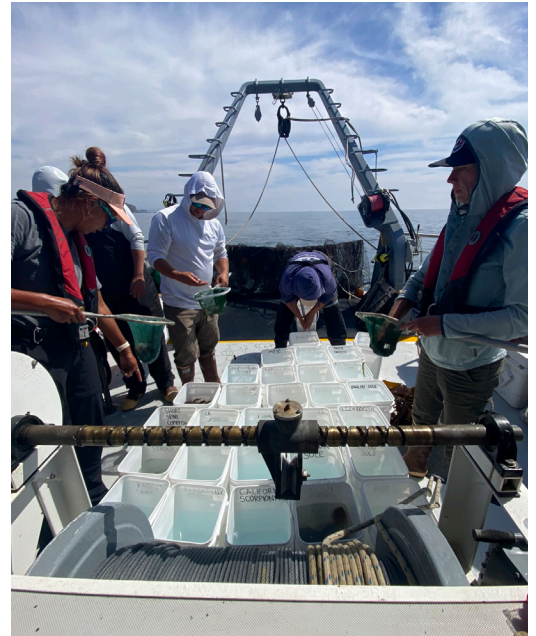




# Demersal Fishes and Megabenthic Invertebrates

BIGHT '23



Southern California Bight  
2023 Regional Monitoring Program  
Volume IV

SCCWRP Technical Report 1470

# **Southern California Bight 2023 Regional Monitoring Program: Volume IV. Demersal Fishes and Megabenthic Invertebrates**

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## **FOREWORD**

The Southern California Bight 2023 Regional Monitoring Program (Bight '23) is an integrated, collaborative effort to provide large-scale assessments of the Southern California Bight (SCB). The Bight '23 survey is an extension of previous regional assessments conducted every five years dating back to 1994. This collaboration represents the combined efforts of over 100 organizations. Bight '23 is organized into six elements: 1) Sediment Quality, which includes Toxicity, Chemistry and Benthic Infauna, 2) Microbiology, 3) Shellfish Bioaccumulation 4) Trash and Microplastics, 5) Ocean Acidification, and 6) Estuarine Assessment. Copies of this report on demersal fish and megabenthic invertebrates, as well as the other Bight '23 reports, workplans and quality assurance plans, are available for download at <https://www.sccwrp.org/about/research-areas/regional-monitoring/southern-california-bight-regional-monitoring-program/bight-program-documents/>.

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## **EXECUTIVE SUMMARY**

Regional monitoring is an important tool to assess status and trends of coastal resources while also providing critical context for local monitoring efforts. The Southern California Bight 2023 Regional Marine Monitoring Program (Bight '23) is the seventh in a series of regional marine monitoring efforts beginning with a pilot project in 1994 and repeated in 1998, 2003, 2008, 2013, and 2018. More than 100 different organizations encompassing regulatory, regulated, academic, and non-governmental agencies collaborated in the Bight '23 Program. A cornerstone of this program is an assessment of the health of coastal ecosystems through an evaluation of sediment quality indicators. The sediment quality element utilizes multiple lines of evidence, including sediment toxicity, sediment chemistry, benthic infauna, and demersal fish and megabenthic invertebrate communities. This report presents the results of the Demersal Fishes and Megabenthic Invertebrates sub-element.

### **Demersal Fishes and Megabenthic Invertebrates Study Questions:**

1. What is the extent and magnitude of contaminant exposure in Bight Strata as measured by trawl sampling?
2. What are the temporal trends in the extent and magnitude of contaminant exposure in Bight Strata as measured by trawl sampling?

A stratified random sampling design was used to ensure an unbiased sampling approach to assess areal extent of environmental condition. Five strata were selected for the trawl-based study including three continental shelf strata (4-30 m, 31-120 m, 121-200 m), an upper slope stratum (201-500 m), and an embayment stratum. Due to limited participation, the outer shelf and upper slope did not meet the study's data quality objectives (DQO) for completeness. Thus, these two strata were not assessed regionally limiting our ability to make conclusions about these strata in Bight '23, including trends. However, data from the outer shelf and upper slope stations that were sampled in Bight '23 are included in Appendix G for reference. A total of 122 trawl stations were sampled, capturing more than 53,194 fishes from 50 families and 130 species, and more than 63,360 invertebrates from 88 families and 140 species.

### **Significant Findings**

In general, Southern California Bight trawl-caught demersal fish communities are in good condition. Approximately 95% of SCB inner and middle continental shelf areas (3 to 120 m depth) had Fish Response Index (FRI) values indicative of reference conditions. Additional compelling evidence of healthy fish communities was the particularly low incidence of pollutant-related stress anomalies such as external tumors, lesions or fin erosion. These

anomalies were prevalent in some fish species from polluted locations during the 1970s and now comprise <0.03% of all fishes examined during Bight '23.

The extent of reference-like fish communities has remained comparably high over the three decades of the Bight Program. Percent of reference area from the inner and middle continental shelf based on the FRI has ranged from 91% to 100% since Bight '94. When comparing across 30 years of surveys, the few “non-reference” sites based on FRI have been in the shallow mainland waters most often in the Santa Barbara Channel. The Technical Committee has agreed that this is more an artifact (i.e., false positive) of the FRI than actual degradation of the fish community.

Fish anomalies have decreased over the three decades of the Bight Program. Though low in all surveys, pollutant-related fish anomalies have decreased from ~0.12% in Bight '94 to ~0.025% in Bight '23 on the inner and middle continental shelf. Moreover, no fin erosion or lesions were observed in Bight '23, similar to the five previous Bight surveys.

Similarly, trawl-caught megabenthic invertebrate communities (e.g., sea stars, crustaceans, etc.) do not appear stressed. While no index like the FRI exists for megabenthic invertebrates, there were no major trends or changes in traditional ecological metrics such as diversity or richness, indicating a stable ecological community.

## **Recommendations**

The most important recommendation from the Bight '23 trawl program is to scale the trawling study design to match the available effort. For the first time in three decades, an insufficient level of effort was applied to make Bight-wide assessments of the entire continental shelf. This QA deviation occurred for several reasons: (1) too many habitats (strata) and not enough effort, (2) instances where agencies did not follow up trawling at contingency overdraw sites when trawl failures occurred at original sites, (3) some agencies did not complete their trawling during the sampling window, even after extending the window to accommodate their field challenges, and (4) lack of communication among field teams when deviations occurred in order to correct course and achieve the desired level of effort to meet defined QA objectives. While there are many potential solutions to overcome these deviations, the Planning Committee and Field Committee must take these factors, and others, into consideration during future Bight project planning so this does not happen again.

New research is necessary to develop thresholds that can be applied to all Bight habitats for both demersal fishes and invertebrates. The FRI has been the accepted assessment tool since Bight '98, but the FRI has limitations. For example, the FRI cannot be applied to demersal fish communities on the upper slope or in embayments because it was not calibrated or validated for these habitats. Moreover, despite using the FRI, known drawbacks remain, such as “false positives” produced in the Santa Barbara Channel nearshore area due to the collection of

naturally occurring, common species assigned high p-values. Despite the recommendation for improving our demersal fish and megabenthic invertebrate community assessment tools since Bight '13, this recommendation has not yet been remedied. All future surveys – both regional and local – will be limited until this recommendation is implemented.

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## I. INTRODUCTION

The Southern California Bight (SCB) is an important ecological region, providing economic, cultural and recreational services to large populations living along the coast. The SCB is situated within an eastern boundary upwelling system, wherein seasonal upwelling of nutrient-rich waters supports large-scale primary productivity along the coastline (Chavez and Messié 2009; Capone and Hutchins 2013). Soft-bottom (mud) substrates within the SCB are diverse, relating to a complex topography, comprising harbors, sandy nearshore areas, submarine canyons, offshore islands, ridges, and basins (Dailey et al. 1993; Piacenza et al. 2015). This diversity of habitats coupled with high productivity, sustains a biologically diverse coastal ocean environment (Dailey et al. 1993; Love et al. 2009). The SCB also represents a transitional area influenced by cold northern currents, temperate ocean waters, and occasional warm tropical waters from the south punctuated by recurring climate patterns such as the El Niño Southern Oscillation (Hickey 1993; Bograd and Lynn 2003; McGowan et al. 2003; Horn et al. 2006). The mixing of currents, episodic oceanographic events, and the multiple habitats allow for the coexistence of a broad spectrum of species, including more than 500 species of fish (Cross and Allen 1993) and thousands of invertebrate species (Thompson et al. 1993). Many of these species separate themselves by depth, habitat, and feeding guilds to reduce food competition and allow multi-species coexistence (Allen 2006; Allen et al. 1998, 2002a, 2007).

The SCB is also subject to significant pollutant inputs due to a highly urbanized coastal environment. More than 20 million people live within an hour's drive of the coastal counties and the infrastructure along the coast includes 17 major wastewater treatment facilities, the nation's two largest commercial ports, more than 20 pleasure craft harbors, and the third largest U.S. naval facility in the US (Lyon and Stein 2009). Additionally, there are 17 major watersheds that discharge largely untreated surface runoff from urban and agricultural land uses to the SCB. As a result of these strong human influences, the SCB coast has had a long history of sediment contamination. Sediment quality impacts have been at the forefront of environmental management efforts for nearly five decades and, as a result, sediment quality has been steadily improving in the SCB. However, some areas continue to have poor sediment quality, particularly those areas closest to anthropogenic influence (Schiff et al. 2016). The SCB is also subject to large-scale climatic changes such as marine heat waves (Leising et al. 2015), low oxygen conditions (Bograd et al. 2008; Booth et al. 2014) and low pH and aragonite saturation state (McLaughlin et al. 2018), which may be altering habitats along the coast (Sato et al. 2017; Howard et al. 2020).

Historically, monitoring had been focused on areas nearest to regulated discharges associated with National Pollutant Discharge Elimination System (NPDES) permits, providing a potentially biased perspective of regional conditions (Schiff et al. 2002). Beginning in 1994 and conducted every five years since 1998, the SCB Regional Marine Monitoring Program (the Bight Program) is

a probabilistic survey implemented by nearly 100 regulated, regulatory, non-governmental and academic organizations with the intention to assess the regional condition of SCB habitats to provide much-needed context for NPDES monitoring (Schiff et al. 2016).

The sediment quality element of the Bight Program evaluates potential impacts on marine benthic communities through multiple lines of evidence: sediment chemistry, biological assemblages, and sediment toxicity. This report discusses the results of the demersal fishes and megabenthic invertebrate community assessment. Marine community attributes such as species composition and abundance are affected by a variety of natural and anthropogenic factors. Natural forces such as oceanographic variability, current patterns, and habitat availability have historically shaped these communities (Dayton et al. 1998; Miller and McGowan 2013). In some cases, anthropogenic factors such as fishing, pollution, and habitat degradation have contributed to the community structure now observed in some areas of the region (Hidalgo et al. 2011; Mora et al. 2011). Global climate change has also been observed to have an impact on coastal communities (Sato et al. 2017; Howard et al. 2020). Disentangling these interacting forces requires robust data on both large spatial and temporal scales (Scavia et al. 2002; Harley et al. 2006; Hsieh et al. 2008). The Bight Program provides a platform to evaluate anthropogenic discharges on the SCB's soft-bottom marine ecology at a greater-than-local scale.

The demersal fish and megabenthic invertebrate portion of Bight '23 was designed to address two questions:

1. What is the extent and magnitude of contaminant exposure in Bight Strata as measured by trawl sampling?
2. What are the temporal trends in the extent and magnitude of contaminant exposure in Bight Strata as measured by trawl sampling?

The probabilistic design of the Bight Program allows for characterization of the breadth and depth of variability in epibenthic communities for multiple habitats and the region overall, providing much-needed context for local NPDES monitoring. Furthermore, because communities were evaluated in three depth strata, during Bight '23, relative habitat quality between habitats can also be described. Two strata represent the offshore habitats: Inner and Middle Shelf, while the Bays stratum represents shallow embayment habitats. See the Quality Assurance and Quality Control section for details.

This report is structured in seven chapters. Chapter II of this report describes the methods used to assess epibenthic communities. Chapter III describes the study results for habitat condition and temporal trends. Discussion and interpretation of the results are contained in Chapter IV.

Conclusions from the study are presented in Chapter V, and recommendations for future studies are presented in Chapter VI. References are contained in Chapter VII. Comparisons between indicators, such as contaminants, will be addressed in the Bight '23 Sediment Quality Synthesis Report.

## II. METHODS

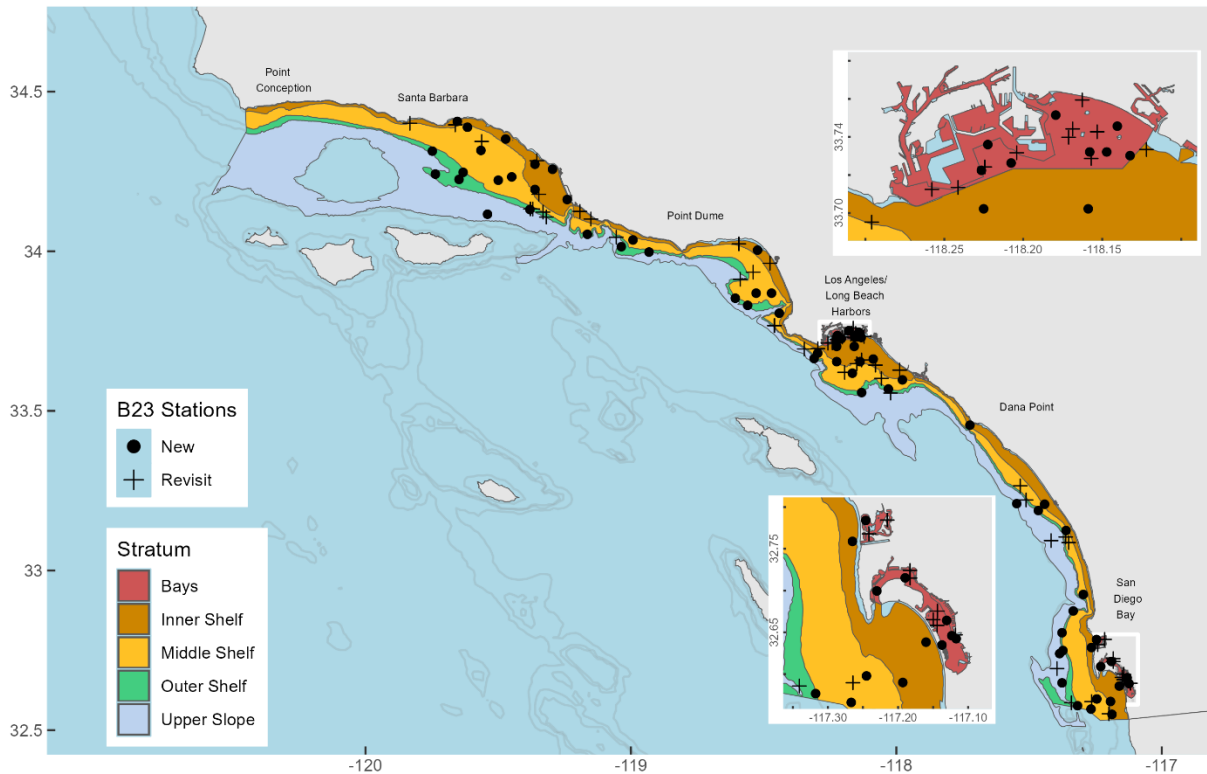
### Study Design

The design of this study followed those of the previous Bight trawl surveys, of which this is the seventh. The survey area for Bight '23 covered the SCB from Point Conception, CA in the north, to the U.S.-Mexico border in the south, and from coastal embayments out to the upper slope (Figure 1). The trawlable soft bottom portions of this region were divided into five strata based on established biogeographic breaks in community composition (Table 1). These strata include: Bays (4-30 m); Inner Shelf (4-30 m); Middle Shelf (31-120 m); Outer Shelf (121-200 m); and Upper Slope (201-500 m).

A stratified random sampling design was selected to ensure an unbiased sampling approach to generate areal assessments of environmental conditions (Stevens 1997). Stratification ensured that an appropriate number of samples were allocated to each stratum to characterize the strata with adequate precision. The goal was to allocate approximately 30 stations to each stratum, yielding a 90% confidence interval of about  $\pm 10\%$  around estimates of areal extent. Area weights were used for calculating unbiased areal assessments of condition in the survey area (Stevens 1997). Briefly, area weights were based on assigned and randomly selected over-draw sites attempted during the survey, excluding pre-survey abandonment due to known exclusions (e.g., MPAs, pipelines, etc.). To assist in assessing temporal trends between surveys, nearly half of the stations were revisited from previous surveys (Table 1; Figure 1).

**Table 1. Summary of strata sampled during the Bight '23 trawl survey.**

Habitat	Stratum	Depth Range (m)	Area (km <sup>2</sup> )	Percent Area of Region	Number of Stations	Percent Revisit Sites
Embayments	Bays	4 -30	71	1%	30	57%
	Inner Shelf	4 - 30	1172.5	17%	30	40%
Continental Shelf	Middle Shelf	31 - 120	2020	29%	29	45%
	Outer Shelf	120 - 200	606	9%	22	32%
Continental Slope	Upper Slope	200 - 500	3131	45%	11	45%
<b>Total</b>			<b>6999</b>	<b>100%</b>	<b>122</b>	<b>44%</b>



**Figure 1. Distribution of trawls completed during the Bight '23 trawl survey.**

## Field Methods

### Information Management

Collection of trawl data (boat positions, depths, species identifications, measurements, etc.) was predominantly done while on station, with the exception of voucher and further identification (FID) samples which were later verified in the lab by collective meetings of participating fish (Southern California Association of Ichthyological Taxonomists and Ecologists; SCAITE) and invertebrate (Southern California Association of Marine Invertebrate Taxonomists; SCAMIT) taxonomists. Most agencies used a field computer system for data collection and submitted their data electronically to a centralized Southern California Coastal Water Research Project (SCCWRP) database through a data portal with a series of data checkers designed to expedite the QA/QC process. Submitted datasets were provided to the Bight '23 Trawl Committee for review, in addition to QA/QC checks and analysis.

### Trawling

Demersal fish and megabenthic invertebrate samples were collected from 122 trawl stations between July 1 and October 31, 2023 (Table 1, Figure 1). Station coordinates, depths, and the stratum classification of each station are given in Appendix A.

Trawl samples were collected according to standard methods described in the Bight '23 Sediment Quality Assessment Field Operations Manual (Bight '23 Sediment Quality Assessment Committee 2023a). Stations were located by a global positioning system (GPS) via the research vessel's wide area augmentation system (WAAS) for better accuracy. If a station could not be trawled or was too deep, it was relocated up to 100 m from the nominal station coordinates not to exceed 10% of the nominal station depth. Overdraw sites were assigned to sites that were unacceptable (i.e. hard bottom obstruction, not proper stratum, etc.) and therefore abandoned.

Samples were collected with a 7.6-m head-rope, semi-balloon otter trawls with a 1.3 cm cod-end mesh. Field organizations were asked to tow along an isobath for 10 minutes (5 – 10 minutes in Bays ) at 0.8 – 1.0 m/sec (1.5 – 2.0 kts) as determined by GPS/WAAS. These trawls covered an estimated average distance of 300 and 600 m for 5- and 10-minute trawls, respectively. Agencies used a pressure-temperature (PT) sensor attached to one of the otter boards throughout the survey to provide net on-bottom data. The target bottom time was 8 – 15 minutes (4 – 7.5 minutes in confined areas within Bays). Field organizations were asked to re-trawl a station if the on-bottom time, as measured by the PT sensor, was less than 8 minutes or greater than 20 minutes for a 10-minute trawl. Sampling organizations adjusted subsequent trawls at an isobath if times were above 15 minutes.

### Processing the Fish and Invertebrate Catch

Demersal fishes and megabenthic invertebrates from the trawls were identified and processed. Megabenthic invertebrate species with a minimum dimension of 1 cm were included; specimens less than 1 cm were excluded from analysis. Other excluded species were pelagic, infaunal, or colonial invertebrates, as well as detached fish parasites (e.g., leeches, cymothoid isopods). Fishes and invertebrates were identified, counted, and batch weighed to the nearest 0.1 kg using spring or digital scales. Species weighing less than 0.1 kg were recorded as “< 0.1 kg”. One organization measured to the nearest 0.01 kg.

Lengths of individual fish were measured to centimeter size class on measuring boards (Bight '23 Sediment Quality Assessment Committee 2023a) . Bony fish were measured for standard length (anterior tip of head to end of caudal peduncle at the posterior border of the hypural plate). Cartilaginous fish and some bony fishes (e.g., eel-like fish) size measurements were total lengths, from the anterior end of the head to the posterior end of the tail. Wingspan was measured for stingrays, bat rays, and whip-tailed rays. Length of invertebrates were not measured due to their non-standard shapes.

Batch weights were done by species. Unknown species were treated as separate species during field processing. Field crews had the option to use the aliquot method for estimating the abundance of large catches of a single species (e.g., over 250 specimens). The abundance of

these individuals was estimated by selecting a representative subsample, comprising at least 250 specimens, and weighing the subsample to the nearest 0.1 kg. Subsequently, the remaining specimens were weighed, that weight was divided by the aliquot weight, and then multiplied by the number of individuals in the aliquot to arrive at an estimate of the total number of individuals. An alternative method for enumerating included adding an unknown number of specimens to a bucket until a weight of 1 kg was reached, then counting the number of individuals in the bucket. The remaining specimens were weighed to estimate the total number of individuals. For fishes, size classes were extrapolated to the estimated total number of individuals based on the representative subsample ratio.

Each organism was examined for gross external anomalies. Targeted fish anomalies included fin erosion, lesions, tumors, ambicoloration, and skeletal deformities. Eye parasites, leeches, monogeneans (flukes) and other external parasites were also noted. Small parasites in the gill cavity or within the body of the fish were not recorded. Targeted invertebrate anomalies included burnspot disease, echinoderm wasting disease, and external parasites.

Voucher specimens, fish and invertebrate specimens of unknown identity, and those with anomalies that required further examination were either fixed in the field with 10% buffered formalin-seawater solution, frozen, or photographed for further identification or vouchering. At least one voucher specimen of each species captured by each agency was retained or photographed (large specimens) to confirm identifications. Specimens taken as vouchers (preserved, frozen, or photographed) were noted on data sheets as well as FID samples.

## **Laboratory Analysis and Quality Control**

### **Sample Preservation for Collections**

Retained fish and invertebrate specimens requiring FID were transferred to the lab. Frozen specimens were kept in freezers. Specimens fixed in formalin in the field were rinsed with water in the lab and then preserved in 70% ethyl alcohol for final storage according to Bight '23 Field Operation Manual methods (Bight '23 Sediment Quality Assessment Committee 2023a).

### **Voucher and Further Identification (FID) Sample Analysis**

A group consensus approach was used to validate vouchers and FID samples with the expertise from two referee organizations: SCAITE ([www.SCAITE.org](http://www.SCAITE.org)) and SCAMIT ([www.SCAMIT.org](http://www.SCAMIT.org)). Preserved samples or photographs were examined at SCAITE or SCAMIT meetings to identify species characteristics and confirm identifications. Samples for which no consensus could be determined were sent to specialists or classified at a less specific level, such as genus, family, or higher taxonomic grouping (fewer than 1%). Further details are provided below (Table 2).

**Table 2. Summary of Voucher specimens and animals needing further identifications (FIDs) for each field organization participating in the Bight '23 trawl survey.**

Field Organization	Total Fish Species	Fish Vouch /FIDs	Fish Name Changes	Fish Unique to Org	Total Invert Species	Invert Vouch/ FIDs	Invert Names Changes	Invert Unique to Org
Org 1	78	51	10	6	109	57	3	8
Org 2	42	39	0	0	40	34	2	0
Org 3	52	56	2	3	67	67	2	1
Org 4	76	76	0	0	95	95	0	0
Org 5	54	54	0	0	46	44	1	0
Org 6	57	64	2	0	57	97	3	0

### Quality Assurance and Quality Control (QA/QC)

A Quality Assurance/Quality Control (QA/QC) plan was developed to ensure comparability among participating organizations within the survey. QA/QC activities included a taxonomy proficiency examination on common trawl fish and invertebrate species, an on-board field audit, on-board rechecks of species measurements, and a post-survey taxonomic review of voucher specimens. Other QA/QC checks involved checking station data relative to nominal survey design strata. Detailed standardized field protocols and QA/QC procedures are described in the Bight '23 QA Manual (Bight '23 Sediment Quality Planning Committee 2023b) and Field Operations Manual (Bight '23 Sediment Quality Assessment Committee 2023a).

All participating field organizations passed the taxonomy proficiency examination. Difficult to identify species included a juvenile Vermilion Rockfish (*Sebastes miniatus*) and two sand stars (*Luidia armata* and *Luidia foliolata*). Onboard field audits showed crews followed the Bight '23 Field Operations Manual. Specific checks include vessel navigation, data capture, spring scale calibration, proper trawl method, post-trawl PT sensor examination, catch sorting method, identifying/quantifying organisms, and correctly handling anomalies/voucher/FIDs. Crews also self-checked their measurement data (e.g., counts, lengths, weights).

Post-survey quality control (QC) checks (Table 3) showed the survey's measurement quality objectives (MQOs) for the outer shelf and upper slope strata completeness were not achieved. Any condition assessment within these two strata would have low confidence from a Bight-wide perspective and was deemed unreasonable by the trawl committee, but information on the two strata can be found in Appendix G for organizations interested in data from a particular site. Reasons for not completing sampling at these two strata include allocation of limited resources, other monitoring requirements, inconsistent follow-up at contingency overdraw sites, fuel costs, and survey time constraints (July 1 – October 31). Figure 2 shows sites either not sampled or replaced.

