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Benthic Infauna of the Southern California Bight Continental Slope: Characterizing Community Structure for the Development of an Index of Disturbance

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ABOUT THE COVER

Cover photo by Lisa Gilbane, showing collection of benthic samples aboard the vessel *Hey Jude* near oil and gas platforms in the Santa Barbara Channel, offshore southern California.

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List of Abbreviations and Acronyms

ANOVA	Analysis of Variance
BOEM	Bureau of Ocean Energy Management
BRI	Benthic Response Index
CA	California
CSI	Chemical Score Index
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
df	degrees of freedom
DOI	US Department of the Interior
ERL	Effects Range Low
ERM	Effects Range Median
ESPIS	Environmental Studies Program Information System
km	kilometer
m	meter
m^2	square meter
MDL	Machine Detection Limit
mg g^{-1}	milligram per gram
mm	millimeter
nMDS	Non-Metric Multi-Dimensional Scaling
O/E	Observed:Expected
OCS	Outer Continental Shelf
OTU	Operational Taxonomic Unit
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
permANOVA	Permutation Analysis of Variance
ppb	parts per billion
ppm	parts per million
RL	Reporting Limit
SCAMIT	Southern California Association of Marine Invertebrate Taxonomists
SCCWRP	Southern California Coastal Water Research Project
SD	Standard Deviation
SQO	Sediment Quality Objective
TN	Total Nitrogen
TOC	Total Organic Carbon
USEPA	United States Environmental Protection Agency

1 Executive Summary

1.1 Background

Benthic infauna are a key ecological component of nearly all marine ecosystems that provide a multitude of ecological services. They are also the most common faunal assemblage used to assess habitat quality across the globe due to their sessile lifestyle that integrates stressors, broad taxonomic diversity with variations in stressor response among taxa, and relatively predictable community-scale changes in both structure and function when exposed to anthropogenic stress.

Unlike the continental shelf, comparatively few studies of benthic infauna from southern California's continental slope ecosystem have occurred since the 1950s. There have been numerous advances in benthic ecology over the last six decades and the lack of a modern, comprehensive synthesis of the resident fauna of the continental slope represents a distinct gap in our understanding of the status and health of the region's coastal ocean. The continental slope represents more than 60% of the benthic habitat in southern California. Without an understanding of the natural infaunal community structure, we have no insight on which to base assessments of anthropogenic disturbance.

The goal of this study was to characterize the natural, baseline structure of the benthic infauna of the continental slope of the Southern California Bight. To accomplish this goal, this project required four distinct objectives: (1) aggregate and synthesize as much modern benthic infaunal data from the region as possible; (2) define reference conditions based on abiotic factors such as proximity to pollutant sources or estimates of pollutant exposure; (3) identify and characterize the distinct benthic communities within the reference condition; and (4) measure any potential assemblage or individual-scale responses to anthropogenic disturbances in the non-reference portion of the data set.

1.2 General Approach

Benthic infauna, sediment composition, and sediment chemistry data were aggregated from four different surveys across the Southern California Bight region between 1972 and 2016 comprising 750 samples from 347 sites at depths ranging from 202 to 1,023 meters (m). Reference conditions were defined using sediment chemistry, proximity to known anthropogenic disturbances (e.g., discharge pipes from wastewater treatment facilities and oil/gas platforms). Additionally, samples with a very low species richness were excluded as potential indication of a disturbed area. Cluster analysis of benthic taxon-specific abundance data from 203 reference samples were used to identify distinct assemblages and the abiotic characteristics that defined each distinct assemblage. Finally, within each habitat, infaunal data were analyzed with a combination of univariate and multivariate techniques to identify any potential changes in assemblage composition with anthropogenic disturbance from non-reference sites.

1.3 Results

Three distinct, naturally occurring habitats for the southern California continental slope were identified:

- **Habitat 1** – **Upper Slope** represents the shallow (200-400 m) shelf/slope transition habitat along the length of the coastline from Santa Barbara, California to Tijuana, Mexico. These sites cover a mix of sediment types from silty-sand to sandy silt, and have relatively low TOC and TN content;
- **Habitat 2** – **Northwest Slope** represents sites between Santa Barbara and Point Conception, California that covers a range of depth, a mix of sediment types and TOC/TN levels; and
- **Habitat 3 – Lower Slope** represents the deep-water (400-1,000 m) slope habitat along the length of the coastline from Santa Barbara, California to Tijuana, Mexico. These sites cover a mix of sediment types from sandy silt to silty-silt and have elevated TOC and TN compared to the Upper Slope.

Within the Upper and Lower Slope Habitats, we detected subtle, community-scale responses to anthropogenic disturbance, but we were unable to detect any meaningful taxa-specific responses to disturbance.

1.4 Conclusions

This work represents the most comprehensive study to focus on the regional ecological patterns in the benthic infauna of the southern California continental slope ecosystem since the late 1950s. While three unique and naturally occurring slope infaunal assemblages can be found in this portion of the continental margin, it appears that the benthic infauna assemblage may be organized quite differently than those of southern California's other habitats (e.g., continental shelf). A potentially stochastic (random) organization of continental slope fauna challenges the traditional approaches to developing a condition assessment index utilized in shallower waters of the region.

1.5 Recommendations

Developing a non-traditional assessment index is challenging but possible. Developing an assessment index would allow managers to quantify human disturbance along the slope habitats of southern California, providing a necessary tool for scoring sites and tracking trends in habitat quality associated with critical management decisions for oil and gas lease tracts or decommissioning.

To build an assessment tool for slope habitats would entail:

- Collecting additional habitat and oceanography stressor gradient data (e.g., temperature, dissolved oxygen, pH, carbonate chemistry) in conjunction with benthic samples;
- Creating a condition assessment framework that incorporates the stochastic features of continental slope infaunal communities such as ecological-traits based models or joint species distribution models; and
- Sampling additional continental slope locations heavily disturbed by human activities to calibrate and validate the index's performance.

2 Introduction

Benthic infauna are a key ecological component of nearly all marine ecosystems. They represent an important trophic link between organic matter production/accumulation in the benthic environment and export to other oceanic environments (Chardy and Dauvin 1992; Kovecses et al. 2005; Wolkovich et al. 2014). The tube-building and bioturbation activities of the infauna also stimulate the productivity of the microbial community and enhance biogeochemical cycling (Michaud et al. 2006; Quintana et al. 2011; Laverock et al. 2014).

Benthic infauna are also the most common faunal assemblage used to assess habitat quality across the globe (e.g., Diaz et al. 2004; Llansó et al. 2009; Environmental Protection Agency 2012) due to their sessile lifestyle, taxonomic diversity, and their ability to integrate stressor exposure over time (Warwick 1988; Dauer 1993; Gray et al. 2002). A byproduct of the broad taxonomic and functional diversity of a typical marine benthic assemblage is an equally broad range in sensitivities to different types stressors (Statzner and Bêche 2010; Oug et al. 2012; DeLong et al. 2018). These characteristics combine to make for relatively predictable community-scale changes in both structure and function when exposed to disturbance (Pearson and Rosenberg 1978; Rhoads et al. 1978).

In southern California, the vast majority of the research and monitoring of macrobenthic infauna has occurred in the relatively shallow coastal waters of the continental shelf, coastal embayments, and estuaries (Ward and Mearns 1979; Ranasinghe et al. 2012; Schiff et al. 2016). The fauna of these shallower components of the coastal ocean are relatively well understood with respect to their biogeography and their response to anthropogenic disturbance (Smith et al. 2001; Ranasinghe et al. 2005; 2009). These patterns are important for mangers and regulatory agencies to understand because these waters are adjacent to a densely populated United States metro-center (http://california.us.censusviewer.com/client) and receive point-source and non-point source discharges from more than 23 million people (City of San Diego 2016; County Sanitation Districts of Los Angeles County 2016; Orange County Sanitation District 2017).

Comparatively less work has been done surveying and analyzing the patterns of the benthic fauna from the deeper waters of southern California's continental slope and deep basin ecosystems. There have been a number of smaller-scale studies focused on the impacts of the persistent oxygen minima zones that occur in some of the isolated deep water basins of the Southern California Bight (Thompson et al. 1993; reviewed in Levin 2003), but most do not provide regional-scale insights into the resident infauna nor do they provide insight into anthropogenic disturbance on the system. The first truly comprehensive study of the region's deep waters was reported by Hartman and Barnard (1958; 1960). The primary focus of this work was exploratory and to create a taxonomic inventory of the region's deep-water fauna; yielding a number of new species descriptions and producing valuable dichotomous keys for identification of the fauna (Hartman and Barnard 1960). A key conclusion of the Hartman and Barnard was that the continental slope and deep basins of the Southern California Bight were a relatively homogeneous expanse, with a sparse infaunal community dominated by chaetopterid and serpulid polychaetes. Additionally, a large survey in 1975-76 found distinct infauna and foraminifera communities associated with slopes and basins (Callahan and Shokes 1977) in the Southern California Bight.

There has been a considerable maturation and technical advancement in the science of benthic ecology since the 1950s-60s and the lack of a comprehensive synthesis of the resident fauna of the continental slope of southern California represents a distinct gap in our understanding of the status and health of the region's coastal ocean. The outer continental shelf and continental slope represent more than 60% of the benthic habitat in the region (Gillett et al. 2017) and it is the transitional zone from the continental margins to the deep basins and abyssal plain of the open ocean. Though relatively separated from the centers of human population, the deeper portions of the continental margins are still exposed to a variety of human disturbance pressures (Montagna and Harper 1996; Terlizzi et al. 2008; Ellis et al. 2012). It is an important area for mineral, petroleum, and natural gas decommissioning, which can have deleterious impacts on resident benthic fauna (Olsgard and Gray 1995; Manoukian et al. 2010; Ellis et al. 2012). In addition, the continental shelf and slope of southern California are bisected by a number of submarine canyons that are thought to serve as potential conduits of contaminated sediments from the highly urbanized rivers and waters of the near-shore to the deeper parts of the continental slope and basins (Palanques et al. 2008; Jesus et al. 2010; Bight '13 Contaminant Impact Assessment Committee 2017). Furthermore, prior commercial harvest of demersal fishes and invertebrates can directly or indirectly (physical disturbance or by-catch) impact benthic infaunal community composition (Gislason et al. 2017; Rijnsdorp et al. 2018).

Without an understanding of the native infaunal community structure of the southern California continental slope, we have no insight into what the natural baseline structure and function of this environment. It is unclear if the whole of the system is a single contiguous habitat, as suggested by Hartman and Barnard (1960), or if there is some degree of community differentiation based upon biotic or abiotic factors. Furthermore, without an understanding of the baseline ecology of the ecosystem, we have no way to determine the presence or consequences of any human disturbances at local (e.g., contamination, physical disturbance) or region-wide (e.g., ocean acidification, climate change) scales.

The goal of this study was to characterize the natural, baseline structure of the benthic infauna of the continental slope of the Southern California Bight. To accomplish this goal, this project required four distinct objectives: (1) Data Sets – aggregate and synthesize as much modern benthic infaunal data from the region as possible; (2) Reference Definition – define reference conditions based on abiotic factors such as proximity to pollutant sources or estimates of pollutant exposure; (3) Biological Assemblages – identify and characterize the distinct benthic communities within the reference condition; and (4) Response to Disturbance – measure any potential assemblage or individual-scale responses to anthropogenic disturbances in the non-reference portion of the data set.

3 Methods

3.1 General Approach

Benthic infauna, sediment composition, and sediment chemistry data were aggregated from different surveys across the Southern California Bight region between 1972 and 2016. Reference conditions were defined using sediment chemistry, proximity to known anthropogenic disturbances (e.g., oil/gas platforms, canyon mouths), and incidences of low species richness (an indicator of a poorly collected sample or an area of frequent hypoxia/anoxia). Cluster analysis of benthic taxon-specific abundance data was used to identify distinct assemblages and the abiotic characteristics associated with each cluster were then used to define habitat characteristics for each assemblage. Lastly, within each habitat, infaunal data were analyzed with a combination of univariate and multivariate techniques to identify any potential changes in assemblage composition with exposure to different levels of anthropogenic disturbance.

3.1.1 Objective 1: Data Sets

Our study area was the continental slope of the Southern California Bight (Figure 1). The region roughly extends from the US-Mexico border northwards to Point Conception, California and between the mainland of the continent in the east to the Channel Islands in the west. Nominal depth boundaries were set at 200 m for the shallowest samples (approximate breakpoint between the outer continental shelf and the upper continental slope) and 1,000 m for the deepest samples (approximate sampling limitation of local research vessels). This is an area oceanographically influenced by the cold-water California Current flowing to the south mixing with the warm-water Davidson Countercurrent flowing to the north (Bray et al. 1999), as well as seasonal upwelling of nutrient-rich bottom waters (Chhak and Di Lorenzo 2007).

The sediment and infaunal data used in this study were obtained from four primary sources (Table 1). We aggregated benthic grab data collected during the summer (June 1 - September 30) from 1972 to 2016. Samples ranged in depth from 202 to 1,023 m. From these data sets, we extracted information on benthic infaunal identity and abundance, sediment grainsize composition, and sediment chemistry. Targeted chemistry parameters included total organic carbon (TOC), total nitrogen (TN), metals, poly-cyclic aromatic hydrocarbons (PAHs), poly-chlorinated biphenyls (PCBs), and dichlorodiphenyltrichloroethane (DDTs). A full list of sediment chemistry measures we considered can be found Appendix A. These chemistry measures represent a mix of purely anthropogenic compounds (e.g., DDTs or PCBs) that were historically introduced to the environment via wastewater and natural movement of sediment-bound compounds (Niedoroda et al. 1996; Zeng and Venkatesan 1999) and naturally occurring compounds that can be concentrated by human activities and delivered to the environment (e.g., metals, PAHs ,or TOC).

The bulk of the samples were collected with a 0.1 square meter (m^2) modified Van Veen grab. Samples from the Los Angeles County Sanitation District collected before 1980 were collected as four replicate 0.04 m^2 Shipek grabs. Given the smaller sample area of these older samples, benthic data from the first three replicate samples were summed together to approximate the samples collected with the Van Veen grab post-1980 – an approach developed by the Los Angeles County Sanitation Districts (*S. Walther, pers. comm.*). For all post-1980 data, if more than one replicate grab was collected, only data from the first replicate sample was used in the final analytical data set. The final data set consisted of 750 samples from 347 stations.

Sample grabs for infauna were sieved on a 1-mm screen and fixed in buffered formalin. Infaunal taxonomy was standardized to Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) Edition 11 (SCAMIT 2016) and ambiguous taxa were aggregated to higher taxonomic levels on a sample-wise basis. The data set contained 1,198 distinct macrobenthic taxa from 15 different phyla (Appendix B). Of the 750 infaunal samples, 86% had synoptically collected sediment chemistry, 83% had sediment grainsize, and 80% had measures of TOC or TN (Table 2).

Figure 1. Map of the Southern California Bight depicting the location of benthic samples collected from the continental slope. Colored dots represent reference samples and grey dots represent non-reference samples. Polygons represent the approximate boundaries of the three different habitats that were identified from biological differences among the reference samples (Figure 2).

Table 1. Inventory of data considered for or used in this study.

Data Source	Data Type	Spatial Extent	Temporal Extent	Comment
Southern California Bight Regional Monitoring Program	Benthic fauna, sediment chemistry, sediment composition, sediment organic matter, and toxicity	Point Conception, CA to US-Mexico border; 202 – 1,023 m	2003, 2008, and 2013	http://www.sccwrp.org/Data/SearchAndMapData/DataCatalog.aspx
Los Angeles County Sanitation District Ocean Monitoring	Benthic fauna, sediment chemistry, sediment composition, and sediment organic matter	Adjacent to Palos Verdes, CA; 305 m	1972-2015	Pers. Comm. Shelly Walther
Los Angeles County Sanitation District Special Studies	Benthic fauna, sediment composition, and sediment organic matter	Adjacent to Palos Verdes, CA; 215 – 860 m	1997 and 2003	Pers. Comm. Shelly Walther
City of San Diego Continental Slope Special Study	Benthic fauna, sediment chemistry, and sediment organic matter	Coronado Escarpment; 199 – 504 m	2004 - 2016	Pers. Comm. Ami Latker
Bureau of Ocean Energy Management	Oil/Gas platform, electrical cable, and pipeline locations	Point Conception, CA to US-Mexico Border	N/A	Pers. Comm. Lisa Gilbane
Bureau of Ocean Energy Management	Natural petroleum and methane seeps	Point Conception, CA to US-Mexico Border	N/A	Pers. Comm. Lisa Gilbane
Bureau of Land Management Outer Continental Shelf Environmental Assessment Program	Benthic fauna, sediment chemistry, and sediment composition	Point Conception, CA to Orange County, CA	1975-1976	Not used; data missing and errors https://www.ngdc.noaa.gov/mgg/geology/data/g02881/readme.txt

Table 2. Number of stations and samples for each data type used in the study.

Data type	# of Stations	# of Samples
Infauna	347	750
Grainsize	295	625
TOC and/or TN	302	600
Metals	296	454
PAHs	264	368
PCBs	204	292
DDTs	246	646

3.1.2 Objective 2: Reference Definition

Based on analogous studies in shallower depths and interactions with local experts, reference criteria were established to identify a group of minimally disturbed reference sites (*sensu* Stoddard et al. 2006). Both natural and anthropogenic forcing factors can influence biotic community composition. By establishing reference criteria and the subsequent identification of reference condition sites, one can characterize any "natural" differences in community composition due to biogeography and other natural factors without the confounding influence of anthropogenic disturbance. The following six filters were used as our reference criteria:

- Stations had to be > 3 kilometers (km) from an oil/gas platform (Olsgard and Gray 1995; Ellis et al. 2012).
- Stations had to be > 3 km from submarine canyon mouths.
- No stations within the zone of influence of the Los Angeles County Sanitation District's Palos Verdes treated effluent outfall (County Sanitation Districts of Los Angeles County 2016).
- Samples could contain no more than five chemicals with concentrations greater than their associated Chemical Score Index (CSI) Minimal Exposure threshold (Bay et al. 2014).
- Samples could contain no chemicals with concentrations greater than their associated CSI Low Exposure threshold (Bay et al. 2014).
- No samples with less than five taxa.

The first three criteria are spatial filters to exclude areas with the potential to accumulate contaminants. The next two filters are based on the CSI, an assessment tool used by the State of California to assess the potential toxic effects of eight individual contaminants, plus the sum concentrations of PCBs, low molecular weight PAHs and high molecular weight PAHs on benthic infauna of the region. CSI Minimal Exposure thresholds are concentrations below which impacts to the biota are not expected. CSI Low Exposure thresholds are concentrations above which impacts are likely to occur. The sixth filter focused on minimum number of taxa, which could be indicative of impacts from unmeasured stressors (e.g., low dissolved oxygen) or of a poor-quality sampling event.

3.1.3 Objective 3: Biological Assemblages

Once a group of reference sites was identified, the possibility of distinct assemblages (i.e., groups of unique biota) and then possibly habitats (i.e., spatially discrete areas of with unique biotic and abiotic characteristics) was evaluated by looking for taxonomic similarities and differences among the samples via clustering the infauna sample data from the reference sites. Taxonomic similarity was quantified as Bray-Curtis dissimilarity values (Bray and Curtis 1957). To maximize the formation of meaningful clusters of sites, dissimilarities were calculated with taxa at three different levels of taxonomic specification: species and above, genus and above, or family and above. A genus-level identification was selected to move forward with, as it produced more cohesive clusters of sites than species-level taxonomic information but maintained greater taxonomic resolution (and likely ecological information) than aggregating taxa to the family level. As an example: Individuals identified as *Tellina carpenteri* or *Tellina modesta* were both changed to *Tellina* and their abundances within a given sample were summed; however, specimens identified as Tellinidae, were left as such.

Of the genus-level taxa, the 90% most frequently observed taxa across the data set (to minimize the number of single-sample clusters) were used to calculate final dissimilarity values between sites. Samples were clustered using a hierarchical sorting algorithm with the unweighted pair group method so as to maximize potential dissimilarities. Clustering was done using the cluster package v 2.0.7 in R.

The relative uniqueness of each cluster was confirmed by characterizing their dominant taxa. Species richness (S) and Shannon-Weiner diversity of the samples were also compared between each cluster. Permutation Analysis of Variance (permANOVA) analysis was used to identify the abiotic variables (water depth, latitude, % sand, % silt, and % clay) influencing dissimilarity among the samples from each identified cluster. Environmental variables identified as significantly ($\alpha = 0.1$) related to the dissimilarity of samples by the permANOVA test were then compared between the biological clusters with a Kruskal-Wallace test to determine if they formed unique habitats delineated by those variables. Additionally, the samples from each cluster were plotted in geographic space to determine if they formed spatially discrete grouping that followed their taxonomic uniqueness. PermANOVAs were conducted the adonis2 function in the Vegan package (v2.4-4 [Oksanen et al. 2017]) in R and Kruskal-Wallis tests were conducted using the kruskal.test function in R.

3.1.4 Objective 4: Response to Disturbance

Across the data set, there were a variety of different chemicals measured in the sediments associated with benthic infauna samples. Of these different chemicals, a core list was created from the compounds most frequently measured across the samples and that represented the major classes of chemicals (Table 3). The different congeners and isomers of DDT, PAHs, and PCBs were summed into total DDTs, total PAHs, and total PCBs, respectively. The total number of compounds exceeding their CSI Minimal, Low, and High-Exposure threshold (Bay et al. 2014) exceedances was also calculated for each sediment sample, providing a more integrated measure of chemical exposure with benchmarks to expected biological responses.

Based upon the patterns in the clustering and post-hoc analyses of reference sites, habitats were established for the continental slope ecosystem of southern California. The abiotic characteristics of each habitat (e.g., water depth, % sand), were then used to assign the non-reference samples into one the three groups/habitats. The benthic infaunal community's response to stress within each habitat (both reference and non-reference samples) was then evaluated using a variety of multivariate and univariate analyses.

Within each habitat, the relationship of reference and non-reference infauna samples was evaluated with non-metric multi-dimensional scaling (nMDS) ordinations based upon species-level and above taxonomic information. PermANOVA was used to determine if there were significant ($\alpha = 0.1$) differences between the biota of the reference and non-reference samples. Lastly, the anthropogenic stressors from Table 3 were correlated to the nMDS ordinations of samples from each habitat. All of the multivariate analyses were conducted with the Vegan package v2.4-4 in R (Oksanen et al. 2017) using the metaMDS function for the Ordinations, adonis2 for the permANOVAs, and envfit for the multivariate correlations.

Within each habitat, individual taxon abundance was correlated and plotted for visual inspection with each of the different chemical constituents to identify any key taxa that could be useful for predicting contamination in other samples from their habitat. Note that given the rigorous sorting and identification procedures used to produce the benthic infauna data (e.g., Bight '13 Benthic Committee 2013 [http://www.sccwrp.org/Documents/BightDocuments/Bight13Documents/Bight13PlanningDocuments.aspx]; County Sanitation Districts of Los Angeles County), absence of a taxon from a sample was treated as a "true absence" and assigned an abundance of 0 for all correlation analyses (Karenyi et al. 2018). Additionally, species richness (S) and Shannon-Wiener diversity values were also correlated to the different stressor measurements. All correlations were Spearman's rank correlations and were calculated using the cor function in R.

Table 3. Disturbance and natural environmental variables used to investigate stressor response among the macrobenthic infauna of the continental slope ecosystem. Distributional moments of each variable across the entire data set are presented, as well as their Spearman's rank correlation to the ordinations (Figure 6) of reference and non-reference samples in each of the three habitats (obtained from envfit function in R). ND indicates no data on that variable. NA indicates no observations of that variable. Chemical Score Index (CSI) thresholds from Bay et al. 2014.

Parameter	Mean	Standard Deviation	Median Value	Maximum Value	r_s Upper Slope	r_s Northwest Slope	r_s Lower Slope
# of CSI Low Disturbance Threshold Exceedances§	1.6	2.7	0.0	11.0	0.10	0.27	0.71
# of CSI Moderate Disturbance Threshold Exceedances§	1.1	2.1	0.0	10.0	0.15	0.26	0.61
# of CSI High Disturbance Threshold Exceedances§	0.7	1.4	0.0	6.0	0.16	NA	0.63
Total Nitrogen (mg g^{-1})	2.4	1.1	2.3	6.6	0.43	0.32	0.16
Total Organic Carbon (mg g^{-1})	16.7	13.2	16.0	66.1	0.55	0.36	0.21
Arsenic (ppm)	7.5	9.7	5.4	116.0	0.16	0.37	0.42
Copper (ppm)	41.2	38.1	27.1	276.0	0.09	0.36	0.40
Mercury (ppm)	0.2	0.2	0.1	2.1	0.09	0.37	0.54
Zinc (ppm)	109.7	76.6	90.5	713.0	0.05	0.31	0.19
Total Chlordanes (ppb)	0.3	1.6	0.0	14.3	0.13	ND	ND
Total DDD (ppb)	450.5	796.7	187.5	5,940.0	0.33	0.11	0.36
Total DDE (ppb)	3029.0	6508.1	684.5	59,490.0	0.32	0.29	0.35
Total DDT (ppb)	2037.2	5930.9	14.3	66,600.0	0.31	0.28	0.57
Total PAH (ppb)	156.7	234.8	61.1	1,559.3	0.23	0.05	0.38
Total PCB (ppb)	160.4	342.1	1.1	2,240.0	0.17	0.19	0.32
Depth (m)	385.8	168.6	305.0	1,023.0	0.42	0.59	0.13
% Sand	22.1	14.3	19.0	88.5	0.28	0.67	0.36
% Silt	64.2	15.0	62.8	95.9	0.41	0.62	0.45
% Clay	13.5	10.0	13.4	38.9	0.45	0.15	0.13

4 Results

4.1 Identifying Habitats

Our selected screening criteria classified 203 samples from 191 stations as reference out of 750 (27%) of the total samples. Reference samples spanned the full depth (200 – 1,023 m) and geographic range (32.51629° N – 34.363147° N in latitude and -120.55833° W to -117.2805° W in longitude) of our dataset (Figure 2). The clustering routine of Bray-Curtis dissimilarity values yielded five different clusters of taxa. When placed in an nMDS ordination, samples from clusters 1, 2, and 3 contained the majority of samples and were relatively distinct from each other (Figure 2). Clusters 4 and 5 were very low-density clusters consisting of six samples (three in each). These six samples were then lumped together with the samples from cluster 3 because of their proximity to cluster 3 in the ordination, their depth (> 450 m), and their geographic location. The most dominant taxa of each cluster group (i.e., > 1% of total abundance) were relatively different from each other (Table 4), though there was small amount of overlap between cluster groups 2 and 3. The maldanid polychaete *Maldane sarsi* was the only dominant taxon found in each cluster. Based upon the full taxonomic composition of the samples, clusters 1, 2, and 3 (plus 4 &5) were significantly different from each other (permANOVA F = 7.42 df = 2,201 $p < 0.001$). Cluster 1 had significantly greater species richness (Kruskal-Wallace Chisq = 83.98 df = 2,202 $p < 0.001$) and diversity (Kruskal-Wallace Chisq = 56.85 df = 2,202 $p < 0.001$) than cluster 3, which in turn was greater than cluster 2 (Figure 3). Differences in total abundance and species richness for each cluster are illustrated in Table 5.

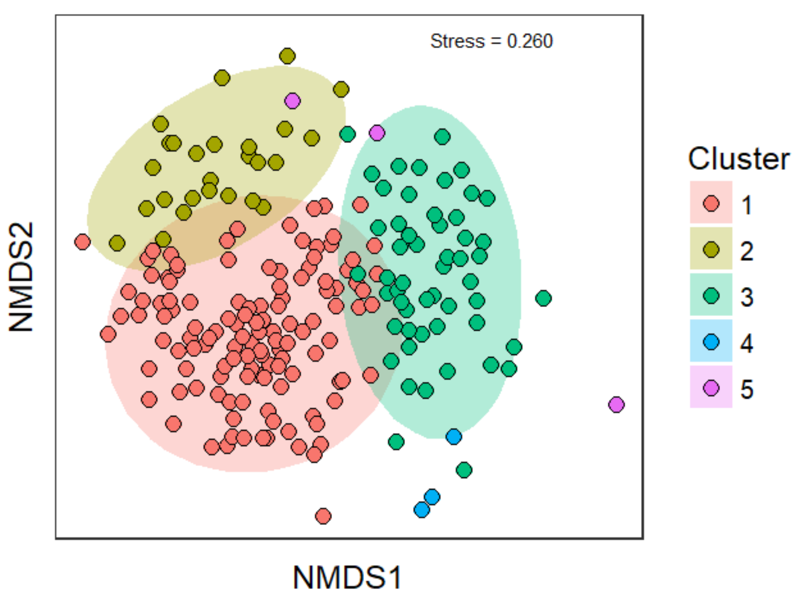

Figure 2. Two-dimensional plot summarizing the nMDS ordination of reference sites. Colors correspond to cluster membership of samples based upon Bray-Curtis dissimilarity of benthic fauna aggregated to the genus level. Ellipses represent multivariate-t distribution of cluster groups and are provided as a visual guide of sample grouping.

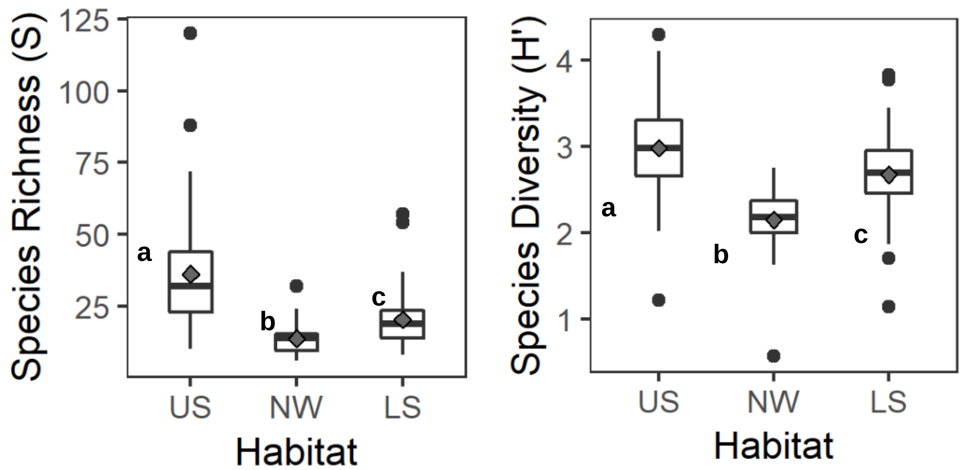

Figure 3. Schematic box-plots of species richness (S) and Shannon-Wiener Diversity (H') among reference sites in each of the three deep water habitats. Grey diamonds indicate the mean value within each habitat: US = Upper Slope (Cluster 1), NW = Northwest Slope (Cluster 2), LS = Lower Slope (Clusters 3, 4 & 5). Letters indicate significantly (α = 0.1) similar/different habitats based upon Dunn post-hoc comparisons of Kruskal-Wallace tests for each parameter between habitats.

Table 4. Dominant benthic infauna (i.e., > 1% of total abundance) in reference samples from each of the three habitats identified across the continental slope of the Southern California Bight. Superscript numbers indicate taxa unique to each habitat among the dominant taxa.

Upper Slope Habitat (Cluster 1)			
Taxon	**Abundance**	**Relative Abundance (%)**	**Cumulative Abundance (%)**
Maldane sarsi	555	4.7	4.7
Chloeia pinnata	373	3.2	7.9
Paraprionospio alata	373	3.2	11.1
[1] *Macoma carlottensis*	370	3.2	14.3
[1] *Tellina carpenteri*	329	2.8	17.1
[1] *Mediomastus* sp	277	2.4	19.4
[1] *Spiophanes kimballi*	270	2.3	21.7
[1] *Axinopsida serricata*	241	2.1	23.8
Yoldiella nana	221	1.9	25.7
[1] *Phyllochaetopterus limicolus*	200	1.7	27.4
Nuculana conceptionis	194	1.7	29.1
Amphiodia sp	193	1.6	30.7
[1] *Compressidens stearnsii*	191	1.6	32.3
[1] *Melinna heterodonta*	180	1.5	33.9
[1] *Pectinaria californiensis*	162	1.4	35.3
Fauveliopsis glabra	161	1.4	36.6
Onuphis iridescens	151	1.3	37.9
[1] *Aphelochaeta monilaris*	150	1.3	39.2
Eclysippe trilobata	143	1.2	40.4
Amphiuridae	128	1.1	41.5
[1] *Ampelisca unsocalae*	126	1.1	42.6
[1] *Spiophanes berkeleyorum*	122	1.0	43.6
Adontorhina cyclia	113	1.0	44.6
Other Taxa combined	6,488	55.4	100.0

Table 4. cont.

Northwest Slope Habitat (Cluster 2)			
Taxon	Abundance	Relative Abundance (%)	Cumulative Abundance (%)
Byblis barbarensis	181	16.6	16.6
[2] *Amphissa bicolor*	81	7.4	24.0
[2] *Prionospio* (*Prionospio*) *ehlersi*	67	6.1	30.2
[2] *Paraphoxus* sp 1	42	3.8	34.0
[2] *Cyclocardia gouldii*	35	3.2	37.2
Onuphis iridescens	32	2.9	40.1
[2] *Astyris permodesta*	31	2.8	43.0
Maldane sarsi	29	2.7	45.6
[2] *Bipalponephtys cornuta*	28	2.6	48.2
Paraprionospio alata	28	2.6	50.8
[2] *Heteromastus filobranchus*	26	2.4	53.2
[2] *Brisaster townsendi*	25	2.3	55.5
[2] *Saxicavella pacifica*	24	2.2	57.7
[2] *Amphissa undata*	19	1.7	59.4
Chloeia pinnata	18	1.6	61.0
[2] *Brisaster latifrons*	16	1.5	62.5
[2] *Limifossor fratula*	14	1.3	63.8
[2] *Glycera nana*	14	1.3	65.1
[2] *Calocarides quinqueseriatus*	14	1.3	66.4
[2] *Chaetoderma nanulum*	13	1.2	67.6
[2] *Lirobittium* sp	13	1.2	68.7
[2] *Glycinde armigera*	12	1.1	69.8
[2] *Cyclocardia* sp	11	1.0	70.9
[2] *Myriochele olgae*	11	1.0	71.9
Other Taxa combined	307	28.1	100.0

Table 4. cont.

Lower Slope Habitat (Clusters 3, 4 & 5)			
Taxon	**Abundance**	**Relative Abundance (%)**	**Cumulative Abundance (%)**
Byblis barbarensis	181	7.6	7.6
Ophiuroidea	83	3.5	11.1
[3] *Paralysippe annectens*	72	3.0	14.1
[3] *Neilonella ritteri*	70	2.9	17.1
Fauveliopsis glabra	62	2.6	19.7
Maldane sarsi	57	2.4	22.1
Eclysippe trilobata	55	2.3	24.4
Amphiuridae	46	1.9	26.4
[3] *Monticellina* sp	42	1.8	28.1
[3] *Tritella tenuissima*	39	1.6	29.8
[3] *Monticellina cryptica*	36	1.5	31.3
[3] *Harpiniopsis epistomata*	36	1.5	32.8
[3] *Leucon bishopi*	33	1.4	34.2
[3] *Axinodon redondoensis*	33	1.4	35.6
Maldanidae	33	1.4	37.0
Lineidae	32	1.3	38.3
[3] *Spiochaetopterus costarum* Cmplx	32	1.3	39.7
[3] *Maldane californiensis*	28	1.2	40.8
[3] *Falcidens hartmanae*	28	1.2	42.0
[3] *Adontorhina cyclia*	26	1.1	43.1
[3] *Sonatsa carinata*	24	1.0	44.1
Yoldiella nana	23	1.0	45.1
[3] *Myriochele gracilis*	23	1.0	46.1
Other Taxa combined	1,281	53.9	100.0

Table 5. Mean abundance and species richness of reference and non-reference samples from each of the three identified habitats across the continental slope of southern California. Standard Deviation shown in parentheses.

Habitat	Sample Condition	Sample Size	Abundance	Species Richness
Upper Slope (Cluster 1)	Non-Reference	446	172.6 (182.5)	28.9 (12.4)
	Reference	118	99.3 (69.8)	36.2 (18.8)
Northwest Slope (Cluster 2)	Non-Reference	5	26.2 (9.3)	15.2 (3.6)
	Reference	27	40.4 (38)	13.7 (5.6)
Lower Slope (Clusters 3, 4 & 5)	Non-Reference	57	64.6 (62)	21.3 (12.9)
	Reference	59	40.3 (32.2)	20.4 (9.6)

Similarly, a permANOVA of abiotic/environmental variables indicated that water depth, latitude, sand, silt, and clay had significant ($\alpha = 0.1$) influence of the segregation of the samples in ordination space (Table 6). As a whole, the samples of cluster 1 were shallower than those of cluster 2 or 3, and their sediments contained a greater amount of sand, a lesser amount of silt, and similar amounts of clay (Figure 4). All of the samples had sediments that could be classified as sandy-silt, with the sediments of cluster 1 being generally sandier than the other habitats, but still dominantly silt. The samples of clusters 2 and 3 were similar to each other with respect to sediment composition. The samples of cluster 3 were deeper than 2. When plotted on a map of the region (Figure 1), it became apparent that samples from clusters 1 and 3 were separated from each other along a depth break of approximately 400 m running the length of the region's coastline until near Santa Barbara, California (~ -119.76911 longitude). Westward from there (~ -120.4562 longitude), across most depths were the samples of cluster 2.

Based on the biotic (Figure 2), abiotic (Figure 4; Table 7), and geographic (Figure 1) differences among the reference samples, we have erected three habitats for the southern California continental slope:

- **Habitat 1 – Upper Slope** represents the shallow (~200 – 400 m) shelf/slope transition habitat along the length of the coastline from Santa Barbara, California to Tijuana, Mexico. These sites cover a mix of sediment types from silty-sand to sandy silt, and have relatively low TOC and TN content.
- **Habitat 2 – Northwest Slope** represents stations between Santa Barbara and Point Conception, California that covers a range of depth, a mix of sediment types and TOC/TN levels.
- **Habitat 3 – Lower Slope** represents the deep-water (~400 – 1,000 m) slope habitat along the length of the coastline from Santa Barbara, California to Tijuana, Mexico. These sites cover a mix of sediment types from sandy silt to silty-silt and have elevated TOC and TN compared to the Upper Slope.

Table 6. PermANOVA output assessing the influence of environmental parameters on the differences between samples of benthic infauna from the continental slope ecosystem.

Parameter	df	Sums of Squares	F-Statistic	*p*-value
Station Water Depth	1	0.59	1.44	0.020
Latitude	1	0.77	1.90	0.010
Sand	1	0.68	1.68	0.030
Silt	1	1.34	3.31	0.010
Clay	1	0.54	1.34	0.010
Residual	153	62.19		

Table 7. Mean of environmental and geographic values among reference sites from each of the three identified habitats across the continental slope of southern California. Standard Deviation shown in parentheses.

Parameter	Upper Slope	Northwest Slope	Lower Slope
Latitude (decimal degrees)	33.0763 (0.53)	34.2328 (0.07)	33.1386 (0.36)
Longitude (decimal degrees)	-117.7408 (0.62)	-120.1454 (0.27)	-117.8301 (0.5)
Depth (m)	316.4 (81.2)	400.8 (51.8)	711.8 (150.5)
Clay (%)	8.3 (11)	6.3 (5.6)	5.8 (4.3)
Sand (%)	24.5 (15.4)	14.1 (9.2)	13.5 (12.2)
Silt (%)	61.8 (20.2)	79.6 (8.3)	78.9 (15.6)
TN (mg g^{-1})	1.2 (0.9)	3 (0.8)	2.7 (1.6)
TOC (mg g^{-1})	17.6 (9.7)	27.9 (8.5)	31.3 (12.8)

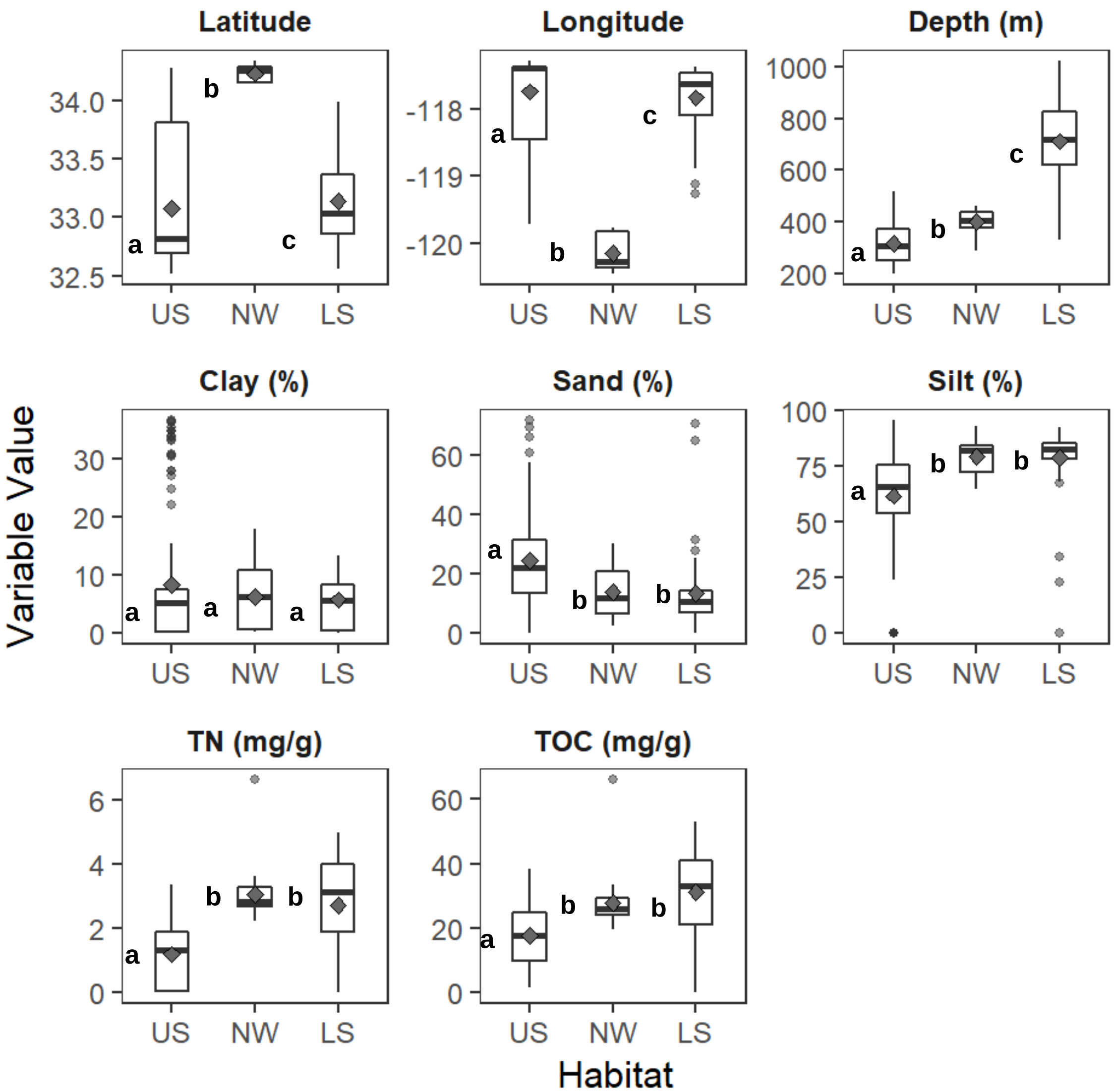

Figure 4. Schematic box-plots of Latitude, Longitude, Depth (m), Clay (%), Sand (%), Silt (%), Total Nitrogen (mg g^{-1}), and Total Organic Carbon (mg g^{-1}) among reference sites in each of the three deep water habitats: US = Upper Slope, NW = Northwest Slope, LS = Lower Slope. Grey diamonds indicate the mean value within each habitat. Letters indicate significantly (α = 0.1) different habitats based upon Dunn post-hoc comparisons of Kruskal-Wallace tests for each parameter between habitats.

4.2 Disturbance Response

In addition to deleterious forcing factors like toxic chemicals and macronutrients, we were also interested in understanding the relative influence of natural factors (e.g., sediment composition and water depth) on macrobenthic community composition within a given habitat and how these factors may correlate with stressor variables. Figure 5 illustrates that there were strong correlations among stressors (e.g., strong direct correlation among the three CSI metrics, or strong inverse correlation between % sand and total nitrogen), but none that would represent major confounding factors (e.g., a theoretical strong relationship between depth and copper).

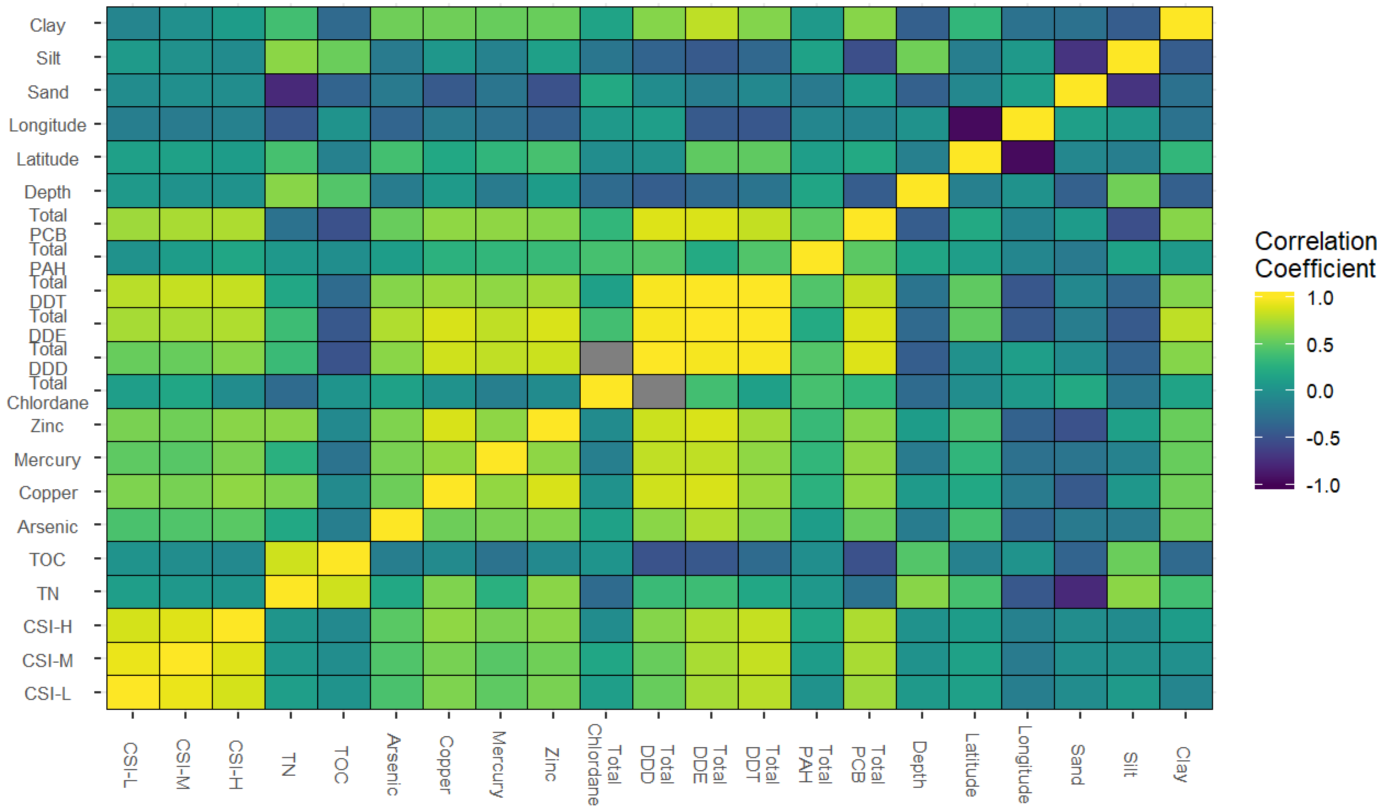

Figure 5. A heatmap depicting the relative correlation between the different potential stressors used in the study. Spearman's correlation coefficients (r_s) were used, with yellow representing a strong direct correlation and purple representing strong inverse correlation.

From the multivariate perspective, visual inspection of the nMDS ordination plots for the Upper and Lower Slope Habitats (Figure 6) indicates that the fauna of reference and non-reference samples were not clearly distinct from each other. The pattern however, suggests a gradient in composition from reference to disturbed samples within the same habitat. The visual pattern was confirmed by the permANOVA testing for differences between the reference and non-reference samples (Table 8). These two pieces of evidence indicate that the macrobenthic communities in the Upper and Lower Slope Habitats do experience compositional changes when exposed to disturbance. In contrast, both visual and statistical evidence indicated that there were no differences between the reference and non-reference samples in the Northwest Slope Habitat. The lack of pattern compared to the other deep-water habitats, was most likely an artifact related to the small number of samples (32), of which only five were considered non-reference.

When the biotic data of the reference and non-reference samples from each habitat were plotted together in an nMDS ordination (Figure 7), it further illustrates the point that the assemblages from the three habitats were relatively distinct from each other (irrespective of condition) and that condition status within habitat represented less distinct shifts in assemblage composition. This pattern is supported by the results of a 2-way permANOVA comparing the composition of the reference and non-reference samples from all three habitats together (Table 9). When reference and non-reference samples were lumped together, the different habitats were still significantly different ($\alpha = 0.1$) from each other. The interaction term between habitat and reference status was also significant, indicating that the differences between habitat and reference were not homogeneous. Inspection of Figure7 and the results in Table 8 would indicate that the similar composition of the Northwest Slope Habitat reference and non-reference samples most likely resulted in the significant interaction term. Furthermore, based on a visual inspection the non-reference samples from each habitat appear more distinct from each other than their reference counterparts and that they are mostly located on the outer parts of the 2-D ordination plot in Figure 7, with the reference sites more centrally located.

Table 8. PermANOVA output evaluating the differences between reference and non-reference samples in each of the three habitats in the continental slope ecosystem.

Habitat	F-Statistic (df)	*p*-value
Upper Slope	19.56 (1, 562)	0.0012
Northwest Slope	1.17 (1, 30)	0.2172
Lower Slope	5.49 (1, 114)	0.0012

Table 9. Results of 2-way permANOVA comparing composition benthic fauna of reference and non-reference (Status) sample from all three continental slope habitats together.

