A PRELIMINARY SURVEY OF LARVAL FISH, ZOOPLANKTON AND PHYTOPLANKTON OF PACIFIC RIN NATIONAL PARK

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INTRODUCTION

Plankton teem in the waters surrounding Pacific Rim National Park. The variety of marine habitats ie., rivers, tidal regions, intermediate-depth coastal regions, and deep continental slope regions, along the Park add to the diversity of the planktonic microscopic plants (phytoplankton) and animals (zooplankton including young fish). Plankton are extremely varied throughout the seasons of the year in Pacific Ocean coastal waters and are creatures more diverse than anywhere else on earth.

This study of the planktonic marine life in the adjacent waters of Pacific Rim National Park was initiated in order to make a list of all the known planktonic organisms in the area and to generally increase the biological knowledge of the marine plankton in British Columbia waters. Planktonic organisms generally consist of numerous invertebrate animals and plants that live their entire life in the open pelagic zone of the ocean as well as numerous juvenile stages of bottom living invertebrates and fishes. Although these organisms are almost all microscopic, a good knowledge of them aids in understanding the marine environment of the area and in particular the seasonal cycle of biological events that go on in the shallow coastal waters.

In this survey of the marine plankton of Pacific Rim National Park, it was originally proposed that the fish larvae and the zooplankton be emphasized. During the literature survey of the Park waters and through personal contacts with several marine biologists studying in the area, it was decided to add phytoplankton to the survey because of the almost complete lack of survey information in nearby waters. Thus this report presents a preliminary survey of the fish larvae zooplankton, and phytoplankton collected during several sampling trips to the park. It is hoped that future collections will produce a more complete survey.

Hydrography and Environmental Conditions

Since Pacific Rim National Park extends for such a long distance along the west coast of Vancouver Island, we had to decide what areas would be most accessible for a plankton survey. After considering the availability of boats, living accommodations, and accessibility to the water, it was concluded that Tofino Inlet, Ucluelet Inlet, and the Broken Group Islands in Barkley Sound would be the three most interesting and available marine areas (See Fig.1). Owing to the short time allowed for this survey, the hydrography and oceanographic conditions of these areas were not summarized nor was the literature thoroughly searched. From the Bibliography of Bell (1971) it appears that Doe (1952), Hollister (1951, 1968), Pickard and McLeod (1953), Waldichuck (1955) and Pickard (1963) would provide the best information about the chemical and physical conditions of the three areas under study. It is quite certain, however, that the coastal environment is quite variable from place to place.

Larval Fish Survey

Many species of fish along the Pacific coast have planktonic eggs and larvae that can be caught with plankton nets. Pacific coast fishes occur as larvae in a wide diversity of shapes and sizes. Those that hatch from small eggs with little stored yolk inhabit the pelagic zone along the coast as free swimming larvae for an extended period of time. Those larvae that hatch from large eggs with large stores of yolk inhabit the pelagic region for only a brief period of time. The majority of fishes lay demersal eggs. Other fish broadcast buoyant eggs near the sea bottom while a third kind release free swimming yolk-sac larvae into the water. Larval fish collected in plankton nets represent a large proportion of the entire fish fauna along the North Pacific coast hut the exact number of species is not known as yet.