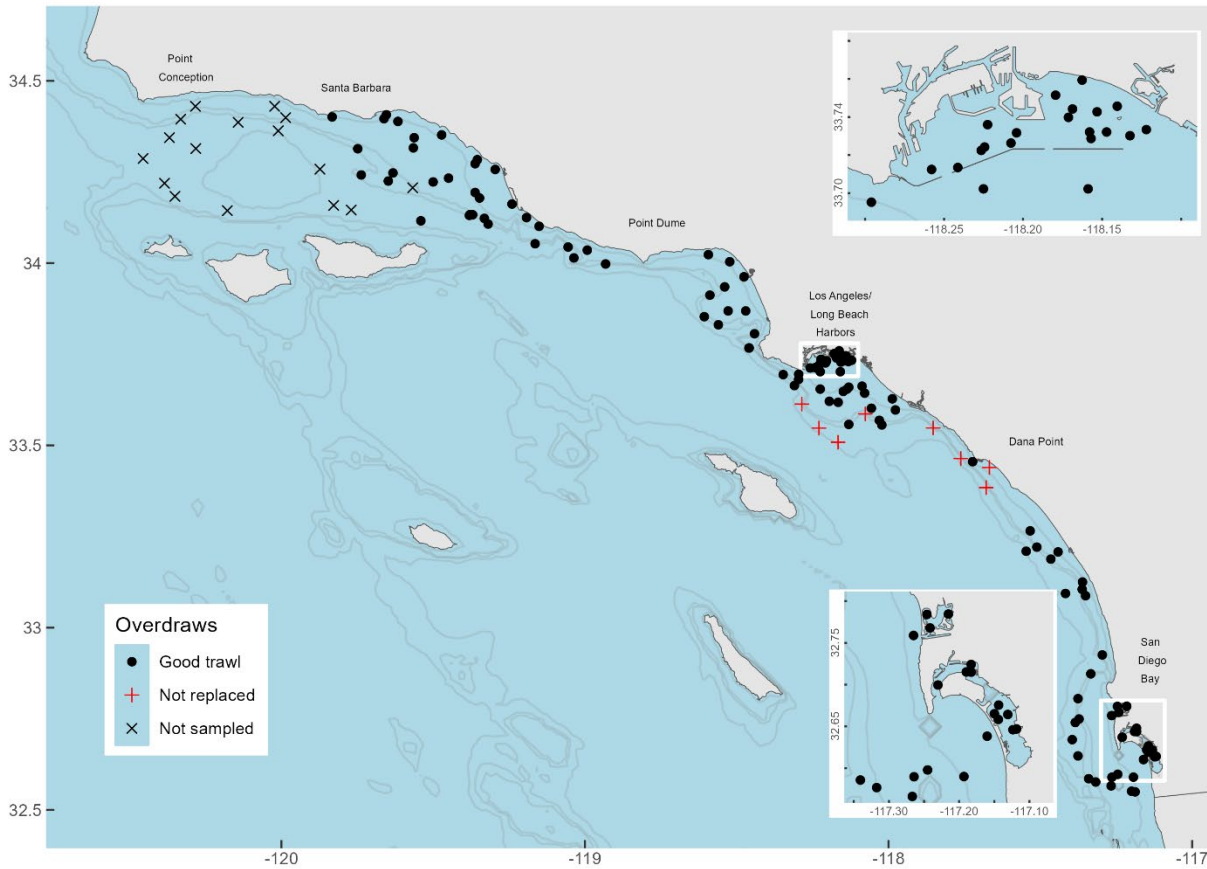
**Table 3. Post-survey quality control checks for the Bight '23 trawl survey.**

Trawls						Accuracy*	Precision**	
Strata	Intensified	Survey Goal	Attempts	Actually Complete	QAQC Completeness (%) MQO = 90%	100m circle	Trawl Events within circle	Trawl Events within 10% depth
Bays	No	30	32	30	100	90	86	NA
Inner Shelf	No	30	32	30	100	100	97	90***
Mid Shelf	No	30	36	29	97	100	93	93
Outer Shelf	No	30	32	22	73	100	100	95
Upper Slope	No	30	17	11	40	100	100	100
Sum		150	149	122	82			

\*Accuracy percentage based on distance of occupation coordinates from assigned; abandoned sites excluded

\*\*Precision based repeated events within circle radius and depth criteria from occupation depth; <=20m, abandoned excluded

\*\*\*12 Inner shelf sites had depths <= 20 m; these were not used in the precision calculations. Bays & Harbors were excluded from 10% depth criteria due to shallow sampling depths



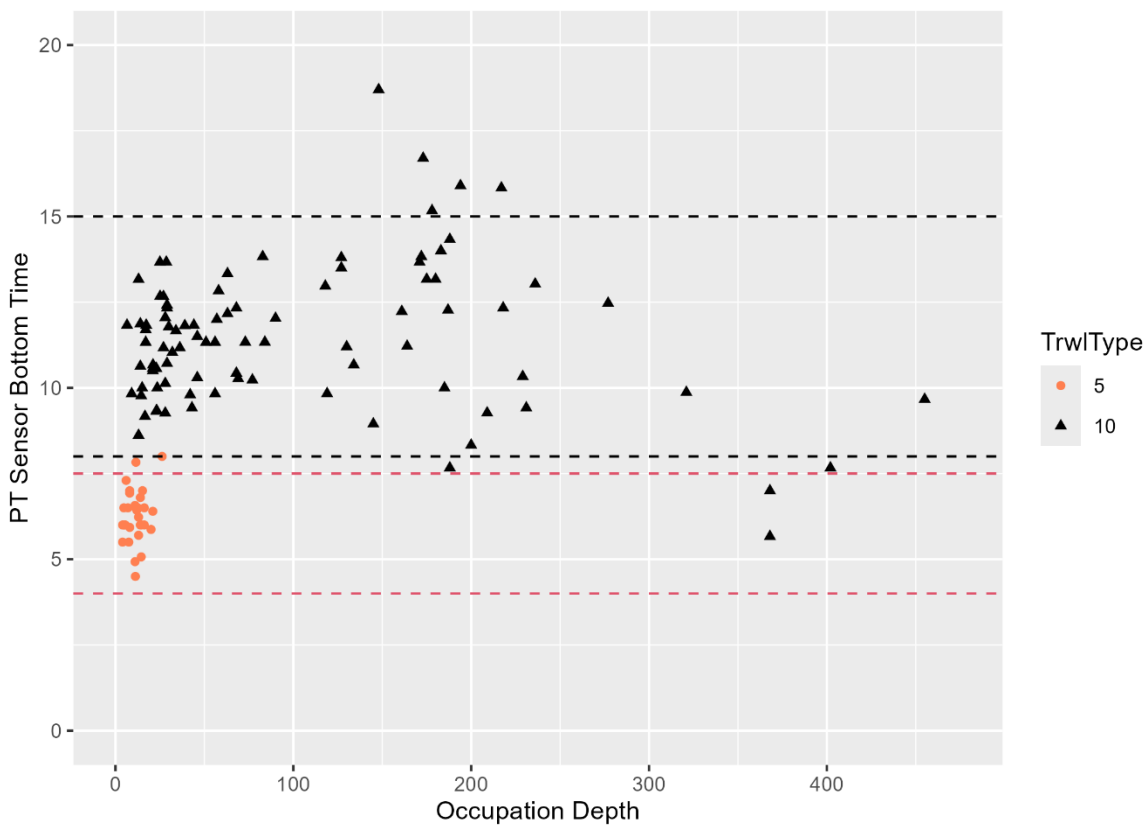
**Figure 2. Locations not sampled in 2023 due to limited resources. Failed trawls that were not replaced with overdraw stations are identified as “not replaced”, while stations with no allocated effort are identified as “not sampled.”**

Location accuracy/precision was good among the participating organizations. Slight deviations could be attributed to field transcription errors while recording data, net deployment, directional changes because of vessel traffic, and undulating depth profiles during the trawl. These slight deviations were deemed minor and would not influence the assessment of a particular stratum. Four sites with less than 8 minutes and 5 sites with more than 15 minutes were flagged in Appendix A-2 (Figure 3). All were located in the outer shelf and upper slope strata, which did not meet the survey MQO. The Outer Shelf and Upper Slope strata were most challenging for participating organizations. The trawl committee did not reject any site due to minor deviations but requested QC flags in the database. Table 4 shows the categorized trawl failures during the Bight '23 survey.

**Table 4. Reasons given why a trawl station was unsuccessful during the Bight '23 Regional Monitoring Survey. Total number of trawls was 150 (2 extra sites were not in survey design), plus 8 secondary attempts were not used in the percentage calculation.**

Failure Reason	Number of Stations	Percent of stations
Natural obstruction (Rocks/Reef/Damaged Net)	8	5.3%
Manmade obstruction-Ship/traps	6	4.0%
Undulating bottom (unsuitable for trawling)	4	2.6%
Pre-abandoned before survey*	3	2.0%
Outside 10% depth criteria	2	1.3%
Not in target stratum	3	2.0%
No Occupation/Event Record	2	1.3%
<b>Total</b>	<b>28</b>	<b>18.6%</b>

\*Vessel safety (too shallow) or known obstruction



**Figure 3. On-bottom times from pressure-temperature sensors mounted on trawl doors during the Bight '23 trawl survey. Dashed lines represent target time limits for 5-minute (orange) and 10-minute (black) trawls.**

Field organizations met the MQOs for counts, lengths, and weights. Since megabenthic invertebrates were not measured for length, they were excluded in the summary (Table 5). All fish and invertebrates greater than 1 cm were identified and examined for anomalies. All field

organizations looked for anomalies for species where the aliquot method was used. Since the aliquot method estimates abundance from total weight, counts and lengths were estimated based on one bucket results with distribution among different size classes based on proportions. Field crews took a representative sample of size classes to create the bucket weight.

**Table 5. Post-survey measurement quality control checks for the Bight '23 trawl survey.**

Indicators	Pre-Survey Goal			Survey Results		
	Accuracy	Precision	Completeness	Fish Accuracy % Error	Invert Accuracy % Error	Total Completeness*
Counting	10.0%	NA	90.0%	6.9	0.5	97
Length	10.0%	NA	90.0%	7.0	NA	100**
Biomass	10.0%	NA	90.0%	4.3	4.5	97
Identification	10.0%	NA	90.0%	0.0	0.0	100
External Anomalies	10.0%	NA	90.0%	0.0	0.0	100

\* Based on present and -88 abundance/biomass values for species in the database. Animals considered parasites, infauna, fouling, or pelagic were excluded.

\*\* Based on fish only. Aliquot lengths were estimated based on a subset of a weighed bucket and excluded.

Post-survey taxonomy QAQC review results are shown in Table 6. The changes were relatively minor, such as replacing old taxonomic names with the current accepted names and adding/modifying some species at specific stations. Organisms considered fouling, infauna, parasitic, and pelagic were left in the database but not analyzed in this report. These normally had abundances of -88 because any counts underestimate the true abundance in the trawl. Other organisms were included in the analysis because they were considered part of the megabenthic invertebrate community, but abundance counts also underestimate their true abundance (e.g., pieces of sponges). These animals were generally given a count of one in the report.

**Table 6. Post-survey taxonomy review results.**

Category	OriginalName	ChangeType	DatabaseChange	Comment
Invert	<i>Aphrodita raripillata</i>	Name	<i>Aphrodita armifera</i>	Replace old name
Invert	<i>Elthusa vulgaris</i>	Name	Cymothoidae	Replace old name
Invert	<i>Heterogorgia tortuosa</i>	Name	<i>Eugorgia ljubenkovia</i>	Replace old name
Invert	<i>Amathia verticillata</i>	Exclude In Analysis	None	Fouling animal*
Invert	<i>Amphichondrius granulatus</i>	Exclude In Analysis	None	Infauna animal*

Category	OriginalName	ChangeType	DatabaseChange	Comment
Invert	<i>Cardiomya</i> sp	Exclude In Analysis	None	Infauna animal*
Invert	<i>Crepidatella lingulata</i>	Exclude In Analysis	None	Fouling animal*
Invert	Cymothoidae	Exclude In Analysis	None	Parasite*
Invert	Decapoda	Exclude In Analysis	None	Pelagic animal*
Invert	<i>Doryteuthis opalescens</i>	Exclude In Analysis	None	Pelagic animal*
Invert	<i>Elythusa vulgaris</i>	Exclude In Analysis	None	Parasite*
Invert	Holothuroidea	Exclude In Analysis	None	Infauna animal*
Invert	<i>Keenaea centifilosa</i>	Exclude In Analysis	None	Infauna animal*
Invert	Polychaeta	Exclude In Analysis	None	Infauna animal*
Invert	<i>Pyrosoma</i>	Exclude In Analysis	None	Pelagic animal*
Invert	<i>Rocinela angustata</i>	Exclude In Analysis	None	Parasite*
Invert	Thaliacea	Exclude In Analysis	None	Pelagic animal*
Invert	<i>Thetys vagina</i>	Exclude In Analysis	None	Pelagic animal*
Invert	<i>Ciona robusta</i>	Include In Analysis	None	Solitary tunicate
Invert	Halichondriidae	Include In Analysis	None	Sea sponge
Invert	<i>Hamatoscalpellum californicum</i>	Include In Analysis	None	Blade barnacle
Invert	<i>Heterogorgia tortuosa</i>	Include In Analysis	None	Sea pen
Invert	<i>Leptopecten latiauratus</i>	Include In Analysis	None	Kelp scallop
Invert	<i>Leucilla nuttingi</i>	Include In Analysis	None	Sea sponge
Invert	<i>Stylatula</i> sp	Include In Analysis	None	Sea pen
Invert	<i>Suberites</i> sp	Include In Analysis	None	Sea sponge
Invert	Tetillidae	Include In Analysis	None	Sea sponge
Invert	<i>Leucilla nuttingi</i>	Abundance	-88	Sea sponge*
Fish	<i>Raja binocolata</i>	Name	<i>Beringraja binocolata</i>	Old name
Fish	<i>Semicossyphus pulcher</i>	Name	<i>Bodianus pulcher</i>	Old name
Fish	<i>Xenistius californiensis</i>	Name	<i>Haemulon californiensis</i>	Old name
Fish	<i>Sebastes</i> sp.	Include In Analysis	None	UI** Rockfish
Fish	<i>Syngnathus</i> sp.	Include In Analysis	None	UI** Pipefish
Fish	<i>Icelinus limbaughi</i>	Add	Length=8cm, count=1	Sta B23-12229
Fish	<i>Icelinus limbaughi</i>	Biomass	wt=<0.1kg	Sta B23-12229
Fish	<i>Sebastes simulator</i>	Name	<i>Sebastes ensifer</i>	Sta B23-12255
Fish	<i>Sebastes ensifer</i>	Add	Length=17cm, count=1	Sta B23-12255
Fish	<i>Sebastes ensifer</i>	Biomass	wt=0.3kg	Sta B23-12255
Fish	<i>Syngnathus</i> sp.	Add	Length=19cm, count=1	Sta B23-12507
Fish	<i>Syngnathus</i> sp.	Add	Length=8cm, count=1	Sta B23-12507
Fish	<i>Syngnathus</i> sp.	Add	Length=8cm, count=2	Sta B23-12507
Fish	<i>Syngnathus</i> sp.	Biomass	wt=<0.1kg	Sta B23-12507
Fish	<i>Syngnathus californiensis</i>	Remove	Length=19cm, count=1	Sta B23-12507
Fish	<i>Syngnathus californiensis</i>	Remove	Length=8cm, count=1	Sta B23-12507
Fish	<i>Syngnathus californiensis</i>	Remove	Length=8cm, count=2	Sta B23-12507

\*Counts underestimate true population

\*\* UI = Unidentified species at a genus level only

Additional invertebrate species excluded from analysis were part of a legacy list (Table 7) and comments reported by the participating organizations. Table 7 shows the basic comment, but the database could include longer text such as too small to identify, could only identify the juvenile to genus, had a broken rostrum to prevent identification, or exclude.

**Table 7. Other post-survey taxonomy exclusions during data analysis.**

Category	Name	Comment
Invertebrate	<i>Sicyonia</i> sp	Unidentified juvenile
Invertebrate	<i>Spirontocaris</i> sp	Unidentified juvenile
Invertebrate	<i>Neocrangon</i> sp	Unidentified juvenile
Invertebrate	<i>Loxorhynchus</i> sp	Unidentified juvenile
Invertebrate	Cancriidae	Unidentified juvenile
Invertebrate	Asteroidea	Unidentified juvenile
Invertebrate	<i>Luidia</i> sp	Unidentified juvenile
Invertebrate	<i>Astropecten</i> sp	Unidentified juvenile
Invertebrate	<i>Amphiodia</i> sp	Infauna animal
Invertebrate	<i>Amphiuridae</i>	Infauna animal
Invertebrate	<i>Strongylocentrotus</i> sp	Unidentified juvenile
Invertebrate	<i>Brisaster</i> sp	Unidentified juvenile
Invertebrate	<i>Metacarcinus</i> sp	Unidentified juvenile
Invertebrate	<i>Virgularia</i> sp	Unidentified juvenile

## Data Analysis

Most data analysis methods are similar to those used in previous regional sampling reports (Allen et al. 1998, 2002a, 2007, 2011; Walther et al. 2017; Wisenbaker et al. 2021). Unless otherwise noted, data wrangling and analyses were performed using R 4.4.0 (R Core Team 2024). Additional R packages were used as extensions to the base language and written by many authors. These included tidyverse (Wickham et al. 2019), dplyr (Wickham et al. 2018), lubridate (Grolemund and Wickam 2011), data.table (Barrett et al. 2024), summarytools (Comtois 2025), geosphere (Hijmans 2024), ggplot2 (Wickham 2009), readxl (Wickham and Bryan 2025), writexl (Ooms 2024), ggpubr (Kassambara 2018), quantreg (Koenker 2016), isotone (de Leeuw et al. 2009), vegan (Oksanen et al. 2017, 2025), grid (R Core Team 2015), scales (Wickham 2016), MASS (Venables and Ripley 2002), geoR (Ribeiro and Diggle 2016), gridExtra (Auguie 2016), plyr (Wickham 2011), reshape2 (Wickham 2007), psych (Revelle 2025), tcltk (R core Team 2024), tolerance (Young 2024), viridis (Garnier et al. 2024), hrbrthemes (Rudis 2024), tidyr (Wickham et al. 2024), RColorBrewer (Neuwirth 2022), beeswarm (Eklund and Trimble 2021), ggbeeswarm (Clarke et al. 2023), ggsci (Xiao 2024), tidytext (Silge and Robinson 2016), Plotrix (Lemon 2006), PBSmapping (Schnute et al. 2015), gpclib (Peng et al. 2013), rgdal (Bivand

et al. 2016), mapprotools (Bivand and Lewin-Koh 2017), broom (Robinson 2014), ggbreak (Xu et al. 2021), and clustsig (Whitaker and Christman 2014). Note that many of these packages used helped with data input, manipulation, analysis, graphics, and mapping. The Comprehensive R Archive Network (CRAN) contains documentation on these and other available packages ([https://cran.r-project.org/web/packages/available\\_packages\\_by\\_name.html](https://cran.r-project.org/web/packages/available_packages_by_name.html)).

Bight '23 biomass was estimated on animal groups having a “<” (less than) qualifier and a cutoff value of 0.1 kg or 0.01 kg, depending on an organization’s shipboard scale limits. In addition, some organizations had a composite category (bucket with multiple species having a “<” qualifier) to get a better estimate of true biomass for a trawl. The approach was slightly different than the previous two surveys (default value of 0.07 kg). The 0.01 kg scale cutoff value allowed for a better estimate of individual species “<” weights. An individual fish or invertebrate was estimated to weigh 0.004 or 0.002 kg, respectively. The abundance was multiplied by these values to estimate biomass. For composites with weights greater than the cutoff value, the number of species groups within the composite was divided by the composite weight to estimate species group weights. If a fish species was thrown overboard before weighing, the weight was based on the average weight for that particular length, if possible (usually 1 large fish). Otherwise, the large species was given the default value from the previous survey (0.07 kg). Results from five-minute trawls (common in bays and verified via PT sensors on the trawl doors) were multiplied by two for abundance and biomass to align them with the standard ten-minute trawls. Likewise, diversity calculations for 5-minute trawls were multiplied by 1.4 to compensate for additional species added during a 10-minute trawl.

The integrated biomass dataset was treated differently. While the Bight '23 data was appended to the dataset unchanged, any historical “<” or “Less Than” qualifiers were given a default value of 0.07 kg for fish and 0.03 kg for invertebrates, the default values from the previous survey. In addition, a historical review found some organizations actually measured values less than 0.1 kg but only reported them in the comments column. These values were incorporated into the analysis. Abundances qualified as “Present” and not counted were given a value of one (e.g., colonial species, parasitic isopods, etc.). Historical station abundance and biomass values of pre-designated 5-minute trawls were also doubled and a 1.4 multiplier applied to diversity values.

Habitat condition was assessed using demersal fish and megabenthic invertebrate community metrics including abundance, biomass, taxonomic richness (number of species present), Shannon diversity ( $H'$ , a diversity index accounting for both abundance and evenness of species present) (Shannon 1948), and signs of disease. To limit over-emphasizing a stratum, area weighted statistics were used following the basic formula:

$$\text{Area Weight} = \frac{\sum_{i=0}^n AW * i}{\sum_{i=0}^n AW}$$

where  $AW$  is the sum of the area weight of a station multiplied by  $i$ , the parameter of interest, divided by the sum of the area weights.

The Ecological Index (E.I.) rank was determined using the total catch for each species during this study for a particular stratum and incorporated three ecological variables: % Number, % Weight, and % Frequency of Occurrence:

$$E.I. = (\%N + \% Wt) * \% F.O.$$

where  $E.I.$  of a species is the sum of its abundance and biomass percentage multiplied by the percent of occurrence for a particular stratum. Since species do not overlap all strata, calculations were limited to individual strata. This index is indicative of the relative importance of each species to the energy flow within each stratum (Allen et al. 2002b; Williams et al. 2015b).

### Fish Response Index (FRI)

Pollution impacts on the shelf were assessed using the Fish Response Index (FRI) (Allen et al. 2001). The FRI was created as a tool for gauging anthropogenic impacts such as sediment contamination on fish assemblages in the SCB inhabiting soft-bottom habitats on the continental shelf in depths ranging from 9 to 215 m (Allen et al. 2001). The FRI was developed for the shelf strata (Inner, Middle and Outer Shelf), using almost 30 years of reference and contaminated (e.g., around wastewater outfalls) site data in depths between 9 and 215 m. The index values were validated against the 60-Meter Survey data (Word and Mearns 1979) taken in 1977 and compared with BRI index calculations (Smith et. al. 2001). The general formula for index weighted average follows Allen et al. (2001):

$$I_s = \frac{\sum_{i=0}^n a_{si}^f P_i}{\sum_{i=0}^n a_{si}^f}$$

where  $I_s$  is the index value for observation  $s$ ,  $n$  is the number of species in the observation  $s$ ,  $P_i$  is the position for the species  $i$  on the pollution gradient (an indicator of the pollution tolerance of the species), and  $a_{si}$  is the abundance of species  $i$  in the observation  $s$ . The exponent  $f$  allows for the transformation in abundance weights to prevent overemphasis on extreme abundances (e.g., 0.5 represents the square root transformation). The P values were derived from canonical correlation scores in ordination space.

FRI values  $\leq 45$  are indicative of reference or unimpacted conditions on the shelf. Previous Bight trawl reports included FRI values for the Shelf and Bays; however, the Bight '23 Demersal Fish and Megabenthic Invertebrates Technical Committee excluded Bays FRI scores from this report

because the index was not calibrated in this stratum. The FRI is representative of generalized disturbance gradients; however, the purpose of this index is not meant to be indicative of fluctuations in the total standing stock of fish species.

### Multivariate Analyses

Multivariate analyses were performed in PRIMER v7 software using demersal fish and megabenthic invertebrate data collected from trawls conducted during Bight '94, Bight '98, Bight '03, Bight '08, Bight '13, Bight '18, and Bight '23 (Clarke 1993; Warwick 1993; Clarke et al. 2014). A one-way analysis of similarity (ANOSIM) was conducted to confirm that demersal fish and megabenthic invertebrate communities differed between embayments and offshore regions. Additional analyses included ordination (non-metric multidimensional scaling; nMDS), as well as hierarchical agglomerative clustering (cluster analysis) with group-average linking. The Bray-Curtis measure of similarity was used as the basis for the ordination and cluster analysis, and abundance data were log transformed to lessen the influence of the most abundant species and increase the importance of rare species. Similarity profile analysis (SIMPROF) was used to confirm the non-random structure of the resultant cluster dendrogram (Clarke et al. 2008), with major ecologically-relevant clusters receiving SIMPROF support retained as cluster groups. A BEST test using the BVSTEP procedure was conducted to determine which subset of species best described patterns within the resulting cluster dendrograms. Similarity percentages analysis (SIMPER) was used to determine which species were responsible for >70% of the contributions to within-group similarity (i.e., characteristic species) by location (to support ANOSIM tests) and by cluster group (to support cluster group selection). A more detailed analysis, supporting tables and figures are presented in Appendix F.

### Multi-Survey Temporal Trends

Temporal trends in fish and invertebrate community metrics were calculated with two complementary techniques: a multi-survey approach and a revisit-site approach. The multi-survey approach is a higher-level approach to temporal analysis that focuses on the proportional change in each of the assessment metrics across the survey area through time. This included analysis of changes in the areal extent estimates of fish abundance, E.I., anomalies and FRI, and invertebrate diversity within the Bays (previously Bays & Harbors, renamed to be consistent with the Bight '23 embayment stratum), Inner and Middle shelf strata from 1994 to 2023. Trends were characterized by survey-to-survey increases or decreases in each metric. This approach provided a greater number of stations (Table 1) and greater confidence in the applicability of the trend across the whole stratum. However, because many of these sites were randomly selected within the stratum for each survey, the observed differences represented a mix of both spatial and temporal variability. The revisit-sites approach complemented the multi-survey approach by providing a more granular measure of condition change by focusing on the

temporal variance at sites with three or more reoccupations between 1998 and 2023. This approach measured the trend in FRI scores at 23 of the 72 revisit sites (FRI was not applied in Bays, Outer Shelf, and Upper Slope Strata revisited sites), which were sampled three or four times in 2023, 2018, 2013, 2008, and either 2003 or 1998.

As each site had an area weight, the percent of area with improving (FRI values dropping below the threshold), declining (FRI values rising above the threshold), or stable (FRI values remaining within the same category) trends were estimated. This approach had a relatively low data density per stratum (11 Inner Shelf sites, 12 Middle Shelf sites), but because the station location was held constant, most of the change in FRI score was attributable to temporal variance (Urquhart and Kincaid 1999; Olsen and Peck 2008).

Simple linear regression was used to model the trends in other metrics for each site (Appendix E). All linear regressions were done using the “tidyverse” and “broom” packages in R (R Core Team 2024). Trends were characterized by the sign of the slope (increasing if the slope is positive or decreasing if the slope is negative) and are given in Appendix E.

To assess if there is potential bias in FRI scores associated with the number of species in a sample that have p-values (a probability value of pollution tolerance), a linear regression of number of species with p-values vs FRI scores was plotted. A box plot of the residuals associated with regression was created by binning the number of species with p-values in the sample including 1-4, 5-8, 9-12, 13-16, and >16 species. If there is no bias in FRI scores relative to the number of species with p-values, then box plots would have similar distributions of residuals.

### **III. RESULTS**

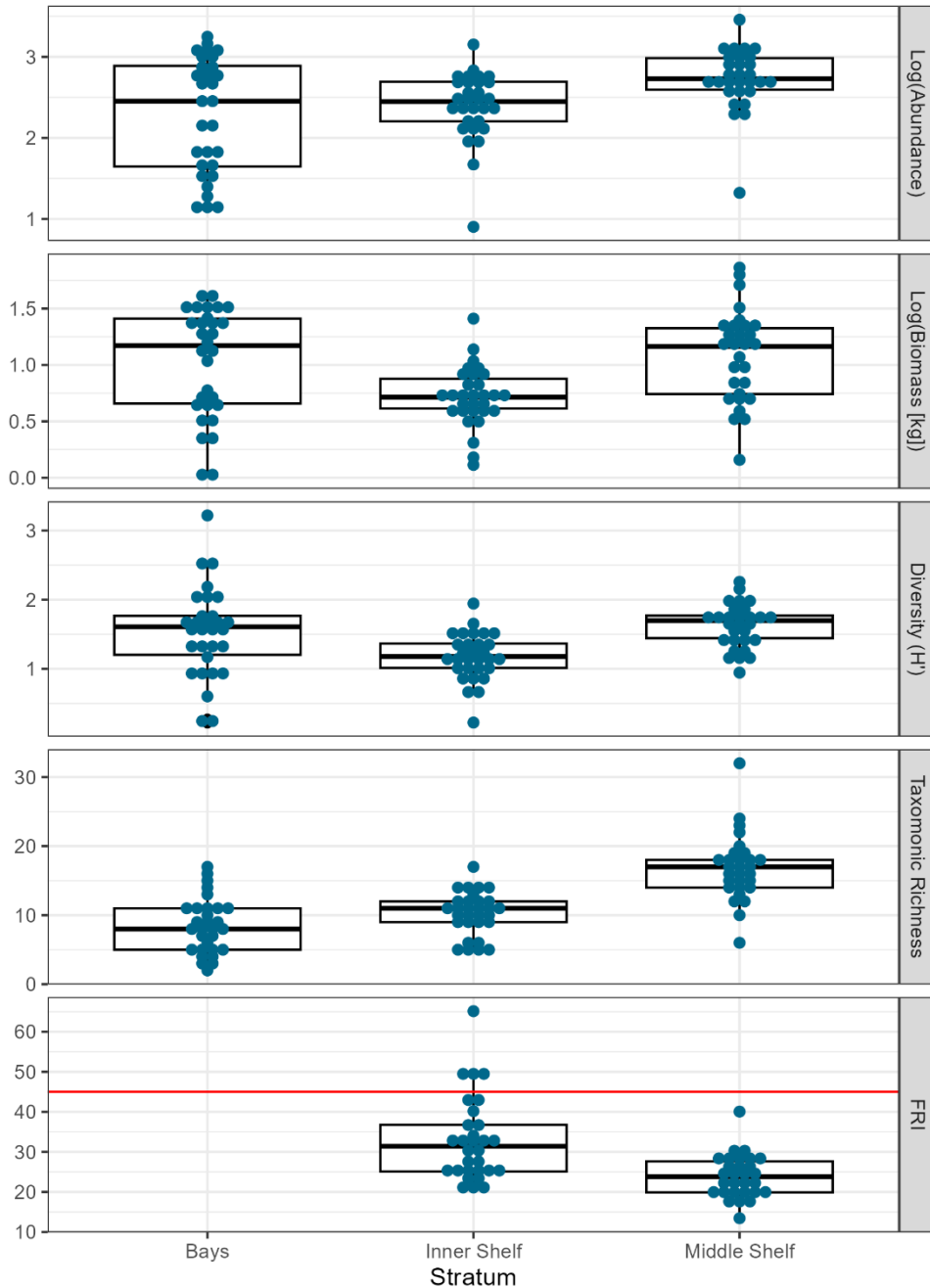
#### **Southern California Bight Habitat Condition in 2023**

##### **Demersal Fish Community Attributes**

A total of 59,763 fish were collected during Bight '23 (Appendix B). For the Bays, Inner Shelf, and Middle Shelf strata, a total of 45,293 fish were collected with an overall area-weighted median abundance of 459 individuals per trawl (Table 8). In these three strata, the number of fishes collected per trawl ranged from seven individuals on the Inner Shelf to 2,863 individuals on the Middle Shelf, and median abundances per haul ranged from 283 to 536 individuals. A total of 1,532.8 kg of fishes were collected during the Bight '23 survey. For the three strata of interest, 1,126.9 kg of fish were collected with an overall median biomass of 6.8 kg per haul. Median biomass ranged from 4.2 kg on the Inner Shelf to at least 13.6 kg on the Middle Shelf and Bays strata. Median H' diversity ranged from 1.18 on the Inner Shelf to 1.7 on the Middle Shelf (Table 8). The Inner Shelf trended toward lower diversity, with smaller variation in species richness compared to the other strata (Figure 4, Figure 5). Median taxonomic richness was 14 for the

three strata of interest and ranged from eight in the Bays to 17 on the Middle Shelf. Taxonomic richness increased offshore, with up to 32 species per trawl collected on the Middle Shelf.

