16	2.0
NS-19	52.8	31.6	9.8	5.8
NS-20	22.7	61.1	10.2	6.0
NS-21	13.3	59.04	17.7	9.9
NS-22	58.6	39.9	.9	.6
NS-23	71.6	27.9	.2	.2
NS-24	52.85	46.82	.2	.1
NS-26	3.9	91.0	2.8	2.3
NS-27	62.1	36.9	.5	.5
NS-28	73.3	18.2	5.3	3.5
NS-29	42.2	40.7	11.3	5.8
NS-30	12.2	50.8	24.8	12.2

APPENDIX III-Table 4. Station locations and suspended sediment concentrations in offshore waters of Nome.

Station	Latitude	Longitude	Date Time (AST)	Depth (m)	Suspended Load (mg/ℓ)
NS-3	64°28.1'	165°24.8'	July 18, 73	0	3.945
			0810	5	3.255
				10	3.385
				15	11.770
NS-4	29.1'	24.2'	July 20, 73	0	5.298
			1620	10	11.623
NS-6	29.8'	28.7'	July 18, 73	0	6.070
			1143		
NS-7	29.6'	28.8'	July 18, 73	0	4.235
			1152		
			July 20, 73	0	4.415
			1640	10	15.615
NS-8	28.6'	29.3'	July 18, 73	0	3.305
			1210	5	3.685
				10	2.665
				15	10.020
NS-9	27.4'	30.0'	July 18, 73	0	2.770
			1325		
NS-10	64°26.7'	165°30.4'	July 19, 73	0	2.580
			1355	5	2.070
				10	1.840
				15	2.575
			July 20, 73	0	1.170
			0815	10	1.905
				20	3.596
NS-11	27.2'	35.2'	July 19, 73	0	1.705
			1450		
			July 20, 73	0	1.445
			0845	10	2.575
				20	4.720
NS-12	28.1'	34.5'	July 19, 73	0	2.705
			1520		
NS-13	29.3'	30.4'	July 19, 73	0	2.805
			1555		

APPENDIX III-Table 4 (continued)

Station	Latitude	Longitude	Date Time (AST)	Depth (m)	Suspended Load (mg/ℓ)
NS-14	30.15'	33.7'	July 19, 73 1605	0	5.293
			July 20, 73 1705	0 10	4.966 17.165
NS-15	30 4'	33.05'	July 19, 73 1625	0	6.713
NS-16	30.9'	37.7'	July 19, 73 1645	0	6.138
NS-17	30.8'	37.7'	July 19, 73 1655	0	3.078
NS-18	64°29.9'	165°38.2'	July 19, 73 1710	0 10	2.823 3.489
NS-19	28.7'	38.8'	July 19, 73 1755	0	2.380
NS-20	28.0'	40.0'	July 19, 73 1810	0 5 10 15	1.904 2.012 4.818 4.783
NS-21	28.2'	43.8'	July 19, 73 1917	0	2.145
			July 20, 73 1855	0 10 20	1.823 3.393 3.345
NS-22	29.2'	43.5'	July 19, 73 1933	0	2.568
NS-23	30.7'	43.3'	July 19, 73 1955	0	2.566
NS-24	31.5'	42.5'	July 19, 73 2012	0	3.475
NS-25	31.5'	47.5'	July 19, 73 2038	0	5.116
NS-26	31.1'	47.7'	July 19, 73 2055	0	0.373

APPENDIX III-Table 4 (continued)

Station	Latitude	Longitude	Date Time (AST)	Depth (m)	Suspended Load (mg/ℓ)
NS-27	29.5'	48.0'	July 19, 73 2108	0	3.948
NS-28	28.8'	48.5'	July 19, 73 2118	0	1.625
				5	1.628
				10	2.121
				15	4.445
NS-29	26.3'	23.2	July 20, 73 1415	0	2.080
NS-30	26.0'	20.5'	July 20, 73 1440	0	2.125
				5	2.799
				10	2.688
				15	3.767
NS-31	28.5'	22.3'	July 20, 73 1545	0	4.808