Parameter	df	Sums of Squares	F-Statistic	*p*-value
Habitat	2	17.9	23.75	0.001
Status	1	6.21	16.49	0.001
Habitat*Status	2	3.72	4.94	0.001
Residual	706	266.0		

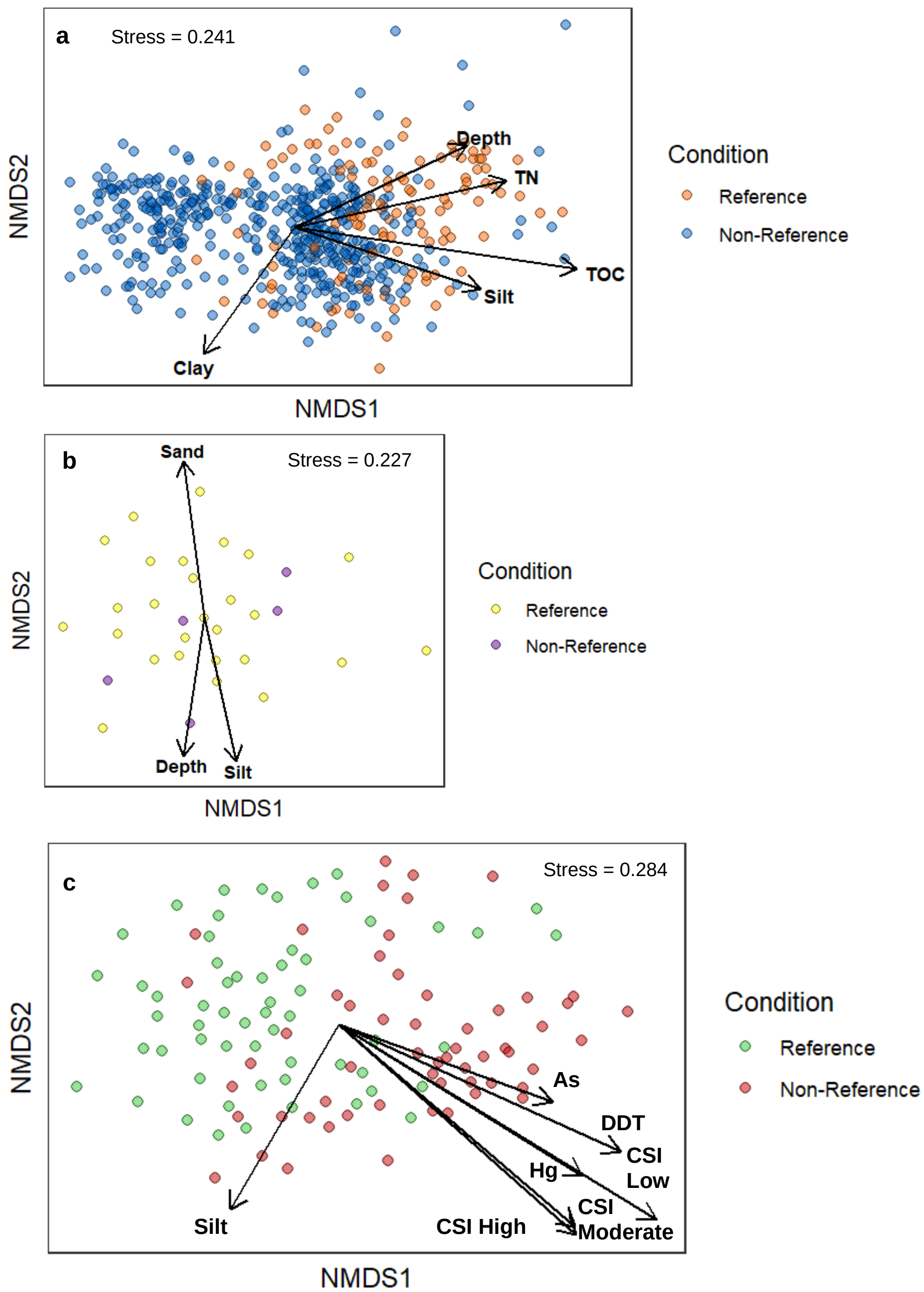

Figure 6. Two-dimensional plot summarizing the nMDS ordination of samples from: a) Upper Slope b) Northwest Slope, and c) Lower Slope illustrating the relative separation of reference samples from non-reference samples. The arrows represent vectors of influence for the different stressors and natural factors from Table 3 that had a correlation coefficient greater than 0.4 (absolute value) with the ordination as plotted. The length of the arrow is proportional to the magnitude of the correlation.

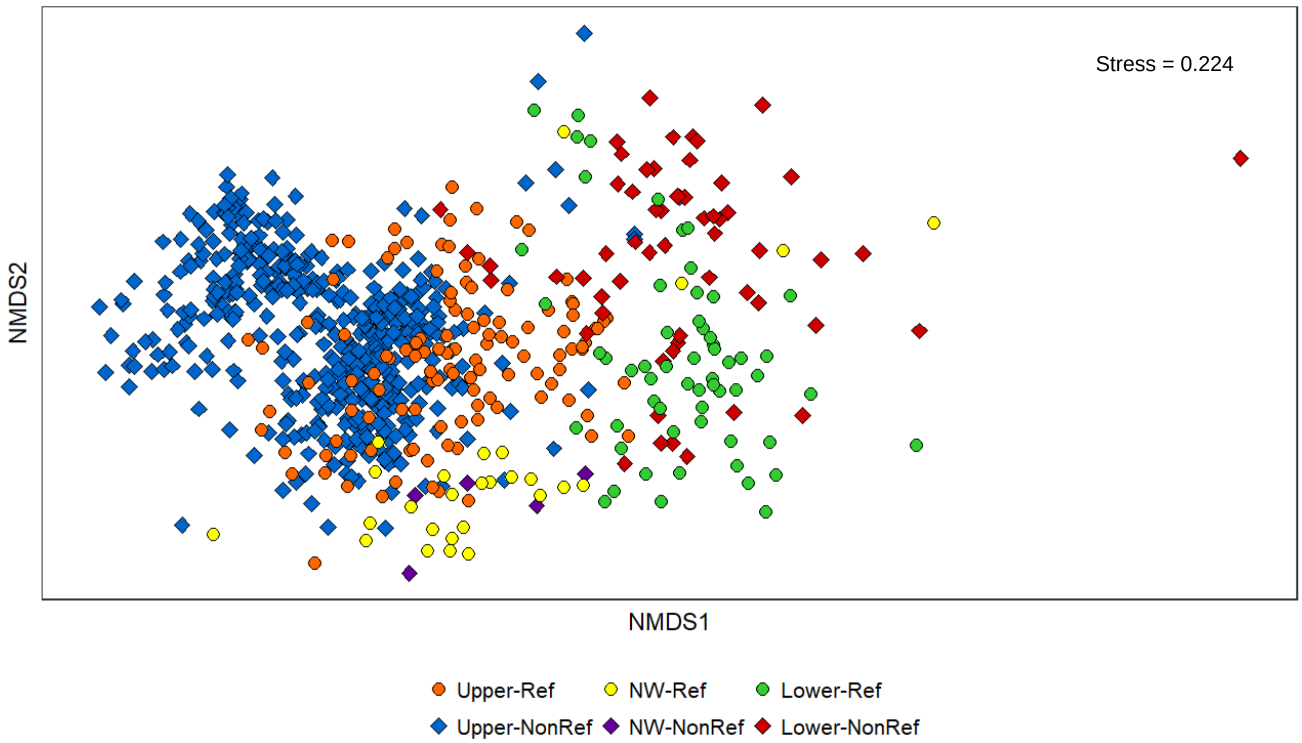

Figure 7. Two-dimensional plot summarizing the nMDS ordination of all reference (Ref) and non-reference (NonRef) samples from the three identified habitats across the continental slope of the Southern California Bight: Upper = Upper Slope, Lower = Lower Slope, and NW = Northwest Slope.

Those stressors from Table 3 that had a correlation coefficient greater than 0.4 with the ordination patterns are plotted as vectors in Figure 6. Though nearly all of the stressor correlations were statistically significant ($\alpha = 0.1$) to the ordination of the Upper Slope Habitat, only TN and TOC had non-spurious relationships (i.e., $r_s > 0.4$ or < -0.4) with the ordination, as did water depth and % clays. Sediments from reference sites had greater amounts of TN than non-reference sites – which is consistent with patterns seen across all of the region (Figure 6) – where there are greater amounts of TN in deeper sediments. Based on the direction of their vectors, silt and TOC content of the sediments appear to explain some of the differences in samples within the reference and non-reference groups of the Upper Slope, but not between the reference and non-reference samples from the other two habitats.

In the Lower Slope, fewer stressors were significantly ($\alpha = 0.1$) correlated to the ordination than in the Upper Slope (Table 3). This pattern was most likely driven by sparser density of stressor data in the Lower Slope compared to the Upper. However, of those stressors that were not spuriously related to the ordination, mercury concentration and all three levels of CSI threshold exceedance were higher in the non-reference samples compared to the reference samples. This pattern would suggest that these toxic chemicals were, in part, responsible for the differences in community composition between the reference and non-reference samples.

From the univariate perspective, Spearman's rank correlations of species richness (S) and Shannon-Weiner species diversity (H') with the stressors from Table 3 were calculated within each habitat and across all deep-water habitats (Table 10). Species diversity in the Upper Slope was inversely related ($r_s < -0.47$) to concentrations of copper, zinc, total DDD, and total DDE. As concentrations of these chemicals increased, species diversity declined. There were no such similar patterns in either the Northwest or Lower Slope Habitats.

Of the 1,011 taxa from the Upper Slope and the 527 from the Lower Slope, there were less than 20 Spearman's ranked correlations with the 15 different stressors listed in Table 3 that had r_s values > 0.5 or < -0.5. The lack of any meaningful patterns among the 18,660 potential taxon-stressor combinations was mostly likely due to the lack of any single taxon being frequently observed across the samples of a given habitat combined with a lack of consistent chemical detections in the same samples where a taxon was observed. Figure 8 illustrates one of the best available examples, where the abundance of the tellinid bivalve *Tellina carpenteria* had a -0.535 correlation to Total Nitrogen. However, visual inspection of the plot would suggest the relationship was tenuous. The relationship may be weakly non-linear and would likely be of limited predictive value in identifying disturbed macrobenthic habitats. Nearly all of the other taxa in Upper and Lower Slope Habitats had much less overlap of taxa observations and chemical measurements, often dominated by zero-count observations of the different taxa. As such, the identification of any individual taxon-stressor relationships was not successful.

Table 10. Spearman's rank correlation coefficients for Shannon-Weiner Diversity or Species Richness of macrobenthic infauna with the stressor and natural variables in each of the continental slope habitats and across the whole data set: US = Upper Slope, NW = Northwest Slope, LS = Lower Slope. CSI Thresholds after Bay et al. (2014).

Parameters	Species Diversity				Species Richness			
	US	NW	LS	All Habitats	US	NW	LS	All Habitats
# of CSI Low Disturbance Threshold Exceedances[1]	-0.039	0.179	-0.137	-0.057	-0.057	0.097	-0.030	-0.066
# of CSI Moderate Disturbance Threshold Exceedances[1]	-0.073	0.359	-0.180	-0.069	-0.073	0.182	-0.016	-0.040
# of CSI High Disturbance Threshold Exceedances[1]	-0.113	NA	-0.258	-0.096	-0.086	NA	-0.096	-0.033
Arsenic (ppm)	-0.373	0.033	-0.243	-0.269	-0.274	0.090	-0.138	-0.127
Copper (ppm)	-0.472	-0.035	-0.330	-0.286	-0.316	-0.133	-0.302	-0.171
Mercury (ppm)	-0.345	0.009	-0.340	-0.191	-0.227	-0.070	-0.197	-0.046
Zinc (ppm)	-0.517	-0.332	-0.384	-0.405	-0.380	-0.441	-0.361	-0.287
Total Nitrogen (mg g^{-1})	-0.379	-0.307	-0.239	-0.560	-0.446	-0.429	-0.354	-0.679
Total Organic Carbon (mg g^{-1})	0.093	-0.090	-0.240	-0.092	-0.183	-0.150	-0.364	-0.411
Total Chlordanes (ppb)	-0.102	ND	ND	-0.004	-0.250	ND	ND	0.036
Total DDD (ppb)	-0.565	0.800	-0.250	-0.360	-0.240	0.400	-0.163	0.013
Total DDE (ppb)	-0.520	0.468	-0.172	-0.372	-0.259	0.321	-0.029	-0.054
Total DDT (ppb)	-0.415	0.118	-0.412	-0.279	-0.283	-0.102	-0.231	-0.063
Total PAH (ppb)	0.002	-0.254	-0.326	-0.124	-0.037	-0.168	-0.231	-0.099
Total PCB (ppb)	-0.325	-0.185	-0.066	0.020	-0.175	-0.204	0.080	0.251
Depth (m)	-0.247	-0.438	-0.385	-0.270	-0.257	-0.489	-0.410	-0.472
% Sand	0.448	0.255	0.334	0.440	0.470	0.415	0.424	0.521
% Silt	-0.186	-0.346	-0.163	-0.263	-0.273	-0.489	-0.250	-0.464
% Clay	-0.379	-0.066	-0.295	-0.202	-0.321	-0.140	-0.248	-0.017

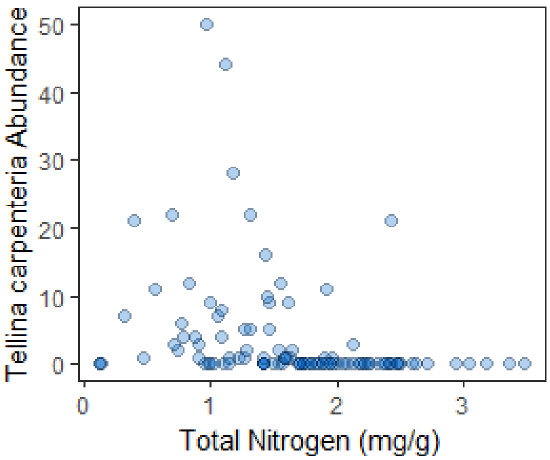

Figure 8. Scatter plot of the abundance of the tellinid bivalve *Tellina carpenteria* with Total Nitrogen (mg g^{-1}) from the Upper Slope Habitat.

To further investigate and quantify the lack of commonly observed taxa between samples, we measured the similarity of the benthic infaunal samples to each other in relation to their geographic proximity. Similarity was compared between samples designated as reference and non-reference within each habitat. Similarity was measured as Bray-Curtis (BC) dissimilarity (Bray and Curtis 1957). Bray-Curtis values were calculated using taxonomic data at their lowest possible level of identification, but also at a taxonomically coarser Operational Taxonomic Unit (OTU) level (Appendix C) in an effort create more homogenous taxa profiles (following Hawkins et al. 2000; Van Sickle et al. 2005) and therefore theoretically more similar samples. The OTUs were defined as all taxa (species or otherwise) occurring in more than 25 samples within each habitat's reference samples. The remaining taxa were then collapsed to the genus level and those genera that occurred in more than 25 samples within each habitat's reference samples were retained. All other taxa were discarded. Bray-Curtis values were calculated using vegdist function in the Vegan Package 2.4-4 from R and linear distance between sites was calculated from latitude and longitude using the geosphere package in R.

As illustrated in Figure 9, reference samples within each habitat that were spatially close to each other (<= 1 km) were quite compositionally different from each other (e.g., BC > 0.5). Table 11 illustrates that, on average, any reference sample from one habitat was as dissimilar to another reference sample from its habitat as those from a different habitat. When sample-to-sample comparisons were made with OTUs, the overall dissimilarity was smaller, but the mean dissimilarity was still nearly as great within habitat as between habitats.

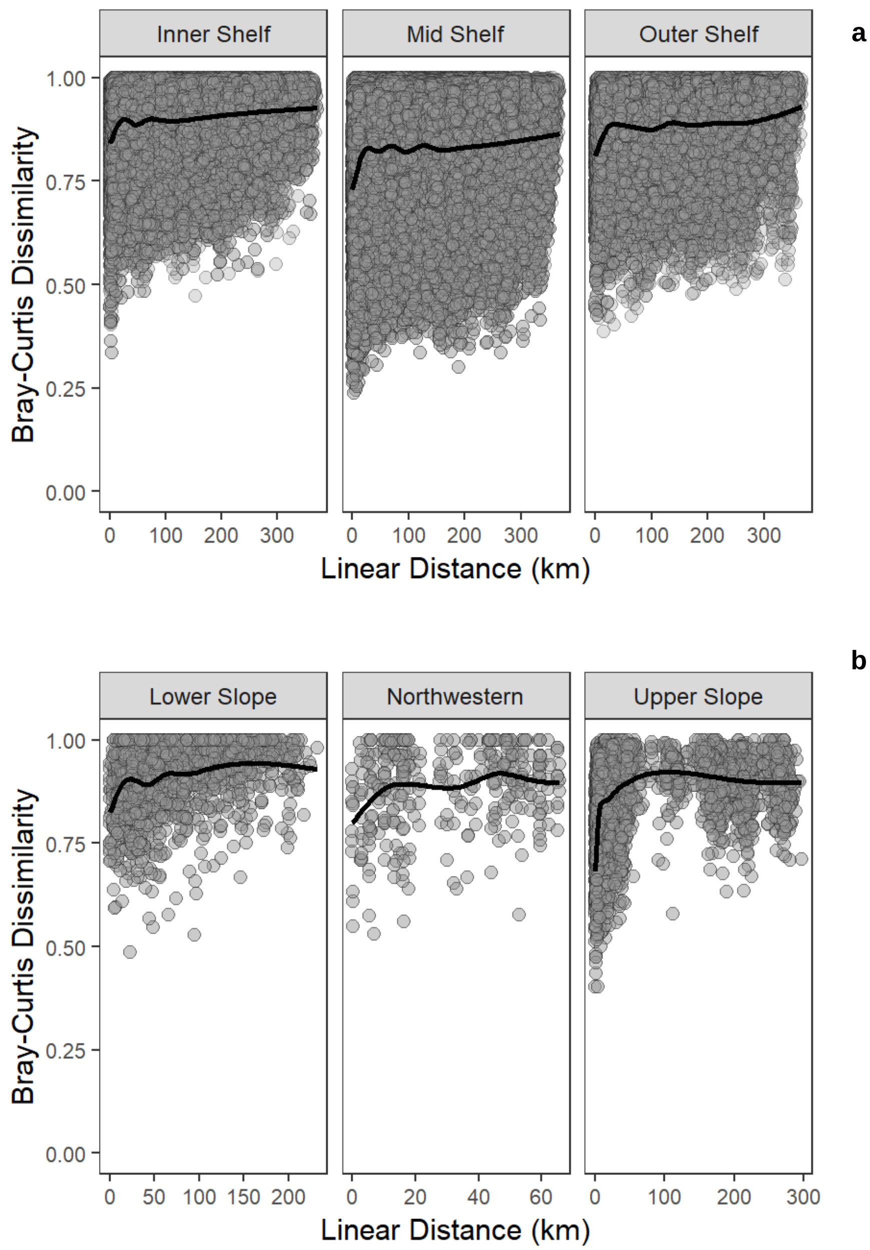

Figure 9. Scatter plots of pair-wise Bray-Curtis dissimilarity of reference samples from continental shelf habitats shallower than 200 m (a) and each continental slope habitat (b). Samples are plotted against the pair-wise linear distance between the samples. The black line represents the general additive model smoothed mean. Continental shelf data (a) are from Gillett et al. 2017.

Table 11. Mean pair-wise Bray-Curtis dissimilarity values calculated between reference samples in each of the three habitats of the continental slope ecosystem using the lowest possible level of taxonomic resolution, as well as Operational Taxonomic Unit resolution.

Input Taxa	Habitat	Upper Slope	Northwest Slope	Lower Slope
Lowest Possible Taxonomic Level	Upper Slope	0.88	0.94	0.96
	Northwest Slope	0.94	0.89	0.97
	Lower Slope	0.96	0.97	0.91
OTU-level	Upper Slope	0.84	0.92	0.94
	Northwest Slope	0.92	0.85	0.95
	Lower Slope	0.94	0.95	0.85

5 Discussion

5.1 Ecology of the Benthic Fauna

This work represents the most comprehensive study to focus on the regional ecological patterns in the benthic infauna of the southern California continental slope ecosystem since the Allan Hancock cruises of the late 1950s (Hartman 1955; Hartman and Barnard 1958; Hartman and Barnard 1960; Hartman 1966). This work covered broader temporal and spatial scales than the Hancock cruises did, with a more complete distribution of samples across the depth gradient from the continental shelf down to deep waters at the base of the continental slope. This scale makes the present study relatively unique for a benthic study at these depths and it is a scale that is only made possible by the fact that a bulk of these data were the product of a collaborative, regional monitoring partnership (Southern California Bight Regional Monitoring Program [Schiff et al. 2016]) that enables consistency in taxonomy, data collection and data quality standards across multiple decades of surveys.

Based upon our analysis of 40+ years of benthic infauna survey data, we were able to identify three relatively distinct natural biological communities that are characteristic of different habitats across the continental slope of the Southern California Bight. The primary segregating feature between the largest habitats was depth, with separation at approximately 400 m of depth. Water depth and subsequent exposure to different temperature regimes, oxygen dynamics and pressure is an important barrier in the biogeography of seemingly contiguous deep sea benthic habitats (e.g., Rex 1981; Levin et al. 1991; Rex et al. 2005). There were some quantitative differences in sediment composition that paralleled the depth differences between the Upper and Lower Slope Habitats. There was a general trend of silt content of sediments increasing with depth, as did the TOC and TN content of those sediments. This pattern is similar to those observed in other upwelling dominated systems, which increase production of biogenic material and transport of terrigenous sediment (Calvert et al. 1995; Sifeddine et al. 2008) However, the sediments of both habitats would be considered silts from a benthic faunal perspective and unlikely to contribute substantially to the differences in community composition observed between the two habitats (though see Henkel and Politano 2017).

After water depth, the secondary segregation between habitats was geographic. The third habitat was centered on the most northwestern portion of the Southern California Bight, west of Santa Barbara, California, and spanning both sides of depth-related break in community composition separating the Upper and Lower Slope Habitats elsewhere in the region. This portion of the Southern California Bight is a biogeographic break-point, transitioning from cold-water fauna of central and northern California to the warm-water fauna of the south (Bergen et al. 2001; Bergen 2006). The fauna of the Northwest Slope Habitat were a mix of those from our Lower Slope and those from further north (see Hyland et al. 1991b). Oceanographically, this is also a unique portion of the region. There is an eddy system in the Santa Barbara Channel that increases the exposure of the fauna to corrosive low-pH waters (Oey 1996; Hauri et al. 2013; Turi et al. 2016) compared to the other habitats we identified.

Our identification of three relatively distinct habitats differed from the pattern previously described by Hartman and Barnard (1958; 1960) who described the deep basins as a relatively homogenous, relatively depauperate habitat. The difference may be due to Hartman and Barnard’s focus on the deepest parts of the region. All of their samples were from approximately 400 to 2000 m, including a large number of samples west of the Channel Islands. The Lower and Northwest Slope Habitats of our study were closest to the area detailed by Hartman and Barnard, but even where the overlap was closest, at a maximum depth of 1000 m we observed greater abundance and diversity of infauna than Hartman and Barnard (1960).

The results from our study indicated there has been some change in the composition, diversity, and density of deep-sea macrofauna of the Southern California Bight since the 1950s. The change was not drastic, but may be reflective of changes in basin-scale oceanographic factors like temperature, productivity, water chemistry or oxygen levels and their interaction with larval disbursement and recruitment (Young and Eckelbarger 1994; Levin and Gage 1998; Rhul et al. 2004). The change may also be the product of reductions in anthropogenic disturbance in adjacent continental shelf habitats (Smith et al. 2001; LACSD 2016; Gillett *in prep*) propagating to the adjacent deeper waters.

5.2 Assessing Habitat Condition

One of the key benefits to studying patterns in benthic community composition is the insight it provides into anthropogenic disturbances. Within the Upper and Lower Slope Habitats, we were able to detect subtle indications of community-scale change characterized in both univariate and multivariate contexts that were associated with exposure to toxic chemicals and greater amounts of organic matter. However, none of these patterns were strong enough to be useful in providing a biological measure of disturbance. Furthermore, there were no discernable stressor-response patterns among the individual taxa that comprised these communities.

There are a variety of different anthropogenic and natural stressors that can influence the structure of benthic communities (Lenihan et al. 2003; Breitburg and Riedel 2005; Gunderson et al. 2016). Though there are myriad of individual potential stressors in the environment, it is reasonable to group them into major classes of toxic chemicals, eutrophication, habitat alteration, physical disturbance, and altered water quality. In the present study, we were able to reasonably characterize exposure to toxic chemicals and eutrophication (Appendix A) and the conclusions we can draw from these data are most likely sound. However, we were unable to fully characterize stress from physical disturbance (e.g., bottom trawling or mineral extraction) or altered water quality (e.g., low dissolved oxygen, low pH, or altered temperature). Exposure to low dissolved oxygen and acidification are important factors that may alter benthic community structure (Levin et al. 2001; Ruhl et al. 2004; Widdicombe and Spicer 2008) for which we could not account. As such, it is possible that the differences in reference and non-reference communities observed in the Upper and Lower Slope Habitats could be related to these or other uncharacterized stressors; none of which would be detected in our stressor-response analyses.

It should also be noted, that the lack of detectable stressor-response patterns among individual taxa was also in part due to the relatively low frequency of occurrence among any one taxon. Of the 1,011 taxa observed in the Upper Slope Habitat, only nine occurred in more than 50% of the samples and 941 taxa occurred in less than 10% of the samples. Similar patterns were observed in the Lower Slope Habitat (no taxa found at more than 50%) and Northwest Slope Habitat (only one taxon in more than 50% of the samples) (see Appendix E).

Patterns in species richness and alpha diversity reported from other continental slope and deeper environments around the world are not dissimilar to those observed in the present study (Blake and Grassle 1994; Rex et al. 2000; Schaff et al. 2000). However, none of these studies had the smaller, regional geographic scale combined with high data density of our work to allow for comparable measures of beta diversity to be made. The pattern of taxa dispersion we observed on the slope – high beta diversity, but apparently little overlap in shared taxa from sample to sample – was surprising. This is quite a different pattern than observed among the macrobenthic communities of the shallower continental shelf off southern California (Figure 9) and other regions (Ellingsen 2001, 2002).

High beta-diversity and low sample-to-sample similarity in composition, despite coming from a physically homogenous habitat, is suggestive of a community that is not organized by species-specific niches (*sensu* Hutchinson 1959). These patterns instead are suggestive that the macrobenthic infauna of the Southern California Bight continental slope could fall under the concept of a neutrally organized community (Hubbell 2001, 2005; Leibold and McPeek 2006). Neutral community theory posits that the faunal abundance a location can support is relatively stable (i.e., a carrying capacity of a set number of individuals). As individuals die, they are not directly replaced by con-specifics optimized for the open niche space, but rather new recruits settle randomly from any taxon in the regional larval pool at that moment (Ricklefs 2006).

We do not know what the effect of a neutrally organized community could be on the way we traditionally assess habitat condition. Many of the assessment tools we use (e.g., tolerance indices [Borja et al. 2000; Smith et al. 2001], species-specific Multi-Metric Indices [Weisberg et al. 1997; Hunt et al. 2001] or predicted assemblage indices [Hawkins et al. 2000; Ranasinghe et al. 2009]) are built upon species identity and the premise that there are a core assemblage of species living in a location that predictably change under exposure to stress (see Diaz et al. 2004 for a detailed review of most types of assessment frameworks). In this paradigm, disturbance pushes a superior competitor out of a niche and a more tolerant, but less-efficient competitor is able to flourish in the superior competitor's absence (Pearson and Rosenberg 1978; Rhoads et al. 1978; Gray et al. 2002; Pawlowski et al. 2014). Inherent in this premise, is that both types of competitors have a reasonable degree of fidelity to their habitat; under non-disturbed conditions the weaker competitor (adults or larvae) have a consistent, low-level background presence in the habitat, if not every sample collected from that habitat. However, if the assemblage captured in a given sample is the product of stochastic recruitment and extirpation as suggested by Hubbell (2005), then our species-specific views of macrobenthic response to stress – that rely on predictable shifts in dominance from species A to B to C – may not work as well.

As a simple test of how a standard benthic assessment index would work in these habitats with potentially different underlying ecological structure, we applied an index calibrated and validated in other southern California environments to the data from the continental slope ecosystem (see Appendix D). Understanding how a traditional benthic assessment index succeeds or fails across the different slope habitats could provide insight on how to build assessment tools tailored to a neutrally organized ecosystem. In this case, the Benthic Response Index (BRI [Smith et al. 2001]) performed reasonably well for the Upper Slope – a habitat that encompasses areas for which the BRI was partially calibrated and validated. The index appeared suitable for a large proportion of the taxa and the index scores tracked gradients of the different stressors as would be expected. The BRI performed less well for the Lower and Northwest Slope Habitats, where it was not suitable for many more than half of the taxa observed and did not track any of the stressor gradients. This test would indicate that a pollution-tolerance type of index, like BRI, with sufficient taxonomic breadth could be a viable option for assessing benthic communities like those in this study.

The conceptual challenge that presents itself when determining how to use biological data to assess the condition of a neutrally organized community is how to balance the very large amounts of variance associated with species composition between samples from the same habitat with the variance that could be imparted to a sample from exposure to stress. Failing to account for or minimize the variance among the reference samples during index calibration can hinder the ability to discriminate between impacted and unimpacted samples (Hawkins et al. 2010). From the technical perspective, there then is a need to select an underlying modelling approach that is mathematically robust to nearly all of the species from the community having a zero-inflated / median -zero distribution within their habitat. Predictions of a species' presence, absence, or abundance need to be made within the natural characteristics of the habitat, as well as the impact of exposure to different types of stress. These are not impossible tasks; they simply have not been grappled with in the bioassessment literature.

One potential option for developing an assessment framework for the continental slope infauna would be to not focus on species-level measurements of community composition, which are highly variable in these habitats, but instead develop a tool that functions on non-taxonomic properties of a community. This strategy would be to minimize the natural variance among samples by changing the unit of measurement (e.g., an aggregated metric vs. species identity/abundance), while still preserving the variance produced by any potential stressors (Violle et al. 2012). Assessment frameworks could be developed to compare the autecological traits of the fauna in samples (e.g., feeding guilds, living position, natural history) aggregating multiple species into a single, potentially less variable measure (Feio and Dolédec 2012; Oug et al. 2012; Leaper et al. 2014) and comparing the distribution of traits across a gradient of stressor exposure.

A second option would be, in lieu of trying to minimize species-specific variance, to express all of the variance for each species together in a multivariate fashion for each distinct habitat with reference sites. These multivariate data could be presented visually in ordination space (Figure 6) and spatial thresholds or envelopes could be constructed around the reference sites and the position of a new sample with respect to that reference envelope in multivariate space could be used to quantify its condition (e.g., reference, non-reference, or indeterminant). Alternatively, a measure dissimilarity between a new sample and that of the reference sites could be used to quantify the sample's condition with a univariate measure that still takes all of the species in sample into consideration (Van Sickle 2008).

A third approach would be to develop a modified version of a traditional Observed:Expected (O/E) model that measures disturbance based upon the species observed in a sample compared to those predicted to occur in a location under reference conditions. Expectations are the product of species occupancy models informed by natural abiotic forcing factors. The traditional O/E models predict a community-scale profile of the dominant taxa expected at a site (Hawkins et al. 2000; Mazor et al. 2016). However, with the low frequency of occurrences (Appendix E) and high beta diversity of the continental slope infaunal community, these types of models could not discriminate samples in our data set (Gillett pers. obs.). However, if an O/E index could be built from predictive joint-species distribution models (Pollock et al. 2014; Clark et al. 2017) of reference communities for each of the continental slope habitats. Joint-species distribution models can mathematically handle large amounts of species absences and zero inflated data, therefore an O/E approach could still provide a viable solution to assessing condition.

Though none of the aforementioned scenarios have been tested in a real-world, practical setting, there are clearly options to explore for the development of an assessment framework in the continental slope habitats of southern California. Irrespective of which approach to condition assessment is investigated, the data sets assembled for the present study would serve as an excellent starting point. We have delineated three unique benthic habitats across the region and identified reference samples within each one. Additional sampling of benthic fauna at clearly degraded locations (e.g., sediment deltas of submarine canyons, known disturbance hot-spots) could provide additional degraded endmember samples to add to the stressor gradients we have already composed and help with index validation. Furthermore, sampling of additional potential stressors to the benthic fauna, such as bottom water oxygen, temperature, and carbonate chemistry, as well as sediment composition and contaminants, would also allow for the characterization of stressor-response relationships covered in the present study as well as other stressors we could not consider due to a lack of bottom water data.

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6.2 R Packages Used

The following functions and packages were used in the analysis of data and are cited within the text. Additionally, we have noted packages and functions commonly used to manipulate data in preparation for analysis. All analyses were executed in R v. 3.4.2. All packages are available from https://cran.r-project.org/.

Functions used to make calculations in this study		
Package	**Function**	**Utility**
Base R	**cor**	Calculate univariate correlations
Base R	**kruskal.test**	Conduction Kruskal-Wallace non-parametric tests
Base R	**glm**	General Linear Models
cluster	**hclust**	Clustering of multivariate data
Vegan	**adonis2**	Conducting permANOVA non-parametric tests
Vegan	**metaMDS**	nMDS ordination of multivariate data
Vegan	**vegdist**	Calculate distance measures between multivariate data
Vegan	**envfit**	Calculate multivariate correlations
Additional functions used in manipulating data		
Package	**Function**	**Utility**
Base R	**row.names**	Assigning or extracting names of rows
Base R	**colnames**	Assigning or extracting names of columns
Base R	**as.matrix**	Turning an element into a matrix
Base R	**data.frame**	Turning an element into a data frame
dplyr	**mutate**	Creating new data columns
dplyr	**rename**	Changing names of existing data columns
dplyr	**select**	Subsetting columns of data
dplyr	**filter**	Subsetting rows of data
dplyr	**arrange**	Sorting data
dplyr	**group_by**	Grouping data by factors
dplyr	**summarise**	Calculating new values from groups of data
dplyr	**join**	Combining columns from data frames based on shared values (like sql)
dplyr	**bind_cols**	Combining columns from data frames based on their position
dplyr	**bind_rows**	Combining rows from data frames based on their position
ggplot2	**ggplot**	Creating figures and plots
purrr	**map**	Applying custom functions across multiple things (like a do loop)
reshape2	**melt**	Making a horizontal dataset vertical
reshape2	**dcast**	Making a vertical dataset horizontal

Appendix A: Inventory of Sediment Chemistry Measures

An inventory of the different sediment chemistry measures obtained from the study datasets organized into compound classes of Chlordane, DDT (and its break down products), Other Legacy Pesticides, Metals, Miscellaneous Organic/Chlorinated, Nutrients, Polybrominated Diphenyl Esters, Polychlorinated Biphenyls, Polyaromatic Hydrocarbons, Pyrethroids, or bulk Sediment Characteristics. Multiple naming conventions for the same compound (e.g., 2,4'-DDD vs. op'-DDD) are presented, but for all analyses they were synonymized.

Compound	Compound Class
alpha-Chlordane	Chlordane
Chlordane	Chlordane
Cis-Chlordane	Chlordane
Cis-Chlordene	Chlordane
Cis-Nonachlor	Chlordane
Oxychlordane	Chlordane
Trans-Chlordane	Chlordane
Trans-Chlordene	Chlordane
Trans-Nonachlor	Chlordane
2,4'-DDD	DDT
2,4'-DDE	DDT
2,4'-DDT	DDT
4,4'-DDD	DDT
4,4'-DDE	DDT
4,4'-DDMU	DDT
4,4'-DDT	DDT
op'-DDD	DDT
op'-DDE	DDT
op'-DDT	DDT
pp'-DDD	DDT
pp'-DDE	DDT
pp'-DDT	DDT
Aldrin	Other Legacy Pesticide
alpha-BHC	Other Legacy Pesticide
Atrazine	Other Legacy Pesticide
beta-BHC	Other Legacy Pesticide
Biphenyl	Other Legacy Pesticide
delta-BHC	Other Legacy Pesticide
Dicofol	Other Legacy Pesticide
Dieldrin	Other Legacy Pesticide
Endosulfan I	Other Legacy Pesticide
Endosulfan II	Other Legacy Pesticide

Compound	Compound Class
Endosulfan sulfate	Other Legacy Pesticide
Endrin	Other Legacy Pesticide
Endrin Aldehyde	Other Legacy Pesticide
Endrin Ketone	Other Legacy Pesticide
gamma-BHC	Other Legacy Pesticide
Lindane (gamma-BHC)	Other Legacy Pesticide
Perthane	Other Legacy Pesticide
Simazine	Other Legacy Pesticide
Toxaphene	Other Legacy Pesticide
Aluminum	Metal
Antimony	Metal
Arsenic	Metal
Barium	Metal
Beryllium	Metal
Cadmium	Metal
Chromium	Metal
Cobalt	Metal
Copper	Metal
Iron	Metal
Lead	Metal
Manganese	Metal
Mercury	Metal
Molybdenum	Metal
Nickel	Metal
Selenium	Metal
Silver	Metal
Strontium	Metal
Thallium	Metal
Tin	Metal
Titanium	Metal
Vanadium	Metal
Zinc	Metal
1,2,4-Trichlorobenzene	Miscellaneous Organic/Chlorinated
1,2-Dichlorobenzene	Miscellaneous Organic/Chlorinated
1,2-Diphenylhydrazine	Miscellaneous Organic/Chlorinated
1,3-Dichlorobenzene	Miscellaneous Organic/Chlorinated
1,4-Dichlorobenzene	Miscellaneous Organic/Chlorinated
1,6,7-Trimethylnaphthalene	Miscellaneous Organic/Chlorinated
1-Methylnaphthalene	Miscellaneous Organic/Chlorinated
1-Methylphenanthrene	Miscellaneous Organic/Chlorinated

Compound	Compound Class
2,3,4,5-Tetrachlorophenol	Miscellaneous Organic/Chlorinated
2,3,4-Trichlorophenol	Miscellaneous Organic/Chlorinated
2,3,5,6-Tetrachlorophenol	Miscellaneous Organic/Chlorinated
2,3,5-Trichlorophenol	Miscellaneous Organic/Chlorinated
2,3,5-Trimethylnaphthalene	Miscellaneous Organic/Chlorinated
2,3,6-Trichlorophenol	Miscellaneous Organic/Chlorinated
2,3,7,8-TCDD	Miscellaneous Organic/Chlorinated
2,3-Benzofluorene	Miscellaneous Organic/Chlorinated
2,4,5-Trichlorophenol	Miscellaneous Organic/Chlorinated
2,4,6-Trichlorophenol	Miscellaneous Organic/Chlorinated
2,4-Dichlorophenol	Miscellaneous Organic/Chlorinated
2,4-Dimethylphenol	Miscellaneous Organic/Chlorinated
2,4-Dinitrophenol	Miscellaneous Organic/Chlorinated
2,4-Dinitrotoluene	Miscellaneous Organic/Chlorinated
2,6-Dimethylnaphthalene	Miscellaneous Organic/Chlorinated
2,6-Dinitrotoluene	Miscellaneous Organic/Chlorinated
2-Chloronaphthalene	Miscellaneous Organic/Chlorinated
2-Chlorophenol	Miscellaneous Organic/Chlorinated
2-Methyl Fluoranthene	Miscellaneous Organic/Chlorinated
2-Methyl-4,6Dinitrophenol	Miscellaneous Organic/Chlorinated
2-Methylnaphthalene	Miscellaneous Organic/Chlorinated
2-Nitrophenol	Miscellaneous Organic/Chlorinated
3,3'-Dichlorobenzidine	Miscellaneous Organic/Chlorinated
3,4,5-Trichlorophenol	Miscellaneous Organic/Chlorinated
3,6-Dimethylphenanthrene	Miscellaneous Organic/Chlorinated
4-Bromophenyl Phenylether	Miscellaneous Organic/Chlorinated
4-Chloro-3-Methylphenol	Miscellaneous Organic/Chlorinated
4-Chlorophenyl Phenylether	Miscellaneous Organic/Chlorinated
4-Nitrophenol	Miscellaneous Organic/Chlorinated
Benzidine	Miscellaneous Organic/Chlorinated
Bis(2-Chloroethyl)Ether	Miscellaneous Organic/Chlorinated
Bis(2-Cl-Ethoxy)Methane	Miscellaneous Organic/Chlorinated
Bis(2-Cl-Isopropyl)Ether	Miscellaneous Organic/Chlorinated
Butylbenzyl Phthalate	Miscellaneous Organic/Chlorinated
Dacthal	Miscellaneous Organic/Chlorinated
Diethyl Phthalate	Miscellaneous Organic/Chlorinated
Diethylhexyl Phthalate	Miscellaneous Organic/Chlorinated
Dimethyl Phthalate	Miscellaneous Organic/Chlorinated
Di-N-Butyl Phthalate	Miscellaneous Organic/Chlorinated
Di-N-Octyl Phthalate	Miscellaneous Organic/Chlorinated

Compound	Compound Class
Heptachlor	Miscellaneous Organic/Chlorinated
Heptachlor epoxide	Miscellaneous Organic/Chlorinated
Hexachlorobenzene	Miscellaneous Organic/Chlorinated
Hexachlorobutadiene	Miscellaneous Organic/Chlorinated
Hexachlorocyclopentadiene	Miscellaneous Organic/Chlorinated
Hexachloroethane	Miscellaneous Organic/Chlorinated
Isophorone	Miscellaneous Organic/Chlorinated
Methoxychlor	Miscellaneous Organic/Chlorinated
Nitrobenzene	Miscellaneous Organic/Chlorinated
N-Nitrosodimethylamine	Miscellaneous Organic/Chlorinated
N-Nitrosodi-N-Propylamine	Miscellaneous Organic/Chlorinated
N-Nitrosodiphenylamine	Miscellaneous Organic/Chlorinated
Oil & Grease	Miscellaneous Organic/Chlorinated
Pentachlorophenol	Miscellaneous Organic/Chlorinated
Phenol	Miscellaneous Organic/Chlorinated
Phenylacetic Acid	Miscellaneous Organic/Chlorinated
Triphenylene	Miscellaneous Organic/Chlorinated
Ammonia	Nutrient
Total Carbon	Nutrient
Total Kjeldahl Nitrogen	Nutrient
Total Nitrogen	Nutrient
Total Organic Carbon	Nutrient
% Organic Matter	Nutrients
Organic Nitrogen	Nutrients
BDE001	Polybrominated Diphenyl Ethers
BDE002	Polybrominated Diphenyl Ethers
BDE003	Polybrominated Diphenyl Ethers
BDE007	Polybrominated Diphenyl Ethers
BDE008	Polybrominated Diphenyl Ethers
BDE010	Polybrominated Diphenyl Ethers
BDE011	Polybrominated Diphenyl Ethers
BDE012	Polybrominated Diphenyl Ethers
BDE013	Polybrominated Diphenyl Ethers
BDE015	Polybrominated Diphenyl Ethers
BDE017	Polybrominated Diphenyl Ethers
BDE025	Polybrominated Diphenyl Ethers
BDE028	Polybrominated Diphenyl Ethers
BDE030	Polybrominated Diphenyl Ethers
BDE032	Polybrominated Diphenyl Ethers
BDE033	Polybrominated Diphenyl Ethers

Compound	Compound Class
BDE035	Polybrominated Diphenyl Ethers
BDE037	Polybrominated Diphenyl Ethers
BDE047	Polybrominated Diphenyl Ethers
BDE049/071	Polybrominated Diphenyl Ethers
BDE066	Polybrominated Diphenyl Ethers
BDE075	Polybrominated Diphenyl Ethers
BDE077	Polybrominated Diphenyl Ethers
BDE085	Polybrominated Diphenyl Ethers
BDE099	Polybrominated Diphenyl Ethers
BDE100	Polybrominated Diphenyl Ethers
BDE116	Polybrominated Diphenyl Ethers
BDE118	Polybrominated Diphenyl Ethers
BDE119	Polybrominated Diphenyl Ethers
BDE126	Polybrominated Diphenyl Ethers
BDE138	Polybrominated Diphenyl Ethers
BDE153	Polybrominated Diphenyl Ethers
BDE154	Polybrominated Diphenyl Ethers
BDE155	Polybrominated Diphenyl Ethers
BDE166	Polybrominated Diphenyl Ethers
BDE181	Polybrominated Diphenyl Ethers
BDE183	Polybrominated Diphenyl Ethers
BDE190	Polybrominated Diphenyl Ethers
BDE194	Polybrominated Diphenyl Ethers
BDE195	Polybrominated Diphenyl Ethers
BDE196	Polybrominated Diphenyl Ethers
BDE197	Polybrominated Diphenyl Ethers
BDE198	Polybrominated Diphenyl Ethers
BDE201	Polybrominated Diphenyl Ethers
BDE202	Polybrominated Diphenyl Ethers
BDE204	Polybrominated Diphenyl Ethers
BDE205	Polybrominated Diphenyl Ethers
BDE206	Polybrominated Diphenyl Ethers
BDE207	Polybrominated Diphenyl Ethers
BDE208	Polybrominated Diphenyl Ethers
BDE209	Polybrominated Diphenyl Ethers
Aroclor 1016	Polychlorinated Biphenyls
Aroclor 1221	Polychlorinated Biphenyls
Aroclor 1232	Polychlorinated Biphenyls
Aroclor 1242	Polychlorinated Biphenyls
Aroclor 1248	Polychlorinated Biphenyls

Compound	Compound Class
Aroclor 1254	Polychlorinated Biphenyls
Aroclor 1260	Polychlorinated Biphenyls
PCB Congener 101	Polychlorinated Biphenyls
PCB Congener 105	Polychlorinated Biphenyls
PCB Congener 110	Polychlorinated Biphenyls
PCB Congener 114	Polychlorinated Biphenyls
PCB Congener 118	Polychlorinated Biphenyls
PCB Congener 119	Polychlorinated Biphenyls
PCB Congener 123	Polychlorinated Biphenyls
PCB Congener 126	Polychlorinated Biphenyls
PCB Congener 128	Polychlorinated Biphenyls
PCB Congener 138	Polychlorinated Biphenyls
PCB Congener 149	Polychlorinated Biphenyls
PCB Congener 151	Polychlorinated Biphenyls
PCB Congener 153	Polychlorinated Biphenyls
PCB Congener 156	Polychlorinated Biphenyls
PCB Congener 157	Polychlorinated Biphenyls
PCB Congener 158	Polychlorinated Biphenyls
PCB Congener 167	Polychlorinated Biphenyls
PCB Congener 168	Polychlorinated Biphenyls
PCB Congener 169	Polychlorinated Biphenyls
PCB Congener 170	Polychlorinated Biphenyls
PCB Congener 177	Polychlorinated Biphenyls
PCB Congener 18	Polychlorinated Biphenyls
PCB Congener 180	Polychlorinated Biphenyls
PCB Congener 183	Polychlorinated Biphenyls
PCB Congener 187	Polychlorinated Biphenyls
PCB Congener 189	Polychlorinated Biphenyls
PCB Congener 194	Polychlorinated Biphenyls
PCB Congener 201	Polychlorinated Biphenyls
PCB Congener 206	Polychlorinated Biphenyls
PCB Congener 28	Polychlorinated Biphenyls
PCB Congener 37	Polychlorinated Biphenyls
PCB Congener 44	Polychlorinated Biphenyls
PCB Congener 49	Polychlorinated Biphenyls
PCB Congener 52	Polychlorinated Biphenyls
PCB Congener 66	Polychlorinated Biphenyls
PCB Congener 70	Polychlorinated Biphenyls
PCB Congener 74	Polychlorinated Biphenyls
PCB Congener 77	Polychlorinated Biphenyls

Compound	Compound Class
PCB Congener 81	Polychlorinated Biphenyls
PCB Congener 87	Polychlorinated Biphenyls
PCB Congener 99	Polychlorinated Biphenyls
PCB003	Polychlorinated Biphenyls
PCB008	Polychlorinated Biphenyls
PCB018	Polychlorinated Biphenyls
PCB028	Polychlorinated Biphenyls
PCB031	Polychlorinated Biphenyls
PCB033	Polychlorinated Biphenyls
PCB037	Polychlorinated Biphenyls
PCB044	Polychlorinated Biphenyls
PCB049	Polychlorinated Biphenyls
PCB052	Polychlorinated Biphenyls
PCB056/060	Polychlorinated Biphenyls
PCB066	Polychlorinated Biphenyls
PCB070	Polychlorinated Biphenyls
PCB074	Polychlorinated Biphenyls
PCB077	Polychlorinated Biphenyls
PCB081	Polychlorinated Biphenyls
PCB087	Polychlorinated Biphenyls
PCB095	Polychlorinated Biphenyls
PCB097	Polychlorinated Biphenyls
PCB099	Polychlorinated Biphenyls
PCB101	Polychlorinated Biphenyls
PCB105	Polychlorinated Biphenyls
PCB110	Polychlorinated Biphenyls
PCB114	Polychlorinated Biphenyls
PCB118	Polychlorinated Biphenyls
PCB119	Polychlorinated Biphenyls
PCB123	Polychlorinated Biphenyls
PCB126	Polychlorinated Biphenyls
PCB128	Polychlorinated Biphenyls
PCB138	Polychlorinated Biphenyls
PCB141	Polychlorinated Biphenyls
PCB149	Polychlorinated Biphenyls
PCB151	Polychlorinated Biphenyls
PCB153	Polychlorinated Biphenyls
PCB153/168	Polychlorinated Biphenyls
PCB156	Polychlorinated Biphenyls
PCB157	Polychlorinated Biphenyls

Compound	Compound Class
PCB158	Polychlorinated Biphenyls
PCB167	Polychlorinated Biphenyls
PCB168	Polychlorinated Biphenyls
PCB168/132	Polychlorinated Biphenyls
PCB169	Polychlorinated Biphenyls
PCB170	Polychlorinated Biphenyls
PCB174	Polychlorinated Biphenyls
PCB177	Polychlorinated Biphenyls
PCB180	Polychlorinated Biphenyls
PCB183	Polychlorinated Biphenyls
PCB187	Polychlorinated Biphenyls
PCB189	Polychlorinated Biphenyls
PCB194	Polychlorinated Biphenyls
PCB195	Polychlorinated Biphenyls
PCB200	Polychlorinated Biphenyls
PCB201	Polychlorinated Biphenyls
PCB203	Polychlorinated Biphenyls
PCB206	Polychlorinated Biphenyls
PCB209	Polychlorinated Biphenyls
2-methyl naphthalene	Polycyclic Aromatic Hydrocarbon
7,12-Dimethylbenz(A)Anthracene	Polycyclic Aromatic Hydrocarbon
9,10-Diphenylanthracene	Polycyclic Aromatic Hydrocarbon
Acenaphthene	Polycyclic Aromatic Hydrocarbon
Acenaphthylene	Polycyclic Aromatic Hydrocarbon
Anthracene	Polycyclic Aromatic Hydrocarbon
Benzo(A)Anthracene	Polycyclic Aromatic Hydrocarbon
Benzo(a)Pyrene	Polycyclic Aromatic Hydrocarbon
Benzo(b)fluoranthene	Polycyclic Aromatic Hydrocarbon
Benzo(e)pyrene	Polycyclic Aromatic Hydrocarbon
Benzo(g,h,i)perylene	Polycyclic Aromatic Hydrocarbon
Benzo(k)fluoranthene	Polycyclic Aromatic Hydrocarbon
Chrysene	Polycyclic Aromatic Hydrocarbon
Dibenzo(a,h)Anthracene	Polycyclic Aromatic Hydrocarbon
Dibenzothiophene	Polycyclic Aromatic Hydrocarbon
Fluoranthene	Polycyclic Aromatic Hydrocarbon
Fluorene	Polycyclic Aromatic Hydrocarbon
Indeno(1,2,3-c,d)pyrene	Polycyclic Aromatic Hydrocarbon
Methyl Pyrene	Polycyclic Aromatic Hydrocarbon
Naphthalene	Polycyclic Aromatic Hydrocarbon
Perylene	Polycyclic Aromatic Hydrocarbon

Compound	Compound Class
Phenanthrene	Polycyclic Aromatic Hydrocarbon
Pyrene	Polycyclic Aromatic Hydrocarbon
Allethrin	Pyrethroid
Bifenthrin	Pyrethroid
Cyfluthrin	Pyrethroid
Cypermethrin	Pyrethroid
Deltamethrin	Pyrethroid
Esfenvalerate	Pyrethroid
Fenpropathrin	Pyrethroid
Fenvalerate	Pyrethroid
Fluvalinate	Pyrethroid
lambda-Cyhalothrin	Pyrethroid
Permethrin-cis	Pyrethroid
Permethrin-trans	Pyrethroid
Prallethrin	Pyrethroid
Resmethrin	Pyrethroid
% Moisture	Sediment Characteristics
% solids	Sediment Characteristics
Eh	Sediment Characteristics
ES	Sediment Characteristics
Hydrogen Sulfide	Sediment Characteristics
Inorganic Carbon	Sediment Characteristics
pH	Sediment Characteristics
Total COD	Sediment Characteristics
Total Solids	Sediment Characteristics
Volatile Total Solids	Sediment Characteristics

Appendix B: Inventory of Benthic Infauna

Inventory of all benthic infauna observed in the study. Their higher taxonomic information is provided, as well as the habitat(s) where each taxon was observed. Habitats are defined in Figure 2 and abbreviated as: US = Upper Slope, NW = Northwest Slope, and LS = Lower Slope.