Based on the Fish Response Index (FRI), 94.6% of the SCB shelf area (i.e., Inner Shelf and Middle Shelf combined) was in reference condition, with the percentage of area in reference condition ranging from 86.7% on the Inner Shelf to 100% on the Middle Shelf (Table 8). Though the Inner Shelf average FRI is trending higher, stations within that stratum show a greater variation in FRI scores than stations on the Middle Shelf (Figure 4). Of the four Inner Shelf sites with FRI scores indicating non-reference conditions, three are located in the northern Bight near Oxnard/Ventura river sources and one is at the mouth of Mission Bay in San Diego (Figure 6).



**Figure 4. Area-weighted demersal fish community metrics by stratum: Log abundance, Log biomass, Shannon diversity (H'), taxonomic richness, and Fish Response Index (FRI) during the Bight '23 trawl survey. Data are median, upper and lower quartiles, and results (represented by blue dots). For FRI, the red line represents maximum FRI score (45) associated with reference community; FRI is not applicable in Bays, see methods for details.**

**Table 8. Demersal fish community metrics by stratum: Abundance, biomass, taxonomic richness, Shannon diversity (H'), and Fish Response Index (FRI) during the Bight '23 trawl survey. FRI scores less than or equal to 45 are associated with a reference fish community. These statistics are area weighted for these three strata. Species richness excludes unidentified rockfish and pipefish.**

<b>Abundance</b>						
<b>Stratum</b>	<b>N Trawls</b>	<b>Median</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>	<b>Total</b>
Bays	30	283	479	12	1,766	14,356
Inner Shelf	30	280	344	7	1,418	10,328
Middle Shelf	29	536	711	20	2,863	20,609
Combined Strata	89	459	561	7	2,863	45,293

<b>Biomass (kg)</b>						
<b>Stratum</b>	<b>N Trawls</b>	<b>Median</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>	<b>Total</b>
Bays	30	13.9	15.6	0.1	40.9	469.3
Inner Shelf	30	4.2	5.4	0.3	24.7	160.5
Middle Shelf	29	13.6	17.1	0.4	72.0	497.2
Combined Strata	89	6.8	12.5	0.1	72.0	1,126.9

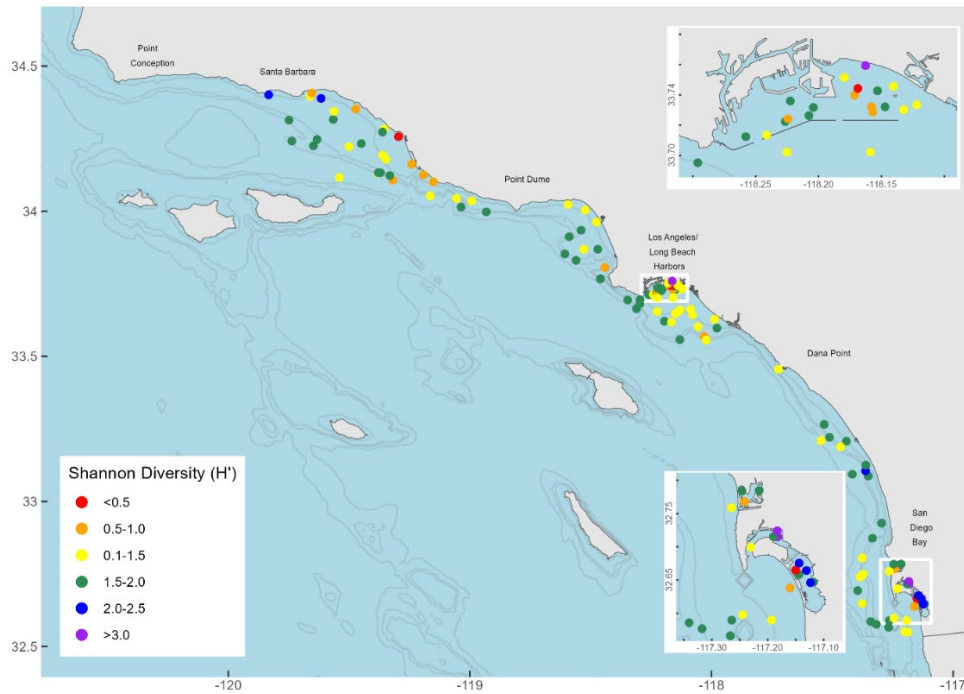
<b>Shannon Diversity (H')</b>					
<b>Stratum</b>	<b>N Trawls</b>	<b>Median</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>
Bays	30	1.61	1.54	0.21	3.22
Inner Shelf	30	1.18	1.17	0.22	1.94
Middle Shelf	29	1.7	1.62	0.95	2.26
Combined Strata	89	1.46	1.44	0.21	3.22

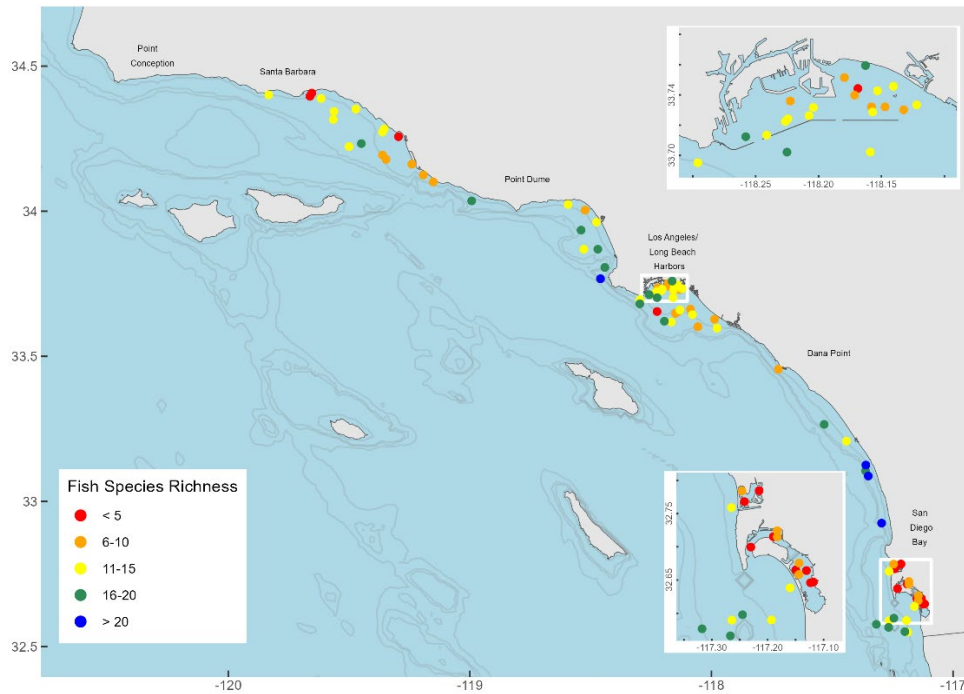
<b>Taxonomic Richness</b>						
<b>Stratum</b>	<b>N Trawls</b>	<b>Median</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>	<b>Total</b>
Bays	30	8	9	2	17	50
Inner Shelf	30	11	10	5	17	46
Middle Shelf	29	17	17	6	32	71
Combined Strata	89	14	14	2	32	102

<b>Fish Response Index (FRI)</b>							
<b>Stratum</b>	<b>N Trawls</b>	<b>Median</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>	<b>% Reference Sites</b>	<b>% Reference Area</b>
Inner Shelf	30	31.4	32.9	20.4	65.1	86.7	86.7
Middle Shelf	29	23.8	24.0	13.4	40.1	100	100
Combined Strata	59	25.6	27.6	13.4	65.1	93.2	94.6

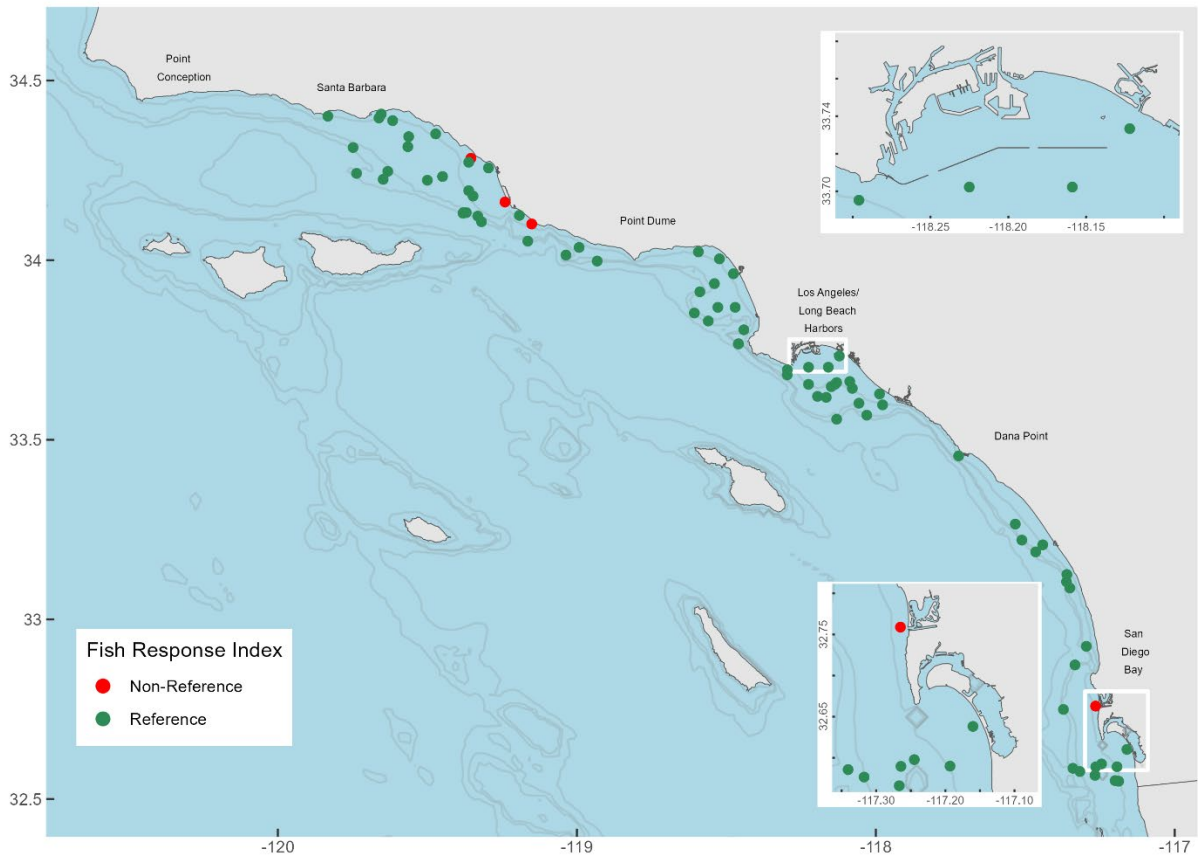


**A**



**B**

**Figure 5. Distribution of demersal fish Shannon diversity ( $H'$ ) per haul during the Bight '23 trawl survey (A). Calculated diversity for each station is sorted into bins and the colors represent the range of diversity values captured in each bin. Species richness is shown (B) for comparison purposes.**



**Figure 6. Distribution of Fish Response Index (FRI) scores in the Inner and Middle Shelf strata during the Bight '23 trawl survey. An FRI score  $\leq 45$  is associated with a fish community in reference condition.**

## Demersal Fish Population Attributes

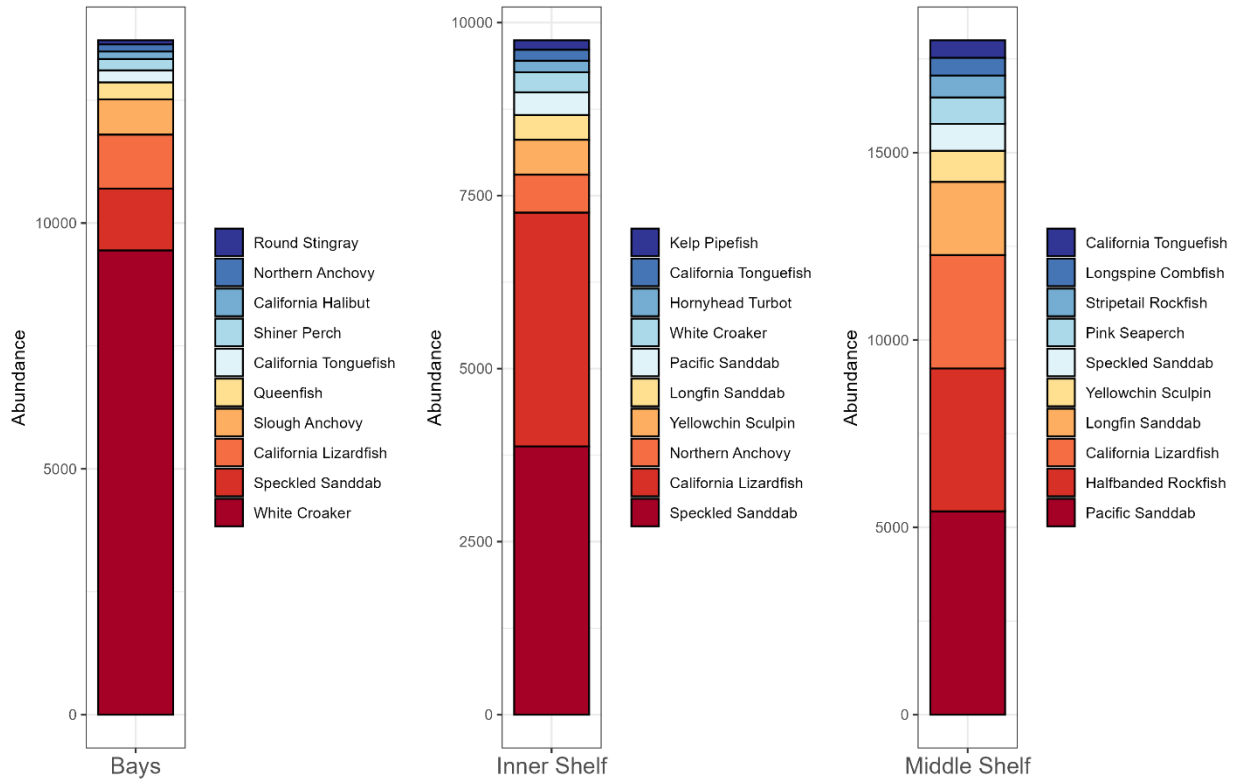
### *Demersal Fish Abundance and Biomass*

A total of 104 species, including unidentified rockfish and pipefish, representing 44 families were identified during Bight '23 (Appendix C-1). The top 10 most abundant fish in the Bight were represented by 8 families and accounted for 86.8% of all fish sampled (Table 9). At Bay stations, White Croaker (*Genyonemus lineatus*) accounted for 65.8% of the abundance ( $n = 9,446$  individuals), 63.3% of the biomass, and was caught at 50% of Bay stations (Figure 7, Appendix C-2). All in the Los Angeles/Long Beach Harbor area. On the Inner Shelf, California Lizardfish (*Synodus lucioceps*;  $n = 3,377$  individuals) and Speckled Sanddab (*Citharichthys stigmaeus*;  $n = 3,877$  individuals) comprised 70.2% of the catch and 35.1% of the biomass, plus they were collected in at least 90% of trawls (Figure 7, Appendix C-3). On the Middle Shelf, Pacific Sanddab (*Citharichthys sordidus*), Halfbanded Rockfish (*Sebastes semicinctus*), California

Lizardfish, and Longfin Sanddab (*Citharichthys xanhostigma*) comprised 69% of the catch and 51.2% of the biomass (Figure 7, Appendix C-4). Halfbanded Rockfish were caught only 55.2% of the time compared to the other three species, which were found on at least 86.2% of stations. California Lizardfish comprised just 4.8% of haul biomass, whereas the other three species comprised at least 12.1% of biomass.

**Table 9. Top ten demersal fish species by abundance for three strata during the Bight '23 trawl survey. The table is sorted by overall abundance rank. Shaded areas indicate species ranked in the top ten in a given stratum. Asterisk indicates combined numbers for the three strata. Abun = Abundance; FO = Frequency of Occurrence.**

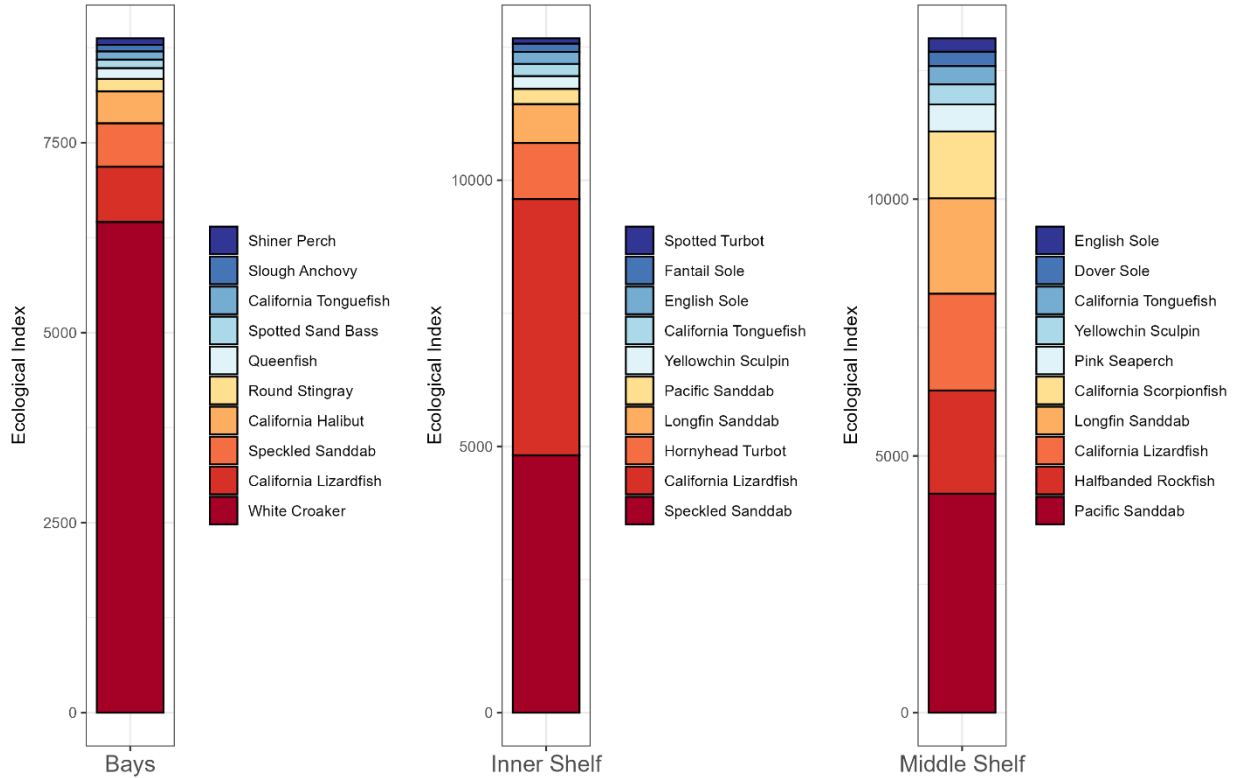
Common Name	Family	Abun Rank*	Mass Rank*	FO Rank*	Total for 3 Strata	Abundance		
						Bays	Inner Shelf	Middle Shelf
White Croaker	Sciaenidae	1	1	39	9,734	9,446	288	-
California Lizardfish	Synodontidae	2	6	1	7,499	1,096	3,377	3,026
Speckled Sanddab	Paralichthyidae	3	7	8	5,850	1,258	3,877	715
Pacific Sanddab	Paralichthyidae	4	4	3	5,755	-	328	5,427
Halfbanded Rockfish	Scorpaenidae	5	3	14	3,813	-	-	3,813
Longfin Sanddab	Paralichthyidae	6	5	5	2,328	18	357	1,953
Yellowchin Sculpin	Psychrolutidae	7	31	6	1,340	6	504	830
California Tonguefish	Cynoglossidae	8	18	2	873	244	159	470
Pink Seaperch	Embiotocidae	9	15	9	750	2	39	709
Slough Anchovy	Engraulidae	10	40	91	720	720	-	-
Northern Anchovy	Engraulidae	11	28	51	695	144	550	1
Stripetail Rockfish	Scorpaenidae	12	20	14	585	-	-	585
Longspine Combfish	Hexagrammida	13	25	11	565	30	65	470
Queenfish	Sciaenidae	16	24	40	366	344	22	-
Hornyhead Turbot	Pleuronectidae	18	10	4	332	28	168	136
Shiner Perch	Embiotocidae	20	35	25	309	230	67	12
California Halibut	Paralichthyidae	24	9	26	168	152	11	5
Kelp Pipefish	Syngnathidae	25	48	30	143	4	137	2
Round Stingray	Urotrygonidae	31	11	59	87	86	1	-



**Figure 7. Top ten demersal fish species by abundance for three strata during the Bight '23 trawl survey. The fish species are sorted from most abundant (bottom) to least abundant (top).**

### Ecological Index

The Ecological Index (E.I.) of species uses three ecological variables (abundance, biomass, and frequency of occurrence) to determine the ecological importance of species to energy flow within each stratum (Allen et al. 2002b; Williams et al. 2015b). The top index scores followed the most abundant species in the Bays, Inner Shelf, and Middle Shelf strata (Figure 8, Table 10). Lower scores were usually the result of one or two ecological variables being low. For example, in Bays, round stingray (*Urobatis halleri*) was the 10<sup>th</sup> most abundant but is ranked 5<sup>th</sup> in E.I. due to high biomass and frequency of occurrence (Figure 8, Appendix C-2). On the Inner Shelf, Hornyhead Turbot (*Pleuronichthys verticalis*) was ranked highly because it occurred frequently (in 83.3% of trawls), despite low abundances (1.6% of total abundance) (Figure 8, Appendix C-3). On the Middle Shelf, California Scorpionfish (*Scorpaena guttata*) occurred in 62.1% of trawls, and comprised 19.1% of total biomass, but occurred in low abundance relative to other common fishes (Figure 8, Appendix C-4).



**Figure 8. Top ten demersal fish species ranked by Ecologic Index (E.I.) for three strata during the Bight '23 trawl survey. The fish species are sorted from highest E.I. (bottom) to lowest E.I. (top).**

**Table 10. Top ten demersal fish species scored by Ecological (E.I.) Index for three strata during the Bight '23 trawl survey. The table is sorted by overall E.I. score for these strata. Shaded areas indicate species that were top ten most abundant in a given stratum. Asterisk indicates combined numbers for the three strata. E.I. values were not area weighted.**

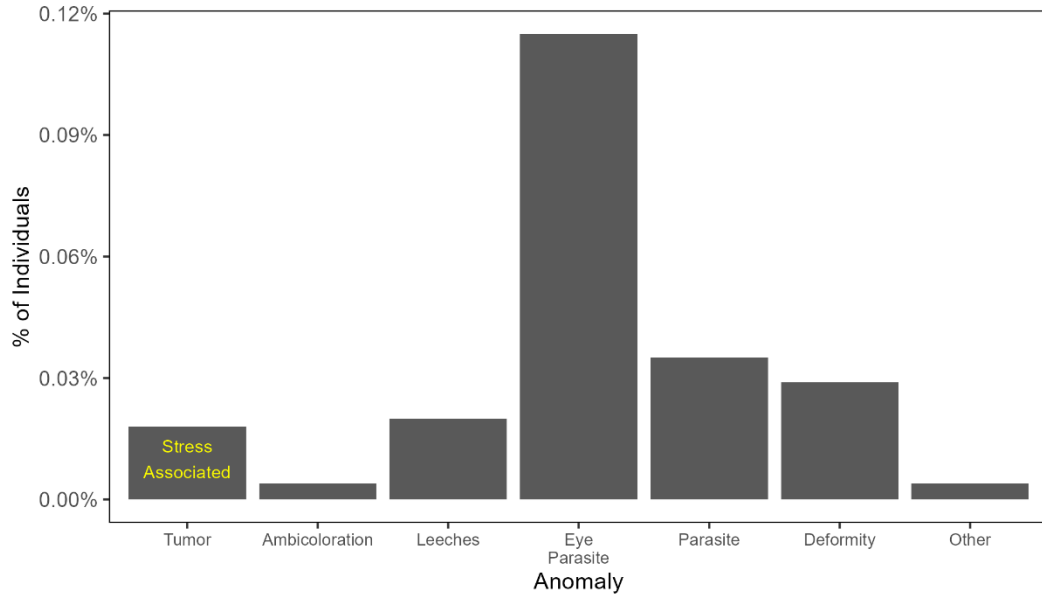
Common Fish Name	E.I. Rank*	Overall E.I. Score*	Abun Rank*	Ecological Index		
				Bays	Inner Shelf	Middle Shelf
California Lizardfish	1	1948	2	726	4814	1883
Pacific Sanddab	2	1002	4	-	285	4266
Speckled Sanddab	3	999	3	573	4834	167
White Croaker	4	980	1	6457	71	-
Longfin Sanddab	5	604	6	5	731	1858
Halfbanded Rockfish	6	294	5	-	-	2011
California Scorpionfish	7	242	15	0	8	1302
California Tonguefish	8	220	8	108	229	357
Hornyhead Turbot	9	198	18	9	1052	214
Yellowchin Sculpin	10	143	7	0	241	393
California Halibut	11	115	24	419	58	16
English Sole	12	103	21	0	224	261
Pink Seaperch	13	101	9	0	11	523

Common Fish Name	E.I. Rank*	Overall E.I. Score*	Abun Rank*	Ecological Index		
				Bays	Inner Shelf	Middle Shelf
Longspine Combfish	14	60	13	2	31	232
Dover Sole	15	41	14	-	-	281
Stripetail Rockfish	16	37	12	-	-	254
Vermilion Rockfish	17	33	23	8	2	116
Fantail Sole	18	31	27	40	156	1
Bigmouth Sole	19	25	26	-	26	104
Round Stingray	19	25	31	165	1	-
Shiner Perch	20	24	20	85	24	1
Queenfish	21	23	16	141	8	-
Northern Anchovy	21	23	11	34	27	0
Roughback Sculpin	22	19	22	-	6	85
Shortspine Combfish	23	16	17	-	-	110
Specklefin Midshipman	23	16	29	57	21	1
California Skate	23	16	38	4	30	29
Spotted Sand Bass	24	15	34	113	-	-
Spotted Turbot	25	13	33	10	101	0
Slough Anchovy	26	10	10	88	-	-

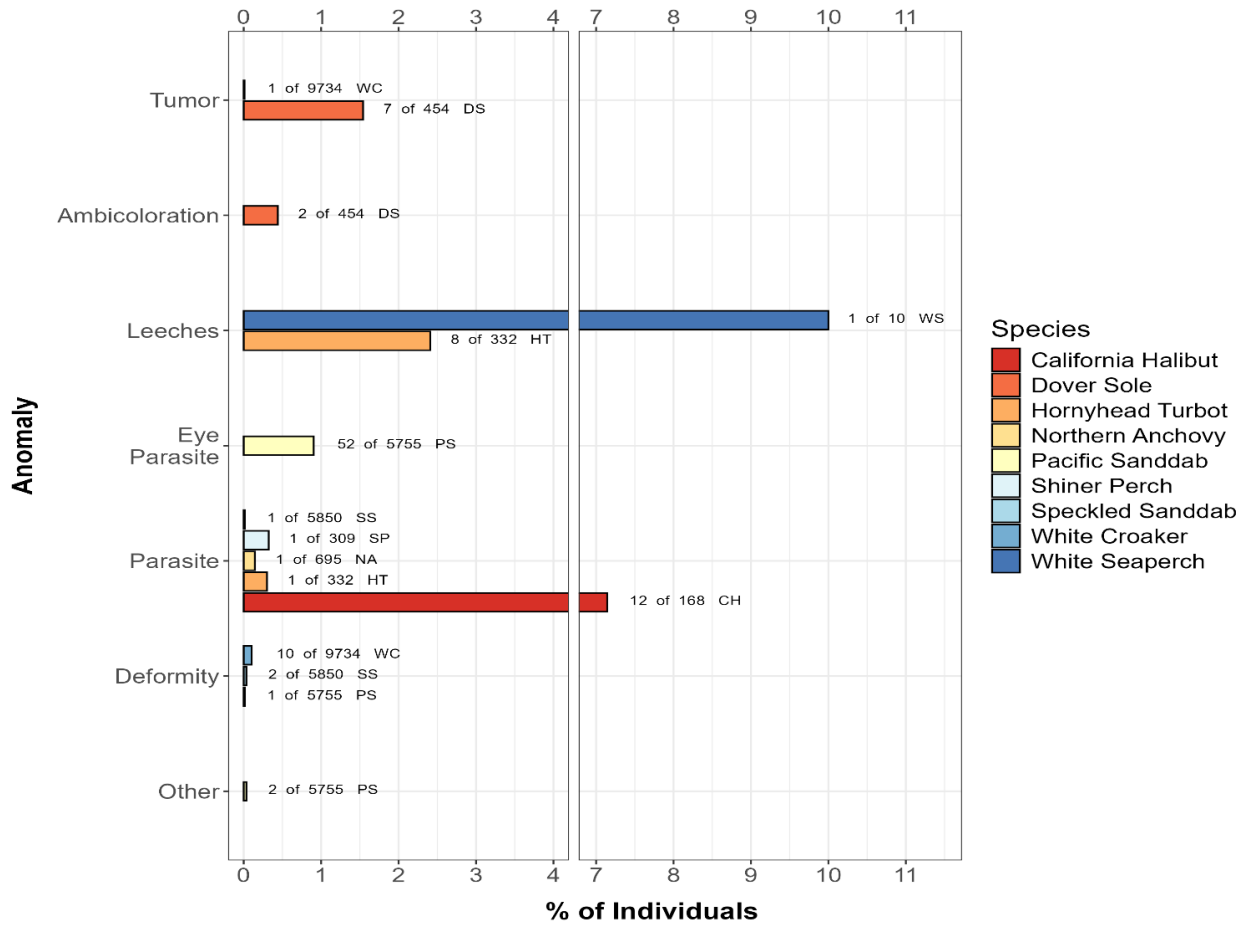
### *Demersal Fish Anomalies*

During the Bight '23 survey, less than 0.1% of fishes examined had an anomaly (Appendix D-1). Eye parasite was the most frequent anomaly type observed (0.1% of individuals, 48% of anomalies), while all other anomaly types occurred in less than 0.12% of individuals of a given species examined (Figures 9, 10). The seven observed anomaly types were recorded across 9 species, and White Seaperch and California Halibut had the two highest frequencies of anomalies, with 10% and 7.1% of individuals presenting anomalies, respectively (Figure 10). Eye parasites occurred on 0.9% of Pacific Sanddab individuals,

