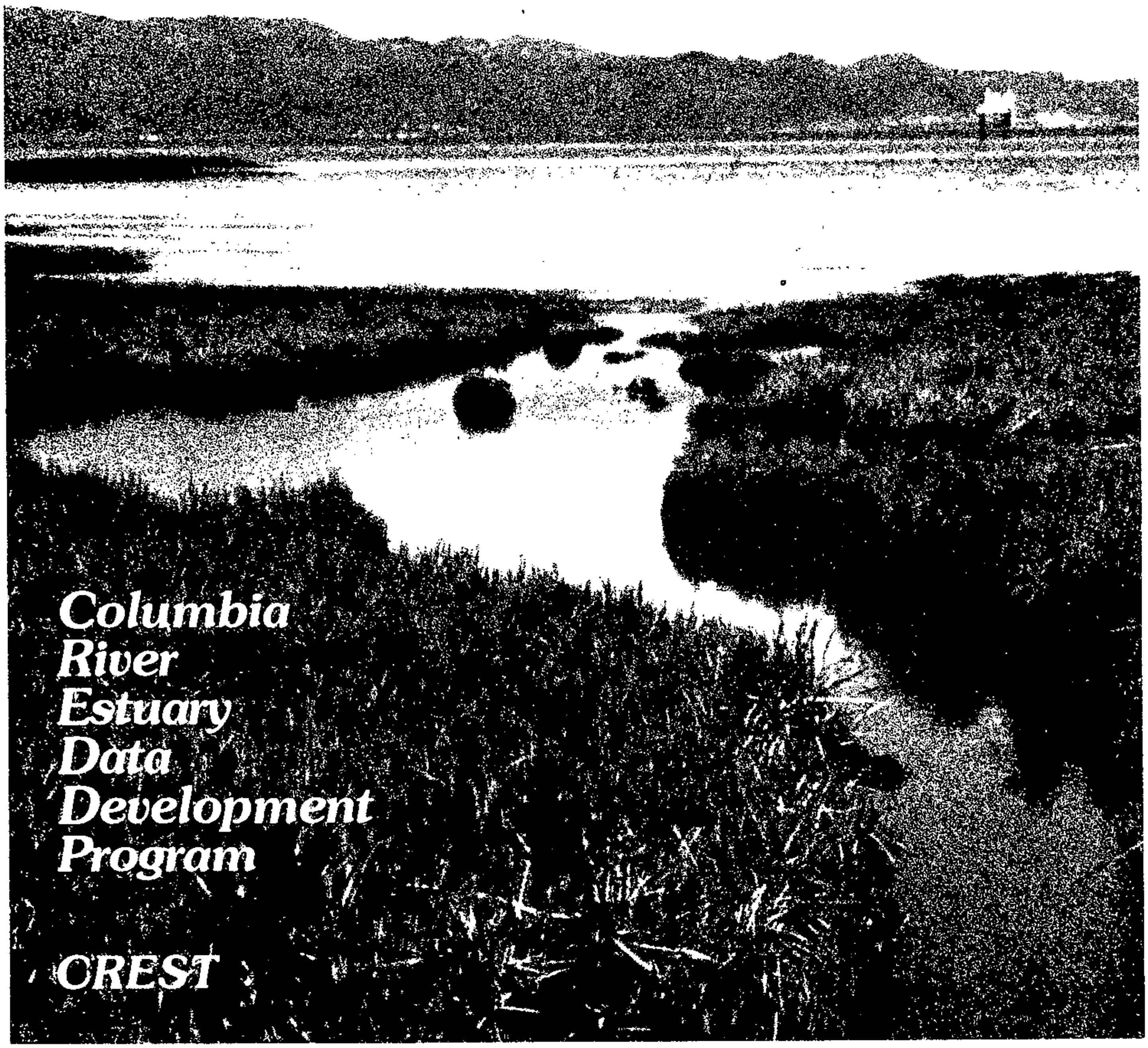
EPIBENTHIC ORGANISMS OF THE COLUMBIA RIVER ESTUARY



Final Report on the Epibenthic Organisms Work Unit
of the Columbia River Estuary Data Development Program

EPIBENTHIC ORGANISMS OF THE COLUMBIA RIVER ESTUARY

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June 1984

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PREFACE

The Columbia River Estuary Data Development Program

This document is one of a set of publications and other materials produced by the Columbia River Estuary Data Development Program (CREDDP). CREDDP has two purposes: to increase understanding of the ecology of the Columbia River Estuary and to provide information useful in making land and water use decisions. The program was initiated by local governments and citizens who saw a need for a better information base for use in managing natural resources and in planning for development. In response to these concerns, the Governors of the states of Oregon and Washington requested in 1974 that the Pacific Northwest River Basins Commission (PNRBC) undertake an interdisciplinary ecological study of the estuary. At approximately the same time, local governments and port districts formed the Columbia River Estuary Study Taskforce (CREST) to develop a regional management plan for the estuary.

PNRBC produced a Plan of Study for a six-year, $6.2 million program which was authorized by the U. S. Congress in October 1978. For the next three years PNRBC administered CREDDP and $3.3 million was appropriated for the program. However, PNRBC was abolished as of October 1981, leaving CREDDP in abeyance. At that point, much of the field work had been carried out, but most of the data were not yet analyzed and few of the planned publications had been completed. To avoid wasting the effort that had already been expended, in December 1981 Congress included $1.5 million in the U. S. Water Resources Council (WRC) budget for the orderly completion of CREDDP. The WRC contracted with CREST to evaluate the status of the program and prepare a revised Plan of Study, which was submitted to the WRC in July 1982. In September, after a hiatus of almost one year, CREDDP work was resumed when a cooperative agreement was signed by CREST and the WRC to administer the program and oversee its completion by June 1984. With the dissolution of the WRC in October 1982, the National Oceanic and Atmospheric Administration (NOAA) assumed the role of the WRC as the federal representative in the cooperative agreement.

CREDDP was designed to meet the needs of those groups who were expected to be the principal users of the information being developed. One such group consists of local government officials, planning commissions, CREST, state and federal agencies, permit applicants, and others involved in planning and permitting activities. The other major anticipated user group includes research scientists and educational institutions. For planning purposes, an understanding of the ecology of the estuary is particularly important, and CREDDP has been designed with this in mind. Ecological research focuses on the linkages among different elements in the food web and the influence on the food web of such physical processes as currents, sediment transport, and salinity intrusion. Such an ecosystem view of the estuary is necessary to predict the effects of estuarine alterations on natural resources.

Research was divided into thirteen projects, called work units. Three work units, Emergent Plant Primary Production, Benthic Primary

Production, and Water Column Primary Production, dealt with the plant life which, through photosynthesis and uptake of chemical nutrients, forms the base of the estuarine food web. The goals of these work units were to describe and map the productivity and biomass patterns of the estuary's primary producers and to describe the relationship of physical factors to primary producers and their productivity levels.

The higher trophic levels in the estuarine food web were the focus of seven CREDDP work units: Zooplankton and Larval Fish, Benthic Infauna, Epibenthic Organisms, Fish, Avifauna, Wildlife, and Marine Mammals. The goals of these work units were to describe and map the abundance patterns of the invertebrate and vertebrate species and describe these species' relationships to relevant physical factors.

Three other work units, Sedimentation and Shoaling, Currents, and Simulation, dealt with physical processes. The work unit goals were to characterize and map bottom sediment distribution, to characterize sediment transport, to determine the causes of bathymetric change, and to determine and model circulation patterns, vertical mixing and salinity patterns.

Final reports on all of these thirteen work units have been published. In addition, these results are integrated in a comprehensive synthesis entitled The Dynamics of the Columbia River Estuarine Ecosystem, the purpose of which is to develop a description of the estuary at the ecosystem level of organization. In this document, the physical setting and processes of the estuary are described first. Next, a conceptual model of biological processes is presented, with particular attention to the connections among the components represented by the work unit categories. This model provides the basis for a discussion of relationships among physical and biological processes and the functional groups of organisms in the estuary. Finally, the estuary is divided into regions according to physical criteria, and selected biological and physical characteristics of habitat types within each region are described. Historical changes in physical processes are also discussed, as are the ecological consequences of such changes.

Much of the raw data developed by the work unit researchers is collected in a magnetic tape archive established by CREDDP at the U.S. Army Corps of Engineers North Pacific Division Data Processing Center in Portland, Oregon. These data files, which are structured for convenient user access, are described in an Index to CREDDP Data. The index also describes and locates several data sets which were not adaptable to computer storage.

The work unit reports, the synthesis, and the data archive are intended primarily for scientists and for resource managers with a scientific background. However, to fulfill its purposes, CREDDP has developed a set of related materials designed to be useful to a wide range of people.

Guide to the Use of CREDDP Information highlights the principal findings of the program and demonstrates how this information can be used to assess the consequences of alterations in the estuary. It is intended for citizens, local government officials, and those planners and other professionals whose training is in fields other than the estuary-related sciences. Its purpose is to help nonspecialists use CREDDP information in planning and permitting processes.

A detailed portrait of the estuary, but one still oriented toward a general readership, is presented in The Columbia River Estuary: Atlas of Physical and Biological Characteristics, about half of which consists of text and illustrations. The other half contains color maps of the estuary interpreting the results of the work units and the ecological synthesis. A separate Bathymetric Atlas of the Columbia River Estuary contains color bathymetric contour maps illustrating the changes between surveys. CREDDP has also produced unbound maps of the estuary designed to be useful to resource managers, planners and citizens. These black-and-white maps illustrate the most recent (1982) bathymetric data as contours and show intertidal vegetation types as well as important cultural features. They are available in two segments at a scale of 1:50,000 and in nine segments at 1:12,000.

Two historical analyses have been produced. Changes in Columbia River Estuary Habitat Types over the Past Century compares information on the extent and distribution of swamps, marshes, flats, and various water depth regimes a hundred years ago with corresponding recent information and discusses the causes and significance of the changes measured. Columbia's Gateway is a two-volume set of which the first volume is a cultural history of the estuary to 1920 in narrative form with accompanying photographs. The second volume is an unbound, boxed set of maps including 39 reproductions of maps originally published between 1792 and 1915 and six original maps illustrating aspects of the estuary's cultural history.

A two-volume Literature Survey of the Columbia River Estuary (1980) is also available. Organized according to the same categories as the work units, Volume I provides a summary overview of the literature available before CREDDP while Volume II is a complete annotated bibliography.

All of these materials are described more completely in Abstracts of Major CREDDP Publications. This document serves as a quick reference for determining whether and where any particular kind of information can be located among the program's publications and archives. In addition to the abstracts, it includes an annotated bibliography of all annual and interim CREDDP reports, certain CREST documents and maps, and other related materials.

To order any of the above publications or to obtain further information about CREDDP, its publications or its archives, write to CREST, P.O. Box 175, Astoria, Oregon 97103, or call (503) 325-0435.

FOREWORD

Fisheries Research Institute, of the University of Washington's College of Ocean and Fishery Sciences, was responsible for the Epibenthic Organisms Work Unit research under the original CREDDP* contract to the prime contractor, Dames and Moore of Seattle, Washington. Pursuant with the continuation of CREDDP in 1982, in November FRI was directly contracted to complete the Epibenthic Organisms Work Unit research and provide summary and interpretation of those results.

Acknowledgements are due many individuals who were involved in or assisted FRI's CREDDP research on epibenthic organisms in the Columbia River Estuary. Among the present project personnel, particular credit is certainly due Jeff Cordell for his persistent efforts in elucidating the complex taxonomy of the estuary's harpacticoid fauna. The author also thanks William Kinney and George Williams, Project Leader and Research Assistant, respectively, for their efforts on the initial research project. Dames and Moore, and especially Jonathan Houghton, are due considerable acknowledgement for their support during the earlier two years of the project. Jeff Cordell and a number of other external reviewers contributed to the final quality of this document. The Productivity of Estuaries Select Program of the College of Ocean and Fisheries Sciences, University of Washington, provided support for the completion of this report.

Whatever contributions this research has made to the growth of estuarine science and management are dedicated to Linda Matheson (deceased).

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*See Appendix A for list of institutional acronyms.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

Epibenthic animals in the Columbia River Estuary tend to fall into two categories according to their usual position within the benthic boundary layer, that region located at the interface between the water column and the bottom sediment. These include: (a) large (>1 cm), highly motile macroinvertebrates such as shrimps and crabs; and, (b) small macro- (1 cm to 0.500 mm), meio- (0.500 mm to 0.060 mm), microfauna (<0.060 mm) such as harpacticoid copepods, gammarid amphipods, and cumaceans, which are termed epibenthic zooplankton because of their movement in and out of the water column.

These epibenthic organisms are found in all of the estuary's habitats which are tidally inundated but tend to be concentrated in the lower tidal elevation (i.e. >0.0 m above MLLW) of the tidal flats and along the demersal slope habitats between 0.0 m and -1.0 m elevations. The low frequency of tidal inundation in estuarine marsh and swamp habitats and the excessive bottom current velocities in the deeper, channel bottom habitats probably limit the development and maintenance of epibenthic zooplankton in these habitats, but motile macroinvertebrates are often common there.

Smaller, more planktonic forms were sampled from within the benthic boundary layer of shallow (i.e. <1 m depth) habitats using a 0.10 m^2 epibenthic suction pump and in channel bottom habitats using a 0.5-m opening-closing epibenthic sled. The suction pump was a fixed sampler which filtered 0.025 m^3 of the water column over 0.1 m^2 of the bottom substrate with little or no contamination from outside this sampling volume. The epibenthic sled filtered epifauna from within the benthic boundary layer as it was towed over the bottom by a surface vessel. The more evasive macrofauna had to be sampled with nets--a 37-m beach seine for demersal slope habitats and a 4.9-m bottom trawl for tidal flat and channel bottom habitats. Sampling procedures were standardized and measurements taken which enabled estimation of the effort expended (i.e. area or volume sampled) for each sample, thus allowing estimation and comparison of epifaunal density (no. individuals m^{-2} or m^{-3}) and standing crop (g wet weight m^{-2} or m^{-3}) in the different habitats.

Harpacticoid (including principally *Scottolana canadensis*, *Microarthridion littorale*, and *Tachidius* spp.), calanoid (*Eurytemora affinis*), and cyclopoid copepods (*Cyclops* spp.), ostracods (*Limnocythere* sp.), cladocerans (*Daphnia* spp.) and rotifers were the prominent components of the epibenthic zooplankton assemblages. The sand shrimp, *Crangon franciscorum*, and Dungeness crab, *Cancer magister*, constituted the principal motile macroinvertebrates. Mysids or "opossum shrimp," *Neomysis mercedis*, were common to both groups and, as such, may have been under-represented in the collections due to their evasion of the epibenthic pump and sled and the relatively large mesh sizes of the beach seine and bottom trawl.

The epifauna sampled within the estuary included components which were both indigenous to the system (i.e. their populations reproductive wholely within the estuary) and exogenous animals which were passively transported into the estuary from the Columbia River or the open ocean.

Among the zooplankters, most of the cladocerans, cyclopoid copepods, and rotifers were freshwater taxa which probably did not constitute viable populations by the time they entered the estuarine mixing zone of the estuary. Dungeness crabs also originated outside the estuary, including principally juveniles which settled out of the water column after metamorphosis from megalopae or migrated in as early instar stages via the benthic (bedload) transport at the mouth of the estuary. Thus, the principal indigenous epifauna were harpacticoid copepods, Eurytemora, mysids, and crangonid shrimp.

As is being illustrated in other Pacific Northwest estuaries, epibenthic zooplankton play important roles in the food web by their conversion and transfer of detrital organic matter to higher trophic levels. Most of the epibenthic zooplankters, in fact, are capable of consuming phytoplankton as well as detritus particles. This flexible feeding mode allows them to exploit the variable composition of food particles which are entrained within the benthic boundary layer at different times (tidal cycles, seasons) and regions of the estuary. The motile macroinvertebrates illustrate similarly dynamic feeding behavior as true omnivores which can exploit phytoplankton and detritus as well as prey upon infaunal and epibenthic animals. The importance of epifauna to the overall flow of trophic energy in the estuary is indicated by the strength of food web linkages to prominent secondary (fishes) and tertiary (marine mammals) consumers.

Seasonal patterns of epifauna distribution, density, and standing crop indicate higher standing stock in tidal flat and demersal slope habitats in the estuarine mixing zone of the estuary. In the case of the epibenthic zooplankton, this involves considerable seasonal shift in peak density from the region 10 km to 20 km from the mouth of the estuary during the spring freshet season (e.g. ~160,000 m^{-2}) to the region 25 km to 35 km from the mouth during the summer-fall low flow season (e.g. ~90,000 m^{-2}). Motile macroinvertebrates maintain density maxima (e.g. ~0.6 to ~0.9 m^{-2}) in the same lower (closer to the mouth of the estuary) region during both spring freshet and summer-fall low flow seasons but also show another, slightly lower density maximum (e.g. ~0.4 m^{-2}) in the upper regions of the estuarine mixing zone during the summer-fall low flow season.

Composition of epifaunal assemblages was also dynamic seasonally. During the monthly sampling between March and August 1980, the numerically prominent epibenthic zooplankton taxa generally shifted from ectinosomatid harpacticoids to Eurytemora affinis between the winter fluctuating flow season and the spring freshet season. Eurytemora, undifferentiated copepod larvae, and Scottolana canadensis were prominent through the spring freshet season. During the summer-fall low flow season, however, laophontid harpacticoids dominated the epibenthic pump collections in shallow habitats but fluvial taxa (e.g., Cyclops spp., Daphnia spp.) were more prominent in the channel bottom habitats sampled with the epibenthic sled. Seasonal composition based upon biomass (gravimetric) was similar in shallow habitats but diverged in the channel bottom habitats, where the larger amphipods (Corophium salmonis) and mysids (Neomysis neomysis) were more prominent during the winter fluctuating flow season and Neomysis and juvenile crangonid shrimp

(Crangon franciscorum) dominated the gravimetric composition between the spring freshet and summer-fall low flow seasons.

These seasonal changes are correlated with circulation processes which are spatially variable as a function of seasonal patterns of river discharge and neap-spring tidal cycles, including location of the maximum turbidity zone and extent of salinity intrusion. Hierarchical cluster analysis of the epibenthic zooplankton density data indicated that the reduction in water column stratification, increased mixing, and expansion of the estuarine mixing zone during the summer-fall low flow season produced a more complex structure of epibenthic zooplankton assemblages. Both the spring freshet and winter fluctuating flow seasons illustrated six or seven taxa clusters which tended to fall into two basic site clusters, one confined to the tidal-fluvial zone and another in the lower reaches of the estuarine mixing zone. Six taxa clusters were also evident during the summer-fall low flow season but the sites were very loosely associated into at least five cluster groups. The distinguishing characteristic of these clusters is that they tended to contain both exogenous riverine as well as endogenous estuarine zooplankters and two taxa clusters contained plume and ocean zone taxa. This implies considerable homogeneity in the distribution of riverine zooplankters through the estuary during the low discharge season as compared to either of the high discharge seasons.

The distribution and standing stock of motile macroinvertebrates reflects the general dominance of Crangon franciscorum throughout the estuarine mixing zone. The occurrence of juvenile Dungeness crab, Cancer magister, produced slightly higher standing crop values in the plume and ocean zone and in the seaward reaches of the estuarine mixing zone but were comparatively unimportant in relation to the overall macroinvertebrate assemblage throughout the estuary. Crangon populations appeared to overwinter on tidal flat habitats in the estuarine mixing zone such as Youngs Bay. Reproduction occurred in the spring and adult shrimp had disappeared from these habitats by early summer. Coincident with the start of the summer-fall low flow season, young-of-the-year Crangon began moving up the estuary with the increased salinity intrusion and landward movement of the turbidity maximum zone and the maximum epibenthic standing stock. Although salinity tolerance cannot be excluded as an explanation for intraestuarine migration, it also suggests a response on the part of the shrimp population to exploit the optimum concentrations of suspended phytoplankton (diatom) cells and epibenthic zooplankton within the benthic boundary layer of the expanding estuarine mixing zone. This dramatic shift in epibenthic assemblages is also reflected in the distribution of their predators. One of the highest correlations among both physical and biological factors related to motile macroinvertebrate standing crop was the density of co-occurring fishes. Distribution of harbor seals, also major predators upon Crangon, also illustrated overlapping seasonal movement.

Although autotrophic processes, detritus availability, and other trophic factors such as predation probably are the factors limiting the production of epibenthic organisms in the Columbia River Estuary, it is obvious that seasonally dynamic circulation processes structure the composition and distribution of both epibenthic zooplankton and motile macroinvertebrates and may indirectly influence the distribution and standing stock of their predators.

1. INTRODUCTION

Descriptions of the unique animal assemblages associated with the interface between the water column and bottom substrate are a relatively recent aspect of research on estuarine or nearshore marine communities, particularly in the case of meio- (0.060 mm to 0.500 mm) and microfauna (< 0.060 mm) (Beyer 1958; Bossanyi 1957; Hesthagen 1973; Boysen 1975). Explanations of the physical or biological factors structuring affecting the taxonomic composition and diversity) or maintaining these assemblages are rare (Sibert 1981). Termed "hyperbenthos" (Beyer 1958; Hesthagen 1973) or "epibenthos", these assemblages are predominantly composed of crustaceans, although larvae and other early life history stages of echinoderms, molluscs, and other marine taxa can also be prevalent. Unlike infauna, which have the relative protection allowed by their position within the sediment, epifauna are relatively motile within the upper 1 cm or on top of the sediment surface and must be adapted to the rigors of life amid high current velocities, high concentrations of suspended sediments, low water visibility, shifting sediment structure, and concentrations of predators such as demersal fishes. Some of the smaller animals are passively concentrated within the benthic boundary layer which stretches within 1 mm (laminar layer) to several meters (turbulent layer) of the bottom and many of the larger epifauna may actively migrate even higher into the water column (Figure 1).

Consequently, epibenthic animals can be classified into two basic categories according to their usual position within this region, (a) the large (>1 cm), motile macroinvertebrates such as shrimps and crabs and, (b) small macro- (0.500 mm to 1 cm), meio-, and microfauna such as mysids, gammarid amphipods, cumaceans, and harpacticoid copepods, which we term "epibenthic zooplankton" because of their movement in and out of the water column.

As most epibenthic crustaceans are detritivores, their prominence as prey resources of secondary consumers in estuarine and nearshore marine communities of the Pacific Northwest suggest that they play a critical role in food web dynamics (Simenstad et al. 1979). Despite such potential importance, quantitative, ecological research on epibenthic crustaceans has typically been limited to habitat- and taxa-specific studies of their availability as prey for juvenile salmonids (Feller and Kaczynski 1975; Brown and Sibert 1977; Levings and Chang 1977; Sibert 1979; Levings 1980a & b; Cordell and Simenstad 1981a & b; Simenstad and Salo 1982).

Although many of the over 1.5×10^8 juvenile salmonids passing annually through the Columbia River Estuary are known to utilize epifaunal animals (Sims 1975; Durkin et al. 1979), documentation of epifauna in that estuary has been predominantly descriptive (Higley and Holtan 1975; Durkin et al. 1976; Durkin and Lipovsky 1977; Good 1977) or restricted to macroinvertebrates (Haertel and Osterberg 1967).

The Columbia River is the largest river on the Pacific Coast of North America, having a total drainage area of 670,810 km^2 inclusive of the watersheds of 11 major tributaries. River discharge, which was

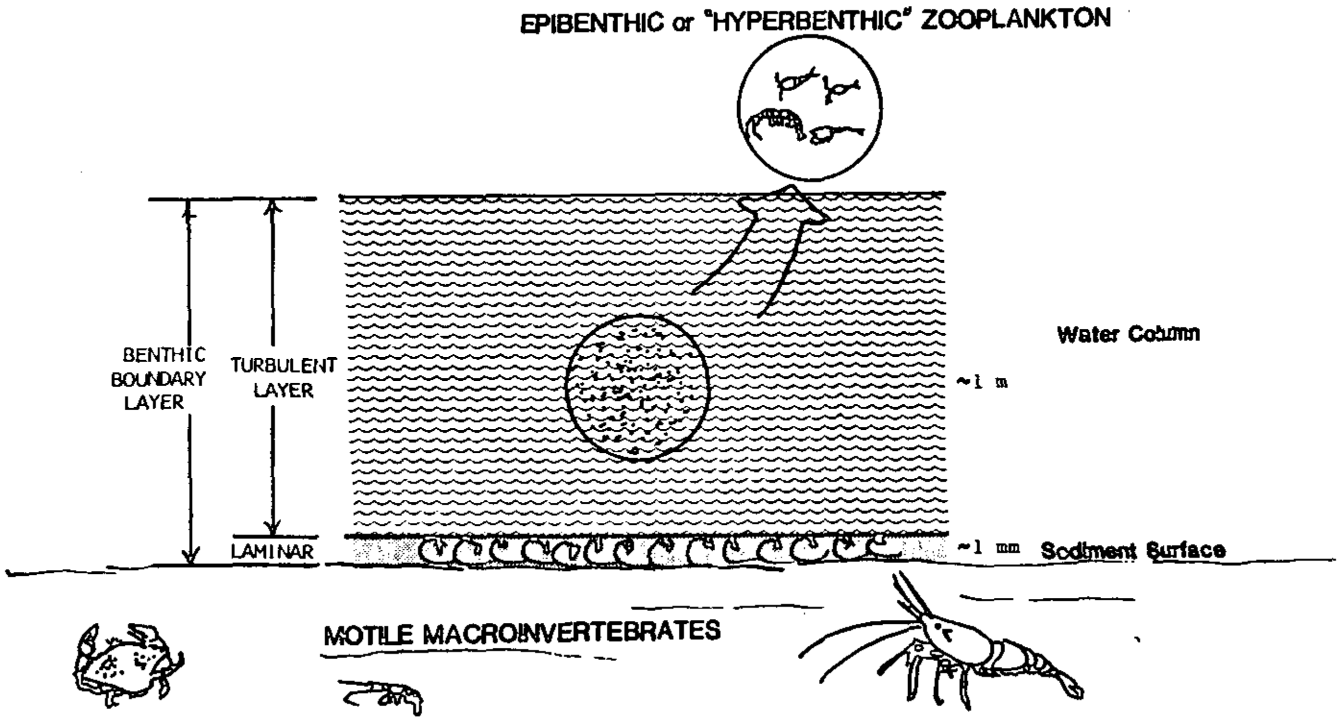


Figure 1. Diagram of benthic boundary layer environment inhabited by epibenthic zooplankton and motile macroinvertebrates.

historically fluctuated seasonally between ~1,800 m^3s^{-1} and 34,000 m^3s^{-1}, now ranges between ~4,200 m^3s^{-1} and 17,000 m^3s^{-1} due to the water regulation effects of 13 major hydroelectric power and irrigation dam projects on the Columbia mainstem and more than 100 dams on its tributaries which were constructed between 1933 and 1972 (Hickson and Rodolf 1951; Neal 1972). The Columbia River Estuary (Fig. 2) is equally impressive, encompassing ~483 km^2, which has also been modified significantly by the construction of three jetties between 1885 and 1939 and largescale, annual dredging of navigational channels since 1945 (Lockett 1963, 1967). Alteration of hydrologic and sedimentation processes by these and other (dyking and filling) anthropogenic changes probably accounts for much of the ~168 km^2 loss of habitat (tidal marshes and swamps and waters >2 m deep) and ~17 km^2 gain (tidal flats and shallows) since 1868 (Thomas 1983).

Based on these earlier studies, the potentially important role of epifauna in the Columbia River estuarine ecosystem was recognized as an important component of any comprehensive research on the estuary and was incorporated as such in the original plan of study for the Columbia River Estuary Data Development Program (CREDDP; Pacific Northwest River Basins Commission 1979). The origin, history, and objectives of CREDDP were described in the Preface to this report. The Epibenthic Organisms Work Unit was one of the original thirteen work units in CREDDP which addressed biological community structure and dynamics in the estuary. Results of the earlier Epibenthic Organisms Work Unit and those of associated work units were described in the 1979-1980 CREDDP Annual Report (Pacific Northwest River Basins Commission 1980a) and a Master of Science thesis (Williams 1983).

Final summary and interpretation of the results of this work unit's research involved the following objectives:

(1) Describe and map key and selected other epibenthic species or assemblages in terms of density, standing crop and production over time;

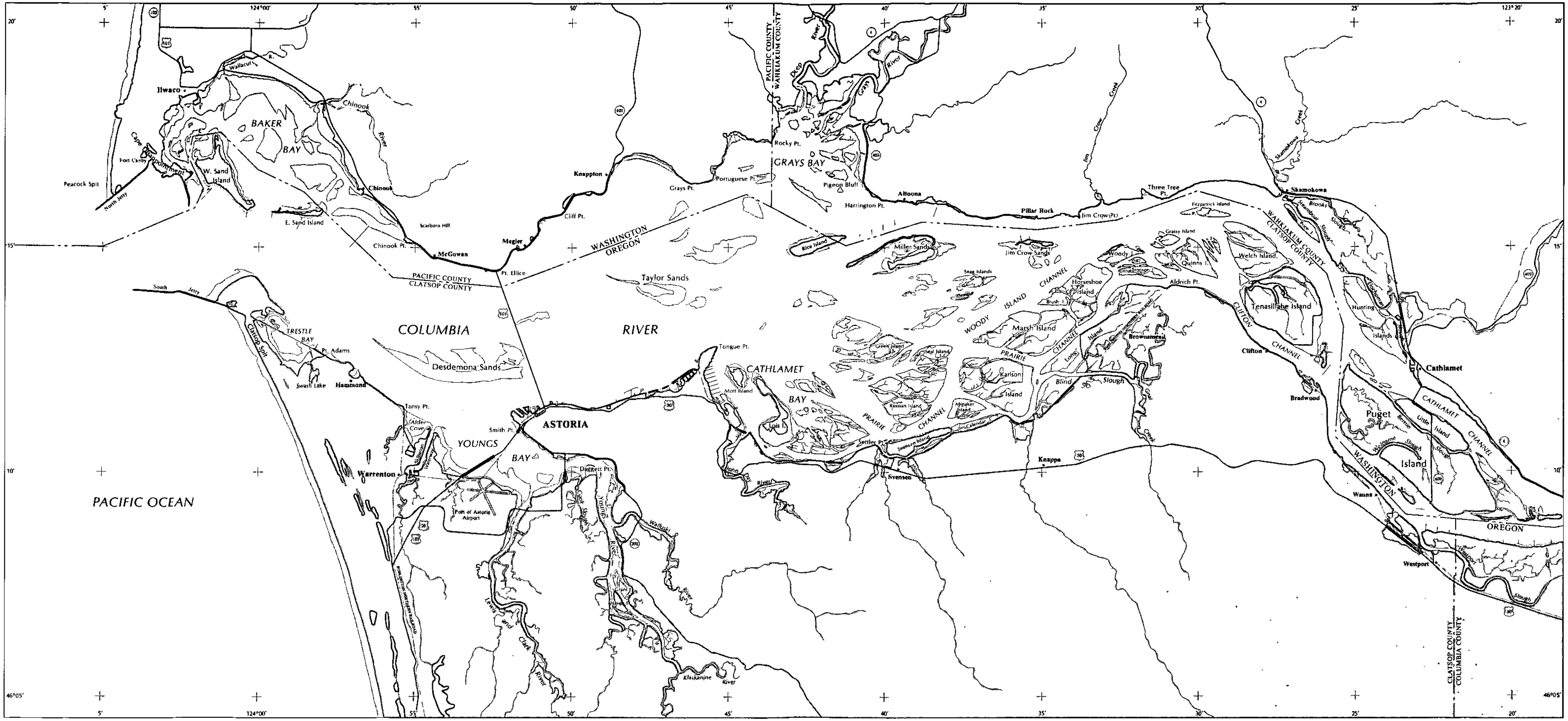
(2) Quantify relationships among epibenthic organisms and physical/chemical (salinity, sediments, depth) and biological (predators, competitors) factors;

(3) Describe the population structure, dynamics, life history, and trophic relationships of Dungeness crab, crangonid shrimp, and mysids; and,

(4) Define functional relationships of epibenthic organisms in the ecosystem, including predator-prey linkages, emigration and immigration, and role in the estuarine carbon budget.

The first three objectives involved completion of sample and data processing from the original CREDDP Epibenthic Organisms Work Unit studies and analyses of the total 18-month dataset; no new samples were to be collected. The fourth and secondary objective was principally to provide interpretive information on the dynamics and role of epibenthic organisms within the Columbia River estuarine ecosystem to a team of scientists which integrated the overall CREDDP results for preparation of Dynamics of the Columbia River Estuarine Ecosystem (see Preface).

The following material describes the results of the research conducted to meet these objectives. A summary of these results also appears in Simenstad and Cordell (in press) and further interpretations of the role of epifauna is included in Dynamics of the Columbia River Estuarine Ecosystem (see Preface).



Columbia River Estuary

Scale 1:160,000

0 1 2 3 4 5 6 7 8 9 10 Kilometers

0 1 2 3 4 5 6 Miles

Map produced in 1983 by Northwest Cartography, Inc.
for the Columbia River Estuary Data Development Program

Shoreline (limit of non-aquatic vegetation)

Intertidal vegetation

Shoals and flats

Lakes, rivers, other non-tidal water features

Major highways

Megler Cities, towns

Railroads

Other cultural features

Figure 2. Columbia River Estuary

2. METHODS

2.1 SAMPLING DESIGN

The following describes the general scheme and methodology utilized to sample epibenthic zooplankton and motile macroinvertebrates in the Columbia River Estuary. More detailed descriptions of sampling procedures are also found in the CREDDP Procedures Manual (Pacific Northwest River Basins Commission 1980b).

2.1.1 Site Location

Epifauna were systematically sampled at 16 sites within the estuary according to a sampling design stratified by habitat and estuarine zone (Figure 3; Table 1). Habitats were defined as: (1) tidal flats of elevation >0.0 m (relative to MLLW); (2) demersal slopes between 0.0 m and -1.0 m; and, (3) channel bottoms between -1.0 m and -15.0 m. In addition, there was some within-habitat differentiation. For example, tidal flats in the estuarine mixing zone were separated into two sites, a fine sand-silt site at Youngs Bay (YBF) and a coarse sand site on Desdemona Sands near the Astoria-Megler highway bridge (BF).

Based on previous description of salinity distribution in the estuary (Haertel and Osterberg 1967), estuarine zones were originally categorized as: (1) marine or polyhaline, (2) estuarine mixing or mesohaline; (3) upper estuarine or oligohaline; and, (4) riverine; these were assumed to correspond to salinity ranges of (1) 30 $^{o}/oo$ to 18 $^{o}/oo$, (2) 18 $^{o}/oo$ to 5 $^{o}/oo$, (3) 5 $^{o}/oo$ to 0.5 $^{o}/oo$, and (4) <0.5 $^{o}/oo$, respectively. Subsequent definition of salinity distribution (Jay 1982) and the integration of the CREDDP data (Simenstad et al. 1984) indicates that only three zones (plume and ocean, estuarine mixing, tidal-fluvial) are justified (Figure 3). This report will discuss epibenthic organism distribution and standing stock in terms of the latter zonation scheme.

As determined from digitization and planimetry of CREDDP base maps, estimations of the total surface areas of each habitat indicate that the dominant habitat is the subtidal area >1 m deep, which constitutes 74% of the total intertidal-subtidal habitat (Table 2); the single most prominent habitat is the subtidal area >1 m deep in the estuarine mixing zone (38% of total).

2.1.2 Sampling Frequency

Except for the Cathlamet Bay channel bottom site, which was included in 1981 to better sample suspected crayfish habitat, all sites were designed to be sampled monthly between March and August 1980 and quarterly between September 1980 and February 1981. Between March 1981 and September 1981 a reduced suite (10) of the original sites and the additional Cathlamet Bay site were sampled quarterly. Later analysis of river discharge, salinity intrusion, tidal cycles, and other aspects of the estuary's circulation (Simenstad et al. 1984) permitted definition of three "hydrologic seasons": (1) winter fluctuating flow (November-April); (2) spring freshet (May-July); and, (3) summer-fall low flow (July-October).

Table 1. List and characteristics of epibenthic organism sampling sites in Columbia River Estuary, March 1980 - July 1981.

Site & Habitat Name	Site Abbreviation	Distance from mouth of estuary (km)	Latitude (deg.min.sec.N)	Longitude (deg.min.sec.W)	Site Number	Study Period
Baker Bay Flat	BBF	6.4	46° 18' 30"	124° 02' 30"	14001	3/80 - 7/81
Ilwaco Channel	IC	3.8	46° 16' 48"	124° 02' 18"	14002	3/80 - 7/81
Sand Island Slope	SIS	6.5	46° 16' 06"	124° 00' 24"	14003	3/80 - 7/81
Youngs Bay Flat	YBF	15.7	46° 10' 18"	123° 53' 48"	14004	3/80 - 7/81
Bridge Channel	BC	19.0	46° 11' 42"	123° 51' 30"	14005	4/80 - 2/81
Bridge Slope	BS	18.0	46° 13' 00"	123° 52' 00"	14006	3/80 - 1/81
Bridge Flat	BF	18.3	46° 12' 30"	123° 52' 00"	14007	3/80 - 7/81
Cathlamet Bay Channel	CBC	37.5	46° 11' 20"	123° 38' 23"	14017	4/81 - 7/81
Rice Island Channel	RIC	31.7	46° 14' 24"	123° 42' 36"	14008	4/80 - 7/81
Rice Island Slope	RIS	30.8	46° 14' 54"	123° 43' 06"	14014	4/80 - 7/81
Grays Bay Flat	GBF	33.8	46° 17' 30"	123° 41' 00"	14010	3/80 - 7/81
Elliott Point Channel	EPC	39.8	46° 15' 18"	123° 36' 30"	14016	4/80 - 2/81
Jim Crow Sands Slope	JCS	41.2	46° 15' 12"	123° 35' 30"	14011	3/80 - 1/81
Jim Crow Sands Flat	JCF	43.7	46° 14' 54"	123° 35' 30"	14012	3/80 - 1/81
Quinn's Island Flat	QIF	50.1	46° 14' 24"	123° 29' 24"	14013	3/80 - 7/81
Bradwood Slope	BDS	54.7	46° 12' 06"	123° 26' 24"	14015	3/80 - 1/81

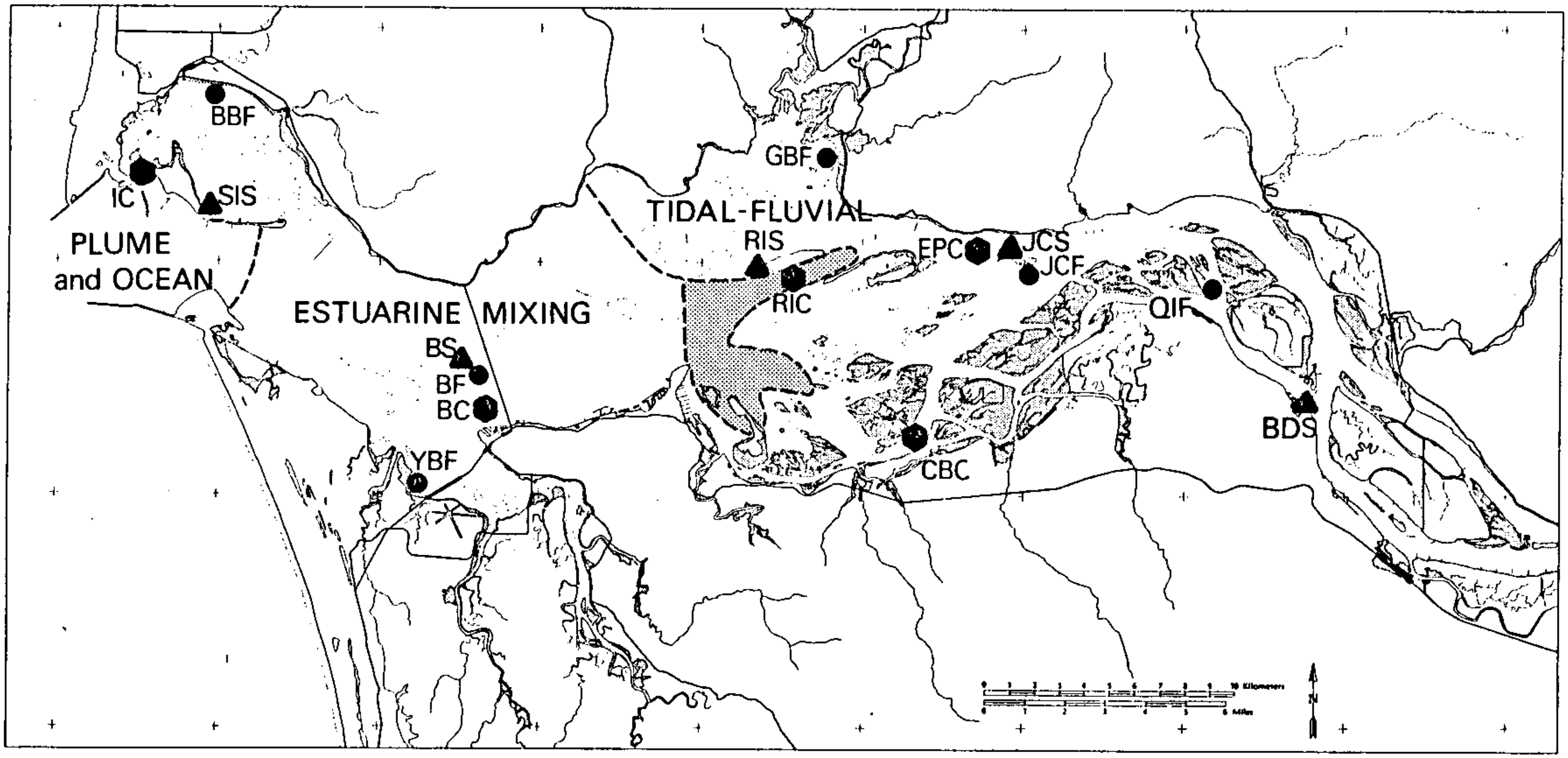


Figure 3. Map of the Columbia River Estuary illustrating location of epibenthic zooplankton and motile macroinvertebrate sampling sites. Dashed lines separate three estuarine zones, with stippled area indicating the transitional region between the estuarine mixing zone and tidal-fluvial zone which shifts seasonally with salinity intrusion.

Table 2. Estimated surface areas (hectares) of intertidal and subtidal habitats in three estuarine zones of the Columbia River estuary; data obtained from digitization or planimetry of CREDDP base maps.

Tidal Elevation Range (m)	Estuarine Zones (hectares) Plume & Ocean	Estuarine Mixing	Tidal-Fluvial	Total
0 - +1	105.3	3,061.8	1,186.7	4,353.8
0 - -1	133.7	4,163.4	2,928.2	7,225.2
< -1	4,001.4	16,536.2	11,627.6	32,165.1
			Estuary Total	43,744.1

2.1.3 Sampling Methods

Epibenthic Zooplankton

Epibenthic Suction Pump

Epibenthic zooplankton in tidal flat and demersal slope habitats were sampled quantitatively with a hydraulic pump system which filtered 0.025 m^3 of the benthic boundary layer, i.e. the water column 0.25 m over 0.1 m^2 of the bottom (Figure 4). At least 150 L of water, as measured by an in-line flowmeter, were filtered unless there was an indication of sand being lifted from the substrate, in which case pumping was terminated in order to avoid contamination by benthic infaunal animals such as nematodes, which would have biased and overestimated epibenthic standing stock. Nested plankton nets positioned in a sampling cylinder at the end of the pump system filtered the sample according to three mesh size categories: (1) 0.500 mm, (2) 0.253 mm, and (3) 0.130 mm. Duplicate samples were collected from adjacent, similar epibenthic areas in as short a time as possible (~5 min).

