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[12] ABSTRACT (PURPOSE, METHOD, RESULTS, CONCLUSIONS)

Benthic fauna in Mamala Bay was sampled on 6–14 August 2003 at 10 stations with a modified van Veen grab sampler and at 30 stations with diver-operated sediment corers. Station locations were selected according to a random probabilistic sampling design. The depth range of the stations was 1.2 to 108.8 m. Baseline conditions in Mamala Bay in 2003 are described with respect to the range in sediment and biological parameters; the spatial distribution of samples with minimal values of taxa richness; cluster analysis of stations based on faunal similarity; dominant species composition; quantitative changes in the abundance and taxa richness of nonmollusks, crustaceans, and mollusks in relation to water depth; and the frequency distribution of areal taxa richness Sediments were predominantly (>66%) sand at all stations. Total organic carbon in the sediments ranged from 0.26% to 0.94%. Total Kjeldahl nitrogen ranged from 60 to 929 mg/dry kg. Values for oxidation-reduction potential showed no evidence of reducing conditions at the surface of sediments at any station. A total of 6,908 nonmollusk individuals from 226 taxa were collected. Polychaetes represented 33.4%, crustaceans 24.7%, nematodes 22.8%, oligochaetes 8.4%, and nemerteans 3.8% of total nonmollusk abundance. Total nonmollusk abundance ranged from 9 individuals/sample (1,984/m^2, at Station 52) to 1,091 individuals/sample (240,496/m^2, at Station 57). The number of nonmollusk taxa ranged from 4 (at Stations 55 and 61) to 75 (at Station 47). Crustacean abundance ranged from 0 (at Stations 32, 49, and 70) to 432 (95,228/m^2, at Station 57). The number of crustacean taxa ranged from 0 (at Stations 32, 49, and 70) to 27 (at Station 44). Mollusks were analyzed separately because they represent time-averaged collections of live and dead shells. Mollusk abundance ranged from 42 individuals/15 cm^3 (at Station 55) to 898 individuals/15 cm^3 (at Station 41). The number of mollusk taxa per 15 cm^3 ranged from 17 (at Station 52) to 89 (at Station 70). Index values for diversity and evenness were quite variable for both nonmollusks and mollusks. Correlation and cluster analyses indicated that the differences in the nonmollusks of Mamala Bay were associated primarily with depth. The data were therefore divided according to eleven 10-m depth ranges and three depth zones (shallow, 0 to 29.9 m; mid-depth, 30.0 to 69.9 m; and deep, ≥70.0 m). The abundance and taxa richness of both nonmollusks and the crustacean component of the nonmollusks were highest in the mid-depth zone. Most low values of nonmollusk taxa richness were recorded for shallow waters and were widely distributed along the bay. The frequency distribution of nonmollusk taxa richness reflected the dichotomy between the taxa-rich sites in intermediate-depth water and the taxa-poor sites in shallow and deep water. The relation to depth was less obvious for mollusks, which were more evenly distributed in the bay, especially in terms of taxa richness. However, cluster analysis showed that stations with the highest mean mollusk abundance and taxa richness were located in the deep-water zone. Several of the lowest values of mollusk taxa richness were recorded at sites in the surf zone or under the influence of ocean swells. The frequency distribution for mollusk taxa richness reflected the relatively uniform distribution of mollusks in the bay. The results of this study, together with the 2001 survey results, establish a baseline for benthic conditions in Mamala Bay. This baseline was used to assess previously reported conditions at the zone of initial dilution (ZID) of the Sand Island and Barbers Point ocean outfalls in 1998 and 2001, respectively. Nonmollusk and mollusk abundance and taxa richness at the outfall ZIDs were close to expected values for comparable depths in Mamala Bay. Crustacean abundance and richness at the ZIDs were somewhat less than expected, a conclusion consistent with the historic evidence for a slightly diminished crustacean assemblage at the ZIDs. Relatively few crustaceans were collected at Station 64, which is located near the Sand Island ocean outfall in the 2003 survey. Station 64 was also characterized by the presence of the indicator species *Ophryotrocha adherens* and *Neanthes arenaceodentata*. The frequency distributions for mollusk taxa richness for the outfall ZID surveys were similar to those for the two bay surveys. The frequency distributions for nonmollusk taxa richness for the outfall ZID surveys followed the taxa-rich segment of the distribution for the bay, i.e., they did not include taxa-poor samples found inshore and offshore of the ZIDs. Comparisons with the Mamala Bay 2001 and 2003 baseline surveys confirm the presence of a diverse and abundant macrobenthos in the immediate vicinity of the Sand Island and Barbers Point ocean outfalls.

2540 Dole Street • Honolulu, Hawai'i 96822 • U.S.A. • (808) 956-7847

AUTHORS:

Dr. Richard C. Swartz
Environmental Consultant
P.O. Box 397
Placida, Florida 33946-0397
Tel.: 941/697-3612
Email: swartz@ewol.com

Dr. Julie H. Bailey–Brock
Professor (Invertebrate Zoology)
Department of Zoology
University of Hawai'i at Mānoa
2538 The Mall, Edmondson Hall 357
Honolulu, Hawai'i 96822
Tel.: 808/956-6149
FAX: 808/956-9812
Email: jbrock@hawaii.edu

Dr. William J. Cooke
Ecological Consultant
Marine Environmental Research
705 Nunu Street
Kailua, Hawai'i 96734
Tel.: 808/254-0203
Email: w.j.cooke@worldnet.att.net

Dr. E. Alison Kay
Emeritus Professor (Malacology)
Department of Zoology
University of Hawai'i at Mānoa
2538 The Mall, Edmondson Hall 351
Honolulu, Hawai'i 96822
Tel.: 808/956-8620
FAX: 808/956-9812
Email: ekay@hawaii.edu

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REGIONAL MONITORING OF BENTHIC FAUNA IN MĀMALA BAY, O'AHU, HAWAI'I, AUGUST 2003

Richard C. Swartz
Julie H. Bailey–Brock
William J. Cooke
E. Alison Kay

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University of Hawai'i at Mānoa
Honolulu, Hawai'i 96822

The taxa abundance and richness counts for benthic organisms and the data calculations in this publication are the responsibility of the authors. The Water Resources Research Center staff is responsible for publication production activities.

ABSTRACT

Benthic fauna in Māmala Bay was sampled on 6–14 August 2003 at 10 stations with a modified van Veen grab sampler and at 30 stations with diver-operated sediment corers. Station locations were selected according to a random probabilistic sampling design. The depth range of the stations was 1.2 to 108.8 m. Baseline conditions in Māmala Bay in 2003 are described with respect to the range in sediment and biological parameters; the spatial distribution of samples with minimal values of taxa richness; cluster analysis of stations based on faunal similarity; dominant species composition; quantitative changes in the abundance and taxa richness of nonmollusks, crustaceans, and mollusks in relation to water depth; and the frequency distribution of areal taxa richness.

Sediments were predominantly (>66%) sand at all stations. Total organic carbon in the sediments ranged from 0.26% to 0.94%. Total Kjeldahl nitrogen ranged from 60 to 929 mg/dry kg. Values for oxidation-reduction potential showed no evidence of reducing conditions at the surface of sediments at any station.

A total of 6,908 nonmollusk individuals from 226 taxa were collected. Polychaetes represented 33.4%, crustaceans 24.7%, nematodes 22.8%, oligochaetes 8.4%, and nemerteans 3.8% of total nonmollusk abundance. Total nonmollusk abundance ranged from 9 individuals/sample (1,984/m^2, at Station 52) to 1,091 individuals/sample (240,496/m^2, at Station 57). The number of nonmollusk taxa ranged from 4 (at Stations 55 and 61) to 75 (at Station 47). Crustacean abundance ranged from 0 (at Stations 32, 49, and 70) to 432 (95,228/m^2, at Station 57). The number of crustacean taxa ranged from 0 (at Stations 32, 49, and 70) to 27 (at Station 44). Mollusks were analyzed separately because they represent time-averaged collections of live and dead shells. Mollusk abundance ranged from 42 individuals/ 15 cm^3 (at Station 55) to 898 individuals/15 cm^3 (at Station 41). The number of mollusk taxa per 15 cm^3 ranged from 17 (at Station 52) to 89 (at Station 70). Index values for diversity and evenness were quite variable for both nonmollusks and mollusks. Correlation and cluster analyses indicated that the differences in the nonmollusks of Māmala Bay were associated primarily with depth. The data were therefore divided according to eleven 10-m depth ranges and three depth zones (shallow, 0 to 29.9 m; mid-depth, 30.0 to 69.9 m; and deep, ≥70.0 m). The abundance and taxa richness of both nonmollusks and the crustacean component of the nonmollusks were highest in the mid-depth zone. Most low values of nonmollusk taxa richness were recorded for shallow waters and were widely distributed along the bay. The frequency distribution of nonmollusk taxa richness reflected the dichotomy between the taxa-rich sites in intermediate-depth water and the taxa-poor sites in shallow and deep water. The relation to depth was less obvious for mollusks, which were more evenly distributed in the bay, especially

in terms of taxa richness. However, cluster analysis showed that stations with the highest mean mollusk abundance and taxa richness were located in the deep-water zone. Several of the lowest values of mollusk taxa richness were recorded at sites in the surf zone or under the influence of ocean swells. The frequency distribution for mollusk taxa richness reflected the relatively uniform distribution of mollusks in the bay.

The results of this study, together with the 2001 survey results, establish a baseline for benthic conditions in Māmala Bay. This baseline was used to assess previously reported conditions at the zone of initial dilution (ZID) of the Sand Island and Barbers Point ocean outfalls in 1998 and 2001, respectively. Nonmollusk and mollusk abundance and taxa richness at the outfall ZIDs were close to expected values for comparable depths in Māmala Bay. Crustacean abundance and richness at the ZIDs were somewhat less than expected, a conclusion consistent with the historic evidence for a slightly diminished crustacean assemblage at the ZIDs. Relatively few crustaceans were collected at Station 64, which is located near the Sand Island ocean outfall in the 2003 survey. Station 64 was also characterized by the presence of the indicator species *Ophryotrocha adherens* and *Neanthes arenaceodentata*. The frequency distributions for mollusk taxa richness for the outfall ZID surveys were similar to those for the two bay surveys. The frequency distributions for nonmollusk taxa richness for the outfall ZID surveys followed the taxa-rich segment of the distribution for the bay, i.e., they did not include taxa-poor samples found inshore and offshore of the ZIDs. Comparisons with the Māmala Bay 2001 and 2003 baseline surveys confirm the presence of a diverse and abundant macrobenthos in the immediate vicinity of the Sand Island and Barbers Point ocean outfalls.

CONTENTS

TEXT FIGURES

TEXT TABLES

APPENDIX TABLES

INTRODUCTION

The Sand Island Wastewater Treatment Plant (WWTP) is a primary treatment system. Wastewaters of mainly domestic origin are treated at the WWTP prior to discharge in Māmala Bay through an 84-in. (2.13-m) diameter outfall located off the southern coast of O'ahu, Hawai'i.

The renewal of a waiver of secondary treatment for sewage discharge through the Sand Island Ocean Outfall was granted to the City and County of Honolulu (CCH) in September 1998 by the Region IX office of the U.S. Environmental Protection Agency (EPA). The permit specifies that regional monitoring activities be conducted in Māmala Bay during years three and five of the renewal period. Thus, after 13 surveys of the macrobenthic, soft-bottom community in the vicinity of the discharge were conducted over the 15-year period from 1986 to 2000, the first regional monitoring survey was conducted in 2001. The fourteenth survey in the vicinity of the outfall occurred in 2002 and the second regional monitoring survey was conducted in 2003. The regional monitoring effort involved a broader sampling of 40 stations randomly selected throughout Māmala Bay. This report describes the extent and magnitude of spatial changes in the structure of the benthic community in the bay. The samples on which this report is based were collected on 6–14 August 2003.

PROJECT ORGANIZATION

General coordination for this project is provided by James E.T. Moncur, director of the Water Resources Research Center of the University of Hawai'i at Mānoa and project principal investigator. The principal members of the project team (listed in alphabetical order) and their contributions to this study are as follows:

Julie H. Bailey–Brock	Polychaete, oligochaete, and sipunculan analysis and report
William J. Cooke	Crustacean analysis and report
E. Alison Kay	Mollusk analysis and report
Richard C. Swartz	Statistical analysis and final report preparation
Ross S. Tanimoto	City and County of Honolulu project representative and coordinator for sediment grain-size, total organic carbon, total Kjeldahl nitrogen, and oxidation-reduction potential analyses

MATERIALS AND METHODS

Locations of the 40 Māmala Bay Regional Study sampling stations are shown in Figure 1. The stations span an area from Barbers Point on the west to just beyond Diamond Head on the east. The area also includes the Sand Island and Barbers Point ocean outfalls. Both outfalls discharge primary treated wastewaters into Māmala Bay. The 40 stations were selected according to a random probabilistic sampling design, in accordance with the EPA Coastal Environmental Monitoring and Assessment Program

Station Positioning

The position of each of the 40 stations was determined using the Garmin differential global positioning system. Positions for the sample collected at each station are given in Appendix Table A.1. The numbers assigned to stations in the 2003 Māmala Bay survey ranged from 31 to 70. The numbers assigned to stations in the 2001 Māmala Bay survey ranged from 61 to 100. Stations with the same number in both surveys (i.e., Stations 61 to 70) were not located at the same position.

Sampling Methods

The sampling methodology used in this study generally follows the recommendations of Swartz (1978) and guidelines of the U.S. Environmental Protection Agency (1987a, 1987b), hereafter referred to as EPA procedures.

A 0.16-m^2 modified van Veen grab sampler deployed from a stern-mounted A-frame on the CCH research vessel *Noi I Kai* was used to obtain bottom samples in deep water (38.4 to 108.8 m). Divers used corers to collect bottom samples in shallow water (1.2 to 39.9 m). Sampling dates were 6–14 August 2003. Penetration of the sampler was adequate for all samples. The minimum penetration depth was 6.5 cm, and the maximum was 9.5 cm (Appendix Table A.2).

One grab sample was taken at each of 10 stations. From each sample, a subsample 7.6 cm in diameter by 5 cm deep was taken for analysis of nonmollusks (fauna excluding mollusks) and a subsample 4.8 cm in diameter by 5 cm deep for analysis of mollusks. Subsampling was necessary because the epifauna and infauna in the area are known to be both small and abundant (Nelson 1986; Russo et al. 1988). Diver-collected core samples 7.6 cm in diameter by 5 cm deep for nonmollusk analysis and 4.8 cm in diameter by 5 cm deep for mollusk analysis were taken at each of 30 other stations. Biological samples for nonmollusk analysis were

processed on a 0.5-mm mesh screen. Organisms retained on the sieve were preserved as appropriate for subsequent identification.

Samples for geochemical analyses (total organic carbon [TOC], total Kjeldahl nitrogen [TKN], and oxidation-reduction potential [ORP]) and for grain-size analyses were obtained from the grabs from which the biological subcores were taken because each grab contained more than enough sediment for both purposes (methods established by National Pollutant Discharge Elimination System permit no. HI0020877). A subsample 7.6 cm in diameter by 5 cm deep was taken for the analyses at each station. At the diver-sampled stations, an additional core was taken for geochemical and grain-size analyses. The top 2 cm of sediment from each sample were used for geochemical analysis. Samples for TOC and TKN analyses were put in screw-cap jars, which were placed on ice, and taken to the laboratory. Sediment ORP was done immediately after the samples were brought aboard the ship. Laboratory analyses of sediment grain size, ORP, and TKN followed EPA procedures. Analysis of TOC followed ASTM method D4129-82M.

Sample Processing

Handling, processing, and preservation of the biological samples followed EPA procedures. Nonmollusk samples were fixed in 15% buffered formalin for a minimum of 24 hours. The fixed samples were elutriated using the technique of Sanders et al. (1965). This method successfully removes from the sediment all organisms that are not heavily calcified (Nelson et al. 1987). The samples were washed several times, and the water from each was poured through 0.5-mm-mesh sieves. Polychaetes and other invertebrates retained on the sieve were transferred to alcohol, stained with rose bengal solution, and stored in 70% ethanol.

When large rubble fragments were collected in the samples, the rubble fragments were carefully washed and visually examined to ensure that any organisms on the external surfaces were removed. The fragments were then placed in a nitric acid bath for 24 hours to recover organisms living in burrows. The acid dissolution technique used was modified from the methods of Brock and Brock (1977), as described in Nelson (1986). In the 2003 samples, nonmollusks were collected from the rubble fragments at Stations 32 (5 taxa, 9 individuals), 33 (3 taxa, 4 individuals), 35 (9 taxa, 19 individuals), 38 (15 taxa, 37 individuals), 40 (11 taxa, 52 individuals), 44 (24 taxa, 119 individuals), 45 (4 taxa, 5 individuals), 47 (24 taxa, 149 individuals), 48 (7 taxa, 11 individuals), 49 (2 taxa, 3 individuals), 50 (19 taxa, 52 individuals), 52 (3 taxa, 3 individuals), 53 (7 taxa, 20 individuals), 59 (8 taxa, 11 individuals), 62 (2 taxa, 2 individuals), and 70 (3 taxa, 4 individuals).

Mollusk samples were placed in labeled jars in the field, then transported on ice to the laboratory where they were refrigerated. To minimize loss of fine sediments, samples were fixed in 75% ethanol for 48 hours, and then air dried. Only fresh shells from 15-cm^3 aliquots were sorted following the methods of Kay (1980) and Kay and Kawamoto (1983). The shells were identified using Kay (1979a) as the primary taxonomic reference. Following identification, the shells were counted.

Because the biological subcores had to be processed using two different procedures, one for mollusks and the other for all other organisms, the two components of the fauna were not directly comparable and thus were analyzed separately. Because the mollusk specimens were not separated into living and dead shell fractions, they represent time-averaged samples. Mollusks have been extensively analyzed by Kay (1975, 1978, 1979b, 1982), Kay and Kawamoto (1980, 1983), Nelson (1986), and Russo et al. (1988).

All specimens were identified to the lowest taxonomic level possible. A selected bibliography for the identification of marine benthic species in Hawai'i is provided in Nelson et al. (1987, appendix D). An additional source used for the identification of polychaetes in Hawai'i is Blake et al. (1995, 1996, 1997, 2000). Voucher specimens were submitted to taxonomic specialists for verification when necessary. All specimens were archived and will be maintained for six years at the University of Hawai'i.

The following taxa collected in the 2003 Māmala Bay survey had not been found in previous surveys at any of the O'ahu outfall sites (Barbers Point, Sand Island, Wai'anae, and Mōkapū): the polychaetes *Exogone* sp. I, *Microspio* sp. A, *Platynereis dumerilii*, *Pygospio muscularis*, and *Typosyllis* sp. J; the ostracod *Loxoconchella anomala*; the tanaid *Synapseudes minutus*; the isopod *Bagatus* sp. A; the amphipods *Ampithoe ramondi*, *Eusiroides diplonyx*, *Melita pahuwai*, and *Ochlesis alii*; the decapod crustaceans *Palaemon* sp. A, *Emerita pacifica*, *Aphanodactylus edmondsoni*, *Portunus granulatus*, and zoea; the bivalves *Chama* sp., *Isognomon* sp., and Teredinidae spp.; and the gastropods *Heliacus sterkii*, *Kermia pumila*, *Rastodens brevilabiosa*, and *Volumitra pailoloana*.

Data Analysis

Statistical comparisons of mean benthic community parameters among the 40 stations were not possible because of the lack of replicate samples. The number of individuals and number of taxa were calculated for each station for all nonmollusks, polychaetes, crustaceans, and mollusks. The Shannon–Wiener diversity index (H') (ln) and evenness index (J) were calculated for each station for all nonmollusks, crustaceans, and mollusks. Calculations of these diversity parameters were carried out using Microsoft Excel software.

Overall comparisons of taxa composition among stations were carried out using cluster analysis (Pielou 1984). The Bray–Curtis similarity index (Bloom 1981) on double square root transformed data was performed using the group-average sorting strategy. Separate cluster analyses were conducted for the nonmollusk and mollusk faunal fractions because of differences in sample collection and processing. To make analysis more manageable, only those taxa that contributed at least 0.05% to the total abundance were included. Using this criterion, only nonmollusk taxa represented by a total of more than three individuals were included in the data set, which was reduced from 226 to 121 taxa. Also, only mollusk taxa represented by a total of more than five individuals were included in the data set, which was reduced from 242 to 124 taxa. The similarity matrices were computed with BioDiversity Pro software.

Benthic community structure in Māmala Bay changes substantially among depth strata (Swartz et al. 2000, 2001a). Stations were therefore initially pooled within eleven 10-m depth ranges (0 to 9.9 m, 10.0 to 19.9 m, 20.0 to 29.9 m, 30.0 to 39.9 m, 40.0 to 49.9 m, 50.0 to 59.9 m, 60.0 to 69.9 m, 70.0 to 79.9 m, 80.0 to 89.9 m, 90.0 to 99.9 m, and 100.0 to 109.9 m). Because of the lack of replicates in five of the eleven 10-m depth ranges, stations were finally pooled into three depth zones prior to statistical analysis (shallow, 0 to 29.9 m; mid-depth, 30.0 to 69.9 m; and deep, $\geq$ 70.0 m).

Parameters of benthic community structure (abundance, taxa richness) were compared statistically among depth zones and also among station clusters identified in the similarity matrices. Depth zones and station clusters that contained at least two stations were included in these analyses. These comparisons were made separately for the nonmollusk and mollusk assemblages. All data were tested for assumptions of normality (Kolmogorov–Smirnov test; Sokal and Rohlf 1995) and heterogeneity of variances (F_{max} test) prior to statistical analysis. Where data sets failed tests of assumptions, square root or $\log_{10}$ transformation was applied. Comparisons of mean values among stations were made with one-way analysis of variance (ANOVA). Following a significant result using ANOVA, a posteriori Student–Newman–Keuls tests were used to determine which differences in means among stations were significant. All statistical analyses were performed using Prophet and Microsoft Excel software. Detailed statistical results are provided in Appendixes B and C.

Biological data from the 2001 Māmala Bay survey (Swartz et al. 2002a) were compared with those from surveys of the ZID and ZID-boundary stations at the Sand Island Ocean Outfall (Stations B3, B4, Z, and B5; sampled in August 1998; Swartz et al. 1999) and Barbers Point Ocean Outfall (Stations HB2, HB3, HB4, and HZ; sampled in January 2001, Swartz et al. 2001b). For consistency, the same outfall data were also used for comparison with the results of the 2003 Māmala Bay survey. In this report the ZID and ZID-boundary stations are collectively referred to as ZID-area stations.

RESULTS

Depth and Sediment Parameters

The depth range among the 40 stations was 1.2 to 108.8 m (Appendix Table A.1). Notes in the survey log indicate several of the shallow stations were in the surf zone (e.g., Stations 39, 52, 53, 60, 63, and 69) or had large waves or swell present (e.g., Stations 31, 32, 39, 40, and 49). There were significant, positive correlations between depth and the number of nonmollusk taxa ($r = 0.595$**), crustacean taxa ($r = 0.365$*), nonmollusk individuals ($r = 0.384$*), and mollusk individuals ($r = 0.426$**). Correlations between depth and the number of mollusk taxa ($r = 0.176$) and crustacean individuals ($r = 0.179$) were not significant.

Results of the sediment grain-size analysis are given in Appendix Table A.3. The sediment compositions at the sampling stations, based on four grain-size categories, are compared in Figure 2. The grain-size categories (Folk 1968) are as follows: coarse sediment, retained on a +1-phi sieve; medium sand, passed through a +1-phi sieve but retained on a +2-phi sieve; fine sand, passed through a +2-phi sieve but retained on a +4-phi sieve; and silt and clay, passed through a +4-phi sieve.

There were differences among stations in sediment grain-size distribution (Appendix Table A.3, Figure 2). The silt-and-clay fraction was the least variable (range: 0.7% to 6.7%, except for 16.2% and 33.2% at Stations 57 and 58, respectively). Much greater ranges were recorded for the fine-sand fraction (0.2% to 86.4%), medium-sand fraction (1.0% to 85.4%), and coarse-sediment fraction (0.1% to 95.0%). Qualitative remarks in the survey log reflect the diversity of sediment conditions: e.g., "lots of rubble" at Stations 34 and 38, "lots of silt" at Stations 57 and 58, "thin layer of sand" at Station 35, "seaweed and coral" at Station 44, and "reef flats" at Station 53. The numbers of nonmollusk individuals, nonmollusk taxa, and crustacean individuals were significantly and positively correlated with the silt-and-clay fraction ($r = 0.658$**, 0.507**, and 0.392*, respectively). There were no significant correlations between the nonmollusk structural parameters and the coarse-sediment, medium-sand, or fine-sand fraction (range in correlation coefficients, r, from 0.015 to 0.225). Similarly, there were no significant correlations between the crustacean structural parameters and the coarse-sediment, medium-sand, or fine-sand fraction (range in r from 0.054 to 0.196). The number of mollusk individuals and number of mollusk taxa were not significantly correlated with any of the four grain-size categories (range in correlation coefficients, r, from 0.010 to 0.3129), although the correlations between the medium sand fraction and the number of mollusk taxa ($r = 0.312$) and mollusk individuals ($r = 0.3129$) were barely insignificant ($p_{0.05} = 0.3130$). Analysis of duplicate samples at Stations 39, 45, 67, and 70 indicated consistency of analytical techniques.

Direct electrode measurements of ORP ranged from +20 to +170 mV (Appendix Table A.2). ORP was less than +50 mV at Stations 37 (20 mV), 50 (20 mV), 42 (25 mV), 41 (30 mV), 33 (40 mV), 35 (40 mV), and 44 (45 mV). Even these relatively low readings show no evidence of strongly reducing conditions in the surface sediment. ORP was significantly and negatively correlated among the 40 stations with the number of nonmollusk taxa (r = –0.544**) and crustacean taxa (r = –0.464**). ORP was not significantly correlated with the number of nonmollusk (r = –0.231), crustacean (r = –0.176), and mollusk (r = –0.295) individuals or with the number of mollusk taxa (r = –0.235).

Values of TKN ranged from 60 to 929 mg/dry kg (Appendix Table A.2). The highest TKN values were recorded at Stations 47, 35, 58, and 33 (929, 751, 677, and 507 mg/dry kg, respectively). TKN at all other stations was less than 440 mg/dry kg. TKN was significantly correlated among the 40 stations with the number of nonmollusk taxa (r = 0.348*), nonmollusk individuals (r = 0.458**), and mollusk individuals (r = –0.386*). TKN was not significantly correlated with the number of crustacean taxa (r = 0.269), mollusk taxa (r = –0.281), and crustacean individuals (r = 0.216).

Total organic carbon in the sediments was low at all stations (range: 0.26% to 0.94%, Appendix Table A.2). TOC was significantly and positively correlated among the 40 stations with the number of nonmollusk (r = 0.431**) and crustacean (r = 0.341*) taxa and with the number of nonmollusk (r = 0.515**) and crustacean (r = 0.366*) individuals. There were no significant correlations between TOC and the number of mollusk taxa (r = –0.113) or mollusk individuals (r = –0.142).

Biological Parameters

Nonmollusks

The nonmollusk fraction of the benthic fauna included polychaetes, oligochaetes, nematodes, platyhelminths, echinoderms, poriferans, anthozoans, hydrozoans, kinorhynchs, a chaetognath species, hemichordates, nemerteans, sipunculans, insects (not marine in origin), priapulids, bryozoans, a phoronid species, chordates, a hemichordate species, mites, pycnogonids, copepods, ostracods, cumaceans, tanaids, amphipods, isopods, and decapod crustaceans.

The 6,908 nonmollusk specimens counted and identified for all stations represent 226 taxa. Polychaetes were the dominant nonmollusk taxon in terms of taxa richness (124 taxa, 54.9%) and abundance (2,306 individuals, 33.4%). Crustaceans ranked second in abundance (1,705 individuals, 24.7%). Nematodes, which were not identified to the species level, constituted 22.8% (1,573 individuals) of numerical abundance, oligochaetes contributed 8.4%

(580 individuals), and nemerteans contributed 3.8% (265 individuals). The 79 crustacean taxa, 27 of which were amphipods, represented 35.0% of the total number of nonmollusk taxa. Abundance estimates for each taxon from each sample are given for each of the 40 stations in Appendix D.

The basic nonmollusk data are provided in Appendix Table B.1 (number of individuals, number of taxa, diversity (H'), and evenness (J)). Nonmollusk abundance ranged from 9 individuals/sample (1,984/m^2, at Station 52) to 1,091 individuals/sample (240,496/m^2, at Station 57) (Figure 3). The number of nonmollusk taxa ranged from 4 (at Stations 55 and 61) to 75 (at Station 47) (Figure 4).

Composite station diversity (H') and evenness (J) for the nonmollusks are shown in Figure 5. Values for both parameters varied substantially among stations. Values for diversity ranged from 0.83 (at Station 39) to 3.50 (at Station 50), and values for evenness ranged from 0.46 (at Station 39) to 0.98 (at Stations 52 and 63).

Thirty-eight taxa ranked among the three most abundant nonmollusk taxa at one or more stations (Table 1). The tanaid *Leptochelia dubia* was the most abundant species in the survey, with a total of 360 individuals found among 16 stations (mean: 9.0 individuals/sample; 1,984/m^2). This tanaid was very abundant at Station 57, with 202 individuals/sample (44,528/m^2) at that station. The polychaete *Euchone* sp. B ranked second in total abundance (283 individuals), but 98.6% of the specimens were collected at just two stations: 198 individuals at Station 58 (43,646/m^2) and 81 individuals at Station 57 (17,855/m^2). The polychaete *Pionosyllis heterocirrata* ranked third in total abundance (274 individuals, mean: 6.8 individuals/sample; 1,499/m^2) and was the most ubiquitous species. It was present at 34 stations and qualified as a dominant at 17 of them. No other taxon was present at more than 23 stations or a dominant at more than 5 stations. Other dominants with a mean abundance exceeding 500 individuals/m^2 included the polychaetes *Phyllochaetopterus verrilli*, *Micropodarke* sp. A, *Synelmis acuminata*, and *Sphaerosyllis* sp. G; the amphipods *Konatopus paao*, *Eriopisella sechellensis*, and *Elasmopus piikoi*; and the sipunculid *Aspidosiphon muelleri*.

The results of cluster analysis indicating the relative similarity of stations based on the 121 most abundant nonmollusk taxa are shown in Figure 6. Six station clusters (A through F) are evident in the dendrogram. Cluster B was further subdivided into three subclusters: B1, B2, and B3. Mean number of nonmollusk taxa ranged from 6.3 taxa/sample in cluster F to 51.5 taxa/sample in subcluster B2 (Appendix Table B.2). Mean nonmollusk abundance ranged from 11.3 individuals/sample (2,469/m^2) in cluster F to 583.3 individuals/sample (128,558/m^2) in subcluster B2. There were significant differences among clusters/subclusters in abundance and taxa richness. The mean number of individuals was significantly greater in subcluster B2

than in clusters F, A, D. The mean number of taxa was significantly greater in subclusters B2 and B3 than in clusters F, D, A, and C; and in subcluster B1 than in clusters F, D, and A. Subclusters B1, B2, and B3, which included a total of 13 stations, linked together at the highest final similarity value (53.5%). Cluster A (16 stations) formed in a chaining pattern that linked with subclusters B1, B2, and B3 at 50.7% similarity. Clusters C (2 stations) and D (4 stations) joined with clusters A and B at a relatively high overall similarity of 47.9%. Cluster E was represented by a single station (40) with a rather unique nonmollusk assemblage. Cluster F was not well defined. It included four unrelated stations, each with a diminished number of nonmollusk fauna, that joined the dendrogram at the end of the cluster computation in a chaining pattern at low similarity values (28.9% to 43.5%) (Figure 6).

The stations of clusters A, C, and D were characterized by low abundance (range in means among clusters: 63.3 to 111.0 individuals/sample, 13,954/m^2 to 24,468/m^2) and low taxa richness (14.0 to 24.5 taxa/sample) relative to subclusters B1, B2, and B3 (279.7 to 330.5 individuals/sample, 61,656/m^2 to 128,580/m^2; 45.0 to 51.5 taxa/sample) (Table 2). The ubiquitous *Pionosyllis heterocirrata* was the dominant species in clusters A and D and ranked second in abundance in cluster C. There were no species in cluster A, C, or D with a mean abundance exceeding 10 individuals/sample (2,200/ m^2). In contrast, there were 13 instances in subclusters B1, B2, and B3 where the abundance of a species exceeded 10 individuals/sample. *Leptochelia dubia* and *Pionosyllis heterocirrata* were abundant in each of the three B subclusters. *Euchone* sp. B was the most abundant species in subcluster B2, but it was not collected in the other B subclusters. Similarly, *Phyllochaetopterus verrilli* was the most abundant species in subcluster B1, but it was not found in subclusters B2 or B3. Other dominant species were very abundant in one B subcluster but uncommon in the others, e.g., *Konatopus paao* and *Eriopisella sechellensis* in subcluster B1, *Synelmis acuminata*, *Aspidosiphon muelleri*, and *Sphaerosyllis* sp. G in subcluster B2, and the polychaete *Salmacina dysteri* in subcluster B3 (Table 2). A unique set of dominant species was found in cluster E (Station 40): the polychaetes *Fabricia* sp. A and *Dipolydora armata*, the amphipods, *Elasmopus piikoi* and *Eriopisa laakona*, and the isopod *Microcharon* sp. The abundance (198.0 individuals/sample, 43,646/m^2) and taxa richness (32.0 taxa/sample in cluster E were intermediate between the B subclusters and clusters A, C, and D. The abundance (11.3 individuals/sample, 2,491/m^2) and taxa richness (6.3 taxa/sample) in cluster F were greatly diminished relative to all other clusters. No species was sufficiently abundant to be designated as a "dominant" in cluster F.

Polychaetes

A total of 2,306 polychaetes representing 124 taxa in 38 families were collected; they comprised 33.4% of total nonmollusk abundance. The largest abundance and taxa richness occurred at Station 58, where 384 individuals (84,648/m^2) from 40 taxa were collected (Figures 7 and 8). No specimens were collected at Station 61. Polychaetes were the most taxa-rich nonmollusk group at 33 stations (Appendix D). They tied with crustacean taxa at 4 stations (Stations 31, 39, 55, and 63) and were exceeded by crustacean taxa at 3 stations (Stations 44, 52, and 61). Polychaetes accounted for 24 of the 38 taxa that ranked among the three most abundant nonmollusk taxa at individual stations (Table 1). The ten most abundant taxa, which represent 60.2% of the polychaete individuals collected this year, were *Euchone* sp. B (12.3%), *Pionosyllis heterocirrata* (11.9%), *Phyllochaetopterus verrilli* (8.9%), *Micropodarke* sp. A (5.9%), *Synelmis acuminata* (5.5%), *Sphaerosyllis* sp. G (4.1%), *Fabricia* sp. A (3.7%), *Prionospio cirrifera* (3.1%), *Salmacina dysteri* (2.5%), and *Polyophthalmus pictus* (2.3%).

The polychaete *Ophryotrocha adherens* is of particular interest as it has been cited as an indicator of organic enrichment (Bailey–Brock 1996). It was abundant at ZID and ZID-boundary stations near the Barbers Point wastewater discharge in January 2001 and at ZID and ZID-boundary stations near the Sand Island wastewater discharge in August 1998 (Swartz et al. 1999, 2001b). No specimens of *O. adherens* were found during the first Māmala Bay survey in August 2001 (Swartz et al. 2002a), when none of the stations were located near the ZID of either wastewater discharge. However, in the current Māmala Bay survey, *O. adherens* was collected at Station 44 (2 individuals comprising 1.5% of all polychaetes) and at Station 64 (7 individuals, 6.1%). Another indicator of organic enrichment, *Neanthes arenaceodentata,* was also found at Station 64 (19 individuals, 16.7%), which is located near the ZID of the Sand Island wastewater discharge. Only two other specimens of *N. arenaceodentata* were found in the survey (one each at Stations 47 and 63).

We looked for evidence of reproduction in all taxa and noted reproductive events such as developing larvae or attached embryos, maturing gametes in the coelom of organisms, and presence of specialized setae (indicative of swarming/spawning behavior). At 16 stations evidence of reproduction was found. Specimens having eggs in the coelom include the syllids *Typosyllis cornuta, Pionosyllis heterocirrata, Exogone* sp. C, *Exogone* sp. E, and *Sphaerosyllis* sp. G; the hesionids *Ophiodromus angustifrons* and *Microphthalmus* spp.; the cirratulid *Aphelochaeta marioni*; the dorvilleid *Protodorvillea biarticulata*; and the questid *Questa caudicirra.* Specimens of the syllids *Grubeosyllis mediodentata, Sphaerosyllis* sp. G, *Exogone* sp. C, and *Pionosyllis spinisetosa* and the pholoid *Pholoe* sp. A had embryos or juveniles attached to the external body wall. Specimens of the syllids *Sphaerosyllis riseri* and *Pionosyllis*

heterocirrata showed characteristics of a swimming stage. These characteristics include enlarged eyes and elongated capillary setae that are used during a spawning behavior in the water column (Schroeder and Hermans 1975). Specialized copulatory hooks were observed in the capitellid *Capitella capitata.*

Trophic categories. Trophic categories are based on Fauchald and Jumars (1979) and are summarized in Figures 9 and 10. Suspension feeders were the most abundant trophic group with 29.8% of all polychaete individuals, followed by omnivores (29.3%), detritivores (25.6%), and carnivores (15.3%). Detritivores represented the most speciose group with 39.8% of all polychaete taxa, followed by omnivores (28.5%), carnivores (17.9%), and suspension feeders (13.8%).

1. Detritivores. Detritivores were absent at Stations 31, 32, 52, 60, 61, and 63 but were the most abundant trophic group at 13 of 40 stations, sharing this position with omnivores at Station 41 and with carnivores at Stations 36 and 69. Detritivores were the most speciose trophic group at 25 of 40 stations. They shared this position with carnivores at Stations 34, 36, and 48 and with omnivores at Stations 34 and 50. Dominant detritivorous taxa collected include *Myriochele oculata* (at Stations 35, 43, and 54), *Polyophthalmus pictus* (at Stations 37, 44, 47, and 50), *Prionospio cirrifera* (at Stations 37, 44, 47, 50, 54, 57, 58, and 67), and *Axiothella quadrimaculata* (at Stations 38, 40, 47, and 50).

2. Omnivores. Omnivores were absent at Stations 36, 49, 52, 55, and 61 but were the most abundant trophic group at 19 of 40 stations. They shared this position with detritivores at Station 41 and with carnivores at Station 63. Omnivores were the most speciose trophic group at 11 of 40 stations, sharing this position with detritivores at Stations 34 and 50 and with carnivores at Stations 31, 34, and 44. Dominant omnivorous taxa collected include *Pionosyllis heterocirrata* (at Stations 35, 37, 38, 41, 43, 44, 47, 50, 51, 54, and 64), *Synelmis acuminata* (at Stations 37, 41, 50, 51, 54, 57, 58, and 67), *Sphaerosyllis* sp. G (at Stations 43, 51, 54, 57, 58, and 64), and *Neanthes arenaceodentata* (at Station 64).

3. Suspension feeders. Suspension feeders were absent at 17 of 40 stations but were the most abundant trophic group at Stations 44, 47, 57, and 58. The highest percent abundance of suspension feeders was 65.4% (at Station 47). They were the most speciose trophic group at Station 32 and shared this position with carnivores at Station 52. Dominant suspension feeding taxa collected include *Euchone* sp. B (at Stations 57 and 58), *Fabricia* sp. A (at Stations 38, 40, 44, 47, 50, 54, and 57), the chaetopterid *Phyllochaetopterus verrilli* (at Station 47), and the serpulid *Salmacina dysteri* (at Stations 44 and 51).

4. Carnivores. Carnivores were absent at Stations 39, 46, 55, 61, and 68 but were the most abundant trophic group at 7 of 40 stations. They were most speciose at 9 stations, sharing this position with omnivores at Stations 31, 34, and 44, with detritivores at Stations 34, 36, and 48,

and with suspension feeders at Station 52. Dominant carnivores collected were *Micropodarke* sp. A (at Stations 35, 37, 38, 43, 44, 47, 50, 51, 54, 57, 58, and 64), *Ophiodromus angustifrons* (at Stations 51, 54, and 64), *Nematonereis unicornis* (at Stations 40, 44, 47, and 58), and *Paramphinome* sp. A (at Stations 43 and 50).

Motility categories. Motility categories are based on Fauchald and Jumars (1979) and are summarized in Figures 11 and 12. Motile taxa represented the greatest percentage of total polychaete abundance with 52.9%, followed by tubicolous taxa with 32.7% and discretely motile taxa with 14.4%. Motile taxa also represented the most speciose group with 59.4% of all polychaete taxa, followed by discretely motile taxa with 24.4% and tubicolous taxa with 16.3%.

1. Tubicolous polychaetes. Tubicolous polychaetes were absent at 17 of 40 stations but were the most abundant motility group at Stations 47, 57, and 58. They were the most speciose motility group at Stations 32 and 52, sharing this position with motile polychaetes. Dominant tubicolous polychaetes collected include *Euchone* sp. B (at Stations 57 and 58), *Fabricia* sp. A (at Stations 38, 40, 44, 47, 50, 54, and 57), *Phyllochaetopterus verrilli* (at Station 47), *Salmacina dysteri* (at Stations 44 and 51), and *Axiothella quadrimaculata* (at Stations 38, 40, 47, and 50).

2. Motile polychaetes. Motile individuals were absent at Station 61 but were never the least abundant motility group at the other 39 stations. Among all three motility categories the motile group was the most speciose at 38 stations, sharing this position with tubicolous polychaetes at Stations 32 and 52 and with discretely motile polychaetes at Stations 36 and 55. Motile polychaetes were second most speciose to discretely motile polychaetes at the one other station where polychaetes were collected—namely, Station 39. The greatest number of motile taxa was collected at Stations 37 and 47 (22 taxa, 73.3% and 59.5%, respectively). Among the more abundant motile taxa collected were *Pionosyllis heterocirrata* (at Stations 35, 37, 38, 41, 43, 44, 47, 50, 51, 54, and 64), *Synelmis acuminata* (at Stations 37, 41, 50, 54, 57, 58, and 67), *Micropodarke* sp. A (at Stations 35, 37, 38, 43, 44, 47, 50, 51, 54, 57, 58, and 64), *Sphaerosyllis* sp. G (at Stations 43, 51, 54, 57, 58, and 64), *Ophiodromus angustifrons* (at Stations 41, 51, and 64), and *Polyophthalmus pictus* (at Stations 37, 44, 47, and 50).

3. Discretely motile polychaetes. Discretely motile polychaetes were the most abundant motility group at Stations 36, 39, 40, 55, and 67, sharing this position with motile polychaetes at Stations 36, 55, and 67. They comprised the most speciose motility group at Stations 36, 39, and 55, sharing this position with motile polychaetes at Stations 36 and 55. Abundant discretely motile taxa collected include *Prionospio cirrifera* (at Stations 37, 44, 47, 50, 54, 57, 58, and 67), *Dipolydora armata* (at Station 40), *Neanthes arenaceodentata* (at Station 64), *Nematonereis unicornis* (at Stations 40 and 44), and *Paraonella* sp. A (at Stations 38 and 47).

Crustaceans

The basic crustacean data are provided in Appendix Table B.3 (number of individuals, number of taxa, diversity (H'), and evenness (J)). A total of 1,705 crustaceans, mites, and pycnogonids representing 24.7% of total nonmollusk abundance were collected. Abundance for each taxon is provided for each station in Appendix D. Abundance (no./sample) ranged from 0 (at Stations 32, 49, and 70) to 432 (95,228/m^2, at Station 57) (Appendix Table B.3, Figure 13).

A total of 79 crustacean, mite, and pycnogonid taxa (copepods were not identified to the species level) were collected; of these, 27 taxa (34.2%) were amphipods. The number of taxa ranged from 0 (at Stations 32, 49, and 70) to 27 (at Station 44) (Appendix Table B.3, Figure 14)

Composite station diversity (H') and evenness (J) for the crustaceans varied substantially among stations (Appendix Table B.3). Among stations where more than one crustacean taxon was collected, values for diversity ranged from 0.33 (at Stations 39 and 61) to 2.54 (at Station 47), and values for evenness ranged from 0.30 (at Station 39) to 1.00 (at Stations 35, 45, 48, 52, and 63). An evenness value of 1.00 occurs when all taxa are represented by the same number of individuals. The samples from the five stations with an evenness value of 1.00 in this survey contained relatively few taxa (2 to 5), all of which were represented by one individual. Thus, the evenness values in these cases are more indicative of the small sample size than a fundamental structural characteristic of the crustacean assemblage.

Amphipods, tanaids, and copepods were the numerically dominant taxa, making up 34.7%, 26.0%, and 21.5% of total crustacean, mite, and pycnogonid abundance, respectively. No taxon was uniformly most abundant at all stations. Copepods, the tanaid *Leptochelia dubia*, and the amphipods *Konatopus paao*, *Eriopisella sechellensis*, and *Elasmopus piikoi* were often among the more abundant crustaceans. Other crustaceans that were particularly abundant (>10 individuals/sample, 2,204/m^2) at least at one station include the tanaid *Tanaissus* sp. A (Stations 57 and 58), the amphipod *Eusiroides diplonyx* (Station 39), the ostracod Myodocope sp. A (Station 37), the amphipod *Seba ekepuu* (Station 50), the isopod *Metacirolana* sp. A (Station 38), and the amphipod *Eriopisa laakona* (Station 40). Twelve crustacean species ranked among the three most abundant nonmollusk taxa at any station (Table 1).

Twelve taxa that had not been found in previous surveys at any of the O'ahu outfall sites were collected in the Māmala Bay 2003 survey. The most interesting of these was a commensal pinnotherid crab, *Aphanodactylus edmondsoni* (Edmondson 1962). This crab had previously been collected as a commensal in terebellid worm tubes. It is unclear if the specimens collected at Station 46 were also associated with terebellid tubes, but it is likely. Also of interest was the collection of the anomuran *Emerita pacifica*, popularly known as the mole crab, at Station 52 in the beach wash zone. The distinctive tanaid, *Synapseudes minutus*, first described from Hawai'i

in Miller (1940), was also collected at Station 52. Two zoea, a larval stage of brachyuran crabs, were collected at Station 47.

The true number of crustacean taxa present in the study area is certainly higher than 79. No single collection or even a series of surveys includes all taxa at a site. Also, copepods are enumerated in our identifications as a single taxon, although several different taxa are certainly present. Cumaceans and mysids are similarly enumerated. Larger (2 cm and up) shrimps and crabs have very low probabilities of being collected, given the small areal coverage (7.6 cm diameter) of the sampling device. The crustacean assemblage in Māmala Bay collected by this method is dominated by small forms (copepods, ostracods, tanaids, isopods, and amphipods) (Barnard 1970, 1977; Barnard and Karaman 1991).

Mollusks

A total of 10,029 mollusks representing 242 taxa were collected. The basic mollusk data are provided in Appendix Table C.1 (number of individuals, number of taxa, diversity (H'), and evenness (J)). Abundance for each taxon is given for each of the 40 stations in Appendix E. Mollusk abundance ranged from 42 individuals/sample (at Station 55) to 898 individuals/sample (at Station 41) (Figure 15). The number of mollusk taxa per sample (no./15 cm^3) ranged from 17 (at Stations 52 and 55) to 89 (at Station 70) (Figure 16).

Composite station diversity (H') and evenness (J) for the mollusks are shown in Figure 17. Values for both parameters were relatively low at Station 48 (H' = 1.28, J = 0.44) because of high dominance by *Cerithidium perparvulum*. Among the other 39 stations, values were similar, ranging from 2.27 (at Station 51) to 3.83 (at Station 70) for diversity and from 0.56 (at Station 51) to 0.92 (at Station 53) for evenness.

Twenty-eight taxa ranked among the three most abundant mollusk taxa at one or more stations (Table 3). The three most abundant taxa were present and dominant at most of the stations. The most abundant species, *Cerithidium perparvulum* (1,280 individuals total), was present at 34 stations and qualified as a top-three dominant at 25 stations. *Pusillina marmorata* (919 individuals) was present at 36 stations and a dominant at 22 stations. *Tricolia variabilis* (836 individuals) was present at 36 stations and a dominant at 19 stations. There were differences in the distributions of the three most abundant species. *Cerithidium perparvulum* and *P. marmorata* tended to co-occur as abundant species. They were dominants together at 19 stations. *Tricolia variabilis* was a dominant at 7 stations in which neither *C. perparvulum* nor *P. marmorata* qualified as a dominant. The fourth most abundant species, *Diala scopulorum*, was much less ubiquitous with a total of 794 individuals found at 12 stations. *Diala scopulorum* was very abundant at Stations 51 (431 individuals) and 41 (227 individuals) and a top-three dominant at just three other stations. The fifth most abundant species, *D. semistriata*

(660 individuals), was present at 27 stations and a dominant at 12 stations. *Diala semistriata* tended to co-occur with *C. perparvulum* and *P. marmorata*, together comprising the top-three dominants at 8 stations. The other dominants with a mean abundance exceeding 7 individuals/sample were *Scaliola* spp. (324 individuals, ranked sixth in total abundance) and *Parashiela beetsi* (294 individuals, ranked seventh in total abundance). Interestingly, the most ubiquitous taxon ranked eighth in total abundance. *Triphora* spp. (225 individuals) was found at 37 stations but was a dominant at only 2 stations. By station, its maximum abundance was only 18 individuals (at Station 70).

The results of cluster analysis indicating the relative similarity of stations based on the 124 most abundant mollusk taxa are shown in Figure 18. Three station clusters (A through C) are evident in the dendrogram. Cluster B was further divided into three subclusters: B1, B2, and B3. Mean mollusk abundance ranged from 101.6 individuals/sample (in cluster C) to 703.2 individuals/sample (in subcluster B2). Mean number of mollusk taxa ranged from 29.8 taxa/sample (in cluster C) to 61.8 taxa/sample (in subcluster B2) (Appendix Table C.2). Among clusters, there were significant differences in mean abundance and taxa richness. The mean number of individuals was significantly greater in subcluster B2 than in clusters/subclusters C, A, B3, and B1 and significantly greater in subcluster B1 than in clusters C and A (Appendix Table C.2). The mean number of taxa was significantly greater in subclusters B1 and B2 than in clusters C and A. Cluster A formed at a similarity of 65.9%. The three B subclusters (17 stations total) fused at a similarity of 60.6%. Clusters A and B combined at a similarity of 59.2%. Cluster C was not well defined. It included a number of unrelated stations that linked with the combined A and B clusters at the end of the cluster computation primarily in a chaining pattern (Figure 18). The similarity between the cluster C stations and the combined A and B clusters ranged from 42.3% to 57.4%.

Cluster B was characterized by several very abundant species whose relative abundance differed among the three subclusters (Table 4). *Cerithidium perparvulum* and *Pusillina marmorata* were abundant in all three subclusters; *Tricolia variabilis* was most abundant in subclusters B1 and B3; and *Diala scopulorum*, *Diala semistriata*, and *Scaliola* spp. were most abundant in subcluster B2. Each of these taxa had a mean abundance of at least 37.8 individuals/sample in one of the B subclusters. Subcluster B1 is more closely connected to subcluster B2 in the dendrogram even though the five dominants in subclusters B1 and B3 were identical. The higher similarity of subclusters B1 and B2 is probably related to the greater mean number of taxa per sample (~60 taxa) in these subclusters than in subcluster B3 (47.4 taxa). The double square root transformation used in the clustering computation puts greater emphasis on the co-occurrence of species than on similarity of the dominant species. Cluster A dominants included *Tricolia variabilis* (mean abundance: 25.3 individuals/sample) and four less abundant

(mean abundance: <10.0 individuals/sample) taxa (*Ittibittium parcum, Fragum mundum, Kellia hawaiensis, and Brachidontes crebristriatus*) that were not dominants in any of the other clusters. The stations that comprise cluster C are characterized by relatively low abundance and low taxa richness. The mean abundance of *Cerithidium perparvulum*, the dominant species in cluster C, was just 11.3 individuals/sample. Cluster C is not a unique assemblage, but rather a collection of species that, with one exception, were much more abundant in other clusters. The exception is *Rissoina cerithiiformis*, which ranked fourth in mean abundance in cluster C at a relatively low mean abundance (5.0 individuals/sample) that exceeded its mean abundance in the other clusters. However, *R. cerithiiformis* was not present in 11 of the 19 cluster C stations, providing another indication that cluster C is comprised of samples with diminished, unrelated faunas.

The mollusk specimens collected were not separated into living and dead shell material and therefore represent time-averaged collections that integrate conditions over a longer period. The living component of the mollusk fauna may respond more quickly to changes in environmental conditions than is evident in the time-averaged collections. Thus, the similarity of the mollusks among sampling stations may have been enhanced by the inclusion of empty shell counts in the cluster analysis.