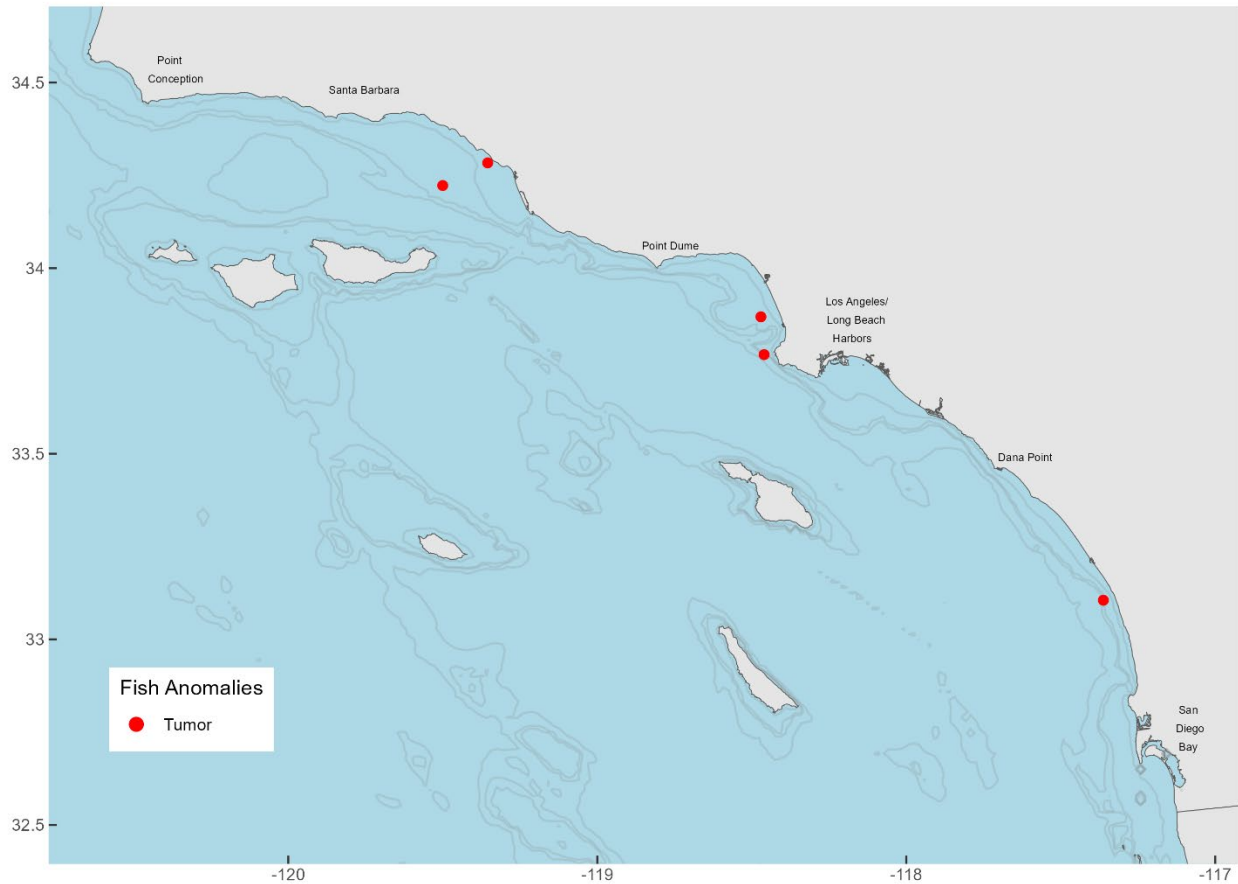
Potential stressor related fish pathologies include tumors, lesions, or fin erosion (Allen 1977; Mearns 1973, 1975; Sindermann et al. 1982). No lesion were observed in Bays or on the Inner and Middle Shelves during the Bight '23 survey. Tumors were found on 0.02% of fishes examined at five stations distributed throughout the Bight except in Bays (Figures 9, 11; Appendix D-1). Tumors were found on Dover Sole (n = 7 individuals), and on a single White Croaker (n = 1 individual) at a single Inner Shelf station (Figure 11, Appendix D-1).



**Figure 9. Percent demersal fish anomalies by type during the Bight '23 trawl survey with stress-related anomalies denoted in yellow, excluding Outer Shelf and Upper Slope.**



**Figure 10. Percent of fish individuals presenting with anomalies within a species for the Bight '23 trawl survey, excluding outer shelf and upper slope. Color represents the fish species. Numbers beside the bars represent the number of individuals within a species with anomalies and the total number of individuals of each species caught (includes species abbreviations). See Appendix D-1 for details.**



**Figure 11. Distribution of demersal fishes collected during the Bight '23 trawl survey with anomalies indicative of disease or stress. Map excludes Outer Shelf and Upper Slope.**

### Megabenthic Invertebrate Community Attributes

A total of 55,519 megabenthic invertebrates were collected during Bight '23 (Table 11, Appendix B2.1). There was an overall median abundance of 112 individuals per trawl and a median biomass of 0.9 kg (Table 11, Figure 12). Bays had the greatest range of total abundance, with hauls across stations ranging between four and 25,896 individuals. As with total abundance, Bays also had the greatest range of total biomass per trawl, ranging from 0.01 to 270.4 kg. Middle Shelf stations generally had the greatest H' diversity, with values across the SCB ranging from 0.01 in the Bays to 2.29 on the Middle Shelf (Table 11, Figure 13). Median taxonomic richness ranged from four in the Bay to 12 on the Middle shelf, following a similar trend to demersal fishes of increasing richness offshore.

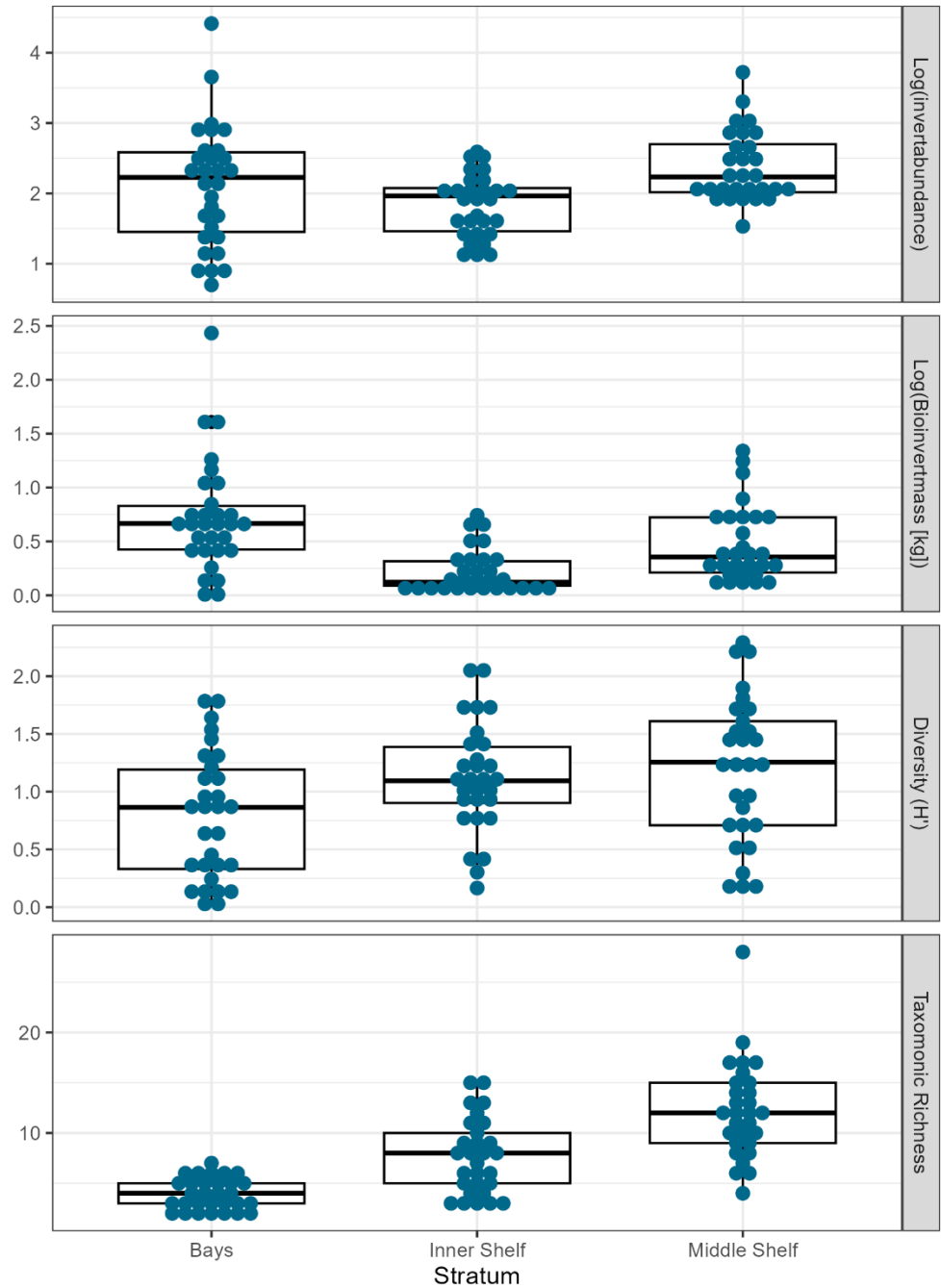
**Table 11. Demersal megabenthic invertebrate community metrics by stratum: Abundance, biomass, richness, and Shannon diversity (H') during the Bight '23 trawl survey. Asterisk indicates one station removed, B23-12211. It had a pelagic species (*Doryteuthis opalescens*) removed from analysis by the trawl committee. Statistics are area weighted for these strata.**

<b>Abundance</b>						
<b>Stratum</b>	<b>N Trawls</b>	<b>Median</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>	<b>Total</b>
Bays	30	169	1,238	4	25,986	37,150
Inner Shelf	29*	91	106	11	388	3,082
Middle Shelf	29	170	527	33	5,269	15,287
Combined Strata	88	112	382	4	25,986	55,519

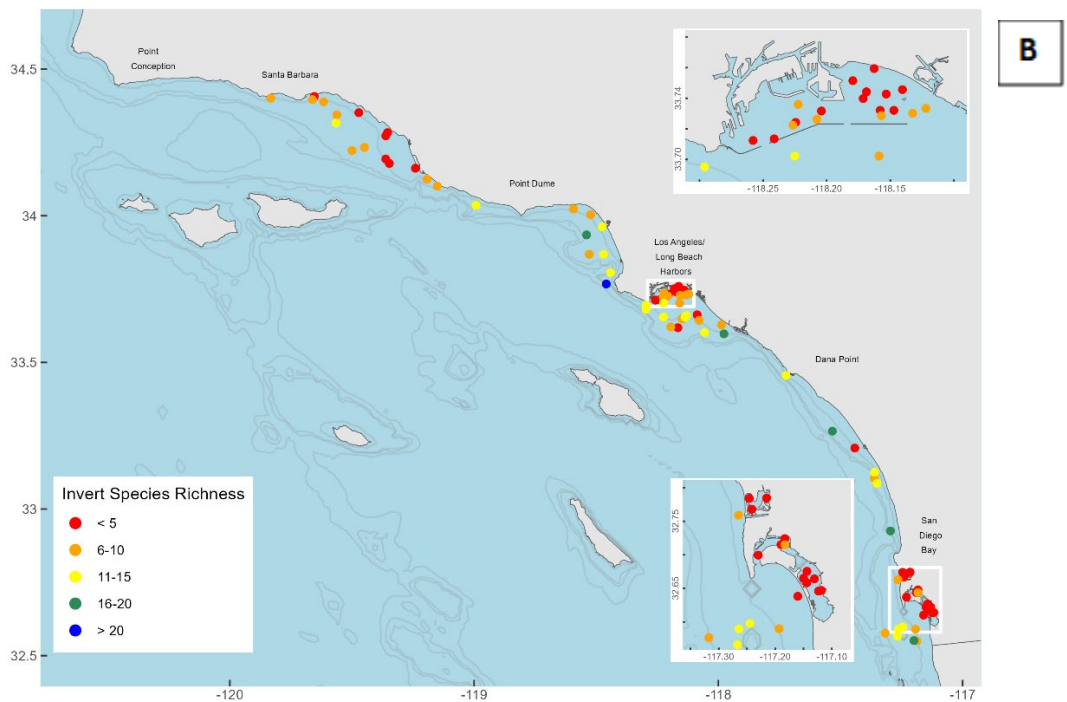
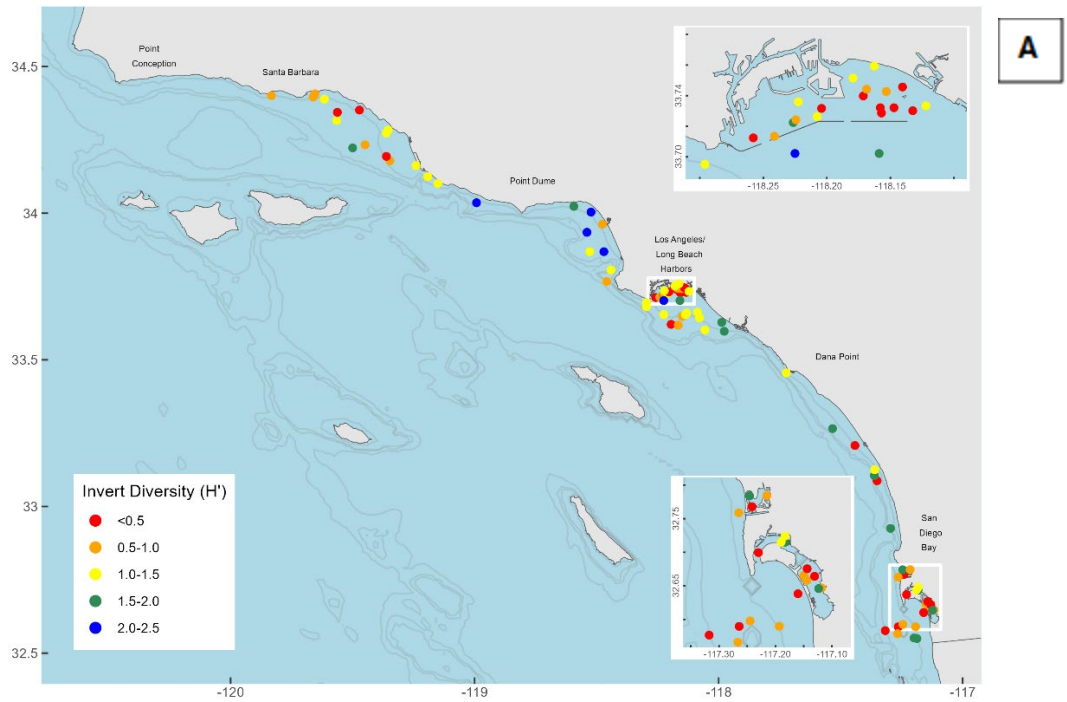
<b>Biomass (kg)</b>						
<b>Stratum</b>	<b>N Trawls</b>	<b>Median</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>	<b>Total</b>
Bays	30	3.6	15.4	0.01	270.4	461.1
Inner Shelf	29*	0.3	0.9	0.06	4.5	26.7
Middle Shelf	29	1.3	3.4	0.23	20.9	97.9
Combined Strata	88	0.9	2.7	0.01	270.4	585.7

<b>Shannon Diversity (H')</b>						
<b>Stratum</b>	<b>N Trawls</b>	<b>Median</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>	
Bays	30	0.86	0.79	0.01	1.80	
Inner Shelf	29*	1.09	1.12	0.17	2.08	
Middle Shelf	29	1.26	1.19	0.17	2.29	
Combined Strata	88	1.19	1.15	0.01	2.29	

<b>Taxonomic Richness</b>						
<b>Stratum</b>	<b>N Trawls</b>	<b>Median</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>	<b>Total</b>
Bays	30	4	4	2	7	35
Inner Shelf	29*	8	8	3	15	62
Middle Shelf	29	12	12	4	28	90
Combined Strata	88	10	10	2	28	137



**Figure 12. Area-weighted megabenthic invertebrate community metrics by stratum from the Bight '23 trawl survey: Log abundance, log biomass, Shannon diversity (H'), and taxonomic richness.**

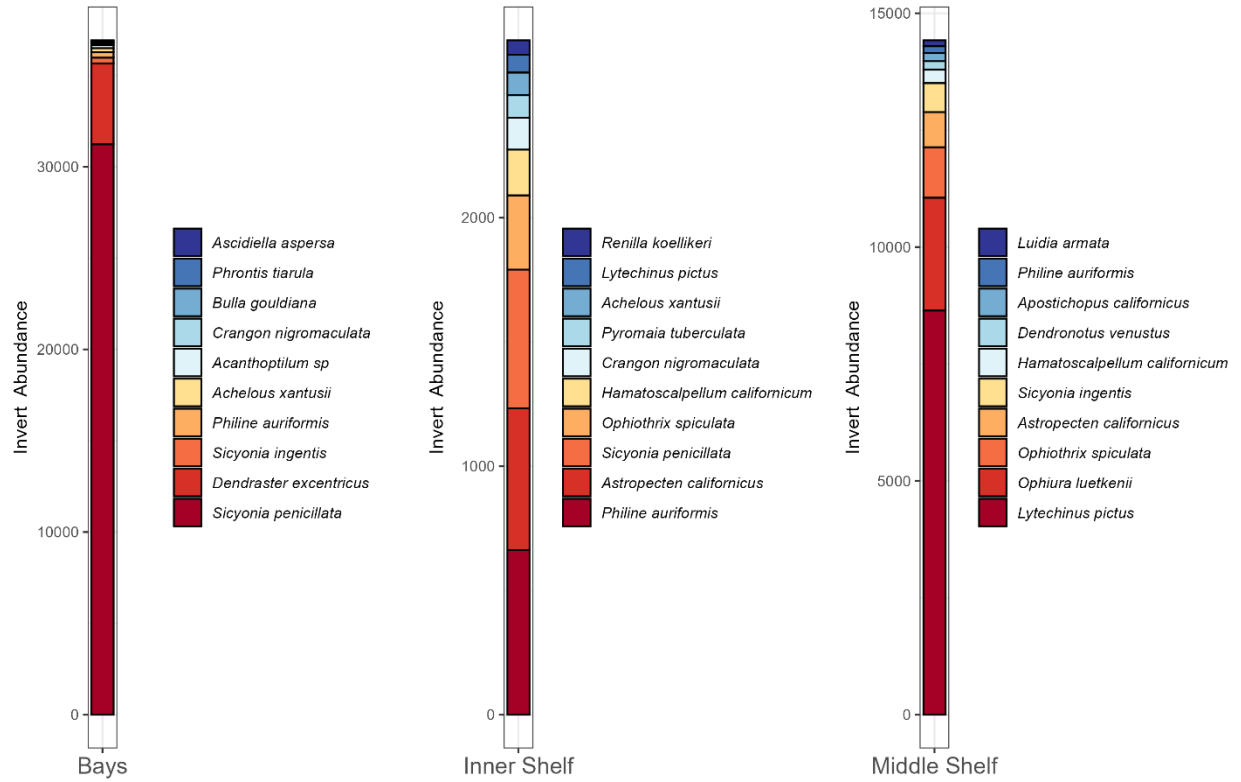


**Figure 13. Distribution of megabenthic invertebrate Shannon diversity ( $H'$ ) per haul during the Bight '23 survey(A). Calculated diversity for each station is sorted into bins and the colors represent the range of diversity values captured in each bin. Species richness is shown (B) for comparison purposes.**

## Megabenthic Invertebrate Population Attributes

### *Megabenthic Invertebrate Abundance and Biomass*

A total of 55,519 invertebrates (120 identified to Species level plus 20 unidentified species represented by either Genus or higher taxonomic level) representing 88 families were collected during Bight '23 (Appendix C-8). The top ten most abundant invertebrates in the Bight were represented by two phyla (Arthropoda and Echinodermata), nine families, and accounted for 95.4% of all invertebrates sampled (Figure 14, Table 12). Numerically, *Sicyonia penicillata* (Target Shrimp) ranked number one in total abundance for the survey and accounted for 56% of all invertebrates sampled in the SCB. It was found mainly in the Bays and diminished as shelf depths increased. One station in the Bays stratum near the mouth of San Diego Bay had an unusually large 5-minute haul of these Target Shrimp (n = 12,975 individuals). To make the stratum comparable to 10-minute trawls in other strata, all abundance and biomass values were doubled for stations with 5-minute trawls. After doubling, *Dendraster excentricus* (Pacific Sand Dollar) was the second most common species in Bays (n = 4,430 individuals) with a total biomass of 40.6 kg, accounting for 8.8% of the total Bays biomass (Figure 14, Table 12, Appendix C-9, Appendix C-11). All the Pacific Sand Dollar individuals came from one station near the mouth of Mission Bay. Removing these two species hauls would still cause Target Shrimp to be ranked number one and eliminate the Pacific Sand Dollar from the top ten list for Bays. On the Inner Shelf, *Philine auriformis* (New Zealand Sea Slug), *Astropecten californicus* (California Sand Star), and *Sicyonia penicillata* accounted for 58.1% of the abundance with the Target Shrimp accounting for 38.1% of the total Inner Shelf biomass (Figure 14, Appendix C-9). On the Middle Shelf, *Lytechinus pictus* (White Urchin) accounted for 56.3% of the abundance but only 9.6% of the Middle Shelf biomass (Figure 14, Appendix C-9). Conversely, *Apostichopus californicus* (California Sea Cucumber) accounted for 64.8% of the Middle Shelf biomass but only 1.1% of the abundance.



**Figure 14. Top ten megabenthic invertebrate species by abundance for three strata during the Bight '23 trawl survey. The invertebrate species are sorted from most abundant (bottom) to least abundant (top).**

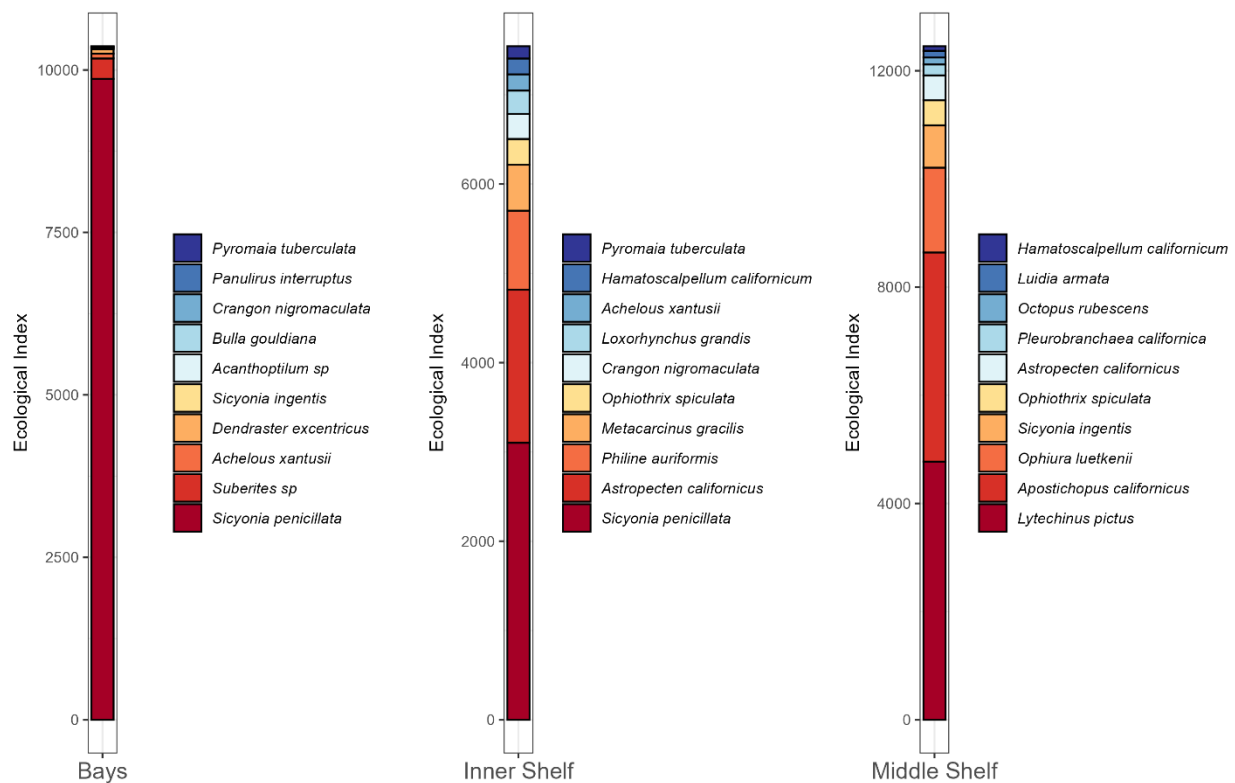
**Table 12. Top ten megabenthic invertebrate species by abundance for three strata during the Bight '23 trawl survey. The table is sorted by abundance rank. Shaded areas indicate species in the top ten most abundant for a given stratum. FO is the frequency of occurrence. Asterisk indicates combined numbers for the strata.**

Species	Phylum:Family	Abun Rank*	Mass Rank*	FO Rank*	SCB*	Abundance		
						Bays	Inner Shelf	Middle Shelf
<i>Sicyonia penicillata</i>	ARTHROPODA:Sicyoniidae	1	1	12	31,820	31,234	558	28
<i>Lytechinus pictus</i>	ECHINODERMATA:Toxopneustidae	2	5	5	8,715	-	72	8,643
<i>Dendraster excentricus</i>	ECHINODERMATA:Dendrasteridae	3	4	131	4,430	4,430	-	-
<i>Ophiura luetkenii</i>	ECHINODERMATA:Ophiuridae	4	11	3	2,435	-	22	2,413
<i>Ophiothrix spiculata</i>	ECHINODERMATA:Ophiotrichidae	5	19	6	1,392	14	299	1,079
<i>Astropecten californicus</i>	ECHINODERMATA:Astropectinidae	6	12	1	1,322	-	570	752
<i>Philine auriformis</i>	MOLLUSCA:Philinidae	7	14	11	1,111	300	663	148
<i>Sicyonia ingentis</i>	ARTHROPODA:Sicyoniidae	8	6	8	934	312	1	621
<i>Hamatoscalpellum californicum</i>	ARTHROPODA:Scalpellidae	9	20	13	472	-	184	288
<i>Achelous xantusii</i>	ARTHROPODA:Portunidae	10	7	23	311	220	91	-
<i>Crangon nigromaculata</i>	ARTHROPODA:Crangonidae	11	28	15	217	88	128	1
<i>Dendronotus venustus</i>	MOLLUSCA:Dendronotidae	12	33	57	191	-	11	180
<i>Acanthoptilum sp</i>	CNIDARIA:Virgulariidae	13	26	18	176	156	-	20
<i>Apostichopus californicus</i>	ECHINODERMATA:Stichopodidae	14	3	9	172	-	-	172
<i>Luidia armata</i>	ECHINODERMATA:Luidiidae	15	17	7	151	-	24	127
<i>Pyromaia tuberculata</i>	ARTHROPODA:Inachoididae	16	36	14	138	36	91	11
<i>Pleurobranchaea californica</i>	MOLLUSCA:Pleurobranchaeidae	18	13	4	115	-	19	96
<i>Octopus rubescens</i>	MOLLUSCA:Octopodidae	19	16	2	78	2	25	51
<i>Bulla gouldiana</i>	MOLLUSCA:Bullidae	20	30	123	74	74	-	-
<i>Luidia foliolata</i>	ECHINODERMATA:Luidiidae	21	29	10	66	-	2	64
<i>Phrontis tiarula</i>	MOLLUSCA:Nassariidae	21	42	125	66	66	-	-
<i>Renilla koellikeri</i>	CNIDARIA:Renillidae	24	44	33	58	-	58	-
<i>Metacarcinus gracilis</i>	ARTHROPODA:Cancridae	25	10	19	50	2	48	-
<i>Asciella aspersa</i>	CHORDATA:Asciidae	27	48	126	48	48	-	-
<i>Panulirus interruptus</i>	ARTHROPODA:Palinuridae	45	9	128	12	12	-	-
<i>Suberites sp</i>	PORIFERA:Suberitidae	45	2	124	12	12	-	-
<i>Loxorhynchus grandis</i>	ARTHROPODA:Epiplatidae	63	8	42	5	-	5	-

### Ecological Index

The top Ecological Index (E.I.) scores generally followed the top abundant species on the Bays, Inner Shelf, and Middle Shelf strata, though biomass contributed heavily to some of the scores (Figure 15, Table 13). In the Bays, *Sicyonia penicillata* (Target Shrimp) was dominant while *Suberites sp* (an orange sponge) contributed 15.6% to the total biomass and occurred in 20% of

the trawls, thus elevating its E.I. rank to second despite being outside the ten most abundant species (Figure 15, Appendix C-11). Note that removing the two large hauls only eliminated Sand Dollars from the list. Target Shrimp were still most important. On the Inner Shelf, in addition to the three most abundant species, ecologically important species were *Metacarcinus gracilis* (Graceful Rock Crab), *Ophiothrix spiculata* (Western Spiny Brittle Star), *Crangon nigromaculata* (Bay Shrimp), and *Loxorhynchus grandis* (Sheep Crab) (Table 13). They occurred in 14 to 52% of trawls, and the high biomass of *L. grandis* contributed to a higher E.I. score (Figure 15, Appendix C-12). On the Middle Shelf, additional ecologically important species (other than those with the greatest abundance or biomass) were *Ophiura luetkenii* (Gray Brittle Star), *Sicyonia ingentis* (Ridgeback Prawn), *Ophiothrix spiculata*, *Astropecten californicus*, *Pleurobranchaea californica* (California Sea Slug), and *Octopus rubescens* (Eastern Pacific Red Octopus) (Table 13). These species occurred in at least 62% of trawls, with *O. luetkenii* comprising a high abundance (15.7%) relative to its biomass (Appendix C-13).



