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The zooplankton communities of Tomales Bay, California

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THE ZOOPLANKTON COMMUNITIES OF TOMALES BAY, CALIFORNIA

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by

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FORWARD

This thesis represents a zooplankton study of Tomales Bay, Marin County, California. It consists of two papers. The first paper, "The Abundance of Copepods in Tomales Bay, California" has been submitted to the California Fish and Game for publication. The second paper, "Diet Studies of the Ctenophore *Pleurobrachia bachei* has been submitted to Fishery Bulletin. The raw data has been compiled in the Appendix.

PART I

THE ABUNDANCE OF COPEPODS IN TOMALES BAY, CALIFORNIA

Introduction

Tomales Bay is one of the least polluted bays in California. Characteristics of the Bay are described in Hardwick (1973), Daetwyler (1966), and Smith et al. (1971). Seasonal changes in plankton distributions have not been described in Tomales Bay. The purpose of this study is to characterize seasonal changes in zooplankton abundances in the Bay and provide preliminary information concerning the factors affecting zooplankton distributions.

Materials and Methods

Three sampling stations were chosen in the lower, middle, and upper portions of Tomales Bay. Monthly samples were taken (except March) from the dock at Lawson's Landing, the Marshall Boat Works, and the Golden Hinde Motel at Inverness (see Figure 1). Plankton samples were taken during both the incoming and the outgoing tide on each sampling day. Tows were taken against the tide to minimize overlap of water masses, with a weighted #6 plankton net with a 30 cm aperature. At each station three replicate samples were taken at the bottom of the water column, the

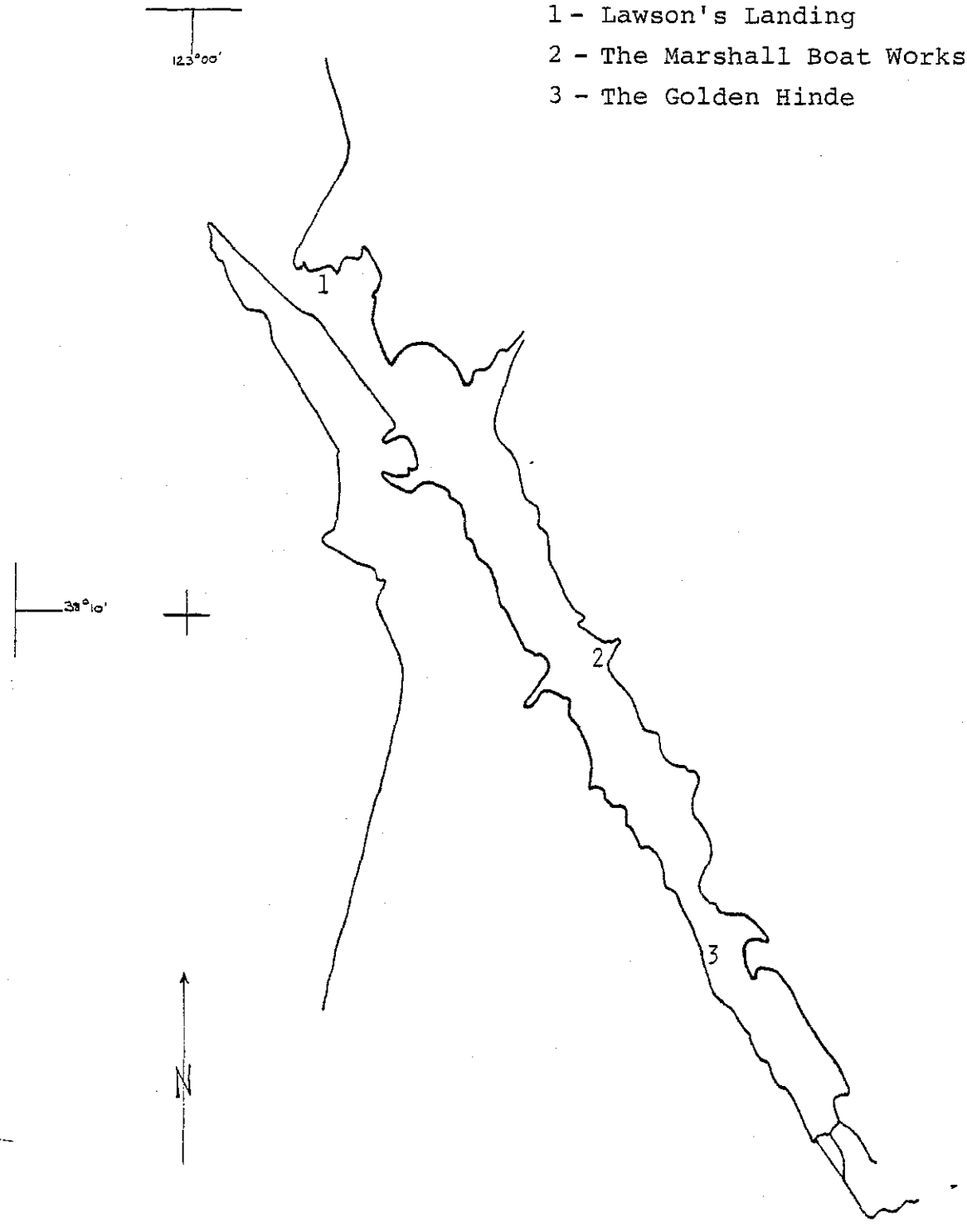

Figure 1. Location of the three stations in Tomales Bay, Marin County, California.

surface and obliquely through the water column. The bottom samples were taken by lowering the net to the bottom and then raising it approximately one foot in order to minimize the clogging of the net with bottom material. Samples from the top of the water column were taken approximately one foot below the surface. Oblique tows were taken at 0.5 m intervals from the bottom to the surface of the water column. After each tow, each sample was immediately preserved in 10 percent buffered formalin. Four-minute plankton tows were made at Lawson's Landing. Current speed was measured crudely by timing the surface velocity of a flat piece of wood over a distance of 15 meters. At the Marshall Boat Works and the Golden Hinde in Inverness, tows were taken over a specific distance because tidal currents were very slow. Samples were identified and counted in the laboratory with a dissecting microscope.

Results and Discussion

The geography of Tomales Bay has been described (Smith et al., 1971). The Bay can be divided into three major regions by their physical characteristics. The Lower Bay, from Pelican Point north to the mouth, is characterized by deep channels along the western shore having moderate to high current velocities, oceanic salinities, relative low oceanic temperatures, and a high transparency to the water. The Mid Bay, between Pelican Point and Indian Beach, has low current velocities, intermediate salinities, variable

temperatures and moderate to low water transparency. The bottom sediments contain more mud than the Lower Bay. The Upper Bay, from Indian Beach to the Point Reyes Delta, has low current velocities, variable salinities, variable temperatures, and low water transparency as in the Mid Bay, but with larger fluctuations of these characteristics. Mud is the predominant bottom sediment in the Upper Bay. Water temperature increases from the Lower Bay to the Upper Bay in magnitude and in the range of variation. Salinity decreases in magnitude but increases in variation from the Lower Bay to the Upper Bay. The three sampling stations chosen for this study (Lawson's Landing, the Marshall Boat Works, and the Golden Hinde in Inverness) each represent one of the three regions described above.