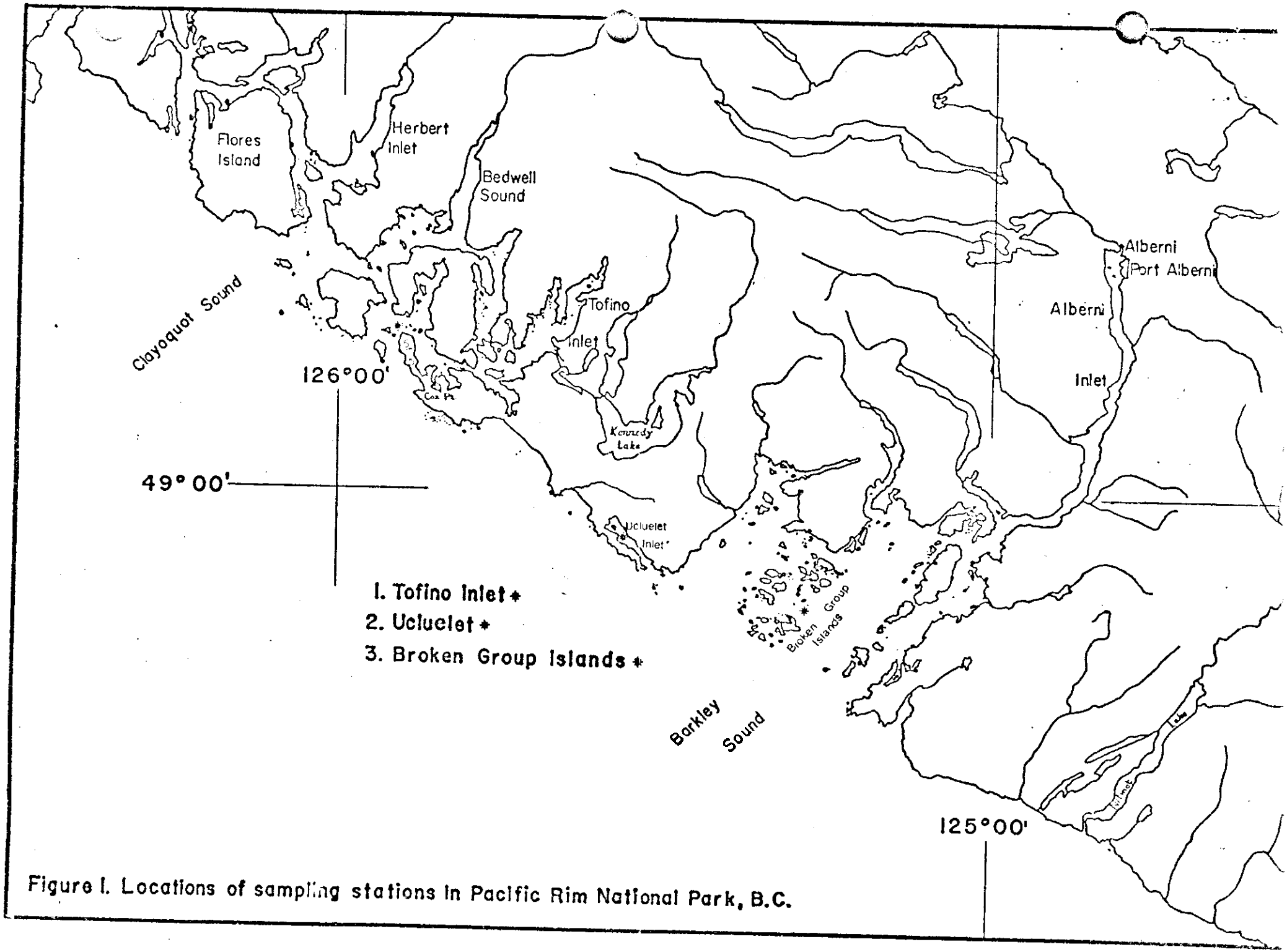

Figure 1. Locations of sampling stations in Pacific Rim National Park, B.C.

There have been no egg or larval fish surveys undertaken anywhere along the western coast of Vancouver Island. The only larval fish studies along western Vancouver Island are Hourston (1959), Stevenson (1962), and Westrheim, ~~et al~~ (1968) which included. studies on larval herring and rockfish only. The only general survey of larval fish in British Columbia waters is that by LeBrasseur ~~et al~~ which is 1,000 miles off the coast of Vancouver Island. Ahlstrom (1963) reported on 25 years of egg and larval surveys in California waters that listed over 35 species. Musienko (1970) reported on almost 200 species of eggs and larvae in the Bering Sea.

The identification of larval fish in any survey must be supported by adult fish surveys in the same waters. Bean and Weed (1919) and Clemens and Wilby (1961) summarize what is known about the fish fauna of the Park waters. All the fish listed by these authors, however, do not spawn in these waters and consequently their larvae would not be present in Pacific Rim Park waters.

Ahlstrom (1963) has stated the three principal reasons why egg and larval surveys are conducted. "(1) For one thing, scientists are interested in the present abundance of an adult fish population and its distribution at time of spawning, and they hope to determine this from the distribution and abundance of its pelagic eggs. (2) Secondly, they are interested in the dynamics of a fish population; in how good or poor the year class resulting from the season's spawning will be; and in the reasons for the marked variations in survival that occur. They hope to determine this by systematically sampling the larvae and their environment during the spawning season. (3) They are interested in marine fish resources, latent as well as exploited, and in their distribution, abundance, and interrelations. Since the majority of fishes have pelagic larvae and many have pelagic eggs, the studies can be carried out on these stages."

Zooplankton Survey

Many different species of distinct animal groups live intermingled in the same faunal area along the British Columbia coast. Most of the zooplankton recorded are juvenile stages of various invertebrate animals living both in the pelagic zone and on the bottom. Since certain animals live in certain water masses and under certain hydrographic conditions, it will be apparent that the different areas will show different assemblages of animals.

There has been no thorough survey of the zooplankton along the west coast of Vancouver Island or anywhere else in British Columbia coastal waters. Copepods were studied by Campbell (1929, 1930) and Davis (1949). Lea (1955) studied the chaetognaths while Williamson (1930) and Hart (1940) identified some miscellaneous invertebrates. Figueira (1971) reviewed all the literature and recorded a large number of records of zooplankton from the region. Littlepage (1970) identified some adult species from two samples in Barkley Sound and Fulton (1968) produced a key to some plankton groups.

Phytoplankton Survey

The near-surface, mixed layer of the sea contains the dominant system of marine life. In these shallow coastal waters is the basic food of the sea, i.e., single-celled plants. The microscopic phytoplankton are composed of many species belonging to several groups: naked algal cells, diatoms with complex shells of silica and swimming and rotating flagellates. Very small forms are also abundant and are collectively called nannoplankton. The species composition of the phytoplankton is everywhere complex and varies from place to place, season to season and year to year.

There have been no surveys of phytoplankton in Pacific Rim National Park waters and only one published paper reported on actual specimens taken from British Columbia waters (Bailey, 1924). Cupp (1943) surveyed the diatoms along the west coast

but most of his collections were from Alaska. Mann (1907), Belyaeva (1963) and Ohwada and Kon (1963) made surveys in the open Pacific Ocean hundreds of miles away from British Columbia waters.