Taxon	Phylum	Class	Order	Family	Habitat
Acarina	Arthropoda	Arachnida			US
Acharax johnsoni	Mollusca	Bivalvia	Solemyida	Solemyidae	LS
Acidostoma hancocki	Arthropoda	Malacostraca	Amphipoda	Acidostomatidae	US-NW
Acila castrensis	Mollusca	Bivalvia	Nuculida	Nuculidae	US-LS
Acoetes pacifica	Annelida	Polychaeta	Aciculata	Acoetidae	US
Acteocina cerealis	Mollusca	Gastropoda	Opisthobranchia	Cylichnidae	US
Acteocina culcitella	Mollusca	Gastropoda	Opisthobranchia	Cylichnidae	US
Acteocina sp	Mollusca	Gastropoda	Opisthobranchia	Cylichnidae	US
Acteon traskii	Mollusca	Gastropoda	"Lower Heterobranchia"	Acteonidae	US
Actiniaria	Cnidaria	Anthozoa	Actiniaria		US-NW-LS
Admete californica	Mollusca	Gastropoda	Hypsogastropoda	Cancellariidae	LS
Admete gracilior	Mollusca	Gastropoda	Hypsogastropoda	Cancellariidae	NW
Adontorhina cyclia	Mollusca	Bivalvia	Lucinida	Thyasiridae	US-LS
Adontorhina lynnae	Mollusca	Bivalvia	Lucinida	Thyasiridae	LS
Aglaja ocelligera	Mollusca	Gastropoda	Opisthobranchia	Aglajidae	US
Aglaja sp	Mollusca	Gastropoda	Opisthobranchia	Aglajidae	US
Aglaophamus erectans	Annelida	Polychaeta	Aciculata	Nephtyidae	US-NW-LS
Aglaophamus paucilamellata	Annelida	Polychaeta	Aciculata	Nephtyidae	US
Aglaophamus sp	Annelida	Polychaeta	Aciculata	Nephtyidae	US
Aglaophamus verrilli	Annelida	Polychaeta	Aciculata	Nephtyidae	US-NW
Agnezia septentrionalis	Chordata	Ascidiacea	Phlebobranchiata	Agneziidae	US
Akanthophoreus phillipsi	Arthropoda	Malacostraca	Tanaidacea	Akanthophoreidae	US
Alaba sp	Mollusca	Gastropoda	Sorbeoconcha	Litiopidae	LS
Alia tuberosa	Mollusca	Gastropoda	Hypsogastropoda	Columbellidae	US
Alvania rosana	Mollusca	Gastropoda	Hypsogastropoda	Rissoidae	US-NW-LS
Amaeana occidentalis	Annelida	Polychaeta	Canalipalpata	Terebellidae	US
Amage anops	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-LS
Amblyops abbreviatus	Arthropoda	Malacostraca	Mysida	Mysidae	US-NW
Amblyops sp	Arthropoda	Malacostraca	Mysida	Mysidae	US
Americhelidium shoemakeri	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US
Americhelidium sp	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US
Americhelidium sp SD4	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US
Ampelisca agassizi	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US

Taxon	Phylum	Class	Order	Family	Habitat
Ampelisca amblyopsoides	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	LS
Ampelisca brevisimulata	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-LS
Ampelisca careyi	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-NW-LS
Ampelisca cf *brevisimulata*	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US
Ampelisca coeca	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	LS
Ampelisca cristata cristata	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US
Ampelisca furcigera	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	LS
Ampelisca hancocki	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-LS
Ampelisca pacifica	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-LS
Ampelisca plumosa	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-LS
Ampelisca pugetica	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-NW
Ampelisca romigi	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-LS
Ampelisca sp	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-LS
Ampelisca unsocalae	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-NW-LS
Ampeliscidae	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-LS
Ampharete acutifrons	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Ampharete finmarchica	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Ampharete sp	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-NW
Ampharetidae	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-NW-LS
Ampharetidae sp SD1	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Ampharetinae	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Amphichondrius granulatus	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US
Amphicteis mucronata	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Amphicteis scaphobranchiata	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Amphicteis sp	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-LS
Amphiodia digitata	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US-LS
Amphiodia psara	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US
Amphiodia sp	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US-NW-LS
Amphiodia urtica	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US
Amphioplus sp	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US-LS
Amphioplus sp A	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US
Amphioplus strongyloplax	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US-LS
Amphipholis pugetana	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US-LS
Amphipholis sp	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US-LS
Amphipholis squamata	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US-NW-LS
Amphipoda	Arthropoda	Malacostraca	Amphipoda		US
Amphiporus bimaculatus	Nemertea	Enopla	Hoplonemertea	Amphiporidae	US
Amphiporus cruentatus	Nemertea	Enopla	Hoplonemertea	Amphiporidae	US-LS

Taxon	Phylum	Class	Order	Family	Habitat
Amphiporus sp	Nemertea	Enopla	Hoplonemertea	Amphiporidae	US
Amphissa bicolor	Mollusca	Gastropoda	Hypsogastropoda	Columbellidae	US-NW-LS
Amphissa undata	Mollusca	Gastropoda	Hypsogastropoda	Columbellidae	US-NW
Amphitrite robusta	Annelida	Polychaeta	Canalipalpata	Terebellidae	LS
Amphiura arcystata	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US-LS
Amphiura diomedeae	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	LS
Amphiura sp	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US
Amphiuridae	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US-NW-LS
Amygdalum pallidulum	Mollusca	Bivalvia	Mytilida	Mytilidae	US
Ananthura luna	Arthropoda	Malacostraca	Isopoda	Antheluridae	LS
Anarthruridae	Arthropoda	Malacostraca	Tanaidacea	Anarthruridae	US
Anarthruridae sp 2	Arthropoda	Malacostraca	Tanaidacea	Anarthruridae	US
Anatoma kelseyi	Mollusca	Gastropoda	Lepetellida	Anatomidae	LS
Ancistrosyllis breviceps	Annelida	Polychaeta	Aciculata	Pilargidae	US
Ancistrosyllis groenlandica	Annelida	Polychaeta	Aciculata	Pilargidae	US-NW-LS
Ancistrosyllis hamata	Annelida	Polychaeta	Aciculata	Pilargidae	US
Ancistrosyllis sp	Annelida	Polychaeta	Aciculata	Pilargidae	US
Anobothrus gracilis	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-NW-LS
Anobothrus sp	Annelida	Polychaeta	Canalipalpata	Ampharetidae	LS
Anonyx lilljeborgi	Arthropoda	Malacostraca	Amphipoda	Uristidae	US
Anopla	Nemertea	Anopla			US-LS
Anoplodactylus erectus	Arthropoda	Pycnogonida	Pegmata	Phoxichilidiidae	US
Anoplodactylus sp	Arthropoda	Pycnogonida	Pegmata	Phoxichilidiidae	US
Antalis pretiosa	Mollusca	Scaphopoda	Dentaliida	Dentaliidae	US
Antalis pretiosum	Mollusca	Scaphopoda	Dentaliida	Dentaliidae	US
Anthozoa	Cnidaria	Anthozoa			US
Antiplanes catalinae	Mollusca	Gastropoda	Hypsogastropoda	Pseudomelatomidae	US
Aoroides columbiae	Arthropoda	Malacostraca	Amphipoda	Aoridae	US
Aoroides intermedia	Arthropoda	Malacostraca	Amphipoda	Aoridae	US
Aoroides sp	Arthropoda	Malacostraca	Amphipoda	Aoridae	US
Aoroides sp A	Arthropoda	Malacostraca	Amphipoda	Aoridae	US
Aphelochaeta glandaria Cmplx	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Aphelochaeta monilaris	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Aphelochaeta petersenae	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Aphelochaeta phillipsi	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Aphelochaeta sp	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-NW-LS
Aphelochaeta sp HYP5	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Aphelochaeta sp LA1	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Aphelochaeta sp LA3	Annelida	Polychaeta	Canalipalpata	Cirratulidae	LS

Taxon	Phylum	Class	Order	Family	Habitat
Aphelochaeta sp SD13	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Aphelochaeta sp SD14	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Aphelochaeta sp SD15	Annelida	Polychaeta	Canalipalpata	Cirratulidae	LS
Aphelochaeta sp SD18 (B13-1)	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Aphelochaeta sp SD3	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Aphelochaeta sp SD5	Annelida	Polychaeta	Canalipalpata	Cirratulidae	LS
Aphelochaeta tigrina	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Aphelochaeta williamsae	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-NW-LS
Aphelochaeta-Monticellina Cmplx	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Aphrodita japonica	Annelida	Polychaeta	Aciculata	Aphroditidae	US
Aphrodita longipalpa	Annelida	Polychaeta	Aciculata	Aphroditidae	US
Aphrodita sp	Annelida	Polychaeta	Aciculata	Aphroditidae	US
Apionsoma misakianum	Sipuncula	Phascolosomatidea	Phascolosomatiformes	Phascolosomatidae	US
Apionsoma sp	Sipuncula	Phascolosomatidea	Phascolosomatiformes	Phascolosomatidae	US
Apistobranchus sp	Annelida	Polychaeta	Canalipalpata	Apistobranchidae	LS
Araphura breviaria	Arthropoda	Malacostraca	Tanaidacea	Tanaellidae	US
Araphura cuspirostris	Arthropoda	Malacostraca	Tanaidacea	Tanaellidae	US-LS
Araphura sp SD1	Arthropoda	Malacostraca	Tanaidacea	Tanaellidae	US
Argissa hamatipes	Arthropoda	Malacostraca	Amphipoda	Argissidae	US
Arhynchite californicus	Echiura	Echiuridea	Echiuroinea	Thalassematidae	US-NW-LS
Arhynchite sp	Echiura	Echiuridea	Echiuroinea	Thalassematidae	US
Aricidea (*Acmira*) *catherinae*	Annelida	Polychaeta		Paraonidae	US-LS
Aricidea (*Acmira*) *horikoshii*	Annelida	Polychaeta		Paraonidae	LS
Aricidea (*Acmira*) *lopezi*	Annelida	Polychaeta		Paraonidae	US-LS
Aricidea (*Acmira*) *rubra*	Annelida	Polychaeta		Paraonidae	US-LS
Aricidea (*Acmira*) *simplex*	Annelida	Polychaeta		Paraonidae	US-LS
Aricidea (*Acmira*) sp	Annelida	Polychaeta		Paraonidae	US-LS
Aricidea (*Acmira*) sp LA1	Annelida	Polychaeta		Paraonidae	LS
Aricidea (*Allia*) *antennata*	Annelida	Polychaeta		Paraonidae	US-LS
Aricidea (*Allia*) *hartleyi*	Annelida	Polychaeta		Paraonidae	LS
Aricidea (*Allia*) *monicae*	Annelida	Polychaeta		Paraonidae	US-LS
Aricidea (*Allia*) *quadrilobata*	Annelida	Polychaeta		Paraonidae	LS
Aricidea (*Allia*) sp A	Annelida	Polychaeta		Paraonidae	US-LS
Aricidea (*Allia*) sp DC1	Annelida	Polychaeta		Paraonidae	US
Aricidea (*Aricidea*) sp	Annelida	Polychaeta		Paraonidae	US

Taxon	Phylum	Class	Order	Family	Habitat
Aricidea (*Strelzovia*) *antennata*	Annelida	Polychaeta		Paraonidae	US
Aricidea (*Strelzovia*) *hartleyi*	Annelida	Polychaeta		Paraonidae	US
Aricidea (*Strelzovia*) sp	Annelida	Polychaeta		Paraonidae	US
Aricidea (*Strelzovia*) sp A	Annelida	Polychaeta		Paraonidae	US
Aristias sp DC1	Arthropoda	Malacostraca	Amphipoda	Aristiidae	US-NW
Armandia brevis	Annelida	Polychaeta		Opheliidae	US
Artacama coniferi	Annelida	Polychaeta	Canalipalpata	Terebellidae	US
Artacamella hancocki	Annelida	Polychaeta	Canalipalpata	Trichobranchidae	US-LS
Aruga oculata	Arthropoda	Malacostraca	Amphipoda	Lysianassidae	US
Asabellides cornuta	Annelida	Polychaeta	Canalipalpata	Ampharetidae	LS
Asabellides lineata	Annelida	Polychaeta	Canalipalpata	Ampharetidae	LS
Ascidiacea	Chordata	Ascidiacea			US
Asellota	Arthropoda	Malacostraca	Isopoda		US-LS
Asteroidea	Echinodermata	Asteroidea			US-NW-LS
Asteronyx longifissus	Echinodermata	Ophiuroidea	Euryalida	Asteronychidae	US-NW-LS
Asteronyx sp	Echinodermata	Ophiuroidea	Euryalida	Asteronychidae	LS
Astropecten californicus	Echinodermata	Asteroidea	Paxillosida	Astropectinidae	US
Astropecten sp	Echinodermata	Asteroidea	Paxillosida	Astropectinidae	US
Astyris permodesta	Mollusca	Gastropoda	Hypsogastropoda	Columbellidae	US-NW-LS
Athenaria	Cnidaria	Anthozoa	Actiniaria		US-NW
Axinodon redondoensis	Mollusca	Bivalvia	Lucinida	Thyasiridae	US-LS
Axinopsida serricata	Mollusca	Bivalvia	Lucinida	Thyasiridae	US
Balanoglossus sp	Chordata	Enteropneusta		Ptychoderidae	US-LS
Balcis oldroydae	Mollusca	Gastropoda	Hypsogastropoda	Eulimidae	US
Baseodiscus sp	Nemertea	Anopla	Heteronemertea	Valenciniidae	US
Bathyagonus pentacanthus	Chordata	Actinopterygii	Scorpaeniformes	Agonidae	US
Bathybembix bairdii	Mollusca	Gastropoda	Seguenziida	Calliotropidae	LS
Bathyleberis cf *garthi*	Arthropoda	Ostracoda	Myodocopida	Cylindroleberididae	US
Bathyleberis garthi	Arthropoda	Ostracoda	Myodocopida	Cylindroleberididae	LS
Bathyleberis sp	Arthropoda	Ostracoda	Myodocopida	Cylindroleberididae	US-LS
Bathyleberis sp LA1	Arthropoda	Ostracoda	Myodocopida	Cylindroleberididae	LS
Bathymedon cf *roquedo*	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US
Bathymedon covilhani	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US-LS
Bathymedon flebilis	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US-LS
Bathymedon kassites	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US-LS
Bathymedon pumilus	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US-LS
Bathymedon roquedo	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US-LS
Bathymedon sp	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US-LS

Taxon	Phylum	Class	Order	Family	Habitat
Bathymedon vulpeculus	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US-LS
Belonectes sp A	Arthropoda	Malacostraca	Isopoda	Munnopsidae	US-LS
Bemlos sp	Arthropoda	Malacostraca	Amphipoda	Aoridae	US
Bipalponephtys cornuta	Annelida	Polychaeta	Aciculata	Nephtyidae	US-NW-LS
Bivalvia	Mollusca	Bivalvia			US-NW-LS
Boccardia sp	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Boccardiella hamata	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Boccardiella sp	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Bougainvilliidae	Cnidaria	Hydrozoa	Filifera	Bougainvilliidae	US
Brada pilosa	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US-LS
Brada pluribranchiata	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US-LS
Brada sp	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US-LS
Brisaster latifrons	Echinodermata	Echinoidea	Spatangoida	Schizasteridae	US-NW-LS
Brisaster sp	Echinodermata	Echinoidea	Spatangoida	Schizasteridae	US-NW-LS
Brisaster townsendi	Echinodermata	Echinoidea	Spatangoida	Schizasteridae	US-NW-LS
Brissopsis pacifica	Echinodermata	Echinoidea	Spatangoida	Brissidae	US-NW-LS
Brissopsis sp	Echinodermata	Echinoidea	Spatangoida	Brissidae	LS
Brissopsis sp LA1	Echinodermata	Echinoidea	Spatangoida	Brissidae	US-NW-LS
Bruzelia tuberculata	Arthropoda	Malacostraca	Amphipoda	Synopiidae	US
Buccinidae	Mollusca	Gastropoda	Hypsogastropoda	Buccinidae	LS
Bullomorpha sp A	Mollusca	Gastropoda	Opisthobranchia		US-LS
Byblis barbarensis	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-NW-LS
Byblis bathyalis	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-LS
Byblis millsi	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US
Byblis sp	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	LS
Byblis thyabilis	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US
Byblis veleronis	Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	US-LS
Bylgides sp	Annelida	Polychaeta	Phyllodocida	Polynoidae	US
Cactosoma sp	Cnidaria	Anthozoa	Actiniaria	Halcampidae	LS
Cadulus californicus	Mollusca	Scaphopoda	Gadilida	Gadilidae	US-LS
Caecognathia crenulatifrons	Arthropoda	Malacostraca	Isopoda	Gnathiidae	US-LS
Caesia perpinguis	Mollusca	Gastropoda	Hypsogastropoda	Nassariidae	US
Califia calida	Annelida	Polychaeta		Orbiniidae	LS
Callianopsis goniophthalma	Arthropoda	Malacostraca	Decapoda	Ctenochelidae	US-NW-LS
Calocarides quinqueseriatus	Arthropoda	Malacostraca	Decapoda	Axiidae	US-NW-LS
Calocarides sp	Arthropoda	Malacostraca	Decapoda	Axiidae	US-LS
Calocarides spinulicauda	Arthropoda	Malacostraca	Decapoda	Axiidae	US
Calyptogena elongata	Mollusca	Bivalvia	Venerida	Vesicomyidae	LS
Calyptogena lepta	Mollusca	Bivalvia	Venerida	Vesicomyidae	LS

Taxon	Phylum	Class	Order	Family	Habitat
Calyptogena sp	Mollusca	Bivalvia	Venerida	Vesicomyidae	US
Campylaspis biplicata	Arthropoda	Malacostraca	Cumacea	Nannastacidae	US
Campylaspis blakei	Arthropoda	Malacostraca	Cumacea	Nannastacidae	US
Campylaspis canaliculata	Arthropoda	Malacostraca	Cumacea	Nannastacidae	US-LS
Campylaspis hartae	Arthropoda	Malacostraca	Cumacea	Nannastacidae	US
Campylaspis maculinodulosa	Arthropoda	Malacostraca	Cumacea	Nannastacidae	US
Campylaspis rubromaculata	Arthropoda	Malacostraca	Cumacea	Nannastacidae	US
Campylaspis rufa	Arthropoda	Malacostraca	Cumacea	Nannastacidae	US
Campylaspis sp A	Arthropoda	Malacostraca	Cumacea	Nannastacidae	US-LS
Campylaspis sp LA1	Arthropoda	Malacostraca	Cumacea	Nannastacidae	LS
Campylaspis sp LA2	Arthropoda	Malacostraca	Cumacea	Nannastacidae	US
Campylaspis sp N	Arthropoda	Malacostraca	Cumacea	Nannastacidae	US
Cancellaria crawfordiana	Mollusca	Gastropoda	Hypsogastropoda	Cancellariidae	US
Capitella capitata Cmplx	Annelida	Polychaeta		Capitellidae	US-LS
Capitella teleta	Annelida	Polychaeta		Capitellidae	US
Capitellidae	Annelida	Polychaeta		Capitellidae	US
Caprella californica Cmplx	Arthropoda	Malacostraca	Amphipoda	Caprellidae	US
Caprella gracilior	Arthropoda	Malacostraca	Amphipoda	Caprellidae	LS
Caprella mutica	Arthropoda	Malacostraca	Amphipoda	Caprellidae	US
Caprella sp SD2	Arthropoda	Malacostraca	Amphipoda	Caprellidae	US
Caprella verrucosa	Arthropoda	Malacostraca	Amphipoda	Caprellidae	US
Caprellidae	Arthropoda	Malacostraca	Amphipoda	Caprellidae	US
Caprellinae sp B	Arthropoda	Malacostraca	Amphipoda	Caprellidae	US-LS
Cardiomya pectinata	Mollusca	Bivalvia		Cuspidariidae	US
Cardiomya planetica	Mollusca	Bivalvia		Cuspidariidae	US
Cardiomya sp	Mollusca	Bivalvia		Cuspidariidae	US-LS
Carinoma mutabilis	Nemertea	Anopla	Palaeonemertea	Carinomidae	US-LS
Carpoapseudes caraspinosus	Arthropoda	Malacostraca	Tanaidacea	Apseudidae	LS
Carpoapseudes sp WS1	Arthropoda	Malacostraca	Tanaidacea	Apseudidae	LS
Caudofoveata	Mollusca	Caudofoveata			US
Caulleriella alata	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Caulleryaspis nuda	Annelida	Polychaeta	Terebellida	Sternaspidae	LS
Cephalaspidea	Mollusca	Gastropoda	Opisthobranchia		LS
Cephalophoxoides homilis	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-LS
Ceratocephale hartmanae	Annelida	Polychaeta	Phyllodocida	Nereididae	LS
Ceratocephale loveni	Annelida	Polychaeta	Aciculata	Nereididae	US-LS
Cerebratulus albifrons	Nemertea	Anopla	Heteronemertea	Lineidae	US

Taxon	Phylum	Class	Order	Family	Habitat
Cerebratulus californiensis	Nemertea	Anopla	Heteronemertea	Lineidae	US-NW-LS
Cerebratulus marginatus	Nemertea	Anopla	Heteronemertea	Lineidae	US-LS
Cerebratulus montgomeryi	Nemertea	Anopla	Heteronemertea	Lineidae	US
Cerebratulus sp	Nemertea	Anopla	Heteronemertea	Lineidae	US-NW-LS
Ceriantharia	Cnidaria	Anthozoa	Ceriantharia		US-NW-LS
Chaetoderma elegans	Mollusca	Caudofoveata	Chaetodermatida	Chaetodermidae	US-LS
Chaetoderma hancocki	Mollusca	Caudofoveata	Chaetodermatida	Chaetodermidae	US-LS
Chaetoderma marinelli	Mollusca	Caudofoveata	Chaetodermatida	Chaetodermidae	US
Chaetoderma nanulum	Mollusca	Caudofoveata	Chaetodermatida	Chaetodermidae	US-NW-LS
Chaetoderma pacificum	Mollusca	Caudofoveata	Chaetodermatida	Chaetodermidae	US-NW-LS
Chaetoderma sp	Mollusca	Caudofoveata	Chaetodermatida	Chaetodermidae	US-LS
Chaetoderma sp A	Mollusca	Caudofoveata	Chaetodermatida	Chaetodermidae	LS
Chaetodermatida	Mollusca	Caudofoveata	Chaetodermatida		US-NW-LS
Chaetodermatidae	Mollusca	Caudofoveata	Chaetodermatida	Chaetodermatidae	US-NW-LS
Chaetodermidae	Mollusca	Caudofoveata	Chaetodermatida	Chaetodermidae	US
Chaetopteridae	Annelida	Polychaeta	Canalipalpata	Chaetopteridae	US-LS
Chaetozone armata	Annelida	Polychaeta	Canalipalpata	Cirratulidae	NW
Chaetozone commonalis	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Chaetozone corona	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Chaetozone gracilis	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Chaetozone hartmanae	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Chaetozone setosa Cmplx	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Chaetozone sp	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Chaetozone sp SD3	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Chaetozone sp SD5	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Chaetozone sp SD7	Annelida	Polychaeta	Canalipalpata	Cirratulidae	LS
Chaetozone spinosa	Annelida	Polychaeta	Canalipalpata	Cirratulidae	LS
Chauliopleona dentata	Arthropoda	Malacostraca	Tanaidacea	Akanthophoreidae	US
Chiridota sp	Echinodermata	Holothuroidea	Apodida	Chiridotidae	US-NW-LS
Chirimia biceps	Annelida	Polychaeta		Maldanidae	US
Chloeia pinnata	Annelida	Polychaeta	Aciculata	Amphinomidae	US-NW-LS
Chone sp	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Chone sp SD3	Annelida	Polychaeta	Sabellida	Sabellidae	US-LS
Cidarina cidaris	Mollusca	Gastropoda	Archaeogastropoda	Chilodontidae	LS
Cirolana sp	Arthropoda	Malacostraca	Isopoda	Cirolanidae	US
Cirratulidae	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Cirratulus cirratus Cmplx	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Cirratulus sp	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-NW

Taxon	Phylum	Class	Order	Family	Habitat
Cirrophorus branchiatus	Annelida	Polychaeta		Paraonidae	US-NW-LS
Cirrophorus furcatus	Annelida	Polychaeta		Paraonidae	-NW-LS
Cirrophorus sp	Annelida	Polychaeta		Paraonidae	LS
Clymenura gracilis	Annelida	Polychaeta		Maldanidae	US-LS
Compressidens stearnsii	Mollusca	Scaphopoda	Gadilida		US-NW-LS
Compsomyax subdiaphana	Mollusca	Bivalvia	Venerida	Veneridae	-NW-LS
Conoidea	Mollusca	Gastropoda	Hypsogastropoda		US
Cooperella subdiaphana	Mollusca	Bivalvia	Venerida	Petricolidae	US
Copepoda	Arthropoda	Maxillopoda			US
Corymorpha palma	Cnidaria	Hydrozoa	Capitata	Corymorphidae	US
Cossura candida	Annelida	Polychaeta		Cossuridae	US-LS
Cossura rostrata	Annelida	Polychaeta		Cossuridae	LS
Cossura sp	Annelida	Polychaeta		Cossuridae	US-LS
Cossura sp A	Annelida	Polychaeta		Cossuridae	US
Coxophoxus hidalgo	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	-NW-LS
Crangon sp	Arthropoda	Malacostraca	Decapoda	Crangonidae	US
Crangonidae	Arthropoda	Malacostraca	Decapoda	Crangonidae	US
Crockerella evadne	Mollusca	Gastropoda	Hypsogastropoda	Clathurellidae	LS
Crockerella sp	Mollusca	Gastropoda	Hypsogastropoda	Clathurellidae	US
Cryptocelis occidentalis	Platyhelminthes	Turbellaria	Polycladida	Cryptocelididae	US
Cucumaria sp	Echinodermata	Holothuroidea	Dendrochirotida	Cucumariidae	US
Cumacea	Arthropoda	Malacostraca	Cumacea		US
Cuspidaria parapodema	Mollusca	Bivalvia		Cuspidariidae	US
Cuspidariidae	Mollusca	Bivalvia		Cuspidariidae	US
Cyamioidea	Mollusca	Bivalvia	Venerida		US
Cyclocardia gouldii	Mollusca	Bivalvia	Carditida	Carditidae	US-NW-LS
Cyclocardia sp	Mollusca	Bivalvia	Carditida	Carditidae	US-NW
Cyclocardia ventricosa	Mollusca	Bivalvia	Carditida	Carditidae	US-NW-LS
Cyclopecten catalinensis	Mollusca	Bivalvia	Ostreida	Propeamussiidae	US
Cyclopecten sp	Mollusca	Bivalvia	Ostreida	Propeamussiidae	US-LS
Cyclopecten zephyrus	Mollusca	Bivalvia	Ostreida	Propeamussiidae	LS
Cylichna diegensis	Mollusca	Gastropoda	Opisthobranchia	Cylichnidae	US-LS
Cylindroleberididae	Arthropoda	Ostracoda	Myodocopida	Cylindroleberididae	LS
Dacrydium pacificum	Mollusca	Bivalvia	Mytilida	Mytilidae	US-LS
Dactylopleustes sp A	Arthropoda	Malacostraca	Amphipoda	Pleustidae	US
Dallicordia alaskana	Mollusca	Bivalvia		Verticordiidae	US-LS
Decamastus gracilis	Annelida	Polychaeta		Capitellidae	US-NW-LS
Decapoda	Arthropoda	Malacostraca	Decapoda		US-NW
Deflexilodes norvegicus	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US

Taxon	Phylum	Class	Order	Family	Habitat
Deilocerus planus	Arthropoda	Malacostraca	Decapoda	Cyclodorippidae	US
Delectopecten vancouverensis	Mollusca	Bivalvia	Ostreida	Pectinidae	US-LS
Deltamysis sp LA1	Arthropoda	Malacostraca	Mysida	Mysidae	US
Demospongiae	Silicea	Demospongiae			NW
Dendrochirotida	Echinodermata	Holothuroidea	Dendrochirotida		US
Dentaliidae	Mollusca	Scaphopoda	Dentaliida	Dentaliidae	US
Dentalium sp	Mollusca	Scaphopoda	Dentaliida	Dentaliidae	US
Dentalium vallicolens	Mollusca	Scaphopoda	Dentaliida	Dentaliidae	US
Dialychone albocincta	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Dialychone sp 1	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Dialychone trilineata	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Diaphana californica	Mollusca	Gastropoda	Opisthobranchia	Diaphanidae	US-NW-LS
Diaphana sp	Mollusca	Gastropoda	Opisthobranchia	Diaphanidae	US
Diastylidae	Arthropoda	Malacostraca	Cumacea	Diastylidae	US
Diastylis californica	Arthropoda	Malacostraca	Cumacea	Diastylidae	US
Diastylis crenellata	Arthropoda	Malacostraca	Cumacea	Diastylidae	US
Diastylis pellucida	Arthropoda	Malacostraca	Cumacea	Diastylidae	US-NW-LS
Diastylis sentosa	Arthropoda	Malacostraca	Cumacea	Diastylidae	US-LS
Diastylis sp	Arthropoda	Malacostraca	Cumacea	Diastylidae	US
Diastylis sp C	Arthropoda	Malacostraca	Cumacea	Diastylidae	US
Diopatra ornata	Annelida	Polychaeta	Aciculata	Onuphidae	US
Diopatra sp	Annelida	Polychaeta	Aciculata	Onuphidae	US
Diopatra tridentata	Annelida	Polychaeta	Aciculata	Onuphidae	US
Diplandros singularis	Platyhelminthes	Turbellaria	Polycladida	Notocirridae	US
Diplehnia caeca	Platyhelminthes	Turbellaria	Polycladida	Plehniidae	US
Diplocirrus sp	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US-LS
Diplocirrus sp LA1	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	LS
Dipolydora akaina	Annelida	Polychaeta	Canalipalpata	Spionidae	LS
Dipolydora caulleryi	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Dipolydora socialis	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Dipolydora sp	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Dodecaceria sp	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Dodecamastus mariaensis	Annelida	Polychaeta		Capitellidae	US-NW-LS
Dodecaseta oraria	Annelida	Polychaeta		Capitellidae	US
Dorvillea (*Schistomeringos*) *longicornis*	Annelida	Polychaeta	Aciculata	Dorvilleidae	US
Dorvillea (*Schistomeringos*) sp	Annelida	Polychaeta	Aciculata	Dorvilleidae	US
Dorvilleidae	Annelida	Polychaeta	Aciculata	Dorvilleidae	US
Dougaloplus amphacanthus	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US
Dougaloplus sp	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	US

Taxon	Phylum	Class	Order	Family	Habitat
Drilonereis falcata	Annelida	Polychaeta	Aciculata	Oenonidae	US
Drilonereis filum	Annelida	Polychaeta	Aciculata	Oenonidae	US
Drilonereis mexicana	Annelida	Polychaeta	Aciculata	Oenonidae	US
Drilonereis sp	Annelida	Polychaeta	Aciculata	Oenonidae	US-LS
Drilonereis sp A	Annelida	Polychaeta	Aciculata	Oenonidae	US
Dromalia alexandri	Cnidaria	Hydrozoa	Siphonophora	Rhodaliidae	LS
Dulichiopsis remis	Arthropoda	Malacostraca	Amphipoda	Dulichiidae	US
Echinodermata	Echinodermata				LS
Echinoidea	Echinodermata	Echinoidea			US-LS
Echiura	Echiura				US-LS
Echiuridea	Echiura	Echiuridea			US
Eclysippe trilobata	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-NW-LS
Edotia sp	Arthropoda	Malacostraca	Isopoda	Idoteidae	US
Edwardsia juliae	Cnidaria	Anthozoa	Actiniaria	Edwardsiidae	US
Edwardsia mcmurrichi	Cnidaria	Anthozoa	Actiniaria	Edwardsiidae	LS
Edwardsia olguini	Cnidaria	Anthozoa	Actiniaria	Edwardsiidae	US
Edwardsia profunda	Cnidaria	Anthozoa	Actiniaria	Edwardsiidae	US-LS
Edwardsia sp	Cnidaria	Anthozoa	Actiniaria	Edwardsiidae	LS
Edwardsia sp DC1	Cnidaria	Anthozoa	Actiniaria	Edwardsiidae	US
Edwardsiidae	Cnidaria	Anthozoa	Actiniaria	Edwardsiidae	US-NW-LS
Ennucula tenuis	Mollusca	Bivalvia	Nuculida	Nuculidae	US-NW-LS
Enopla	Nemertea	Enopla			US-LS
Enopla sp A	Nemertea	Enopla			US
Enteropneusta	Chordata	Enteropneusta			US-LS
Epitonium berryi	Mollusca	Gastropoda	Hypsogastropoda	Epitoniidae	US
Epitonium sawinae	Mollusca	Gastropoda	Hypsogastropoda	Epitoniidae	US
Eptatretus stoutii	Chordata	Myxini	Myxiniformes	Myxinidae	US
Eranno bicirrata	Annelida	Polychaeta	Aciculata	Lumbrineridae	US
Eranno lagunae	Annelida	Polychaeta	Aciculata	Lumbrineridae	US-NW-LS
Eranno sp	Annelida	Polychaeta	Aciculata	Lumbrineridae	US-LS
Ericthonius brasiliensis	Arthropoda	Malacostraca	Amphipoda	Ischyroceridae	LS
Ericthonius rubricornis	Arthropoda	Malacostraca	Amphipoda	Ischyroceridae	US-NW
Eteone brigitteae	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Euchone arenae	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Euchone incolor	Annelida	Polychaeta	Canalipalpata	Sabellidae	LS
Euchone sp	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Euchone sp A	Annelida	Polychaeta	Canalipalpata	Sabellidae	LS
Euchone velifera	Annelida	Polychaeta	Canalipalpata	Sabellidae	US-LS
Euclymeninae	Annelida	Polychaeta		Maldanidae	US-LS
Euclymeninae sp A	Annelida	Polychaeta		Maldanidae	US-NW-LS
Euclymeninae sp B	Annelida	Polychaeta		Maldanidae	US
Eucranta anoculata	Annelida	Polychaeta	Phyllodocida	Polynoidae	US-LS

Taxon	Phylum	Class	Order	Family	Habitat
Eudorella pacifica	Arthropoda	Malacostraca	Cumacea	Leuconidae	US-NW-LS
Eudorella redacticruris	Arthropoda	Malacostraca	Cumacea	Leuconidae	US
Eudorellopsis longirostris	Arthropoda	Malacostraca	Cumacea	Leuconidae	US
Eulalia californiensis	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Eulalia levicornuta Cmplx	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Eulalia sp	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Eulima raymondi	Mollusca	Gastropoda	Hypsogastropoda	Eulimidae	US
Eulimidae	Mollusca	Gastropoda	Hypsogastropoda	Eulimidae	US
Eumida longicornuta	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Eumida sp	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Eunice americana	Annelida	Polychaeta	Aciculata	Eunicidae	US-NW
Eunice sp	Annelida	Polychaeta	Aciculata	Eunicidae	US
Eunicidae	Annelida	Polychaeta	Aciculata	Eunicidae	US
Eunoe sp	Annelida	Polychaeta	Aciculata	Polynoidae	US
Euphilomedes carcharodonta	Arthropoda	Ostracoda	Myodocopida	Philomedidae	US
Euphilomedes longiseta	Arthropoda	Ostracoda	Myodocopida	Philomedidae	US
Euphilomedes producta	Arthropoda	Ostracoda	Myodocopida	Philomedidae	US-LS
Euphilomedes sp	Arthropoda	Ostracoda	Myodocopida	Philomedidae	US
Euphrosine arctia	Annelida	Polychaeta	Aciculata	Euphrosinidae	LS
Euphysa sp A	Cnidaria	Hydrozoa	Capitata	Corymorphidae	LS
Eurycope californiensis	Arthropoda	Malacostraca	Isopoda	Munnopsidae	US-LS
Eurydice caudata	Arthropoda	Malacostraca	Isopoda	Cirolanidae	US
Eusarsiella thominx	Arthropoda	Ostracoda	Myodocopida	Sarsiellidae	US
Euspira sp	Mollusca	Gastropoda	Hypsogastropoda	Naticidae	US
Eusyllinae	Annelida	Polychaeta	Aciculata	Syllidae	US-LS
Eusyllis sp	Annelida	Polychaeta	Aciculata	Syllidae	US
Excorallana truncata	Arthropoda	Malacostraca	Isopoda	Corallanidae	US
Exogone lourei	Annelida	Polychaeta	Aciculata	Syllidae	US-LS
Exogone sp SD1	Annelida	Polychaeta	Aciculata	Syllidae	US-LS
Fabrisabella sp	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Fabrisabella sp A	Annelida	Polychaeta	Canalipalpata	Sabellidae	US-LS
Fabrisabella sp LA1	Annelida	Polychaeta	Canalipalpata	Sabellidae	LS
Falcidens hartmanae	Mollusca	Caudofoveata	Chaetodermatida	Falcidentidae	US-NW-LS
Falcidens longus	Mollusca	Caudofoveata	Chaetodermatida	Falcidentidae	US-NW
Falcidens macracanthos	Mollusca	Caudofoveata	Chaetodermatida	Falcidentidae	US
Fauveliopsis glabra	Annelida	Polychaeta	Canalipalpata	Fauveliopsidae	US-LS
Fauveliopsis sp	Annelida	Polychaeta	Canalipalpata	Fauveliopsidae	US-LS
Fauveliopsis sp SD1	Annelida	Polychaeta	Canalipalpata	Fauveliopsidae	US-LS
Flabelligera infundibularis	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US

Taxon	Phylum	Class	Order	Family	Habitat
Flabelligeridae	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US-LS
Flabelligeridae sp OC1	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	LS
Foxiphalus obtusidens	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-LS
Foxiphalus similis	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US
Furcillidens incrassatus	Mollusca	Caudofoveata	Chaetodermatida	Falcidentidae	-NW-LS
Gadila aberrans	Mollusca	Scaphopoda	Gadilida	Gadilidae	US
Gadila tolmiei	Mollusca	Scaphopoda	Gadilida	Gadilidae	US-NW-LS
Galathowenia oculata	Annelida	Polychaeta	Canalipalpata	Oweniidae	LS
Galathowenia pygidialis	Annelida	Polychaeta	Canalipalpata	Oweniidae	LS
Galathowenia sp	Annelida	Polychaeta	Canalipalpata	Oweniidae	US
Gammaridea	Arthropoda	Malacostraca	Amphipoda		US-NW-LS
Gammaropsis ociosa	Arthropoda	Malacostraca	Amphipoda	Photidae	US
Garosyrrhoe bigarra	Arthropoda	Malacostraca	Amphipoda	Synopiidae	US
Gastropoda	Mollusca	Gastropoda			US-NW-LS
Gastropteron pacificum	Mollusca	Gastropoda	Opisthobranchia	Gastropteridae	US-NW-LS
Glottidia albida	Brachiopoda	Inarticulata	Lingulida	Lingulidae	US-LS
Glycera americana	Annelida	Polychaeta	Aciculata	Glyceridae	US
Glycera branchiopoda	Annelida	Polychaeta	Aciculata	Glyceridae	US-LS
Glycera nana	Annelida	Polychaeta	Aciculata	Glyceridae	US-NW-LS
Glycera oxycephala	Annelida	Polychaeta	Aciculata	Glyceridae	US
Glycera robusta	Annelida	Polychaeta	Aciculata	Glyceridae	US
Glycera sp	Annelida	Polychaeta	Aciculata	Glyceridae	US
Glycera sp LA1	Annelida	Polychaeta	Aciculata	Glyceridae	US
Glycera tenuis	Annelida	Polychaeta	Aciculata	Glyceridae	US
Glycera tesselata	Annelida	Polychaeta	Aciculata	Glyceridae	US-LS
Glycinde armigera	Annelida	Polychaeta	Aciculata	Goniadidae	US-NW-LS
Glycinde sp	Annelida	Polychaeta	Aciculata	Goniadidae	US
Glyphanostomum pallescens	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-LS
Gnathia productatridens	Arthropoda	Malacostraca	Isopoda	Gnathiidae	US
Gnathiidae	Arthropoda	Malacostraca	Isopoda	Gnathiidae	US
Golfingia sp 1	Sipuncula	Sipunculidea	Golfingiformes	Golfingiidae	LS
Goniada annulata	Annelida	Polychaeta	Aciculata	Goniadidae	US
Goniada brunnea	Annelida	Polychaeta	Aciculata	Goniadidae	US-NW-LS
Goniada maculata	Annelida	Polychaeta	Aciculata	Goniadidae	US-LS
Gymnonereis crosslandi	Annelida	Polychaeta	Aciculata	Nereididae	US-LS
Halcampa decemtentaculata	Cnidaria	Anthozoa	Actiniaria	Halcampidae	US-NW-LS
Halianthella sp A	Cnidaria	Anthozoa	Actiniaria	Halcampidae	US-LS
Halicoides synopiae	Arthropoda	Malacostraca	Amphipoda	Pardaliscidae	US-LS
Haliella abyssicola	Mollusca	Gastropoda	Littorinimorpha	Eulimidae	US-LS

Taxon	Phylum	Class	Order	Family	Habitat
Haliophasma geminatum	Arthropoda	Malacostraca	Isopoda	Anthuridae	US-LS
Haloclavidae	Cnidaria	Anthozoa	Actiniaria	Haloclavidae	NW
Harmothoe fragilis	Annelida	Polychaeta	Aciculata	Polynoidae	US
Harmothoe sp	Annelida	Polychaeta	Aciculata	Polynoidae	US-LS
Harmothoe sp LA1	Annelida	Polychaeta	Aciculata	Polynoidae	LS
Harmothoinae	Annelida	Polychaeta	Phyllodocida	Polynoidae	US-LS
Harpacticoida	Arthropoda	Maxillopoda	Harpacticoida		US
Harpiniinae	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US
Harpiniopsis emeryi	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-LS
Harpiniopsis epistomata	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-NW-LS
Harpiniopsis fulgens	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-LS
Harpiniopsis galera	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-NW-LS
Harpiniopsis naiadis	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-LS
Harpiniopsis profundis	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	LS
Harpiniopsis similis	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	LS
Harpiniopsis sp	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	LS
Harpiniopsis sp WS1	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	LS
Hartmanodes hartmanae	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US
Havelockia sp	Echinodermata	Holothuroidea	Dendrochirotida	Phyllophoridae	US
Hemicyclops thysanotus	Arthropoda	Maxillopoda	Poecilostomatoida	Clausidiidae	US
Hemilamprops sp A	Arthropoda	Malacostraca	Cumacea	Lampropidae	US-LS
Hemilamprops sp B	Arthropoda	Malacostraca	Cumacea	Lampropidae	US
Hermundura fauveli	Annelida	Polychaeta	Phyllodocida	Pilargidae	US
Hesionidae	Annelida	Polychaeta	Aciculata	Hesionidae	US
Hesperonoe complanata	Annelida	Polychaeta	Aciculata	Polynoidae	LS
Hesperonoe laevis	Annelida	Polychaeta	Aciculata	Polynoidae	US-NW-LS
Hesperonoe sp	Annelida	Polychaeta	Aciculata	Polynoidae	US-NW
Heteromastus filiformis Cmplx	Annelida	Polychaeta		Capitellidae	US-NW
Heteromastus filobranchus	Annelida	Polychaeta		Capitellidae	US-NW-LS
Heteromastus sp	Annelida	Polychaeta		Capitellidae	US-NW
Heteronemertea	Nemertea	Anopla	Heteronemertea		US
Heteronemertea sp SD2	Nemertea	Anopla	Heteronemertea		US-LS
Heterophoxus affinis	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-NW-LS
Heterophoxus ellisi	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-NW-LS
Heterophoxus oculatus	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-LS
Heterophoxus sp	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-NW-LS
Heterophoxus sp LA1	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US
Hiatella arctica	Mollusca	Bivalvia	Venerida	Hiatellidae	US

Taxon	Phylum	Class	Order	Family	Habitat
Hinea insculpta	Mollusca	Gastropoda	Hypsogastropoda	Nassariidae	US
Hippolytidae	Arthropoda	Malacostraca	Decapoda	Hippolytidae	US
Hippomedon columbianus	Arthropoda	Malacostraca	Amphipoda	Lysianassidae	US
Hippomedon sp	Arthropoda	Malacostraca	Amphipoda	Lysianassidae	LS
Hippomedon sp A	Arthropoda	Malacostraca	Amphipoda	Lysianassidae	US
Hirudinea	Annelida	Hirudinea			US
Holmesiella anomala	Arthropoda	Malacostraca	Mysida	Mysidae	US
Holothuroidea	Echinodermata	Holothuroidea			US
Hoplonemertea	Nemertea	Enopla	Hoplonemertea		US-LS
Hoplonemertea sp SD2	Nemertea	Enopla	Hoplonemertea		US
Hormathiidae	Cnidaria	Anthozoa	Actiniaria	Hormathiidae	US
Huxleyia munita	Mollusca	Bivalvia	Solemyida	Nucinellidae	US
Hyalidae	Arthropoda	Malacostraca	Amphipoda	Hyalidae	US
Hydrozoa	Cnidaria	Hydrozoa			US
Ilyarachna acarina	Arthropoda	Malacostraca	Isopoda	Munnopsidae	US-LS
Ilyarachna profunda	Arthropoda	Malacostraca	Isopoda	Munnopsidae	US-LS
Isocheles pilosus	Arthropoda	Malacostraca	Decapoda	Diogenidae	US
Isopoda	Arthropoda	Malacostraca	Isopoda		NW
Janiralata sp	Arthropoda	Malacostraca	Isopoda	Janiridae	LS
Jasmineira sp	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Jasmineira sp B	Annelida	Polychaeta	Canalipalpata	Sabellidae	US-LS
Jassa slatteryi	Arthropoda	Malacostraca	Amphipoda	Ischyroceridae	US
Joeropsis dubia	Arthropoda	Malacostraca	Isopoda	Joeropsididae	LS
Keenaea centifilosum	Mollusca	Bivalvia	Venerida	Cardiidae	US
Kinbergonuphis vexillaria	Annelida	Polychaeta	Aciculata	Onuphidae	US-LS
Kurtiella compressa	Mollusca	Bivalvia	Venerida	Lasaeidae	US-LS
Kurtiella mortoni	Mollusca	Bivalvia	Venerida	Lasaeidae	US
Kurtiella sp	Mollusca	Bivalvia	Venerida	Lasaeidae	US
Kurtiella sp D	Mollusca	Bivalvia	Venerida	Lasaeidae	US
Kurtiella sp LA1	Mollusca	Bivalvia	Venerida	Lasaeidae	US-LS
Kurtiella sp LA2	Mollusca	Bivalvia	Venerida	Lasaeidae	LS
Kurtiella tumida	Mollusca	Bivalvia	Venerida	Lasaeidae	US-LS
Kurtzina beta	Mollusca	Gastropoda	Hypsogastropoda	Mangeliidae	US
Lagisca sp	Annelida	Polychaeta	Aciculata	Polynoidae	LS
Lampropidae sp SD1	Arthropoda	Malacostraca	Cumacea	Lampropidae	US
Lanassa gracilis	Annelida	Polychaeta	Canalipalpata	Terebellidae	US-LS
Lanassa sp	Annelida	Polychaeta	Canalipalpata	Terebellidae	LS
Lanassa venusta venusta	Annelida	Polychaeta	Canalipalpata	Terebellidae	US-LS
Lanice conchilega	Annelida	Polychaeta	Canalipalpata	Terebellidae	US
Laonice cirrata	Annelida	Polychaeta	Canalipalpata	Spionidae	US-LS

