AN ABSTRACT OF THE THESIS OF

JOHN CHARLES MARKHAM for the Master of Arts
(Name of student) (Degree)

in Oceanography presented on May 11, 1967
(Major) (Date)

Title A Study of the Animals Inhabiting Laminarian Holdfasts in Yaquina Bay, Oregon

Redacted for Privacy

Abstract approved
(Signature)
Herbert F. Frolander

During the six-month period of July through December, 1966, a study of animals inhabiting laminarian holdfasts in Yaquina Bay, Oregon, was carried out to determine what animals live in this habitat and to gain some idea of the factors which influence their presence and distribution. This study deals with yet another facet of the ecology of this Oregon estuary, which has been the object of intensive biological, geological, and hydrographic studies for the past several years.

Fifty samples were collected and analyzed and found to contain a total of 6,687 individuals representing 99 taxa. Identification was carried to species as far as possible although several individuals were juvenile or incomplete and so could be determined only to higher taxonomic levels. Some species showed limited distributions, but most species were widespread spatially and seasonally. The species

composition of the samples at a given location was quite constant throughout the period of sampling, but at each time of sampling it varied markedly among different locations in the bay. Since the animals found in holdfasts also occurred in other situations offering shelter and evidently readily moved from one holdfast to another, it was impossible to define any unique holdfast community.

When the animals taken were lumped by group, the most numerous were polychaetes, which comprised twenty-eight percent of all of the individuals. Other groups present in relatively large numbers were pelecypods, nematodes, cirripedes, and gastropods.

There have been no other studies of holdfasts-inhabiting animals in estuaries reported from the Pacific coast, so the results found were difficult to compare with other findings. Other surveys have been made on this coast which dealt with animals living in holdfasts in oceanic situations, and the results of the present study were somewhat comparable to them.

A Study of the Animals Inhabiting Laminarian Holdfasts in Yaquina Bay, Oregon

by

John Charles Markham

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Arts

June 1967

APPROVED:

Redacted for Privacy

Professor of Oceanography
in charge of major

Redacted for Privacy

Chairman of Department of Oceanography

Redacted for Privacy

Dean of Graduate School

Date thesis is presented May 11, 1969

Typed by Lucinda M. Nyberg for John Charles Markham

ACKNOWLEDGMENT

This study was made possible through grants from the U. S. Department of Health, Education and Welfare (Public Health Service), Grant No. 5T1-WP-61-02, and from the U. S. Department of the Interior, Grant No. 1T1-WP-111-01. The writer wishes to express his sincere appreciation to his major and minor professors, Drs. Herbert F. Frolander and Ivan Pratt, for much helpful advice and assistance throughout the study, to Mr. Danil Hancock for his identification of polychaetes, and to Mr. Jon McCormick and Mr. John Ratliff for assisting in the field collections.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

A STUDY OF THE ANIMALS INHABITING LAMINARIAN HOLDFASTS IN YAQUINA BAY, OREGON

I. INTRODUCTION

Even to the most casual observer, a kelp holdfast appears to serve as a suitable habitat for a very large number of small benthic animals of several taxonomic groups. Probably most students taking field studies at marine laboratories have looked at this habitat superficially, but remarkably few researchers have made any effort to conduct serious studies of it. Indeed, the available literature records only two such studies from the Pacific coast of this country. Andrews (1925) made a brief survey of the animals living in holdfasts of *Nereocystis luetkeana* in the vicinity of Friday Harbor, Washington, and later (Andrews, 1945) studied the animals occurring in holdfasts of five species of laminarians around the Monterey Peninsula, California. Geographically, the present study lies almost midway between the other two, a fact which makes comparison of findings of considerable interest. Both of the regions where Andrews worked are essentially oceanic environments, characterized by constantly high salinities and constantly low temperatures, whereas Yaquina Bay, a typical estuarine environment, shows great and rapid fluctuations in temperature, salinity, and other ecologically important factors through the year and in the course of a single daily tidal cycle (Emery and Stevenson, 1957, Frolander, 1964). It is likely that Andrews' findings from two similar habitats should correspond more nearly with each other than with the results from this estuarine study.

Other studies on the Pacific coast have also touched on the problem of animals living in holdfasts as a part of a larger ecological study of a particular region. Principal among these are the intensive studies of Shelford and his students in the San Juan Islands (Shelford and Towler, 1925, Shelford et al., 1935) and of Hewatt (1937) in Monterey Bay.

Dexter (1947) conducted a study of several bottom communities, including those of kelp plants, in an estuary on the Atlantic coast. His findings and those of the present survey may be expected to agree insofar as general estuarine influences are involved, but marked ecological differences between the two coasts may well outweigh such effects. Dexter sampled by dredging and so obtained mostly fairly large animals as well as several not actually inhabiting the holdfasts.

The algae whose holdfasts were selected for this study all belong to the order Laminariales of the class Heterogeneratae, division Phaeophyta (brown algae). Of particular importance to the present study is the structure of the sporophyte, which Tilden (1935, p. 258) characterizes as being ". . . of large size, solid or hollow, simple or branched, cylindrical to flattened, usually with three distinct regions--holdfast, stipe, and lamina . . ."

All major groups of benthic marine algae are represented in the flora of Yaquina Bay (Kjeldsen, 1967). However, laminarians, or as they are popularly known, "kelps," were exclusively selected for study because: 1) they alone possess holdfasts large enough to harbor significant numbers of animals; 2) they are abundant throughout the lower region of the bay, in all situations where a suitable substrate is present and on many floating docks they are the only macroalgae evident; 3) they are easy to collect with a minimum loss of the animals inhabiting their holdfasts.

Kjeldsen (1967) reports a total of twelve species of laminarians found growing or floating unattached in Yaquina Bay. Of these, the following seven species consistently grow within the confines of the bay: Laminaria saccharina Lamouroux, f. saccharina; L. setchellii Silva; L. sinclairii (Harvey) Farlow; Hedophyllum sessile (C. Agardh) Setchell; Nereocystis luetkeana (Mertens) Postels and Ruprecht; Alaria marginata Postels and Ruprecht; and Egregia menziesii (Turner) Areschoug subsp. menziesii. In the present study, specimens of all of these species except Laminaria sinclairii and L. setchellii were taken. Unfortunately, Kjeldsen's (1967) key was unavailable at the time of this study. Determination of the species of algae was made with aid of keys by Druehl (1965) and of Smith (1944).

Doty (1946) distinguished six or seven vegetation zones in the intertidal region due to the unequal semidiurnal tides characteristic of the Pacific coast. Kjeldsen (1967) related the distribution of algae in Yaquina Bay to variations in temperature and salinity and showed that of the seven laminarians found, *Laminaria saccharina* has an optimal temperature range of 10 - 14° C; for the other six species, the optimum is 10 - 12° C. Similarly, he showed that *L. saccharina* grows best in salinities between 27 and 35‰, while the other species have an optimum of 30 - 35‰. These physiological optima determined by Kjeldsen agree well with his finding that only *L. saccharina* is found upstream from the Yaquina Bay bridge to a significant degree. According to hydrographic data collected during the period of the present study (Frolander, 1966), the salinity of the lower part of Yaquina Bay remained within the optimal ranges. Water temperatures recorded at the time of collection were nearly all within Kjeldsen's optimal ranges, and at no time did they exceed the tolerable ranges.

II. AREA AND METHODS OFSTUDY

Area of Study

The present study was carried out in Yaquina Bay, which is a large submerged river mouth located on the northern Oregon coast. The particular portion of the bay considered lies between latitudes 44° 37' and 44° 38' N and between longitudes 124° 01' and 124° 04' W. Burt and McAlister (1959) characterize it as a Type D or well-mixed estuary from July to January, i.e. during the period included in this study, although Kulm (1965) finds it is often well-mixed only until November. During the rest of the year, it is a partly mixed (Type B) estuary. The temperature and salinity of the ocean off the Oregon coast remain close to 10° C and 33‰ through the year (Pattullo and Denner, 1965), and at high tide and during periods of low runoff, the water in Yaquina estuary comes close to these values. However, at low tide during high runoff, the outflowing fresh water has a pronounced effect, and the salinity drops while the temperature rises or falls according to the season of the year, so the estuary is a considerably more rigorous environment than the open ocean.

Yaquina Bay has a natural bottom ranging from sand at the mouth to fine silt upstream (Kulm, 1965), affording little place for the attachment of large algae. However, man has markedly altered this situation; both sides of the entrance are bounded by rock jetties, and throughout the sheltered part of the bay there are numerous floating wooden docks, which serve as suitable substrates. The jetty on the north side is of uniform width, while that on the south side has six perpendicular spurs of varied lengths projecting toward the channel. Unfortunately, the north jetty was being extended seaward during the course of this study, and no one was permitted to collect on it while work was underway. Collections were made in the south jetty out to the third spur and from floating docks as far upstream on both sides of the estuary as laminarians occurred.

All collections from the north side of the bay were taken on floats, but on the south side the only floating dock was on Hinton Point in King Slough. Accordingly, nearly all plants collected on the south side of the bay came from rocks or piling. Rocks are stationary and subject to periodic exposure, the frequency and duration of such exposure depending on their height; thus they constitute an essentially intertidal environment, subjecting their inhabitants to considerable variations of temperature and moisture. On the other hand, floats rise and fall with the tide and so their submerged regions are not exposed to the air. Consequently, even though an organism on a float may be only a few centimeters below the water surface, it is in reality in a subtidal environment and subject only to those changes which the surrounding water itself undergoes.

In the course of sampling, over one hundred holdfasts were taken from within the bay. Of these, fifty were dissected and the animals they contained counted and classified. Twenty-five samples came from six sampling stations on the north side of the bay and an equal number from six stations on the south side. These stations are designated by the letters A to L (Figure 1) reading clockwise from the lower right. Descriptions of the stations are in Table I. Numbered stations (Figure 1, Table I) were the sites of various special samplings and experiments.

All of the samples were taken during the period of July through December, 1966. Samples were taken on several dates during July and August; during each of the other four months all samples were taken on a single day, on the lowest low tide of that particular month.

Sampling Methods

After a particular holdfast had been selected for study, note was made of the following: date and time of collection; height of sample above or below the water line; nature of the substrate; temperature of the air or water (depending on whether the holdfast was exposed or submerged) species of alga; and any unusual facts. These data are presented in Table II. The holdfast was then pulled or cut loose and any remainder scraped from the substrate. If a holdfast was to be studied within a week, it was placed in a refrigerated room; otherwise, it was preserved in buffered 5 percent formalin solution or frozen until such time as it could be studied.