METHODS

Field Work

A 10-foot long conical plankton net was used to take all the samples. The net had a 24-inch diameter mouth and a plastic bucket at tbe end collected the plankton. The netting was No. 30 Grit Gauze and had mesh openings of about 0.7 mm. The net was towed from a boat. This net was designed and towed specifically to catch larval fish but, because of the relatively small mesh, zooplankton and phytoplankton were collected at the same time. Ctenophores and jellyfish clogged the meshes quite often and this clogging resulted in the smaller zooplankton and phytoplankton being collected qualitatively.

The samples were taken from the plastic buckets in the net and poured into 24-oz. bottles. Formalin was added to make a 5-10% formalin preserving solution. A label was added to each bottle and then packed away for shipping to Ottawa. Table I lists all of the samples that were taken up until 1 March, 1972. Samples were collected in Tofino Inlet, Ucluelet Inlet and Broken Group Islands, Barkley Sound (Fig. 1).

The main difficulty encountered in the field work was the unpredictable weather. Mr. Amundrud did not have an assistant with him and at times the wind and tide made collecting dangerous. On two occasions the plankton nets caught in the propellor of the motor and were damaged beyond repair.

Lab Work

The larval fish and zooplankton analyses were routinely handled with *a* dissecting scope (magnification range *40X-70X).* The copepods required a compound microscope (magnification range 40X-210X) to identify them to species.

The identification of diatoms required a special procedure. Diatoms were prepared and identified with the following procedure: a'.) sample was subsampled; b.) subsample was washed with distilled water; c.) nitric acid added to sample in a 50:50 ratio: d.) subsample allowed to sit for three days; e.) diatoms cleaned

TABLE I. List of the plankton collections taken in Pacific Rim National Park.

Date	Place*	Reference No. & No. of Samples
4 July 71	Tofino Inlet	692-1 to 19
20 July 71	Tofino Inlet	20 to 45
3 July 71	Ucluelet Inlet	46 to 63
20 July 71	Tofino Inlet	64 to 68
4 August 71	Tofino Inlet	69 to 88
9 August 71	Barkley Sound	89 to 99
5 October 71	Barkley Sound	71Z-1 to 11
28 February 72	Barkley Sound	742-1 to 12
2 April 72	Barkley Sound	75Z-1 to 12

*See Fig. 1 for exact locations.

with distilled water; f.) diatoms allowed to settle; g.) diatoms transferrred to glass slide; h.) diatoms on glass slide dryed out with hot plate; i.) Hyrax mounting medium added to slide and cover slip put on; j.) diatoms ready to be looked at. After the diatoms were identified, the slides were accessioned to the collection of the National Herbarium in the National Museum of Natural Sciences.

Personnel

When this study was proposed, Mr. Jim Amundrud planned to remain in Victoria, B.C. for the entire year and sample the study areas periodically. He also planned to do a great amount of identifying of the organisms collected. However, during the summer Mr. Amundrud became discouraged with the project and subsequently left in August. Mr. John Dobrocky, who was living in Victoria, B.C. was contacted and he agreed to sample the Broken Group islands area in Barkley Sound periodically in the fall, winter, and spring. He sampled once in October, but he found the winter too severe and he was unable to get into Barkley Sound safely. He sampled once in February and another trip is planned in March.

After Mr. Amundrud left in August, all the samples were shipped back to the Canadian Oceanographic Identification Centre in Ottawa for identification. Staff at the Identification Centre were extremely helpful in providing assistance. Miss Lynda Gamble did literature searching and preliminary sorting of the larval fish. Dr. D.J. Faber identified the larval fish, Mr. Len Marhue identified the zooplankton, and Mrs. Eugenia Krelina identified the phytoplankton.

Future Work

It is suggested that National Parks Staff could assist the zooplankton and phytoplankton field work but probably not the larval fish survey work. A plankton net provided by the Museum could be set out from a dock in either Tofino Inlet or Ucluelet Inlet or both and allowed to "fish" for about ten minutes. Those collections should be taken once each week during a one or two-year period. Owing to the lack of yearround data in both zooplankton and phytoplankton in the area, the collections could prove to be extremely valuable and would almost certainly yield new records of occurrences in British Columbia waters. Staff of the Canadian Oceanographic Identificatiaon Centre will assist with the identifications if National Parks staff will assist in collecting the samples.

RESULTS

Larval Fish

The variety of larval fish collected during this study is not very large. The small number of sampling dates through the year and the presence of large numbers of Ctenophores in the water interferred with sampling. This survey can only be regarded as preliminary owing to the seasonal occurrence of different species and the limited collections taken in 1971.

Barkley Sound (Table II) showed the largest variety of larval fish and was dominated by pricklebacks (Stichaeidae). Tofino Inlet produced small numbers of all species (Table III). The large numbers of pipefish and sticklebacks suggest that attached algae are abundant in the Inlet. The variety of larvae collected in Ucluelet Inlet (Table IV), suggests the presence of a hard bottom. Both gobies and pricklebacks prefer hard rocky bottoms on which to spawn while pipefish and sticklebacks prefer aquatic plants. Further survey work needs to be done.

The foilowing sections describe something about the biology of the larval fish that were collected.