Taxon	Phylum	Class	Order	Family	Habitat
Laonice nuchala	Annelida	Polychaeta	Canalipalpata	Spionidae	US-LS
Laonice sp	Annelida	Polychaeta	Canalipalpata	Spionidae	US-LS
Lasaeidae	Mollusca	Bivalvia	Venerida	Lasaeidae	LS
Laticorophium baconi	Arthropoda	Malacostraca	Amphipoda	Corophiidae	LS
Leaena caeca	Annelida	Polychaeta	Terebellida	Terebellidae	LS
Leanira alba	Annelida	Polychaeta	Aciculata	Sigalionidae	LS
Lebbeus sp	Arthropoda	Malacostraca	Decapoda	Hippolytidae	US
Ledella sp	Mollusca	Bivalvia	Nuculanida	Nuculanidae	LS
Leiochrides hemipodus	Annelida	Polychaeta		Capitellidae	US-LS
Leiochrides sp	Annelida	Polychaeta		Capitellidae	LS
Leitoscoloplos mexicanus	Annelida	Polychaeta		Orbiniidae	US
Leitoscoloplos panamensis	Annelida	Polychaeta		Orbiniidae	US
Leitoscoloplos pugettensis	Annelida	Polychaeta		Orbiniidae	US-LS
Leitoscoloplos sp	Annelida	Polychaeta		Orbiniidae	US-NW
Leitoscoloplos sp A	Annelida	Polychaeta		Orbiniidae	US-NW-LS
Lepidasthenia berkeleyae	Annelida	Polychaeta	Aciculata	Polynoidae	US
Lepidasthenia longicirrata	Annelida	Polychaeta	Aciculata	Polynoidae	US-NW
Lepidepecreum garthi	Arthropoda	Malacostraca	Amphipoda	Lysianassidae	US
Lepidepecreum gurjanovae	Arthropoda	Malacostraca	Amphipoda	Lysianassidae	US
Lepidonotus spiculus	Annelida	Polychaeta	Aciculata	Polynoidae	LS
Leptochelia dubia Cmplx	Arthropoda	Malacostraca	Tanaidacea	Leptocheliidae	US-LS
Leptophoxus falcatus icelus	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-LS
Leptoplanidae	Platyhelminthes	Turbellaria	Polycladida	Leptoplanidae	US
Leptostylis calva	Arthropoda	Malacostraca	Cumacea	Diastylidae	US-LS
Leptostylis sp E	Arthropoda	Malacostraca	Cumacea	Diastylidae	LS
Leptosynapta sp	Echinodermata	Holothuroidea	Apodida	Synaptidae	US-LS
Leucon bishopi	Arthropoda	Malacostraca	Cumacea	Leuconidae	LS
Leucon declivis	Arthropoda	Malacostraca	Cumacea	Leuconidae	US-NW-LS
Leucon falcicosta	Arthropoda	Malacostraca	Cumacea	Leuconidae	US
Leucon fulvus	Arthropoda	Malacostraca	Cumacea	Leuconidae	LS
Leucon magnadentata	Arthropoda	Malacostraca	Cumacea	Leuconidae	LS
Leucon sp	Arthropoda	Malacostraca	Cumacea	Leuconidae	LS
Leucon sp J	Arthropoda	Malacostraca	Cumacea	Leuconidae	US
Leucon subnasica	Arthropoda	Malacostraca	Cumacea	Leuconidae	US
Levinsenia gracilis	Annelida	Polychaeta		Paraonidae	US-LS
Levinsenia multibranchiata	Annelida	Polychaeta		Paraonidae	US-NW-LS
Levinsenia oculata	Annelida	Polychaeta		Paraonidae	LS
Levinsenia sp	Annelida	Polychaeta		Paraonidae	US-NW-LS

Taxon	Phylum	Class	Order	Family	Habitat
Levinsenia sp B	Annelida	Polychaeta		Paraonidae	US-LS
Liljeborgia cota	Arthropoda	Malacostraca	Amphipoda	Liljeborgiidae	US-NW
Liljeborgiidae	Arthropoda	Malacostraca	Amphipoda	Liljeborgiidae	US
Limatula saturna	Mollusca	Bivalvia	Limida	Limidae	LS
Limifossor fratula	Mollusca	Caudofoveata	Chaetodermatida	Limifossoridae	US-NW-LS
Limnodriloides barnardi	Annelida	Oligochaeta	Haplotaxida	Tubificidae	US
Limnodriloides sp	Annelida	Oligochaeta	Haplotaxida	Tubificidae	US
Lineidae	Nemertea	Anopla	Heteronemertea	Lineidae	US-NW-LS
Lineus bilineatus	Nemertea	Anopla	Heteronemertea	Lineidae	US-LS
Lineus flavescens	Nemertea	Anopla	Heteronemertea	Lineidae	US
Lineus sp	Nemertea	Anopla	Heteronemertea	Lineidae	US-LS
Lirobittium calenum	Mollusca	Gastropoda	Sorbeoconcha	Cerithiidae	US
Lirobittium larum	Mollusca	Gastropoda	Sorbeoconcha	Cerithiidae	US
Lirobittium paganicum	Mollusca	Gastropoda	Sorbeoconcha	Cerithiidae	US
Lirobittium rugatum	Mollusca	Gastropoda	Sorbeoconcha	Cerithiidae	US
Lirobittium sp	Mollusca	Gastropoda	Sorbeoconcha	Cerithiidae	US-NW
Listriella albina	Arthropoda	Malacostraca	Amphipoda	Liljeborgiidae	US-NW-LS
Listriella eriopisa	Arthropoda	Malacostraca	Amphipoda	Liljeborgiidae	US
Listriella sp	Arthropoda	Malacostraca	Amphipoda	Liljeborgiidae	US
Listriolobus hexamyotus	Echiura	Echiuridea	Echiuroinea	Thalassematidae	US-NW-LS
Listriolobus pelodes	Echiura	Echiuridea	Echiuroinea	Thalassematidae	US-LS
Listriolobus sp	Echiura	Echiuridea	Echiuroinea	Thalassematidae	LS
Loxosomella sp	Entoprocta		Solitaria	Loxosomatidae	LS
Loy thompsoni	Mollusca	Gastropoda	Opisthobranchia	Onchidorididae	US-NW
Lucinoma aequizonatum	Mollusca	Bivalvia	Lucinida	Lucinidae	US-NW
Lucinoma annulatum	Mollusca	Bivalvia	Lucinida	Lucinidae	US-NW-LS
Luidia foliolata	Echinodermata	Asteroidea	Paxillosida	Luidiidae	US
Luidia sp	Echinodermata	Asteroidea	Paxillosida	Luidiidae	US
Lumbriclymene lineus	Annelida	Polychaeta		Maldanidae	US-LS
Lumbriclymene sp	Annelida	Polychaeta		Maldanidae	US
Lumbrineridae	Annelida	Polychaeta	Aciculata	Lumbrineridae	US-LS
Lumbrinerides sp	Annelida	Polychaeta	Aciculata	Lumbrineridae	US
Lumbrineris cruzensis	Annelida	Polychaeta	Aciculata	Lumbrineridae	US-NW
Lumbrineris index	Annelida	Polychaeta	Aciculata	Lumbrineridae	US
Lumbrineris japonica	Annelida	Polychaeta	Aciculata	Lumbrineridae	US
Lumbrineris latreilli	Annelida	Polychaeta	Aciculata	Lumbrineridae	US
Lumbrineris ligulata	Annelida	Polychaeta	Aciculata	Lumbrineridae	US
Lumbrineris limicola	Annelida	Polychaeta	Aciculata	Lumbrineridae	US
Lumbrineris sp	Annelida	Polychaeta	Aciculata	Lumbrineridae	US-NW-LS
Lumbrineris sp E	Annelida	Polychaeta	Aciculata	Lumbrineridae	US
Lumbrineris sp Group I	Annelida	Polychaeta	Aciculata	Lumbrineridae	US

Taxon	Phylum	Class	Order	Family	Habitat
Lumbrineris/Scoletoma sp	Annelida	Polychaeta	Aciculata	Lumbrineridae	US-LS
Luzonia chilensis	Mollusca	Bivalvia		Cuspidariidae	US-LS
Lysianassidae	Arthropoda	Malacostraca	Amphipoda	Lysianassidae	US
Lysianassoidea	Arthropoda	Malacostraca	Amphipoda		US-LS
Lysippe sp	Annelida	Polychaeta	Canalipalpata	Ampharetidae	LS
Lysippe sp A	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Lysippe sp B	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-LS
Lytechinus pictus	Echinodermata	Echinoidea	Camarodonta	Toxopneustidae	US
Macoma carlottensis	Mollusca	Bivalvia	Venerida	Tellinidae	US-NW-LS
Macoma sp	Mollusca	Bivalvia	Venerida	Tellinidae	US-NW
Macoma yoldiformis	Mollusca	Bivalvia	Venerida	Tellinidae	US
Maera bousfieldi	Arthropoda	Malacostraca	Amphipoda	Melitidae	US
Maera nelsonae	Arthropoda	Malacostraca	Amphipoda	Melitidae	US
Magelona berkeleyi	Annelida	Polychaeta	Canalipalpata	Magelonidae	US
Magelona hartmanae	Annelida	Polychaeta	Canalipalpata	Magelonidae	US
Magelona sp B	Annelida	Polychaeta	Canalipalpata	Magelonidae	US
Makrokylindrus sp A	Arthropoda	Malacostraca	Cumacea	Diastylidae	LS
Makrokylindrus sp SD1	Arthropoda	Malacostraca	Cumacea	Diastylidae	LS
Malacoceros indicus	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Maldane californiensis	Annelida	Polychaeta		Maldanidae	US-LS
Maldane sarsi	Annelida	Polychaeta		Maldanidae	US-NW-LS
Maldane sp	Annelida	Polychaeta		Maldanidae	US-NW-LS
Maldanidae	Annelida	Polychaeta		Maldanidae	US-NW-LS
Maldaninae	Annelida	Polychaeta		Maldanidae	US
Malletia faba	Mollusca	Bivalvia	Nuculanida	Malletiidae	US
Malletia pacifica	Mollusca	Bivalvia	Nuculanida	Malletiidae	US-LS
Malletia sp	Mollusca	Bivalvia	Nuculanida	Malletiidae	LS
Malmgreniella bansei	Annelida	Polychaeta	Aciculata	Polynoidae	US
Malmgreniella baschi	Annelida	Polychaeta	Aciculata	Polynoidae	US
Malmgreniella macginitiei	Annelida	Polychaeta	Aciculata	Polynoidae	US
Malmgreniella sanpedroensis	Annelida	Polychaeta	Aciculata	Polynoidae	US
Malmgreniella scriptoria	Annelida	Polychaeta	Aciculata	Polynoidae	US-LS
Malmgreniella sp	Annelida	Polychaeta	Aciculata	Polynoidae	US-LS
Malmgreniella sp A	Annelida	Polychaeta	Aciculata	Polynoidae	US-NW
Malmgreniella sp B Cmplx	Annelida	Polychaeta	Aciculata	Polynoidae	US
Malmgreniella sp SD2	Annelida	Polychaeta	Aciculata	Polynoidae	US-LS
Mangeliidae	Mollusca	Gastropoda	Hypsogastropoda	Mangeliidae	US
Marphysa disjuncta	Annelida	Polychaeta	Aciculata	Eunicidae	US-LS
Marphysa sp	Annelida	Polychaeta	Aciculata	Eunicidae	US

Taxon	Phylum	Class	Order	Family	Habitat
Mastobranchus sp	Annelida	Polychaeta		Capitellidae	LS
Mayerella banksia	Arthropoda	Malacostraca	Amphipoda	Caprellidae	US-LS
Mediomastus sp	Annelida	Polychaeta		Capitellidae	US-LS
Megasurcula carpenteriana	Mollusca	Gastropoda	Hypsogastropoda	Pseudomelatomidae	US
Melinna heterodonta	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-NW-LS
Melinna oculata	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-LS
Melinna sp	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Melphisana bola Cmplx	Arthropoda	Malacostraca	Amphipoda	Melphidippidae	US
Mendicula ferruginosa	Mollusca	Bivalvia	Lucinida	Thyasiridae	US-LS
Mesolamprops bispinosus	Arthropoda	Malacostraca	Cumacea	Lampropidae	US
Metaphoxus frequens	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US
Metasychis disparidentatus	Annelida	Polychaeta		Maldanidae	US-NW-LS
Metedwardsia sp A	Cnidaria	Anthozoa	Actiniaria	Edwardsiidae	LS
Metopa dawsoni	Arthropoda	Malacostraca	Amphipoda	Stenothoidae	US-LS
Mexamage longibranchiata	Annelida	Polychaeta	Canalipalpata	Ampharetidae	LS
Micranellum crebricinctum	Mollusca	Gastropoda	Hypsogastropoda	Caecidae	US
Microglyphis brevicula	Mollusca	Gastropoda	"Lower Heterobranchia"	Ringiculidae	US-LS
Micropodarke dubia	Annelida	Polychaeta	Aciculata	Hesionidae	US
Microspio pigmentata	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Micrura alaskensis	Nemertea	Anopla	Heteronemertea	Lineidae	US-LS
Micrura sp	Nemertea	Anopla	Heteronemertea	Lineidae	US-LS
Micrura wilsoni	Nemertea	Anopla	Heteronemertea	Lineidae	US-LS
Modiolinae	Mollusca	Bivalvia	Mytilida	Mytilidae	US
Molgula napiformis	Chordata	Ascidiacea	Stolidobranchiata	Molgulidae	US
Molgula pugetiensis	Chordata	Ascidiacea	Stolidobranchiata	Molgulidae	US
Molgula sp	Chordata	Ascidiacea	Stolidobranchiata	Molgulidae	NW
Molpadia intermedia	Echinodermata	Holothuroidea	Molpadida	Molpadiidae	US-LS
Monobrachium parasitum	Cnidaria	Hydrozoa	Filifera	Olindiidae	US-LS
Monoculodes emarginatus	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US-LS
Monoculodes glyconicus	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US-LS
Monoculodes latissimanus	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US-LS
Monoculodes sp	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US
Monostyliferoidea	Nemertea	Enopla	Hoplonemertea		US-LS
Monticellina cryptica	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Monticellina serratiseta	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Monticellina siblina	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Monticellina sp	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS

Taxon	Phylum	Class	Order	Family	Habitat
Monticellina sp SD7	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Monticellina sp SD9	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US
Monticellina tesselata	Annelida	Polychaeta	Canalipalpata	Cirratulidae	US-LS
Mooreonuphis nebulosa	Annelida	Polychaeta	Aciculata	Onuphidae	US
Mooreonuphis segmentispadix	Annelida	Polychaeta	Aciculata	Onuphidae	US
Mooreonuphis sp	Annelida	Polychaeta	Aciculata	Onuphidae	US
Mooresamytha bioculata	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-LS
Mooresamytha sp	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Munnogonium tillerae	Arthropoda	Malacostraca	Isopoda	Paramunnidae	US
Munnopsidae	Arthropoda	Malacostraca	Isopoda	Munnopsidae	LS
Munnopsurus sp A	Arthropoda	Malacostraca	Isopoda	Munnopsidae	US-LS
Myodocopida	Arthropoda	Ostracoda	Myodocopida		LS
Myriochele gracilis	Annelida	Polychaeta	Canalipalpata	Oweniidae	US-NW-LS
Myriochele olgae	Annelida	Polychaeta	Canalipalpata	Oweniidae	US-NW-LS
Myriochele sp	Annelida	Polychaeta	Canalipalpata	Oweniidae	US-NW-LS
Myriochele striolata	Annelida	Polychaeta	Canalipalpata	Oweniidae	US
Myriotrochus sp WS1	Echinodermata	Holothuroidea	Apodida	Myriotrochidae	LS
Mysida	Arthropoda	Malacostraca	Mysida		US-NW
Mysidae	Arthropoda	Malacostraca	Mysida	Mysidae	US-NW
Mysidella americana	Arthropoda	Malacostraca	Mysida	Mysidae	US-LS
Myxoderma platyacanthum	Echinodermata	Asteroidea	Zorocallida	Zoroasteridae	NW
Naididae	Annelida	Clitellata	Haplotaxida	Naididae	US
Nassariidae	Mollusca	Gastropoda	Hypsogastropoda	Nassariidae	US-NW
Natatolana californiensis	Arthropoda	Malacostraca	Isopoda	Cirolanidae	LS
Neilonella mexicana	Mollusca	Bivalvia	Nuculanida	Neilonellidae	LS
Neilonella ritteri	Mollusca	Bivalvia	Nuculanida	Neilonellidae	US-NW-LS
Neilonella sp	Mollusca	Bivalvia	Nuculanida	Neilonellidae	LS
Neilonellidae	Mollusca	Bivalvia	Nuculanida	Neilonellidae	LS
Nellobia eusoma	Echiura	Echiuridea	Bonelloinea	Bonelliidae	US-LS
Nematoda	Nematoda				US
Nemertea	Nemertea				US
Neocrangon communis	Arthropoda	Malacostraca	Decapoda	Crangonidae	US
Neolepton salmoneum	Mollusca	Bivalvia	Venerida	Neoleptonidae	US
Neomediomastus glabrus	Annelida	Polychaeta		Capitellidae	LS
Neomeniomorpha sp B	Mollusca	Solenogastres	Cavibelonia		LS
Neomeniomorpha sp SD3	Mollusca	Solenogastres	Cavibelonia		US
Neotrypaea gigas	Arthropoda	Malacostraca	Decapoda	Callianassidae	US
Nephasoma diaphanes	Sipuncula	Sipunculidea	Golfingiformes	Golfingiidae	US-LS

Taxon	Phylum	Class	Order	Family	Habitat
Nephasoma pellucidum	Sipuncula	Sipunculidea	Golfingiformes	Golfingiidae	US
Nephasoma sp	Sipuncula	Sipunculidea	Golfingiformes	Golfingiidae	US-LS
Nephtyidae	Annelida	Polychaeta	Aciculata	Nephtyidae	US
Nephtys caecoides	Annelida	Polychaeta	Aciculata	Nephtyidae	US-LS
Nephtys ferruginea	Annelida	Polychaeta	Aciculata	Nephtyidae	US-LS
Nephtys punctata	Annelida	Polychaeta	Aciculata	Nephtyidae	US
Nephtys sp	Annelida	Polychaeta	Aciculata	Nephtyidae	US-NW
Nereididae	Annelida	Polychaeta	Aciculata	Nereididae	US
Nereiphylla ferruginea Cmplx	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Nereiphylla sp	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Nereiphylla sp 2	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Nereis sp	Annelida	Polychaeta	Aciculata	Nereididae	US
Nereis sp A	Annelida	Polychaeta	Aciculata	Nereididae	US-LS
Nereis sp SD1	Annelida	Polychaeta	Aciculata	Nereididae	US
Neverita draconis	Mollusca		Hypsogastropoda	Naticidae	US
Neverita recluziana	Mollusca	Gastropoda	Hypsogastropoda	Naticidae	US
Nicippe tumida	Arthropoda	Malacostraca	Amphipoda	Pardaliscidae	US-LS
Nicomache lumbricalis	Annelida	Polychaeta		Maldanidae	US
Nicomache sp	Annelida	Polychaeta		Maldanidae	US-LS
Ninoe sp	Annelida	Polychaeta	Aciculata	Lumbrineridae	US-LS
Ninoe tridentata	Annelida	Polychaeta	Aciculata	Lumbrineridae	US
Notocomplana rupicola	Platyhelminthes	Turbellaria	Polycladida	Notoplanidae	US
Notomastus hemipodus	Annelida	Polychaeta		Capitellidae	US-LS
Notomastus latericeus	Annelida	Polychaeta		Capitellidae	US
Notomastus magnus	Annelida	Polychaeta		Capitellidae	US-NW
Notomastus sp	Annelida	Polychaeta		Capitellidae	US-NW-LS
Notomastus sp A	Annelida	Polychaeta		Capitellidae	US
Notoplana sp	Platyhelminthes	Rhabditophora	Polycladida	Notoplanidae	LS
Notoproctus pacificus	Annelida	Polychaeta		Maldanidae	US
Nuculana conceptionis	Mollusca	Bivalvia	Nuculanida	Nuculanidae	US-LS
Nuculana sp A	Mollusca	Bivalvia	Nuculanida	Nuculanidae	US
Nuculana sp B	Mollusca	Bivalvia	Nuculanida	Nuculanidae	US-LS
Nuculana taphria	Mollusca	Bivalvia	Nuculanida	Nuculanidae	US
Nuculanida	Mollusca	Bivalvia	Nuculanida		LS
Nuculanidae	Mollusca	Bivalvia	Nuculanida	Nuculanidae	US
Nuculanoidea	Mollusca	Bivalvia	Nuculanida		LS
Octobranchus sp	Annelida	Polychaeta	Canalipalpata	Trichobranchidae	US
Odostomia sp	Mollusca	Gastropoda	"Lower Heterobranchia"	Pyramidellidae	US
Oediceropsis elsula	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	LS
Oedicerotidae	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US

Taxon	Phylum	Class	Order	Family	Habitat
Oerstedia dorsalis	Nemertea	Enopla	Monostilifera	Oerstediidae	LS
Oligochaeta	Annelida	Oligochaeta			US-NW-LS
Oncopagurus haigae	Arthropoda	Malacostraca	Decapoda	Parapaguridae	US
Onuphidae	Annelida	Polychaeta	Aciculata	Onuphidae	US
Onuphis affinis	Annelida	Polychaeta	Aciculata	Onuphidae	US
Onuphis geophiliformis	Annelida	Polychaeta	Aciculata	Onuphidae	US
Onuphis iridescens	Annelida	Polychaeta	Aciculata	Onuphidae	US-NW-LS
Onuphis multiannulata	Annelida	Polychaeta	Aciculata	Onuphidae	US
Onuphis sp	Annelida	Polychaeta	Aciculata	Onuphidae	US
Onuphis sp A	Annelida	Polychaeta	Aciculata	Onuphidae	US-LS
Opheliidae	Annelida	Polychaeta		Opheliidae	LS
Ophelina acuminata	Annelida	Polychaeta		Opheliidae	US-LS
Ophelina farallonensis	Annelida	Polychaeta		Opheliidae	LS
Ophelina pallida	Annelida	Polychaeta		Opheliidae	US-LS
Ophelina sp	Annelida	Polychaeta		Opheliidae	LS
Ophiacantha sp	Echinodermata	Ophiuroidea	Ophiurida	Ophiacanthidae	LS
Ophiacanthidae	Echinodermata	Ophiuroidea	Ophiurida	Ophiacanthidae	LS
Ophioscolex corynetes	Echinodermata	Ophiuroidea	Ophiurida	Ophiomyxidae	LS
Ophiosphalma jolliense	Echinodermata	Ophiuroidea	Ophiurida	Ophiuridae	LS
Ophiothrix spiculata	Echinodermata	Ophiuroidea	Ophiurida	Ophiotricidae	LS
Ophiura leptoctenia	Echinodermata	Ophiuroidea	Ophiurida	Ophiuridae	LS
Ophiura luetkenii	Echinodermata	Ophiuroidea	Ophiurida	Ophiuridae	US
Ophiuridae	Echinodermata	Ophiuroidea	Ophiurida	Ophiuridae	US-LS
Ophiuroconis bispinosa	Echinodermata	Ophiuroidea	Ophiurida	Ophiodermatidae	LS
Ophiuroidea	Echinodermata	Ophiuroidea			US-LS
Ophryotrocha sp A	Annelida	Polychaeta	Aciculata	Dorvilleidae	US
Opisa tridentata	Arthropoda	Malacostraca	Amphipoda	Opisidae	US
Oplorhiza polynema	Cnidaria	Hydrozoa	Conica		LS
Oradarea longimana	Arthropoda	Malacostraca	Amphipoda	Eusiridae	US-LS
Orbiniidae	Annelida	Polychaeta		Orbiniidae	US
Orchomene anaquelus	Arthropoda	Malacostraca	Amphipoda	Lysianassidae	US
Orchomenella decipiens	Arthropoda	Malacostraca	Amphipoda	Lysianassidae	US-LS
Orchomenella pacifica	Arthropoda	Malacostraca	Amphipoda	Lysianassidae	US-LS
Orchomenella pinguis	Arthropoda	Malacostraca	Amphipoda	Lysianassidae	US
Oweniidae	Annelida	Polychaeta	Canalipalpata	Oweniidae	US-NW-LS
Oxydromus pugettensis	Annelida	Polychaeta	Aciculata	Hesionidae	US
Pachynus barnardi	Arthropoda	Malacostraca	Amphipoda	Pachynidae	US
Pacifoculodes barnardi	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US-LS
Paguroidea	Arthropoda	Malacostraca	Decapoda		US
Palaeonemertea	Nemertea	Anopla	Palaeonemertea		US-NW-LS

Taxon	Phylum	Class	Order	Family	Habitat
Palaeonemertea sp D	Nemertea	Anopla	Palaeonemertea		US-LS
Pandora bilirata	Mollusca	Bivalvia	Pholadomyida	Pandoridae	US
Pannychia moseleyi	Echinodermata	Holothuroidea	Elasipodida	Laetmogonidae	US
Paradialychone bimaculata	Annelida	Polychaeta	Canalipalpata	Sabellidae	US-LS
Paradialychone ecaudata	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Paradialychone harrisae	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Paradialychone paramollis	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Paradiopatra parva	Annelida	Polychaeta	Aciculata	Onuphidae	US-NW-LS
Paradiopatra sp	Annelida	Polychaeta	Aciculata	Onuphidae	US
Paradoneis eliasoni	Annelida	Polychaeta		Paraonidae	US
Paradoneis sp	Annelida	Polychaeta		Paraonidae	US-LS
Paralamprops sp	Annelida	Polychaeta	Cumacea	Paraonidae	LS
Paralysippe annectens	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-NW-LS
Paramage scutata	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US-LS
Paramblyops sp LA1	Arthropoda	Malacostraca	Mysida	Mysidae	US
Paramblyops sp SMB1	Arthropoda	Malacostraca	Mysida	Mysidae	US
Paramicrodeutopus schmitti	Arthropoda	Malacostraca	Amphipoda	Aoridae	US
Paranaitis polynoides	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Paranemertes californica	Nemertea	Enopla	Hoplonemertea	Emplectonematidae	US-LS
Paraonidae	Annelida	Polychaeta		Paraonidae	US-LS
Parapagurodes makarovi	Arthropoda	Malacostraca	Decapoda	Paguridae	US
Paraphoxus sp 1	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-NW-LS
Paraprionospio alata	Annelida	Polychaeta	Canalipalpata	Spionidae	US-NW-LS
Pardaliscella sp	Arthropoda	Malacostraca	Amphipoda	Pardaliscidae	US-LS
Pardaliscella symmetrica	Arthropoda	Malacostraca	Amphipoda	Pardaliscidae	US
Pardaliscidae	Arthropoda	Malacostraca	Amphipoda	Pardaliscidae	US
Pareurythoe californica	Annelida	Polychaeta	Aciculata	Amphinomidae	LS
Parexogone acutipalpa	Annelida	Polychaeta	Aciculata	Syllidae	US
Parexogone molesta	Annelida	Polychaeta	Aciculata	Syllidae	US
Parvaplustrum sp A	Mollusca	Gastropoda	"Lower Heterobranchia"	Aplustridae	US
Parvaplustrum sp B	Mollusca	Gastropoda	"Lower Heterobranchia"	Aplustridae	US-LS
Parvilucina tenuisculpta	Mollusca	Bivalvia	Lucinida	Lucinidae	US-NW-LS
Parviplana hymani	Platyhelminthes	Turbellaria	Polycladida	Leptoplanidae	US
Peachia quinquecapitata	Cnidaria	Anthozoa	Actiniaria	Haloclavidae	US
Pectinaria californiensis	Annelida	Polychaeta	Canalipalpata	Pectinariidae	US-NW-LS
Pectinariidae	Annelida	Polychaeta	Canalipalpata	Pectinariidae	LS

Taxon	Phylum	Class	Order	Family	Habitat
Pectinidae	Mollusca	Bivalvia	Ostreida	Pectinidae	US
Pennatula californica	Cnidaria	Anthozoa	Pennatulacea	Pennatulidae	NW
Pennatula phosphorea	Cnidaria	Anthozoa	Pennatulacea	Pennatulidae	LS
Pennatulacea	Cnidaria	Anthozoa	Pennatulacea		LS
Pennatulacea sp A	Cnidaria	Anthozoa	Pennatulacea		LS
Pentamera populifera	Echinodermata	Holothuroidea	Dendrochirotida	Phyllophoridae	US
Pentamera pseudocalcigera	Echinodermata	Holothuroidea	Dendrochirotida	Phyllophoridae	US-NW-LS
Pentamera pseudopopulifera	Echinodermata	Holothuroidea	Dendrochirotida	Phyllophoridae	US
Pentamera sp	Echinodermata	Holothuroidea	Dendrochirotida	Phyllophoridae	US
Periploma rosewateri	Mollusca	Bivalvia	Pholadomyida	Periplomatidae	LS
Petaloclymene pacifica	Annelida	Polychaeta		Maldanidae	US
Petaloproctus ornatus	Annelida	Polychaeta		Maldanidae	LS
Petalosarsia sp A	Arthropoda	Malacostraca	Cumacea	Pseudocumatidae	LS
Phascolion sp A	Sipuncula	Sipunculidea	Golfingiformes	Phascolionidae	US
Pherusa negligens	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US
Pherusa neopapillata	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US-LS
Pherusa papillata	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US
Pherusa sp	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US-LS
Pherusa sp SD2	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US-LS
Philine alba	Mollusca	Gastropoda	Opisthobranchia	Philinidae	US
Philine auriformis	Mollusca	Gastropoda	Opisthobranchia	Philinidae	US-LS
Philine californica	Mollusca	Gastropoda	Opisthobranchia	Philinidae	US
Philine polystrigma	Mollusca	Gastropoda	Opisthobranchia	Philinidae	LS
Philine sp	Mollusca	Gastropoda	Opisthobranchia	Philinidae	US-LS
Philine sp A	Mollusca	Gastropoda	Opisthobranchia	Philinidae	US
Philomedes dentata	Arthropoda	Ostracoda	Myodocopida	Philomedidae	US
Philomedes sp A	Arthropoda	Ostracoda	Myodocopida	Philomedidae	LS
Philomedidae	Arthropoda	Ostracoda	Myodocopida	Philomedidae	LS
Phimochirus californiensis	Arthropoda	Malacostraca	Decapoda	Paguridae	US
Phisidia sanctaemariae	Annelida	Polychaeta	Canalipalpata	Terebellidae	US-LS
Phisidia sp	Annelida	Polychaeta	Canalipalpata	Terebellidae	LS
Pholadomyoida	Mollusca	Bivalvia	Pholadomyida		US
Pholoe glabra	Annelida	Polychaeta	Aciculata	Pholoidae	US
Pholoides asperus	Annelida	Polychaeta	Aciculata	Pholoidae	US
Phoronida	Phorona		Phoronida		US-NW-LS
Phoronis sp	Phorona		Phoronida	Phoronidae	US-NW
Phoronis sp SD1	Phorona		Phoronida	Phoronidae	US
Photis bifurcata	Arthropoda	Malacostraca	Amphipoda	Photidae	US
Photis brevipes	Arthropoda	Malacostraca	Amphipoda	Photidae	US
Photis californica	Arthropoda	Malacostraca	Amphipoda	Photidae	US

Taxon	Phylum	Class	Order	Family	Habitat
Photis chiconola	Arthropoda	Malacostraca	Amphipoda	Photidae	US
Photis lacia	Arthropoda	Malacostraca	Amphipoda	Photidae	US-NW-LS
Photis parvidons	Arthropoda	Malacostraca	Amphipoda	Photidae	US-NW
Photis sp	Arthropoda	Malacostraca	Amphipoda	Photidae	US-NW
Photis sp WS1	Arthropoda	Malacostraca	Amphipoda	Photidae	LS
Photis viuda	Arthropoda	Malacostraca	Amphipoda	Photidae	US-NW
Phoxocephalidae	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-NW-LS
Phyllochaetopterus limicolus	Annelida	Polychaeta	Canalipalpata	Chaetopteridae	US-NW-LS
Phyllochaetopterus prolifica	Annelida	Polychaeta	Canalipalpata	Chaetopteridae	US
Phyllochaetopterus sp	Annelida	Polychaeta	Canalipalpata	Chaetopteridae	US
Phyllodoce cuspidata	Annelida	Polychaeta	Aciculata	Phyllodocidae	US-LS
Phyllodoce groenlandica	Annelida	Polychaeta	Aciculata	Phyllodocidae	US-NW-LS
Phyllodoce hartmanae	Annelida	Polychaeta	Aciculata	Phyllodocidae	US-LS
Phyllodoce longipes	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Phyllodoce medipapillata	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Phyllodoce pettiboneae	Annelida	Polychaeta	Aciculata	Phyllodocidae	US-LS
Phyllodoce sp	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Phyllodocidae	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Physonectae	Cnidaria	Hydrozoa	Siphonophora		LS
Pilargis berkeleyae	Annelida	Polychaeta	Aciculata	Pilargidae	US
Pinnixa franciscana	Arthropoda	Malacostraca	Decapoda	Pinnotheridae	US
Pinnixa occidentalis Cmplx	Arthropoda	Malacostraca	Decapoda	Pinnotheridae	US
Pinnixa sp	Arthropoda	Malacostraca	Decapoda	Pinnotheridae	US
Pinnotheridae	Arthropoda	Malacostraca	Decapoda	Pinnotheridae	US
Piscicolidae	Annelida	Clitellata	Rhynchobdellida	Piscicolidae	US
Pista brevibranchiata	Annelida	Polychaeta	Canalipalpata	Terebellidae	US
Pista disjuncta	Annelida	Polychaeta	Terebellida	Terebellidae	LS
Pista estevanica	Annelida	Polychaeta	Canalipalpata	Terebellidae	US-LS
Pista sp	Annelida	Polychaeta	Canalipalpata	Terebellidae	US
Pista wui	Annelida	Polychaeta	Canalipalpata	Terebellidae	US-LS
Platynereis bicanaliculata	Annelida	Polychaeta	Aciculata	Nereididae	US
Pleurobranchaea californica	Mollusca	Gastropoda	Opisthobranchia	Pleurobranchidae	US
Pleurogonium californiense	Arthropoda	Malacostraca	Isopoda	Paramunnidae	US
Pleurogonium sp A	Arthropoda	Malacostraca	Isopoda	Paramunnidae	US
Pleusymtes subglaber	Arthropoda	Malacostraca	Amphipoda	Pleustidae	US
Podarkeopsis glabrus	Annelida	Polychaeta	Aciculata	Hesionidae	US-LS
Podarkeopsis perkinsi	Annelida	Polychaeta	Aciculata	Hesionidae	US-NW-LS
Podarkeopsis sp	Annelida	Polychaeta	Aciculata	Hesionidae	US-LS

Taxon	Phylum	Class	Order	Family	Habitat
Podarkeopsis sp A	Annelida	Polychaeta	Aciculata	Hesionidae	US
Poecilochaetus johnsoni	Annelida	Polychaeta	Canalipalpata	Poecilochaetidae	US
Pogonophora	Annelida	Florideophyceae	Ceramiales	Dasyaceae	US
Policordia sp OC1	Mollusca	Bivalvia		Lyonsiellidae	US
Polycirrinae	Annelida	Polychaeta	Canalipalpata	Terebellidae	LS
Polycirrus californicus	Annelida	Polychaeta	Canalipalpata	Terebellidae	US
Polycirrus sp	Annelida	Polychaeta	Canalipalpata	Terebellidae	US-LS
Polycirrus sp A	Annelida	Polychaeta	Canalipalpata	Terebellidae	US-LS
Polycirrus sp I	Annelida	Polychaeta	Canalipalpata	Terebellidae	LS
Polycirrus sp OC1	Annelida	Polychaeta	Canalipalpata	Terebellidae	US
Polycladida	Platyhelminthes	Turbellaria	Polycladida		US
Polydora sp	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Polygireulima rutila	Mollusca	Gastropoda	Hypsogastropoda	Eulimidae	US
Polynoidae	Annelida	Polychaeta	Aciculata	Polynoidae	US-NW-LS
Polynoinae	Annelida	Polychaeta	Aciculata	Polynoidae	US-NW-LS
Polyschides quadrifissatus	Mollusca	Scaphopoda	Gadilida	Gadilidae	US
Polyschides sp	Mollusca	Scaphopoda	Gadilida	Gadilidae	US
Potamethus sp A	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Prachynella lodo	Arthropoda	Malacostraca	Amphipoda	Pachynidae	NW
Praxillella gracilis	Annelida	Polychaeta		Maldanidae	US-LS
Praxillella pacifica	Annelida	Polychaeta		Maldanidae	US-NW-LS
Praxillura maculata	Annelida	Polychaeta		Maldanidae	US
Praxillura sp	Annelida	Polychaeta		Maldanidae	LS
Prionospio (*Minuspio*) *lighti*	Annelida	Polychaeta	Canalipalpata	Spionidae	US-NW-LS
Prionospio (*Minuspio*) sp	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Prionospio (*Minuspio*) sp A	Annelida	Polychaeta	Canalipalpata	Spionidae	US-LS
Prionospio (*Prionospio*) *dubia*	Annelida	Polychaeta	Canalipalpata	Spionidae	US-LS
Prionospio (*Prionospio*) *ehlersi*	Annelida	Polychaeta	Canalipalpata	Spionidae	US-NW-LS
Prionospio (*Prionospio*) *jubata*	Annelida	Polychaeta	Canalipalpata	Spionidae	US-NW
Prionospio (*Prionospio*) sp	Annelida	Polychaeta	Canalipalpata	Spionidae	US-NW-LS
Procampylaspis caenosa	Arthropoda	Malacostraca	Cumacea	Nannastacidae	US-LS
Procampylaspis sp SD1	Arthropoda	Malacostraca	Cumacea	Nannastacidae	LS
Proceraea sp	Annelida	Polychaeta	Aciculata	Syllidae	US
Proclea sp	Annelida	Polychaeta	Canalipalpata	Terebellidae	LS
Proclea sp A	Annelida	Polychaeta	Canalipalpata	Terebellidae	US
Propebela turricula	Mollusca	Gastropoda	Hypsogastropoda	Mangeliidae	US
Protis pacifica	Annelida	Polychaeta	Sabellida	Serpulidae	LS

Taxon	Phylum	Class	Order	Family	Habitat
Protocirrineris sp B	Annelida	Polychaeta	Canalipalpata	Cirratulidae	LS
Protomedeia articulata Cmplx	Arthropoda	Malacostraca	Amphipoda	Corophiidae	US-NW-LS
Protula superba	Annelida	Polychaeta	Canalipalpata	Serpulidae	LS
Pseudarchaster pusillus	Echinodermata	Asteroidea	Valvatida	Goniasteridae	NW
Pseudatherospio fauchaldi	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Pseudharpinia excavata	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	LS
Pseudomma sp	Arthropoda	Malacostraca	Mysida	Mysidae	US-NW-LS
Pseudotaranis strongi	Mollusca	Gastropoda	Hypsogastropoda	Pseudomelatomidae	US
Psilodens sp	Mollusca	Caudofoveata	Chaetodermatida	Scutopidae	LS
Pycnogonida	Arthropoda	Pycnogonida			US
Rhabdus rectius	Mollusca	Scaphopoda	Dentaliida	Rhabdidae	US-LS
Rhachotropis barnardi	Arthropoda	Malacostraca	Amphipoda	Eusiridae	US-LS
Rhachotropis distincta	Arthropoda	Malacostraca	Amphipoda	Eusiridae	US-NW-LS
Rhachotropis luculenta	Arthropoda	Malacostraca	Amphipoda	Eusiridae	US
Rhachotropis sp	Arthropoda	Malacostraca	Amphipoda	Eusiridae	US
Rhachotropis sp A	Arthropoda	Malacostraca	Amphipoda	Eusiridae	US
Rhamphobrachium sp	Annelida	Polychaeta	Aciculata	Onuphidae	US
Rhepoxynius abronius	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	NW
Rhepoxynius bicuspidatus	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US-LS
Rhepoxynius daboius	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	US
Rhepoxynius menziesi	Arthropoda	Malacostraca	Amphipoda	Phoxocephalidae	LS
Rhizorhagium formosum	Cnidaria	Hydrozoa	Filifera	Bougainvilliidae	US
Rhodine bitorquata	Annelida	Polychaeta		Maldanidae	US-LS
Rhynohalicella halona	Arthropoda	Malacostraca	Amphipoda	Pardaliscidae	US
Rictaxis painei	Mollusca	Gastropoda	"Lower Heterobranchia"	Acteonidae	US
Rictaxis punctocaelatus	Mollusca	Gastropoda	"Lower Heterobranchia"	Acteonidae	US
Rocinela angustata	Arthropoda	Malacostraca	Isopoda	Aegidae	US
Rutiderma lomae	Arthropoda	Ostracoda	Myodocopida	Rutidermatidae	US
Sabellidae	Annelida	Polychaeta	Canalipalpata	Sabellidae	US-LS
Sabellidae sp LA1	Annelida	Polychaeta	Canalipalpata	Sabellidae	LS
Sabellides manriquei	Annelida	Polychaeta	Canalipalpata	Ampharetidae	LS
Sabellinae	Annelida	Polychaeta	Canalipalpata	Sabellidae	US
Saccella penderi	Mollusca	Bivalvia	Nuculanida	Nuculanidae	US
Saccoglossus sp	Chordata	Enteropneusta		Harrimaniidae	US-LS
Salmacina sp	Annelida	Polychaeta	Canalipalpata	Serpulidae	LS
Samytha californiensis	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Saxicavella nybakkeni	Mollusca	Bivalvia	Venerida	Hiatellidae	US
Saxicavella pacifica	Mollusca	Bivalvia	Venerida	Hiatellidae	US-NW-LS

Taxon	Phylum	Class	Order	Family	Habitat
Scalibregma californicum	Annelida	Polychaeta		Scalibregmatidae	US-LS
Scalibregmatidae	Annelida	Polychaeta		Scalibregmatidae	US
Scaphopoda	Mollusca	Scaphopoda			US-NW-LS
Scaphopoda sp SD1	Mollusca	Scaphopoda			US
Schisturella cocula	Arthropoda	Malacostraca	Amphipoda	Uristidae	US
Schisturella tracalero	Arthropoda	Malacostraca	Amphipoda	Uristidae	US
Schizocardium sp	Chordata	Enteropneusta		Spengeliidae	US-LS
Scionella japonica	Annelida	Polychaeta	Canalipalpata	Terebellidae	US
Scleroconcha trituberculata	Arthropoda	Ostracoda	Myodocopida	Philomedidae	US-LS
Scolanthus triangulus	Cnidaria	Anthozoa	Actiniaria	Edwardsiidae	US
Scoletoma sp	Annelida	Polychaeta	Aciculata	Lumbrineridae	US-LS
Scoletoma sp A	Annelida	Polychaeta	Aciculata	Lumbrineridae	US
Scoletoma sp C	Annelida	Polychaeta	Aciculata	Lumbrineridae	US
Scoletoma tetraura Cmplx	Annelida	Polychaeta	Aciculata	Lumbrineridae	US-NW
Scoloplos acmeceps	Annelida	Polychaeta		Orbiniidae	US
Scoloplos armiger Cmplx	Annelida	Polychaeta		Orbiniidae	US
Scoloplos sp	Annelida	Polychaeta		Orbiniidae	LS
Semiodera inflata	Annelida	Polychaeta	Canalipalpata	Flabelligeridae	US
Serpulidae	Annelida	Polychaeta	Canalipalpata	Serpulidae	US
Siboglinum veleronis	Annelida	Polychaeta	Canalipalpata	Siboglinidae	LS
Sigalionidae	Annelida	Polychaeta	Aciculata	Sigalionidae	US
Sigambra setosa	Annelida	Polychaeta	Aciculata	Pilargidae	LS
Sigambra sp	Annelida	Polychaeta	Aciculata	Pilargidae	US
Sigambra sp DC1	Annelida	Polychaeta	Aciculata	Pilargidae	NW
Sigambra tentaculata	Annelida	Polychaeta	Aciculata	Pilargidae	US-NW-LS
Sige sp	Annelida	Polychaeta	Aciculata	Phyllodocidae	LS
Sige sp A	Annelida	Polychaeta	Aciculata	Phyllodocidae	US
Siphonolabrum californiensis	Arthropoda	Malacostraca	Tanaidacea	Anarthruridae	US-LS
Sipuncula	Sipuncula				US-LS
Sipunculidae	Sipuncula	Sipunculidea	Sipunculiformes	Sipunculidae	LS
Siriella pacifica	Arthropoda	Malacostraca	Mysida	Mysidae	US
Skenea sp A	Mollusca	Gastropoda	Trochida	Skeneidae	LS
Solamen columbianum	Mollusca	Bivalvia	Mytilida	Mytilidae	US-LS
Solariella peramabilis	Mollusca	Gastropoda	Trochida	Solariellidae	US
Solemya pervernicosa	Mollusca	Bivalvia	Solemyida	Solemyidae	US-LS
Solenogastres	Mollusca	Solenogastres			US
Sonatsa carinata	Annelida	Polychaeta		Maldanidae	LS
Sosane occidentalis	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Sosane sp	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US
Sosanopsis sp A	Annelida	Polychaeta	Canalipalpata	Ampharetidae	US

Taxon	Phylum	Class	Order	Family	Habitat
Spatangoida	Echinodermata	Echinoidea	Spatangoida		US-NW-LS
Spatangus californicus	Echinodermata	Echinoidea	Spatangoida	Spatangidae	US-NW
Spathoderma californicum	Mollusca	Caudofoveata	Chaetodermatida	Prochaetodermatidae	US-LS
Spathoderma sp A	Mollusca	Caudofoveata	Chaetodermatida	Prochaetodermatidae	US
Sphaerosyllis sp	Annelida	Polychaeta	Aciculata	Syllidae	US
Sphaerosyllis sp SD2	Annelida	Polychaeta	Aciculata	Syllidae	US
Spio filicornis	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Spiochaetopterus costarum Cmplx	Annelida	Polychaeta	Canalipalpata	Chaetopteridae	US-LS
Spionidae	Annelida	Polychaeta	Canalipalpata	Spionidae	US-NW-LS
Spiophanes anoculata	Annelida	Polychaeta	Canalipalpata	Spionidae	LS
Spiophanes berkeleyorum	Annelida	Polychaeta	Canalipalpata	Spionidae	US-LS
Spiophanes duplex	Annelida	Polychaeta	Canalipalpata	Spionidae	US-NW-LS
Spiophanes fimbriata	Annelida	Polychaeta	Canalipalpata	Spionidae	US-NW-LS
Spiophanes kimballi	Annelida	Polychaeta	Canalipalpata	Spionidae	US-LS
Spiophanes norrisi	Annelida	Polychaeta	Canalipalpata	Spionidae	US
Spiophanes sp	Annelida	Polychaeta	Canalipalpata	Spionidae	US-NW-LS
Spiophanes wigleyi	Annelida	Polychaeta	Canalipalpata	Spionidae	US-LS
Spiophanicola spinulosus	Arthropoda	Maxillopoda	Poecilostomatoida	Spiophanicolidae	US
Spirontocaris sica	Arthropoda	Malacostraca	Decapoda	Hippolytidae	US-LS
Spirontocaris sp	Arthropoda	Malacostraca	Decapoda	Hippolytidae	US
Stachyptilum superbum	Cnidaria	Anthozoa	Pennatulacea	Stachyptilidae	US-NW-LS
Staurocalyptus dowlingi	SILICEA	Hexactinellida	Lyssacinosa	Rossellidae	LS
Stenothoides bicoma	Arthropoda	Malacostraca	Amphipoda	Stenothoidae	US
Stereobalanus sp	Chordata	Enteropneusta		Harrimaniidae	US-LS
Sternaspis affinis	Annelida	Polychaeta	Canalipalpata	Sternaspidae	US-LS
Sternaspis maior	Annelida	Polychaeta	Terebellida	Sternaspidae	LS
Sternaspis williamsae	Annelida	Polychaeta	Canalipalpata	Sternaspidae	US-LS
Sthenelais tertiaglabra	Annelida	Polychaeta	Aciculata	Sigalionidae	US
Sthenelanella uniformis	Annelida	Polychaeta	Aciculata	Sigalionidae	US
Streblosoma crassibranchia	Annelida	Polychaeta	Canalipalpata	Terebellidae	US
Streblosoma pacifica	Annelida	Polychaeta	Canalipalpata	Terebellidae	US-NW
Streblosoma sp	Annelida	Polychaeta	Canalipalpata	Terebellidae	US-LS
Streblosoma sp B	Annelida	Polychaeta	Canalipalpata	Terebellidae	US
Strongylocentrotus fragilis	Echinodermata	Echinoidea	Camarodonta	Strongylocentrotidae	US-LS
Stylochoplana sp A	Platyhelminthes	Turbellaria	Polycladida	Stylochoplanidae	US
Subadyte mexicana	Annelida	Polychaeta	Aciculata	Polynoidae	US-LS
Subadyte sp	Annelida	Polychaeta	Aciculata	Polynoidae	US-LS
Subadyte sp LA1	Annelida	Polychaeta	Aciculata	Polynoidae	US