Analyses of Samples

Before a holdfast was studied it was trimmed at the top. By arbitrary convention it was decided to consider the holdfast to be that portion of the alga containing haptera and no more. In some cases the haptera extended a short distance up the stripes, which were then cut so as to include these haptera. In the case of Hedophyllum sessile, which has no stripe, the blade was trimmed as close as possible to the holdfast without removing any haptera.

Each holdfast was then measured to provide a rough approximation of the bottom contact area and the maximum height. Next it was placed on a piece of paper towel to blot excess water and weighed, in agreement with the method recommended by Thorson (1957) for determining wet weights. These data appear in Table III.

Each holdfast was carefully dissected and all animals removed and placed in a separate dish. Then the holdfast was placed under a 30x dissecting microscope and all of the remaining animals large enough to be seen were also removed. Those species which were readily identified were counted and removed, while others were identified with appropriate keys or given to persons well acquainted with the particular taxonomic groups for identification. As Andrews (1925) had earlier observed, holdfasts harbor a great many juvenile forms. In many cases these were impossible to identify to species by means of available references and so were listed in higher taxonomic ranks. References used for identification included Berkeley and Berkeley (1948, 1952) and Hartman and Reish (1950) for polychaetes, Keen (1963) and Morris (1952) for mollusks, Barnard (1954) for amphipods and Light *et al.* (1964) for many groups.

All tube-dwelling worms were removed from their tubes, but, in accordance with Thorson's (1957) method, the shells of mollusks were retained. The animals were then blotted dry and weighed and their weight compared to the total weight of the sample. In some instances, a few especially large individuals (most commonly *Mytilus edulis* L.) weighted the results considerably. This has been noted in Table III. After all of the species had been tabulated, the total number of individuals in the holdfast was determined and from this the percentage of that total represented by each species present was calculated. Where colonial forms, such as hydroids and ectoprocts, were present, each species was recorded as a single individual rather than being counted as separate colonies or numerous individuals. Table IV shows numerical comparisons made among groups of samples taken in different months and at different stations.

The total number of individuals found was 6,687. Those holdfasts containing roughly 1 percent of the total individuals or more (sixty-six to 574) were then selected for analysis of degree of affinity to one another. These included thirty-two of the fifty examined holdfasts and contained 5,847 individuals, a little more than 87 percent of the total. It was felt that if samples containing fewer than this number of individuals were used, the results of comparison would be less meaningful. Each of the holdfasts selected was compared with all other holdfasts from the same station and with the others taken during the same month according to the method developed by Sanders (1960). In this method, two samples are compared with one another by noting which species are common to both. Then the percentage which each common species represents in each sample is noted and the smaller figure recorded. All of these percentages are then totaled to give an affinity index. The resultant values from this study are presented in trellis diagrams in Table V. The more nearly equal the relative abundances of the species present in the pair of samples compared, the greater is the value of this index. The maximum possible value, 100, would result when two samples of identical percentage compositions were compared. An advantage of this technique is that the calculated index is independent of the total number of species in the samples.

A total of 99 species and higher taxonomic categories was found. For each of these a monthly tabulation was prepared showing how many individuals were found at each station (Table VI).

Associated Studies

In addition to the fifty holdfasts studied, various other samples were taken and tests conducted to provide additional information about the animals inhabiting laminarian holdfasts. In order to compare the associations of animals in the holdfasts from the twelve stations in the bay with those in holdfasts growing under different conditions, four holdfasts were collected in the early part of the summer from other areas. Two of these came from a reef on the open coast some distance north of the mouth of the bay, while a third was found washed in at the same place but attached to the empty shell of a large barnacle. This station is designated by the number 1 in Figure 1. A fourth holdfast was found attached to a cobble embedded in the flat sandstone region on the north side of Yaquina Bay west of the highway bridge (Station 2 in Figure 1). These samples, of species of algae different from the others found in the bay, were studied in the same manner as the other fifty. Table VII contains the data from them, while Table VIII compares affinities of them to each other and to other July samples.

In addition to determining the numbers of animals present in the holdfasts, it was considered desirable to establish whether holdfast animals remain permanently in a single holdfast or move from one to another. For this reason three field experiments were devised.

First, several holdfasts were collected and all visible animals removed without dissection of the holdfasts. The holdfasts were then placed in an unaerated container of seawater for at least a week in order to free them of the remaining animals. Thereafter the holdfasts were replaced in the areas of collection by means of rubber bands attached to either nails or bolts. It was assumed that any animals left in the holdfasts at the time of replacement would have rotted away and become lost before they were recollected, so all animals later found would have entered the holdfasts after they had been replaced in the field. Tables IX, X, and XI include data from these samples.

A second field experiment was conducted to study repopulation and movement by holdfast animals. Several cellulose sponges were cut into sections and fastened to rocks and floats in the collecting areas in the same manner as the replaced holdfasts. Although a cellulose sponge is quite different in appearance and texture from a real holdfast, it can be firmly pressed against the substrate and it contains many openings which small animals might enter. Thus it provides physical shelter similar to that of a real holdfast without biological effects which might serve to attract animals. Laboratory studies confirmed that a cellulose sponge tends to decompose after long periods of continuous exposure to sea water. For this reason, several of the sponges placed in the field were not recovered.

A final field study was made to determine possible pelegic movement of holdfast-inhabiting animals. This involved the taking of surface night-light samples at various points in the bay adjacent to floating collecting sites. This was done at slack tide on moonless nights with a flashlight in a glass jar for attraction and a #12 mesh Clarke-Bumpus sampler net and bucket for collection. It was recognized that this sampling would capture only those animals attracted to a light while missing any other occasionally pelagic species.

III. RESULTS

Animals Found in Holdfasts

In the fifty laminarian holdfasts examined a total of 6,687 animals was found. These represented twenty classes in twelve phyla. Due to the fact that many of the individuals found were juveniles, identification was very difficult in some instances, particularly among mollusks. Wherever possible, individuals were keyed to species. In all, ninety-nine taxonomically distinct groups were determined, which for the sake of discussion may be designated as taxa. It must be borne in mind however that only sixty-five of these groups were determined to the species level, while fourteen were keyed to genus, two to family, two to order, nine to class, and four to phylum. In addition, three types of larvae are listed in their respective groups. The taxa determined to be present are listed for each month in Table VI. In some instances a listed taxon represents several species; a reasonable estimate of the total number of species present might be 120 to 130.

Of the ninety-nine taxa, by far the most numerous is the group of unidentified nematodes, numbering 940 individuals. Eight taxa each total more than 200 individuals, and another seven lie between 100 and 200.

Several general conclusions may be drawn from this study. An estuary provides an environment of considerable extremes and rapid changes, such that specific numbers are subject to variation. The animal groupings are far more variable from different parts of the bay than they are seasonally at any one station. This fact is supported by most of the observations which follow.

Hydroids occurred throughout the period of study, most commonly in the upper regions of the bay. Nearly all of the colonies were missing hydranths and so could not be identified satisfactorily. Most of them, however, appeared to belong to the family Campanularidae (McCormick, personal communication, 1967).

The turbellarian *Notoplana* sp., while rare, occurred in July and again in November, both times at Station E, near the mouth of the bay. This form is very common in exposed rocky coast regions in *Mytilus californianus* beds, a fact which suggests that it is oceanic, regardless of the season.

Nematodes, of which there were evidently at least two species, were very widespread, occurring in thirty-five of the fifty samples. The reasons for some of the large numbers found are not apparent. The greatest abundance (280) was present in a holdfast (Sample 19) attached to a piece of wood on the bridge (Station C), but the presence of wood apparently was not a significant factor in their abundance, since nematodes were not markedly numerous in samples taken on wooden pilings, only one hundred meters farther upstream.

Among polychaetes the unquestioned numerical dominants are the two sabellids *Sabella media* and *Schizobranchia insignis*, both found commonly at all stations except those farthest up the bay, A, K, and L. Every sample contained polychaetes, although Sample 3 had only one. Species occurring only once or twice may have been present by accident. In contrast, a few species were widespread in time and space but were never present in large numbers. These include *Halosydna brevisetosa*, *Platynereis bicanaliculata*, and *Eulalia aviculiseta*.

Various arthropods, not surprisingly, were also very common, being present in forty-eight of the fifty samples. Although all of the barnacles identified were *Balanus glandula* Darwin, it is possible that some were actually *B. cariosus* (Pallas); large numbers and frequent small specimens made keying of more than a very few impracticable. *Balanus* was very widespread in time and place, but was especially abundant at Station A, where it often comprised more than half of the total number of individuals.

Both of the two most abundant amphipods, *Amphithoë simulans* and *Corophium spinicorne*, occurred farther up the bay than Station B. *Amphithoë* shows some exception to this distribution in that forty specimens were taken at Station D. *Corophium*, in contrast, except for four isolated individuals, was found exclusively at Stations A, K, and L.

All of the insects found were limited in distribution to the three collecting stations on the jetty spurs, where the most nearly oceanic conditions prevail. While not all of them were identified, those that were represented only two species, the dipteran Aphrosylus sp. , in larval and pupal form, and the staphylinid Liparocephalus cordicollis as adults and larvae. Both of these are characteristically marine (Anderson, personal communication, 1967) and are evidently unable to tolerate the more brackish conditions farther up the bay.

Mollusks were also very widespread, being absent from only one sample. As previously stated, their identification was extremely difficult, and often impossible beyond the generic level. Keen's (1963) key served well to this point, but the large numbers of minute juvenile individuals and absence of a suitable local reference limited further identification. The chitons present probably represented at least four species but all were too immature for identification (Hunter, personal communication, 1967). The snail Lacuna sp. was fairly widespread in time and location. Among pelecypods, the two mytilids Mytilus edulis and Modiolus modiolus were nearly ubiquitous and clearly the numerical dominants of the phylum. It is entirely probable that some of the individuals listed as Mytilus edulis were in reality M. californianus, especially those from the lower parts of the bay. Unfortunately, in specimens of the size encountered, specific differences are difficult to discern.

Of the ectoprocts present, Hippothoa hyalina was found encrusting most of the holdfasts, sometimes nearly covering the entire exposed surface. Ascidians were few but widely scattered in space and time.

Comparison of Samples

Several different methods were used to compare the samples with one another. In Table IV three types of calculations were made to compare samples from each month and station. Although only moderate significance can be assigned to the particular values of the figures, generalizations can be derived from their tendency to be grouped. The number of individuals per sample is fairly constant for all six months, while the total number of species per sample clearly bears an inverse relationship to the number of samples. This indicates that generally the same species were found throughout the year. The numbers in the final column, the diversity indices, are obtained by dividing the number of species by the number of individuals for each group. The greatest possible diversity, occurring when each species is represented by a single individual, has a numerical value equal to 1; as the diversity of a sample or a group of samples decreases, the value of this index also decreases, approaching 0. The value of this index (Table IV) is quite low for each group, indicating a small diversity. In the first part of the table, its value is also very constant, indicating that each monthly group is similar to the others.