Epibenthic Sled

Epibenthic zooplankton in channel bottom habitats were sampled quantitatively with an opening-closing 0.5-m epibenthic sled equipped with two 0.130 mm mesh nets (Figure 5). Tow time on the bottom, once the sled doors had been opened, was two minutes against the prevailing current if present. Sampling volume was recorded *in situ* by propeller flowmeters in each net (Section 2.2).

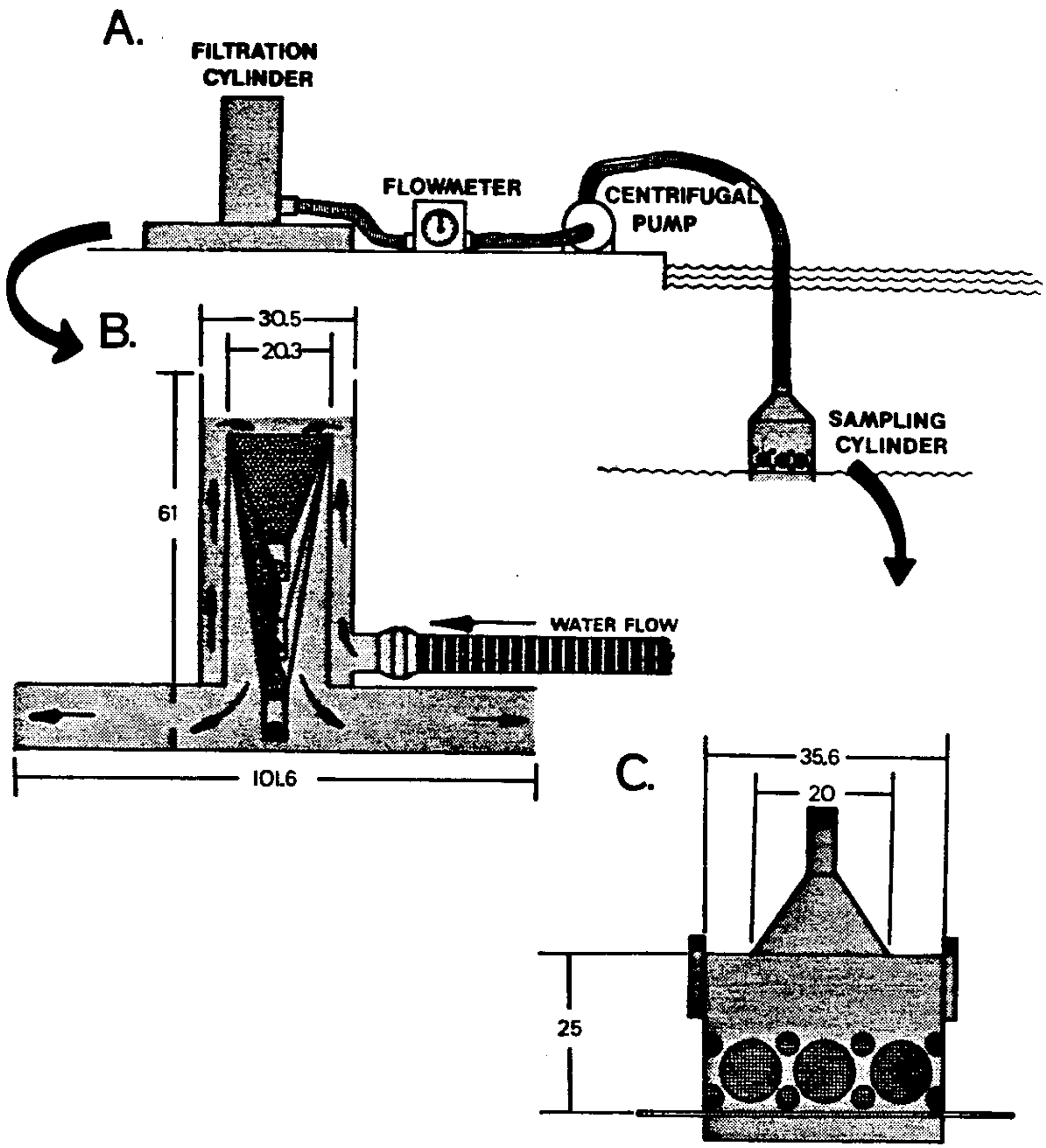


Figure 4. Epibenthic suction pump system utilized to quantitatively sample epibenthic zooplankton in tidal flat and demersal slope habitats in the Columbia River Estuary. Measurements are in cm.

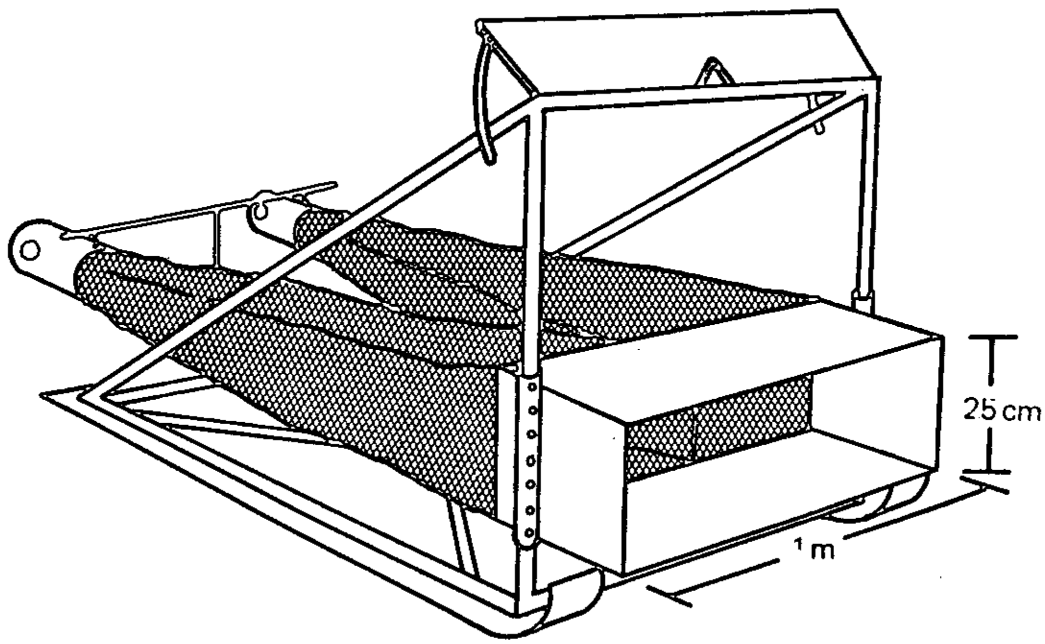


Figure 5. Epibenthic sled utilized to quantitatively sample epibenthic zooplankton in channel bottom habitats in the Columbia River Estuary. Sled is illustrated without open-closing device attached.

Motile Macroinvertebrates

Beach Seine

Motile macroinvertebrates and associated fishes in demersal slope habitats were sampled with a 37-m beach seine equipped with a fine-meshed bag, constructed of 6-mm mesh knotless nylon, located in the middle of the net. The wings of the net were 18-m long and were constructed of 2.86-cm mesh. Designed to sweep as close to the bottom as possible, the seine was equipped with a solid-core leadline which outweighed the buoyancy provided by the floats along the toprope (floatline). Polypropylene ropes for hand-hauling the seine were attached to the spreader bars located at the end of each wing. Duplicate sets were made along adjacent sections of beach in as short a time as possible (~15 min) during daylight low tide periods. The net was set parallel to and 30 m from the shoreline and smoothly hauled in perpendicular to the beach in order to consistently sample a known benthic area and water volume, i.e. 520 m^2 and 790 m^3, respectively.

Bottom Trawl

Motile macroinvertebrates and associated fishes in tidal flat and channel bottom habitats were sampled with a 4.9-m semi-balloon trawl equipped with a fine-mesh cod end constructed of 6-mm mesh nylon. The mesh size at the mouth opening was 3.8 cm and was constructed of #15 nylon twine. When effectively deployed, this net had a net opening of ~86.4 cm x 3.1 m. Sampling volume was recorded in situ using a propeller flowmeter suspended in the mouth of the net from the toprope. The starting and ending location of each trawl sample was also recorded on a NOAA chart. Duplicate, two minute tows were made in adjacent, similar benthic areas, one with and one against the prevailing current if present, in as short a time as possible. Sampling was conducted during daylight slack high tide periods although some channel collections were made at other times in the tidal cycle.

2.2 PHYSICAL MEASUREMENTS

Physical measurements documented during each sample collection (constituting two replicates) at each site included temperature (°C measured with mercury thermometer) and salinity (°/oo measured with refractometer) of a water sample collected from the sample depth using a 5-L Van Dorn water sampler. Sample depth was determined from the boat's fathometer recording corrected for the transducer depth. Water volumes filtered by the epibenthic sled were estimated using General Oceanics model 2030 digital flowmeters suspended in the mouths of the two nets.

2.3 FIELD SAMPLE PROCESSING

Zooplankton samples were washed from cod end buckets using filtered water from the sample location and poured into 473-cc PVC jars and 10% bufferred formalin added to produce at least a 5% formalin solution. The label added to the sample before sealing included sample number, station number, date, time, gear, collector, and contents.

Samples from beach seine and bottom trawl collections were separated into motile macroinvertebrates and fishes. All organisms saved for later processing were preserved in 10% bufferred formalin with labels describing the informtion listed above. Except for a subsample preserved for stomach contents analysis, large macroinvertebrates such as crab were released after enumeration, weighing, individual length measurements, and sex determination. Shrimp and mysids were preserved in total. Fishes were also preserved in total except in the case of large catches, which were systematically subsampled and the remainder released. Large specimens reserved for preservation were cut open along the abdominal cavity to allow penetration of the formalin to the stomach. Although the fish data is not reported in this report, it has been utilized in the interpretation of the epibenthic organism distribution and abundance and in the integration of the overall CREDDP results (Simenstad et al. 1984).

2.4 LABORATORY SAMPLE PROCESSING

After five or more days of fixation in the formalin solution zooplankton samples were sieved to remove the formalin and subsequently preserved in 45% isopropanol in labeled vials. Rose bengal dye was added to the 0.250 mm and 0.125 fractions at this time in order to stain the animals for better sorting. If necessary prior to sorting, the 0.125 mm fractions of each replicate were panned to remove sand. Organisms were sorted to taxa and life history stages, enumerated, and weighed (damp wet weight) to the nearest 0.001 g.

Selected taxa were measured for size frequency analysis. Length measurements of gammarid amphipods constituted the distance between the anterior tip of the carapace (including rostrum if present) to tip of telson with the animal stretched to full length. Lengths of harpacticoid, calanoid, and cyclopoid copepods, euphausiids, mysids, and shrimps were measured as the tip of the rostrum to the tip of the telson. Crabs were measured by maximum carapace width, i.e., the distance inside the posterior-most teeth arranged along the lateral margin of the carapace.

Although systematic analyses of macroinvertebrate stomach contents were not included in the work unit objectives, quantitative processing of a small subset of representative Crangon franciscorum and Neomysis mercedis samples was conducted in order to gain some information on composition and temporal/spatial variation in their food habits. Procedures for dissection and examination of stomach and intestine contents generally followed those of Kost and Knight (1975). An incision was made or the exoskeleton teased apart along the dorsal surface of the organism and the gastrointestional tract was removed and placed in a drop of glycerine on a microscope slide. The stomach was separated from the intestine, gently ruptured, and the contents spread throughout the glycerine. A cover slip was placed over the contents and the slide was allowed to dry overnight. The prepared slides were examined under a dissecting microscope and the taxa, life history stages, and parts of organisms were identified and enumerated.

Dungeness crab stomachs were examined qualitatively by dissecting from preserved specimens and the contents distributed through water in a

Petri dish. Prey taxa were identified and their number estimated using a dissecting microscope.

2.5 DATA ANALYSIS

2.5.1 Coding

All epibenthic zooplankton and motile macroinvertebrate data were recorded on NODC-type computer forms (Pacific Northwest River Basins Commission 1980b; Mercier 1984) which utilize the NODC taxonomic code system of assigning up to a 12 digit numeric code to identify aquatic organisms to any phylogenetic level.

2.5.2 Transfer

Once checked for errors and omissions, raw data recorded on the computer forms were keypunched on standard 80-column computer cards. The data cards were then read into a Cyber 173/750 computer located at the University of Washington's Academic Computer Center where the data was stored on permanent disk and magnetic tape for retrieval and analysis.

2.5.3 Tabulation and Statistical Summary

Collection, environmental conditions, and biological sampling conditions data were tabulated and basic statistics generated for measured variables using the FRI computer program SAMPLE SUMMARY (FRG-370).

Tabulation and basic statistical summarization of the raw epibenthic zooplankton data were performed using the FRI computer program SUPERPLANKTON (FR 363) specifically developed for analysis of the NODC-type zooplankton data format. The program tabulates the plankton collections by various gear types, sites, and collection periods. The number and wet weight data, by taxa and life history stage, is adjusted to a standard sample volume and the density and standing crop (m^{-3}) is computed. The percentage numerical and gravimetric composition and a number of diversity indices for the total composition are also calculated. The structure of the NODC taxonomic code enables the truncation of the code by two, four, and six digits to standardize the animals by genus, family, and class, respectively. SUPERPLANKTON is designed to operate at any one of these specified truncation levels and can produce tables either on each life history stage or on pooled life history stages (e.g. separating eggs) per taxa.

Raw data from motile macroinvertebrate and associated fish catches were entered separate data files. Tabulation and basic statistical summarization of these data were accomplished using the FRI computer program CATCH SUMMARY (FRG 368).

Macroinvertebrate food habits data were tabulated and summarized for basic composition and statistics using FRI computer program GUTBUGS (FR 360).

Summary data from SUPERPLANKTON tabulations and other related physical and biological data were input into a summary data matrix using a modified (by Dr. James Anderson, FRI/UW) version of Hewlett-Packard's (HP) Basic Statistics and Data Manipulation Pac (BSDM) installed on an HP-87 microcomputer. Data were then manipulated for use in plotting or further anal ysis using other HP software.

2.5.4 Correlative Physical and Biological Data

Physical and biological data which could be related to spatial and temporal composition, distribution, and standing stock of epifauna, but which were not obtained during Epibenthic Organisms Work Unit research, were obtained directly or from the reports submitted by other CREDDP researchers. Sediment structure data from or near the epifauna sampling sites, which included mean phi, skew, coarsest 1%, and % silt and clay, were obtained from Sedimentation Work Unit data through the cooperation of Chris Sherwood (Oceanography, UW). River discharge data and tidal range and amplitude data from Astoria and Wauna were obtained from the Circulation Work Unit through the assistance of David Jay (Geophysics, UW). Chlorophyll a and organic seston concentrations (from deepest measurement) at or near epibenthic sampling stations were extracted from data generated from Water Column Primary Production Work Unit research, courtesy of Larry Small and Bruce Frey (Oceanography, OSU). These data were combined with the Epibenthic Organisms Work Unit data in the summary data matrix for analysis (Section 2.5.3).

2.5.5 Relationship between Epibenthic Organism Standing Crop and Other Biotic and Abiotic Variables

Partial correlation coefficients among biotic and abiotic variables were generated from the summary data matrix using Hewett-Packard's Basic Statistics and Data Management (BSDM) program on series 80 microcomputers.

2.5.6 Numerical Classification

Epibenthic zooplankton structure was investigated through agglomerative hierarchical classification (clustering) of density data using the Bray-Curtis dissimilarity measure (Bray and Curtis 1959) and group averaging sorting. Similarities among sampling sites were determined using transformed ($\ln [X_{ij} + 1]$) data and taxa assemblages were clustered using standardized ($X_{ij}/\Sigma X_{ik}$) data, where X_{ij} represents the density of taxa i in collection j and ΣX_{ik} is the sum of all taxa. Clustering analyses and plotting were conducted through the interactive Program CLUSTER, developed by James A. Keniston and Albert V. Tyler at Oregon State University, Corvallis, Oregon, and installed on the University of Washington's Academic Computer Center's Cyber 170/750 computer. The reader is referred to Clifford and Stephenson (1975) and Gauch (1982) for more detailed information regarding these analytical methods.

2.6 QUALITY ASSURANCE PROCEDURES

Taxonomic identifications of rare or uncertain taxa, particularly harpacticoid copepods, were verified or resolved by Mr. Jeffery Cordell, Project Manager. All field and laboratory data were both manually and computer verified. Manual verification involved at least two reviews of the data forms prior to data entry. Computer verification involved checking for error messages produced by the various FRI data analysis programs and review of the summary tables and basic statistics for data out of expected ranges and other anomalies. Any errors were noted on the original data recording sheets and corrected on all computer files using a text/data editor; the 80-column computer cards, however, were not corrected.

2.7 DATA ADEQUACY

Data for some sites were unavoidably missed during some months due to weather conditions, mechanical breakdowns of sampling vessels, and lost or damaged sampling gear under tight time constraints. Of the possible 136 collections (duplicate samples), two epibenthic zooplankton and 23 macroinvertebrate collections were missed. In addition, eight temperature and 35 salinity measurements were missed due to malfunction, loss, or unavailability of instruments.

Due to the inherent variability in estimation of sampling effort, some data will overestimate the actual variability in epibenthic organism standing stock. Specifically, estimations of the benthic area sampled by the beach seine and bottom trawl were based on several tenuous assumptions. It was assumed that: (1) the nets did not lift off the bottom during the period they were towed; (2) they deployed properly and consistently on all sets which were not aborted for obvious evidence of gear malfunction; (3) the trawl tow beginning and ending points estimated from the bathymetric charts approximated the actual distance trawled; and, (4) the trawl did not catch a significant number of macroinvertebrates and fishes in being dropped or raised through the water column. The epibenthic sled was considered susceptible only to errors associated with the first assumption (above) because the opening-closing mechansism eliminated contamination from water column animals and because the effort estimate was based upon the digital flowmeter readings.

Quantitative sampling of extremely evasive organisms also biases these data. Standing stock estimates for mysids, for example, are probably underestimated because an unknown proportion were able to evade the epibenthic pump and sled but they were too small to be effectively retained by the beach seine and bottom trawl. The diurnal sampling design also minimizes representative sampling of nocturnally-active organisms such as male *Corophium* amphipods (Davis 1978).

3. RESULTS

3.1 TAXONOMIC COMPOSITION

3.1.1 Epibenthic Zooplankton

Based on the highest resolution of taxonomic and life history categories, 406 categories of epibenthic zooplankton were sampled in tidal flat and demersal slope habitats and 292 categories were identified from channel bottom habitats (Appendix B). Harpacticoid, calanoid, and cyclopoid copepods were the more prominent taxa numerically (76.4% of the total mean density; Table 3). The calanoid Eurytemora affinis was the most abundant species but harpacticoids (primarily an undescribed ectinosomid [Ectinosoma sp.?], Scottolana canadensis, Microarthridion littorale, Tachidius triangularis, and Attheyella sp.) comprised almost 35% of the mean density over the 18 month sampling period; Cyclops spp. were the most abundant cyclopoids (Table 3).

Seasonal changes in numerical composition of epibenthic zooplankton taxa were prevalent during the monthly sampling period (March - August 1980; Figure 6). In the shallow habitats sampled by the epibenthic pump, ectinosomatid harpacticoids were prominent during the late winter fluctuating flow months and Eurytemora affinis dominated during the spring freshet season. Ostracods (Limnocythere) comprised over half the densities in the early summer-fall low flow season. Copepod larvae (undifferentiated nauplii and early stage copepodids) were also numerically abundant from April through July. Deeper habitats sampled by the epibenthic sled also showed Eurytemora affinis and copepod larvae to dominate during the spring freshet season, but freshwater forms (e.g. Daphnia, Cyclops) became denser with the onset of the summer-fall low flow season. Scottolana canadensis was also more prominent between the late spring freshet and early summer-fall low flow seasons.

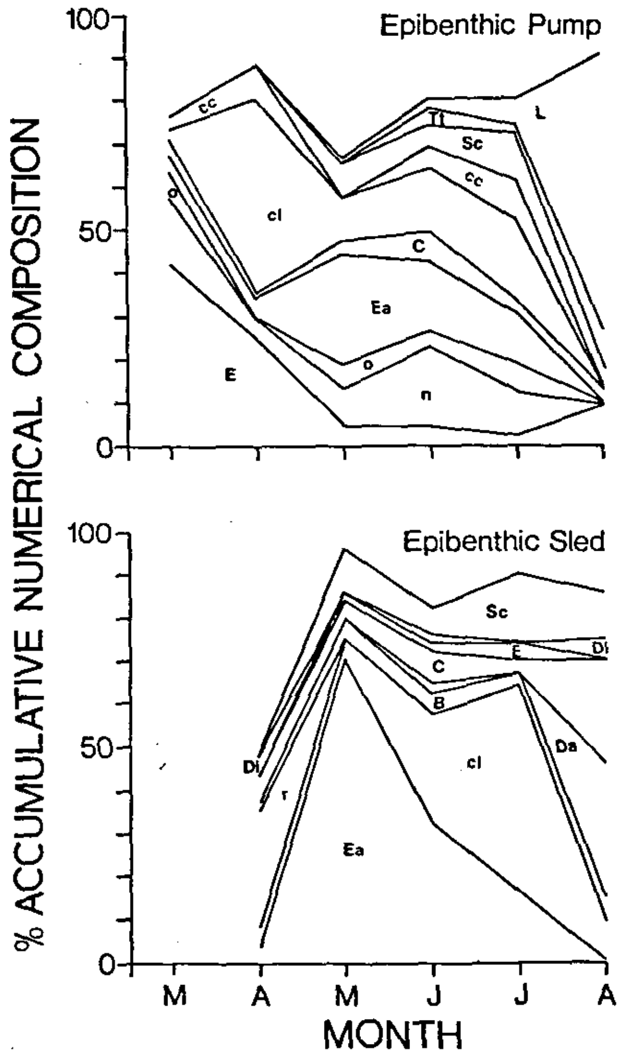
The gravimetric composition illustrated somewhat different seasonal changes (Figure 7). Cumaceans (Leucon sp.), amphipods (Corophium salmonis), and Eurytemora affinis together combined for ~60% of the epibenthic zooplankton density in shallow habitats during the late winter fluctuating flow season but Eurytemora affinis alone completely dominated (~70%) the standing crop during May. As the spring freshet season progressed, Crangon franciscorum and Neomysis mercedis displaced Eurytemora. Other taxa of mysids (Acanthomysis macropsis, Archaeomysis grebnitzkii, Neomysis integer) and gammarid amphipods (Anisogammarus sp., Corophium spinicorne, Eogammarus confervicolus, E. oclairi, Eohaustorius sp., Paraphoxus sp.) were numerically rare but often comprised a significant (i.e., >1%) portion of the standing crop at some stations, particularly those in euhaline waters close to the mouth of the estuary.

3.1.2 Motile Macroinvertebrates

Overall, Crangon franciscorum (sand shrimp) completely dominated the motile macroinvertebrate assemblage in the estuary in terms of both density and standing crop. Two other congeneric shrimps, C. nigricauda and C. stylirostris, also occurred in the bottom trawl collections in

Table 3. Numerical composition (%) of prominent (>1% of mean density) zooplankton taxa (class, family) among epifauna in the Columbia River Estuary, March 1980 - July 1981.

Taxa	Principal Life History Stages	Numerical Composition (% of mean density)		
Rotifera	adults			2.7
Cladocera				4.7
Daphnidae			1.3	
Daphnia spp.	juveniles	0.7		
D. pulex Leydig	juveniles→adults	0.1		
D. rosea Sars	"	0.2		
D. galeata Sars	"	0.1		
D. retrocurva Forbes	juveniles	0.3		
D. parvula Fordyce	adults	<0.1		
Bosmidae			2.5	
Bosmina longirostris O.F. Muller	nauplii→adults	2.5		
Ostracoda			2.4	
Limnocytheridae	"		1.8	
Limnocythere Brady sp.	"	1.8		
Copepoda	"			76.4
"	nauplii		18.4	
Calanoida	nauplii→adults		17.7	
"	nauplii & adults	4.5		
Temoridae	copepodids→adults		12.2	
Epischura nevadensis Lilljeborg	adults	<0.1		
Eurytemora affinis (Poppe)	copepodids→adults	12.2		
Harpacticoida	nauplii→adults		34.9	
"	nauplii & copepodids	0.3		
Canuellidae			8.7	
Scottolana canadensis (Willey)	copepodids→adults	8.5		
Ectinosomatidae	"		17.5	
Microsetella Brady and Anderson sp.	adults	<0.1		
Ectinosoma Boeck sp.	copepodids→adults	0.1		
Tachidiidae			5.3	
Microarthridion littorale (Poppe)	"	2.6		
Tachidius Lillheborg sp.	copepodids	<0.1		
T. (Neotachidius) triangularis Shen and Tai	copepodids→adults	1.9		
Giesbrecht	"	0.3		
Canthocamptidae			2.2	
Bryocamptus Chappuis sp.	adults	0.5		
Mesochra lillejeborgi Boeck	"	<0.1		
M. alaskana M.S. Wilson	"	<0.1		
M. pygmaea (Claus)	"	<0.1		
Attheyella Brady sp.	"	1.7		
Cyclopoida	nauplii→adults		5.3	
Cyclopidae	copepodids→adults		5.1	
Halicyclops Norman sp.	"	<0.1		
Cyclops O.F. Muller sp.	"	1.3		
C. vernalis Fischer	"	1.7		
C. bicuspidatus thomasi S.A. Forbes	"	<1.9		
Mesocyclops edax (S. A. Forbes)	adult	0.1		
Paracyclops fimbriatus poppei (Rehberg)	copepodids adults	0.1		
Oithona Baird sp.	"	0.1		
O. similis Claus	adult	<0.1		



Legend

cc = calanoid copepodites
cl = undifferentiated copepod larvae
C = *Cyclops* spp.
Cf = *Crangon franciscorum*
Cs = *Corophium salmonis*
Da = *Daphnia* spp.
Di = *Diaptomus* spp.
E = Ectinosomatidae
Ea = *Eurytemora affinis*
L = *Limnocythere* sp.
Lo = Laophontidae
Lu = *Leucon* sp.
n = nematodes
Nm = *Neomysis mercedis*
o = oligochaetes
Sc = *Scottolana canadensis*
Tt = *Tachidius triangularis*

Figure 6. Accumulative numerical composition (%) of epibenthic zooplankton in the Columbia River Estuary, March - August 1980.

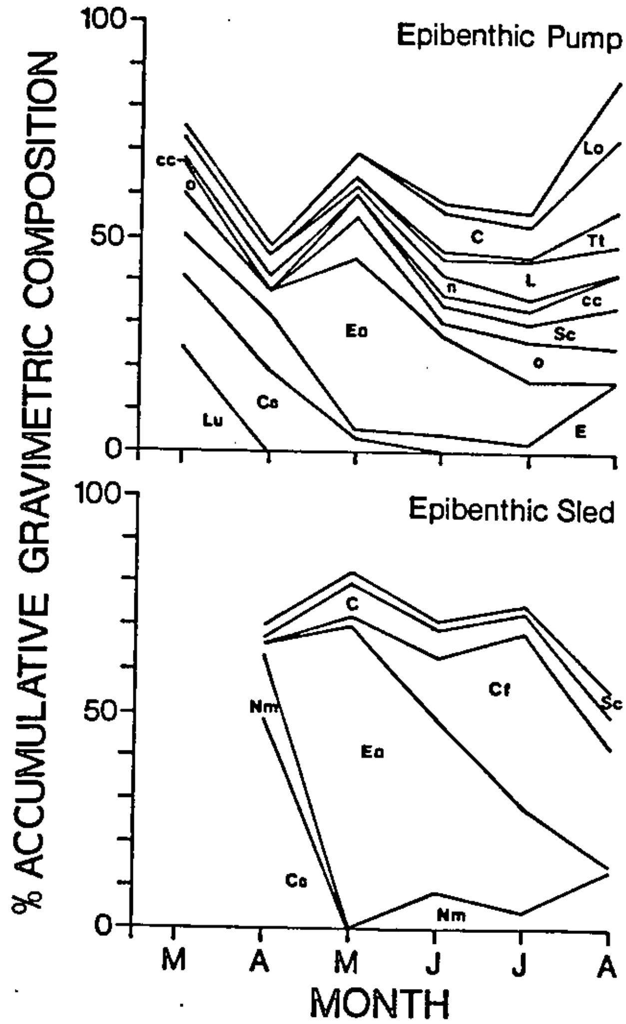


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Figure 7. Accumulative gravimetric composition (%) of epibenthic zooplankton in the Columbia River Estuary, March - August 1980.

euhaline waters at the outer margin of the estuary (almost exclusively at the Ilwaco Channel site) but were neither common nor abundant. Dungeness crab (Cancer magister) was also prominent but its occurrence was generally restricted to the plume and ocean zone at the entrance of the estuary and channel bottom habitats in the seaward region of the estuarine mixing zone.

3.2 DENSITY

3.2.1 Epibenthic Zooplankton

The density of epibenthic zooplankton over all sites in the estuary averaged 18,805 ± 3,839 m^{-2} (± standard error) but ranged broadly between 95 and 40,000 m^{-2}; the 95% confidence interval about the mean density was 11,210 to 26,400 m^{-2}. The distribution of the density estimates approximated a negative binomial distribution with a median value of 5,204 m^{-2}.

Epibenthic zooplankton densities were quite divergent in the three habitats, however. Highest densities occurred on tidal flats ($\bar{x}$ = 21,809 ± 4,671 m^{-2}; 95% confidence interval between 12,455 and 31,165 m^{-2}) compared to densities in demersal slopes (12,562 ± 4,180 m^{-2}) and channel bottom habitats (9,996 ± 3,242).

Spatial distributions of epibenthic zooplankton densities through the estuary (Figures 8-10) suggested different degrees of seasonal influences among the three habitats. Maximum densities in tidal flat habitats during the spring freshet season (Figure 8) occurred between 15 km and 20 km from the mouth of the estuary (Youngs Bay and Bridge flat sites). During summer-fall low flow months the density distribution appeared to be bimodal at either end of the estuary, although the mode at the landward end of the estuary is based on only one data point, which is insufficient without other evidence to indicate a "mode". Densities during winter fluctuating flow months were relatively uniform through the estuary except for maxima at Baker Bay and Youngs Bay, i.e. within 20 km from the mouth of the estuary.

Demersal slope habitats (Figure 9) illustrated a similar density distribution during spring freshet months, but densities during both summer-fall low flow and winter-fluctuating months were relatively uniformly distributed except for one maximum at Sand Island during the summer-fall period.

Although epibenthic zooplankton densities in channel bottom habitats (Figure 10) during spring freshet months were also highest within the estuarine mixing zone, the density distribution during summer-fall low flow months indicated a shift in densities up (landward) the estuary into the tidal fluvial zone. Densities during winter fluctuating flow months were comparatively low and uniformly distributed throughout the estuary.

Habitat-associated differences in epibenthic zooplankton densities are also illustrated by time series over the 18-month sampling period (Figure 11; note continuous Julian date). Except for unusually high

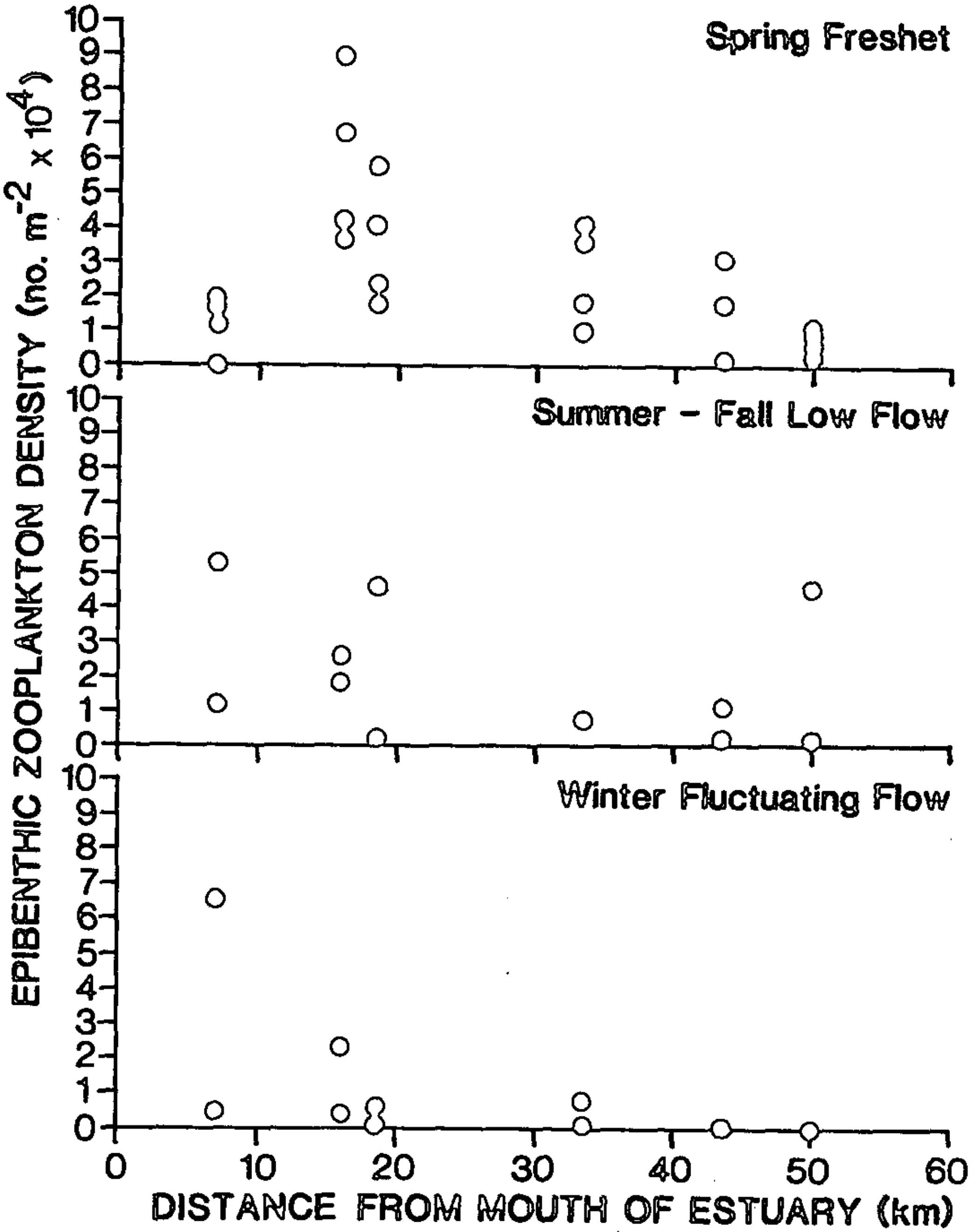

Figure 8. Spatial distribution (km from mouth of estuary) of epibenthic zooplankton density (individuals m^{-2}) in tidal flat habitats during three hydrologic seasons in the Columbia River Estuary, March 1980 - July 1981.

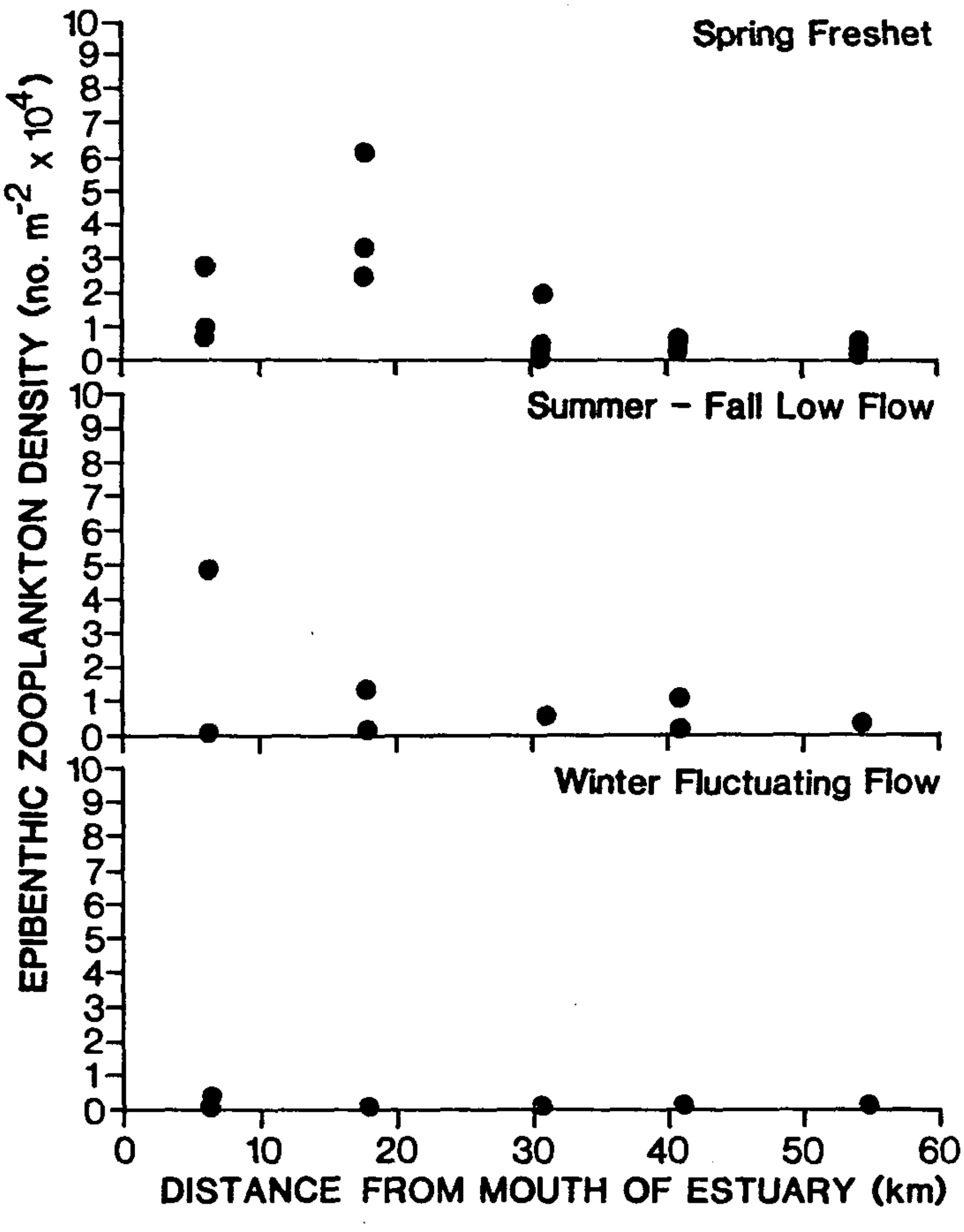

Figure 9. Spatial distribution (km from mouth of estuary) of epibenthic zooplankton density (individuals m^{-2}) in demersal slope habitats during three hydrologic seasons in the Columbia River Estuary, March 1980 -July 1981.

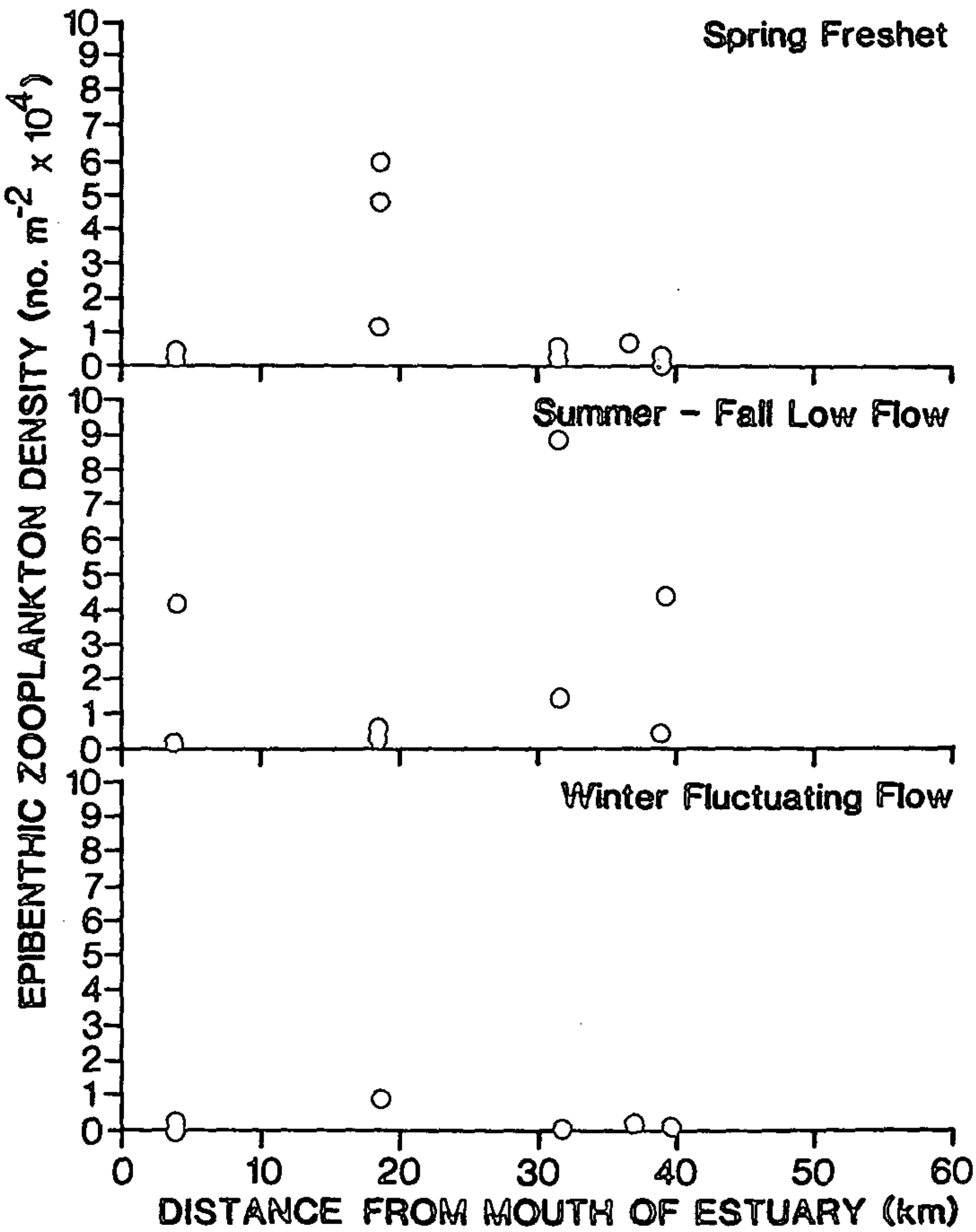

Figure 10. Spatial distribution (km from mouth of estuary) of epibenthic zooplankton density (individuals m^{-2}) in channel bottom habitats during three hydrologic seasons in the Columbia River Estuary, March 1980 - July 1981.