Taxa richness

The Māmala Bay collections in 2003 (79 crustacean, 226 total nonmollusk, and 242 mollusk taxa in 40 samples) were similar to those of the first Māmala Bay survey in 2001 (67 crustacean, 234 total nonmollusk, and 266 mollusk taxa in 40 samples [Swartz et al. 2002a]). Both of the Māmala Bay collections were much more diverse than previous collections near the Sand Island (e.g., 42 crustacean, 174 total nonmollusk, and 152 mollusk taxa in 42 samples in 1998) and Barbers Point (e.g., 51 crustacean, 186 total nonmollusk, and 129 mollusk taxa in 35 samples in 2001) wastewater discharges (Swartz et al. 1999, 2001b). The higher taxa richness of the Māmala Bay collections resulted from the samples being obtained from a much greater range in depth and habitat types.

DISCUSSION

The 2003 Māmala Bay Regional Benthic Survey

The design of the 2003 Māmala Bay survey followed that of the 2001 Māmala Bay survey, which was completely different from that of previous monitoring surveys in the vicinity of the Sand Island and Barbers Point wastewater discharges. Earlier surveys were spatially restricted to station transects along depth contours that passed through the mixing zone of the

discharge sites. Replicate samples were collected at all stations, and statistical comparisons were made of ecological conditions at mixing zone and reference sites. The same station locations were used year after year in the fixed-transect design. The 2001 and 2003 Māmala Bay surveys were based on 40 stations randomly distributed throughout the bay but usually not in the immediate vicinity of the wastewater outfalls, and samples were not replicated at any station. The random selection of stations in the 2001 and 2003 surveys were independent of one another, so the two surveys have no stations in common. The 2001 and 2003 surveys were designed to assess ecological conditions on a broad spatial scale and to define the range of natural variability of the macrobenthos throughout the bay.

A great diversity of habitats was encountered in Māmala Bay, including stations characterized by extensive coverage of coral, seaweed, rubble, and rocks; sites in the surf zone; a site in Pearl Harbor (Station 53); a site near the Sand Island outfall (Station 64); areas with thin sediment coverage; as well as more typical soft-bottom habitats. Slope orientation varied from the south orientation of the Sand Island and Barbers Point sites to southwesterly and southeasterly orientations of sites at other stations in Māmala Bay. Slope orientation can influence the structure of benthic communities through differences in current regimes and susceptibility to large ocean swells. In particular, the depth range (1 to 109 m) of the 2003 Māmala Bay stations was much greater than that of stations in previous, fixed-transect surveys. The range in sediment conditions was also greater, although it was relatively narrow for some parameters (e.g., TOC, 0.26% to 0.94%; silt and clay, 0.7% to 33.2%).

The increased diversity of habitat conditions resulted in increased taxonomic diversity for the macrobenthos. More nonmollusk, crustacean, and mollusk taxa were collected in the 2001 and 2003 regional surveys than in any of the previous 29 surveys at the Sand Island and Barbers Point sites. There was also a much greater range in structural parameters (abundance, taxa richness, and diversity expressed on a per-sample basis) than in any previous survey. This was especially true for the nonmollusk and crustacean assemblages.

Correlation analyses of the relations between depth, sediment parameters (grain size, TOC, TKN, ORP), and biological conditions among the 40 stations often gave statistically significant results. There were significant, positive correlations between depth and the numbers of nonmollusk taxa, crustacean taxa, nonmollusk individuals, and mollusk individuals. The numbers of nonmollusk individuals, nonmollusk taxa, and crustacean individuals showed significant, positive correlations with the silt-and-clay sediment fraction. Sediment TOC was significantly and positively correlated with the numbers of nonmollusk individuals, nonmollusk taxa, crustacean individuals, and crustacean taxa. ORP was significantly and negatively correlated with the number of nonmollusk taxa and the number of crustacean taxa, i.e., taxa richness increased as the potential for reducing conditions decreased. These data suggest that

the Māmala Bay benthos is strongly influenced by depth, sediment conditions, or related factors. These relationships are typical of other benthic communities (Bergen et al. 2001).

Cluster analysis of the nonmollusk benthos resulted in five reasonably well-defined station clusters (A through E) in terms of dominant species and community structure, plus a sixth cluster (F) that included several unrelated stations (Figure 6, Appendix Table B.2, Table 2). Cluster B was further subdivided into three subclusters: B1, B2, and B3. There were differences among clusters in mean water depth, which was significantly greater for cluster C (100.4 m) than for clusters/subclusters F (6.0 m), A (13.4 m), D (14.9 m), B1 (27.7 m), B2 (63.8 m), and B3 (64.5 m); for subclusters B2 and B3 than for clusters/subclusters F, A, D, and B1; and for subcluster B1 than for clusters F and A (Appendix Table B.2). Comparison of sediment parameters among station clusters showed no significant differences in the mean percent TOC and in the mean proportion of the medium-sand fraction. However, the mean proportion of the silt-and-clay fraction was significantly higher for subcluster B2 (15.2%) than for cluster/subcluster F (1.9%) A (1.9%), D (2.3%), B1 (2.8%), and B3 (3.9%). Thus, subcluster B2 was characterized by intermediate depths (mean: 63.8 m, range: 41.5 to 87.2 m), the highest mean proportion of the silt-and-clay fraction (15.2%, significantly greater than most other clusters/subclusters), the highest mean nonmollusk abundance (583.3 individuals/sample, significantly greater than clusters F, A, and D), the highest mean nonmollusk taxa richness (51.5 taxa/sample, significantly higher than clusters F, D, A, and C), and the highest mean crustacean abundance (142.8 individuals/sample). Subclusters B1 and B3 were also characterized by intermediate depths, although that of subcluster B1 was shallower (mean: 27.7 m, range: 17.7 to 39.9 m) than that of subcluster B3 (mean: 64.5 m, range: 52.4 to 73.2 m). Subclusters B1 and B3 also had very high values for mean nonmollusk abundance (330.5 and 279.7 individuals/sample, respectively), mean nonmollusk taxa richness (45.0 and 50.7 taxa/sample, respectively), and mean crustacean abundance (95.5 and 75.0 individuals/sample, respectively). Mean crustacean taxa richness at subclusters B1 and B3 (15.2 and 14.0 taxa/sample, respectively) exceeded that of all other clusters. Clusters A, D, and F were all characterized by relatively shallow depths (range of depth means: 6.0 to 14.9 m) and with often significantly lower mean values for nonmollusk abundance (range of means: 11.2 to 68.8 individuals/sample), nonmollusk taxa richness (6.3 to 15.6 taxa/sample), crustacean abundance (6.5 to 18.3 individuals/sample), and crustacean taxa richness (2.8 to 4.0 taxa/sample). Cluster C was comprised of the two deepest stations (92.0 and 108.8 m) with intermediate values for nonmollusk abundance (mean: 111.0 individuals/sample) and nonmollusk taxa richness (mean: 24.5 taxa/sample) and with low values for crustacean abundance (mean: 8.5 individuals/sample) and crustacean taxa richness (mean: 3.5 taxa/sample). Cluster E was not included in the statistical comparisons described above

because of the lack of replicates. It was represented by a single, shallow (5.8 m) station with values for nonmollusk abundance (198 individuals), nonmollusk taxa richness (32 taxa), crustacean abundance (109 individuals), and crustacean taxa richness (8 taxa) that were similar to the lower ranges for the three B subclusters but usually greater than the upper ranges for clusters A, C, D, and F.

Diverse and abundant nonmollusk faunas characterized all of the three B subclusters, but they were distinctly different in dominant species composition (Table 2). Unique top-five dominants collected include *Phyllochaetopterus verrilli*, *Konatopus paao*, and *Eriopisella sechellensis* in subcluster B1, *Euchone* sp. B, *Synelmis acuminata*, *Aspidosiphon muelleri*, and *Sphaerosyllis* sp. G in subcluster B2, and *Salmacina dysteri* in subcluster B3. *Leptochelia dubia* and *Pionosyllis heterocirrata* were abundant in each of the three B subclusters. Almost all of the top-five dominants in the B subclusters were very abundant, with mean values exceeding 10 individuals/sample. None of the top-five dominants in clusters A, C, and D exceeded 10 individuals/sample. The ubiquitous *Pionosyllis heterocirrata* ranked first or second in mean abundance in clusters A, C, and D (range of means: 3.0 to 9.3 individuals/sample). No species in the greatly diminished faunas of cluster F had a mean abundance exceeding 0.5 individuals/sample. *Fabricia* sp. A, *Dipolydora armata*, *Elasmopus piikoi*, *Eriopisa laakona*, and *Microcharon* sp. A. made up the unique set of top-five dominant species at Station 40, the single station that comprised cluster E. The total abundance of these five species at Station 40 was 133.0 individuals/sample. The mean total abundance of the same five species at the other 39 stations was 2.8 individuals/sample.

Both the correlation and cluster analyses indicate that the structure of the nonmollusk benthic community differs substantially with water depth. Highest mean abundance and taxa richness were recorded for the three B subclusters, all located at intermediate depths (27.7 to 64.5 m). Lower values of both parameters typically were recorded for those clusters located at shallower and deeper mean depths. These findings indicate that factors associated with water depth clearly influence the benthos.

To examine the relation of the benthos to depth more directly, the 40 stations were divided among eleven 10-m depth ranges: 0 to 9.9 m, 10.0 to 19.9 m, 20.0 to 29.9 m, 30.0 to 39.9 m, 40.0 to 49.9 m, 50.0 to 59.9 m, 60.0 to 69.9 m, 70.0 to 79.9 m, 80.0 to 89.9 m, 90.0 to 99.9 m, and 100.0 to 109.9 m. The spatial patterns of changes in nonmollusk abundance and nonmollusk taxa richness were similar with respect to depth (Appendix Table B.4, Figures 19, and 20). Five of the eleven depth ranges were represented by a single sample. The data were therefore pooled for statistical comparisons into three depth zones: shallow (0 to 29.9 m), intermediate (30.0 to 69.9 m), and deep (≥70.0 m). Among depth zones, there were highly significant differences in the mean number of nonmollusk individuals ($F = 26.00^{**}$, $p =$

0.0001). It was significantly greater in the intermediate zone (mean: 509.6 individuals/sample, range: 106 to 1,091 individuals/sample) than in the shallow zone (mean: 81.5 individuals/sample, range: 9 to 257 individuals/sample). Mean abundance was also low, but not significantly different, in the deep zone (mean: 137.2 individuals/sample, range: 102 to 178 individuals/sample). The stations with the seven lowest values of nonmollusk abundance (all <30 individuals/sample) were located at depths less than 12.2 m.

Among depth zones, there were also highly significant differences in nonmollusk taxa richness ($F = 26.63^{**}$, $p < 0.0001$; Appendix Table B.4, Figure 20). The mean number of nonmollusk taxa was significantly greater in the mid-depth zone (mean: 52.4 taxa/sample, range: 32 to 75 taxa/sample) than in the shallow zone (mean: 16.8 taxa/sample, range: 4 to 51 taxa/sample). Mean abundance was also low, but not significantly different, in the deep zone (mean: 37.5 taxa/sample, range: 23 to 53 taxa/sample). The stations with the eight lowest values of nonmollusk taxa richness (all <10 taxa/sample) were located at depths less than 12.2 m.

These data confirm the influence of depth on the benthos that was indicated by the correlation and cluster analyses. Several results were obtained. Nonmollusk taxa richness peaked at depths between 40 and 50 m and declined in shallower and deeper waters. Relatively high taxa richness occurred at depths between 30 and 90 m and declined in deeper and shallower waters. Richness declined with decreasing depth even among the shallower stations, reaching a minimum mean value of 11.4 taxa/sample in areas less than 10 m deep.

An analysis of changes in abundance and taxa richness in relation to depth was also made for the crustaceans because of their sensitivity to environmental stress. Essentially, the same results as for all nonmollusks were obtained (Appendix Table B.4, Figures 21 and 22). There were highly significant differences in crustacean abundance and taxa richness in relation to depth zones. Maximum values of both parameters were recorded for samples taken in the mid-depth zone between the 30 and 70 m depths (mean abundance: 129.4 individuals/sample, mean richness: 15.6 taxa/sample). Much lower values were recorded for samples from the shallow (mean abundance: 20.7 individuals/sample, mean richness: 4.1 taxa/sample) and deep (mean abundance: 22.8 individuals/sample, mean richness: 7.5 taxa/sample) depth zones. No crustaceans were collected at Stations 32, 49, and 70 at depths of 7.6, 3.7, and 16.5 m, respectively.

There were qualitative shifts in taxa composition among depth ranges. Thirty-three nonmollusk taxa qualified as dominants at one or more of the eleven depth ranges (Table 5). Of these 33 taxa, 6 were most abundant in shallow water (<30.0 m), 17 at mid-depths (30.0 to 69.9 m), and 10 in deep water (>70.0 m). The 9 most abundant taxa in the 2003 Māmala Bay survey all reached their maximum abundance at mid-depths. No single taxon was collected at all depth ranges. *Pionosyllis heterocirrata* was collected at ten depth ranges and was a top-five

dominant at eight depth ranges. Inexplicably, it was not collected at Station 57, where the single sample from the depth range (40.0 to 49.9 m) with the highest nonmollusk abundance and richness was taken. The most abundant nonmollusk species, *Leptochelia dubia*, was collected at nine depth ranges and was a dominant at seven of them. It was not found at the shallowest and deepest depth ranges. *Euchone* sp. B was very abundant at the 40.0 to 49.9 m and 60.0 to 69.9 m depth ranges but rare or absent at all others. Similarly, *Phyllochaetopterus verrilli* was very abundant at the 30.0 to 39.9 m depth range but was not found at any others. *Micropodarke* sp. A was collected at all depth ranges except those deeper than 90.0 m. *Konatopus paao* was collected only at each of the five depth ranges shallower than 50.0 m. *Eusiroides diplonyx*, *Dipolydora armata*, and *Eriopisa laakona* were collected only in the 0 to 9.9 m depth range, where they were among the top-five dominants. None of these three species from the shallowest depth range were abundant (mean abundance for each <3.5 individuals/sample). *Acrocirrus* sp. A was collected only in the 100.0 to 100.9 depth zone, where it was a dominant. In summary, the nonmollusks in the mid-depth zone (30.0 to 69.9 m) were most characteristic of Māmala Bay. A few species appeared in deeper and shallower water, but they were not very abundant.

Among the three depth zones, there were no statistically significant differences in sediment TOC ($F = 0.55$, $p = 0.582$) or the medium-sand grain-size fraction ($F = 0.20$, $p = 0.820$) (Appendix Table B.4). Statistical comparison of the mean silt-and-clay grain-size fraction indicated significant differences ($F = 18.22$, $p = <0.0001$). Student–Newman–Keuls tests showed that it was significantly greater in the mid-depth zone (8.93%) than in the shallow zone (2.00%). The elevated silt-and-clay fraction in the mid-depth zone is due to very high values at two stations (16.23% at Station 57 and 33.19% at Station 58). The mean silt-and-clay fraction at the other six stations in the mid-depth zone was only 3.67%. The mean silt-and-clay grain-size fraction in the deep zone (5.11%) was not significantly different from the other zones. These results do not mean that sediment characteristics do not affect the Māmala Bay benthos. However, the data show clearly that factors associated with depth are more strongly related to nonmollusk abundance and taxa richness on the spatial scale of the present survey. Depth as a variable may best represent the cumulative net effect of complex interactions among multiple environmental variables. It is beyond the scope of a monitoring survey to identify these interactions, but they may include factors such as the pattern of sediment scouring by wave action, primary production, predator distribution, current regimes, and sediment characteristics.

Cluster analysis of stations based on mollusk abundance and species composition resulted in two reasonably well-defined clusters (A and B), plus a third cluster (C) that includes a number of unrelated stations (Figure 18, Appendix Table C.2, Table 4). Cluster B was further subdivided into three subclusters (B1, B2, and B3) that share a common letter code to indicate their relatively close similarity to each other in the dendrogram. Mean water depth was

significantly greater for subcluster B2 (61.0 m) than for clusters/subclusters A (11.8 m), B1 (16.6 m), B3 (17.0 m), and C (27.4 m). Statistical comparisons of TOC, silt-and-clay grain-size fraction, and medium-sand grain-size fraction showed no significant differences among clusters (Appendix Table C.2). There were highly significant differences among clusters in mean number of mollusk individuals (F = 30.04**, p = 0.0001). Mean mollusk abundance was significantly greater for subcluster B2 (703.2 individuals/sample) than for clusters/subclusters C (101.6 individuals/sample), A (108.0 individuals/sample), B3 (273.4 individuals/sample), and B1 (346.7 individuals/sample); and for subcluster B1 (346.7) than for clusters C (101.6) and A (108.0). There were also highly significant differences among clusters in mean number of mollusk taxa (F = 15.30**, p = 0.0001). It was significantly greater for subclusters B2 (61.8 taxa/sample) and B1 (60.0) than for clusters C (29.8) and A (33.8).

Qualitative shifts in species composition and differences in abundance at the species level separate the mollusk station clusters (Table 4). Cluster B was characterized by several very abundant species. *Cerithidium perparvulum* and *Pusillina marmorata* were abundant in all three subclusters; *Tricolia variabilis* was most abundant in subclusters B1 and B3; *Diala scopulorum*, *Diala semistriata*, and *Scaliola* spp. were most abundant in subcluster B2. Each of these taxa had a mean abundance of at least 37.8 individuals/sample in one of the B subclusters. The stations that comprise clusters A and C were characterized by relatively low abundance and low taxa richness. Except for *Tricolia variabilis* (25.3 individuals/sample) in cluster A and *Cerithidium perparvulum* (11.3 individuals/sample) in cluster C, all of the species in these two clusters had mean abundances of less than 10.0 individuals/sample. However, a few species had higher mean abundances in these clusters than in all other clusters: *Fragum mundum* (6.3 individuals/sample), *Kellia hawaiensis* (6.8 individuals/sample), *and Brachidontes crebristriatus* (9.5 individuals/sample) in cluster A and *Rissoina cerithiiformis* (5.0 individuals/sample) in cluster C.

The highly significant, positive correlation between depth and mollusk abundance and the results of the cluster analysis provided evidence of the importance of depth in the distribution of mollusks. Mollusk abundance and taxa richness were therefore compared among the eleven 10-m depth ranges and among the shallow (0 to 29.9 m), intermediate (30.0 to 69.9 m), and deep (≥70.0 m) depth zones (Appendix Table C.3, Figures 23 and 24). There were highly significant differences among the depth zones in mollusk abundance (F = 8.10**, p = 0.0012). Mean mollusk abundance was significantly greater for the deep depth zone (646.8 individuals/sample) than for the shallow depth zone (199.5 individuals/sample). However, there were no significant differences among the depth zones in mollusk taxa richness (F = 1.07, p = 0.3536).

The mollusks have a different relation to depth than the nonmollusks. The mollusks reached highest abundance at depths between 50 and 100 m, while the nonmollusks were most abundant at depths between 30 and 70 m. Both groups were significantly less abundant in the shallow depth zone (0 to 29.9 m). There was a significant reduction in mean number of taxa in the shallow depth zone for nonmollusks but not for mollusks.

The preceding analyses of nonmollusks and mollusks compared station groups on the basis of faunal similarity and depth range in Māmala Bay. A different, qualitative assessment of station grouping is to examine the spatial distribution of samples whose faunal characteristics show evidence of possible stress effects. Areal taxa richness, expressed as the number of taxa collected per sample, is probably the best structural indicator for benthic communities. Taxa richness typically declines during benthic degradation caused by various kinds of pollution. Between 4 and 75 nonmollusk taxa/sample were collected at each of the 40 Māmala Bay stations. Figure 25 shows the spatial distribution of the eight stations (31, 32, 39, 49, 52, 55, 61, and 63) where fewer than 10 nonmollusk taxa were collected. Sites of substantial pollution stress might be indicated if these taxa-poor stations were concentrated in a particular area of Māmala Bay. This was not the case because the eight stations were widely distributed across the bay. The restriction of these eight stations to shallow-water depths between 1.8 and 12.2 m was also not an indication of pollution stress because reduced taxa richness of nonmollusks in shallow waters appears to be a natural characteristic of the entire bay. A similar analysis for the mollusks showed that the eight stations with the lowest taxa richness (Stations 39, 47, 48, 52, 55, 58, 59, and 69; taxa range: 17 to 25 taxa/sample) were also widely distributed in Māmala Bay (Figure 26) and, moreover, covered a greater depth range (1.8 to 69.2 m) than that of the nonmollusks. Stations 39, 52, and 55 are common sites of fewest taxa collection for both the nonmollusks and mollusks. The diver's field notes indicate that two of these stations (39 and 52) were in the surf zone. Five other stations identified as lowest taxa richness sites for nonmollusks or mollusks were also in surf zones or at a site of sea swell, indicating the sediment might be disturbed by wave action. These sites do not offer an optimal soft-bottom infaunal habitat for the rich and abundant benthic assemblage found in most of Māmala Bay.

Station 64 in the 2003 Māmala Bay survey was located close to the Sand Island ocean outfall. This station is not listed as one of the respective eight stations with the lowest nonmollusk or mollusk taxa richness. In fact, station 64 ranked as the eleventh richest station in terms of nonmollusk taxa and the fourteenth richest station in terms of mollusk taxa.

The diversity of benthic conditions in Māmala Bay makes it difficult to establish baselines for future comparisons. Certainly, mean values of biological variables like abundance and taxa richness have little meaning for the bay as a whole. Identification of dominant species, mean abundance, and mean taxa richness (especially with respect to depth ranges for the

nonmollusks) facilitates comparison of conditions in 2003 with results of the 2001 survey as well as with results of any future regional surveys. In addition, the frequency distribution of areal taxa richness offers a simple graphical baseline for the range of benthic conditions within the survey area where sampling was conducted randomly and without replication. For the nonmollusks, this distribution shows a shift in slope from the relatively taxa-poor samples with 18 or fewer taxa (50% of all samples; all collected at shallow stations, 1.8 to 22.6 m depths) to the taxa-rich samples with 19 or more taxa (50% of all samples; collected primarily at intermediate depths; Figure 27). For the mollusks, this distribution is much more gradual, reflecting the generally more uniform distribution of mollusk taxa in the bay (Figure 28). The 2003 frequency distributions for the nonmollusks and mollusks are essentially the same as those for the 2001 survey (Figures 29 and 30). Both the 2001 and 2003 nonmollusk distributions show the shift in slope when the taxa-rich stations enter the distribution. The 2001 shift is more abrupt, probably because there were more stations in the taxa-rich, mid-depth zone (30 to 69.9 m) in 2001 (17 stations) than in 2003 (8 stations).

Benthic Conditions Near the Sand Island and Barbers Point Outfalls in the Context of the Māmala Bay Survey

One application of the results of the 2003 Māmala Bay regional survey is an assessment of conditions near the Sand Island and Barbers Point ocean outfalls in relation to that of the entire bay. Since only one sample was collected in the immediate vicinity of the outfalls as part of the regional survey, results of recent core surveys at the outfalls were used in the assessment. The design of the outfall surveys is different from the Māmala Bay survey, with the former based on fixed stations with replicate samples and the latter based on randomly located stations without replicates. The samples themselves were essentially identical, except that the mollusk counts for Barbers Point were based on smaller subsamples than that for Sand Island or Māmala Bay. The Barbers Point counts were adjusted (proportional 50% increase in abundance, estimated 25% increase in taxa richness) to make them comparable. The survey at the Barbers Point outfall was conducted in January 2001 and included four stations located on the boundary or within the ZID of the outfall, each with five replicates, for a total of 20 "ZID-area samples" (Swartz et al. 2001b). The survey of the Sand Island ZID was conducted in August 1998 and included four stations located on the boundary or within the ZID, each with six replicates, for a total of 24 "ZID-area samples" (Swartz et al. 1999).

The mean number of nonmollusk individuals and the mean number of nonmollusk taxa in the Sand Island and Barber Point ZID-area samples in relation to mean values recorded for the eleven depth ranges in the Māmala Bay survey are shown in Figures 31 and 32, respectively.

The ZID-area data have been placed in position according to depth range on the x-axis of these figures. Despite differences in survey dates and design, mean nonmollusk abundance and mean nonmollusk taxa richness for the Barbers Point and Sand Island ZID-area samples are very close to expected values, based on the relation between depth and the nonmollusk community established in the Māmala Bay survey. These data do not indicate any adverse alteration of the nonmollusk benthos at the ocean outfall mixing zones.

There was an important qualitative difference in nonmollusk species composition between the 2001 and 2003 Māmala Bay surveys and earlier surveys near the outfalls. *Ophryotrocha adherens*, an indicator species for organic conditions near outfalls, has often been very abundant at the ZID-area stations (Bailey–Brock 1996; Bailey–Brock et al. 2001; Swartz et al. 2001c). For example, the mean abundance of *O. adherens* was 61.5 individuals/sample (13,557 individuals/m^2) at the Sand Island ZID-area stations in August 1998 and 5.8 individuals/sample (1,279/m^2) at the Barbers Point ZID-area stations in January 2001 (Swartz et al. 1999, 2001b). No specimens of *O. adherens* were collected at any of the 40 sampling stations in the 2001 Māmala Bay survey, which did not include any stations near the outfalls. In the 2003 Māmala Bay survey only two specimens of *O. adherens* were collected from the 39 stations that were not near the outfalls (0.05 individual/sample, 11.3/m^2), whereas seven specimens (1,543 individuals/m^2) were collected in the sample from Station 64 near the Sand Island outfall. Similarly, only two specimens of *Neanthes arenaceodentata*, another indicator species of organic enrichment, were collected from the stations away from the outfalls, whereas 19 individuals (4,188/m^2) were collected at Station 64. These data indicate the efficacy of the indicator species concept, although caution is necessary in interpreting data on the presence/absence of indicators in small, unreplicated samples such as those collected in the Māmala Bay surveys.

The mean number of crustacean individuals and the mean number of crustacean taxa in the Sand Island and Barber Point ZID-area samples in relation to mean values recorded for samples collected from the eleven depth ranges in Māmala Bay are shown in Figures 33 and 34, respectively. Mean crustacean abundance at stations in both ZID areas was slightly more than that of Māmala Bay stations at depths less than 30.0 m or greater than 79.9 m but was less than that of stations in the mid-depth zone between 30.0 and 69.9 m. Similarly, mean crustacean taxa richness at stations in both ZID areas was greater than that of stations at depths less than 30 m or greater than 90 m but was less than that of stations at depths between 30.0 and 89.9 m, indicating the possibility of a slight reduction near the outfalls. Also, only three crustacean taxa were collected at Station 64 (68.0 m depth) near the Sand Island outfall in the 2003 Māmala Bay survey. A substantially greater number of crustaceans (11 to 27 taxa, mean: 17.1) were collected at stations located away from the outfalls in depths between 38.0 and 88.0 m. These

results are consistent with the historic pattern of a diminished crustacean assemblage at some of the ZID-area stations (Swartz et al. 1999, 2001b).

The mean numbers of mollusk individuals and taxa in the Sand Island and Barber Point ZID-area samples in relation to mean values recorded for samples collected from the eleven depth ranges in the Māmala Bay survey are shown in Figures 35 and 36, respectively. There is a lot of variability in mollusk abundance among depth ranges, but mean values for the two ZID areas are intermediate between those for adjacent bay-wide depth ranges and exceed those for seven of the eleven bay-wide depth ranges. The mollusk taxa richness data are less variable. Mean values for the two ZID areas established are very close to expected values based on the analysis of the mollusk community in the bay-wide survey. These data do not indicate any adverse alteration of the mollusks at the ocean outfall mixing zones.

The frequency distributions for nonmollusk areal taxa richness in the 2001 and 2003 Māmala Bay surveys are compared with the distributions for the Sand Island and Barbers Point ZID-area samples in Figure 29. The four distributions are very similar for the 30% of the samples with the highest number of taxa. The two ZID-area distributions do not show the sharp decline in the number of nonmollusk taxa per sample seen for the Māmala Bay distributions. This difference reflects the location of the ZID-area stations in the taxa-rich habitat found at intermediate and slightly deeper depths in the bay. The ZID-area stations do not extend into shallow or very deep water where fewer taxa are naturally present. Nonmollusk taxa richness in the ZID areas was therefore determined to be at the higher end of natural variability in Māmala Bay.

The frequency distributions for mollusk areal taxa richness in the 2001 and 2003 Māmala Bay surveys are compared with the distributions for the Sand Island and Barbers Point ZID-area samples in Figure 30. The two ZID-area distributions are centrally located within the range of natural variability established in the Māmala Bay distributions. Both ZID-area distributions do not include the lowest or highest values of the Māmala Bay distributions. As in the case of the nonmollusks, these differences reflect the location of the ZID-area stations in the bay. Their locations do not include the rocky or thin sand-layer sites where fewer mollusks were collected in the bay-wide survey, nor do they include the very deep sites where the greatest number of mollusk taxa was collected in the bay-wide survey. Mollusk taxa richness in the ZID areas was therefore determined to be toward the middle of the range for the entire bay.

SUMMARY AND CONCLUSIONS

A broad-scale spatial survey of benthic assemblages and sediment conditions was conducted at 40 stations throughout Māmala Bay in August 2003. A variety of benthic conditions were encountered, including extensive coverage by rocks, rubble, algae, thin-layer sediments, as well as typical soft-bottom benthic habitats. Despite this diversity, some sediment parameters were relatively constant. All ORP values were positive, indicating the absence of anaerobic conditions throughout the bay. All measurements of sediment TOC were in the narrow range between 0.26% and 0.94%, providing little evidence for the high sediment organic enrichment seen elsewhere in depositional areas where TOC concentrations typically exceed 1%, e.g., 1.2% to 10.9% for sediments of the Kattegat (Pearson et al. 1985); 0.6% to 8.9% for sediments off the coast of Maine (Bader 1954); 1.4% to 4.1% for stations near the Los Angeles ocean sewage outfalls (Swartz et al. 1986); and 4.0% to 10.7% in Kingston Harbour, Jamaica, a semi-enclosed bay subject to organic pollution (Wade 1972; Wade et al. 1972). Muddy sediments with a high silt-and-clay fraction were not collected. There was greater variability in the proportion of the grain-size distribution represented by the different sand fractions, but all samples were composed of at least 66% sand.

The total number of benthic taxa found in the 2001 and 2003 Māmala Bay surveys exceeded that collected in any previous survey near the Sand Island and Barbers Point ocean outfalls. This is attributable to the greater diversity of habitats in the bay. Differences in abundance and taxa richness of the nonmollusks and crustaceans were associated primarily with water depth. High mean nonmollusk abundance and taxa richness were recorded for intermediate depths (30.0 to 69.9 m), whereas lower means were recorded for shallower and deeper depths. Cluster analysis confirmed the relation between depth and faunal similarity. Differences in dominant nonmollusk taxa were reflected in the few taxa present only in shallow or deep water, as compared to the many taxa present in intermediate-depth water. The mollusks were more uniformly distributed in Māmala Bay, although cluster analysis showed that stations with the highest mollusk abundance and taxa richness were located in deeper water.

The results of the 2001 and 2003 Māmala Bay surveys are similar to those of a recent benthic survey in southern California. Bergen et al. (2001) collected benthic samples at 175 uncontaminated sites on the continental shelf (10 to 200 m) from Point Conception, California, to the United States–Mexican border. The southern California survey was much larger in scope in terms of number of samples, depth range, and latitudinal extent. Bergen et al. (2001) identified four infaunal assemblages in their study area: a shallow-water (10 to 32 m), a mid-depth (32 to 115 m), and two deep-water (115 to 200 m) assemblages, one in fine sediment and another in coarse sediment. Water depth was the principal factor in discriminating among

benthic faunal conditions both in Māmala Bay and off southern California. Abundance and taxa richness were lower in shallow water (<30 m) relative to intermediate depths in both investigations. Sediment parameters did not clearly discriminate among faunal conditions in shallow and intermediate depths in both study areas. Only at deeper sites (>115 m), which were not sampled in Māmala Bay, were sediment conditions off southern California clearly associated with biological differences. One difference between the two investigations is that the faunal differences between shallow and intermediate depths off southern California were characterized to a greater extent by differences in dominant species composition rather than differences in relative abundance. Another difference is that the overlap in dominant species composition between depths was less prevalent off southern California than in Māmala Bay.

The results of the 2001 and 2003 Māmala Bay surveys establish a baseline or reference for future comparisons to assess natural changes or potential effects of pollution. The range in sediment and biological conditions or "range of natural variability" is one element of this baseline. Ranges have limited utility for comparisons because they are often based on a diversity of conditions that are not relevant to a site-specific assessment. This is especially true for biological conditions in Māmala Bay, where depth could be a confounding factor if it were ignored. The minimal values of biological ranges have utility because they establish a lower bound, below which conditions may be unacceptable. Sites reflecting minimal values of parameters like areal taxa richness may indicate areas of special concern. Low values of nonmollusk taxa richness were recorded for sites that appear to be naturally limited to the shallow waters of the bay. Several of the lowest values of mollusk taxa richness were also recorded for shallow sites in the surf zone or affected by ocean swell. Even though the 2001 and 2003 surveys were based on completely different, randomly selected sets of 40 stations, conclusions about the importance of depth-related factors to the structure of the macrobenthic assemblage are virtually identical. Species composition is an important part of the Māmala Bay baseline. Dominant species have been identified in relation to station clusters and depth ranges. At least one species, *Ophryotrocha adherens*, is a reliable indicator of sites under the influence of the two ocean outfalls in the bay. The most statistically rigorous component of the 2003 baseline is the calculation of mean abundance and taxa richness for nonmollusk, crustacean, and mollusk assemblages in relation to station clusters or depth ranges. These data can be used to assess spatial or temporal changes in the structure of the benthos. Finally, the frequency distribution of areal taxa richness is suggested as a baseline parameter. This distribution is representative of the entire bay and is independent of depth or other stratifying factors in random sampling designs. The distribution for mollusk richness reflects relative uniformity throughout the bay. The distribution for nonmollusk richness reflects the dichotomy between the taxa-rich sites at intermediate depths and the less taxa-rich sites in shallow and deep water.

An immediate application of the Māmala Bay baseline is to assess conditions described in earlier outfall surveys in the context of conditions found throughout the bay in 2003. Mean abundance and mean taxa richness of the nonmollusks and mollusks sampled in the recent surveys of the ZID areas at the Sand Island (in 1998) and Barbers Point (in 2001) outfalls were close to expected values for comparable depths in Māmala Bay, whereas the mean values for crustaceans were somewhat less than the expected values. This is consistent with the historic evidence for a slightly diminished crustacean assemblage in ZID areas (Swartz et al. 1999, 2001b). The frequency distributions of nonmollusk taxa richness for the ZID-area surveys followed the taxa-rich segment of the distribution for the bay, i.e., they did not include taxa-poor samples found inshore and offshore of the ZIDs. The frequency distributions of mollusk taxa richness for the ZID-area surveys were more similar to the frequency distributions for the 2001 and 2003 bay surveys. Comparison of recent ZID-area surveys with the Māmala Bay 2003 baseline confirms the presence of a diverse and abundant macrobenthos within and near the ZIDs of the Sand Island and Barbers Point ocean outfalls.

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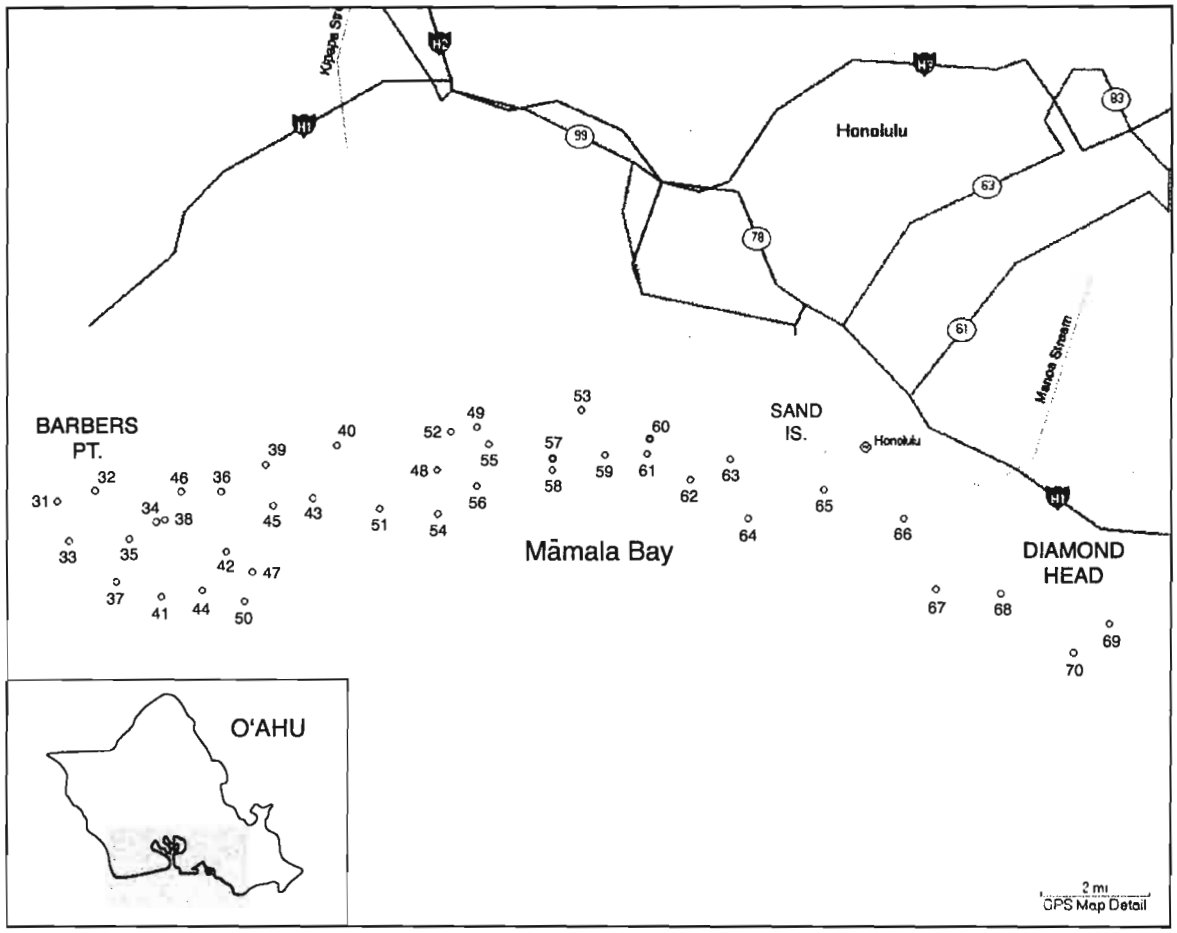
TEXT FIGURES



SOURCE: Division of Environmental Quality, Department of Environmental Services, City and County of Honolulu.

FIGURE 1. Māmala Bay regional study sampling stations, O'ahu, Hawai'i, August 2003

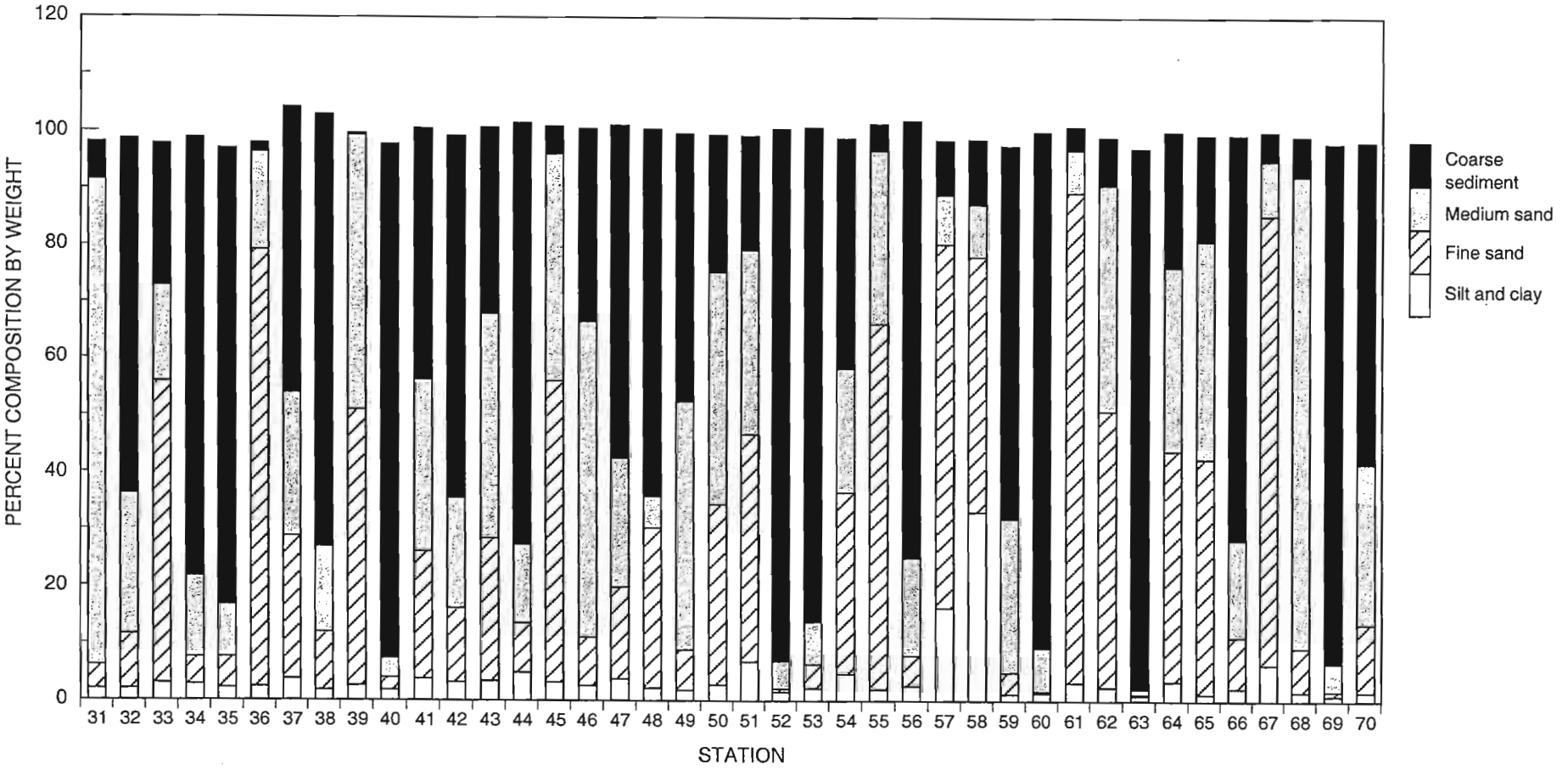


FIGURE 2. Sediment grain-size characteristics, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

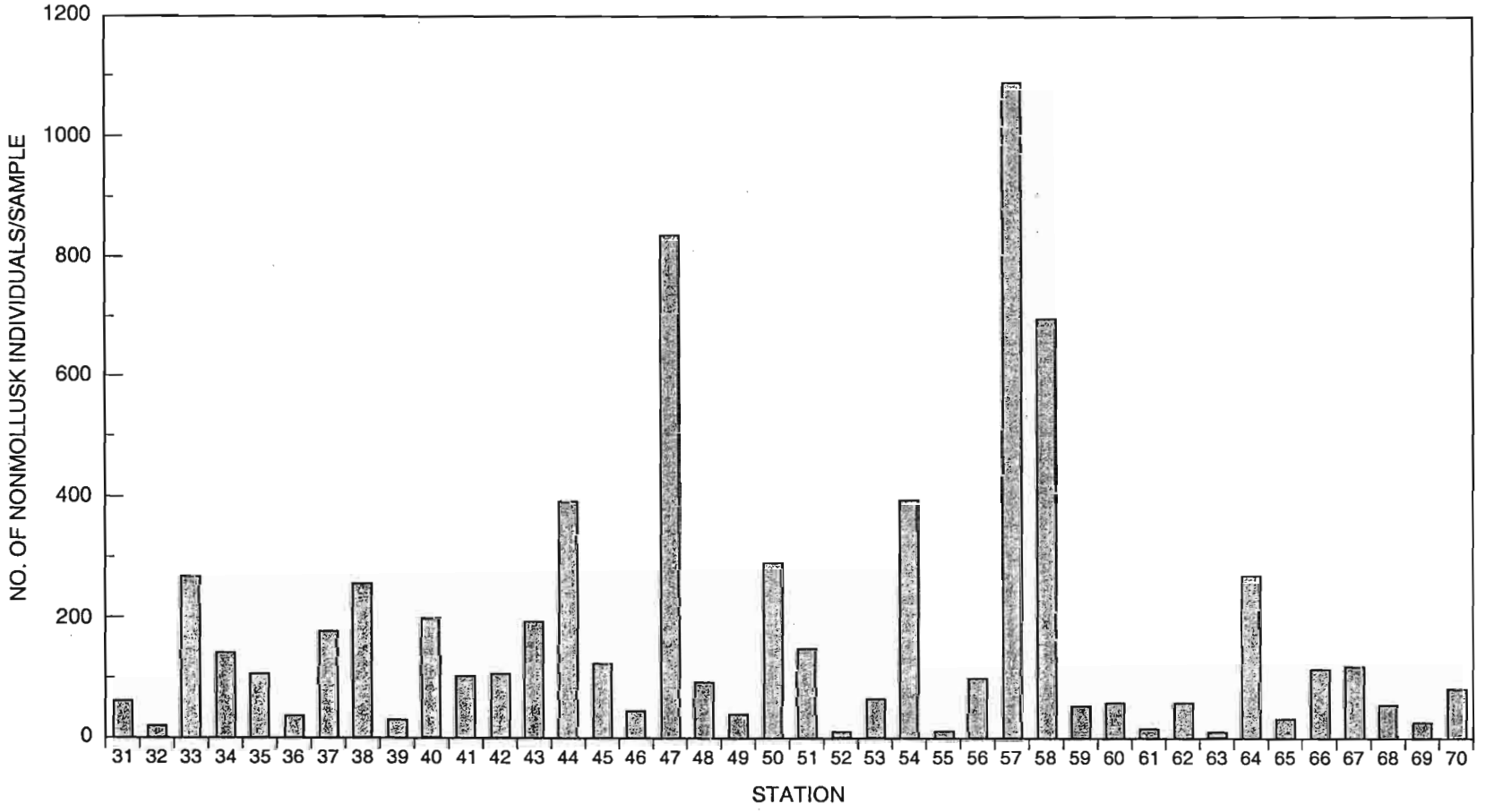


FIGURE 3. Number of nonmollusk individuals per sample, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

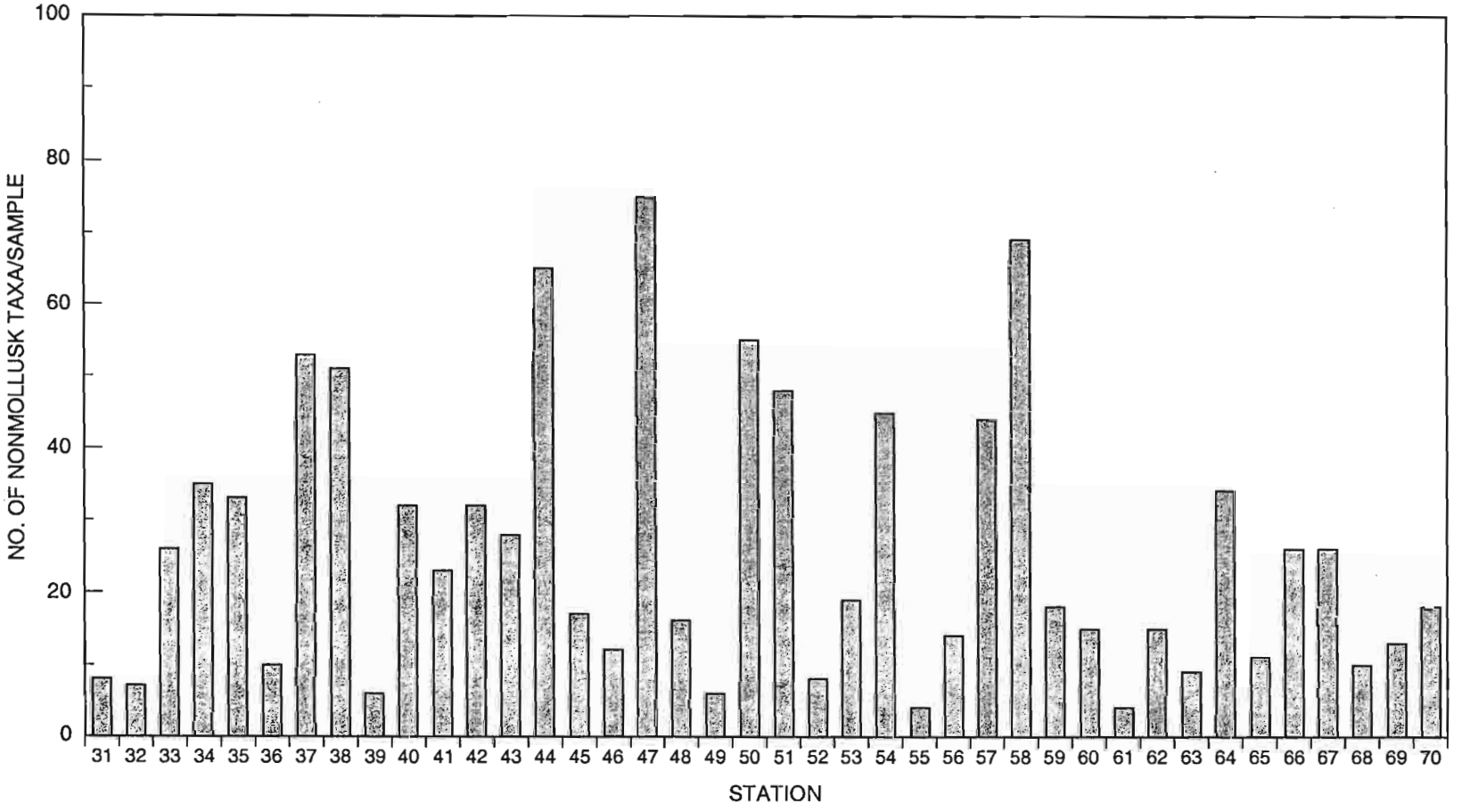


FIGURE 4. Number of nonmollusk taxa per sample, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

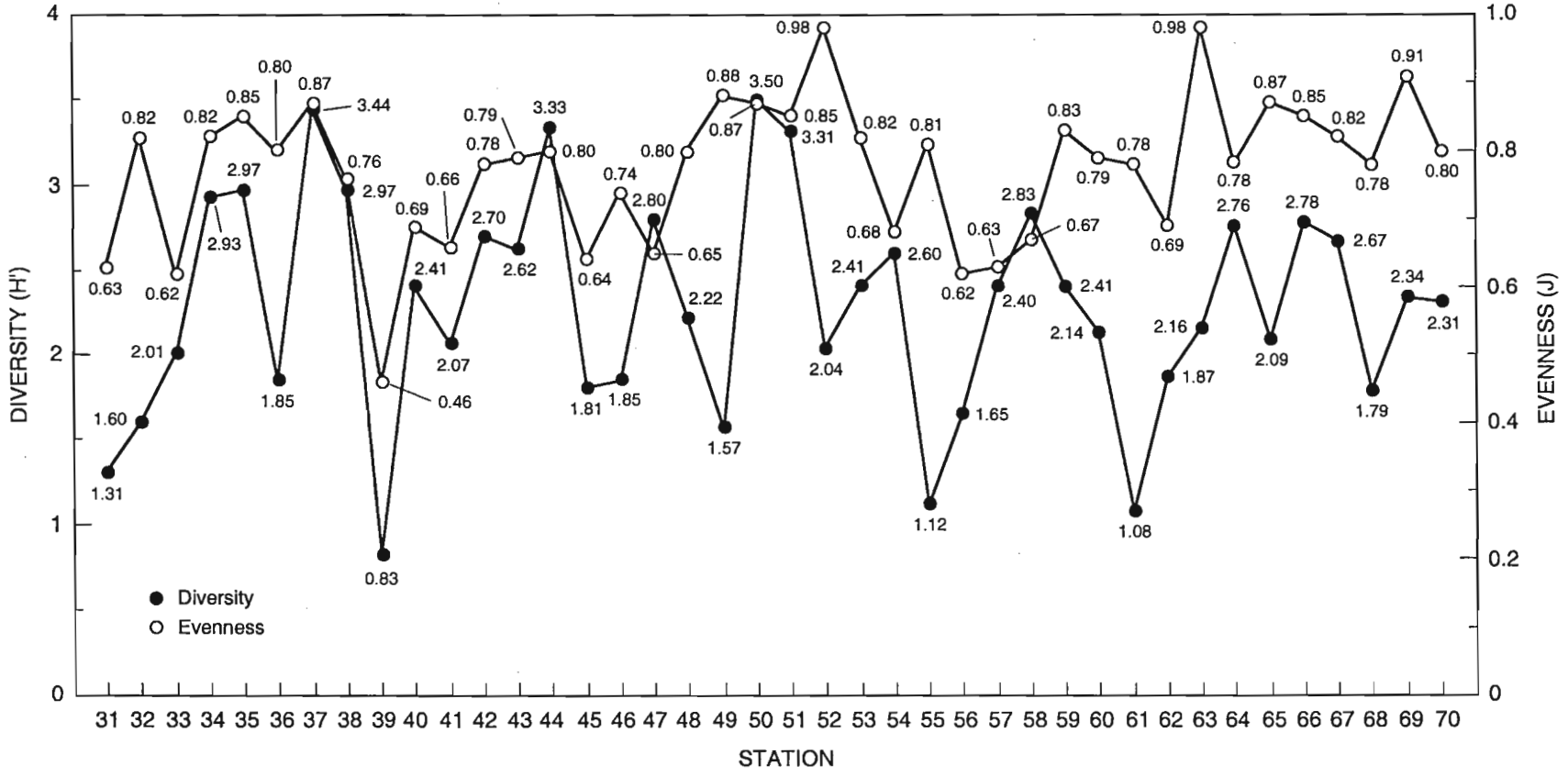


FIGURE 5. Shannon–Wiener diversity index (H') and evenness index (J) for nonmollusks, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