In the second part of Table IV, the samples are grouped according to station rather than by month. It is immediately evident that in this case the last three columns, the computed values, are much more variable and show little relation to the number of samples from each station. From these data it may be readily inferred that the samples vary far more from one station to the next than they do from month to month, a result which agrees with species tabulations (Table VI).

Table V includes the results of comparing selected samples by Sanders' (1960) method. The results are presented in trellis diagrams, first by station and then by month. The extremes of these calculated affinity values range from a low of 2.0 to a high of 74.8. Crandell (1967) used the same method for comparing samples of harpacticoid copepods in Yaquina Bay and obtained values from 0.0 to 88.9, somewhat more extreme than those herein.

At Station A only two samples, 32 and 42, exceeded the cutoff value of sixty-six individuals, so only one affinity index was computed. At 74.8, this was the highest of all the indices, due to the fact that most of the samples from this station consisted of more than 50 percent Balanus glandula.

Stations B and C (Table V), because of their geographical proximity, were compared to each other for all months. Seasonal differences were less marked than those between the two stations, although in some instances the correlations between samples from the same station are poorer than those from different stations. Although collections closer together in time might be expected to be more alike, no such relationship exists here. At these two stations there are much greater affinities between holdfasts from the same species of alga than between those from different species, a result which in this case seems to dominate over both seasonal and spatial effects. At these two stations, the seven samples represent four different species of algae (see Table II). The single Egregia menziesii (Sample 19) alone has consistently low agreement with all of the other samples.

The affinity indices of samples at Station D show no definite trend attributable to either time or algal species. At Station E all samples were from Hedophyllum sessile so no species effect entered the results. Most of the values are high, but once again no consistent seasonal relationship is evident.

There was only one sample from Station I large enough for this type of analysis, and Stations F, G, H, J, and K had too few samples containing enough animals for any conclusions to be drawn from the resultant trellis diagrams. The indices at Station L had a marked seasonal correlation, those pairs closest in time having the greatest affinities. The highest value, between Samples 2 and 13, is due mainly to the presence of large numbers of *Corophium spinicorne* in both.

In the second part of Table V, the trellis diagrams are grouped by month. In the July group the lowest values are those resulting from comparisons of other samples with Sample 2. This sample is the only one from up the bay (Station L) and is also the only *Laminaria saccharina*. The August results, dealing entirely with *L. saccharina* from upper bay stations, complement those for July very well. For these two months, the comparisons between samples from Stations C and L are very nearly alike, and all other stations, when compared with Station L, show higher affinities as one progresses up the bay. The October and November indices are generally higher for closer stations, but there are many exceptions and no marked highs or lows. For December the data are insufficient for conclusions.

Comparison of Associated Studies

Results of study of the four holdfasts collected on the outer coast and lower bay are summarized in Table VII. These species of algae were not the same as the others taken, and they contained markedly different proportions of animals. However, only four of the animal species in these samples did not occur at least once in the bay samples. Since these holdfasts were all collected at the end of June and the beginning of July, they were compared with the other samples from July. The resultant affinity indices are presented in Table VIII. These results are low because many of the species of animals which were abundant in the open coast samples were rare in the bay.

Of the fifteen holdfasts replaced around the bay, six were recovered, the others probably having been dislodged by water movements. Results of analyses of these samples are summarized in Table IX. The 210 individuals found represent a total of thirty-seven different species, all of which also occurred in the other fifty samples. The number of species and individuals present in these holdfasts (Table X) are comparable to those present in undisturbed holdfasts of similar dimensions (Table III), so the replaced holdfasts may be considered to have become essentually repopulated. They reached this condition in as little as fourteen days, even though a holdfast normally lasts at least a year. As an added test to ascertain whether the species of plant had a pronounced effect on the animals attracted, two of the holdfasts, R1 and R4, were planted in locations where they never occur naturally. Sample R1 was a *Laminaria saccharina* from up the bay placed on the jetty, while R4 was a *Hedophyllum sessile* from the jetty placed up the bay. No particular difference on the numbers of individuals or species of animals which these two samples attracted was evident (Table X). Although many more tests of a similar nature would be necessary for one to state with confidence that the species of holdfast is of little importance in determining which animals inhabit it, there is certainly an indication here that such is the case. By means of Sanders' (1960) method of comparing samples, indices of affinity were calculated from the comparisons of replaced holdfasts with one another (Table XI) and with others not replaced (Table XII). The unreplaced samples used were those taken closest in time and location to the second collecting of the samples which had been replaced. In most cases the indices of affinity are low although the reason for this is not clear.

At some sampling stations scrapings of barnacles covering an area of roughly 50 cm^2 were taken immediately adjacent to sampled holdfasts and a tabulation made of the animals living among them. Since the barnacles were regarded as part of the substrate, they were not counted among the contained animals. The results from two of these samples are shown in Table XIII. The numbers of species and individuals were comparable with those in holdfasts of similar size, but in each case one species dominated much more than it did in any holdfast. For this reason, the affinity indices (Table XIII), derived from comparison of the scrapings with adjacent holdfast samples, are very low. In all cases, the species found were also present in holdfast samples. This finding is in keeping with the observation of Shelford _et al_. (1935) that practically all of the species to be found in holdfasts are regular inhabitants of other parts of the habitat.

Most of the cellulose sponges or "artificial holdfasts" were badly decomposed before they had been in the field for what seemed enough time for colonization. Consequently only four were recovered. These contained mostly amphipods and isopods, in far higher proportions than they occurred in the holdfasts, but no species were found in these sponges which did not also occur in holdfasts.

Night-light samples contained mostly barnacle nauplii and calanoid and cyclopoid copepods, which were never found in the holdfasts sampled. Adult animals, comprising only a small part of the total, included *Gnorimosphaeroma oregonensis oregonensis* and *Corophium spinicorne*. Thus it is clear that at least some of the holdfast inhabitants do move about in the water occasionally. There were also several polychaete larvae present in the night-light samples. It is possible that many of these larval stages represent species whose adults occupy holdfasts.

Efforts were made to determine the possible effects of currents in causing animals to seek refuge in holdfasts. Neal (1966) recorded tidal currents as great as 78 cm/sec in mid-channel in Yaquina Bay some distance upstream from the present study, but measurements made from various docks in the bay at time of predicted maximum flow with a current measuring device (Carruthers, 1962) failed to record any current. Laboratory tests by Andrews (1945) showed that currents are more important than the effects of light in inducing animals to enter and to remain in holdfasts.

Tables XIV and XV were compiled to compare the results of this study with the findings of Andrews (1925, 1945) and of Dexter (1946). The percentage which each indicated animal group comprises in each survey is listed in Table XIV, and affinity indices derived from these percentages appear in Table XV.

IV. SUMMARY AND CONCLUSIONS

A six-month study was made of the marine animals inhabiting the holdfasts of laminarians in Yaquina Bay, a typical estuary on the north-central Oregon coast. Very few studies have been made of this habitat on this coast, and none is reported of holdfast inhabitants in a typical Pacific coast estuary.

In all, 6,687 individuals were recorded from the fifty holdfast samples analyzed. These represented ninety-nine species and higher taxa. The species composition of the holdfast habitat is quite heterogeneous, and sufficient data were not available to characterize the groupings of species as named communities in the conventional ecological sense.

The most numerous animals were nematodes, polychaetes (especially sabellids) and a few species of gastropods and pelecypods. No studies were undertaken to assess the ecological importance of these species from the viewpoint of trophic relationships.

Generally, a far greater variability was seen among samples taken from different locations in the bay than among those taken from a single location at different times of the year. Additional studies revealed that the animals in the holdfasts move about considerably and readily enter other holdfasts. Another means of dispersal of holdfast-inhabiting animals undoubtedly is as larvae, many of which are free-swimming or planktonic in the water. The inhabitants of the holdfasts are not a part of a unique holdfast community but tend to occur in the holdfasts of several species of algae as well as in other situations offering shelter.

In order to compare the results of this study with those of Andrews (1925, 1945) and Dexter (1946), Table XIV was compiled from the data presented in the literature. Calculations are of the percentage of the total number of animals taken in each study which each indicated animal group comprises. To determine indices of affinity, these percentages were compared in the same manner as for the individual samples (Sanders, 1960), with the results shown in Table XV. However, since higher groups rather than species were used for the comparisons in this instance, Table XV is in no way comparable to Table V.

Several observations may be made from Tables XIV and XV. Yaquina Bay has the greatest number of different animal groups in holdfasts, twenty-four of the twenty-eight listed. Six groups were present only in this study, while three, Ophiuroidea, Echinoidea, and Vertebrata, were present in the other three studies but absent here. Among the Pacific coast studies, polychaetes are nearly uniformly high, while they are much less important in the Atlantic coast survey, possibly because Dexter collected by dredging, in contrast to the other three. The highest affinity index comes from the comparison of Andrews' two studies, while the lowest values, as may be expected, occurred when the Atlantic coast study was compared with those from the Pacific coast. According to this method of comparison, Yaquina Bay is most like the Monterey area.

V. BIBLIOGRAPHY

Anderson, N. H. 1967. Assistant professor, Oregon State University, Department of Entomology. Personal communication. Corvallis, Oregon.

Andrews, Harry L. 1925. Animals living on kelp. Publications of the Puget Sound Biological Station 5:25-27.

________________. 1945. The kelp beds of the Monterey region. Ecology 26(1):24-37.

Barnard, J. Laurens. 1954. Marine amphipoda of Oregon. Corvallis, Oregon State College Press. 103 p. (Oregon State Monographs. Studies in Zoology no. 8)

Berkeley, Edith and Cyril Berkeley. 1948. Annelida, Polychaeta Errantia. Canadian Pacific Fauna 9b(1):1-100.

________________. 1952. Annelida, Polychaeta Sedentaria. Canadian Pacific Fauna 9b(2):1-139.

Burt, Wayne V. and W. Bruce McAlister. 1959. Recent studies in the hydrography of Oregon estuaries. Research Briefs of the Fish Commission of Oregon 7(1):14-27.

Carruthers, J. N. 1962. The easy measurement of bottom currents at modest depths. Civil Engineering, (London) 57:483-486.

Crandell, George Frank. 1967. Seasonal and spatial distribution of harpacticoid copepods in relation to salinity and temperature in Yaquina Bay, Oregon. Ph. D. thesis. Corvallis, Oregon State University. 137 numb. leaves.