Lawson's Landing

The zooplankton found at Lawson's Landing are representative of the Lower Bay. The greatest diversity of copepod species occurs here, with twelve species of calanoid copepods, one species of cyclopoid copepods, and several harpacticoids being found. Harpacticoid counts are combined because of taxonomic problems. *Acartia clausi* reached its highest density of $1700/m^3$ in February and was the dominant copepod all year. *A. clausi* was found to be lowest in abundance in June. In a separate study, *Pleurobranchia bachei*, a ctenophore predator on *A. clausi*, was observed to reach its highest densities during early July at a site just

outside the entrance to Tomales Bay. The second most abundant copepod occurring here was *Pseudocalanus elongatus* which also reached its peak of 600/m^3 in February. The general abundance of patterns of *P. elongatus* closely parallel those of *A. clausi*. The non-calanoid copepods, *Othiona* sp. and harpacticoids, were also found throughout the year, reaching peak abundances of 50/m^3 and 120/m^3 respectively in May. *Centropages abdominalis* was not found during the summer months. A high peak of 21/m^3 was recorded in January. This copepod is usually estuarine (Brodskii, 1950). *Tortanus discaudatus* was present throughout the year, reaching peak abundances of 48/m^3 in May. *Calanus pacificus* was absent from the Bay during the summer months, with a peak abundance of 65/m^3 in December. This copepod occurs in cool and saline waters (Brodskii, 1950). The next three copepods, *Rhincalanus nasutus, Eucalanus bungii bungii,* and *Epilabidocera longipedata*, occurred occasionally in winter, with abundances seldom exceeding 2/m^3. Other rare species were *Labidocera trispinosa, Paracalanus parvus, Acartia longiremis,* and *Metridia* sp., with abundances generally less than 1/m^3.

A comparison of the total copepods found in high and low tide for each station is shown in Figure 2. These two graphs show that copepod abundance is highest in the winter months. Two level nested analysis of variance (ANOVA) showed that there is a very significant difference between high- and

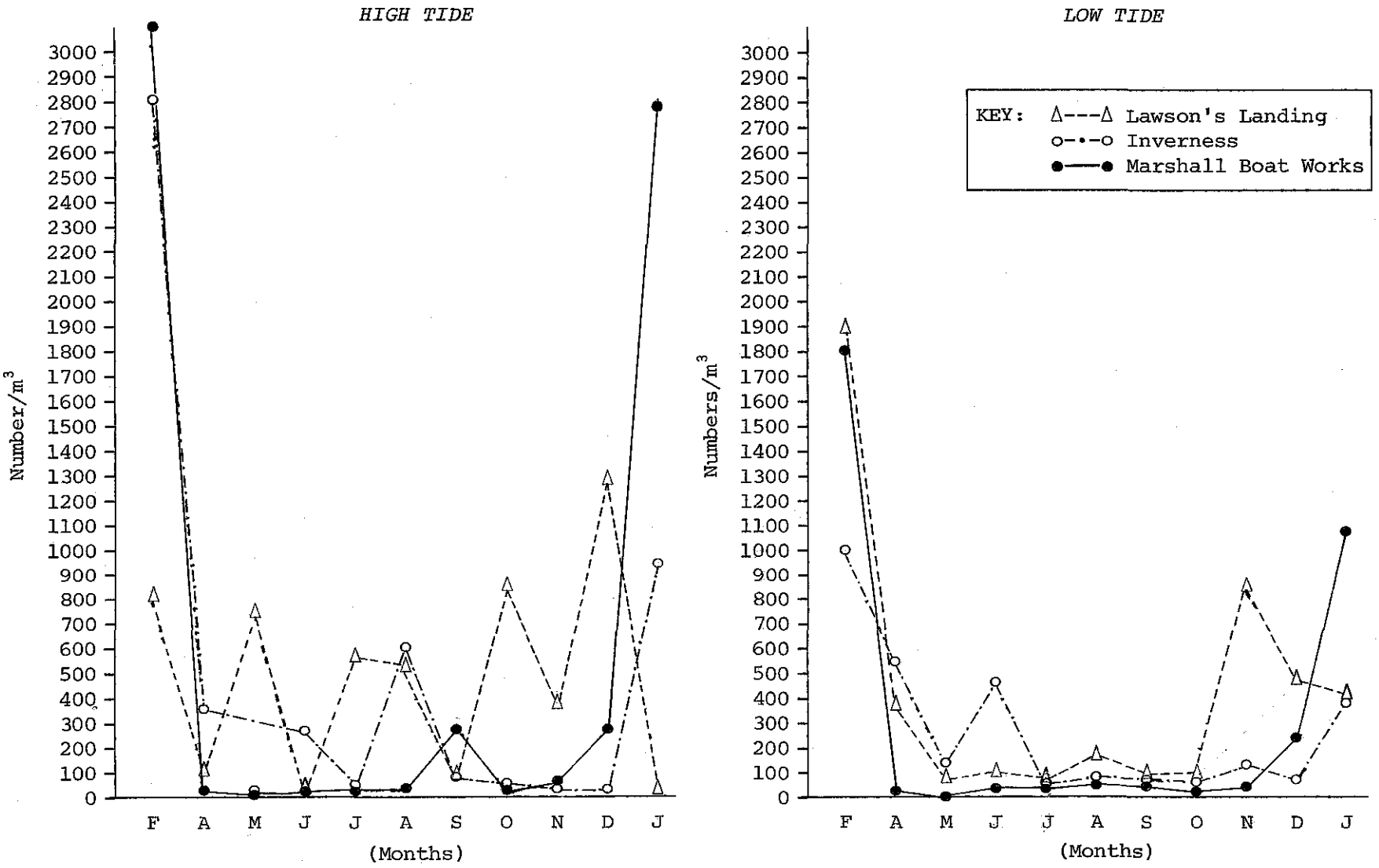

Figure 2. Total copepods of Tomales Bay

low tide abundances of copepods ($p < 0.01$) but no significant difference between months ($p > 0.05$ NS).

Lawson's Landing, with its close proximity to the Pacific Ocean, was found to have copepod species that are representative of the nearshore and oceanic waters. The highest number of copepods and the greatest diversity of species occurred in the winter.

The Marshall Boat Works

The Mid Bay region station was represented by the Marshall Boat Works station. Only seven species of calanoid copepods, several harpacticoids, and *Othiona* sp. were found. Harpacticoids were found throughout the year. *Othiona* sp. occurred regularly during the winter months. *Acartia clausi* was the dominant copepod with abundances of up to 3100/m^3 during February and reaching a low of 0.2/m^3 in May. A second peak of 290/m^3 occurred in September. The second ranking copepod was *Centropages abdominalis*, which reached a peak of 1100/m^3 in January. This copepod was the most abundant species during the winter months. *C. abdominalis* is a more estuarine copepod with its highest abundance occurring at the Marshall Boat Works as opposed to either Lawson's Landing or the Golden Hinde stations. *Pseudocalanus elongatus* was the third most abundant copepod occurring at the Marshall Boat Works, reaching the highest abundance of 68/m^3 in January. The abundances of *P. elongatus* closely paralleled those of *Acartia clausi* and *C. abdominalis* by occurring in

higher numbers during the winter months. *Tortanus discaudatus* was found mainly during the winter months with a peak of $17/m^3$ occurring during January. *Calanus pacificus* and *Epilabidocera longipedata* occurred infrequently during the winter months with peaks of $31/m^3$ and $0.2/m^3$ respectively.

Two level nested ANOVA showed a high significance between months ($p < 0.01$) but no significance was found between the abundances in the high and low tide levels ($p > 0.05$).

The Mid Bay has fewer species than the Lower Bay. Mid Bay species are those able to withstand a certain amount of freshening and a wider range of salinities. The greatest abundance and diversity of copepod species occurred during the winter months.

The Golden Hinde

Only four calanoid copepods were found at the Upper Bay station, The Golden Hinde. The harpacticoid species occurred throughout the year. The only copepod species occurring throughout the year was *Acartia clausi* which was also numerically dominant at the other two locations. It was most abundant in February ($2800/m^3$). *Centropages abdominalis* was the second most abundant copepod occurring sporadically during the summer but often during the winter months. A peak of $70/m^3$ was recorded in January. *Tortanus discaudatus* occurred mainly in January with a peak of $100/m^3$. This species also occurred only in November.

Two level nested ANOVA showed significant difference between both months ($p < 0.05$) and tide level ($p < 0.05$). The Golden Hinde had very high abundances of copopod numbers even though this station was represented by the lowest species diversity (see Figure 2).

A three-way factorial ANOVA was run to compare station location, months, and tide level. All interaction terms were nonsignificant ($f > 1$ NS). The high variation of numbers found in the replicates probably influenced the results of the ANOVA.