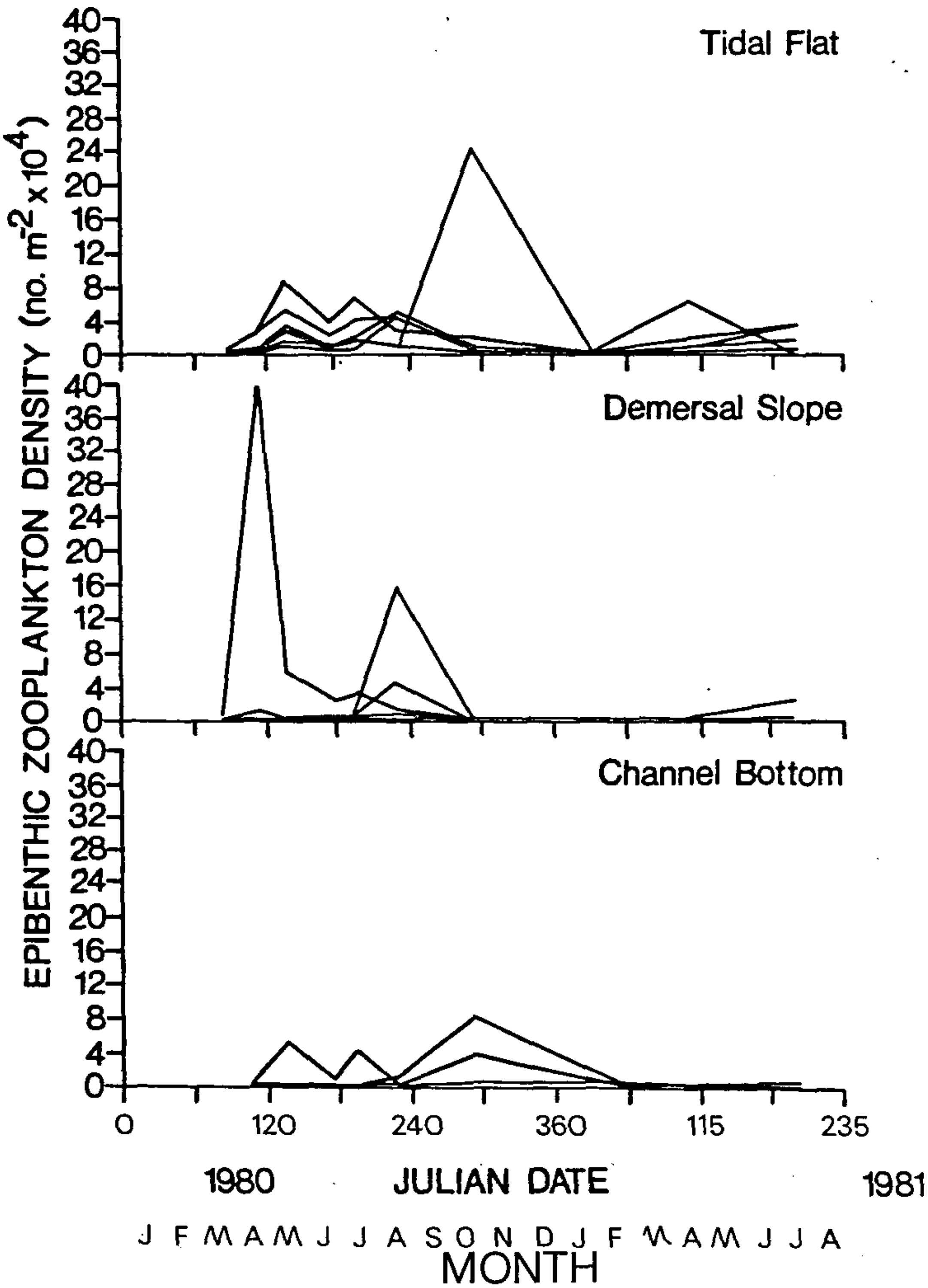

Figure 11. Temporal distribution (Julian date) of epibenthic zooplankton density (individuals m^{-2}) in six tidal flat, five demersal slope, and five channel bottom habitats in the Columbia River Estuary, March 1980 - July 1981.

densities at Bridge Flat in October 1980 and Baker Bay in April 1981, densities at the five tidal flat sites consistently showed maximum in May and July-August. Densities then decreased to minima during the winter and gradually increased from April to July 1981. Densities in demersal slope habitats generally exhibited only one summer (August) maxima except for a spring (April-May) peak at the Bridge Slope site. Only one channel bottom site (Bridge Channel) showed a spring-early summer maxima, while the other four sites all illustrated peak densities occurring in October.

3.2.2 Motile Macroinvertebrates

Motile macroinvertebrate density averaged 0.09 ± 0.02 m^{-2} across the estuary, ranging between 0 and 1.72 m^{-2} with a 95% confidence interval of 0.04 and 0.14 m^{-2}.

The rank order of macroinvertebrate density by habitat also followed that of the epibenthic zooplankton, averaging higher in tidal flat habitats (0.12 ± 0.04 m^{-2}) than in demersal slope (0.08 ± 0.04 m^{-2}) or channel bottoms (0.07 ± 0.04 m^{-2}).

Density distributions of motile macroinvertebrates (principally Crangon and mysids) through the estuary changed among hydrologic seasons (Figures 12-14). Macroinvertebrates in tidal flat habitats were concentrated within 20 km of the estuary's mouth during the spring freshet season (Figure 12) but had expanded, though in lower density (~0.1 m^{-2}), to Grays Bay (km 32) during the summer-fall low flow season. During winter fluctuating flow months, densities both decreased throughout the estuary and become concen trated back in the lower bays.

Motile macroinvertebrates in demersal slope habitats were considerably denser in the central portions of the estuary (Bridge Slope) and showed the same summer-fall expansion to the lower reaches of the tidal fluvial zone (Figure 13).

Although densities in channel bottom habitats during the spring freshet season were lower than those in the shallower habitats (Figure 13), the highest density during summer-fall low flow months occurred in the channel habitat at Rice Island (Figure 14). By winter, densities had declined dramatically throughout the estuary.

In addition to being concentrated in the lower 10 km of the estuary, densities of Dungeness crab were significant (i.e., >0.01 individuals m^{-2}) only during the spring freshet season (Figure 15). This pattern may not be representative of crab densities at and outside the mouth of the estuary, however. Based upon data from concurrent 8-m trawl catches by NMFS in the channel habitat at the mouth (NMFS stations 1 and 2), crab densities ~0.2 individuals m^{-2} may persist into the summer-fall low flow season (Figure 15).

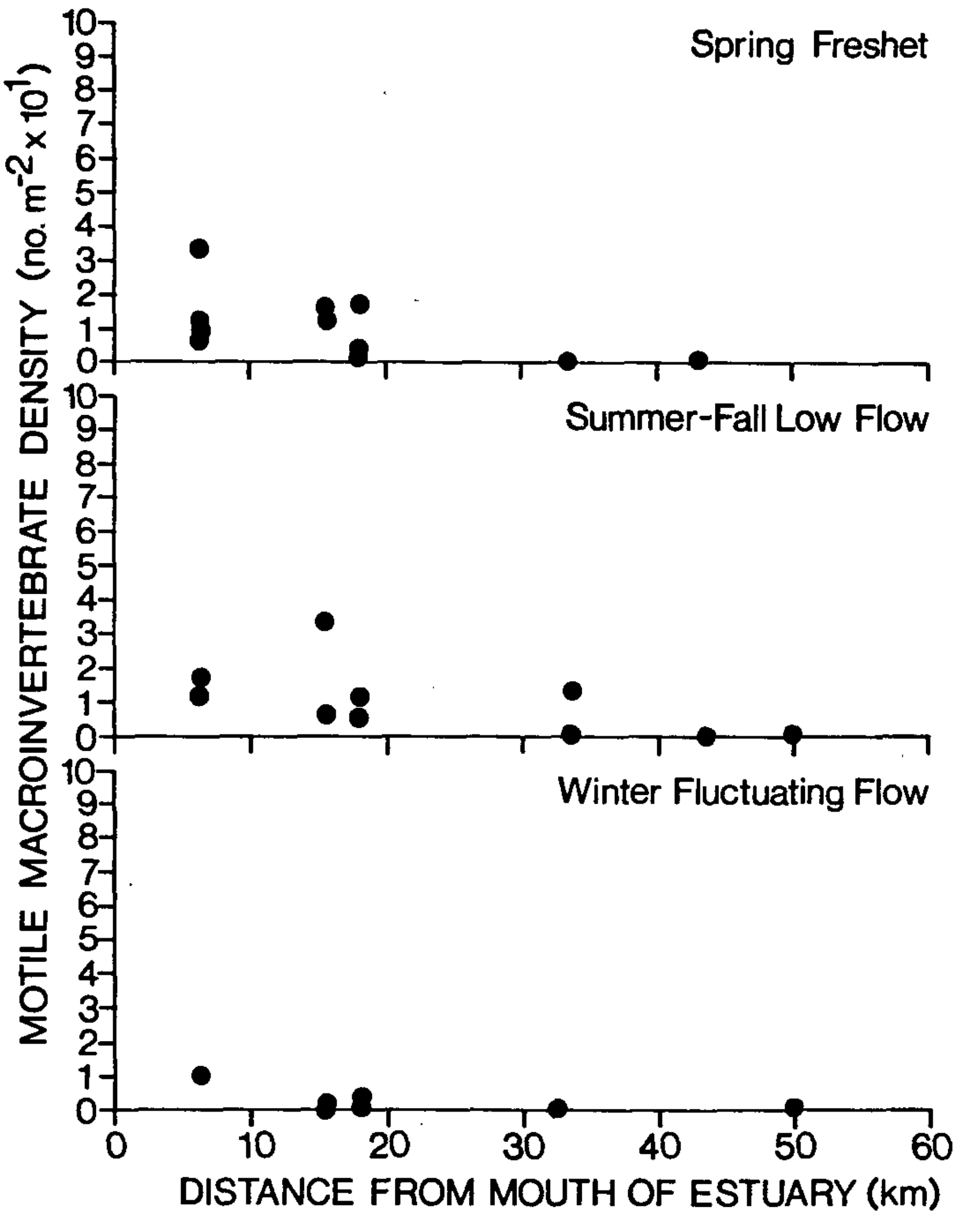

Figure 12. Spatial distribution (km from mouth of estuary) of motile macroinvertebrate density (individuals m^{-2}) in tidal flat habitats during three hydrologic seasons in the Columbia River Estuary, March 1980 - July 1981.

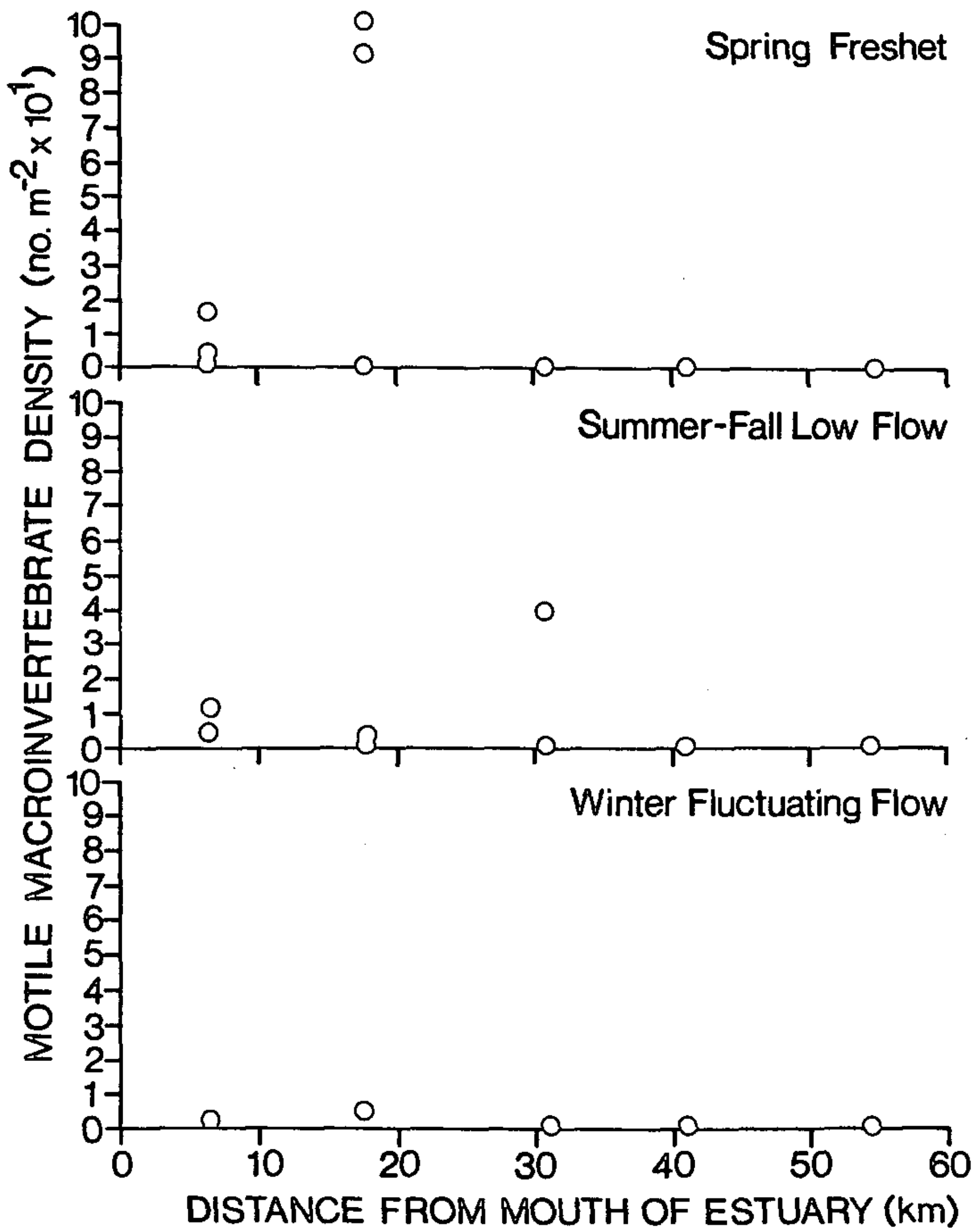

Figure 13. Spatial distribution (km from mouth of estuary) of motile macroinvertebrate density (individuals m^{-2}) in demersal slope habitats during three hydrologic seasons in the Columbia River Estuary, March 1980 - July 1981.

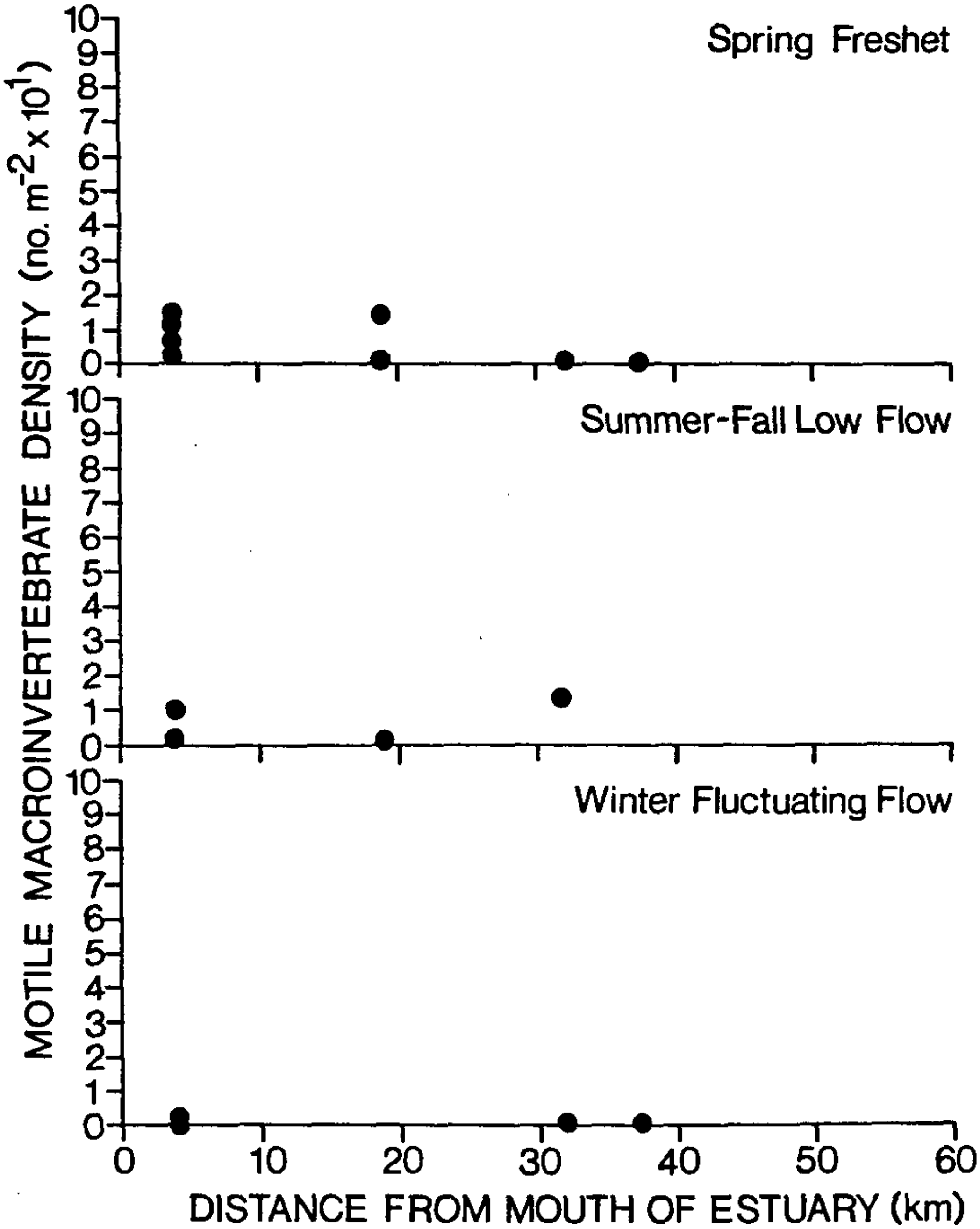

Figure 14. Spatial distribution (km from mouth of estuary) of motile macroinvertebrate density (individuals m^{-2}) in channel bottom habitats during three hydrologic seasons in the Columbia River Estuary, March 1980 - July 1981.

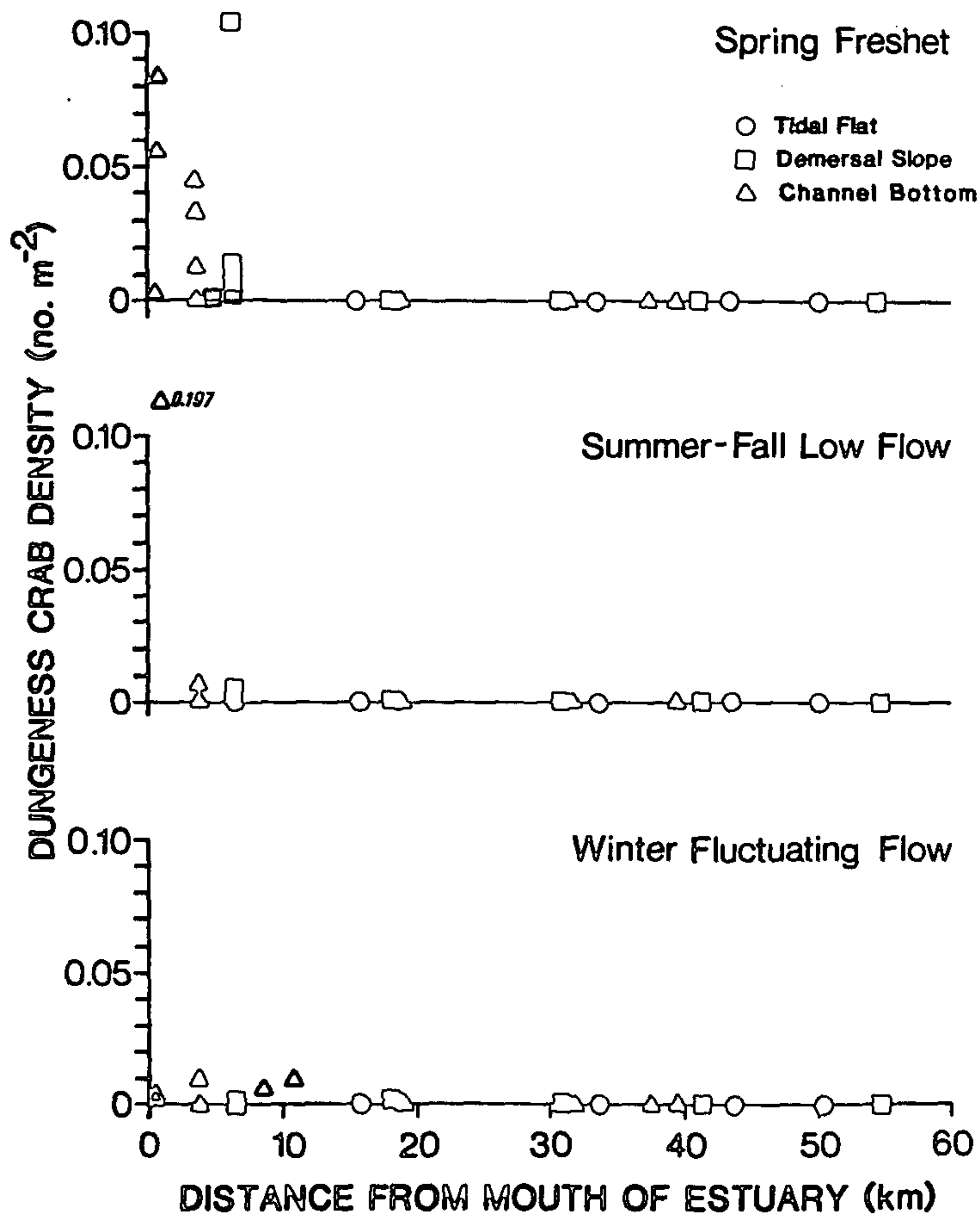

Figure 15. Spatial distribution (km from mouth of estuary) of Dungeness crab (Cancer magister) density (individuals m^{-2}) during three hydrologic seasons and among three habitats in the Columbia River Estuary, March 1980 - July 1981. Open symbols indicate crab densities from comparable CREDDP collections by NMFS.

3.3 STANDING CROP

3.3.1 Epibenthic Zooplankton

Due to the relatively uniform size and biomass of epibenthic zooplankton, standing crop estimates mirrored the density distribution. Average standing crop at all sites over the sampling period was 185.80 $\pm$ 34.23 mg m^{-2}, ranged between 1.8 and 3864.5 mg m^{-2}, and had a 95% confidence interval around the mean of 118.1 to 253.5 mg m^{-2}. The median of the standing crop distribution was 74.0 mg m^{-2}. Spatial and temporal trends followed those illustrated by the density data.

3.3.2 Motile Macroinvertebrates

Standing crop of Dungeness crab and crangonid shrimp, the dominant motile macroinvertebrates, averaged 0.17 $\pm$ 0.06 g m^{-2}, ranged between 0.0 and 6.34 g m^{-2}, and had a 95% confidence interval around the mean of 0.05 to 0.30 g m^{-2}. The median of the standing crop distribution was 0.0 because almost 85% of the 114 samples were 0.0. Trends in seasonal distribution of standing crop resembled those of density, although sites in the plume and ocean zone during spring and winter months and lower reaches of the estuarine mixing zone during summer-fall months showed somewhat higher standing crop values than the other sites due to the presence of Dungeness crab.

3.4 RELATIONSHIPS BETWEEN EPIBENTHIC ORGANISM STANDING CROP AND OTHER BIOTIC AND ABIOTIC VARIABLES

There are several partial correlation coefficients among epifauna density and standing crop and other biotic and abiotic variables (Table 4) which, although they cannot be considered causal, may indicate limiting factors on faunal distribution and standing stock. Both epibenthic zooplankton density (EPIDEN) and standing crop (EPISC), however, were not strongly correlated with any one variable, the highest correlation (0.267) being between standing stock and sediment skew. Sediment skew was also positively (0.688) correlated with motile macroinvertebrate standing crop (MACSC), although total fish density (FSHDEN) was even more correlated (0.709). Much of the positively correlation between fish density and macroinvertebrate standing crop may be attributable to the presence of starry flounder (Platichthys stellatus) and their predation upon Crangon franciscorum, as indicated by the relatively high (0.329) correlation between starry flounder standing crop (SFSC) and Crangon densities (CRADEN). Motile macroinvertebrate standing crop, Crangon density, and starry flounder standing crop were all positively correlated (0.349 to 0.372) with salinity and/or negatively with the distance from the mouth of the estuary (RIVKM).

3.5 EPIBENTHIC ZOOPLANKTON ASSEMBLAGE STRUCTURE

Numerical classification of sampling sites and taxa indicated dramatic changes in assemblage structure among months (Appendix C). Station and taxa clusters delineated during three months representing the three hydrologic seasons illustrated the dynamic structure of these assemblages (Figure 16a-c). In May, during the spring freshet season,

Table 4. Partial correlation coefficient matrix of epibenthic organism standing stock variables and other biotic and abiotic variables in the Columbia River Estuary, March 1980 - July 1981.

	2 EPISC	3 MACDEN	4 MACSC	5 CRADEN	6 JDATE	7 TIME	8 RIVKM	9 SITELV	10 TEMPC	11 SALTY	12 RIVDIS	13 TRWAUN	14 THWAUN
EPIDEN	.794	.121	-.037	.142	-.083	-.046	-.104	-.100	.123	-.037	-.062	-.071	-.003
EPISC		.111	-.054	.131	-.079	-.066	-.052	-.061	.112	-.063	-.110	-.095	.002
MACDEN			.094	.996	-.085	-.117	-.184	-.032	.161	-.018	.007	.004	.078
MACSC				.049	-.066	-.078	-.278	-.007	.126	.372	-.048	-.011	.186
CRADEN					-.074	-.121	-.161	-.025	.184	-.058	-.001	-.055	.061
JDATE						-.133	-.065	.037	-.130	-.041	.046	.020	.044
TIME							.356	-.100	.037	-.224	.121	.177	.032
RIVKM								-.020	.080	-.742	.025	.089	-.012
SITELV									.050	-.086	.038	.081	.014
TEMPC										-.147	-.234	-.165	.383
SALTY											-.170	-.061	-.058
RIVDIS												.410	-.235
TRWAUN													.216
THWAUN													
TRASTO													
THASTO													
XPHI													
SKEW													
COA1%													
%S-C													
CHLA													
FSHDEN													
SAMDEN													
SEDEN													
SFSC													

EPIDEN = Epibenthic zooplankton density
2 - EPISC = Epibenthic zooplankton standing crop
3 - MACDEN = Motile macroinvertebrate density
4 - MACSC = Motile macroinvertebrate standing crop
5 - CRADEN = Crangonid shrimp density
6 - JDATE = Julian date
7 - TIME = Local time of sampling
8 - RIVKM = Distance (km) from mouth of estuary
9 - SITELV = Tidal elevation (m) of sampling site
10 - TEMPC = Temperature (C)
11 - SALTY = Salinity (%)
12 - RIVDIS = River discharge (1000 m^3s^{-1})
13 - TRWAUN = Tidal range (m) at Wauna
14 - THWAUN = Tidal height (m) at Wauna

Table 4. Partial correlation coefficient matrix of epibenthic organism standing stock variables and other biotic and abiotic variables in the Columbia River Estuary, March 1980 - June 1981 - continued.

	15 TRASTO	16 THASTO	17 XPHI	18 SKEW	19 COA1%	20 %S-C	21 CHLA	22 SESTON	23 FSHDEN	24 SAMDEN	25 SFDEN	26 SFSC
EPIDEN	.009	-.175	.092	.162	.052	.074	-.190	.138	.015	-.028	.050	.092
EPISC	.015	-.202	.026	.267	.021	.016	-.169	.041	-.020	-.007	.001	.023
MACDEN	.053	-.087	.240	.688	.191	.235	-.109	-.000	.071	-.035	.219	.355
MACSC	.171	-.066	-.068	.162	.077	-.103	-.117	-.037	.709	-.022	-.013	.197
CRADEN	.033	-.097	.243	.084	.174	.239	-.116	-.013	.038	-.034	.214	.329
JDATE	-.064	.151	.012	.001	.076	.010	-.353	-.300	-.085	-.117	-.202	-.171
TIME	.072	-.009	.100	-.207	.029	.109	.259	-.049	.006	.076	-.164	-.010
RIVKM	-.021	-.016	-.190	-.451	-.357	-.081	.620	.146	-.160	.183	-.024	-.363
SITELV	.062	.047	-.444	-.241	-.240	-.383	-.094	.043	-.116	-.032	-.294	-.297
TEMPC	.416	-.583	.211	.176	.045	.282	.338	.178	.176	-.166	.286	.008
SALTY	-.066	.028	.207	.324	.287	.115	-.567	-.184	.192	-.069	.061	.349
RIVDIS	-.081	.449	-.019	-.134	.087	.033	.146	.044	-.144	-.067	-.170	-.107
TRWAUN	.187	.382	-.054	-.133	-.036	-.005	.082	-.018	-.005	-.006	-.031	-.075
THWAUN	.936	-.148	.046	.031	.024	.099	.437	.183	.295	-.014	.238	.140
TRASTO		-.228	.080	.024	.058	.147	.593	.267	.269	-.011	.232	.141
THASTO			-.124	-.190	-.045	-.127	-.181	-.137	-.150	.025	-.210	-.135
XPHI				.389	.671	.934	-.014	.123	-.029	-.124	.255	.335
SKEW					.561	.252	-.259	-.019	.084	-.144	.056	.195
COA1%						.507	-.133	-.006	.072	-.257	.125	.346
%S-C							.130	.120	-.064	-.056	.233	.268
CHLA								.447	-.121	.502	-.011	-.287
SESTON									-.030	.225	.157	.280
FSHDEN										-.011	.208	.342
SFDEN											-.010	-.046
SFSC												.465

15 - TRASTO = Tidal range (m) at Astoria
16 - THASTO = Tidal height (m) at Astoria
17 - XPHI = Mean ø of sampling site sediment
18 - SKEW = Skew of sampling site sediment
19 - COA1% = Coarsest 1% of sampling site sediment
20 - %S-C = % sand-cobble sampling site sediment
21 - CHLA = Chlorophyll *a*
22 - SESTON = Organic seston
23 - FSHDEN = Total fish density
24 - SAMDEN = Juvenile salmon density
25 - SFDEN = Starry flounder density
26 - SFSC = Starry flounder standing crop

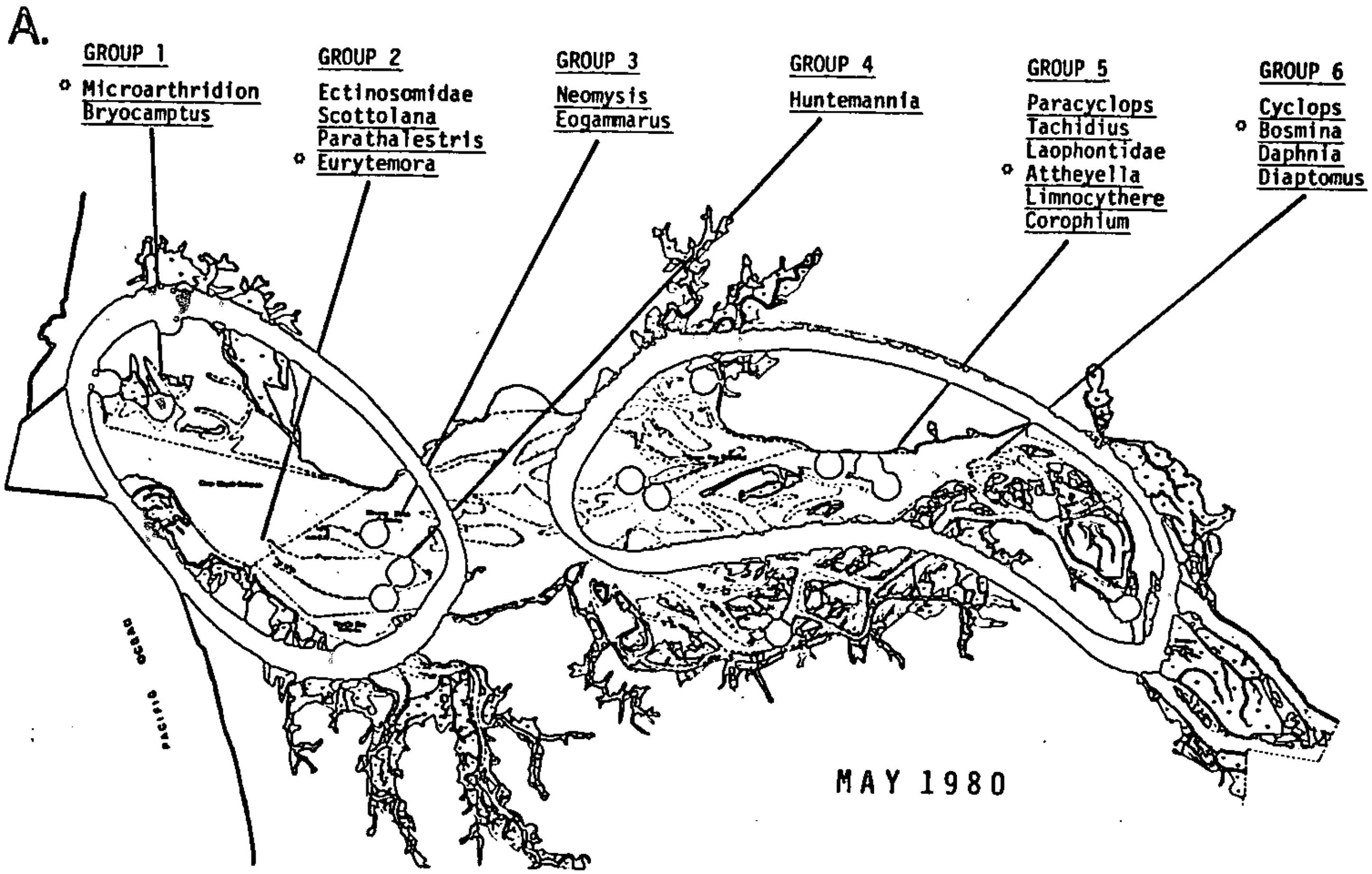

Figure 16. Distribution of epibenthic zooplankton assemblage clusters in the Columbia River Estuary during three hydrologic seasons: (A) spring freshet season (represented by May 1980); (B) summer-fall low flow season (October 1980); and, (C) winter fluctuating high flow season (February 1981).

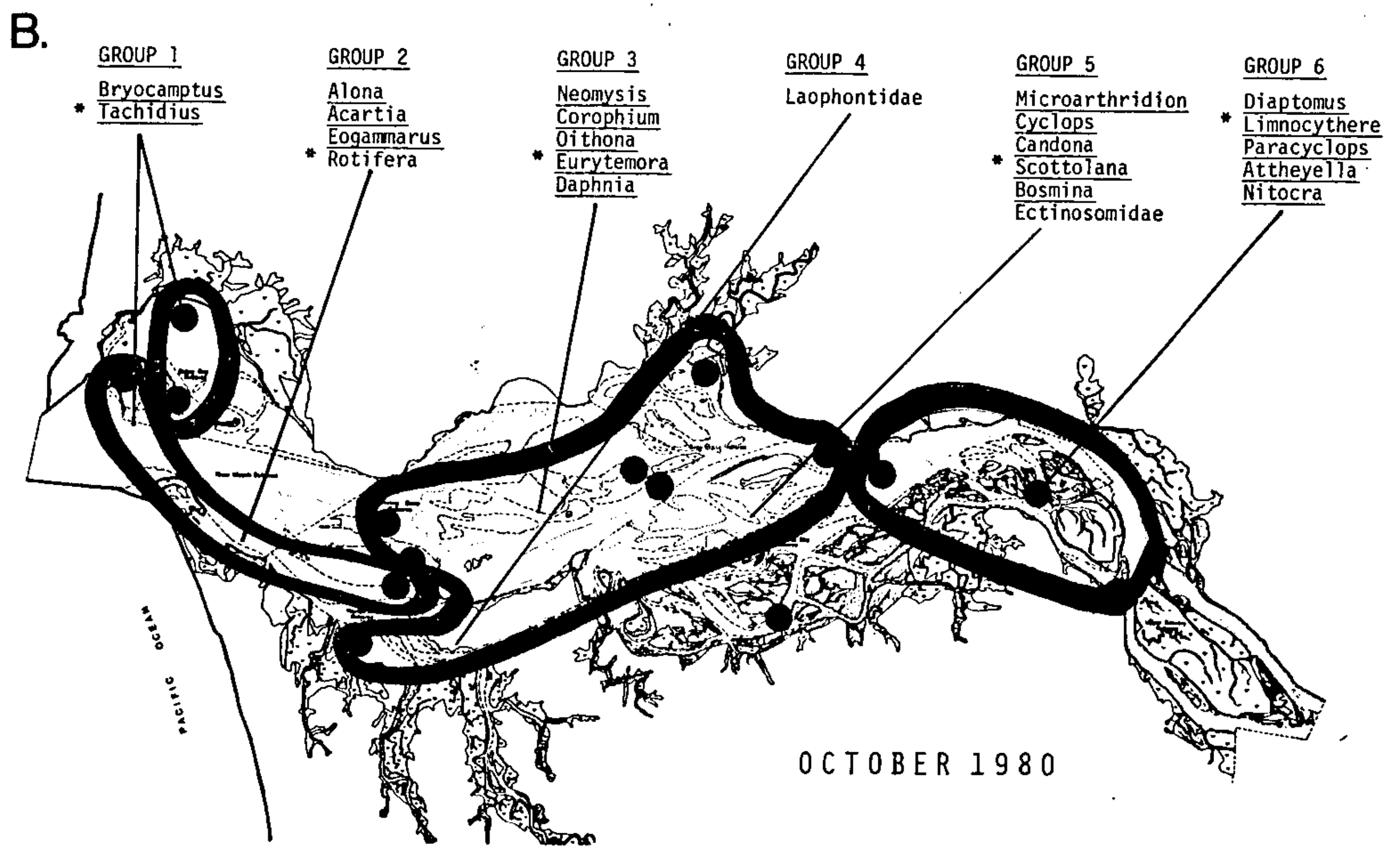

Figure 16. (cont.)

C.

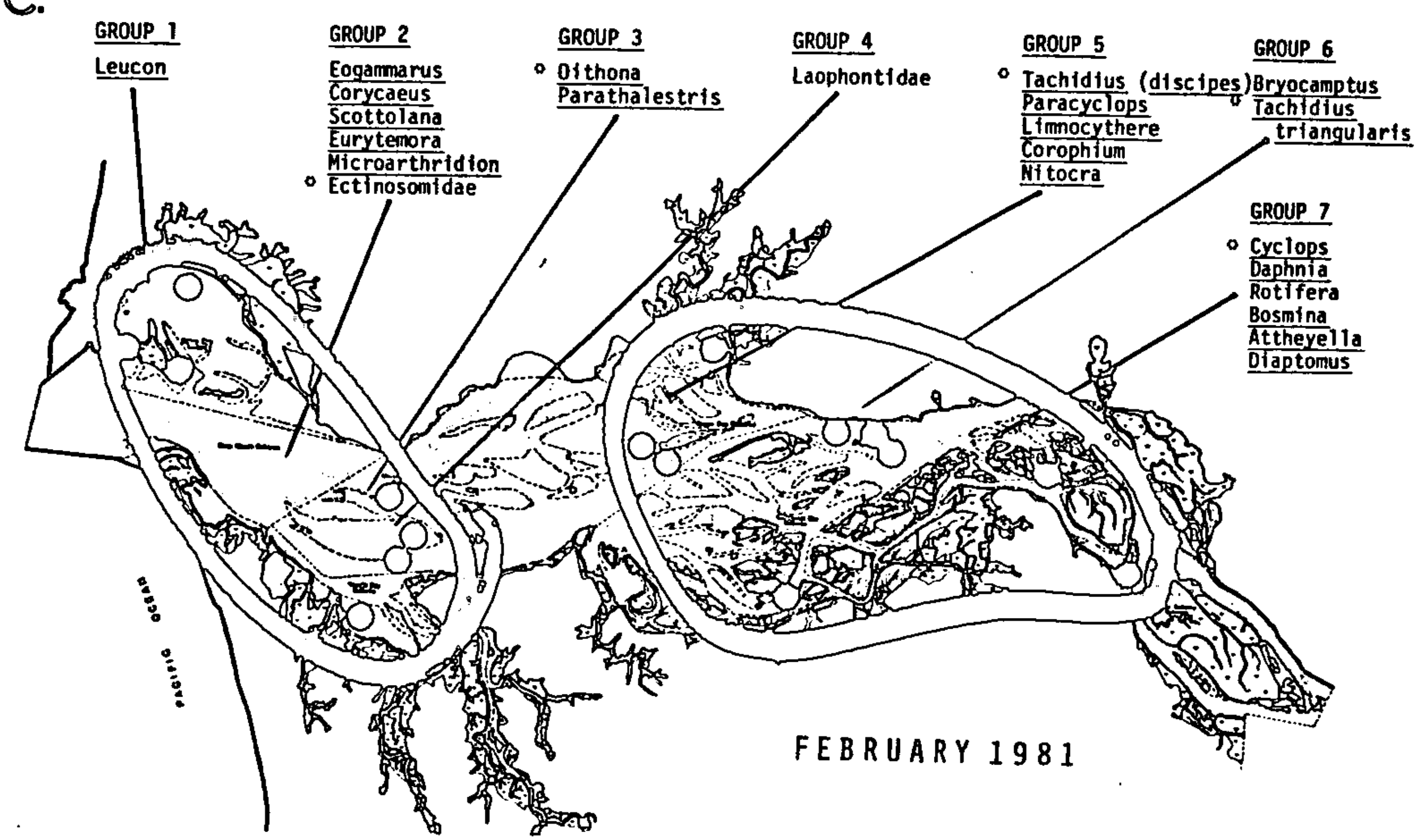

Figure 16. (cont.)

two station cluster groups were evident, one within and one above 25 km from the mouth of the estuary (Figure 16a). Stations located in the tidal fluvial zone were characterized almost entirely by a riverine assemblage of freshwater cyclopoid copepods and cladocerans, although another mixed group of cyclopoid and harpacticoid copepods, ostracods, and the gammarid amphipods Corophium spp. also occurred predominantly in the tidal flat and demersal slope habitats of the upper reaches of the estuary. Assemblages in the lower estuary were limited almost completely to euryhaline taxa, including one large group of harpacticoid copepods (e.g. Scottolana canadensis), the calanoid Eurytemora affinis, and three other two- or one-taxa groups of harpacticoids, mysids, and amphipods.

By October, at the end of the summer-fall low flow season, assemblage structure had become much more complex (Figure 16b). Station associations were less robust and fell into as many as five cluster groups: (1) channels within 20 km of the mouth of the estuary; (2) tidal flat and demersal slope habitats within 10 km of the mouth; (3) flats and slopes in the central portion of the estuary and a channel bottom station 40 km from the mouth; (4) flats, slopes, and channels between 30 and 35 km from the mouth; and, (5) flats and slopes in the upper region of the estuary >40 km from the mouth. Taxa clusters were equally complex and included fluvial, euryhaline, and euhaline fauna within several of the six clusters. Distribution of clusters characterized by euryhaline harpacticoids and Eurytemora extended well above the central portion of the estuary but euhaline taxa such as Acartia and Oithona occurred as far as 50 km from the mouth of the estuary.