Taxon	Phylum	Class	Order	Family	Habitat
Syllidae	Annelida	Polychaeta	Aciculata	Syllidae	US
Synidotea calcarea	Arthropoda	Malacostraca	Isopoda	Idoteidae	LS
Synidotea sp	Arthropoda	Malacostraca	Isopoda	Idoteidae	US
Syrrhoe longifrons	Arthropoda	Malacostraca	Amphipoda	Synopiidae	US-LS
Syrrhoe sp A	Arthropoda	Malacostraca	Amphipoda	Synopiidae	US
Tanaella propinquus	Arthropoda	Malacostraca	Tanaidacea	Tanaellidae	US-LS
Tanaidacea	Arthropoda	Malacostraca	Tanaidacea		US-LS
Tanaopsis cadieni	Arthropoda	Malacostraca	Tanaidacea	Tanaopsidae	US-LS
Tectidrilus diversus	Annelida	Oligochaeta	Haplotaxida	Tubificidae	US
Tectidrilus probus	Annelida	Oligochaeta	Haplotaxida	Tubificidae	US
Tectidrilus profusus	Annelida	Oligochaeta	Haplotaxida	Tubificidae	US
Tectidrilus sp	Annelida	Oligochaeta	Haplotaxida	Tubificidae	US
Tellina cadieni	Mollusca	Bivalvia	Venerida	Tellinidae	US
Tellina carpenteri	Mollusca	Bivalvia	Venerida	Tellinidae	US-LS
Tellina modesta	Mollusca	Bivalvia	Venerida	Tellinidae	US
Tellina sp	Mollusca	Bivalvia	Venerida	Tellinidae	US
Tellina sp B	Mollusca	Bivalvia	Venerida	Tellinidae	US-LS
Tellinidae	Mollusca	Bivalvia	Venerida	Tellinidae	US-NW
Tenellia adspersa	Mollusca	Gastropoda	Nudibranchia	Terqipedidae	US
Tenonia priops	Annelida	Polychaeta	Aciculata	Polynoidae	US-NW
Terebellidae	Annelida	Polychaeta	Canalipalpata	Terebellidae	US-LS
Terebellides californica	Annelida	Polychaeta	Canalipalpata	Trichobranchidae	US-NW-LS
Terebellides reishi	Annelida	Polychaeta	Canalipalpata	Trichobranchidae	US-LS
Terebellides sp	Annelida	Polychaeta	Canalipalpata	Trichobranchidae	US-NW-LS
Terebellides sp Type D	Annelida	Polychaeta	Canalipalpata	Trichobranchidae	US-LS
Terebellinae	Annelida	Polychaeta	Canalipalpata	Terebellidae	US-LS
Tetrastemma albidum	Nemertea	Enopla	Hoplonemertea	Tetrastemmatidae	US
Tetrastemma candidum	Nemertea	Enopla	Hoplonemertea	Tetrastemmatidae	US
Tetrastemma nigrifrons	Nemertea	Enopla	Hoplonemertea	Tetrastemmatidae	LS
Tetrastemma sp	Nemertea	Enopla	Hoplonemertea	Tetrastemmatidae	US
Thalassematidae	Echiura	Echiuridea	Echiuroinea	Thalassematidae	NW
Therochaeta pacifica	Annelida	Polychaeta	Terebellida	Flabelligeridae	LS
Thyasira flexuosa	Mollusca	Bivalvia	Lucinida	Thyasiridae	US-LS
Thyasiridae	Mollusca	Bivalvia	Lucinida	Thyasiridae	US-LS
Thyasiridae sp SD1	Mollusca	Bivalvia	Lucinida	Thyasiridae	LS
Thysanocardia nigra	Sipuncula	Sipunculidea	Golfingiformes	Golfingiidae	US-NW
Trachycardium quadragenarium	Mollusca	Bivalvia	Venerida	Cardiidae	US
Travisia brevis	Annelida	Polychaeta		Opheliidae	US
Travisia gigas	Annelida	Polychaeta		Opheliidae	US
Travisia pupa	Annelida	Polychaeta		Opheliidae	US

Taxon	Phylum	Class	Order	Family	Habitat
Trichobranchidae sp LA1	Annelida	Polychaeta	Canalipalpata	Trichobranchidae	LS
Tritella tenuissima	Arthropoda	Malacostraca	Amphipoda	Caprellidae	US-NW-LS
Tritia insculpta	Mollusca	Gastropoda	Hypsogastropoda	Nassariidae	LS
Tubulanidae	Nemertea	Anopla	Palaeonemertea	Tubulanidae	US-LS
Tubulanidae sp B	Nemertea	Anopla	Palaeonemertea	Tubulanidae	US
Tubulanidae sp C	Nemertea	Anopla	Palaeonemertea	Tubulanidae	US
Tubulanus polymorphus	Nemertea	Anopla	Palaeonemertea	Tubulanidae	US-LS
Tubulanus sp	Nemertea	Anopla	Palaeonemertea	Tubulanidae	US-NW-LS
Tubulanus sp A	Nemertea	Anopla	Palaeonemertea	Tubulanidae	US-LS
Turbonilla sp	Mollusca	Gastropoda	"Lower Heterobranchia"	Pyramidellidae	US
Turbonilla sp A	Mollusca	Gastropoda	"Lower Heterobranchia"	Pyramidellidae	US
Turbonilla sp SD1	Mollusca	Gastropoda	"Lower Heterobranchia"	Pyramidellidae	US
Typhlotanais crassus	Arthropoda	Malacostraca	Tanaidacea	Nototanaidae	US-LS
Typhlotanais sp	Arthropoda	Malacostraca	Tanaidacea	Nototanaidae	US-LS
Typhlotanais williamsi	Arthropoda	Malacostraca	Tanaidacea	Nototanaidae	US
Typosyllis farallonensis	Annelida	Polychaeta	Aciculata	Syllidae	US
Typosyllis heterochaeta	Annelida	Polychaeta	Aciculata	Syllidae	US-LS
Typosyllis hyperioni	Annelida	Polychaeta	Aciculata	Syllidae	US-LS
Typosyllis sp	Annelida	Polychaeta	Aciculata	Syllidae	US
Urochordata	Chordata				US
Valettiopsis dentatus	Arthropoda	Malacostraca	Amphipoda	Valettiopsidae	US
Valettiopsis sp DC1	Arthropoda	Malacostraca	Amphipoda	Valettiopsidae	US
Vemakylindrus hystricosa	Arthropoda	Malacostraca	Cumacea	Diastylidae	US-LS
Virgularia agassizii	Cnidaria	Anthozoa	Pennatulacea	Virgulariidae	US-LS
Virgularia sp	Cnidaria	Anthozoa	Pennatulacea	Virgulariidae	US-LS
Virgulariidae	Cnidaria	Anthozoa	Pennatulacea	Virgulariidae	US-LS
Vitrinella sp	Mollusca	Gastropoda	Hypsogastropoda	Tornidae	US
Volvulella californica	Mollusca	Gastropoda	Opisthobranchia	Retusidae	US-NW-LS
Volvulella cylindrica	Mollusca	Gastropoda	Opisthobranchia	Retusidae	US-LS
Volvulella panamica	Mollusca	Gastropoda	Opisthobranchia	Retusidae	US
Volvulella sp	Mollusca	Gastropoda	Opisthobranchia	Retusidae	US
Waldo arthuri	Mollusca	Bivalvia	Venerida	Galeommatidae	LS
Waldo sp A	Mollusca	Bivalvia	Venerida	Galeommatidae	US
Westwoodilla tone	Arthropoda	Malacostraca	Amphipoda	Oedicerotidae	US
Xanthoidea	Arthropoda	Malacostraca	Decapoda		US
Xenoleberis californica	Arthropoda	Ostracoda	Myodocopida	Cylindroleberididae	US
Yoldia seminuda	Mollusca	Bivalvia	Nuculanida	Yoldiidae	US
Yoldiella nana	Mollusca	Bivalvia	Nuculanida	Yoldiidae	US-LS
Yoldiella sp	Mollusca	Bivalvia	Nuculanida	Yoldiidae	US-LS

Taxon	Phylum	Class	Order	Family	Habitat
Yoldiidae	Mollusca	Bivalvia	Nuculanida	Yoldiidae	LS
Ypsilothuria bitentaculata	Echinodermata	Holothuroidea	Dendrochirotida	Ypsilothuriidae	LS
Ysideria hastata	Annelida	Polychaeta	Aciculata	Polynoidae	US
Zeuxo normani	Arthropoda	Malacostraca	Tanaidacea	Tanaidae	US
Zygeupolia rubens	Nemertea	Anopla	Heteronemertea	Valenciniidae	US-LS

Appendix C: Operational Taxonomic Units

Operational Taxonomic Units (OTUs) used in comparing Bray-Curtis dissimilarity among reference samples from each habitat. The habitat(s) where a given OTU was observed is noted as well. Habitats are defined in Figure 2 and abbreviated as: US = Upper Slope, NW = Northwest Slope, and LS = Lower Slope.

OTU	Habitat
Adontorhina cyclia	US-LS
Aglaophamus erectans	US-NW-LS
Ampelisca spp.	US-NW-LS
Ampelisca pacifica	US-LS
Ampelisca unsocalae	US-NW-LS
Ampharete	US
Ampharetidae	US-NW-LS
Amphiodia spp.	US-NW-LS
Amphioplus strongyloplax	US
Amphissa	US-NW
Amphiuridae	US-NW-LS
Ancistrosyllis groenlandica	US-NW-LS
Aphelochaeta spp.	US-LS
Aphelochaeta glandaria Cmplx	US-LS
Aphelochaeta monilaris	US-LS
Aricidea spp.	US-LS
Axinopsida serricata	US
*Bathymedon*spp.	US-LS
Bipalponephtys cornuta	US-NW-LS
Bivalvia	US-LS
Brisaster spp.	US-NW-LS
Brisaster townsendi	US-NW-LS
Brissopsis pacifica	US-NW-LS
Byblis spp.	US-NW-LS
Cadulus californicus	US-LS
Chaetoderma	US-NW-LS
Chaetodermatidae	US-NW-LS
Chaetozone	US-NW-LS
Chiridota sp	US-NW
Chloeia pinnata	US-NW-LS
Cirrophorus	US-NW-LS
Compressidens stearnsii	US-LS
Cossura spp.	US-LS
Cyclocardia spp.	US-NW
Diastylis pellucida	US-NW-LS
Dougaloplus amphacanthus	US

OTU	Habitat
Eclysippe trilobata	US-NW-LS
Ennucula tenuis	US-NW-LS
Euclymeninae	US-NW-LS
Falcidens hartmanae	US-NW-LS
Fauveliopsis	US-LS
Fauveliopsis glabra	US-LS
Gadila tolmiei	US-NW-LS
Glycera nana	US-NW-LS
Glycinde armigera	US-NW-LS
Goniada spp.	US-NW-LS
Harpiniopsis epistomata	US-NW-LS
Harpiniopsis fulgens	US-LS
Heteromastus spp.	US-NW
Heterophoxus spp.	US-NW-LS
Heterophoxus ellisi	US-NW-LS
Laonice cirrata	US-LS
Laonice nuchala	US-LS
Leiochrides spp.	US-LS
Leitoscoloplos spp.	US-NW-LS
Leitoscoloplos sp A	US-NW-LS
Leucon spp.	US-NW-LS
Levinsenia spp.	US-NW-LS
Limifossor fratula	US-NW-LS
Lineidae	US-NW-LS
Lirobittium spp.	US-NW
Lumbrineris spp.	US-NW
Lumbrineris cruzensis	US
Macoma carlottensis	US-NW
Maldane sarsi	US-NW-LS
Maldanidae	US-NW-LS
Malmgreniella spp.	US-NW-LS
Mediomastus sp	US-LS
Melinna heterodonta	US-NW-LS
Monoculodes spp.	US-LS
Monticellina cryptica	US-LS
Monticellina sp	US-LS
Myriochele gracilis	US-NW-LS
Nephtys ferruginea	US
Notomastus spp.	US-LS
Nuculana conceptionis	US-LS
Onuphis iridescens	US-NW-LS
Ophiuroidea	US-LS

OTU	Habitat
Paradiopatra parva	US-NW-LS
Paraprionospio alata	US-NW-LS
Parvilucina tenuisculpta	US-NW
Pectinaria californiensis	US
Phyllochaetopterus limicolus	US-NW-LS
Phyllodoce spp.	US-NW-LS
Pista spp.	US-LS
Polycirrus spp.	US-LS
Prionospio spp.	US-NW-LS
Prionospio (*Prionospio*) *ehlersi*	US-NW-LS
Scaphopoda	US-NW-LS
Scoletoma tetraura Cmplx	US
Spiophanes berkeleyorum	US
Spiophanes fimbriata	US-NW-LS
Spiophanes kimballi	US-LS
Tellina carpenteri	US-LS
Terebellides spp.	US-LS
Terebellides californica	US-NW-LS
Thyasira flexuosa	US
Tritella tenuissima	US-NW-LS
Yoldiella nana	US-LS

Appendix D: Performance of Pre-existing Assessment Tools

Though at present there are no calibrated and validated, biology-based assessment tools for the continental slope habitats of southern California, there are tools available for shallower, continental shelf habitats. The BRI (Smith et al. 2001) is an abundance weighted tolerance index that, in simplified terms, evaluates the condition of a habitat based upon the abundance of pre-defined pollution-tolerant taxa compared to the abundance of pre-defined pollution-sensitive taxa. The BRI has been calibrated for application in continental shelf habitats in southern California from a depth six to 324 m, though customary practice has limited the application of the index to samples no deeper than 200 m (see Gillett et al. 2017).

The deep water benthic habitats that are the focus of the present study can be viewed as a continuation of the continental shelf ecosystem where there is a transition in macrobenthic community composition with depth, rather than an abrupt ecotonal shift (Gillett et al. 2017). This is especially true of the Upper Slope Habitat, which encompasses the outer shelf – upper slope transition zone. As such, we wanted to test the performance of the continental shelf-focused BRI to each of the deep-water habitats of the present study and determine if it could provide a reasonable framework for interpreting at least some portion of the region's deep-water habitats.

At its core, the functionality of the BRI is based upon the identity of the taxa within a sample and how the index assigns their relative degree of pollution tolerance/sensitivity (referred to as a p-code). As such, the first step in assessing the performance of the BRI was to determine if it was appropriate for the taxa observed in the deep-water samples and provided adequate taxonomic coverage. Index coverage was calculated as the percent of taxa in a sample that were recognized by the BRI (i.e., taxa that had a p-code associated with them) and as the percent of a sample's abundance that was recognized by the BRI. There was very good coverage by the BRI in the Upper Slope Habitat, with an average of 77% of the taxa, comprising 85% of the abundance, recognized by the index (Table D-1). As a point of comparison, in the 2013 Southern California Bight Regional Survey, an average of 79% of the taxa and 86.5% of the abundance per sample from the continental shelf was recognized by the BRI. In contrast to the Upper Slope Habitat, only 57 and 45% of the taxa from the Northwest and Lower Slope Habitats were recognized by the index, with similarly low coverage numbers for their abundance.

Table D-1. Mean and Standard Deviation of the proportion of benthic infauna from each of the three continental slope habitats with Benthic Response Index (BRI) tolerance values from the perspective of total abundance and taxonomic richness.

Habitat	% of Abundance with a p-Code		% of Taxa with a p-Code	
	Mean	Standard Deviation	Mean	Standard Deviation
Upper Slope	85.0	14.3	76.8	11.1
Northwest Slope	56.4	20.5	56.5	14.8
Lower Slope	46.1	19.1	44.9	14.3

BRI scores were calculated for all of the deep water samples using the SCCWRP online BRI calculator (http://data.sccwrp.org/upload/bri_map.v6.php). Spearman's rank correlations were calculated between BRI scores and the stressor measurements within each habitat and across all habitats to evaluate the index's response to stress outside of the continental shelf environment using the cor function in base R v3.4.2. Additionally, BRI scores were compared to the nMDS ordination of each habitat to assess how the index scored reference and non-reference samples in R v3.4.2 using the envfit function of the Vegan package v2.4-4 (Oksanen et al. 2017).

There were relatively strong correlations ($r_s > 0.6$) between BRI score and a number of stressors (e.g., copper, mercury, total DDT) in the Upper Slope (Table D-2). Note that higher BRI scores indicate worse conditions, so the strong direct correlations observed with the stressors make indicate the index was responsive to the disturbances. There were no strong correlations between BRI score and the stressors in the Northwest and Lower Slope Habitats, echoing the BRI's lack of taxonomic coverage in those habitats. Similarly, there was a strong multivariate correlation ($r = 0.817$) between BRI scores and nMDS ordination of samples from the Upper Slope (Figure D-1) showing an increase in BRI scores (i.e., worsening condition) between reference and non-reference samples. There were no meaningful correlations between BRI scores and the ordinations of either of the other habitats.

Table D-2. Spearman's rank correlations (rs) of Benthic Response Index (BRI [Smith et al. 2001]) scores to the potential stressors within each habitat and across the entire data set. Chemical Score Index (CSI) thresholds defined in Bay et al. (2014).

Parameter	Upper Slope	Northwest Slope	Lower Slope	All Habitats
# of CSI Low Disturbance Threshold Exceedances	0.111	-0.210	0.102	0.055
# of CSI Moderate Disturbance Threshold Exceedances	0.162	-0.166	0.053	0.120
# of CSI High Disturbance Threshold Exceedances	0.207	NA	0.048	0.157
Arsenic (ppm)	0.674	-0.121	-0.039	0.503
Copper (ppm)	0.702	-0.221	0.078	0.428
Mercury (ppm)	0.669	0.131	-0.026	0.516
Zinc (ppm)	0.765	-0.125	0.062	0.474
Total Nitrogen (mg g^{-1})	0.033	-0.321	0.125	-0.166
Total Organic Carbon mg g^{-1})	-0.257	-0.189	0.077	-0.431
Total Chlordanes (ppb)	-0.087	ND	ND	0.191
Total DDD (ppb)	0.704	-0.308	0.313	0.784
Total DDE (ppb)	0.786	-0.813	0.028	0.796
Total DDT (ppb)	0.790	-0.381	-0.008	0.634
Total PAH (ppb)	0.186	0.015	-0.109	-0.080
Total PCB (ppb)	0.688	0.172	0.026	0.652
Depth (m)	-0.037	-0.224	-0.042	-0.418
% Sand	-0.295	0.138	-0.046	-0.036
% Silt	0.000	-0.157	0.077	-0.305
% Clay	0.442	0.171	-0.047	0.560

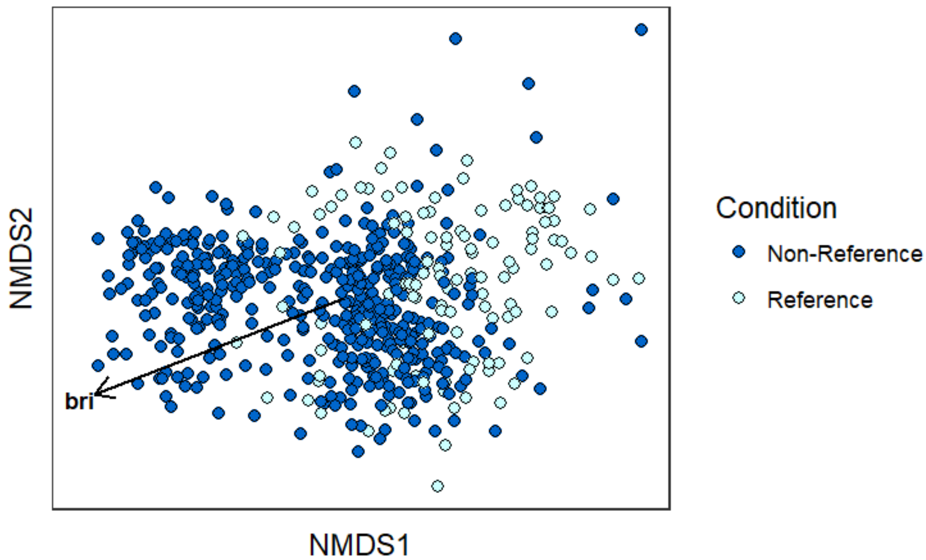

Figure D-1. Two-dimensional plot summarizing the nMDS ordination of samples from the Upper Slope. The arrow represents the relationship of the Benthic Response Index (BRI [Smith et al. 2001]) scores with the ordination as plotted (r = 0.817).

The potential applicability of the BRI to the Upper Slope Habitat is suggestive that the community structure of the continental slope taxa may actually not prohibit the utility of a similar, tolerance score index to fauna with this type of underlying community structure. We would hypothesize that the key to success, is that the BRI uses tolerance scores derived for more than 1,200 different taxa. This would suggest that indices that capture capturing the true gamma-diversity of an ecosystem through space and time may make assessing the condition of a neutrally organized community a valid prospect. With regard to continental slope of southern California, we would caution against directly using the BRI (designed for the continental shelf) in new habitats where its sensitivity to disturbance and insensitivity to natural gradients have not yet been validated. The BRI scores are most likely useful as a relative measure of condition (e.g., site A had a lower BRI score than site B and was therefore in better condition) in the Upper Slope Habitat. However, at present we would caution against using the condition category thresholds used to classify BRI scores such as reference, marginally disturbed, and highly disturbed, as they have not been validated for the depth of the Upper Slope Habitat and Smith et al. (2001) demonstrated changes in index performance with increasing depth.

Appendix E: Frequency of Occurrence and Relative Abundance of Benthic Infauna

The frequency of occurrence (% of samples containing the taxon) and relative abundance within each of the three continental slope habitats for each taxon observed in the dataset.

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Paraprionospio alata	77.2	2.7
Upper Slope	Parvilucina tenuisculpta	67.3	10.8
Upper Slope	Pectinaria californiensis	67.1	5.6
Upper Slope	Axinopsida serricata	53.2	20.3
Upper Slope	Onuphis iridescens	52.8	1.0
Upper Slope	Macoma carlottensis	52.7	4.9
Upper Slope	Glycera nana	51.9	0.7
Upper Slope	Aphelochaeta monilaris	51.2	1.7
Upper Slope	Chloeia pinnata	50.7	1.8
Upper Slope	Pista wui	47.2	2.7
Upper Slope	Glycinde armigera	45.9	0.5
Upper Slope	Maldane sarsi	43.8	3.2
Upper Slope	Notomastus hemipodus	42.9	1.4
Upper Slope	Bipalponephtys cornuta	42.8	1.0
Upper Slope	Melinna heterodonta	39.8	1.1
Upper Slope	Ampelisca unsocalae	35.7	0.8
Upper Slope	Spiophanes berkeleyorum	34.3	1.1
Upper Slope	Diastylis pellucida	34.1	0.6
Upper Slope	Tellina sp B	33.7	1.6
Upper Slope	Limifossor fratula	32.9	0.4
Upper Slope	Decamastus gracilis	30.9	2.1
Upper Slope	Lumbrineris sp	30.7	0.5
Upper Slope	Rhabdus rectius	27.6	0.5
Upper Slope	Nephtys ferruginea	26.9	0.2
Upper Slope	Prionospio (Prionospio) ehlersi	24.7	0.3
Upper Slope	Lumbrineris cruzensis	24.6	0.3
Upper Slope	Gadila tolmiei	23.7	0.6
Upper Slope	Mediomastus sp	23.1	0.7
Upper Slope	Euphilomedes producta	23.0	2.2
Upper Slope	Heteromastus filobranchus	22.8	0.7
Upper Slope	Tellina carpenteri	22.6	0.7
Upper Slope	Cyclocardia ventricosa	21.7	0.2
Upper Slope	Amphiuridae	21.6	0.3
Upper Slope	Micrura sp	20.0	0.2
Upper Slope	Lineidae	18.7	0.3

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Aphelochaeta glandaria Cmplx	18.2	0.6
Upper Slope	Nereis sp A	17.3	0.2
Upper Slope	Ancistrosyllis groenlandica	17.0	0.2
Upper Slope	Phyllochaetopterus limicolus	17.0	0.4
Upper Slope	Brisaster townsendi	16.4	0.2
Upper Slope	Laonice cirrata	16.3	0.1
Upper Slope	Lirobittium rugatum	16.3	1.1
Upper Slope	Spiophanes kimballi	16.3	0.6
Upper Slope	Cerebratulus californiensis	16.1	0.2
Upper Slope	Heterophoxus ellisi	15.9	0.2
Upper Slope	Leitoscoloplos sp A	15.5	0.2
Upper Slope	Goniada brunnea	15.0	0.1
Upper Slope	Compressidens stearnsii	14.3	0.4
Upper Slope	Ophiuroidea	14.3	0.2
Upper Slope	Monoculodes latissimanus	14.0	0.1
Upper Slope	Aphelochaeta-Monticellina Cmplx	13.8	1.0
Upper Slope	Nuculana conceptionis	13.6	0.3
Upper Slope	Prionospio (Prionospio) jubata	13.6	0.1
Upper Slope	Spiophanes fimbriata	13.6	0.2
Upper Slope	Nicippe tumida	13.4	0.1
Upper Slope	Paradiopatra parva	13.4	0.2
Upper Slope	Scoletoma tetraura Cmplx	12.7	0.1
Upper Slope	Aglaophamus erectans	12.5	0.1
Upper Slope	Malmgreniella sp	12.5	0.1
Upper Slope	Phyllodoce groenlandica	12.4	0.1
Upper Slope	Laonice nuchala	12.0	0.1
Upper Slope	Chaetoderma nanulum	11.5	0.1
Upper Slope	Eudorella pacifica	11.1	0.1
Upper Slope	Eunice americana	11.1	0.1
Upper Slope	Malmgreniella scriptoria	11.1	0.1
Upper Slope	Glycera americana	10.8	0.1
Upper Slope	Prionospio (Minuspio) lighti	10.6	0.1
Upper Slope	Spiochaetopterus costarum Cmplx	10.1	0.1
Upper Slope	Subadyte mexicana	10.1	0.1
Upper Slope	Spiophanes duplex	9.9	0.3
Upper Slope	Philine auriformis	9.7	0.1
Upper Slope	Thyasira flexuosa	9.7	0.1
Upper Slope	Kurtiella tumida	9.5	0.1
Upper Slope	Odostomia sp	9.5	0.1
Upper Slope	Dougaloplus amphacanthus	9.2	0.1
Upper Slope	Levinsenia gracilis	9.2	0.1

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Strongylocentrotus fragilis	9.2	0.1
Upper Slope	Maldanidae	9.0	0.1
Upper Slope	Aphelochaeta sp	8.8	0.1
Upper Slope	Eranno lagunae	8.8	0.1
Upper Slope	Leitoscoloplos pugettensis	8.8	0.1
Upper Slope	Anobothrus gracilis	8.5	0.1
Upper Slope	Polycirrus sp	8.3	0.1
Upper Slope	Adontorhina cyclia	8.1	0.1
Upper Slope	Amphiodia sp	8.0	0.3
Upper Slope	Caecognathia crenulatifrons	8.0	0.1
Upper Slope	Monoculodes emarginatus	8.0	0.1
Upper Slope	Ampharetidae	7.8	0.1
Upper Slope	Amphissa bicolor	7.8	0.1
Upper Slope	Cylichna diegensis	7.8	0.1
Upper Slope	Chaetodermidae	7.4	0.1
Upper Slope	Gastropteron pacificum	7.2	0.1
Upper Slope	Listriolobus pelodes	7.2	0.1
Upper Slope	Rictaxis punctocaelatus	7.2	0.1
Upper Slope	Saxicavella pacifica	7.2	0.2
Upper Slope	Heterophoxus sp	7.1	0.1
Upper Slope	Monticellina tesselata	7.1	0.1
Upper Slope	Sige sp A	7.1	0.1
Upper Slope	Brissopsis pacifica	6.9	0.1
Upper Slope	Chaetoderma pacificum	6.9	0.1
Upper Slope	Lineus bilineatus	6.9	0.1
Upper Slope	Lumbrineridae	6.9	0.1
Upper Slope	Lumbrineris index	6.7	0.1
Upper Slope	Malmgreniella sanpedroensis	6.7	0.1
Upper Slope	Dorvillea (Schistomeringos) longicornis	6.5	0.1
Upper Slope	Eclysippe trilobata	6.5	0.2
Upper Slope	Acteocina culcitella	6.4	0.1
Upper Slope	Euphilomedes carcharodonta	6.4	0.2
Upper Slope	Harpiniopsis fulgens	6.4	0.1
Upper Slope	Kurtiella compressa	6.2	0.1
Upper Slope	Pinnixa occidentalis Cmplx	6.2	0.0
Upper Slope	Samytha californiensis	6.2	0.1
Upper Slope	Scaphopoda	6.2	0.1
Upper Slope	Amphioplus strongyloplax	6.0	0.1
Upper Slope	Cadulus californicus	6.0	0.1
Upper Slope	Chiridota sp	6.0	0.1
Upper Slope	Capitella capitata Cmplx	5.8	0.9

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Myriochele gracilis	5.8	0.2
Upper Slope	Naididae	5.8	0.1
Upper Slope	Yoldia seminuda	5.8	0.1
Upper Slope	Aricidea (Acmira) catherinae	5.7	0.0
Upper Slope	Ennucula tenuis	5.7	0.1
Upper Slope	Hesperonoe laevis	5.7	0.1
Upper Slope	Heteromastus sp	5.7	0.1
Upper Slope	Pherusa neopapillata	5.7	0.0
Upper Slope	Aricidea (Strelzovia) antennata	5.5	0.0
Upper Slope	Chone sp	5.3	0.1
Upper Slope	Cossura candida	5.3	0.0
Upper Slope	Monticellina cryptica	5.3	0.1
Upper Slope	Polyschides sp	5.3	0.1
Upper Slope	Spiophanes sp	5.3	0.0
Upper Slope	Aglaja ocelligera	5.1	0.0
Upper Slope	Bivalvia	5.1	0.0
Upper Slope	Falcidens macracanthos	5.1	0.1
Upper Slope	Haliophasma geminatum	5.1	0.1
Upper Slope	Tellina cadieni	5.1	0.1
Upper Slope	Amphiodia digitata	4.9	0.1
Upper Slope	Aricidea (Acmira) lopezi	4.9	0.0
Upper Slope	Cirratulidae	4.9	0.0
Upper Slope	Echinoidea	4.9	0.1
Upper Slope	Myriochele olgae	4.9	0.3
Upper Slope	Pentamera pseudocalcigera	4.9	0.0
Upper Slope	Amphiodia urtica	4.8	0.1
Upper Slope	Hinea insculpta	4.8	0.0
Upper Slope	Terebellides californica	4.8	0.1
Upper Slope	Tubulanus polymorphus	4.8	0.1
Upper Slope	Cuspidaria parapodema	4.6	0.0
Upper Slope	Euclymeninae	4.6	0.1
Upper Slope	Fauveliopsis glabra	4.6	0.2
Upper Slope	Listriella albina	4.6	0.0
Upper Slope	Pinnixa sp	4.6	0.0
Upper Slope	Podarkeopsis glabrus	4.6	0.0
Upper Slope	Yoldiella nana	4.6	0.3
Upper Slope	Lucinoma annulatum	4.4	0.0
Upper Slope	Polycirrus sp A	4.4	0.1
Upper Slope	Prionospio (Prionospio) sp	4.4	0.0
Upper Slope	Ampharete acutifrons	4.2	0.0
Upper Slope	Bathymedon pumilus	4.2	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Brisaster sp	4.2	0.1
Upper Slope	Cirrophorus branchiatus	4.2	0.0
Upper Slope	Nellobia eusoma	4.2	0.1
Upper Slope	Phoronis sp	4.2	0.1
Upper Slope	Pseudomma sp	4.2	0.0
Upper Slope	Turbonilla sp	4.1	0.0
Upper Slope	Westwoodilla tone	4.1	0.0
Upper Slope	Cossura sp	3.9	0.1
Upper Slope	Onuphis sp	3.9	0.0
Upper Slope	Ampelisca pacifica	3.7	0.1
Upper Slope	Amphicteis scaphobranchiata	3.7	0.0
Upper Slope	Fabrisabella sp A	3.7	0.0
Upper Slope	Goniada maculata	3.7	0.0
Upper Slope	Notomastus sp	3.7	0.0
Upper Slope	Petaloclymene pacifica	3.7	0.1
Upper Slope	Phyllodoce hartmanae	3.7	0.0
Upper Slope	Brada pluribranchiata	3.5	0.0
Upper Slope	Euclymeninae sp A	3.5	0.0
Upper Slope	Notomastus magnus	3.5	0.0
Upper Slope	Sternaspis affinis	3.5	0.0
Upper Slope	Aglaja sp	3.4	0.0
Upper Slope	Ampelisca careyi	3.4	0.1
Upper Slope	Ampharete sp	3.4	0.0
Upper Slope	Ceriantharia	3.4	0.0
Upper Slope	Cossura sp A	3.4	0.0
Upper Slope	Monticellina sp	3.4	0.0
Upper Slope	Polynoidae	3.4	0.0
Upper Slope	Protomedeia articulata Cmplx	3.4	0.1
Upper Slope	Chaetozone sp	3.2	0.0
Upper Slope	Paraphoxus sp 1	3.2	0.1
Upper Slope	Praxillella pacifica	3.2	0.1
Upper Slope	Ampelisca sp	3.0	0.1
Upper Slope	Malmgreniella sp A	3.0	0.0
Upper Slope	Solemya pervernicosa	3.0	0.0
Upper Slope	Falcidens longus	2.8	0.0
Upper Slope	Gastropoda	2.8	0.0
Upper Slope	Gnathiidae	2.8	0.0
Upper Slope	Heterophoxus oculatus	2.8	0.0
Upper Slope	Limnodriloides barnardi	2.8	0.0
Upper Slope	Limnodriloides sp	2.8	0.0
Upper Slope	Notomastus sp A	2.8	0.1

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Oligochaeta	2.8	0.0
Upper Slope	Polycladida	2.8	0.0
Upper Slope	Typosyllis heterochaeta	2.8	0.0
Upper Slope	Bathymedon roquedo	2.7	0.0
Upper Slope	Bathymedon vulpeculus	2.7	0.0
Upper Slope	Chaetozone setosa Cmplx	2.7	0.0
Upper Slope	Hemicyclops thysanotus	2.7	0.0
Upper Slope	Jasmineira sp B	2.7	0.0
Upper Slope	Leitoscoloplos sp	2.7	0.0
Upper Slope	Lirobittium sp	2.7	0.0
Upper Slope	Metasychis disparidentatus	2.7	0.0
Upper Slope	Sabellidae	2.7	0.0
Upper Slope	Tubulanus sp	2.7	0.0
Upper Slope	Amphissa undata	2.5	0.0
Upper Slope	Brisaster latifrons	2.5	0.0
Upper Slope	Cardiomya planetica	2.5	0.0
Upper Slope	Cerebratulus sp	2.5	0.0
Upper Slope	Deflexilodes norvegicus	2.5	0.0
Upper Slope	Diplehnia caeca	2.5	0.0
Upper Slope	Heterophoxus affinis	2.5	0.0
Upper Slope	Microglyphis brevicula	2.5	0.0
Upper Slope	Ophelina acuminata	2.5	0.0
Upper Slope	Spatangoida	2.5	0.0
Upper Slope	Tanaella propinquus	2.5	0.0
Upper Slope	Ampelisca brevisimulata	2.3	0.1
Upper Slope	Amphiura arcystata	2.3	0.0
Upper Slope	Araphura cuspirostris	2.3	0.0
Upper Slope	Calocarides quinqueseriatus	2.3	0.0
Upper Slope	Delectopecten vancouverensis	2.3	0.1
Upper Slope	Malmgreniella sp B Cmplx	2.3	0.0
Upper Slope	Nemertea	2.3	0.0
Upper Slope	Nuculana sp B	2.3	0.0
Upper Slope	Palaeonemertea sp D	2.3	0.0
Upper Slope	Pista estevanica	2.3	0.0
Upper Slope	Rhachotropis barnardi	2.3	0.0
Upper Slope	Tellina modesta	2.3	0.0
Upper Slope	Aphelochaeta tigrina	2.1	0.0
Upper Slope	Brada pilosa	2.1	0.3
Upper Slope	Cephalophoxoides homilis	2.1	0.0
Upper Slope	Copepoda	2.1	0.0
Upper Slope	Drilonereis sp	2.1	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Eulalia californiensis	2.1	0.0
Upper Slope	Eulalia levicornuta Cmplx	2.1	0.0
Upper Slope	Myriochele sp	2.1	0.0
Upper Slope	Pholoe glabra	2.1	0.0
Upper Slope	Polycirrus californicus	2.1	0.0
Upper Slope	Tectidrilus diversus	2.1	0.0
Upper Slope	Travisia pupa	2.1	0.0
Upper Slope	Tritella tenuissima	2.1	0.0
Upper Slope	Amage anops	1.9	0.0
Upper Slope	Brissopsis sp LA1	1.9	0.0
Upper Slope	Capitellidae	1.9	0.0
Upper Slope	Dacrydium pacificum	1.9	0.1
Upper Slope	Dipolydora socialis	1.9	0.0
Upper Slope	Falcidens hartmanae	1.9	0.0
Upper Slope	Harmothoe sp	1.9	0.0
Upper Slope	Harpiniopsis epistomata	1.9	0.0
Upper Slope	Levinsenia multibranchiata	1.9	0.0
Upper Slope	Lumbrineris sp Group I	1.9	0.0
Upper Slope	Lumbrineris/Scoletoma sp	1.9	0.0
Upper Slope	Malmgreniella baschi	1.9	0.0
Upper Slope	Monticellina serratiseta	1.9	0.0
Upper Slope	Nephtys caecoides	1.9	0.0
Upper Slope	Orchomenella decipiens	1.9	0.0
Upper Slope	Pachynus barnardi	1.9	0.0
Upper Slope	Pista sp	1.9	0.0
Upper Slope	Scleroconcha trituberculata	1.9	0.0
Upper Slope	Subadyte sp	1.9	0.0
Upper Slope	Syrrhoe longifrons	1.9	0.0
Upper Slope	Tectidrilus sp	1.9	0.0
Upper Slope	Acila castrensis	1.8	0.0
Upper Slope	Acteocina cerealis	1.8	0.0
Upper Slope	Aricidea (Allia) sp A	1.8	0.0
Upper Slope	Boccardiella hamata	1.8	0.1
Upper Slope	Chaetodermatidae	1.8	0.0
Upper Slope	Ericthonius rubricornis	1.8	0.0
Upper Slope	Halcampa decemtentaculata	1.8	0.0
Upper Slope	Leucon declivis	1.8	0.0
Upper Slope	Levinsenia sp B	1.8	0.0
Upper Slope	Lirobittium paganicum	1.8	0.0
Upper Slope	Macoma sp	1.8	0.0
Upper Slope	Monticellina siblina	1.8	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Myriochele striolata	1.8	0.0
Upper Slope	Nereis sp	1.8	0.0
Upper Slope	Onuphidae	1.8	0.0
Upper Slope	Paradialychone ecaudata	1.8	0.0
Upper Slope	Pherusa negligens	1.8	0.0
Upper Slope	Subadyte sp LA1	1.8	0.0
Upper Slope	Terebellidae	1.8	0.0
Upper Slope	Typosyllis sp	1.8	0.0
Upper Slope	Ampharete finmarchica	1.6	0.0
Upper Slope	Ancistrosyllis hamata	1.6	0.0
Upper Slope	Asteroidea	1.6	0.0
Upper Slope	Campylaspis blakei	1.6	0.0
Upper Slope	Chaetoderma marinelli	1.6	0.0
Upper Slope	Cyclocardia sp	1.6	0.0
Upper Slope	Diastylis crenellata	1.6	0.0
Upper Slope	Exogone lourei	1.6	0.0
Upper Slope	Fauveliopsis sp	1.6	0.0
Upper Slope	Levinsenia sp	1.6	0.0
Upper Slope	Lysippe sp A	1.6	0.0
Upper Slope	Magelona sp B	1.6	0.0
Upper Slope	Ninoe tridentata	1.6	0.0
Upper Slope	Phyllochaetopterus sp	1.6	0.0
Upper Slope	Phyllodoce sp	1.6	0.0
Upper Slope	Polygireulima rutila	1.6	0.0
Upper Slope	Rhachotropis distincta	1.6	0.0
Upper Slope	Terebellides reishi	1.6	0.0
Upper Slope	Ampelisca hancocki	1.4	0.0
Upper Slope	Amphipholis squamata	1.4	0.0
Upper Slope	Anopla	1.4	0.0
Upper Slope	Aphelochaeta williamsae	1.4	0.0
Upper Slope	Astyris permodesta	1.4	0.0
Upper Slope	Campylaspis sp A	1.4	0.0
Upper Slope	Carinoma mutabilis	1.4	0.0
Upper Slope	Chaetozone commonalis	1.4	0.0
Upper Slope	Cyclopecten catalinensis	1.4	0.1
Upper Slope	Dentalium vallicolens	1.4	0.0
Upper Slope	Enopla	1.4	0.0
Upper Slope	Hirudinea	1.4	0.0
Upper Slope	Lumbrineris ligulata	1.4	0.0
Upper Slope	Malmgreniella bansei	1.4	0.0
Upper Slope	Marphysa disjuncta	1.4	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Nephtys sp	1.4	0.0
Upper Slope	Onuphis sp A	1.4	0.0
Upper Slope	Paranemertes californica	1.4	0.0
Upper Slope	Pherusa sp SD2	1.4	0.0
Upper Slope	Phyllodoce cuspidata	1.4	0.0
Upper Slope	Polyschides quadrifissatus	1.4	0.0
Upper Slope	Prionospio (Prionospio) dubia	1.4	0.0
Upper Slope	Rhodine bitorquata	1.4	0.0
Upper Slope	Amaeana occidentalis	1.2	0.0
Upper Slope	Americhelidium shoemakeri	1.2	0.0
Upper Slope	Ampelisca pugetica	1.2	0.0
Upper Slope	Anonyx lilljeborgi	1.2	0.0
Upper Slope	Aphelochaeta sp LA1	1.2	0.0
Upper Slope	Balcis oldroydae	1.2	0.0
Upper Slope	Cardiomya sp	1.2	0.0
Upper Slope	Diaphana californica	1.2	0.0
Upper Slope	Dodecamastus mariaensis	1.2	0.0
Upper Slope	Echiuridea	1.2	0.0
Upper Slope	Gymnonereis crosslandi	1.2	0.0
Upper Slope	Heteromastus filiformis Cmplx	1.2	0.0
Upper Slope	Ilyarachna acarina	1.2	0.0
Upper Slope	Leitoscoloplos panamensis	1.2	0.0
Upper Slope	Lumbrineris japonica	1.2	0.0
Upper Slope	Luzonia chilensis	1.2	0.0
Upper Slope	Metaphoxus frequens	1.2	0.0
Upper Slope	Neilonella ritteri	1.2	0.1
Upper Slope	Nematoda	1.2	0.0
Upper Slope	Nereiphylla ferruginea Cmplx	1.2	0.0
Upper Slope	Pherusa sp	1.2	0.0
Upper Slope	Photis sp	1.2	0.0
Upper Slope	Podarkeopsis perkinsi	1.2	0.0
Upper Slope	Sipuncula	1.2	0.0
Upper Slope	Terebellides sp	1.2	0.0
Upper Slope	Bruzelia tuberculata	1.1	0.0
Upper Slope	Cardiomya pectinata	1.1	0.0
Upper Slope	Diopatra tridentata	1.1	0.0
Upper Slope	Edwardsiidae	1.1	0.0
Upper Slope	Glycera sp	1.1	0.0
Upper Slope	Hesperonoe sp	1.1	0.0
Upper Slope	Hippomedon columbianus	1.1	0.0
Upper Slope	Lanassa venusta venusta	1.1	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Listriella eriopisa	1.1	0.0
Upper Slope	Luidia sp	1.1	0.0
Upper Slope	Lytechinus pictus	1.1	0.0
Upper Slope	Melinna oculata	1.1	0.0
Upper Slope	Nuculana sp A	1.1	0.0
Upper Slope	Onuphis geophiliformis	1.1	0.0
Upper Slope	Ophelina pallida	1.1	0.0
Upper Slope	Parvaplustrum sp B	1.1	0.0
Upper Slope	Pentamera sp	1.1	0.0
Upper Slope	Phisidia sanctaemariae	1.1	0.0
Upper Slope	Phyllochaetopterus prolifica	1.1	0.0
Upper Slope	Procampylaspis caenosa	1.1	0.0
Upper Slope	Rhachotropis sp A	1.1	0.0
Upper Slope	Saccella penderi	1.1	0.0
Upper Slope	Scoletoma sp	1.1	0.0
Upper Slope	Sigambra tentaculata	1.1	0.0
Upper Slope	Tanaopsis cadieni	1.1	0.0
Upper Slope	Ampelisca agassizi	0.9	0.0
Upper Slope	Ampharetinae	0.9	0.0
Upper Slope	Amphioplus sp	0.9	0.0
Upper Slope	Aoroides columbiae	0.9	0.0
Upper Slope	Aphelochaeta petersenae	0.9	0.0
Upper Slope	Arhynchite californicus	0.9	0.0
Upper Slope	Boccardia sp	0.9	0.0
Upper Slope	Cancellaria crawfordiana	0.9	0.0
Upper Slope	Chaetopteridae	0.9	0.0
Upper Slope	Enteropneusta	0.9	0.0
Upper Slope	Eumida longicornuta	0.9	0.0
Upper Slope	Euphilomedes sp	0.9	0.0
Upper Slope	Fauveliopsis sp SD1	0.9	0.0
Upper Slope	Harmothoinae	0.9	0.0
Upper Slope	Harpiniopsis galera	0.9	0.0
Upper Slope	Heteronemertea sp SD2	0.9	0.0
Upper Slope	Holmesiella anomala	0.9	0.0
Upper Slope	Lepidasthenia berkeleyae	0.9	0.0
Upper Slope	Leptochelia dubia Cmplx	0.9	0.0
Upper Slope	Lirobittium calenum	0.9	0.1
Upper Slope	Lumbrineris latreilli	0.9	0.0
Upper Slope	Lysippe sp B	0.9	0.0
Upper Slope	Malmgreniella macginitiei	0.9	0.0
Upper Slope	Mayerella banksia	0.9	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Mooreonuphis sp	0.9	0.0
Upper Slope	Munnopsurus sp A	0.9	0.0
Upper Slope	Pandora bilirata	0.9	0.0
Upper Slope	Paramage scutata	0.9	0.0
Upper Slope	Parvaplustrum sp A	0.9	0.0
Upper Slope	Phoronis sp SD1	0.9	0.0
Upper Slope	Photis parvidons	0.9	0.0
Upper Slope	Pinnotheridae	0.9	0.0
Upper Slope	Pista brevibranchiata	0.9	0.0
Upper Slope	Rhachotropis luculenta	0.9	0.0
Upper Slope	Solamen columbianum	0.9	0.0
Upper Slope	Streblosoma sp B	0.9	0.0
Upper Slope	Tellina sp	0.9	0.0
Upper Slope	Thysanocardia nigra	0.9	0.0
Upper Slope	Volvulella californica	0.9	0.0
Upper Slope	Alvania rosana	0.7	0.0
Upper Slope	Amphichondrius granulatus	0.7	0.0
Upper Slope	Amphicteis mucronata	0.7	0.0
Upper Slope	Amphiporus sp	0.7	0.0
Upper Slope	Aoroides sp A	0.7	0.0
Upper Slope	Aphrodita sp	0.7	0.0
Upper Slope	Araphura breviaria	0.7	0.0
Upper Slope	Argissa hamatipes	0.7	0.0
Upper Slope	Arhynchite sp	0.7	0.0
Upper Slope	Aricidea (Allia) antennata	0.7	0.0
Upper Slope	Aricidea (Strelzovia) hartleyi	0.7	0.0
Upper Slope	Axinodon redondoensis	0.7	0.0
Upper Slope	Bathymedon covilhani	0.7	0.0
Upper Slope	Campylaspis canaliculata	0.7	0.0
Upper Slope	Dendrochirotida	0.7	0.0
Upper Slope	Dentaliidae	0.7	0.0
Upper Slope	Diastylis sp	0.7	0.0
Upper Slope	Dougaloplus sp	0.7	0.0
Upper Slope	Euchone velifera	0.7	0.0
Upper Slope	Euclymeninae sp B	0.7	0.0
Upper Slope	Eudorellopsis longirostris	0.7	0.0
Upper Slope	Eulalia sp	0.7	0.0
Upper Slope	Flabelligera infundibularis	0.7	0.0
Upper Slope	Foxiphalus obtusidens	0.7	0.0
Upper Slope	Gadila aberrans	0.7	0.0
Upper Slope	Heteronemertea	0.7	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Hippomedon sp A	0.7	0.0
Upper Slope	Ilyarachna profunda	0.7	0.0
Upper Slope	Jassa slatteryi	0.7	0.0
Upper Slope	Keenaea centifilosum	0.7	0.0
Upper Slope	Leptostylis calva	0.7	0.0
Upper Slope	Lineus sp	0.7	0.0
Upper Slope	Lumbrineris limicola	0.7	0.0
Upper Slope	Magelona berkeleyi	0.7	0.0
Upper Slope	Maldane sp	0.7	0.0
Upper Slope	Melinna sp	0.7	0.0
Upper Slope	Mooresamytha bioculata	0.7	0.0
Upper Slope	Mysida	0.7	0.0
Upper Slope	Nereis sp SD1	0.7	0.0
Upper Slope	Nuculana taphria	0.7	0.0
Upper Slope	Palaeonemertea	0.7	0.0
Upper Slope	Paradialychone harrisae	0.7	0.0
Upper Slope	Paralysippe annectens	0.7	0.0
Upper Slope	Paranaitis polynoides	0.7	0.0
Upper Slope	Paraonidae	0.7	0.0
Upper Slope	Parexogone molesta	0.7	0.0
Upper Slope	Pentamera populifera	0.7	0.0
Upper Slope	Philomedes dentata	0.7	0.0
Upper Slope	Phoronida	0.7	0.0
Upper Slope	Photis bifurcata	0.7	0.0
Upper Slope	Phyllodoce medipapillata	0.7	0.0
Upper Slope	Saxicavella nybakkeni	0.7	0.0
Upper Slope	Scaphopoda sp SD1	0.7	0.0
Upper Slope	Sosane occidentalis	0.7	0.0
Upper Slope	Spatangus californicus	0.7	0.0
Upper Slope	Spiophanes norrisi	0.7	0.0
Upper Slope	Stereobalanus sp	0.7	0.0
Upper Slope	Tanaidacea	0.7	0.0
Upper Slope	Tubulanidae	0.7	0.0
Upper Slope	Typosyllis hyperioni	0.7	0.0
Upper Slope	Volvulella panamica	0.7	0.0
Upper Slope	Acteocina sp	0.5	0.0
Upper Slope	Actiniaria	0.5	0.0
Upper Slope	Aglaophamus paucilamellata	0.5	0.0
Upper Slope	Aglaophamus sp	0.5	0.0
Upper Slope	Aglaophamus verrilli	0.5	0.0
Upper Slope	Ampeliscidae	0.5	0.8