The Lower Bay contains more species of copepods than either the Mid Bay or the Upper Bay. The closeness of the oceanic waters is a major influencing factor in the copepod species composition. The Lower Bay had more constant abundances of generally less than $300/m^3$ total copepods during the summer months. The number of species decreased in the upper, more variable parts of the Bay. With the return of the winter months, the numbers of copepods in the Bay increased (see Figure 2).

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PART II

DIET STUDIES OF THE CTENOPHORE

PLEUROBRACHIA BACHEI

Introduction

Ctenophores are a seasonally dominant carnivorous zooplankton of coastal waters. They prey selectively on small crustaceans and may regulate their abundances (Hirota, 1974). Two species occur in the mouth of Tomales Bay, *Pleurobrachia bachei* and *Beröe* sp. The purpose of this study is to describe the diets and food size relationships of *P. bachaei*. *Beröe* has not been studied because the species is too fragile to be sampled for diet studies. The feeding biology of only one other ctenophore has been studied. *P. pileus* was shown to use passive ambush or entrapment as a mode of predation (Anderson, 1974). In this study, *P. bachei* was found to use only the latter method.

Methods and Materials

Pleurobrachia bachei were collected from Bodega Bay just north of the entrance to Tomales Bay (38°14'00" N, 122°58'35" W). Two collections totaling 331 specimens of *P. bachei* were taken: July 5, 1978 (301) and September 2, 1978 (30). The results from both samples were pooled for an analysis of their diets.

Horizontal tows from one-meter depth to the surface were taken with a #6 plankton net having an aperture of 30 cm. The tows were of a short duration to minimize the chance that the ctenophores would capture prey in the receiving vial of the net. The ctenophores were immediately separated from the plankton and preserved in 10 percent buffered formalin. No extrusion of gut contents was observed during either sampling or preservation. In the laboratory, the aboral to oral distance and body diameter at the apex of the tentacle sheath was measured for each specimen. The guts were dissected and all diet items identified and measured. Crustaceans were the major food items. Copepods were measured from the head to the caudal rami. Other crustaceans were measured from the aboral to oral end. All measurements were made with a calibrated occular micrometer to the nearest 0.01 millimeter.

The limited equipment available did not permit sampling at different depths. Generally, other ctenophore species occur rarely in tows deeper than 25 m and usually occur within 5 m of the surface in waters of 75 m in depth (Anderson, 1974). Ctenophores in the study area did not occur below 3 m, suggesting that the sample is probably representative of the vertical distribution of the *P. bachei* population.

Feeding experiments were conducted in the laboratory with *P. bachei* and several concentrations of its principal

prey item, *Acartia clausi*. Three *P. bachei* were kept in seawater which was filtered through a 44μ mesh screen for twenty-four hours prior to the feeding experiment. This allowed the ctenophores to completely empty their guts of previous prey items. Each *P. bachei* was placed in a 250 ml container supplied with a continuous flow of filtered seawater. Each ctenophore was measured along the aboral-oral axis and its general condition noted before and after the experimental run. The concentrations of prey items were 2×10^5, 4×10^5, and 6×10^5 per cubic meter. The feeding experiments were run for twenty-four hours. Upon termination of each experiment, the remaining copepods were counted and the presence or absence of food in the gut of the *P. bachei* was noted.

Results

Pleurobrachia bachei used in the feeding abundance experiments ranged in size from 5 mm to 8 mm. At the termination of each experiment, the containers were filtered through a 110μ mesh net to remove and count any remaining copepods. By the end of the twenty-four hour feeding period, the ctenophores had eaten $1.2 \times 10^4/m^3$ of *Acartia clausi*. Fecal pellets, resulting from the consumption of *A. clausi* by the ctenophores, were observed in each container. One ctenophore still had food in the gut at the termination of the experiment. Another ctenophore was observed to be in poor condition, with many tentacle pieces observed on

the bottom of the container. Even though the container with the largest concentration of *A. clausi* contained the smallest experimental ctenophore, the number of copepods eaten was similar to those eaten by the larger ctenophores. This allows one to speculate that a larger ctenophore in better health would have eaten more in the same situation. At concentrations of $4 \times 10^5/m^3$ and up, Rowe (1971) found that the feeding rate of *P. pileus* was independent of food concentration.

Gut Content Analysis

Three items comprised 61.6 percent of all the 632 prey found in the 331 *Pleurobrachia bachei*. These were *Pseudocalanus elongatus* (27.9 percent), *Acartia clausi* (8.7 percent), and cirriped napuli (25 percent). *Othiona* sp. represented 2 percent of the prey items. Items comprising less than 1 percent of the diet were: cirriped cyprids, *Podon polyphemoides*, *Tortanus discaudatus*, brachyuran zoea, spionid polychaets, and harpacticoid eggs. The remaining 38.4 percent was composed mostly of unidentifiable calanoid copepodites and napuli. Of all *P. bachei* analyzed, only 6.2 percent had empty guts, suggesting that they are constantly eating. Ctenophores containing prey in the last stages of digestion occurred in 12.7 percent of the specimens.

Copepod abundance in Tomales Bay can be found in Table 1. *Acartia clausi* were found to increase from 26.3

TABLE 1

COPEPODS FOUND IN TOMALES BAY

Species		Number/m^3	Percentage	Average (%)
		June 23, 1978		
Acartia clausi				
	high tide	47.3	25.2	26.3
	low tide	132.5	27.4	
Pseudocalanus elongatus				
	high tide	102.5	54.6	33.4
	low tide	58.8	12.2	
Othiona sp.				
	high tide	29.4	15.7	15.0
	low	69.2	14.3	
Others				
	high tide	8.4	4.5	25.3
	low tide	222.6	46.1	
TOTAL:	high tide	187.6	100.0	100.0
	low tide	483.0	100.0	
		July 27, 1978		
Acartia clausi				
	high tide	498.8	61.4	69.4
	low tide	107.7	77.5	
Pseudocalanus elongatus				
	high tide	196.9	24.2	14.7
	low tide	7.2	5.2	
Othiona sp.				
	high tide	84.8	10.4	11.9
	low tide	18.5	13.3	
Others				
	high tide	32.0	3.9	4.0
	low tide	5.6	4.0	
TOTAL:	high tide	812.0	100.0	100.0
	low tide	139.0	100.0	

percent to 69.4 percent of the total copepod population from June to July, 1978. *Pseudocalanus elongatus* decreased from 33.4 percent to 14.7 percent, and *Othiona* sp. from 15.0 percent to 11.8 percent. The large decrease in "Others" was due to the absence of large numbers of harpacticoids in the July 27, 1978 sample. Also included in "Others" are *Tortanus discaudatus* and *Calanus pacificus*. *T. discaudatus* was seldom found in the diet (0.1 percent) and *C. pacificus* was not eaten, although available to the ctenophores in the plankton. Of all prey items available to *P. bachei*, only those items less than 2 mm in size were taken. This data suggests that *P. bachei* selects smaller sized copepods even though larger ones are available (see Figure A). The preferred size range of prey was found to be between 0.5 mm and 1.2 mm.

A significant correlation between *P. bachei* size and the number of copepods captured was found ($r = 0.154$, $N = 211$, $p < 0.05$, slope = 0.259). There was no significant relationship, however, between ctenophore size and copepod size ($r = 0.09$ NS). These results suggest that while larger ctenophores are able to capture more copepods per unit time, they do not appear to be better able to capture larger sized copepods.