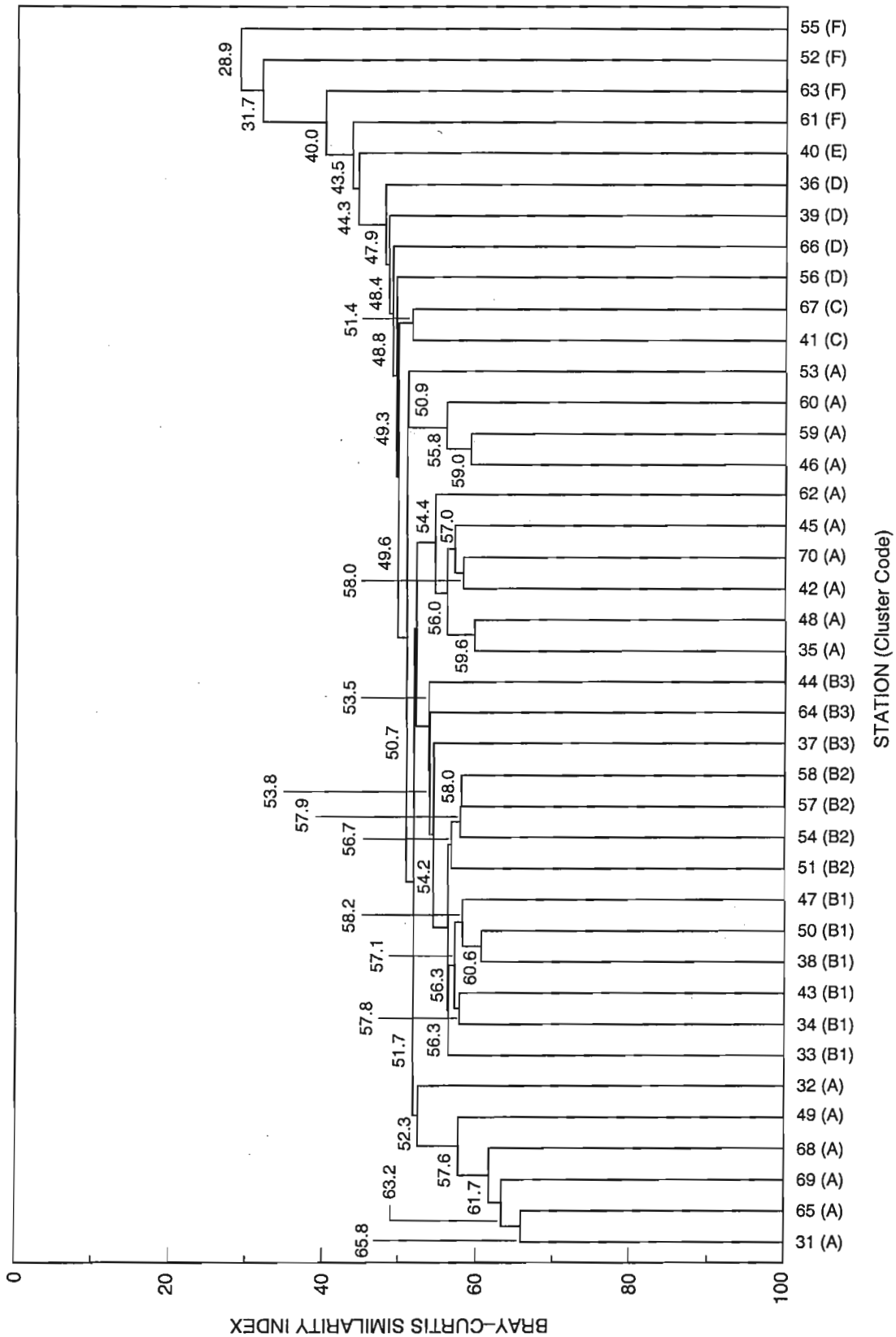


FIGURE 6. Dendrogram for double square root transformed nonmollusk data showing cluster codes and similarity among Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

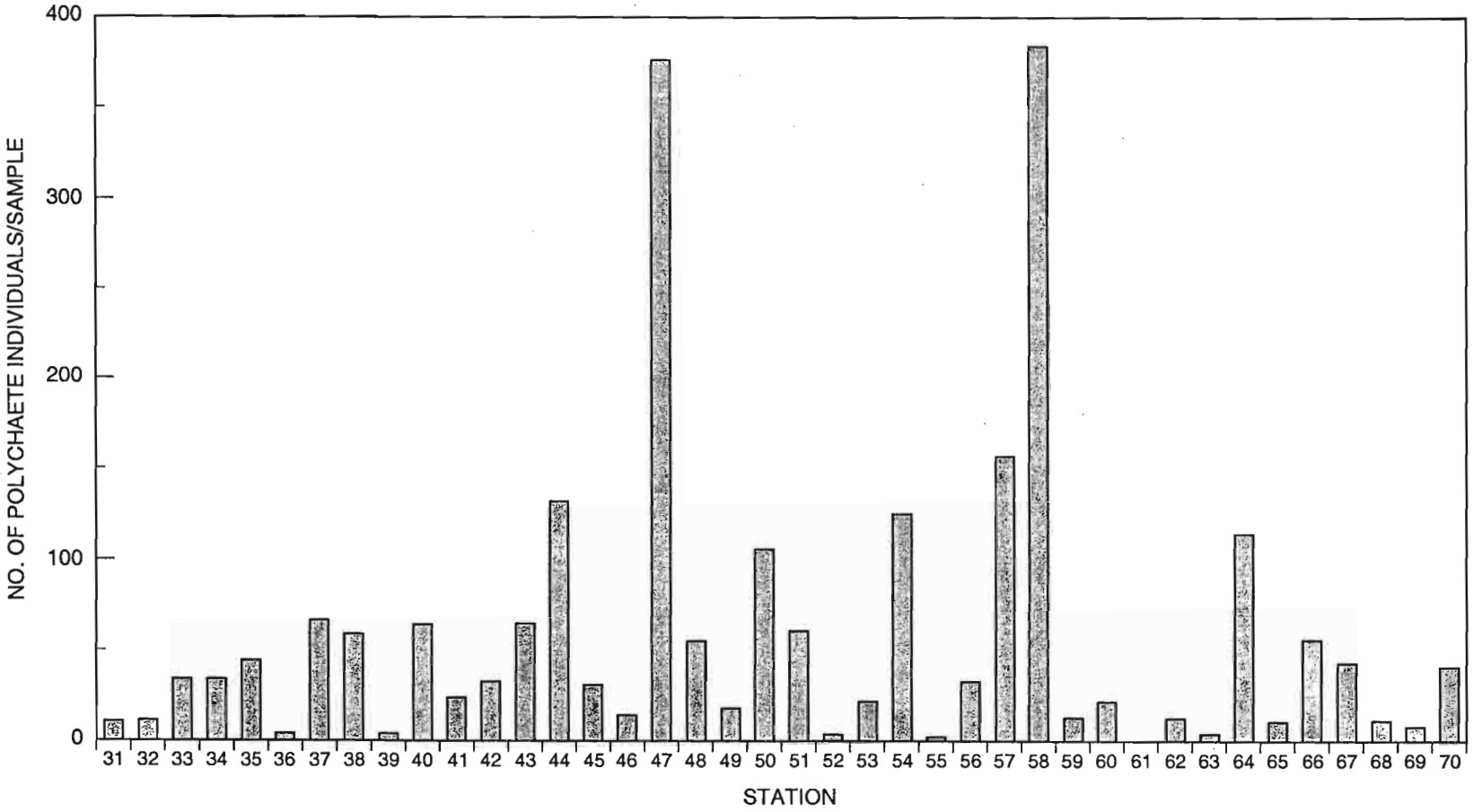


FIGURE 7. Number of polychaete individuals per sample, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

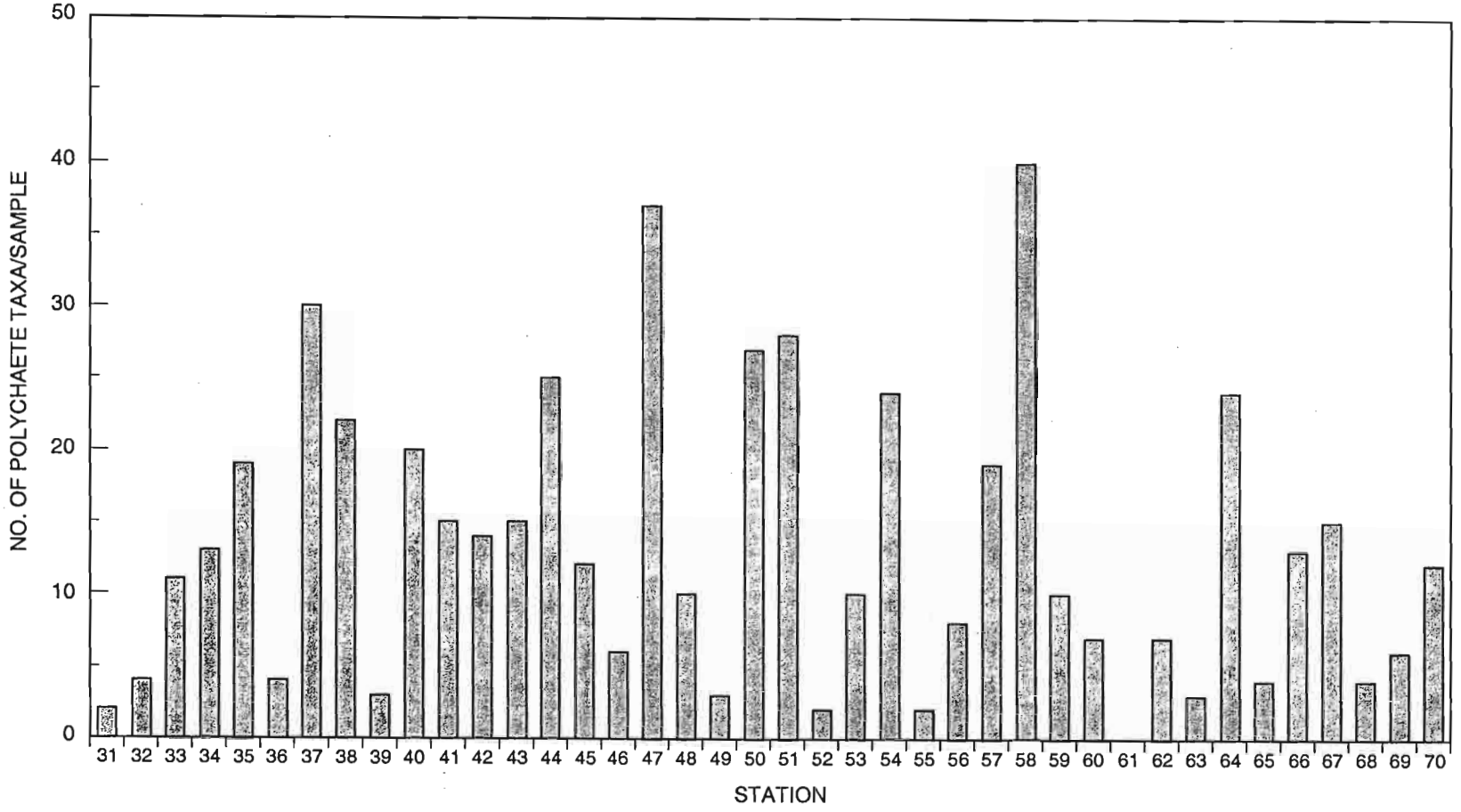


FIGURE 8. Number of polychaete taxa per sample, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

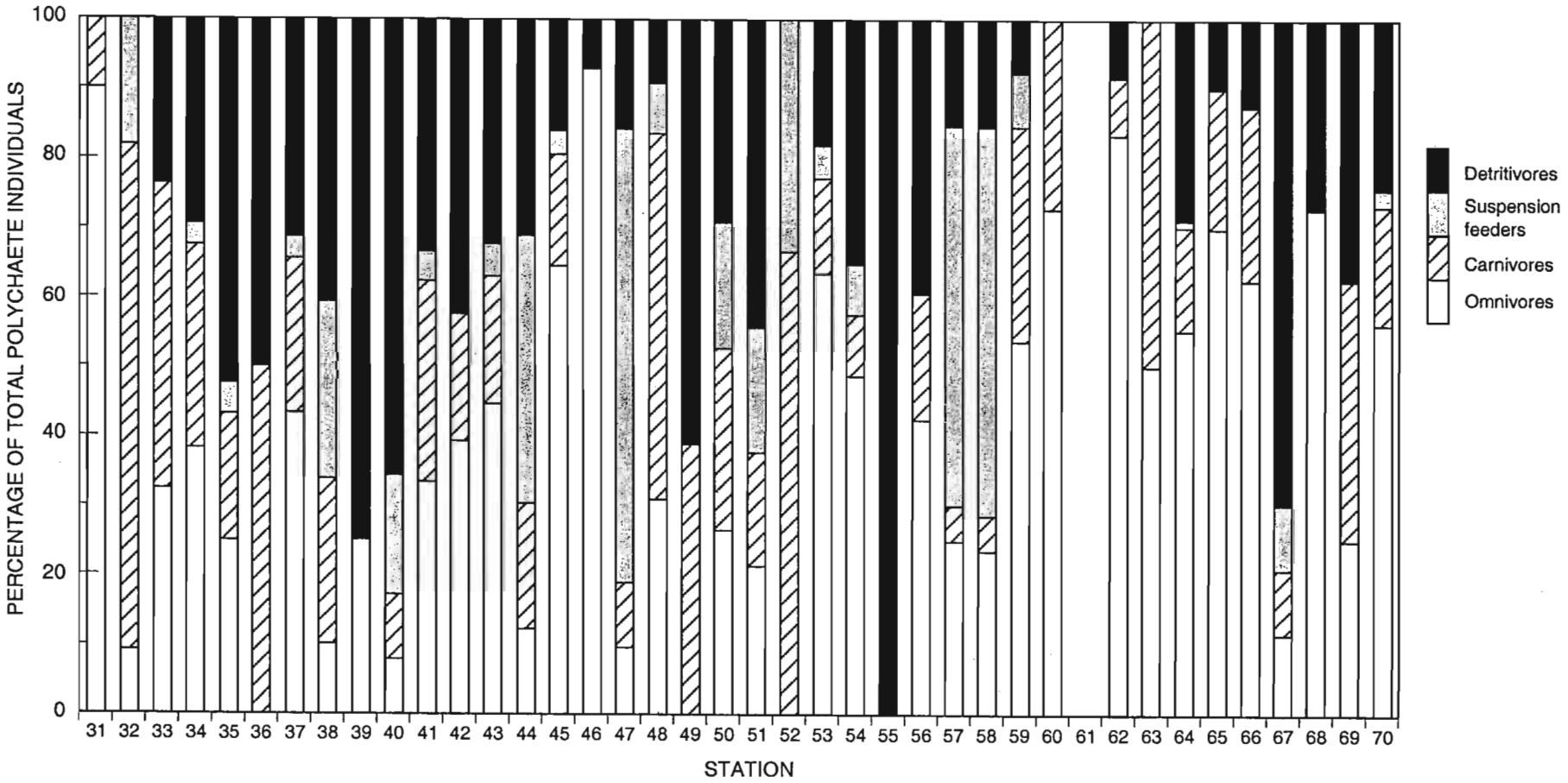


FIGURE 9. Percentage of total polychaete individuals in four trophic categories, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

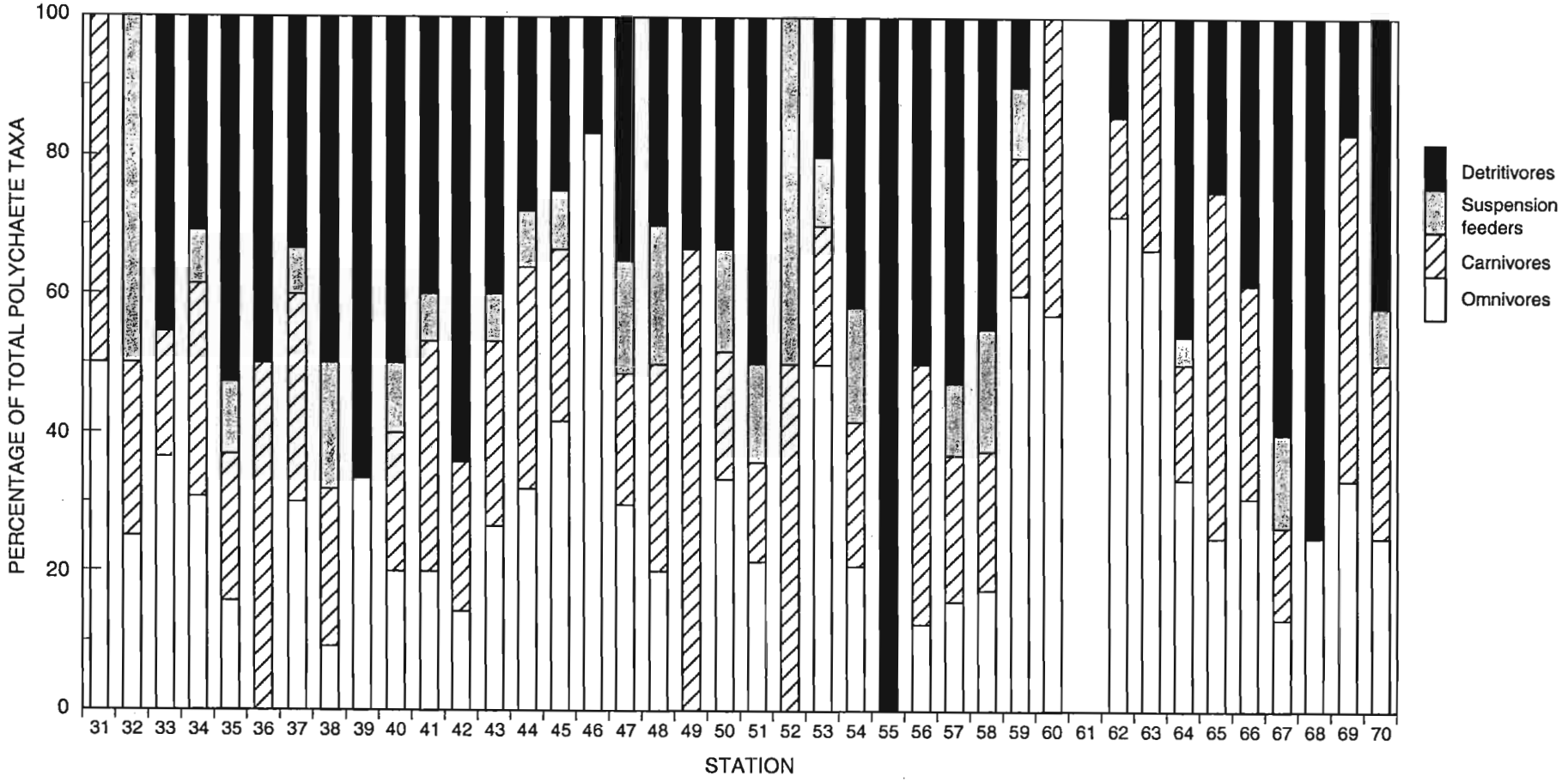


FIGURE 10. Percentage of total polychaete taxa in four trophic categories, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

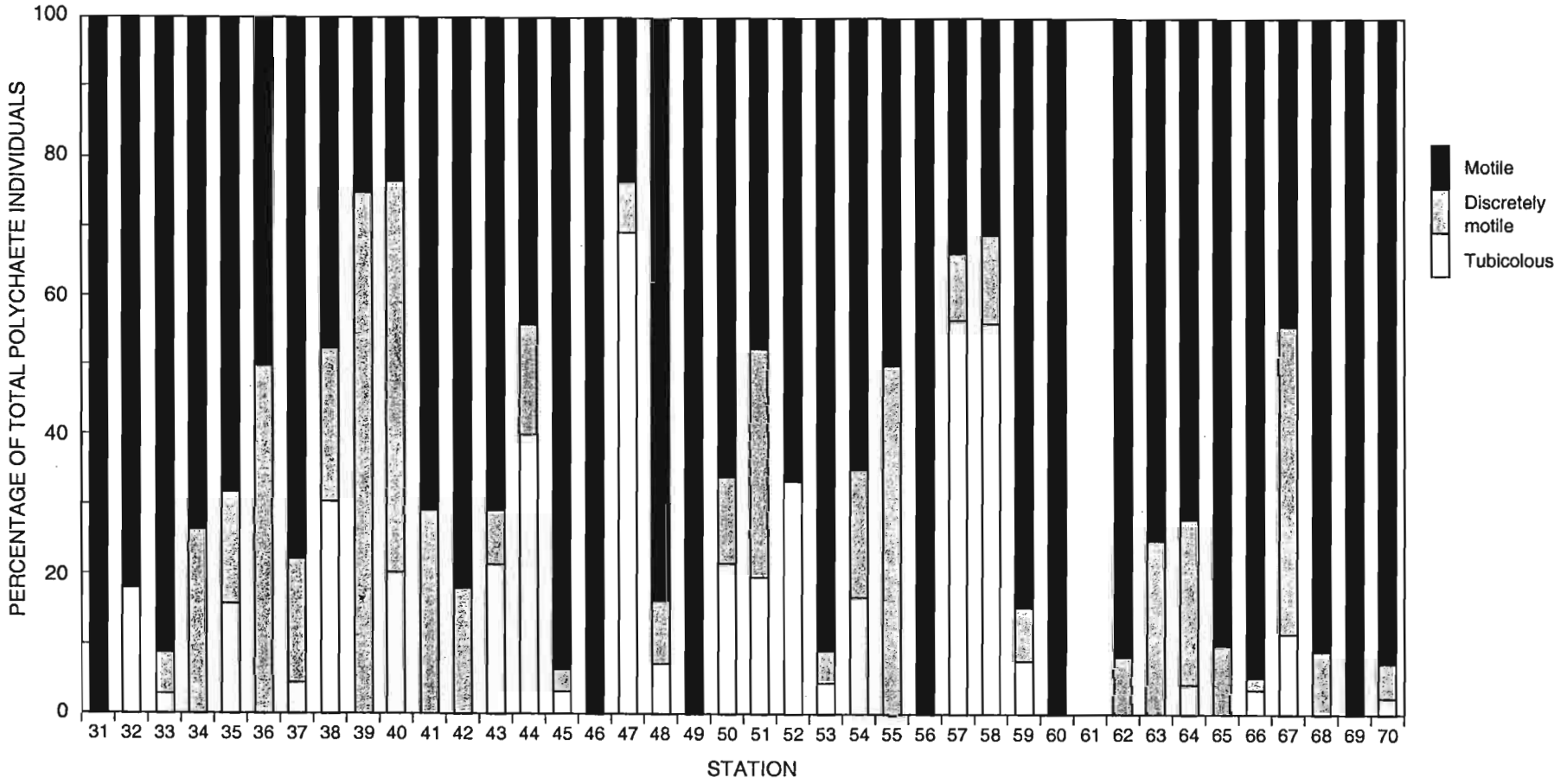


FIGURE 11. Percentage of total polychaete individuals in three motility categories, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

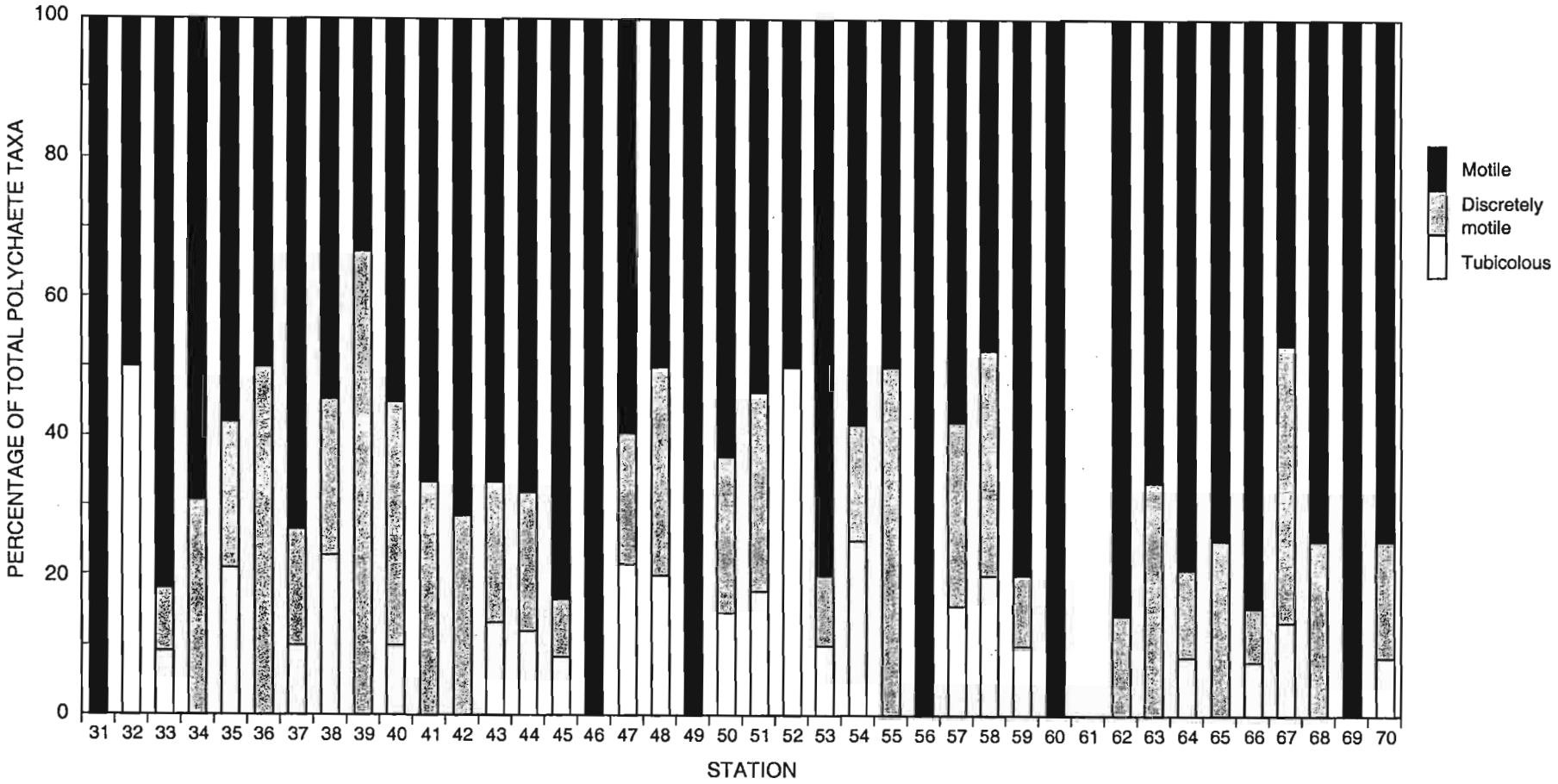


FIGURE 12. Percentage of total polychaete taxa in three motility categories, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

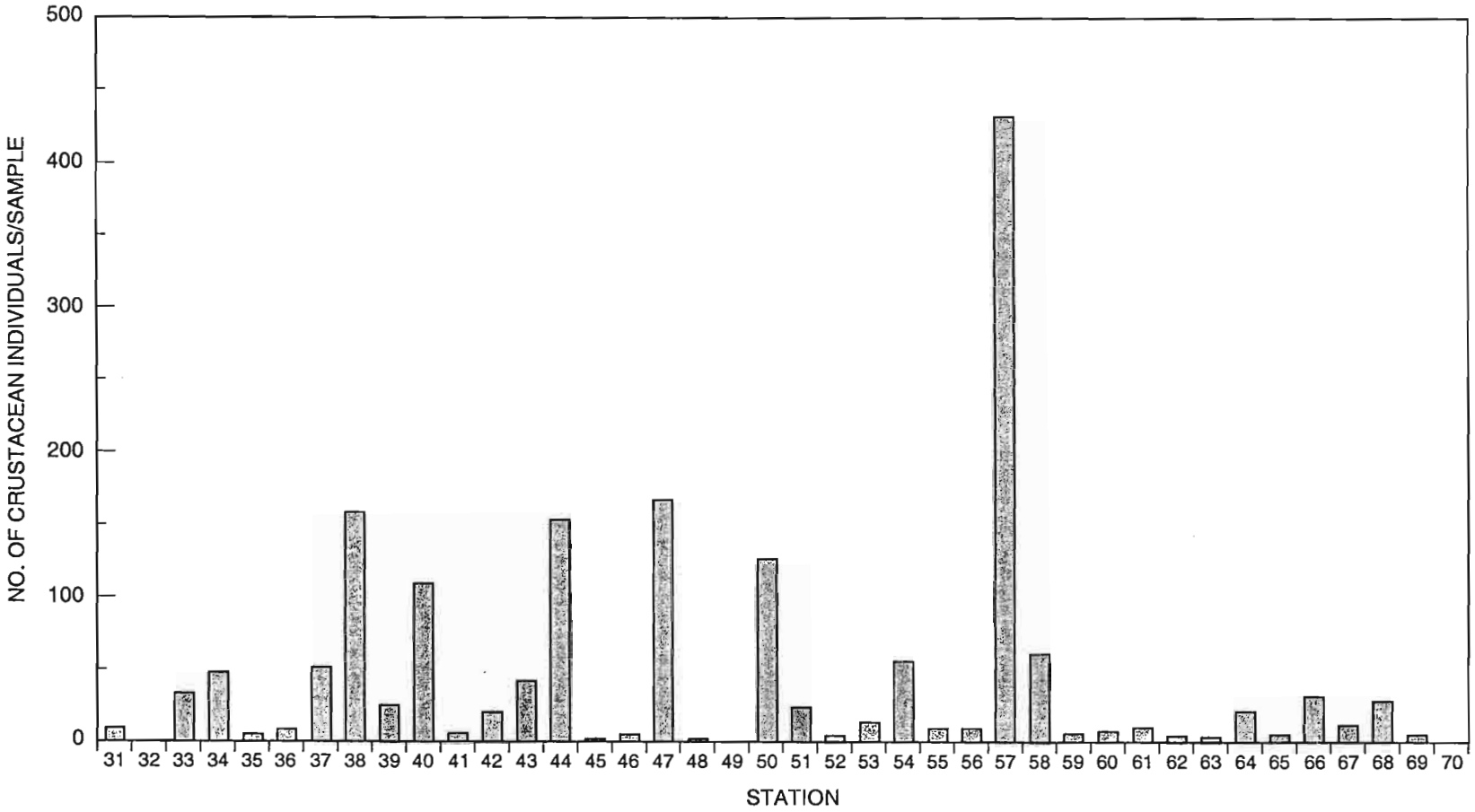


FIGURE 13. Number of crustacean individuals per sample, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

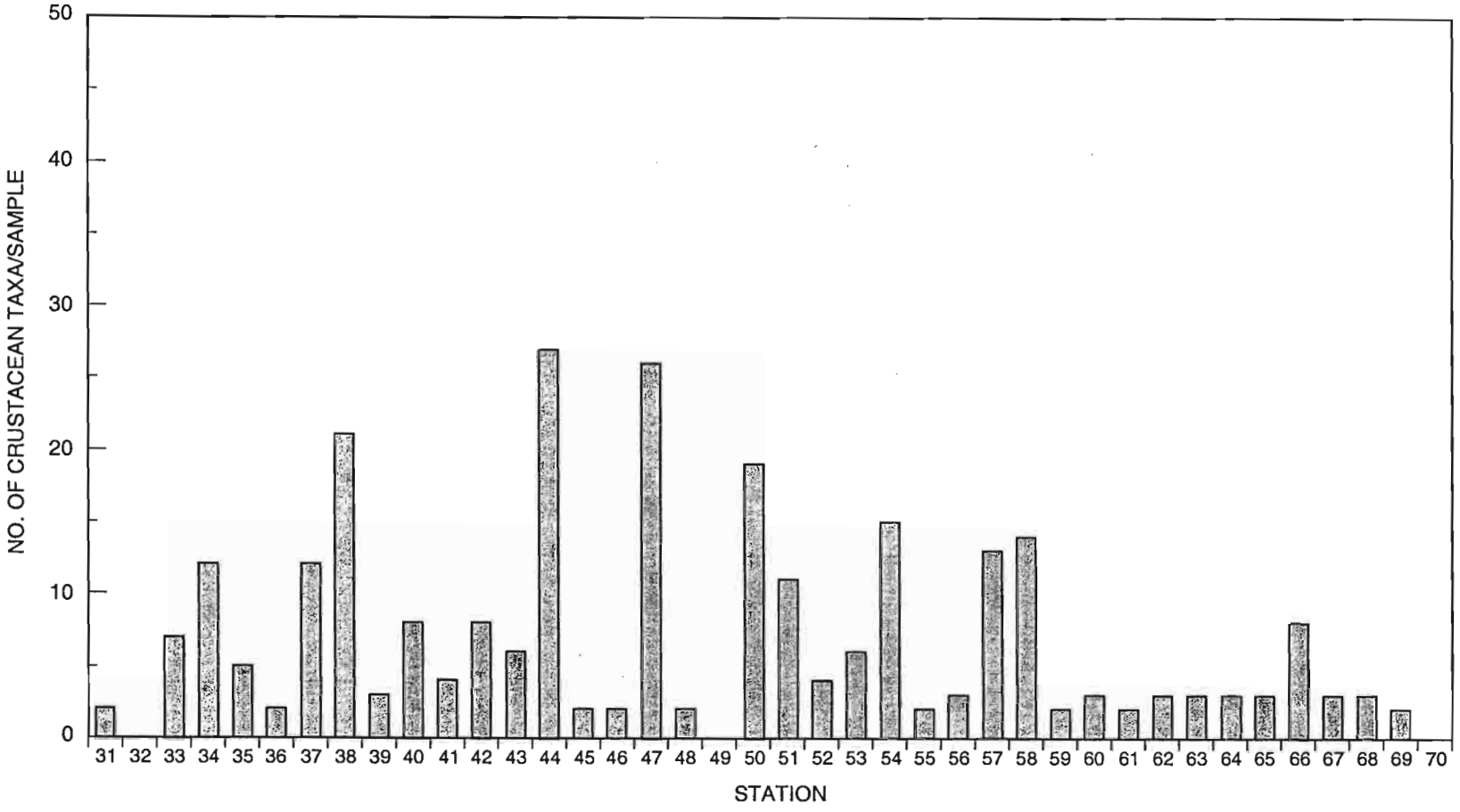


FIGURE 14. Number of crustacean taxa per sample, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

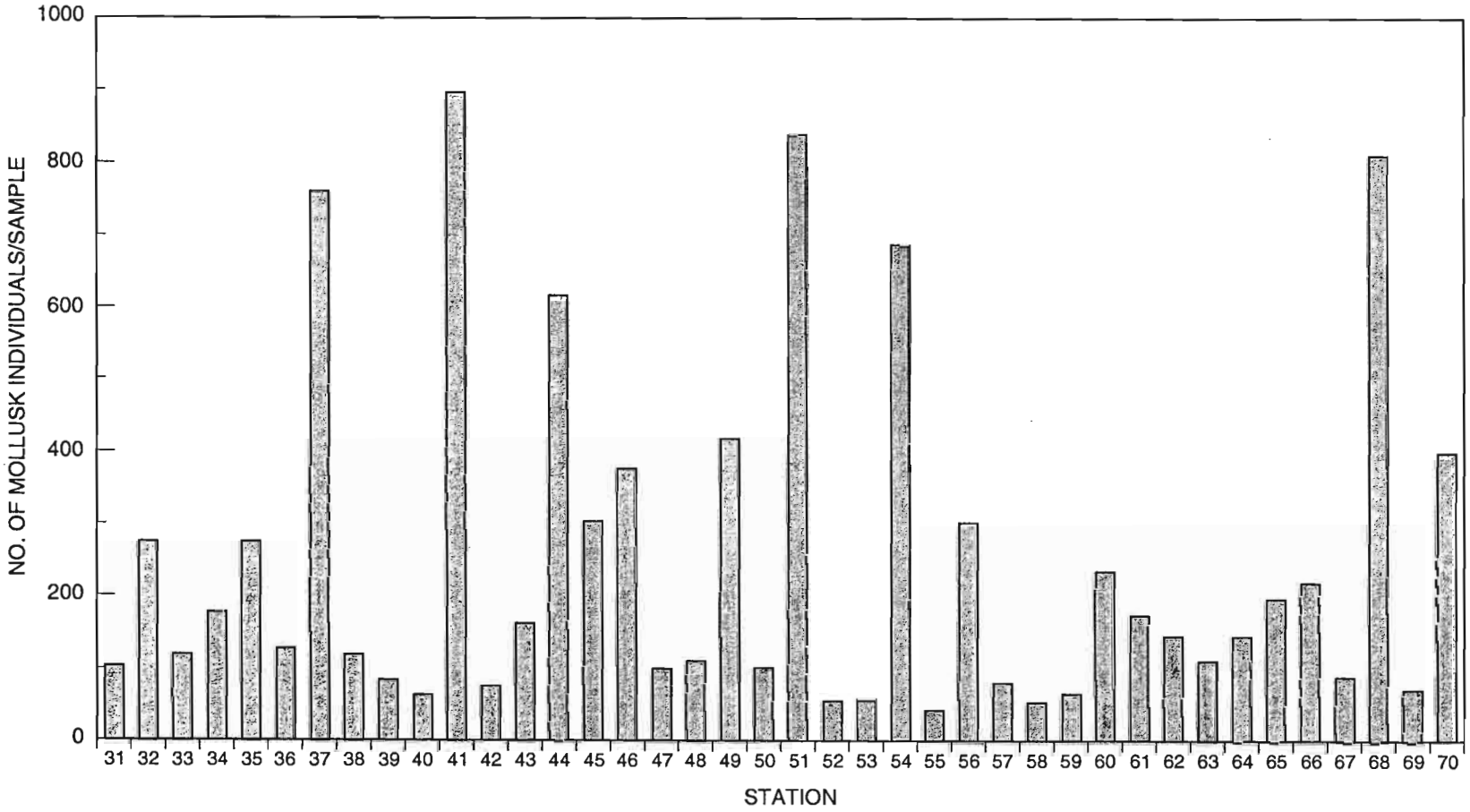


FIGURE 15. Number of mollusk individuals per sample, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

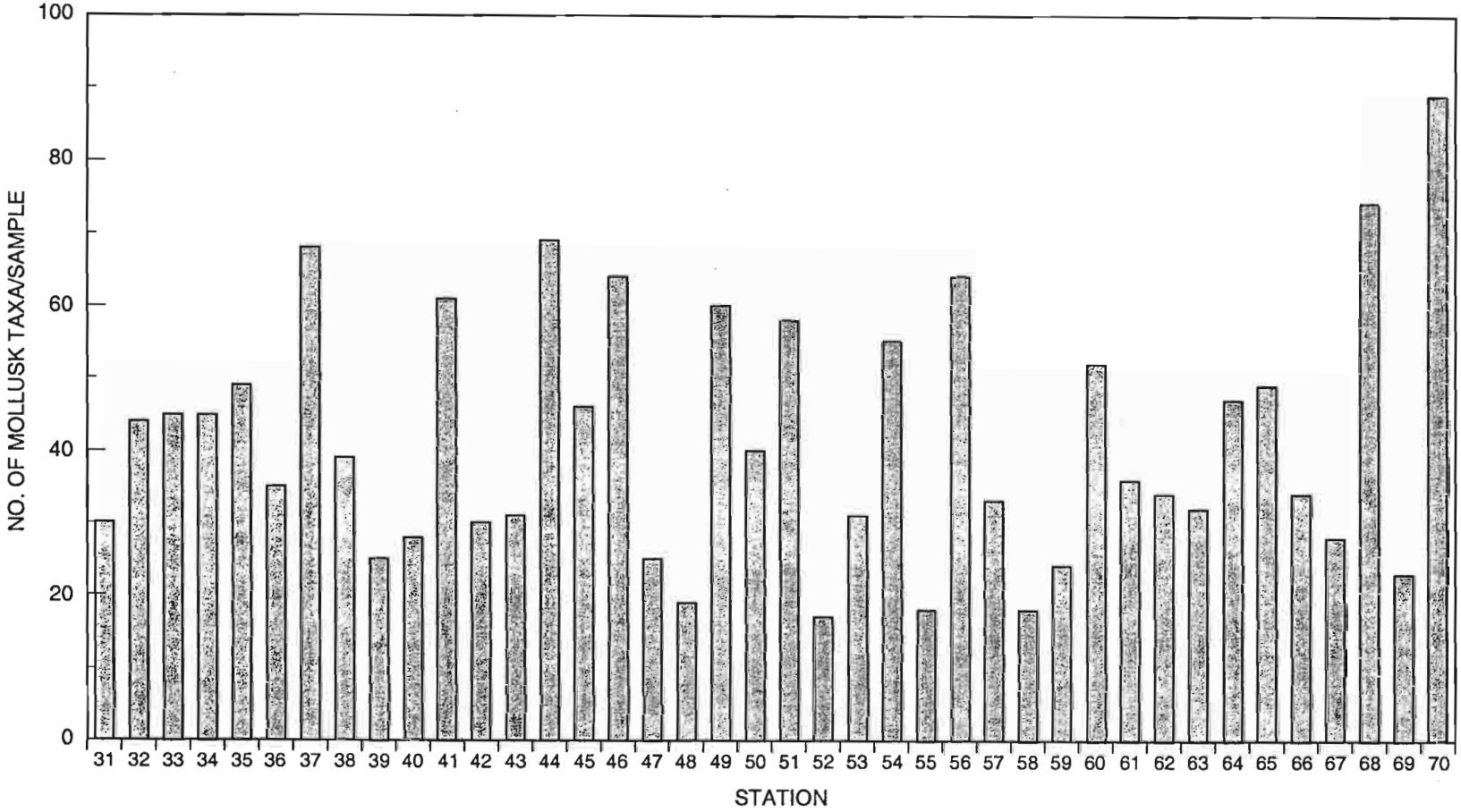


FIGURE 16. Number of mollusk taxa per sample, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

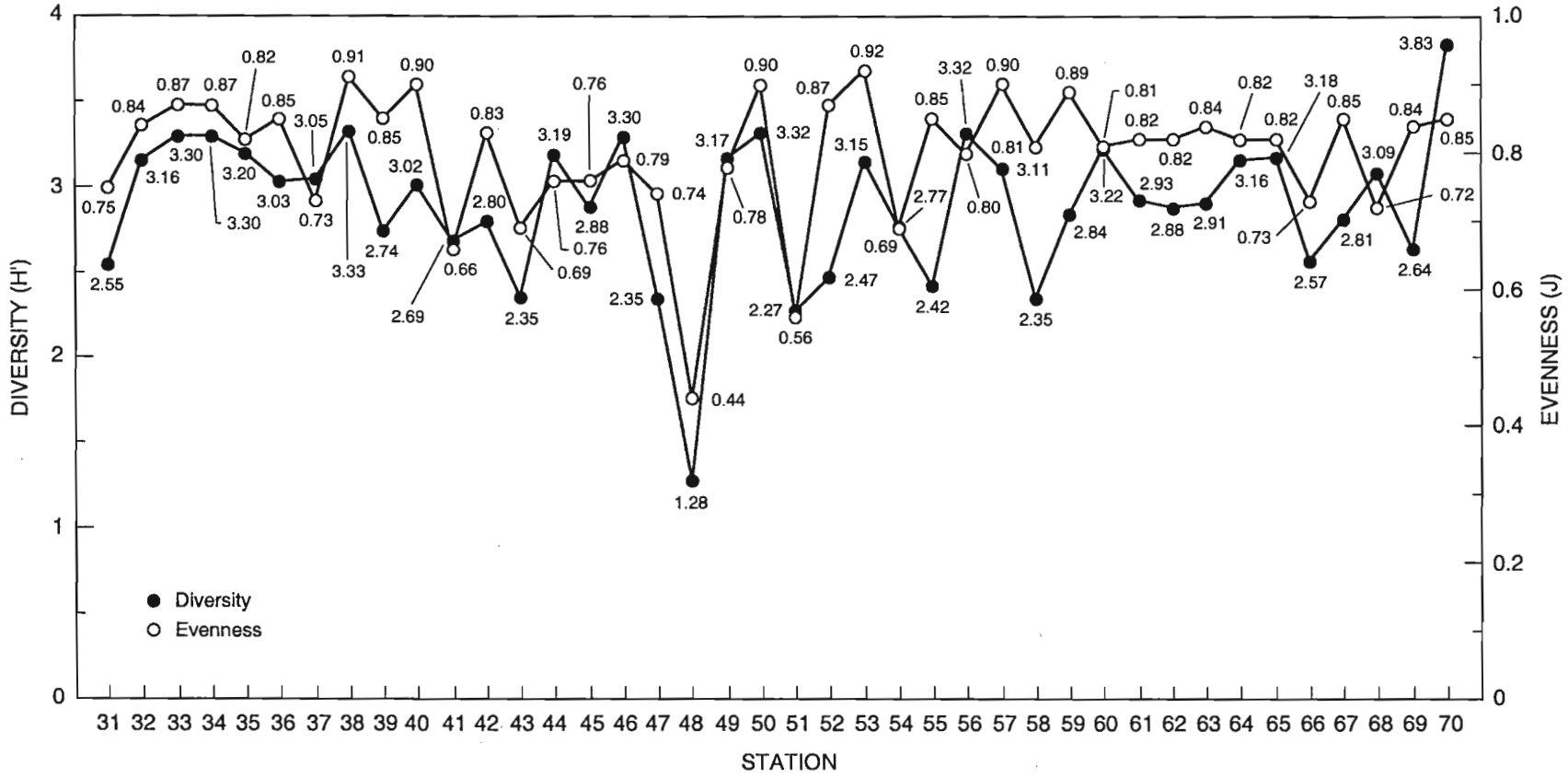


FIGURE 17. Shannon–Wiener diversity index (H') and evenness index (J) for mollusks, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

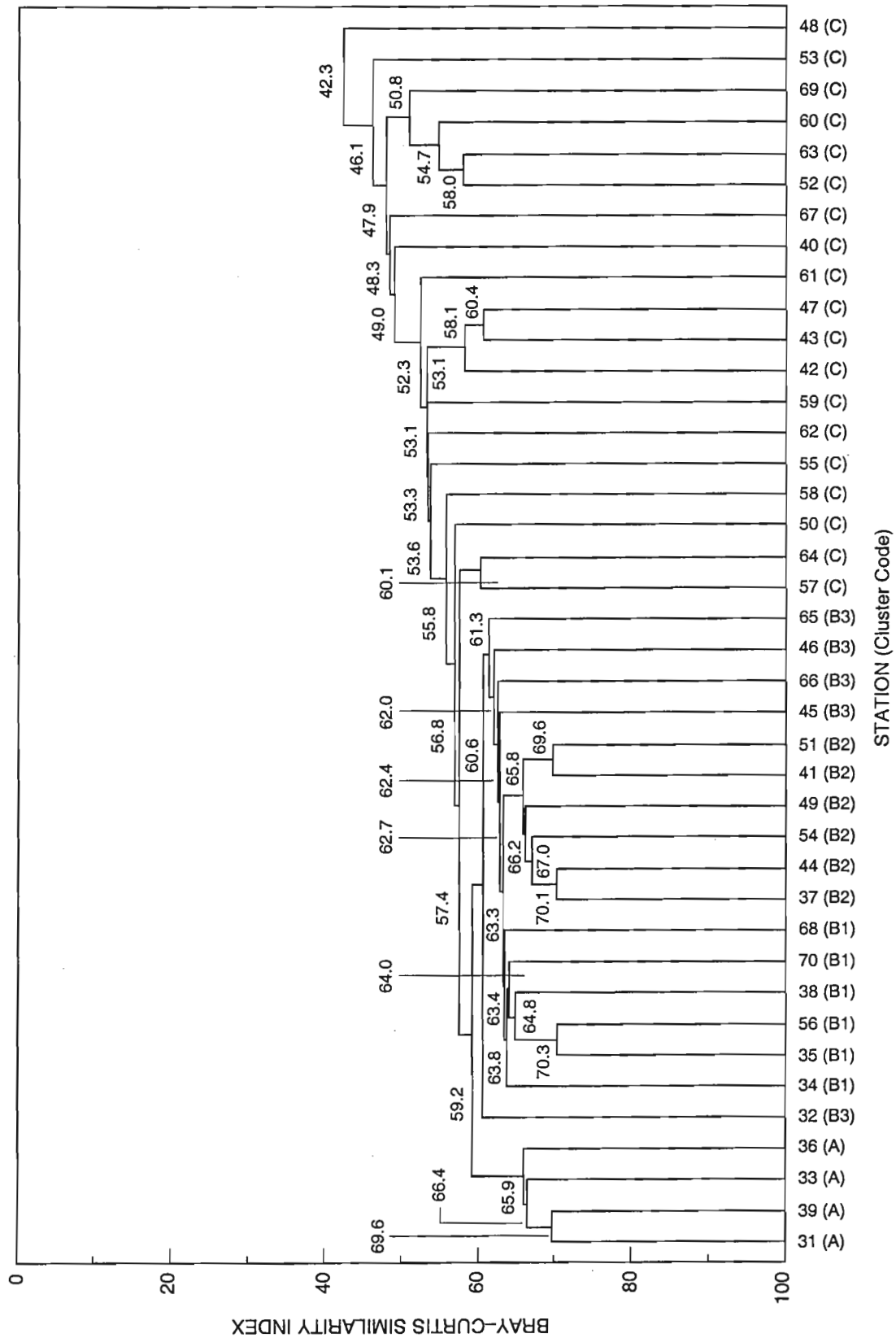


FIGURE 18. Dendrogram for double square root transformed mollusk data showing cluster codes and similarity among Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

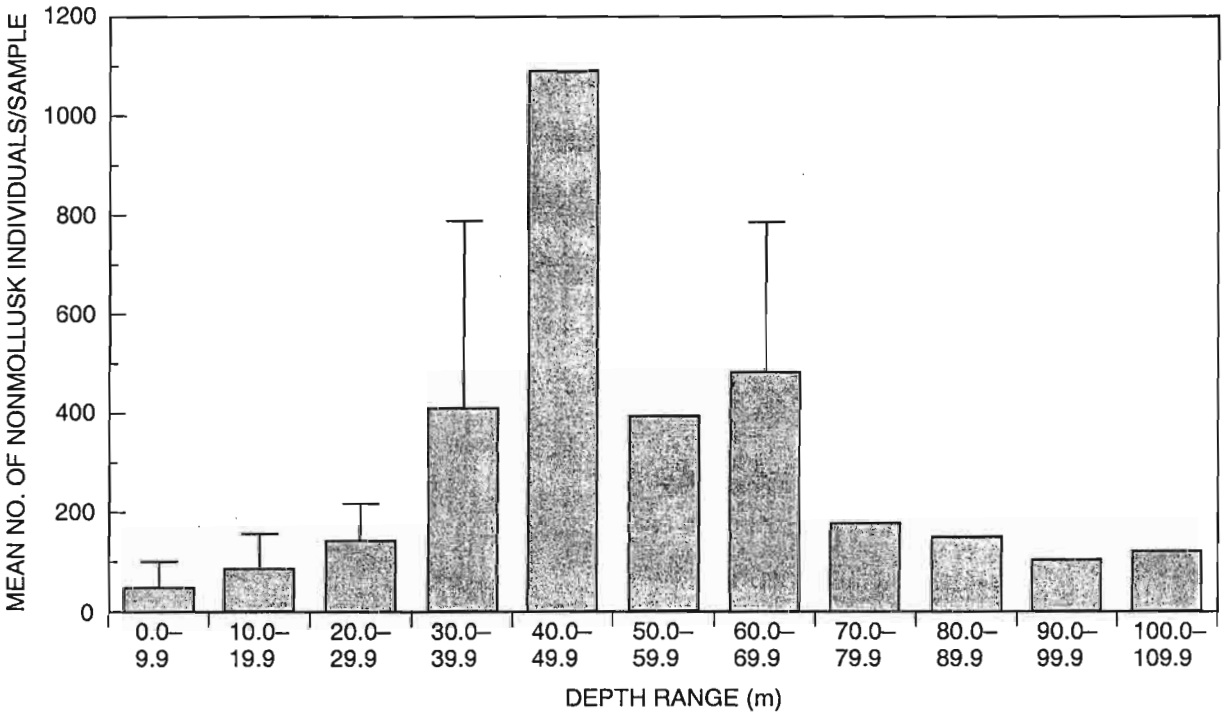


FIGURE 19. Mean (+1 SD) number of nonmollusk individuals per sample in relation to 10-m depth ranges, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