In the winter fluctuating high flow season, represented by February 1981, the distribution of the clusters resembled that of the spring freshet season (Figure 16c). Seven taxa clusters again fell into discrete estuarine and fluvial station clusters.

3.6 FOOD WEB LINKAGES

3.6.1 Epibenthic Zooplankton

Review of literature describing food resources of phyolgenetically- or ecologically-similar epibenthic zooplankton taxa indicated that most of the epibenthic crustaceans which dominate the assemblages in the estuary would be classified as detritivores (Lasker et al. 1977; Brown and Sibert 1977; Heinle et al. 1977; Rieper 1978; Vanden Berghe and Bergmans 1981) although large, more planktonic zooplankters such as Eurytemora affinis probably have the ability to utilize autotrophic (i.e. phytoplankton) as well as heterotrophic food resources (Heinle and Flemer 1975).

3.6.2 Motile Macroinvertebrates

Both Neomysis mercedis and Crangon franciscorum indicated omnivorous food habits (Table 4) but diet composition appeared to vary considerably by season and location within the estuary. A composite summary of all Neomysis examined from the June 1980 samples indicated that rotifers were the numerically prevalent food organism (36.8% of total), followed by diatoms (12.5%) and cladocerans (primarily Bosmina sp; 18.4%), during the spring freshet season. A composite of all Neomysis examined from Youngs Bay, however, indicated that predation upon epibenthic meiofauna, particularly harpacticoid copepods such as Ectinosomids (41.6%) and Scottolana canadensis (37.9%), was more typical of shrimp on that tidal flat.

Crangon franciscorum also illustrated similar temporal/spatial variability, although not in the same patterns. Shrimp collected from throughout the estuary in August 1980 had fed primarily upon Scottolana canadensis (61.0%) and secondarily upon diatoms (21.4%). Shrimp collected from Youngs Bay throughout the 18-month sampling period appeared to feed on the same two food resources but numerical composition had reversed to 62.6% diatoms and 22.7% Scottolana canadensis.

Qualititative analyses of juvenile Dungeness crab from the lower reaches of the Estuarine Mixing Zone indicated that they are carnivorous upon macroinvertebrate components of the benthic infauna and epifauna. Identifiable organisms included Corophium sp., Neomysis mercedis, Cancer magister, barnacle cyprid larvaea, and remains of bivalve molluscs and fish.

3.7 Crangon AND Neomysis POPULATION DYNAMICS

Length frequency distributions of Crangon franciscorum (represented by Youngs Bay, Figure 17) indicate that although maturing ("yearling") or adult shrimp are present in the lower half of the estuarine mixing zone during the winter and early spring (April), they have departed the estuary by May, presumably to reproduce in more euhaline environs (Israel 1936; Krygier and Horton 1975). Juveniles ("young-of-year") resulting from winter spawning offshore and in the plume and ocean zone of the estuary appear by April and continue to occupy and grow in the estuarine mixing zone. Suggestions of a bimodal size frequency distribution in August could indicate influx of juveniles from a second, later spawning, corresponding with Krygier and Horton's (1975) documentation of bimodal spawning in Yaquina Bay, Oregon.

Unlike Crangon, Neomysis mercedis reproduce and develop entirely within the estuary. Although they are distributed throughout the estuary, the center of their distribution tends to extend from the middle of the estuarine mixing zone into the tidal-fluvial zone. There is an apparent separation of sexes, as most of the mysids captured in the lower and central reaches of the estuary were males but low catches of females in general could indicate that sampling biases were involved (Williams 1983, Table 5). Gravid females were found primarily in lower reaches of the tidal fluvial zone between April and August (ibid).

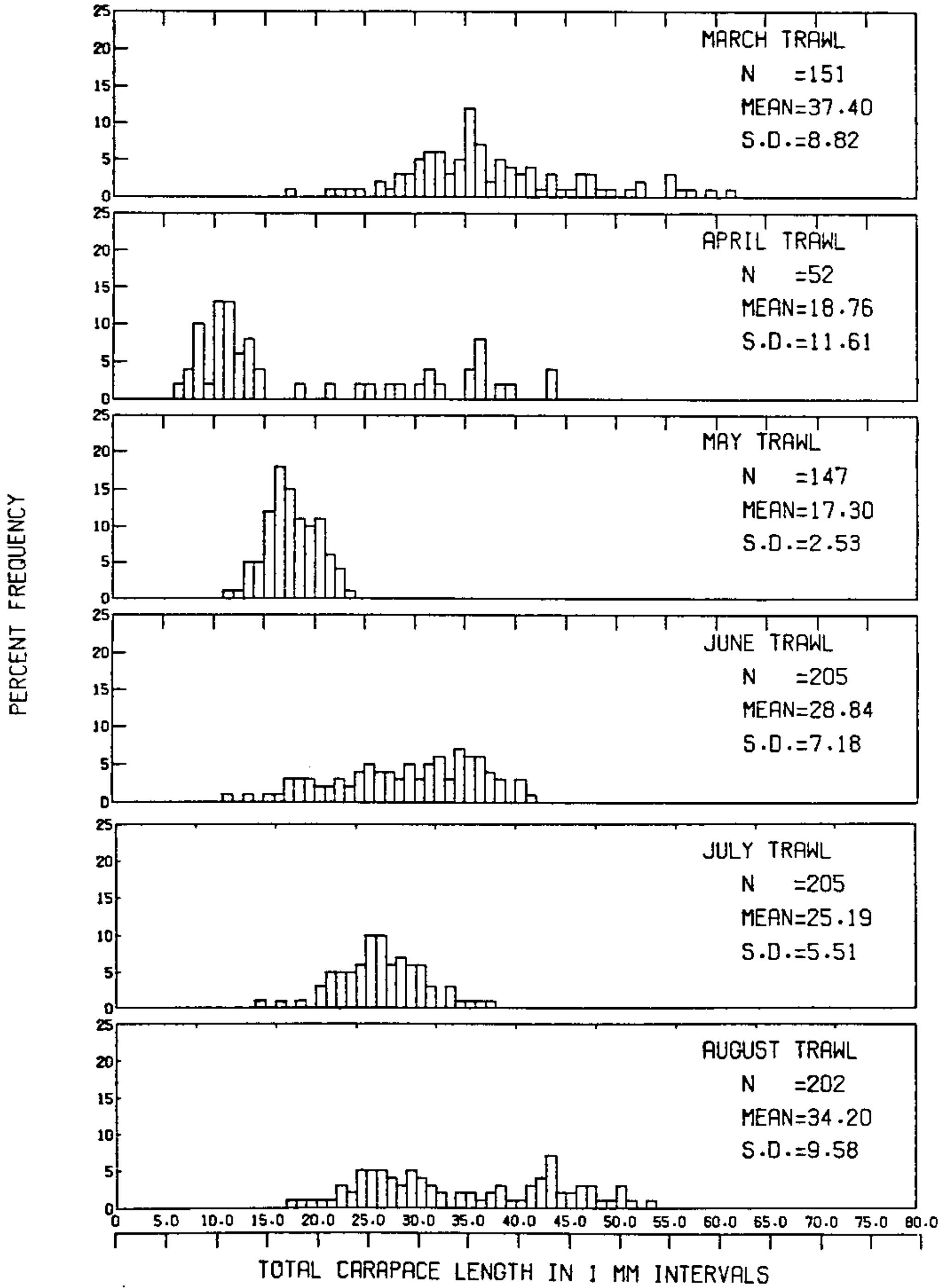

Figure 17. Length (carapace) frequency distribution of sand shrimp (Crangon franciscorum) in Youngs Bay, Columbia River Estuary, March 1980 - August 1980.

Table 5. Numerical composition (%) of food organisms consumed by Neomysis mercedis and Crangon franciscorum in the Columbia River Estuary, March 1980 - July 1981. n = number of stomachs examined.

Food Item	Numerical Composition (%)			
	Neomysis mercedis		Crangon franciscorum	
	Estuary-wide Distribution June 1980 (n=54)	Seasonal Distribution Youngs Bay (n=26)	Estuary-wide Distribution August 1980 (n=41)	Seasonal Distribution Youngs Bay (n=39)
Diatoms	12.5	3.7	21.4	62.6
Nematodes	...	...	...	0.7
Rotifers	36.8	1.9	...	0.1
Polychaete Annelids; Nereidae	...	...	3.3	1.9
Cladocerans	0.4	0.6	0.6	0.1
Sida crystallina	0.4	...	...	...
Daphnia sp.	0.4	...	...	...
Bosmina sp.	17.6	5.0	0.6	0.4
Chydoridae	0.4			
Leydigia quadrangularis	0.4	...	...	...
Ostracods	1.1	...	0.1	...
Calanoid Copepods				
Eurytemora affinis	2.6	3.7	...	9.1
Harpacticoid Copepods	0.7	...	1.0	...
Scottolana canadensis	9.6	37.9	61.0	22.7
Ectinosomidae	3.3	41.6	1.0	1.3
Tachidiae	0.4	...	...	...
Tachidius triangularis	0.4	...	0.1	0.3
Cyclopoid Copepods	...	1.2	...	...
Cyclops sp.	1.1	...	...	...
C. bicuspidatus	1.1	1.9	3.7	...
C. vernalis	1.8	2.5	4.7	...
Barnacle cypris	...	...	1.0	...
Mysidacea	...	...	0.3	...
Gammarid Amphipods	1.1	...	...	...
Corophium sp.	...	...	...	0.3
C. salmonis	...	...	0.4	0.1
Eogammarus confervicolus	0.4	...	0.1	...
Eohaustorius sp.	0.1	...	...	...
Decapods				
Crangon franciscorum	...	...	0.6	0.1
Plant Detritus	0.4	...	...	...

4. DISCUSSION

4.1 PHYSICAL AND ECOLOGICAL INFLUENCES UPON STRUCTURE AND STANDING STOCK OF EPIBENTHIC ZOOPLANKTON ASSEMBLAGES

Seasonal patterns in the standing stock of epibenthic zooplankton coincide with two major hydrologic characteristics of the estuarine mixing zone of the estuary, the maximum intrusion of saline water and the upstream boundary of the turbidity maximum zone or "null zone". Maximum salinity intrusion during high flow seasons is probably only 20 km to 25 km from the mouth of the estuary but may extend as far as 45 km landward during the summer-fall low flow season (Jay 1982). Correspondingly, the upstream boundary of the maximum turbidity zone probably shifts from 14 km to 15 km from the mouth during high flow seasons to a position 19 km to 23 km from the mouth of the estuary during low flow seasons (Simenstad et al. 1984). Thus, the distribution of specific taxa can be related to their preadapted salinity tolerances but reproductive populations are probably maintained (despite the effects of net seaward transport) physically by entrainment within the turbidity maximum and landward currents along the bottom. Production of these populations is also probably enhanced by the entrainment and prolonged cycling of detritus particles within the same region, although CREDDP produced no data on detritus distribution and composition with which to test this hypothesis.

In addition to supporting the influence of salinity intrusion, the change from homogeneous to heterogeneous taxa groups between high and low flow seasons also indicates the effect of seasonal variation in the strength or presence/absence of water column stratification. Although dependent upon tidal conditions, the water column tends to be more strongly stratified more often during high flow seasons than during low flow seasons, when neap-spring tidal forces extend much further up the estuary. As a result, the more thorough mixing during the summer-fall low flow season would transport and integrate fluvial, euryhaline, and euhaline taxa within the same epibenthic regions of the estuary. Despite this physically dynamic system, euryhaline taxa such as Eurytemora affinis are able to sustain high population densities within the central, estuarine mixing zone of the estuary, probably through active vertical migration (Wooldridge and Erasmus 1980).

4.2 PHYSICAL AND ECOLOGICAL INFLUENCES UPON DISTRIBUTION AND STANDING STOCK OF MOTILE MACROINVERTEBRATES

As a euryhaline species, the distribution and standing stock of Crangon franciscorum probably relates to the increased salinity intrusion during the summer-fall low flow season but is also coincident with the distribution shift in their principal prey resources, the epibenthic zooplankton. Epibenthic-feeding fishes, which prey upon both epibenthic zooplankton and motile macroinvertebrates, and marine mammals (seals and sea lions) also expand their distributions further up the estuary in response to these dynamic shifts in prey resource concentrations (Haertel and Osterberg 1967; Beach et al. 1981; National Marine Fisheries Service 1984). Consequently, the distribution and standing stock of Crangon franciscorum may be determined by the combined effects of physical forces, population dynamics, and trophic interactions with prey and predators. The same influences undoubtedly affect the distribution and abundance of the less motile Neomysis mercedis, although physical effects may be predominant.

Although the 1980-1981 CREDDP data does not show Dungeness crab to occupy a significant portion of the Columbia River Estuary, there are other data to indicate that their distribution at other times may be somewhat more landward than reported herein. Haertel and Osterberg (1967) described Dungeness crab as occupying euhaline to mesohaline demersal habitats. Durkin (1975) described crab abundance during the spring and summer to be relatively high at the landward margin of the plume and ocean zone in the channel adjacent to Clatsop Spit, but they were also collected in low numbers in the channel just downstream of Astoria. Durkin et al. (1981) also provided data in support of Dungeness crab distribution extending almost 20 km up the estuary (to Astoria) in channel bottom habitats. However, crab densities were mesurable reduced in May as compared to November collections. In contrast, densities 5 km closer to the mouth (in the vicinity of Tansy Point, Figure 2) were higher during both October and May and numerically comparable to densities from colections at the mouth of the estuary. Thus, Dungeness crab in the Columbia River Estuary may be relatively confined to the euhaline waters of the channel bottom habitats and to shift the center of their estuarine density distribution with the tidal intrusion of oceanic water and the movement of the turbidity maximum zone.

Compared to other, more marine estuaries in the region, however, the strong and variable freshwater dominance in the Columbia River Estuary apparently limits the horizontal and depth incursion of Dungeness crab. Armstrong et al. (1981) indicated that Dungeness crabs occurred in densities as high as 0.81 m^{-2} at the mouth of Grays Harbor but they also occurred as far as 25 km inside the estuary, although at steadily decreasing densities. Densities at the most landward trawl sampling station, where the mean salinity still averaged 20 $^{o}/oo$, averaged approximately 0.01 individuals m^{-2}. Also in contrast to the Columbia River Estuary, Dungeness crabs were abundant on tidal flats throughout much of Grays Harbor. This suggests that the freshwater dominance of most of the tidal flat habitats in the Columbia River Estuary also reduces the distribution and influence of Dungeness crab in these habitats.

Probably the strongest indication of the less-important role of Dungeness crab in the Columbia River Estuary compared to more saline estuaries is the complete lack of any crab larvae in the extensive pelagic zooplankton collections conducted by Haertel and Osterberg (1967) and by CREDDP during the same period (English 1984). In contrast, both Armstrong et al. (1981) and Simenstad and Eggers (1981) reported high densities of C. magister megalopae as far as 20 km landward from the mouth of Grays Harbor during the month of April.

4.3 FOOD WEB RELATIONSHIPS

Although we have no direct evidence, standing stock distributions of epibenthic zooplankton would suggest that the null zone region of the estuarine mixing zone is a locale of entrainment and concentration of detritus particles which supports zooplankters in the benthic boundary layer. Whether allochthonous organic matter, phytoplankton cells which have sunk from the water column, or benthic diatom cells which have been swept off the tidal flats, this detritus resource may be retained within the null zone for time periods longer than the expected flushing time of the estuary as a whole.

The high standing stock of epibenthic zooplankton assemblages on tidal flats in the estuarine mixing zone also suggests that either: (1) detrital particles are advected laterally along the benthic boundary layer from the sublittoral channel habitat; (2) the rate of particle deposition from surface waters over tidal flats (sinking?) is also high; and/or, (3) benthic primary production is enhanced in the intertidal flat habitat in this region. Unfortunately, there are few or no data to elucidate these questions.

Whatever the sources of and factors producing enhanced production of epibenthic zooplankton in the estuarine mixing zone, motile macroinvertebrates and other secondary consumers utilize these assemblages extensively (Figure 18). It is probable that, in addition to physiologically-defined salinity tolerances, the distribution and standing stock of Crangon are strongly influenced by the dynamics of their epibenthic zooplankton prey resources.

4.4 ESTUARINE PRODUCTION OF EPIBENTHIC ZOOPLANKTON AND MOTILE MACROINVERTEBRATES

Direct, accurate estimation of production (biomass or carbon generated per unit ot time) of crustaceans requires complicated cohort analyses and number of rigid assumptions (such as insignificant immigration and emigration from a unit population) (Winberg 1971). The CREDDP sampling design for epibenthic zooplankton and motile macroinvertebrates did not permit this approach, in part due to the low sampling frequency and the tremendous flux of organisms into, out of, and throughout the estuary. For the sake of comparisons, however, first order approximations can be generated using production/biomass (P/B) ratios from the literature for the same or similar faunal assemblages. Based upon the combined meiofauna and small macrofauna composition of the epibenthic zooplankton assemblages, an annual P/B ratio of 9.0 was adopted (McIntyre 1969; Conover 1974; Sibert 1979); an annual P/B ratio of 8.0 was adopted for motile macroinvertebrates based on Kuipers and Dapper (1981).

Calculating production by apportioning the P/B ratio by standing crop estimates over the monthly and quarterly sampling intervals, it was estimated that epibenthic zooplankton in the estuary produce approximately 64.7 mt C yr^{-1} and motile macroinvertebrates produce 22.0 mt C yr^{-1}. For the epibenthic zooplankton, approximately 39% of the production occurred in tidal flats, 36% in demersal slope, and 25% in channel

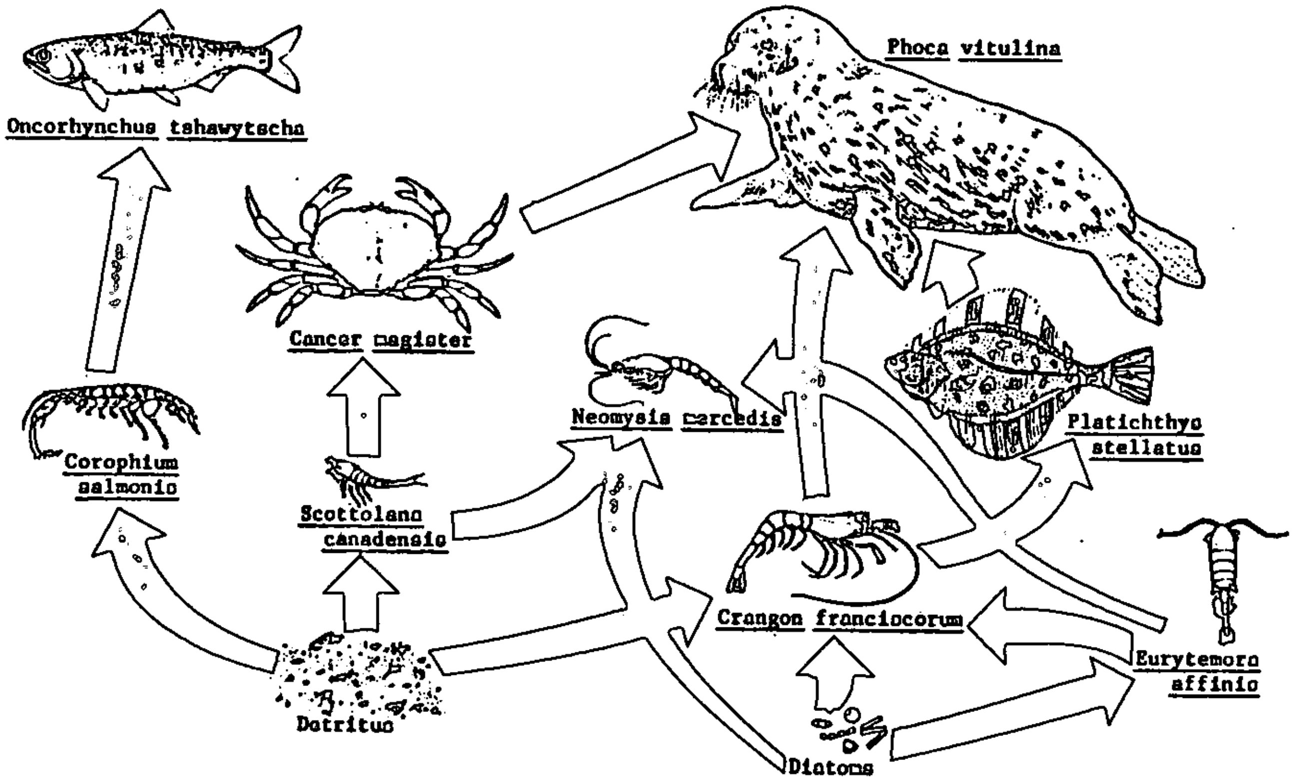

Figure 18. Qualitative food web relationships involving epibenthic zooplankton and motile macroinvertebrates in the Columbia River Estuary.

bottom habitats. Only 20% of the motile macroinvertebrate production occurred on tidal flats, while 41% and 39% occurred in demersal slope and channel bottom habitats, respectively.

5. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, epibenthic zooplankton in the Columbia River Estuary are spatially and seasonally structured by circulation, salinity intrusion, and null zone processes while motile macroinvertebrate assemblages appear to be structured by salinity intrusion and the distribution of their principal prey resources, the epibenthic zooplankters. In addition, the overlying effect of fish and marine mammal predators upon the motile macroinvertebrates undoubtedly influences the ultimate production of these epifauna.

Most of our conclusions regarding factors influencing the structure, distribution, and standing stock of epibenthic organisms in the Columbia River Estuary, however, are based upon conjecture or, at best, weak data sets. For example, despite the potentially important role of detritus in supporting the standing stock of epibenthic zooplankton in the estuary, we know little of the sources of detritus input into the estuary or of the processes which make it available to epifauna. Undoubtedly, the historic changes in river hydrology as it affects estuarine circulation and primary production have altered both the sources and fates of detritus in the estuary. Similarly, changes in wetland (i.e. swamp and marsh) habitat over the past century have probably altered the composition and magnitude of endogenous detritus production. Until we have a better understanding of the functional relationships between the detritus resource and detritivores such as epibenthic zooplankton we will be limited in our ability to predict or evaluate further changes in the estuarine ecosystem. Considerably more research needs to be focused upon the sources, flow, and fate of organic detritus within the estuary and upon the heterotrophic food web processes which are based upon it.

However, epibenthic zooplankton in the Columbia River Estuary have been classified as detritivores simply on the basis of information from the scientific literature. Such information is often of questionable applicability to the Columbia River estuarine ecosystem, especially given the differences between that system and those which have been studied. More direct, specific research is needed on the actual food resources utilized by the principal endemic zooplankters. The extent of utilization of heterotrophic versus autotrophic food resources determines to a great extent the potential impact of any modification of circulation or estuarine habitats.

Although circulation processes characterizing the turbidity maximum have certainly been one important aspect of the CREDDP Circulation, Sedimentation, and Simulation work units results, we still are relatively limited in our understanding of the spatial and temporal dynamics of the null zone. This is particularly true because most of our information on circulation, including velocities, salinities, and mixing, typically originate from measurements obtained above (i.e. >1 m) the benthic boundary layer. More detailed, finer resolution research is needed to better define actual laminar flow regimes, transport, and mixing characteristics of this "very-near" bottom layer of the turbidity maximum region of the estuary.

Our research on epifauna has also been basically descriptive with interpretations of functional mechanisms based upon correlations among observed patterns of distribution and standing stock and other physical and biological characteristics. More mechanistic studies of the factors influencing relative availability of epibenthic zooplankton to sampling are needed. Much of the variation inherent in our data probably originated from finer scale cycles (e.g. diel, tidal) which could not be included in our sampling design. These factors, which may be important to either active or passive movements of epifauna, need to be further investigated in order to place the existing CREDDP data in context as well as to further elucidate the mechanisms which influence epifauna distribution.

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APPENDIX A. Institutional Acronyms

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CREDDP	Columbia River Estuary Data Development Program; Astoria, OR
CREST	Columbia River Estuary Study Taskforce, Astoria, OR
FRI	Fisheries Research Institute; College of Ocean and Fishery Sciences, University of Washington, Seattle, WA
NMFS	National Marine Fisheries Service; Hammond Lab and Northwest and Alaska Fisheries Center, Seattle, WA
NODC	National Oceanographic Data Center; Environmental Data Service, National Oceanic and Atmospheric Administration, Washington, D.C.
OSU	Oregon State University; Corvallis, OR
PNRBC	Pacific Northwest River Basins Commission
UW	University of Washington; Seattle, WA

APPENDIX B. Summary of CREDDP epibenthic collections by 0.1-m^2 epibenthic suction pump and 0.5-m epibenthic sled in the Columbia River Estuary, March 1980 - July 1981.

Epibenthic Pump Collections

GRAND SUMMARY

FROM COLLECTIONS:

FILEID	STATION	SAMPLE
80MR25	14001	E 1
80MR25	14001	E 2
80MR25	14003	E 1
80MR25	14003	E 2
80MR25	14004	E 1
80MR25	14004	E 2
80MR25	14006	E 1
80MR25	14006	E 2
80MR26	14007	E 1
80MR26	14007	E 2
80MR26	14010	E 1
80MR26	14010	E 2
80MR26	14011	E 1
80MR26	14011	E 2
80MR26	14012	E 1
80MR26	14012	E 2
80MR26	14013	E 1
80MR26	14013	E 2
80AP22	14001	E 1
80AP22	14001	E 2
80AP22	14003	E 1
80AP22	14003	E 2
80AP23	14004	E 1
80AP23	14004	E 2
80AP23	14006	E 1
80AP23	14006	E 2
80AP22	14007	E 1
80AP22	14007	E 2
80AP21	14010	E 1
80AP21	14010	E 2
80AP21	14011	E 1
80AP21	14011	E 2
80AP21	14012	E 1
80AP21	14012	E 2
80AP23	14013	E 1
80AP23	14013	E 2
80AP23	14015	E 1
80AP23	14015	E 2
80MY16	14001	E 1
80MY16	14001	E 2
80MY16	14003	E 1
80MY16	14003	E 2
80MY16	14004	E 1
80MY16	14004	E 2
80MY16	14006	E 1
80MY16	14006	E 2
80MY16	14007	E 1
80MY16	14007	E 2
80MY17	14010	E 1
80MY17	14010	E 2

EPIBENTHIC PLANKTON ANALYSIS
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SITE TABLE, PAGE 2

FROM COLLECTIONS:

FILEID	STATION	SAMPLE
80MY16	14011	E 1
80MY16	14011	E 2
80MY17	14012	E 1
80MY17	14012	E 2
80MY17	14013	E 1
80MY17	14013	E 2
80MY17	14015	E 1
80MY17	14015	E 2
80JN21	14001	E 1
80JN21	14001	E 2
80JN21	14003	E 1
80JN21	14003	E 2
80JN21	14004	E 1
0JN21	14004	E 1
80JN21	14004	E 1
80JN21	14004	E 2
80JN24	14006	E 1
80JN24	14006	E 2
80JN24	14007	E 1
80JN24	14007	E 2
80JN22	14010	E 1
80JN22	14010	E 2
80JN22	14011	E 1
80JN22	14011	E 2
80JN22	14012	E 1
80JN22	14012	E 2
80JN22	14013	E 1
80JN22	14013	E 2
80JN22	14014	E 1
80JN22	14014	E 2
80JN22	14015	E 1
80JN22	14015	E 2
80JY13	14001	E 1
80JY13	14001	E 2
80JY13	14003	E 1
80JY13	14003	E 2
80JY13	14004	E 1
80JY13	14004	E 2
80JY12	14006	E 1
80JY12	14006	E 2
80JY13	14007	E 1
80JY13	14007	E 2
80JY12	14010	E 1
80JY12	14010	E 2
80JY12	14011	E 1
80JY12	14011	E 2
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80JY12	14012	E 2
80JY12	14013	E 1
80JY12	14013	E 2
80JY12	14014	E 1
80JY12	14014	E 2
80JY12	14015	E 1
80JY12	14015	E 2

EPIBENTHIC PLANKTON ANALYSIS
****

FROM COLLECTIONS:

FIELD ID	STATION	SAMPLE
80AU16	14001	E 1
80AU16	14001	E 2
80AU16	14003	E 1
80AU16	14003	E 2
80AU17	14004	E 1
80AU17	14004	E 2
80AU17	14006	E 1
80AU17	14006	E 2
80AU16	14007	E 1
80AU16	14007	E 2
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80AU16	14013	E 1
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80AU18	14014	E 1
80AU18	14014	E 2
80AU16	14015	E 1
80AU16	14015	E 2
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80OC17	14001	E 2
80OC17	14003	E 1
80OC17	14003	E 2
80OC18	14004	E 1
80OC18	14004	E 2
80OC17	14006	E 1
80OC17	14006	E 2
80OC17	14007	E 1
80OC17	14007	E 2
80OC18	14010	E 1
80OC18	14010	E 2
80OC17	14011	E 1
80OC17	14011	E 2
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80OC17	14012	E 2
80OC17	14013	E 1
80OC17	14013	E 2
80OC18	14014	E 1
80OC18	14014	E 2
80OC17	14015	E 1
80OC17	14015	E 2
81JA27	14001	E 1
81JA27	14001	E 2
81JA27	14003	E 1
81JA27	14003	E 2
81JA28	14004	E 1
81JA28	14004	E 2
81JA28	14006	E 1
81JA28	14006	E 2
81JA28	14007	E 1
81JA28	14007	E 2

EPIBENTHIC PLANKTON ANALYSIS
****

FROM COLLECTIONS:

FILEID	STATION	SAMPLE
81JA28	14010	E 1
81JA28	14010	E 2
81JA27	14011	E 1
81JA27	14011	E 2
81JA27	14012	E 1
81JA27	14012	E 2
81JA27	14013	E 1
81JA27	14013	E 2
81JA28	14014	E 1
81JA28	14014	E 2
81JA28	14015	E 1
81JA28	14015	E 2
81AP14	14001	E 1
81AP14	14001	E 2
81AP14	14003	E 1
81AP14	14000	E 1
81AP14	14003	E 2
81AP14	14004	E 1
81AP14	14004	E 2
81AP14	14007	E 1
81AP14	14007	E 2
81AP14	14010	E 1
81AP14	14010	E 2
81AP14	14013	E 1
81AP14	14013	E 2
81AP14	14014	E 1
81AP14	14014	E 2
81JY14	14003	E 1
81JY14	14003	E 2
81JY14	14001	E 1
81JY14	14001	E 2
81JY14	14004	E 1
81JY14	14004	E 2
81JY14	14007	E 1
81JY14	14007	E 2
81JY14	14010	E 1
81JY14	14010	E 2
81JY14	14013	E 1
81JY14	14013	E 2
81JY14	14014	E 1
81JY14	14014	E 2

SPECIES DEFINITION -
TRUNCATED = NO
LH-STAGE = COMPLETE
PARTS CODE UNALTERED

ABUNDANCES AND WEIGHTS ARE ADJUSTED TO A VOLUME OF 1.0 CUBIC METERS

Epibenthic Sled Collections

EPIBENTHIC PLANKTON ANALYSIS
****

	MEAN	RANGE	S.D.	COEF.VAR
SAMPLE VOLUME (M**3)	.03	.03- .03	.04	1.52
TOTAL WET WEIGHT (PER M**3)	.796	.012- 26.924	2.267	2.848
TOTAL ABUNDANCE (PER M**3)	89696.58	120.00- * .19E+07	231967.77	2.59
SAMPLE WET WEIGHT (PER M**3)	.574	0- 16.080	1.419	2.469
SAMPLE DRY WEIGHT (PER M**3)	0	0- 0	0	0

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUN-DANCE	BIO-MASS
HYDROIDA	0-POLYP	160.0	.8	160.0 - 160.0	11.3	.004	.000	.004- .004	.00	.0000	0	.00	.00
TURBELLARIA	1-EGG	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
TURBELLARIA	8-ADULT	1360.0	6.8	40.0 - 840.0	68.5	.048	.000	.004- .040	.00	.0001	.0000	.01	.03
TURBELLARIA	C-J/A NOSEX	25286.7	127.1	40.0 - 2500.0	357.5	1.622	.008	.004- .280	.03	.0001	.0002	.14	1.02
TURBELLARIA	L-EGG-C FEM	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
TREMATODA	C-J/A NOSEX	200.0	1.0	200.0 - 200.0	14.2	.004	.000	.004- .004	.00	.0000	0	.00	.00
ROTIFERA	8-ADULT	274026.7	1377.0	40.0 - 48000.0	5481.7	3.271	.016	.004- 1.600	.12	.0000	.0000	1.54	2.07
ROTIFERA	A-JUV+ADULT	13920.0	69.9	1920.0 - 12000.0	860.8	.108	.001	.008- .100	.01	.0000	.0000	.08	.07
ROTIFERA	C-J/A NOSEX	27933.3	140.4	40.0 - 10880.0	869.9	.234	.001	.004- .040	.00	.0000	.0000	.16	.15
NEMATODA	8-ADULT	25600.0	128.6	40.0 - 6040.0	727.8	.176	.001	.004- .044	.00	.0000	.0000	.14	.11
NEMATODA	9-LR+JV+AD	320.0	1.6	320.0 - 320.0	22.7	.004	.000	.004- .004	.00	.0000	0	.00	.00
NEMATODA	A-JUV+ADULT	182360.0	916.4	880.0 - 92800.0	8850.4	.426	.002	.004- .250	.02	.0000	.0000	1.02	.27
NEMATODA	C-J/A NOSEX	* .1E+07	6924.8	40.0 - 144360.0	19884.7	7.046	.035	.004- 1.604	.13	.0000	.0000	7.72	4.45
NEMATOMORPHA	8-ADULT	69960.0	351.6	160.0 - 11840.0	1393.6	.497	.002	.004- .067	.01	.0000	.0000	.39	.31
NEMATOMORPHA	C-J/A NOSEX	400.0	2.0	160.0 - 240.0	20.4	.024	.000	.008- .016	.00	.0001	.0000	.00	.02
POLYCHAETA	6-LARVA	840.0	4.2	40.0 - 320.0	28.8	.052	.000	.004- .016	.00	.0001	.0000	.00	.03
POLYCHAETA	7-JUVENILE	3386.7	17.0	40.0 - 2000.0	155.5	.135	.001	.004- .067	.01	.0001	.0000	.02	.09
POLYCHAETA	C-J/A NOSEX	120.0	.6	40.0 - 40.0	6.3	.006	.000	.004- .004	.00	.0001	.0000	.00	.01

EPIBENTHIC PLANKTON ANALYSIS
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SUMMARY TABLE, PAGE 4

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUN-DANCE	BIO-MASS
POLYNOIDAE	6-LARVA	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00
PHYLLODOCIDAE	7-JUVENILE	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004-.004	.00	.0001	0	.00	.01
NEANTHES LIMNICOLA	C-J/A NOSEX	400.0	2.0	400.0 - 400.0	28.4	.400	.002	.400-.400	.03	.0010	0	.00	.25
SPIONIDAE	6-LARVA	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004-.004	.00	.0001	0	.00	.00
SPIONIDAE	7-JUVENILE	1160.0	5.8	40.0 - 1000.0	71.4	.108	.001	.004-.100	.01	.0001	.0000	.01	.07
SPIONIDAE	C-J/A NOSEX	573.3	2.9	40.0 - 213.3	21.0	.033	.000	.004-.016	.00	.0001	.0000	.00	.02
CIRRATULIDAE	7-JUVENILE	666.7	3.4	666.7 - 666.7	47.3	.067	.000	.067-.067	.00	.0001	0	.00	.04
CIRRATULIDAE	C-J/A NOSEX	17906.7	90.0	7240.0 - 10666.7	911.7	.147	.001	.067-.080	.01	.0000	.0000	.10	.09
AMPHARETIDAE	7-JUVENILE	7648.9	38.4	40.0 - 1333.3	189.5	.430	.002	.004-.105	.01	.0001	.0000	.04	.27
AMPHARETIDAE	C-J/A NOSEX	34920.0	175.5	40.0 - 32080.0	2275.3	1.768	.009	.004-1.604	.11	.0001	.0000	.20	1.12
HOBSONIA FLORIDA	7-JUVENILE	520.0	2.6	160.0 - 360.0	27.9	.012	.000	.004-.008	.00	.0000	.0000	.00	.01
HOBSONIA FLORIDA	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.040	.000	.040-.040	.00	.0010	0	.00	.03
HOBSONIA FLORIDA	C-J/A NOSEX	240.0	1.2	40.0 - 200.0	14.4	.008	.000	.004-.004	.00	.0001	.0001	.00	.01
SABELLIDAE	C-J/A NOSEX	1213.3	6.1	40.0 - 1013.3	72.7	.013	.000	.004-.005	.00	.0000	.0000	.01	.01
MANAYUNKIA SP.	C-J/A NOSEX	93.3	.5	93.3 - 93.3	6.6	.009	.000	.009-.009	.00	.0001	0	.00	.01
OLIGOCHAETA	6-LARVA	1200.0	6.0	1200.0 - 1200.0	85.1	.004	.000	.004-.004	.00	.0000	0	.01	.00
OLIGOCHAETA	7-JUVENILE	2960.0	14.9	40.0 - 2000.0	149.2	.056	.000	.004-.008	.00	.0001	.0000	.02	.04
OLIGOCHAETA	8-ADULT	408.0	2.1	40.0 - 160.0	13.3	.374	.002	.002-.280	.02	.0012	.0026	.00	.24
OLIGOCHAETA	9-LR+JV+AD	160.0	.8	80.0 - 80.0	8.0	.008	.000	.004-.004	.00	.0001	0	.00	.01
OLIGOCHAETA	A-JUV+ADULT	87440.0	439.4	240.0 - 86400.0	6124.6	.808	.004	.004-.800	.06	.0000	.0000	.49	.51
OLIGOCHAETA	C-J/A NOSEX	421076.7	2116.0	40.0 - 68666.7	6388.7	6.453	.032	.004-1.604	.15	.0000	.0000	2.36	4.07
HIRUDINEA	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.040	.000	.040-.040	.00	.0010	0	.00	.03
GASTROPODA	7-JUVENILE	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004-.004	.00	.0001	0	.00	.01
MESOGASTROPODA	7-JUVENILE	80.0	.4	80.0 - 80.0	5.7	.008	.000	.008-.008	.00	.0001	0	.00	.01
GONIOBASIS PLICIFERA	7-JUVENILE	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00

EPIBENTHIC PLANKTON ANALYSIS
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SUMMARY TABLE, PAGE 7

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
THECOSOMATA	7-JUVENILE	1120.0	5.6	1120.0 - 1120.0	79.4	.016	.000	.016- .016	.00	.0000	0	.01	.01
BIVALVIA	6-LARVA	10106.7	50.8	40.0 - 3200.0	294.6	.433	.002	.004- .100	.01	.0001	.0000	.06	.27
BIVALVIA	7-JUVENILE	88178.7	443.1	32.0 - 32200.0	2457.3	3.604	.018	.002- 1.604	.12	.0001	.0002	.49	2.28
BIVALVIA	C-J/A NOSEX	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
VENEROIDA	7-JUVENILE	1440.0	7.2	40.0 - 1040.0	77.9	.164	.001	.004- .080	.01	.0001	.0001	.01	.10
CORBICULA SP.	7-JUVENILE	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
CORBICULA MANILENSIS (FLUMINEA	7-JUVENILE	120.0	.6	40.0 - 80.0	6.3	.008	.000	.004- .004	.00	.0001	.0000	.00	.01
ACARINA	7-JUVENILE	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
ACARINA	8-ADULT	1100.0	5.5	40.0 - 500.0	42.7	.094	.000	.004- .050	.00	.0001	.0000	.01	.06
ACARINA	C-J/A NOSEX	2440.0	12.3	40.0 - 880.0	74.8	.064	.000	.004- .016	.00	.0000	.0000	.01	.04
ACARINA HYDRACARINA PROSTIGMAT	8-ADULT	120.0	.6	40.0 - 40.0	4.9	.012	.000	.004- .004	.00	.0001	0	.00	.01
ACARINA HYDRACARINA PROSTIGMAT	C-J/A NOSEX	320.0	1.6	40.0 - 120.0	11.3	.028	.000	.004- .008	.00	.0001	.0000	.00	.02
CRUSTACEA	1-EGG	520.0	2.6	520.0 - 520.0	36.9	.012	.000	.012- .012	.00	.0000	0	.00	.01
CLADOCERA	1-EGG	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CLADOCERA	C-J/A NOSEX	200.0	1.0	40.0 - 160.0	11.7	.020	.000	.004- .016	.00	.0001	0	.00	.01
CLADOCERA-EUCLADOCERA	7-JUVENILE	160.0	.8	160.0 - 160.0	11.3	.016	.000	.016- .016	.00	.0001	0	.00	.01
DIAPHANOSOMA BRACHYURUM	7-JUVENILE	213.3	1.1	53.3 - 80.0	8.8	.021	.000	.005- .008	.00	.0001	.0000	.00	.01
DIAPHANOSOMA BRACHYURUM	8-ADULT	120.0	.6	40.0 - 40.0	4.9	.012	.000	.004- .004	.00	.0001	0	.00	.01
DIAPHANOSOMA BRACHYURUM	C-J/A NOSEX	1760.0	8.8	40.0 - 666.7	52.7	.148	.001	.004- .067	.00	.0001	.0000	.01	.09
SIDA CRYSTALLINA	7-JUVENILE	80.0	.4	80.0 - 80.0	5.7	.008	.000	.008- .008	.00	.0001	0	.00	.01
SIDA CRYSTALLINA	8-ADULT	136.0	.7	16.0 - 40.0	5.0	.014	.000	.002- .004	.00	.0001	0	.00	.01
DAPHNIA SP.	7-JUVENILE	59280.0	297.9	40.0 - 8080.0	1067.1	.841	.004	.004- .104	.01	.0001	.0000	.33	.53
DAPHNIA SP.	8-ADULT	760.0	3.8	40.0 - 280.0	27.1	.048	.000	.004- .020	.00	.0001	.0000	.00	.03
DAPHNIA SP.	A-JUV+ADULT	560.0	2.8	80.0 - 480.0	34.5	.008	.000	.004- .004	.00	.0000	.0000	.00	.01
DAPHNIA SP.	C-J/A NOSEX	3328.0	16.7	40.0 - 280.0	44.9	.170	.001	.002- .016	.00	.0001	.0000	.02	.11