**Figure 15. Top ten megabenthic invertebrate species by Ecological Index (E.I.) for three strata during the Bight '23 trawl survey. The invertebrate species are sorted from highest E.I. (bottom) to lowest E.I. (top).**

**Table 13. Top ten megabenthic invertebrate species ranked by Ecological Index (E.I.) for three strata during the Bight '23 trawl survey. The table is sorted by overall E.I. rank. Shaded areas indicate species ranked in the top ten in a given stratum. Asterisk indicates combined numbers for the three strata.**

Species	E.I. Rank*	Overall E.I. Score*	Ecological Index		
			Bays	Inner Shelf	Middle Shelf
<i>Sicyonia penicillata</i>	1	5118	9,864	3,103	-
<i>Lytechinus pictus</i>	2	492	-	-	4,774
<i>Apostichopus californicus</i>	3	215	-	-	3,866
<i>Ophiura luetkenii</i>	4	146	-	-	1,567
<i>Astropecten californicus</i>	5	136	-	1,713	459
<i>Sicyonia ingentis</i>	6	93	14	-	783
<i>Ophiothrix spiculata</i>	7	86	-	290	465
<i>Suberites</i> sp	8	84	313	-	-
<i>Philine auriformis</i>	9	53	-	886	-
<i>Achelous xantusii</i>	10	37	75	181	-
<i>Hamatoscalpellum californicum</i>	11	20	-	177	85
<i>Pleurobranchaea californica</i>	12	19	-	-	203
<i>Dendraster excentricus</i>	13	17	69	-	-
<i>Octopus rubescens</i>	14	16	-	-	128
<i>Luidia armata</i>	15	15	-	-	124
<i>Crangon nigromaculata</i>	16	13	6	281	-
<i>Metacarcinus gracilis</i>	17	10	-	514	-
<i>Pyromaia tuberculata</i>	18	8	4	138	-
<i>Acanthoptilum</i> sp	19	7	8	-	-
<i>Loxorhynchus grandis</i>	20	4	-	261	-
<i>Panulirus interruptus</i>	24	2	6	-	-
<i>Bulla gouldiana</i>	25	2	7	-	-

### *Megabenthic Invertebrate Anomalies*

The overall occurrence of invertebrate anomalies was low during Bight '23, with anomalies found on just 0.03% of the invertebrates examined (Table 14). A total of five anomalies were found on three species of invertebrates. The most prevalent anomaly was burnspot disease, which was found only on the Middle Shelf on one *Metacarcinus anthonyi* (Yellow Rock Crab) individual and three *Sicyonia ingentis* (Ridgeback Prawn) individuals. Invertebrates that were not thoroughly examined during the processing of trawls were localized to species at Bays stations where the aliquot method was used to handle extremely large abundances of a species.

**Table 14. Number of megabenthic invertebrate anomalies by type, species and stratum during the Bight '23 trawl survey. \* Note that species with an anomaly code of “None Examined” were excluded from total examined column. Double asterisk represents anomalies from the three strata combined.**

AnomalyCode	Species	Stratum			Total**	Total Examined*	Percent Anomaly
		Bays	Inner Shelf	Middle Shelf			
Burnspot disease	<i>Metacarcinus anthonyi</i>	-	-	1	1	14	7.14
Burnspot disease	<i>Sicyonia ingentis</i>	-	-	3	3	934	0.32
Parasite	<i>Crangon nigromaculata</i>	-	1	-	1	217	0.46
All Anomalies	All Species	-	1	4	5	17982	0.03

## Multi-Survey Temporal Trends

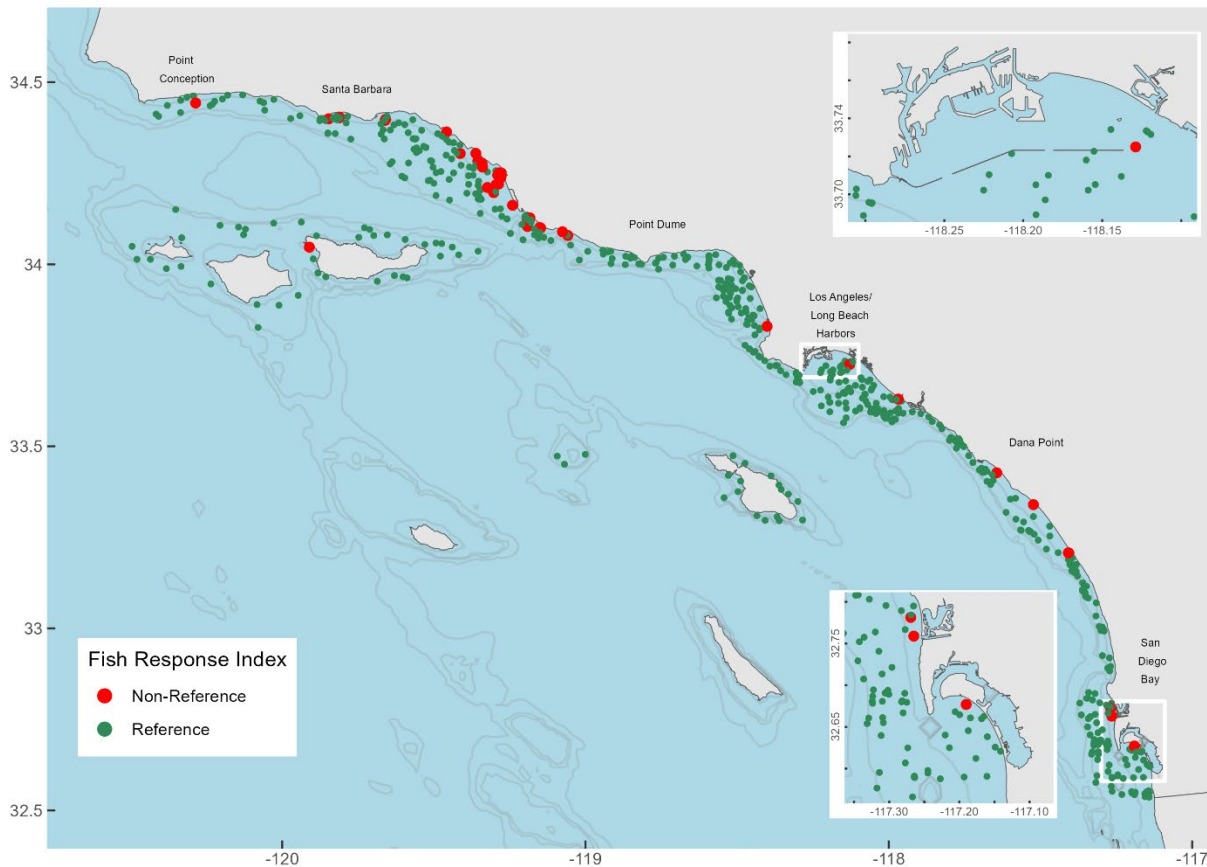
### Trends in Demersal Fish Community Attributes

Trends in the condition of the SCB from 1994 to 2023 were assessed using the Fish Response Index (FRI; Allen et al. 2001). Additional details for fish abundance, biomass, taxonomic richness, and Shannon Diversity (H') can be found in Appendix B1.6, B1.7, B1.8, and B1.9.

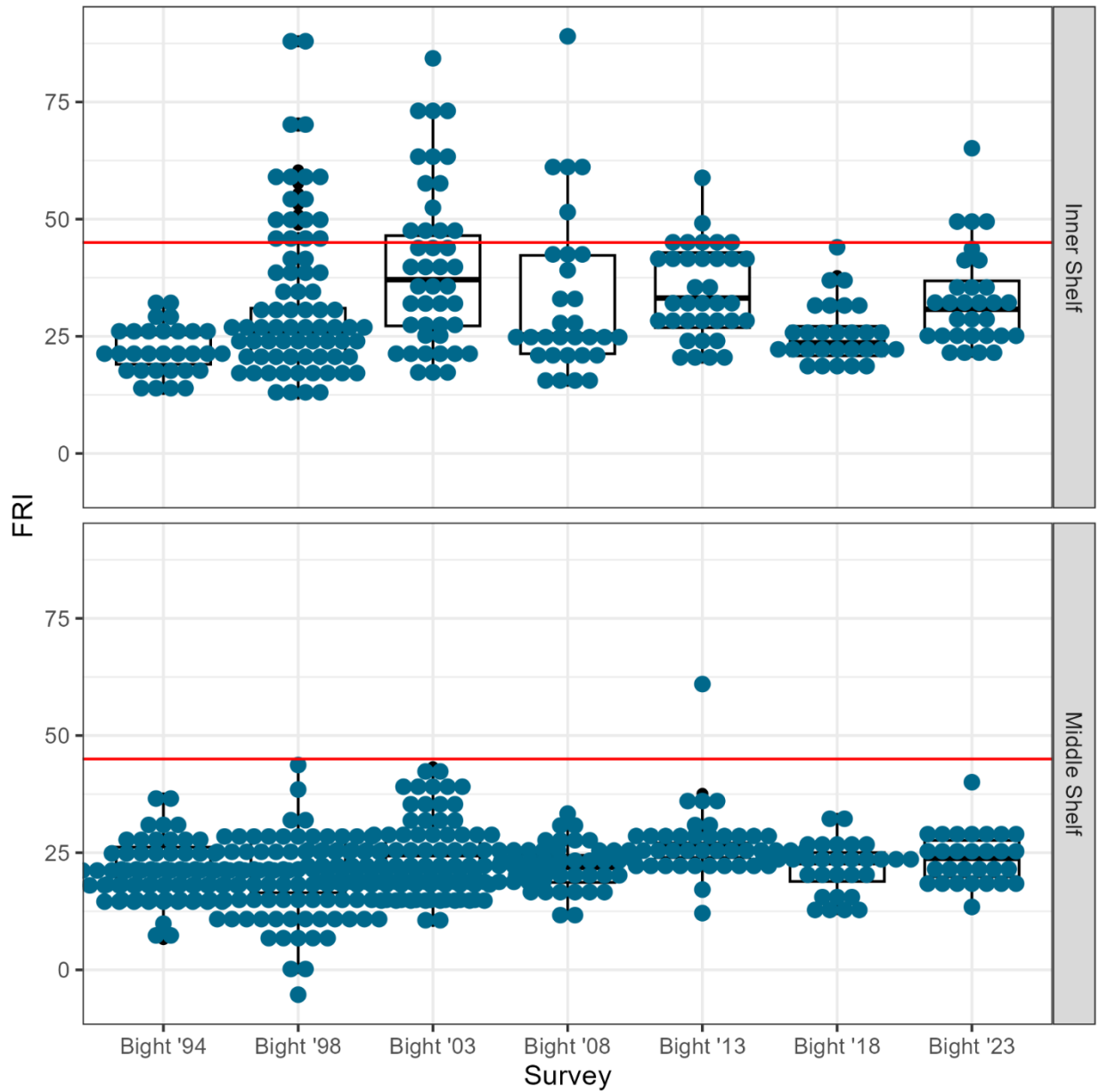
Over 90% of the inner and middle shelf survey areas were in reference condition based on the FRI during the seven Bight regional monitoring surveys (Table 15, Figure 16). The percentage of stations in reference condition ranged from 88% in Bight '03 to 100% in Bight '94 and Bight '18. The percentage of inner and middle shelf area in reference condition ranged from 91% in Bight '03 to 100% in Bight '94 and Bight '18. Seven percent of stations (n=45) had FRI scores associated with non-reference conditions out of a total of 674 inner and middle shelf stations sampled during the seven Bight surveys. Nearly all sites associated with non-reference conditions occurred in the Inner Shelf (n=44), while the Middle Shelf had one site in non-reference condition, which occurred in Bight '13 (Figure 17). Fish abundance, biomass, taxonomic richness and Shannon diversity (H') showed no clear increasing or decreasing trends within a stratum among the six surveys.

**Table 15. Percent of stations and area in reference condition as measured by the Fish Response Index (FRI) scores in the SCB by survey. The FRI is not area-weighted in this table and only the Inner and Middle Shelf strata have been included for all surveys. Species without p-values were removed. One FRI score was calculated per station. Percentages are based on stations in reference condition ( $\leq 45$ ) divided by total stations for a particular survey.**

Survey	Number of Reference Stations	Number of Non-Reference	Percent of Reference Stations	Percent of Reference Area
Bight '94	90	0	100%	100%
Bight '98	181	16	92%	98%
Bight '03	114	15	88%	91%
Bight '08	58	5	92%	94%
Bight '13	73	5	94%	92%
Bight '18	58	0	100%	100%
Bight '23	55	4	93%	95%
<b>All Surveys</b>	<b>629</b>	<b>45</b>	<b>93%</b>	<b>96%</b>



**Figure 16. Distribution of Fish Response Index (FRI) scores, for Inner and Middle shelf strata, for all Bight surveys (1994 – 2023). An FRI score  $\leq 45$  is associated with a fish community in reference condition.**

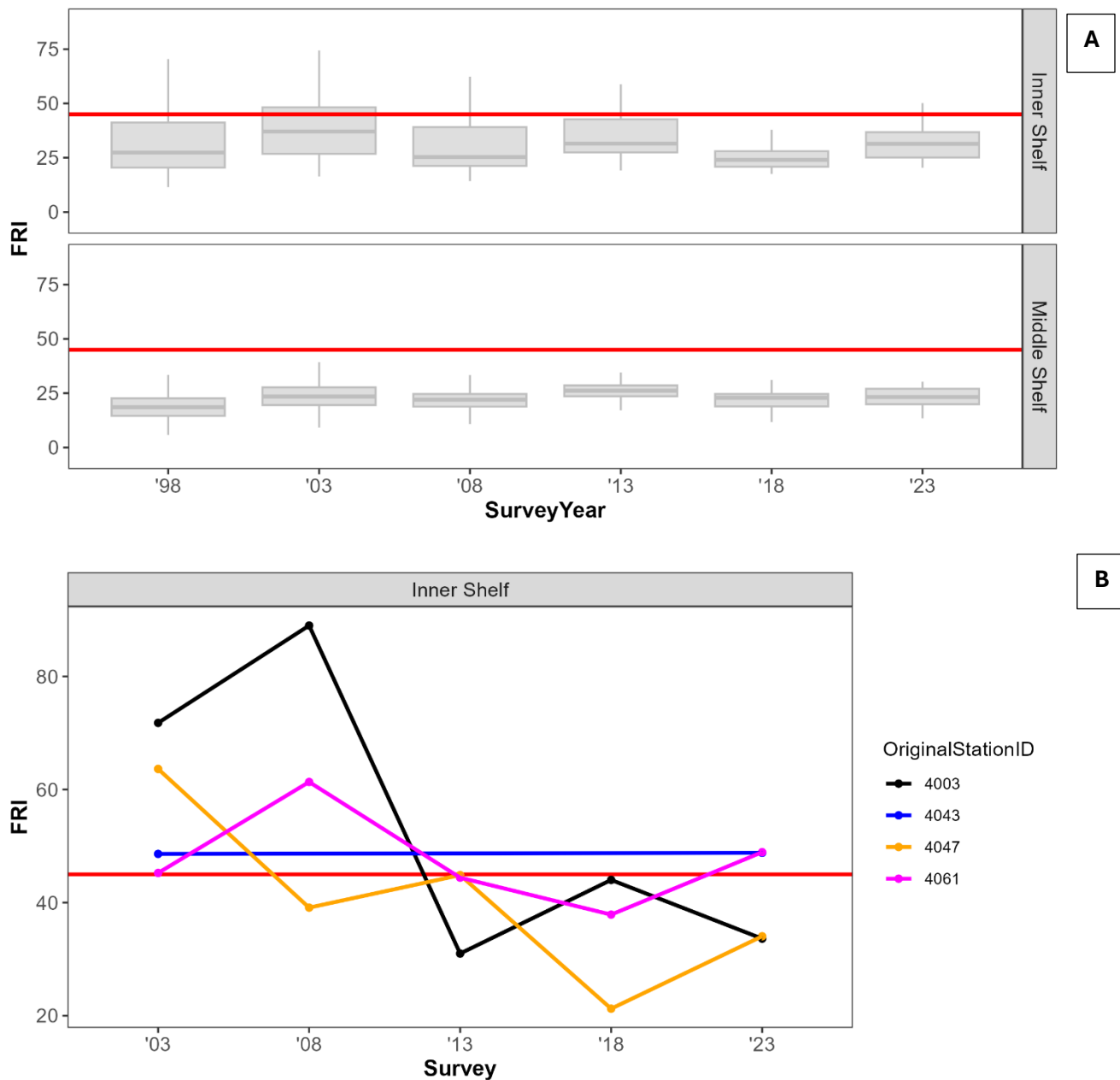


**Figure 17. Fish Response Index (FRI) scores in the SCB by shelf stratum and survey. Data are median, upper and lower quartiles, and results (represented by blue dots). The red line represents FRI score associated with reference community ( $\leq 45$ ); FRI is not applicable in Bays and at Upper Slope depths.**

*Site Revisit Temporal Trends of Demersal Fish*

Based upon sites revisited from 1998 through 2023, the majority of the SCB shelf were considered “stable” based on no significant trend, or improvement in FRI scores over time (84% and 100% of area, for Inner and Middle Shelf, respectively; Figure 18, Table 16).

Other fish metrics, Shannon diversity ( $H'$ ) and taxonomic richness, showed similarly stable trends over time in the three strata assessed (Bays, Inner Shelf and Middle Shelf). Trends in  $H'$  diversity were considered “stable” in 92.1% of the three strata areas combined, ranging from 83% of the Middle Shelf to 100% of the Bays (Appendix E-1, E-3, and E-4). Diversity increased on the Inner Shelf and Middle Shelf (9.1% and 8.3% of the area, respectively), while one site decreased in diversity in the Middle Shelf (8.3% of the area). The Middle Shelf had increasing taxonomic richness in 16.7% of the area, while the Bays had less than 6.7% of the area with decreasing richness.



**Figure 18. Trends in individual revisited sites across surveys for two shelf strata. Red line is an FRI score of 45; sites greater than 45 are considered “non-reference”; sites less than 45 are “reference”. (A) Grey box plots represent all Bight data collected during that survey. (B) FRI values at individual stations where values changed categories. These are all Inner Shelf sites. All other revisit stations remained within reference conditions ( $\leq 45$ ) during all surveys.**

**Table 16. Count and associated percent of revisit sites characterized as improving, stable or declining based on the trend in FRI scores changing categories between 1998/2003 and 2023 for each stratum.**

Stratum	# of Sites	Sites Changing Cat	Changed Improving	Stable	Declining*
Inner Shelf	12	4	2 (17%)	8 (67%)	2 (17%)
Middle Shelf	11	0	0 (0%)	11 (100%)	0 (0%)

\*Although two revisit sites increased in FRI score (i.e. showed a "declining" condition), one FRI score remained <45 (i.e. in "reference condition").

### *Multivariate Analyses of Demersal Fish Assemblages*

Multivariate analyses were used to discriminate between demersal fish assemblages from a total of 1,195 trawls conducted during Bight surveys (Bight '94 – Bight '23). A total of four stations were excluded from these analyses because no demersal fishes were collected in these trawls. Fish assemblages located within Bays were found to be significantly different than those located on the coastal shelf and Upper Slope of the SCB (one-way ANOSIM,  $\rho = 0.498$ ,  $p \leq 0.001$ , number of permutations = 999). Based on SIMPER analysis, the two regions had an average dissimilarity of 94%, and differed primarily due to numbers of White Croaker, California Halibut, Barred Sand Bass, California Tonguefish, and Spotted Sand Bass in the Bays, versus Pacific Sanddabs, Specked Sanddab, Dover Sole, California Lizardfish, and Slender Sole on the shelf and slope. Subsequent multivariate analyses were performed separately on data from each region.

#### Bays

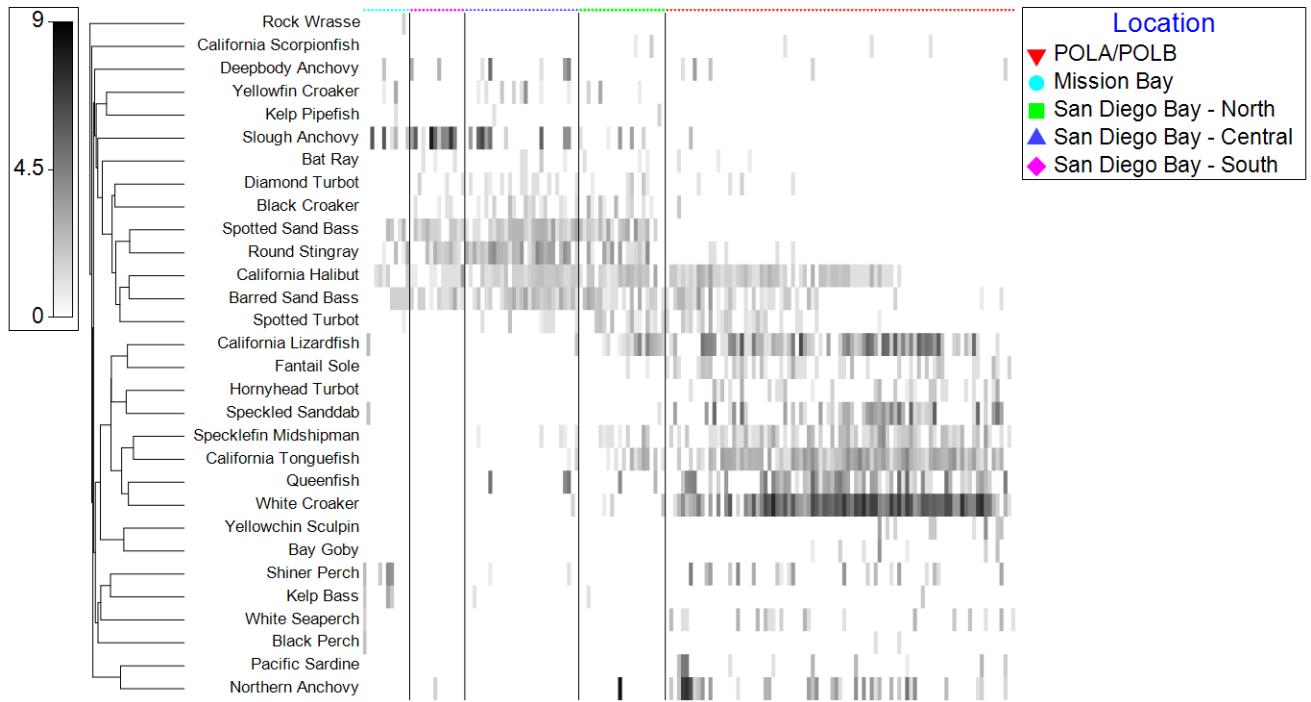
Multivariate analysis of demersal fish communities in Bays included a total of 166 trawls conducted during Bight surveys (Bight '98 – Bight '23) (Table 17). Fish assemblages located in each embayment were found to be significantly different from one another, including all three ecoregions of San Diego Bay (SDB) (one-way ANOSIM,  $\rho = 0.731$ ,  $p = 0.001$ , number of permutations = 999). Ordination analysis showed the most distinct separation was between Port of LA/Port of Long Beach (POLA/POLB) and all other embayments (Figure 19, Figure 20) supported by higher average dissimilarity based on SIMPER analysis. Survey years were also significantly different from one another (one-way ANOSIM,  $\rho = 0.096$ ,  $p = 0.001$ , number of permutations = 999), with pairwise comparisons finding that 1998 was significantly different from all years while subsequent surveys were less distinct; for example, the last three surveys were not significantly different from one another. Differences between years may in part be driven by the distribution and number of stations within each bay, as 1998 had nearly double the number of stations in POLA/POLB compared to SDB and Mission Bay while subsequent surveys were more balanced. These analyses resulted in 7 ecologically-relevant SIMPROF-supported cluster groups, or fish assemblages (cluster groups A-G; Table 17, Figure 19, Figure 20), which were overlaid on station maps to examine spatial distribution. These assemblages

represented from 1 to 86 trawls each and ranged from 32 to 49% similarity (mean = 40%) for cluster groups with  $n > 1$ . A BEST/BVSTEP test ( $p = 0.95$ ,  $p = 0.001$ , number of permutations = 999) implicated California Lizardfish, California Tonguefish (*Symphurus atricaudus*), California Halibut (*Paralichthys californicus*), White Croaker (*Genyonemus lineatus*), Queenfish (*Seriphys politus*), Round Stingray (*Urobatis helleri*), Spotted Sand Bass (*Paralabrax maculatofasciatus*), Barred Sand Bass (*Paralabrax nebulifer*), Specklefin Midshipman (*Porichthys myriaster*), and Slough Anchovy (*Anchoa delicatissima*) as being influential to the overall pattern (gradient) seen in Figure 19. Two of the cluster groups (groups A and C) were small “outlier” clusters ( $n = 2$  trawls) that were composed of stations from only one survey year each (1998 and 2018, respectively). SIMPROF groups largely supported spatial gradients of fish communities based on habitat type (e.g., shallow eelgrass, deep sandy bottom, etc.), oceanographic influence, and proximity to a harbor mouth. SIMPER results of dominant fish species are discussed in more detail in Appendix F. There were no discernible patterns for demersal fish assemblages associated with areas that may be more impacted (e.g., marinas, constricted channels) within the larger embayments. This could be in part due to the limitation of trawl sampling in more open areas that are not usually the most impacted compared to constricted, shallow areas and in part due to the transient nature of fishes within and between embayment and coastal habitats.