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Amphipholis sp	0.5	0.0
Upper Slope	Amphipoda	0.5	0.0
Upper Slope	Amygdalum pallidulum	0.5	0.0
Upper Slope	Ancistrosyllis breviceps	0.5	0.0
Upper Slope	Antalis pretiosa	0.5	0.0
Upper Slope	Aphelochaeta sp HYP5	0.5	0.0
Upper Slope	Aphelochaeta sp SD14	0.5	0.0
Upper Slope	Aphelochaeta sp SD18 (B13-1)	0.5	0.0
Upper Slope	Aphrodita japonica	0.5	0.0
Upper Slope	Apionsoma misakianum	0.5	0.0
Upper Slope	Aricidea (Acmira) rubra	0.5	0.0
Upper Slope	Aricidea (Acmira) sp	0.5	0.0
Upper Slope	Aricidea (Strelzovia) sp A	0.5	0.0
Upper Slope	Artacama coniferi	0.5	0.0
Upper Slope	Artacamella hancocki	0.5	0.0
Upper Slope	Belonectes sp A	0.5	0.0
Upper Slope	Bullomorpha sp A	0.5	0.0
Upper Slope	Byblis barbarensis	0.5	0.7
Upper Slope	Byblis veleronis	0.5	0.0
Upper Slope	Caesia perpinguis	0.5	0.0
Upper Slope	Cerebratulus albifrons	0.5	0.0
Upper Slope	Chauliopleona dentata	0.5	0.0
Upper Slope	Cirratulus sp	0.5	0.0
Upper Slope	Clymenura gracilis	0.5	0.0
Upper Slope	Cyclocardia gouldii	0.5	0.0
Upper Slope	Echiura	0.5	0.0
Upper Slope	Edwardsia profunda	0.5	0.0
Upper Slope	Fabrisabella sp	0.5	0.0
Upper Slope	Glycera tesselata	0.5	0.0
Upper Slope	Haliella abyssicola	0.5	0.0
Upper Slope	Holothuroidea	0.5	0.0
Upper Slope	Hoplonemertea	0.5	0.0
Upper Slope	Huxleyia munita	0.5	0.0
Upper Slope	Kurtiella sp	0.5	0.0
Upper Slope	Kurtzina beta	0.5	0.0
Upper Slope	Lepidasthenia longicirrata	0.5	0.0
Upper Slope	Lepidepecreum garthi	0.5	0.0
Upper Slope	Lirobittium larum	0.5	0.0
Upper Slope	Maldane californiensis	0.5	0.0
Upper Slope	Malletia pacifica	0.5	0.0
Upper Slope	Micrura alaskensis	0.5	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Molpadia intermedia	0.5	0.0
Upper Slope	Mysidae	0.5	0.0
Upper Slope	Nephasoma diaphanes	0.5	0.0
Upper Slope	Nephtyidae	0.5	0.0
Upper Slope	Nereiphylla sp	0.5	0.0
Upper Slope	Neverita recluziana	0.5	0.0
Upper Slope	Notomastus latericeus	0.5	0.0
Upper Slope	Oedicerotidae	0.5	0.0
Upper Slope	Ophiuridae	0.5	0.0
Upper Slope	Pacifoculodes barnardi	0.5	0.0
Upper Slope	Phascolion sp A	0.5	0.0
Upper Slope	Photis lacia	0.5	0.0
Upper Slope	Polycirrus sp OC1	0.5	0.0
Upper Slope	Polydora sp	0.5	0.0
Upper Slope	Prionospio (Minuspio) sp	0.5	0.0
Upper Slope	Rhepoxynius bicuspidatus	0.5	0.0
Upper Slope	Scionella japonica	0.5	0.0
Upper Slope	Solariella peramabilis	0.5	0.0
Upper Slope	Tectidrilus probus	0.5	0.0
Upper Slope	Tellinidae	0.5	0.0
Upper Slope	Terebellides sp Type D	0.5	0.0
Upper Slope	Tubulanidae sp B	0.5	0.0
Upper Slope	Tubulanus sp A	0.5	0.0
Upper Slope	Volvulella cylindrica	0.5	0.0
Upper Slope	Waldo sp A	0.5	0.0
Upper Slope	Zygeupolia rubens	0.5	0.0
Upper Slope	Acoetes pacifica	0.4	0.0
Upper Slope	Americhelidium sp	0.4	0.0
Upper Slope	Americhelidium sp SD4	0.4	0.0
Upper Slope	Ampelisca cf brevisimulata	0.4	0.0
Upper Slope	Ampelisca plumosa	0.4	0.0
Upper Slope	Amphioplus sp A	0.4	0.0
Upper Slope	Amphiura sp	0.4	0.0
Upper Slope	Anoplodactylus sp	0.4	0.0
Upper Slope	Araphura sp SD1	0.4	0.0
Upper Slope	Athenaria	0.4	0.0
Upper Slope	Bathyleberis sp	0.4	0.0
Upper Slope	Bathymedon flebilis	0.4	0.0
Upper Slope	Bougainvilliidae	0.4	0.0
Upper Slope	Brada sp	0.4	0.0
Upper Slope	Calocarides spinulicauda	0.4	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Calyptogena sp	0.4	0.0
Upper Slope	Campylaspis biplicata	0.4	0.0
Upper Slope	Campylaspis rubromaculata	0.4	0.0
Upper Slope	Campylaspis sp N	0.4	0.0
Upper Slope	Capitella teleta	0.4	0.0
Upper Slope	Cerebratulus marginatus	0.4	0.0
Upper Slope	Chaetodermatida	0.4	0.0
Upper Slope	Chaetozone hartmanae	0.4	0.0
Upper Slope	Crangonidae	0.4	0.0
Upper Slope	Cumacea	0.4	0.0
Upper Slope	Cyclopecten sp	0.4	0.0
Upper Slope	Deilocerus planus	0.4	0.0
Upper Slope	Dialychone albocincta	0.4	0.0
Upper Slope	Dipolydora sp	0.4	0.0
Upper Slope	Dorvillea (Schistomeringos) sp	0.4	0.0
Upper Slope	Drilonereis mexicana	0.4	0.0
Upper Slope	Drilonereis sp A	0.4	0.0
Upper Slope	Epitonium sawinae	0.4	0.0
Upper Slope	Eranno bicirrata	0.4	0.0
Upper Slope	Eulimidae	0.4	0.0
Upper Slope	Eunicidae	0.4	0.0
Upper Slope	Eurydice caudata	0.4	0.0
Upper Slope	Eusyllinae	0.4	0.0
Upper Slope	Eusyllis sp	0.4	0.0
Upper Slope	Excorallana truncata	0.4	0.0
Upper Slope	Galathowenia sp	0.4	0.0
Upper Slope	Gammaridea	0.4	0.0
Upper Slope	Glottidia albida	0.4	0.0
Upper Slope	Glycera branchiopoda	0.4	0.0
Upper Slope	Glycera tenuis	0.4	0.0
Upper Slope	Glyphanostomum pallescens	0.4	0.0
Upper Slope	Goniada annulata	0.4	0.0
Upper Slope	Halianthella sp A	0.4	0.0
Upper Slope	Harmothoe fragilis	0.4	0.0
Upper Slope	Heterophoxus sp LA1	0.4	0.0
Upper Slope	Hiatella arctica	0.4	0.0
Upper Slope	Hippolytidae	0.4	0.0
Upper Slope	Kinbergonuphis vexillaria	0.4	0.0
Upper Slope	Lepidepecreum gurjanovae	0.4	0.0
Upper Slope	Leptoplanidae	0.4	0.0
Upper Slope	Leucon falcicosta	0.4	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Leucon subnasica	0.4	0.0
Upper Slope	Listriella sp	0.4	0.0
Upper Slope	Loy thompsoni	0.4	0.0
Upper Slope	Lucinoma aequizonatum	0.4	0.0
Upper Slope	Luidia foliolata	0.4	0.0
Upper Slope	Lumbriclymene sp	0.4	0.0
Upper Slope	Lumbrineris sp E	0.4	0.0
Upper Slope	Macoma yoldiformis	0.4	0.0
Upper Slope	Malacoceros indicus	0.4	0.0
Upper Slope	Maldaninae	0.4	0.0
Upper Slope	Malletia faba	0.4	0.0
Upper Slope	Megasurcula carpenteriana	0.4	0.0
Upper Slope	Mendicula ferruginosa	0.4	0.0
Upper Slope	Micrura wilsoni	0.4	0.0
Upper Slope	Molgula pugetiensis	0.4	0.0
Upper Slope	Monoculodes sp	0.4	0.0
Upper Slope	Monostyliferoidea	0.4	0.0
Upper Slope	Mooreonuphis segmentispadix	0.4	0.0
Upper Slope	Mysidella americana	0.4	0.0
Upper Slope	Nassariidae	0.4	0.0
Upper Slope	Nephtys punctata	0.4	0.0
Upper Slope	Nereiphylla sp 2	0.4	0.0
Upper Slope	Nicomache lumbricalis	0.4	0.0
Upper Slope	Nicomache sp	0.4	0.0
Upper Slope	Notocomplana rupicola	0.4	0.0
Upper Slope	Ophryotrocha sp A	0.4	0.0
Upper Slope	Orchomenella pacifica	0.4	0.0
Upper Slope	Orchomenella pinguis	0.4	0.0
Upper Slope	Pannychia moseleyi	0.4	0.0
Upper Slope	Paradoneis sp	0.4	0.0
Upper Slope	Parapagurodes makarovi	0.4	0.0
Upper Slope	Pectinidae	0.4	0.0
Upper Slope	Pherusa papillata	0.4	0.0
Upper Slope	Philine sp	0.4	0.0
Upper Slope	Photis californica	0.4	0.0
Upper Slope	Phoxocephalidae	0.4	0.0
Upper Slope	Phyllodoce pettiboneae	0.4	0.0
Upper Slope	Phyllodocidae	0.4	0.0
Upper Slope	Piscicolidae	0.4	0.0
Upper Slope	Platynereis bicanaliculata	0.4	0.0
Upper Slope	Proclea sp A	0.4	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Rhachotropis sp	0.4	0.0
Upper Slope	Rhizorhagium formosum	0.4	0.0
Upper Slope	Rocinela angustata	0.4	0.0
Upper Slope	Sabellinae	0.4	0.0
Upper Slope	Schisturella cocula	0.4	0.0
Upper Slope	Scoletoma sp C	0.4	0.0
Upper Slope	Serpulidae	0.4	0.0
Upper Slope	Sigambra sp	0.4	0.0
Upper Slope	Sosanopsis sp A	0.4	0.0
Upper Slope	Spathoderma californicum	0.4	0.0
Upper Slope	Spio filicornis	0.4	0.0
Upper Slope	Spionidae	0.4	0.0
Upper Slope	Spiophanes wigleyi	0.4	0.0
Upper Slope	Sthenelais tertiaglabra	0.4	0.0
Upper Slope	Streblosoma crassibranchia	0.4	0.0
Upper Slope	Streblosoma sp	0.4	0.0
Upper Slope	Syllidae	0.4	0.0
Upper Slope	Syrrhoe sp A	0.4	0.0
Upper Slope	Tectidrilus profusus	0.4	0.0
Upper Slope	Tenonia priops	0.4	0.0
Upper Slope	Terebellinae	0.4	0.0
Upper Slope	Tetrastemma albidum	0.4	0.0
Upper Slope	Tetrastemma candidum	0.4	0.0
Upper Slope	Thyasiridae	0.4	0.0
Upper Slope	Trachycardium quadragenarium	0.4	0.0
Upper Slope	Typhlotanais sp	0.4	0.0
Upper Slope	Typhlotanais williamsi	0.4	0.0
Upper Slope	Virgularia agassizii	0.4	0.0
Upper Slope	Vitrinella sp	0.4	0.0
Upper Slope	Yoldiella sp	0.4	0.0
Upper Slope	Acarina	0.2	0.0
Upper Slope	Acidostoma hancocki	0.2	0.0
Upper Slope	Acteon traskii	0.2	0.0
Upper Slope	Admete gracilior	0.2	0.0
Upper Slope	Agnezia septentrionalis	0.2	0.0
Upper Slope	Akanthophoreus phillipsi	0.2	0.0
Upper Slope	Alia tuberosa	0.2	0.0
Upper Slope	Amblyops abbreviatus	0.2	0.0
Upper Slope	Amblyops sp	0.2	0.0
Upper Slope	Ampelisca cristata cristata	0.2	0.0
Upper Slope	Ampelisca romigi	0.2	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Ampharetidae sp SD1	0.2	0.0
Upper Slope	Amphicteis sp	0.2	0.0
Upper Slope	Amphiodia psara	0.2	0.0
Upper Slope	Amphipholis pugetana	0.2	0.0
Upper Slope	Amphiporus bimaculatus	0.2	0.0
Upper Slope	Amphiporus cruentatus	0.2	0.0
Upper Slope	Anarthruridae	0.2	0.0
Upper Slope	Anarthruridae sp 2	0.2	0.0
Upper Slope	Ancistrosyllis sp	0.2	0.0
Upper Slope	Anoplodactylus erectus	0.2	0.0
Upper Slope	Antalis pretiosum	0.2	0.0
Upper Slope	Anthozoa	0.2	0.0
Upper Slope	Antiplanes catalinae	0.2	0.0
Upper Slope	Aoroides intermedia	0.2	0.0
Upper Slope	Aoroides sp	0.2	0.0
Upper Slope	Aphelochaeta phillipsi	0.2	0.0
Upper Slope	Aphelochaeta sp SD13	0.2	0.0
Upper Slope	Aphelochaeta sp SD3	0.2	0.0
Upper Slope	Aphrodita longipalpa	0.2	0.0
Upper Slope	Apionsoma sp	0.2	0.0
Upper Slope	Aricidea (Acmira) simplex	0.2	0.0
Upper Slope	Aricidea (Allia) monicae	0.2	0.0
Upper Slope	Aricidea (Allia) sp DC1	0.2	0.0
Upper Slope	Aricidea (Aricidea) sp	0.2	0.0
Upper Slope	Aricidea (Strelzovia) sp	0.2	0.0
Upper Slope	Aristias sp DC1	0.2	0.0
Upper Slope	Armandia brevis	0.2	0.0
Upper Slope	Aruga oculata	0.2	0.0
Upper Slope	Ascidiacea	0.2	0.0
Upper Slope	Asellota	0.2	0.0
Upper Slope	Asteronyx longifissus	0.2	0.0
Upper Slope	Astropecten californicus	0.2	0.0
Upper Slope	Astropecten sp	0.2	0.0
Upper Slope	Balanoglossus sp	0.2	0.0
Upper Slope	Baseodiscus sp	0.2	0.0
Upper Slope	Bathyagonus pentacanthus	0.2	0.0
Upper Slope	Bathyleberis cf garthi	0.2	0.0
Upper Slope	Bathymedon cf roquedo	0.2	0.0
Upper Slope	Bathymedon kassites	0.2	0.0
Upper Slope	Bathymedon sp	0.2	0.0
Upper Slope	Bemlos sp	0.2	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Boccardiella sp	0.2	0.0
Upper Slope	Byblis bathyalis	0.2	0.0
Upper Slope	Byblis millsi	0.2	0.0
Upper Slope	Byblis thyabilis	0.2	0.0
Upper Slope	Bylgides sp	0.2	0.0
Upper Slope	Callianopsis goniophthalma	0.2	0.0
Upper Slope	Calocarides sp	0.2	0.0
Upper Slope	Campylaspis hartae	0.2	0.0
Upper Slope	Campylaspis maculinodulosa	0.2	0.0
Upper Slope	Campylaspis rufa	0.2	0.0
Upper Slope	Campylaspis sp LA2	0.2	0.0
Upper Slope	Caprella californica Cmplx	0.2	0.0
Upper Slope	Caprella mutica	0.2	0.0
Upper Slope	Caprella sp SD2	0.2	0.0
Upper Slope	Caprella verrucosa	0.2	0.0
Upper Slope	Caprellidae	0.2	0.0
Upper Slope	Caprellinae sp B	0.2	0.0
Upper Slope	Caudofoveata	0.2	0.0
Upper Slope	Caulleriella alata	0.2	0.0
Upper Slope	Ceratocephale loveni	0.2	0.0
Upper Slope	Cerebratulus montgomeryi	0.2	0.0
Upper Slope	Chaetoderma elegans	0.2	0.0
Upper Slope	Chaetoderma hancocki	0.2	0.0
Upper Slope	Chaetoderma sp	0.2	0.0
Upper Slope	Chaetozone corona	0.2	0.0
Upper Slope	Chaetozone gracilis	0.2	0.0
Upper Slope	Chaetozone sp SD3	0.2	0.0
Upper Slope	Chaetozone sp SD5	0.2	0.0
Upper Slope	Chirimia biceps	0.2	0.0
Upper Slope	Chone sp SD3	0.2	0.0
Upper Slope	Cirolana sp	0.2	0.0
Upper Slope	Cirratulus cirratus Cmplx	0.2	0.0
Upper Slope	Conoidea	0.2	0.0
Upper Slope	Cooperella subdiaphana	0.2	0.0
Upper Slope	Corymorpha palma	0.2	0.0
Upper Slope	Crangon sp	0.2	0.0
Upper Slope	Crockerella sp	0.2	0.0
Upper Slope	Cryptocelis occidentalis	0.2	0.0
Upper Slope	Cucumaria sp	0.2	0.0
Upper Slope	Cuspidariidae	0.2	0.0
Upper Slope	Cyamioidea	0.2	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Dactylopleustes sp A	0.2	0.0
Upper Slope	Dallicordia alaskana	0.2	0.0
Upper Slope	Decapoda	0.2	0.0
Upper Slope	Deltamysis sp LA1	0.2	0.0
Upper Slope	Dentalium sp	0.2	0.0
Upper Slope	Dialychone sp 1	0.2	0.0
Upper Slope	Dialychone trilineata	0.2	0.0
Upper Slope	Diaphana sp	0.2	0.0
Upper Slope	Diastylidae	0.2	0.0
Upper Slope	Diastylis californica	0.2	0.0
Upper Slope	Diastylis sentosa	0.2	0.0
Upper Slope	Diastylis sp C	0.2	0.0
Upper Slope	Diopatra ornata	0.2	0.0
Upper Slope	Diopatra sp	0.2	0.0
Upper Slope	Diplandros singularis	0.2	0.0
Upper Slope	Diplocirrus sp	0.2	0.0
Upper Slope	Dipolydora caulleryi	0.2	0.0
Upper Slope	Dodecaceria sp	0.2	0.0
Upper Slope	Dodecaseta oraria	0.2	0.0
Upper Slope	Dorvilleidae	0.2	0.0
Upper Slope	Drilonereis falcata	0.2	0.0
Upper Slope	Drilonereis filum	0.2	0.0
Upper Slope	Dulichiopsis remis	0.2	0.0
Upper Slope	Edotia sp	0.2	0.0
Upper Slope	Edwardsia juliae	0.2	0.0
Upper Slope	Edwardsia olguini	0.2	0.0
Upper Slope	Edwardsia sp DC1	0.2	0.0
Upper Slope	Enopla sp A	0.2	0.0
Upper Slope	Epitonium berryi	0.2	0.0
Upper Slope	Eptatretus stoutii	0.2	0.0
Upper Slope	Eranno sp	0.2	0.0
Upper Slope	Eteone brigitteae	0.2	0.0
Upper Slope	Euchone arenae	0.2	0.0
Upper Slope	Euchone sp	0.2	0.0
Upper Slope	Eucranta anoculata	0.2	0.0
Upper Slope	Eudorella redacticruris	0.2	0.0
Upper Slope	Eulima raymondi	0.2	0.0
Upper Slope	Eumida sp	0.2	0.0
Upper Slope	Eunice sp	0.2	0.0
Upper Slope	Eunoe sp	0.2	0.0
Upper Slope	Euphilomedes longiseta	0.2	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Eurycope californiensis	0.2	0.0
Upper Slope	Eusarsiella thominx	0.2	0.0
Upper Slope	Euspira sp	0.2	0.0
Upper Slope	Exogone sp SD1	0.2	0.0
Upper Slope	Flabelligeridae	0.2	0.0
Upper Slope	Foxiphalus similis	0.2	0.0
Upper Slope	Gammaropsis ociosa	0.2	0.0
Upper Slope	Garosyrrhoe bigarra	0.2	0.0
Upper Slope	Glycera oxycephala	0.2	0.0
Upper Slope	Glycera robusta	0.2	0.0
Upper Slope	Glycera sp LA1	0.2	0.0
Upper Slope	Glycinde sp	0.2	0.0
Upper Slope	Gnathia productatridens	0.2	0.0
Upper Slope	Halicoides synopiae	0.2	0.0
Upper Slope	Harpacticoida	0.2	0.0
Upper Slope	Harpiniinae	0.2	0.0
Upper Slope	Harpiniopsis emeryi	0.2	0.0
Upper Slope	Harpiniopsis naiadis	0.2	0.0
Upper Slope	Hartmanodes hartmanae	0.2	0.0
Upper Slope	Havelockia sp	0.2	0.0
Upper Slope	Hemilamprops sp A	0.2	0.0
Upper Slope	Hemilamprops sp B	0.2	0.0
Upper Slope	Hermundura fauveli	0.2	0.0
Upper Slope	Hesionidae	0.2	0.0
Upper Slope	Hoplonemertea sp SD2	0.2	0.0
Upper Slope	Hormathiidae	0.2	0.0
Upper Slope	Hyalidae	0.2	0.0
Upper Slope	Hydrozoa	0.2	0.0
Upper Slope	Isocheles pilosus	0.2	0.0
Upper Slope	Jasmineira sp	0.2	0.0
Upper Slope	Kurtiella mortoni	0.2	0.0
Upper Slope	Kurtiella sp D	0.2	0.0
Upper Slope	Kurtiella sp LA1	0.2	0.0
Upper Slope	Lampropidae sp SD1	0.2	0.0
Upper Slope	Lanassa gracilis	0.2	0.0
Upper Slope	Lanice conchilega	0.2	0.0
Upper Slope	Laonice sp	0.2	0.0
Upper Slope	Lebbeus sp	0.2	0.0
Upper Slope	Leiochrides hemipodus	0.2	0.0
Upper Slope	Leitoscoloplos mexicanus	0.2	0.0
Upper Slope	Leptophoxus falcatus icelus	0.2	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Leptosynapta sp	0.2	0.0
Upper Slope	Leucon sp J	0.2	0.0
Upper Slope	Liljeborgia cota	0.2	0.0
Upper Slope	Liljeborgiidae	0.2	0.0
Upper Slope	Lineus flavescens	0.2	0.0
Upper Slope	Listriolobus hexamyotus	0.2	0.0
Upper Slope	Lumbriclymene lineus	0.2	0.0
Upper Slope	Lumbrinerides sp	0.2	0.0
Upper Slope	Lysianassidae	0.2	0.0
Upper Slope	Lysianassoidea	0.2	0.0
Upper Slope	Maera bousfieldi	0.2	0.0
Upper Slope	Maera nelsonae	0.2	0.0
Upper Slope	Magelona hartmanae	0.2	0.0
Upper Slope	Malmgreniella sp SD2	0.2	0.0
Upper Slope	Mangeliidae	0.2	0.0
Upper Slope	Marphysa sp	0.2	0.0
Upper Slope	Melphisana bola Cmplx	0.2	0.0
Upper Slope	Mesolamprops bispinosus	0.2	0.0
Upper Slope	Metopa dawsoni	0.2	0.0
Upper Slope	Micranellum crebricinctum	0.2	0.0
Upper Slope	Micropodarke dubia	0.2	0.0
Upper Slope	Microspio pigmentata	0.2	0.0
Upper Slope	Modiolinae	0.2	0.0
Upper Slope	Molgula napiformis	0.2	0.0
Upper Slope	Monobrachium parasitum	0.2	0.0
Upper Slope	Monoculodes glyconicus	0.2	0.0
Upper Slope	Monticellina sp SD7	0.2	0.0
Upper Slope	Monticellina sp SD9	0.2	0.0
Upper Slope	Mooreonuphis nebulosa	0.2	0.0
Upper Slope	Mooreonuphis sp SD2	0.2	0.0
Upper Slope	Mooresamytha sp	0.2	0.0
Upper Slope	Munnogonium tillerae	0.2	0.0
Upper Slope	Neocrangon communis	0.2	0.0
Upper Slope	Neolepton salmoneum	0.2	0.0
Upper Slope	Neomeniomorpha sp SD3	0.2	0.0
Upper Slope	Neotrypaea gigas	0.2	0.0
Upper Slope	Nephasoma pellucidum	0.2	0.0
Upper Slope	Nephasoma sp	0.2	0.0
Upper Slope	Nereididae	0.2	0.0
Upper Slope	Neverita draconis	0.2	0.0
Upper Slope	Ninoe sp	0.2	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Notoproctus pacificus	0.2	0.0
Upper Slope	Nuculanidae	0.2	0.0
Upper Slope	Octobranchus sp	0.2	0.0
Upper Slope	Oncopagurus haigae	0.2	0.0
Upper Slope	Onuphis affinis	0.2	0.0
Upper Slope	Onuphis multiannulata	0.2	0.0
Upper Slope	Ophiura luetkenii	0.2	0.0
Upper Slope	Opisa tridentata	0.2	0.0
Upper Slope	Oradarea longimana	0.2	0.0
Upper Slope	Orbiniidae	0.2	0.0
Upper Slope	Orchomene anaquelus	0.2	0.0
Upper Slope	Oweniidae	0.2	0.0
Upper Slope	Oxydromus pugettensis	0.2	0.0
Upper Slope	Paguroidea	0.2	0.0
Upper Slope	Paradialychone bimaculata	0.2	0.0
Upper Slope	Paradialychone paramollis	0.2	0.0
Upper Slope	Paradiopatra sp	0.2	0.0
Upper Slope	Paradoneis eliasoni	0.2	0.0
Upper Slope	Paramblyops sp LA1	0.2	0.0
Upper Slope	Paramblyops sp SMB1	0.2	0.0
Upper Slope	Paramicrodeutopus schmitti	0.2	0.0
Upper Slope	Pardaliscella sp	0.2	0.0
Upper Slope	Pardaliscella symmetrica	0.2	0.0
Upper Slope	Pardaliscidae	0.2	0.0
Upper Slope	Parexogone acutipalpa	0.2	0.0
Upper Slope	Parviplana hymani	0.2	0.0
Upper Slope	Peachia quinquecapitata	0.2	0.0
Upper Slope	Pentamera pseudopopulifera	0.2	0.0
Upper Slope	Philine alba	0.2	0.0
Upper Slope	Philine californica	0.2	0.0
Upper Slope	Philine sp A	0.2	0.0
Upper Slope	Phimochirus californiensis	0.2	0.0
Upper Slope	Pholadomyoida	0.2	0.0
Upper Slope	Pholoides asperus	0.2	0.0
Upper Slope	Photis brevipes	0.2	0.0
Upper Slope	Photis chiconola	0.2	0.0
Upper Slope	Photis viuda	0.2	0.0
Upper Slope	Phyllodoce longipes	0.2	0.0
Upper Slope	Pilargis berkeleyae	0.2	0.0
Upper Slope	Pinnixa franciscana	0.2	0.0
Upper Slope	Pleurobranchaea californica	0.2	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Pleurogonium californiense	0.2	0.0
Upper Slope	Pleurogonium sp A	0.2	0.0
Upper Slope	Pleusymtes subglaber	0.2	0.0
Upper Slope	Podarkeopsis sp	0.2	0.0
Upper Slope	Podarkeopsis sp A	0.2	0.0
Upper Slope	Poecilochaetus johnsoni	0.2	0.0
Upper Slope	Pogonophora	0.2	0.0
Upper Slope	Policordia sp OC1	0.2	0.0
Upper Slope	Polynoinae	0.2	0.0
Upper Slope	Potamethus sp A	0.2	0.0
Upper Slope	Praxillella gracilis	0.2	0.0
Upper Slope	Praxillura maculata	0.2	0.0
Upper Slope	Prionospio (Minuspio) sp A	0.2	0.0
Upper Slope	Proceraea sp	0.2	0.0
Upper Slope	Propebela turricula	0.2	0.0
Upper Slope	Pseudatherospio fauchaldi	0.2	0.0
Upper Slope	Pseudotaranis strongi	0.2	0.0
Upper Slope	Pycnogonida	0.2	0.0
Upper Slope	Rhamphobrachium sp	0.2	0.0
Upper Slope	Rhepoxynius daboius	0.2	0.0
Upper Slope	Rhynohalicella halona	0.2	0.0
Upper Slope	Rictaxis painei	0.2	0.0
Upper Slope	Rutiderma lomae	0.2	0.0
Upper Slope	Saccoglossus sp	0.2	0.0
Upper Slope	Scalibregma californicum	0.2	0.0
Upper Slope	Scalibregmatidae	0.2	0.0
Upper Slope	Schisturella tracalero	0.2	0.0
Upper Slope	Schizocardium sp	0.2	0.0
Upper Slope	Scolanthus triangulus	0.2	0.0
Upper Slope	Scoletoma sp A	0.2	0.0
Upper Slope	Scoloplos acmeceps	0.2	0.0
Upper Slope	Scoloplos armiger Cmplx	0.2	0.0
Upper Slope	Semiodera inflata	0.2	0.0
Upper Slope	Sigalionidae	0.2	0.0
Upper Slope	Siphonolabrum californiensis	0.2	0.0
Upper Slope	Siriella pacifica	0.2	0.0
Upper Slope	Solenogastres	0.2	0.0
Upper Slope	Sosane sp	0.2	0.0
Upper Slope	Spathoderma sp A	0.2	0.0
Upper Slope	Sphaerosyllis sp	0.2	0.0
Upper Slope	Sphaerosyllis sp SD2	0.2	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Upper Slope	Spiophanicola spinulosus	0.2	0.0
Upper Slope	Spirontocaris sica	0.2	0.0
Upper Slope	Spirontocaris sp	0.2	0.0
Upper Slope	Stachyptilum superbum	0.2	0.0
Upper Slope	Stenothoides bicoma	0.2	0.0
Upper Slope	Sternaspis williamsae	0.2	0.0
Upper Slope	Sthenelanella uniformis	0.2	0.0
Upper Slope	Streblosoma pacifica	0.2	0.0
Upper Slope	Stylochoplana sp A	0.2	0.0
Upper Slope	Synidotea sp	0.2	0.0
Upper Slope	Tenellia adspersa	0.2	0.0
Upper Slope	Tetrastemma sp	0.2	0.0
Upper Slope	Travisia brevis	0.2	0.0
Upper Slope	Travisia gigas	0.2	0.0
Upper Slope	Tubulanidae sp C	0.2	0.0
Upper Slope	Turbonilla sp A	0.2	0.0
Upper Slope	Turbonilla sp SD1	0.2	0.0
Upper Slope	Typhlotanais crassus	0.2	0.0
Upper Slope	Typosyllis farallonensis	0.2	0.0
Upper Slope	Urochordata	0.2	0.0
Upper Slope	Valettiopsis dentatus	0.2	0.0
Upper Slope	Valettiopsis sp DC1	0.2	0.0
Upper Slope	Vemakylindrus hystricosa	0.2	0.0
Upper Slope	Virgularia sp	0.2	0.0
Upper Slope	Virgulariidae	0.2	0.0
Upper Slope	Volvulella sp	0.2	0.0
Upper Slope	Xanthoidea	0.2	0.0
Upper Slope	Xenoleberis californica	0.2	0.0
Upper Slope	Ysideria hastata	0.2	0.0
Upper Slope	Zeuxo normani	0.2	0.0
Upper Slope	Zoarcidae	0.2	0.0
Northwest Slope	Prionospio (Prionospio) ehlersi	51.4	5.9
Northwest Slope	Bipalponephtys cornuta	42.9	2.7
Northwest Slope	Glycinde armigera	37.1	1.3
Northwest Slope	Maldane sarsi	37.1	2.5
Northwest Slope	Paraprionospio alata	37.1	2.7
Northwest Slope	Calocarides quinqueseriatus	34.3	1.3
Northwest Slope	Limifossor fratula	34.3	1.5
Northwest Slope	Onuphis iridescens	34.3	2.7
Northwest Slope	Glycera nana	31.4	1.2
Northwest Slope	Heteromastus filobranchus	31.4	2.1

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Northwest Slope	Brisaster townsendi	25.7	2.1
Northwest Slope	Myxoderma platyacanthum	25.7	0.7
Northwest Slope	Falcidens hartmanae	22.9	0.9
Northwest Slope	Leucon declivis	20.0	0.8
Northwest Slope	Paraphoxus sp 1	20.0	4.1
Northwest Slope	Amphissa bicolor	17.1	6.5
Northwest Slope	Chaetoderma nanulum	17.1	1.3
Northwest Slope	Maldanidae	17.1	0.6
Northwest Slope	Astyris permodesta	14.3	3.4
Northwest Slope	Brisaster latifrons	14.3	1.3
Northwest Slope	Chaetodermatidae	14.3	0.8
Northwest Slope	Cyclocardia gouldii	14.3	2.8
Northwest Slope	Lineidae	14.3	0.7
Northwest Slope	Melinna heterodonta	14.3	1.0
Northwest Slope	Saxicavella pacifica	14.3	2.1
Northwest Slope	Brisaster sp	11.4	0.6
Northwest Slope	Chiridota sp	11.4	0.4
Northwest Slope	Halcampa decemtentaculata	11.4	0.5
Northwest Slope	Phyllochaetopterus limicolus	11.4	0.5
Northwest Slope	Praxillella pacifica	11.4	0.4
Northwest Slope	Sigambra tentaculata	11.4	0.3
Northwest Slope	Ampelisca pugetica	8.6	0.2
Northwest Slope	Amphissa undata	8.6	1.5
Northwest Slope	Athenaria	8.6	0.3
Northwest Slope	Brissopsis pacifica	8.6	0.2
Northwest Slope	Callianopsis goniophthalma	8.6	0.2
Northwest Slope	Ceriantharia	8.6	0.3
Northwest Slope	Leitoscoloplos sp	8.6	0.6
Northwest Slope	Neilonella ritteri	8.6	0.2
Northwest Slope	Polynoinae	8.6	0.2
Northwest Slope	Prionospio (Minuspio) lighti	8.6	0.2
Northwest Slope	Prionospio (Prionospio) sp	8.6	0.5
Northwest Slope	Scaphopoda	8.6	0.5
Northwest Slope	Actiniaria	5.7	0.2
Northwest Slope	Aglaophamus erectans	5.7	0.2
Northwest Slope	Ampelisca unsocalae	5.7	0.2
Northwest Slope	Ampharetidae	5.7	0.2
Northwest Slope	Bivalvia	5.7	0.2
Northwest Slope	Byblis barbarensis	5.7	14.5
Northwest Slope	Chaetoderma pacificum	5.7	0.2
Northwest Slope	Chaetodermatida	5.7	0.2

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Northwest Slope	Chloeia pinnata	5.7	1.4
Northwest Slope	Cyclocardia sp	5.7	0.9
Northwest Slope	Cyclocardia ventricosa	5.7	0.6
Northwest Slope	Eclysippe trilobata	5.7	0.2
Northwest Slope	Ericthonius rubricornis	5.7	0.2
Northwest Slope	Eudorella pacifica	5.7	0.3
Northwest Slope	Gastropoda	5.7	0.2
Northwest Slope	Heteromastus sp	5.7	0.3
Northwest Slope	Heterophoxus sp	5.7	0.2
Northwest Slope	Leitoscoloplos sp A	5.7	0.2
Northwest Slope	Lepidasthenia longicirrata	5.7	0.2
Northwest Slope	Levinsenia sp	5.7	0.2
Northwest Slope	Listriolobus hexamyotus	5.7	0.5
Northwest Slope	Myriochele gracilis	5.7	0.5
Northwest Slope	Oligochaeta	5.7	0.4
Northwest Slope	Palaeonemertea	5.7	0.2
Northwest Slope	Paralysippe annectens	5.7	0.2
Northwest Slope	Photis parvidons	5.7	0.3
Northwest Slope	Phoxocephalidae	5.7	0.2
Northwest Slope	Podarkeopsis perkinsi	5.7	0.2
Northwest Slope	Polynoidae	5.7	0.2
Northwest Slope	Stachyptilum superbum	5.7	0.4
Northwest Slope	Thysanocardia nigra	5.7	0.2
Northwest Slope	Tritella tenuissima	5.7	0.2
Northwest Slope	Acidostoma hancocki	2.9	0.1
Northwest Slope	Admete gracilior	2.9	0.1
Northwest Slope	Aglaophamus verrilli	2.9	0.1
Northwest Slope	Alvania rosana	2.9	0.1
Northwest Slope	Amblyops abbreviatus	2.9	0.1
Northwest Slope	Ampelisca careyi	2.9	0.1
Northwest Slope	Ampharete sp	2.9	0.1
Northwest Slope	Amphiodia sp	2.9	0.1
Northwest Slope	Amphipholis squamata	2.9	0.1
Northwest Slope	Amphiuridae	2.9	0.1
Northwest Slope	Ancistrosyllis groenlandica	2.9	0.2
Northwest Slope	Anobothrus gracilis	2.9	0.1
Northwest Slope	Aphelochaeta sp	2.9	0.2
Northwest Slope	Aphelochaeta williamsae	2.9	0.1
Northwest Slope	Arhynchite californicus	2.9	0.1
Northwest Slope	Aristias sp DC1	2.9	0.4
Northwest Slope	Asteroidea	2.9	0.1

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Northwest Slope	Asteronyx longifissus	2.9	0.1
Northwest Slope	Brissopsis sp LA1	2.9	0.1
Northwest Slope	Cerebratulus californiensis	2.9	0.1
Northwest Slope	Cerebratulus sp	2.9	0.1
Northwest Slope	Chaetozone armata	2.9	0.2
Northwest Slope	Cirratulus sp	2.9	0.1
Northwest Slope	Cirrophorus branchiatus	2.9	0.1
Northwest Slope	Cirrophorus furcatus	2.9	0.1
Northwest Slope	Compressidens stearnsii	2.9	0.2
Northwest Slope	Compsomyax subdiaphana	2.9	0.1
Northwest Slope	Coxophoxus hidalgo	2.9	0.5
Northwest Slope	Decamastus gracilis	2.9	0.1
Northwest Slope	Decapoda	2.9	0.1
Northwest Slope	Demospongiae	2.9	0.2
Northwest Slope	Diaphana californica	2.9	0.1
Northwest Slope	Diastylis pellucida	2.9	0.1
Northwest Slope	Dodecamastus mariaensis	2.9	0.1
Northwest Slope	Edwardsiidae	2.9	0.3
Northwest Slope	Ennucula tenuis	2.9	0.1
Northwest Slope	Eranno lagunae	2.9	0.1
Northwest Slope	Euclymeninae sp A	2.9	0.2
Northwest Slope	Eunice americana	2.9	0.2
Northwest Slope	Falcidens longus	2.9	0.2
Northwest Slope	Furcillidens incrassatus	2.9	0.1
Northwest Slope	Gadila tolmiei	2.9	0.4
Northwest Slope	Gammaridea	2.9	0.1
Northwest Slope	Gastropteron pacificum	2.9	0.2
Northwest Slope	Goniada brunnea	2.9	0.1
Northwest Slope	Haloclavidae	2.9	0.1
Northwest Slope	Harpiniopsis epistomata	2.9	0.1
Northwest Slope	Harpiniopsis galera	2.9	0.2
Northwest Slope	Hesperonoe laevis	2.9	0.1
Northwest Slope	Hesperonoe sp	2.9	0.1
Northwest Slope	Heteromastus filiformis Cmplx	2.9	0.2
Northwest Slope	Heterophoxus affinis	2.9	0.1
Northwest Slope	Heterophoxus ellisi	2.9	0.1
Northwest Slope	Isopoda	2.9	0.1
Northwest Slope	Levinsenia multibranchiata	2.9	0.1
Northwest Slope	Liljeborgia cota	2.9	0.1
Northwest Slope	Lirobittium sp	2.9	1.0
Northwest Slope	Listriella albina	2.9	0.1

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Northwest Slope	Loy thompsoni	2.9	0.1
Northwest Slope	Lucinoma aequizonatum	2.9	0.2
Northwest Slope	Lucinoma annulatum	2.9	0.2
Northwest Slope	Lumbrineris cruzensis	2.9	0.1
Northwest Slope	Lumbrineris sp	2.9	0.1
Northwest Slope	Macoma carlottensis	2.9	0.2
Northwest Slope	Macoma sp	2.9	0.1
Northwest Slope	Maldane sp	2.9	0.2
Northwest Slope	Malmgreniella sp A	2.9	0.1
Northwest Slope	Metasychis disparidentatus	2.9	0.1
Northwest Slope	Molgula sp	2.9	0.1
Northwest Slope	Myriochele olgae	2.9	0.9
Northwest Slope	Myriochele sp	2.9	0.1
Northwest Slope	Mysida	2.9	0.1
Northwest Slope	Mysidae	2.9	0.1
Northwest Slope	Nassariidae	2.9	0.1
Northwest Slope	Nephtys sp	2.9	0.1
Northwest Slope	Notomastus magnus	2.9	0.4
Northwest Slope	Notomastus sp	2.9	0.1
Northwest Slope	Oweniidae	2.9	0.1
Northwest Slope	Paradiopatra parva	2.9	0.1
Northwest Slope	Parvilucina tenuisculpta	2.9	0.1
Northwest Slope	Pectinaria californiensis	2.9	0.1
Northwest Slope	Pennatula californica	2.9	0.1
Northwest Slope	Pentamera pseudocalcigera	2.9	0.1
Northwest Slope	Phoronida	2.9	0.1
Northwest Slope	Phoronis sp	2.9	0.4
Northwest Slope	Photis lacia	2.9	0.1
Northwest Slope	Photis sp	2.9	0.1
Northwest Slope	Photis viuda	2.9	0.2
Northwest Slope	Phyllodoce groenlandica	2.9	0.1
Northwest Slope	Prachynella lodo	2.9	0.1
Northwest Slope	Prionospio (Prionospio) jubata	2.9	0.1
Northwest Slope	Protomedeia articulata Cmplx	2.9	0.3
Northwest Slope	Pseudarchaster pusillus	2.9	0.1
Northwest Slope	Pseudomma sp	2.9	0.1
Northwest Slope	Rhachotropis distincta	2.9	0.1
Northwest Slope	Rhepoxynius abronius	2.9	0.1
Northwest Slope	Scoletoma tetraura Cmplx	2.9	0.2
Northwest Slope	Sigambra sp DC1	2.9	0.1
Northwest Slope	Spatangoida	2.9	0.1

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Northwest Slope	Spatangus californicus	2.9	0.2
Northwest Slope	Spionidae	2.9	0.1
Northwest Slope	Spiophanes duplex	2.9	0.1
Northwest Slope	Spiophanes fimbriata	2.9	0.1
Northwest Slope	Spiophanes sp	2.9	0.1
Northwest Slope	Streblosoma pacifica	2.9	0.1
Northwest Slope	Tellinidae	2.9	0.1
Northwest Slope	Tenonia priops	2.9	0.1
Northwest Slope	Terebellides californica	2.9	0.1
Northwest Slope	Terebellides sp	2.9	0.5
Northwest Slope	Thalassematidae	2.9	0.1
Northwest Slope	Tubulanus sp	2.9	0.1
Northwest Slope	Volvulella californica	2.9	0.1
Lower Slope	Eclysippe trilobata	38.5	4.4
Lower Slope	Paralysippe annectens	36.1	5.5
Lower Slope	Ophiuroidea	31.1	1.9
Lower Slope	Tritella tenuissima	31.1	1.6
Lower Slope	Ampelisca unsocalae	26.2	1.4
Lower Slope	Falcidens hartmanae	25.4	1.0
Lower Slope	Maldanidae	25.4	1.0
Lower Slope	Adontorhina cyclia	24.6	0.9
Lower Slope	Maldane sarsi	24.6	3.7
Lower Slope	Phyllochaetopterus limicolus	24.6	3.0
Lower Slope	Astyris permodesta	23.8	2.9
Lower Slope	Axinodon redondoensis	23.8	0.9
Lower Slope	Lineidae	23.8	0.6
Lower Slope	Gadila tolmiei	23.0	1.1
Lower Slope	Harpiniopsis epistomata	21.3	0.8
Lower Slope	Maldane californiensis	21.3	1.0
Lower Slope	Byblis barbarensis	20.5	5.0
Lower Slope	Limifossor fratula	20.5	1.0
Lower Slope	Leiochrides hemipodus	19.7	0.7
Lower Slope	Monticellina cryptica	19.7	0.8
Lower Slope	Myriochele gracilis	19.7	5.5
Lower Slope	Ampharetidae	18.9	0.9
Lower Slope	Neilonella ritteri	18.9	1.6
Lower Slope	Stereobalanus sp	18.9	1.1
Lower Slope	Enteropneusta	18.0	0.9
Lower Slope	Aphelochaeta sp	17.2	0.5
Lower Slope	Chaetodermatidae	15.6	0.4
Lower Slope	Spiophanes fimbriata	15.6	0.3

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Dodecamastus mariaensis	14.8	0.9
Lower Slope	Monticellina sp	14.8	0.8
Lower Slope	Terebellides sp	14.8	0.4
Lower Slope	Cerebratulus californiensis	12.3	0.3
Lower Slope	Leucon bishopi	12.3	0.6
Lower Slope	Leucon declivis	12.3	0.3
Lower Slope	Fauveliopsis glabra	11.5	1.1
Lower Slope	Leiochrides sp	11.5	0.4
Lower Slope	Sonatsa carinata	11.5	0.4
Lower Slope	Adontorhina lynnae	10.7	0.6
Lower Slope	Bivalvia	10.7	0.2
Lower Slope	Listriella albina	10.7	0.3
Lower Slope	Amphiuridae	9.8	0.9
Lower Slope	Chaetoderma hancocki	9.8	0.3
Lower Slope	Dacrydium pacificum	9.8	0.5
Lower Slope	Fauveliopsis sp	9.8	0.6
Lower Slope	Spiochaetopterus costarum Cmplx	9.8	0.8
Lower Slope	Yoldiella nana	9.8	0.4
Lower Slope	Aphelochaeta monilaris	9.0	0.3
Lower Slope	Bathymedon pumilus	9.0	0.2
Lower Slope	Edwardsia profunda	9.0	0.2
Lower Slope	Euclymeninae sp A	9.0	0.2
Lower Slope	Glycera branchiopoda	9.0	0.2
Lower Slope	Glycinde armigera	9.0	0.2
Lower Slope	Heterophoxus ellisi	9.0	0.2
Lower Slope	Prionospio (Prionospio) ehlersi	9.0	0.2
Lower Slope	Bipalponephtys cornuta	8.2	0.2
Lower Slope	Cephalophoxoides homilis	8.2	0.2
Lower Slope	Hemilamprops sp A	8.2	0.2
Lower Slope	Leptosynapta sp	8.2	0.2
Lower Slope	Melinna heterodonta	8.2	0.7
Lower Slope	Rhabdus rectius	8.2	0.2
Lower Slope	Tubulanus polymorphus	8.2	0.2
Lower Slope	Aricidea (Acmira) rubra	7.4	0.2
Lower Slope	Brissopsis pacifica	7.4	0.2
Lower Slope	Cadulus californicus	7.4	0.3
Lower Slope	Califia calida	7.4	0.2
Lower Slope	Levinsenia oculata	7.4	0.3
Lower Slope	Mendicula ferruginosa	7.4	0.5
Lower Slope	Terebellides californica	7.4	0.2
Lower Slope	Aricidea (Allia) sp A	6.6	0.3

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Harmothoe sp	6.6	0.2
Lower Slope	Spiophanes wigleyi	6.6	0.1
Lower Slope	Sternaspis williamsae	6.6	0.2
Lower Slope	Subadyte sp	6.6	0.3
Lower Slope	Trichobranchidae sp LA1	6.6	0.3
Lower Slope	Brada pilosa	5.7	0.4
Lower Slope	Campylaspis canaliculata	5.7	0.1
Lower Slope	Cirratulidae	5.7	0.1
Lower Slope	Compressidens stearnsii	5.7	0.1
Lower Slope	Cossura candida	5.7	0.1
Lower Slope	Edwardsiidae	5.7	0.2
Lower Slope	Harmothoinae	5.7	0.1
Lower Slope	Ilyarachna acarina	5.7	0.1
Lower Slope	Luzonia chilensis	5.7	0.1
Lower Slope	Micrura sp	5.7	0.2
Lower Slope	Ophelina pallida	5.7	0.2
Lower Slope	Palaeonemertea	5.7	0.1
Lower Slope	Palaeonemertea sp D	5.7	0.1
Lower Slope	Pista wui	5.7	0.1
Lower Slope	Polynoidae	5.7	0.1
Lower Slope	Spathoderma californicum	5.7	0.1
Lower Slope	Spirontocaris sica	5.7	0.2
Lower Slope	Ampelisca plumosa	4.9	0.3
Lower Slope	Amphiura diomedeae	4.9	0.2
Lower Slope	Cerebratulus sp	4.9	0.2
Lower Slope	Ceriantharia	4.9	0.1
Lower Slope	Chaetozone sp	4.9	0.1
Lower Slope	Eurycope californiensis	4.9	0.2
Lower Slope	Gastropteron pacificum	4.9	0.1
Lower Slope	Harpiniopsis fulgens	4.9	0.1
Lower Slope	Levinsenia sp	4.9	0.1
Lower Slope	Monoculodes latissimanus	4.9	0.3
Lower Slope	Mooresamytha bioculata	4.9	0.1
Lower Slope	Nellobia eusoma	4.9	0.2
Lower Slope	Oediceropsis elsula	4.9	0.1
Lower Slope	Rhodine bitorquata	4.9	0.1
Lower Slope	Spiophanes sp	4.9	0.1
Lower Slope	Subadyte mexicana	4.9	0.1
Lower Slope	Amphipholis squamata	4.1	0.2
Lower Slope	Ancistrosyllis groenlandica	4.1	0.1
Lower Slope	Aricidea (Acmira) sp	4.1	0.3