EPIBENTHIC PLANKTON ANALYSIS
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ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUN-DANCE	BIO-MASS
DAPHNIA SP.	L-EGG-C FEM	240.0	1.2	40.0 - 160.0	12.0	.024	.000	.004- .016	.00	.0001	0	.00	.02
DAPHNIA PULEX	8-ADULT	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
DAPHNIA PULEX	C-J/A NOSEX	120.0	.6	40.0 - 40.0	4.9	.012	.000	.004- .004	.00	.0001	0	.00	.01
DAPHNIA ROSEA	7-JUVENILE	13520.0	67.9	40.0 - 4000.0	389.7	.164	.001	.004- .067	.01	.0000	.0000	.08	.10
DAPHNIA ROSEA	8-ADULT	1480.0	7.4	40.0 - 320.0	35.3	.068	.000	.004- .016	.00	.0001	.0000	.01	.04
DAPHNIA ROSEA	A-JUV+ADULT	2760.0	13.9	200.0 - 1120.0	107.9	.020	.000	.004- .008	.00	.0000	.0000	.02	.01
DAPHNIA ROSEA	C-J/A NOSEX	5986.7	30.1	40.0 - 1280.0	141.3	.109	.001	.004- .016	.00	.0000	.0000	.03	.07
DAPHNIA ROSEA	L-EGG-C FEM	200.0	1.0	40.0 - 160.0	11.7	.020	.000	.004- .016	.00	.0001	0	.00	.01
DAPHNIA GALEATA	7-JUVENILE	4026.7	20.2	40.0 - 640.0	88.1	.083	.000	.004- .013	.00	.0000	.0000	.02	.05
DAPHNIA GALEATA	8-ADULT	520.0	2.6	40.0 - 160.0	14.5	.048	.000	.004- .016	.00	.0001	.0000	.00	.03
DAPHNIA GALEATA	A-JUV+ADULT	2680.0	13.5	440.0 - 640.0	85.2	.024	.000	.004- .008	.00	.0000	.0000	.02	.02
DAPHNIA GALEATA	C-J/A NOSEX	9400.0	47.2	40.0 - 1280.0	172.3	.200	.001	.004- .032	.00	.0000	.0000	.05	.13
DAPHNIA GALEATA	L-EGG-C FEM	200.0	1.0	40.0 - 160.0	11.7	.008	.000	.004- .004	.00	.0001	.0001	.00	.01
DAPHNIA RETROCURVA	7-JUVENILE	16760.0	84.2	40.0 - 3920.0	439.1	.279	.001	.004- .067	.01	.0000	.0000	.09	.18
DAPHNIA RETROCURVA	8-ADULT	640.0	3.2	40.0 - 120.0	16.3	.040	.000	.004- .008	.00	.0001	.0000	.00	.03
DAPHNIA RETROCURVA	A-JUV+ADULT	160.0	.8	160.0 - 160.0	11.3	.004	.000	.004- .004	.00	.0000	0	.00	.00
DAPHNIA RETROCURVA	C-J/A NOSEX	6200.0	31.2	40.0 - 4240.0	304.4	.136	.001	.004- .080	.01	.0000	.0000	.03	.09
DAPHNIA PARVULA	8-ADULT	120.0	.6	40.0 - 80.0	6.3	.008	.000	.004- .004	.00	.0001	.0000	.00	.01
DAPHNIA PARVULA	C-J/A NOSEX	120.0	.6	40.0 - 40.0	4.9	.012	.000	.004- .004	.00	.0001	0	.00	.01
ILYOCRYPTUS SP.	7-JUVENILE	480.0	2.4	40.0 - 160.0	14.9	.040	.000	.004- .016	.00	.0001	.0000	.00	.03
ILYOCRYPTUS SP.	8-ADULT	2320.0	11.7	40.0 - 1280.0	108.4	.052	.000	.004- .020	.00	.0001	.0000	.01	.03
ILYOCRYPTUS SP.	A-JUV+ADULT	3200.0	16.1	1560.0 - 1640.0	160.0	.080	.000	.040- .040	.00	.0000	.0000	.02	.05
ILYOCRYPTUS SP.	C-J/A NOSEX	1000.0	5.0	40.0 - 400.0	35.5	.100	.001	.004- .040	.00	.0001	0	.01	.06
ILYOCRYPTUS SP.	L-EGG-C FEM	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CERIODAPHNIA SP.	7-JUVENILE	2186.7	11.0	40.0 - 480.0	58.8	.133	.001	.004- .044	.00	.0001	.0000	.01	.08

EPIBENTHIC PLANKTON ANALYSIS
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SUMMARY TABLE, PAGE 9

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUN-DANCE	BIO-MASS
CERIODAPHNIA SP.	8-ADULT	280.0	1.4	40.0 - 160.0	13.0	.012	.000	.004- .004	.00	.0001	.0000	.00	.01
CERIODAPHNIA SP.	C-J/A NOSEX	1640.0	6.2	40.0 - 520.0	55.9	.036	.000	.004- .016	.00	.0000	.0000	.01	.02
CERIODAPHNIA SP.	L-EGG-C FEM	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
CERIODAPHNIA RETICULATA	7-JUVENILE	520.0	2.6	40.0 - 160.0	18.5	.036	.000	.004- .016	.00	.0001	.0000	.00	.02
CERIODAPHNIA RETICULATA	8-ADULT	960.0	4.8	40.0 - 240.0	26.5	.040	.000	.004- .008	.00	.0001	.0000	.01	.03
CERIODAPHNIA RETICULATA	A-JUV+ADULT	240.0	1.2	240.0 - 240.0	17.0	.004	.000	.004- .004	.00	.0000	0	.00	.00
CERIODAPHNIA RETICULATA	C-J/A NOSEX	786.7	4.0	40.0 - 240.0	21.8	.047	.000	.004- .008	.00	.0001	.0000	.00	.03
CERIODAPHNIA RETICULATA	L-EGG-C FEM	120.0	.6	40.0 - 40.0	4.9	.012	.000	.004- .004	.00	.0001	0	.00	.01
CERIODAPHNIA QUADRANGULA	7-JUVENILE	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CERIODAPHNIA QUADRANGULA	8-ADULT	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
SCAPHOLEBERIS MUCRONATA	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
SCAPHOLEBERIS MUCRONATA	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
BOSMINA SP.	6-LARVA	200.0	1.0	200.0 - 200.0	14.2	.004	.000	.004- .004	.00	.0000	0	.00	.00
BOSMINA SP.	7-JUVENILE	11920.0	59.9	40.0 - 3040.0	374.8	.144	.001	.004- .020	.00	.0000	.0000	.07	.09
BOSMINA SP.	8-ADULT	74290.0	373.3	40.0 - 5000.0	825.7	1.596	.008	.004- .400	.03	.0000	.0000	.42	1.01
BOSMINA SP.	A-JUV+ADULT	222640.0	1119.8	80.0 - 17920.0	2666.1	.981	.005	.004- .160	.02	.0000	.0000	1.25	.62
BOSMINA SP.	C-J/A NOSEX	33600.0	168.8	40.0 - 16000.0	1182.6	2.230	.011	.004- 1.600	.11	.0001	.0000	.19	1.41
BOSMINA SP.	L-EGG-C FEM	56472.0	283.8	40.0 - 3200.0	501.1	1.611	.008	.004- .200	.02	.0000	.0000	.32	1.02
BOSMINA LONGIROSTRIS	7-JUVENILE	360.0	1.6	360.0 - 360.0	25.5	.004	.000	.004- .004	.00	.0000	0	.00	.00
BOSMINA LONGIROSTRIS	8-ADULT	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004- .004	.00	.0001	0	.00	.00
BOSMINA LONGIROSTRIS	L-EGG-C FEM	200.0	1.0	200.0 - 200.0	14.2	.004	.000	.004- .004	.00	.0000	0	.00	.00
EVADNE NORDMANNI	8-ADULT	1040.0	5.2	40.0 - 960.0	68.1	.024	.000	.004- .016	.00	.0001	.0000	.01	.02
PODON SP.	7-JUVENILE	80.0	.4	80.0 - 80.0	5.7	.008	.000	.008- .008	.00	.0001	0	.00	.01
PODON SP.	L-EGG-C FEM	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
PODON POLYPHALMOIDES	L-EGG-C FEM	.0	.0	.0 - .0	.0	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	NUMBERS/M**3 MEAN	NUMBERS/M**3 RANGE	NUMBERS/M**3 S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	WET WEIGHT,GRAMS/M**3 MEAN	WET WEIGHT,GRAMS/M**3 RANGE	WET WEIGHT,GRAMS/M**3 S.D.	AVG. BIOMASS MEAN	AVG. BIOMASS S.D.	PERCENTAGES ABUN-DANCE	PERCENTAGES BIO-MASS
CHYDORIDAE	7-JUVENILE	400.0	2.0	40.0 - 120.0	13.2	.024	.000	.004- .008	.00	.0001	.0000	.00	.02
CHYDORIDAE	8-ADULT	160.0	.8	40.0 - 80.0	6.9	.016	.000	.004- .008	.00	.0001	0	.00	.01
CHYDORIDAE	C-J/A NOSEX	2560.0	12.9	40.0 - 640.0	64.5	.196	.001	.004- .064	.01	.0001	.0000	.01	.12
CHYDORIDAE	L-EGG-C FEM	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
ALONA SP.	7-JUVENILE	1160.0	5.8	120.0 - 1040.0	74.2	.008	.000	.004- .004	.00	.0000	.0000	.01	.01
ALONA SP.	8-ADULT	6086.7	30.6	40.0 - 2440.0	206.1	.251	.001	.004- .080	.01	.0001	.0000	.03	.16
ALONA SP.	A-JUV+ADULT	120.0	.6	120.0 - 120.0	8.5	.004	.000	.004- .004	.00	.0000	0	.00	.00
ALONA SP.	C-J/A NOSEX	6453.3	32.4	40.0 - 1066.7	169.1	.296	.001	.004- .067	.01	.0001	.0000	.04	.19
ALONA SP.	L-EGG-C FEM	1000.0	5.0	40.0 - 640.0	47.7	.024	.000	.004- .004	.00	.0001	.0000	.01	.02
ALONA GUTTATA	8-ADULT	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004- .004	.00	.0001	0	.00	.00
ALONA GUTTATA	L-EGG-C FEM	160.0	.8	160.0 - 160.0	11.3	.016	.000	.016- .016	.00	.0001	0	.00	.01
ALONA RUSTICA	8-ADULT	2560.0	12.9	40.0 - 1760.0	128.7	.060	.000	.004- .016	.00	.0001	.0000	.01	.04
ALONA RUSTICA	A-JUV+ADULT	10560.0	53.1	3520.0 - 7040.0	556.8	.080	.000	.016- .064	.00	.0000	.0000	.06	.05
ALONA RUSTICA	C-J/A NOSEX	600.0	3.0	40.0 - 480.0	34.3	.028	.000	.004- .016	.00	.0001	.0000	.00	.02
ALONA RUSTICA	L-EGG-C FEM	2560.0	12.9	1120.0 - 1440.0	129.0	.032	.000	.016- .016	.00	.0000	.0000	.01	.02
ALONA AFFINIS	8-ADULT	240.0	1.2	240.0 - 240.0	17.0	.004	.000	.004- .004	.00	.0000	0	.00	.00
ALONA AFFINIS	C-J/A NOSEX	640.0	3.2	640.0 - 640.0	45.4	.064	.000	.064- .064	.00	.0001	0	.00	.04
ALONA AFFINIS	L-EGG-C FEM	120.0	.6	120.0 - 120.0	8.5	.004	.000	.004- .004	.00	.0000	0	.00	.00
ALONA QUADRANGULARIS	8-ADULT	520.0	2.6	40.0 - 400.0	34.1	.020	.000	.004- .016	.00	.0001	.0000	.00	.01
ALONA QUADRANGULARIS	C-J/A NOSEX	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004- .004	.00	.0001	0	.00	.00
CHYDORUS SP.	7-JUVENILE	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CHYDORUS SP.	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CHYDORUS SP.	L-EGG-C FEM	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CHYDORUS SPHAERICUS	8-ADULT	5893.3	29.6	40.0 - 2000.0	159.2	.417	.002	.004- .200	.01	.0001	.0000	.03	.26
CHYDORUS SPHAERICUS	A-JUV+ADULT	200.0	1.0	200.0 - 200.0	14.2	.004	.000	.004- .004	.00	.0000	0	.00	.00

EPIBENTHIC PLANKTON ANALYSIS
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SUMMARY TABLE, PAGE 11

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	NUMBERS/M**3 MEAN	NUMBERS/M**3 RANGE	NUMBERS/M**3 S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	WET WEIGHT MEAN	WET WEIGHT RANGE	WET WEIGHT S.D.	AVG. BIOMASS MEAN	AVG. BIOMASS S.D.	PERCENTAGES ABUN-DANCE	PERCENTAGES BIO-MASS
CHYDORUS SPHAERICUS	C-J/A NOSEX	280.0	1.4	40.0 - 80.0	10.2	.016	.000	.004-.004	.00	.0001	.0000	.00	.01
CHYDORUS SPHAERICUS	L-EGG-C FEM	400.0	2.0	40.0 - 80.0	9.6	.036	.000	.004-.004	.00	.0001	.0000	.00	.02
LEYDIGIA SP.	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00
LEYDIGIA QUADRANGULARIS	8-ADULT	480.0	2.4	40.0 - 360.0	25.9	.032	.000	.004-.020	.00	.0001	.0000	.00	.02
LEYDIGIA QUADRANGULARIS	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00
PSEUDOCHYDORUS GLOBOSUS	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00
PSEUDOCHYDORUS GLOBOSUS	C-J/A NOSEX	200.0	1.0	40.0 - 160.0	11.7	.020	.000	.004-.016	.00	.0001	0	.00	.01
MONOSPILUS DISPAR	8-ADULT	240.0	1.2	40.0 - 200.0	14.4	.008	.000	.004-.004	.00	.0001	.0001	.00	.01
MONOSPILUS DISPAR	L-EGG-C FEM	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00
ALONELLA SP.	7-JUVENILE	80.0	.4	80.0 - 80.0	5.7	.008	.000	.008-.008	.00	.0001	0	.00	.01
ALONELLA SP.	8-ADULT	6880.0	34.6	40.0 - 4960.0	353.7	.060	.000	.004-.040	.00	.0000	.0000	.04	.04
ALONELLA SP.	A-JUV+ADULT	119520.0	600.6	3720.0 - 60800.0	5589.2	.328	.002	.004-.160	.02	.0000	.0000	.67	.21
ALONELLA SP.	L-EGG-C FEM	31840.0	160.0	40.0 - 15120.0	1481.0	.244	.001	.004-.168	.01	.0000	.0000	.18	.15
PLEUROXUS DENTICULATUS	8-ADULT	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004-.004	.00	.0001	0	.00	.00
CAMPTOCERCUS RECTIROSTRIS	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00
OSTRACODA	7-JUVENILE	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004-.004	.00	.0001	0	.00	.01
OSTRACODA	C-J/A NOSEX	560.0	2.8	40.0 - 520.0	37.0	.008	.000	.004-.004	.00	.0001	.0001	.00	.01
PODOCOPA	7-JUVENILE	105400.0	529.6	40.0 - 18240.0	1994.7	.728	.004	.004-.067	.01	.0000	.0000	.59	.46
PODOCOPA	8-ADULT	280.0	1.4	40.0 - 120.0	10.9	.020	.000	.004-.008	.00	.0001	.0000	.00	.01
PODOCOPA	A-JUV+ADULT	5120.0	25.7	5120.0 - 5120.0	362.9	.016	.000	.016-.016	.00	.0000	0	.03	.01
PODOCOPA	C-J/A NOSEX	2850.0	14.3	40.0 - 480.0	61.0	.121	.001	.004-.025	.00	.0001	.0000	.02	.08
PODOCOPA	L-EGG-C FEM	16.0	.1	16.0 - 16.0	1.1	.002	.000	.002-.002	.00	.0001	0	.00	.00
EUCYPRIS SP.	8-ADULT	2840.0	14.3	2840.0 - 2840.0	201.3	.320	.002	.320-.320	.02	.0001	0	.02	.20
EUCYPRIS SP.	C-J/A NOSEX	200.0	1.0	200.0 - 200.0	14.2	.004	.000	.004-.004	.00	.0000	0	.00	.00
CYPRIA SP.	8-ADULT	360.0	1.8	360.0 - 360.0	25.5	.012	.000	.012-.012	.00	.0000	0	.00	.01

EPIBENTHIC PLANKTON ANALYSIS

SUMMARY TABLE, PAGE 12

ORGANISM NAME	PARTS CODE / LH-STAGE	NUMBERS/M**3 TOTAL	NUMBERS/M**3 MEAN	NUMBERS/M**3 RANGE	NUMBERS/M**3 S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	WET WEIGHT MEAN	WET WEIGHT RANGE	WET WEIGHT S.D.	AVG. BIOMASS MEAN	AVG. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS
CYPRIA SP.	L-EGG-C FEM	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
DARWINULA STEVENSONI	8-ADULT	480.0	2.4	40.0 - 200.0	20.4	.016	.000	.004- .004	.00	.0001	.0000	.00	.01
LIMNOCYTHERE SP.	7-JUVENILE	16773.3	84.3	40.0 - 3333.3	429.0	.225	.001	.004- .100	.01	.0000	.0000	.09	.14
LIMNOCYTHERE SP.	8-ADULT	10896.0	54.8	40.0 - 3120.0	277.3	.274	.001	.002- .120	.01	.0000	.0000	.06	.17
LIMNOCYTHERE SP.	A-JUV+ADULT	389960.0	1959.6	320.0 - 217080.0	16433.1	2.446	.012	.004- .968	.08	.0000	.0000	2.18	1.55
LIMNOCYTHERE SP.	C-J/A NOSEX	32440.0	163.0	40.0 - 8320.0	918.4	.800	.004	.004- .400	.03	.0001	.0000	.18	.51
CANDONA SP.	7-JUVENILE	20520.0	103.1	40.0 - 16400.0	1176.2	1.672	.008	.004- 1.604	.11	.0000	.0000	.11	1.06
CANDONA SP.	8-ADULT	6200.0	31.2	40.0 - 1200.0	141.7	.396	.002	.004- .160	.01	.0001	.0000	.03	.25
CANDONA SP.	A-JUV+ADULT	8520.0	42.8	240.0 - 4760.0	237.3	.497	.002	.004- .120	.01	.0001	.0000	.05	.31
CANDONA SP.	C-J/A NOSEX	6760.0	34.0	40.0 - 2400.0	189.9	.284	.001	.004- .080	.01	.0001	.0001	.04	.18
COPEPODA	2-NAUPLIUS	* .3E+07	16907.9	40.0 - 890000.0	86246.7	6.163	.031	.004- 1.600	.12	.0000	.0000	18.85	3.69
COPEPODA	F-COPEPODID	16520.0	83.0	40.0 - 16480.0	1168.2	.020	.000	.004- .016	.00	.0001	.0001	.09	.01
COPEPODA	M-EGG CASE	1480.0	7.4	40.0 - 320.0	32.4	.088	.000	.004- .016	.00	.0001	.0000	.01	.06
CALANOIDA	2-NAUPLIUS	4520.0	22.7	80.0 - 2720.0	218.5	.032	.000	.004- .016	.00	.0000	.0000	.03	.02
CALANOIDA	C-J/A NOSEX	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
CALANOIDA	F-COPEPODID	668106.7	3357.3	40.0 - 206000.0	16762.4	4.377	.022	.004- 1.600	.12	.0000	.0000	3.74	2.76
PARACALANUS SP.	C-J/A NOSEX	120.0	.6	40.0 - 80.0	6.3	.008	.000	.004- .004	.00	.0001	.0000	.00	.01
CLAUSOCALANUS ARCUICORNIS	F-COPEPODID	320.0	1.6	320.0 - 320.0	22.7	.016	.000	.016- .016	.00	.0001	0	.00	.01
PSEUDOCALANUS SP.	8-ADULT	160.0	.8	160.0 - 160.0	11.3	.016	.000	.016- .016	.00	.0001	0	.00	.01
SCOLECITHRICELLA SP.	8-ADULT	1.6	.0	1.6 - 1.6	.1	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00
METRIDIA LUCENS	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CENTROPAGES SP.	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CENTROPAGES ABDOMINALIS	8-ADULT	120.0	.6	120.0 - 120.0	8.5	.008	.000	.008- .008	.00	.0001	0	.00	.01
CENTROPAGES ABDOMINALIS	F-COPEPODID	120.0	.6	40.0 - 80.0	6.3	.008	.000	.004- .004	.00	.0001	.0000	.00	.01
DIAPTOMUS SP.	8-ADULT	6933.3	34.8	40.0 - 760.0	112.2	.396	.002	.004- .067	.01	.0001	.0000	.04	.25

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
DIAPTOMUS SP.	A-JUV+ADULT	7200.0	36.2	160.0 - 1120.0	153.3	.146	.001	.004- .040	.00	.0000	.0000	.04	.09
DIAPTOMUS SP.	C-J/A NOSEX	640.0	3.2	40.0 - 480.0	35.1	.024	.000	.004- .016	.00	.0001	.0000	.00	.02
DIAPTOMUS SP.	F-COPEPODID	77676.0	390.3	40.0 - 8400.0	913.6	1.530	.008	.004- .200	.02	.0000	.0000	.44	.97
DIAPTOMUS FRANCISCANUS	B-ADULT	120.0	.6	40.0 - 80.0	6.3	.008	.000	.004- .004	.00	.0001	.0000	.00	.01
DIAPTOMUS ASHLANDI	B-ADULT	4106.7	20.6	40.0 - 640.0	110.5	.227	.001	.004- .067	.01	.0001	.0000	.02	.14
DIAPTOMUS ASHLANDI	A-JUV+ADULT	2440.0	12.3	2440.0 - 2440.0	173.0	.040	.000	.040- .040	.00	.0000	0	.01	.03
EPISCHURA NEVADENSIS	B-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
EURYTEMORA SP.	7-JUVENILE	600.0	3.0	600.0 - 600.0	42.5	.040	.000	.040- .040	.00	.0001	0	.00	.03
EURYTEMORA SP.	B-ADULT	2200.0	11.1	40.0 - 1120.0	95.0	.052	.000	.004- .040	.00	.0001	.0001	.01	.03
EURYTEMORA SP.	F-COPEPODID	1080.0	5.4	160.0 - 920.0	66.1	.008	.000	.004- .004	.00	.0000	.0000	.01	.01
EURYTEMORA AFFINIS	B-ADULT	310660.0	1561.1	.0 - 55333.3	6081.1	9.634	.049	NEG.- 2.000	.20	.0001	.0000	1.74	6.21
EURYTEMORA AFFINIS	A-JUV+ADULT	12280.0	61.7	560.0 - 4440.0	438.4	.380	.002	.016- .160	.01	.0000	.0000	.07	.24
EURYTEMORA AFFINIS	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
EURYTEMORA AFFINIS	F-COPEPODID	* .1E+07	5488.8	40.0 - 138000.0	15477.9	10.036	.050	.004- 1.333	.15	.0000	.0000	6.12	6.34
EURYTEMORA AFFINIS	L-EGG-C FEM	160.0	1.0	40.0 - 320.0	22.8	.020	.000	.004- .016	.00	.0001	.0000	.00	.01
EURYTEMORA AMERICANA	F-COPEPODID	2520.0	12.7	480.0 - 2040.0	148.4	.020	.000	.004- .016	.00	.0000	.0000	.01	.01
ACARTIA SP.	A-JUV+ADULT	4480.0	22.5	4480.0 - 4480.0	317.6	.016	.000	.016- .016	.00	.0000	0	.03	.01
ACARTIA SP.	C-J/A NOSEX	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004- .004	.00	.0001	0	.00	.00
ACARTIA SP.	F-COPEPODID	2120.0	10.7	.0 - 1440.0	105.0	.048	.000	NEG.- .016	.00	.0001	.0000	.01	.03
ACARTIA CLAUSI	B-ADULT	1480.0	7.4	40.0 - 720.0	66.4	.024	.000	.004- .004	.00	.0001	.0000	.01	.02
ACARTIA CLAUSI	A-JUV+ADULT	240.0	1.2	240.0 - 240.0	17.0	.004	.000	.004- .004	.00	.0000	0	.00	.00
ACARTIA CLAUSI	F-COPEPODID	960.0	4.8	40.0 - 480.0	42.8	.016	.000	.004- .004	.00	.0000	.0000	.01	.01
ACARTIA LONGIREMIS	B-ADULT	440.0	2.2	40.0 - 200.0	18.5	.016	.000	.004- .004	.00	.0001	.0000	.00	.01
ACARTIA LONGIREMIS	F-COPEPODID	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
HARPACTICOIDA	2-NAUPLIUS	6760.0	34.0	40.0 - 4320.0	334.8	.124	.001	.004- .004	.00	.0001	.0000	.04	.08

EPIBENTHIC PLANKTON ANALYSIS
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SUMMARY TABLE, PAGE 14

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
HARPACTICOIDA	8-ADULT	1760.0	8.8	40.0 - 480.0	49.7	.100	.001	.004-.016	.00	.0001	.0000	.01	.06
HARPACTICOIDA	C-J/A NOSEX	2173.3	10.9	40.0 - 640.0	54.5	.141	.001	.004-.020	.00	.0001	.0000	.01	.09
HARPACTICOIDA	F-COPEPODID	50133.3	251.9	40.0 - 18560.0	1458.6	1.164	.006	.004-.200	.02	.0001	.0000	.28	.73
HARPACTICOIDA	L-EGG-C FEM	240.0	1.2	40.0 - 160.0	12.0	.024	.000	.004-.016	.00	.0001	0	.00	.02
HARPACTICOIDA	M-EGG CASE	33333.3	167.5	40.0 - 11333.3	1095.9	.719	.004	.004-.400	.03	.0000	.0000	.19	.45
SCOTTOLANA CANADENSIS	8-ADULT	360960.0	1813.9	40.0 - 90000.0	9659.3	5.427	.027	.004-1.640	.15	.0000	.0000	2.02	3.43
SCOTTOLANA CANADENSIS	A-JUV+ADULT	105640.0	530.9	200.0 - 88320.0	6288.4	.580	.003	.004-.320	.03	.0000	.0000	.59	.37
SCOTTOLANA CANADENSIS	C-J/A NOSEX	1640.0	8.2	80.0 - 800.0	68.6	.028	.000	.004-.008	.00	.0000	.0000	.01	.02
SCOTTOLANA CANADENSIS	F-COPEPODID	* .1E+07	5275.3	40.0 - 256000.0	21956.2	5.723	.029	.004-1.600	.13	.0000	.0000	5.88	3.61
SCOTTOLANA CANADENSIS	L-EGG-C FEM	12360.0	62.1	40.0 - 4000.0	320.9	.672	.003	.004-.240	.02	.0001	.0000	.07	.42
SCOTTOLANA CANADENSIS	M-EGG CASE	17720.0	89.0	160.0 - 9280.0	818.3	.080	.000	.004-.020	.00	.0000	.0000	.10	.05
SCOTTOLANA CANADENSIS	U-MATING PR	320.0	1.6	320.0 - 320.0	22.7	.016	.000	.016-.016	.00	.0001	0	.00	.01
CANUELLIDAE	7-JUVENILE	5200.0	26.1	5200.0 - 5200.0	368.6	.040	.000	.040-.040	.00	.0000	0	.03	.03
ECTINOSOMATIDAE	8-ADULT	* .1E+07	7996.3	40.0 - 757333.3	64237.1	7.725	.039	.004-4.067	.31	.0000	.0000	8.91	4.88
ECTINOSOMATIDAE	A-JUV+ADULT	* .1E+07	6466.5	280.0 - 494000.0	42427.8	3.789	.019	.004-2.000	.15	.0000	.0000	7.21	2.39
ECTINOSOMATIDAE	C-J/A NOSEX	400.0	2.0	40.0 - 160.0	13.8	.024	.000	.004-.004	.00	.0001	.0000	.00	.02
ECTINOSOMATIDAE	F-COPEPODID	2880.0	14.5	40.0 - 986.7	87.9	.196	.001	.004-.083	.01	.0001	.0000	.02	.12
ECTINOSOMATIDAE	L-EGG-C FEM	138200.0	694.5	40.0 - 72000.0	5460.5	1.601	.008	.004-.400	.04	.0000	.0000	.77	1.01
MICROSETELLA SP.	8-ADULT	480.0	2.4	80.0 - 400.0	28.9	.048	.000	.008-.040	.00	.0001	0	.00	.03
ECTINOSOMA SP.	8-ADULT	13760.0	69.1	40.0 - 4440.0	437.0	.124	.001	.004-.020	.00	.0000	.0000	.08	.08
ECTINOSOMA SP.	F-COPEPODID	120.0	.6	40.0 - 80.0	6.3	.012	.000	.004-.008	.00	.0001	0	.00	.01
ECTINOSOMA SP.	L-EGG-C FEM	1000.0	5.0	40.0 - 800.0	57.8	.026	.000	.004-.016	.00	.0001	.0001	.01	.02
HARPACTICUS SP.	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00
TACHIDIIDAE	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00
TACHIDIIDAE	A-JUV+ADULT	94000.0	472.4	94000.0 - 94000.0	6663.*	.100	.001	.100-.100	.01	.0000	0	.53	.06

ORGANISM NAME PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUN-DANCE	BIO-MASS
TACHIDIIDAE	F-COPEPODID	3613.3	18.2	40.0 - 1333.3	123.6	.101	.001	.004- .033	.00	.0001	.0000	.02	.06
TACHIDIIDAE	L-EGG-C FEM	16000.0	80.4	16000.0 - 16000.0	1134.2	.100	.001	.100- .100	.01	.0000	0	.09	.06
MICROARTHRIDION SP.	B-ADULT	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004- .004	.00	.0001	0	.00	.00
MICROARTHRIDION LITTORALE	B-ADULT	181833.3	913.7	40.0 - 128000.0	9114.6	2.795	.014	.004- 1.600	.12	.0001	.0000	1.02	1.77
MICROARTHRIDION LITTORALE	A-JUV+ADULT	254666.7	1279.7	200.0 - 109333.3	10726.1	.357	.002	.004- .067	.01	.0000	.0000	1.43	.23
MICROARTHRIDION LITTORALE	C-J/A NOSEX	280.0	1.4	40.0 - 160.0	13.0	.028	.000	.004- .016	.00	.0001	0	.00	.02
MICROARTHRIDION LITTORALE	F-COPEPODID	25693.3	129.1	40.0 - 13160.0	1126.0	.149	.001	.004- .040	.00	.0001	.0000	.14	.09
MICROARTHRIDION LITTORALE	L-EGG-C FEM	104666.7	527.0	40.0 - 96000.0	6809.8	1.921	.010	.004- 1.600	.11	.0001	.0000	.59	1.21
TACHIDIUS SP.	B-ADULT	960.0	4.8	960.0 - 960.0	68.1	.016	.000	.016- .016	.00	.0000	0	.01	.01
TACHIDIUS SP.	F-COPEPODID	360.0	1.8	40.0 - 320.0	22.8	.020	.000	.004- .016	.00	.0001	.0000	.00	.01
TACHIDIUS TRIANGULARIS	B-ADULT	119666.7	601.3	40.0 - 30400.0	3373.7	.821	.004	.004- .200	.02	.0000	.0000	.67	.52
TACHIDIUS TRIANGULARIS	A-JUV+ADULT	234973.3	1180.8	360.0 - 83000.0	7483.1	.577	.003	.004- .150	.02	.0000	.0000	1.32	.36
TACHIDIUS TRIANGULARIS	F-COPEPODID	29226.7	146.9	80.0 - 10400.0	1104.8	.187	.001	.004- .067	.01	.0000	.0000	.16	.12
TACHIDIUS TRIANGULARIS	L-EGG-C FEM	59253.3	297.8	40.0 - 15840.0	1631.7	.333	.002	.004- .100	.01	.0000	.0000	.33	.21
TACHIDIUS TRIANGULARIS	U-MATING PR	1600.0	8.0	160.0 - 480.0	52.7	.064	.000	.008- .016	.00	.0000	.0000	.01	.04
TACHIDIUS DISCIPES	B-ADULT	28240.0	141.9	40.0 - 12320.0	1212.0	.088	.000	.004- .024	.00	.0000	.0000	.16	.06
TACHIDIUS DISCIPES	A-JUV+ADULT	45240.0	227.3	2360.0 - 23840.0	2167.8	.180	.001	.004- .160	.01	.0000	.0000	.25	.11
TACHIDIUS DISCIPES	C-J/A NOSEX	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
TACHIDIUS DISCIPES	F-COPEPODID	560.0	2.8	80.0 - 480.0	34.5	.020	.000	.004- .016	.00	.0000	.0000	.00	.01
TACHIDIUS DISCIPES	L-EGG-C FEM	5640.0	28.3	40.0 - 2240.0	193.6	.092	.000	.004- .020	.00	.0000	.0000	.03	.06
LAOPHONTIDAE	4-MEGALOP	640.0	3.2	640.0 - 640.0	45.4	.016	.000	.016- .016	.00	.0000	0	.00	.01
LAOPHONTIDAE	B-ADULT	84271.1	423.5	40.0 - 15560.0	1796.6	1.430	.007	.004- .200	.02	.0001	.0000	.47	.90
LAOPHONTIDAE	A-JUV+ADULT	38963.3	195.8	960.0 - 28640.0	2067.2	.222	.001	.005- .160	.01	.0000	.0000	.22	.14
LAOPHONTIDAE	C-J/A NOSEX	2680.0	13.5	40.0 - 2000.0	144.7	.099	.000	.004- .067	.00	.0001	.0000	.02	.06
LAOPHONTIDAE	F-COPEPODID	14240.0	71.6	40.0 - 7080.0	541.2	.460	.002	.004- .200	.02	.0001	.0000	.08	.29

EPIBENTHIC PLANKTON ANALYSIS
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SUMMARY TABLE, PAGE 16

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
LAOPHONTIDAE	L-EGG-C FEM	16310.0	82.0	40.0 - 4080.0	433.6	.403	.002	.004-.080	.01	.0001	.0000	.09	.25
LAOPHONTIDAE	U-MATING PR	240.0	1.2	80.0 - 160.0	12.7	.008	.000	.004-.004	.00	.0000	.0000	.00	.01
ONYCHOCAMPTUS MOHAMMED	5-VELIGER	200.0	1.0	200.0 - 200.0	14.2	.004	.000	.004-.004	.00	.0000	0	.00	.00
ONYCHOCAMPTUS MOHAMMED	8-ADULT	7880.0	39.6	80.0 - 5280.0	410.4	.040	.000	.004-.016	.00	.0000	.0000	.04	.03
ONYCHOCAMPTUS MOHAMMED	F-COPEPODID	800.0	4.0	800.0 - 800.0	56.7	.016	.000	.016-.016	.00	.0000	0	.00	.01
ONYCHOCAMPTUS MOHAMMED	L-EGG-C FEM	1040.0	5.2	80.0 - 640.0	50.9	.036	.000	.004-.016	.00	.0000	.0000	.01	.02
ONYCHOCAMPTUS MOHAMMED	U-MATING PR	640.0	3.2	640.0 - 640.0	45.4	.016	.000	.016-.016	.00	.0000	0	.00	.01
CYLLINDROPSYLLIDAE	8-ADULT	320.0	1.6	320.0 - 320.0	22.7	.008	.000	.008-.008	.00	.0000	0	.00	.01
CYLLINDROPSYLLIDAE	L-EGG-C FEM	120.0	.6	120.0 - 120.0	8.5	.008	.000	.008-.008	.00	.0001	0	.00	.01
PARALEPTASTACUS SP.	8-ADULT	45680.0	230.6	40.0 - 32000.0	2374.7	.740	.004	.004-.400	.03	.0000	.0000	.26	.47
PARALEPTASTACUS SP.	L-EGG-C FEM	14160.0	71.2	160.0 - 12000.0	861.7	.416	.002	.016-.200	.02	.0001	.0000	.08	.26
NITOCRA SP.	8-ADULT	4680.0	23.5	40.0 - 1040.0	99.9	.228	.001	.004-.024	.00	.0001	.0000	.03	.14
NITOCRA SP.	C-J/A NOSEX	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004-.004	.00	.0001	0	.00	.00
NITOCRA SP.	L-EGG-C FEM	360.0	1.8	40.0 - 240.0	18.1	.032	.000	.004-.024	.00	.0001	.0000	.00	.02
CLETODIDAE	7-JUVENILE	400.0	2.0	400.0 - 400.0	28.4	.040	.000	.040-.040	.00	.0001	0	.00	.03
CLETODIDAE	8-ADULT	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004-.004	.00	.0001	0	.00	.01
CLETODIDAE	F-COPEPODID	120.0	.6	40.0 - 40.0	4.9	.012	.000	.004-.004	.00	.0001	0	.00	.01
HUNTEMANNIA JADENSIS	8-ADULT	15155.6	76.2	40.0 - 4666.7	371.5	.524	.003	.004-.067	.01	.0001	.0000	.08	.33
HUNTEMANNIA JADENSIS	A-JUV+ADULT	3040.0	15.3	160.0 - 2880.0	204.4	.020	.000	.004-.016	.00	.0000	.0000	.02	.01
HUNTEMANNIA JADENSIS	C-J/A NOSEX	680.0	3.4	40.0 - 400.0	30.0	.056	.000	.004-.040	.00	.0001	.0000	.00	.04
HUNTEMANNIA JADENSIS	F-COPEPODID	120.0	.6	40.0 - 80.0	[illegible]	.012	.000	.004-.008	.00	.0001	0	.00	.01
HUNTEMANNIA JADENSIS	L-EGG-C FEM	1160.0	5.8	40.0 - 400.0	36.5	.096	.000	.004-.040	.00	.0001	.0000	.01	.06
CANTHOCAMPTIDAE	C-J/A NOSEX	120.0	.6	120.0 - 120.0	8.5	.004	.000	.004-.004	.00	.0000	0	.00	.00
CANTHOCAMPTIDAE	F-COPEPODID	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00
BRYOCAMPTUS SP.	8-ADULT	57413.3	286.5	40.0 - 23360.0	1861.3	.781	.004	.004-.160	.02	.0000	.0000	.32	.49

ORGANISM NAME	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUN-DANCE	BIO-MASS
BRYOCAMPTUS SP.	A-JUV+ADULT	43440.0	218.3	440.0 - 31000.0	2254.6	.120	.001	.004- .100	.01	.0000	.0000	.24	.08
BRYOCAMPTUS SP.	C-J/A NOSEX	320.0	1.6	40.0 - 160.0	13.2	.026	.000	.004- .016	.00	.0001	.0000	.00	.02
BRYOCAMPTUS SP.	F-COPEPODID	520.0	2.6	40.0 - 320.0	25.4	.036	.000	.004- .016	.00	.0001	.0000	.00	.02
BRYOCAMPTUS SP.	L-EGG-C FEM	18506.7	93.0	40.0 - 6106.7	560.6	.520	.003	.004- .105	.01	.0001	.0000	.10	.33
MESOCHRA SP.	B-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
MESOCHRA LILLIJEBORGI	B-ADULT	960.0	4.8	960.0 - 960.0	68.1	.016	.000	.016- .016	.00	.0000	0	.01	.01
MESOCHRA LILLIJEBORGI	L-EGG-C FEM	480.0	2.4	480.0 - 480.0	34.0	.016	.000	.016- .016	.00	.0000	0	.00	.01
MESOCHRA ALASKANA	B-ADULT	960.0	4.8	960.0 - 960.0	68.1	.016	.000	.016- .016	.00	.0000	0	.01	.01
MESOCHRA ALASKANA	L-EGG-C FEM	480.0	2.4	480.0 - 480.0	34.0	.016	.000	.016- .016	.00	.0000	0	.00	.01
MESOCHRA PYGMAEA	B-ADULT	1840.0	9.2	80.0 - 960.0	77.7	.048	.000	.004- .016	.00	.0000	.0000	.01	.03
MESOCHRA PYGMAEA	L-EGG-C FEM	120.0	.6	120.0 - 120.0	8.5	.004	.000	.004- .004	.00	.0000	0	.00	.00
ATTHEYELLA SP.	B-ADULT	164653.3	827.4	40.0 - 37360.0	4177.4	.831	.004	.004- .168	.01	.0000	.0000	.92	.52
ATTHEYELLA SP.	A-JUV+ADULT	230760.0	1159.6	200.0 - 94720.0	8227.8	.455	.002	.004- .160	.01	.0000	.0000	1.29	.29
ATTHEYELLA SP.	C-J/A NOSEX	960.0	4.8	40.0 - 800.0	57.1	.028	.000	.004- .016	.00	.0001	.0000	.01	.02
ATTHEYELLA SP.	F-COPEPODID	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
ATTHEYELLA SP.	L-EGG-C FEM	27560.0	138.5	40.0 - 8320.0	844.4	.452	.002	.004- .080	.01	.0001	.0000	.15	.29
THALESTRIDAE	B-ADULT	480.0	2.4	40.0 - 400.0	28.6	.048	.000	.004- .040	.00	.0001	0	.00	.03
DIAKTHRODES SP.	B-ADULT	320.0	1.6	320.0 - 320.0	22.7	.032	.000	.032- .032	.00	.0001	0	.00	.02
CYCLOPOIDA	C-J/A NOSEX	666.7	3.4	666.7 - 666.7	47.3	.067	.000	.067- .067	.00	.0001	0	.00	.04
CYCLOPOIDA	F-COPEPODID	1866.7	9.4	40.0 - 960.0	84.6	.103	.001	.004- .071	.01	.0001	.0000	.01	.06
CORYCAEUS SP.	B-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CORYCAEUS SP.	F-COPEPODID	160.0	.8	160.0 - 160.0	11.3	.008	.000	.008- .008	.00	.0001	0	.00	.01
CORYCAEUS ANGLICUS	B-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CORYCAEUS ANGLICUS	F-COPEPODID	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
HALICYCLOPS SP.	B-ADULT	240.0	1.2	40.0 - 80.0	8.9	.020	.000	.004- .008	.00	.0001	.0000	.00	.01

EPIBENTHIC PLANKTON ANALYSIS
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SUMMARY TABLE, PAGE 18

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
HALICYCLOPS SP.	A-JUV+ADULT	720.0	3.6	280.0 - 440.0	36.9	.008	.000	.004- .004	.00	.0000	.0000	.00	.01
HALICYCLOPS SP.	F-COPEPODID	1160.0	5.8	440.0 - 720.0	89.7	.012	.000	.004- .008	.00	.0000	.0000	.01	.01
HALICYCLOPS SP.	L-EGG-C FEM	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CYCLOPS SP.	A-JUV+ADULT	164000.0	824.1	560.0 - 160000.0	11341.6	1.616	.008	.004- 1.600	.11	.0000	.0000	.92	1.02
CYCLOPS SP.	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CYCLOPS SP.	F-COPEPODID	83815.6	421.2	40.0 - 6000.0	934.7	1.118	.006	.004- .200	.02	.0000	.0000	.47	.71
CYCLOPS VERNALIS	1-EGG	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CYCLOPS VERNALIS	7-JUVENILE	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CYCLOPS VERNALIS	8-ADULT	6306.7	31.7	40.0 - 1280.0	135.1	.299	.002	.004- .100	.01	.0001	.0000	.04	.19
CYCLOPS VERNALIS	A-JUV+ADULT	136040.0	683.6	120.0 - 48000.0	3992.1	2.549	.013	.004- 1.600	.12	.0000	.0000	.76	1.61
CYCLOPS VERNALIS	C-J/A NOSEX	1240.0	6.2	40.0 - 480.0	38.8	.072	.000	.004- .016	.00	.0001	.0000	.01	.05
CYCLOPS VERNALIS	F-COPEPODID	67843.3	340.9	40.0 - 6000.0	788.6	1.842	.009	.004- .200	.02	.0000	.0000	.38	1.16
CYCLOPS BICUSPIDATUS THOMASI	5-VELIGER	200.0	1.0	200.0 - 200.0	14.2	.004	.000	.004- .004	.00	.0000	0	.00	.00
CYCLOPS BICUSPIDATUS THOMASI	8-ADULT	5453.3	27.4	40.0 - 1440.0	161.7	.179	.001	.004- .067	.01	.0001	.0000	.03	.11
CYCLOPS BICUSPIDATUS THOMASI	A-JUV+ADULT	208800.0	1049.2	80.0 - 128000.0	9087.9	2.367	.012	.004- 1.600	.11	.0000	.0000	1.17	1.49
CYCLOPS BICUSPIDATUS THOMASI	C-J/A NOSEX	2680.0	13.5	40.0 - 640.0	64.0	.156	.001	.004- .064	.00	.0001	.0000	.02	.10
CYCLOPS BICUSPIDATUS THOMASI	F-COPEPODID	126901.3	637.7	40.0 - 5400.0	1099.8	2.644	.013	.004- .467	.04	.0000	.0000	.71	1.67
MESOCYCLOPS EDAX	8-ADULT	1173.3	5.9	400.0 - 773.3	61.6	.112	.001	.040- .072	.01	.0001	.0000	.01	.07
MESOCYCLOPS EDAX	C-J/A NOSEX	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004- .004	.00	.0001	0	.00	.00
PARACYCLOPS FIMBRIATUS	8-ADULT	10000.0	50.3	40.0 - 2960.0	279.3	.223	.001	.004- .033	.00	.0001	.0000	.06	.14
PARACYCLOPS FIMBRIATUS	A-JUV+ADULT	2280.0	11.5	200.0 - 960.0	91.1	.016	.000	.004- .004	.00	.0000	.0000	.01	.01
PARACYCLOPS FIMBRIATUS	C-J/A NOSEX	400.0	2.0	40.0 - 200.0	18.3	.024	.000	.004- .016	.00	.0001	.0000	.00	.02
PARACYCLOPS FIMBRIATUS	F-COPEPODID	22200.0	111.6	40.0 - 6720.0	617.8	.421	.002	.004- .064	.01	.0001	.0000	.12	.27
PARACYCLOPS FIMBRIATUS	L-EGG-C FEM	600.0	3.0	40.0 - 160.0	16.5	.048	.000	.004- .016	.00	.0001	.0000	.00	.03
OITHONA SP.	2-NAUPLIUS	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004- .004	.00	.0001	0	.00	.00