Dexter, Ralph W. 1947. The marine communities of a tidal inlet at Cape Ann, Massachusetts: a study in bioecology. Ecological Monographs 17(3):261-294.

Doty, Maxwell S. 1946. Critical tide factors that are correlated with the vertical distribution of marine algae and other organisms along the Pacific coast. Ecology 27(4):315-328.

Druehl, Louis D. 1965. On the taxonomy, distribution, and ecology of the brown algal genus Laminaria in the northeast Pacific. Ph. D. thesis. Vancouver, The University of British Columbia. 183 numb. leaves.

Emery, K. O. and R. E. Stevenson. 1957. Estuaries and lagoons. I. Physical and chemical characteristics. In: Marine ecology, ed. by Joel W. Hedgpeth. New York. p. 673-750. (Geological Society of America. Memoir no. 67, vol. 1)

Frolander, Herbert F. 1964. Biological and chemical features of tidal estuaries. Journal of the Water Pollution Control Federation 36(8):1037-1048.

________________. 1966. Unpublished hydrographical data from Yaquina Bay, Oregon. Corvallis, Oregon State University, Department of Oceanography.

Hartman, Olga and Donald J. Reish. 1950. The marine annelids of Oregon. Corvallis, Oregon State College Press. 64 p. (Oregon State Monographs. Studies in Zoology no. 6)

Hewatt, Willis G. 1937. Ecological studies on selected marine intertidal communities of Monterey Bay, California. The American Midland Naturalist 18(2):161-206.

Hunter, Elwood B. 1967. Yachats, Oregon. Personal communication. Corvallis, Oregon.

Keen, A. Myra. 1963. Marine molluscan genera of western North America; an illustrated key. Stanford, Stanford University Press. 126 p.

Kjeldsen, Chris Kelvin. 1967. Effects of variations in salinity and temperature on some estuarine macro-algae. Ph. D. thesis. Corvallis, Oregon State University. 157 numb. leaves.

Kulm, LaVerne Duane. 1965. Sediments of Yaquina Bay, Oregon. Ph. D. thesis. Corvallis, Oregon State University. 184 numb. leaves.

Light, S. F. et al. 1964. Intertidal invertebrates of the central California coast. Berkeley, University of California Press. 466 p.

McCormick, Jon M. 1967. Graduate student, Oregon State University, Department of Oceanography. Personal communication. Corvallis, Oregon.

Morris, Percy A. 1952. A field guide to shells of the Pacific coast and Hawaii. Boston, Houghton Mifflin. 220 p. (The Peterson Field Guide Series no. 6)

Neal, Victor T. 1966. Tidal currents in Yaquina Bay. Northwest Science 40(2):68-74.

Pattullo, June and Warren Denner. 1965. Processes affecting seawater characteristics along the Oregon coast. Limnology and Oceanography 10(3):443-450.

Sanders, Howard L. 1960. Benthic studies in Buzzards Bay, III. The structure of the soft bottom community. Limnology and Oceanography 5(2):138-153.

Shelford, V. E. and E. D. Towler. 1925. Animal communities of the San Juan Channel and adjacent areas. Publications of the Puget Sound Biological Station 5:33-73.

Shelford, V. E. et al. 1935. Some marine biotic communities of the Pacific coast of North America. Ecological Monographs 5(3):249-354.

Smith, Gilbert M. 1944. Marine algae of the Monterey Peninsula. Stanford, Stanford University Press. 622 p.

Thorson, Gunnar. 1957. Bottom communities (sublittoral or shallow shelf). In: Marine ecology, ed. by Joel W. Hedgpeth. New York. p. 461-534. (Geological Society of America. Memoir no. 67, vol. 1)

Tilden, Josephine E. 1935. The algae and their life relations. Fundamentals of phycology. Minneapolis, University of Minnesota Press. 550 p.

APPENDIX

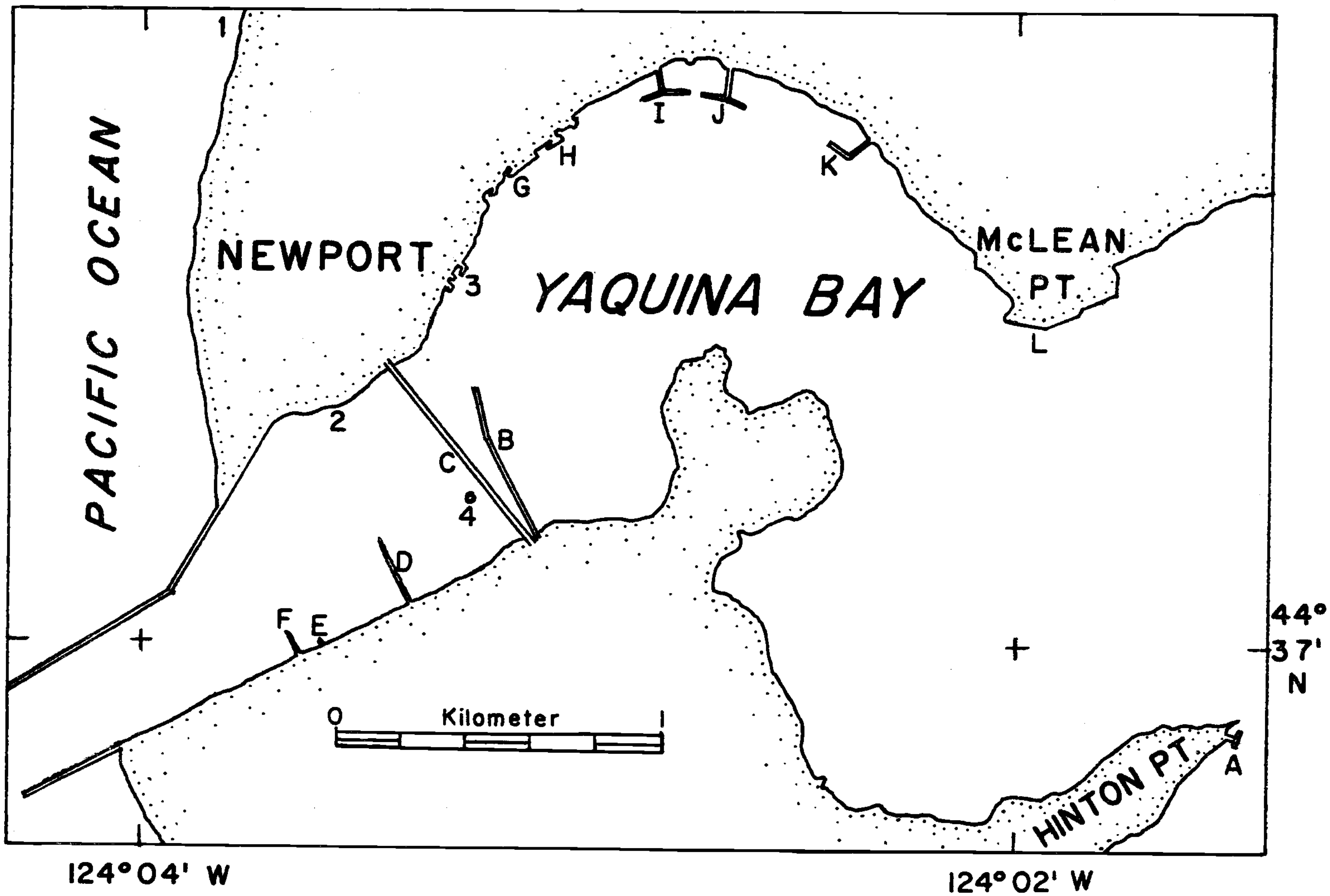

Figure I. Chart of Yaquina Bay, Oregon, with sampling stations indicated. For descriptions of stations see Table I.

Table I. Descriptions of sampling stations.

Station	Distance from End of South Jetty (km)	Detailed Description
A	4.5	Floating dock of privately owned moorage (Smitty's Harbor) on west side of King Slough, Hinton Point.
B	1.8	Scattered rocks and wooden pilings supporting foot bridge extending from south shore of bay to edge of shipping channel.
C	1.7	Concrete footings supporting piers of Highway 101 bridge.
D	1.3	Spur 1 of South Jetty, roughly 230 m long.
E	1.0	Spur 2, 20 m long.
F	0.9	Spur 3, 90 m long.
G	2.2	Port Dock 1, publicly owned floating dock.
H	2.5	Port Dock 3, publicly owned floating dock.
I	2.8	Port Dock 5, publicly owned floating dock.
J	3.0	Port Dock 7, publicly owned floating dock.
K	3.1	Floating dock of privately owned moorage (U-Launch Ramp).
L	3.4	Floating dock adjacent to lumber loading facilities, McLean Point.
1	2.4 (north)	Rock reef exposed at low tide, open coast.
2	1.4	Sandstone flat, lower bay.
3	2.0	Floating dock, U.S. Coast Guard Station.
4	1.6	Steel ladder on tower holding flashing light, west of bridge.

Table II. Data from collection of samples. Each sample is the holdfast of a single alga.

Sample No.	Station	Species of Alga	Date (1966)	Time (PST)	Ht. of Sample Above or Below Water (cm)	Temp. of Air (A) or Water (W) (°C)	Substrate	Other
1	B	H. sess[a]	9 July	---	---	---	cobble	
2	L	L. sacc[b]	14 July	---	-10	---	wood float	
3	K	L. sacc	14 July	---	-10	---	wood float	
4	G	L. sacc	14 July	---	-10	---	wood float	
5	G	L. sacc	14 July	---	-10	---	rubber tire	
6	G	L. sacc	14 July	---	-10	---	wood float	
7	A	L. sacc	15 July	0940	-10	14.1 W	wood float	
8	D	A. marg[c]	19 July	0745	---	15.8 A	boulder	
9	D	E. menz[d]	29 July	0630	+35	---	boulder	
10	E	H. sess	30 July	0700	+50	13.8 A	boulder	
11	E	H. sess	30 July	0705	+60	13.8 A	boulder	
12	B	L. sacc	3 Aug	0800	-13	10.6 W	wood pile	
13	L	L. sacc	11 Aug	---	-10	12.0 W	wood float	
14	K	L. sacc	11 Aug	0820	-?	13.3 W	wood float	
15	A	L. sacc	19 Aug	1330	-15	14.2 W	wood float	Muddy
16	I	L. sacc	24 Aug	0810	-10	10.7 W	wood float	
17	J	L. sacc	26 Aug	0750	-20	11.2 W	wood float	
18	H	L. sacc	26 Aug	0820	-10	9.7 W	wood float	
19	C	E. menz	14 Sept	0515	+10	---	wood board	
20	D	H. sess	14 Sept	0555	+55	---	boulder	
21	E	H. sess	14 Sept	0630	+45	---	boulder	
22	A	L. sacc	14 Sept	1055	-10	13.8 W	rubber tire	
23	G	L. sacc	14 Sept	1445	-10	13.0 W	wood float	

Table II. (cont.)