Pricklebacks (Stichaeidae)

Clemens and Wilby (1961) list 13 species of pricklebacks from British Columbia waters. Not all of these, however, breed in coastal B.C. waters. Pricklebacks are bottom dwelling fish but some of their larvae become planktonic after hatching. Very little is known about the reproductive habits of these small non-commercial fish, but it is certain they lay adhesive eggs. Ichthyologists do not agree on the classification of these fishes and there will no doubt be changes in their taxonomy as more knowledge is gained.

Ninety-nine prickleback larvae were collected in Barkley Sound (Table II), 1 larva in Tofino Inlet (Table III), and 35 larvae in Ucluelet Inlet (Table IV). The genera of Stichaeidae that are most likely represented in this collection include the following: Anoplarchus, Chirolophis, Epigeichthys, Lumpenus, Phytichthyn and Xiphister. Ehrenbaum (1905 and 1909) has illustrated larvae of the genera Lumpenus and Chirolophis.

Gobies (Gobiidae)

The gobies of B.C. are small, bottom-dwelling fishes that live in coastal inlets. Clemens and Wilby (1961) list 3 species for B.C. Gobies lay their eggs in empty shells or other protected places and *the* male guards them until they hatch.

One goby larvae was collected in Tofino Inlet (Table III) and 22 in Ucluelet Inlet (Table IV). It is uncertain as to even which genera these specimens belong. Prasad (1958) has described the larvae of Clevelandia.

Sticklebacks (Gastereosteus aculeatus Linnaeus 1758)

There is only one known stickleback species (Gasterosteidae) in British Columbia waters (Clemens and Wilby, 1961). In this species, the male constructs a neat in which the eggs are laid after which the male guards the nest and eggs until the larvae leave,

Seventeen stickleback larvae were collected in Barkley Sound (Table II), 7 in Tofino Inlet (Table III) and 15 in Ucluelet Inlet (Table IV). Ehrenbaum (1905 and 1909) illustrates the morphology of larval sticklebacks.

Rockfish (Sebastes)

There are at least *24* species of rockfish (Scorpaenidae) living in British Columbia waters (Clemens and Wilby, 1961). These fish are livebearers and females release large numbers of pelagic larvae in coastal waters. Ichthyologists do not all agree on the genus name and I am using Sebastes for all species.

Six rockfish larvae were collected in Barkley Sound (Table I) and 8 larvae in Tofino Inlet (Table III). No attempt was made to identify the specimens to species. Moser (1967) and Westrheim ~~et al~~ (1968) have summarized the available information concerning the identification of planktonic rockfish larvae. \$loser (1967) has descriptions of 16 species of rockfish larvae.

Sculpins (Cottidae)

The sculpins are mostly small insignificant fishes that, live in tidepools, shallow waters, and also on the bottom at great depths. Clemens and Wilby (1961) list 23 different genera

that dwell in British Columbia waters. These fish are very abundant in their numbers and variety along the B.C. coast. Sculpins usually lay their eggs in clumps on the bottom. Some species attend the eggs while others do not. Some larvae swim into the pelagic region after hatching.

Four sculpin larvae were collected in Barkley Sound (Table II) and one in Ucluelet Inlet (Table IV). It is uncertain as to even which genera these specimens belong.

Ehrenbaum (1905 and 1909) shows several stages of Myoxocephalus larvae (=Cottus scorpius), Enophrys larvae (=Cottus bubalis), and Triglops larvae. Budd (1940) shows a stage of Artedius and Gorbunova (1964) shows a stage of Hemilepidotus.

Pipefish (Syngnathus griseolineatus Ayres 1854)

Only one species of pipefish (Syngnathidae) occurs in British Columbia waters (Clemens and Wilby, 1961). Pipefish eggs are transferred to males who carry them in a pouch for a number of days. After release from the pouch the young lead a short pelagic existence.

Pipefish larvae were only collected in Tofino Inlet, where 4 were taken. Mito (1966) shows the larvae of Syngnathus.

Seasnails (Liparidae)

Seasnails possess a ventral sucker that they use to attach to bottom objects (rocks, shells, etc.). They lay their eggs in clumps on the bottom and do not guard them during incubation. Clemens and Wilby (1961) list 7 species of the genus Liparis from British Columbia waters. The other 6 genera are rare and probably do not spawn in shallow coastal waters.

Two seasnail larvae were collected from Barkley Sound (Table II) and one larvae from Tofino Inlet (Table III). These specimens are probably species of the genus Liparis. Ehrenbaum (1905 and 1909) describes the larvae of 2 species of Liparis from the Baltic Sea and Aoyama (1959) illustrates a Liparis larvae from Japan.

Flatfish or flounders (Pleuronectidae)

Clemens and Wilby (1961) list 18 species of flounders from B.C. waters. Almost all flounders produce pelagic, non-adhesive

eggs which float in the pelagic zone until they hatch. The larvae also remain in the pelagic zone until they are old enough to live on the bottom, Most species spawn in the spring.