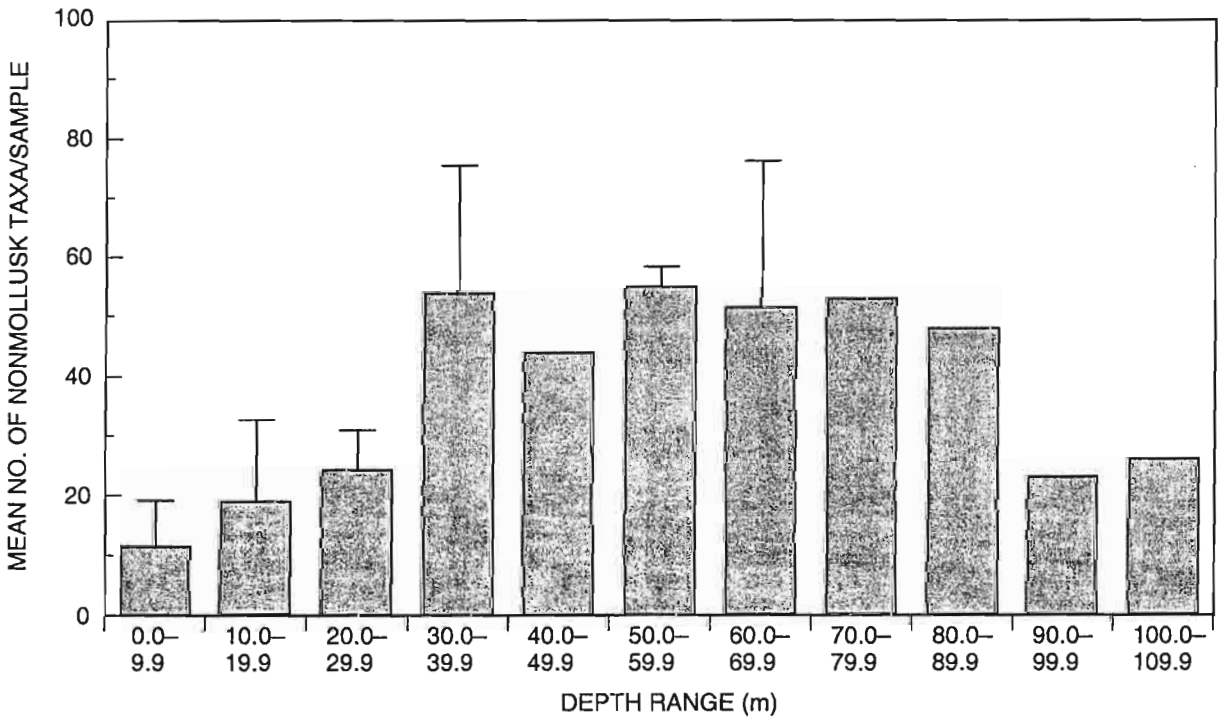


FIGURE 20. Mean (+1 SD) number of nonmollusk taxa per sample in relation to 10-m depth ranges, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

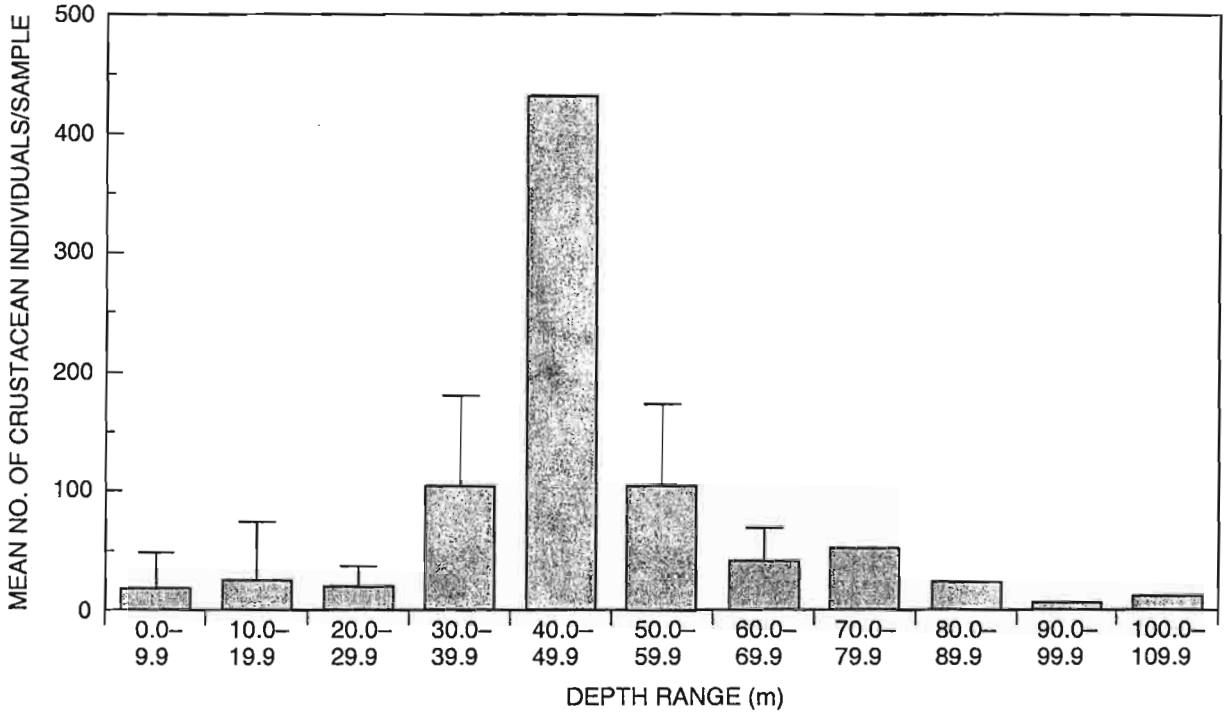


FIGURE 21. Mean (+1 SD) number of crustacean individuals per sample in relation to 10-m depth ranges, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

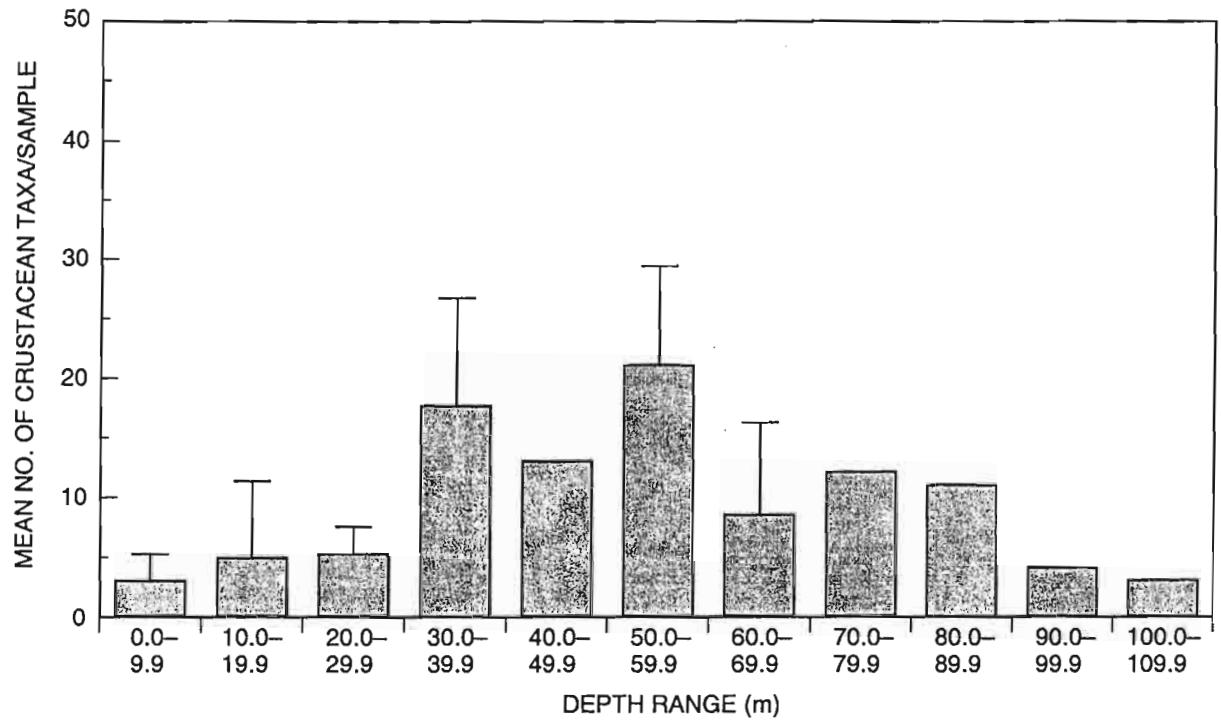


FIGURE 22. Mean (+1 SD) number of crustacean taxa per sample in relation to 10-m depth ranges, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

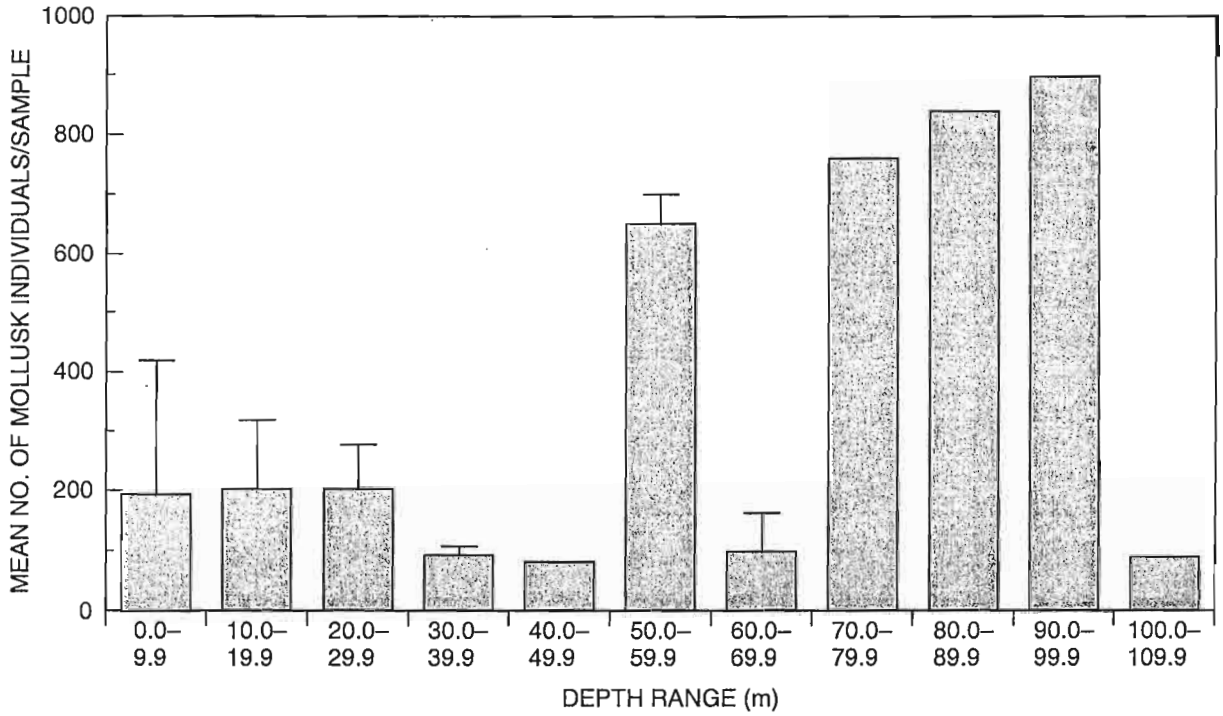


FIGURE 23. Mean (+1 SD) number of mollusk individuals per sample in relation to 10-m depth ranges, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

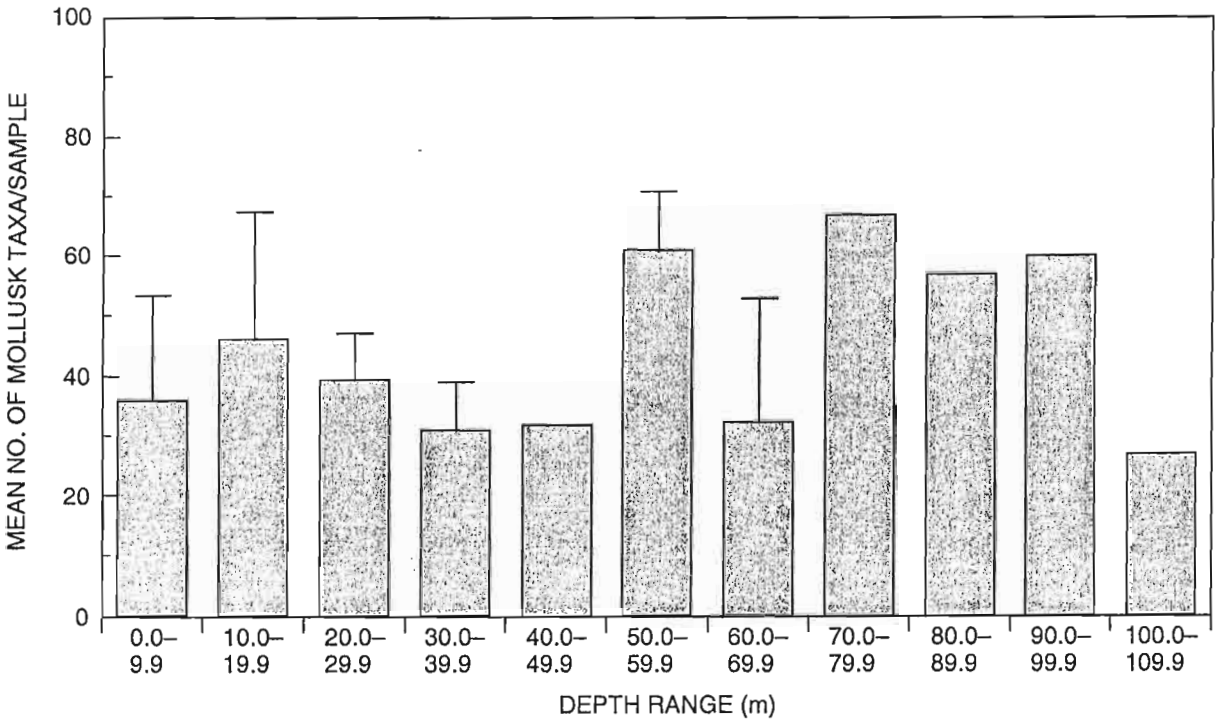
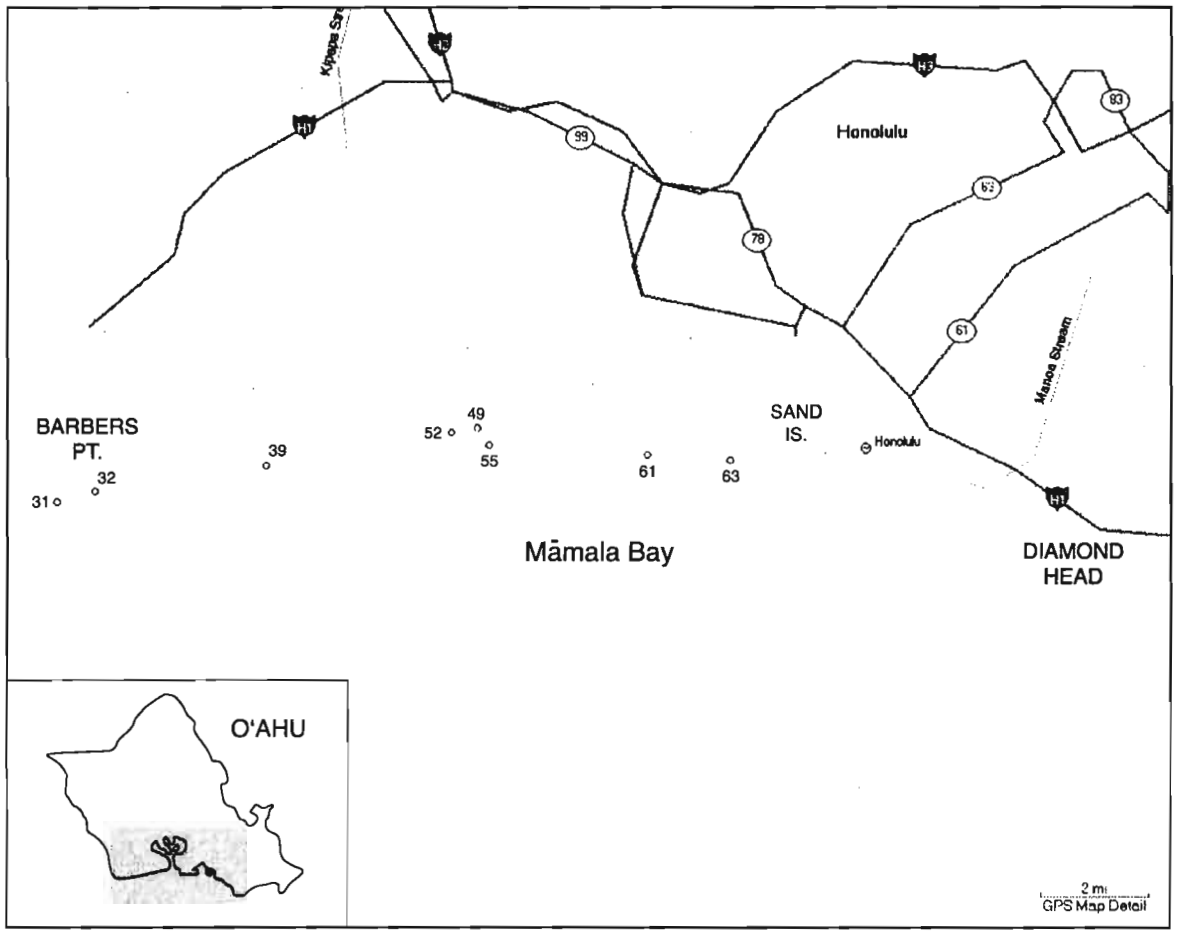
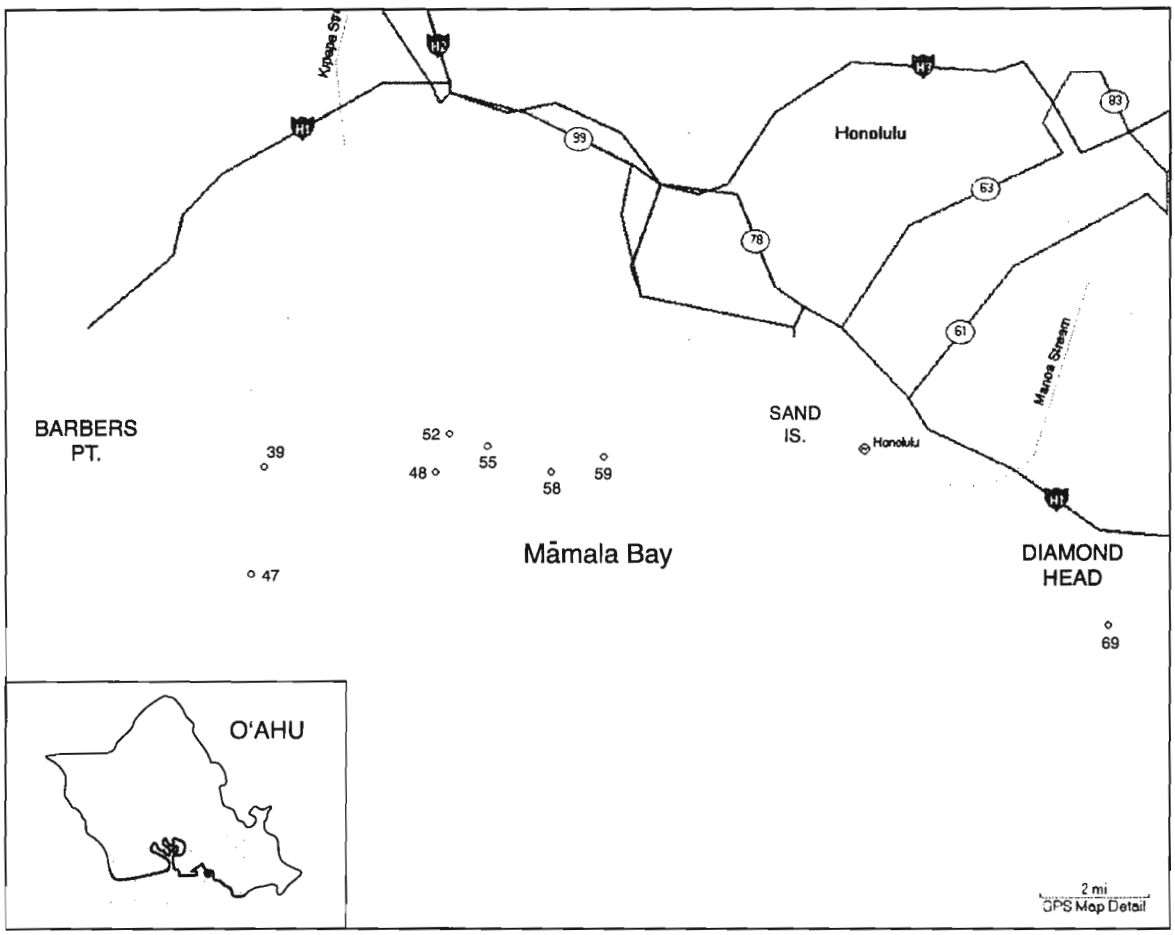


FIGURE 24. Mean (+1 SD) number of mollusk taxa per sample in relation to 10-m depth ranges, Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003



SOURCE: Division of Environmental Quality, Department of Environmental Services, City and County of Honolulu.

FIGURE 25. Location of stations where ten or fewer nonmollusk taxa were sampled, Māmala Bay, O'ahu, Hawai'i, August 2003



SOURCE: Division of Environmental Quality, Department of Environmental Services, City and County of Honolulu.

FIGURE 26. Location of stations where twenty-five or fewer mollusk taxa were sampled, Māmala Bay, O'ahu, Hawai'i, August 2003

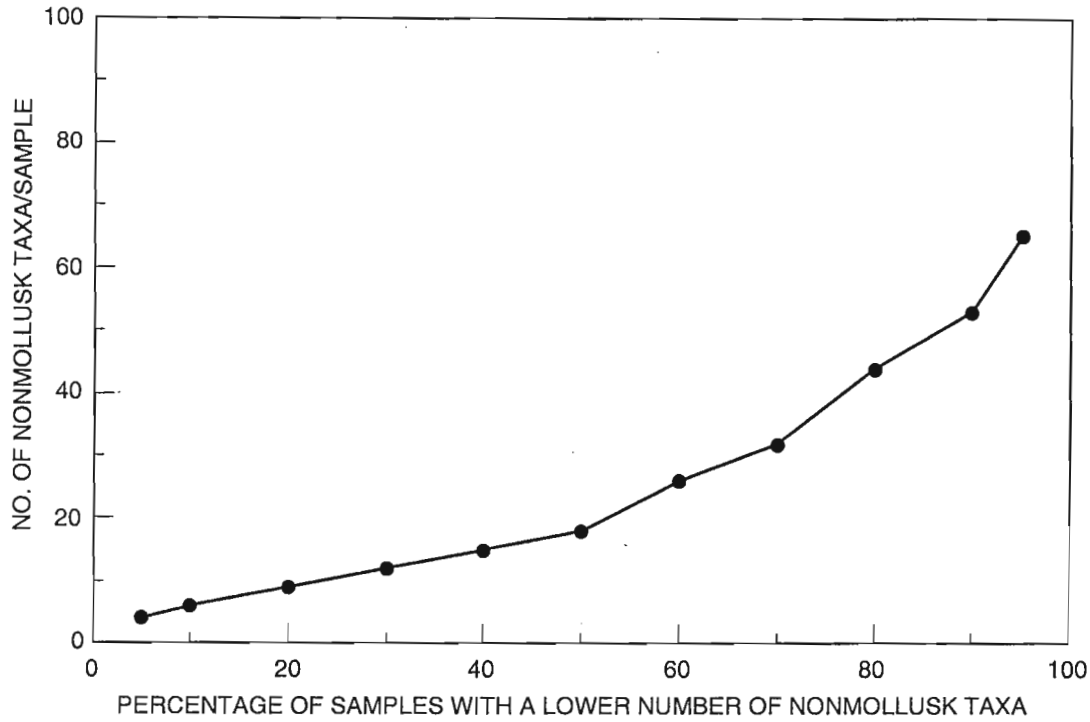


FIGURE 27. Frequency distribution for the number of nonmollusk taxa at Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

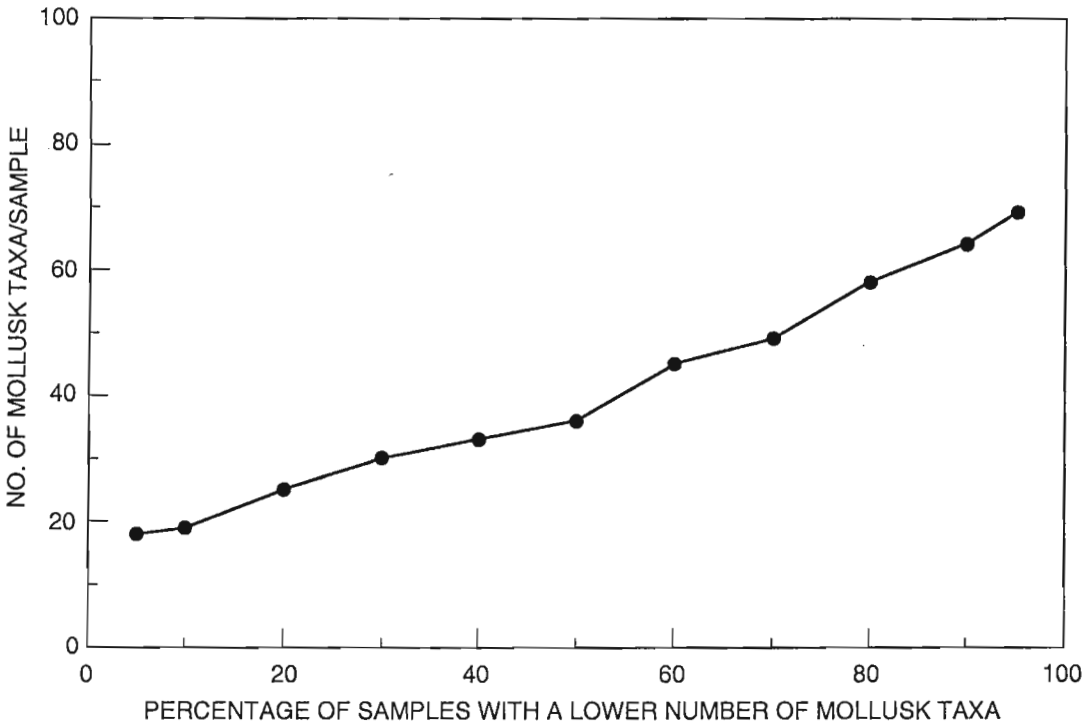


FIGURE 28. Frequency distribution for the number of mollusk taxa at Māmala Bay sampling stations, O'ahu, Hawai'i, August 2003

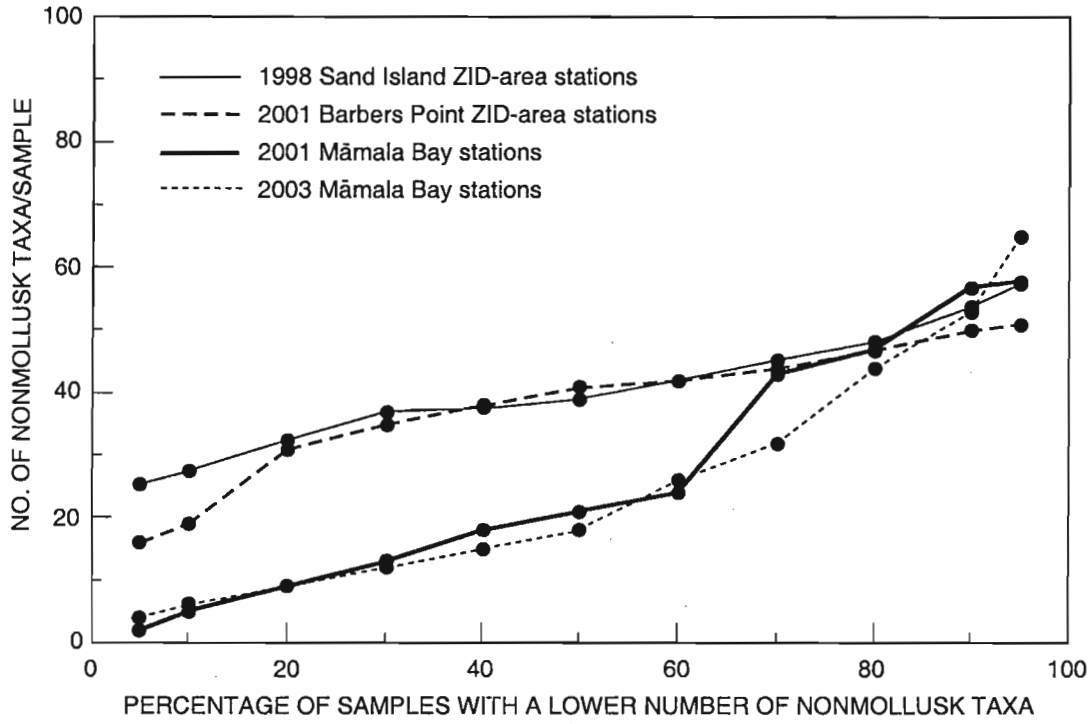


FIGURE 29. Frequency distribution for the number of nonmollusk taxa at Māmala Bay stations sampled in 2001 and 2003 compared with the distributions for the ZID-area stations sampled at the Sand Island Ocean Outfall in 1998 and at the Barbers Point Ocean Outfall in 2001

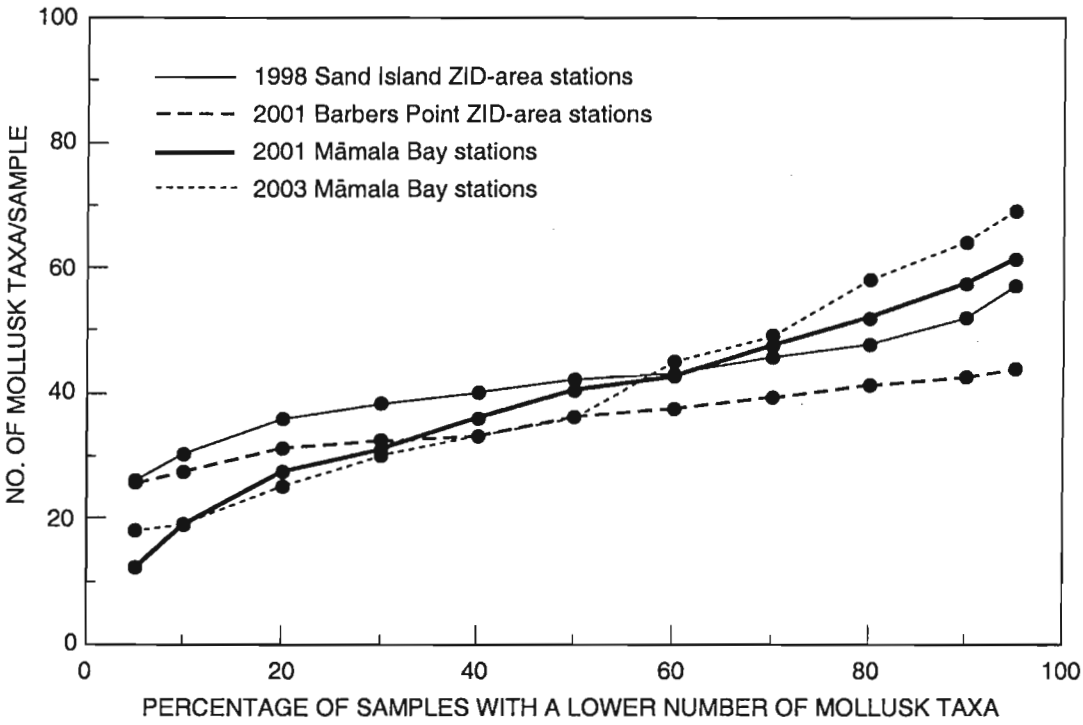


FIGURE 30. Frequency distribution for the number of mollusk taxa at Māmala Bay stations sampled in 2001 and 2003 compared with the distributions for the ZID-area stations sampled at the Sand Island Ocean Outfall in 1998 and at the Barbers Point Ocean Outfall in 2001

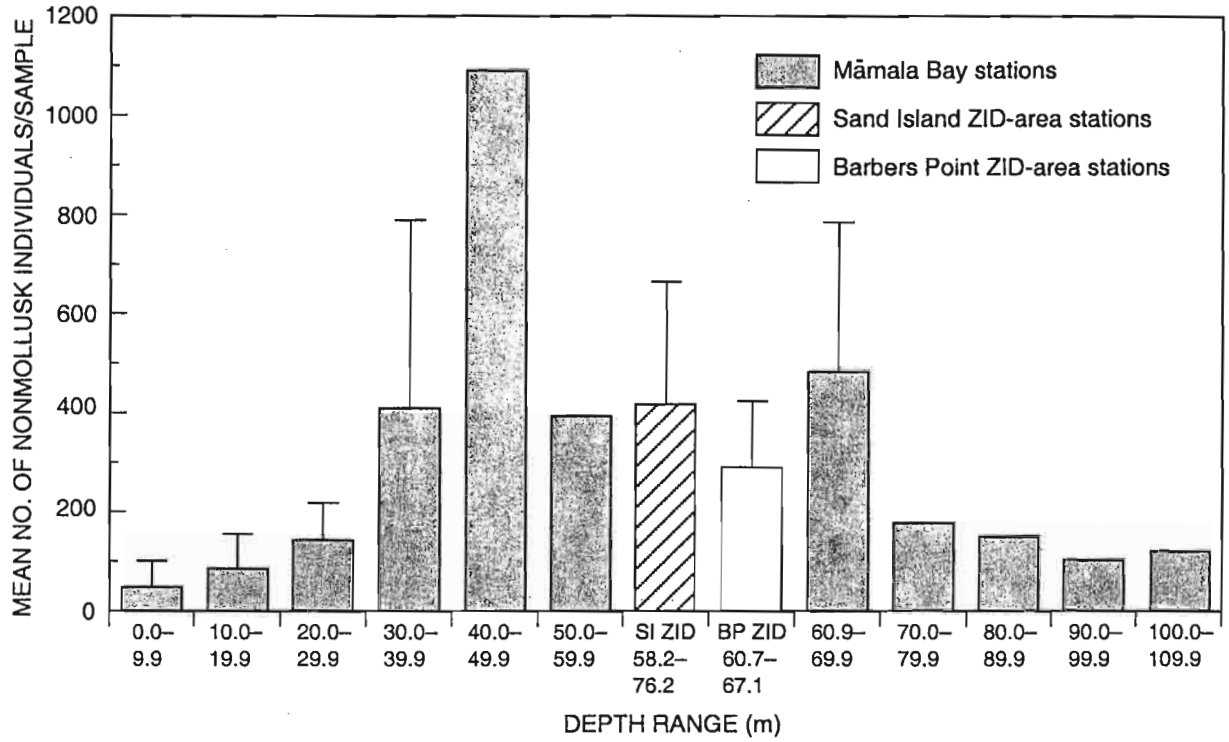


FIGURE 31. Mean (+1 SD) number of nonmollusk individuals relative to depth at Māmala Bay stations sampled in 2003 compared with that at ZID-area stations sampled at the Sand Island Ocean Outfall in 1998 and at the Barbers Point Ocean Outfall in 2001

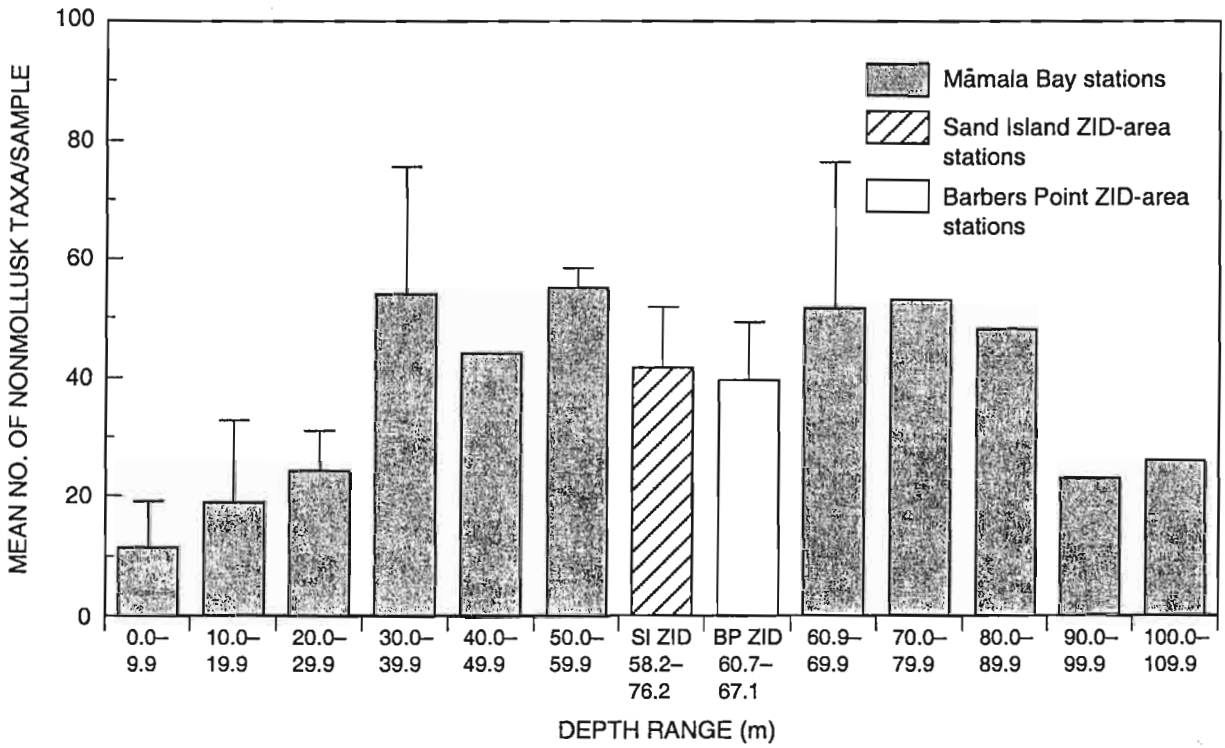


FIGURE 32. Mean (+1 SD) number of nonmollusk taxa relative to depth at Māmala Bay stations sampled in 2003 compared with that at ZID-area stations sampled at the Sand Island Ocean Outfall in 1998 and at the Barbers Point Ocean Outfall in 2001

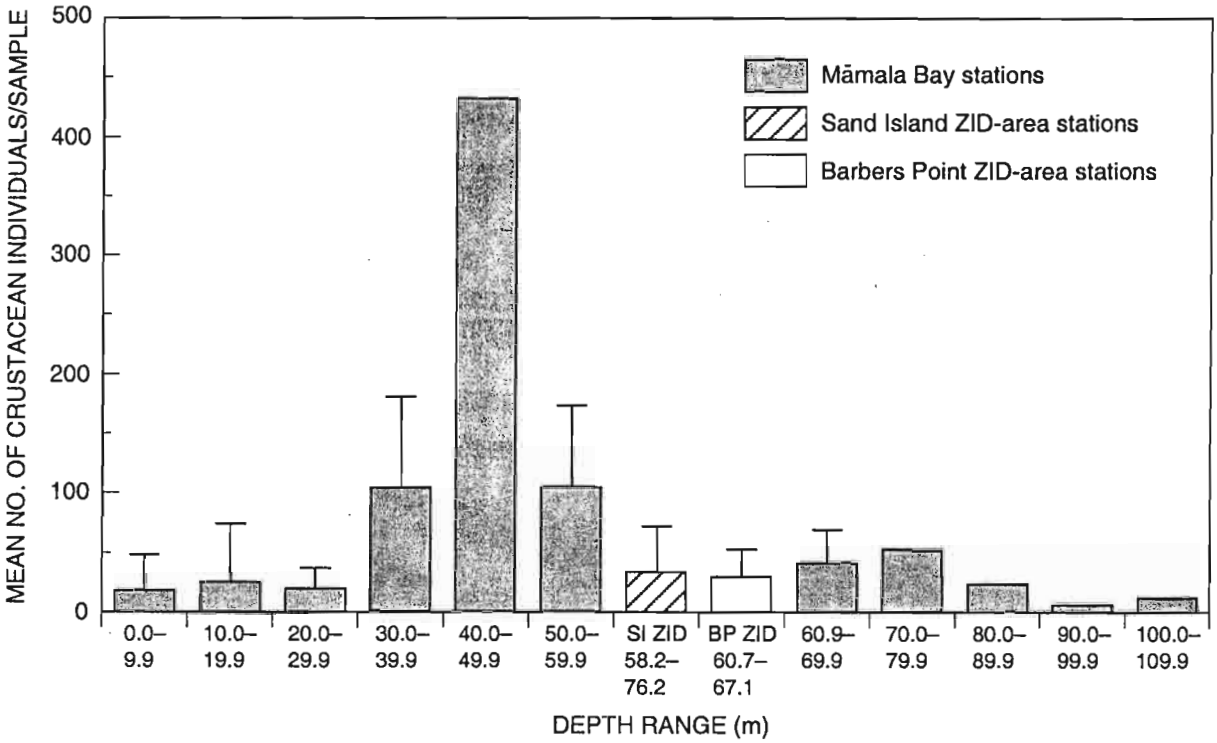


FIGURE 33. Mean (+1 SD) number of crustacean individuals relative to depth at Māmala Bay stations sampled in 2003 compared with that at ZID-area stations sampled at the Sand Island Ocean Outfall in 1998 and at the Barbers Point Ocean Outfall in 2001

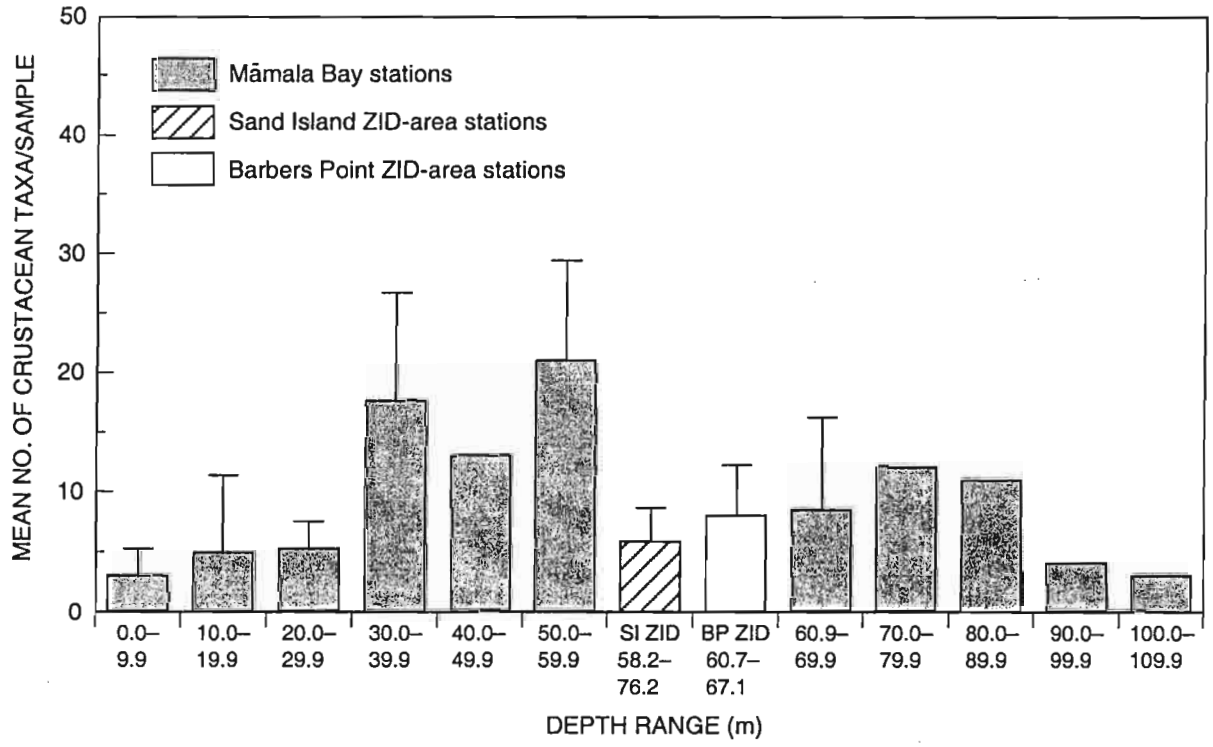


FIGURE 34. Mean (+1 SD) number of crustacean taxa relative to depth at Māmala Bay stations sampled in 2003 compared with that at ZID-area stations sampled at the Sand Island Ocean Outfall in 1998 and at the Barbers Point Ocean Outfall in 2001

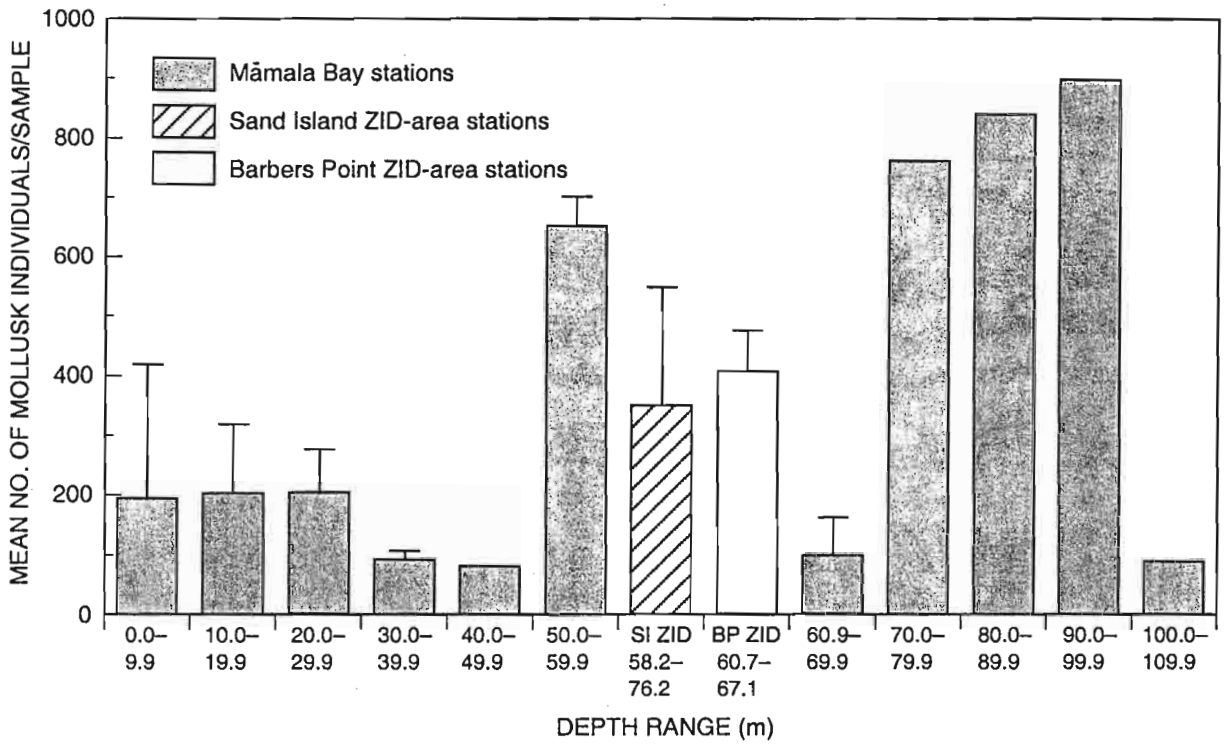


FIGURE 35. Mean (+1 SD) number of mollusk individuals relative to depth at Māmala Bay stations sampled in 2003 compared with that at ZID-area stations sampled at the Sand Island Ocean Outfall in 1998 and at the Barbers Point Ocean Outfall in 2001

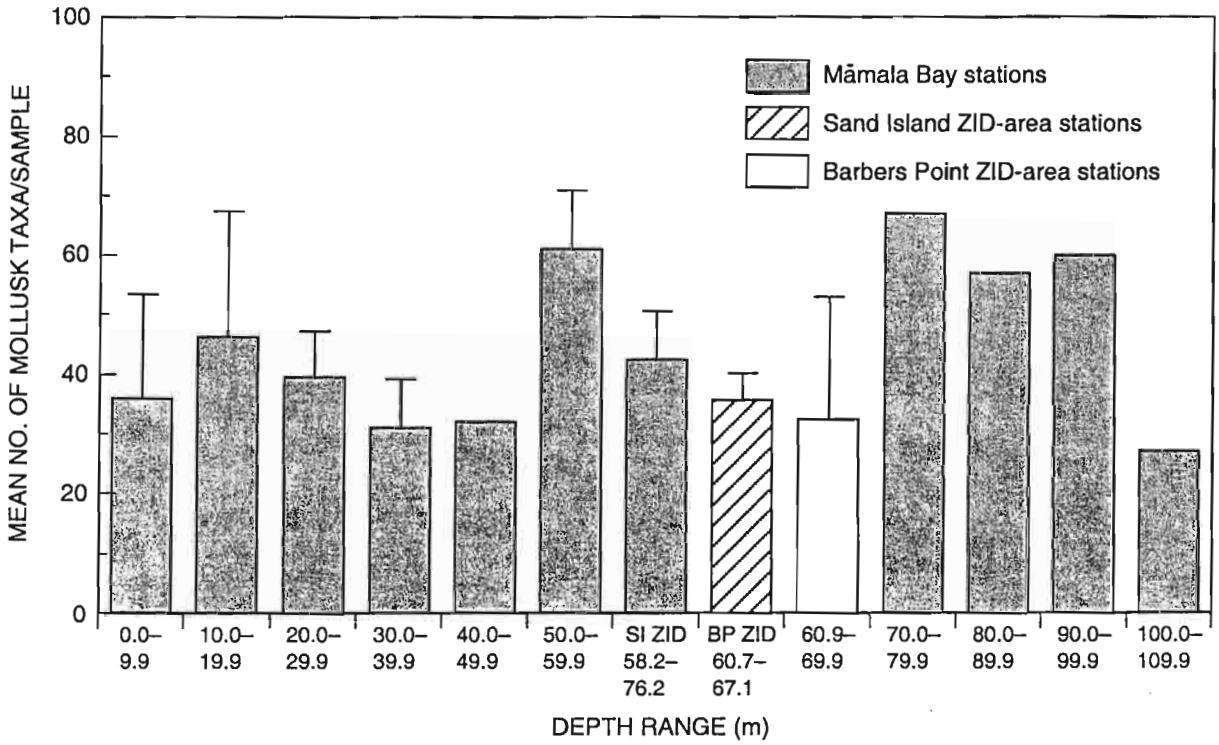


FIGURE 36. Mean (+1 SD) number of mollusk taxa relative to depth at Māmala Bay stations sampled in 2003 compared with that at ZID-area stations sampled at the Sand Island Ocean Outfall in 1998 and at the Barbers Point Ocean Outfall in 2001

TEXT TABLES

TABLE 1. Abundance of Numerically Dominant Nonmollusk Taxa, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals/Sample								
	Station Cluster/Subcluster								
	31	32	33	34	35	36	37	38	39
Leptochelia dubia			1	9*			7	10	
Euchone sp. B									
Pionosyllis heterocirrata	9*	1	7*	8*	9*		3	5	1
Phyllochaetopterus verrilli									
Konatopus paao			1	10*				78*	1
Micropodarke sp. A			3	3	3		4	8	
Synelmis acuminata							16*		
Aspidosiphon muelleri					3		3		
Eriopisella sechellensis			6				11*		
Elasmopus piikoi									
Sphaerosyllis sp. G				2	1				
Fabricia sp. A		1			1			12*	
Salmacina dysteri									
Polyophthalmus pictus				2	1		3	2	
Branchiostoma sp. A			7*		8*	3	2		
Tanaissus sp. A							1		
Myriochele oculata			1		4		1	1	
Microphthalmus spp.	1	8*	12*		2				
Eusiroides diplonyx	7*								23*
Myodocope sp. A				7			10*	3	
Protodorvillea biarticulata					1			2	
Seba ekepuu								6	
Metacirolana sp. A				5				22*	
Paramphinome sp. A				4	1	1	2	1	
Dipolydora armata									
Typosyllis cornuta							1		
Eriopisa laakona									
Neanthes arenaceodentata									
Ericthonius brasiliensis					1				
Cirratulidae sp. B									
Lumbrineris tetraura									
Rhodine sp. A					5*			1	
Spionidae sp. D									
Pionosyllis spinisetosa			1						
Spiophanes bombyx									
Typosyllis variegata									
Ogyrides sp. A						7*			
Acrocirrus sp. A									

TABLE 1—*Continued*

Taxon	No. of Individuals/Sample								
	Station Cluster/Subcluster								
	40	41	42	43	44	45	46	47	48
Leptochelia dubia		2		19*	54*	1		13	
Euchone sp. B									
Pionosyllis heterocirrata	1	4*	12*	14*	3	15*	8*	12	16*
Phyllochaetopterus verrilli								203*	
Konatopus paao				2				12	
Micropodarke sp. A	1		3	6	9	1		19	24*
Synelmis acuminata		3			2				
Aspidosiphon muelleri			1					1	
Eriopisella sechellensis			7*	13*				50*	
Elasmopus piikoi	76*							4	
Sphaerosyllis sp. G			1	11				1	1
Fabricia sp. A	10				3			33*	1
Salmacina dysteri					48*				
Polyophthalmus pictus		1	2		9			16	
Branchiostoma sp. A			1	3				3	7*
Tanaissus sp. A					6				
Myriochele oculata				11				2	
Microphthalmus spp.	1		1	1					3
Eusiroides diplonyx									
Myodocope sp. A			1		3			1	
Protodorvillea biarticulata			2			2			2
Seba ekepuu					4		4*		
Metacirolana sp. A					1				
Paramphinome sp. A			2	3	1	1		2	
Dipolydora armata	26*								
Typosyllis cornuta	2					1	2		
Eriopisa laakona	16*								
Neanthes arenaceodentata								1	
Ericthonius brasiliensis								3	
Cirratulidae sp. B					15*				
Lumbrineris tetraura									
Rhodine sp. A	1				1			1	
Spionidae sp. D									
Pionosyllis spinisetosa						1		1	
Spiophanes bombyx									
Typosyllis variegata					3				
Ogyrides sp. A									
Acrocirrus sp. A									

TABLE 1—*Continued*

Taxon	No. of Individuals/Sample								
	Station Cluster/Subcluster								
	49	50	51	52	53	54	55	56	57
Leptochelia dubia		15	6*			2			202*
Euchone sp. B			1			2			81*
Pionosyllis heterocirrata		14	5		1	21*		14*	
Phyllochaetopterus verrilli									
Konatopus paao		37*							1
Micropodarke sp. A		16*	3			4		4*	3
Synelmis acuminata		4	2			15*			29*
Aspidosiphon muelleri			20*			4			2
Eriopisella sechellensis		7	1			11			3
Elasmopus piikoi		11				3		2	
Sphaerosyllis sp. G			3		4*	21*			6
Fabricia sp. A		9	2		1	5			5
Salmacina dysteri			7*						
Polyophthalmus pictus		5	1			2		7*	
Branchiostoma sp. A		4				3			3
Tanaissus sp. A						4			26
Myriochele oculata			1			11			3
Microphthalmus spp.	6*								
Eusiroides diplonyx									
Myodocope sp. A									9
Protodorvillea biarticulata	11*		1		3				
Seba ekepuu		20*							
Metacirolana sp. A		2			5*				
Paramphinome sp. A		4			2	2		1	
Dipolydora armata									
Typosyllis cornuta			1		3				
Eriopisa laakona					1				
Neanthes arenaceodentata									
Ericthonius brasiliensis		6				1			
Cirratulidae sp. B									
Lumbrineris tetraura	1	4	1						2
Rhodine sp. A		6							
Spionidae sp. D			5						
Pionosyllis spinisetosa		1							
Spiophanes bombyx			1						
Typosyllis variegata					5*				
Ogyrides sp. A									
Acrocirrus sp. A									

TABLE 1—*Continued*

Taxon	No. of Individuals/Sample								
	Station Cluster/Subcluster								
	58	59	60	61	62	63	64	65	66
Leptochelia dubia	12			1			6		
Euchone sp. B	198*								
Pionosyllis heterocirrata	1	1	1		2	1	25*	7*	22*
Phyllochaetopterus verrilli									
Konatopus paao									
Micropodarke sp. A	3					2	8		6*
Synelmis acuminata	51*								
Aspidosiphon muelleri	57*		1				11*		
Eriopisella sechellensis						1			
Elasmopus piikoi						1			1
Sphaerosyllis sp. G	22	1	1		1		8		10*
Fabricia sp. A	2						1		
Salmacina dysteri	2								
Polyophthalmus pictus									2
Branchiostoma sp. A					1		5		
Tanaissus sp. A	10								
Myriochele oculata	1						4		2
Microphthalmus spp.			1					1	
Eusiroides diplonyx									
Myodocope sp. A	3				2		1		
Protodorvillea biarticulata							8		
Seba ekepuu		4*							
Metacirolana sp. A									
Paramphinome sp. A									6*
Dipolydora armata									
Typosyllis cornuta		1	13*				1		
Eriopisa laakona			5*						
Neanthes arenaceodentata						1	19*		
Ericthonius brasiliensis									6*
Cirratulidae sp. B									
Lumbrineris tetraura	2		4*						1
Rhodine sp. A									
Spionidae sp. D	2								
Pionosyllis spinisetosa					4*				
Spiophanes bombyx	5								
Typosyllis variegata									
Ogyrides sp. A								1	
Acrocirrus sp. A									

TABLE 1—*Continued*

Taxon	No. of Individuals/Sample				Regional Total	No. of Stations Where Taxa Present	No. of Stations Where Taxa Dominant
	Station Cluster/Subcluster						
	67	68	69	70			
Leptochelia dubia					360	16	5
Euchone sp. B				1	283	5	2
Pionosyllis heterocirrata	2	8*	1	20*	274	34	17
Phyllochaetopterus verrilli					203	1	1
Konatopus paao					142	8	3
Micropodarke sp. A			1	3	137	23	4
Synelmis acuminata	3			1	126	10	4
Aspidosiphon muelleri	11*			1	115	12	4
Eriopisella sechellensis					110	10	4
Elasmopus piikoi					98	7	1
Sphaerosyllis sp. G					94	16	3
Fabricia sp. A					86	14	2
Salmacina dysteri	1				58	4	2
Polyophthalmus pictus					53	13	1
Branchiostoma sp. A				1	51	14	3
Tanaissus sp. A	4*				51	6	1
Myriochele oculata	4*				46	13	1
Microphthalmus spp.			1	3	41	13	3
Eusiroides diplonyx		11*			41	3	3
Myodocope sp. A					40	10	1
Protodorvillea biarticulata			3	4*	39	11	2
Seba ekepuu					38	5	3
Metacirolana sp. A					35	5	2
Paramphinome sp. A				1	34	16	1
Dipolydora armata					26	1	1
Typosyllis cornuta					25	9	1
Eriopisa laakona					22	3	2
Neanthes arenaceodentata					21	3	1
Ericthonius brasiliensis	1				18	6	1
Cirratulidae sp. B					15	1	1
Lumbrineris tetraura					15	7	1
Rhodine sp. A					15	6	1
Spionidae sp. D	4*				11	3	1
Pionosyllis spinisetosa				2	10	6	1
Spiophanes bombyx	4*				10	3	1
Typosyllis variegata					8	2	1
Ogyrides sp. A					8	2	1
Acrocirrus sp. A	6*				6	1	1

*Ranked among the three most abundant nonmollusk taxa at individual stations. Taxa with three or fewer individuals per station were not eligible to be classified as a dominant at that station.