**Table 17. Description of Bays fish cluster groups defined in Figure 19 and Figure 20.**

	Cluster Group						
	A	B	C	D	E	F	G
No. of Trawls	1	5	1	86	3	67	3
Average Similarity	*	32	*	45	49	39	34
Mean Sp Richness	1	4	3	9	5	6	2
Mean Abundance	2	18	8	484	62	227	10
Depth (m)							
Min	15	8	7	4	3	2	5
Max	15	18	7	27	4	16	11
Mean	15	13	7	15	4	7	8
% Trawls by Survey							
1998	100	40	0	34	33	25	0
2003	0	0	0	8	0	12	33
2008	0	0	0	7	0	15	67
2013	0	0	0	17	0	16	0
2018	0	20	100	14	33	16	0
2023	0	40	0	20	33	15	0

\* Similarity only calculated for groups with  $>1$  trawl



**Figure 19. Shade plot of the top 30 demersal fish species by embayment. Note: Abundance represents log-transformed abundance, with individual trawls represented across the x-axis.**

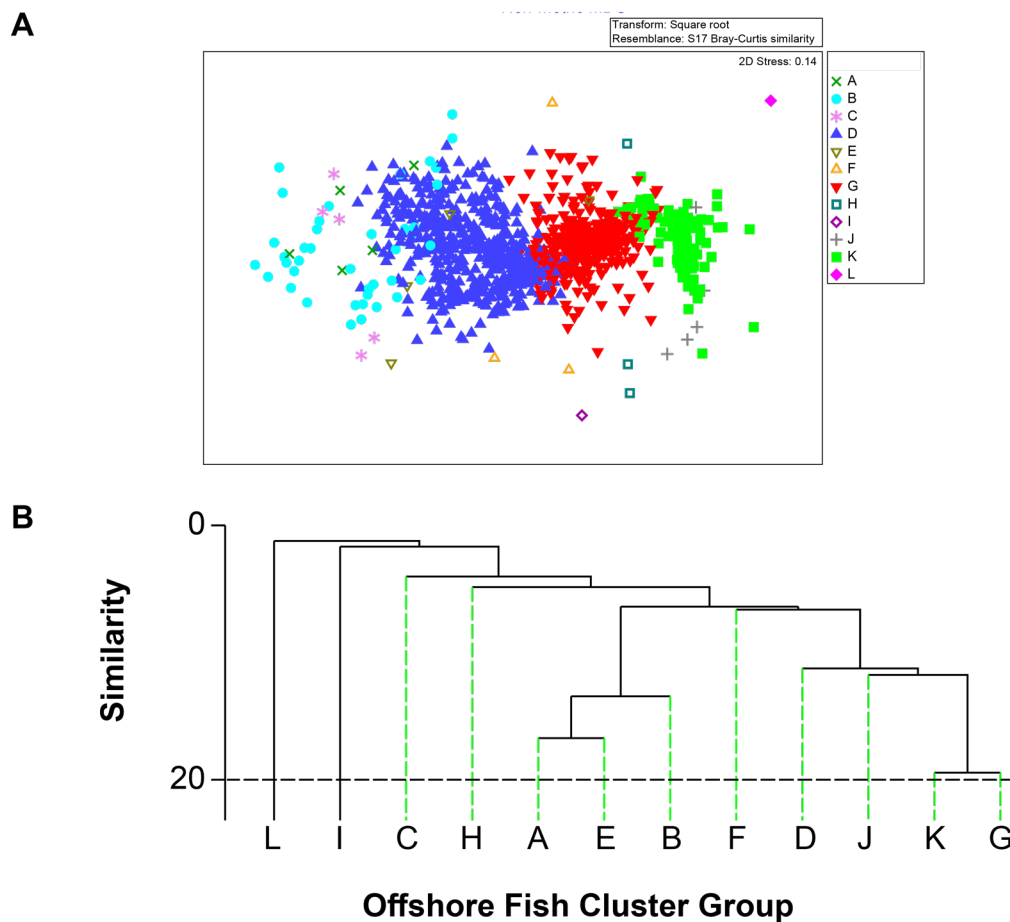


**Figure 20. Demersal fish SIMPROF groups within POLA/POLB (A), Mission Bay (B), and San Diego Bay (C).**

### Coastal Shelf and Upper Slope Strata

Initial multivariate analyses of demersal fish communities on the SCB shelf and Upper Slope included a total of 997 trawls conducted during Bight surveys (Bight '94 – Bight '23). Following the removal of two additional outliers (B13-9396, B13-9435), subsequent analyses of 995 trawls resulted in 12 main ecologically-relevant SIMPROF-supported groups, or types of demersal fish assemblage (cluster groups A-L; Figure 21, Figure 22, Table 18). These assemblages represented from 1 to 507 trawls each and ranged from 20 to 40% similarity (mean = 33%) for cluster groups with more than one trawl. A BEST/BVSTEP test ( $p = 0.954$ ,  $p \leq 0.001$ , number of permutations = 999) implicated California Lizardfish, Dover Sole, English Sole, Hornyhead Turbot, Longfin Sanddab, Pacific Sanddab, Slender Sole, Speckled Sanddab, Stripetail Rockfish, and Yellowchin Sculpin as being influential to the overall pattern (gradient) of the cluster dendrogram. There were no discernible patterns in the demersal fish assemblages associated with survey year or proximity to known pollution sources (e.g., major POTW discharge sites). Instead, assemblages

appeared to be influenced primarily by depth (Figure 23) and most likely unique characteristics of specific station locations (e.g., habitat differences), and/or the unique composition of fish assemblages. Eight of the cluster groups (groups A, C, E, F, H, I, J, L) were small “outlier” clusters with  $\leq 5$  trawls in each group. Sixty-three percent ( $n = 17$ ) of these “outlier” trawls, and 87% ( $n = 35$ ) of trawls in cluster group B, were conducted at stations located north of Point Dume and/or proximal to one of the Channel Islands (Figure 22A). With the exception of group E, the “outlier” groups had lower mean abundance than the larger cluster groups (i.e.,  $\leq 29$  versus  $\geq 161$  fishes per haul), and several also had very low species richness (i.e.,  $\leq 5$  species per haul). Only 19% of these trawls from appropriate depths ( $n = 4$ ) had FRI values indicative of non-reference conditions (Table 18). The remaining clusters (groups B, D, G, K) each spanned the entire SCB (Figure 22B), representing the transition of common fish assemblages from the Inner Shelf to the Upper Slope. The species composition and main descriptive characteristics of each cluster group are included in Appendix F, along with additional analyses of group B, D, G, and K sub-groups.

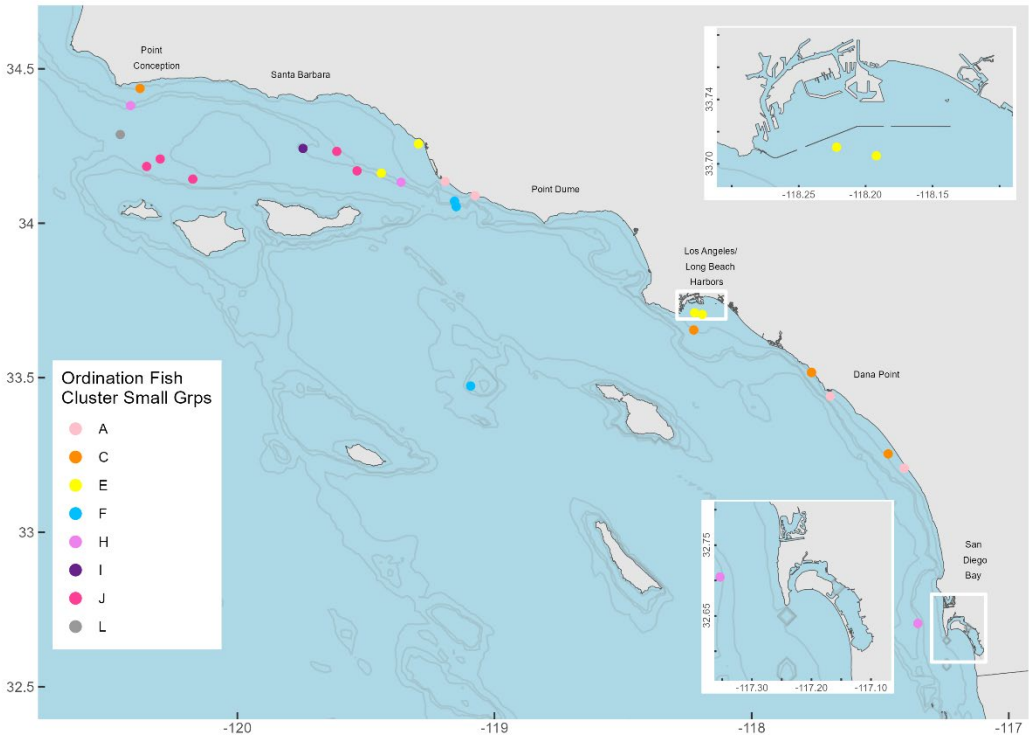


**Figure 21. Results of ordination and cluster analysis of demersal fish assemblages from Bight trawl stations sampled in 1994, 1998, 2003, 2008, 2013, 2018, and 2023. Data are presented as (A) nMDS ordination and (B) a dendrogram of main cluster groups. Groups were named to increase with mean depth.**

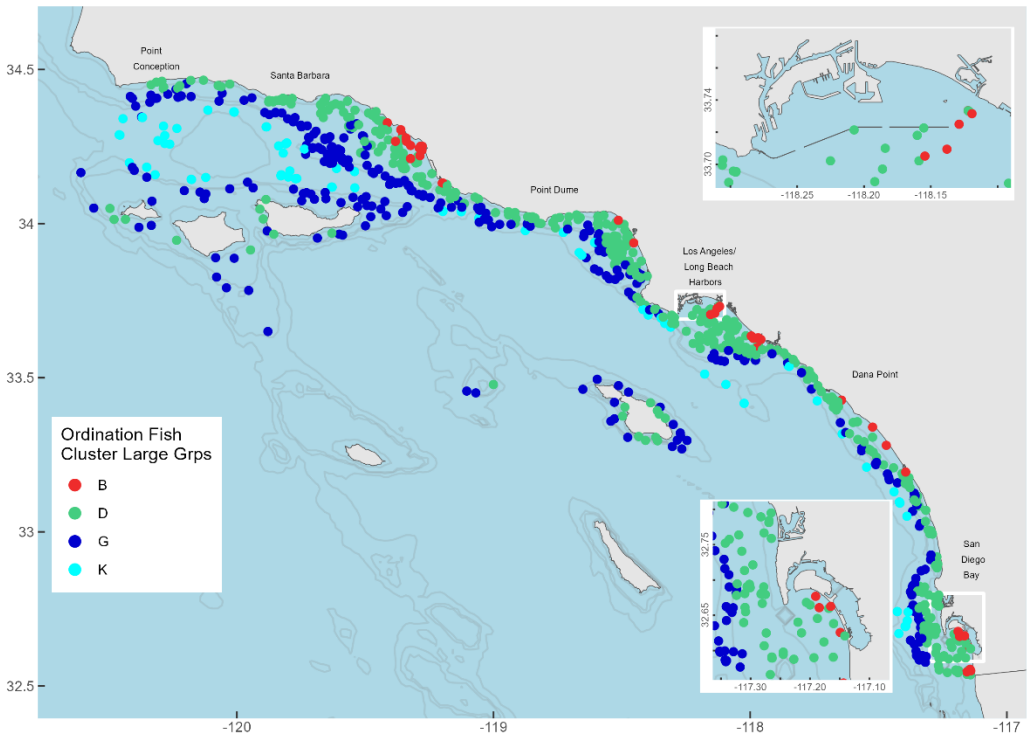
**Table 18. Description of offshore fish cluster groups A-L defined in Figure 21 (above). N/A category under FRI is the number of sites for which FRI is not applicable due to depth.**

	Cluster Group											
	A	B	C	D	E	F	G	H	I	J	K	L
No. of Trawls	5	40	5	507	4	3	327	3	1	5	94	1
Average Similarity (%)	27	38	20	31	38	38	37	24	*	40	38	*
Mean Sp Richness	10	9	5	11	11	2	14	4	1	4	10	4
Mean Abundance	29	290	9	234	1556	4	442	15	1	8	161	6
Depth (m)												
Min	8	7	16	7	16	50	43	132	200	152	181	424
Max	21	30	28	98	150	125	304	224	200	475	479	424
Mean	12	14	20	39	52	93	145	168	200	350	375	424
FRI Scores												
N/A	0	0	0	0	0	0	31	1	0	4	93	1
n≥45	3	16	0	26	0	0	4	1	0	0	0	0
%Non-Reference	60	40	0	5	0	0	1	50	0	0	0	0
%Trawls by Survey												
1994	0	3	20	14	25	0	12	33	0	0	1	0
1998	60	75	40	27	0	67	20	0	100	20	0	0
2003	40	13	0	17	0	0	22	0	0	40	19	100
2008	0	0	20	11	0	0	11	0	0	40	26	0
2013	0	3	0	14	0	33	13	0	0	0	27	0
2018	0	5	0	9	50	0	12	67	0	0	19	0
2023	0	3	20	9	25	0	10	0	0	0	9	0

\* Similarity only calculated for groups with >1 trawl

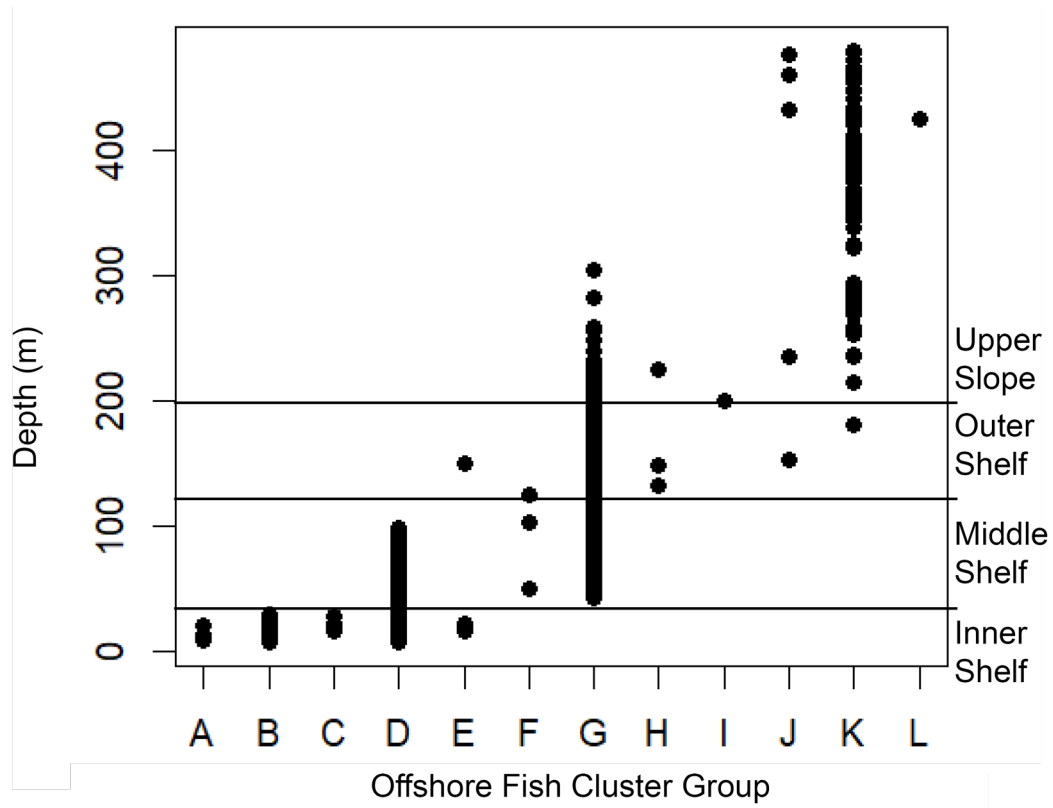


A



B

**Figure 22. Distribution of (A) small "outlier" offshore fish cluster groups (n ≤ 5 trawls) and (B) large groups (n > 5 trawls).**



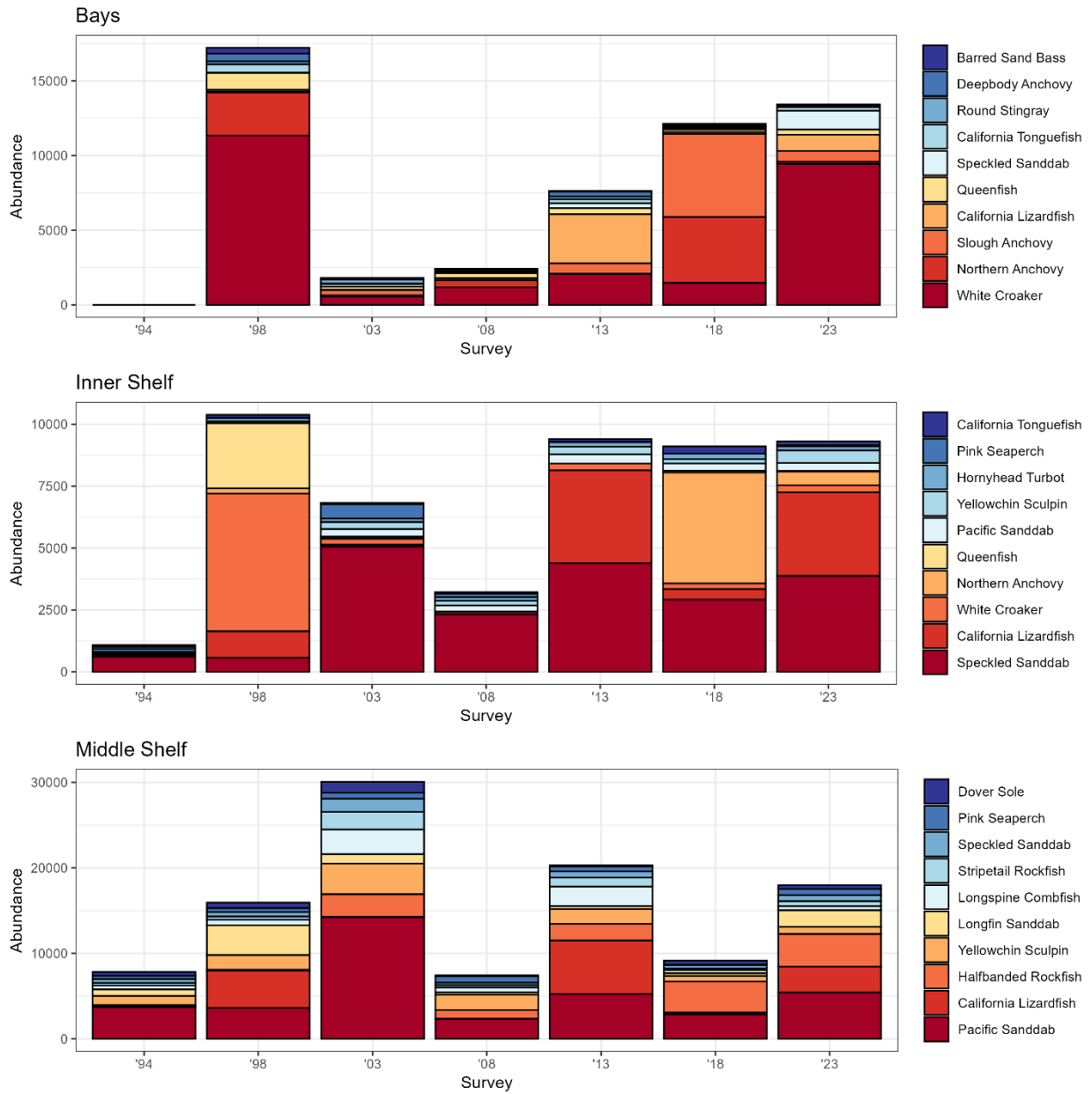
**Figure 23. Depth distribution for each offshore fish cluster group described in Figure 22 (above). Each data point represents a single trawl.**

## Trends in Demersal Fish Population Attributes

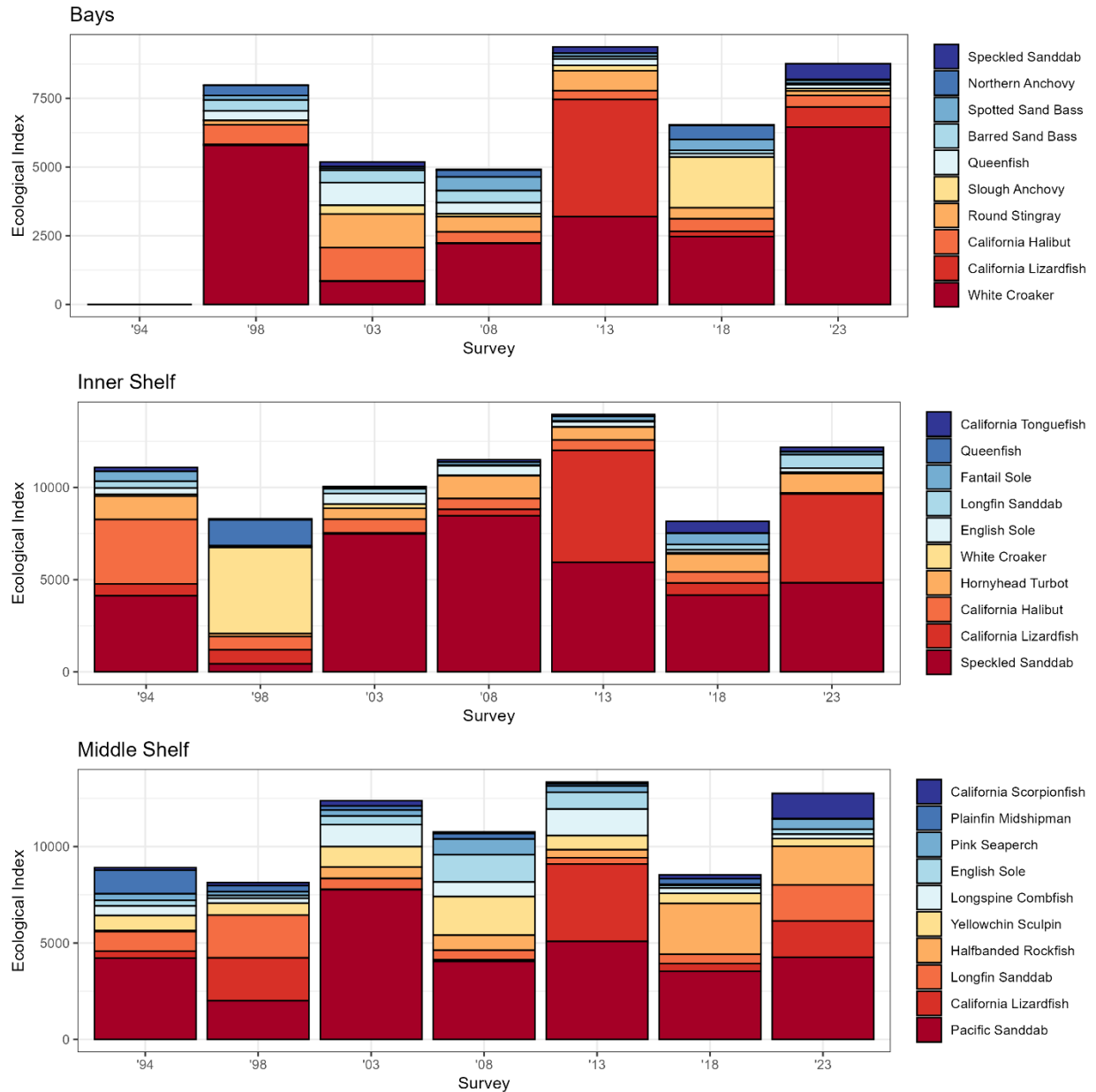
For each Bight survey, there was some variation in the most abundant fish (Figure 24). White Croaker was the most abundant fish found in Bays for survey years Bight '98, Bight '03, Bight '08 and once again in Bight '23 with 9,446 individuals collected in Bight '23. California Lizardfish and Slough Anchovy were the most abundant fishes collected in Bays during Bight '13 and Bight '18, respectively. Speckled Sanddab was the most abundant fish collected on the Inner Shelf during Bight '94, Bight '03, Bight '08, Bight '13 and Bight '23. White Croaker and Northern Anchovy were the most abundant fishes collected on the Inner Shelf during Bight '98 and Bight '18, respectively. Pacific Sanddab was the most abundant fish collected on the Middle Shelf during Bight '94, Bight '03, Bight '08, and Bight '23, with the highest abundance collected during Bight '03 (13,547 individuals). California Lizardfish was the most abundant fish collected on the Middle Shelf during Bight '98 and Bight '13, while the Halfbanded Rockfish was the most abundant fish collected on the Middle Shelf during Bight '18. California Lizardfish experienced a dramatic increase in abundance in 2013 compared to previous Bight surveys; abundances then decreased in 2018 to levels within historic ranges of the earlier Bight surveys, but have increased again in 2023, returning to similar elevated levels observed in 2013. Northern Anchovy had record high abundances in Bay and on the Inner Shelf during Bight '18 (n= 4,421 and 4,482, respectively) compared to previous Bight surveys, but have decreased again in Bight '23 (n= 550 for Bays and n=144 for Inner Shelf).

### *Trends in Ecological Index*

The Ecological Index (E.I.) rank of species uses three ecological variables (abundance, biomass and frequency of occurrence) to determine the ecological importance of species to energy flow (Allen et al. 2002b; Williams et al. 2015b). The top fish species by E.I. for each stratum were generally similar to the top ten by abundance, with a few exceptions and some differences in ranking (Figure 25). E.I. ranks varied throughout Bight surveys in Bays. White Croaker ranked highest in Bight '98, Bight '08 and now again in Bight '23 (E.I., 5759, 2220, and 6457, respectively). California Halibut ranked highest during Bight '03 (E.I., 1239), California Lizardfish ranked highest during Bight '13 and Slough Anchovy ranked highest during Bight '18 (E.I., 1832). On the Inner Shelf, Speckled Sanddab ranked highest in Bight '94 (E.I., 4616), Bight '03 (E.I., 7443), Bight '08 (E.I., 8114), Bight '18 (E.I., 4048), and now again in Bight '23 (E.I., 4834). The California Lizard fish is a close second ranking in Bight '23 with E.I. = 4814. White Croaker ranked highest during Bight '98 and California Lizardfish ranked highest in Bight '13 on the Inner Shelf (E.I., 4640 and 6014, respectively). Pacific Sanddab remains the highest ranked species on the Middle Shelf during each Bight survey (E.I. range = 3470 to 7501), with the exception of Bight '98 when California Lizardfish ranked highest (E.I., 2369).