Discussion

Except for July, *Pleurobrachia bachei* occurred in Tomales Bay throughout the year. July was the month when

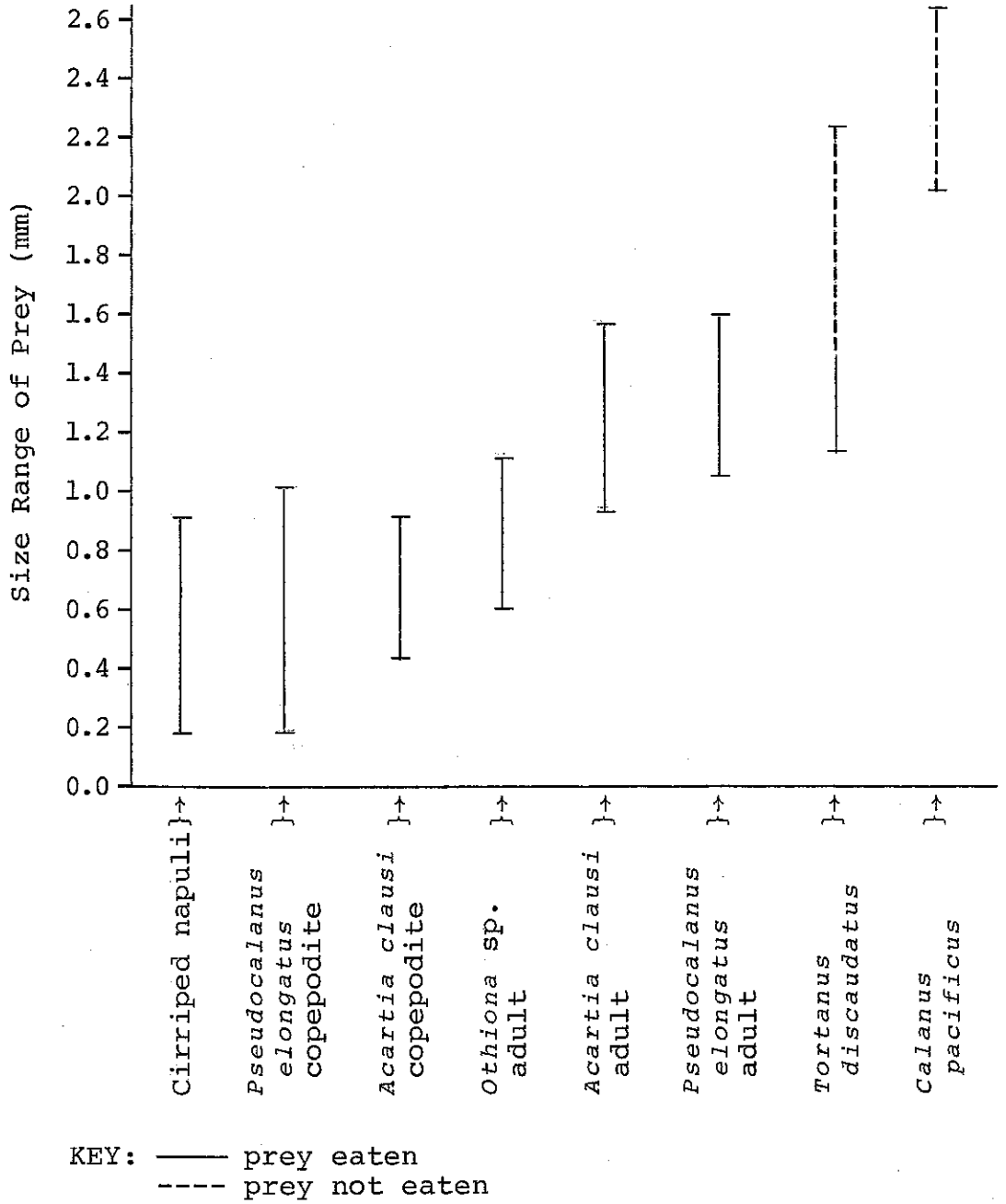

Figure A. Size of prey items found in Tomales Bay

most of the *P. bachei* were caught outside the entrance to Tomales Bay (see Figure B). Higher abundances of copepods were found outside the entrance to Tomales Bay during the summer months than inside the Bay.

The feeding behavior for the related ctenophore, *P. pileus*, has been described by Anderson (1974), Rowe (1971), and Reeve et al. (1978). Anderson (1975) found the copepods most likely to be caught by ctenophores were those with high swimming velocities. This was also found to be the case in the present study. *Acartia clausi* and *Pseudocalanus elongatus*, the most abundant prey item in the diet of *P. bachei*, are both relatively high velocity swimmers according to Anderson (1975). *Othiona* sp. although abundant in the plankton (15 percent and 11.9 percent), were found as prey items only 1 percent of the time. These copepods are sluggish swimmers which often "play dead" when captured and are often released (Hirota, 1974). Larger copepods, such as *Tortanus discaudatus* and *Calanus pacificus*, were relatively rare or absent in the diet. Anderson (1974) has observed *T. discaudatus* to break free after becoming caught by *P. pileus*. The possible damage sustained by the ctenophores during prey capture has caused them to select for a smaller sized prey. In the present study, no copepods larger than 2 mm were found in the ctenophore guts. As *T. discaudatus* is a preferred prey item of *P. pileus* (Anderson, 1974), its absence in the gut is not due to low abundances

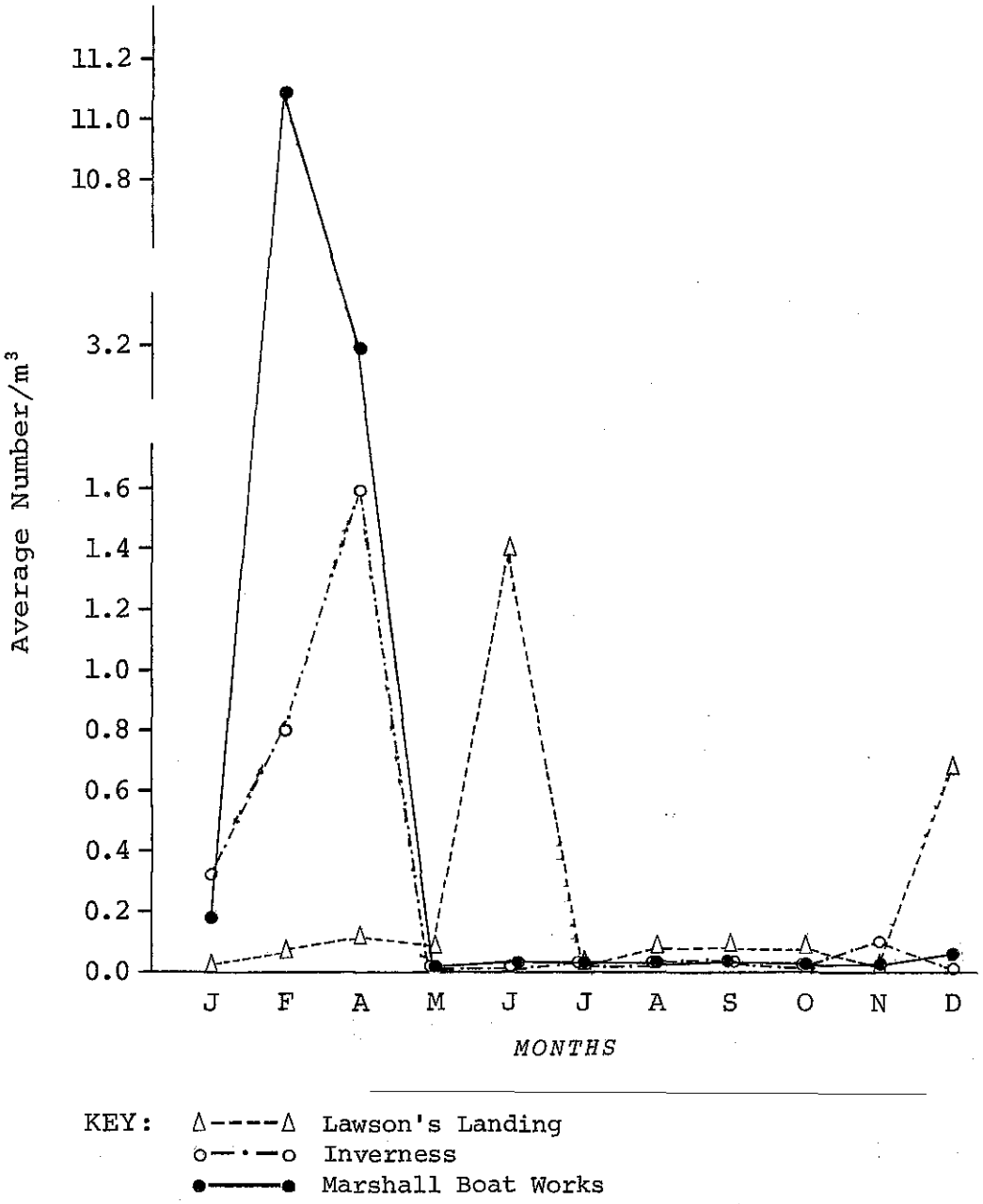

Figure B. Abundances of *Pleurobrachia bachei* at three stations in Tomales Bay

in the plankton (1 percent in the plankton, 0.1 percent in the gut).