One flounder larva was collected in Barkley Sound (Table II) and 2 in Tofino Inlet (Table 111). Numerous genera of B.C. Flounder larvae have been described. They include: Pleuronichthys by Budd (1940) and Mito (1966),. Hippoglossus by Thompson (1936), Parophrys by Budd (1940), Platichthys by Orcutt (1950), Psettichthys by Hickman (1959), Glyptocephalus (=Pleuronectes cynoglossus), Limanda (=Pleuronectes limanda and Hippoglossoides (=Drepanopsetta plattessoides) by Ehrenbaum (1905 and 1909).

Herring (Clupea pallasii Valenciennes 1847)

Only one species of herring is found in B.C. waters (Clemens and Wilby (1961). Adhesive eggs are spawned in large numbers in shallow water and the eggs are not cared for. They hatch in about 2 weeks.

One herring larva was caught in Barkley Sound (Table II). Fraser (1916) and Uchida et al (1958) illustrate stages of herring larvae.

TABLE II. A list of larval fish collected in plankton nets from the Broken Group Islands, Barkley Sound, British Columbia in 1971

Date	Species	No. of Specimens	Sample No.
9 July	Rockfish (*Sebastes* sp.)	1	692-89
"	Rockfish (*Sebastes* sp.)	3	692-90
"	Rockfish (*Sebastes* sp.)	2	692-91
"	Prickleback (Stichaeidae)	1	692-90
"	Pricklebacks (Stichaeidae)	79	692-93
"	Pricklebacks (Stichaeidae)	8	692-94
"	Pricklebacks (Stichaeidae)	2	692-95
"	Prickleback (Stichaeidae)	1	692-96
"	Pricklebacks (Stichaeidae)	2	692-97
"	Pricklebacks (Stichaeidae)	6	692-98
"	Sticklebacks (*Gastereosteus* sp.)	14	692-93
"	Sticklebacks (*Gastereosteus* sp.)	2	692-94
"	Stickleback (*Gastereosteus* sp.)	1	692-97
"	Seasnail (Liparidae)	1	692-92
"	Sculpins (Cottidae)	3	692-93
5 Oct.	Herring (*Clupea* sp.)	1	712-02
"	Sculpin (Cottidae)	1	712-05
"	Seasnail (Liparidae)	1	712-07
"	Flatfish (Pleuronectidae)	1	712-10

Total number 130

TABLE III. A list of larval fish collected in plankton nets from Tofino Inlet, British Columbia in 1971

Date	Species	No. of Specimens	Sample No.
3 July	Stickleback (*Gastereosteus* sp.)	1	692-45
4 "	Stickleback (*Gastereosteus* sp.)	1	692-08
"	Rockfish (*Sebastes* sp.)	3	692-12
"	Goby (Gobiidae)	1	692-17
"	Seasnail (Liparidae)	1	692-22
20 July	Stickleback (*Gastereosteus* sp.)	1	692-01
"	Flatfish (Pleuronectidae)	1	69Z-27
"	Flatfish (Pleuronectidae)	1	692-43
"	Pipefish (*Syngnathus* sp.)	1	692-39
"	Pipefish (*Syngnathus* sp.)	1	692-42
"	Pipefish (*Syngnathus* sp.)	1	692-44
"	Rockfish (*Sebastes* sp.)	1	69Z-40
4 Aug.	Stickleback (*Gastereosteus* sp.)	1	69Z-69
"	Stickleback (*Gastereosteus* sp.)	1	692-75
"	Stickleback (*Gastereosteus* sp.)	1	69Z-76
"	Stickleback (*Gastereosteus* sp.)	1	692-81
"	Rockfish (*Sebastes* sp.)	1	692-80
"	Rockfish (*Sebastes* sp.)	1	692-82
"	Rockfish (*Sebastes* sp.)	1	692-84
"	Rockfish (*Sebastes* sp.)	1	69Z-86
"	Pipefish (*Syngnathus* sp.)	1	692-69
"	Prickleback (Stichaeidae)	1	69Z-88
	Total Number	24	

TABLE IV. A list of larval fish collected in plankton nets from Ucluelet Inlet, British Columbia, in 1971

Date	Species	No. of Specimens	Sample No.
3 July	Prickleback (Stichaeidae)	1	692-46
"	Prickleback (Stichaeidae)	1	69Z-51
"	Pricklebacks (Stichaeidae)	12	692-52
"	Pricklebacks (Stichaeidae)	20	692-54
"	Prickleback (Stichaeidae)	1	69Z-58
"	Stickleback (*Gastereosteus* sp.)	1	692-47
"	Stickleback (*Gastereosteus* sp.)	1	692-50
"	Stickleback (*Gastereosteus* sp.)	2	69Z-53
"	Stickleback (*Gastereosteus* sp.)	6	692-54
"	Stickleback (*Gastereosteus* sp.)	4	692-55
"	Stickleback (*Gastereosteus* sp.)	1	692-61
"	Goby (Gobiidae)	7	692-53
"	Goby (Gobiidae)	6.	692-55
"	Goby (Gobiidae)	1	692-59
"	Goby (Gobiidae)	8	692-61
"	Sculpin (Cottidae)	1	692-56
	Total Number	73	

Zooplankton

Two samples from Broken Group Islands, two samples from Tofino Inlet and two samples from Ucluelet Inlet were examined, (see Tables V, VI, and VII). There was insufficient time to examine any additional samples. A complete survey of zooplankton in any marine area requires year-round collections.