TABLE 2. Mean Abundance of Numerically Dominant Taxa in Nonmollusk Station Clusters/Subclusters, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals/Sample							
	Station Cluster/Subcluster							
	A	B1	B2	B3	C	D	E	F
Leptochelia dubia	0.1	11.2*	55.5*	22.3*	1.0			0.3
Euchone sp. B	0.1		70.5*					
Pionosyllis heterocirrata	6.9*	10.0*	6.8	10.3*	3.0*	9.3*	1.0	0.3
Phyllochaetopterus verrilli		33.8*						
Konatopus paao		23.3*	0.3			0.3		
Micropodarke sp. A	2.2*	9.2	3.3	7.0*		2.5*	1.0	0.5
Synelmis acuminata	0.1	0.7	24.3*	6.0	3.0*			
Aspidosiphon muelleri	0.4	0.2	20.8*	4.7	5.5*			
Eriopisella sechellensis	0.4	12.7*	3.8	3.7				0.3
Elasmopus piikoi		2.5	0.8			0.8	76.0*	0.3
Sphaerosyllis sp. G	0.6	2.3	13.0*	2.7		2.5*		
Fabricia sp. A	0.3	9.0	3.5	1.3			10.0*	
Salmacina dysteri			2.3	16.0*	0.5			
Polyophthalmus pictus	0.2	4.2	0.8	4.0	0.5	2.3*		
Microphthalmus spp.	1.7*	2.2					1.0	
Eusiroides diplonyx	1.1					5.8*		
Protodorvillea biarticulata	1.8*	0.3	0.3	2.7				
Dipolydora armata							26.0*	
Typosyllis cornuta	1.3*		0.3	0.7			2.0	
Eriopisa laakona	0.4						16.0*	
Neanthes arenaceodentata		0.2		6.3*				0.3
Aphelochaeta marioni		0.2	0.8		2.5*		1.0	
Microcharon sp. A						1.0	5.0*	
Acrocirrus sp. A					3.0*			

*Ranked among the five most abundant taxa in one or more station clusters/subclusters.

TABLE 3. Abundance of Numerically Dominant Mollusk Taxa, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals/Sample								
	Station Cluster/Subcluster								
	31	32	33	34	35	36	37	38	39
Cerithidium perparvulum	2	32*	2	27*	40*	3	168*	13*	2
Pusillina marmorata	1	31*	4	14*	31*	5	65*	11*	5
Tricolia variabilis	38*	16	18*	8	23*	24*	14	8	21*
Diala scopulorum							61		
Diala semistriata	1	2		5	23*	2	99*	1	
Scaliola spp.		3		1	6	1	49	1	
Parashiela beetsi		26*	1	7	17		20	10*	
Triphora spp.	1	6	1	3	3		12	3	
Cerithidium diplax	1	10	1		7		16	2	1
Orbitestella regina	2		1	1	1	5	4		5
Rochefortina sandwichensis	1	20	2	17*	8	2	20	4	
Alcyna ocellata	2	5			2	3	15	2	1
Dendropoma spp.	4		2	8		5		1	3
Ittibittium parcum	5	1	4			4			8*
Rissoina cerithiiformis				3	10		2	2	
Finella pupoides									
Fragum mundum	6*	8	16*	4	2	3		3	
Kellia hawaiensis	4	22	1	5		19*			3
Leptothyra rubricincta	1		1						
Cyclostremiscus emeryi	2	1	2			5	3		6*
Brachidontes crebristriatus	13*		11*			8*			6*
Cerithium zebrum				2			4	1	
Carinapex minutissima		3	2		4				
Rissoina ambigua									
Schwartziella triticea									
Pyrgulina sp.							4		
Rissoidae spp.		3							
Odostomia sp.									

TABLE 3—*Continued*

Taxon	No. of Individuals/Sample								
	Station Cluster/Subcluster								
	40	41	42	43	44	45	46	47	48
Cerithidium perparvulum	5*	181*	21*	14*	81*	72*	24*	39*	80*
Pusillina marmorata		34	5*	3	110*	30*	50*	8*	
Tricolia variabilis	2	8	4		13	10	75*	7*	
Diala scopulorum		227*	1		11			1	
Diala semistriata	1	113*	9*	43*	77*	16	9	7*	
Scaliola spp.		43	2	6	16	31*	6	6	
Parashiela beetsi		12		1	23	22	12	2	
Triphora spp.	3	13	4	1	10	5	4	2	2
Cerithidium diplax		27	1	2	9	16	8	5	10*
Orbitestella regina		4			6	1	8		
Rochefortina sandwichensis		5	1	1	10	8		1	1
Alcyna ocellata		9	1	1	27	2	6	1	1
Dendropoma spp.	2	3		1	1	1	19		
Ittibittium parcum	1	1					9	1	
Rissoina cerithiiformis	12*				1		5		
Finella pupoides		1		49*					
Fragum mundum	5*		1			2	5		1
Kellia hawaiensis						4			
Leptothyra rubricincta		2					2		
Cyclostremiscus emeryi		1					8		
Brachidontes crebristriatus	2						1		
Cerithium zebrum	3	7			1		4		
Carinapex minutissima		2							4*
Rissoina ambigua	2								
Schwartziella triticea									
Pyrgulina sp.									
Rissoidae spp.									
Odostomia sp.									

TABLE 3—*Continued*

Taxon	No. of Individuals/Sample								
	Station Cluster/Subcluster								
	49	50	51	52	53	54	55	56	57
Cerithidium perparvulum		3	65*			186*	4*	44*	7*
Pusillina marmorata	85*	5	50*	1	3	65*	1	43*	6*
Tricolia variabilis	26	16*	6	5		2	11*	1	2
Diala scopulorum	1		431*						15*
Diala semistriata	50*		37			103*		20*	
Scaliola spp.	22		35			62		8	2
Parashiela beetsi	23	2	5			21	1	16	4
Triphora spp.	12	4	14	3	3	10	2	17	2
Cerithidium diplax		1	8	1		17	1	3	
Orbitestella regina	2	3	3			5	2	2	1
Rochefortina sandwichensis	6		3		1	5		2	2
Alcyna ocellata	27*		4			4			2
Dendropoma spp.	2	6*	2		1		8*	1	3
Ittibittium parcum		2	1		9*		1		2
Rissoina cerithiiformis	1	8*		7*		2		3	
Finella pupoides			20			4			5
Fragum mundum					2			2	
Kellia hawaiensis		1					2		
Leptothyra rubricincta		4		5	1				2
Cyclostremiscus emeryi		4	3			1	1		
Brachidontes crebristriatus		4		1	1		2		
Cerithium zebrum		1		10*	6*			1	
Carinapex minutissima		3	1		1	1		3	
Rissoina ambigua		3		8*	2				
Schwartziella triticea				6					
Pyrgulina sp.			10						1
Rissoidae spp.						2			
Odostomia sp.			2		4*			4	

TABLE 3—*Continued*

Taxon	No. of Individuals/Sample								
	Station Cluster/Subcluster								
	58	59	60	61	62	63	64	65	66
Cerithidium perparvulum	2	6*		5	16*		9*	17*	58*
Pusillina marmorata	3	7*	14	25*	27*		27*	23*	19
Tricolia variabilis	1	10*	30*	28*	21*	17*	25*	41*	31*
Diala scopulorum	19*						8		
Diala semistriata		6*			4	1		3	22*
Scaliola spp.								3	6
Parashiela beetsi	1	3		6			3	6	15
Triphora spp.	4*	6*	16	1	7	5	3	4	6
Cerithidium diplax					12		2	7	17
Orbitestella regina	4*			19*	5		2	6	1
Rochefortina sandwichensis		1		2	1		1	3	1
Alcyna ocellata		2	7	4	7		6	3	2
Dendropoma spp.					3		4	4	1
Ittibittium parcum	1		2	2			5	5	
Rissoina cerithiiformis			33*	2		14*	2		
Finella pupoides	2						1		1
Fragum mundum					1				
Kellia hawaiensis							3		
Leptothyra rubricincta		2	24*	1		12*	2	1	
Cyclostremiscus emeryi				2	1		1	6	
Brachidontes crebristriatus									
Cerithium zebrum	1		8			7			1
Carinapex minutissima		3	3			4			
Rissoina ambigua			9			8			
Schwartziella triticea			4			12*			
Pyrgulina sp.	5*							1	
Rissoidae spp.									
Odostomia sp.									

TABLE 3—*Continued*

Taxon	No. of Individuals/Sample				Regional Total	No. of Stations Where Taxa Present	No. of Stations Where Taxa Dominant
	Station Cluster/Subcluster						
	67	68	69	70			
Cerithidium perparvulum	3	22		27*	1,280	34	25
Pusillina marmorata		62*	1	45*	919	36	22
Tricolia variabilis		240*	4	30*	836	36	19
Diala scopulorum	18*			1	794	12	5
Diala semistriata	2	2		2	660	27	12
Scaliola spp.	7*	5		3	324	23	2
Parashiela beetsi		23		12	294	27	2
Triphora spp.		10	5	18	225	37	2
Cerithidium diplax	3	10		10	208	28	1
Orbitestella regina		50		17	160	26	2
Rochefortina sandwichensis	14*	10		5	158	30	2
Alcyna ocellata	1	3		1	151	29	1
Dendropoma spp.		39		10	134	25	2
Ittibittium parcum		67*	1		132	21	3
Rissoina cerithiiformis		1	17*	5	130	19	6
Finella pupoides	3				86	9	1
Fragum mundum	2	10		6	79	18	3
Kellia hawaiensis		11		3	78	12	1
Leptothyra rubricincta		10	2	1	73	17	2
Cyclostremiscus emeryi		20		1	68	18	1
Brachidontes crebristriatus		13			62	11	4
Cerithium zebrum			2		59	16	2
Carinapex minutissima			5	10	49	15	1
Rissoina ambigua			9*	3	44	8	2
Schwartziella triticea		5	1		28	5	1
Pyrgulina sp.					21	5	1
Rissoidae spp.			7*	9	21	4	1
Odostomia sp.		2			12	4	1

*Ranked among the three most abundant nonmollusk taxa at individual stations. Taxa with three or fewer individuals per station were not eligible to be classified as a dominant at that station.

TABLE 4. Mean Abundance of Numerically Dominant Taxa in Mollusk Station Clusters/Subclusters, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

Taxon	Mean No. of Mollusk Individuals/Sample				
	Station Cluster/Subcluster				
	A	B1	B2	B3	C
Cerithidium perparvulum	2.25	28.83*	113.50*	40.60*	11.26*
Pusillina marmorata	3.75	34.33*	68.17*	30.60*	7.16*
Tricolia variabilis	25.25*	51.67*	11.50*	34.60*	9.63*
Diala scopulorum		0.17	121.83*		3.26
Diala semistriata	0.75	8.83	79.83*	10.40	3.84*
Scaliola spp.	0.25	4.00	37.83*	9.80	1.21
Parashiela beetsi	0.25	14.17*	17.33	16.20*	1.21
Lophocochlias minutissimus	2.50	12.33*	12.83	14.60*	1.42
Triphora spp.	0.50	9.00	11.83	5.00	3.84*
Ittibittium parcum	5.25*	11.17	0.33	3.00	1.42
Rissoina cerithiiformis		4.00	1.00	1.00	5.00*
Fragum mundum	6.25*	4.50		3.00	0.63
Kellia hawaiensis	6.75*	3.17		5.20	0.32
Brachidontes crebristriatus	9.50*	2.17		0.20	0.53

*Ranked among the five most abundant taxa in one or more station clusters/subclusters.

TABLE 5. Mean Abundance of Numerically Dominant Nonmollusk Taxa in Relation to 10-m Depth Ranges Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals					
	Depth Range (m)					
	0–9.9	10.0–19.9	20.0–29.9	30.0–39.9	40.0–49.9	50.0–59.9
Leptochelia dubia		2.0*	3.5*	9.3	202.0*	28.0*
Euchone sp. B		0.1			81.0*	1.0
Pionosyllis heterocirrata	2.0*	7.9*	11.5*	12.7*		12.0*
Phyllochaetopterus verrilli				67.7*		
Konatopus paao	0.1	8.8*	0.5	16.3*	1.0	
Micropodarke sp. A	0.3	4.2*	3.2*	12.7*	3.0	6.5
Synelmis acuminata		0.1		1.3	29.0*	8.5
Aspidosiphon muelleri	0.1	0.1	0.5	0.7	2.0	2.0
Eriopisella sechellensis	0.1		3.2*	21.3*	3.0	5.5
Elasmopus piikoi	6.4*	0.2	0.2	5.0		1.5
Sphaerosyllis sp. G	0.4	0.4	3.8*	0.7	6.0	10.5*
Fabricia sp. A	1.0	1.3	0.2	14.0*	5.0	4.0
Prionospio cirrifera		0.8	0.5	4.3	8.0	10.5*
Salmacina dysteri						24.0*
Branchiostoma sp. A		1.1	3.2*	2.7	3.0	1.5
Tanaissus sp. A					26.0*	5.0
Myriochele oculata		0.1	3.0	0.7	3.0	5.5
Eusiroides diplonyx	3.4*					
Myodocope sp. A		1.0	0.3	0.7	9.0	1.5
Nematonereis unicornis	0.3	0.3	0.3	3.7		2.5
Ophiodromus angustifrons		0.5	1.0	0.7	2.0	2.5
Metacirolana sp. A	0.4	2.7*		0.7		0.5
Laonice cirrata		0.4	0.3	2.3		3.0
Leptochelia sp. A				3.7	10.0*	1.5
Dipolydora armata	2.2*					
Eriopisa laakona	1.8*					
Prionospio cirrobranchiata		0.1			2.0	2.0
Joeropsis hawaiiensis	0.3	0.3		0.3		
Spionidae sp. D						
Aphelochaeta marioni	0.1			0.3		
Spiophanes bombyx						
Acrocirrus sp. A						
Gammaropsis atlantica				0.3		

TABLE 5—*Continued*

Taxon	No. of Individuals				
	Depth Range (m)				
	60.0–69.9	70.0–79.9	80.0–89.9	90.0–99.9	100.0–109.9
Leptochelia dubia	9.0	7.0*	6.0*	2.0*	
Euchone sp. B	99.0*		1.0		
Pionosyllis heterocirrata	13.0*	3.0	5.0*	4.0*	2.0
Phyllochaetopterus verrilli					
Konatopus paao					
Micropodarke sp. A	5.5	4.0*	3.0		
Synelmis acuminata	25.5*	16.0*	2.0	3.0*	3.0
Aspidosiphon muelleri	34.0*	3.0	20.0*		11.0*
Eriopisella sechellensis		11.0*	1.0		
Elasmopus piikoi					
Sphaerosyllis sp. G	15.0*		3.0		
Fabricia sp. A	1.5		2.0		
Prionospio cirrifera	5.0	4.0*	1.0	1.0	3.0
Salmacina dysteri	1.0		7.0*		1.0
Branchiostoma sp. A	2.5	2.0			
Tanaissus sp. A	5.0	1.0			4.0*
Myriochele oculata	2.5	1.0	1.0		4.0*
Eusiroides diplonyx					
Myodocope sp. A	2.0	10.0*			
Nematonereis unicornis	5.0	2.0		2.0*	
Ophiodromus angustifrons	3.5	1.0	5.0*	2.0*	2.0
Metacirolana sp. A					
Laonice cirrata	2.0	1.0	5.0*	1.0	
Leptochelia sp. A	1.0		1.0		
Dipolydora armata					
Eriopisa laakona					
Prionospio cirrobranchiata			5.0*	2.0*	2.0
Joeropsis hawaiiensis		4.0*			
Spionidae sp. D	1.0		5.0*		4.0*
Aphelochaeta marioni	1.5			2.0*	3.0
Spiophanes bombyx	2.5		1.0		4.0*
Acrocirrus sp. A					6.0*
Gammaropsis atlantica	0.5	4.0*			

*Ranked among the five most abundant nonmollusk taxa at one or more depth ranges.

APPENDIXES

Appendix A. Sediment Data and Sample Locations

TABLE A.1. Position and Depth for Sediment Samples, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

Station	Sampling Date	Position		Depth (m)
		Latitude	Longitude	
31	13 August	21° 17' 06.5"	158° 05' 58.0"	6.4
32	13 August	21° 17' 16.5"	158° 05' 19.2"	7.6
33	13 August	21° 16' 28.1"	158° 05' 45.5"	22.6
34	13 August	21° 16' 46.3"	158° 04' 15.1"	18.6
35	13 August	21° 16' 30.5"	158° 04' 43.0"	22.9
36	13 August	21° 17' 15.9"	158° 03' 08.8"	12.5
37	06 August	21° 15' 48.0"	158° 04' 56.5"	73.2
38	13 August	21° 16' 48.4"	158° 04' 06.9"	17.7
39	13 August	21° 17' 41.6"	158° 02' 22.8"	5.8
40	14 August	21° 18' 00.8"	158° 01' 08.6"	5.8
41	06 August	21° 15' 34.3"	158° 04' 09.4"	92.0
42	13 August	21° 16' 17.6"	158° 03' 02.2"	37.5
43	14 August	21° 17' 10.1"	158° 01' 33.2"	29.0
44	06 August	21° 15' 40.7"	158° 03' 27.5"	52.4
45	14 August	21° 17' 02.8"	158° 02' 14.5"	22.6
46	14 August	21° 17 15.5"	158° 03' 49.6"	14.6
47	06 August	21° 15' 58.3"	158° 02' 36.0"	38.4
48	14 August	21° 17' 36.9"	157° 59' 25.1"	11.6
49	14 August	21° 18' 18.6"	157° 58' 44.0"	3.7
50	13 August	21° 15' 29.3"	158° 02' 43.7"	39.9
51	06 August	21° 16' 59.7"	158° 00' 24.3"	87.2
52	14 August	21° 18' 14.3"	157° 59' 10.5"	1.8
53	14 August	21° 18' 39.1"	157° 57' 32.0"	1.2
54	06 August	21° 16' 53.9"	157° 59' 23.4"	57.3
55	14 August	21° 18' 01.8"	157° 58' 31.2"	5.2
56	14 August	21° 17' 20.7"	157° 58' 43.3"	19.2
57	06 August	21° 17' 47.0"	157° 57' 24.6"	41.5
58	06 August	21° 17' 37.0"	157° 57' 25.2"	69.2
59	07 August	21° 17' 51.7"	157° 56' 31.3"	18.9
60	07 August	21° 18' 06.2"	157° 55' 42.0"	1.8
61	07 August	21° 17' 52.3"	157° 55' 47.2"	12.2
62	07 August	21° 17' 27.8"	157° 55' 02.7"	20.1
63	07 August	21° 17' 46.9"	157° 54' 20.4"	4.9
64	06 August	21° 16' 49.7"	157° 54' 02.2"	68.0
65	07 August	21° 17' 18.1"	157° 52' 43.7"	18.0
66	07 August	21° 16' 49.8"	157° 51' 21.5"	22.3
67	06 August	21° 15' 41.7"	157° 50' 47.2"	108.8
68	07 August	21° 15' 37.1"	157° 49' 40.5"	4.9
69	07 August	21° 15' 07.5"	157° 47' 48.8"	5.8
70	07 August	21° 14' 40.2"	157° 48' 25.2"	16.5

SOURCE: Oceanographic Team, Department of Environmental Services, City and County of Honolulu.

TABLE A.2. Sediment Chemical Characterization of Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

Station	PD (cm)	ORP (+mV)	TKN (mg/dry kg)	TOC (% dry weight)
31	Dive core	120	364	0.47
32	Dive core	130	385	0.46
33	Dive core	40	507	0.52
34	Dive core	110	362	0.63
35	Dive core	40	751	0.94
36	Dive core	110	345	0.47
37	8.0	20	251	0.43
38	Dive core	95	379	0.42
39	Dive core	120	419	0.40
40	Dive core	165	368	0.58
41	7.5	30	60	0.37
42	Dive core	25	267	0.30
43	Dive core	145	281	0.30
44	8.0	45	110	0.51
45	Dive core	160	437	0.63
46	Dive core	170	260	0.39
47	6.5	120	929	0.85
48	Dive core	170	350	0.49
49	Dive core	145	353	0.37
50	Dive core	20	370	0.37
51	8.0	90	188	0.39
52	Dive core	145	248	0.31
53	Dive core	160	348	0.36
54	9.5	120	215	0.27
55	Dive core	150	297	0.39
56	Dive core	115	357	0.46
57	8.5	120	380	0.66
58	6.5	75	677	0.73
59	Dive core	135	252	0.47
60	Dive core	160	301	0.48
61	Dive core	135	266	0.41
62	Dive core	135	232	0.34
63	Dive core	150	262	0.29
64	6.5	120	261	0.32
65	Dive core	160	218	0.26
66	Dive core	120	194	0.26
67	7.0	140	244	0.35
68	Dive core	145	245	0.34
69	Dive core	105	238	0.26
70	Dive core	110	287	0.32

SOURCE: PD (penetration depth), ORP (oxidation-reduction potential), and TKN (total Kjeldahl nitrogen) data from Oceanographic Team and Environmental Quality Laboratory, Department of Environmental Services, City and County of Honolulu; TOC (total organic carbon) data from Columbia Analytical Services, Inc. (Kelso, Washington).

TABLE A.3. Sediment Grain-Size Analysis of Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

Station	Sample Dry Weight Distribution (%)							
	Phi Size							
	-2	-1	0	1	2	3	4	>4–12
31	0.60	0.28	0.85	4.71	85.39	4.14	0.12	1.91
32	0.28	3.47	18.88	39.68	24.74	9.39	0.27	1.93
33	6.53	6.33	5.81	6.34	16.58	49.81	3.49	2.84
34	35.65	8.55	7.99	24.91	14.27	3.96	0.88	2.65
35	32.79	9.09	16.28	21.92	9.27	4.13	1.25	2.11
36	0.00	0.05	0.28	1.23	17.18	75.93	0.89	2.34
37	1.81	5.77	16.92	25.58	25.14	21.30	3.90	3.71
38	28.95	6.99	14.49	25.36	14.98	3.98	6.25	1.79
39	0.00	0.00	0.00	0.13	48.46	48.06	0.39	2.52
39 (dup)	0.00	0.00	0.01	0.14	48.18	48.46	0.39	2.40
40	2.73	31.34	41.51	14.67	3.30	1.83	0.48	1.77
41	0.00	3.36	13.50	27.18	30.28	17.71	4.80	3.68
42	22.37	8.55	12.66	20.02	19.50	10.62	2.47	3.06
43	0.57	0.60	6.51	25.11	39.38	19.10	6.14	3.30
44	16.35	12.71	24.19	20.90	13.71	6.65	2.30	4.73
45	0.00	0.00	0.29	4.42	39.97	49.58	3.56	2.87
45 (dup)	0.00	0.00	0.29	4.45	39.64	49.75	3.80	3.10
46	0.00	0.42	2.97	30.51	55.35	8.48	0.25	2.50
47	19.17	9.48	10.89	18.99	22.68	13.45	2.73	3.68
48	8.34	18.86	22.25	15.14	5.45	27.25	1.01	2.08
49	3.32	6.60	14.26	22.93	43.72	6.87	0.12	1.80
50	0.00	0.82	4.62	18.66	40.83	28.35	3.36	2.74
51	1.48	1.52	3.53	13.36	32.48	26.29	13.76	6.69
52	4.38	15.40	44.62	29.22	4.79	0.53	0.08	1.57
53	8.33	6.66	19.47	52.43	7.60	3.76	0.45	2.08
54	0.45	3.79	13.98	22.12	21.82	21.45	10.55	4.60
55	0.00	0.16	1.26	3.05	30.45	64.21	0.19	1.91
56	2.66	7.69	26.31	40.30	17.07	4.91	0.53	2.45
57	0.40	0.77	3.03	5.17	8.71	21.99	42.15	16.23
58	0.09	1.69	3.46	6.12	9.28	16.59	28.23	33.19
59	1.72	6.60	14.38	42.77	26.84	3.75	0.15	1.17
60	9.45	9.28	24.92	47.09	7.62	0.15	0.28	1.26
61	0.00	2.72	0.14	1.11	7.59	46.57	39.78	3.02
62	0.00	0.04	0.63	7.48	39.81	36.73	11.95	2.30
63	0.00	0.97	24.45	69.58	0.97	0.11	0.06	0.93
64	0.29	1.69	5.66	16.11	32.38	31.52	9.12	3.23
65	0.14	0.33	1.66	16.31	38.42	39.15	2.22	1.15
66	5.59	20.16	20.52	24.90	17.05	5.47	3.69	2.07
67	0.65	0.26	1.25	2.87	9.44	45.78	32.56	6.04
67 (dup)	0.07	0.95	1.16	3.06	9.69	46.75	32.79	6.70
68	0.00	0.01	0.13	6.75	83.05	7.43	0.28	1.47
69	7.61	16.68	45.66	21.33	4.77	0.97	0.11	0.73
70	2.15	5.20	17.76	32.22	27.37	10.75	0.63	1.57
70 (dup)	0.68	3.88	18.30	32.70	29.11	11.91	0.68	1.51

SOURCE: Environmental Quality Laboratory, Department of Environmental Services, City and County of Honolulu.

NOTE: The values listed indicate the fraction percentage of the estimated dry weight of the sediment samples. The coarse fraction (-2 to +4) was analyzed by the sieve method. The fine fraction (greater than +4 to +12) was analyzed by the pipette method.

Appendix B. Basic Statistics and Variances for Nonmollusk Data

TABLE B.1. Abundance, Taxa Richness, Diversity, and Evenness of Nonmollusks, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

	Station									
	31	32	33	34	35	36	37	38	39	40
No. of Individuals	60	19	268	140	105	34	178	257	29	198
No. of Taxa	8	7	26	35	33	10	53	51	6	32
Diversity Index (H')	1.31	1.60	2.01	2.93	2.97	1.85	3.44	2.97	0.83	2.41
Evenness Index (J)	0.63	0.82	0.62	0.82	0.85	0.80	0.87	0.76	0.46	0.69

	Station									
	41	42	43	44	45	46	47	48	49	50
No. of Individuals	102	106	192	392	124	45	835	92	38	291
No. of Taxa	23	32	28	65	17	12	75	16	6	55
Diversity Index (H')	2.07	2.70	2.62	3.33	1.81	1.85	2.80	2.22	1.57	3.50
Evenness Index (J)	0.66	0.78	0.79	0.80	0.64	0.74	0.65	0.80	0.88	0.87

	Station									
	51	52	53	54	55	56	57	58	59	60
No. of Individuals	149	9	64	395	11	99	1,091	698	52	58
No. of Taxa	48	8	19	45	4	14	44	69	18	15
Diversity Index (H')	3.31	2.04	2.41	2.60	1.12	1.65	2.40	2.83	2.41	2.14
Evenness Index (J)	0.85	0.98	0.82	0.68	0.81	0.62	0.63	0.67	0.83	0.79

	Station									
	61	62	63	64	65	66	67	68	69	70
No. of Individuals	15	58	10	269	31	113	120	54	26	81
No. of Taxa	4	15	9	34	11	26	26	10	13	18
Diversity Index (H')	1.08	1.87	2.16	2.76	2.09	2.78	2.67	1.79	2.34	2.31
Evenness Index (J)	0.78	0.69	0.98	0.78	0.87	0.85	0.82	0.78	0.91	0.80

TABLE B.2. Depth, Sediment, and Biological Conditions for Nonmollusk Station Clusters/Subclusters, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

	Station Cluster/Subcluster							
	A	B1	B2	B3	C	D	E[a]	F
No. of Stations	16	6	4	3	2	4	1	4
No. of Nonmollusk Individuals: Mean	63.31	330.50	583.25	279.67	111.00	68.75	198	11.25
No. of Nonmollusk Individuals: Range	19–124	140–835	149–1091	178–392	102–120	29–113		9–15
No. of Nonmollusk Taxa: Mean	15.63	45.00	51.50	50.67	24.50	14.00	32	6.25
No. of Nonmollusk Taxa: Range	6–33	26–75	44–69	34–65	23–26	6–26		4–9
No. of Crustacean Individuals: Mean	6.94	95.50	142.75	75.00	8.50	18.25	109	6.50
No. of Crustacean Individuals: Range	0–28	33–167	23–432	21–153	6–11	8–31		3–10
No. of Crustacean Taxa: Mean	2.69	15.17	13.25	14.00	3.50	4.00	8	2.75
No. of Crustacean Taxa: Range	0–8	6–26	11–15	3–27	3–4	2–8		2–4
Depth (m): Mean	13.37	27.69	63.78	64.52	100.43	14.94	5.79	6.02
Depth (m): Range	1.22–37.49	17.68–39.93	41.45–87.17	52.43–73.15	92.05–108.81	5.79–22.25		1.83–12.19
TOC (%): Mean	0.43	0.52	0.51	0.42	0.36	0.40	0.58	0.35
TOC (%): Range	0.26–0.94	0.30–0.85	0.27–0.73	0.32–0.51	0.35–0.37	0.26–0.47		0.29–0.41
Silt and Clay (%): Mean	1.88	2.83	15.18	3.89	5.03	2.33	1.77	1.86
Silt and Clay (%): Range	0.73–3.06	1.79–3.68	4.60–33.19	3.23–4.73	3.68–6.37	2.07–2.46		0.93–3.02
Medium Sand (%): Mean	32.47	24.79	18.07	23.74	19.92	24.91	3.30	10.95
Medium Sand (%): Range	4.77–85.39	14.27–40.83	8.71–32.48	13.71–32.38	9.57–30.28	17.05–48.32		0.97–30.45

TABLE B.2—*Continued*

	Statistical Comparison		
	F Ratio	*p*	Significant Differences
No. of Stations			
No. of Nonmollusk Individuals: Mean No. of Nonmollusk Individuals: Range	7.48**	<0.0001	B2 > F, A, D
No. of Nonmollusk Taxa: Mean No. of Nonmollusk Taxa: Range	14.54**	<0.0001	B3, B2 > F, D, A, C; B1 > F, D, A
No. of Crustacean Individuals: Mean No. of Crustacean Individuals: Range	3.38*	0.0107	No pairwise contrasts are significantly different
No. of Crustacean Taxa: Mean No. of Crustacean Taxa: Range	8.33**	<0.0001	B1 > A, F, C, D; B3 > A, F; B2 > A
Depth (m): Mean Depth (m): Range	37.58**	<0.0001	C > F, A, D, B1, B2, B3; B2, B3 > F, A, D, B1; B1 > F, A
TOC (%): Mean TOC (%): Range	0.71ns	0.6459	
Silt and Clay (%): Mean Silt and Clay (%): Range	6.186**	0.0002	B2 > F, A, D, B1, B3
Medium Sand (%): Mean Medium Sand (%): Range	0.82ns	0.5623	

[a] Cluster E was excluded from the statistical comparison because of the lack of replicates.

* $p < 0.05$, ** $p < 0.01$, ns = not significant.

TABLE B.3. Abundance, Taxa Richness, Diversity, and Evenness of Crustaceans, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

	Station									
	31	32	33	34	35	36	37	38	39	40
No. of Individuals	9	0	33	47	5	8	51	158	25	109
No. of Taxa	2	0	7	12	5	2	12	21	3	8
Diversity Index (H')	0.53	0.00	1.33	2.06	1.61	0.38	2.20	1.93	0.33	1.06
Evenness Index (J)	0.76	ND	0.69	0.83	1.00	0.54	0.88	0.63	0.30	0.51

	Station									
	41	42	43	44	45	46	47	48	49	50
No. of Individuals	6	20	42	153	2	5	167	2	0	126
No. of Taxa	4	8	6	27	2	2	26	2	0	19
Diversity Index (H')	1.33	1.77	1.32	2.45	0.69	0.50	2.54	0.69	0.00	2.32
Evenness Index (J)	0.96	0.85	0.74	0.74	1.00	0.72	0.78	1.00	ND	0.79

	Station									
	51	52	53	54	55	56	57	58	59	60
No. of Individuals	23	4	13	55	9	9	432	61	6	7
No. of Taxa	11	4	6	15	2	3	13	14	2	3
Diversity Index (H')	2.20	1.39	1.59	1.98	0.64	1.00	1.36	2.31	0.64	0.80
Evenness Index (J)	0.92	1.00	0.89	0.73	0.92	0.91	0.53	0.87	0.92	0.72

	Station									
	61	62	63	64	65	66	67	68	69	70
No. of Individuals	10	4	3	21	5	31	11	28	5	0
No. of Taxa	2	3	3	3	3	8	3	3	2	0
Diversity Index (H')	0.33	1.04	1.10	0.77	0.95	1.75	0.92	0.81	0.50	0.00
Evenness Index (J)	0.47	0.95	1.00	0.70	0.86	0.84	0.83	0.73	0.72	ND

NOTE: ND = not determined.

TABLE B.4. Sediment and Nonmollusk Conditions in Relation to 10-m Depth Ranges, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

	Depth Range (m)										
	0–9.9	10.0–19.9	20.0–29.9	30.0–39.9	40.0–49.9	50.0–59.9	60.0–69.9	70.0–79.9	80.0–89.9	90.0–99.9	100.0–109.9
Code for Statistical Comparisons [a]	S	S	S	M	M	M	M	D	D	D	D
No. of Stations	12	10	6	3	1	2	2	1	1	1	1
No. of Nonmollusk Individuals: Mean	48.00	84.60	143.33	410.67	1091	393.50	483.50	178	149	102	120
No. of Nonmollusk Individuals: Range	9–198	15–257	58–268	106–835		392–395	269–698				
No. of Nonmollusk Taxa: Mean	11.42	18.90	24.166667	54.00	44	55.00	51.50	53	48	23	26
No. of Nonmollusk Taxa: Range	4–32	4–51	15–33	32–75		45–65	34–69				
No. of Crustacean Individuals: Mean	17.67	25.00	19.50	104.33	432	104.00	41.00	51	23	6	11
No. of Crustacean Individuals: Range	0–109	0–158	2–42	20–167		55–153	21–61				
No. of Crustacean Taxa: Mean	3.00	4.90	5.17	17.67	13	21.00	8.50	12	11	4	3
No. of Crustacean Taxa: Range	0–8	0–21	2–8	8–26		15–27	3–14				
Depth (m): Mean	4.57	15.97	23.22	38.61	41.45	54.86	68.58	73.15	87.17	92.05	108.81
Depth (m): Range	1.22–7.62	11.58–19.2	20.12–28.96	37.49–39.93		52.43–57.30	67.97–69.19				
TOC (%): Mean	0.39	0.43	0.50	0.51	0.66	0.39	0.53	0.43	0.39	0.37	0.35
TOC (%): Range	0.26–0.58	0.26–0.63	0.26–0.94	0.30–0.85		0.27–0.51	0.32–0.73				
Silt and Clay (%): Mean	1.65	2.07	2.60	3.16	16.23	4.67	18.21	3.71	6.69	3.68	6.37
Silt and Clay (%): Range	0.73–2.46	1.15–3.02	2.07–3.30	2.74–3.68		4.60–4.73	3.23–33.19				
Medium Sand (%): Mean	28.73	22.54	26.98	27.67	8.71	17.77	20.83	25.14	32.48	30.28	9.57
Medium Sand (%): Range	0.97–85.39	5.45–55.35	9.27–39.81	19.50–40.83		13.71–21.82	9.28–32.38				

TABLE B.4—*Continued*

	Statistical Comparison		
	F Ratio	*p*	Significant Differences
Code for Statistical Comparisons			
No. of Stations			
No. of Nonmollusk Individuals: Mean	26.00**[b]	<0.0001	M > S
No. of Nonmollusk Individuals: Range			
No. of Nonmollusk Taxa: Mean	26.63**	<0.0001	M > S
No. of Nonmollusk Taxa: Range			
No. of Crustacean Individuals: Mean	11.55**[b]	0.0001	M > S
No. of Crustacean Individuals: Range			
No. of Crustacean Taxa: Mean	14.72**	<0.0001	M > S
No. of Crustacean Taxa: Range			
Depth (m): Mean			
Depth (m): Range			
TOC (%): Mean	0.55ns[c]	0.5815	
TOC (%): Range			
Silt and Clay (%): Mean	18.22**[c]	<0.0001	M > S
Silt and Clay (%): Range			
Medium Sand (%): Mean	0.20ns	0.8200	
Medium Sand (%): Range			

[a] There are no replicates for five of the eleven 10-m depth ranges. The data were therefore pooled for statistical analysis into three depth ranges: shallow (S), 0–29.9 m; mid-depth (M), 30.0–69.9 m; and deep (D), ≥ 70.0 m.

[b] ANOVA based on square root-transformed data to meet assumption of homogeneity of variances.

[c] ANOVA based on log-transformed data to meet assumption of homogeneity of variances.

**$p < 0.01$, ns = not significant.

Appendix C. Basic Statistics and Variances for Mollusk Data

TABLE C.1. Abundance, Taxa Richness, Diversity, and Evenness of Mollusks, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

	Station									
	31	32	33	34	35	36	37	38	39	40
No. of Individuals	103	274	119	176	275	127	761	119	83	63
No. of Taxa	30	44	45	45	49	35	68	39	25	28
Diversity Index (H')	2.55	3.16	3.30	3.30	3.20	3.03	3.05	3.33	2.74	3.02
Evenness Index (J)	0.75	0.84	0.87	0.87	0.82	0.85	0.73	0.91	0.85	0.90

	Station									
	41	42	43	44	45	46	47	48	49	50
No. of Individuals	898	76	162	616	304	375	99	111	418	101
No. of Taxa	61	30	31	69	46	64	25	19	60	40
Diversity Index (H')	2.69	2.80	2.35	3.19	2.88	3.30	2.35	1.28	3.17	3.32
Evenness Index (J)	0.66	0.83	0.69	0.76	0.76	0.79	0.74	0.44	0.78	0.90

	Station									
	51	52	53	54	55	56	57	58	59	60
No. of Individuals	839	55	58	687	42	302	80	53	64	235
No. of Taxa	58	17	31	55	18	64	33	18	24	52
Diversity Index (H')	2.27	2.47	3.15	2.77	2.42	3.32	3.11	2.35	2.84	3.22
Evenness Index (J)	0.56	0.87	0.92	0.69	0.85	0.80	0.90	0.81	0.89	0.81

	Station									
	61	62	63	64	65	66	67	68	69	70
No. of Individuals	174	144	111	144	196	218	89	810	70	398
No. of Taxa	36	34	32	47	49	34	28	74	23	89
Diversity Index (H')	2.93	2.88	2.91	3.16	3.18	2.57	2.81	3.09	2.64	3.83
Evenness Index (J)	0.82	0.82	0.84	0.82	0.82	0.73	0.85	0.72	0.84	0.85

TABLE C.2. Depth, Sediment, and Biological Conditions for Mollusk Station Clusters/Subclusters, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

	Station Cluster					Statistical Comparison		
	A	B1	B2	B3	C	F Ratio	*p*	Significant Differences
No. of Stations	4	6	6	5	19			
No. of Individuals: Mean	108.00	346.67	703.17	273.40	101.63	30.04**	<0.0001	B2 > C, A, B3, B1; B1 > C, A
No. of Individuals: Range	83–127	119–810	418–898	196–375	42–235			
No. of Taxa: Mean	33.75	60.00	61.83	47.40	29.79	15.30**	<0.0001	B1, B2 > C, A
No. of Taxa: Range	25–45	39–89	55–69	34–64	17–52			
Depth (m): Mean	11.81	16.61	60.96	17.01	27.45	3.76*	0.0120	B2 > C, B3, B1, A
Depth (m): Range	5.79–22.56	4.88–22.86	3.66–92.05	7.62–22.56	1.22–108.81			
TOC (%): Mean	0.47	0.52	0.39	0.40	0.43	0.62ns	0.6501	
TOC (%): Range	0.40–0.52	0.32–0.94	0.27–0.51	0.26–0.63	0.26–0.85			
Silt and Clay (%): Mean	2.39	2.00	4.20	2.13	4.77	0.48ns	0.7464	
Silt and Clay (%): Range	1.91–2.84	1.47–2.65	1.80–6.69	1.15–2.99	0.73–33.19			
Medium Sand (%): Mean	41.87	27.81	27.86	35.07	16.92	2.19ns	0.0903	
Medium Sand (%): Range	16.58–85.39	9.27–83.05	13.71–43.72	17.05–55.35	0.97–40.83			

*$p < 0.05$, **$p < 0.01$, ns = not significant.

TABLE C.3. Sediment and Mollusk Conditions in Relation to 10-m Depth Ranges, Māmala Bay Sampling Stations, O'ahu, Hawai'i, August 2003

	Depth Range (m)										
	0–9.9	10.0–19.9	20.0–29.9	30.0–39.9	40.0–49.9	50.0–59.9	60.0–69.9	70.0–79.9	80.0–89.9	90.0–99.9	100.0–109.9
Code for Statistical Comparisons[a]	S	S	S	M	M	M	M	D	D	D	D
No. of Stations	12	10	6	3	1	2	2	1	1	1	1
No. of Individuals: Mean	193.50	204.20	203.67	92.00	80	651.50	98.50	761	839	898	89
No. of Individuals: Range	42–810	64–398	119–304	76–101		616–687	53–144				
No. of Taxa: Mean	36.17	46.40	39.83	31.67	33	62.00	32.50	68	58	61	28
No. of Taxa: Range	17–74	19–89	31–49	25–40		55–69	18–47				
Depth (m): Mean	4.57	15.97	23.22	38.61	41.45	54.86	68.58	73.15	87.17	92.05	108.81
Depth (m): Range	1.22–7.62	11.58–19.2	20.12–28.96	37.49–39.93		52.43–57.30	67.97–69.19				

	Statistical Comparison		
	F Ratio	*p*	Significant Differences
Code for Statistical Comparisons			
No. of Stations			
No. of Individuals: Mean	8.10**	0.0012	D > S
No. of Individuals: Range			
No. of Taxa: Mean	1.07ns	0.3536	
No. of Taxa: Range			
Depth (m): Mean			
Depth (m): Range			

[a] There are no replicates for five of the eleven 10-m depth ranges. The data were therefore pooled for statistical analysis into three depth ranges: shallow (S), 0–29.9 m; mid-depth (M), 30.0–69.9 m; and deep (D), ≥ 70.0 m.

*$p < 0.01$, ns = not significant.