Both Hirota (1974) and Anderson (1974) have observed larger ctenophores to prey upon larger copepods. In the present study, a majority of the copepods caught ranged between 0.5 mm and 1.2 mm. As ctenophore size increases, the number of copepods caught increased, but this did not include larger sized copepods. The captured *T. discaudatus* ranged from 1.1 mm to 1.4 mm but were copepodites and not adults. *C. pacificus*, occurring in equal plankton abundances as *T. discaudatus*, were not found in the guts at all. Cirriped naupli are not included in Table 1 as a decrease in numbers could be related to natural settling which causes a large decrease in their numbers.

Table 1 shows an increase in *Acartia clausi* and a decrease in *Pseudocalanus elongatus* from June to July. The changes in abundances possibly show that *P. bachei* utilizes the most abundant copepods and is a selective predator. Another factor supporting this idea is that *P. elongatus* is the most abundant copepod in the gut, possibly accounting for their decrease in the plankton. The numbers of *A. clausi* in the plankton increased, while their precentages in the gut was low. Copepods were found to be the predominant diet item of *P. bachei* (71 percent). This diet preference has also been reported by others (Rowe, 1971; Hirota, 1974; and Anderson, 1974).

Small *P. bachei*, between the sizes of 0.7 mm to 0.95 mm, were found without any food in their guts. They had what appeared to be a lipid reserve in the body cavity. The lipid particles were globular in shape and filled the body cavity. Copepods were not observed in the gut until the ctenophores reached a size of 3.4 mm, suggesting the continued utilization of the embryonic lipid reserve in small ctenophores.

Using Hirota's time of complete prey digestion for *P. bachei* as between nine and fifteen minutes, one can speculate on the mortality of copepods due to *P. bachei*. using the formula: (# of *P. bachei*/m^3)(# of copepods eaten/hour)(average # of diet items)(24 hours), one can approximate the copepod mortality due to *P. bachei* found in Tomales Bay, 11.1/m^3, one finds a mortality value of 3.19×10^3 copepods/24 hours/11.1 *P. bachei*/m^3. This would lead one to suspect that *P. bachei* is a major predator on the copepods of Tomales Bay.

Conclusions

The foregoing results show that *Pleurobrachia bachei* 1) feed primarily on copepods, 2) tends to capture larger numbers of copepods with increasing ctenophore body size but does not select larger sized copepods with increasing ctenophore body size, 3) tends to feed on prey less than 2 mm in size, 4) preys on the most abundant species of copepods

and appears not be to selective on particular species within the size range taken, and 5) captures faster swimming copepods more often than slower swimming copepods.

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APPENDIX

TABLE A

NUMBER OF SPECIES IN TOMALES BAY BY LOCATION

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	High Tide			High Tide			High Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	February 19, 1978								
Acartia clausi	171.9	121.2	155.1	785.4	8401.6	3099.9	981.4	8615.1	2854.5
Pseudocalanus elongatus	387.5	437.4	638.6	54.4	25.7	14.8	—	—	—
Harpacticoid	6.7	1.9	4.8	4.9	3.0	4.9	3.1	2.1	3.1
Othiona sp.	4.2	6.1	6.5	1.0	—	—	—	—	—
Centropages abdominalis	2.7	—	0.6	328.4	129.6	104.8	4.1	10.3	2.1
Calanus pacificus	2.1	1.0	4.6	4.9	4.0	4.9	—	—	—
Tortanus discaudatus	—	0.8	3.5	—	—	—	—	—	—
Acartia longiremis	—	0.2	1.7	—	—	—	—	—	—
Acartis tonsa	—	—	—	—	—	—	4.1	12.4	26.8
Epilabidocera longipedata	—	—	—	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	0.4	—	—	—	—	—	—
Paracalanus parvus	0.2	0.4	1.0	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	—	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	3.6	2.9	17.7	42.5	263.1	122.7	7.2	16.5	8.3
mysid	0.6	0.4	5.2	—	12.9	8.9	1.0	4.9	—
Pleurobrachia bachei	—	—	0.2	10.9	4.0	—	—	2.1	2.1
Sagitta sp.	0.2	0.2	0.6	1.0	3.0	2.0	—	4.1	5.2
fish larvae	—	—	—	—	—	1.0	—	—	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	Low Tide			Low Tide			Low Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
February 19, 1978									
Acartia clausi	934.7	1957.0	1738.1	461.9	4513.4	1486.6	367.4	1183.7	997.9
Pseudocalanus elongatus	188.9	188.2	186.3	37.6	14.8	33.6	—	—	—
Harpacticoid	4.6	5.0	8.1	20.8	5.9	3.0	—	1.0	1.0
Othiona sp.	18.0	5.4	16.5	1.0	—	1.0	—	—	—
Centropages abdominalis	10.0	7.7	12.7	550.0	564.8	248.3	—	1.0	1.0
Calanus pacificus	2.3	5.4	5.8	12.9	15.8	31.7	—	—	—
Tortanus discaudatus	1.5	5.4	4.2	—	2.0	—	—	—	—
Acartia longiremis	—	—	—	—	—	1.0	—	—	—
Acartis tonsa	—	—	—	—	—	—	1.0	2.1	8.3
Epilabidocera longipedata	—	—	—	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	—	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—		—	—	—	—
zoea (brachyura)	184.3	445.1	471.2	126.6	1727.0	561.8	2.1	15.5	13.4
mysid	4.6	2.3	4.2	—	22.7	16.8	—	—	—
Pleurobrachia bachei	—	—	—	30.0	6.9	14.8	—	—	—
Sagitta sp.	0.8	—	0.4	1.0	3.0	2.0	—	—	—
fish larvae	0.4	—	0.8	—	—	—	1.0	1.0	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	High Tide			High Tide			High Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
April 26, 1978									
Acartia clausi	38.9	66.3	89.0	4.4	71.4	4.0	182.7	330.4	347.9
Pseudocalanus elongatus	10.7	15.9	18.2	—	3.0	0.7	—	—	—
Harpacticoid	1.0	2.3	1.0	2.7	3.5	2.7	1.0	0.6	1.0
Othiona sp.	4.9	2.3	8.4	—	—	—	—	—	—
Centropages abdominalis	1.0	2.6	2.6	1.0	18.3	4.0	—	—	—
Calanus pacificus	—	0.3	0.8	—	0.2	—	—	—	—
Tortanus discaudatus	—	0.1	—	—	—	—	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	0.3	1.6	1.0
Epilabidocera longipedata	—	—	—	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	1.3	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	—	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	0.5	2.0	2.0	5.7	34.3	5.7	47.0	71.6	111.1
mysid	—	—	1.3	—	0.5	—	1.0	0.3	1.0
Pleurobrachia bachei	0.5	—	—	2.0	0.5	0.7	2.6	0.6	1.0
Sagitta sp.	0.8	0.3	—	0.5	0.2	—	12.6	35.3	37.6
fish larvae	0.3	—	—	0.2	0.2	0.5	6.8	1.6	6.8

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	Low Tide			Low Tide			Low Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	April 26, 1978								
Acartia clausi	240.7	484.3	363.7	1.7	17.3	11.4	—	—	539.2
Pseudocalanus elongatus	11.9	6.6	8.7	—	2.0	0.2	—	—	—
Harpacticoid	6.9	11.7	8.8	0.7	0.7	1.5	—	—	2.5
Othiona sp.	1.2	2.8	3.5	—	—	—	—	—	—
Centropages abdominalis	1.6	2.7	2.5	0.7	16.3	1.5	—	—	—
Calanus pacificus	0.7	0.3	0.4	—	0.2	—	—	—	—
Tortanus discaudatus	0.2	0.2	—	—	—	—	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	—	—	—	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	0.1	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	—	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	3.8	6.7	4.5	9.6	14.3	4.7	—	—	8.0
mysid	3.8	7.7	8.6	—	2.0	—	—	—	9.9
Pleurobrachia bachei	—	—	—	13.1	0.2	2.7	—	—	1.9
Sagitta sp.	0.2	0.2	—	—	—	—	—	—	3.3
fish larvae	0.2	0.5	1.0	0.7	—	—	—	—	56.9