Representatives of ten animal phylas were collected in the four samples: Protozoa, Ctenophora, Cnidaria, Nematoda, Chaetognatha, Mollusca, Echinodermata, Arthropoda, Annelida and Chordata. The Arthropoda were the most abundant and varied in both inlets. In these particular samples there are no significant differences between the zooplankton from Tofino and Ucluelet Inlets. The samples show the dominance of juvenile stages of bottom invertebrates in relation to the invertebrates that live their entire life in the pelagic zone, such as copepods and cladocerans. A good survey of the zooplankton of this park would require samples from other season's of the year and additional time for identification purposes.

There were no samples taken at any of the sites with a mesh fine enough to collect the snaller organisms and it is hoped that additional samples can be taken in a future year with a proper net.

Table V A list of zooplankton collected in Plankton nets from Broken Group Islands. Barkley Sound, British Columbia, on 2 April, 1972

Species	Sample Number
Phylum Cnidaria	
Class Hydrozoa	
Sarsia tubulosa (Sars, 1835)	752-12
Sarsia sp.	752-12
Dipleurosoma sp.	752-12
Obelia spp.	752-12
Unidentified siphophore	752-12
Phylum Chaetognatha	
Sagitta elegans Verrill, 1873	752-12
Sagitta elegans Verrill, 1873	75Z-23
Eukrohnia harnata ? (Mobius, 1875)	752-23
Unidentified juveniles	752-12
Phylum Mollusca	
Class Gastropoda	
Gastropod egg case	752-12
Unidentified thecosome pteropod	752-12
Limacina sp.	
Phylum Arthropoda	
Class Crustacea	
Subclass Copepoda	
Order Calanoida	
Calanus plumchrus Marukawa, 1921	752-12
Calanus plumchrus Marukawa, 1921	752-23
Pseudocalanus minutus (Kroyer, 1849)	752-12
Acartia longiremis (Lilljeborg, 1853)	752-12

Table V. continued

Subclass Cirripedia	
Barnacle nauplius	752-12
Subclass Malacostraca	
Order Amphipoda	
Euprimno abyssalis Bowman, 1953	752-23
Parathemisto pacifica Stebbing, 1888	752-23
Order Decapoda	
Brachyuran Zoea	752-12
Brachyuran Zoea	752-23
Caridean Zoea	752-12
Caridean Zoea	752-23
Anomuran Zoea	752-12
Phylum Annelida	
Class Polychaeta	
Autolytus alexandri Malmgren, 1867	752-23
Autolytus cornutus A. Agassiz, 1863	752-23
Phylum Chordata	
Class Copelata	
Oikopleura sp.	752-12
Oikopleura sp.	752-23
Fritillaria borealis ? Lohmann, 1896	752-12
Class Pisces	
Unidentified egg	752-12

TABLE VI A list of zooplankton collected in plankton nets from Tofino Inlet, British Columbia, on 4 August, 1971

Species	Sample Number
Phylum Ctenophora	
Class Tentaculata	
Pleurobrachia pileus (Fabricius, 1780)	692-15
Mertensia sp.	692-15
Phylum Cnidaria	
Class Hydrozoa	
Sarsia tubulosa (M. Sars, 1835)	692-15
Polyorchis penicillatus (Eschscholtz, 1829)	692-15
Proboscidactyla flavicirrata Brandt, 1835	692-15
Proboscidactyla flavicirrata Brandt, 1835	692-73
Lensia sp.	692-15
Lensia sp.	692-73
Unidentified Leptomedusae	692-15
Unidentified Leptomedusae	692-73
Phylum Nematoda	
Unidentified specimens	692-15
Unidentified specimens	692-73
Phylum Mollusca	
Class Gastropoda	
Gastropod egg case	692-15
Gastropod egg case	692-73
Phylum Echinodermata	
Ophiuroidea larva	692-15
Ophiuroidea larva	692-73

Continue Table VI

Species	Sample Number
Phylum Arthropoda	
Class Crustacea	
Suborder Cladocera	
Podon sp.	692-15
Podon sp.	692-73
Evadne sp.	692-73
Subclass Copepoda	
Order Calanoida	
Acartia longiremis (Lilljeborg, 1853)	692-15
Acartia longiremis (Lilljeborg, 1853)	692-73
Eucalanus bungii bungii Johnson, 1938	692-15
Centropages abdominalis Sato, 1913	692-73
Pseudocalanus minutus (Kroyer, 1849)	692-73
Unidentified nauplii	692-73
Order Cyclopoida	
Oithona sp.	692-15
Corycaeus anglicus Lubbock, 1857	692-73
Order Harpacticoida	
Amonardia sp.	692-73
Harpacticus sp.	692-73
Unidentified specimen	692-73
Order Caligoida	
Unidentified specimen	692-73
Subclass Cirripedia	
Barnacle nauplius	69Z-15
Barnacle nauplius	692-73
Barnacle cypris	692-73