**Figure 24. Top ten demersal fish species by abundance for Bays, Inner Shelf, and Middle Shelf strata collected for all Bight trawl surveys. The fish species are sorted from most abundant (bottom) to least abundant (top) within a stratum for all years. Note that Bays were not sampled during Bight '94.**

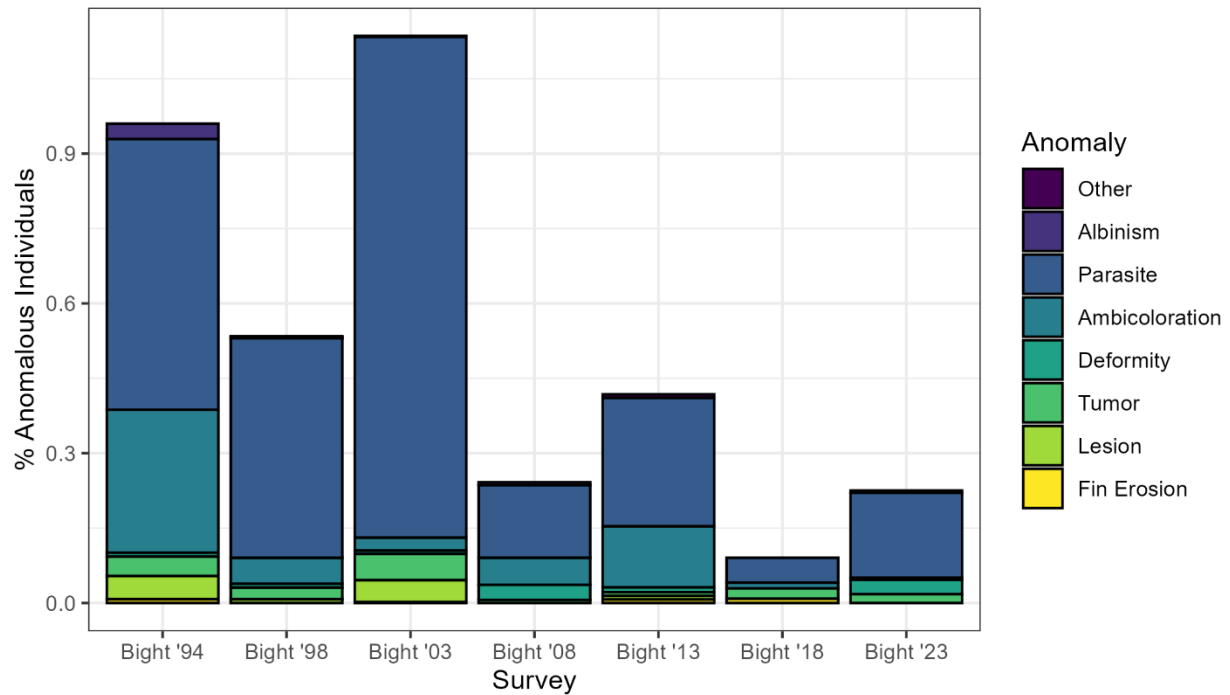


**Figure 25. Top ten demersal fish species ranked by Ecological Index (E.I.) for Bays, Inner Shelf, and Middle Shelf strata collected for all Bight trawl surveys. The fish species are sorted from the highest E.I. (bottom) to lowest E.I. (top) within a stratum for all years. Note that Bays were not sampled during Bight '94.**

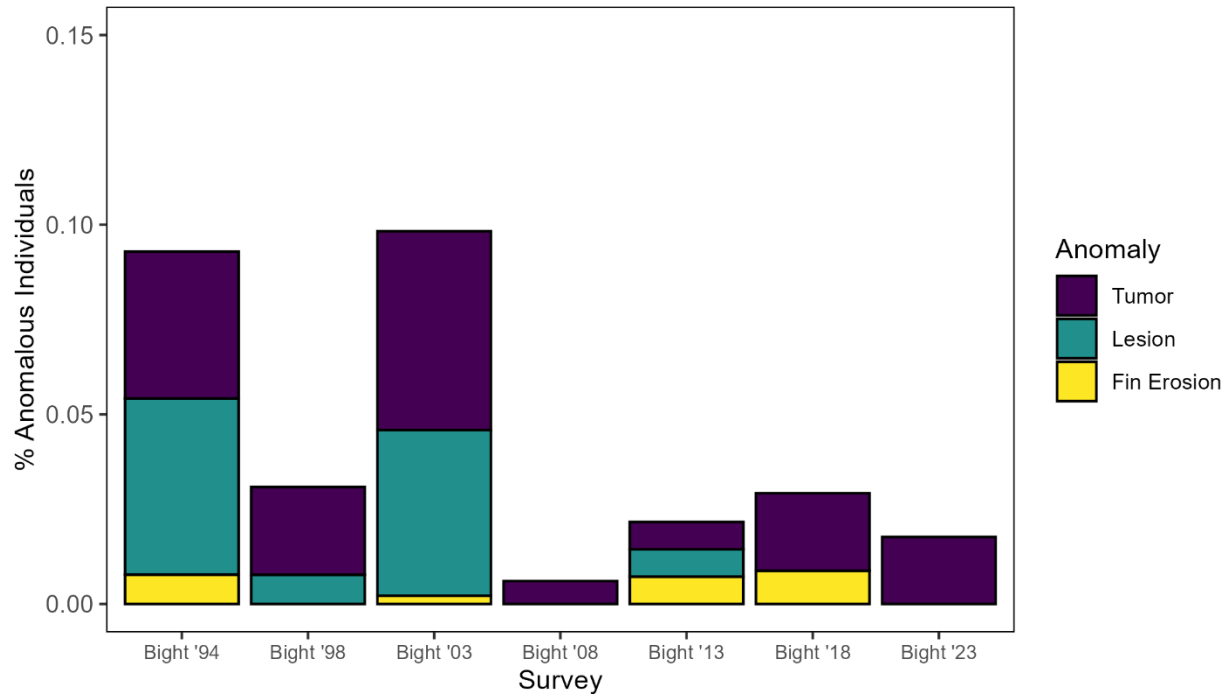
### *Trends in Demersal Fish Anomalies*

The prevalence of total fish anomalies was less than 1.5% of individuals in the Bays, Inner Shelf, and Middle Shelf, for all Bight surveys and has decreased in occurrence from Bight '94 to Bight '23 (Figure 26, Table D-2). Although the observation of total fish anomalies increased in these three strata in Bight '23, the prevalence remains less than 0.5% of all individuals observed. The

most common anomaly among the seven regional monitoring surveys was parasites. Fin erosion, lesions, and tumors are potentially indicative of exposure to environmental stressors (Allen 1977; Mearns 1973, 1975; Sindermann et al. 1982). The percentage of fish with potential stress- or disease-associated anomalies for all Bight trawl surveys in the three strata was low (< 0.10% of individuals; Figure 27) and ranged from <0.006% during Bight '08 to just over 0.10% during Bight '03. Bight '94 and '03 showed prevalence of stress-associated anomalies in ~ 0.10% of individuals. Bight '98, '13 and '18 were similar to Bight '23, showing roughly 0.025% of individuals with potential stress-associated anomalies. Tumors made up the largest percentage of anomalies indicative of stress (over half of stress-associated anomalies).



**Figure 26. Percent of individual demersal fish with anomalies for all Bight trawl surveys. Data does not include the Outer Shelf and Upper Slope.**

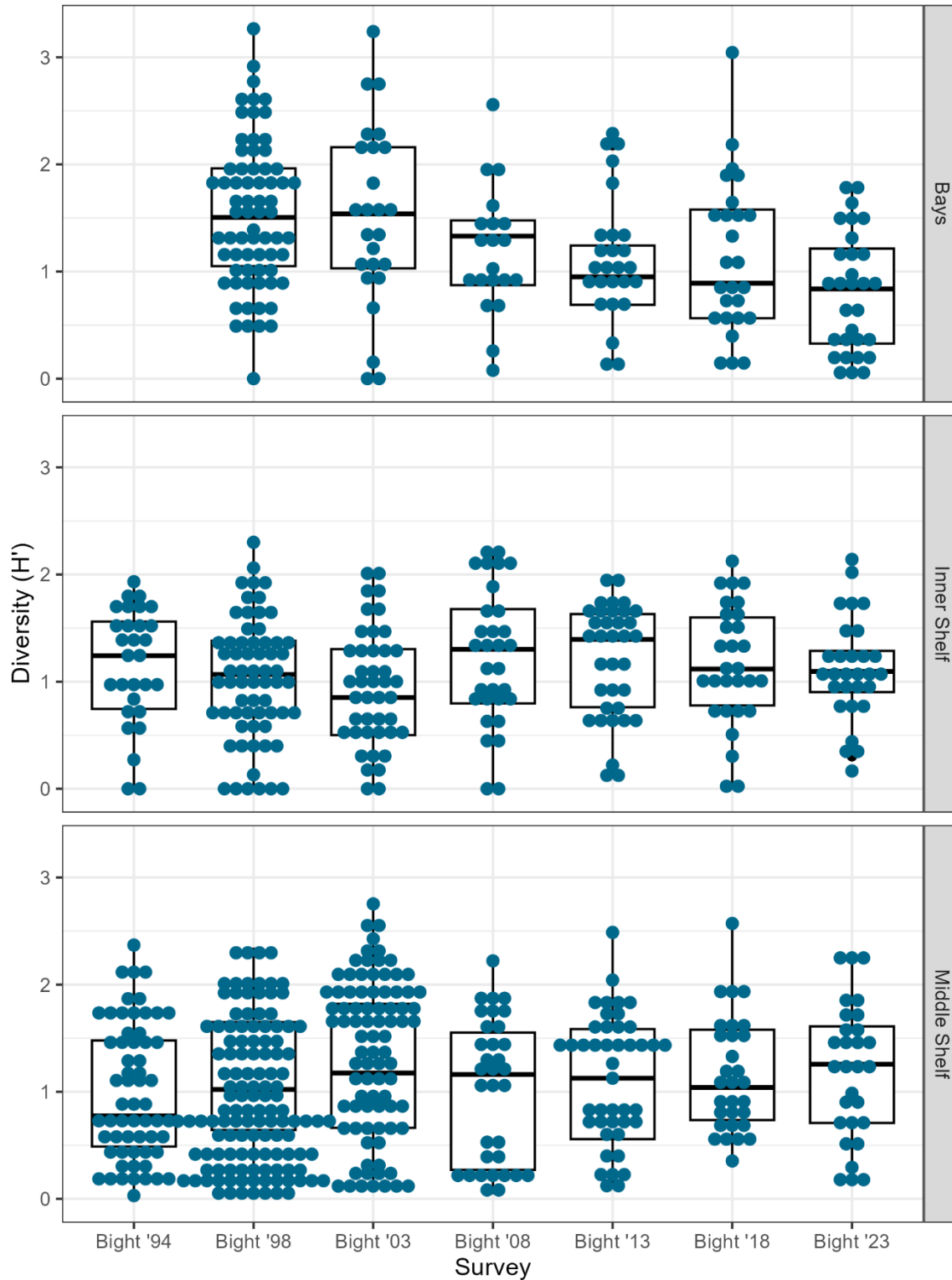


**Figure 27. Percent of individual demersal fish with potential stress- or disease-associated anomalies for all Bight trawl surveys. Data does not include the Outer Shelf and Upper Slope.**

### Trends in Megabenthic Invertebrate Community Attributes

Trends in megabenthic invertebrates across the SCB in Bays, Inner Shelf and Middle Shelf from 1994 to 2023 were evaluated using Shannon diversity ( $H'$ ) (Figure 28).  $H'$  diversity had no consistent pattern of increasing or decreasing trends across Bight surveys on the Inner and Middle Shelf strata. Median  $H'$  diversity ranged from 0.85 in Bight '03 to 1.39 in Bight '13 on the Inner Shelf, and from 0.78 in Bight '94 to 1.26 in Bight '23 on the Middle Shelf (Appendix B2.11). The only stratum where a trend was evident was in the Bays & Harbors, which showed a small, but consistent, decrease from Bight'98 to Bight '23, with median values decreasing from 1.51 in Bight '98 to 0.86 in Bight '23. Abundance and taxonomic richness have shown little variability over the different Bight cycles for all strata, including Bays (Appendix B2.5 and B2.7).

Invertebrate biomass in Bays has increased in Bight '23 compared to previous Bight surveys (Appendix B2.6), in part due to the large Target Shrimp collection in one San Diego trawl. The median invertebrate biomass for Bays ranged from 0.13 kg in Bight '98 to 3.68 kg in Bight '23 (Appendix B2.9). Biomass on the Inner and Middle Shelf strata have remained at relatively similar levels to previous Bight surveys (Appendix B2.6).



**Figure 28. Megabenthic invertebrate Shannon diversity (H') in the SCB by stratum and survey. Data are median, upper and lower quartiles, and results (represented by blue dots). Note that Bays were not sampled during Bight '94.**

### *Site Revisit Temporal Trends of Megabenthic Invertebrates*

Shannon diversity ( $H'$ ) and taxonomic richness showed similarly stable trends in the revisited sites in the Bays, Inner Shelf, and Middle Shelf. (Appendix E-7 and E-8). Trends in Shannon diversity ( $H'$ ) were considered “stable” in 92.1% of the three strata area, ranging from 83% of the Middle Shelf to 100% of the Bays area (Appendix E-7, E-9, and E-10). Diversity increased in 9.1% of the Inner Shelf area and 8.3% of the Middle Shelf area. Diversity also decreased in 8.3% of the area on the Middle Shelf (one site). Trends in taxonomic richness were considered “stable” in 92.1% of the three strata areas, ranging from 83% of the Middle Shelf to 100% of the Inner Shelf area (Appendix E-8, E-11, and E-12). Richness increased in 16.7% of the Middle Shelf area and decreased in 6.7% of the Bays area.

### *Multivariate Analyses of Megabenthic Invertebrate Assemblages*

Multivariate analyses were used to discriminate between megabenthic invertebrate assemblages from a total of 1,185 trawls conducted during Bight Surveys (Bight '94 – Bight '23). Fourteen sites were excluded from these analyses because no megabenthic invertebrates were collected in these trawls. Invertebrate assemblages located within Bays were found to be significantly different than those located on the coastal shelf and Upper Slope of the SCB (one-way ANOSIM,  $p = 0.497$ ,  $p \leq 0.001$ , number of permutations = 999). Based on SIMPER analysis, the two regions had an average dissimilarity of 97%, and differed primarily due to numbers of *Pyromaia tuberculata*, *Sicyonia penicillata*, *Crangon nigromaculata*, *Penaeus californiensis* and *Arcuatula senhousia* in the Bays, versus *Astropecten californicus*, *Sicyonia ingentis*, *Lytechinus pictus*, *Strongylocentrotus fragilis*, and *Octopus rubescens* on the shelf and Upper Slope. Subsequent multivariate analyses were performed separately on data from each region.

#### Bays

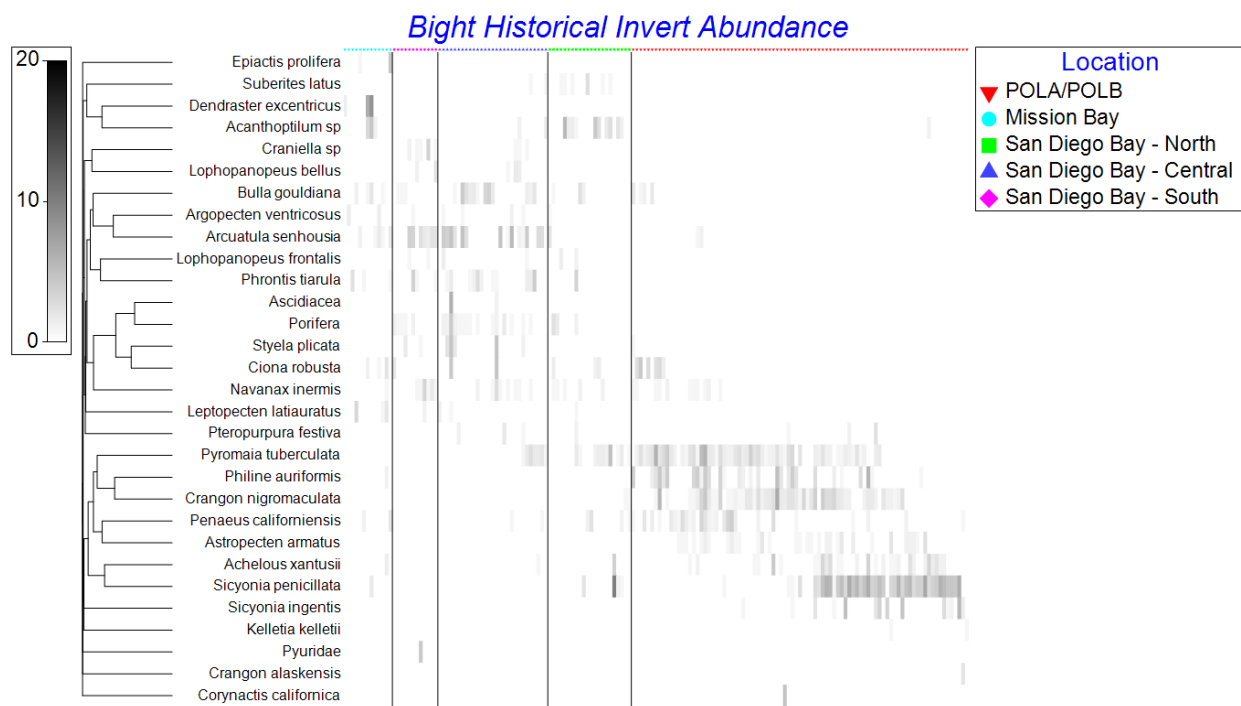
Multivariate analyses of megabenthic invertebrate communities in Bays & Harbors included a total of 166 trawls conducted during Bight Surveys (Bight '98 – Bight '23). Invertebrate assemblages by location were found to be significantly different from one another (one-way ANOSIM,  $p = 0.549$ ,  $p = 0.001$ , number of permutations = 999), with pairwise comparisons showing that San Diego Bay Central and San Diego Bay South were the only areas not significantly different from one another. Survey years were also significantly different from one another (one-way ANOSIM,  $p = 0.175$ ,  $p = 0.001$ , number of permutations = 999), with pairwise comparisons showing that all years were significantly different from one another except for 2013 and 2018. Differences between years appear to be due to the establishment of dominant *Sicyonia penicillata* communities in POLA/POLB beginning in 2013, with more widespread distribution noted in 2023. This change is highlighted by the shift in E.I. values (discussed in more detail in Appendix F) and E.I. ranks compared to secondary invertebrate species. These

analyses resulted in a total of seven SIMPROF-supported cluster groups, or types of trawl invertebrate assemblages (cluster groups A-G; Table 19, Figure 29, Figure 30), which were overlaid on station maps to examine spatial distribution. These assemblages represented from 3 to 94 trawls each and ranged from 14 to 31% similarity (mean = 21%) for clusters with more than one trawl. A BEST/BVSTEP test ( $p = 0.956$ ,  $p = 0.001$ , number of permutations = 999) implicated *Acanthoptilum* sp (Sea Pen), *Achelous xantusii*, *Sicyonia penicillata*, *Penaeus californiensis*, *Astropecten armatus* (Spiny Sand Star), *Bulla gouldiana* (California Bubble Snail), Porifera, *Crangon nigromaculata*, *Arcuatula senhousia* (Asian Date Mussel), *Navanax inermis* (California Aglaja), *Philine auriformis* (New Zealand Bubble Snail), and *Pyromaia tuberculata* (Tuberculate Pear Crab) as being influential to the pattern (gradient) observed in Figure 29. SIMPROF groups largely reflected spatial differences between embayments (e.g., Group D primarily within POLA/POLB), as well as potential habitat types such as shallow eelgrass beds within Mission Bay and SDB – South. Group C was the most prevalent example with large degrees of overlap between the middle and inner portions of Mission Bay and SDB – Central and SDB – South where the communities were dominated by *Arcuatula senhousia* and ascidians. There were no discernible patterns for megabenthic invertebrate assemblages associated with areas that may be more impacted (e.g., marinas, constricted channels) within the larger embayments.

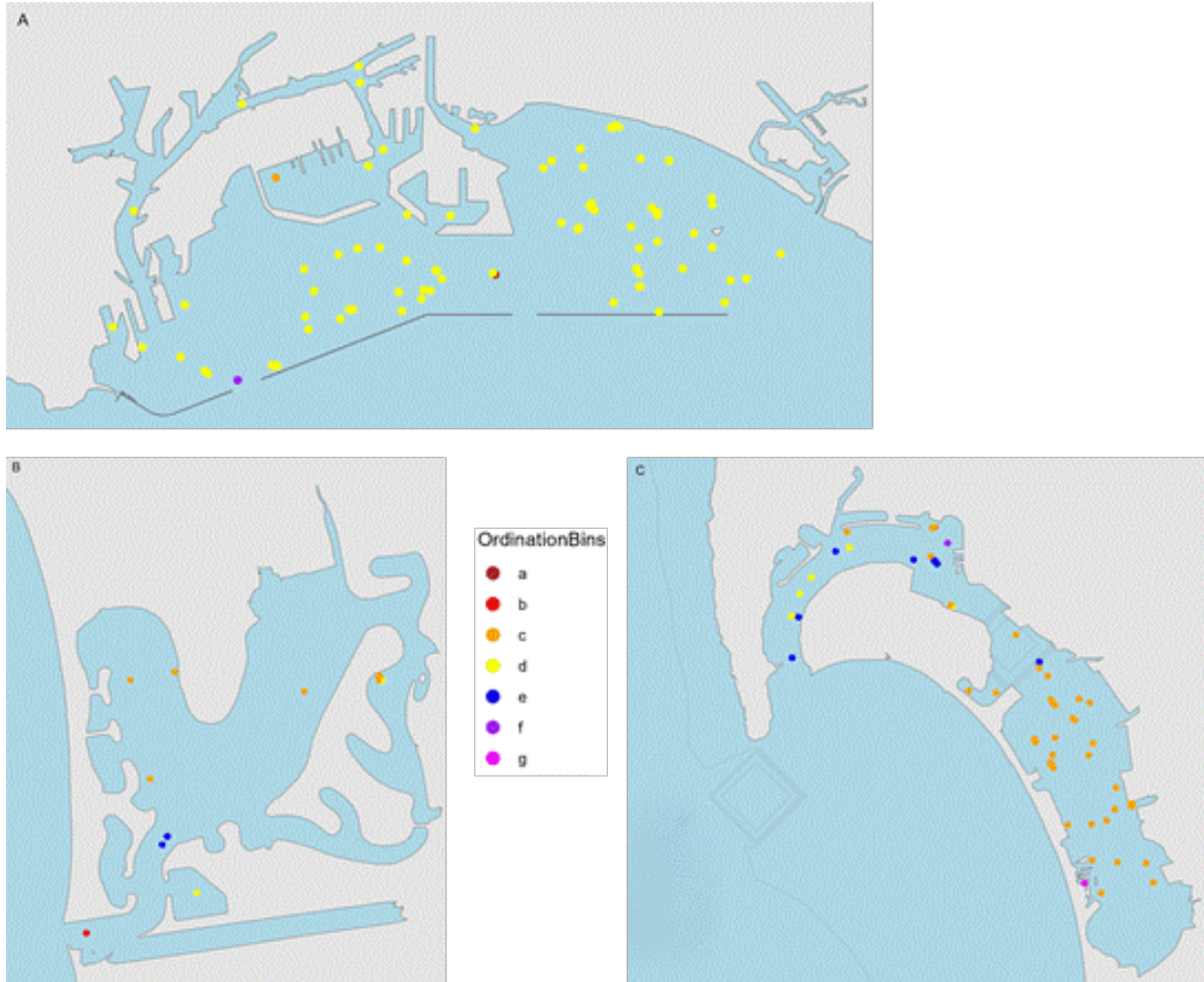
**Table 19. Description of Bays invertebrate cluster groups defined in Figure 29 and Figure 30.**

	Cluster Group						
	A	B	C	D	E	F	G
No. of Trawls	1	1	54	94	12	3	1
Average Similarity	*	*	14	23	31	14	*
Mean Sp Richness	2	3	5	6	5	4	1
Mean Abundance	2	5	64	402	481	12	1
Depth (m)							
Min	15	7	3	3	5	7	3
Max	15	7	13	27	18	27	3
Mean	15	7	6	14	12	15	3
% Trawls by Survey							
1998	0	0	31	34	0	33	0
2003	100	0	11	7	0	0	100
2008	0	100	13	9	25	0	0
2013	0	0	13	16	17	67	0
2018	0	0	15	15	33	0	0
2023	0	0	17	19	25	0	0

\* Similarity only calculated for groups with >1 trawl



**Figure 29. Shade plot of top 30 megabenthic invertebrate species by embayment (Note that shading is the log-transformed abundance value normalized to the range of values for each species). Note: Abundance represents log-transformed abundance, with individual trawls represented across the x-axis.**

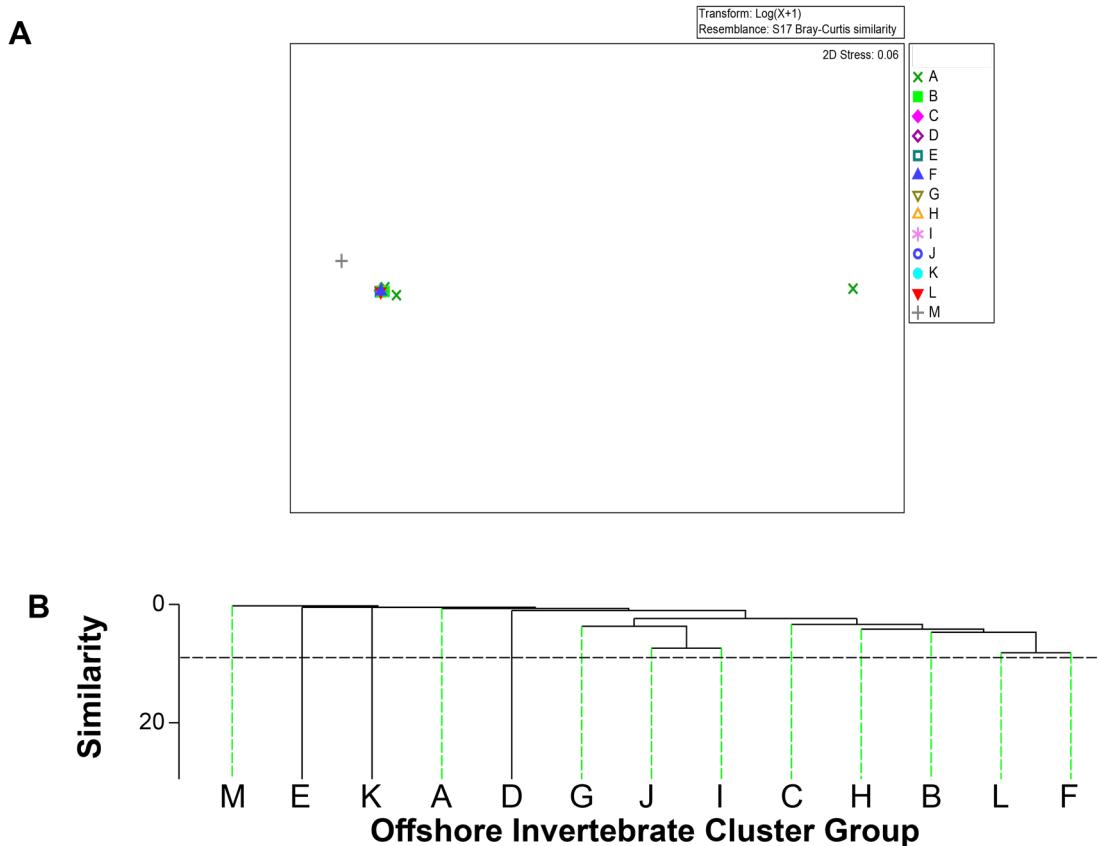


**Figure 30. Megabenthic invertebrate SIMPROF groups within POLA/POLB (A), Mission Bay (B), and San Diego Bay (C) based on historical results over time.**

### Coastal Shelf and Upper Slope Strata

Multivariate analyses of megabenthic invertebrate communities on the SCB shelf and Upper Slope included a total of 987 trawls conducted during Bight Surveys (Bight '94 – Bight '23). These analyses resulted in 13 main ecologically-relevant SIMPROF-supported groups, or types of megabenthic invertebrate assemblages (Table 20, Figure 31, Figure 32). These assemblages represented from 1 to 565 trawls each and ranged from 17 to 70% similarity (mean = 31%) for clusters with more than one trawl. A BEST/BVSTEP test ( $\rho = 0.952$ ,  $p \leq 0.001$ , number of permutations = 999) implicated *Acanthoptilum* sp, *Apostichopus californicus*, *Astropecten californicus*, *Brissopsis pacifica*, *Crangon nigromaculata*, *Luidia foliolata*, *Lytechinus pictus*, *Myxoderma platyacanthum*, *Octopus rubescens*, *Ophiura luetkenii*, *Philine auriformis*, *Pleurobranchaea californica*, *Sicyonia ingentis*, and *Strongylocentrotus fragilis* as being influential to the overall pattern (gradient) of the cluster dendrogram. As with demersal fishes, there were no discernible patterns in the megabenthic invertebrate assemblages associated

with proximity to known pollution sources (e.g., major POTW discharge sites). Instead, invertebrate assemblages also appeared to be influenced primarily by depth (Figure 33) and most likely unique characteristics of specific station locations (e.g., habitat differences), and/or the unique composition of invertebrate assemblages. Ten of the invertebrate cluster groups (groups A, C, D, E, G, H, I, J, K, M) were small “outlier” clusters with  $\leq 4$  trawls in each group. With the exception of cluster group I, these trawls had low species richness ( $\leq 7$  species per haul), whereas mean abundance per trawl was highly variable (1 – 576 organisms per haul). Sixty-five percent (65%) of these trawls were from sites located north of Point Dume (Figure 32A) and 50% were conducted in 1998 (Table 20). The remaining clusters (groups B, F, L) each spanned the entire SCB (Figure 32B), representing the transition of common invertebrate assemblages from the Inner Shelf to the Upper Slope. The species composition and main descriptive characteristics of each cluster group are included in Appendix F, along with additional analyses of group B, F, and L sub-groups.