Sample No.	Station	Species of Alga	Date (1966)	Time (PST)	Ht. of Sample Above or Below Water (cm)	Temp. of Air (A) or Water (W) (°C)	Substrate	Other
24	J	L. sacc	14 Sept	1515	- 5	13.2 W	wood float	
25	L	L. sacc	14 Sept	1525	-10	14.2 W	wood float	
26	L	L. sacc	16 Oct	1345	-35	9.4 W	metal cable	Rust
27	K	L. sacc	16 Oct	1400	-15	9.4 W	wood float	Muddy
28	J	L. sacc	16 Oct	1420	-10	9.4 W	wood float	
29	I	L. sacc	16 Oct	1440	-10	9.4 W	wood float	
30	H	L. sacc	16 Oct	1505	-10	9.3 W	wood float	
31	G	L. sacc	16 Oct	1520	-10	9.3 W	wood float	
32	A	L. sacc	16 Oct	1630	-30	10.2 W	wood float	
33	B	L. sacc	16 Oct	1920	+?	10.0 A	wood pile	
34	C	N. luet[e]	16 Oct	1935	+30	---	concrete	
35	C	L. sacc	16 Oct	1935	+30	---	concrete	
36	D	E. menz	16 Oct	2005	+70	---	boulder	
37	E	H. sess	16 Oct	2040	+50	---	boulder	Muddy
38	K	L. sacc	13 Nov	1430	-10	10.4 W	wood float	
39	J	L. sacc	13 Nov	1503	-10	10.5 W	wood float	
40	I	L. sacc	13 Nov	1515	-15	10.5 W	wood float	
41	G	L. sacc	13 Nov	1525	-10	10.5 W	wood float	
42	A	L. sacc	13 Nov	1630	-?	10.9 W	wood float	
43	B	H. sess	13 Nov	1810	- 5	10.8 W	boulder	
44	C	H. sess	13 Nov	1820	0	10.8 W	concrete	Muddy
45	E	H. sess	13 Nov	1910	---	---	boulder	
46	F	H. sess	13 Nov	1930	+15	---	boulder	
47	K	L. sacc	12 Dec	1415	-10	11.0 W	wood float	

Table II. (cont.)

Sample No.	Station	Species of Alga	Date (1966)	Time (PST)	Ht. of Sample Above or Below Water (cm)	Temp. of Air (A) or Water (W) (°C)	Substrate	Other
48	H	L. sacc	12 Dec	1500	-15	---	wood float	
49	D	H. sess	12 Dec	1810	+25	---	wood float	
50	F	H. sess	12 Dec	1845	+30	---	boulder	

[a] Hedophyllum sessile

[b] Laminaria saccharina

[c] Alaria marginata

[d] Egregia menziesii

[e] Nereocystis luetkeana

Table III. Data from examination of samples. Each sample is the holdfast of a single alga.

	Collected Holdfasts			Contained Animals			
Sample No.	Basal Area (cm^2)	Max. ht. (cm)	Wet Wt. (g)	No. of Indiv.	No. of Species	Total Wet Wt. (g)	Wt. as % of Hold-fast Wt.
1	24	---	---	132	19	---	---
2	8	2	5.2	76	12	0.17	3.3
3	5	1 1/2	3.2	2	2	0.03	0.9
4	10	2	4.3	26	8	0.22	5.2
5	2	1	0.8	13	7	0.003	0.4
6	8	1	4.5	23	12	0.21	4.7
7	3	---	3.8	30	6	2.19	58.4[a]
8	10	1	9.4	100	16	0.45	4.8
9	160	4	166.4	575	30	5.86	3.5
10	48	3	55.4	221	26	3.73	6.7
11	35	2	21.6	115	17	2.26	10.5
12	25	2	25.5	96	15	3.80	14.9
13	54	2	26.2	302	24	1.45	5.5
14	51	3	40.4	280	24	6.15	15.2
15	14	2 1/2	16.4	15	9	0.53	3.2
16	41	4	23.3	36	17	2.23	9.6
17	33	5	34.8	57	20	1.17	3.4
18	30	3	57.8	151	21	26.49	45.9[a]
19	54	5	104.7	366	15	3.61	3.4
20	20	3 1/2	41.5	249	28	7.18	17.3
21	45	3 1/2	115.2	298	27	---	---
22	20	2 1/2	21.6	52	10	5.20	24.1[a]
23	6	1	2.1	19	6	0.07	3.3
24	35	5	23.4	58	14	2.45	10.4
25	21	3	21.6	93	16	1.16	5.4
26	63	2	107.3	129	20	1.36	1.3
27	--	---	14.6	41	12	0.74	5.1
28	20	---	22.0	110	21	0.78	3.6
29	16	6	22.6	51	19	5.71	25.3[a]
30	25	5	16.7	66	15	0.82	4.9
31	16	1 1/2	12.8	122	21	1.08	8.4
32	20	2 1/2	28.5	71	15	11.40	40.0[a]
33	20	3	30.7	153	22	0.67	2.2
34	25	2 1/2	20.2	78	18	1.66	8.2
35	--	---	4.7	35	15	0.50	10.7
36	20	3	26.1	211	22	1.28	4.9

Table III. (cont.)

Collected Holdfasts				Contained Animals			
Sample No.	Basal Area (cm^2)	Max. ht. (cm)	Wet Wt. (g)	No. of Indiv.	No. of Species	Total Wet Wt. (g)	Wt. as % of Hold-fast Wt.
37	92	3	105.2	312	34	2.82	2.7
38	24	3	23.5	60	13	0.52	2.2
39	22	3	28.5	131	19	0.69	2.4
40	20	3	19.2	56	14	0.58	3.0
41	70	2	24.8	96	21	2.90	11.7
42	--	---	54.9	170	14	28.98	52.8[a]
43	21	3	22.0	77	20	1.12	5.1
44	42	3 1/2	78.9	277	28	20.40	24.9[b]
45	42	3	68.7	242	32	5.45	7.9
46	28	2 1/2	46.2	190	28	4.13	8.9
47	19	2 1/2	9.6	24	12	2.25	23.4[a]
48	36	3 1/2	34.4	84	22	4.42	12.8[c]
49	36	3	31.8	246	26	1.68	5.3
50	55	4	88.9	270	31	3.87	4.4

[a] Results affected by large <u>Mytilus edulis</u>.

[b] Results affected by large <u>Pisaster ochraceous</u>.

[c] Results affected by large <u>Nereis vexillosa</u>.

Table IV. Numerical analyses of individuals and species of animals in groups of samples.

Month	No. of Samples	No. of Indiv.	No. of Species	Indiv. Per Sample	Species Per Sample	Diversity Index[a]
July	11	1313	51	119	4.6	0.039
Aug	7	937	44	134	6.3	0.047
Sept	7	1135	49	161	7.0	0.043
Oct	12	1379	63	125	5.2	0.046
Nov	9	1299	56	144	6.2	0.043
Dec	4	624	42	156	10.5	0.067
Station						
A	5	338	27	68	5.4	0.081
B	2	362	32	181	16.0	0.089
C	6	852	34	142	5.7	0.040
D	5	1381	51	276	10.2	0.037
E	5	1188	58	232	11.6	0.049
F	2	460	34	230	17.0	0.074
G	6	299	39	50	6.5	0.130
H	3	301	32	100	10.3	0.107
I	3	143	32	48	10.3	0.224
J	4	356	40	89	10.0	0.112
K	5	407	37	80	7.4	0.091
L	4	600	39	150	9.8	0.090
Total	50	6687	99	134	2.0	0.015

[a]Diversity index computed by dividing number of species by number of individuals.

Table V. Trellis diagrams comparing selected samples to determine indices of affinity, the numbers in the tables.

Part a. Diagrams arranged by station.

Station A

Month	Sample No.	
Nov	42	74.8
	Month	Oct
	Sample No.	32

Stations B and C

Month	Sample No.						
Aug	12						43.1
Sept	19					9.8	11.4
Oct	33				22.9	18.4	19.8
Oct	35			33.0	25.6	50.0	43.5
Nov	43		45.0	26.6	13.2	30.7	23.8
Nov	44	44.0	60.0	42.1	26.5	55.2	44.9
	Month	Nov	Oct	Oct	Sept	Aug	July
	Sample	43	35	33	19	12	1

Station D

Month	Sample No.				
July	9				25.3
Sept	20			25.9	42.5
Oct	36		36.4	18.8	16.4
Dec	49	16.1	21.9	24.1	9.3
	Month	Oct	Sept	July	July
	Sample	36	20	9	8

Station E

Month	Sample No.				
July	11				39.2
Sept	21			32.7	31.8
Oct	37		44.6	46.2	48.9
Nov	45	56.1	39.7	41.6	55.0
	Month	Oct	Sept	July	July
	Sample	37	21	11	10

Table V. (cont.)

Part a. (cont.)

Station F

Month	Sample No.	
Dec	50	55.5

Month	Nov
Sample	46

Station G

Month	Sample No.	
Nov	41	62.4

Month	Oct
Sample	31

Station H

Month	Sample No.		
Oct	30		19.8
Dec	48	34.1	25.1

Month	Oct	Aug
Sample	30	18

Station J

Month	Sample No.	
Nov	39	45.6

Month	Oct
Sample	28

Station L

Month	Sample No.			
Aug	13			71.3
Sept	25		17.0	14.3
Oct	26	20.2	16.0	5.6

Month	Sept	Aug	July
Sample	25	13	2

Table V. (cont.)

Part b. Diagrams arranged by month.

July

Station	Sample No.					
B	1					17.0
D	8				19.1	2.0
D	9			26.3	35.6	5.2
E	10		54.8	22.9	45.4	3.5
E	11	42.2	23.1	15.4	23.4	2.1
	Station	E	D	D	B	L
	Sample	10	9	8	1	2

August

Station	Sample No.			
K	14			51.3
H	18		35.7	26.3
B	12	20.9	23.4	16.5
	Station	H	K	L
	Sample	18	14	13

September

Station	Sample No.			
C	19			5.6
D	20		45.2	7.8
E	21	31.6	11.1	3.1
	Station	D	C	L
	Sample	20	19	25

October

Station	Sample No.								
J	28								41.8
H	30							57.6	38.0
G	31						56.3	50.5	61.5
C	35					47.1	30.6	33.3	50.9
B	33				33.7	29.2	12.1	14.3	30.9
D	36			50.2	29.2	14.2	16.1	15.5	20.5
E	37		27.8	30.2	44.2	36.5	22.8	23.4	30.9
A	32	6.7	7.1	14.5	29.1	25.8	8.7	11.0	12.5
	Station	E	D	B	C	G	H	J	L
	Sample	37	36	33	35	31	30	28	26

Table V. (cont.)