Continue Table VI

Species	Sample Number
Subclass Malacostraca	
Order Amphipoda	
Unidentified juvenile	692-73
Order Euphausiacea	
Calyptopis larva	692-73
Order Decapoda	
Brachyuran zoea	692-15
Caridean zoea	692-73
Porcellana sp.	692-15
Porcellana sp.	692-73
Macruran zoea	692-15
Macruran megalops	692-15
Phylum Annelida	
Class Polychaeta	
Autolytus cornutus A. Agassiz, 1862	692-15
Typhloscolex muelleri Busch, 1851	692-15
Spionidae trochophore larvae	692-15
Spionidae trochophore larvae	692-73
Phylum Chordata	
Class Copelata	
Oikopleura sp.	692-15
Oikopleura sp.	692-73
Fritillaria sp.	692-73
Class Pisces	
Unidentified eggs	692-73

Table VII A list of zooplankton collected in plankton nets from Ucluelet Inlet, British Columbia on 3 July, 1971

Species	Sample Number
Phylum Protozoa	
Order Foraminifera	
Unidentified specimens	692-62
Order Radiolaria	
Unidentified specimens	692-62
Phylum Cnidaria	
Class Hydrozoa	
Proboscidactyla flacicirrata Brandt, 1835	692-62
Dipleurosoma sp.?	692-62
Dipleurosoma sp.?	692-53
Lensia sp.	692-53
Phylum Nematoda	
Unidentified nematodes	692-62
Phylum Chaetognatha	
Sagitta sp.	692-53
Phylum Mollusca	
Class Pelycepoda	
Bivalve larva	692-53
Phylum Echinodermata	
Asteroidea larvae	692-53
Phylum Arthropoda	
Class Crustacea	
Suborder Cladocera	
Evadne sp.	692-53
Podon sp.	692-62

Continue Table VII

Species	Sample Number
Subclass Copepoda	
Order Calanoida	
Acartia longiremis (Lilljeborg, 1853)	692-53
Acartia sp. juveniles	692-62
Metridia sp.	692-53
Order Cyclopoida	
Oithona sp.	692-62
Subclass Cirripedia	
Barnacle nauplius	692-53
Barnacle nauplius	692-62
Subclass Malacostraca	
Order Decapoda	
Brachyuran zoea	692-53
Brachyuran zoea	692-62
Macruran zoea	692-53
Macruran zoea	692-62
Caridean zoea	692-53
Phylum Annelida	
Class Polychaeta	
Apionidae trochophore larvae	692-53
Typhloscolex muelleri Busch, 1851	692-53
Phylum Chordata	
Class Copelata	
Oikopleura sp.	692-53
Oikopleura sp.	692-62
Class Pisces	
Unidentified eggs	692-53

Phytoplankton

Although the samples were not examined in their entirety, 'diatoms 'were the dominant plants in the plankton tows examined. Table VIII is a list of diatoms identified from a single sample from the Broken Group Islands; Table IX is a list of diatoms identified from a single plankton sample from Tofino Inlet, and Table X is a list of diatoms identified from a single sample from Ucluelet Inlet. Thirty seven genera of diatoms were identified in these three samples. The samples exanined from Tofino Inlet showed a much larger variety of diatoms than did the other samples. Although the samples could not provide a quantitative comparison, the larger variety of diatoms in Tofino Inlet suggest waters of higher productivity than those of Barkley Sound or Ucluelet Inlet.

There were no samples taken at any of the sites with a mesh fine enough to collect the entire population of phytoplankton. It is hoped that additional samples can be taken in the future with proper sampling gear.

TABLE VIII A list of diatoms collected in plankton nets from the Broken Group Islands, Barkley Sound, British Columbia on 9 July, 1971 (69Z-91)

Species
Achnanthes sp.
Actinocyclus ? octonarius var. *tenellus* (Bréb.) Hend.
Bacteriastrum delicatulum Cl.
Biddulphia aurita (Lyng.) Breb.
Campyloneis grevillei (W. Sm.) Grun.
Cocconeis ? placentula Ehr.
C. scotellum Ehr.
C. sublitoralle Hend.
C. ? peitoides Hust.
C. sp.
Coscinodiscus excentricus Ehr.
C. radiatus Ehr.
C. sp.
Melosira juergensi Agardh.
Navicula directa (W. Sm.) Ralfs
N. sp.
Rhoicosphaenia curvata (Kz.) Grun.
Skeletonema costatum (Grev.) Cl.
Surirella sp.
Thalassionema nitzschioides Grun.
Thalassiosira nordenskioldii Cl.
T. decipiens Grun.
T. sp.

Table IX. A list of diatoms collected in plankton nets from Tofino Inlet, British Columbia on 4 July 1971

Species
Achnanthes longipes Aqar.
A. hauckiana Grun.
A. **sp.**
Amphiprora **sp.**
Amphora pusio Cl.
A. ? baccata Mann
A. ? gigantea Grun.
A. ? dubiosa Østr.
A, ? obscura Krasske
A. sp.
Asterionella formosa Has
Auliscus ? sculptus (W. Sm) Rolbs.
Bacteriastrum elongatum Cl.
Biddulphia aurita (Lyngb.) Bréb
Caloneis sp.
Campyloneis grevillei (W. Sm.) Grun.
Cocconeis scutellum Ehr.
C. ? disculoides Hust.
C,. speciosa Greg.
C. placentula E. intermedia Hust.
Cymatopteura sp.
Dimeregramma **minor** (Greg.) Ralfs.
Diploneis ? domblittensis (Grun) Cl.
D. didyma (Ehr.) Cl.
Fragilaria sp.
Gomphonema ? salsum Pant.
Grarnrnatophora marina (Lyngb.) Kz.