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUN-DANCE	BIO-MASS
OITHONA SP.	8-ADULT	2240.0	11.3	40.0 - 2000.0	142.2	.212	.001	.004- .200	.01	.0001	.0000	.01	.13
OITHONA SP.	C-J/A NOSEX	2800.0	14.1	80.0 - 1000.0	100.3	.077	.000	.004- .033	.00	.0000	.0000	.02	.05
OITHONA SP.	F-COPEPODID	680.0	3.4	40.0 - 400.0	29.6	.032	.000	.004- .006	.00	.0001	.0000	.00	.02
OITHONA SIMILIS	8-ADULT	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004- .004	.00	.0001	0	.00	.00
BALANOMORPHA	2-NAUPLIUS	67290.0	338.1	40.0 - 10520.0	1390.7	.741	.004	.004- .080	.01	.0001	.0000	.38	.47
BALANOMORPHA	E-CYPRIS	3120.0	15.7	40.0 - 2000.0	143.6	.272	.001	.004- .200	.01	.0001	.0000	.02	.17
MYSIDACEA-MYSIDA	7-JUVENILE	360.0	1.8	40.0 - 160.0	13.5	.068	.000	.004- .040	.00	.0003	.0004	.00	.04
ARCHAEOMYSIS GREBNITZKII	8-ADULT	80.0	.4	40.0 - 40.0	4.0	.160	.001	.040- .120	.01	.0020	.0014	.00	.10
NEOMYSIS SP.	7-JUVENILE	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
NEOMYSIS MERCEDIS	7-JUVENILE	80.0	.4	40.0 - 40.0	4.0	.200	.001	.080- .120	.01	.0025	.0007	.00	.13
NEOMYSIS MERCEDIS	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.520	.003	.520- .520	.04	.0130	0	.00	.33
NEOMYSIS MERCEDIS	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.200	.001	.200- .200	.01	.0050	0	.00	.13
CUMACEA	7-JUVENILE	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
LEUCON SP	7-JUVENILE	9120.0	45.8	40.0 - 7000.0	505.0	.828	.004	.004- .644	.05	.0001	.0000	.05	.52
LEUCON SP	8-ADULT	360.0	1.8	40.0 - 320.0	22.8	.044	.000	.004- .040	.00	.0001	.0000	.00	.03
LEUCON SP	A-JUV+ADULT	3120.0	15.7	280.0 - 2840.0	202.2	.680	.003	.040- .640	.05	.0002	.0001	.02	.43
LEUCON SP	C-J/A NOSEX	400.0	2.0	40.0 - 160.0	15.4	.064	.000	.004- .040	.00	.0001	.0001	.00	.04
EUDORELLOPSIS SP.	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
GAMMARIDEA	7-JUVENILE	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
COROPHIUM SP.	7-JUVENILE	5906.7	29.7	40.0 - 1453.3	117.0	.724	.004	.004- .124	.01	.0001	.0002	.03	.46
COROPHIUM SALMONIS	7-JUVENILE	1120.0	5.6	40.0 - 480.0	40.8	1.336	.007	.004- .960	.07	.0011	.0008	.01	.84
COROPHIUM SALMONIS	8-ADULT	400.0	2.0	160.0 - 240.0	20.4	.920	.005	.120- .800	.06	.0028	.0032	.00	.58
COROPHIUM SALMONIS	A-JUV+ADULT	3400.0	17.1	360.0 - 2560.0	186.1	3.120	.016	.240- 2.080	.16	.0010	.0005	.02	1.97
COROPHIUM SALMONIS	C-J/A NOSEX	240.0	1.2	80.0 - 160.0	12.7	.720	.004	.080- .640	.05	.0025	.0021	.00	.45
EUGAMMARUS CONFERVICOLUS	7-JUVENILE	1280.0	6.4	40.0 - 480.0	44.7	.424	.002	.004- .200	.02	.0002	.0002	.01	.27

EPIBENTHIC PLANKTON ANALYSIS
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SUMMARY TABLE, PAGE 20

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
EUGAMMARUS SP.	7-JUVENILE	6680.0	33.6	40.0 - 4000.0	324.9	.456	.002	.004- .240	.02	.0001	.0000	.04	.29
EOHAUSTORIUS SP.	7-JUVENILE	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
PARAPHOXUS SP.	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.240	.001	.240- .240	.02	.0060	0	.00	.15
AMPHIPODA-HYPERIIDEA	7-JUVENILE	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CRANGONIDAE	7-JUVENILE	40.0	.2	40.0 - 40.0	2.8	.080	.000	.080- .080	.01	.0020	0	.00	.05
CRANGON SP.	4-MEGALOP	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
CRANGON FRANCISCORUM	7-JUVENILE	80.0	.4	40.0 - 40.0	4.0	.560	.003	.120- .440	.03	.0070	.0057	.00	.35
INSECTA I	6-LARVA	80.0	.4	80.0 - 80.0	5.7	.004	.000	.004- .004	.00	.0001	0	.00	.00
COLLEMBOLA	8-ADULT	906.7	4.6	40.0 - 666.7	47.6	.127	.001	.004- .067	.01	.0003	.0004	.01	.08
COLLEMBOLA	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
COLLEMBOLA	C-J/A NOSEX	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
ISOTOMIDAE	C-J/A NOSEX	80.0	.4	80.0 - 80.0	5.7	.008	.000	.008- .008	.00	.0001	0	.00	.01
ENTOMOBRYIDAE	C-J/A NOSEX	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
ODONATA	H-NYMPH	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
ANISOPTERA	H-NYMPH	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
ZYGOPTERA	H-NYMPH	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
PSOCOPTERA	H-NYMPH	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
THYSANOPTERA	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
COLEOPTERA	C-J/A NOSEX	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
DIPTERA	8-ADULT	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
CERATOPOGONIDAE	6-LARVA	520.0	2.6	40.0 - 440.0	31.4	.016	.000	.004- .008	.00	.0001	.0000	.00	.01
CERATOPOGONIDAE	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
NEMATOCERA	6-LARVA	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004- .004	.00	.0001	0	.00	.01
NEMATOCERA	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00
NEMATOCERA	G-PUPA	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004- .004	.00	.0001	0	.00	.00

EPIBENTHIC PLANKTON ANALYSIS
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SUMMARY TABLE, PAGE 21

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.E.	PERCENTAGES ABUNDANCE	BIOMASS
DIPTERA-CHIRONOMIDAE	6-LARVA	24925.3	125.3	40.0 - 6400.0	604.6	1.024	.005	.004-.214	.02	.0001	.0001	.14	.65
DIPTERA-CHIRONOMIDAE	8-ADULT	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00
TARDIGRADA	8-ADULT	10760.0	54.1	40.0 - 7360.0	529.0	.272	.001	.004-.060	.01	.0001	.0000	.06	.17
TARDIGRADA	C-J/A NOSEX	1800.0	9.0	40.0 - 680.0	68.3	.060	.000	.004-.016	.00	.0001	.0000	.01	.04
TARDIGRADA	L-EGG-C FEM	2400.0	12.1	1120.0 - 1280.0	120.3	.080	.000	.016-.064	.00	.0000	.0000	.01	.05
BRYOZOA(ECTOPROCTA)	8-ADULT	120.0	.6	120.0 - 120.0	8.5	.004	.000	.004-.004	.00	.0000	0	.00	.00
TELEOSTEI	1-EGG	160.0	.8	40.0 - 40.0	5.6	.016	.000	.004-.004	.00	.0001	0	.00	.01
TELEOSTEI	6-LARVA	80.0	.4	40.0 - 40.0	4.0	.008	.000	.004-.004	.00	.0001	0	.00	.01
ENGRAULIS MORDAX	1-EGG	40.0	.2	40.0 - 40.0	2.8	.004	.000	.004-.004	.00	.0001	0	.00	.00
OSMERIDAE	6-LARVA	120.0	.6	40.0 - 80.0	6.3	.008	.000	.004-.004	.00	.0001	.0000	.00	.01
UNIDENTIFIED EGG	1-EGG	467960.0	2351.6	40.0 - 212200.0	17665.6	.784	.004	.004-.240	.02	.0000	.0000	2.62	.49
UNIDENTIFIED EGG	M-EGG CASE	2120.0	10.7	40.0 - 666.7	64.0	.124	.001	.004-.067	.00	.0001	.0000	.01	.08
UNIDENTIFIED	C-J/A NOSEX	52040.0	261.5	40.0 - 48000.0	3406.6	1.732	.009	.004-1.600	.11	.0002	.0003	.29	1.09

TOTAL NUMBER OF PLANKTON CATEGORIES 406

SHANNON-WEINER DIVERSITY INDEX NUMBERS 4.97
BIOMASS 6.24

BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS 4.97

*** GRAND SUMMARY ***

FROM COLLECTIONS:

FIELD	STATION	SAMPLE
80AP14	14002	G 1
80AP14	14002	G 2
80AP14	14005	G 1
80AP24	14008	G 1
80AP24	14008	G 2
80AP24	14014	G 1
80AP24	14014	G 2
80AP24	14016	G 1
80MY19	14005	G 1
80MY19	14005	G 2
80MY19	14008	G 1
80MY19	14008	G 2
80MY19	14014	G 1
80MY19	14014	G 2
80MY19	14016	G 1
80MY19	14016	G 2
80MY20	14002	G 1
80MY20	14002	G 2
80JN23	14002	G 1
80JN23	14002	G 2
80JN23	14005	G 1
80JN23	14005	G 2
80JN23	14008	G 1
80JN23	14008	G 2
80JN23	14016	G 1
80JN23	14016	G 2
80JY14	14002	G 1
80JY14	14002	G 2
80JY14	14005	G 1
80JY14	14005	G 2
80JY14	14008	G 1
80JY14	14008	G 2
80JY14	14016	G 1
80JY14	14016	G 2
80AU15	14002	G 1
80AU15	14002	G 2
80AU15	14005	G 1
80AU15	14005	G 2
80AU15	14008	G 1
80AU15	14008	G 2
80AU15	14016	G 1
80AU15	14016	G 2
80OC14	14008	G 2
80OC19	14002	G 1
80OC19	14002	G 2
80OC19	14008	G 1
80OC19	14008	G 1
80OC19	14008	G 2
80OC19	14016	G 1
80OC19	14016	G 2

EPIBENTHIC PLANKTON ANALYSIS
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FROM COLLECTIONS:

FIELD ID	STATION	SAMPLE
81JA30	14002	G 1
81JA30	14002	G 2
81FE26	14002	G 1
81FE26	14002	G 2
81FE26	14005	G 1
81FE26	14005	G 2
81FE26	14008	G 1
81FE26	14008	G 2
81FE26	14016	G 1
81FE26	14016	G 2
81AP15	14002	G 1
81AP15	14002	G 2
81AP15	14008	G 1
81AP15	14008	G 2
81AP15	14017	G 1
81AP15	14017	G 2
81JY16	14002	G 1
81JY16	14002	G 2
81JY16	14008	G 1
81JY16	14008	G 2
81JY16	14017	G 1
81JY16	14017	G 2

SPECIES DEFINITION -
TRUNCATED = NO
LH-STAGE = COMPLETE
PARTS CODE UNALTERED

ABUNDANCES AND WEIGHTS ARE ADJUSTED TO A VOLUME OF 1.0 CUBIC METERS

	MEAN	RANGE	S.D.	COEF.VAR
SAMPLE VOLUME (M**3)	9.85	.20- 91.48	12.21	1.24
TOTAL WET WEIGHT (PER M**3)	.568	.007- 4.942	.958	1.686
TOTAL ABUNDANCE (PER M**3)	38064.38	379.99- 360972.28	75479.46	1.98
SAMPLE WET WEIGHT (PER M**3)	.523	0- 4.492	.834	1.596
SAMPLE DRY WEIGHT (PER M**3)	0	0- 0	0	0

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUN-DANCE	BIO-MASS
HYDROIDA	U-POLYP	110.9	1.5	10.7 - 49.3	7.2	.010	.000	.001- .005	.00	.0001	.0000	.00	.02
HYDROIDA	A-MEDUSA	374.7	5.2	20.4 - 333.3	39.4	.049	.001	.001- .033	.00	.0003	.0004	.01	.12

EPIBENTHIC PLANKTON ANALYSIS

SUMMARY TABLE, PAGE 3

ORGANISM NAME / PART. CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
CORDYLOPHORA SP.	U-POLYP	10.2	.1	10.2 - 10.2	1.2	.001	.000	.001-.001	.00	.0001	0	.00	.00
CORDYLOPHORA SP.	W-COLONY	.1	.0	.1 - .1	.0	.141	.002	.141-.141	.02	1.7303	0	.00	.35
OBELIA SP.	W-COLONY	30.4	.4	30.4 - 30.4	3.6	.030	.000	.030-.030	.00	.0010	0	.00	.07
SIPHONOPHORA	W-COLONY	20.4	.3	10.2 - 10.2	1.7	.042	.001	.001-.041	.00	.0020	.0028	.00	.10
TURBELLARIA	8-ADULT	541.5	7.0	266.1 - 279.3	45.1	.045	.001	.005-.040	.00	.0001	.0001	.02	.11
TURBELLARIA	C-J/A NOSEX	972.2	13.5	5.2 - 358.9	58.3	.029	.000	NEG.-.012	.00	.0001	.0000	.04	.07
**NAME NOT FOUND (4004000000)	C-J/A NOSEX	24.8	.3	24.8 - 24.8	2.9	.000	.000	NEG.-NEG.	.00	.0000	0	.00	.00
ROTIFERA	8-ADULT	77239.5	1072.8	20.3 - 40333.3	5003.2	.225	.003	NEG.-.050	.01	.0000	.0000	2.82	.55
ROTIFERA	C-J/A NOSEX	58504.5	812.6	122.4 - 20546.3	3119.7	.030	.000	NEG.-.012	.00	.0000	.0000	2.13	.07
NEMATODA	8-ADULT	167.6	2.3	14.9 - 109.8	13.9	.006	.000	NEG.-.004	.00	.0000	.0000	.01	.02
NEMATODA	C-J/A NOSEX	22679.8	315.0	1.0 - 8000.0	1242.0	.321	.004	NEG.-.093	.01	.0001	.0000	.83	.79
NEMATOMORPHA	6-ADULT	7667.7	106.5	27.5 - 3124.9	477.6	.015	.000	NEG.-.004	.00	.0000	.0000	.28	.04
POLYCHAETA	6-LARVA	5320.5	73.9	17.9 - 3000.0	399.6	.101	.001	.001-.050	.01	.0001	.0000	.19	.25
POLYNOIDAE	7-JUVENILE	10.2	.1	10.2 - 10.2	1.2	.001	.000	.001-.001	.00	.0001	0	.00	.00
NEANTHES LIMNICOLA	7-JUVENILE	2.3	.0	2.3 - 2.3	.3	.093	.001	.093-.093	.01	.0400	0	.00	.23
SPIONIDAE	6-LARVA	1540.9	21.4	40.9 - 1500.0	176.8	.060	.001	.010-.050	.01	.0001	.0002	.06	.15
SPIONIDAE	7-JUVENILE	2498.7	34.7	35.1 - 1000.0	165.3	.144	.002	.001-.093	.01	.0001	.0000	.09	.35
OLIGOCHAETA	7-JUVENILE	29.0	.4	6.2 - 21.4	2.7	.003	.000	NEG.-.002	.00	.0001	0	.00	.01
OLIGOCHAETA	C-J/A NOSEX	1530.5	[illegible]	1.0 - 691.9	91.4	.112	.002	NEG.-.053	.01	.0001	.0000	.06	.27
GASTROPODA	7-JUVENILE	30.7	.4	10.2 - 20.4	2.7	.002	.000	.001-.001	.00	.0001	.0000	.00	.00
MESOGASTROPODA	6-LARVA	184.6	2.6	5.2 - 179.4	21.1	.007	.000	NEG.-.006	.00	.0001	.0000	.01	.02
BIVALVIA	6-LARVA	1327.9	18.4	1.3 - 837.3	112.9	.019	.000	NEG.-.012	.00	.0001	.0000	.05	.05
BIVALVIA	7-JUVENILE	10324.2	143.4	3.6 - 4000.0	637.8	.277	.004	NEG.-.067	.01	.0001	.0001	.38	.68
MYTILIDAE	7-JUVENILE	10.2	.1	10.2 - 10.2	1.2	.010	.000	.010-.010	.00	.0010	0	.00	.02
VENEROIDA	7-JUVENILE	128.8	1.8	128.8 - 128.8	15.2	.004	.000	.004-.004	.00	.0000	0	.00	.01

EPIBENTHIC PLANKTON ANALYSIS
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SUMMARY TABLE, PAGE 4

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUN-DANCE	BIO-MASS
CORBICULA SP.	7-JUVENILE	110.6	1.5	.1 - 106.5	12.5	.272	.003	NEG.- .213	.03	.0207	.0340	.00	.54
ACARINA	7-JUVENILE	248.1	3.4	248.1 - 248.1	29.2	.025	.000	.025- .025	.00	.0001	0	.01	.06
ACARINA	8-ADULT	77.3	1.1	1.8 - 77.5	3.1	.008	.000	NEG.- .008	.00	.0001	0	.00	.02
ACARINA	C-J/A NOSEX	76.5	1.1	16.7 - 59.8	7.3	.008	.000	.002- .006	.00	.0001	0	.00	.02
DIAPHANOSOMA BRACHYURUM	7-JUVENILE	630.1	8.9	7.3 - 465.1	55.5	.036	.001	NEG.- .023	.00	.0001	.0000	.02	.09
DIAPHANOSOMA BRACHYURUM	8-ADULT	151.7	2.2	12.0 - 116.3	14.3	.016	.000	.001- .012	.00	.0001	0	.01	.04
DIAPHANOSOMA BRACHYURUM	C-J/A NOSEX	32.7	.5	11.9 - 20.8	2.9	.003	.000	.001- .002	.00	.0001	0	.00	.01
DAPHNIDAE	7-JUVENILE	41.0	.6	16.0 - 24.9	3.5	.000	.000	NEG.- NEG.	.00	.0000	.0000	.00	.00
DAPHNIA SP.	7-JUVENILE	7355.6	102.2	2.9 - 4534.9	545.0	.130	.002	NEG.- .093	.01	.0000	.0000	.27	.34
DAPHNIA SP.	8-ADULT	19.3	.3	19.3 - 19.3	2.3	.000	.000	NEG.- NEG.	.00	.0000	0	.00	.00
DAPHNIA SP.	A-JUV+ADULT	27278.2	406.6	151.6 - 18604.7	2310.3	.125	.002	.001- .078	.01	.0000	.0000	1.07	.31
DAPHNIA SP.	C-J/A NOSEX	1853.6	25.7	6.9 - 1774.1	203.3	.039	.001	NEG.- .034	.00	.0000	.0000	.07	.10
DAPHNIA SP.	L-EGG-C FEM	1250.5	17.4	17.7 - 465.1	74.4	.077	.001	.002- .034	.00	.0001	.0000	.05	.19
DAPHNIA PULEX	7-JUVENILE	59.5	.8	12.1 - 33.4	4.5	.006	.000	.001- .003	.00	.0001	0	.00	.01
DAPHNIA PULEX	8-ADULT	44.7	.6	1.8 - 13.3	2.6	.004	.000	NEG.- .001	.00	.0001	.0000	.00	.01
DAPHNIA PULEX	A-JUV+ADULT	158.6	2.2	41.6 - 117.0	14.6	.007	.000	.002- .005	.00	.0001	.0001	.01	.02
DAPHNIA PULEX	C-J/A NOSEX	56.8	.8	2.0 - 42.8	5.2	.004	.000	NEG.- .002	.00	.0001	.0000	.00	.01
DAPHNIA PULEX	L-EGG-C FEM	44.1	.6	1.8 - 19.9	3.0	.004	.000	NEG.- .002	.00	.0001	.0000	.00	.01
DAPHNIA ROSEA	7-JUVENILE	308.7	4.3	49.3 - 197.0	24.8	.012	.000	.002- .005	.00	.0001	.0000	.01	.03
DAPHNIA ROSEA	8-ADULT	645.4	9.5	3.6 - 248.1	39.2	.042	.001	NEG.- .025	.00	.0000	.0000	.02	.11
DAPHNIA ROSEA	A-JUV+ADULT	4021.7	55.9	19.5 - 2907.0	348.8	.128	.002	NEG.- .116	.01	.0000	.0000	.15	.31
DAPHNIA ROSEA	C-J/A NOSEX	94.3	1.3	6.6 - 47.8	7.3	.003	.000	NEG.- .002	.00	.0000	.0000	.00	.01
DAPHNIA ROSEA	L-EGG-C FEM	416.6	5.8	1.9 - 232.6	28.4	.028	.000	NEG.- .012	.00	.0001	.0000	.02	.07
DAPHNIA GALEATA	7-JUVENILE	114.4	1.6	1.6 - 98.5	11.7	.007	.000	NEG.- .005	.00	.0001	.0000	.00	.02
DAPHNIA GALEATA	8-ADULT	249.9	3.5	1.8 - 248.1	29.2	.025	.000	NEG.- .025	.00	.0001	0	.01	.06

EPIBENTHIC PLANKTON ANALYSIS

ORGANISM NAME / PART, CODE	LIFE STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
DAPHNIA GALEATA	A-JUV+ADULT	2500.4	35.7	108.0 - 1203.2	105.7	.059	.001	.001-.033	.00	.0000	.0000	.09	.16
DAPHNIA GALEATA	C-J/A NOSEX	173.2	2.4	3.2 - 132.1	15.9	.002	.000	NEG.-.001	.00	.0000	.0000	.01	.01
DAPHNIA GALEATA	L-EGG-C FEM	127.2	1.2	1.0 - 66.8	9.8	.006	.000	NEG.-.003	.00	.0001	.0000	.00	.01
DAPHNIA RETROCURVA	7-JUVENILE	958.8	13.7	246.3 - 490.2	70.6	.035	.000	.005-.025	.00	.0000	.0000	.04	.08
DAPHNIA RETROCURVA	A-JUV+ADULT	16235.5	232.2	17.3 - 5581.4	1030.0	.024	.001	NEG.-.023	.00	.0000	.0000	.62	.13
DAPHNIA RETROCURVA	C-J/A NOSEX	35.9	.5	11.7 - 24.0	3.1	.002	.000	.001-.001	.00	.0001	.0000	.00	.01
DAPHNIA RETROCURVA	L-EGG-C FEM	491.5	6.0	1.4 - 155.0	29.0	.030	.000	NEG.-.012	.00	.0001	.0000	.02	.07
DAPHNIA PARVULA	L-EGG-C FEM	15.6	.2	1.5 - 14.1	1.7	.002	.000	NEG.-.001	.00	.0001	0	.00	.00
ILYOCRYPTUS SP.	7-JUVENILE	23.0	.3	23.0 - 23.0	2.7	.002	.000	.002-.002	.00	.0001	0	.00	.01
ILYOCRYPTUS SP.	8-ADULT	49.5	.7	5.0 - 33.4	4.2	.005	.000	NEG.-.003	.00	.0001	0	.00	.01
ILYOCRYPTUS SP.	C-J/A NOSEX	139.3	1.9	2.0 - 77.5	13.4	.014	.000	NEG.-.008	.00	.0001	0	.01	.03
ILYOCRYPTUS SP.	L-EGG-C FEM	49.3	.7	49.3 - 49.3	5.8	.005	.000	.005-.005	.00	.0001	0	.00	.01
CERIODAPHNIA SP.	7-JUVENILE	976.2	13.6	12.2 - 300.8	47.4	.036	.000	NEG.-.025	.00	.0000	.0000	.04	.09
CERIODAPHNIA SP.	8-ADULT	16.3	.2	16.3 - 16.3	1.9	.001	.000	NEG.-NEG.	.00	.0001	0	.00	.00
CERIODAPHNIA RETICULATA	8-ADULT	62.6	.9	2.0 - 33.4	4.3	.005	.000	NEG.-.003	.00	.0001	.0000	.00	.01
CERIODAPHNIA RETICULATA	A-JUV+ADULT	83.3	1.2	83.3 - 83.3	9.8	.002	.000	.002-.002	.00	.0000	0	.00	.01
CERIODAPHNIA RETICULATA	C-J/A NOSEX	36.0	.5	36.0 - 36.0	4.2	.001	.000	.001-.001	.00	.0000	0	.00	.00
CERIODAPHNIA RETICULATA	L-EGG-C FEM	35.2	.5	1.8 - 33.4	3.9	.004	.000	NEG.-.003	.00	.0001	0	.00	.01
CERIODAPHNIA QUADRANGULA	A-JUV+ADULT	467.9	6.5	467.9 - 467.9	55.1	.003	.000	.003-.003	.00	.0000	0	.02	.01
CERIODAPHNIA QUADRANGULA	C-J/A NOSEX	11.9	.2	11.9 - 11.9	1.4	.001	.000	.001-.001	.00	.0001	0	.00	.00
CERIODAPHNIA QUADRANGULA	L-EGG-C FEM	70.4	1.0	3.6 - 66.8	7.9	.004	.000	NEG.-.003	.00	.0001	0	.00	.01
BOSMINA SP.	2-NAUPLIUS	6.6	.1	6.8 - 6.8	.8	.000	.000	NEG.-NEG.	.00	.0001	0	.00	.00
BOSMINA SP.	7-JUVENILE	3511.0	48.8	3.4 - 2095.4	320.7	.114	.002	NEG.-.090	.01	.0000	.0000	.13	.28
BOSMINA SP.	8-ADULT	2619.6	36.4	11.8 - 1964.7	237.2	.029	.000	NEG.-.025	.00	.0000	.0000	.10	.07
BOSMINA SP.	A-JUV+ADULT	57827.0	803.6	58.3 - 7187.8	1416.7	.296	.004	NEG.-.045	.01	.0000	.0000	2.11	.72

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
BOSMINA SP.	C-J/A NOSEX	5601.0	66.7	10.1 - 2790.7	344.1	.154	.002	NEG.- .093	.01	.0000	.0000	.18	.38
BOSMINA SP.	L-EGG-C FEM	15329.9	219.9	3.6 - 2272.7	579.6	.559	.006	NEG.- .093	.02	.0000	.0000	.58	1.10
EVADNE NORDMANNI	6-ADULT	52.9	.6	52.9 - 47.9	5.1	.004	.000	.004- .004	.00	.0001	0	.00	.01
PODON SP.	7-JUVENILE	257.5	3.6	257.5 - 257.5	30.3	.009	.000	.009- .009	.00	.0000	0	.01	.02
PODON POLYPHAEMOIDES	C-J/A NOSEX	214.6	3.0	214.6 - 214.6	25.3	.004	.000	.004- .004	.00	.0000	0	.01	.01
ALONA SP.	7-JUVENILE	18.0	.3	2.0 - 17.0	1.5	.002	.000	NEG.- .001	.00	.0001	0	.00	.00
ALONA SP.	6-ADULT	1240.3	17.2	77.5 - 930.2	112.9	.109	.002	.008- .093	.01	.0001	.0000	.05	.27
ALONA SP.	C-J/A NOSEX	56.9	.8	1.9 - 46.0	5.5	.004	.000	NEG.- .002	.00	.0001	.0000	.00	.01
ALONA SP.	L-EGG-C FEM	77.5	1.1	77.5 - 77.5	9.1	.008	.000	.008- .008	.00	.0001	0	.00	.02
ALONA GUTTATA	6-ADULT	37.8	.5	17.9 - 19.9	3.1	.003	.000	NEG.- .002	.00	.0001	.0000	.00	.01
ALONA GUTTATA	C-J/A NOSEX	176.0	2.4	24.9 - 85.6	17.8	.007	.000	NEG.- .004	.00	.0000	.0000	.01	.02
ALONA QUADRANGULARIS	C-J/A NOSEX	14.0	.2	2.0 - 12.0	1.4	.001	.000	NEG.- .001	.00	.0001	0	.00	.00
CHYDORUS SPHAERICUS	6-ADULT	754.5	10.5	5.3 - 248.1	34.4	.044	.001	NEG.- .025	.00	.0000	.0000	.03	.11
CHYDORUS SPHAERICUS	C-J/A NOSEX	116.1	1.6	6.1 - 69.1	9.7	.004	.000	NEG.- .002	.00	.0000	.0000	.00	.01
CHYDORUS SPHAERICUS	L-EGG-C FEM	6.9	.1	2.9 - 4.0	.6	.001	.000	NEG.- NEG.	.00	.0001	0	.00	.00
LEYDIGIA QUADRANGULARIS	7-JUVENILE	6.1	.1	6.1 - 6.1	.7	.000	.000	NEG.- NEG.	.00	.0000	0	.00	.00
LEYDIGIA QUADRANGULARIS	6-ADULT	118.3	1.6	2.0 - 116.3	13.7	.012	.000	NEG.- .012	.00	.0001	0	.00	.03
LEYDIGIA QUADRANGULARIS	C-J/A NOSEX	71.5	1.0	3.7 - 42.8	5.6	.007	.000	NEG.- .004	.00	.0001	.0000	.00	.02
ALONELLA SP.	L-EGG-C FEM	33.4	.5	33.4 - 33.4	3.9	.003	.000	.003- .003	.00	.0001	0	.00	.01
PODOCOPA	7-JUVENILE	10.1	.1	3.5 - 6.6	.9	.001	.000	NEG.- NEG.	.00	.0001	.0000	.00	.00
PODOCOPA	C-J/A NOSEX	72.5	1.0	6.0 - 53.2	6.5	.007	.000	NEG.- .005	.00	.0001	.0000	.00	.02
LIMNOCYTHERE SP.	6-ADULT	1649.4	22.9	1649.4 - 1649.4	194.4	.027	.000	.027- .027	.00	.0000	0	.06	.07
LIMNOCYTHERE SP.	C-J/A NOSEX	1523.0	21.2	32.7 - 1490.3	175.6	.006	.000	NEG.- .005	.00	.0000	.0000	.06	.02
CANDONA SP.	6-ADULT	77.2	1.1	77.5 - 77.5	9.1	.008	.000	.008- .008	.00	.0001	0	.00	.02
COPEPODA	2-NAUPLIUS	469193.2	6516.6	5.9 - 125282.6	19184.2	.881	.012	NEG.- .248	.03	.0000	.0000	17.11	2.15

EPIBENTHIC PLANKTON ANALYSIS

SUMMARY TABLE, PAGE 7

ORGANISM NAME	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
COPEPODA	F-COPEPODID	69.2	1.2	3.4 - 85.0	10.1	.009	.000	NEG.- .009	.00	.0001	0	.00	.02
COPEPODA	M-EGG CASE	143.6	2.0	7.7 - 69.1	11.3	.006	.000	NEG.- .003	.00	.0000	.0000	.01	.01
CALANOIDA	Z-NAUPLIUS	2779.2	39.6	179.4 - 2360.5	279.7	.022	.000	.004- .012	.00	.0000	.0000	.10	.05
CALANOIDA	C-J/A NOSEX	92.0	1.3	92.0 - 92.0	10.8	.001	.000	.001- .001	.00	.0000	0	.00	.00
CALANOIDA	F-COPEPODID	169316.4	2391.5	45.1 - 66206.9	8965.2	.517	.007	NEG.- .172	.02	.0000	.0000	6.17	1.26
CALANUS SP.	F-COPEPODID	635.1	3.7	112.4 - 122.6	19.5	.031	.000	.010- .020	.00	.0001	.0001	.01	.07
EUCALANUS SP.	F-COPEPODID	10.2	.1	10.2 - 10.2	1.2	.001	.000	.001- .001	.00	.0001	0	.00	.00
PARACALANUS SP.	B-ADULT	206.4	2.9	34.7 - 171.7	20.6	.012	.000	.003- .009	.00	.0001	.0000	.01	.03
PARACALANUS SP.	A-JUV+ADULT	7249.6	100.7	515.0 - 5000.0	606.1	.056	.001	.004- .033	.00	.0000	.0000	.26	.14
PARACALANUS SP.	F-COPEPODID	1034.7	14.4	34.7 - 1000.0	117.9	.053	.001	.003- .050	.01	.0001	.0000	.04	.13
PARACALANUS PARVUS	A-JUV+ADULT	480.4	6.7	224.9 - 255.5	39.8	.020	.000	.010- .010	.00	.0000	.0000	.02	.05
PSEUDOCALANIDAE	F-COPEPODID	208.2	2.9	69.4 - 138.8	18.2	.007	.000	.003- .003	.00	.0000	.0000	.01	.02
CLAUSOCALANUS PARAPERGENS	B-ADULT	337.3	4.7	337.3 - 337.3	39.7	.010	.000	.010- .010	.00	.0000	0	.01	.02
CLAUSOCALANUS PARAPERGENS	A-JUV+ADULT	296.4	4.1	296.4 - 296.4	34.9	.010	.000	.010- .010	.00	.0000	0	.01	.02
CTENOCALANUS VANUS	B-ADULT	81.6	1.1	81.6 - 81.6	9.6	.001	.000	.001- .001	.00	.0000	0	.00	.00
CTENOCALANUS VANUS	A-JUV+ADULT	71.5	1.0	71.5 - 71.5	8.4	.001	.000	.001- .001	.00	.0000	0	.00	.00
MICROCALANUS SP.	C-J/A NOSEX	179.4	2.5	179.4 - 179.4	21.1	.006	.000	.006- .006	.00	.0000	0	.01	.01
PSEUDOCALANUS SP.	B-ADULT	190.1	2.6	42.9 - 65.8	11.3	.014	.000	.001- .009	.00	.0001	.0000	.01	.03
PSEUDOCALANUS SP.	A-JUV+ADULT	1109.3	15.4	21.1 - 793.7	98.3	.014	.000	.001- .010	.00	.0000	.0000	.04	.03
PSEUDOCALANUS SP.	F-COPEPODID	12.0	.2	12.0 - 12.0	1.4	.001	.000	.001- .001	.00	.0001	0	.00	.00
PSEUDOCALANUS SP.	L-EGG-C FEM	49.3	.7	49.3 - 49.3	5.8	.005	.000	.005- .005	.00	.0001	0	.00	.01
CENTROPAGES ABDOMINALIS	F-COPEPODID	147.8	2.0	49.3 - 98.0	15.6	.002	.000	NEG.- NEG.	.00	.0000	.0000	.01	.00
DIAPTOMUS SP.	B-ADULT	2205.1	30.6	3.7 - 1040.5	127.9	.086	.001	NEG.- .025	.00	.0001	.0000	.08	.21
DIAPTOMUS SP.	A-JUV+ADULT	1623.5	22.5	42.6 - 455.5	88.2	.016	.000	NEG.- .008	.00	.0000	.0000	.06	.04
DIAPTOMUS SP.	F-COPEPODID	12535.5	174.1	9.9 - 2790.7	445.2	.114	.002	NEG.- .023	.00	.0009	.0000	.46	.28

ORGANISM NAME	PAPIS CODE / LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
DIAPTOMUS SP.	L-EGG-C FEM	145.6	2.7	1.8 - 116.3	16.4	.020	.000	NEG.- .012	.00	.0001	0	.01	.05
DIAPTOMUS FRANCISCANUS	U-ADULT	123.9	1.7	59.7 - 64.2	10.3	.004	.000	.002- .002	.00	.0000	0	.00	.01
DIAPTOMUS NOVAMEXICANUS	d-ADULT	84.6	1.2	41.8 - 42.6	7.0	.005	.000	NEG.- .004	.00	.0001	.0001	.00	.01
DIAPTOMUS ASHLANDI	U-ADULT	291.5	4.1	12.0 - 212.9	25.5	.008	.000	NEG.- .005	.00	.0000	.0000	.01	.02
EPISCHURA NEVADENSIS	6-ADULT	1117.6	12.5	23.0 - 1094.6	129.0	.033	.000	.002- .030	.00	.0001	.0001	.04	.08
EPISCHURA NEVADENSIS	F-COPEPODID	1459.5	20.3	1459.5 - 1459.5	172.0	.003	.000	.003- .003	.00	.0000	0	.05	.01
EPISCHURA NEVADENSIS	L-EGG-C FEM	243.2	3.4	243.2 - 243.2	28.7	.003	.000	.003- .003	.00	.0000	0	.01	.01
EURYTEMORA AFFINIS	8-ADULT	199946.7	2777.0	1.8 - 77268.6	10236.9	5.294	.074	NEG.- 2.095	.35	.0000	.0000	7.29	12.94
EURYTEMORA AFFINIS	F-COPEPODID	377751.0	5246.5	1.8 - 198304.8	19357.5	3.644	.051	NEG.- .898	.16	.0000	.0000	13.78	8.91
EURYTEMORA AFFINIS	L-EGG-C FEM	24042.7	333.9	3.4 - 12093.0	1563.9	.557	.008	NEG.- .248	.03	.0000	.0000	.88	1.36
ACARTIA SP.	F-COPEPODID	12706.3	176.5	49.0 - 4000.0	763.9	.106	.001	NEG.- .050	.01	.0000	.0000	.46	.26
ACARTIA CLAUSI	U-ADULT	7384.2	102.6	14.1 - 2832.6	485.3	.184	.003	NEG.- .086	.01	.0001	.0000	.27	.45
ACARTIA CLAUSI	A-JUV+ADULT	944.2	13.1	944.2 - 944.2	111.3	.004	.000	.004- .004	.00	.0000	0	.03	.01
ACARTIA CLAUSI	F-COPEPODID	1780.7	24.7	30.4 - 744.3	119.7	.035	.000	.003- .025	.00	.0000	.0000	.06	.09
ACARTIA LONGIREMIS	8-ADULT	415.2	5.8	9.2 - 333.3	34.7	.040	.001	NEG.- .033	.00	.0001	.0000	.02	.10
ACARTIA TONSA	6-ADULT	51.1	.7	51.1 - 51.1	6.0	.001	.000	.001- .001	.00	.0000	0	.00	.00
HARPACTICOIDA	2-NAUPLIUS	34.7	.5	34.7 - 34.7	4.1	.003	.000	.003- .003	.00	.0001	0	.00	.01
HARPACTICOIDA	8-ADULT	700.4	9.7	116.3 - 344.8	50.7	.058	.001	.012- .034	.00	.0001	.0000	.03	.14
HARPACTICOIDA	C-J/A NOSEX	2796.9	38.8	1000.0 - 1796.9	240.9	.123	.002	.033- .090	.01	.0000	.0000	.10	.30
HARPACTICOIDA	F-COPEPODID	681.0	9.5	6.8 - 449.2	54.6	.063	.001	NEG.- .045	.01	.0001	.0000	.02	.15
HARPACTICOIDA	L-EGG-C FEM	42.8	.6	42.8 - 42.8	5.0	.004	.000	.004- .004	.00	.0001	0	.00	.01
HARPACTICOIDA	M-EGG CASE	53.0	.7	17.7 - 35.3	4.6	.004	.000	.002- .002	.00	.0001	.0000	.00	.01
SCOTTOLANA CANADENSIS	6-ADULT	37263.2	517.5	3.9 - 15814.0	2220.7	.402	.006	NEG.- .093	.02	.0000	.0000	1.36	.90
SCOTTOLANA CANADENSIS	A-JUV+ADULT	33650.6	467.4	600.2 - 31446.5	3707.2	.055	.001	NEG.- .045	.01	.0000	.0000	1.23	.13
SCOTTOLANA CANADENSIS	C-J/A NOSEX	4.0	.1	4.0 - 4.0	.5	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00