Appendix D. Taxon Abundance for Nonmollusks

TABLE D.1. Taxon Abundance from Nine Stations for Nonmollusk Components (Excluding Crustaceans), Māmala Bay Sampling Stations 31 Through 39, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
POLYCHAETA									
Acrocirrus sp. A	0	0	0	0	0	0	0	0	0
Amphicorina sp. B	0	0	0	0	0	0	0	1	0
Amphiglena mediterranea	0	0	0	0	0	0	0	1	0
Amphiglena sp. A	0	0	0	0	1	0	0	0	0
Aonides sp. A	0	0	0	1	0	0	0	1	0
Aphelochaeta marioni	0	0	0	0	0	0	0	0	0
Arabella multidentata	0	0	0	1	0	0	0	0	0
Armandia intermedia	0	0	3	0	0	0	2	1	0
Augeneriella dubia	0	0	0	0	0	0	0	0	0
Axiothella quadrimaculata	0	0	0	0	1	0	0	3	0
Branchiomma nigromaculata	0	0	0	0	0	0	0	0	0
Brania rhopalophora	0	0	0	0	0	0	0	0	0
Brania sp. B	0	0	0	0	0	0	0	0	0
Capitella capitata	0	0	1	0	0	0	2	0	0
Capitellidae spp.	0	0	0	0	0	0	2	1	0
Caulleriella acicula	0	0	0	0	0	0	0	0	0
Caulleriella sp. A	0	0	0	0	0	0	0	0	0
Ceratonereis tentaculata	0	0	0	0	0	0	0	0	0
Cirratulidae sp. B	0	0	0	0	0	0	0	0	0
Dipolydora armata	0	0	0	0	0	0	0	0	0
Dipolydora normalis	0	0	0	0	0	0	0	0	0
Euchone sp. B	0	0	0	0	0	0	0	0	0
Eunice vittata	0	0	0	0	0	0	0	0	0
Exogone longicornis	0	0	0	0	0	0	2	0	0
Exogone sp. C	0	0	0	0	0	0	0	0	0
Exogone sp. E	0	0	0	2	0	0	1	0	0
Exogone sp. F	0	0	0	0	0	0	0	0	0
Exogone sp. H	0	0	0	0	0	0	0	0	0
Exogone sp. I	0	0	0	0	0	0	0	1	0
Fabricia sp. A	0	1	0	0	1	0	0	12	0
Glycera tesselata	0	0	0	0	0	0	0	1	0
Goniada emerita	0	0	0	0	0	0	0	0	0
Grubeosyllis mediodentata	0	0	1	0	0	0	1	0	0
Haplosyllis spongicola	0	0	0	0	0	0	0	0	0
Harmothoe sp. A	0	0	0	0	0	0	1	0	0
Hesionidae sp. D	0	0	0	0	0	0	0	0	0
Hesionura australiensis	0	0	0	0	0	0	0	0	0
Hydroides bannerorum	0	0	0	0	0	0	1	0	0
Jasmineira caudata	0	0	0	0	0	0	0	0	0
Josephella marenzelleri	0	0	0	0	0	0	1	0	0
Laonice cirrata	0	0	2	4	0	0	1	0	0
Laonome sp. A	0	0	0	0	0	0	0	0	0
Linopherus microcephala	0	0	0	0	0	0	0	3	0
Lumbrineris latreilli	0	0	0	0	0	0	1	0	0
Lumbrineris tetraura	0	0	0	0	0	0	0	0	0
Lysidice ninetta	0	0	0	0	0	0	0	0	0
Lysippe sp. A	0	0	0	0	0	0	0	0	0

TABLE D.1—*Continued*

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
Magelona cincta	0	0	0	0	0	1	0	0	0
Magelona sp. A	0	0	0	0	0	0	0	0	0
Malacoceros sp. A	0	0	0	0	0	0	0	0	0
Maldanidae sp. A	0	0	0	0	0	0	0	0	0
Micronereis sp. B	0	0	0	0	0	0	1	0	0
Micropodarke sp. A	0	0	3	3	3	0	4	8	0
Microphthalmus spp.	1	8	12	0	2	0	0	0	0
Microspio sp. A	0	0	0	0	0	0	0	0	1
Monticellina cf. *dorsobranchialis*	0	0	0	0	0	0	0	0	0
Mooreonuphis sp. A	0	0	0	0	0	0	0	0	0
Myriochele oculata	0	0	1	0	4	0	1	1	0
Myriochele sp. A	0	0	0	0	0	0	0	0	0
Neanthes arenaceodentata	0	0	0	0	0	0	0	0	0
Nematonereis unicornis	0	0	0	0	2	0	2	1	0
Nereis sp. B	0	0	0	0	0	0	3	0	0
Nothria sp. B	0	0	0	0	0	0	0	0	0
Notomastus tenuis	0	0	0	0	0	0	0	0	0
Odontosyllis sp. A	0	0	0	0	0	0	0	0	0
Odontosyllis sp. B	0	0	0	0	0	0	0	0	0
Ophiodromus angustifrons	0	0	0	2	0	1	1	0	0
Ophiodromus sp. B	0	0	0	0	0	0	1	0	0
Ophryotrocha adherens	0	0	0	0	0	0	0	0	0
Paleanotus sp. E	0	0	0	0	0	0	0	0	0
Paramphinome sp. A	0	0	0	4	1	1	2	1	0
Paraonella sp. A	0	0	0	0	2	0	0	6	0
Pholoe sp. A	0	0	0	0	0	0	0	0	0
Pholoe sp. B	0	0	0	0	0	0	0	0	0
Phyllochaetopterus verrilli	0	0	0	0	0	0	0	0	0
Phyllodoce madeirensis	0	0	0	0	0	0	1	0	0
Pileolaria dalestraughanae	0	1	0	0	0	0	0	0	0
Pionosyllis heterocirrata	9	1	7	8	9	0	3	5	1
Pionosyllis spinisetosa	0	0	1	0	0	0	0	0	0
Pionosyllis weismanni	0	0	0	0	0	0	0	0	0
Pisione remota	0	0	0	0	0	0	0	0	0
Pisione sp. A	0	0	0	0	0	0	0	0	0
Pista unibranchia	0	0	0	0	0	0	0	0	0
Platynereis bicanaliculata	0	0	0	0	0	0	0	0	0
Platynereis dumerilii	0	0	0	0	0	0	1	0	0
Polycirrus sp. C	0	0	0	0	0	0	0	0	0
Polygordius sp. A	0	0	0	0	0	0	1	0	0
Polyophthalmus pictus	0	0	0	2	1	0	3	2	0
Prionospio cirrifera	0	0	0	3	0	0	4	4	0
Prionospio cirrobranchiata	0	0	0	0	0	0	0	0	0
Prionospio steenstrupi	0	0	0	1	2	0	0	1	0
Progoniada sp. A	0	0	0	0	0	0	2	0	0
Protoaricia sp. A	0	0	0	0	0	0	2	0	0
Protodorvillea biarticulata	0	0	0	0	1	0	0	2	0
Protodorvillea egena	0	0	0	0	0	0	0	0	0
Protodrilus sp. A	0	0	0	0	4	0	0	2	0

TABLE D.1—*Continued*

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
Pseudopotamilla reniformis	0	0	0	0	0	0	0	0	0
Pygospio muscularis	0	0	0	0	0	1	0	0	2
Questa caudicirra	0	0	0	0	0	0	0	0	0
Questa sp. A	0	0	1	0	0	0	3	0	0
Rhodine sp. A	0	0	0	0	5	0	0	1	0
Saccocirrus oahuensis	0	0	0	0	2	0	0	0	0
Salmacina dysteri	0	0	0	0	0	0	0	0	0
Samythella sp. A	0	0	0	0	0	0	0	0	0
Schistomeringos rudolphi	0	0	0	0	0	0	0	0	0
Scolelepis victoriensis	0	0	0	0	1	0	0	0	0
Scolelepis sp. B	0	0	0	0	0	0	0	0	0
Scyphoproctus djiboutiensis	0	0	0	0	0	0	0	0	0
Sigalionidae sp. A	0	0	0	0	0	0	0	0	0
Sigambra tentaculata	0	0	2	0	0	0	0	0	0
Sphaerosyllis riseri	0	0	0	0	0	0	0	0	0
Sphaerosyllis sp. G	0	0	0	2	1	0	0	0	0
Spio blakei	0	0	0	0	0	0	0	0	0
Spiochaetopterus sp. A	0	0	0	0	0	0	0	0	0
Spionidae sp. D	0	0	0	0	0	0	0	0	0
Spiophanes bombyx	0	0	0	0	0	0	0	0	0
Syllides bansei	0	0	0	1	0	0	0	0	0
Synelmis acuminata	0	0	0	0	0	0	16	0	0
Synelmis albini	0	0	0	0	0	0	0	0	0
Typosyllis cornuta	0	0	0	0	0	0	1	0	0
Typosyllis variegata	0	0	0	0	0	0	0	0	0
Typosyllis sp. H	0	0	0	0	1	0	0	0	0
Typosyllis sp. J	0	0	0	0	0	0	0	0	0
Vermiliopsis torquata	0	0	0	0	0	0	0	0	0
OLIGOCHAETA	1	3	66	26	3	11	16	7	0
NEMATODA	36	4	105	22	24	7	25	18	0
PLATYHELMINTHES	0	1	1	3	7	0	2	2	0
PORIFERA	0	0	0	0	0	0	0	0	0
ECHINODERMATA									
Echinoidea	0	0	1	1	0	0	0	0	0
Holothuroidea	0	0	0	0	1	0	0	0	0
Ophiuroidea	0	0	0	0	0	0	1	1	0
ANTHOZOA	0	0	0	1	0	0	0	0	0
HYDROZOA	0	0	0	0	0	0	0	0	0
KINORHYNCHA	0	0	0	0	0	0	1	0	0
NEMERTEA	3	0	19	1	7	1	5	8	0

TABLE D.1—*Continued*

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
INSECTA	0	0	0	2	0	0	0	2	0
SIPUNCULA									
Apionsoma misakianum	0	0	1	0	2	0	0	0	0
Aspidosiphon muelleri	0	0	0	0	3	0	3	0	0
Sipuncula sp. O	0	0	1	0	0	0	1	0	0
Sipuncula sp.	0	0	0	1	1	0	3	1	0
PRIAPULIDA	0	0	0	0	0	0	0	0	0
CHAETOGNATHA									
Spadella gaetanoi	0	0	0	1	0	0	0	0	0
PHORONIDA									
Phoronis psammophila	0	0	0	0	0	0	0	0	0
BRYOZOA	0	0	0	1	0	0	1	1	0
HEMICHORDATA	0	0	0	0	0	0	0	0	0
CHORDATA									
Branchiostoma sp. A	0	0	7	0	8	3	2	0	0
Osteichthyes	1	0	0	0	0	0	0	0	0
Total No. of Individuals/Station	51	19	235	93	100	26	127	99	4
Total No. of Taxa/Station	6	7	19	23	28	8	41	30	3
Total No. of Individuals Sampled									
Total No. of Taxa Sampled									

TABLE D.2. Taxon Abundance from Nine Stations for Nonmollusk Components (Excluding Crustaceans), Māmala Bay Sampling Stations 40 Through 48, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
POLYCHAETA									
Acrocirrus sp. A	0	0	0	0	0	0	0	0	0
Amphicorina sp. B	0	0	0	0	0	0	0	0	0
Amphiglena mediterranea	0	0	0	0	0	0	0	0	0
Amphiglena sp. A	0	0	0	0	0	0	0	6	3
Aonides sp. A	1	1	0	0	0	0	0	1	0
Aphelochaeta marioni	1	2	0	0	0	0	0	1	0
Arabella multidentata	1	0	0	0	0	0	0	0	0
Armandia intermedia	0	0	1	0	0	0	0	2	0
Augeneriella dubia	0	0	0	3	0	0	0	0	0
Axiothella quadrimaculata	3	0	0	0	2	0	0	13	0
Branchiomma nigromaculata	0	0	0	0	0	0	0	0	0
Brania rhopalophora	0	0	0	0	0	0	1	0	0
Brania sp. B	0	0	0	0	0	0	0	0	0
Capitella capitata	0	0	0	0	0	2	0	0	0
Capitellidae spp.	0	0	0	4	2	0	0	6	0
Caulleriella acicula	0	0	0	0	0	0	0	0	0
Caulleriella sp. A	0	0	0	0	0	0	0	0	0
Ceratonereis tentaculata	0	0	0	0	2	0	0	0	0
Cirratulidae sp. B	0	0	0	0	15	0	0	0	0
Dipolydora armata	26	0	0	0	0	0	0	0	0
Dipolydora normalis	1	0	0	0	0	0	0	0	0
Euchone sp. B	0	0	0	0	0	0	0	0	0
Eunice vittata	0	0	0	0	0	0	0	0	0
Exogone longicornis	0	1	0	0	0	0	0	0	0
Exogone sp. C	0	0	0	0	0	2	0	0	0
Exogone sp. E	0	0	0	3	0	0	0	0	0
Exogone sp. F	0	0	0	0	0	0	0	1	0
Exogone sp. H	0	0	0	0	0	0	0	0	0
Exogone sp. I	0	0	0	0	0	0	0	0	0
Fabricia sp. A	10	0	0	0	3	0	0	33	1
Glycera tesselata	0	0	0	0	0	0	0	0	0
Goniada emerita	0	0	0	0	0	0	0	0	0
Grubeosyllis mediodentata	0	0	0	0	0	0	0	0	0
Haplosyllis spongicola	0	0	0	0	0	0	0	12	0
Harmothoe sp. A	0	0	0	0	0	0	0	0	0
Hesionidae sp. D	0	0	0	0	4	0	0	0	0
Hesionura australiensis	0	0	0	0	0	0	0	0	0
Hydroides bannerorum	0	0	0	0	0	0	0	0	0
Jasmineira caudata	0	0	0	0	0	0	0	0	0
Josephella marenzelleri	0	0	0	0	0	0	0	0	0
Laonice cirrata	0	1	1	0	4	0	0	3	0
Laonome sp. A	0	0	0	0	0	0	0	0	0
Linopherus microcephala	0	0	0	0	1	0	0	0	0
Lumbrineris latreilli	0	1	0	0	0	0	0	1	0
Lumbrineris tetraura	0	0	0	0	0	0	0	0	0
Lysidice ninetta	1	0	0	0	0	0	0	0	0
Lysippe sp. A	0	0	0	0	0	0	0	0	0

TABLE D.2—*Continued*

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
Magelona cincta	0	0	0	0	0	0	0	0	0
Magelona sp. A	0	0	0	1	0	0	0	0	0
Malacoceros sp. A	0	0	1	0	0	0	0	0	0
Maldanidae sp. A	3	0	1	0	0	0	0	0	0
Micronereis sp. B	0	0	0	0	0	0	0	1	0
Micropodarke sp. A	1	0	3	6	9	1	0	19	24
Microphthalmus spp.	1	0	1	1	0	0	0	0	3
Microspio sp. A	0	0	0	0	0	0	0	0	0
Monticellina cf. *dorsobranchialis*	0	0	0	0	0	0	0	0	0
Mooreonuphis sp. A	0	0	0	0	0	0	0	0	0
Myriochele oculata	0	0	0	11	0	0	0	2	0
Myriochele sp. A	0	0	0	0	0	0	0	0	0
Neanthes arenaceodentata	0	0	0	0	0	0	0	1	0
Nematonereis unicornis	3	2	0	0	5	0	0	9	2
Nereis sp. B	0	0	0	0	2	0	0	0	0
Nothria sp. B	0	0	0	0	0	0	0	0	0
Notomastus tenuis	0	0	0	0	0	0	0	1	0
Odontosyllis sp. A	0	0	0	0	0	0	0	1	0
Odontosyllis sp. B	0	0	0	0	0	0	0	0	0
Ophiodromus angustifrons	0	2	0	2	2	3	0	0	0
Ophiodromus sp. B	0	1	0	0	0	0	0	0	0
Ophryotrocha adherens	0	0	0	0	2	0	0	0	0
Paleanotus sp. E	0	0	0	0	0	0	0	1	0
Paramphinome sp. A	0	0	2	3	1	1	0	2	0
Paraonella sp. A	1	0	0	0	0	0	0	3	2
Pholoe sp. A	0	0	0	0	1	0	0	1	0
Pholoe sp. B	0	0	0	0	1	0	0	0	0
Phyllochaetopterus verrilli	0	0	0	0	0	0	0	203	0
Phyllodoce madeirensis	0	0	0	0	0	0	0	2	0
Pileolaria dalestraughanae	0	0	0	0	0	0	0	0	0
Pionosyllis heterocirrata	1	4	12	14	3	15	8	12	16
Pionosyllis spinisetosa	0	0	0	0	0	1	0	1	0
Pionosyllis weismanni	0	0	0	0	1	0	0	4	0
Pisione remota	0	1	0	0	0	0	0	0	0
Pisione sp. A	1	0	2	0	0	0	1	0	0
Pista unibranchia	0	0	0	0	0	0	0	1	0
Platynereis bicanaliculata	0	0	0	0	0	0	0	1	0
Platynereis dumerilii	0	0	0	0	0	0	0	0	0
Polycirrus sp. C	0	0	0	0	0	0	0	0	0
Polygordius sp. A	0	0	0	0	0	0	0	0	0
Polyophthalmus pictus	0	1	2	0	9	0	0	16	0
Prionospio cirrifera	0	1	3	2	8	0	0	6	0
Prionospio cirrobranchiata	0	2	0	0	0	0	0	0	0
Prionospio steenstrupi	0	0	0	2	0	0	0	4	0
Progoniada sp. A	0	1	0	0	0	0	0	0	0
Protoaricia sp. A	0	0	0	0	0	0	0	0	0
Protodorvillea biarticulata	0	0	2	0	0	2	0	0	2
Protodorvillea egena	0	0	0	1	0	0	0	0	0
Protodrilus sp. A	3	0	0	0	0	0	0	0	0

TABLE D.2—*Continued*

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
Pseudopotamilla reniformis	0	0	0	0	0	1	0	2	0
Pygospio muscularis	0	0	0	0	0	0	0	0	0
Questa caudicirra	0	0	0	0	0	0	0	0	0
Questa sp. A	0	0	0	0	0	0	0	0	0
Rhodine sp. A	1	0	0	0	1	0	0	1	0
Saccocirrus oahuensis	2	0	0	0	0	0	0	0	0
Salmacina dysteri	0	0	0	0	48	0	0	0	0
Samythella sp. A	0	0	0	0	0	0	0	0	0
Schistomeringos rudolphi	0	0	0	0	0	0	0	0	0
Scolelepis victoriensis	0	0	0	0	0	0	0	0	1
Scolelepis sp. B	0	0	0	0	0	0	0	0	0
Scyphoproctus djiboutiensis	0	0	1	0	0	0	0	0	0
Sigalionidae sp. A	0	0	0	0	0	0	0	0	0
Sigambra tentaculata	0	0	0	1	0	0	0	1	0
Sphaerosyllis riseri	0	0	0	0	1	0	1	0	0
Sphaerosyllis sp. G	0	0	1	11	0	0	0	1	1
Spio blakei	0	0	0	0	0	1	0	0	0
Spiochaetopterus sp. A	0	0	0	0	0	0	0	0	0
Spionidae sp. D	0	0	0	0	0	0	0	0	0
Spiophanes bombyx	0	0	0	0	0	0	0	0	0
Syllides bansei	0	0	0	0	0	0	1	0	0
Synelmis acuminata	0	3	0	0	2	0	0	0	0
Synelmis albini	1	0	0	0	0	0	0	0	0
Typosyllis cornuta	2	0	0	0	0	1	2	0	0
Typosyllis variegata	0	0	0	0	3	0	0	0	0
Typosyllis sp. H	0	0	0	0	0	0	0	0	0
Typosyllis sp. J	0	0	0	0	0	1	0	0	0
Vermiliopsis torquata	0	0	0	0	0	0	0	1	0
OLIGOCHAETA	5	12	3	23	10	54	0	32	11
NEMATODA	8	50	35	51	60	12	20	222	14
PLATYHELMINTHES	0	2	2	0	2	0	2	0	0
PORIFERA	0	0	0	0	3	0	0	0	0
ECHINODERMATA									
Echinoidea	0	0	1	0	2	0	1	0	0
Holothuroidea	11	0	0	0	0	0	0	1	0
Ophiuroidea	0	0	1	0	1	0	0	2	0
ANTHOZOA	0	0	0	0	2	0	0	0	0
HYDROZOA	0	0	0	0	4	0	0	1	0
KINORHYNCHA	0	0	0	0	0	0	0	0	0
NEMERTEA	1	8	6	5	6	25	3	20	3

TABLE D.2—*Continued*

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
INSECTA	0	0	0	1	7	0	0	5	0
SIPUNCULA									
Apionsoma misakianum	0	0	0	0	2	0	0	3	0
Aspidosiphon muelleri	0	0	1	0	0	0	0	1	0
Sipuncula sp. O	0	0	0	1	0	0	0	0	0
Sipuncula sp.	0	0	2	0	4	0	0	1	0
PRIAPULIDA	0	0	1	0	0	0	0	0	0
CHAETOGNATHA									
Spadella gaetanoi	0	0	0	0	0	0	0	0	0
PHORONIDA									
Phoronis psammophila	0	0	0	1	0	0	0	0	0
BRYOZOA	0	0	0	0	4	0	0	1	0
HEMICHORDATA	0	0	0	0	0	0	0	0	0
CHORDATA									
Branchiostoma sp. A	0	0	1	3	0	0	0	3	7
Osteichthyes	0	0	0	0	0	0	0	0	0
Total No. of Individuals/Station	89	96	86	150	239	122	40	668	90
Total No. of Taxa/Station	24	19	24	22	38	15	10	49	14
Total No. of Individuals Sampled									
Total No. of Taxa Sampled									

TABLE D.3. Taxon Abundance from Nine Stations for Nonmollusk Components (Excluding Crustaceans), Māmala Bay Sampling Stations 49 Through 57, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	54	57
POLYCHAETA									
Acrocirrus sp. A	0	0	0	0	0	0	0	0	0
Amphicorina sp. B	0	0	0	0	0	0	0	0	0
Amphiglena mediterranea	0	4	0	1	0	0	0	0	0
Amphiglena sp. A	0	4	0	0	0	0	0	0	0
Aonides sp. A	0	2	0	0	0	0	0	0	0
Aphelochaeta marioni	0	0	0	0	0	0	0	0	0
Arabella multidentata	0	0	0	0	0	0	0	0	0
Armandia intermedia	0	3	1	0	0	0	1	0	0
Augeneriella dubia	0	0	0	0	0	0	0	0	0
Axiothella quadrimaculata	0	6	0	0	0	0	0	0	0
Branchiomma nigromaculata	0	0	0	0	0	0	0	0	0
Brania rhopalophora	0	1	0	0	0	1	0	0	0
Brania sp. B	0	1	0	0	0	0	0	0	0
Capitella capitata	0	0	0	0	0	0	0	0	2
Capitellidae spp.	0	0	1	0	0	0	0	0	0
Caulleriella acicula	0	0	0	0	0	0	0	0	0
Caulleriella sp. A	0	0	0	0	0	0	0	0	0
Ceratonereis tentaculata	0	0	0	0	0	0	0	0	0
Cirratulidae sp. B	0	0	0	0	0	0	0	0	0
Dipolydora armata	0	0	0	0	0	0	0	0	0
Dipolydora normalis	0	0	0	0	0	0	0	0	1
Euchone sp. B	0	0	1	0	0	2	0	0	81
Eunice vittata	0	0	0	0	0	0	0	0	0
Exogone longicornis	0	0	0	0	0	0	0	0	0
Exogone sp. C	0	0	0	0	0	0	0	0	0
Exogone sp. E	0	2	0	0	0	3	0	0	0
Exogone sp. F	0	1	0	0	0	0	0	0	0
Exogone sp. H	0	0	0	0	0	0	0	0	0
Exogone sp. I	0	0	0	0	0	0	0	0	0
Fabricia sp. A	0	9	2	0	1	5	0	0	5
Glycera tesselata	0	0	0	0	0	0	0	0	0
Goniada emerita	0	0	0	0	0	0	0	0	0
Grubeosyllis mediodentata	0	0	0	0	0	0	0	0	0
Haplosyllis spongicola	0	0	0	0	0	0	0	0	0
Harmothoe sp. A	0	0	0	0	0	1	0	0	0
Hesionidae sp. D	0	0	0	0	0	0	0	0	0
Hesionura australiensis	0	0	0	0	0	0	0	0	0
Hydroides bannerorum	0	0	0	0	0	0	0	0	0
Jasmineira caudata	0	0	0	0	0	1	0	0	0
Josephella marenzelleri	0	0	0	0	0	0	0	0	0
Laonice cirrata	0	3	5	0	0	2	0	0	0
Laonome sp. A	0	0	1	0	0	1	0	0	0
Linopherus microcephala	0	0	0	2	0	0	0	0	0
Lumbrineris latreilli	0	0	1	0	0	0	0	0	0
Lumbrineris tetraura	1	4	1	0	0	0	0	0	2
Lysidice ninetta	0	0	0	0	0	0	0	0	0
Lysippe sp. A	0	0	0	0	0	0	0	0	0

TABLE D.3—*Continued*

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	54	57
Magelona cincta	0	0	0	0	0	0	0	0	0
Magelona sp. A	0	0	0	0	0	0	0	0	0
Malacoceros sp. A	0	0	0	0	0	0	0	0	0
Maldanidae sp. A	0	0	0	0	0	0	0	0	0
Micronereis sp. B	0	0	0	0	0	0	0	0	0
Micropodarke sp. A	0	16	3	0	0	4	0	4	3
Microphthalmus spp.	6	0	0	0	0	0	0	0	0
Microspio sp. A	0	0	0	0	0	0	0	0	0
Monticellina cf. *dorsobranchialis*	0	0	1	0	0	0	0	0	0
Mooreonuphis sp. A	0	0	1	0	0	0	0	0	0
Myriochele oculata	0	0	1	0	0	11	0	0	3
Myriochele sp. A	0	0	0	0	0	1	0	0	0
Neanthes arenaceodentata	0	0	0	0	0	0	0	0	0
Nematonereis unicornis	0	2	0	0	1	0	0	0	0
Nereis sp. B	0	0	0	0	0	0	0	0	0
Nothria sp. B	0	0	1	0	0	0	0	0	0
Notomastus tenuis	0	2	0	0	0	2	0	0	1
Odontosyllis sp. A	0	0	0	0	0	0	0	0	0
Odontosyllis sp. B	0	1	0	0	0	0	0	0	0
Ophiodromus angustifrons	0	2	5	0	0	3	0	0	2
Ophiodromus sp. B	0	0	0	0	0	0	0	0	0
Ophryotrocha adherens	0	0	0	0	0	0	0	0	0
Paleanotus sp. E	0	0	0	0	0	0	0	0	0
Paramphinome sp. A	0	4	0	0	2	2	0	1	0
Paraonella sp. A	0	0	0	0	0	0	0	0	0
Pholoe sp. A	0	0	0	0	0	0	0	0	0
Pholoe sp. B	0	0	0	0	0	0	0	0	0
Phyllochaetopterus verrilli	0	0	0	0	0	0	0	0	0
Phyllodoce madeirensis	0	0	0	0	0	0	0	1	1
Pileolaria dalestraughanae	0	0	0	0	0	0	0	0	0
Pionosyllis heterocirrata	0	14	5	0	1	21	0	14	0
Pionosyllis spinisetosa	0	1	0	0	0	0	0	0	0
Pionosyllis weismanni	0	3	0	0	0	0	0	0	0
Pisione remota	0	0	0	0	0	0	0	0	0
Pisione sp. A	0	0	0	0	0	4	0	2	0
Pista unibranchia	0	0	0	0	0	0	0	0	0
Platynereis bicanaliculata	0	0	0	0	0	0	0	0	0
Platynereis dumerilii	0	0	0	0	0	0	0	0	0
Polycirrus sp. C	0	0	1	0	0	0	0	0	0
Polygordius sp. A	0	0	0	0	0	0	0	0	0
Polyophthalmus pictus	0	5	1	0	0	2	0	7	0
Prionospio cirrifera	0	4	1	0	0	13	0	0	8
Prionospio cirrobranchiata	0	0	5	0	0	4	0	0	2
Prionospio steenstrupi	0	1	0	0	0	4	0	0	3
Progoniada sp. A	0	0	0	0	0	1	0	0	0
Protoaricia sp. A	0	0	0	0	0	0	0	0	0
Protodorvillea biarticulata	11	0	1	0	3	0	0	0	0
Protodorvillea egena	0	0	0	0	0	0	0	0	1
Protodrilus sp. A	0	0	0	0	0	0	0	3	0

TABLE D.3—*Continued*

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	54	57
Pseudopotamilla reniformis	0	0	0	0	0	0	0	0	0
Pygospio muscularis	0	0	0	0	0	0	0	0	0
Questa caudicirra	0	0	0	0	0	0	0	0	0
Questa sp. A	0	0	0	0	0	0	0	0	0
Rhodine sp. A	0	6	0	0	0	0	0	0	0
Saccocirrus oahuensis	0	0	0	0	0	0	0	1	0
Salmacina dysteri	0	0	7	0	0	0	0	0	0
Samythella sp. A	0	0	1	0	0	0	0	0	1
Schistomeringos rudolphi	0	0	2	0	0	1	0	0	2
Scolelepis victoriensis	0	0	0	0	0	0	1	0	0
Scolelepis sp. B	0	1	0	0	0	0	0	0	0
Scyphoproctus djiboutiensis	0	0	0	0	1	0	0	0	0
Sigalionidae sp. A	0	0	0	0	0	0	0	0	0
Sigambra tentaculata	0	0	0	0	0	0	0	0	0
Sphaerosyllis riseri	0	0	0	0	0	0	0	0	4
Sphaerosyllis sp. G	0	0	3	0	4	21	0	0	6
Spio blakei	0	0	0	0	0	0	0	0	0
Spiochaetopterus sp. A	0	0	0	0	0	0	0	0	0
Spionidae sp. D	0	0	5	0	0	0	0	0	0
Spiophanes bombyx	0	0	1	0	0	0	0	0	0
Syllides bansei	0	0	0	0	1	0	0	0	0
Synelmis acuminata	0	4	2	0	0	15	0	0	29
Synelmis albini	0	0	0	0	0	0	0	0	0
Typosyllis cornuta	0	0	1	0	3	0	0	0	0
Typosyllis variegata	0	0	0	0	5	0	0	0	0
Typosyllis sp. H	0	0	0	0	0	0	0	0	0
Typosyllis sp. J	0	0	0	0	0	0	0	0	0
Vermiliopsis torquata	0	0	0	0	0	0	0	0	0
OLIGOCHAETA	7	14	13	0	22	41	0	0	32
NEMATODA	11	20	21	1	5	148	0	55	305
PLATYHELMINTHES	0	4	1	1	0	0	0	1	1
PORIFERA	0	0	0	0	0	0	0	0	0
ECHINODERMATA									
Echinoidea	0	1	1	0	0	0	0	0	0
Holothuroidea	0	0	0	0	0	0	0	0	4
Ophiuroidea	0	0	1	0	0	0	0	0	3
ANTHOZOA	0	0	2	0	0	0	0	0	0
HYDROZOA	0	0	0	0	0	0	0	0	0
KINORHYNCHA	0	0	0	0	0	0	0	0	95
NEMERTEA	2	9	5	0	2	18	0	1	31

TABLE D.3—*Continued*

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	54	57
INSECTA	0	0	1	0	0	0	0	0	6
SIPUNCULA									
Apionsoma misakianum	0	0	0	0	0	0	0	0	0
Aspidosiphon muelleri	0	0	20	0	0	4	0	0	2
Sipuncula sp. O	0	0	0	0	0	0	0	0	0
Sipuncula sp.	0	4	0	0	0	1	0	0	5
PRIAPULIDA	0	1	0	0	0	0	0	0	15
CHAETOGNATHA									
Spadella gaetanoi	0	2	0	0	0	0	0	0	0
PHORONIDA									
Phoronis psammophila	0	0	0	0	0	0	0	0	0
BRYOZOA	0	0	0	0	0	0	0	0	0
HEMICHORDATA	0	0	0	0	0	0	0	0	0
CHORDATA									
Branchiostoma sp. A	0	4	0	0	0	3	0	0	3
Osteichthyes	0	0	0	0	0	0	0	0	0
Total No. of Individuals/Station	38	165	126	5	51	340	2	90	659
Total No. of Taxa/Station	6	36	37	4	13	30	2	11	31
Total No. of Individuals Sampled									
Total No. of Taxa Sampled									

TABLE D.4. Taxon Abundance from Nine Stations for Nonmollusk Components (Excluding Crustaceans), Māmala Bay Sampling Stations 58 Through 66, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
POLYCHAETA									
Acrocirrus sp. A	0	0	0	0	0	0	0	0	0
Amphicorina sp. B	0	0	0	0	0	0	0	0	0
Amphiglena mediterranea	0	1	0	0	0	0	0	0	0
Amphiglena sp. A	0	0	0	0	0	0	0	0	0
Aonides sp. A	0	0	0	0	0	0	0	0	0
Aphelochaeta marioni	3	0	0	0	0	0	0	0	0
Arabella multidentata	0	0	1	0	0	0	0	0	0
Armandia intermedia	1	0	0	0	0	0	0	0	0
Augeneriella dubia	0	0	0	0	0	0	0	0	0
Axiothella quadrimaculata	0	0	0	0	0	0	0	0	0
Branchiomma nigromaculata	1	0	0	0	0	0	0	0	0
Brania rhopalophora	0	0	0	0	0	0	0	0	0
Brania sp. B	0	0	0	0	0	0	0	0	0
Capitella capitata	0	0	0	0	0	0	3	0	0
Capitellidae spp.	1	0	0	0	0	0	0	0	0
Caulleriella acicula	0	0	0	0	0	0	2	0	0
Caulleriella sp. A	0	0	0	0	0	0	1	0	0
Ceratonereis tentaculata	0	0	0	0	0	0	0	0	0
Cirratulidae sp. B	0	0	0	0	0	0	0	0	0
Dipolydora armata	0	0	0	0	0	0	0	0	0
Dipolydora normalis	1	0	0	0	0	0	0	0	0
Euchone sp. B	198	0	0	0	0	0	0	0	0
Eunice vittata	1	0	0	0	0	0	0	0	0
Exogone longicornis	0	0	0	0	0	0	1	0	0
Exogone sp. C	6	0	0	0	1	0	0	0	0
Exogone sp. E	7	0	0	0	0	0	0	0	0
Exogone sp. F	0	0	0	0	0	0	0	0	0
Exogone sp. H	0	0	1	0	0	0	0	0	0
Exogone sp. I	0	0	0	0	0	0	0	0	0
Fabricia sp. A	2	0	0	0	0	0	1	0	0
Glycera tesselata	1	0	0	0	0	0	0	0	0
Goniada emerita	0	0	0	0	0	0	1	0	0
Grubeosyllis mediodentata	0	0	0	0	0	0	1	0	0
Haplosyllis spongicola	0	0	0	0	0	0	0	0	0
Harmothoe sp. A	0	0	0	0	0	0	0	0	0
Hesionidae sp. D	0	0	0	0	0	0	0	0	0
Hesionura australiensis	0	2	0	0	0	0	0	0	0
Hydroides bannerorum	0	0	0	0	0	0	0	0	0
Jasmineira caudata	2	0	0	0	0	0	0	0	0
Josephella marenzelleri	0	0	0	0	0	0	0	0	0
Laonice cirrata	4	0	0	0	0	0	0	0	0
Laonome sp. A	9	0	0	0	0	0	0	0	0
Linopherus microcephala	0	0	0	0	0	0	0	1	0
Lumbrineris latreilli	1	0	0	0	0	0	0	0	0
Lumbrineris tetraura	2	0	4	0	0	0	0	0	1
Lysidice ninetta	0	1	0	0	0	0	0	0	0
Lysippe sp. A	4	0	0	0	0	0	0	0	0

TABLE D.4—*Continued*

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
Magelona cincta	0	0	0	0	0	0	0	0	0
Magelona sp. A	0	0	0	0	0	0	0	0	0
Malacoceros sp. A	0	0	0	0	0	0	0	0	0
Maldanidae sp. A	3	0	0	0	0	0	0	0	0
Micronereis sp. B	0	0	0	0	0	0	0	0	0
Micropodarke sp. A	3	0	0	0	0	2	8	0	6
Microphthalmus spp.	0	0	1	0	0	0	0	1	0
Microspio sp. A	0	0	0	0	0	0	0	0	0
Monticellina cf. *dorsobranchialis*	11	0	0	0	0	0	0	0	0
Mooreonuphis sp. A	0	0	0	0	0	0	0	0	0
Myriochele oculata	1	0	0	0	0	0	4	0	2
Myriochele sp. A	0	0	0	0	0	0	0	0	0
Neanthes arenaceodentata	0	0	0	0	0	1	19	0	0
Nematonereis unicornis	10	0	0	0	0	0	0	0	0
Nereis sp. B	1	0	0	0	0	0	0	0	0
Nothria sp. B	0	0	0	0	0	0	0	0	0
Notomastus tenuis	1	0	0	0	0	0	0	0	1
Odontosyllis sp. A	0	0	0	0	0	0	0	0	0
Odontosyllis sp. B	0	0	0	0	0	0	0	0	0
Ophiodromus angustifrons	0	2	0	0	0	0	7	0	1
Ophiodromus sp. B	0	0	0	0	0	0	0	0	0
Ophryotrocha adherens	0	0	0	0	0	0	7	0	0
Paleanotus sp. E	0	0	0	0	0	0	0	0	0
Paramphinome sp. A	0	0	0	0	0	0	0	0	6
Paraonella sp. A	0	0	0	0	0	0	0	0	0
Pholoe sp. A	1	0	0	0	0	0	0	0	0
Pholoe sp. B	0	0	0	0	0	0	0	0	0
Phyllochaetopterus verrilli	0	0	0	0	0	0	0	0	0
Phyllodoce madeirensis	0	0	0	0	0	0	0	0	0
Pileolaria dalestraughanae	0	0	0	0	0	0	0	0	0
Pionosyllis heterocirrata	1	1	1	0	2	1	25	7	22
Pionosyllis spinisetosa	0	0	0	0	4	0	0	0	0
Pionosyllis weismanni	0	0	0	0	0	0	0	0	0
Pisione remota	0	0	0	0	0	0	0	0	0
Pisione sp. A	0	1	0	0	0	0	1	0	0
Pista unibranchia	0	0	0	0	0	0	0	0	0
Platynereis bicanaliculata	0	0	0	0	0	0	0	0	0
Platynereis dumerilii	0	0	0	0	0	0	0	0	0
Polycirrus sp. C	0	0	0	0	0	0	0	0	0
Polygordius sp. A	0	0	0	0	0	0	0	0	0
Polyophthalmus pictus	0	0	0	0	0	0	0	0	2
Prionospio cirrifera	9	0	0	0	0	0	1	0	1
Prionospio cirrobranchiata	0	0	0	0	0	0	0	1	0
Prionospio steenstrupi	6	0	0	0	0	0	0	0	0
Progoniada sp. A	1	0	0	0	0	0	1	0	0
Protoaricia sp. A	0	0	0	0	0	0	0	0	0
Protodorvillea biarticulata	0	0	0	0	0	0	8	0	0
Protodorvillea egena	0	0	0	0	0	0	1	0	0
Protodrilus sp. A	0	0	0	0	0	0	0	0	1

TABLE D.4—*Continued*

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
Pseudopotamilla reniformis	0	0	0	0	0	0	0	0	0
Pygospio muscularis	0	0	0	0	0	0	0	0	0
Questa caudicirra	0	0	0	0	0	0	3	0	0
Questa sp. A	0	0	0	0	0	0	3	0	0
Rhodine sp. A	0	0	0	0	0	0	0	0	0
Saccocirrus oahuensis	0	0	0	0	0	0	0	0	0
Salmacina dysteri	2	0	0	0	0	0	0	0	0
Samythella sp. A	2	0	0	0	0	0	0	0	0
Schistomeringos rudolphi	3	0	0	0	0	0	6	0	0
Scolelepis victoriensis	0	0	0	0	0	0	0	0	0
Scolelepis sp. B	0	0	0	0	0	0	0	0	0
Scyphoproctus djiboutiensis	1	0	0	0	0	0	0	0	0
Sigalionidae sp. A	0	0	0	0	1	0	0	0	0
Sigambra tentaculata	0	0	0	0	2	0	0	0	0
Sphaerosyllis riseri	2	2	0	0	0	0	1	0	2
Sphaerosyllis sp. G	22	1	1	0	1	0	8	0	10
Spio blakei	1	0	0	0	1	0	0	0	0
Spiochaetopterus sp. A	1	0	0	0	0	0	0	0	0
Spionidae sp. D	2	0	0	0	0	0	0	0	0
Spiophanes bombyx	5	0	0	0	0	0	0	0	0
Syllides bansei	0	0	0	0	0	0	0	0	1
Synelmis acuminata	51	0	0	0	0	0	0	0	0
Synelmis albini	0	1	0	0	0	0	0	0	0
Typosyllis cornuta	0	1	13	0	0	0	1	0	0
Typosyllis variegata	0	0	0	0	0	0	0	0	0
Typosyllis sp. H	0	0	0	0	0	0	0	0	0
Typosyllis sp. J	0	0	0	0	0	0	0	0	0
Vermiliopsis torquata	0	0	0	0	0	0	0	0	0
OLIGOCHAETA	41	11	17	3	8	0	58	3	9
NEMATODA	111	10	6	0	29	1	46	8	11
PLATYHELMINTHES	1	1	1	0	0	0	1	0	0
PORIFERA	0	0	0	0	0	0	0	0	0
ECHINODERMATA									
Echinoidea	0	0	0	0	0	0	0	0	0
Holothuroidea	1	0	0	0	0	0	0	0	0
Ophiuroidea	2	0	0	0	0	0	0	0	0
ANTHOZOA	0	0	0	0	0	0	0	0	0
HYDROZOA	1	0	0	0	0	1	0	0	0
KINORHYNCHA	0	0	0	0	0	0	0	0	3
NEMERTEA	26	9	4	2	3	1	10	3	1

TABLE D.4—*Continued*

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
INSECTA	1	0	0	0	0	0	0	0	0
SIPUNCULA									
Apionsoma misakianum	2	0	0	0	1	0	0	0	0
Aspidosiphon muelleri	57	0	1	0	0	0	11	0	0
Sipuncula sp. O	0	0	0	0	0	0	0	0	0
Sipuncula sp.	2	1	0	0	0	0	3	0	2
PRIAPULIDA	4	0	0	0	0	0	0	2	0
CHAETOGNATHA									
Spadella gaetanoi	0	0	0	0	0	0	0	0	0
PHORONIDA									
Phoronis psammophila	1	0	0	0	0	0	0	0	0
BRYOZOA	2	1	0	0	0	0	0	0	0
HEMICHORDATA	1	0	0	0	0	0	0	0	0
CHORDATA									
Branchiostoma sp. A	0	0	0	0	1	0	5	0	0
Osteichthyes	0	0	0	0	0	0	0	0	0
Total No. of Individuals/Station	637	46	51	5	54	7	248	26	82
Total No. of Taxa/Station	55	16	12	2	12	6	31	8	18
Total No. of Individuals Sampled									
Total No. of Taxa Sampled									

TABLE D.5. Taxon Abundance from Four Stations for Nonmollusk Components (Excluding Crustaceans), Māmala Bay Sampling Stations 67 Through 70 and Regional Total, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	69	70	
POLYCHAETA					
Acrocirrus sp. A	6	0	0	0	6
Amphicorina sp. B	0	0	0	0	1
Amphiglena mediterranea	0	0	0	0	7
Amphiglena sp. A	0	0	0	0	14
Aonides sp. A	3	0	0	0	10
Aphelochaeta marioni	3	0	0	0	10
Arabella multidentata	0	0	0	0	3
Armandia intermedia	0	0	0	0	15
Augeneriella dubia	0	0	0	0	3
Axiothella quadrimaculata	0	0	0	0	28
Branchiomma nigromaculata	0	0	0	0	1
Brania rhopalophora	0	0	1	0	4
Brania sp. B	0	0	0	0	1
Capitella capitata	0	0	0	0	10
Capitellidae spp.	1	0	0	3	21
Caulleriella acicula	0	0	0	0	2
Caulleriella sp. A	0	0	0	0	1
Ceratonereis tentaculata	0	0	0	0	2
Cirratulidae sp. B	0	0	0	0	15
Dipolydora armata	0	0	0	0	26
Dipolydora normalis	0	0	0	0	3
Euchone sp. B	0	0	0	1	283
Eunice vittata	0	0	0	0	1
Exogone longicornis	0	0	0	0	4
Exogone sp. C	0	0	0	0	9
Exogone sp. E	0	0	0	0	18
Exogone sp. F	0	0	0	0	2
Exogone sp. H	0	0	0	0	1
Exogone sp. I	0	0	0	0	1
Fabricia sp. A	0	0	0	0	86
Glycera tesselata	0	0	1	0	3
Goniada emerita	0	0	0	0	1
Grubeosyllis mediodentata	0	0	0	0	3
Haplosyllis spongicola	0	0	0	0	12
Harmothoe sp. A	0	0	0	0	2
Hesionidae sp. D	0	0	0	0	4
Hesionura australiensis	0	0	0	0	2
Hydroides bannerorum	0	0	0	0	1
Jasmineira caudata	0	0	0	0	3
Josephella marenzelleri	0	0	0	0	1
Laonice cirrata	0	0	0	0	30
Laonome sp. A	0	0	0	0	11
Linopherus microcephala	0	0	0	0	7
Lumbrineris latreilli	2	0	0	0	7
Lumbrineris tetraura	0	0	0	0	15

TABLE D.5—*Continued*

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	69	70	
Lysidice ninetta	0	0	0	0	2
Lysippe sp. A	0	0	0	0	4
Magelona cincta	0	0	0	0	1
Magelona sp. A	0	0	0	0	1
Malacoceros sp. A	0	0	0	0	1
Maldanidae sp. A	0	0	0	0	7
Micronereis sp. B	0	0	0	0	2
Micropodarke sp. A	0	0	1	3	137
Microphthalmus spp.	0	0	1	3	41
Microspio sp. A	0	0	0	0	1
Monticellina cf. *dorsobranchialis*	0	0	0	0	12
Mooreonuphis sp. A	0	0	0	0	1
Myriochele oculata	4	0	0	0	46
Myriochele sp. A	0	0	0	0	1
Neanthes arenaceodentata	0	0	0	0	21
Nematonereis unicornis	0	0	0	0	39
Nereis sp. B	0	0	0	0	6
Nothria sp. B	0	0	0	0	1
Notomastus tenuis	0	0	0	0	8
Odontosyllis sp. A	0	0	0	0	1
Odontosyllis sp. B	0	0	0	0	1
Ophiodromus angustifrons	2	0	0	0	37
Ophiodromus sp. B	0	0	0	0	2
Ophryotrocha adherens	0	0	0	0	9
Paleanotus sp. E	0	0	0	0	1
Paramphinome sp. A	0	0	0	1	34
Paraonella sp. A	0	0	0	0	14
Pholoe sp. A	0	0	0	0	3
Pholoe sp. B	0	0	0	0	1
Phyllochaetopterus verrilli	0	0	0	0	203
Phyllodoce madeirensis	0	0	0	0	5
Pileolaria dalestraughanae	0	0	0	0	1
Pionosyllis heterocirrata	2	8	1	20	274
Pionosyllis spinisetosa	0	0	0	2	10
Pionosyllis weismanni	0	0	0	0	8
Pisione remota	0	0	0	0	1
Pisione sp. A	0	1	0	1	14
Pista unibranchia	0	0	0	0	1
Platynereis bicanaliculata	0	0	0	0	1
Platynereis dumerilii	0	0	0	0	1
Polycirrus sp. C	0	0	0	0	1
Polygordius sp. A	0	0	0	0	1
Polyophthalmus pictus	0	0	0	0	53
Prionospio cirrifera	3	0	0	1	72
Prionospio cirrobranchiata	2	0	0	0	16
Prionospio steenstrupi	3	0	0	0	27
Progoniada sp. A	0	0	0	0	6
Protoaricia sp. A	0	0	0	0	2
Protodorvillea biarticulata	0	0	3	4	39

TABLE D.5—*Continued*

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	69	70	
Protodorvillea egena	0	0	0	0	3
Protodrilus sp. A	0	0	0	0	13
Pseudopotamilla reniformis	0	0	0	0	3
Pygospio muscularis	0	1	0	0	4
Questa caudicirra	0	0	0	0	3
Questa sp. A	0	1	0	0	8
Rhodine sp. A	0	0	0	0	15
Saccocirrus oahuensis	0	0	0	0	5
Salmacina dysteri	1	0	0	0	58
Samythella sp. A	0	0	0	0	4
Schistomeringos rudolphi	0	0	0	0	14
Scolelepis victoriensis	0	0	0	0	3
Scolelepis sp. B	0	0	0	0	1
Scyphoproctus djiboutiensis	0	0	0	0	3
Sigalionidae sp. A	0	0	0	0	1
Sigambra tentaculata	0	0	0	0	6
Sphaerosyllis riseri	0	0	0	0	13
Sphaerosyllis sp. G	0	0	0	0	94
Spio blakei	0	0	0	1	4
Spiochaetopterus sp. A	0	0	0	0	1
Spionidae sp. D	4	0	0	0	11
Spiophanes bombyx	4	0	0	0	10
Syllides bansei	0	0	0	0	4
Synelmis acuminata	3	0	0	1	126
Synelmis albini	0	0	0	0	2
Typosyllis cornuta	0	0	0	0	25
Typosyllis variegata	0	0	0	0	8
Typosyllis sp. H	0	0	0	0	1
Typosyllis sp. J	0	0	0	0	1
Vermiliopsis torquata	0	0	0	0	1
OLIGOCHAETA	5	0	1	12	580
NEMATODA	39	12	5	16	1573
PLATYHELMINTHES	0	2	0	2	40
PORIFERA	0	0	0	0	3
ECHINODERMATA					
Echinoidea	0	0	0	0	8
Holothuroidea	4	0	0	0	22
Ophiuroidea	1	0	0	0	13
ANTHOZOA	0	0	0	0	5
HYDROZOA	1	0	0	0	8
KINORHYNCHA	0	0	0	0	99

TABLE D.5—*Continued*

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	69	70	
NEMERTEA	4	1	4	8	265
INSECTA	0	0	0	0	25
SIPUNCULA					
Apionsoma misakianum	0	0	2	0	13
Aspidosiphon muelleri	11	0	0	1	115
Sipuncula sp. O	0	0	0	0	3
Sipuncula sp.	1	0	0	0	32
PRIAPULIDA	0	0	0	0	23
CHAETOGNATHA					
Spadella gaetanoi	0	0	0	0	3
PHORONIDA					
Phoronis psammophila	0	0	0	0	2
BRYOZOA	0	0	0	0	11
HEMICHORDATA	0	0	0	0	1
CHORDATA					
Branchiostoma sp. A	0	0	0	1	51
Osteichthyes	0	0	1	0	2
Total No. of Individuals/Station	109	26	21	81	
Total No. of Taxa/Station	23	7	11	18	
Total No. of Individuals Sampled					5,203
Total No. of Taxa Sampled					147

TABLE D.6. Taxon Abundance from Nine Stations for Crustacean Components, Māmala Bay Sampling Stations 31 Through 39, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
ACARI									
Halacaridae sp. A	0	0	0	0	0	0	0	0	0
PYCNOGONIDA									
Anoplodactylus projectus	0	0	0	0	0	0	0	0	0
Callipallene (?) sp. A	0	0	0	0	0	0	0	0	0
COPEPODA	2	0	19	9	1	1	4	10	1
OSTRACODA–MYODOCOPIDA									
Myodocope sp. A	0	0	0	7	0	0	10	3	0
Myodocope sp. B	0	0	0	0	0	0	0	0	0
OSTRACODA–PODOCOPIDA									
Bairdia hanaumaensis	0	0	0	0	1	0	0	0	0
Bairdia kauaiensis	0	0	0	0	0	0	0	6	0
Loxoconchella anomala	0	0	0	0	0	0	0	0	0
Macrocypris gracilis	0	0	0	0	0	0	0	0	0
CUMACEA	0	0	3	0	1	0	4	0	0
TANAIDACEA									
Apseudes tropicalis	0	0	0	0	0	0	0	0	0
Apseudes sp. A	0	0	0	1	0	0	0	0	0
Leptochelia dubia	0	0	1	9	0	0	7	10	0
Leptochelia sp. A	0	0	0	0	0	0	0	0	0
Synapseudes minutus	0	0	0	0	0	0	0	0	0
Tanaissus sp. A	0	0	0	0	0	0	1	0	0
ISOPODA									
Apanthura inornata	0	0	0	0	1	0	0	1	0
Bagatus sp. A	0	0	0	0	0	0	0	1	0
Caecianiropsis sp. A	0	0	0	0	0	0	0	0	0
Cryptoniscus form	0	0	0	0	0	0	0	0	0
"*Dynamenella*" (?) sp. A	0	0	0	0	0	0	0	0	0
Hyssuridae sp. A	0	0	0	0	0	0	1	2	0
Janira algicola	0	0	0	0	0	0	3	3	0
Joeropsis hawaiiensis	0	0	0	1	0	0	4	2	0
Mesanthura hieroglyphica	0	0	0	0	0	0	0	1	0
Metacirolana sp. A	0	0	0	5	0	0	0	22	0
Microcharon sp. A	0	0	0	0	0	0	0	0	0
Munna acarina	0	0	0	1	0	0	1	0	0
Paranthura ostergaardi	0	0	0	0	0	0	0	0	0
Pleurocope sp. A	0	0	0	1	0	0	0	0	0

TABLE D.6—*Continued*

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
AMPHIPODA–CAPRELLIDEA									
Caprella cf. *subtilis*	0	0	0	0	0	0	0	0	0
Metaprotella sandalensis	0	0	0	0	0	0	0	0	0
AMPHIPODA–GAMMARIDEA									
Amphilochidae sp(p).	0	0	0	0	0	0	0	0	0
Ampithoe ramondi	0	0	0	0	0	0	0	0	0
Atylus nani	0	0	0	0	0	0	0	0	0
Bemlos macromanus	0	0	0	0	0	0	0	0	0
Bemlos waipio	0	0	0	0	0	0	0	1	0
Ceradocus hawaiiensis	0	0	0	0	0	0	0	6	0
Elasmopus piikoi	0	0	0	0	0	0	0	0	0
Ericthonius brasiliensis	0	0	0	0	1	0	0	0	0
Eriopisa laakona	0	0	0	0	0	0	0	0	0
Eriopisa sp. A	0	0	0	0	0	0	0	0	0
Eriopisella sechellensis	0	0	6	0	0	0	11	0	0
Eusiroides diplonyx	7	0	0	0	0	0	0	0	23
Gammaropsis atlantica	0	0	0	0	0	0	4	0	0
Gammaropsis pokipoki	0	0	0	0	0	0	0	0	0
Ischyrocerus oahu	0	0	1	0	0	0	0	0	0
Ischyrocerus kapu	0	0	0	0	0	0	0	0	0
Konatopus paao	0	0	1	10	0	0	0	78	1
Leucothoe hyhelia	0	0	0	0	0	0	0	0	0
Melita pahuwai	0	0	0	0	0	0	0	0	0
Ochlesis alii	0	0	0	0	0	0	0	0	0
Paradexamine maunaloa	0	0	0	0	0	0	0	0	0
Paraphoxus sp.	0	0	2	0	0	0	0	0	0
Pereionotus alaniphlias	0	0	0	0	0	0	1	1	0
Photis kapapa	0	0	0	0	0	0	0	0	0
Seba ekepuu	0	0	0	0	0	0	0	6	0
DECAPODA–NATANTIA									
Alpheus paracrinitus	0	0	0	0	0	0	0	0	0
Leptochela hawaiiensis	0	0	0	0	0	0	0	0	0
Metapenaeus sp. A	0	0	0	0	0	0	0	0	0
Palaemon sp. A	0	0	0	0	0	0	0	0	0
Pontophilus cf. *sculptus*	0	0	0	0	0	0	0	1	0
Processa aequimana	0	0	0	0	0	0	0	0	0
Processa hawaiiensis	0	0	0	0	0	0	0	1	0
Processa macrognatha	0	0	0	1	0	0	0	0	0
Ogyrides sp. A	0	0	0	0	0	7	0	0	0
DECAPODA–ANOMURA									
Emerita pacifica	0	0	0	0	0	0	0	0	0
Pagurid sp. A	0	0	0	0	0	0	0	1	0
Pomatocheles sp. A	0	0	0	0	0	0	0	1	0