Part b. (cont.)

November

Station	Sample No.						
J	39						8.2
G	41					38.4	24.8
C	44				45.3	16.1	32.4
B	43			44.0	38.2	11.2	38.9
E	45		28.3	52.1	29.8	12.0	12.9
F	46	46.3	21.4	44.6	40.9	21.7	11.4
	Station	E	B	C	G	J	A
	Sample	45	43	44	41	39	42

December

Station	Sample No.		
D	49		23.3
F	50	25.4	35.5
	Station	D	H
	Sample	49	48

Table VI. Tabulation of species found in samples.

July Station Sample No.	A 7	C 1	D 8, 9	E 10, 11	G 4, 5, 6	K 3	L 2	Total
Species								
Coelenterata	1		1		1			3
Hydrozoa, colony (unidentified)	1				1			2
Anthozoa			1					1
Metridium senile (L.)			1					1
Platyhelminthes, turbellaria				7				7
Notoplana sp.				7				7
Nemertinea			11	33			1	45
Amphiporus imparispinosus Griffin				19				19
Emplectonema gracile (Johnston)				13				13
Paranemertes peregrina Coe			1					1
Unidentified			10	1			1	12
Nematoda (unidentified)		6	96	15	4	1		122
Annelida, Polychaeta	2	59	122	53	17	1	3	247
Lepidonotus squamatus (L.)	1							1
Halosydna brevisetosa Kinberg		2	1		3			6
Eteone longa (Fabricius)			1					1
Anaitides williamsi Hartman					1			1
Eulalia aviculiseta Hartman			19	4				23
Nereid (unidentified)		2		1				3
Platynereis bicanaliculata (Baird)				1	4	1	1	7
Nereis vexillosa Grube		6						6
Typosyllis fasciata Malmgren	1		6	5	3		2	17
Arabella iricolor (Montagu)			1	1				2
Thelepus crispus Johnson			1					1
Sabellaria cematarium Keferstein			16					16
Sabella media (Bush)		23	16	24				63
Schizobranchia insignis Bush		25	24	11	1			61
Dexiospira spirillum (L.)				2				2
Unidentified		1	27	4	5			37
Arthropoda	26	31	29	20	9		62	177
Arachnida, Acarina (unidentified)			5	3				8
Crustacea	26	31	20	2	8		62	149
Ostracoda (unidentified)					2			2
Cirripedia	15	5	18	2	4		2	46
Balanus glandula Darwin	15	5	18	2	4		2	46
Malacostraca	11	26	2		2		60	101
Isopoda		18	2		2		25	47
Gnorimosphaeroma oregonensis oregonensis (Dana)		18	2		1		7	28
Idothea wosnesenskii (Brandt)					1		18	19
Amphipoda	11	6					35	52

Table VI. (cont.)

July Station Sample No.	A 7	C 1	D 8, 9	E 10, 11	G 4, 5, 6	K 3	L 2	Total
Species								
Amphithoë simulans Alderman		6					2	8
Corophium spinicorne Stimpson	11						33	44
Decapoda		2						2
Brachyuran larva		2						2
Insecta			4	15				19
Coleoptera, Staphylinidae (adult)				5				5
Liparocephalus cordicollis LeConte				5				5
(larva)			1	2				3
Diptera, Dolichopodidae								
Aphrosylus sp. (Pupa)			1					1
(Larva)			2	8				10
Mollusca	1	35	421	207	29		9	702
Amphineura (unidentified)			1		1			2
Gastropoda		5	26	19	26		8	84
Acmaea spp.			13	8	2		1	24
Lacuna sp.		4	3	4	24		7	42
Barleeia sp.			2					2
Odostomia spp.			1					1
Onchidella sp.			5	7				12
Unidentified		1	2					3
Pelecypoda	1	30	394	188	2		1	616
Modiolus modiolus (L.)			185	107	2			294
Mytilus edulis L.	1	6	84	28				119
?Orobitella sp.				3				3
?Hiatella sp.			64	14				78
?Saxicavella sp.			56	6				62
Unidentified		24	6	30			1	60
Ectoprocta, colonies		1	3	1			1	6
Hippothoa hyalina (L.)			1	1				2
Unidentified		1	2				1	4
Chordata, Ascidiacea					4			4
Baltenia villosa (Stimpson)					3			3
Styela monteyensis (Dall)					1			1
Total	30	132	675	336	62	2	76	1313

Table VI. (cont.)

August Station Sample(s)	A 15	C 12	H 18	I 16	J 17	K 14	L 13	Total
Species								
Coelenterata						1	1	2
Hydrozoa, colony (unidentified)						1	1	2
Nemertinea				2			1	3
Emplectonema gracile (Johnston)							1	1
Tubulanus sexlineatus (Griffin)				2				2
Nematoda (unidentified)		2	2				6	10
Annelida, Polychaeta	5	20	14	16	31	36	4	126
Halosydna brevisetosa Kinberg	1	2	7	1	3	3	1	18
Eulalia aviculiseta Hartman		1						1
Nereid (unidentified)		4						4
Platynereis bicanaliculata (Baird)				7	6	22	1	36
Nereis vexillosa Grube	1		1		4	7		13
Typosyllis fasciata Malmgren		1	1	1	12	4	1	20
Sabella media (Bush)		2	3	2	1			8
Schizobranchia insignis Bush		10	1	5	1			17
Unidentified	3		1		4		1	9
Sipunculoidea				1				1
Phascolosoma agassizii Keferstein				1				1
Arthropoda	7	19	94	6	9	139	240	514
Arachnida, Acarina (unidentified)							1	1
Crustacea	7	19	94	6	9	139	239	513
Ostracoda, unidentified							1	1
Unidentified							1	1
Cirripedia	6	16	10		5	32	21	90
Balanus glandula Darwin	6	16	10		5	32	21	90
Malacostraca	1	3	84	6	4	107	216	421
Isopoda	1		83	6		74	115	279
Gnorimosphaeroma oregonensis oregonensis (Dana)	1		82	5		32	21	141
Idothea wosnesenskii (Brandt)			1	1		42	94	138
Amphipoda						31	101	132
Amphithoë simulans Alderman						11	6	17
Corophium spiricorne Stimpson						20	95	115
Decapoda		3	1		4	2		10
Pachycheles rudis Stimpson			1		4			5
Cancer oregonensis (Dana)		1						1
Pugettia gracilis Dana		2				2		4
Mollusca		54	34	4	16	102	48	258
Amphineura (unidentified)			3					3

Table VI. (cont.)

August								
Station	A	C	H	I	J	K	L	
Sample(s)	15	12	18	16	17	14	13	Total
Species								
Gastropoda			15	1	7	66	19	108
Acmaea spp.			9	1	1	8	3	22
Lacuna sp.			6		6	56	13	81
? Skeneopsis sp.						1		1
Unidentified						1	3	4
Pelecypoda		54	16	3	9	36	29	147
Adula californiensis (Phillipi)			1					1
Modiolus modiolus (L.)		46				4	4	54
Mytilus edulis L.		4	11	2	5	26	13	61
? Leptopecten					1	1		2
? Hiatella sp.		1	1	1	1	2	8	14
? Saxicavella sp.		3	3					6
Pholadidae (unidentified)					1			1
Unidentified					1	3	4	8
Ectoprocta, colonies	3	1	2	2	1	1	2	12
Bugula californica Robertson	1			1				2
Hippothoa hyalina (L.)		1	1			1	1	4
Membranipora membranacea (L.)	1						1	2
Unidentified	1		1	1	1			4
Echinodermata			5	3				8
Holothuroidea			5	3				8
Eupentacta quinquesimita (Selenka)			5	3				8
Chordata, Ascidiacea				2		1		3
Pyura haustor (Stimpson)				1				1
Styela montereyensis (Dall)				1		1		2
Total	15	96	151	36	57	280	302	937

September								
Station	A	C	D	E	G	J	L	
Sample	22	19	20	21	23	24	25	Total
Species								
Porifera, fragments			1					1
Coelenterata					1	1	1	3
Hydrozoa, colony (unidentified)					1		1	2
Anthozoa						1		1
Metridium senile (L.)						1		1
Nemertinea						1		1
Unidentified						1		1

Table VI. (cont.)

September (cont.) Station / Sample	A 22	C 19	D 20	E 21	G 23	J 24	L 25	Total
Species								
Nematoda (unidentified)		280	81	49	5			415
Annelida, Polychaeta	5	47	53	160	7	20	10	302
Harmothoë triannulata Moore						1		1
Halosydna brevisetosa Kinberg	1	6	3			2	3	15
Anaitides williamsi Hartman				1				1
Eulalia aviculiseta Hartman			1	8				9
Platynereis bicanaliculata (Baird)	2	1	1			6	1	11
Typosyllis fasciata Malmgren		4			2			6
Lumbrinereis latreilli Aoudouin and Milne-Edwards				1				1
Flabelligera infundibularis Johnson							2	2
Ampharete sp.				1				1
Sabella media (Bush)		12	19	2	5	5	4	47
Schizobranchia insignis Bush		20	29	142		6		197
Unidentified	2	4		5				11
Sipunculoidea				2				2
Phascolosoma agassizii Keferstein				2				2
Arthropoda	42	16	26	9		27	56	176
Crustacea	42	16	25	7		27	56	173
Ostracoda, unid			18	5				23
Cirripedia	35	4		1		6		46
Balanus glandula Darwin	35	4		1		6		46
Malacostraca	7	12	7	1		21	56	104
Isopoda	6		1			19	53	79
Gnorimosphaeroma oregonensis oregonensis (Dana)	6					18	53	77
Idothea wosnesenskii (Brandt)			1			1		2
Amphipoda	1	6	4				3	14
Amphithoë simulans Alderman			4					4
Corophium spinicorne Stimpson	1						3	4
Eurystheus tenuicornis (Holmes)		6						6
Decapoda		6	2	1		2		11
Cancer oregonensis (Dana)		5	2	1				8
Pugettia gracilis Dana		1				2		3
Insecta			1	2				3
Adult (unidentified)				1				1
Larva (unidentified)			1	1				2
Mollusca	3	23	86	73	6	8	24	223
Amphineura (unidentified)			3					3
Gastropoda		6	58	7			1	72
Acmaea spp.			2					2
Lacuna sp.		6	16					22

Table VI. (cont.)