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	High Tide			High Tide			High Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	May 23, 1978								
Acartia clausi	182.6	246.2	493.7	0.2	0.7	0.2	14.6	40.8	—
Pseudocalanus elongatus	33.6	27.0	23.9	—	—	—	—	—	—
Harpacticoid	151.4	158.0	120.7	1.0	1.7	0.7	1.6	0.3	—
Othiona sp.	73.8	53.8	51.7	—	—	—	—	—	—
Centropages abdominalis	9.4	7.3	10.3	—	0.5	—	—	—	—
Calanus pacificus	5.6	3.4	6.3	—	—	—	—	—	—
Tortanus discaudatus	63.4	31.8	48.5	—	—	—	—	—	—
Acartia longiremis	0.2	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	—	—	—	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	0.8	0.3	0.5	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	—	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	13.8	9.0	11.6	2.2	14.3	8.9	6.5	5.2	—
mysid	6.5	6.8	7.9	0.5	1.2	0.5	0.3	0.3	—
Pleurobrachia bachei	0.4	—	—	—	—	—	—	—	—
Sagitta sp.	1.3	0.8	0.5	—	—	—	0.6	—	—
fish larvae	0.4	0.1	0.3	—	—	—	0.6	0.3	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	Low Tide			Low Tide			Low Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	May 23, 1978								
Acartia clausi	11.9	6.0	3.8	2.7	1.5	1.0	85.2	168.8	—
Pseudocalanus elongatus	1.0	0.9	0.2	—	—	—	—	—	—
Harpacticoid	7.6	14.3	73.8	1.0	2.2	0.5	0.3	1.0	—
Othiona sp.	2.8	1.0	1.2	—	—	—	—	—	—
Centropages abdominalis	4.3	5.4	0.9	0.2	0.2	0.2	—	0.3	—
Calanus pacificus	—	0.3	—	—	—	—	—	—	—
Tortanus discaudatus	0.9	0.5	0.3	—	—	—	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	—	—	—	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	—	—	—	—	—	—	—
Edvane normanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	1.7	3.3	2.8	1.5	14.8	7.4	14.3	15.2	—
mysid	1.9	0.3	0.5	—	2.0	0.2	1.0	2.3	—
Pleurobrachia bachei	—	—	—	—	—	—	—	—	—
Sagitta sp.	—	—	—	—	—	—	—	—	—
fish larvae	—	—	—	—	—	—	3.2	1.3	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	High Tide			High TIde			High Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	June 23, 1978								
Acartia clausi	12.8	31.9	2.6	28.9	157.5	6.9	—	—	274.2
Pseudocalanus elongatus	14.9	65.5	22.1	—	0.2	—	—	—	—
Harpacticoid	1.8	4.0	1.8	0.5	0.2	0.7	—	—	1.4
Othiona sp.	7.3	11.2	10.9	—	—	—	—	—	—
Centropages abdominalis	—	—	—	3.0	6.9	3.5	—	—	—
Calanus pacificus	0.5	0.1	—	—	—	—	—	—	—
Tortanus discaudatus	0.1	0.1	—	—	—	—	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	0.2
Epilabidocera longipedata	—	—	—	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	—	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	1.1	4.6	0.6	1.0	1.5	1.7	—	—	4.3
mysid	0.1	0.6	0.1	—	—	0.2	—	—	0.6
Pleurobrachia bachei	0.4	1.0	0.7	—	—	—	—	—	—
Sagitta sp.	—	—	—	—	—	—	—	—	—
fish larvae	—	0.1	—	—	—	—	—	—	2.1

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	Low Tide			Low Tide			Low Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	June 23, 1978								
Acartia clausi	28.3	69.6	34.5	1.5	1.0	2.7	—	—	467.8
Pseudocalanus elongatus	35.4	8.0	15.4	—	—	—	—	—	—
Harpacticoid	40.0	135.3	44.6	0.5	0.7	1.0	—	—	11.3
Othiona sp.	36.1	14.1	19.0	—	0.2	0.2	—	—	—
Centropages abdominalis	—	—	—	5.2	1.7	7.7	—	—	—
Calanus pacificus	0.9	—	0.2	—	—	—	—	—	—
Tortanus discaudatus	0.9	0.2	0.5	—	—	—	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	—	—	—	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	—	—	—	—	—	—	—
Edvane mordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	78.2	25.8	42.8	1.0	1.5	0.2	—	—	0.6
mysid	38.8	14.5	16.5	—	1.0	—	—	—	91.4
Pleurobrachia bachei	3.3	0.9	1.3	—	—	—	—	—	—
Sagitta sp.	—	—	—	—	—	—	—	—	—
fish larvae	0.4	0.7	0.4	—	—	—	—	—	5.2

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	High Tide			High Tide			High Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	July 27, 1978								
Acartia clausi	16.4	118.0	364.4	7.9	78.8	3.2	—	—	56.4
Pseudocalanus elongatus	13.6	24.6	158.7	3.0	14.1	2.2	—	—	—
Harpacticoid	3.4	3.8	5.6	2.5	11.1	1.2	—	—	4.9
Othiona sp.	10.8	21.0	53.0	0.5	5.7	—	—	—	—
Centropages abdominalis	—	—	—	1.7	6.7	2.0	—	—	0.8
Calanus pacificus	2.6	4.4	6.6	—	—	—	—	—	—
Tortanus discaudatus	0.2	0.8	4.6	—	0.2	—	—	—	—
Acartia longiremis	—	—	—	—	0.2	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	—	—	0.5	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	0.5	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	1.1	1.1	8.9	0.2	0.5	1.5	—	—	1.2
mysid	1.0	0.5	2.5	—	0.5	—	—	—	—
Pleurobrachia bachei	—	—	—	—	—	—	—	—	—
Sagitta sp.	—	—	—	—	—	—	—	—	—
fish larvae	—	—	—	—	—	—	—	—	0.2