TABLE D.6—*Continued*

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
DECAPODA–BRACHYURA									
Aphanodactylus edmondsoni	0	0	0	0	0	0	0	0	0
Chlorinoides goldsboroughi (?)	0	0	0	0	0	0	0	0	0
Coelocarcinus foliatus	0	0	0	0	0	0	0	0	0
Megalops	0	0	0	1	0	0	0	1	0
Nucia (?) sp. A	0	0	0	1	0	0	0	0	0
Pilumnus sp. A	0	0	0	0	0	0	0	0	0
Portunus granulatus	0	0	0	0	0	0	0	0	0
Portunus macrophthalamus	0	0	0	0	0	0	0	0	0
Zoea	0	0	0	0	0	0	0	0	0
Total No. of Individuals/Station	0	0	7	12	5	2	12	21	3
Total No. of Taxa/Station	9	0	33	47	5	8	51	158	25
Total No. of Individuals Sampled									
Total No. of Taxa Sampled									

TABLE D.7. Taxon Abundance from Nine Stations for Crustacean Components, Māmala Bay Sampling Stations 40 Through 48, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
ACARI									
Halacaridae sp. A	0	0	0	0	1	0	0	0	0
PYCNOGONIDA									
Anoplodactylus projectus	0	0	0	0	2	0	0	1	0
Callipallene (?) sp. A	0	0	0	0	1	0	0	0	0
COPEPODA	6	2	5	6	24	1	0	15	0
OSTRACODA–MYODOCOPIDA									
Myodocope sp. A	0	0	1	0	3	0	0	1	0
Myodocope sp. B	0	0	0	0	0	0	0	0	0
OSTRACODA–PODOCOPIDA									
Bairdia hanaumaensis	0	0	0	0	0	0	0	0	0
Bairdia kauaiensis	3	0	0	0	1	0	0	0	0
Loxoconchella anomala	0	0	0	0	0	0	0	0	0
Macrocypris gracilis	0	0	0	0	3	0	0	0	0
CUMACEA	0	0	0	0	6	0	0	0	0
TANAIDACEA									
Apseudes tropicalis	0	0	2	0	1	0	0	0	0
Apseudes sp. A	0	0	0	0	0	0	0	0	0
Leptochelia dubia	0	2	0	19	54	1	0	13	0
Leptochelia sp. A	0	0	0	0	3	0	0	11	0
Synapseudes minutus	0	0	0	0	0	0	0	0	0
Tanaissus sp. A	0	0	0	0	6	0	0	0	0
ISOPODA									
Apanthura inornata	0	1	0	0	0	0	0	1	0
Bagatus sp. A	0	0	0	0	0	0	0	0	0
Caecianiropsis sp. A	0	0	0	0	0	0	0	0	0
Cryptoniscus form	0	0	0	0	0	0	0	0	0
"*Dynamenella*" (?) sp. A	0	0	0	0	2	0	0	0	0
Hyssuridae sp. A	1	0	0	0	0	0	0	0	0
Janira algicola	1	0	0	0	4	0	0	13	0
Joeropsis hawaiiensis	0	0	0	0	0	0	0	1	0
Mesanthura hieroglyphica	0	0	0	0	0	0	0	0	0
Metacirolana sp. A	0	0	0	0	1	0	0	0	0
Microcharon sp. A	5	0	0	0	0	0	0	0	0
Munna acarina	0	0	0	0	4	0	0	2	0
Paranthura ostergaardi	0	0	0	0	1	0	0	0	0
Pleurocope sp. A	0	0	0	0	0	0	0	0	0

TABLE D.7—*Continued*

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
AMPHIPODA–CAPRELLIDEA									
Caprella cf. *subtilis*	0	0	0	0	0	0	0	1	0
Metaprotella sandalensis	0	0	0	0	10	0	0	1	0
AMPHIPODA–GAMMARIDEA									
Amphilochidae sp(p).	1	0	0	0	4	0	0	4	0
Ampithoe ramondi	0	0	0	0	4	0	0	7	0
Atylus nani	0	0	0	0	0	0	0	0	0
Bemlos macromanus	0	0	0	1	8	0	0	3	0
Bemlos waipio	0	0	0	0	0	0	0	0	0
Ceradocus hawaiiensis	0	0	0	0	2	0	0	12	0
Elasmopus piikoi	76	0	0	0	0	0	0	4	0
Ericthonius brasiliensis	0	0	0	0	0	0	0	3	0
Eriopisa laakona	16	0	0	0	0	0	0	0	0
Eriopisa sp. A	0	0	0	0	0	0	0	0	0
Eriopisella sechellensis	0	0	7	13	0	0	0	50	0
Eusiroides diplonyx	0	0	0	0	0	0	0	0	0
Gammaropsis atlantica	0	0	0	0	0	0	0	1	0
Gammaropsis pokipoki	0	0	0	0	0	0	0	0	0
Ischyrocerus oahu	0	0	0	0	0	0	0	0	0
Ischyrocerus kapu	0	0	0	0	0	0	0	4	0
Konatopus paao	0	0	0	2	0	0	0	12	0
Leucothoe hyhelia	0	0	1	0	0	0	0	1	0
Melita pahuwai	0	0	0	0	0	0	0	0	0
Ochlesis alii	0	0	0	0	0	0	0	0	0
Paradexamine maunaloa	0	0	0	0	0	0	0	0	0
Paraphoxus sp.	0	1	0	0	0	0	0	2	0
Pereionotus alaniphlias	0	0	0	0	0	0	0	0	0
Photis kapapa	0	0	0	0	0	0	0	0	0
Seba ekepuu	0	0	0	0	4	0	4	0	0
DECAPODA–NATANTIA									
Alpheus paracrinitus	0	0	0	0	0	0	0	0	0
Leptochela hawaiiensis	0	0	0	0	0	0	0	0	0
Metapenaeus sp. A	0	0	2	0	0	0	0	0	0
Palaemon sp. A	0	0	0	0	1	0	0	0	0
Pontophilus cf. *sculptus*	0	0	0	0	0	0	0	1	0
Processa aequimana	0	0	0	0	0	0	0	1	0
Processa hawaiiensis	0	0	1	0	0	0	0	0	0
Processa macrognatha	0	0	0	0	0	0	0	0	0
Ogyrides sp. A	0	0	0	0	0	0	0	0	0
DECAPODA–ANOMURA									
Emerita pacifica	0	0	0	0	0	0	0	0	0
Pagurid sp. A	0	0	0	0	0	0	0	0	0
Pomatocheles sp. A	0	0	0	0	0	0	0	0	0

TABLE D.7—*Continued*

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
DECAPODA–BRACHYURA									
Aphanodactylus edmondsoni	0	0	0	0	0	0	1	0	0
Chlorinoides goldsboroughi (?)	0	0	0	0	1	0	0	0	0
Coelocarcinus foliatus	0	0	0	0	0	0	0	0	1
Megalops	0	0	0	0	0	0	0	0	0
Nucia (?) sp. A	0	0	0	0	1	0	0	0	0
Pilumnus sp. A	0	0	0	0	1	0	0	0	0
Portunus granulatus	0	0	0	0	0	0	0	0	1
Portunus macrophthalamus	0	0	1	1	0	0	0	0	0
Zoea	0	0	0	0	0	0	0	2	0
Total No. of Individuals/Station	8	4	8	6	27	2	2	26	2
Total No. of Taxa/Station	109	6	20	42	153	2	5	167	2
Total No. of Individuals Sampled									
Total No. of Taxa Sampled									

TABLE D.8. Taxon Abundance from Nine Stations for Crustacean Components, Māmala Bay Sampling Stations 49 Through 57, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	56	57
ACARI									
Halacaridae sp. A	0	0	0	0	0	0	0	0	0
PYCNOGONIDA									
Anoplodactylus projectus	0	0	0	0	0	0	0	0	0
Callipallene (?) sp. A	0	0	0	0	0	0	0	0	0
COPEPODA	0	2	2	0	1	23	3	5	149
OSTRACODA–MYODOCOPIDA									
Myodocope sp. A	0	0	0	0	0	0	0	0	9
Myodocope sp. B	0	0	1	0	0	1	0	0	0
OSTRACODA–PODOCOPIDA									
Bairdia hanaumaensis	0	0	0	0	0	0	0	0	0
Bairdia kauaiensis	0	1	3	0	0	2	0	0	0
Loxoconchella anomala	0	0	0	0	0	0	0	0	0
Macrocypris gracilis	0	6	0	0	0	0	0	0	0
CUMACEA	0	0	1	0	0	1	0	0	26
TANAIDACEA									
Apseudes tropicalis	0	0	0	0	0	1	0	0	0
Apseudes sp. A	0	0	0	0	0	0	0	0	0
Leptochelia dubia	0	15	6	0	0	2	0	0	202
Leptochelia sp. A	0	0	1	0	0	0	0	0	10
Synapseudes minutus	0	0	0	1	0	0	0	0	0
Tanaissus sp. A	0	0	0	0	0	4	0	0	26
ISOPODA									
Apanthura inornata	0	0	0	0	0	1	0	0	0
Bagatus sp. A	0	0	0	0	0	0	0	0	0
Caecianiropsis sp. A	0	0	0	0	0	0	0	0	1
Cryptoniscus form	0	0	0	0	0	0	0	0	1
"*Dynamenella*" (?) sp. A	0	0	0	0	0	0	0	0	0
Hyssuridae sp. A	0	2	0	0	0	0	0	0	0
Janira algicola	0	3	0	0	0	0	0	0	0
Joeropsis hawaiiensis	0	0	0	1	3	0	0	0	0
Mesanthura hieroglyphica	0	0	0	0	0	0	0	0	0
Metacirolana sp. A	0	2	0	0	5	0	0	0	0
Microcharon sp. A	0	0	0	0	0	0	0	0	0
Munna acarina	0	0	3	0	0	2	0	0	2
Paranthura ostergaardi	0	0	0	0	0	0	0	0	0
Pleurocope sp. A	0	0	2	0	0	0	0	0	0

TABLE D.8—*Continued*

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	56	57
AMPHIPODA–CAPRELLIDEA									
Caprella cf. *subtilis*	0	0	0	0	0	0	0	0	0
Metaprotella sandalensis	0	0	0	0	0	0	0	0	0
AMPHIPODA–GAMMARIDEA									
Amphilochidae sp(p).	0	2	0	0	2	0	6	0	0
Ampithoe ramondi	0	0	0	0	0	0	0	0	0
Atylus nani	0	0	0	0	0	0	0	0	0
Bemlos macromanus	0	1	1	0	1	0	0	0	0
Bemlos waipio	0	0	0	0	0	0	0	0	0
Ceradocus hawaiiensis	0	6	0	0	0	0	0	0	0
Elasmopus piikoi	0	11	0	0	0	3	0	2	0
Ericthonius brasiliensis	0	6	0	0	0	1	0	0	0
Eriopisa laakona	0	0	0	0	1	0	0	0	0
Eriopisa sp. A	0	0	0	0	0	0	0	0	0
Eriopisella sechellensis	0	7	1	0	0	11	0	0	3
Eusiroides diplonyx	0	0	0	0	0	0	0	0	0
Gammaropsis atlantica	0	0	0	0	0	0	0	0	0
Gammaropsis pokipoki	0	0	0	0	0	0	0	0	1
Ischyrocerus oahu	0	0	0	0	0	0	0	0	0
Ischyrocerus kapu	0	0	0	0	0	0	0	0	0
Konatopus paao	0	37	0	0	0	0	0	0	1
Leucothoe hyhelia	0	2	0	0	0	0	0	0	0
Melita pahuwai	0	0	0	1	0	0	0	0	0
Ochlesis alii	0	1	0	0	0	0	0	0	0
Paradexamine maunaloa	0	0	0	0	0	0	0	0	0
Paraphoxus sp.	0	0	0	0	0	1	0	0	0
Pereionotus alaniphlias	0	0	0	0	0	0	0	0	0
Photis kapapa	0	0	2	0	0	1	0	0	0
Seba ekepuu	0	20	0	0	0	0	0	0	0
DECAPODA–NATANTIA									
Alpheus paracrinitus	0	1	0	0	0	0	0	0	1
Leptochela hawaiiensis	0	0	0	0	0	1	0	0	0
Metapenaeus sp. A	0	0	0	0	0	0	0	0	0
Palaemon sp. A	0	0	0	0	0	0	0	0	0
Pontophilus cf. *sculptus*	0	0	0	0	0	0	0	0	0
Processa aequimana	0	0	0	0	0	0	0	0	0
Processa hawaiiensis	0	0	0	0	0	0	0	0	0
Processa macrognatha	0	0	0	0	0	0	0	0	0
Ogyrides sp. A	0	0	0	0	0	0	0	0	0
DECAPODA–ANOMURA									
Emerita pacifica	0	0	0	1	0	0	0	0	0
Pagurid sp. A	0	1	0	0	0	0	0	0	0
Pomatocheles sp. A									

TABLE D.8—*Continued*

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	56	57
DECAPODA–BRACHYURA									
Aphanodactylus edmondsoni	0	0	0	0	0	0	0	0	0
Chlorinoides goldsboroughi (?)	0	0	0	0	0	0	0	0	0
Coelocarcinus foliatus	0	0	0	0	0	0	0	0	0
Megalops	0	0	0	0	0	0	0	0	0
Nucia (?) sp. A	0	0	0	0	0	0	0	2	0
Pilumnus sp. A	0	0	0	0	0	0	0	0	0
Portunus granulatus	0	0	0	0	0	0	0	0	0
Portunus macrophthalamus	0	0	0	0	0	0	0	0	0
Zoea	0	0	0	0	0	0	0	0	0
Total No. of Individuals/Station	0	19	11	4	6	15	2	3	13
Total No. of Taxa/Station	0	126	23	4	13	55	9	9	432
Total No. of Individuals Sampled									
Total No. of Taxa Sampled									

TABLE D.9. Taxon Abundance from Nine Stations for Crustacean Components, Māmala Bay Sampling Stations 58 Through 66, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
ACARI									
Halacaridae sp. A	0	0	0	0	0	0	0	0	1
PYCNOGONIDA									
Anoplodactylus projectus	0	0	0	0	0	0	0	0	0
Callipallene (?) sp. A	0	0	0	0	0	0	0	0	0
COPEPODA	9	2	1	9	1	0	14	3	11
OSTRACODA–MYODOCOPIDA									
Myodocope sp. A	3	0	0	0	2	0	1	0	0
Myodocope sp. B	0	0	0	0	0	0	0	0	0
OSTRACODA–PODOCOPIDA									
Bairdia hanaumaensis	0	0	0	0	0	0	0	0	0
Bairdia kauaiensis	0	0	0	0	0	0	0	0	0
Loxoconchella anomala	1	0	0	0	0	0	0	0	0
Macrocypris gracilis	7	0	0	0	0	0	0	0	0
CUMACEA									
TANAIDACEA									
Apseudes tropicalis	0	0	0	0	0	0	0	0	0
Apseudes sp. A	0	0	0	0	0	0	0	0	0
Leptochelia dubia	12	0	0	1	0	0	6	0	0
Leptochelia sp. A	2	0	0	0	0	0	0	0	0
Synapseudes minutus	0	0	0	0	0	0	0	0	0
Tanaissus sp. A	10	0	0	0	0	0	0	0	0
ISOPODA									
Apanthura inornata	4	0	0	0	0	0	0	0	0
Bagatus sp. A	0	0	0	0	0	0	0	0	0
Caecianiropsis sp. A	0	0	0	0	0	0	0	0	5
Cryptoniscus form	0	0	0	0	0	0	0	0	0
"*Dynamenella*" (?) sp. A	0	0	0	0	0	0	0	0	0
Hyssuridae sp. A	1	0	1	0	0	0	0	0	0
Janira algicola	0	0	0	0	0	0	0	0	0
Joeropsis hawaiiensis	0	0	0	0	0	0	0	0	0
Mesanthura hieroglyphica	0	0	0	0	0	0	0	0	0
Metacirolana sp. A	0	0	0	0	0	0	0	0	0
Microcharon sp. A	0	0	0	0	0	0	0	0	4
Munna acarina	5	0	0	0	0	0	0	1	0
Paranthura ostergaardi	0	0	0	0	0	0	0	0	0
Pleurocope sp. A	1	0	0	0	0	0	0	0	0

TABLE D.9—*Continued*

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
AMPHIPODA–CAPRELLIDEA									
Caprella cf. *subtilis*	0	0	0	0	0	0	0	0	0
Metaprotella sandalensis	0	0	0	0	0	0	0	0	0
AMPHIPODA–GAMMARIDEA									
Amphilochidae sp(p).	4	0	0	0	0	0	0	0	1
Ampithoe ramondi	0	0	0	0	0	0	0	0	0
Atylus nani					1				
Bemlos macromanus	0	0	0	0	0	0	0	0	0
Bemlos waipio	0	0	0	0	0	0	0	0	0
Ceradocus hawaiiensis	0	0	0	0	0	0	0	0	0
Elasmopus piikoi	0	0	0	0	0	1	0	0	1
Ericthonius brasiliensis	0	0	0	0	0	0	0	0	6
Eriopisa laakona	0	0	5	0	0	0	0	0	0
Eriopisa sp. A	0	0	0	0	0	0	0	0	2
Eriopisella sechellensis	0	0	0	0	0	1	0	0	0
Eusiroides diplonyx	0	0	0	0	0	0	0	0	0
Gammaropsis atlantica	1	0	0	0	0	0	0	0	0
Gammaropsis pokipoki	0	0	0	0	0	0	0	0	0
Ischyrocerus oahu	0	0	0	0	0	0	0	0	0
Ischyrocerus kapu	0	0	0	0	0	0	0	0	0
Konatopus paao	0	0	0	0	0	0	0	0	0
Leucothoe hyhelia	0	0	0	0	0	0	0	0	0
Melita pahuwai	0	0	0	0	0	0	0	0	0
Ochlesis alii	0	0	0	0	0	0	0	0	0
Paradexamine maunaloa	1	0	0	0	0	0	0	0	0
Paraphoxus sp.	0	0	0	0	0	0	0	0	0
Pereionotus alaniphlias	0	0	0	0	0	0	0	0	0
Photis kapapa	0	0	0	0	0	0	0	0	0
Seba ekepuu	0	4	0	0	0	0	0	0	0
DECAPODA–NATANTIA									
Alpheus paracrinitus	0	0	0	0	0	0	0	0	0
Leptochela hawaiiensis	0	0	0	0	0	0	0	0	0
Metapenaeus sp. A	0	0	0	0	0	0	0	0	0
Palaemon sp. A	0	0	0	0	0	0	0	0	0
Pontophilus cf. *sculptus*	0	0	0	0	0	0	0	0	0
Processa aequimana	0	0	0	0	0	0	0	0	0
Processa hawaiiensis	0	0	0	0	0	0	0	0	0
Processa macrognatha	0	0	0	0	0	0	0	0	0
Ogyrides sp. A	0	0	0	0	0	0	0	1	0
	0	0	0	0	0	0	0	0	0
DECAPODA–ANOMURA	0	0	0	0	0	0	0	0	0
Emerita pacifica	0	0	0	0	0	0	0	0	0
Pagurid sp. A	0	0	0	0	0	1	0	0	0
Pomatocheles sp. A	0	0	0	0	0	0	0	0	0

TABLE D.9—*Continued*

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
DECAPODA–BRACHYURA									
Aphanodactylus edmondsoni	0	0	0	0	0	0	0	0	0
Chlorinoides goldsboroughi (?)	0	0	0	0	0	0	0	0	0
Coelocarcinus foliatus	0	0	0	0	0	0	0	0	0
Megalops	0	0	0	0	0	0	0	0	0
Nucia (?) sp. A	0	0	0	0	0	0	0	0	0
Pilumnus sp. A	0	0	0	0	0	0	0	0	0
Portunus granulatus	0	0	0	0	0	0	0	0	0
Portunus macrophthalamus	0	0	0	0	0	0	0	0	0
Zoea	0	0	0	0	0	0	0	0	0
Total No. of Individuals/Station	14	2	3	2	3	3	3	3	8
Total No. of Taxa/Station	61	6	7	10	4	3	21	5	31
Total No. of Individuals Sampled									
Total No. of Taxa Sampled									

TABLE D.10. Taxon Abundance from Four Stations for Crustacean Components, Māmala Bay Sampling Stations 67 Through 70 and Regional Total, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	69	70	
ACARI					
Halacaridae sp. A	0	0	0	0	2
PYCNOGONIDA					
Anoplodactylus projectus	0	0	0	0	3
Callipallene (?) sp. A	0	0	0	0	1
COPEPODA	6	16	4	0	367
OSTRACODA–MYODOCOPIDA					
Myodocope sp. A	0	0	0	0	40
Myodocope sp. B	0	0	0	0	2
OSTRACODA–PODOCOPIDA					
Bairdia hanaumaensis	0	0	0	0	1
Bairdia kauaiensis	0	0	0	0	16
Loxoconchella anomala	0	0	0	0	1
Macrocypris gracilis	0	0	0	0	16
CUMACEA	0	0	0	0	42
TANAIDACEA					
Apseudes tropicalis	0	0	0	0	4
Apseudes sp. A	0	0	0	0	1
Leptochelia dubia	0	0	0	0	360
Leptochelia sp. A	0	0	0	0	27
Synapseudes minutus	0	0	0	0	1
Tanaissus sp. A	4	0	0	0	51
ISOPODA					
Apanthura inornata	0	1	0	0	10
Bagatus sp. A	0	0	0	0	1
Caeciantropsis sp. A	0	0	0	0	6
Cryptoniscus form	0	0	0	0	1
"*Dynamenella*" (?) sp. A	0	0	0	0	2
Hyssuridae sp. A	0	0	0	0	8
Janira algicola	0	0	0	0	27
Joeropsis hawaiiensis	0	0	0	0	12
Mesanthura hieroglyphica	0	0	0	0	1
Metacirolana sp. A	0	0	0	0	35
Microcharon sp. A	0	0	0	0	9
Munna acarina	0	0	0	0	21
Paranthura ostergaardi	0	0	0	0	1
Pleurocope sp. A	0	0	0	0	4

TABLE D.10—*Continued*

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	69	70	
AMPHIPODA–CAPRELLIDEA					
Caprella cf. *subtilis*	0	0	0	0	1
Metaprotella sandalensis	0	0	0	0	11
AMPHIPODA–GAMMARIDEA					
Amphilochidae sp(p).	0	0	0	0	24
Ampithoe ramondi	0	0	0	0	11
Atylus nani	0	0	0	0	1
Bemlos macromanus	0	0	0	0	15
Bemlos waipio	0	0	0	0	1
Ceradocus hawaiiensis	0	0	0	0	26
Elasmopus piikoi	0	0	0	0	98
Ericthonius brasiliensis	1	0	0	0	18
Eriopisa laakona	0	0	0	0	22
Eriopisa sp. A	0	0	0	0	2
Eriopisella sechellensis	0	0	0	0	110
Eusiroides diplonyx	0	11	0	0	41
Gammaropsis atlantica	0	0	0	0	6
Gammaropsis pokipoki	0	0	0	0	1
Ischyrocerus oahu	0	0	0	0	1
Ischyrocerus kapu	0	0	0	0	4
Konatopus paao	0	0	0	0	142
Leucothoe hyhelia	0	0	0	0	4
Melita pahuwai	0	0	0	0	1
Ochlesis alii	0	0	0	0	1
Paradexamine maunaloa	0	0	0	0	1
Paraphoxus sp.	0	0	0	0	6
Pereionotus alaniphlias	0	0	0	0	2
Photis kapapa	0	0	0	0	3
Seba ekepuu	0	0	0	0	38
DECAPODA–NATANTIA					
Alpheus paracrinitus	0	0	0	0	2
Leptochela hawaiiensis	0	0	0	0	1
Metapenaeus sp. A	0	0	0	0	2
Palaemon sp. A	0	0	0	0	1
Pontophilus cf. *sculptus*	0	0	0	0	2
Processa aequimana	0	0	0	0	1
Processa hawaiiensis	0	0	0	0	2
Processa macrognatha	0	0	0	0	1
Ogyrides sp. A	0	0	0	0	8
DECAPODA–ANOMURA					
Emerita pacifica	0	0	0	0	1
Pagurid sp. A	0	0	0	0	3
Pomatocheles sp. A	0	0	0	0	1

TABLE D.10—*Continued*

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	69	70	
DECAPODA–BRACHYURA					
Aphanodactylus edmondsoni	0	0	0	0	1
Chlorinoides goldsboroughi (?)	0	0	0	0	1
Coelocarcinus foliatus	0	0	1	0	2
Megalops	0	0	0	0	2
Nucia (?) sp. A	0	0	0	0	4
Pilumnus sp. A	0	0	0	0	1
Portunus granulatus	0	0	0	0	1
Portunus macrophthalamus	0	0	0	0	2
Zoea	0	0	0	0	2
Total No. of Individuals/Station	3	3	2	0	
Total No. of Taxa/Station	11	28	5	0	
Total No. of Individuals Sampled					79
Total No. of Taxa Sampled					1,705

Appendix E. Taxon Abundance for Mollusks

TABLE E.1. Taxon Abundance from Nine Stations for Mollusk Components, Māmala Bay Sampling Stations 31 Through 39, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
BIVALVIA									
Arca sp.	0	0	0	0	0	0	0	0	0
Barbatia divaricata	0	0	1	0	0	0	0	0	0
Barbatia nuttingi	0	0	0	0	0	0	0	0	0
Barbatia sp.	0	0	0	0	0	0	1	0	0
Brachidontes crebristriatus	13	0	11	0	0	8	0	0	6
Cardita thaanumi	0	0	0	0	0	0	0	0	0
Carditella hawaiensis	1	2	2	3	5	1	0	0	1
Chama spp.	0	0	0	0	0	0	0	0	0
Chlamydella sp. A	0	2	0	0	0	2	1	0	0
Chlamys sp.	0	0	0	0	0	0	0	0	0
Cosa waikikia	0	0	0	0	0	0	10	0	0
Crenella sp.	1	2	1	3	0	4	0	0	0
Ctena bella	0	0	1	0	0	0	0	0	0
Ctena transversa	0	0	0	0	0	0	0	0	0
Ctena sp.	0	0	0	0	0	0	0	0	0
Cuspidaria hawaiensis	0	0	0	0	0	0	0	0	0
Cuspidaria spp.	0	3	0	0	0	0	0	0	0
Epicodakia sp.	0	0	0	0	0	0	0	0	0
Ervilia bisculpta	2	1	2	0	0	0	1	0	0
Fragum mundum	6	8	16	4	2	3	0	3	0
Gastrochaena spp.	0	0	0	0	0	0	0	0	0
Grammatomya kanaka	0	0	0	0	0	0	6	0	0
Isognomon spp.	0	0	0	0	0	0	0	0	0
Kellia hawaiensis	4	22	1	5	0	19	0	0	3
Kellia rosea	0	0	0	0	0	0	0	0	0
Kona symmetrica	0	6	0	0	1	0	1	0	1
Laevichlamys irregularis	0	0	0	0	0	0	0	0	0
Lima spp.	0	0	0	0	0	0	1	0	0
Lucina edentula	0	0	0	0	0	0	0	0	0
Malleus regula	0	0	0	4	5	1	5	0	0
Malleus sp. A	0	9	0	0	0	0	0	0	0
Mytilidae sp.	0	13	0	0	0	0	6	0	0
Nucula hawaiensis	0	0	0	0	0	0	1	0	0
Ostrea sp.	0	1	1	0	0	1	5	0	0
Pinna sp.[a]	0	0	0	0	0	0	frag +	0	0
Rochefortina sandwichensis	1	20	2	17	8	2	20	4	0
Semelangulus crebrimaculatus	0	0	0	0	0	0	0	0	0
Septifer bryanae	0	6	0	7	4	2	0	4	1
Septifer spp.	0	0	0	0	0	0	0	0	0
Tellina crucigera	0	0	0	0	0	0	0	0	0
Tellina sp.	0	0	0	0	0	0	0	0	0
Teredinidae spp.	0	0	0	0	0	0	0	0	0
Bivalvia sp. C	0	0	0	1	0	0	0	0	0
Bivalvia spp.	0	0	0	1	0	1	0	0	0

TABLE E.1—*Continued*

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
GASTROPODA									
Acteocina hawaiensis	0	0	0	0	0	0	0	0	0
Acteocina sandwicensis	0	0	1	0	0	0	0	0	0
Acteocina sp.	0	0	0	0	0	0	3	0	0
Alcyna ocellata	2	5	0	0	2	3	15	2	1
Alcyna subangulata	1	0	0	0	1	1	0	4	0
Alvania isolata	0	0	0	0	0	0	0	0	0
Anacithara perfecta	0	0	0	0	0	0	0	0	0
Antisabia foliacea	1	0	1	0	0	3	0	1	1
Aplysiidae spp.	0	0	0	0	0	0	0	1	0
Atys debilis	0	3	0	0	0	0	0	0	0
Atys semistriata	0	0	0	0	0	0	0	0	0
Atys sp.	0	0	0	0	0	0	0	0	0
Balcis acanthyllis	0	0	0	0	0	1	0	0	0
Balcis aciculata	0	0	0	0	0	0	5	0	0
Balcis brunnimaculata	0	0	0	0	0	0	0	0	0
Balcis conoidalis	0	0	0	0	0	0	1	0	0
Balcis spp.	0	0	0	0	0	0	6	0	0
Barleeia calcarea	0	0	0	0	0	0	0	0	0
Bittium impendens	1	0	0	0	1	0	3	5	3
Brookula iki	0	0	0	0	0	0	0	0	0
Bulla vernicosa	0	0	0	0	0	0	0	0	0
Caecum cf. *glabella*	0	0	0	0	0	0	0	0	0
Caecum cf. *glabriformis*	0	0	0	0	0	0	3	0	0
Caecum sepimentum	2	1	3	5	7	1	13	4	2
Caecum sp.	0	0	0	0	0	0	0	0	0
Carinapex minutissima	0	3	2	0	4	0	0	0	0
Cephalaspidea sp.	0	0	0	1	0	0	0	0	0
Cerithidium diplax	1	10	1	0	7	0	16	2	1
Cerithidium perparvulum	2	32	2	27	40	3	168	13	2
Cerithiopsis spp.	0	0	2	0	0	0	0	0	0
Cerithium atromarginatum	0	0	0	0	0	0	0	0	0
Cerithium columna	0	0	0	0	2	0	3	0	0
Cerithium interstriatum	0	0	0	2	6	0	9	2	0
Cerithium nesioticum	0	0	0	0	0	0	0	2	0
Cerithium rostratum	0	0	0	0	0	0	0	0	0
Cerithium zebrum	0	0	0	2	0	0	4	1	0
Cerithium sp.	2	2	0	2	3	2	7	0	4
Ceritoturris bittium	0	0	0	0	0	0	0	0	0
Clavus mighelsi	0	0	1	0	0	0	0	0	0
Clavus sp.	0	0	0	0	0	0	0	0	0
Collonista candida	0	1	2	3	0	0	2	0	0
Costellariidae spp.	0	0	0	0	0	0	0	0	0
Crepidula aculeata	0	0	0	0	0	0	0	0	0
Cycloscala hyalina	0	0	0	0	0	0	1	0	0
Cyclostremiscus emeryi	2	1	2	0	0	5	3	0	6
Cyclostremiscus striatus	0	0	0	0	0	1	0	0	0
Cylichna pusilla	1	1	1	0	0	0	0	0	0

TABLE E.1—*Continued*

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
Cymatiidae spp.	0	0	0	0	0	0	0	0	0
Cystiscus huna	0	0	0	0	0	0	0	0	0
Daphnellinae sp.	0	0	2	0	0	0	0	0	0
Dendropoma spp.	4	0	2	8	0	5	0	1	3
Diala scopulorum	0	0	0	0	0	0	61	0	0
Diala semistriata	1	2	0	5	23	2	99	1	0
Diniatys dentifer	0	1	0	0	1	0	1	0	0
Diodora granifera	0	0	0	0	0	0	0	0	0
Eatoniella janetaylorae	0	0	0	3	0	1	5	3	0
Eatoniella pigmenta	0	0	0	0	0	0	0	0	0
Echineulima sp.	0	0	0	0	0	0	0	0	0
Elacorbis callusa	0	0	0	0	0	0	0	0	0
Emarginula dilecta	0	0	0	0	0	0	0	0	0
Epitonium spp.	0	0	0	0	0	0	1	0	0
Etrema acricula	0	0	0	0	0	0	0	0	0
Euchelus gemmatus	0	0	0	0	1	0	2	0	0
Eucithara angiostoma	0	0	0	0	1	0	0	0	0
Eucithara pusilla	0	0	0	0	0	0	0	0	0
Eucithara sp.	0	0	0	0	0	0	0	0	0
Eulima peasei	0	0	0	0	0	0	0	0	0
Evalea peasei	0	0	0	1	2	0	0	0	0
Evalea waikikiensis	0	0	0	0	0	0	0	0	0
Finella pupoides	0	0	0	0	0	0	0	0	0
Gibbula marmorea	0	0	0	1	0	0	0	0	0
Granula sandwicensis	0	0	2	0	0	0	0	0	0
Granulina vitrea	1	0	5	2	1	0	1	3	0
Granulina sp.	0	0	0	0	0	0	0	0	0
Haminoea spp.	0	0	0	0	1	0	0	0	0
Heliacus implexus	0	0	0	0	0	0	0	0	0
Heliacus sterkii	0	0	0	0	0	0	0	0	0
Herviera gliriella	0	0	3	5	2	0	3	2	0
Herviera patricia	0	0	0	0	0	0	0	0	0
Hinemoa indica	0	0	0	1	0	0	0	2	0
Hipponix australis	0	0	0	0	1	0	0	0	0
Hipponix pilosus	1	0	3	0	0	0	0	1	0
Ittibittium parcum	5	1	4	0	0	4	0	0	8
Julia exquisita	0	2	0	1	4	1	1	0	0
Juliidae spp.	0	0	0	0	1	0	0	1	0
Kermia aniani	0	0	1	0	0	0	0	0	0
Kermia pumila	0	0	0	0	0	0	0	0	0
Koloonella sp.	0	0	0	0	0	0	0	0	0
Leptothyra rubricincta	1	0	1	0	0	0	0	0	0
Leptothyra verruca	0	1	4	0	0	0	0	0	1
Lophocochlias minutissimus	1	8	1	7	17	7	29	5	1
Lophocochlias sp. A	1	2	0	0	1	1	0	2	1
Macteola segesta	0	0	0	0	0	0	0	0	0
Merelina granulosa	0	0	0	0	0	0	0	0	0
Merelina hewa	0	0	0	0	0	0	0	0	0

TABLE E.1—*Continued*

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
Merelina wanawana	0	0	0	0	0	0	0	0	0
Merelina spp.	0	0	0	0	0	0	0	0	0
Metaxia brunnicephala	0	0	0	1	0	0	0	0	0
Microdaphne trichodes	0	0	0	0	0	0	0	0	0
Miralda paulbartschi	3	0	1	0	0	0	0	0	2
Miralda scopulorum	0	0	0	0	0	0	0	0	0
Mitrella margarita	0	0	3	0	0	0	0	0	0
Mitrella spp.	0	0	0	0	0	0	0	0	0
Mitrolumna alphonsiana	0	0	0	0	0	0	0	0	0
Mitrolumna spp.	0	0	0	0	0	0	0	0	0
Modulus tectum	0	0	0	1	0	0	0	0	0
Morula spp.	0	0	0	0	0	0	0	0	0
Muricidae spp.	0	0	0	0	1	0	0	0	0
Nassarius spp.	0	0	0	0	0	0	0	0	0
Natica gualteriana	0	0	0	0	0	0	0	0	0
Natica sp.	0	0	0	0	0	0	0	0	0
Nerita sp.	0	0	0	0	0	0	1	0	0
Odostomia gulicki	0	0	0	0	0	0	0	0	0
Odostomia oxia	0	0	0	0	0	0	0	0	0
Odostomia stearnsiella	0	0	1	0	0	0	0	0	0
Odostomia sp.	0	0	0	0	0	0	0	0	0
Omalogyra japonica	0	0	0	1	1	2	1	0	0
Omalogyra sp.	0	0	0	0	0	0	2	0	0
Orbitestella regina	2	0	1	1	1	5	4	0	5
Orbitestella sp. A	0	0	0	0	0	0	1	0	0
Orbitestella sp. B	0	0	0	1	0	1	1	0	0
Otopleura mitralis	0	0	0	0	0	0	0	0	0
Parashiela beetsi	0	26	1	7	17	0	20	10	0
Peristernia chlorostoma	0	1	1	0	0	0	0	0	0
Phenacolepas scobinata	0	0	0	0	0	0	0	0	0
Philippia oxytropis	0	1	0	0	0	0	0	1	0
Planaxis suturalis	0	0	0	0	0	0	0	0	0
Plesiotrochus luteus	0	0	1	0	1	0	2	0	0
Powellisetia fallax	0	0	0	0	0	0	0	0	0
Pupa pudica	0	0	0	0	0	0	0	0	0
Pupa sp.	0	0	0	0	1	0	0	0	0
Pusillina marmorata	1	31	4	14	31	5	65	11	5
Pyramidellidae sp. B	0	0	0	0	0	0	0	0	0
Pyramidellidae sp. C	0	0	0	0	0	0	3	0	0
Pyramidellidae spp.	0	0	0	1	0	0	0	0	0
Pyramidelloides gracilis	0	0	0	0	2	0	1	0	0
Pyramidelloides miranda	0	0	0	0	1	0	0	0	0
Pyrgulina oodes	0	0	0	0	0	0	0	0	0
Pyrgulina sp.	0	0	0	0	0	0	4	0	0
Rastodens brevilabiosa	0	0	0	1	0	0	0	0	0
Rastodens labiosa	0	0	0	0	0	0	0	0	0
Rastodens sp.	0	0	0	0	0	0	0	0	0
Rhinoclavis articulata	0	0	0	0	0	0	0	0	0

TABLE E.1—*Continued*

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
Rissoella confusa	0	0	0	0	3	0	3	0	0
Rissoella longispira	0	7	0	0	0	0	0	0	0
Rissoella sp.	0	0	0	0	0	0	0	0	0
Rissoina ambigua	0	0	0	0	0	0	0	0	0
Rissoina cerithiiformis	0	0	0	3	10	0	2	2	0
Rissoina costata	0	0	0	0	0	0	0	0	0
Rissoina pulchella	0	0	0	1	9	0	23	1	0
Rissoidae spp.	0	3	0	0	0	0	0	0	0
Rufodardanula conica	0	0	0	0	0	0	0	0	0
Rufodardanula ponderi	0	0	0	0	0	0	0	5	2
Rufodardanula sp.	0	0	0	1	0	0	0	0	0
Sansonia kenneyi	0	0	0	2	0	0	0	1	0
Scaliola spp.	0	3	0	1	6	1	49	1	0
Schwartziella ephamilla	0	1	0	6	6	0	16	2	1
Schwartziella triticea	0	0	0	0	0	0	0	0	0
Scissurella pseudoequatoria	0	0	0	0	0	0	0	0	0
Seminella peasei	0	0	1	0	0	0	0	0	0
Seminella smithi	0	0	1	0	1	0	1	0	0
Seminella sp.	0	0	0	0	0	0	0	0	0
Serpulorbis spp.	0	0	0	0	0	0	1	0	0
Sinezona insignis	0	4	0	0	0	3	0	0	0
Smaragdia bryanae	0	0	0	0	0	0	0	0	0
Stosicia hiloense	0	0	0	0	0	0	0	0	0
Strebloceras subannulatum	0	0	0	0	0	0	0	0	0
Strombus sp.	0	0	0	0	0	0	0	0	0
Styliferina goniochila	0	1	0	1	1	0	3	2	0
Synaptocochlea concinna	0	0	0	0	0	0	0	0	0
Teinostoma sulcata	0	0	0	0	0	0	2	0	0
Terebra spp.	0	0	0	0	0	0	0	0	0
Tricolia variabilis	38	16	18	8	23	24	14	8	21
Triphora spp.	1	6	1	3	3	0	12	3	0
Trivia hordacea	0	0	0	0	0	0	0	0	0
Trochus intextus	0	0	0	0	0	0	0	0	0
Turbo sandwicensis	0	0	0	0	1	0	1	0	0
Turbonilla cornelliana	0	0	0	0	0	0	1	0	0
Turbonilla thaanumi	0	0	0	0	0	0	0	0	0
Turbonilla sp. E	0	0	0	0	0	0	0	0	0
Turbonilla sp. H	0	0	0	0	0	0	0	0	0
Turbonilla spp.	0	0	1	0	0	0	0	1	0
Turridae sp.	0	0	0	0	0	0	0	0	0
Vanikoro sp.	0	0	0	0	0	0	0	0	0
Veprecula brunonia	0	0	0	0	0	0	1	0	0
Vermetidae sp.	0	0	0	0	0	0	0	0	0
Vexillum diutenera	0	0	0	0	0	0	0	0	0
Vexillum piceum	0	0	0	0	0	0	0	0	0
Vexillum spp.	0	1	0	0	0	0	0	0	0
Volutomitra pailoloana	0	0	0	0	0	0	0	0	0
Volvarina fusiformis	0	0	0	0	0	0	0	0	0

TABLE E.1—*Continued*

Taxon	No. of Individuals								
	Station								
	31	32	33	34	35	36	37	38	39
Williamia radiata	0	0	0	0	0	0	3	0	0
Zebina bidentata	0	0	0	0	0	0	0	1	0
Zebina sp.	0	0	0	0	0	0	0	0	0
Gastropoda sp. A	0	2	0	0	2	0	0	1	1
Gastropoda spp.	0	0	0	0	0	0	1	0	0
SCAPHOPODA									
Scaphopoda sp.	0	0	0	0	0	0	0	0	0
POLYPLACOPHORA									
Polyplacophora sp.	0	0	0	1	0	1	0	0	0
Total No. of Individuals/Station	103	274	119	176	275	127	761	119	83
Total No. of Individuals/cm^3	6.9	18.3	7.9	11.7	18.3	8.5	50.7	7.9	5.5
Total No. of Taxa	30	44	45	45	49	35	68	39	25

[a]Pinna are indicated by a "+" for larval shells and by "frag" for shell fragments.

TABLE E.2. Taxon Abundance from Nine Stations for Mollusk Components, Māmala Bay Sampling Stations 40 Through 48, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
BIVALVIA									
Arca sp.	0	0	0	0	0	0	0	0	0
Barbatia divaricata	0	0	1	0	1	0	1	0	0
Barbatia nuttingi	0	0	0	0	0	0	0	0	0
Barbatia sp.	0	0	0	0	1	0	2	0	0
Brachidontes crebristriatus	2	0	0	0	0	0	1	0	0
Cardita thaanumi	0	0	0	0	0	0	0	0	0
Carditella hawaiensis	1	0	0	0	1	1	3	0	0
Chama spp.	0	0	0	0	0	0	0	0	0
Chlamydella sp. A	0	0	0	0	1	0	0	0	0
Chlamys sp.	0	0	0	0	0	0	0	0	0
Cosa waikikia	0	0	0	0	3	0	0	0	0
Crenella sp.	0	0	3	0	0	1	0	0	0
Ctena bella	0	0	0	0	0	0	0	0	0
Ctena transversa	0	0	0	0	1	0	0	0	0
Ctena sp.	0	8	0	0	1	0	0	0	0
Cuspidaria hawaiensis	0	0	0	0	0	0	0	0	0
Cuspidaria spp.	0	0	0	0	0	1	0	0	0
Epicodakia sp.	0	1	0	1	0	0	0	0	0
Ervilia bisculpta	0	6	0	6	0	2	2	0	0
Fragum mundum	5	0	1	0	0	2	5	0	1
Gastrochaena spp.	0	0	0	0	1	0	0	0	0
Grammatomya kanaka	0	1	0	0	0	1	0	0	0
Isognomon spp.	0	0	0	0	1	0	0	0	0
Kellia hawaiensis	0	0	0	0	0	4	0	0	0
Kellia rosea	0	0	0	0	0	1	0	0	0
Kona symmetrica	0	0	0	0	2	3	1	0	1
Laevichlamys irregularis	0	0	0	0	0	1	0	0	0
Lima spp.	0	0	0	0	1	0	0	0	0
Lucina edentula	0	0	1	0	0	0	0	0	0
Malleus regula	0	2	0	0	0	0	0	0	0
Malleus sp. A	0	0	0	0	0	0	0	0	0
Mytilidae sp.	0	0	0	0	0	0	0	1	1
Nucula hawaiensis	1	1	0	0	0	0	0	0	0
Ostrea sp.	0	3	0	0	5	1	1	0	0
Pinna sp.[a]	0	+	+	+	+	+	0	+	0
Rochefortina sandwichensis	0	5	1	1	10	8	0	1	1
Semelangulus crebrimaculatus	0	0	0	1	1	0	0	2	0
Septifer bryanae	0	0	0	0	9	3	0	0	0
Septifer spp.	0	5	0	0	0	0	0	0	0
Tellina crucigera	0	0	1	1	0	0	0	0	0
Tellina sp.	0	0	0	3	0	0	0	0	0
Teredinidae spp.	0	0	0	0	0	0	0	0	0
Bivalvia sp. C	0	0	0	0	0	0	0	0	0
Bivalvia spp.	0	0	0	0	0	2	0	0	0

TABLE E.2—*Continued*

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
GASTROPODA									
Acteocina hawaiensis	0	0	0	3	0	0	0	0	0
Acteocina sandwicensis	0	5	0	0	0	0	1	0	0
Acteocina sp.	0	0	0	0	0	0	0	1	0
Alcyna ocellata	0	9	1	1	27	2	6	1	1
Alcyna subangulata	0	0	0	0	0	0	0	0	0
Alvania isolata	0	0	0	0	0	0	0	0	0
Anacithara perfecta	0	0	0	0	0	0	0	0	0
Antisabia foliacea	1	0	0	0	0	1	0	0	0
Aplysiidae spp.	0	0	0	0	0	0	0	0	0
Atys debilis	0	0	1	0	0	0	0	0	0
Atys semistriata	0	0	1	0	0	0	0	0	0
Atys sp.	0	2	0	0	0	0	0	0	0
Balcis acanthyllis	0	0	0	0	0	0	0	0	0
Balcis aciculata	0	0	3	5	0	0	0	1	0
Balcis brunnimaculata	0	0	0	0	0	0	0	0	0
Balcis conoidalis	0	0	0	0	0	0	0	0	0
Balcis spp.	0	37	0	0	10	0	2	0	0
Barleeia calcarea	0	0	0	0	0	0	0	0	0
Bittium impendens	4	0	1	0	2	1	8	0	0
Brookula iki	0	0	0	0	0	0	0	0	0
Bulla vernicosa	0	0	0	0	2	0	0	0	0
Caecum cf. *glabella*	0	0	0	0	0	0	2	0	0
Caecum cf. *glabriformis*	0	0	0	0	0	0	0	0	0
Caecum sepimentum	1	5	2	0	28	7	5	0	1
Caecum sp.	0	0	0	0	0	1	0	0	0
Carinapex minutissima	0	2	0	0	0	0	0	0	4
Cephalaspidea sp.	0	0	0	0	3	0	0	0	0
Cerithidium diplax	0	27	1	2	9	16	8	5	10
Cerithidium perparvulum	5	181	21	14	81	72	24	39	80
Cerithiopsis spp.	0	1	0	0	0	0	0	0	0
Cerithium atromarginatum	0	0	0	0	0	0	0	0	0
Cerithium columna	0	4	0	0	3	2	0	0	0
Cerithium interstriatum	0	5	1	1	8	2	1	0	0
Cerithium nesioticum	1	0	0	1	1	0	2	0	0
Cerithium rostratum	0	14	0	0	18	0	0	0	0
Cerithium zebrum	3	7	0	0	1	0	4	0	0
Cerithium sp.	0	0	0	0	0	3	0	0	0
Ceritoturris bittium	0	1	0	0	0	0	0	0	0
Clavus mighelsi	0	0	0	0	0	0	0	0	0
Clavus sp.	0	0	0	0	0	0	0	0	0
Collonista candida	0	0	0	0	2	0	2	0	0
Costellariidae spp.	0	0	0	0	0	0	0	0	0
Crepidula aculeata	0	0	0	0	0	0	0	0	0
Cycloscala hyalina	0	0	0	0	0	0	0	0	0
Cyclostremiscus emeryi	0	1	0	0	0	0	8	0	0
Cyclostremiscus striatus	1	0	0	0	0	0	0	0	0
Cylichna pusilla	0	0	0	0	0	0	0	0	0

TABLE E.2—*Continued*

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
Cymatiidae spp.	0	0	0	0	1	0	0	0	0
Cystiscus huna	0	0	0	0	0	0	0	0	0
Daphnellinae sp.	0	0	0	0	0	0	0	0	0
Dendropoma spp.	2	3	0	1	1	1	19	0	0
Diala scopulorum	0	227	1	0	11	0	0	1	0
Diala semistriata	1	113	9	43	77	16	9	7	0
Diniatys dentifer	0	0	0	1	0	0	0	0	0
Diodora granifera	0	0	0	0	0	0	1	0	0
Eatoniella janetaylorae	0	3	0	5	5	5	2	0	0
Eatoniella pigmenta	0	0	0	0	0	0	0	0	0
Echineulima sp.	0	0	0	0	1	0	0	0	0
Elacorbis callusa	0	0	0	0	0	0	0	0	0
Emarginula dilecta	0	0	0	0	0	0	0	0	0
Epitonium spp.	0	2	0	0	0	0	0	0	0
Etrema acricula	0	0	0	0	1	0	0	0	0
Euchelus gemmatus	0	1	0	0	3	1	3	0	0
Eucithara angiostoma	0	0	0	0	0	0	0	0	0
Eucithara pusilla	0	2	0	0	0	0	0	0	0
Eucithara sp.	0	0	1	0	0	0	0	1	0
Eulima peasei	0	0	0	0	0	0	0	0	0
Evalea peasei	0	0	0	0	0	0	0	0	0
Evalea waikikiensis	0	0	0	0	0	0	0	0	0
Finella pupoides	0	1	0	49	0	0	0	0	0
Gibbula marmorea	0	0	0	0	0	0	0	0	0
Granula sandwicensis	2	0	0	0	1	0	0	0	1
Granulina vitrea	0	0	2	1	2	0	0	0	0
Granulina sp.	0	2	0	0	0	0	1	0	0
Haminoea spp.	0	0	0	0	0	0	0	0	0
Heliacus implexus	0	0	0	0	1	0	0	0	0
Heliacus sterkii	0	0	0	0	0	0	0	0	0
Herviera gliriella	0	2	0	0	0	0	3	0	0
Herviera patricia	0	0	0	0	0	0	0	0	0
Hinemoa indica	0	0	0	0	0	0	1	0	1
Hipponix australis	0	0	0	0	0	0	0	0	0
Hipponix pilosus	0	0	0	0	0	2	0	0	0
Ittibittium parcum	1	1	0	0	0	0	9	1	0
Julia exquisita	0	0	0	0	0	0	0	0	0
Juliidae spp.	0	0	0	0	0	2	0	0	0
Kermia aniani	0	0	0	0	1	0	0	0	0
Kermia pumila	0	0	0	0	0	0	0	0	0
Koloonella sp.	0	0	0	0	1	0	2	0	0
Leptothyra rubricincta	0	2	0	0	0	0	2	0	0
Leptothyra verruca	2	2	0	0	3	0	4	1	0
Lophocochlias minutissimus	0	3	2	2	9	25	19	6	1
Lophocochlias sp. A	0	0	0	0	0	0	9	0	0
Macteola segesta	0	0	0	0	0	0	0	0	0
Merelina granulosa	0	0	0	0	0	0	0	0	0
Merelina hewa	0	0	0	0	0	0	0	0	0

TABLE E.2—*Continued*

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
Merelina wanawana	0	0	0	0	0	0	0	0	0
Merelina spp.	0	0	0	0	0	0	6	0	0
Metaxia brunnicephala	0	0	0	0	0	0	0	0	0
Microdaphne trichodes	0	0	0	0	0	0	0	0	0
Miralda paulbartschi	0	0	0	0	0	0	2	0	0
Miralda scopulorum	0	0	0	0	1	1	0	0	0
Mitrella margarita	2	0	0	0	0	0	0	0	0
Mitrella spp.	0	0	0	0	0	0	0	0	0
Mitrolumna alphonsiana	0	0	0	0	0	0	0	0	0
Mitrolumna spp.	0	0	0	0	0	0	0	0	0
Modulus tectum	0	0	0	0	0	0	2	0	0
Morula spp.	0	0	0	0	0	0	0	0	0
Muricidae spp.	0	0	0	0	1	0	0	0	0
Nassarius spp.	0	0	0	0	0	0	0	0	0
Natica gualteriana	0	1	0	2	0	0	0	0	0
Natica sp.	0	0	0	0	0	0	0	0	0
Nerita sp.	0	0	0	0	0	0	0	0	0
Odostomia gulicki	0	0	0	0	0	0	0	0	0
Odostomia oxia	3	0	0	0	0	0	0	0	0
Odostomia stearnsiella	0	0	0	0	0	0	0	0	0
Odostomia sp.	0	0	0	0	0	0	0	0	0
Omalogyra japonica	0	0	0	1	1	0	1	1	0
Omalogyra sp.	0	2	0	0	0	0	0	0	0
Orbitestella regina	0	4	0	0	6	1	8	0	0
Orbitestella sp. A	0	0	0	0	0	0	0	0	0
Orbitestella sp. B	0	12	0	0	6	0	0	0	0
Otopleura mitralis	1	0	0	0	0	0	0	0	0
Parashiela beetsi	0	12	0	1	23	22	12	2	0
Peristernia chlorostoma	0	0	0	0	0	0	0	0	1
Phenacolepas scobinata	0	0	0	0	0	0	0	0	0
Philippia oxytropis	0	0	0	0	0	0	1	0	0
Planaxis suturalis	0	0	0	0	0	0	0	0	0
Plesiotrochus luteus	1	0	0	0	4	0	1	0	0
Powellisetia fallax	0	1	0	0	0	0	0	0	0
Pupa pudica	0	0	0	2	0	0	0	1	0
Pupa sp.	0	1	0	0	0	0	0	0	0
Pusillina marmorata	0	34	5	3	110	30	50	8	0
Pyramidellidae sp. B	0	0	0	0	0	0	0	0	0
Pyramidellidae sp. C	0	6	1	1	1	1	1	0	0
Pyramidellidae spp.	0	0	0	0	0	0	0	0	0
Pyramidelloides gracilis	0	0	0	0	1	0	1	0	0
Pyramidelloides miranda	0	0	0	0	0	0	0	0	0
Pyrgulina oodes	0	3	0	1	0	0	0	1	0
Pyrgulina sp.	0	0	0	0	0	0	0	0	0
Rastodens brevilabiosa	0	0	0	0	0	0	0	0	0
Rastodens labiosa	1	0	0	0	0	0	0	0	0
Rastodens sp.	0	0	0	0	0	0	0	0	0
Rhinoclavis articulata	0	0	0	0	0	0	0	0	1

TABLE E.2—*Continued*

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
Rissoella confusa	0	3	0	0	0	0	0	0	0
Rissoella longispira	0	1	0	2	5	2	0	0	0
Rissoella sp.	0	0	1	0	0	2	0	0	0
Rissoina ambigua	2	0	0	0	0	0	0	0	0
Rissoina cerithiiformis	12	0	0	0	1	0	5	0	0
Rissoina costata	0	0	0	0	0	0	0	0	0
Rissoina pulchella	1	45	2	0	22	3	2	2	1
Rissoidae spp.	0	0	0	0	0	0	0	0	0
Rufodardanula conica	0	0	0	0	6	1	5	0	0
Rufodardanula ponderi	1	0	0	0	0	0	2	0	0
Rufodardanula sp.	0	0	0	0	0	0	0	0	0
Sansonia kenneyi	0	0	0	0	0	0	0	0	0
Scaliola spp.	0	43	2	6	16	31	6	6	0
Schwartziella ephamilla	0	3	1	0	17	0	1	0	0
Schwartziella triticea	0	0	0	0	0	0	0	0	0
Scissurella pseudoequatoria	0	0	0	0	0	0	0	0	0
Seminella peasei	0	0	0	0	0	0	0	0	0
Seminella smithi	0	0	0	0	3	0	0	0	0
Seminella sp.	0	0	0	0	0	0	0	0	0
Serpulorbis spp.	0	4	0	1	0	0	0	1	0
Sinezona insignis	0	2	0	0	0	0	0	0	0
Smaragdia bryanae	0	0	0	0	0	0	0	0	0
Stosicia hiloense	0	0	0	0	4	0	1	0	0
Strebloceras subannulatum	0	0	0	0	1	0	0	0	0
Strombus sp.	0	0	0	0	0	0	0	0	0
Styliferina goniochila	0	1	0	0	7	0	5	0	0
Synaptocochlea concinna	0	0	0	0	0	0	1	0	0
Teinostoma sulcata	0	0	0	0	0	0	0	0	0
Terebra spp.	0	0	0	0	0	0	0	0	0
Tricolia variabilis	2	8	4	0	13	10	75	7	0
Triphora spp.	3	13	4	1	10	5	4	2	2
Trivia hordacea	0	0	0	0	0	0	0	0	0
Trochus intextus	0	0	1	0	0	0	1	0	0
Turbo sandwicensis	0	1	0	0	1	0	1	0	0
Turbonilla cornelliana	0	0	0	0	0	0	0	0	1
Turbonilla thaanumi	0	0	0	0	0	0	0	0	1
Turbonilla sp. E	0	0	0	0	0	0	2	0	0
Turbonilla sp. H	0	0	0	0	0	0	1	0	0
Turbonilla spp.	0	0	0	0	0	1	0	0	0
Turridae sp.	0	0	0	0	0	0	0	0	0
Vanikoro sp.	1	1	0	0	0	0	1	0	0
Veprecula brunonia	0	0	0	0	0	0	0	0	0
Vermetidae sp.	0	0	0	0	0	0	1	0	0
Vexillum diutenera	0	0	0	0	0	0	0	0	0
Vexillum piceum	0	0	0	0	0	0	0	0	0
Vexillum spp.	0	0	0	0	0	0	0	0	0
Volutomitra pailoloana	0	0	0	0	0	0	0	0	0
Volvarina fusiformis	0	0	0	0	0	0	0	0	0

TABLE E.2—*Continued*

Taxon	No. of Individuals								
	Station								
	40	41	42	43	44	45	46	47	48
Williamia radiata	0	0	0	0	4	0	0	0	0
Zebina bidentata	0	0	0	0	0	0	0	0	0
Zebina sp.	0	0	0	0	0	0	0	0	0
Gastropoda sp. A	0	0	0	0	0	4	0	0	1
Gastropoda spp.	0	0	0	0	0	0	0	0	0
SCAPHOPODA									
Scaphopoda sp.	0	0	0	0	0	0	0	0	0
POLYPLACOPHORA									
Polyplacophora sp.	0	0	0	0	0	0	3	0	0
Total No. of Individuals/Station	63	898	76	162	616	304	375	99	111
Total No. of Individuals/cm^3	4.2	59.9	5.1	10.8	41.1	20.3	24.8	6.6	7.4
Total No. of Taxa	28	61	30	31	69	46	64	25	19

[a]Pinna are indicated by a "+" for larval shells and by "frag" for shell fragments.