September (cont.) Station	A	C	D	E	G	J	L	
Sample	22	19	20	21	23	24	25	Total
Species								
Barleeia sp.		6	16					22
Odostomia sp.			29	3				32
Unidentified			8					8
Pelecypoda	3	17	25	66	6	8	23	148
Adula californiensis (Philippi)		17		3				20
Modiolus modiolus (L.)			18	49				67
Mytilus edulis L.	3		1	4	5	6	11	30
Chlamys hastatus Sowerby							1	1
Lasaea sp.			1				3	4
? *Protothaca* sp.			1					1
? *Hiatella* sp.			4	5	1	2		12
? *Saxicavella* sp.							7	7
Unidentified				5			1	6
Ectoprocta, colonies	1		1			1	2	5
Bugula californica Robertson						1	1	2
Hippothoa hyalina (L.)			1					1
Membranipora membranacea (L.)	1						1	2
Echinodermata			1	5				6
Asteroidea				1				1
Pisaster ochraceous (Brandt)				1				1
Holothuroidea			1	4				5
Eupentacta quinquesimita (Selenka)			1	4				5
Chordata, Ascidiacea	1							1
Styela montereyensis (Dall)	1							1
Total	52	366	249	298	19	58	93	1135

Table VI. (cont.)

October Station / Sample(s)	A 32	B 33	C 34, 35	D 36	E 37	G 31	H 30	I 29	J 28	K 27	L 26	Total
Species												
Porifera, fragments					1							1
Coelenterata	1	1				1		2	2		1	8
Hydrozoa, colony (unidentified)	1	1				1		1	1		1	6
Anthozoa								1	1			2
Metridium senile (L.)								1	1			2
Platyhelminthes, Turbellaria	1											1
Acoel (unidentified)	1											1
Nemertinea	2			1	5			1	2	1		12
Amphiporus imparispinosus Griffin									1			1
Emplectonema gracile (Johnston)	2											2
Paranemertes peregrina Coe					5				1			6
Tubulanus polymorphus Renier								1				1
Unidentified				1						1		2
Nematoda (unidentified)	1	31	12	13	60	5			3		11	136
Annelida, Polychaeta	15	18	39	39	93	87	55	37	84	28	69	564
Harmothoë triannulata Moore								1				1
Halosydna brevisetosa Kinberg	1	3	9	2		4	2	2		2		25
Paleonotis chrysolepsis Schmarda										1		1
Eulalia aviculiseta Hartman		1	1	1	8						1	12
Nereid (unidentified)		1									1	2
Platynereis bicanaliculata (Baird)	1		1		2		2	4	2			12
Nereis vexillosa Grube	1		1	3		1					3	9
Typosyllis fasciata Malmgren	2		7	7	2	12	8	1	3	2	2	46
Polydora sp.											1	1

Table VI. (cont.)

October (cont.) Station	A	B	C	D	E	G	H	I	J	K	L	
Sample(s)	32	33	34, 35	36	37	31	30	29	28	27	26	Total
Species												
Caulleriella alata (Southern)											1	1
Paraonis gracilis (Tauber)	1				1							2
Schistocomus hiltoni Chamberlin								1	20			21
Streblosoma bairdi (Malmgren)											2	2
Thelepus setosus (Quatrefages)	6				6	12						24
Thelepus crispus Johnson				1								1
Naineris dendritica (Kinberg)	2											2
Sabellaria cementarium Moore					1							1
Sabella media (Bush)		10	12	17	49	49	21	17	38	8	56	277
Schizobranchia insignis Bush			5	7	11	8	11	10	20		1	73
Dexiospira spirillum (L.)		1										1
Larva		1										1
Unidentified	1	1	3	1	13	1	11	1	1	15	1	43
Sipunculoidea					1							1
Phascolosoma agassizii Keferstein					1							1
Arthropoda	46	34	29	2	12	12	7	1	5	9	5	162
Arachnida, Acarina (unidentified)			1									1
Pycnogonida		1										1
Achilea echinata Hodge		1										1
Crustacea	46	33	28	2	12	12	7	1	5	9	5	160
Ostracoda (unidentified)			1		1							2
Cirripedia	46	12	20		3	7	2		4		4	98
Balanus glandula Darwin	46	12	20		3	7	2		4		4	98
Malacostraca		21	7	2	8	5	5	1	1	9	1	60
Chelifera		21			1	3						25
Leptochelia dubia Krøyer		21			1	3						25

Table VI. (cont.)

October (cont.) Station	A	B	C	D	E	G	H	I	J	K	L	
Sample(s)	32	33	34, 35	36	37	31	30	29	28	27	26	Total
<u>Species</u>												
Isopoda			1		2	1	4			7	1	16
<u>Gnorimosphaeroma</u> <u>oregonensis</u> <u>oregonensis</u> (Dana			1		2		4					7
<u>Idothea</u> <u>wosnesenskii</u> (Brandt)						1				7	1	9
Amphipoda			5							1		6
<u>Corophium</u> <u>spinicorne</u> Stimpson										1		1
<u>Euryptheus</u> <u>tenuicornis</u> (Holmes)			5									5
Decapoda			1	2	5	1	1	1	1	1		13
<u>Pachycheles</u> <u>rudis</u> Stimpson				1			1			1		3
<u>Cancer</u> <u>oregonensis</u> (Dana)			1	1	4							6
<u>Pugettia</u> <u>gracilis</u> Dana					1	1		1	1			4
Mollusca	5	65	29	155	137	13	1	7	6	1	42	461
Amphineura (unidentified)			1	5	1	1						8
Gastropoda		49		139	8		1	1	1		1	200
<u>Acmaea</u> sp.									1			1
<u>Lacuna</u> sp.				11	3						1	15
? <u>Skeneopsis</u> sp.							1					1
<u>Odostomia</u> spp.		49		125	5			1				180
Unidentified				3								3
Pelecypoda	5	16	28	11	128	12		6	5	1	41	253
<u>Adula</u> <u>californiensis</u> (Phillipi)			5						1			6
<u>Modiolus</u> <u>modiolus</u> (L.)		6	13	8	117	3		1			2	150
<u>Mytilus</u> <u>edulis</u> L.	3	6	7		7	8		2	1	1	19	54
? <u>Lasaea</u> sp.											6	6
? <u>Hiatella</u> sp.		1	1	3	4	1			3			13
Unidentified	2	3	2					3			14	24

Table VI. (cont.)

October (cont.)												
Station	A	B	C	D	E	G	H	I	J	K	L	
Sample(s)	32	33	34, 35	36	37	31	30	29	28	27	26	Total
Species												
Ectoprocta, colonies		2	3	1	1	2	2	2	2	1	1	17
Bugula californica Robertson		1				1	1	1	1	1		6
Hippothoa hyalina (L.)		1	2	1	1	1	1	1	1		1	10
Membranipora membranacea (L.)			1									1
Echinodermata			1		1	1	1	1	5			10
Holothuroidea			1		1	1	1	1	5			10
Eupentacta quinquesimita (Selenka)			1		1	1	1	1	5			10
Chordata, Ascidiacea		2			1	1			1	1		6
Pyura haustor (Stimpson)		2							1			3
Styela montereyensis (Dall)					1							1
Unidentified						1				1		2
Total	71	153	113	211	312	122	66	51	110	41	129	1379

Table VI. (cont.)

November										
Station	A	B	C	E	F	G	I	J	K	
Sample	42	43	44	45	46	41	40	39	38	Total
Species										
Coelenterata	1	1		4	1	2	1	1	1	12
Hydrozoa, colony (unidentified)	1	1		1	1	1	1	1	1	8
Anthozoa				3		1				4
Metridium senile (L.)				3						3
Anemone (unidentified)						1				1
Platyhelminthes (Turbellaria)				1						1
Notoplana sp.				1						1
Nemertinea	1	4		14	13			5		37
Amphiporus imparispinosus Griffin		1		10	10			5		26
Emplectonema gracile (Johnston)		3								3
Paranemertes peregrima Coe				1	1					2
Tubulanus sexlineatus (Griffin)				3	1					4
Unidentified	1				1					2
Nematoda (unidentified)	4	6	53	40	42	9	3	1		158
Annelida, Polychaeta	29	13	66	28	70	50	42	114	33	445
Lepidonotus squamatus Moore	1					1				2
Halosydna brevisetosa Kinberg	3	3	9		2		3	1	4	25
Eulalia aviculiseta Hartman	1	1		1	8				2	13
Nereid (unidentified)			1				2	1	2	6
Platynereis bicanaliculata (Baird)				2	13					15
Nereis vexillosa Grube		5				2				7
Typosyllis fasciata Malmgren	4	3	4	11	3	11	5	3	7	51
Caulleriella alata (Southern)					7					7
Ampharete sp.									7	7
Terebellid (unidentified)	18				1					19
Streblosoma bairdi (Malmgren)								31		31
Sabellaria cementarium Moore								1		1
Sabella media (Bush)		1	13	12	17	25	25	68	11	172
Pseudopotamilla occelata Moore								2		2
Schizobranchia insignis Bush	1		21		14	11	1	6		54
Chone gracilis Moore								1		1
Unidentified	1		18	2	5		6			32
Arthropoda	126	25	66	17	15	19	5	4	12	289
Arachnida, Acarina (unidentified)	3					2				5
Crustacea	123	25	66	11	15	17	5	4	12	278
Cirripedia	117	19	58	6	8	13	5	1	12	239
Balanus glandula Darwin	117	19	58	6	8	13	5	1	12	239
Malacostraca	6	6	8	5	7	4		3		39
Chelifera		2								2
Leptochelia dubia Krøyer		2								2
Isopoda					1	2		1		4
Gnorimosphaeroma oregonensis oregonensis (Dana					1	2				3

Table VI. (cont.)