Continue Table **IX**

Species
Hantzschia **sp.**
Licmophora joergensii **Ag.**
Navicula ? *cancellata* Danz.
N. digito-radiata (Greg.) **Ralfs**
N. directa (W. Sm) Ralfs
N. ramosissima Agan.) Cl.
N. ? *elegans* W. Sn.
N. **sp.**
Nitzschia ? *bilobata* W. **Sm.**
N. lanceolata W. Sn.
N. litoratis Grun.
N. angularis W. **Sm.**
N. punctata (W. Sm.) Grun.
N. thermalis **(Kz.)** Grun
N. **sp.**
Opeophora pacifica (Grun.) Petit
O. ? *marina* (Greg.) **Petit**
Paralia sulcata **(Ehr.) Cl.**
Pinnularia ? *arctica* **Cl.**
P. **sp.**
Plagiogramma **sp.**
Pseudoeunotia ? *doliolus* (Wall.) Grun.
Rhabdonema ? *arcoatum* (Lyngb.) Kz.
Rhoicosphenia curvata (Kz) **Grun.**
Skeletonema costatum (Grev.) Cl.
Striatella ? *unipunctata* (Lyngb.) **Ag.**
Surirella ? *inducta* A.S. **Schn.**
S. elegans Ehr.
S. crumella Bréb.
S. gemma(Ehr.) **Kz.**
S. **sp.**
Synedra tabulata (Ag.) Kz.

. Continue Table IX

Species
Thalassiosira **nordenskioldii** Cl.
T. **sp.**
Thalassiothrix delicatula Cupp
T. frauenbeldii Grun.

Table X. A list of diatoms collected in plankton nets from Ucluelet Inlet, British Columbia on 4 July, 1971.

Species
Achnanthes longipes Ag.
A. pseudogroelandica Hend.
A. sp.
A. laevis ? Greg.
Amphora porteus Greg.
A. Sp.
Climacosphenia sp.
Cocconeis angermannica Cl.
C. britanica ? Naeg.
C. disculoides Hust.
C. scutellum E.
C. speciosa ? Greg.
C. sublittoralis ? Hend.
C. sp.
Dimeregramma minor (Greg.) Ralfs
Grammatophora arctica ? Cl.
G. marina (lyngb) Kz.
Licmophora Sp.
Melosira juergensii Ag.
M. sp.
N. rosellata Kz.
Navicula digito-radiata ? (Greg.) Ralfs
Nitzegua bukibata W. Sm., var. minor ? Grun.
N. sp.
Rhabdonema adriaticum ? Kz.
R. sp.
Skeletonema costatum (Greg.) Cl.
Syncdra tabulata (Ag.) Kz.
S. undulata Bail.
Thalassiosira nordenskioldii Cl.
Thalassiothrix delicatula Cupp
T. *mediterranea Pavill. ? var. pacifica* Cupp

DISCUSSION

This study reports on the composition of plankton in three selected areas of Pacific Rim National Park during the summer of 1971. Originally the author was mainly interested in capturing pelagic fish larvae whose occurrence reflect the spawning activities of fishes in the Park waters. However, the almost complete lack of plankton surveys in the Vancouver Island area suggested that a complete plankton survey be attempted in order to document the wide variety of organisms that inhabit B.C. coastal waters. There are a number of' things that a plankton survey can contribute to in a Natural Resource Inventory. Among them are factual information regarding pollution, productivity, upwelling and red tide outbreaks.

The plankton organisms, phytoplankton in particular, are sensitive to industrial and sewage pollutants. Since the park is just being established, it is essential that the plankton organisms be identified and documented now as a base on which to start. Any act of pollution that occurs in the future can be documented by comparing the sensitive plankton organisms before and after the "act", If documentation of the plankton'organisms is not made now, there will be no basis of comparison between now and the future.

The productivity of coastal waters adjacent to' the Park is an important factor in determining the present and potential natural resources of the waters. Recommendations for harvesting fin fish, shell fish and algae will be made sometime in the future and the relative productivity of each area can be a good indicator of the resources available. At the present time there are no published research studies to allow such estimations.

Upwelling is a well known oceanographic phenomenon that occurs quite frequently along the west coasts of continents. There are indications that upwelling occurs along the coast of Vancouver Island. Studies by chemical and physical oceanographers have presented evidence of upwelling but the important biological implications have not as yet been described for this area. No doubt the upwelling will have significant effects upon the biological events occurring in the waters of the Park.

One group of microplankton causes the red tide in Pacific waters and also contributes to the toxicity of shellfish at certain times of the year. Paralytic shellfish poisoning is quite widespread and the distribution and abrupt occurrence of the causative organism cannot be known without some kind of monitoring programme.

Based on the experience of this one year's work, I would like to recommend that a monitoring programme be established in both Tofino and Ucluelet Inlets. This programme could be implemented with a minimum of effort. To be effective this monitoring should be at weekly intervals. The Museum will provide bottles, preservatives and collecting instructions. The collections can be shipped to Ottawa for identification. In addition to the plankton monitoring programme, there should be a survey made of the fishes along the shore of the Park. This survey would complement a larval fish survey to be undertaken in the same general areas.

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