TABLE E.3. Taxon Abundance from Nine Stations for Mollusk Components, Māmala Bay Sampling Stations 49 Through 57, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	56	57
BIVALVIA									
Arca sp.	0	0	0	0	0	0	0	0	0
Barbatia divaricata	0	1	0	0	0	1	0	0	0
Barbatia nuttingi	0	0	0	0	1	0	0	0	0
Barbatia sp.	0	0	0	0	0	0	0	0	0
Brachidontes crebristriatus	0	4	0	1	1	0	2	0	0
Cardita thaanumi	0	0	0	0	1	0	0	0	0
Carditella hawaiensis	0	0	1	0	0	1	0	3	0
Chama spp.	0	0	0	0	0	0	0	0	1
Chlamydella sp. A	0	0	3	0	0	0	0	0	0
Chlamys sp.	0	0	0	0	0	1	0	0	0
Cosa waikikia	2	0	6	0	0	0	0	0	0
Crenella sp.	0	0	0	0	0	0	0	0	0
Ctena bella	0	0	0	0	0	0	0	0	0
Ctena transversa	0	0	0	0	0	0	0	0	0
Ctena sp.	0	0	9	0	0	0	0	0	2
Cuspidaria hawaiensis	0	0	0	0	0	1	0	0	0
Cuspidaria spp.	0	0	0	0	0	0	0	0	0
Epicodakia sp.	0	0	0	0	0	2	0	0	0
Ervilia bisculpta	0	0	7	0	0	4	0	0	1
Fragum mundum	0	0	0	0	2	0	0	2	0
Gastrochaena spp.	0	0	0	0	0	0	0	0	0
Grammatomya kanaka	4	0	0	0	0	1	0	0	0
Isognomon spp.	0	0	0	0	0	0	0	2	0
Kellia hawaiensis	0	1	0	0	0	0	2	0	0
Kellia rosea	0	0	0	0	0	0	0	0	0
Kona symmetrica	2	0	0	0	0	0	0	0	0
Laevichlamys irregularis	0	0	0	0	0	0	0	0	0
Lima spp.	0	0	1	0	0	0	0	0	0
Lucina edentula	1	0	0	0	0	0	0	0	0
Malleus regula	0	0	0	0	0	0	0	4	0
Malleus sp. A	4	0	0	0	0	0	1	0	0
Mytilidae sp.	0	0	0	0	0	0	0	0	0
Nucula hawaiensis	0	1	0	0	0	0	0	0	0
Ostrea sp.	1	0	1	0	0	9	0	1	0
Pinna sp.[a]	+	0	+	0	0	+	+	0	+
Rochefortina sandwichensis	6	0	3	0	1	5	0	2	2
Semelangulus crebrimaculatus	1	0	0	0	0	0	0	0	1
Septifer bryanae	0	0	3	0	0	8	0	2	0
Septifer spp.	8	0	0	0	0	0	0	0	0
Tellina crucigera	0	0	0	0	0	1	0	0	0
Tellina sp.	0	0	0	0	0	0	0	0	0
Teredinidae spp.	0	0	0	0	0	0	0	0	0
Bivalvia sp. C	0	0	0	0	0	0	0	0	0
Bivalvia spp.	2	0	0	0	0	3	0	0	0

TABLE E.3—*Continued*

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	56	57
GASTROPODA									
Acteocina hawaiensis	0	0	0	0	0	0	0	0	0
Acteocina sandwicensis	0	0	9	0	0	0	0	0	0
Acteocina sp.	0	0	0	0	0	0	0	0	0
Alcyna ocellata	27	0	4	0	0	4	0	0	2
Alcyna subangulata	0	1	1	0	0	0	0	1	0
Alvania isolata	0	0	0	0	0	0	0	0	0
Anacithara perfecta	1	0	0	0	0	0	0	0	0
Antisabia foliacea	0	1	0	1	1	0	0	1	0
Aplysiidae spp.	0	0	0	0	0	0	0	0	0
Atys debilis	0	0	0	0	0	0	0	0	0
Atys semistriata	0	0	0	0	0	0	0	3	0
Atys sp.	0	0	0	0	0	0	0	0	0
Balcis acanthyllis	0	0	0	0	0	0	0	0	0
Balcis aciculata	2	0	10	0	1	18	0	0	0
Balcis brunnimaculata	0	0	0	0	0	0	0	0	0
Balcis conoidalis	0	0	0	0	0	0	0	0	0
Balcis spp.	5	1	15	0	0	18	0	0	1
Barleeia calcarea	0	0	0	0	0	0	0	1	0
Bittium impendens	0	2	3	0	0	2	0	1	0
Brookula iki	0	0	0	0	0	0	0	0	0
Bulla vernicosa	1	0	0	0	0	0	0	0	0
Caecum cf. *glabella*	0	0	0	0	0	0	0	0	0
Caecum cf. *glabriformis*	2	0	0	0	0	0	0	0	0
Caecum sepimentum	14	2	0	0	0	11	0	15	0
Caecum sp.	1	0	0	0	0	0	0	0	1
Carinapex minutissima	0	3	1	0	1	1	0	3	0
Cephalaspidea sp.	1	0	0	0	0	0	0	0	0
Cerithidium diplax	0	1	8	1	0	17	1	3	0
Cerithidium perparvulum	0	3	65	0	0	186	4	44	7
Cerithiopsis spp.	0	0	3	0	0	0	0	1	0
Cerithium atromarginatum	0	0	0	1	0	0	0	0	0
Cerithium columna	1	0	0	0	0	0	0	6	1
Cerithium interstriatum	5	0	0	0	0	2	0	2	0
Cerithium nesioticum	0	0	0	0	0	0	0	0	0
Cerithium rostratum	0	1	7	0	0	2	0	0	0
Cerithium zebrum	0	1	0	10	6	0	0	1	0
Cerithium sp.	2	0	2	0	3	7	0	0	3
Ceritoturris bittium	0	0	0	0	0	0	0	0	0
Clavus mighelsi	0	0	0	0	0	0	0	0	0
Clavus sp.	0	0	0	0	0	0	0	0	0
Collonista candida	0	1	1	1	0	0	1	0	2
Costellariidae spp.	0	0	0	0	0	0	0	0	0
Crepidula aculeata	0	0	0	0	0	0	0	0	0
Cycloscala hyalina	0	0	0	0	0	0	0	0	0
Cyclostremiscus emeryi	0	4	3	0	0	1	1	0	0
Cyclostremiscus striatus	0	0	0	0	0	0	0	0	0
Cylichna pusilla	0	0	0	0	0	0	0	0	0

TABLE E.3—*Continued*

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	56	57
Cymatiidae spp.	0	0	0	0	0	0	0	0	0
Cystiscus huna	0	0	0	0	0	0	0	0	0
Daphnellinae sp.	0	0	0	0	0	0	0	1	0
Dendropoma spp.	2	6	2	0	1	0	8	1	3
Diala scopulorum	1	0	431	0	0	0	0	0	15
Diala semistriata	50	0	37	0	0	103	0	20	0
Diniatys dentifer	4	0	0	0	0	0	0	1	0
Diodora granifera	0	0	0	0	1	0	0	0	0
Eatoniella janetaylorae	2	0	1	0	0	0	0	1	0
Eatoniella pigmenta	0	0	0	0	0	0	0	0	0
Echineulima sp.	0	0	0	0	0	0	0	0	0
Elacorbis callusa	0	0	0	0	0	0	0	0	0
Emarginula dilecta	0	0	0	0	0	0	0	0	0
Epitonium spp.	1	0	2	0	0	1	0	0	0
Etrema acricula	0	0	0	0	0	0	0	0	0
Euchelus gemmatus	4	0	0	0	0	0	0	1	0
Eucithara angiostoma	0	0	0	0	0	0	0	0	0
Eucithara pusilla	0	0	0	0	0	0	0	0	0
Eucithara sp.	0	0	0	0	0	0	0	0	0
Eulima peasei	0	0	0	0	0	0	0	0	0
Evalea peasei	0	0	0	0	0	0	0	0	0
Evalea waikikiensis	0	0	0	0	1	0	0	0	0
Finella pupoides	0	0	20	0	0	4	0	0	5
Gibbula marmorea	0	1	0	0	0	0	0	0	0
Granula sandwicensis	0	0	0	0	0	0	0	1	0
Granulina vitrea	1	2	0	0	0	0	0	5	0
Granulina sp.	1	0	2	0	0	0	0	2	0
Haminoea spp.	0	0	0	0	0	0	0	0	0
Heliacus implexus	0	0	0	0	0	0	0	0	0
Heliacus sterkii	0	0	0	1	0	0	0	0	0
Herviera gliriella	1	0	3	0	1	0	0	1	0
Herviera patricia	0	0	0	0	0	0	0	0	0
Hinemoa indica	0	0	0	1	1	0	0	0	0
Hipponix australis	0	1	0	0	0	0	0	0	0
Hipponix pilosus	0	0	0	0	2	0	0	3	0
Ittibittium parcum	0	2	1	0	9	0	1	0	2
Julia exquisita	0	0	0	0	0	0	0	4	0
Juliidae spp.	0	0	0	0	0	0	0	0	0
Kermia aniani	0	0	0	0	0	0	0	0	0
Kermia pumila	0	0	0	0	0	0	0	0	0
Koloonella sp.	0	0	0	0	0	0	0	0	0
Leptothyra rubricincta	0	4	0	5	1	0	0	0	2
Leptothyra verruca	1	1	1	0	2	0	0	0	0
Lophocochlias minutissimus	14	4	6	0	1	16	2	15	0
Lophocochlias sp. A	0	1	0	0	2	0	0	2	1
Macteola segesta	0	0	0	0	0	0	0	0	0
Merelina granulosa	0	0	0	0	0	0	0	1	0
Merelina hewa	0	0	0	0	1	0	0	0	0

TABLE E.3—*Continued*

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	56	57
Merelina wanawana	0	0	0	0	0	0	0	0	0
Merelina spp.	0	1	0	0	0	0	0	0	0
Metaxia brunnicephala	0	0	0	0	0	0	0	0	0
Microdaphne trichodes	0	0	0	0	0	0	0	1	0
Miralda paulbartschi	0	1	0	0	1	0	0	0	0
Miralda scopulorum	0	0	0	0	0	0	0	0	0
Mitrella margarita	0	0	0	0	0	0	0	1	0
Mitrella spp.	2	0	0	0	0	0	0	0	0
Mitrolumna alphonsiana	0	0	0	0	0	0	0	0	0
Mitrolumna spp.	0	0	0	0	0	0	0	0	0
Modulus tectum	0	0	0	0	0	0	0	0	0
Morula spp.	0	0	0	0	0	0	0	0	0
Muricidae spp.	0	0	0	0	0	0	0	1	0
Nassarius spp.	0	0	0	0	0	0	0	1	0
Natica gualteriana	0	0	1	0	0	0	0	0	0
Natica sp.	0	0	0	0	0	0	0	1	0
Nerita sp.	0	0	0	0	0	0	0	0	0
Odostomia gulicki	0	0	0	0	0	0	0	0	0
Odostomia oxia	0	0	0	0	0	0	0	0	0
Odostomia stearnsiella	0	0	0	0	0	0	0	0	0
Odostomia sp.	0	0	2	0	4	0	0	4	0
Omalogyra japonica	0	0	4	0	0	0	1	0	0
Omalogyra sp.	0	0	1	0	0	1	0	0	0
Orbitestella regina	2	3	3	0	0	5	2	2	1
Orbitestella sp. A	0	0	2	0	0	0	0	0	0
Orbitestella sp. B	2	0	0	0	0	6	0	0	1
Otopleura mitralis	0	0	0	0	0	0	0	0	0
Parashiela beetsi	23	2	5	0	0	21	1	16	4
Peristernia chlorostoma	1	0	0	0	1	0	0	0	0
Phenacolepas scobinata	0	0	0	0	0	0	0	0	0
Philippia oxytropis	0	0	0	0	0	0	0	1	0
Planaxis suturalis	0	0	0	0	0	0	0	0	0
Plesiotrochus luteus	3	0	0	0	0	1	0	0	0
Powellisetia fallax	0	0	0	0	0	0	0	0	0
Pupa pudica	0	0	0	0	0	0	0	0	0
Pupa sp.	0	0	0	0	0	0	0	0	0
Pusillina marmorata	85	5	50	1	3	65	1	43	6
Pyramidellidae sp. B	0	0	0	0	0	0	0	0	0
Pyramidellidae sp. C	0	0	2	0	0	3	0	0	2
Pyramidellidae spp.	0	0	0	0	0	0	0	0	0
Pyramidelloides gracilis	2	0	0	0	0	0	0	2	0
Pyramidelloides miranda	0	0	0	0	0	0	0	0	0
Pyrgulina oodes	2	0	0	0	0	4	0	0	0
Pyrgulina sp.	0	0	10	0	0	0	0	0	1
Rastodens brevilabiosa	0	0	0	0	0	0	0	0	0
Rastodens labiosa	0	1	0	2	0	0	0	0	0
Rastodens sp.	0	0	0	0	0	0	0	4	0
Rhinoclavis articulata	0	0	0	0	0	0	0	0	0

TABLE E.3—*Continued*

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	56	57
Rissoella confusa	0	0	0	0	0	4	0	0	0
Rissoella longispira	4	0	2	0	0	4	0	1	0
Rissoella sp.	7	0	0	0	0	0	0	0	0
Rissoina ambigua	0	3	0	8	2	0	0	0	0
Rissoina cerithiiformis	1	8	0	7	0	2	0	3	0
Rissoina costata	0	0	0	0	0	0	0	0	0
Rissoina pulchella	12	1	13	0	1	37	1	4	1
Rissoidae spp.	0	0	0	0	0	2	0	0	0
Rufodardanula conica	14	0	0	0	0	0	0	1	0
Rufodardanula ponderi	0	0	0	0	0	0	0	0	0
Rufodardanula sp.	0	0	0	0	0	0	0	0	0
Sansonia kenneyi	0	0	1	0	0	0	0	1	0
Scaliola spp.	22	0	35	0	0	62	0	8	2
Schwartziella ephamilla	7	0	3	0	0	7	0	19	0
Schwartziella triticea	0	0	0	6	0	0	0	0	0
Scissurella pseudoequatoria	0	0	0	0	0	0	0	0	0
Seminella peasei	0	0	0	0	1	0	0	1	0
Seminella smithi	0	0	0	0	0	0	0	0	0
Seminella sp.	1	0	0	0	0	0	0	0	0
Serpulorbis spp.	0	0	3	0	0	1	0	0	1
Sinezona insignis	1	0	0	0	0	0	0	0	0
Smaragdia bryanae	0	0	0	0	0	0	0	0	0
Stosicia hiloense	1	0	0	1	0	0	0	0	0
Strebloceras subannulatum	0	0	0	0	0	0	0	0	0
Strombus sp.	0	0	0	0	0	1	0	0	0
Styliferina goniochila	8	1	2	0	0	6	0	2	2
Synaptocochlea concinna	0	0	0	0	0	0	0	0	0
Teinostoma sulcata	0	0	0	0	0	0	0	0	0
Terebra spp.	0	0	0	0	0	0	0	3	0
Tricolia variabilis	26	16	6	5	0	2	11	1	2
Triphora spp.	12	4	14	3	3	10	2	17	2
Trivia hordacea	0	0	0	0	0	0	0	0	0
Trochus intextus	0	0	0	0	0	0	0	2	0
Turbo sandwicensis	0	1	0	0	0	0	0	1	0
Turbonilla cornelliana	2	0	0	0	0	1	0	0	1
Turbonilla thaanumi	0	0	0	0	0	0	0	0	0
Turbonilla sp. E	0	0	2	0	0	1	0	0	0
Turbonilla sp. H	0	0	0	0	0	0	0	0	0
Turbonilla spp.	0	0	0	0	0	0	0	0	0
Turridae sp.	0	0	2	0	0	0	0	0	0
Vanikoro sp.	0	0	3	0	0	0	0	0	0
Veprecula brunonia	0	0	0	0	0	1	0	0	0
Vermetidae sp.	0	0	0	0	0	0	0	0	0
Vexillum diutenera	0	1	0	0	0	0	0	0	0
Vexillum piceum	1	0	0	0	0	0	0	0	0
Vexillum spp.	0	0	0	0	0	0	0	0	0
Volutomitra pailoloana	0	0	0	0	0	0	0	0	0
Volvarina fusiformis	0	0	0	0	0	0	0	0	0

TABLE E.3—*Continued*

Taxon	No. of Individuals								
	Station								
	49	50	51	52	53	54	55	56	57
Williamia radiata	2	0	0	0	0	6	0	2	0
Zebina bidentata	0	0	0	0	1	0	0	1	0
Zebina sp.	0	3	0	0	0	0	0	0	0
Gastropoda sp. A	0	0	0	0	0	1	0	1	0
Gastropoda spp.	0	0	0	0	0	0	0	0	2
SCAPHOPODA									
Scaphopoda sp.	0	0	1	0	0	3	0	0	0
POLYPLACOPHORA									
Polyplacophora sp.	0	0	0	0	0	0	0	0	0
Total No. of Individuals/Station	418	101	839	55	58	687	42	302	80
Total No. of Individuals/cm^3	27.9	6.7	55.9	3.7	3.9	45.8	2.8	20.1	5.3
Total No. of Taxa	60	40	58	17	31	55	18	64	33

[a]Pinna are indicated by a "+" for larval shells and by "frag" for shell fragments.

TABLE E.4. Taxon Abundance from Nine Stations for Mollusk Components, Māmala Bay Sampling Stations 58 Through 66, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
BIVALVIA									
Arca sp.	0	0	0	0	0	0	0	0	0
Barbatia divaricata	0	0	1	0	0	2	0	0	0
Barbatia nuttingi	0	0	2	0	0	0	1	0	0
Barbatia sp.	0	0	0	0	0	0	0	0	0
Brachidontes crebristriatus	0	0	0	0	0	0	0	0	0
Cardita thaanumi	0	0	0	0	0	0	0	0	0
Carditella hawaiensis	0	0	0	0	0	0	2	1	0
Chama spp.	0	0	0	0	0	0	0	0	0
Chlamydella sp. A	0	0	0	0	0	0	0	0	0
Chlamys sp.	0	0	0	0	0	0	0	0	0
Cosa waikikia	0	0	0	0	0	0	0	0	0
Crenella sp.	0	0	0	0	0	0	0	1	0
Ctena bella	0	0	0	0	0	0	0	0	0
Ctena transversa	0	0	0	0	0	0	0	0	0
Ctena sp.	0	0	0	0	0	0	1	0	0
Cuspidaria hawaiensis	0	0	0	0	0	0	0	0	0
Cuspidaria spp.	0	0	0	0	0	0	0	0	0
Epicodakia sp.	0	0	0	0	0	0	0	0	0
Ervilia bisculpta	0	0	0	0	1	0	1	3	0
Fragum mundum	0	0	0	0	1	0	0	0	0
Gastrochaena spp.	0	0	0	0	0	0	0	0	0
Grammatomya kanaka	0	0	0	0	0	0	1	0	1
Isognomon spp.	0	0	1	0	0	0	0	0	0
Kellia hawaiensis	0	0	0	0	0	0	3	0	0
Kellia rosea	0	0	0	0	0	0	0	0	0
Kona symmetrica	0	0	0	0	0	0	0	1	0
Laevichlamys irregularis	0	0	0	0	0	0	0	0	0
Lima spp.	0	0	0	0	0	0	0	0	0
Lucina edentula	0	0	0	0	0	0	0	0	0
Malleus regula	0	0	0	0	0	0	0	0	0
Malleus sp. A	0	0	0	0	0	0	0	1	0
Mytilidae sp.	0	0	0	0	0	0	1	1	0
Nucula hawaiensis	0	0	0	0	0	0	1	0	0
Ostrea sp.	0	0	0	0	0	1	0	2	0
Pinna sp.[a]	0	0	0	0	0	0	0	+	0
Rochefortina sandwichensis	0	1	0	2	1	0	1	3	1
Semelangulus crebrimaculatus	0	0	0	0	0	0	0	0	0
Septifer bryanae	0	0	0	0	0	0	0	0	2
Septifer spp.	0	0	0	0	0	0	0	0	0
Tellina crucigera	0	0	0	0	0	0	0	0	0
Tellina sp.	0	0	0	0	0	0	0	0	0
Teredinidae spp.	0	0	0	0	0	0	0	0	0
Bivalvia sp. C	0	0	0	0	0	0	0	0	0
Bivalvia spp.	2	0	1	2	0	0	0	0	0

TABLE E.4—*Continued*

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
GASTROPODA									
Acteocina hawaiensis	0	0	0	0	0	0	0	0	0
Acteocina sandwicensis	0	0	0	0	0	0	0	0	0
Acteocina sp.	0	0	0	0	1	0	1	0	0
Alcyna ocellata	0	2	7	4	7	0	6	3	2
Alcyna subangulata	0	0	1	1	0	0	0	0	0
Alvania isolata	0	0	0	0	0	0	0	0	0
Anacithara perfecta	0	0	0	0	0	0	0	0	0
Antisabia foliacea	0	0	5	3	0	3	1	1	0
Aplysiidae spp.	0	0	0	0	0	0	0	0	0
Atys debilis	0	0	0	0	0	0	0	0	0
Atys semistriata	0	0	0	0	0	0	0	0	0
Atys sp.	0	0	0	0	0	0	0	0	0
Balcis acanthyllis	0	0	0	0	0	0	0	0	0
Balcis aciculata	0	1	0	0	0	0	0	0	0
Balcis brunnimaculata	0	0	1	0	0	0	0	0	0
Balcis conoidalis	0	0	0	0	0	0	0	0	0
Balcis spp.	1	0	0	0	0	1	2	0	1
Barleeia calcarea	0	0	0	0	0	0	0	0	0
Bittium impendens	0	3	2	0	0	0	0	2	3
Brookula iki	0	0	0	1	2	0	0	0	0
Bulla vernicosa	0	0	0	0	0	0	0	0	0
Caecum cf. *glabella*	0	0	0	1	0	0	0	0	0
Caecum cf. *glabriformis*	0	0	0	0	0	0	2	0	0
Caecum sepimentum	0	2	2	3	2	0	2	4	0
Caecum sp.	0	0	0	0	0	0	0	0	0
Carinapex minutissima	0	3	3	0	0	4	0	0	0
Cephalaspidea sp.	0	0	0	0	0	0	0	0	0
Cerithidium diplax	0	0	0	0	12	0	2	7	17
Cerithidium perparvulum	2	6	0	5	16	0	9	17	58
Cerithiopsis spp.	0	1	0	1	0	0	0	0	0
Cerithium atromarginatum	0	0	0	0	0	2	0	0	0
Cerithium columna	0	0	0	1	0	0	1	1	0
Cerithium interstriatum	0	0	1	1	0	1	0	3	2
Cerithium nesioticum	0	0	0	0	0	1	0	0	0
Cerithium rostratum	0	0	0	0	0	0	0	1	1
Cerithium zebrum	1	0	8	0	0	7	0	0	1
Cerithium sp.	3	0	3	0	1	0	3	4	3
Ceritoturris bittium	0	0	0	0	0	0	0	0	0
Clavus mighelsi	0	0	0	0	0	0	0	0	0
Clavus sp.	0	0	2	0	0	0	0	0	0
Collonista candida	0	0	4	0	0	1	1	1	0
Costellariidae spp.	0	0	0	0	0	0	0	0	0
Crepidula aculeata	0	0	0	0	0	1	0	0	0
Cycloscala hyalina	0	0	0	0	0	0	0	0	0
Cyclostremiscus emeryi	0	0	0	2	1	0	1	6	0
Cyclostremiscus striatus	0	0	0	0	0	0	0	0	0
Cylichna pusilla	0	0	0	0	0	0	0	0	0

TABLE E.4—*Continued*

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
Cymatiidae spp.	0	0	0	0	0	0	0	0	0
Cystiscus huna	0	0	0	0	0	0	0	0	0
Daphnellinae sp.	0	1	0	0	0	0	0	0	0
Dendropoma spp.	0	0	0	0	3	0	4	4	1
Diala scopulorum	19	0	0	0	0	0	8	0	0
Diala semistriata	0	6	0	0	4	1	0	3	22
Diniatys dentifer	0	0	0	0	0	0	0	0	0
Diodora granifera	0	0	0	0	0	0	1	0	0
Eatoniella janetaylorae	0	0	0	0	4	0	0	3	0
Eatoniella pigmenta	0	0	0	0	0	0	1	0	0
Echineulima sp.	0	0	0	0	0	0	0	0	0
Elacorbis callusa	0	0	0	0	0	0	0	0	0
Emarginula dilecta	0	0	0	0	0	0	0	0	0
Epitonium spp.	0	0	0	0	1	0	0	0	0
Etrema acricula	0	0	0	0	0	0	0	0	0
Euchelus gemmatus	0	0	1	0	0	0	0	1	1
Eucithara angiostoma	0	0	0	0	0	0	0	0	0
Eucithara pusilla	0	0	0	0	0	0	0	0	0
Eucithara sp.	0	0	0	0	0	0	0	0	0
Eulima peasei	0	0	2	0	0	0	0	0	0
Evalea peasei	0	0	0	0	0	0	0	0	0
Evalea waikikiensis	0	0	1	0	0	0	0	0	0
Finella pupoides	2	0	0	0	0	0	1	0	1
Gibbula marmorea	0	2	0	0	1	0	0	1	0
Granula sandwicensis	0	0	3	0	0	0	0	0	0
Granulina vitrea	0	0	1	0	0	0	0	0	0
Granulina sp.	0	0	0	0	0	0	0	0	1
Haminoea spp.	0	0	0	0	1	0	0	0	0
Heliacus implexus	0	0	0	0	0	0	0	0	0
Heliacus sterkii	0	0	0	0	0	0	0	0	0
Herviera gliriella	0	1	2	0	1	0	2	0	2
Herviera patricia	0	0	1	0	0	0	0	0	0
Hinemoa indica	1	1	1	0	0	1	0	0	0
Hipponix australis	0	0	0	0	0	0	0	0	0
Hipponix pilosus	0	0	1	0	2	0	0	0	0
Ittibittium parcum	1	0	2	2	0	0	5	5	0
Julia exquisita	0	0	0	0	1	0	0	2	1
Juliidae spp.	0	0	0	0	0	0	0	0	0
Kermia aniani	0	0	2	0	0	1	0	0	0
Kermia pumila	0	0	1	0	0	0	0	0	0
Koloonella sp.	0	0	0	0	0	0	0	0	0
Leptothyra rubricincta	0	2	24	1	0	12	2	1	0
Leptothyra verruca	0	0	0	1	0	0	0	0	0
Lophocochlias minutissimus	0	0	0	5	1	0	2	11	10
Lophocochlias sp. A	0	0	0	0	0	0	1	2	0
Macteola segesta	0	0	0	0	0	0	0	0	0
Merelina granulosa	0	0	0	0	0	0	0	0	0
Merelina hewa	0	0	12	1	3	1	1	0	0

TABLE E.4—*Continued*

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
Merelina wanawana	0	1	0	0	0	1	1	0	0
Merelina spp.	0	0	0	0	0	0	0	0	0
Metaxia brunnicephala	0	0	0	0	0	0	0	0	0
Microdaphne trichodes	0	0	0	0	0	0	0	0	0
Miralda paulbartschi	0	0	0	0	0	0	2	1	0
Miralda scopulorum	0	0	0	0	0	0	0	0	0
Mitrella margarita	0	0	0	0	0	1	0	0	0
Mitrella spp.	0	0	0	0	0	0	1	0	0
Mitrolumna alphonsiana	0	0	0	0	0	0	0	0	0
Mitrolumna spp.	0	0	0	0	1	0	0	0	0
Modulus tectum	0	0	0	0	0	0	0	0	0
Morula spp.	0	0	0	0	0	1	0	0	0
Muricidae spp.	0	0	0	0	0	0	0	0	0
Nassarius spp.	0	0	0	0	0	0	0	0	0
Natica gualteriana	0	0	0	0	0	0	0	0	0
Natica sp.	0	0	0	0	1	0	0	0	0
Nerita sp.	0	0	0	0	0	0	0	0	0
Odostomia gulicki	0	0	1	0	0	0	0	0	0
Odostomia oxia	0	0	0	0	0	0	0	0	0
Odostomia stearnsiella	0	0	0	0	0	1	0	0	0
Odostomia sp.	0	0	0	0	0	0	0	0	0
Omalogyra japonica	0	0	0	1	0	0	0	0	0
Omalogyra sp.	0	0	0	0	0	0	0	0	0
Orbitestella regina	4	0	0	19	5	0	2	6	1
Orbitestella sp. A	0	0	0	8	0	0	0	4	0
Orbitestella sp. B	0	0	0	0	0	0	0	0	0
Otopleura mitralis	0	0	0	0	0	0	0	0	0
Parashiela beetsi	1	3	0	6	0	0	3	6	15
Peristernia chlorostoma	0	0	1	0	0	0	0	0	0
Phenacolepas scobinata	0	0	0	0	0	0	0	0	0
Philippia oxytropis	0	0	0	0	0	2	0	0	0
Planaxis suturalis	0	0	1	0	0	0	0	0	0
Plesiotrochus luteus	0	0	0	0	1	0	0	0	0
Powellisetia fallax	0	0	0	0	0	0	0	0	0
Pupa pudica	0	0	0	0	0	0	0	0	0
Pupa sp.	0	0	0	0	0	0	0	0	0
Pusillina marmorata	3	7	14	25	27	0	27	23	19
Pyramidellidae sp. B	0	0	0	0	0	0	0	0	0
Pyramidellidae sp. C	0	0	0	0	0	0	0	0	0
Pyramidellidae spp.	0	0	0	0	0	0	0	0	0
Pyramidelloides gracilis	0	0	0	0	0	0	0	0	0
Pyramidelloides miranda	0	0	0	0	0	0	0	0	0
Pyrgulina oodes	0	1	0	0	0	0	0	0	1
Pyrgulina sp.	5	0	0	0	0	0	0	1	0
Rastodens brevilabiosa	0	0	0	0	0	0	0	0	0
Rastodens labiosa	0	0	4	0	0	0	0	0	0
Rastodens sp.	0	0	0	0	0	2	0	0	0
Rhinoclavis articulata	0	0	0	0	0	0	0	0	0

TABLE E.4—*Continued*

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
Rissoella confusa	0	0	0	0	0	0	0	2	0
Rissoella longispira	0	0	0	0	3	0	0	0	0
Rissoella sp.	0	0	0	3	0	0	0	0	0
Rissoina ambigua	0	0	9	0	0	8	0	0	0
Rissoina cerithiiformis	0	0	33	2	0	14	2	0	0
Rissoina costata	0	0	2	0	0	0	1	0	0
Rissoina pulchella	0	1	0	0	0	1	0	0	1
Rissoidae spp.	0	0	0	0	0	0	0	0	0
Rufodardanula conica	0	0	0	0	0	0	0	1	0
Rufodardanula ponderi	0	0	0	0	0	0	0	0	0
Rufodardanula sp.	0	0	0	0	0	0	0	0	0
Sansonia kenneyi	0	0	0	0	0	0	0	0	1
Scaliola spp.	0	0	0	0	0	0	0	3	6
Schwartziella ephamilla	0	1	0	2	0	0	0	2	2
Schwartziella triticea	0	0	4	0	0	12	0	0	0
Scissurella pseudoequatoria	0	0	0	3	0	0	0	0	0
Seminella peasei	0	0	1	0	0	0	0	0	0
Seminella smithi	0	0	1	0	0	0	0	0	0
Seminella sp.	0	0	0	0	0	0	0	0	0
Serpulorbis spp.	1	0	0	0	0	0	2	0	0
Sinezona insignis	0	0	0	10	0	0	0	0	0
Smaragdia bryanae	0	0	0	0	2	0	0	0	1
Stosicia hiloense	0	0	9	0	0	2	0	0	0
Strebloceras subannulatum	0	0	0	0	0	0	0	0	0
Strombus sp.	0	0	0	0	0	0	0	0	0
Styliferina goniochila	0	1	0	6	5	0	1	1	1
Synaptocochlea concinna	0	0	2	1	0	0	1	0	0
Teinostoma sulcata	0	0	0	0	0	0	0	0	0
Terebra spp.	0	0	0	0	0	0	0	0	1
Tricolia variabilis	1	10	30	28	21	17	25	41	31
Triphora spp.	4	6	16	1	7	5	3	4	6
Trivia hordacea	0	0	0	0	0	0	0	0	0
Trochus intextus	0	0	1	1	3	1	0	1	0
Turbo sandwicensis	0	0	1	1	0	0	0	1	0
Turbonilla cornelliana	0	0	0	0	0	0	0	0	0
Turbonilla thaanumi	0	0	0	0	0	0	0	0	1
Turbonilla sp. E	0	0	0	0	1	0	0	0	0
Turbonilla sp. H	0	0	0	0	0	0	0	0	0
Turbonilla spp.	1	0	0	0	0	0	0	0	0
Turridae sp.	0	0	0	0	0	0	0	0	0
Vanikoro sp.	0	0	0	0	0	0	0	0	0
Veprecula brunonia	0	0	0	0	0	0	0	0	0
Vermetidae sp.	0	0	0	18	0	0	0	0	0
Vexillum diutenera	0	0	1	0	0	0	0	0	0
Vexillum piceum	0	0	0	0	0	0	0	0	0
Vexillum spp.	0	0	0	0	0	0	0	0	0
Volutomitra pailoloana	1	0	0	0	0	0	0	0	0
Volvarina fusiformis	0	0	1	0	0	1	0	0	0

TABLE E.4—*Continued*

Taxon	No. of Individuals								
	Station								
	58	59	60	61	62	63	64	65	66
Williamia radiata	0	0	0	0	0	0	0	1	0
Zebina bidentata	0	1	1	0	0	2	1	1	0
Zebina sp.	0	0	3	0	0	0	0	0	0
Gastropoda sp. A	0	0	0	2	0	0	1	0	0
Gastropoda spp.	0	0	1	0	0	0	0	0	0
SCAPHOPODA									
Scaphopoda sp.	0	0	0	0	0	0	0	0	0
POLYPLACOPHORA									
Polyplacophora sp.	0	0	0	0	0	0	0	1	0
Total No. of Individuals/Station	53	64	235	174	144	111	144	196	218
Total No. of Individuals/cm^3	3.5	4.3	15.7	11.6	9.6	7.4	9.6	13.1	14.5
Total No. of Taxa	18	24	52	36	34	32	47	49	34

[a]Pinna are indicated by a "+" for larval shells and by "frag" for shell fragments.

TABLE E.5. Taxon Abundance from Four Stations for Mollusk Components, Māmala Bay Sampling Stations 67 Through 70 and Regional Total, O'ahu, Hawai'i, August 2003

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	68	70	
BIVALVIA					
Arca sp.	0	5	0	0	5
Barbatia divaricata	0	0	0	1	10
Barbatia nuttingi	0	0	0	0	4
Barbatia sp.	0	3	0	2	9
Brachidontes crebristriatus	0	13	0	0	62
Cardita thaanumi	0	0	0	0	1
Carditella hawaiensis	0	2	0	5	36
Chama spp.	0	0	0	0	1
Chlamydella sp. A	0	0	0	1	10
Chlamys sp.	0	0	0	1	2
Cosa waikikia	1	0	0	0	22
Crenella sp.	0	1	0	3	20
Ctena bella	0	0	0	0	1
Ctena transversa	0	0	0	0	1
Ctena sp.	0	0	0	0	21
Cuspidaria hawaiensis	0	0	0	0	1
Cuspidaria spp.	0	0	0	0	4
Epicodakia sp.	0	0	0	1	5
Ervilia bisculpta	1	0	0	4	44
Fragum mundum	2	10	0	6	79
Gastrochaena spp.	0	0	0	0	1
Grammatomya kanaka	0	0	0	0	15
Isognomon spp.	0	4	0	0	8
Kellia hawaiensis	0	11	0	3	78
Kellia rosea	0	0	0	0	1
Kona symmetrica	0	1	0	2	22
Laevichlamys irregularis	0	0	0	0	1
Lima spp.	1	0	0	0	4
Lucina edentula	0	0	0	0	2
Malleus regula	0	0	0	0	21
Malleus sp. A	0	2	0	0	17
Mytilidae sp.	0	0	0	0	23
Nucula hawaiensis	0	0	0	1	6
Ostrea sp.	3	0	1	0	37
Pinna sp.[a]	++	+	0	0	frag+
Rochefortina sandwichensis	14	10	0	5	158
Semelangulus crebrimaculatus	1	0	0	0	7
Septifer bryanae	0	5	0	8	64
Septifer spp.	0	0	0	0	13
Tellina crucigera	0	0	0	0	3
Tellina sp.	0	0	0	0	3
Teredinidae spp.	1	0	0	0	1
Bivalvia sp. C	0	0	0	0	1
Bivalvia spp.	0	3	0	4	21

TABLE E.5—*Continued*

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	68	70	
GASTROPODA					
Acteocina hawaiensis	0	0	0	0	3
Acteocina sandwicensis	0	0	0	0	16
Acteocina sp.	1	1	0	0	8
Alcyna ocellata	1	3	0	1	151
Alcyna subangulata	0	2	0	1	15
Alvania isolata	0	1	0	0	1
Anacithara perfecta	0	0	0	0	1
Antisabia foliacea	0	9	4	0	39
Aplysiidae spp.	0	0	0	0	1
Atys debilis	0	0	0	0	4
Atys semistriata	0	0	0	1	5
Atys sp.	0	0	0	0	2
Balcis acanthyllis	0	0	0	0	1
Balcis aciculata	0	0	0	0	46
Balcis brunnimaculata	0	0	0	0	1
Balcis conoidalis	0	0	0	0	1
Balcis spp.	5	5	0	2	112
Barleeia calcarea	0	0	0	0	1
Bittium impendens	0	2	2	4	55
Brookula iki	0	1	0	0	4
Bulla vernicosa	0	0	0	0	3
Caecum cf. *glabella*	0	0	0	0	3
Caecum cf. *glabriformis*	0	0	0	0	7
Caecum sepimentum	2	4	0	15	165
Caecum sp.	0	0	0	0	3
Carinapex minutissima	0	0	5	10	49
Cephalaspidea sp.	0	0	0	0	5
Cerithidium diplax	3	10	0	10	208
Cerithidium perparvulum	3	22	0	27	1,280
Cerithiopsis spp.	0	0	0	1	10
Cerithium atromarginatum	0	13	0	0	16
Cerithium columna	0	1	0	2	28
Cerithium interstriatum	0	1	0	3	57
Cerithium nesioticum	0	0	0	4	12
Cerithium rostratum	0	2	0	0	46
Cerithium zebrum	0	0	2	0	59
Cerithium sp.	0	10	0	4	73
Ceritoturris bittium	0	0	0	0	1
Clavus mighelsi	0	0	0	0	1
Clavus sp.	0	0	0	0	2
Collonista candida	0	4	0	3	32
Costellariidae spp.	0	0	0	1	1
Crepidula aculeata	0	0	0	0	1
Cycloscala hyalina	0	0	0	0	1
Cyclostremiscus emeryi	0	20	0	1	68
Cyclostremiscus striatus	0	1	0	0	3
Cylichna pusilla	0	0	0	2	5

TABLE E.5—*Continued*

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	68	70	
Cymatiidae spp.	0	0	0	0	1
Cystiscus huna	0	0	0	2	2
Daphnellinae sp.	0	0	0	0	4
Dendropoma spp.	0	39	0	10	134
Diala scopulorum	18	0	0	1	794
Diala semistriata	2	2	0	2	660
Diniatys dentifer	0	0	0	1	10
Diodora granifera	0	1	0	1	5
Eatoniella janetaylorae	1	0	0	2	46
Eatoniella pigmenta	0	0	0	0	1
Echineulima sp.	0	0	0	0	1
Elacorbis callusa	0	0	0	1	1
Emarginula dilecta	0	2	0	0	2
Epitonium spp.	0	0	0	0	8
Etrema acricula	0	0	0	1	2
Euchelus gemmatus	0	5	0	1	25
Eucithara angiostoma	0	0	0	0	1
Eucithara pusilla	0	0	0	0	2
Eucithara sp.	0	0	0	0	2
Eulima peasei	0	0	0	0	2
Evalea peasei	0	0	0	3	6
Evalea waikikiensis	0	0	0	0	2
Finella pupoides	3	0	0	0	86
Gibbula marmorea	0	8	0	0	14
Granula sandwicensis	0	0	0	5	15
Granulina vitrea	0	0	0	1	28
Granulina sp.	0	0	0	0	9
Haminoea spp.	0	0	0	0	2
Heliacus implexus	0	0	0	0	1
Heliacus sterkii	0	0	0	0	1
Herviera gliriella	1	2	0	0	37
Herviera patricia	0	0	0	0	1
Hinemoa indica	0	0	0	1	12
Hipponix australis	0	0	0	1	3
Hipponix pilosus	0	4	0	0	19
Ittibittium parcum	0	67	1	0	132
Julia exquisita	0	0	0	1	18
Juliidae spp.	0	0	0	0	4
Kermia aniani	0	0	1	0	6
Kermia pumila	0	0	0	0	1
Koloonella sp.	2	0	0	0	5
Leptothyra rubricincta	0	10	2	1	73
Leptothyra verruca	0	6	0	2	32
Lophocochlias minutissimus	0	15	1	15	261
Lophocochlias sp. A	0	12	0	6	44
Macteola segesta	0	0	0	1	1
Merelina granulosa	0	0	1	0	2
Merelina hewa	0	0	0	2	21

TABLE E.5—*Continued*

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	68	70	
Merelina wanawana	0	1	0	1	5
Merelina spp.	0	7	0	0	14
Metaxia brunnicephala	0	0	0	0	1
Microdaphne trichodes	0	0	0	0	1
Miralda paulbartschi	0	1	1	1	16
Miralda scopulorum	0	0	0	0	2
Mitrella margarita	0	0	0	0	7
Mitrella spp.	0	0	0	0	3
Mitrolumna alphonsiana	0	0	1	0	1
Mitrolumna spp.	0	0	0	0	1
Modulus tectum	0	0	0	0	3
Morula spp.	0	0	1	0	2
Muricidae spp.	0	0	0	0	3
Nassarius spp.	0	0	0	2	3
Natica gualteriana	0	0	0	0	4
Natica sp.	1	0	0	0	3
Nerita sp.	0	0	0	0	1
Odostomia gulicki	0	0	0	0	1
Odostomia oxia	0	0	0	0	3
Odostomia stearnsiella	0	0	0	0	2
Odostomia sp.	0	2	0	0	12
Omalogyra japonica	3	0	0	1	19
Omalogyra sp.	0	0	0	0	6
Orbitestella regina	0	50	0	17	160
Orbitestella sp. A	0	0	0	1	16
Orbitestella sp. B	1	0	0	0	31
Otopleura mitralis	0	0	0	0	1
Parashiela beetsi	0	23	0	12	294
Peristernia chlorostoma	0	0	1	0	7
Phenacolepas scobinata	0	0	0	1	1
Philippia oxytropis	0	0	0	1	7
Planaxis suturalis	0	0	0	0	1
Plesiotrochus luteus	0	3	1	2	21
Powellisetia fallax	0	0	0	0	1
Pupa pudica	0	0	0	0	3
Pupa sp.	0	0	0	0	2
Pusillina marmorata	0	62	1	45	919
Pyramidellidae sp. B	0	3	0	0	3
Pyramidellidae sp. C	0	0	0	0	21
Pyramidellidae spp.	0	0	0	0	1
Pyramidelloides gracilis	0	2	0	0	11
Pyramidelloides miranda	0	0	0	0	1
Pyrgulina oodes	4	0	0	0	17
Pyrgulina sp.	0	0	0	0	21
Rastodens brevilabiosa	0	0	0	0	1
Rastodens labiosa	0	0	0	1	9
Rastodens sp.	0	0	0	0	6
Rhinoclavis articulata	0	0	0	0	1

TABLE E.5—*Continued*

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	68	70	
Rissoella confusa	0	0	0	0	15
Rissoella longispira	0	1	0	2	34
Rissoella sp.	0	0	0	0	13
Rissoina ambigua	0	0	9	3	44
Rissoina cerithiiformis	0	1	17	5	130
Rissoina costata	0	9	0	2	14
Rissoina pulchella	0	0	0	4	189
Rissoidae spp.	0	0	7	9	21
Rufodardanula conica	0	0	0	0	28
Rufodardanula ponderi	0	0	0	0	10
Rufodardanula sp.	0	1	0	2	4
Sansonia kenneyi	0	0	0	0	6
Scaliola spp.	7	5	0	3	324
Schwartziella ephamilla	0	3	0	8	108
Schwartziella triticea	0	5	1	0	28
Scissurella pseudoequatoria	0	2	0	0	5
Seminella peasei	0	0	0	0	4
Seminella smithi	0	0	0	2	9
Seminella sp.	0	1	0	0	2
Serpulorbis spp.	6	0	0	1	22
Sinezona insignis	0	2	0	2	24
Smaragdia bryanae	0	0	0	0	3
Stosicia hiloense	0	0	0	1	19
Strebloceras subannulatum	0	0	0	2	3
Strombus sp.	0	0	0	0	1
Styliferina goniochila	0	13	0	9	79
Synaptocochlea concinna	0	0	0	0	6
Teinostoma sulcata	0	0	0	0	2
Terebra spp.	0	0	0	0	4
Tricolia variabilis	0	240	4	30	836
Triphora spp.	0	10	5	18	225
Trivia hordacea	0	0	0	1	1
Trochus intextus	0	2	0	0	13
Turbo sandwicensis	0	0	0	0	10
Turbonilla cornelliana	0	0	0	0	6
Turbonilla thaanumi	0	0	0	0	2
Turbonilla sp. E	0	0	0	0	6
Turbonilla sp. H	0	0	0	1	2
Turbonilla spp.	0	1	0	0	5
Turridae sp.	0	0	0	3	5
Vanikoro sp.	0	0	0	0	6
Veprecula brunonia	0	0	0	0	2
Vermetidae sp.	0	0	0	0	19
Vexillum diutenera	0	0	0	0	2
Vexillum piceum	0	0	0	0	1
Vexillum spp.	0	0	0	0	1
Volutomitra pailoloana	0	0	0	0	1
Volvarina fusiformis	0	0	0	0	2

TABLE E.5—*Continued*

Taxon	No. of Individuals				Regional Total
	Station				
	67	68	68	70	
Williamia radiata	0	2	0	4	24
Zebina bidentata	0	0	0	0	9
Zebina sp.	0	0	1	0	7
Gastropoda sp. A	1	2	0	1	20
Gastropoda spp.	0	0	0	0	4
SCAPHOPODA					
Scaphopoda sp.	0	0	0	0	4
POLYPLACOPHORA					
Polyplacophora sp.	0	0	0	0	6
Total No. of Individuals/Station	89	809	70	398	10,029
Total No. of Individuals/cm^3	5.9	53.9	4.7	26.5	16.7
Total No. of Taxa	28	74	23	89	242