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Bathymedon flebilis	4.1	0.1
Lower Slope	Carpoapseudes caraspinosus	4.1	0.1
Lower Slope	Chaetodermatida	4.1	0.1
Lower Slope	Chaetozone spinosa	4.1	0.1
Lower Slope	Decamastus gracilis	4.1	0.4
Lower Slope	Delectopecten vancouverensis	4.1	0.2
Lower Slope	Diastylis pellucida	4.1	0.2
Lower Slope	Harpiniopsis emeryi	4.1	0.1
Lower Slope	Heterophoxus affinis	4.1	0.1
Lower Slope	Kurtiella tumida	4.1	0.4
Lower Slope	Laonice cirrata	4.1	0.1
Lower Slope	Laonice nuchala	4.1	0.1
Lower Slope	Leptophoxus falcatus icelus	4.1	0.1
Lower Slope	Leucon magnadentata	4.1	0.1
Lower Slope	Ophiosphalma jolliense	4.1	0.1
Lower Slope	Pherusa sp	4.1	0.1
Lower Slope	Pherusa sp SD2	4.1	0.1
Lower Slope	Polycirrus sp A	4.1	0.1
Lower Slope	Prionospio (Prionospio) sp	4.1	0.1
Lower Slope	Ampelisca pacifica	3.3	0.2
Lower Slope	Amphiodia sp	3.3	0.4
Lower Slope	Amphiura arcystata	3.3	0.1
Lower Slope	Aphelochaeta glandaria Cmplx	3.3	0.1
Lower Slope	Aphelochaeta phillipsi	3.3	0.1
Lower Slope	Aphelochaeta sp LA3	3.3	0.2
Lower Slope	Aphelochaeta sp SD14	3.3	0.2
Lower Slope	Aphelochaeta williamsae	3.3	0.1
Lower Slope	Aricidea (Acmira) catherinae	3.3	0.1
Lower Slope	Aricidea (Acmira) sp LA1	3.3	0.2
Lower Slope	Balanoglossus sp	3.3	0.2
Lower Slope	Brisaster townsendi	3.3	0.1
Lower Slope	Brissopsis sp LA1	3.3	0.1
Lower Slope	Cerebratulus marginatus	3.3	0.1
Lower Slope	Chloeia pinnata	3.3	0.8
Lower Slope	Echinoidea	3.3	0.1
Lower Slope	Eranno sp	3.3	0.1
Lower Slope	Glycera nana	3.3	0.1
Lower Slope	Glyphanostomum pallescens	3.3	0.2
Lower Slope	Jasmineira sp B	3.3	0.1
Lower Slope	Leitoscoloplos pugettensis	3.3	0.1
Lower Slope	Leitoscoloplos sp A	3.3	0.1

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Listriolobus hexamyotus	3.3	0.1
Lower Slope	Lysippe sp B	3.3	0.1
Lower Slope	Macoma carlottensis	3.3	0.1
Lower Slope	Neilonella mexicana	3.3	0.1
Lower Slope	Nicippe tumida	3.3	0.2
Lower Slope	Notomastus hemipodus	3.3	0.2
Lower Slope	Nuculana conceptionis	3.3	0.1
Lower Slope	Paraonidae	3.3	0.1
Lower Slope	Periploma rosewateri	3.3	0.1
Lower Slope	Pista estevanica	3.3	0.1
Lower Slope	Podarkeopsis perkinsi	3.3	0.1
Lower Slope	Sabellidae	3.3	0.1
Lower Slope	Saxicavella pacifica	3.3	0.3
Lower Slope	Scalibregma californicum	3.3	0.1
Lower Slope	Solemya pervernicosa	3.3	0.1
Lower Slope	Spiophanes duplex	3.3	0.1
Lower Slope	Strongylocentrotus fragilis	3.3	0.1
Lower Slope	Tellina carpenteri	3.3	0.3
Lower Slope	Thyasiridae sp SD1	3.3	0.1
Lower Slope	Virgulariidae	3.3	0.2
Lower Slope	Ypsilothuria bitentaculata	3.3	0.1
Lower Slope	Aglaophamus erectans	2.5	0.0
Lower Slope	Ampelisca coeca	2.5	0.0
Lower Slope	Amphissa bicolor	2.5	0.1
Lower Slope	Aphelochaeta sp SD18 (B13-1)	2.5	0.1
Lower Slope	Araphura cuspirostris	2.5	0.1
Lower Slope	Aricidea (Allia) monicae	2.5	0.0
Lower Slope	Asteronyx longifissus	2.5	0.1
Lower Slope	Bathyleberis sp	2.5	0.1
Lower Slope	Bullomorpha sp A	2.5	0.0
Lower Slope	Chaetoderma pacificum	2.5	0.0
Lower Slope	Chaetopteridae	2.5	0.0
Lower Slope	Ennucula tenuis	2.5	0.1
Lower Slope	Eucranta anoculata	2.5	0.0
Lower Slope	Eudorella pacifica	2.5	0.0
Lower Slope	Euphilomedes producta	2.5	0.1
Lower Slope	Furcillidens incrassatus	2.5	0.0
Lower Slope	Goniada maculata	2.5	0.0
Lower Slope	Haliella abyssicola	2.5	0.1
Lower Slope	Harpiniopsis profundis	2.5	0.1
Lower Slope	Heteronemertea sp SD2	2.5	0.1

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Heterophoxus sp	2.5	0.0
Lower Slope	Ilyarachna profunda	2.5	0.1
Lower Slope	Laonice sp	2.5	0.1
Lower Slope	Lumbrineris sp	2.5	0.1
Lower Slope	Lumbrineris/Scoletoma sp	2.5	0.1
Lower Slope	Maldane sp	2.5	0.1
Lower Slope	Mediomastus sp	2.5	0.2
Lower Slope	Metasychis disparidentatus	2.5	0.1
Lower Slope	Metedwardsia sp A	2.5	0.1
Lower Slope	Monticellina tesselata	2.5	0.1
Lower Slope	Munnopsurus sp A	2.5	0.1
Lower Slope	Myriochele olgae	2.5	0.1
Lower Slope	Nephasoma diaphanes	2.5	0.2
Lower Slope	Oligochaeta	2.5	0.1
Lower Slope	Onuphis iridescens	2.5	0.1
Lower Slope	Ophiacantha sp	2.5	0.1
Lower Slope	Pacifoculodes barnardi	2.5	0.1
Lower Slope	Paramage scutata	2.5	0.1
Lower Slope	Paraprionospio alata	2.5	0.1
Lower Slope	Philine polystrigma	2.5	0.0
Lower Slope	Philine sp	2.5	0.1
Lower Slope	Philomedidae	2.5	0.1
Lower Slope	Phisidia sanctaemariae	2.5	0.1
Lower Slope	Polycirrus sp	2.5	0.1
Lower Slope	Protis pacifica	2.5	0.0
Lower Slope	Pseudharpinia excavata	2.5	0.0
Lower Slope	Pseudomma sp	2.5	0.1
Lower Slope	Saccoglossus sp	2.5	0.1
Lower Slope	Stachyptilum superbum	2.5	0.0
Lower Slope	Tanaella propinquus	2.5	0.1
Lower Slope	Tellina sp B	2.5	0.0
Lower Slope	Terebellidae	2.5	0.0
Lower Slope	Terebellides sp Type D	2.5	0.1
Lower Slope	Tubulanidae	2.5	0.0
Lower Slope	Tubulanus sp A	2.5	0.0
Lower Slope	Virgularia agassizii	2.5	0.1
Lower Slope	Acharax johnsoni	1.6	0.0
Lower Slope	Actiniaria	1.6	0.0
Lower Slope	Alvania rosana	1.6	0.2
Lower Slope	Ampelisca furcigera	1.6	0.0
Lower Slope	Ampelisca hancocki	1.6	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Ampelisca romigi	1.6	0.1
Lower Slope	Amphicteis sp	1.6	0.1
Lower Slope	Amphiodia digitata	1.6	0.1
Lower Slope	Amphioplus sp	1.6	0.1
Lower Slope	Amphioplus strongyloplax	1.6	0.0
Lower Slope	Amphipholis pugetana	1.6	0.0
Lower Slope	Amphipholis sp	1.6	0.0
Lower Slope	Anobothrus gracilis	1.6	0.1
Lower Slope	Aphelochaeta sp SD15	1.6	0.0
Lower Slope	Aricidea (Acmira) lopezi	1.6	0.0
Lower Slope	Aricidea (Acmira) simplex	1.6	0.1
Lower Slope	Aricidea (Allia) quadrilobata	1.6	0.0
Lower Slope	Asellota	1.6	0.0
Lower Slope	Asteroidea	1.6	0.0
Lower Slope	Bathyleberis sp LA1	1.6	0.0
Lower Slope	Bathymedon roquedo	1.6	0.0
Lower Slope	Bathymedon vulpeculus	1.6	0.0
Lower Slope	Brisaster sp	1.6	0.0
Lower Slope	Byblis sp	1.6	0.0
Lower Slope	Byblis veleronis	1.6	0.1
Lower Slope	Calyptogena lepta	1.6	0.2
Lower Slope	Chaetoderma nanulum	1.6	0.1
Lower Slope	Cirrophorus branchiatus	1.6	0.1
Lower Slope	Cossura sp	1.6	0.0
Lower Slope	Cyclocardia gouldii	1.6	0.0
Lower Slope	Cyclocardia ventricosa	1.6	0.0
Lower Slope	Cyclopecten zephyrus	1.6	0.1
Lower Slope	Cylindroleberididae	1.6	0.1
Lower Slope	Dallicordia alaskana	1.6	0.0
Lower Slope	Diaphana californica	1.6	0.0
Lower Slope	Diastylis sentosa	1.6	0.0
Lower Slope	Drilonereis sp	1.6	0.0
Lower Slope	Echiura	1.6	0.0
Lower Slope	Edwardsia sp	1.6	0.1
Lower Slope	Eusyllinae	1.6	0.0
Lower Slope	Exogone lourei	1.6	0.1
Lower Slope	Fabrisabella sp A	1.6	0.0
Lower Slope	Fauveliopsis sp SD1	1.6	0.0
Lower Slope	Galathowenia pygidialis	1.6	0.2
Lower Slope	Halicoides synopiae	1.6	0.0
Lower Slope	Haliophasma geminatum	1.6	0.1

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Harpiniopsis similis	1.6	0.0
Lower Slope	Heteromastus filobranchus	1.6	0.1
Lower Slope	Kinbergonuphis vexillaria	1.6	0.0
Lower Slope	Kurtiella sp LA2	1.6	0.1
Lower Slope	Lasaeidae	1.6	0.0
Lower Slope	Leanira alba	1.6	0.0
Lower Slope	Leptochelia dubia Cmplx	1.6	0.1
Lower Slope	Leptostylis calva	1.6	0.0
Lower Slope	Leucon sp	1.6	0.0
Lower Slope	Lineus sp	1.6	0.0
Lower Slope	Lucinoma annulatum	1.6	0.2
Lower Slope	Lumbrineridae	1.6	0.0
Lower Slope	Metopa dawsoni	1.6	0.0
Lower Slope	Microglyphis brevicula	1.6	0.0
Lower Slope	Micrura alaskensis	1.6	0.0
Lower Slope	Myriochele sp	1.6	0.0
Lower Slope	Nuculanida	1.6	0.0
Lower Slope	Ophelina acuminata	1.6	0.0
Lower Slope	Ophiacanthidae	1.6	0.0
Lower Slope	Ophiuridae	1.6	0.0
Lower Slope	Ophiuroconis bispinosa	1.6	0.0
Lower Slope	Oradarea longimana	1.6	0.0
Lower Slope	Orchomenella pacifica	1.6	0.0
Lower Slope	Oweniidae	1.6	0.0
Lower Slope	Paradiopatra parva	1.6	0.1
Lower Slope	Paraphoxus sp 1	1.6	0.1
Lower Slope	Parvilucina tenuisculpta	1.6	0.1
Lower Slope	Pennatulacea	1.6	0.0
Lower Slope	Petaloproctus ornatus	1.6	0.1
Lower Slope	Phisidia sp	1.6	0.3
Lower Slope	Phoronida	1.6	0.1
Lower Slope	Phyllodoce hartmanae	1.6	0.0
Lower Slope	Podarkeopsis glabrus	1.6	0.0
Lower Slope	Polycirrinae	1.6	0.3
Lower Slope	Praxillella pacifica	1.6	0.1
Lower Slope	Prionospio (Prionospio) dubia	1.6	0.0
Lower Slope	Protula superba	1.6	0.1
Lower Slope	Rhachotropis barnardi	1.6	0.1
Lower Slope	Rhachotropis distincta	1.6	0.0
Lower Slope	Scaphopoda	1.6	0.0
Lower Slope	Scoletoma sp	1.6	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Sigambra tentaculata	1.6	0.0
Lower Slope	Sipuncula	1.6	0.0
Lower Slope	Spatangoida	1.6	0.0
Lower Slope	Spionidae	1.6	0.0
Lower Slope	Spiophanes kimballi	1.6	0.1
Lower Slope	Thyasira flexuosa	1.6	0.1
Lower Slope	Virgularia sp	1.6	0.0
Lower Slope	Volvulella californica	1.6	0.0
Lower Slope	Yoldiidae	1.6	0.0
Lower Slope	Acila castrensis	0.8	0.0
Lower Slope	Admete californica	0.8	0.0
Lower Slope	Alaba sp	0.8	0.0
Lower Slope	Amage anops	0.8	0.0
Lower Slope	Ampelisca amblyopsoides	0.8	0.0
Lower Slope	Ampelisca brevisimulata	0.8	0.0
Lower Slope	Ampelisca careyi	0.8	0.0
Lower Slope	Ampelisca sp	0.8	0.0
Lower Slope	Ampeliscidae	0.8	0.2
Lower Slope	Amphiporus cruentatus	0.8	0.0
Lower Slope	Amphitrite robusta	0.8	0.0
Lower Slope	Ananthura luna	0.8	0.0
Lower Slope	Anatoma kelseyi	0.8	0.0
Lower Slope	Anobothrus sp	0.8	0.2
Lower Slope	Anopla	0.8	0.0
Lower Slope	Aphelochaeta petersenae	0.8	0.1
Lower Slope	Aphelochaeta sp SD5	0.8	0.0
Lower Slope	Aphelochaeta tigrina	0.8	0.0
Lower Slope	Apistobranchus sp	0.8	0.0
Lower Slope	Arhynchite californicus	0.8	0.0
Lower Slope	Aricidea (Acmira) horikoshii	0.8	0.1
Lower Slope	Aricidea (Allia) antennata	0.8	0.0
Lower Slope	Aricidea (Allia) hartleyi	0.8	0.0
Lower Slope	Artacamella hancocki	0.8	0.0
Lower Slope	Asabellides cornuta	0.8	0.0
Lower Slope	Asabellides lineata	0.8	0.0
Lower Slope	Asteronyx sp	0.8	0.0
Lower Slope	Bathybembix bairdii	0.8	0.0
Lower Slope	Bathyleberis garthi	0.8	0.0
Lower Slope	Bathymedon covilhani	0.8	0.0
Lower Slope	Bathymedon kassites	0.8	0.0
Lower Slope	Bathymedon sp	0.8	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Belonectes sp A	0.8	0.0
Lower Slope	Brada pluribranchiata	0.8	0.0
Lower Slope	Brada sp	0.8	0.0
Lower Slope	Brisaster latifrons	0.8	0.0
Lower Slope	Brissopsis sp	0.8	0.0
Lower Slope	Buccinidae	0.8	0.0
Lower Slope	Byblis bathyalis	0.8	0.0
Lower Slope	Cactosoma sp	0.8	0.0
Lower Slope	Caecognathia crenulatifrons	0.8	0.0
Lower Slope	Callianopsis goniophthalma	0.8	0.0
Lower Slope	Calocarides quinqueseriatus	0.8	0.0
Lower Slope	Calocarides sp	0.8	0.0
Lower Slope	Calyptogena elongata	0.8	0.0
Lower Slope	Campylaspis sp A	0.8	0.0
Lower Slope	Campylaspis sp LA1	0.8	0.0
Lower Slope	Capitella capitata Cmplx	0.8	0.0
Lower Slope	Caprella gracilior	0.8	0.0
Lower Slope	Caprellinae sp B	0.8	0.0
Lower Slope	Cardiomya sp	0.8	0.0
Lower Slope	Carinoma mutabilis	0.8	0.0
Lower Slope	Carpoapseudes sp WS1	0.8	0.0
Lower Slope	Caulleryaspis nuda	0.8	0.0
Lower Slope	Cephalaspidea	0.8	0.0
Lower Slope	Ceratocephale hartmanae	0.8	0.0
Lower Slope	Ceratocephale loveni	0.8	0.1
Lower Slope	Chaetoderma elegans	0.8	0.0
Lower Slope	Chaetoderma sp	0.8	0.0
Lower Slope	Chaetoderma sp A	0.8	0.0
Lower Slope	Chaetozone corona	0.8	0.0
Lower Slope	Chaetozone hartmanae	0.8	0.0
Lower Slope	Chaetozone setosa Cmplx	0.8	0.0
Lower Slope	Chaetozone sp SD7	0.8	0.0
Lower Slope	Chiridota sp	0.8	0.0
Lower Slope	Chone sp SD3	0.8	0.0
Lower Slope	Cidarina cidaris	0.8	0.0
Lower Slope	Cirrophorus furcatus	0.8	0.0
Lower Slope	Cirrophorus sp	0.8	0.0
Lower Slope	Clymenura gracilis	0.8	0.0
Lower Slope	Compsomyax subdiaphana	0.8	0.0
Lower Slope	Cossura rostrata	0.8	0.0
Lower Slope	Coxophoxus hidalgo	0.8	0.1

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Crockerella evadne	0.8	0.0
Lower Slope	Cyclopecten sp	0.8	0.1
Lower Slope	Cylichna diegensis	0.8	0.0
Lower Slope	Diplocirrus sp	0.8	0.0
Lower Slope	Diplocirrus sp LA1	0.8	0.0
Lower Slope	Dipolydora akaina	0.8	0.0
Lower Slope	Dromalia alexandri	0.8	0.0
Lower Slope	Echinodermata	0.8	0.0
Lower Slope	Edwardsia mcmurrichi	0.8	0.0
Lower Slope	Enopla	0.8	0.0
Lower Slope	Eranno lagunae	0.8	0.0
Lower Slope	Ericthonius brasiliensis	0.8	0.0
Lower Slope	Euchone incolor	0.8	0.0
Lower Slope	Euchone sp A	0.8	0.0
Lower Slope	Euchone velifera	0.8	0.0
Lower Slope	Euclymeninae	0.8	0.1
Lower Slope	Euphrosine arctia	0.8	0.0
Lower Slope	Euphysa sp A	0.8	0.0
Lower Slope	Exogone sp SD1	0.8	0.0
Lower Slope	Fabrisabella sp LA1	0.8	0.0
Lower Slope	Flabelligeridae	0.8	0.0
Lower Slope	Flabelligeridae sp OC1	0.8	0.0
Lower Slope	Foxiphalus obtusidens	0.8	0.0
Lower Slope	Galathowenia oculata	0.8	0.0
Lower Slope	Gammaridea	0.8	0.0
Lower Slope	Gastropoda	0.8	0.0
Lower Slope	Glottidia albida	0.8	0.0
Lower Slope	Glycera tesselata	0.8	0.0
Lower Slope	Golfingia sp 1	0.8	0.0
Lower Slope	Goniada brunnea	0.8	0.0
Lower Slope	Gymnonereis crosslandi	0.8	0.0
Lower Slope	Halcampa decemtentaculata	0.8	0.0
Lower Slope	Halianthella sp A	0.8	0.0
Lower Slope	Harmothoe sp LA1	0.8	0.0
Lower Slope	Harpiniopsis galera	0.8	0.0
Lower Slope	Harpiniopsis naiadis	0.8	0.0
Lower Slope	Harpiniopsis sp	0.8	0.0
Lower Slope	Harpiniopsis sp WS1	0.8	0.1
Lower Slope	Hesperonoe complanata	0.8	0.0
Lower Slope	Hesperonoe laevis	0.8	0.0
Lower Slope	Heterophoxus oculatus	0.8	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Hippomedon sp	0.8	0.1
Lower Slope	Hoplonemertea	0.8	0.0
Lower Slope	Janiralata sp	0.8	0.0
Lower Slope	Joeropsis dubia	0.8	0.0
Lower Slope	Kurtiella compressa	0.8	0.0
Lower Slope	Kurtiella sp LA1	0.8	0.0
Lower Slope	Lagisca sp	0.8	0.0
Lower Slope	Lanassa gracilis	0.8	0.0
Lower Slope	Lanassa sp	0.8	0.0
Lower Slope	Lanassa venusta venusta	0.8	0.0
Lower Slope	Laticorophium baconi	0.8	0.0
Lower Slope	Leaena caeca	0.8	0.0
Lower Slope	Ledella sp	0.8	0.1
Lower Slope	Lepidonotus spiculus	0.8	0.0
Lower Slope	Leptostylis sp E	0.8	0.0
Lower Slope	Leucon fulvus	0.8	0.0
Lower Slope	Levinsenia gracilis	0.8	0.0
Lower Slope	Levinsenia multibranchiata	0.8	0.0
Lower Slope	Levinsenia sp B	0.8	0.0
Lower Slope	Limatula saturna	0.8	0.0
Lower Slope	Lineus bilineatus	0.8	0.0
Lower Slope	Listriolobus pelodes	0.8	0.0
Lower Slope	Listriolobus sp	0.8	0.0
Lower Slope	Loxosomella sp	0.8	0.0
Lower Slope	Lumbriclymene lineus	0.8	0.1
Lower Slope	Lysianassoidea	0.8	0.0
Lower Slope	Lysippe sp	0.8	0.0
Lower Slope	Makrokylindrus sp A	0.8	0.0
Lower Slope	Makrokylindrus sp SD1	0.8	0.0
Lower Slope	Malletia pacifica	0.8	0.0
Lower Slope	Malletia sp	0.8	0.0
Lower Slope	Malmgreniella scriptoria	0.8	0.0
Lower Slope	Malmgreniella sp	0.8	0.0
Lower Slope	Malmgreniella sp SD2	0.8	0.0
Lower Slope	Marphysa disjuncta	0.8	0.0
Lower Slope	Mastobranchus sp	0.8	0.0
Lower Slope	Mayerella banksia	0.8	0.0
Lower Slope	Melinna oculata	0.8	0.0
Lower Slope	Mexamage longibranchiata	0.8	0.0
Lower Slope	Micrura wilsoni	0.8	0.0
Lower Slope	Molpadia intermedia	0.8	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Monobrachium parasitum	0.8	0.0
Lower Slope	Monoculodes emarginatus	0.8	0.0
Lower Slope	Monoculodes glyconicus	0.8	0.0
Lower Slope	Monostyliferoidea	0.8	0.0
Lower Slope	Monticellina siblina	0.8	0.0
Lower Slope	Munnopsidae	0.8	0.0
Lower Slope	Myodocopida	0.8	0.0
Lower Slope	Myriotrochus sp WS1	0.8	0.0
Lower Slope	Mysidella americana	0.8	0.0
Lower Slope	Natatolana californiensis	0.8	0.0
Lower Slope	Neilonella sp	0.8	0.0
Lower Slope	Neilonellidae	0.8	0.1
Lower Slope	Neomediomastus glabrus	0.8	0.0
Lower Slope	Neomeniomorpha sp B	0.8	0.0
Lower Slope	Nephasoma sp	0.8	0.0
Lower Slope	Nephtys caecoides	0.8	0.0
Lower Slope	Nephtys ferruginea	0.8	0.0
Lower Slope	Nereis sp A	0.8	0.0
Lower Slope	Nicomache sp	0.8	0.0
Lower Slope	Ninoe sp	0.8	0.0
Lower Slope	Notomastus sp	0.8	0.0
Lower Slope	Notoplana sp	0.8	0.0
Lower Slope	Nuculana sp B	0.8	0.0
Lower Slope	Nuculanoidea	0.8	0.0
Lower Slope	Oerstedia dorsalis	0.8	0.0
Lower Slope	Onuphis sp A	0.8	0.1
Lower Slope	Opheliidae	0.8	0.0
Lower Slope	Ophelina farallonensis	0.8	0.0
Lower Slope	Ophelina sp	0.8	0.0
Lower Slope	Ophioscolex corynetes	0.8	0.0
Lower Slope	Ophiothrix spiculata	0.8	0.1
Lower Slope	Ophiura leptoctenia	0.8	0.2
Lower Slope	Oplorhiza polynema	0.8	0.0
Lower Slope	Orchomenella decipiens	0.8	0.0
Lower Slope	Paradialychone bimaculata	0.8	0.0
Lower Slope	Paradoneis sp	0.8	0.0
Lower Slope	Paralamprops sp	0.8	0.0
Lower Slope	Paranemertes californica	0.8	0.0
Lower Slope	Pardaliscella sp	0.8	0.0
Lower Slope	Pareurythoe californica	0.8	0.1
Lower Slope	Parvaplustrum sp B	0.8	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Pectinaria californiensis	0.8	0.1
Lower Slope	Pectinariidae	0.8	0.0
Lower Slope	Pennatula phosphorea	0.8	0.0
Lower Slope	Pennatulacea sp A	0.8	0.0
Lower Slope	Pentamera pseudocalcigera	0.8	0.0
Lower Slope	Petalosarsia sp A	0.8	0.0
Lower Slope	Pherusa neopapillata	0.8	0.0
Lower Slope	Philine auriformis	0.8	0.0
Lower Slope	Philomedes sp A	0.8	0.0
Lower Slope	Photis lacia	0.8	0.0
Lower Slope	Photis sp WS1	0.8	0.0
Lower Slope	Phoxocephalidae	0.8	0.0
Lower Slope	Phyllodoce cuspidata	0.8	0.0
Lower Slope	Phyllodoce groenlandica	0.8	0.1
Lower Slope	Phyllodoce pettiboneae	0.8	0.0
Lower Slope	Physonectae	0.8	0.0
Lower Slope	Pista disjuncta	0.8	0.0
Lower Slope	Podarkeopsis sp	0.8	0.0
Lower Slope	Polycirrus sp I	0.8	0.0
Lower Slope	Polynoinae	0.8	0.0
Lower Slope	Praxillella gracilis	0.8	0.0
Lower Slope	Praxillura sp	0.8	0.0
Lower Slope	Prionospio (Minuspio) lighti	0.8	0.0
Lower Slope	Prionospio (Minuspio) sp A	0.8	0.0
Lower Slope	Procampylaspis caenosa	0.8	0.0
Lower Slope	Procampylaspis sp SD1	0.8	0.0
Lower Slope	Proclea sp	0.8	0.0
Lower Slope	Protocirrineris sp B	0.8	0.0
Lower Slope	Protomedeia articulata Cmplx	0.8	0.0
Lower Slope	Psilodens sp	0.8	0.0
Lower Slope	Rhepoxynius bicuspidatus	0.8	0.0
Lower Slope	Rhepoxynius menziesi	0.8	0.0
Lower Slope	Sabellidae sp LA1	0.8	0.0
Lower Slope	Sabellides manriquei	0.8	0.0
Lower Slope	Salmacina sp	0.8	0.0
Lower Slope	Schizocardium sp	0.8	0.1
Lower Slope	Scleroconcha trituberculata	0.8	0.0
Lower Slope	Scoloplos sp	0.8	0.0
Lower Slope	Siboglinum veleronis	0.8	0.1
Lower Slope	Sigambra setosa	0.8	0.0
Lower Slope	Sige sp	0.8	0.0

Habitat	Taxon	Frequency of Occurrence (%)	Relative Abundance (%)
Lower Slope	Siphonolabrum californiensis	0.8	0.0
Lower Slope	Sipunculidae	0.8	0.0
Lower Slope	Skenea sp A	0.8	0.0
Lower Slope	Solamen columbianum	0.8	0.0
Lower Slope	Spiophanes anoculata	0.8	0.0
Lower Slope	Spiophanes berkeleyorum	0.8	0.0
Lower Slope	Staurocalyptus dowlingi	0.8	0.0
Lower Slope	Sternaspis affinis	0.8	0.1
Lower Slope	Sternaspis maior	0.8	0.0
Lower Slope	Streblosoma sp	0.8	0.0
Lower Slope	Synidotea calcarea	0.8	0.0
Lower Slope	Syrrhoe longifrons	0.8	0.0
Lower Slope	Tanaidacea	0.8	0.0
Lower Slope	Tanaopsis cadieni	0.8	0.0
Lower Slope	Terebellides reishi	0.8	0.0
Lower Slope	Terebellinae	0.8	0.0
Lower Slope	Tetrastemma nigrifrons	0.8	0.0
Lower Slope	Therochaeta pacifica	0.8	0.0
Lower Slope	Thyasiridae	0.8	0.0
Lower Slope	Tritia insculpta	0.8	0.0
Lower Slope	Tubulanus sp	0.8	0.0
Lower Slope	Typhlotanais crassus	0.8	0.0
Lower Slope	Typhlotanais sp	0.8	0.0
Lower Slope	Typosyllis heterochaeta	0.8	0.0
Lower Slope	Typosyllis hyperioni	0.8	0.0
Lower Slope	Vemakylindrus hystricosa	0.8	0.0
Lower Slope	Volvulella cylindrica	0.8	0.0
Lower Slope	Waldo arthuri	0.8	0.0
Lower Slope	Yoldiella sp	0.8	0.0
Lower Slope	Zygeupolia rubens	0.8	0.0

Appendix F: Benthic Habitat Condition of the Continental Shelf Surrounding Oil and Gas Platforms in the Santa Barbara Channel, Offshore Southern California

Introduction

The continental shelf of southern California is an important location for the extraction of petroleum and natural gas within the coastal waters of the United States. There are 23 platforms within Federal waters offshore California (McCrary et al. 2003; BSEE 2018). The age of these platforms varies, with the oldest installed in 1967 (Love et al. 2003; BSEE 2018). Fifteen of these platforms are within the Santa Barbara Channel portion of the Southern California Bight. The Santa Barbara Channel is an ecologically unique region of the Pacific Coast in that beyond the mineral resources there, it is a transition between biogeographic regions (Oregonian to the north and Californian to the south), contains a number of marine protected areas, and borders the second largest metroplex in the United States (Schiff et al. 2016).

A variety of operational platform-related activities (e.g., drilling, maintenance, waste water production), as well as the physical presence of the platform influence the condition of the seafloor habitat near the platform (Bishop et al. 2017; Heery et al. 2017; Henry et al. 2017). The cables, pipes, and support structures provide protection from predation and hard substrate for epifauna to grow on compared to the low-profile soft sediments that comprise much of the continental shelf seafloor. In many cases, demersal fishes and megainvertebrates may benefit from the structural complexity created by the platform (Love and York 2005; Page et al. 2008; Claisse et al. 2014).

In contrast to demersal and pelagic fauna, sessile infauna abundance and species compositions are changed by platform operations (Denoyelle et al. 2010; Manoukian et al. 2010; Ellis et al. 2012). When wells are drilled for oil and gas exploration or production on the sea floor, fluids and sediments from the drilling process can be released into the water and settle onto the sea floor. Depositions from drilling can bury organisms and increase sediment toxicity over time due to additives introduced to improve the performance of the drilling fluid (Neff 1987). The amount of materials released from drilling can be substantial – nearly 2000 metric tons material may be discharged during drilling of an exploration well (Neff 1987). The area affected from drilling depositions depends on the volume of released materials, the age of the platform, depth of water, sediment characteristics, and ocean conditions. As such, the area of deposition can range from 10 to 20 m of the discharging platform (Neff 2005) to over 2000 m (Davies et al. 1984). Consequently, benthic impacts were an important area of study for Federal platforms in southern California early in their development and installation. A large survey in 1975-76 examined seafloor metals, chemicals, sediments, and infauna communities associated potential areas for development throughout the Southern California Bight (Callahan and Shokes 1977). Later, the *California Outer Continental Shelf Monitoring Program* evaluated the effect of drilling 39 wells from three offshore platforms off Point Arguello, California from 1986 to 1995 (Hyland et al. 1991a; Lissner 1993).

Most of the platforms in in the Santa Barbara channel ecosystem have been in operation for four to five decades and a number of them are approaching the end of their productive lifespans (Schroeder and Love 2004; Henrion et al. 2014; Bull and Love 2019). Many of these older platforms are being targeted for decommissioning, which in California currently means the complete removal of oil and gas facilities. An assessment of the present-day conditions of the benthic habitats around the platforms is important information for mangers and regulators seeking to predict local environmental disturbance to the seafloor. It would be best that the information be observational – as opposed a generalized conceptual model – and have as close spatial and temporal proximity to any planned operations as is possible.

Unfortunately, at the present moment nearly all the information available in the scientific literature detailing the relationships between sediment habitat condition and oil/gas platform operation are not from southern California (e.g., North Sea – Olsgard and Gray 1995; Gulf of Mexico –Montagna and Harper, Jr. 1996; Hernández Arana et al. 2005; Mediterranean Sea – Manoukian et al. 2010; Terlizzi et al. 2008). Hyland et al. (1990; 1991a; 1991b; 1994) represents that most recent analysis of sediment chemistry and infauna from soft-sediment habitats near southern California oil platforms. As such, there is a lack of current information on the condition of benthic habitat surrounding platforms from southern California, leaving local managers at a disadvantage as decommissioning assessments begin.

The goal of this study was to assess the benthic habitat condition of continental shelf sediments surrounding four active oil/gas platforms in the Santa Barbara Channel in southern California. To provide the broadest context of condition, while still keeping the evaluations focused on the biological resources of the continental shelf, condition was evaluated with macrobenthic fauna, sediment toxicity, and sediment chemical composition (evaluated against biologically meaningful thresholds). To provide a regional context for our observations of condition, results were compared to those from the most recent Southern California Bight Regional Monitoring Program Survey, conducted in 2013 (Schiff et al. 2016).

Methods

Study Area and Sampling Design

Sampling was focused around four active oil platforms (A, B, C, and Hillhouse) in the eastern part of the Santa Barbara Channel (Figure F-1). This area of the Southern California Bight is on the continental shelf with water depths of ~60 m (i.e., mid-shelf depths). This is an area oceanographically influenced by the cold-water California Current flowing to the south mixing with the warm-water Davidson Countercurrent flowing to the north (Bray et al. 1999), as well as seasonal upwelling of nutrient-rich bottom waters (Chhak and Di Lorenzo 2007). Additionally, these waters are adjacent to a densely populated United States metro-center (http://california.us.censusviewer.com/client) and receive point-source and non-point source discharges from more than 23 million people (County Sanitation Districts of Los Angeles County 2016; Orange County Sanitation District 2017).

Two sampling strata were created around the platforms, representing polygons with 0-1 km and 1-2 km distances from any of the platforms. Within these strata, 250 m exclusion buffers were created around the platform structures, underwater pipes and cables, as well the shell mounds associated with each platform. These buffers ensured sampling crew safety, prevented damage to the platform infrastructure, and maximize the likelihood of finding sediments suitable for sampling via a grab (i.e., not on shell debris or consolidated sediments). Ten sample sites were allocated within each stratum via a stratified, random tessellated design (Stevens and Olsen 2003; 2004; Olsen and Peck 2008). The random allocation process allows for an even distribution of sites among strata. An additional 20 overdraw sites were selected for each stratum in case samples could not be collected at any of the initially identified sampling sites.

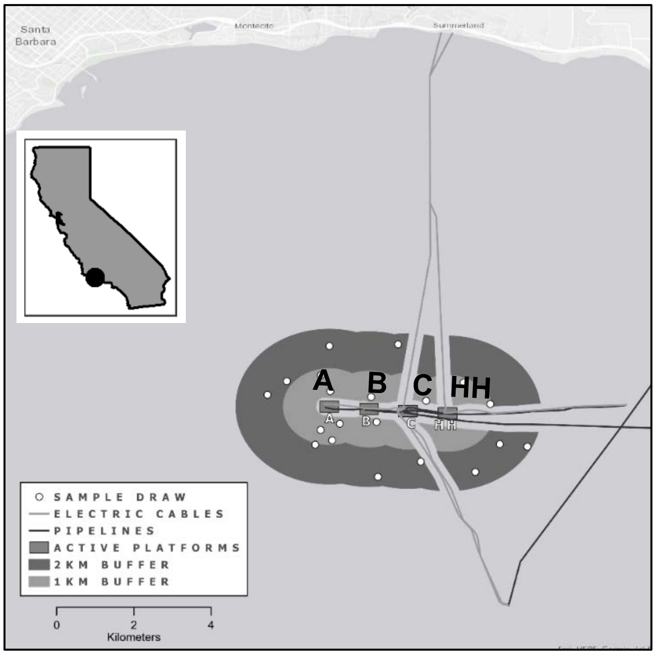

Figure F-1. A map depicting the approximate location of the 20 sampling sites within the 1-km and 2-km strata around the A, B, C, and Hillhouse (HH) oil platforms offshore Santa Barbara, California.

Analytical Approach

Habitat condition was assessed at each site with three types of measurements: macrobenthic community composition (benthic infauna), sediment chemistry, and sediment toxicity. Sediment for each assessment component were collected from each of the 20 sampling sites using a double 0.1 m^2 Van Veen grab following the sampling protocols detailed in the Southern California Bight 2018 Regional Marine Monitoring Survey (Bight ’18) Sediment Quality Assessment Field Operations Manual (Bight ’18 Field Sampling and Logistics Committee 2018). All measurements from the platform strata were compared to measurements from across the region at the same mid-shelf depth range (30 – 93 m) collected as part of the prior regional survey, the 2013 Southern California Bight Regional Monitoring Program Survey (Bight ’13; Bay et al. 2015; Dodder et al. 2016; Gillett et al. 2017). Benthic infauna from platform samples were also compared to mid-shelf depth samples within the Santa Barbara Channel collected in all previous Bight surveys from 1994, 1998, 2003, and 2008. The platform strata samples were collected in the same season as the rest of Bight ’18 sampling, however, the regional mid-shelf depth samples were not available for comparison at the time this report was due. Comparison of the platform strata to the most recently available samples in ecologically similar habitats allows for contextualization of the results against regional patterns and the separation of local- and regional-scale factors on each component.

Macrobenthic communities were assessed using multivariate comparisons of taxonomic composition and calculation of condition scores using the BRI (Smith et al. 2001) derived for southern California. Sediment chemistry was assessed by measurements of individual compounds (metals, PCBs, PAHs, and pesticides) and calculation of potential exposure scores using the California Chemical Score Index (CSI [Bay et al. 2014]). Sediment toxicity was evaluated using a 10-day survival test (USEPA 1994; ASTM 2010) and the results were interpreted with the California Sediment Quality Objectives (SQOs) framework (Bay et al. 2014).

Benthic Fauna

Methods for processing and identification of benthic fauna followed the guidelines of the Bight ’18 Macrobenthic Sample Analysis Laboratory Manual (Bight ’18 Benthic Committee 2018). In short, sediments were sieved on a 1-mm screen, the material retained on the screen was placed in a chemical relaxant solution, and then fixed with 10% buffered formalin. Samples were rinsed and transferred from formalin to 70% ethanol 2-5 days after collection. Organisms were sorted from the retained material, counted, and identified the lowest possible taxonomic level following the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) Edition 12 (SCAMIT 2018). Quality assurance and control protocols and data quality objectives for sample sorting, identification, and enumeration are detailed in Bight ’18 Benthic Committee (2018).

Taxonomic composition among the platform samples was visually compared by ordination of Bray-Curtis dissimilarity values in a 2-D non-Metric Multi-Dimensional Scaling (nMDS) plot. Similarly, the composition of the platform samples was compared to all mid-shelf depth samples from Bight ’13. Taxonomic composition was also compared to samples from the mid-shelf depth within Santa Barbara Channel collected in Bight Regional Surveys from 1994, 1998, 2003, 2008, and 2013 to compare the platform samples to the temporal taxonomic changes in the immediate vicinity through time. Differences in taxonomic composition between the platform samples and the Bight survey samples were quantified with a 1-way permANOVA ($\alpha = 0.1$), with data source as the independent variable. Differences in univariate measures of community composition (e.g., abundance, diversity, etc.) between oil platform samples and those from the Bight ’13 survey compared using a 1-way ANOVA, with data source as the treatment variable. All nMDS ordinations and permANOVA analyses were conducted with the Vegan package (v 2.5-4) in R (v3.5.3). ANOVA analyses were conducted with the aov function in R (v3.5.3).

Habitat condition of the sediments at each site was assessed using the BRI (Smith et al. 2001). BRI scores and condition categories were calculated using SCCWRP’s online calculator http://data.sccwrp.org/upload/bri_map.v6.php. BRI scores and condition categories were compared to those of other mid-shelf sites within the region sampled during the Bight ’13.

Sediment Chemistry

Methods for processing and measuring sediment contaminants, grainsize composition, and organic matter content followed Dodder et al. (2016). Individual target analytes are listed in Table F-1 and included a suite of compounds typically measured in regional surveys: Metals, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), pesticides, measures of sediment grainsize, total organic carbon (TOC) and total nitrogen (TN). Briefly, grainsize samples were sieved on 2-mm and 1-mm screens to capture the gravel fraction and the remaining smaller particles were analyzed using a SM2560D laser refractometer. Sediments for TOC and TN analysis were acidified with hydrochloric acid vapors and combusted in a high temperature elemental analyzer with gas chromatography. Samples for all metals except for mercury were digested in a strong acid, with the digestate analyzed by inductively coupled plasma mass spectrometry. Mercury was analyzed using cold vapor atomic adsorption spectroscopy. The trace organics (PAHs, PCBs, and pesticides) were solvent extracted and analyzed with gas chromatography mass spectrometry.

Comparisons of key compounds of interest including Total PAHs, Low (< 4 aromatic rings) and High (> 3 aromatic rings) molecular weight PAHs, copper, barium, and total DDE, as well as TOC, TN, and grainsize were compared between the platform samples and those from mid-shelf depths collected during the Bight ’13. Comparisons of individual compounds between oil platform and Bight ’13 samples were quantified in a 1-way ANOVA, with the data source as the treatment variable ($\alpha = 0.1$). ANOVA calculations were conducted with the aov function in R (v3.5.3). Habitat condition based upon potential chemical exposure was assessed using the CSI component of the California SQOs framework (Bay et al.

2014). Comparisons of CSI scores and the distribution of habitat condition categories was made between the sample platforms and samples collected from similar mid-shelf depth sites across the region in the Bight ’13.

Sediment Toxicity

Laboratory methods, quality assurance and control, and California SQOs for assessing habitat condition base upon whole sediment toxicity testing followed the guidelines of Bay et al. (2015). The toxicity of sediments collected from each of the platform stations was evaluated with a 10-day survival test using the amphipod *Eohaustorius estuarius* (USEPA 1994; ASTM 2010). Twenty amphipods were used in each replicate test at 15±2 °C under constant illumination. Sediment toxicity was quantified as control adjusted survival after the 10-day exposure. Control adjusted survival rates for the platform samples was compared to that of similar mid-shelf depth samples from across the region during the Bight ’13. Habitat condition based upon the toxicity of the sediment was evaluated using California’s SQO assessment framework (Bay et al. 2014). The distribution of condition categories was compared that of similar mid-shelf depth samples from across the region during the Bight ’13.

Table F-1. Chemical analyses performed on sediments from the oil platform samples. Parameters are grouped by their measurement type. Machine Detection Limit (MDL) and Reporting Limit (RL) for each measurement and its associated analytical method are provided for reference.

Group	Parameter	MDL	RL	Units	Method
Conventionals	Percent Solids	0.1	0.1	%	SM 2540 B
Grainsize	Clay	0.1	0.1	%	SM 2560 D
Grainsize	Gravel	0.1	0.1	%	SM 2560 D
Grainsize	Sand	0.1	0.1	%	SM 2560 D
Grainsize	Silt	0.1	0.1	%	SM 2560 D
Metal	Aluminum	1	5	ppm	EPA 6020
Metal	Antimony	0.025	0.05	ppm	EPA 6020
Metal	Arsenic	0.025	0.05	ppm	EPA 6020
Metal	Barium	0.025	0.05	ppm	EPA 6020
Metal	Beryllium	0.025	0.05	ppm	EPA 6020
Metal	Cadmium	0.0025	0.005	ppm	EPA 6020
Metal	Chromium	0.0025	0.005	ppm	EPA 6020
Metal	Copper	0.0025	0.005	ppm	EPA 6020
Metal	Iron	1	5	ppm	EPA 6020
Metal	Lead	0.0025	0.005	ppm	EPA 6020
Metal	Mercury	0.00001	0.00002	ppm	EPA 245.7
Metal	Nickel	0.01	0.02	ppm	EPA 6020
Metal	Selenium	0.025	0.05	ppm	EPA 6020
Metal	Silver	0.01	0.02	ppm	EPA 6020
Metal	Zinc	0.025	0.05	ppm	EPA 6020
Nutrient	Total Nitrogen	0.01	0.01	%	EPA 9060
Nutrient	Total Organic Carbon	0.01	0.01	%	EPA 9060
Pesticides	2,4'-DDD	0.267	0.5	ppb	EPA 8270D
Pesticides	2,4'-DDE	0.2	0.5	ppb	EPA 8270D
Pesticides	2,4'-DDT	0.194	0.5	ppb	EPA 8270D
Pesticides	4,4'-DDD	0.198	0.5	ppb	EPA 8270D
Pesticides	4,4'-DDE	0.193	0.5	ppb	EPA 8270D
Pesticides	4,4'-DDMU	0.223	0.5	ppb	EPA 8270D
Pesticides	4,4'-DDT	0.128	0.5	ppb	EPA 8270D
Pesticides	Chlordane-alpha	0.187	0.5	ppb	EPA 8270D
Pesticides	Chlordane-gamma	0.179	0.5	ppb	EPA 8270D
Pesticides	cis-Nonachlor	0.192	0.5	ppb	EPA 8270D
Pesticides	Oxychlordane	0.25	0.5	ppb	EPA 8270D
Pesticides	trans-Nonachlor	0.186	0.5	ppb	EPA 8270D

Table F-1. cont.

Group	Parameter	MDL	RL	Units	Method
PAH	1-Methylnaphthalene	0.084	0.5	ppb	EPA 8270D
PAH	1-Methylphenanthrene	0.076	0.5	ppb	EPA 8270D
PAH	2,3,5-Trimethylnaphthalene	0.059	0.5	ppb	EPA 8270D
PAH	2,6-Dimethylnaphthalene	0.065	0.5	ppb	EPA 8270D
PAH	2-Methylnaphthalene	0.106	0.5	ppb	EPA 8270D
PAH	Acenaphthene	0.078	0.5	ppb	EPA 8270D
PAH	Acenaphthylene	0.058	0.5	ppb	EPA 8270D
PAH	Anthracene	0.046	0.5	ppb	EPA 8270D
PAH	Benz[a]anthracene	0.107	0.5	ppb	EPA 8270D
PAH	Benzo[a]pyrene	0.106	0.5	ppb	EPA 8270D
PAH	Benzo[b]fluoranthene	0.063	0.5	ppb	EPA 8270D
PAH	Benzo[e]pyrene	0.098	0.5	ppb	EPA 8270D
PAH	Benzo[g,h,i]perylene	0.093	0.5	ppb	EPA 8270D
PAH	Benzo[k]fluoranthene	0.111	0.5	ppb	EPA 8270D
PAH	Biphenyl	0.092	0.5	ppb	EPA 8270D
PAH	Chrysene	0.067	0.5	ppb	EPA 8270D
PAH	Dibenz[a,h]anthracene	0.106	0.5	ppb	EPA 8270D
PAH	Fluoranthene	0.035	0.5	ppb	EPA 8270D
PAH	Fluorene	0.068	0.5	ppb	EPA 8270D
PAH	Indeno[1,2,3-cd]pyrene	0.087	0.5	ppb	EPA 8270D
PAH	Naphthalene	0.187	0.5	ppb	EPA 8270D
PAH	Perylene	0.114	0.5	ppb	EPA 8270D
PAH	Phenanthrene	0.074	0.5	ppb	EPA 8270D
PAH	Pyrene	0.048	0.5	ppb	EPA 8270D
PCB	PCB008	0.017	0.2	ppb	EPA 8270D
PCB	PCB018	0.029	0.2	ppb	EPA 8270D
PCB	PCB028	0.023	0.2	ppb	EPA 8270D
PCB	PCB037	0.06	0.2	ppb	EPA 8270D
PCB	PCB044	0.028	0.2	ppb	EPA 8270D
PCB	PCB049	0.036	0.2	ppb	EPA 8270D
PCB	PCB052	0.012	0.2	ppb	EPA 8270D

Table F-1. cont.

Group	Parameter	MDL	RL	Units	Method
PCB	PCB066	0.027	0.2	ppb	EPA 8270D
PCB	PCB070	0.023	0.2	ppb	EPA 8270D
PCB	PCB074	0.021	0.2	ppb	EPA 8270D
PCB	PCB077	0.018	0.2	ppb	EPA 8270D
PCB	PCB081	0.084	0.2	ppb	EPA 8270D
PCB	PCB087	0.081	0.2	ppb	EPA 8270D
PCB	PCB099	0.028	0.2	ppb	EPA 8270D
PCB	PCB101	0.027	0.2	ppb	EPA 8270D
PCB	PCB105	0.047	0.2	ppb	EPA 8270D
PCB	PCB110	0.074	0.2	ppb	EPA 8270D
PCB	PCB114	0.072	0.2	ppb	EPA 8270D
PCB	PCB118	0.069	0.2	ppb	EPA 8270D
PCB	PCB119	0.071	0.2	ppb	EPA 8270D
PCB	PCB123	0.018	0.2	ppb	EPA 8270D
PCB	PCB126	0.086	0.2	ppb	EPA 8270D
PCB	PCB128	0.081	0.2	ppb	EPA 8270D
PCB	PCB138	0.057	0.2	ppb	EPA 8270D
PCB	PCB149	0.092	0.2	ppb	EPA 8270D
PCB	PCB151	0.073	0.2	ppb	EPA 8270D
PCB	PCB153	0.065	0.2	ppb	EPA 8270D
PCB	PCB156	0.089	0.2	ppb	EPA 8270D
PCB	PCB157	0.103	0.2	ppb	EPA 8270D
PCB	PCB158	0.074	0.2	ppb	EPA 8270D
PCB	PCB167	0.049	0.2	ppb	EPA 8270D
PCB	PCB168+132	0.094	0.2	ppb	EPA 8270D
PCB	PCB169	0.116	0.2	ppb	EPA 8270D
PCB	PCB170	0.118	0.25	ppb	EPA 8270D
PCB	PCB177	0.085	0.25	ppb	EPA 8270D
PCB	PCB180	0.154	0.25	ppb	EPA 8270D
PCB	PCB183	0.056	0.25	ppb	EPA 8270D
PCB	PCB187	0.168	0.25	ppb	EPA 8270D
PCB	PCB189	0.109	0.25	ppb	EPA 8270D
PCB	PCB194	0.164	0.25	ppb	EPA 8270D
PCB	PCB195	0.093	0.25	ppb	EPA 8270D
PCB	PCB201	0.104	0.25	ppb	EPA 8270D
PCB	PCB206	0.155	0.25	ppb	EPA 8270D

Results

Benthic Infauna

Across the 20 samples, 338 different taxa were identified (see Supplemental Data). A comparison of the benthic fauna collected from the 1-km and 2-km strata indicated that the strata were relatively similar to each other. Within both strata, the macrobenthic community was dominated by the ophiuroid *Amphiodia urtica*, and the polychaetes *Spiophanes duplex*, *Aglaophamus verrilli*, and *Mediomastus* sp., which were among the top ten most abundant taxa across all the samples. A permANOVA of Bray-Curtis dissimilarities indicated that there were no differences between the infauna from the 1-km and 2-km strata ($p = 0.45$, df = 1,18). Multivariate comparison between the platform samples and those mid-shelf samples from the Bight '13 suggest that there were differences in community composition and abundance between the two data sets (permANOVA $p = 0.001$, df = 1,48). A visual inspection of the dissimilarities (Figure F-2) confirms the permANOVA results, in that platform samples clustered to themselves (i.e., more similar) than to the Bight '13, albeit without complete separation from the Bight '13 samples.