November (cont.)										
Station	A	B	C	E	F	G	I	J	K	
Sample	42	43	44	45	46	41	40	39	38	Total
Species										
Idothea wosnesenskii (Brandt)								1		1
Amphipoda	6	2			1	1				10
Amphithoë simulans Alderman		1				1				2
Corophium spinicorne Stimpson	6	1			1					8
Decapoda		2	8	5	5	1		2		23
Pachycheles rudis Stimpson				1				2		3
Cancer oregonensis (Dana)		1	3		4	1				9
Pugettia gracilis Dana		1	5	4	1					11
Insecta				6						6
Diptera, Dolichopodidae				6						6
Aphrosylus sp. (Larva)				6						6
Mollusca	9	26	88	132	47	14	4	4	13	337
Amphineura (unidentified)				2						2
Gastropoda		1	3	18	21			1	1	45
Lacuna sp.				2	1					3
Barleeia sp.				1						1
? Plicifusus sp.		1		13						14
Odostomia spp.				2	20				1	23
Unidentified			3					1		4
Pelecypoda	9	25	78	112	26	14	4	3	12	281
Modiolus modiolus (L.)			51	64	9	4	1		1	130
Mytilus edulis L.	9	24	21	23		4	1	3	10	95
? Leptopecten sp.							2			2
? Hiatella sp.				13	13	1			1	28
? Saxicavella sp.		1	3	7	4	3				18
Unidentified			3	5		2				10
Ectoprocta, colonies		2	1	2	1	2		1	1	10
Hippothoa hyalina (L.)		1	1	1	1	1		1	1	7
Unidentified		1		1		1				3
Echinodermata			2	3	1		1			7
Asteroidea			2	1						3
Pisaster ochraceous (Brandt)			2							2
Unidentified				1						1
Holothuroidea				2	1		1			4
Eupentacta quinquesimita (Selenka)				2	1		1			4
Chordata, Ascidiacea			1	1				1		3
Unidentified			1	1				1		3
Total	170	77	277	242	190	96	56	131	60	1299

Table VI. (cont.)

December					
Station	D	F	H	K	
Sample	49	50	48	47	Total
Species					
Porifera, fragments	1				1
Coelenterata	2	1	2		5
Hydrozoa, colony (unidentified)			1		1
Anthozoa	2	1	1		4
Metridium senile (L.)	2	1	1		4
Nemertinea	41	6			47
Amphioporus imparispinosus Griffin	20				20
Emplectonema gracile (Johnston)	19				19
Paranemertes peregrina Coe	1	3			4
Unidentified	1	3			4
Nematoda (unidentified)	10	87	1	1	99
Annelida, Polychaeta	53	115	37	15	220
Halosydna brevisetosa Kinberg		1	4	3	8
Eulalia aviculiseta Hartman	1	1	8		10
Nereid (unidentified)	1				1
Platynereis bicanaliculata (Baird)			3	3	6
Nereis vexillosa Grube			3		3
Typosyllis fasciata Malmgren	41	5	6	6	58
Sabella media (Bush)	9	56	3		68
Schizobranchia insignis Bush		43	10	2	55
Unidentified		7		1	8
Larva	1	2			3
Arthropoda	96	17	10	2	125
Arachnida, Acarina (unidentified)	1				1
Crustacea	89	16	10	2	117
Cirripedia	50	10	6		66
Balanus glandula Darwin	50	10	6		66
Malacostraca	39	6	4	2	51
Chelifera		1			1
Leptochelia dubia Krøyer		1			1
Isopoda			1	1	2
Gnorimosphaeroma oregonensis oregonensis (Dana)			1	1	2
Amphipoda	36	1	1		38
Amphithoë simulans Alderman	36				36
Corophium spinicorne Stimpson		1	1		2
Decapoda	3	4	2	1	10
Oedignathus inermis (Stimpson)			2	1	3
Pugettia gracilis Dana	2	4			6
Pugettia producta (Randall)	1				1
Insecta	6	1			7

Table VI. (cont.)

December (cont.)					
Station	D	F	H	K	
Sample	49	50	48	47	Total
Species					
Larva (unidentified)	3				3
Diptera, Dolichopodidae					
Aphrosylus sp. (Larva)	3	1			4
Mollusca	43	41	32	5	121
Gastropoda	12	11	3		26
Acmaea spp.			1		1
Lacuna sp.	2	3	1		6
Barleeia sp.	8	8	1		17
Onchidella sp.	1				1
Unidentified	1				1
Pelecypoda	31	30	29	5	95
Modiolus modiolus (L.)	25	13	4		42
Mytilus edulis L.	4	3	14	3	24
? Hiatella sp.		7	10	1	18
? Saxicavella sp.		6			6
Unidentified	2	1	1	1	5
Ectoprocta, colonies		1	2	1	4
Bugula californica Robertson			1		1
Hippothoa hyalina (L.)		1	1		2
Unidentified				1	1
Chordata, Ascidiacea		2			2
Unidentified		2			2
Total	246	270	84	24	624

	A	B	C	D	E	F	G	H	I	J	K	L	
Overall Total	338	362	852	1381	1188	460	299	301	143	356	407	600	6687

Table VII. Data from collection and examination of samples from outer coast and lower bay.

		Replaced Holdfasts					Contained Animal	
Sample No.	Station	Species of Alga	Date (1966)	Substrate	Basal Area (cm^2)	Wt. (g)	No. of Indiv.	No. of Species
C1	1	L. litt[a]	28 Jun	shell of Balanus sp.	--	12.5	57	13
C2	1	H. sess[b]	30 Jun	rock	--	123.1	211	22
C3	1	A. nana[c] L. and[d]	30 Jun	rock	49	--	159	17
C4	2	E. menz[e]	2 Jul	rock	49	--	175	19

[a]Lessoniopsis littoralis (Farlow and Setchell) Reinke

[b]Hedophyllum sessile (C. Agardh) Setchell

[c]Alaria nana Schrader

[d]Laminaria andersonii Eaton

[e]Egregia menziesii (Turner) Areschoug

Table VIII. Trellis diagram comparing samples from open coast with each other and with samples from inside bay during July to determine indices of affinity.

Sample No.								
C1				5.0	11.6	18.1	42.6	17.5
C2			6.3	2.7	7.1	6.1	7.6	2.8
C3		9.0	26.0	2.7	0.9	5.4	4.3	25.2
C4	14.4	1.6	5.1	6.4	7.1	10.1	23.7	17.0
Sample No.	C3	C2	C1	11	10	9	8	1

Table IX. Data from collection of replaced holdfasts examined as physical habitats.

Sample No.	Station	Species of Alga[a]	Replacement Date (1966)	Recovery Date (1966)	Substrate
R1	D	*L. sacc*	19 Aug	14 Sept	boulder
R2	G	*H. sess*	22 Aug	14 Sept	wood float
R3	3	*L. sacc*	25 Aug	13 Nov	wood float
R4	A	*H. sess*	30 Aug	14 Sept	wood float
R5	A	*L. sacc*	13 Sept	16 Oct	wood float
R6	4	*L. sacc*	14 Sept	16 Oct	metal ladder

[a]For explanation of abbreviations see Table II.

Table X. Data from examination of replaced holdfasts.

Replaced Holdfasts			Contained Animals					
Sample No.	Basal Area (cm^2)	Wt. (g)	No. of Indiv.	No. of Species Motile	No. of Species Sessile[a]	Diversity Index[b]	Total Wt. (g)	Wt. as % of Hold-fast Wt.
R1	53	37.4	42	13	2	0.357	2.59	6.9
R2	28	71.8	47	15	2	0.362	0.50	2.8
R3	8	10.7	17	8	3	0.647	2.58	24.0
R4	12	17.9	40	10	3	0.325	0.28	1.5
R5	20	8.6	24	18	2	0.417	0.51	5.9
R6	12	5.3	40	9	3	0.300	0.06	1.1
Total	133	151.7	210	33	4	0.176	6.52	4.3

[a]Includes hydroids, ectoprocts, cirripedes, and sabellids.

[b]Diversity index computed by dividing number of species by number of individuals.

Table XI. Trellis diagram comparing replaced holdfasts with each other to determine indices of affinity.

Sample No.					
R2					4.3
R3				34.0	15.4
R4			29.3	28.9	19.5
R5		41.7	25.0	33.6	16.1
R6	37.5	30.0	36.9	27.0	24.5
Sample No.	R5	R4	R3	R2	R1

Table XII. Comparison of replaced holdfasts with adjacent samples to determine indices of affinity.

Replaced holdfast	R1	R2	R3	R4	R5	R6	R6
Adjacent sample	20	23	41	22	32	34	35
Index of affinity	13.5	53.2	28.4	22.7	9.8	30.2	28.2

Table XIII. Data from collection and examination of scrapings of barnacles.

Sample No.	Station	Date (1966)	Wt. (g)	No. of Contained Indiv.	No. of Contained Species	Dominant Species	Adj. Sample No.	Affinity with Adj. Sample
S1	J	26 Aug	27.7	374	12	*Schizobranchia*	17	15.4
S2	G	16 Oct	30.0	45	13	Nematoda	31	30.1

Table XIV. Comparison of results of present study with those from three other studies (Andrews, 1925, 1945, Dexter, 1946) showing percentage which each listed animal group comprises of total number of animals taken in each study.

Animal Group	Yaquina Bay (present study) (%)	San Juan Is. (Andrews, 1925) (%)	Monterey (Andrews, 1945) (%)	Annisquam River (Dexter, 1947) (%)
Porifera	T	---	- -	1.3
Hydrozoa	0.3	---	---	8.3
Anthozoa	0.2	---	0.3	2.0
Turbellaria	0.1	---	0.7	---
Nemertea	2.2	1.4	1.6	---
Nematoda	14.1	---	---	---
Polychaeta	28.5	22.1	22.1	3.8
Sipunculoidea	0.1	0.2	1.9	---
Xiphosura	---	---	---	0.4
Acarina	0.2	---	---	---
Pycnogonida	T	---	---	---
Ostracoda	0.4	---	---	---
Cirripedia	8.7	---	---	0.4
Chelifera	0.4	---	---	---
Isopoda	6.4	T	2.6	1.7
Amphipoda	3.8	55.3	25.8	5.8
Decapoda	1.0	3.3	15.0	26.8
Insecta	0.5	---	---	---
Amphineura	0.3	T	1.4	---
Gastropoda	8.0	5.0	12.3	25.6
Pelecypoda	23.2	0.1	1.0	6.2
Ectoprocta	0.8	---	---	3.8
Asteroidea	0.1	---	1.1	5.8
Ophiuroidea	---	11.8	8.5	0.6
Echinoidea	---	0.1	4.7	0.7
Holothuroidea	0.4	---	0.7	---
Ascidiacea	0.3	---	0.1	3.0
Vertebrata	---	0.7	0.2	3.8
Total percent	100.0	100.0	100.0	100.0
Total individs.	6,687	2,646	22,752	707

T - indicates that group, while present, comprised less than 0.05% of total.

--- indicates that group was not found in study.

Table XV. Trellis diagrams comparing four studies to determine indices of affinity. (Numbers are derived from comparison of orders, classes, and phyla, using percentages which occur in Table XIV.

Study			
Yaquina Bay (present study)			
San Juan Is. (Andrews, 1925)			33.5
Monterey (Andrews, 1945)		66.7	41.4
Annisquam River (Dexter, 1947)	42.6	19.4	26.6
Study	Mont.	S. J. Is.	Yaq. Bay