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	Low Tide			Low Tide			Low Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	July 27, 1978								
Acartia clausi	11.6	38.1	58.0	0.5	14.6	19.0	—	—	59.9
Pseudocalanus elongatus	0.9	1.2	5.1	—	—	—	—	—	—
Harpacticoid	0.6	1.5	2.7	0.2	1.0	0.5	—	—	1.0
Othiona sp.	0.3	4.4	13.8	—	—	—	—	—	—
Centropages abdominalis	—	—	—	0.2	0.7	0.2	—	—	—
Calanus pacificus	—	—	—	—	—	—	—	—	—
Tortanus discaudatus	—	0.3	0.5	—	—	—	—	—	—
Acartia longiremis	—	—	—	0.2	0.5	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	—	0.2	—	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	0.2	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	0.6	2.1	8.8	—	—	0.2	—	—	4.5
mysid	—	0.2	0.3	—	0.2	—	—	—	0.2
Pleurobrachia bachei	—	—	—	—	—	—	—	—	—
Sagitta sp.	—	—	—	—	—	—	—	—	—
fish larvae	—	—	0.2	—	—	—	—	—	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	High Tide			High Tide			High Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	August 24, 1978								
Acartia clausi	21.6	37.5	159.5	68.4	103.7	32.3	897.3	311.6	—
Pseudocalanus elongatus	28.6	50.3	224.3	—	0.2	0.2	—	—	—
Harpacticoid	1.7	2.3	4.0	4.2	1.5	0.5	1.0	0.6	—
Othiona sp.	8.7	10.6	38.6	—	—	—	—	—	—
Centropages abdominalis	—	—	—	11.1	6.5	4.9	—	—	—
Calanus pacificus	—	—	—	—	—	—	—	—	—
Tortanus discaudatus	1.1	1.5	10.5	—	—	—	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	—	—	0.1	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	0.1	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	0.7	0.8	10.5	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	3.9	18.8	29.3	0.7	0.7	0.7	1.9	0.6	—
mysid	0.3	0.1	0.6	0.7	0.5	0.2	—	—	—
Pleurobrachia bachei	—	—	0.1	—	—	—	—	—	—
Sagitta sp.	0.1	0.1	—	—	—	—	—	—	—
fish larvae	—	—	—	—	—	—	—	—	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	Low Tide			Low Tide			Low Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	August 24, 1978								
Acartia clausi	60.8	119.8	122.9	13.1	94.6	26.2	—	—	77.4
Pseudocalanus elongatus	52.5	15.3	18.8	1.5	2.7	—	—	—	—
Harpacticoid	5.0	6.1	4.0	2.2	2.5	1.7	—	—	1.0
Othiona sp.	32.2	11.3	17.7	—	1.5	—	—	—	—
Centropages abdominalis	—	—	—	3.7	7.9	5.2	—	—	—
Calanus pacificus	—	—	—	—	—	—	—	—	—
Tortanus discaudatus	3.0	1.0	3.0	—	1.0	0.2	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	0.3	—	0.1	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	0.3	—	—	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	7.5	1.7	6.2	1.0	5.2	1.2	—	—	0.6
mysid	1.2	0.6	1.1	0.2	2.5	0.5	—	—	—
Pleurobrachia bachei	—	—	—	—	—	—	—	—	—
Sagitta sp.	—	—	0.3	—	—	—	—	—	—
fish larvae	—	0.1	0.1	—	—	—	—	—	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	High Tide			High Tide			High Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	September 26, 1978								
Acartia clausi	15.1	12.3	35.2	192.3	221.5	290.1	—	—	82.4
Pseudocalanus elongatus	12.0	6.0	14.5	—	—	—	—	—	—
Harpacticois	4.2	8.5	3.3	3.2	2.2	5.2	—	—	1.0
Othiona sp.	21.6	8.2	22.6	—	—	—	—	—	—
Centropages abdominalis	—	—	—	1.2	1.0	1.0	—	—	—
Calanus pacificus	0.9	0.5	3.3	—	—	—	—	—	—
Tortanus discaudatus	3.1	1.3	4.0	—	—	—	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	0.2	—	0.2	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	1.1	0.7	3.8	—	0.5	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	1.3	1.6	3.6	2.2	2.0	4.7	—	—	1.0
mysid	0.4	1.3	0.5	0.7	4.2	0.5	—	—	0.3
Pleurobrachia bachei	—	—	0.2	—	—	—	—	—	—
Sagitta sp.	—	—	—	—	—	—	—	—	—
fish larvae	—	—	—	—	—	—	—	—	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	Low Tide			Low Tide			Low Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	September 26, 1978								
Acartia clausi	17.6	149.1	49.2	22.2	12.6	17.3	—	—	44.4
Pseudocalanus elongatus	9.7	10.7	23.0	—	—	—	—	—	—
Harpacticoid	4.3	2.9	3.6	6.9	0.7	13.6	—	—	1.3
Othiona sp.	12.1	10.9	10.7	—	—	—	—	—	—
Centropages abdominalis	—	—	—	0.2	3.2	0.5	—	—	—
Calanus pacificus	0.5	—	1.4	—	—	—	—	—	—
Tortanus discaudatus	2.2	3.1	6.2	—	—	—	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	0.3	0.2	1.6	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	2.6	2.9	8.5	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	1.6	5.5	18.0	5.7	7.9	0.5	—	—	0.3
mysid	0.2	0.5	1.6	3.0	6.2	0.2	—	—	—
Pleurobrachia bachei	—	—	—	—	—	—	—	—	—
Sagitta sp.	0.2	0.2	0.2	—	—	—	—	—	—
fish larvae	—	—	—	—	0.2	—	—	—	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	High Tide			High Tide			High Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
October 27, 1978									
Acartia clausi	207.0	971.7	653.2	32.1	175.6	7.9	—	—	68.2
Pseudocalanus elongatus	87.6	90.2	154.7	5.9	30.9	0.5	—	—	—
Harpacticoid	4.8	4.8	5.9	11.1	3.7	1.2	—	—	1.1
Othiona sp.	2.3	5.3	5.3	—	0.5	—	—	—	—
Centropages abdominalis	—	—	—	3.7	3.0	0.7	—	—	0.2
Calanus pacificus	3.5	4.8	3.8	—	—	—	—	—	—
Tortanus discaudatus	10.3	7.9	22.1	0.5	4.4	—	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartis tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	0.2	0.2	0.5	—	0.2	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	0.6	0.3	2.3	—	0.5	—	—	—	—
Edvane nordmanni	4.5	3.3	7.6	0.2	3.2	—	—	—	—
zoea (Brachyura)	1.2	1.2	2.7	0.7	1.2	0.2	—	—	0.3
mysid	2.7	4.4	5.6	0.5	1.2	—	—	—	0.2
Pleurobrachia bachei	—	—	0.2	—	—	—	—	—	—
Sagitta sp.	—	0.2	—	—	—	—	—	—	—
fish larvae	—	—	—	—	—	—	—	—	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	Low Tide			Low Tide			Low Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
October 27, 1978									
Acartia clausi	14.4	74.8	68.1	0.2	2.2	1.7	—	—	54.1
Pseudocalanus elongatus	15.5	4.5	16.8	0.2	—	—	—	—	—
Harpacticoid	5.1	7.3	4.6	4.0	3.7	2.2	—	—	4.7
Othiona sp.	2.2	0.6	1.8	—	—	—	—	—	—
Centropages abdominalis	—	0.1	0.1	0.2	0.7	0.5	—	—	—
Calanus pacificus	1.0	0.4	1.0	—	—	—	—	—	—
Tortanus discaudatus	1.3	1.0	2.8	—	—	—	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	—	—	0.2	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	0.1	—	0.2	—	—	—	—	—	—
Edvane nordmanni	0.1	—	0.1	—	—	—	—	—	—
zoea (brachyura)	6.8	2.5	5.7	—	—	—	—	—	—
mysid	0.7	0.1	0.8	—	—	—	—	—	—
Pleurobrachia bachei	—	—	—	—	—	—	—	—	—
Sagitta sp.	—	—	—	—	—	—	—	—	—
fish larvae	—	—	—	—	—	—	—	—	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	High Tide			High Tide			High Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	November 28, 1978								
Acartia clausi	207.1	205.8	238.1	31.6	41.2	15.3	32.1	24.6	10.0
Pseudocalanus elongatus	115.8	121.0	110.2	—	5.4	0.2	—	—	—
Harpacticoid	7.0	8.0	7.5	60.7	93.3	51.4	0.6	4.5	13.0
Othiona sp.	51.8	9.3	15.1	—	1.5	—	—	—	—
Centropages abdominalis	0.9	0.3	1.0	0.2	3.2	0.7	0.3	0.6	0.3
Calanus pacificus	6.3	6.2	7.3	—	1.5	—	—	—	—
Tortanus discaudatus	58.5	6.5	9.8	—	—	—	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	0.1	0.4	0.7	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	0.9	1.0	1.4	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	0.2	0.1	0.1	—	—	—	—	—	—
Podon polyphemoides	2.3	2.3	1.4	0.2	1.0	—	—	—	—
Edvane nordmanni	49.3	45.8	40.7	1.2	1.7	1.2	—	—	—
zoea (brachyura)	0.5	0.8	0.5	0.5	1.5	0.5	0.3	—	—
mysid	0.4	1.2	0.2	—	—	—	—	—	—
Pleurobrachia bachei	—	—	—	—	—	—	—	—	—
Sagitta sp.	1.6	1.1	0.7	—	—	—	—	—	—
fish larvae	—	—	—	—	—	—	—	—	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	Low Tide			Low Tide			Low Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	November 27, 1978								
Acartia clausi	175.5	175.1	575.3	3.5	4.0	3.0	72.2	152.3	—
Pseudocalanus elongatus	51.2	35.4	235.0	—	—	—	—	—	—
Harpacticoid	14.8	14.9	21.9	38.5	142.2	38.8	1.6	8.1	—
Othiona sp.	4.7	4.2	11.0	—	—	—	—	—	—
Centropages abdominalis	—	0.2	0.6	1.5	1.0	0.2	—	—	—
Calanus pacificus	2.6	2.8	4.9	—	—	—	—	—	—
Tortanus discaudatus	6.6	3.4	11.3	—	—	—	0.6	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	0.3	0.1	0.4	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	0.1	0.4	0.1	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	0.5	0.6	1.1	—	—	—	—	—	—
Edvane nordmanni	9.3	7.7	14.6	0.5	1.0	—	—	—	—
zoea (brachyura)	6.3	3.7	8.7	1.0	6.4	4.0	0.3	2.3	—
mysid	0.4	0.4	1.2	—	0.2	—	0.6	0.3	—
Pleurobrachia bachei	—	—	—	—	—	—	—	0.3	—
Sagitta sp.	0.5	0.2	0.4	—	—	—	—	—	—
fish larvae	0.1	0.1	0.2	—	—	—	1.0	0.3	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	High Tide			High Tide			High Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	December 21, 1978								
Acartia clausi	141.1	122.9	628.3	51.4	396.3	155.8	32.1	24.6	—
Pseudocalanus elongatus	138.6	111.7	554.1	36.0	33.6	9.1	—	—	—
Harpacticoid	23.6	15.7	45.9	11.9	18.0	4.0	1.0	2.3	—
Othiona sp.	29.7	13.5	58.6	2.2	4.4	0.7	—	—	—
Centropages abdominalis	0.9	0.4	2.5	144.4	211.9	115.6	0.6	0.6	—
Calanus pacificus	16.9	7.7	65.8	1.2	7.4	3.2	—	—	—
Tortanus discaudatus	13.9	4.5	33.3	1.2	4.7	1.5	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	0.2	0.2	0.4	—	0.2	0.2	—	—	—
Eucalanus bungii bungii	0.2	—	0.7	—	—	—	—	—	—
Rhincalanus nasutus	—	—	1.6	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trisponosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	0.2	—	3.7	4.2	5.2	—	—	—
Edvane nordmanni	1.8	0.2	4.1	2.5	2.2	2.5	—	—	—
zoea (brachyura)	9.2	5.2	26.5	31.9	52.6	24.2	—	—	—
mysid	6.3	4.7	16.9	—	5.2	1.0	—	—	—
Pleurobrachia bachei	1.1	—	2.3	—	0.2	—	—	—	—
Sagitta sp.	7.6	3.6	22.3	3.5	4.7	2.5	—	—	—
fish larvae	0.2	0.7	4.9	0.2	0.7	—	—	—	—