ORGANISM NAME	LH-STAGE	NUMBER/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUN-DANCE	BIO-MASS
SCOTTOLANA CANADENSIS	F-COPEPODID	192635.7	2117.2	12.9 - 38453.1	6838.6	.277	.008	NEG.- .093	.02	.0000	.0000	5.56	1.51
SCOTTOLANA CANADENSIS	L-EGG-C FEM	933.0	13.0	119.0 - 465.1	69.2	.047	.001	.012- .023	.00	.0001	.0000	.03	.11
ECTINOSOMATIDAE	B-ADULT	192457.2	2673.0	9.9 - 15*348.8	10304.0	1.345	.019	NEG.- .930	.11	.0000	.0000	7.02	3.29
ECTINOSOMATIDAE	A-JUV+ADULT	202319.2	2810.0	216.5 - 172093.0	20333.7	1.136	.016	NEG.- .930	.11	.0000	.0000	7.38	2.78
ECTINOSOMATIDAE	C-J/A NOSEX	4.1	.1	4.1 - 4.1	.5	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00
ECTINOSOMATIDAE	F-COPEPODID	34.7	.5	34.7 - 34.7	4.1	.003	.000	.003- .003	.00	.0001	0	.00	.01
ECTINOSOMATIDAE	L-EGG-C FEM	94818.8	1316.9	23.9 - 50232.6	7014.3	.453	.006	NEG.- .093	.02	.0000	.0000	3.46	1.11
ECTINOSOMATIDAE	D-MATING PR	24212.5	336.3	12.9 - 18604.7	2260.7	.187	.003	NEG.- .093	.02	.0000	.0000	.88	.46
ECTINOSOMA SP.	B-ADULT	130.6	1.8	130.6 - 130.6	15.4	.001	.000	NEG.- NEG.	.00	.0000	0	.00	.00
ECTINOSOMA SP.	A-JUV+ADULT	204.1	2.8	204.1 - 204.1	24.1	.001	.000	NEG.- NEG.	.00	.0000	0	.01	.00
ECTINOSOMA SP.	F-COPEPODID	16.3	.2	16.3 - 16.3	1.9	.001	.000	NEG.- NEG.	.00	.0001	0	.00	.00
TACHIDIIDAE	B-ADULT	142.5	2.0	142.5 - 142.5	16.8	.001	.000	.001- .001	.00	.0000	0	.01	.00
TACHIDIIDAE	F-COPEPODID	1000.0	13.9	1000.0 - 1000.0	117.9	.033	.000	.033- .033	.00	.0000	0	.04	.08
TACHIDIIDAE	L-EGG-C FEM	11.9	.2	11.9 - 11.9	1.4	.001	.000	.001- .001	.00	.0001	0	.00	.00
MICROARTHRIDION LITTORALE	B-ADULT	20935.0	290.9	60.8 - 7441.9	1209.7	.297	.004	.001- .093	.02	.0000	.0000	.76	.73
MICROARTHRIDION LITTORALE	A-JUV+ADULT	10352.7	143.8	20.3 - 7000.0	842.6	.065	.001	NEG.- .050	.01	.0000	.0000	.38	.16
MICROARTHRIDION LITTORALE	C-J/A NOSEX	1796.9	25.0	898.5 - 898.5	143.7	.135	.002	.045- .090	.01	.0001	.0000	.07	.33
MICROARTHRIDION LITTORALE	F-COPEPODID	443.3	6.2	6.8 - 358.9	42.7	.020	.000	NEG.- .012	.00	.0001	.0000	.02	.05
MICROARTHRIDION LITTORALE	L-EGG-C FEM	2230.4	31.0	3.4 - 1500.0	180.5	.112	.002	NEG.- .050	.01	.0001	.0000	.08	.27
TACHIDIUS TRIANGULARIS	B-ADULT	9735.8	135.2	3.4 - 4333.3	694.8	.182	.003	NEG.- .093	.01	.0000	.0000	.36	.45
TACHIDIUS TRIANGULARIS	A-JUV+ADULT	1946.9	27.1	514.3 - 775.5	137.6	.005	.000	NEG.- .003	.00	.0000	.0000	.07	.01
TACHIDIUS TRIANGULARIS	L-EGG-C FEM	60.3	.9	8.2 - 40.0	5.4	.002	.000	NEG.- NEG.	.00	.0001	.0000	.00	.01
TACHIDIUS TRIANGULARIS	D-MATING PR	81.0	1.1	16.3 - 65.3	7.9	.002	.000	NEG.- NEG.	.00	.0000	.0000	.00	.00
TACHIDIUS DISCIPES	B-ADULT	115.1	1.6	46.0 - 69.1	9.7	.005	.000	.002- .002	.00	.0000	.0000	.00	.01
LAOPHONTIDAE	B-ADULT	164.0	2.3	3.7 - 85.8	11.1	.014	.000	NEG.- .009	.00	.0001	.0000	.01	.03

EPIBENTHIC PLANKTON ANALYSIS

SUMMARY TABLE, PAGE 10

ORGANISM NAME	PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUN-DANCE	BIO-MASS
LAOPHONTIDAE		L-EGG-C FEM	3.9	.1	3.9 - 3.9	.5	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00
CYLLINDROPSYLLIDAE		8-ADULT	333.3	4.6	333.3 - 333.3	37.3	.033	.000	.033- .033	.00	.0001	0	.01	.08
CYLLINDROPSYLLIDAE		C-J/A NOSEX	10.2	.1	10.2 - 10.2	1.2	.001	.000	.001- .001	.00	.0001	0	.00	.00
CYLLINDROPSYLLIDAE		L-EGG-C FEM	333.3	4.6	333.3 - 333.3	37.3	.033	.000	.033- .033	.00	.0001	0	.01	.08
PARALEPTASTACUS SP.		8-ADULT	254.9	3.5	6.9 - 248.1	29.2	.025	.000	NEG.- .025	.00	.0001	.0000	.01	.06
PARALEPTASTACUS SP.		L-EGG-C FEM	8.2	.1	8.2 - 8.2	1.0	.001	.000	NEG.- NEG.	.00	.0001	0	.00	.00
NITOCRA SP.		8-ADULT	3.4	.0	3.4 - 3.4	.4	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00
NITOCRA SP.		L-EGG-C FEM	301.3	4.2	53.2 - 248.1	29.8	.030	.000	.005- .025	.00	.0001	0	.01	.07
TETRAGONICIPITIDAE		8-ADULT	60.8	.8	30.4 - 30.4	5.0	.006	.000	.003- .003	.00	.0001	0	.00	.01
TETRAGONICIPITIDAE		F-COPEPODID	60.8	.8	60.8 - 60.8	7.2	.003	.000	.003- .003	.00	.0001	0	.00	.01
CLETODIDAE		C-J/A NOSEX	35.6	.5	35.6 - 35.6	4.2	.001	.000	.001- .001	.00	.0000	0	.00	.00
CLETODIDAE		F-COPEPODID	10.2	.1	10.2 - 10.2	1.2	.001	.000	.001- .001	.00	.0001	0	.00	.00
HUNTEMANNIA JADENSIS		8-ADULT	98.8	1.4	1.8 - 41.2	5.9	.005	.000	NEG.- .001	.00	.0001	.0000	.00	.01
HUNTEMANNIA JADENSIS		F-COPEPODID	8.2	.1	8.2 - 8.2	1.0	.001	.000	NEG.- NEG.	.00	.0001	0	.00	.00
BRYOCAMPTUS SP.		8-ADULT	3164.0	44.2	12.9 - 1500.0	213.6	.229	.003	NEG.- .100	.02	.0001	.0000	.12	.56
BRYOCAMPTUS SP.		L-EGG-C FEM	9.8	.1	3.4 - 6.5	.9	.001	.000	NEG.- NEG.	.00	.0001	0	.00	.00
ATTHEYELLA SP.		8-ADULT	460.9	6.4	1.8 - 232.6	29.6	.038	.001	NEG.- .023	.00	.0001	.0000	.02	.09
ATTHEYELLA SP.		C-J/A NOSEX	11.9	.2	11.9 - 11.9	1.4	.001	.000	.001- .001	.00	.0001	0	.00	.00
CYCLOPOIDA		2-NAUPLIUS	12093.0	168.0	12093.0 - 12093.0	1425.2	.093	.001	.093- .093	.01	.0000	0	.44	.23
CYCLOPOIDA		F-COPEPODID	18.4	.3	8.2 - 10.2	1.5	.002	.000	NEG.- .001	.00	.0001	0	.00	.00
CORYCAEUS ANGLICUS		8-ADULT	309.3	4.3	10.2 - 239.3	29.0	.019	.000	.001- .012	.00	.0001	.0000	.01	.05
CORYCAEUS ANGLICUS		F-COPEPODID	59.8	.8	59.8 - 59.8	7.0	.006	.000	.006- .006	.00	.0001	0	.00	.01
CYCLOPS SP.		A-JUV+ADULT	864.9	12.0	864.9 - 864.9	101.9	.002	.000	.002- .002	.00	.0000	0	.03	.00
CYCLOPS SP.		F-COPEPODID	26785.4	372.0	11.8 - 5862.1	1003.3	.488	.007	NEG.- .093	.02	.0000	.0000	.98	1.19
CYCLOPS VERNALIS		2-NAUPLIUS	17.7	.2	17.7 - 17.7	2.1	.002	.000	.002- .002	.00	.0001	0	.00	.00

ORGANISM NAME	PART, LIFE-STAGE CODE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
CYCLOPS VERNALIS	6-ADULT	5276.6	91.3	6.0 - 3720.9	584.9	.266	.004	NEG.- .093	.02	.0001	.0000	.24	.65
CYCLOPS VERNALIS	A-JUV+ADULT	59210.5	822.4	17.7 - 13953.5	2535.2	.286	.004	NEG.- .093	.01	.0000	.0000	2.16	.70
CYCLOPS VERNALIS	C-J/A NOSEX	85.8	1.2	85.8 - 85.8	10.1	.009	.000	.009- .009	.00	.0001	0	.00	.02
CYCLOPS VERNALIS	F-COPEPODID	14186.0	196.9	6.5 - 2790.7	517.7	.436	.006	NEG.- .093	.02	.0001	.0002	.52	1.07
CYCLOPS VERNALIS	L-EGG-C FEM	732.0	10.2	1.4 - 248.1	43.7	.064	.001	NEG.- .025	.00	.0001	.0000	.03	.16
CYCLOPS BICUSPIDATUS THOMASI	6-ADULT	2569.4	35.7	33.4 - 930.2	123.6	.244	.003	NEG.- .093	.02	.0001	.0000	.09	.60
CYCLOPS BICUSPIDATUS THOMASI	A-JUV+ADULT	39237.7	545.0	50.1 - 4651.7	916.7	.429	.006	NEG.- .045	.01	.0000	.0000	1.43	1.05
CYCLOPS BICUSPIDATUS THOMASI	C-J/A NOSEX	1924.2	62.3	6.8 - 1796.9	211.7	.091	.001	NEG.- .090	.01	.0001	0	.07	.22
CYCLOPS BICUSPIDATUS THOMASI	F-COPEPODID	6521.7	90.6	33.4 - 1555.2	229.6	.234	.003	NEG.- .093	.01	.0000	.0000	.24	.57
CYCLOPS BICUSPIDATUS THOMASI	L-EGG-C FEM	644.3	8.9	8.2 - 232.6	37.7	.041	.001	NEG.- .012	.00	.0001	.0000	.02	.10
MESOCYCLOPS EDAX	6-ADULT	15.8	.2	1.8 - 14.1	1.7	.002	.000	NEG.- .001	.00	.0001	0	.00	.00
PARACYCLOPS FIMBRIATUS	6-ADULT	278.1	3.9	3.5 - 248.1	29.3	.028	.000	NEG.- .025	.00	.0001	0	.01	.07
PARACYCLOPS FIMBRIATUS	F-COPEPODID	17.7	.2	17.7 - 17.7	2.1	.002	.000	.002- .002	.00	.0001	0	.00	.00
OITHONA SP.	7-JUVENILE	1226.4	17.0	1226.4 - 1226.4	144.5	.010	.000	.010- .010	.00	.0000	0	.04	.02
OITHONA SP.	6-ADULT	11.2	.2	11.2 - 11.2	1.3	.001	.000	NEG.- NEG.	.00	.0001	0	.00	.00
OITHONA SP.	A-JUV+ADULT	766.5	10.6	766.5 - 766.5	90.3	.001	.000	.001- .001	.00	.0000	0	.03	.00
OITHONA SP.	C-J/A NOSEX	99.2	1.4	99.2 - 99.2	11.7	.010	.000	.010- .010	.00	.0001	0	.00	.02
OITHONA SP.	F-COPEPODID	3008.5	41.8	49.3 - 1500.0	231.8	.068	.001	.004- .050	.01	.0000	.0000	.11	.17
OITHONA SIMILIS	A-JUV+ADULT	4333.3	60.2	4333.3 - 4333.3	513.7	.033	.000	.033- .033	.00	.0000	0	.16	.08
BALANOMORPHA	2-NAUPLIUS	75810.1	1052.9	5.0 - 34000.0	4962.0	.369	.005	NEG.- .093	.01	.0000	.0000	2.76	.90
BALANOMORPHA	E-CYPRIS	720.6	10.0	1.8 - 333.3	46.6	.057	.001	NEG.- .033	.00	.0001	.0000	.03	.14
BALANUS SP.	6-ADULT	.1	.0	.1 - .1	.0	.008	.000	.008- .008	.00	.1000	0	.00	.02
MYSIDACEA-MYSIDA	7-JUVENILE	53.0	.7	5.2 - 20.4	3.3	.065	.001	NEG.- .053	.01	.0012	.0019	.00	.16
ACANTHOMYSIS MACROPSIS	7-JUVENILE	20.4	.3	.4 - 20.0	2.4	.054	.001	.004- .050	.01	.0062	.0053	.00	.13
ACANTHOMYSIS MACROPSIS	6-ADULT	6.1	.1	.1 - 5.0	.6	.086	.001	.003- .033	.01	.0171	.0144	.00	.21

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
ACANTHOMYSIS MACROPSIS	L-EGG-C FEM	.5	.0	.5 - .5	.1	.007	.000	.007- .007	.00	.0133	0	.00	.02
ARCHAEOMYSIS GREBNITZKII	8-ADULT	11.1	.2	.0 - 5.0	.8	.102	.031	.001- .050	.01	.0602	.0979	.00	.25
ARCHAEOMYSIS GREBNITZKII	C-J/A NOSEX	.4	.0	.4 - .4	.0	.004	.000	.004- .004	.00	.0100	0	.00	.01
NEOMYSIS MERCEDIS	7-JUVENILE	492.3	6.6	.4 - 133.7	23.9	.799	.011	.002- .310	.04	.0069	.0146	.02	1.95
NEOMYSIS MERCEDIS	8-ADULT	150.4	2.1	.1 - 49.3	7.3	1.204	.017	.003- .299	.05	.0257	.0448	.01	2.94
NEOMYSIS MERCEDIS	A-JUV+ADULT	136.4	1.9	.4 - 60.0	10.2	.839	.012	.006- .359	.02	.0105	.0056	.01	2.04
NEOMYSIS MERCEDIS	L-EGG-C FEM	17.8	.2	.1 - 7.0	1.0	.421	.006	.003- .093	.02	.0343	.0277	.00	1.03
NEOMYSIS INTEGER	7-JUVENILE	10.1	[illegible]	.1 - 10.0	1.2	.053	.001	.003- .050	.01	.0225	.0247	.00	.13
NEOMYSIS INTEGER	8-ADULT	10.8	.2	.0 - 10.0	1.2	.044	.001	.003- .033	.00	.0329	.0376	.00	.11
NEOMYSIS INTEGER	A-JUV+ADULT	.9	.0	.9 - .9	.1	.011	.000	.011- .011	.00	.0120	0	.00	.03
NEOMYSIS INTEGER	L-EGG-C FEM	.2	.0	.1 - .2	.0	.013	.000	.003- .009	.00	.0488	.0125	.00	.03
LEUCON SP	7-JUVENILE	141.0	2.0	6.5 - 91.2	11.4	.035	.000	NEG.- .030	.00	.0002	.0001	.01	.09
LEUCON SP	8-ADULT	10.2	.1	10.2 - 10.2	1.2	.001	.000	.001- .001	.00	.0001	0	.00	.00
LEUCON SP	C-J/A NOSEX	40.6	[illegible]	10.2 - 30.4	3.8	.004	.000	.001- .003	.00	.0001	0	.00	.01
SADURIA ENTOMON	7-JUVENILE	.2	.0	.0 - .1	.0	.028	.000	.003- .025	.00	.1417	.0825	.00	.07
SADURIA ENTOMON	C-J/A NOSEX	.2	.0	.2 - .2	.0	.023	.000	.023- .023	.00	.1282	0	.00	.06
COROPHIUM SP.	7-JUVENILE	1474.6	20.5	1.0 - 930.2	117.4	.309	.004	NEG.- .200	.03	.0001	.0002	.05	.75
COROPHIUM SALMONIS	7-JUVENILE	1079.2	15.0	1.2 - 904.8	107.4	.587	.008	NEG.- .479	.06	.0155	.0343	.04	1.43
COROPHIUM SALMONIS	8-ADULT	9.3	.1	.1 - 8.2	1.0	.010	.000	.001- .008	.00	.0052	.0064	.00	.02
COROPHIUM SALMONIS	A-JUV+ADULT	1130.6	15.7	1130.6 - 1130.6	133.2	.998	.014	.998- .998	.12	.0009	0	.04	2.44
COROPHIUM SALMONIS	C-J/A NOSEX	1.6	.0	1.6 - 1.6	.2	.004	.000	.004- .004	.00	.0020	0	.00	.01
COROPHIUM SALMONIS	L-EGG-C FEM	.1	.0	.1 - .1	.0	.001	.000	.001- .001	.00	.0200	0	.00	.00
COROPHIUM SPINICORNE	7-JUVENILE	3.4	.0	3.4 - 3.4	.4	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00
COROPHIUM SPINICORNE	8-ADULT	.4	.0	.1 - .2	.0	.026	.000	.001- .025	.00	.0550	.0636	.00	.06
ANISOGAMMARUS SP.	7-JUVENILE	944.9	13.1	3.5 - 898.5	105.9	.187	.003	.004- .093	.02	.0088	.0151	.03	.40

ORGANISM NAME	PARTS CODE	LIFE-STAGE	NUM/M**3 TOTAL	NUM/M**3 MEAN	NUM/M**3 RANGE	NUM/M**3 S.D.	WET WEIGHT, GRAMS/M**3 TOTAL	WET WEIGHT MEAN	WET WEIGHT RANGE	WET WEIGHT S.D.	AVG. BIOMASS MEAN	AVG. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS
EOGAMMARUS CONFERVICOLUS		7-JUVENILE	99.9	1.2	8.? - 81.8	9.7	.021	.000	NEG.- .020	.00	.0002	.0001	.00	.05
EOGAMMARUS SP.		7-JUVENILE	177.5	24.6	10.0 - 437.3	115.4	.166	.002	.001- .060	.01	.0006	.0016	.06	.40
EOGAMMARUS OCLAIRI		7-JUVENILE	.0	.0	.0 - .0	.0	.003	.000	.003- .003	.00	.0833	0	.00	.01
EOGAMMARUS OCLAIRI		A-JUV+ADULT	16.2	.2	.8 - 8.1	1.2	.184	.003	.025- .090	.01	.0164	.0096	.00	.45
EOHAUSTORIUS SP.		C-J/A NOSEX	.0	.0	.0 - .0	.0	.003	.000	.003- .003	.00	.0833	0	.00	.01
EUPHAUSIACEA		6-LARVA	224.8	3.1	92.0 - 132.9	18.9	.002	.000	.001- .001	.00	.0000	.0000	.01	.00
HIPPOLYTIDAE		4-MEGALOP	10.2	.1	10.2 - 10.2	1.2	.010	.000	.010- .010	.00	.0010	0	.00	.02
CRANGON SP.		7-JUVENILE	.1	.0	.1 - .1	.0	.014	.000	.014- .014	.00	.1250	0	.00	.03
CRANGON FRANCISCORUM		7-JUVENILE	15.7	.2	.1 - 2.9	.5	5.503	.076	.002- 1.240	.24	.3226	.3688	.00	13.45
CRANGON FRANCISCORUM		8-ADULT	51.9	.7	.0 - 49.3	5.8	3.153	.044	.024- 1.661	.21	.9652	.7275	.00	7.71
CANCER MAGISTER		4-MEGALOP	.0	.0	.0 - .0	.0	.001	.000	.001- .001	.00	.0513	0	.00	.00
COLLEMBOLA		6-ADULT	6.5	.1	6.5 - 6.5	.8	.001	.000	NEG.- NEG.	.00	.0001	0	.00	.00
COLLEMBOLA		C-J/A NOSEX	8.2	.1	8.2 - 8.2	1.0	.001	.000	NEG.- NEG.	.00	.0001	0	.00	.00
EPHEMEROPTERA		6-LARVA	23.0	.3	23.0 - 23.0	2.7	.002	.000	.002- .002	.00	.0001	0	.00	.01
ODONATA		H-NYMPH	2.0	.0	2.0 - 2.0	.2	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00
ZYGOPTERA		H-NYMPH	1.8	.0	1.8 - 1.8	.2	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00
PLECOPTERA		H-NYMPH	2.0	.0	2.0 - 2.0	.2	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00
INSECTA II		6-LARVA	1.8	.0	1.8 - 1.8	.2	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00
TRICOPTERA		6-LARVA	1.8	.0	1.8 - 1.8	.2	.000	.000	NEG.- NEG.	.00	.0001	0	.00	.00
CERATOPOGONIDAE		6-LARVA	126.8	1.8	3.6 - 119.6	14.1	.012	.000	NEG.- .012	.00	.0001	.0000	.00	.03
CHAOBORUS		6-LARVA	1.2	.0	1.2 - 1.2	.1	.093	.001	.093- .093	.01	.0769	0	.00	.23
DIPTERA-CHIRONOMIDAE		6-LARVA	493.5	6.9	1.5 - 119.6	22.8	.049	.001	NEG.- .013	.00	.0001	.0000	.02	.11
TARDIGRADA		C-J/A NOSEX	119.6	1.7	119.6 - 119.6	14.1	.012	.000	.012- .012	.00	.0001	0	.00	.03
GYMNOLAEMATA		X-CYPH.LARV	551.1	7.7	6.2 - 500.0	59.1	.055	.001	NEG.- .050	.01	.0001	.0000	.02	.13
INSECTA II		7-JUVENILE	676.9	9.4	10.2 - 666.7	76.6	.034	.000	.001- .033	.00	.0001	.0000	.02	.08

EPIBENTHIC PLANKTON ANALYSIS
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SUMMARY TABLE, PAGE 14

ORGANISM NAME / PARTS CODE	LH-STAGE	NUMBERS/M**3 TOTAL	MEAN	RANGE	S.D.	WET WEIGHT,GRAMS/M**3 TOTAL	MEAN	RANGE	S.D.	AVG. BIOMASS MEAN	S.D.	PERCENTAGES ABUNDANCE	BIOMASS
SAGITTA SP.	7-JUVENILE	69.8	1.0	10.0 - 59.8	7.1	.039	.001	.006- .033	.00	.0017	.0023	.00	.10
SAGITTA SP.	8-ADULT	.4	.0	.4 - .4	.1	.004	.000	.004- .004	.00	.0100	0	.00	.01
SAGITTA ELEGANS	7-JUVENILE	35.1	.5	35.1 - 35.1	4.1	.004	.000	.004- .004	.00	.0001	0	.00	.01
LARVACEA	C-J/A NOSEX	8000.0	111.1	8000.0 - 8000.0	942.8	.033	.000	.033- .033	.00	.0000	0	.29	.08
OIKOPLEURA SP.	C-J/A NOSEX	12026.2	167.4	71.5 - 7000.0	938.3	.069	.001	.002- .050	.01	.0000	.0000	.44	.17
TELEOSTEI	1-EGG	2.2	.1	1.8 - 3.7	.5	.001	.000	NEG.- NEG.	.00	.0001	0	.00	.00
TELEOSTEI	6-LARVA	39.0	.5	.9 - 19.3	2.3	.019	.000	NEG.- .010	.00	.0464	.1002	.00	.05
OSMERIDAE	6-LARVA	161.4	2.2	1.6 - 40.0	7.0	.097	.001	.002- .030	.01	.0028	.0056	.01	.24
COTTIDAE	7-JUVENILE	[illegible]	.0	.1 - .1	.0	.014	.000	.014- .014	.00	.2000	0	.00	.03
COTTIDAE	C-J/A NOSEX	.1	.0	.1 - .1	.0	.008	.000	.008- .008	.00	.1200	0	.00	.02
COTTUS ASPER	6-LARVA	46.0	.6	46.0 - 46.0	5.4	.023	.000	.023- .023	.00	.0005	0	.00	.06
PAROPHRYS VETULUS	7-JUVENILE	.2	.0	.2 - .2	.0	.015	.000	.015- .015	.00	.0902	0	.00	.04
UNIDENTIFIED EGG	1-EGG	371.5	5.2	5.0 - 194.2	24.8	.007	.000	NEG.- .001	.00	.0000	.0000	.01	.02
UNIDENTIFIED EGG	8-EGG CASE	230.2	3.2	13.7 - 83.4	13.2	.010	.000	NEG.- .004	.00	.0001	.0000	.01	.02
UNIDENTIFIED	C-J/A NOSEX	4302.8	60.0	6.9 - 2000.0	289.2	.111	.002	NEG.- .050	.01	.0000	.0000	.16	.27

TOTAL NUMBER OF PLANKTON CATEGORIES 292

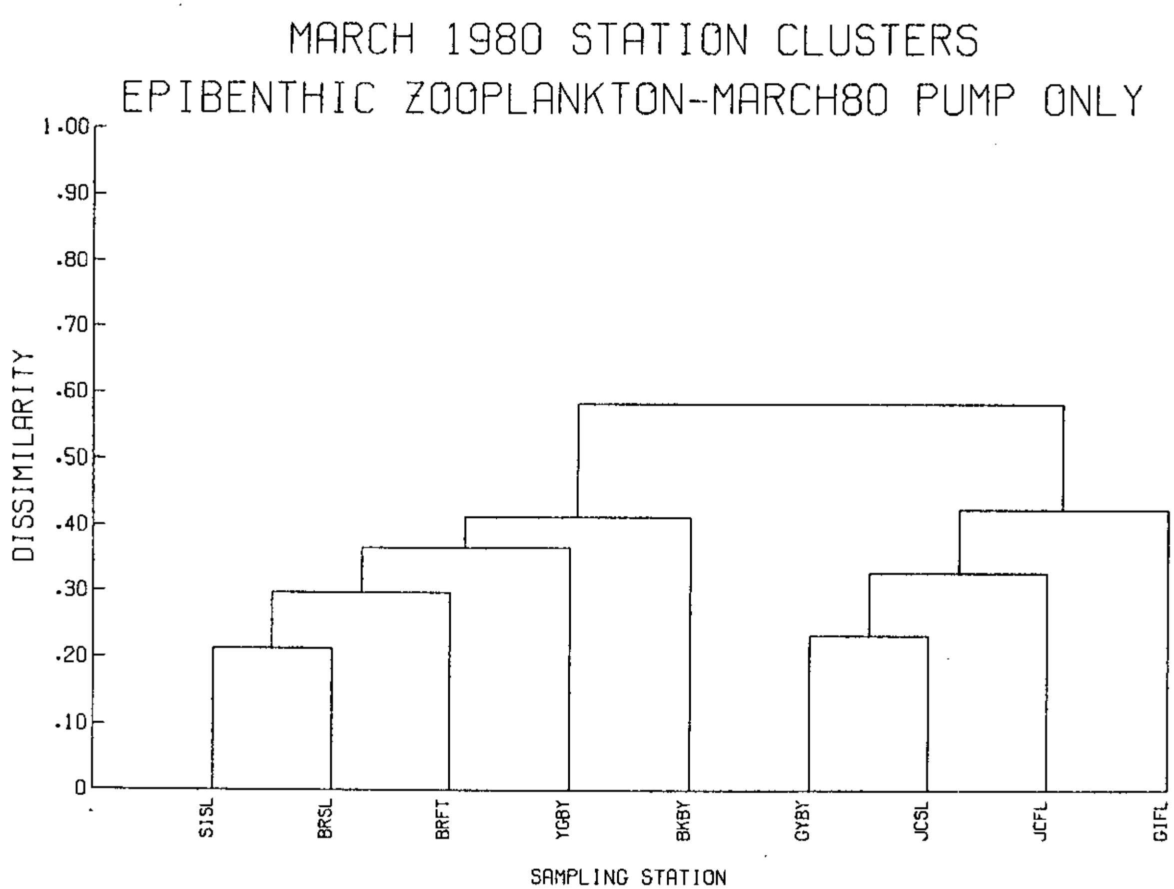
SHANNON-WEINER DIVERSITY INDEX NUMBERS 4.55
BIOMASS 5.40
BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS 4.55

APPENDIX C. Monthly cluster dendograms of epibenthic zooplankton sampling stations and taxa in the Columbia River Estuary, March 1980 - July 1981; see Section 2.5.6 for description of classification technique.

Sampling Station Clusters

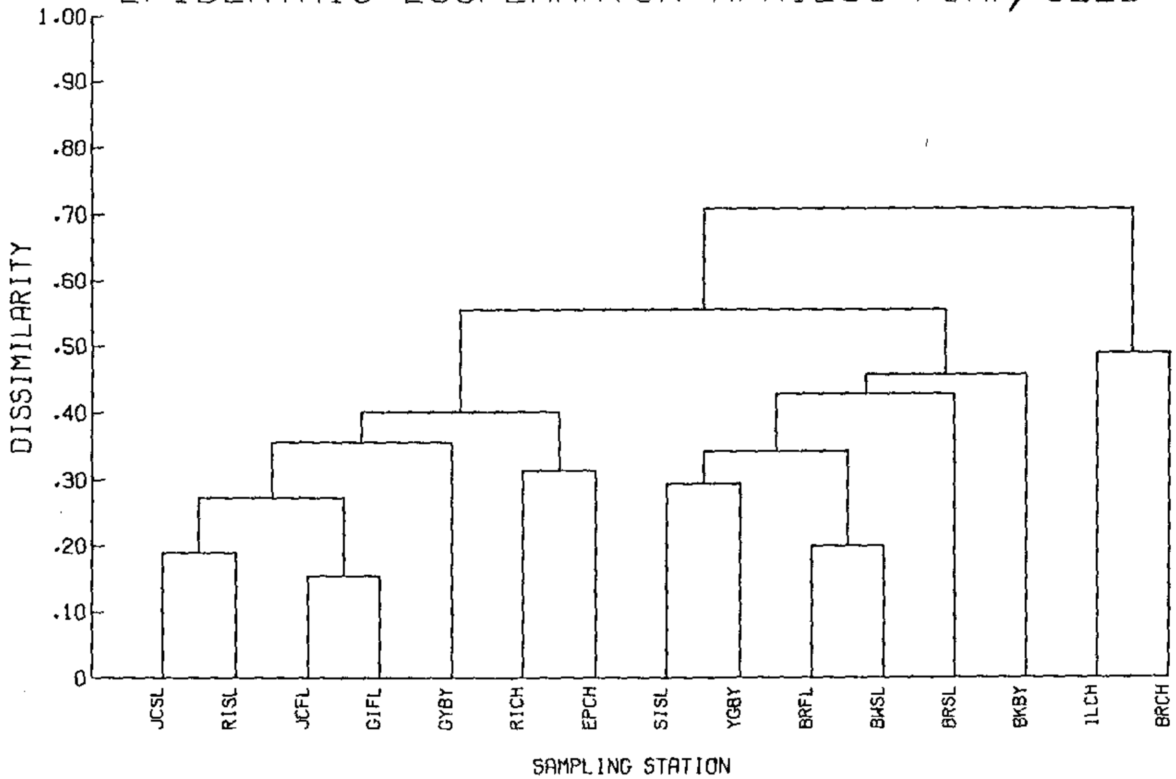
Legend

Code	Location
BKBY	Baker Bay Flat
BRCH	Bridge Channel
BRFT	Bridge Flat
BRSL	Bridge Slope
BWSL	Bradwood Slope
CHBY	Cathlamet Bay Channel
EPCH	Elliot Point Channel
GIFL	Guinn's Island Flat
GYBY	Grays Bay Flat
ILCH	Ilwaco Channel
JCFL	Jim Crow Sands Flat
JCSL	Jim Crow Sands Slope
RICH	Rice Island Channel
RISL	Rice Island Slope
SISL	Sand Island Slope
YGBY	Youngs Bay Slope

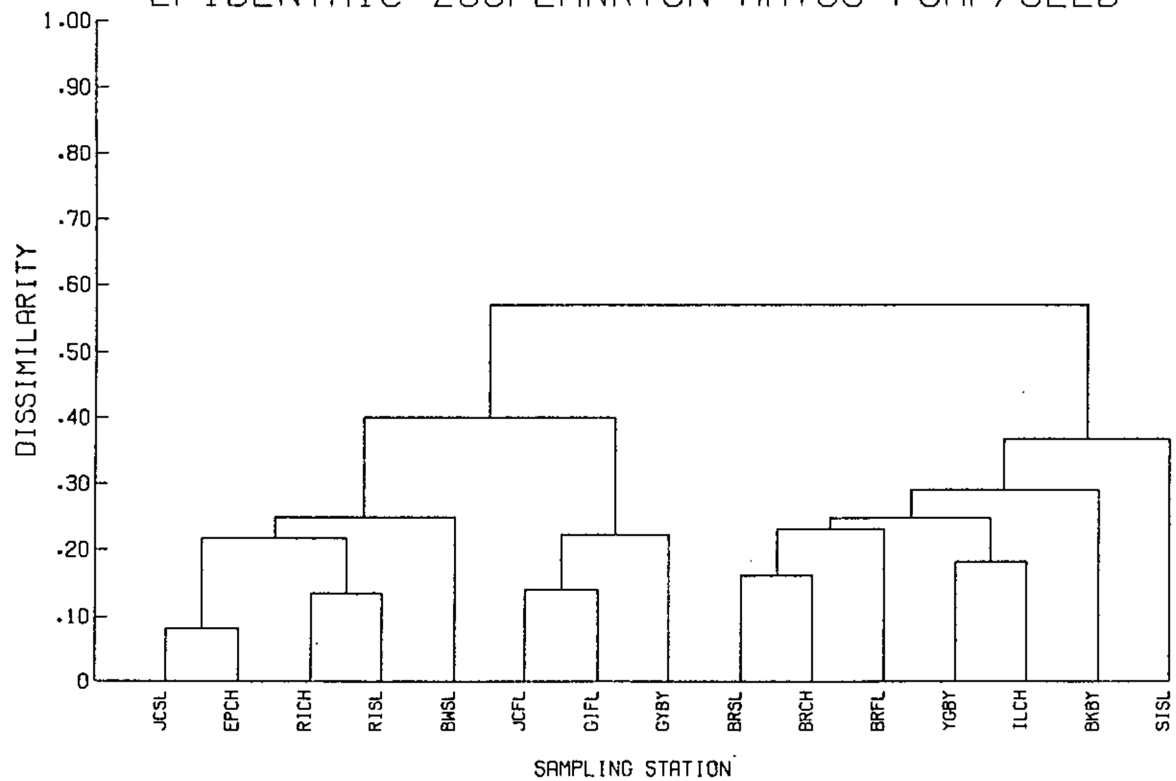

MARCH 1980 STATION CLUSTERS
EPIBENTHIC ZOOPLANKTON-MARCH80 PUMP ONLY
DISSIMILARITY
1.00
.90
.80
.70
.60
.50
.40
.30
.20
.10
0
SISL
BRSL
BRFT
YGBY
BKBY
GYBY
JCSL
JCFL
GIFL
SAMPLING STATION

APRIL 1980 STATION CLUSTERS

EPIBENTHIC ZOOPLANKTON-APRIL80 PUMP/SLED

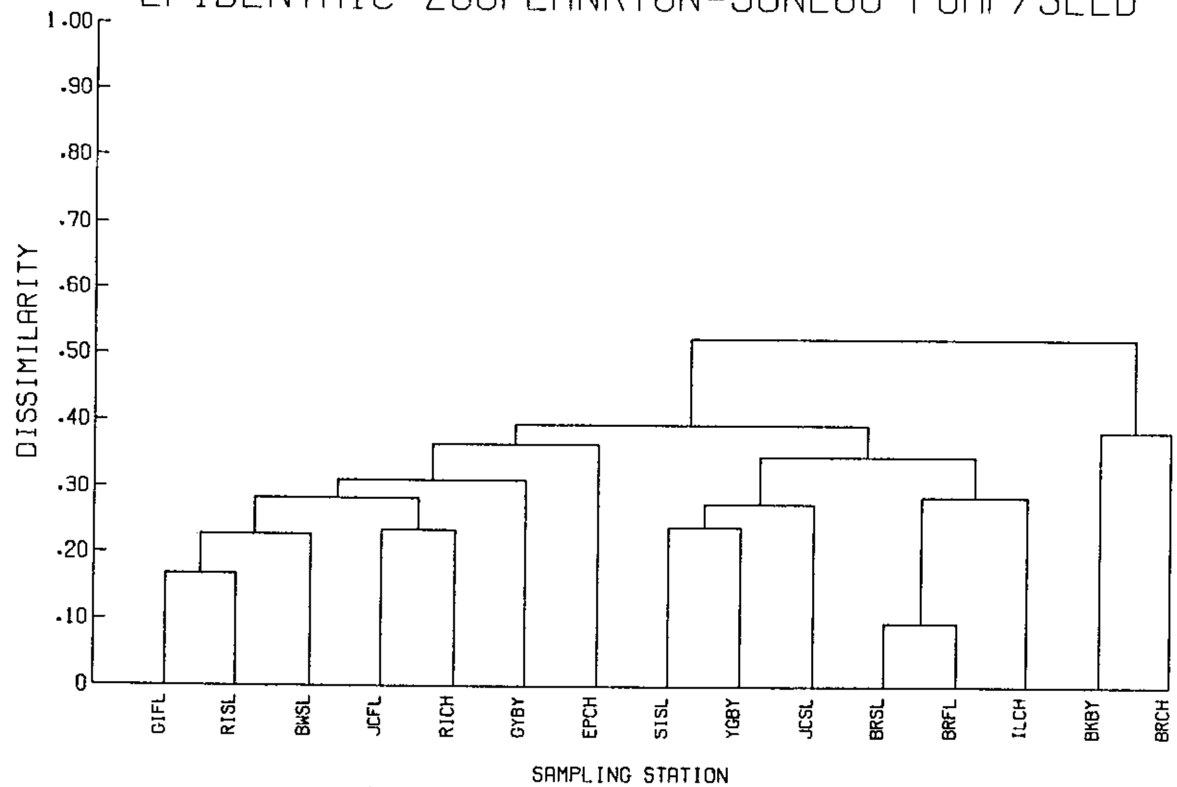


MAY 1980 STATION CLUSTERS
EPIBENTHIC ZOOPLANKTON-MAY80 PUMP/SLED

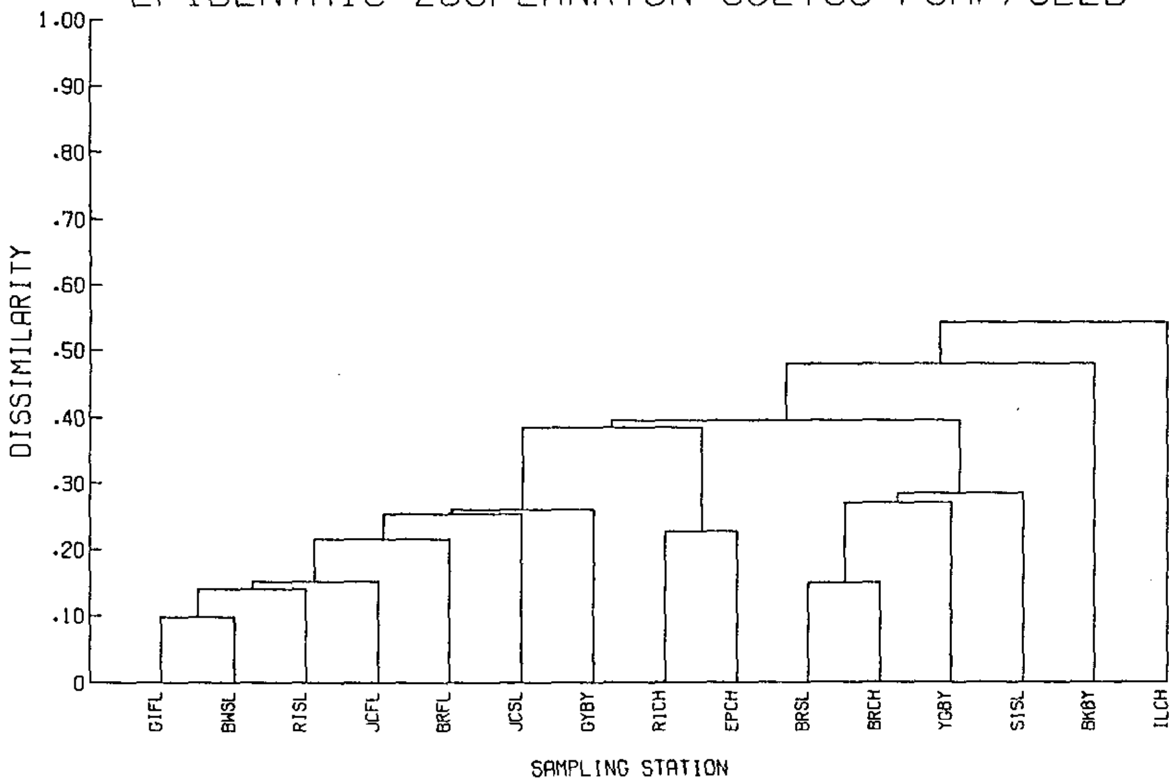


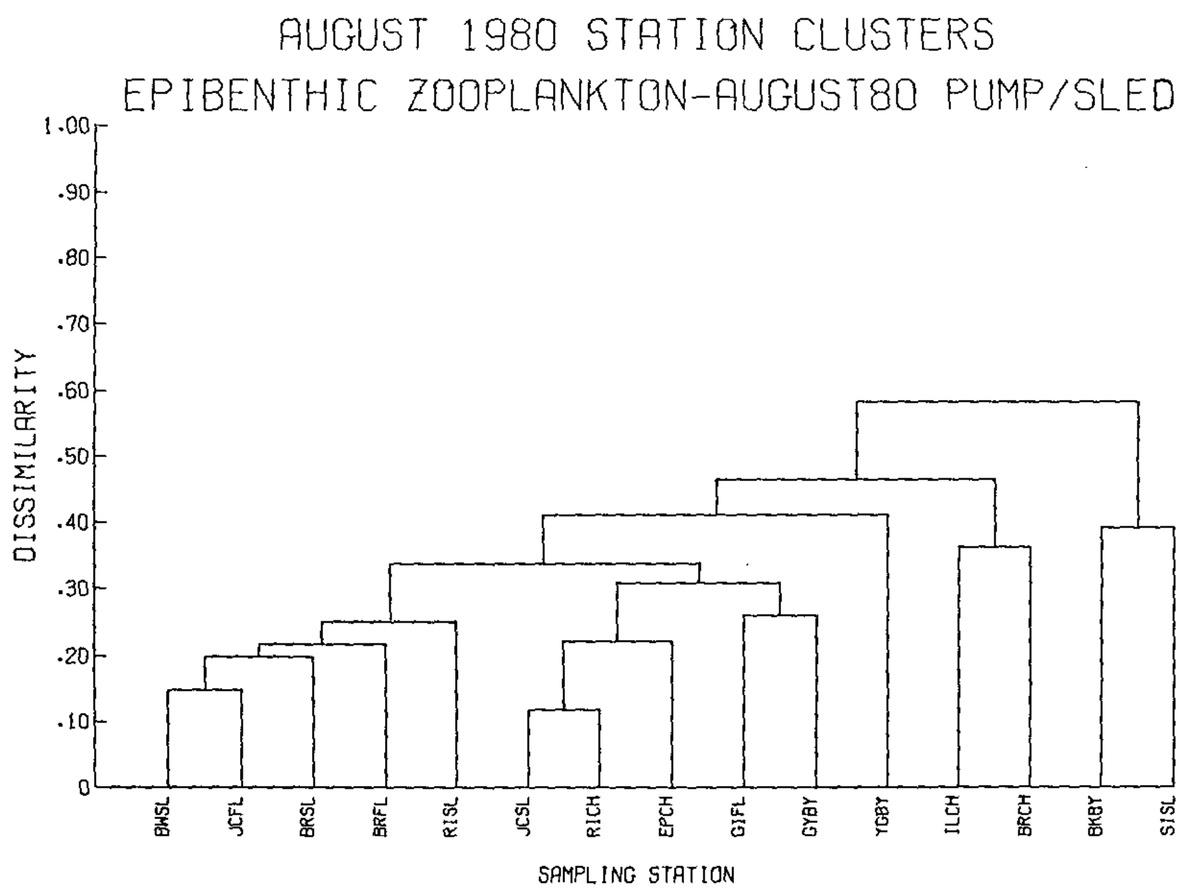
JUNE 1980 STATION CLUSTERS

EPIBENTHIC ZOOPLANKTON-JUNE80 PUMP/SLED



JULY 1980 STATION CLUSTERS
EPIBENTHIC ZOOPLANKTON-JULY80 PUMP/SLED

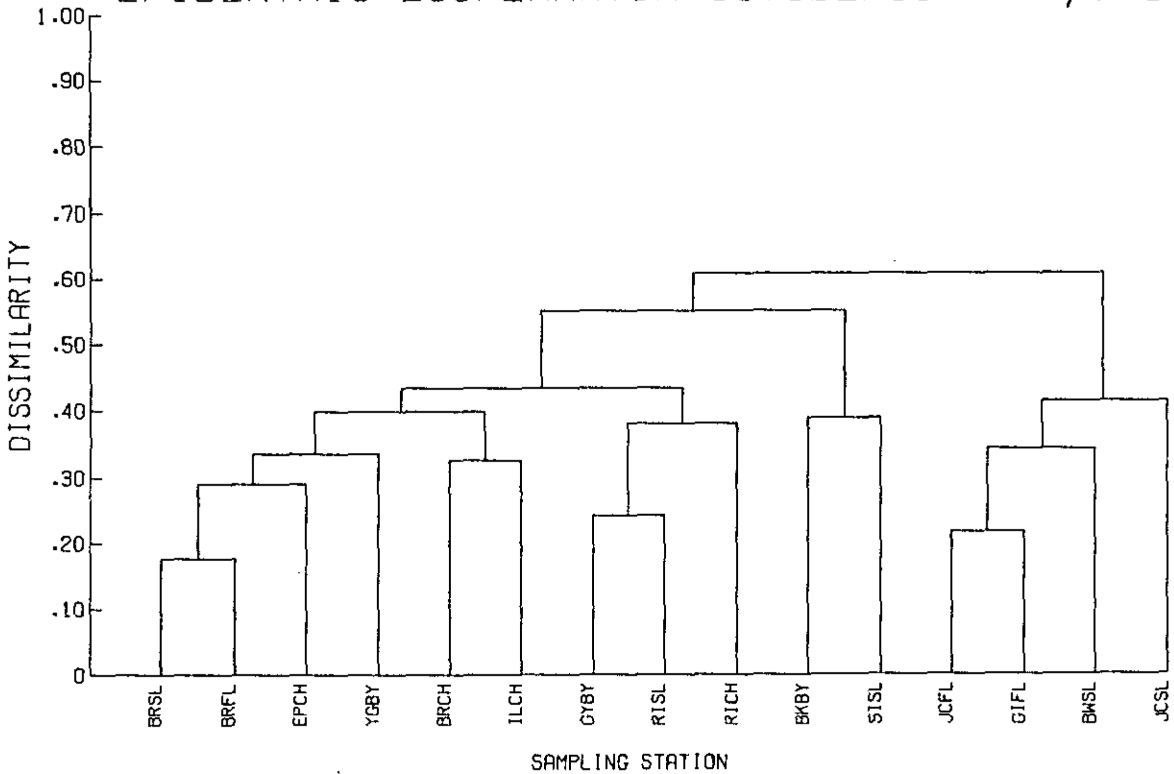



AUGUST 1980 STATION CLUSTERS
EPIBENTHIC ZOOPLANKTON-AUGUST80 PUMP/SLED
DISSIMILARITY
1.00
.90
.80
.70
.60
.50
.40
.30
.20
.10
0
BWSL
JCFL
BRSL
BRFL
RISL
JCSL
RICH
EPCH
GIFL
GYBY
YGBY
ILCH
BRCH
BKBY
SISL
SAMPLING STATION