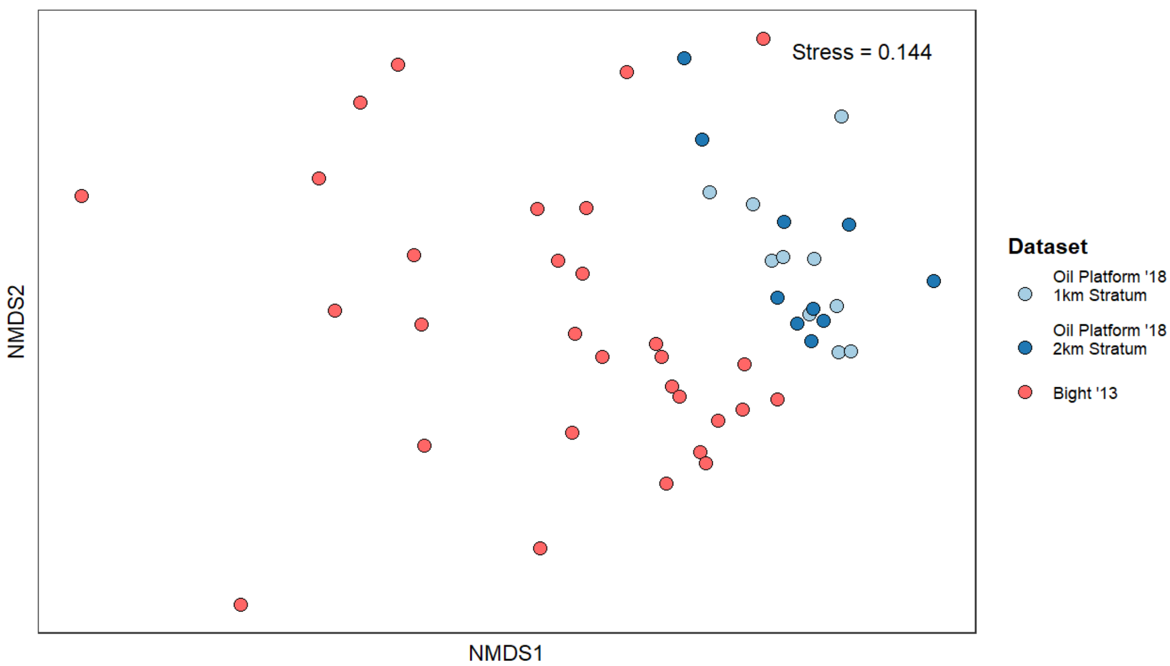

Figure F-2. A nMDS plot summarizing the similarity of regional and oil platform samples. Benthic infauna Bray-Curtis dissimilarities calculated from species abundance of samples 1 km and 2 km from four oil platforms (Oil Platform '18), as well as those from mid-shelf depths across the Southern California Bight collected in 2013 (Bight '13).

It should be noted that the comparison of the oil platform samples to all mid-shelf Bight '13 samples incorporate both temporal (five-year difference between sampling) and spatial differences (0.031 vs. 1.856 dd latitude and 0.060 vs. 3.256 dd longitude among the platform and Bight '13 samples). Figure F-3 illustrates that when compared to mid-shelf samples only from the Santa Barbara Channel (i.e., minimizing spatial variance), the oil platform samples were relatively similar to samples collected in 2013 and 2008; especially compared to samples from even older surveys.

From a univariate perspective, the samples from around the oil platforms were somewhat different than similar mid-shelf samples from the Bight ’13. The oil platform samples had significantly lower total abundance (p = 0.012), taxa richness (p < 0.001), and Shannon-Weiner taxa diversity (p = 0.006) than the Bight ’13 samples based upon the results of the 1-way ANOVA tests (Table F-2; Figure F-4).

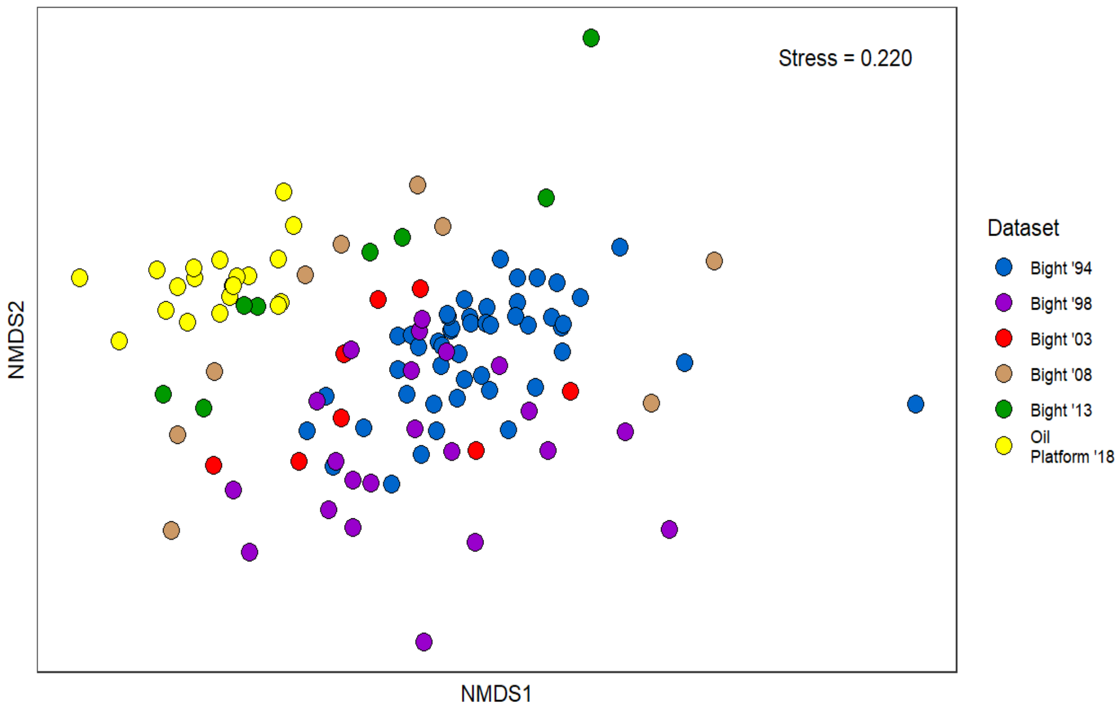

Figure F-3. A nMDS plot summarizing the similarity of oil platform samples and those from mid-shelf depths within the Santa Barbara Channel. Benthic infauna Bray-Curtis dissimilarities calculated from species abundance of samples 1 km and 2 km from four oil platforms (collected in Oil Platform ’18), as well as samples from mid-shelf depths across the channel (collected in Bight ’94, Bight ’98, Bight ’03, Bight ’08, and Bight ’13).

Table F-2. Mean and Standard Deviation (SD) values of total abundance, Shannon-Weiner diversity, and species richness for the Oil Platform ’18 samples and those from mid-shelf depths across the Southern California Bight in 2013 (Bight ’13).

	Total Abundance			Species Diversity (H')			Species Richness (S)		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Bight '13	491.2	464.7	30	3.7	0.4	30	96.1	28.1	30
Oil Platform '18	218.3	69.6	20	3.3	0.5	20	60.2	19.8	20

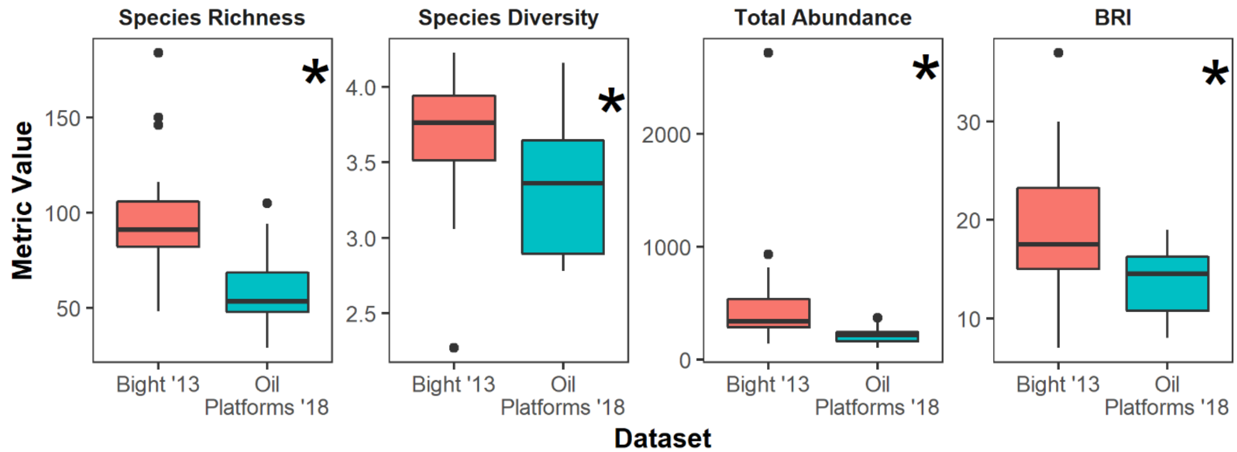

Figure F-4. Schematic box-plots comparing (from left to right) Species Richness, Species Diversity (H'), Total Abundance (# grab-1), and Benthic Response Index (BRI) score between Oil Platform '18 samples and those from mid-shelf depths across the Southern California Bight collected in 2013 (Bight '13). An asterisk indicates a significant difference (α = 0.1) in a 1-way ANOVA test.

Based upon the BRI condition assessment tool, all of the sampling sites around the oil platforms were in reference condition (Figure F-5). In comparison to the mid-shelf depth samples from across the region assessed during the Bight '13, the oil platform samples had (i.e., healthier) BRI scores and a greater percent of the samples were categorized in reference condition than those from the Bight '13 dataset (Figure F-6).

Sediment Chemistry

Measurements were made for 87 different chemical contaminants at each of the 20 sampling sites (Table F-1). In addition, we were able to make measurements of sediment grainsize, as well as TOC and TN content. The observed concentrations for individual compounds from each sample are presented in Supplemental Data for this report. For all subsequent analyses, only data from the first lab replicate at a given station were used. Sediment for some but not all stations were measured twice as part of the standard quality control process (see Supplemental Data). Of the priority toxic compounds with published biological effects thresholds (Table F-3), no compounds were observed at concentrations above their ERM or CSI High Impact value and most of the compounds were below any biologically meaningful concentration at all. Total DDEs (i.e., 2,4 DDE + 4,4 DDE) was the compound measured most frequently in exceedance of its thresholds: Nineteen samples had total DDEs above the CSI Low Impact threshold, with two of those samples above the Moderate Impact threshold; 16 samples had total DDEs above the ERL threshold. The contaminant with the second most exceedances was arsenic, with 11 samples above the ERL value.

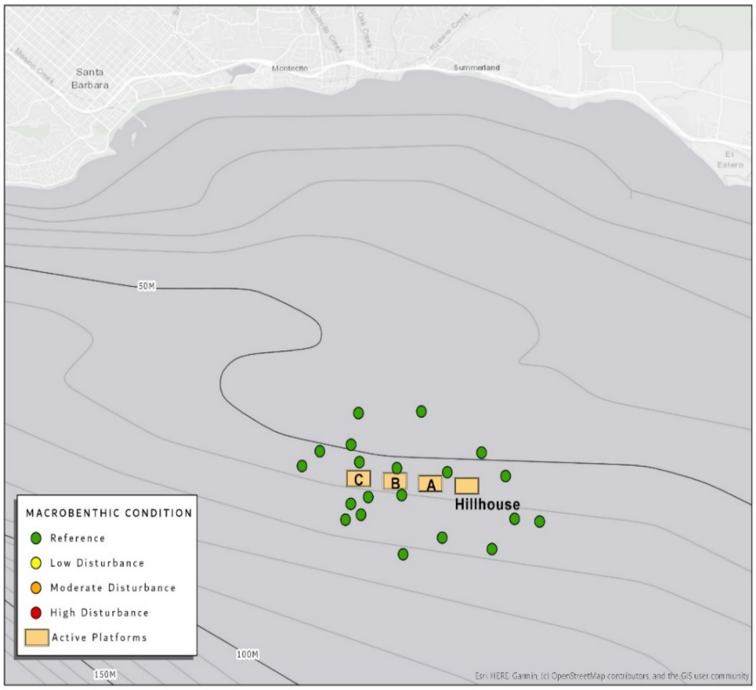

Figure F-5. Map of sampling sites located around the A, B, C, and Hillhouse oil platforms. The green circles indicate a reference condition of the sediment habitat based upon macrobenthic infauna community composition, as evaluated by the Southern California BRI assessment tool (Smith et al. 2001).

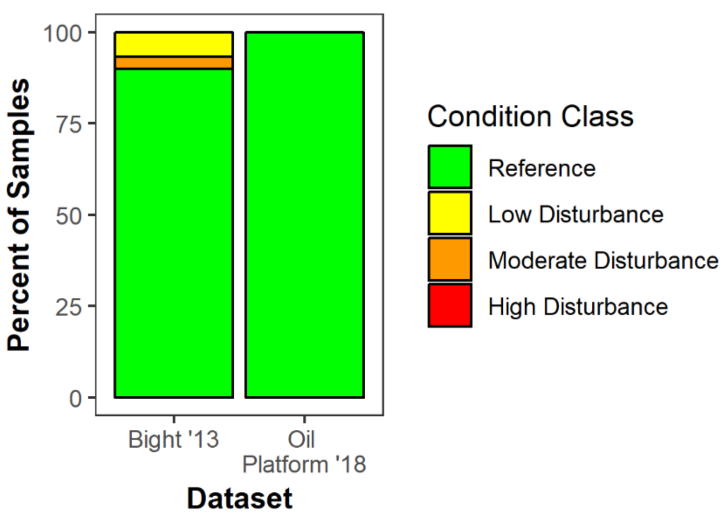

Figure F-6. Stacked bar plot of samples in each Condition Class among the mid-shelf depth samples from the Bight '13 and those from the Oil Platform '18 sampling. Condition was based upon macrobenthic infauna community composition, as evaluated by the Southern California BRI assessment tool (Smith et al. 2001).

Table F-3. The counts of oil platform samples where concentrations of chemicals were measured in exceedance of their respective ERL/ERM (Long et al. 1995) or CSI Condition (Bay et al. 2014) thresholds. A blank cell indicates that the assessment framework did not have a threshold for that particular chemical compound.

Chemical	Greater than ERL	Greater than ERM	CSI Condition Thresholds		
			Low Impact	Moderate Impact	High Impact
Arsenic	11	0			
Cadmium	0	0			
Chromium	0	0			
Copper	0	0	0	0	0
Lead	0	0	0	0	0
Mercury	0	0	0	0	0
Nickel	7	0			
Silver	0	0			
Zinc	0	0	0	0	0
2-methyl naphthalene	0	0			
Acenaphthene	0	0			
Acenaphthylene	0	0			
Anthracene	0	0			
Benzo(a)anthracene	0	0			
Benzo(a)pyrene	0	0			
Chrysene	0	0			
Fluoranthene	0	0			
Fluorene	0	0			
Naphthalene	0	0			
Phenanthrene	0	0			
Pyrene	0	0			
Summed High Molecular Weight PAHs			1	0	0
Summed Low Molecular Weight PAHs			0	0	0
Sum of all PAHs	0	0			
Summed DDDs			2	0	0
Summed DDEs	16	0	19	2	0
Summed DDTs	0	0	5	0	0
Cis-Chlordane			0	0	0
Trans-Chlordane			0	0	0
Summed PCBs	0	0	0	0	0

Compared to samples collected from mid-shelf depths across the region as part of the Bight ’13, samples from the oil platforms had significantly higher concentrations of barium ($p < 0.001$), high molecular weight PAHs ($p = 0.035$), and total PAHs ($p = 0.069$) (Figure F-7). In contrast, oil platform samples had similar amounts of copper and low molecular weight PAHs as the regional samples. The concentration of total DDE was higher in regional samples than those from the oil platforms ($p = 0.087$). Sediments from the oil platform samples were sandier ($p = 0.073$) than those from the Bight ’13, TOC content, and TN content were similar ($p > 0.1$) between the oil platform samples and those from the Bight ’13 (Figure F-8).

Based upon the CSI condition assessment tool, 100% of the sampling sites around the oil platforms had minimal potential chemical exposure (Figure F-9). CSI scores of the oil platform samples were similar to that of Bight ’13 mid-shelf samples from across the region (Figure F-10). All of the oil platform samples were evaluated to have minimum chemical exposure to benthic fauna, as were 100% of mid-shelf samples assessed as part of Bight ’13.

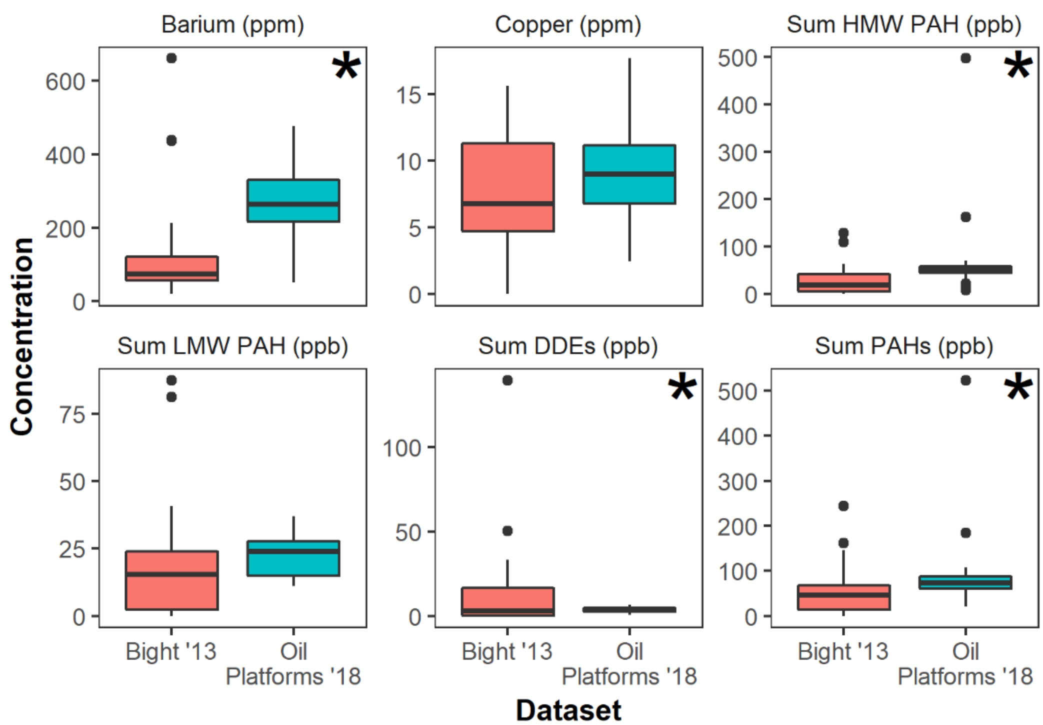

Figure F-7. Schematic box plots comparing select chemical compounds between Oil Platform ’18 and mid-shelf depths samples across the Southern California Bight collected in 2013 (Bight ’13). An asterisk indicates a significant difference (α = 0.1) in a 1-way ANOVA test.

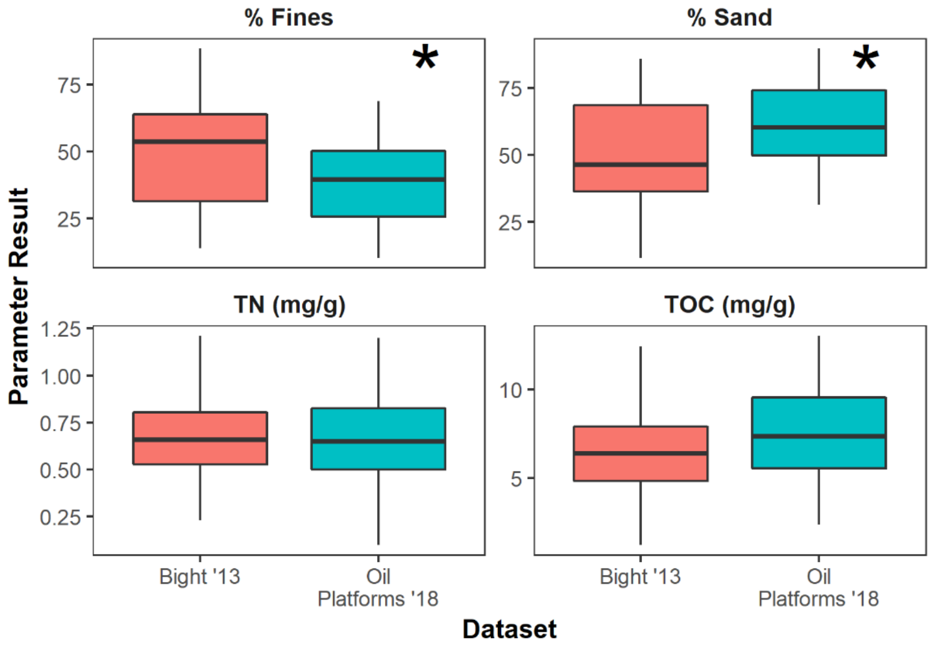

Figure F-8. Schematic box plots comparing measures of sediment grainsize composition (% Fines = % Mud + % Clay), total organic carbon (TOC), total nitrogen (TN) between Oil Platform '18 samples and those from mid-shelf depths across the Southern California Bight collected in 2013 (Bight '13). An asterisk indicates a significant difference (α = 0.1) in a 1-way ANOVA test.

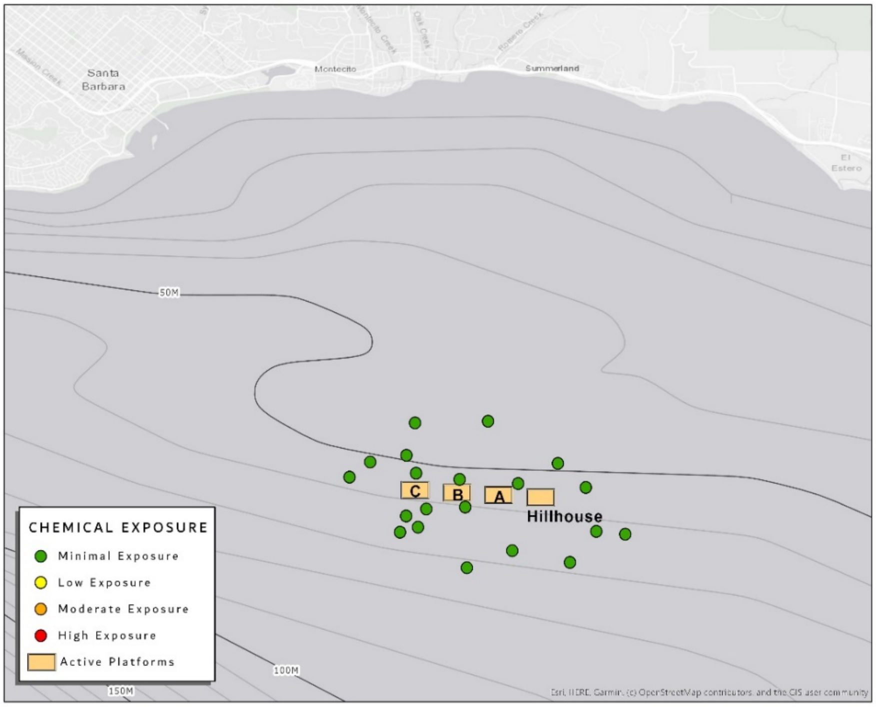

Figure F-9. Map of sampling sites located around the A, B, C, and Hillhouse oil platforms. The green circle indicates minimal exposure of the sediment habitat based upon chemical concentrations, as evaluated by the California CSI assessment tool (Bay et al. 2014).

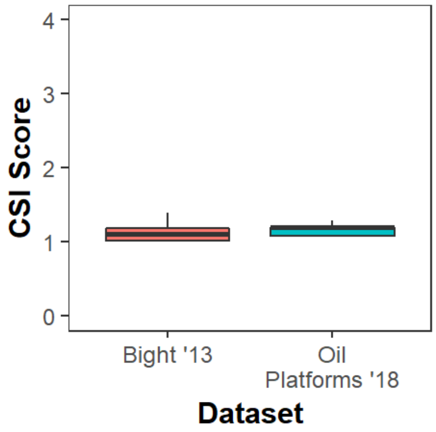

Figure F-10. Schematic box plots comparing California CSI scores between oil platform samples (Oil Platform '18) and those from mid-shelf depths across southern California in 2013 (Bight '13).

Sediment Toxicity

Successful 10-day survival toxicity tests were conducted with sediments from each of the 20 oil platform sampling sites (Table F-4). Fifteen of the samples showed no toxicity. Five of the samples showed low toxicity, three of which were located in the 1-km stratum (Figure F-11). The condition of 75% of the oil platform samples were evaluated as non-toxic using the SQO assessment framework compared to 100% of mid shelf samples assessed in the Bight '13.

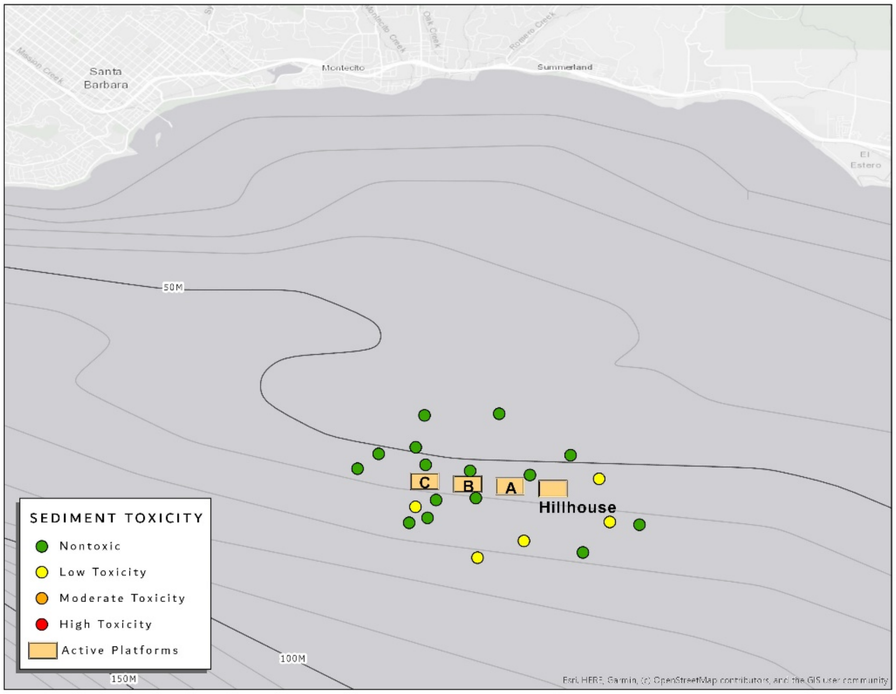

Figure F-11. Map of sampling sites located around the A, B, C, and Hillhouse oil platforms. The green and yellow circles indicate reference and low condition of the sediment habitat based upon sediment toxicity, as evaluated by the California SQO assessment framework (Bay et al. 2014).

Table F-4. Results from 10-day amphipod *Eohaustorius estuarius* survival toxicity tests for the oil platform samples, as well as the negative control tests. Mean survival of the five replicate tests for each site are presented, as well as control adjusted survival, results of the T-test between control sample, and condition categories following the California SQO framework (Bay et al. 2014).

StationID	Dilution Factor	Test Endpoint	Mean Survival (%)	Number of Tests	SD Survival	Mean Adjusted Survival (% of Control)	p-value	Significant Effect	Condition Category
1km-001	0	10 day survival	88	5	9.1	89.8	0.034	SC	Low Toxicity
1km-002	0	10 day survival	95	5	3.5	96.9	0.087	NSC	Nontoxic
1km-003	0	10 day survival	86	5	7.4	87.8	0.009	SC	Low Toxicity
1km-004	0	10 day survival	87	5	16.0	88.8	0.101	NSC	Nontoxic
1km-005	0	10 day survival	96	5	6.5	98.0	0.277	NSC	Nontoxic
1km-006	0	10 day survival	96	5	2.2	98.0	0.121	NSC	Nontoxic
1km-007	0	10 day survival	97	5	2.7	99.0	0.290	NSC	Nontoxic
1km-008	0	10 day survival	95	5	5.0	96.9	0.141	NSC	Nontoxic
1km-009	0	10 day survival	89	5	13.9	90.8	0.111	NSC	Nontoxic
1km-010	0	10 day survival	95	5	11.2	96.9	0.294	NSC	Nontoxic
2km-001	0	10 day survival	84	5	6.5	85.7	0.003	SC	Low Toxicity
2km-002	0	10 day survival	93	5	5.7	94.9	0.065	NSC	Nontoxic
2km-003	0	10 day survival	96	5	4.2	98.0	0.201	NSC	Nontoxic
2km-004	0	10 day survival	97	5	2.7	99.0	0.290	NSC	Nontoxic
2km-005	0	10 day survival	85	5	15.4	86.7	0.066	NSC	Nontoxic
2km-006	0	10 day survival	87	5	4.5	88.8	0.001	SC	Low Toxicity
2km-007	0	10 day survival	96	5	4.2	98.0	0.201	NSC	Nontoxic
2km-008	0	10 day survival	97	5	2.7	99.0	0.290	NSC	Nontoxic
2km-009	0	10 day survival	81	5	11.4	82.7	0.014	SC	Low Toxicity
2km-010	0	10 day survival	89	5	12.4	90.8	0.092	NSC	Nontoxic
Control	NA	10 day survival	98	5	2.7	100.0	NA	NA	Nontoxic

Control adjusted survival was slightly lower at the oil platform samples compared to that of samples from mid-shelf depth sites from across the region collected in the Bight ’13 (Figure F-12).

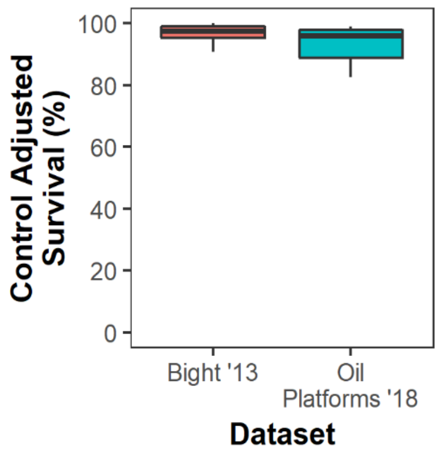

Figure F-12. Schematic box plots comparing control adjusted survival in 10-day survival sediment toxicity between oil platform samples (Oil Platform ’18) and those from mid-shelf depths across the Southern California Bight in 2013 (Bight ’18).

Among the three measures of habitat condition, the sediment toxicity results were the only ones that deviated from an unimpacted condition category. Comparisons of the chemical and sediment conditions between the five low toxicity samples and the fifteen no toxicity samples were made to provide some insight into the potential causality of the test result. Differences in the concentrations of major constituents (barium, copper, mercury, zinc, total high molecular weight PAHs, total low molecular weight PAHs, total PAHs, total DDEs, total nitrogen, total organic carbon, and clay composition) between the two groups of samples were quantified with a one-way ANOVA, with toxicity test status as the treatment variable ($\alpha = 0.1$). The low toxicity samples had significantly higher concentrations of copper, mercury, zinc and total DDEs (Figure F-13) than did the samples with reference toxicity values. Additionally, sediments from the low toxicity samples contained significantly more clay, nitrogen and organic carbon (Figure F-13). There were no differences in the amounts of barium or the different PAH mixes tested between the two types of samples.

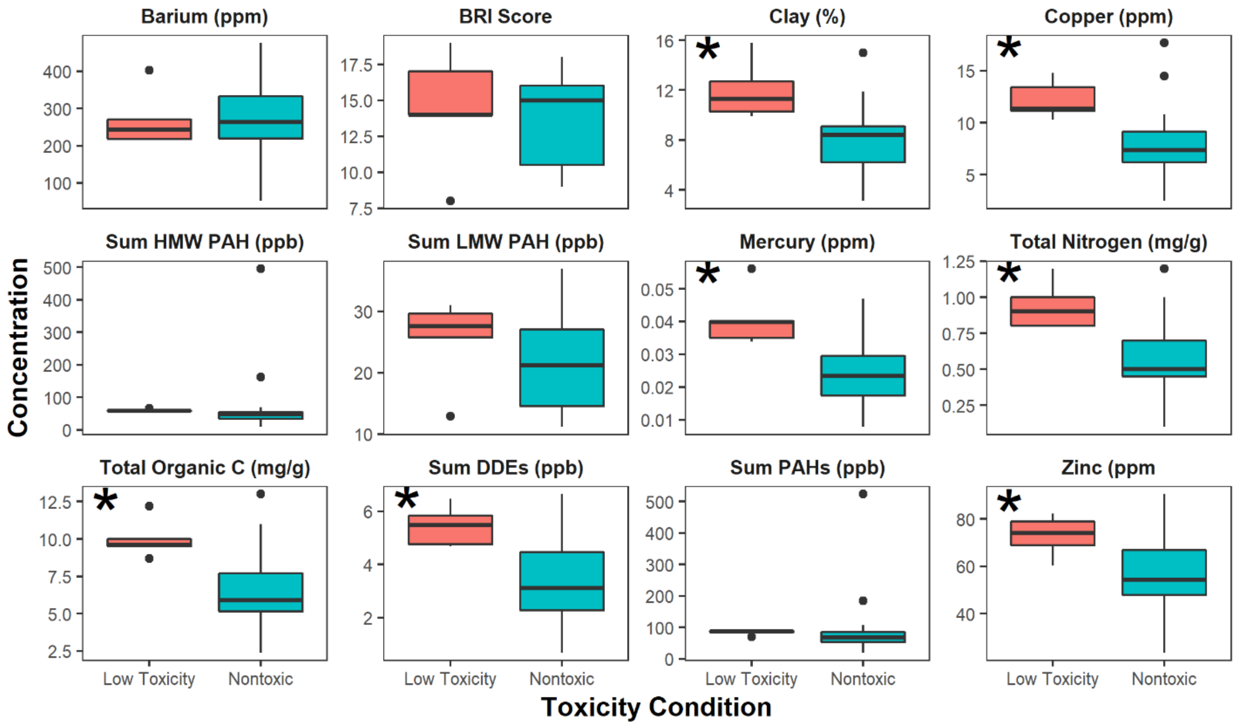

Figure F-13. Schematic box plots of important chemical compounds, sediment characteristics, and BRI scores between samples collected from around the A, B, C, and Hillhouse oil platforms that exhibited either low toxicity or no toxicity. An asterisk indicates compounds for which the low toxicity samples had significantly higher concentrations based upon the results of a one-way ANOVA (α = 0.1).

Comparisons of benthic community composition and condition index scores were made between the samples with low and no toxicity values to provide some insight into the potential expression of any toxicity in fauna living in the system. Differences in community composition were estimated visually with an nMDS ordination and quantified with one-way permANOVA between the two groups of samples, with toxicity test status as the treatment variable (α = 0.1). Similarly, the difference in BRI score between the two groups of samples was quantified with a one-way ANOVA (α = 0.1). ANOVA tests were conducted using the aov function in R (v 3.5.3) and the permANOVA was conducted using the adonis2 function in the Vegan package (2.5-4) in R (v 3.5.3).There were no differences in benthic community composition between the low toxicity and no toxicity samples (permANOVA $p = 0.405$, df = 1,18) (Figure F-14).

There was no clear expression of the patterns the sediment toxicity among the macrofauna observed at the 20 sites that were sampled around the platforms. The profiles of taxa composition and abundance among the samples were not identical, but they were all quite similar to each other and differences were not related to results of the toxicity tests. The low toxicity result – within the interpretation framework we used – represents only a subtle potential impact to the environment (Bay and Weisberg 2012). This subtle effect was clearly not reflected in the benthic fauna at any of the sites and as such should not be a point of major concern in the management of these platforms.

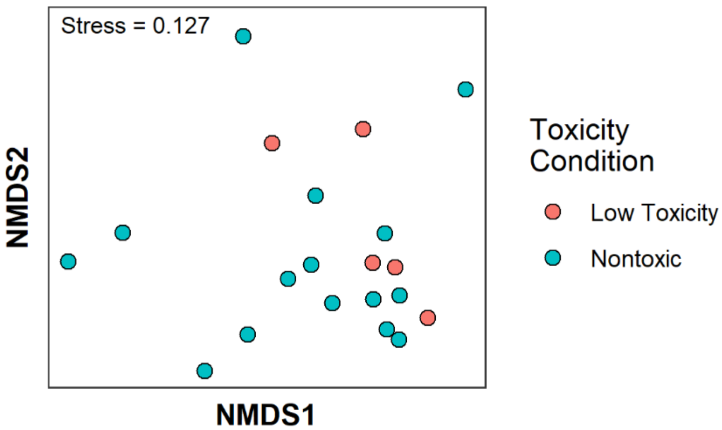

Figure F-14. A nMDS plot summarizing the similarity of Low and Nontoxic samples collected 1 to 2 km from the A, B, C, and Hillhouse oil platforms. The ordination was based upon Bray-Curtis dissimilarities calculated from species abundance.

Overall Habitat Condition

When the three measurements of habitat condition – macrobenthic community composition, sediment chemistry, and sediment toxicity – were combined together following the guidelines of the California SQO framework, all of the samples from around the oil platforms were in unimpacted condition (Figure F-15).

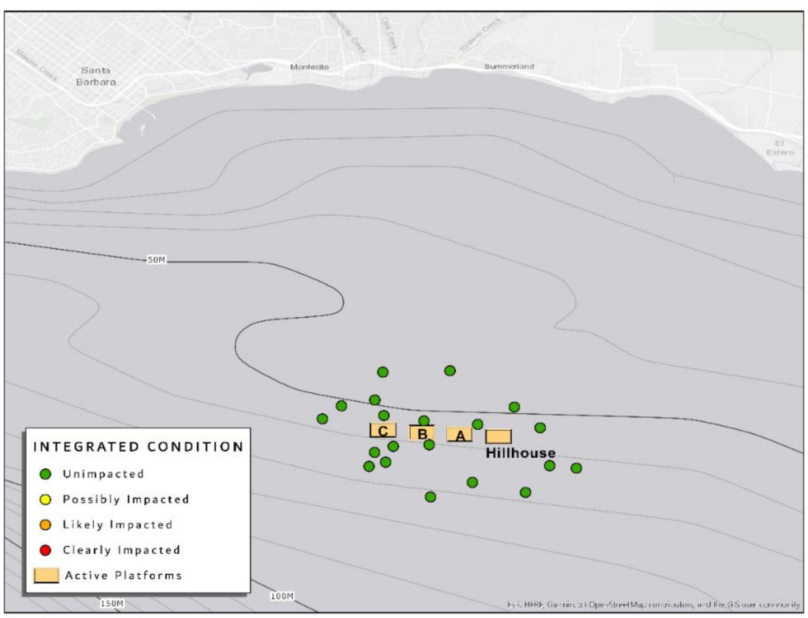

Figure F-15. Map of sampling sites located 1 to 2 km from the A, B, C, and Hillhouse oil platforms. The green circles indicate the reference condition of the sediment habitat based upon the integration of macrobenthic community composition, chemical concentrations, and sediment toxicity as evaluated by the California SQO assessment framework (Bay et al. 2014).

Discussion

This work is the first comprehensive condition assessments of benthic habitats adjacent to oil and gas platforms in southern California in over 20 years. Using three different measures of habitat condition, we demonstrated that the soft sediment seafloor surrounding the A, B, C, and Hillhouse oil platforms were in a relatively unimpacted state. Differences in species similarities and abundances, and elevated chemistry were found nearer to platforms. However, when compared to regional samples, all of the area we sampled had reference-condition benthic infauna and sediments with minimal levels of potential chemical exposure. Taken together, these results would suggest that the oil platforms were not negatively impacting the continental shelf habitat around them. This overall result illustrates the value of targeted assessment studies conducted within the larger framework of regional, probabilistic assessments. The combination of sampling schemes provides insight into the impacts of different human activities – oil and gas extraction in this case – on the coastal ocean; answering directed questions at spatial- or mechanistic-scales that would be more challenging to address with only regional monitoring program data.

The benthic fauna that were living around the oil platforms were typical of mid-shelf fauna found across the Southern California Bight (Ranasinghe et al. 2012; Gillett et al. 2017). The total abundance of organisms found in the oil platform samples was somewhat lower than what was typical for the region, but the samples were far from depauperate. Density of fauna in a location can be influenced by a mix of natural (e.g., predation or recruitment) (Wilson 1990; Cowen and Sponaugle 2009) or anthropogenic processes (Pearson and Rosenberg 1978; Warwick 1986). The habitat condition index we applied indicated that all of the samples were in reference condition, which would suggest that the somewhat low abundance was probably a biologically-based phenomena. Eventual comparison of the fauna from the oil platform samples to more recently collected benthic community information from the 2018 Southern California Bight Regional Monitoring Program, may provide further insight into the lower overall abundances and taxa richness observed in the samples.

Benthic infauna are the best indicator of overall habitat condition in marine systems as they reflect potential impacts to the biological resources across multiple trophic levels that live there (McIntyre 1984; Warwick 1988; Gray and Elliott 2009). Focusing on the biota directly, speaks to a number of the designated beneficial uses for the California State Water Resources Control Board (2012), and provides an ecologically meaningful insight into any potential disturbances of an ecosystem.

The sediment chemistry and toxicity measures of habitat condition provide contextual information that can help in interpreting the causality of any observed biotic degradation. While a variety of different chemical compounds were detected in the sediments of the oil platform samples, very few of them were at concentrations known to impact the fauna of the system. This is good confirmatory evidence to support the results of the infauna-based assessment that indicated the whole of the area sampled around the platforms was in reference condition. There were high levels of the DDT breakdown product DDE, but that is a characteristic of much of the continental shelf sediments in the northern parts of the Southern California Bight (Niedoroda et al. 1996; Zeng and Venkatesan 1999; Doddard et al. 2016) and most likely not related to the platforms. In contrast, barium concentrations were elevated in sediments from around the oil platforms compared to the regional average, which was not surprising given the association of barium with drill cuttings (Olsen et al. 2007; Schaanning et al. 2008). Other chemicals one might associate with oil platform operation (e.g., PAHs from the petroleum or copper from anti-fouling paint) were not particularly elevated in the samples relative to regional background concentrations, nor where they at concentrations believed to impact the fauna living in the habitat.

All of the samples were evaluated as being in reference/minimal chemical exposure condition (i.e., non-disturbed) from the biology/chemistry- perspective, but 25% of those samples exhibited low levels of toxicity. This level of disagreement among multiple measures of habitat condition are not uncommon and speaks to the benefits of looking at multiple facets of benthic habitat condition (Chapman et al. 1997; Bay and Weisberg 2012; Schiff et al. 2016). Conducting toxicity tests with ambient material provides a biological relevant test of any potentially harmful compound that is in the sediment – not just the ones chosen to be measured. As such, in its most direct interpretation, low toxicity results would be suggestive that some compounds were present in the environment that may have potentially negative consequences for resident fauna. However, these types of toxicity tests typically use only a single species that is selected for consistency of results and sensitivity to toxic chemicals, not whether the test organisms were a component of the local faunal assemblages (Chapman et al. 2002). While this approach provides a reliable assessment of toxicity, the link between single-species toxicity tests and observable impacts in the community composition of resident biota is not always tightly coupled (Buchwalter et al. 2007; Poteat and Buchwalter 2014).

The disconnect between toxicity tests and in situ benthic fauna was born out in our results, where there were no observable differences in community composition or benthic index score between the samples with low toxicity and nontoxic results. In contrast, there were interesting patterns between the sediment chemistry measures and the toxicity test results. The five samples that showed low-levels of toxicity had greater concentrations of copper, mercury, zinc, total DDEs, total nitrogen, and total organic carbon. However, those concentrations were below the most commonly used thresholds that imply potential toxicity or problems to resident fauna, although the concentrations observed were above both the ERL (2.2 ppb) and CSI low impact (1.19 ppb) thresholds. The DDE concentrations may partially explain the observed toxicity, but it should be noted that nearly all of the no toxicity samples also had DDE concentrations in excess of the two thresholds.

Overall, we cannot rule out that the combination of multiple low-levels of these compounds or the presence of some unmeasured toxic chemicals in the sediments from around the platforms could have caused the observed toxicity. However, in addition to the elevated chemicals, the sediments of five samples also had elevated clay content compared to the 15 non-toxic samples. Sediments with a high clay content have been observed to cause mortality to the amphipod test organisms; especially if they are large specimens (Anderson et al. 2017). It is therefore possible that the low toxicity evaluation could have not been related to any toxic chemicals in the sediments. Given the lack of any clear response in the benthic community and the magnitude of the chemical concentration that were measured, it seems reasonable that the elevated clay content of the sediments was the most parsimonious factor behind the observed toxicity.

The assessment framework used for interpretation of the sediment chemistry and toxicity data, as well their integration with the benthic infauna results, was adopted from California's Sediment Quality Objectives (SQO) program (Bay et al. 2014). This framework was originally designed for application in the poly- and euhaline habitats of California's enclosed bays and estuaries as opposed to the continental shelf habitat of the present study. In contrast, the benthic infauna data were assessed with tools developed specifically for the continental shelf habitats of southern California (Smith et al. 2001). At present, there are no analogous frameworks to the SQO approach for interpreting and integrating chemistry and toxicity data for the coastal oceans of California. However, despite its estuarine origins, the SQO framework has proven to be a valuable way of distilling the complex patterns of biologically relevant chemical concentrations and toxicity results into a single, easily understandable value for southern California's continental shelf habitats (Bay et al. 2015; Dodder et al. 2016). Furthermore, the toxicity thresholds used were identical or very similar to those used in similar habitats around the United States (USEPA 2014). As such, the SQO framework represents the best available option – in a non-regulatory context – to help integrate and interpret the chemistry and toxicity monitoring data from the region (Schiff et al. 2016).

An important caveat with the patterns we observed, is that we actively chose to not sample within the shell debris/ muds and cutting deposit fields of the platforms due the incompatibility of the sampling gear with consolidated, shell hash sediments. These sediments have been shown to be toxic to resident fauna and a potential source of chemicals to the surrounding environment (Neff 1987; Schaanning et al. 2008;

Ellis et al. 2012). A targeted study of sediments and chemicals in the debris fields, in conjunction with a soft sediment study would provide a more complete evaluation of platforms on their adjacent sediment.

In situations where sediments could be sampled directly underneath or immediately adjacent to oil platform structures, other studies have observed habitat degradation in the form of altered benthic communities, elevated sediment contaminants (typically hydrocarbons, copper, and barium), and toxic responses to sediment (Chapman et al. 1991; Hernández Arana et al. 2005; Terlizzi et al. 2008; Spagnolo et al. 2014). The degree of habitat degradation in most studies from the Gulf of Mexico and the Mediterranean Sea declines moving away from the platform and few effects can be detected beyond 1,500 to 2,000 m. In contrast, studies from the North Sea demonstrate effects to sediment condition out to 6 km from the platform (Olsgard and Gray 1995; Schaanning et al. 2008; Bakke et al. 2013), which is thought to be a function of the size of platforms and the scale of their operations there compared to other locales (Spagnolo et al. 2014). The spatial patterns observed in our study more closely resemble that of the Gulf of Mexico and Mediterranean platforms with no meaningful departures from unimpacted conditions at distances from 250 m to 2 km from a platform).

Much of the oil and gas extraction infrastructure offshore southern California is nearing the end of the practical lifespan and will most likely be decommissioned in the foreseeable future (McCrary et al. 2003; Schroeder and Love 2004; Henrion et al. 2014). Any type of removal activity will invariably have the potential to disturb the surrounding sea floor habitat, the impacts of which will most likely need to be quantified. These results from our study could be used to represent the baseline environmental conditions of the sediment habitat surrounding the A, B, C, and Hillhouse oil platforms prior to any decommissioning activities that were to take place. Our characterization of the benthic infauna, the chemical content, and toxicity of the sediments around the platforms should be used as a point of reference for any future changes in operations and evaluating their potential impacts on the local environment. Furthermore, given the similarity of the benthic fauna observed in the present study to those of other parts of the Santa Barbara Channel and the region as a whole, infaunal data collected from the northern portions of the Southern California Bight during routine monitoring should also be used as a benchmark to interpret temporal patterns in benthic community change at the four platforms in our study, as well as other platforms in the region.

Conclusions

- The soft-sediment benthic habitat surrounding the A, B, C, and Hillhouse oil platforms in the Santa Barbara Channel was unimpacted in 2018 based upon our integration of the benthic infauna, sediment chemistry, and toxicity condition measures.
- Of the individual measures of habitat condition, 100% of the samples had reference condition benthic fauna and minimal levels of chemical exposure. In contrast, only 75% of the samples showed no toxicity and the remaining 25% of samples showed low levels of toxicity.
- In comparison to other continental shelf habitats from across the Southern California Bight, samples from around the oil platforms were in similar condition across all three measurements of habitat condition; they were slightly better with respect to the benthic fauna, nearly identical in terms of sediment chemistry, and slightly worse with respect to toxicity of the sediments.
- The infauna, chemistry, and toxicity data collected from around the platforms should serve as a baseline of existing conditions against which the potential impact of any future changes in platform operation or decommissioning activities can be compared.

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Supplemental Data

See file M16AC00013 final report Appendix F supplement A and B.xlsx, not in this printed report. Supplement A of this workbook presents the absolute abundance (number of individuals per grab), relative abundance (% of total abundance per grab), and the rank abundance of each taxon observed in the macrobenthic samples for each sample collected around the oil/gas platforms.

Supplement B of this workbook presents the measured concentration of each chemical compound and measure of sediment composition for each sample collected around the oil/gas platforms. One asterisk indicates that the analyte was measured above the machine detection limit, but below the reporting limit (see Table F-1 in the main body) and the result is therefore and estimate. Two asterisks indicate that the sample was heterogeneous and sample homogeneity could not be readily achieved using routine laboratory practices, therefore accuracy and/or precision acceptance limits do not apply for that analyte. Three asterisks indicate that analyte results were lower than 10 times the machine detection limit, therefore accuracy and/or precision acceptance limits do not apply.

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