TABLE A-- Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	Low Tide			Low Tide			Low Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
	December 21, 1978								
Acartia clausi	19.8	41.1	240.6	50.6	392.2	178.8	—	—	76.0
Pseudocalanus elongatus	24.1	27.3	171.3	2.7	13.7	5.7	—	—	—
Harpacticoid	2.3	2.6	8.7	10.1	21.5	9.6	—	—	3.4
Othiona sp.	5.5	4.6	25.8	0.7	3.0	1.5	—	—	—
Centropages abdominalis	0.4	0.8	—	20.0	107.8	44.7	—	—	2.4
Calanus pacificus	6.9	2.7	5.5	0.7	1.1	1.0	—	—	—
Tortanus discaudatus	0.9	2.0	20.1	1.0	2.2	1.2	—	—	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	—	—	—	—	—	—	—	—	—
Eucalanus bungii bungii	0.1	—	0.6	—	—	—	—	—	—
Rhincalanus nasutus	—	0.4	0.5	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	0.01	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	0.3	—	0.4	—	—	—	—
Podon polyphemoides	—	0.3	—	1.2	10.4	3.5	—	—	—
Edvane nordmanni	1.5	2.2	6.4	1.2	3.0	1.0	—	—	—
zoea (brachyura)	—	0.4	0.5	4.0	24.8	14.3	—	—	1.9
mysid	—	—	0.1	—	1.5	0.7	—	—	—
Pleurobrachia bachei	—	—	0.4	—	—	—	—	—	—
Sagitta sp.	0.6	1.1	2.9	0.2	0.7	1.5	—	—	—
fish larvae	—	0.1	0.1	—	—	—	—	—	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	High Tide			High Tide			High Tide		
	surface	bottom	oblique	surface	bottom	oblique	surface	bottom	oblique
January 26, 1979									
Acartia calusi	4.6	12.6	7.4	1704.4	1535.3	1522.5	411.1	1070.6	—
Pseudocalanus elongatus	7.1	12.6	7.8	55.6	25.9	68.9	—	—	—
Harpacticoid	4.6	3.4	3.8	105.2	75.1	34.8	8.4	5.8	—
Othiona sp.	3.4	4.6	3.8	—	1.0	0.2	—	—	—
Centropages abdominalis	0.4	1.7	0.7	1624.4	744.4	1094.1	56.0	69.3	—
Calanus pacificus	1.7	—	0.7	14.8	2.7	10.4	—	—	—
Tortanus discaudatus	0.4	—	0.1	3.7	9.4	17.0	204.7	97.8	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	—	—	—	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	—	0.7	—	0.5	—	—	—
Edvane nordmanni	—	—	—	—	—	0.2	—	—	—
zoea (brachyura)	—	—	—	42.2	20.2	61.2	38.2	51.2	—
mysid	—	—	—	10.4	21.0	13.8	1.0	1.9	—
Pleurocrachia bachei	—	—	—	—	—	0.2	1.0	—	—
Sagitta sp.	0.4	0.4	0.3	12.6	4.0	6.4	2.6	1.9	—
fish larvae	—	—	—	2.2	1.5	2.2	—	0.6	—

TABLE A--Continued

Species	LAWSON'S LANDING			MARSHALL BOAT WORKS			INVERNESS		
	Low Tide			Low Tide			Low Tide		
	surface	bottom	oblique	surface	bottom	obliqie	surface	bottom	oblique
January 26, 1979									
Acartia clausi	431.5	239.7	326.4	319.3	509.6	832.6	339.8	404.6	—
Pseudocalanus elongatus	39.1	23.1	27.9	7.1	13.3	16.5	—	—	—
Harpacticoid	31.7	26.2	27.8	48.1	35.6	42.5	2.6	1.6	—
Othiona sp.	17.8	12.0	2.8	—	—	—	—	—	—
Centropages abdominalis	20.0	27.3	21.3	222.9	106.7	180.0	11.7	9.1	—
Calanus pacificus	2.0	1.3	1.3	3.7	1.5	2.2	—	—	—
Tortanus discaudatus	0.4	1.6	0.7	3.7	1.5	3.2	26.2	29.5	—
Acartia longiremis	—	—	—	—	—	—	—	—	—
Acartia tonsa	—	—	—	—	—	—	—	—	—
Epilabidocera longipedata	—	0.4	0.1	—	—	—	—	—	—
Eucalanus bungii bungii	—	—	—	—	—	—	—	—	—
Rhincalanus nasutus	—	—	—	—	—	—	—	—	—
Paracalanus parvus	—	—	—	—	—	—	—	—	—
Metridia sp.	—	—	—	—	—	—	—	—	—
Labidocera trispinosa	—	—	—	—	—	—	—	—	—
Podon polyphemoides	—	—	—	—	—	—	—	—	—
Edvane nordmanni	—	—	—	—	—	—	—	—	—
zoea (brachyura)	2.9	4.0	14.2	43.7	9.6	14.6	14.6	27.5	—
mysid	—	—	3.0	0.4	—	0.7	—	—	—
Pleurobrachia bachei	—	—	—	—	—	—	—	—	—
Sagitta sp.	0.4	0.4	0.4	0.8	—	1.0	1.0	5.2	—
fish larvae	7.8	7.1	6.7	2.2	0.7	1.2	0.3	1.6	—