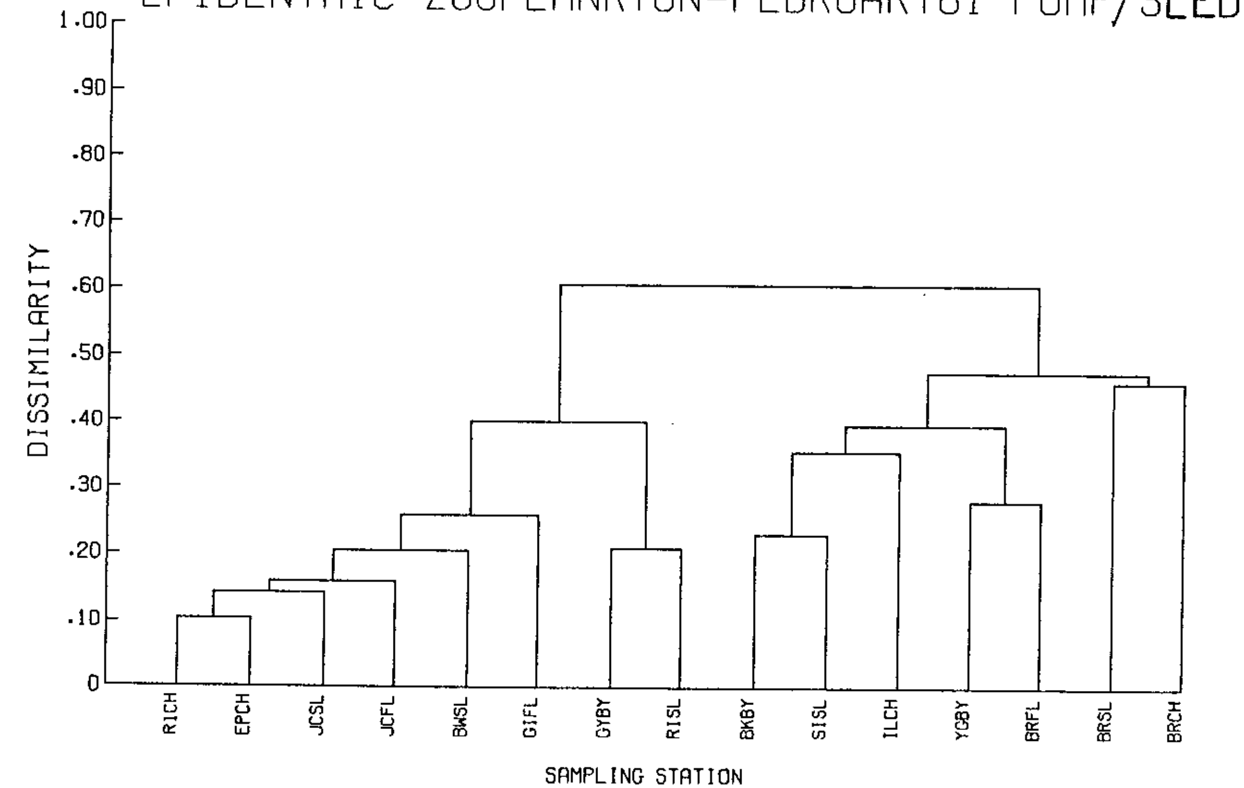
379

OCTOBER 1980 STATION CLUSTERS

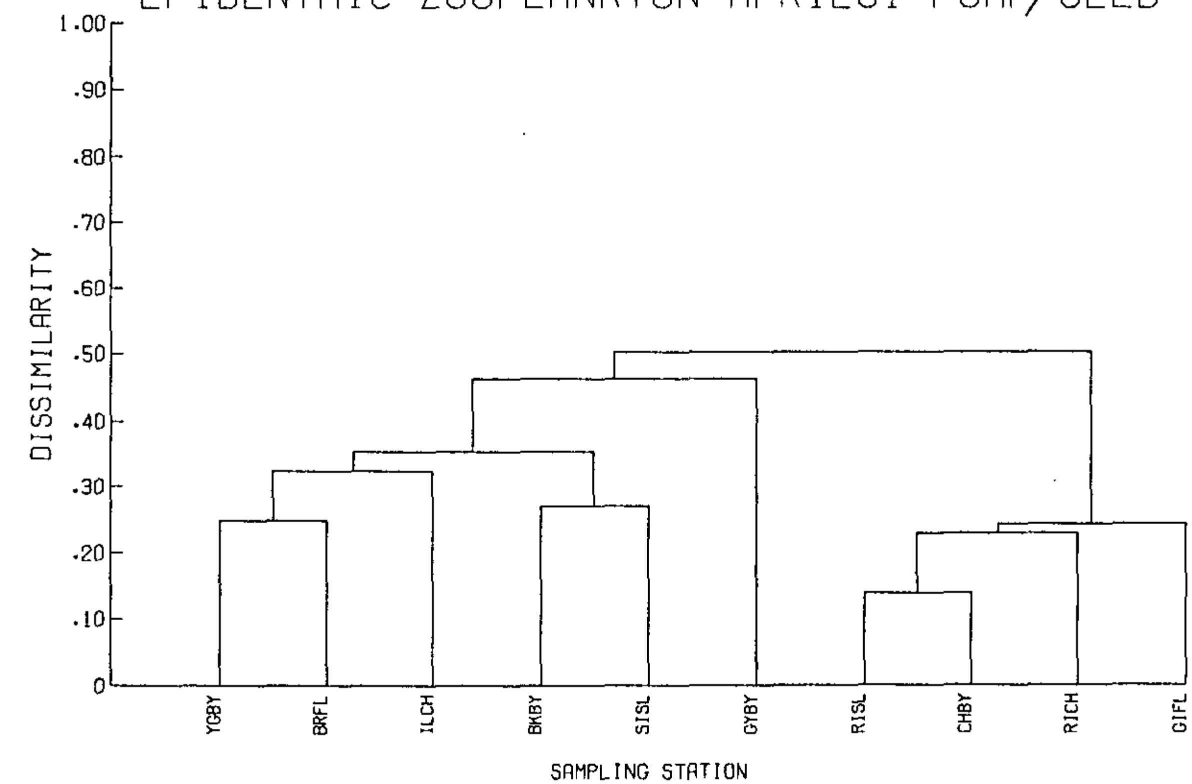
EPIBENTHIC ZOOPLANKTON-OCTOBER80 PUMP/SLED

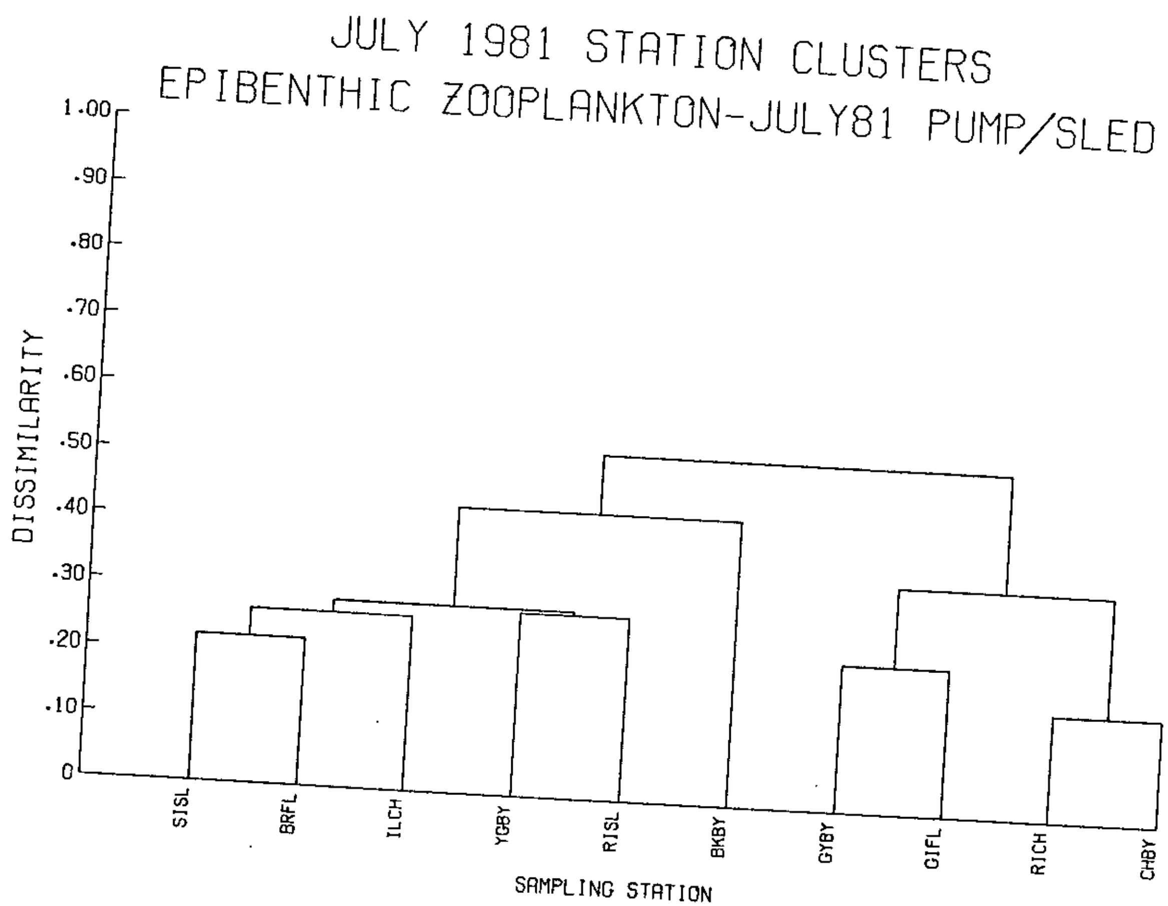


FEBRUARY 1981 STATION CLUSTERS
EPIBENTHIC ZOOPLANKTON-FEBRUARY81 PUMP/SLED



APRIL 1981 STATION CLUSTERS
EPIBENTHIC ZOOPLANKTON-APRIL81 PUMP/SLED




JULY 1981 STATION CLUSTERS
EPIBENTHIC ZOOPLANKTON-JULY81 PUMP/SLED
DISSIMILARITY
1.00
.90
.80
.70
.60
.50
.40
.30
.20
.10
0
SISL
BRFL
ILCH
YGBY
RISL
BKBY
GYBY
CIFL
RICH
CHBY
SAMPLING STATION

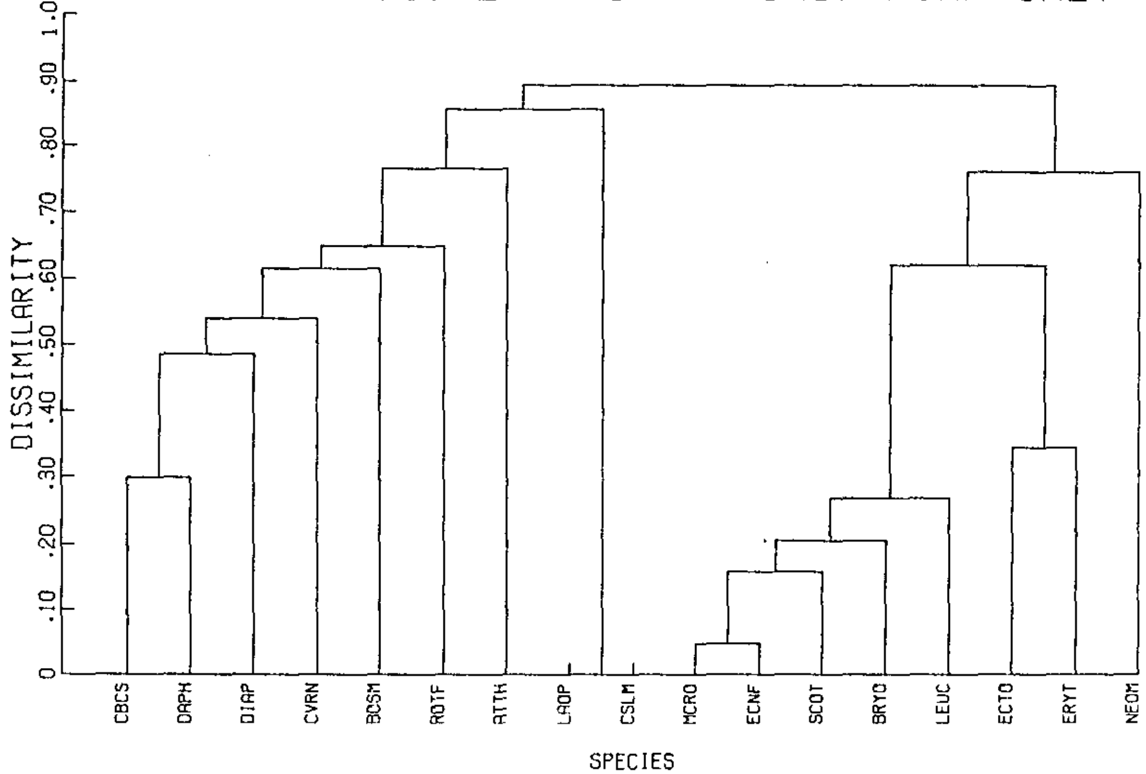
Taxa Clusters

Legend

Code	Location
ACAR	*Acartia* spp.
ALON	*Alona* spp.
ATTH	*Attheyella* sp.
BOSM	*Bosmina* sp.
BRYO	*Bryocamptus* sp.
CAND	*Candona* sp.
CBCS	*Cyclops bicuspidatus*
CORO	*Corophium* spp.
CORY	*Corycaeus* spp.
CSLM	*Corophium salmonis*
CVRN	*Cyclops vernalis*
DAPH	*Daphnia* spp.
DIAP	*Diaptomus* spp.
ECNF	*Eogammarus confervicolus*
ECTO	*Ectinocomatidae*
EOGM	*Eogammarus* spp.
EPIS	*Epischura nevadensis*
ERYT	*Eurytemora affinis*
HUNT	*Huntemannia jadensis*
LAOP	Laophontidae
LEUC	*Leucon* spp.
LMNO	*Limnocythere* sp.
MCRO	*Microarthridion littorale*
MESO	*Mesochra* spp.
NEOM	*Neomysis mercedis*
NTOC	*Nitocra* sp.
OITH	*Oithona* sp.
PARL	*Paraleptastacus* sp.
PCFM	*Paracyclops fimbriatus*
PCYC	*Paracyclops* spp.
ROTF	*Rotifera*
SCOT	*Scottolana canadensis*
TDIS	*Tachidius discipes*
TTRI	*Tachidius triangularis*

MARCH 1980 TAXA CLUSTERS

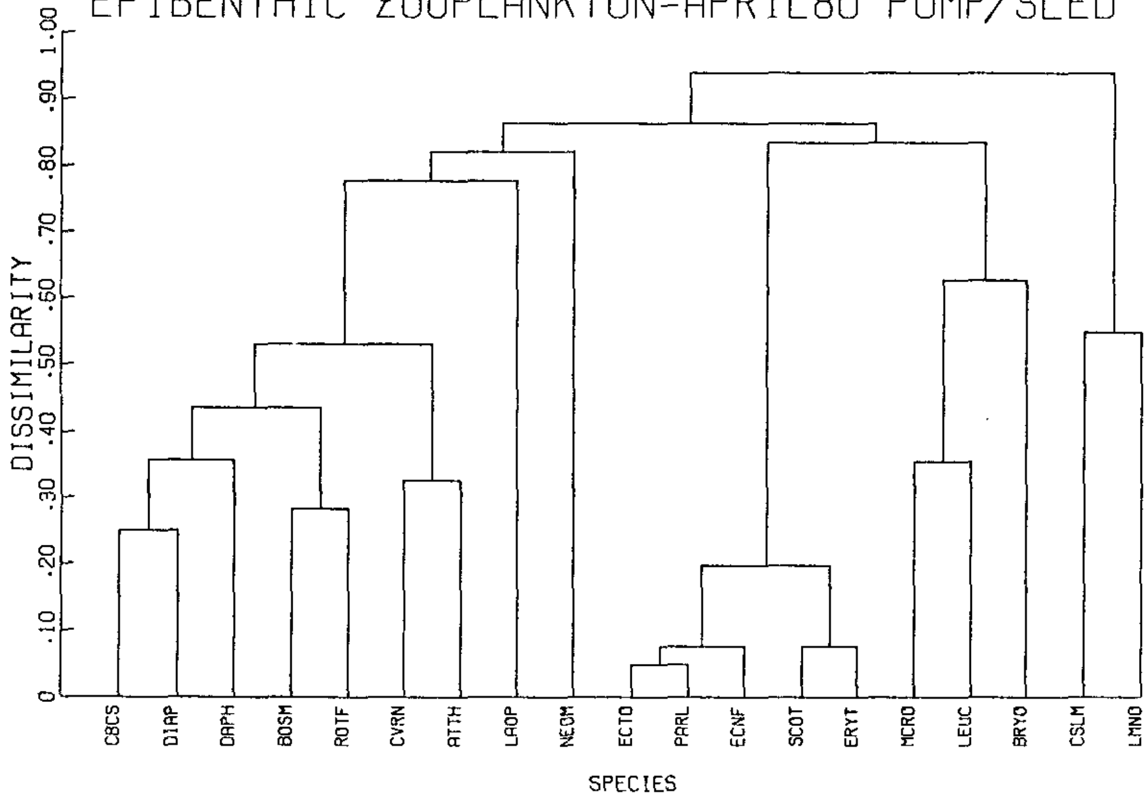
EPIBENTHIC ZOOPLANKTON-MARCH80 PUMP ONLY

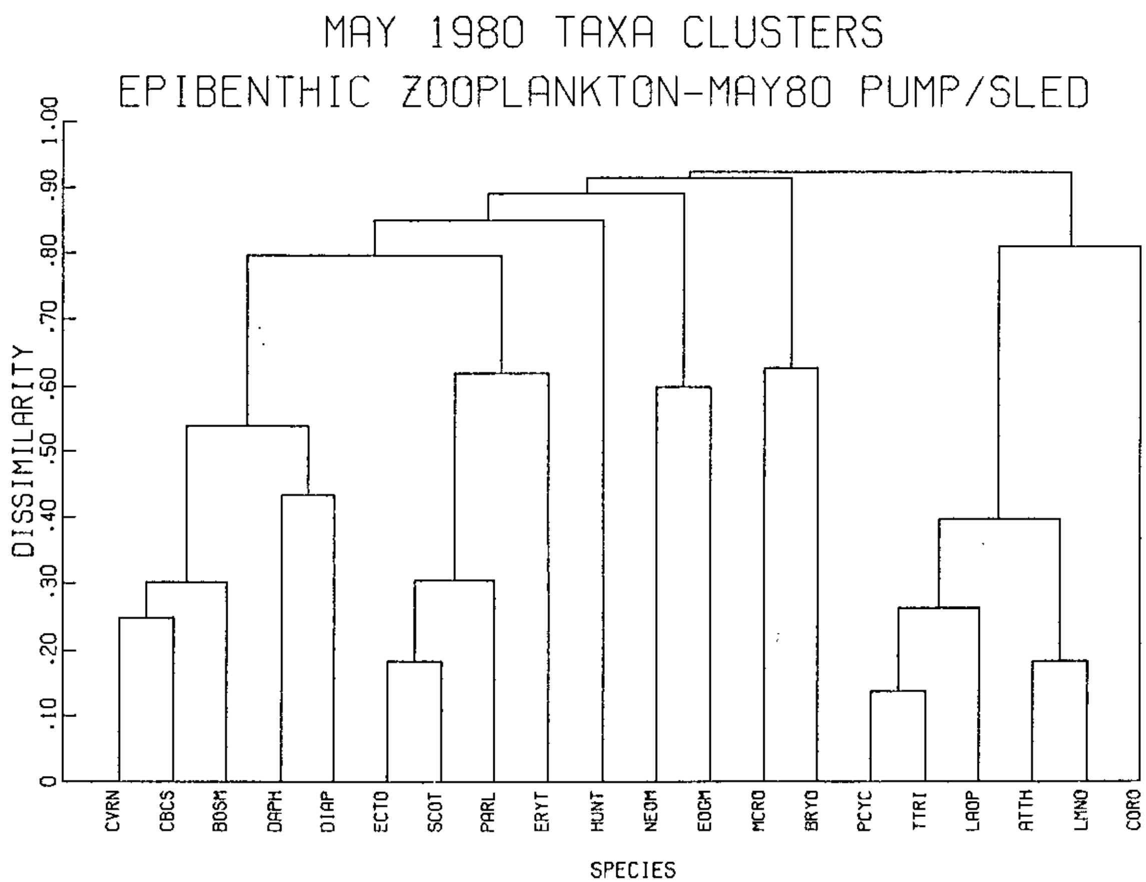


201

APRIL 1980 TAXA CLUSTERS

EPIBENTHIC ZOOPLANKTON-APRIL80 PUMP/SLED

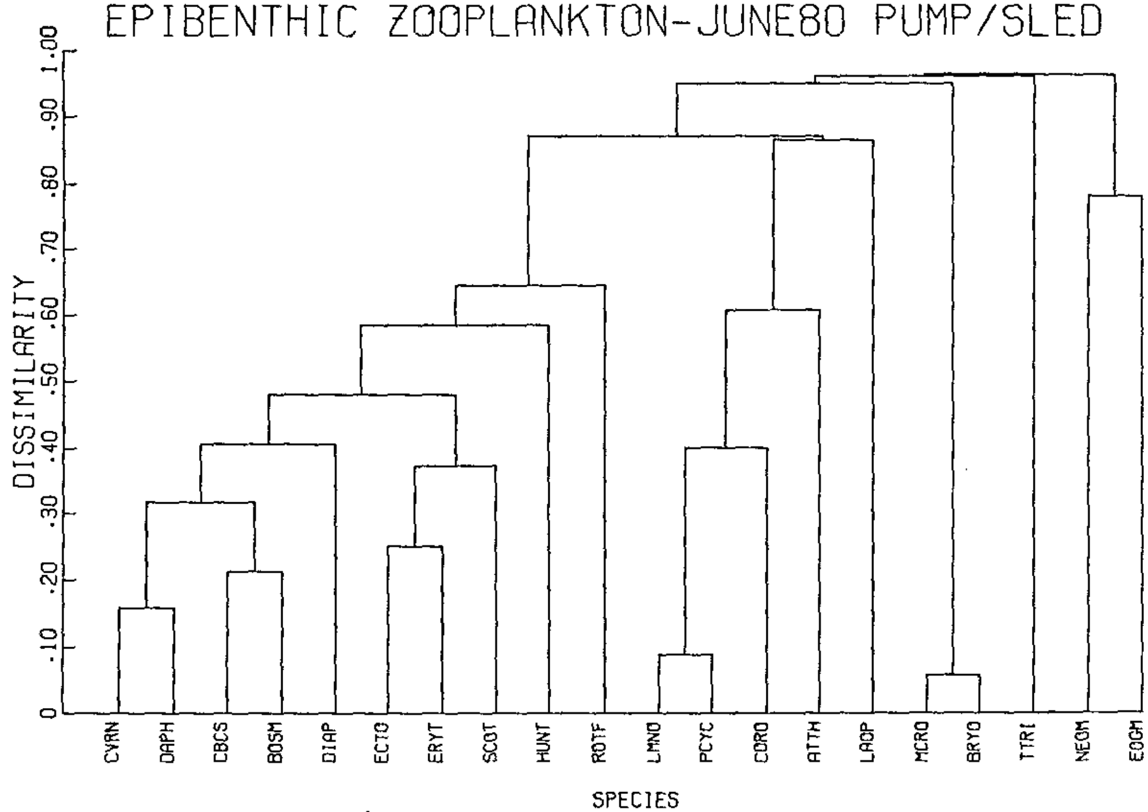




MAY 1980 TAXA CLUSTERS
EPIBENTHIC ZOOPLANKTON-MAY80 PUMP/SLED
DISSIMILARITY
0
.10
.20
.30
.40
.50
.60
.70
.80
.90
1.00
CVRN
CBCS
BOSM
DAPH
DIAP
ECTO
SCOT
PARL
ERYT
HUNT
NEOM
EOCM
MCRO
BRYO
PCYC
TTRI
LAOP
ATTH
LMNO
CORO
SPECIES

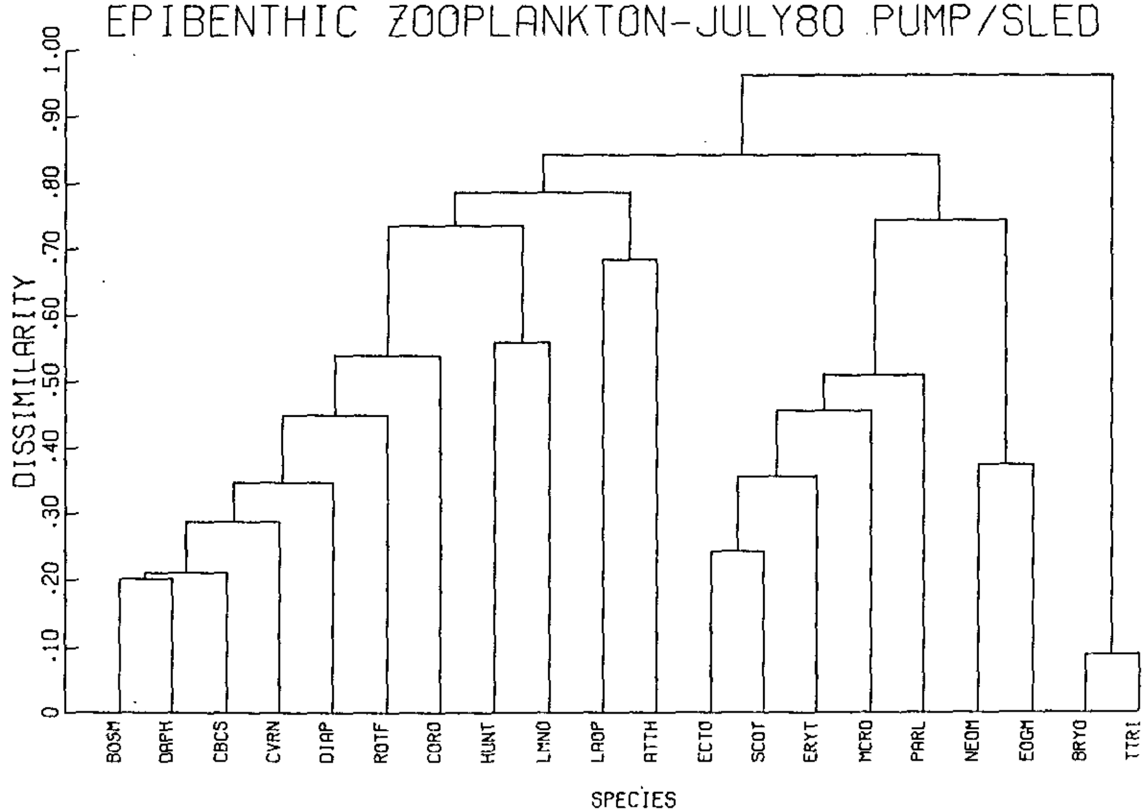
JUNE 1980 TAXA CLUSTERS

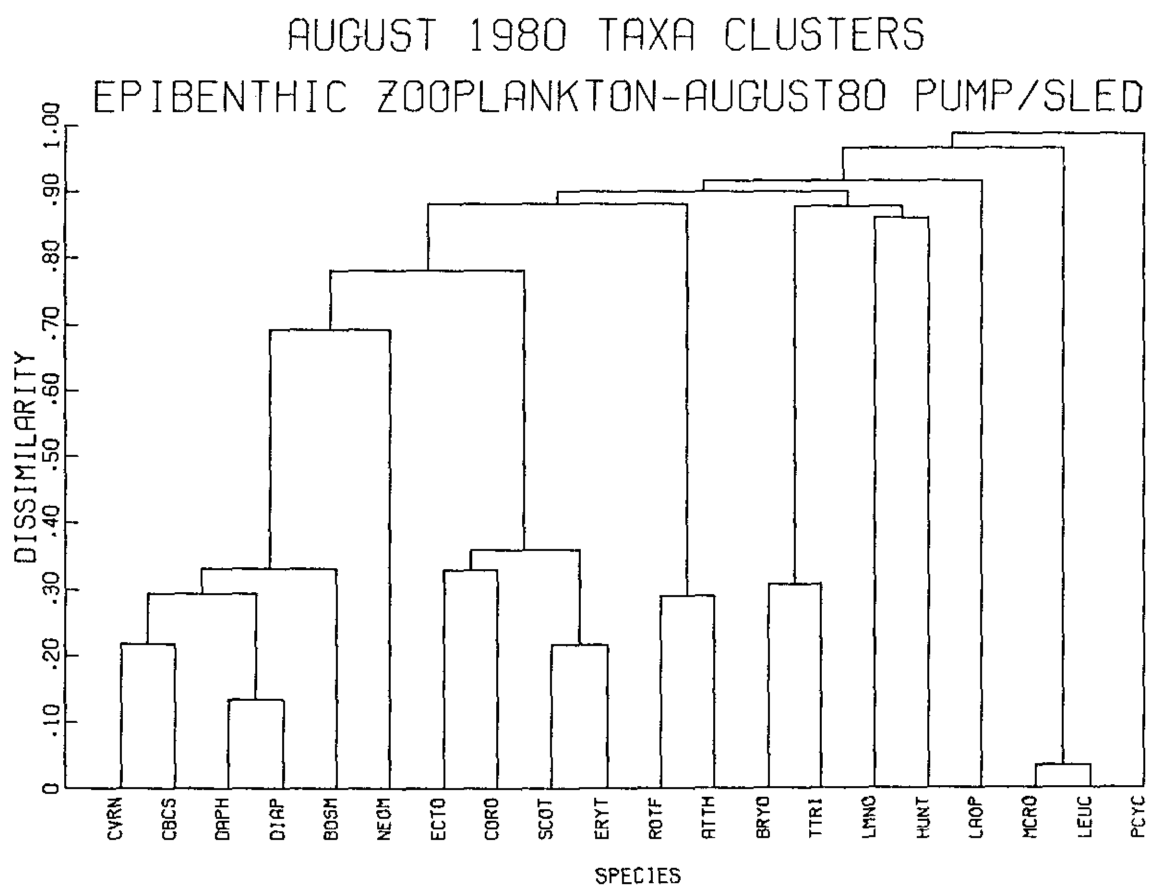
EPIBENTHIC ZOOPLANKTON-JUNE80 PUMP/SLED



JULY 1980 TAXA CLUSTERS

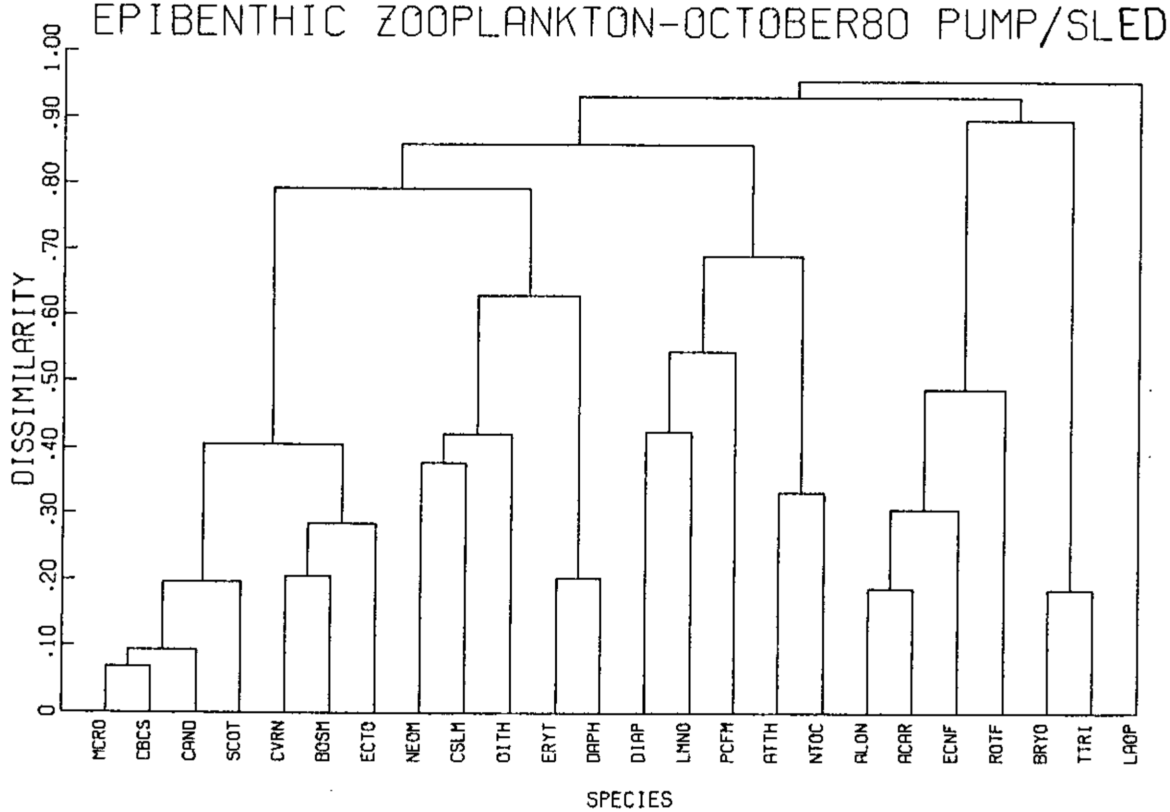
EPIBENTHIC ZOOPLANKTON-JULY80 PUMP/SLED




AUGUST 1980 TAXA CLUSTERS
EPIBENTHIC ZOOPLANKTON-AUGUST80 PUMP/SLED
DISSIMILARITY
0
.10
.20
.30
.40
.50
.60
.70
.80
.90
1.00
CVRN
CBCS
DAPH
DIAP
BOSM
NEOM
ECTO
CORO
SCOT
ERYT
ROTF
ATTH
BRYO
TTRI
LMNO
HUNT
LAOP
MCRO
LEUC
PCYC
SPECIES

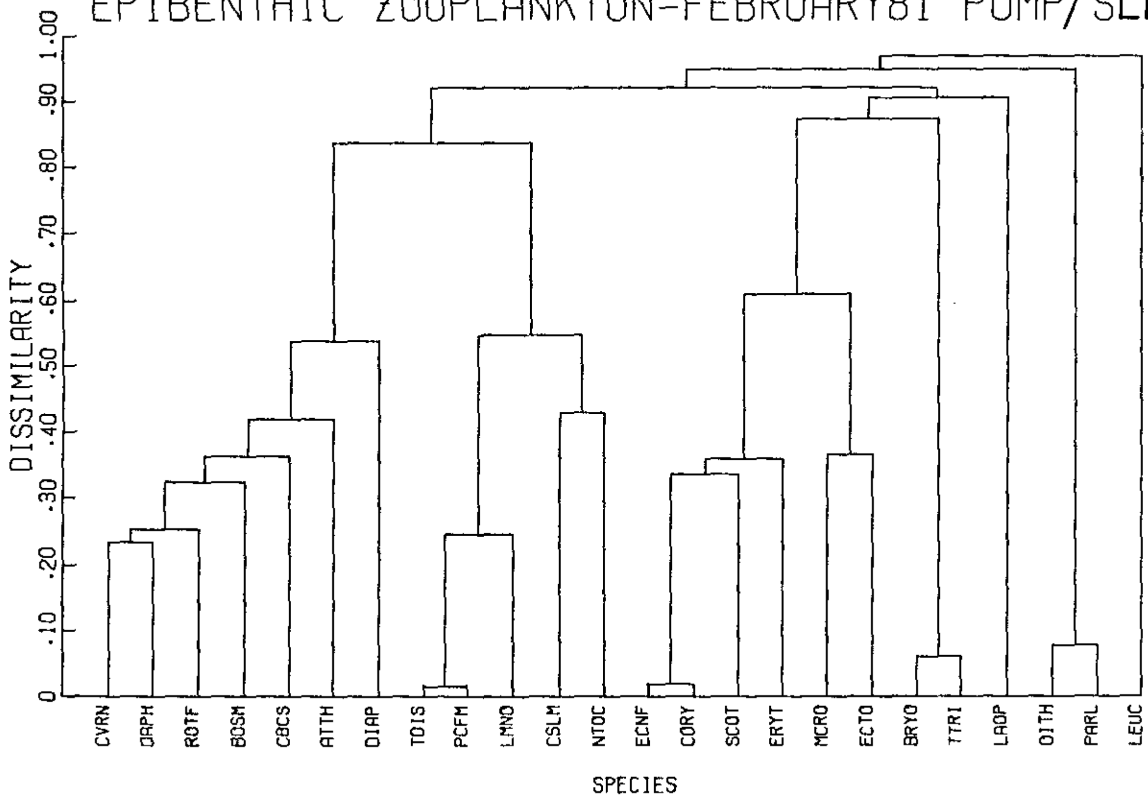
OCTOBER 1980 TAXA CLUSTERS

EPIBENTHIC ZOOPLANKTON-OCTOBER80 PUMP/SLED



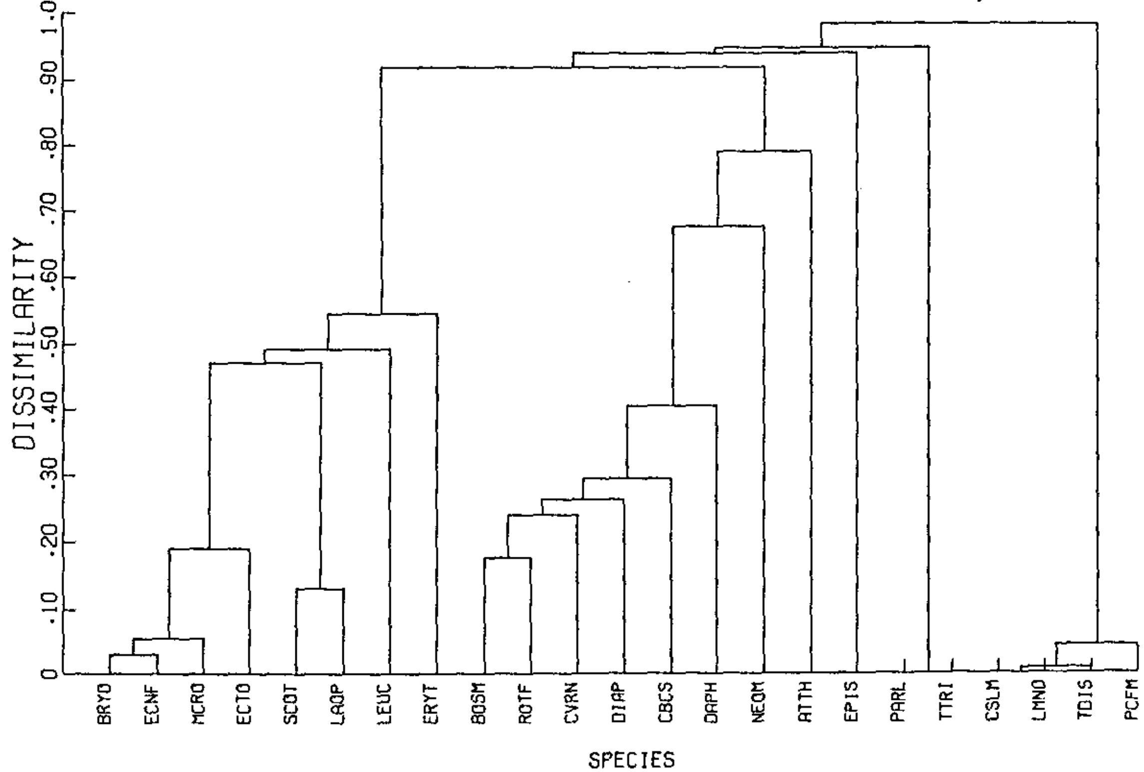
FEBRUARY 1981 TAXA CLUSTERS

EPIBENTHIC ZOOPLANKTON-FEBRUARY81 PUMP/SLED



APRIL 1981 TAXA CLUSTERS

EPIBENTHIC ZOOPLANKTON-APRIL81 PUMP/SLED



JULY 1981 TAXA CLUSTERS

EPIBENTHIC ZOOPLANKTON-JULY81 PUMP/SLED