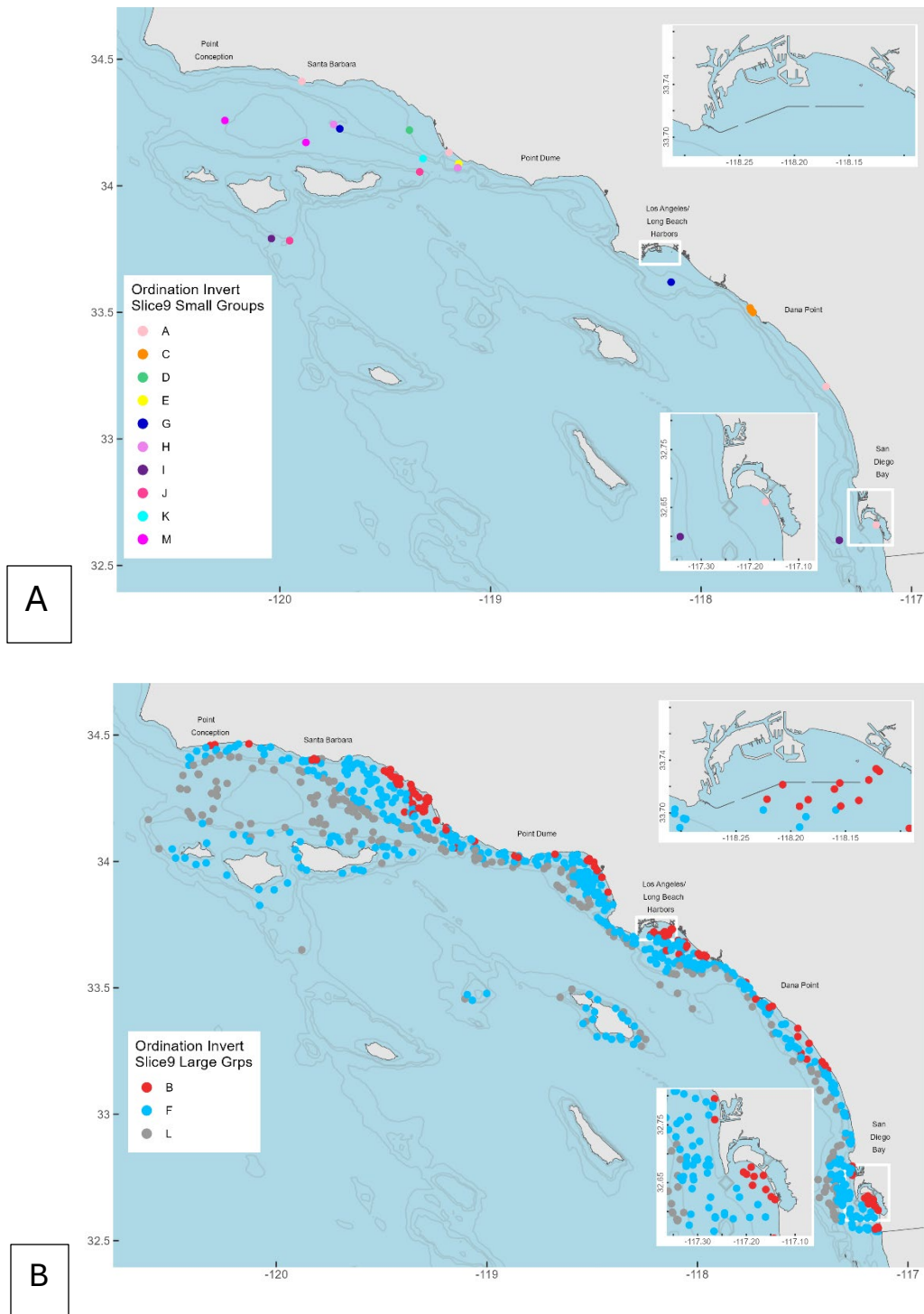


**Figure 31. Results of ordination and cluster analysis of megabenthic invertebrate assemblages from Bight trawl stations sampled in 1994, 1998, 2003, 2008, 2013, 2018, and 2023. Data are presented as (A) nMDS ordination and (B) a dendrogram of main cluster groups. Groups were named to increase with depth.**

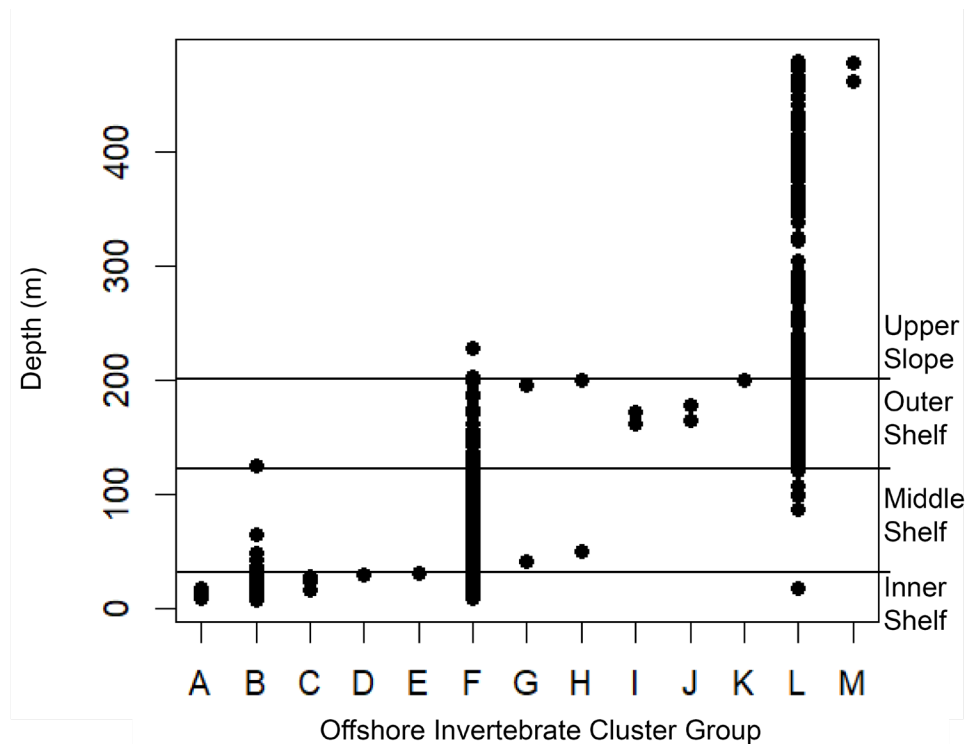
**Table 20. Description of offshore invertebrate cluster groups A-M defined in Figure 31 (above).**

	Cluster Group												
	A	B	C	D	E	F	G	H	I	J	K	L	M
No. of Trawls	4	121	3	1	1	565	2	2	2	2	1	281	2
Avg Similarity (%)	18	18	27	*	*	22	36	46	17	34	*	25	70
Mean Sp Richness	4	5	7	1	1	10	3	2	14	8	1	12	3
Mean Abundance	576	33	22	1	1	547	3	3	256	34	1	2158	113
Depth (m)													
Min	8	7	16	29	31	9	41	50	162	165	200	18	461
Max	18	125	28	29	31	227	195	200	172	177	200	479	477
Mean	13	19	22	29	31	59	118	125	167	171	200	247	469
%Trawls per Survey													
1994	0	7	0	0	0	14	0	0	0	0	0	8	0
1998	50	33	33	100	100	27	100	100	50	100	0	10	0
2003	0	18	67	0	0	19	0	0	0	0	100	18	0
2008	0	7	0	0	0	10	0	0	0	0	0	19	0
2013	0	10	0	0	0	12	0	0	0	0	0	20	50
2018	50	16	0	0	0	8	0	0	50	0	0	15	50
2023	0	9	0	0	0	9	0	0	0	0	0	10	0

\* Similarity only calculated for groups with >1 trawl



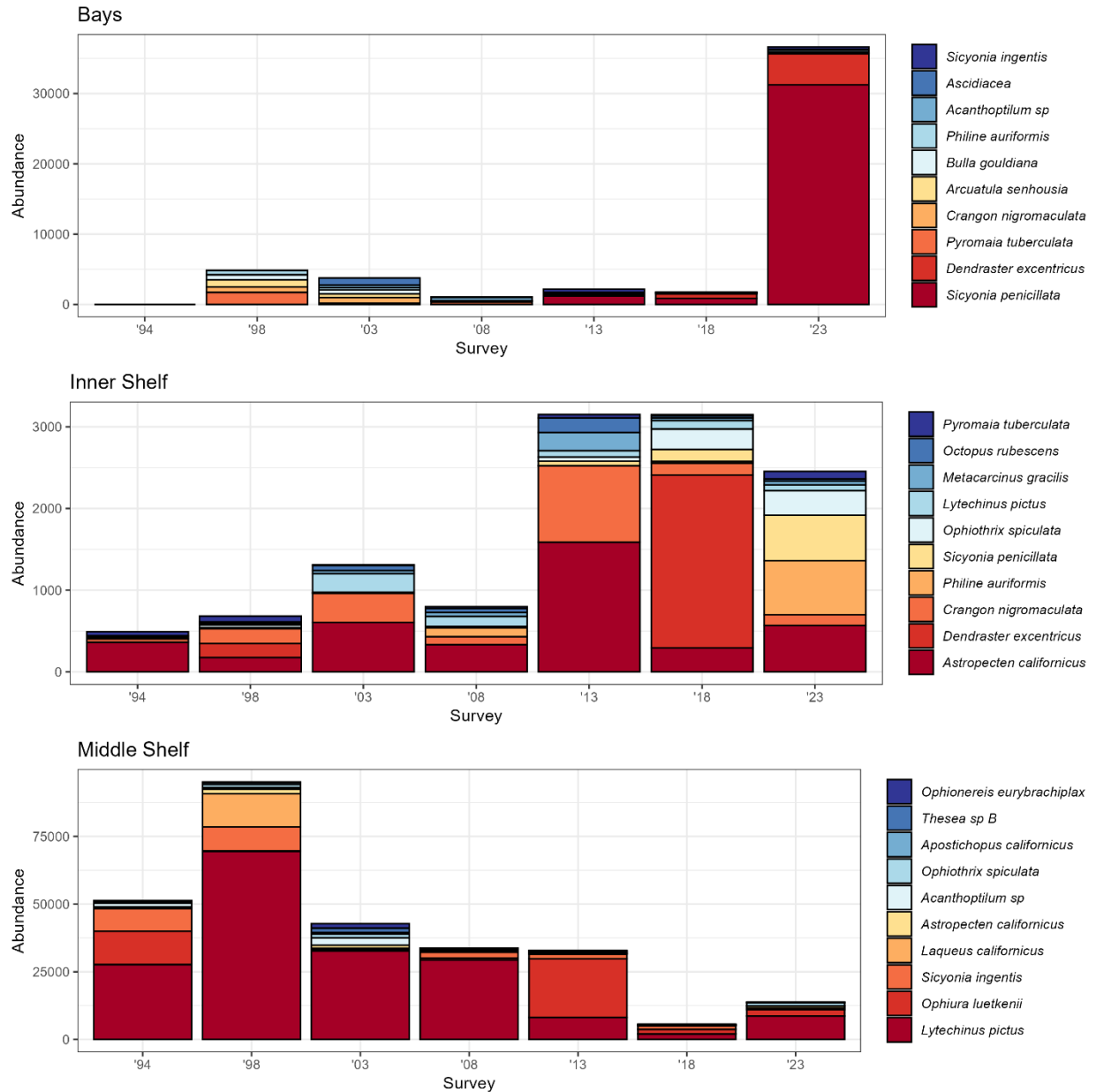
**Figure 32. Distribution of (A) small “outlier” offshore invertebrate cluster groups ( $n \leq 4$  trawls) and (B) large groups ( $n > 4$  trawls).**



**Figure 33. Depth distribution for each offshore invertebrate cluster group described in Figure 31, Each data point represents a single trawl.**

### Trends in Megabenthic Invertebrate Population Attributes

The relative dominance of the top ten megabenthic invertebrate species by abundance for the three strata (Bays, Inner Shelf, and Middle Shelf) collected for all Bight trawl surveys was variable across Bight surveys (Figure 34). The one large haul of *Sicyonia penicillata*, Target Shrimp, in San Diego in Bight '23, overshadows the abundance of invertebrates collected in prior Bight surveys in the Bays (Appendix C-14). Prior to Bight '08, *Pyromaia tuberculata* and *Crangon nigromaculata*, were very abundant, then *Sicyonia penicillata* and *Dendroaster excentricus* started to increase in abundance. *Astropecten californicus* (Sand Star) was the most abundant invertebrate collected in nearly all surveys on the Inner Shelf, though abundances varied. *Dendroaster excentricus* increased at several stations during Bight'18 but were not caught during Bight '23, or the 2003 to 2013 surveys (Appendix C-15). In Bight '23, *Sicyonia penicillata* and *Philine auriformis* increased abundance on the Inner Shelf. *Lytechinus pictus* was the most abundant invertebrate on the Middle Shelf over all Bight surveys, though abundances varied. *Ophiura luetkenii* saw two large spikes in abundances during the Bight'94 and Bight'13 survey years (Appendix C-16). *Sicyonia ingentis* saw larger abundances in 1994 and 1998 but have returned to moderate levels. The brachiopod, *Laqueus californicus*, was fourth most abundant only because of a high abundance during the Bight'98 survey.

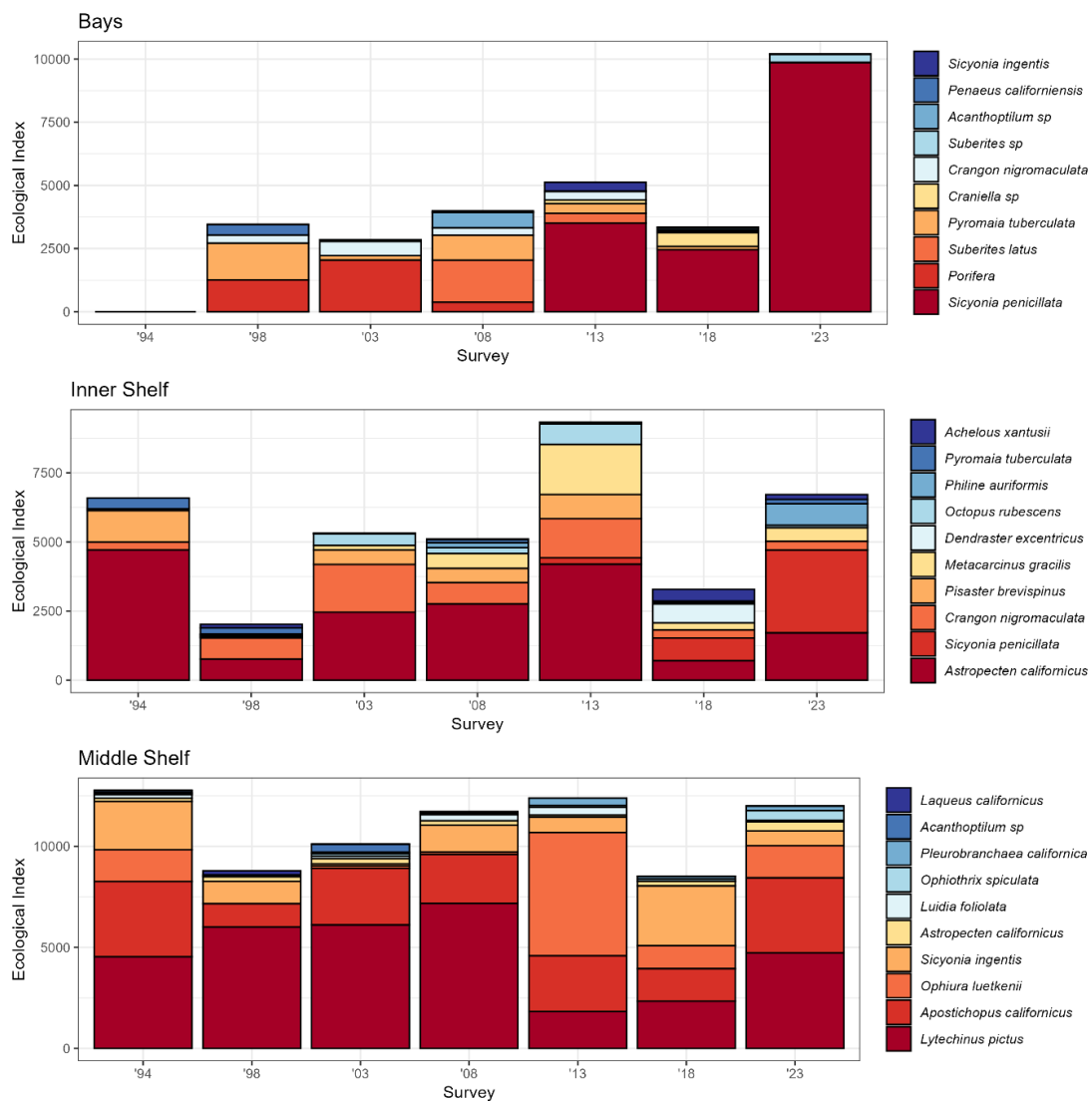


**Figure 34. Top ten megabenthic invertebrate species by abundance for three strata collected over all Bight surveys. The invertebrate species are sorted from most abundant (bottom) to least abundant (top) within a stratum for all years. Note that Bays were not sampled during Bight '94.**

### *Trends in Ecological Index*

The Ecological Index (E.I.) rank of species uses three ecological variables (abundance, biomass and frequency of occurrence) to determine the ecological importance of species. Similar to abundance, the ranking of the top ten invertebrate species by E.I. for each stratum collected for all Bight trawl surveys was variable for the three strata (Figure 35). The first four ranking

invertebrates in Bays were *Sicyonia penicillata*, Porifera, *Suberites* spp (sponge identified to genus or species) and *Pyromaia tuberculata* (small crab, generally up to 20 mm). *Sicyonia penicillata* has been a dominant species in Bays beginning in Bight '13, with their numbers increasing in Bight '23 (Appendix C-17). *Astropecten californicus* ranked first on the Inner Shelf. Echinoderms (*Astropecten*, *Pisaster* and *Dendraster*) and crustaceans (*Sicyonia*, *Crangon*, *Metacarcinus*, *Pyromaia*, and *Achelous*) were also important contributors to the Inner Shelf with *Octopus rubescens* as the top predictor (Appendix C-18). *Lytechinus pictus* ranked first on the Middle Shelf. Other important contributors were *Apostichopus* (Sea Cucumber), *Ophiura* (Brittle Star), and a different species of shrimp (*Sicyonia ingentis*), though scores varied over all the survey years (Appendix C-19).



**Figure 35. Top ten megabenthic invertebrate species ranked by Ecological Index (E.I.) for three strata collected over all Bight surveys. The invertebrate species are sorted from highest E.I. (bottom) to lowest E.I. (top) within a stratum for all years. Note that Bays were not sampled during Bight '94.**

## IV. DISCUSSION

### Limited evidence of contaminant exposure in SCB demersal fish populations

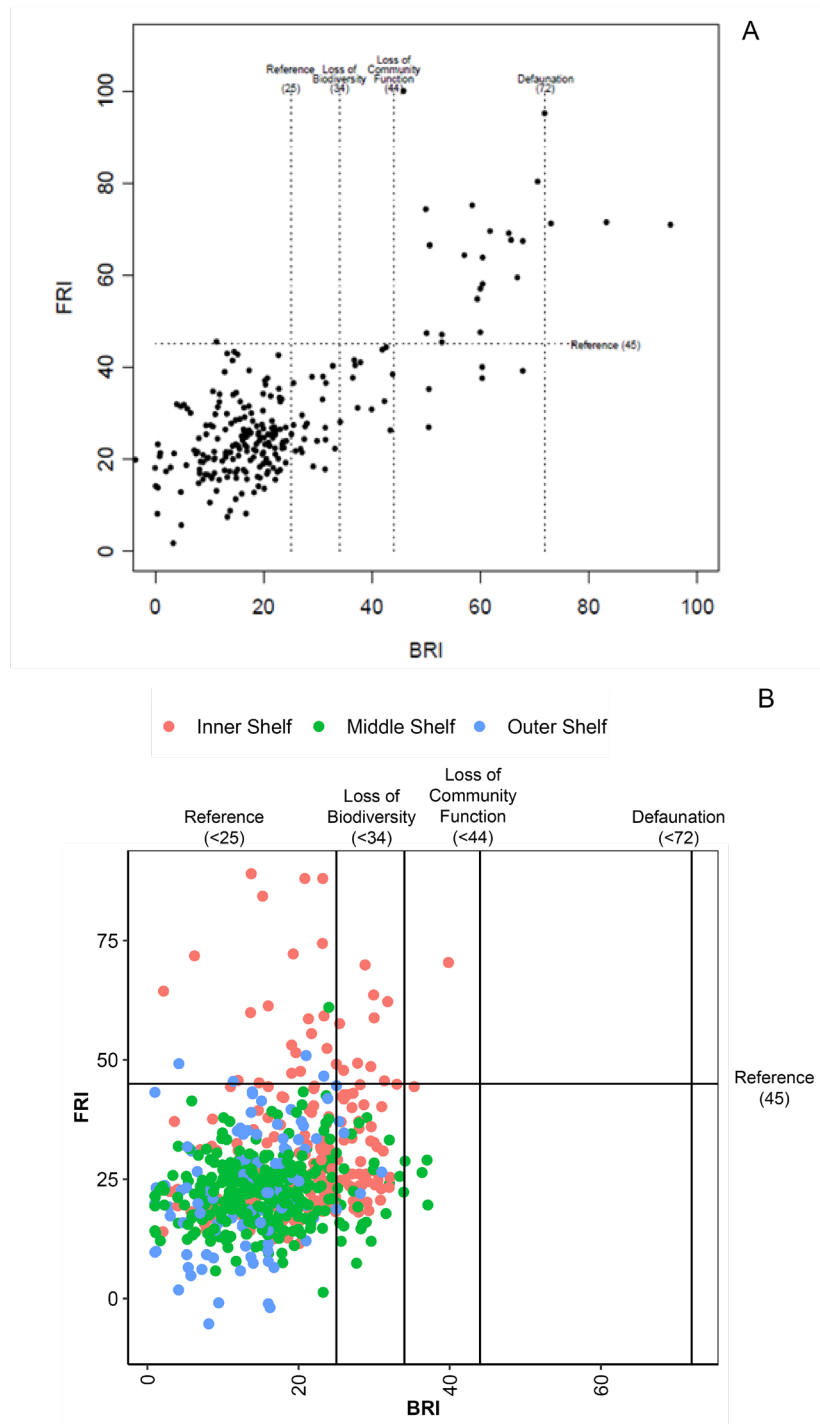
Based on multiple lines of evidence, SCB fish populations appeared healthy in 2023, suggesting little evidence of contaminant exposure impacting demersal fish communities. First, few anomalies indicative of stress (tumors, fin erosion, and lesions) were observed during Bight '23, and they were scattered throughout the SCB, with no clear association with any single region. In Bight '23, anomalies indicative of stress affected <0.1% of fish examined. This falls within the typical range for all previous Bight surveys, where anomalies indicative of stress were consistently low and ranged from 0.03% in Bight '08 to 0.16% in Bight '94. The rate of anomalies indicative of stress remains low when compared to surveys conducted in the 1970s when fin rot and tumors were observed in 31% and 3.3%, respectively, of Dover Sole collected between Pt. Conception and San Diego (Word et al. 1977).

Second, using the Fish Response Index (FRI) to measure fish community response to pollution gradients on the continental shelf (Allen et al. 2001), we found that 94.6% of the Inner and Middle Shelf Bight area was in reference condition in Bight '23. Historically, over 90% of demersal fish communities in the SCB survey area have remained in reference condition based on the FRI. Trends analysis limited to revisit sites further indicates that the majority of the SCB Inner and Middle Shelf strata are in “stable condition,” with no significant trend in either improving or declining condition over time. Out of 676 Inner and Middle Shelf stations sampled over seven surveys, 43 had FRI scores associated with non-reference conditions (6% of stations). Ninety-eight percent (n=42) of these stations occurred on the Inner Shelf. Eighty percent (n=9) of the non-reference stations on the Inner and Middle Shelf were located in the northern Bight, occurring from Point Dume to Point Conception. However, non-reference stations did not consistently correspond to “outlier” cluster groups determined by multivariate analyses. This suggests that the demersal fish assemblages expected to occur in the northern Bight, and on the Inner Shelf, are different from the areas where the FRI was developed and elevated FRI values in these regions perhaps are not indicative of sediment contamination. An analyses of two Inner Shelf revisit stations demonstrated that certain species such as the Shiner Perch are assigned high p values, despite being a common species at these shallow depths (Appendix Table H1). This artifact (i.e., occurrence “false-positives”) of the FRI is supported by contrasting the relationship between Benthic Response Index (BRI) to the FRI using the original calibration dataset (Figure 36A) to data collected during Bight '94 - Bight '18 (Figure 36B). These results are further supported by the overall lack of correlation between the FRI and BRI (Appendix H1), especially on the Inner Shelf (Figure 36B) and north of Point Dume (Appendix H2). The FRI does not correlate with Shannon Diversity ( $H'$ , Appendix H3), the percent of abundance with associated P values (Appendix H4), the percent of species with associated P values (Appendix

H5), or with chemistry and toxicity scores (Appendix H6) or other chemistry parameters (total organic carbon, total nitrogen, total PAH, total PCB, copper, mercury; Appendix H7-H9).

The Ecological Index (E.I.) looks at a species contribution by combining three basic ecological parameters: % Number, % Weight, and % Frequency of Occurrence (Allen et al. 2002; Williams et al. 2015b). Scores are heavily influenced by the frequency of occurrence. Thus, scores do not necessarily follow abundance, reflecting ecosystem energy flow for commonly caught species while highlighting larger solitary predators. In Bays, commonly caught species (e.g., White Croaker, California Lizardfish, Speckled Sanddab, and California Halibut) score high on the index as do Round Stingray. The Los Angeles/Long Beach Harbor area has a mix of Bay and Inner Shelf species such as White Croaker, Speckled Sanddabs, and California Lizardfish. In general, relatively few species overlap across three or fewer strata (Appendix C-2, C-3, C-4). Trend analysis (Figure 25) showed that E.I. scores varied over the surveys, depending on potential recruitment to strata or abundance and size of the species. Multiple surveys were needed for commonly caught species to emerge for each stratum, suggesting the presence of a core community assemblage. Despite survey results for a stratum, any given survey year could be influenced by high species abundances or recruitment years such as California Lizardfish in 2013.

Overall, SCB demersal fish populations continue to appear generally healthy since the 1994 Bight survey and there is no evidence of long-term trends in any of the potential indicators of contaminant exposure in fish communities. Despite variability in fish community composition, there were no discernible trends in fish abundance, biomass, taxonomic richness, Shannon diversity, FRI or E.I. scores over multiple surveys. Additionally, based on multivariate analyses, there were no discernible patterns in demersal fish assemblages that could be associated with known pollution sources (e.g., proximity to major POTW discharge sites). Instead, communities appeared to be influenced primarily by depth, followed by habitat differences, and natural fluctuations of species populations that resulted in the occasional occurrence of unique assemblages.



**Figure 36. Benthic Response Index (BRI) versus Fish Response Index for (A) the original calibration dataset (n=259 trawls, 10-200 m, 1973 to 1994) using data from Palos Verdes and Santa Monica (Allen et al. 2001) and (B) all Bight stations collected with paired results (n=790 trawls, 7-216 m, Bight '94 – Bight '18) from Point Conception south to the US/Mexico Border. The BRI thresholds are represented by the vertical lines, and the FRI reference threshold is indicated by the horizontal line.**

## **Megabenthic invertebrate community attributes have remained similar in shelf strata across Bight surveys, with notable shifts in Bays**

Currently, there are no reliable biointegrity assessment tools for trawl-caught invertebrates (Walther et al. 2017) that are able to be applied across all Bight strata. This presents a need for future surveys to assess megabenthic invertebrate population health beyond using diversity indices and the presence of anomalies. Invertebrate community attributes have shown little change across Bight cycles in shelf strata, other than an occasional station with a high abundance of a few species. Analysis of only revisit sites shows that the majority of the SCB (> 90% of area) is “stable,” with no significant trends in either H' diversity or taxonomic richness. Species such as the Target Shrimp *Sicyonia penicillata* had decreased diversity (Appendix E-8) and expanded richness across strata. Target Shrimp in Bays were first noted in POLA/POLB in 2000 (Montagne and Cadien 2001), appearing in increasingly large numbers across subsequent Bight surveys and have since seen their populations boom in POLA/POLB and San Diego Bay (Stolzenbach et al. 2021, 2026; Swiderski et al. 2026), resulting in downward trends in diversity despite intact species richness. While E.I. ranks were variable throughout the shelf strata over time, Target Shrimp have become notably dominant over the last three Bight surveys. This subtropical species is an example of range shifts in response to potential changing ocean conditions (Estrada-Ramirez and Calderon-Aguilera 2001).

Overall, SCB megabenthic invertebrate populations have been generally healthy since the 1994 Bight survey and there is no evidence of long-term trends in any of the potential indicators of contaminant exposure in invertebrate communities. Observed anomalies in invertebrates were infrequently encountered, remaining below 0.02%. Despite variability in megabenthic invertebrate community composition, there were no discernible trends in invertebrate abundance, biomass, taxonomic richness, Shannon diversity, or E.I. scores over multiple surveys. Instead, as with the fish, invertebrate communities appeared to be influenced primarily by depth, followed by habitat differences, and the occasional occurrence of unique assemblages likely attributable to trawl catch variability.

## **The Bight Program fills a need for regional monitoring of demersal fish and megabenthic invertebrate communities to contextualize changing ocean conditions in the SCB**

The Bight Regional Monitoring Program is valuable because data are collected to examine temporal and spatial patterns. This allows managers to put local monitoring in context with the rest of the region. In addition, monitoring provides a unique mechanism to examine biological communities, habitats, changing oceanographic environment and identify shifts in baseline conditions (Schiff et al. 2016). While overall community metrics such as abundance, biomass and diversity have remained generally stable, the Bight program has documented changes in

community composition since 1994. These population fluctuations, while not obviously linked to contaminant exposure, may be linked to broad regional changes in temperature, dissolved oxygen, ocean currents, or ocean acidification. Changes in community composition related to larger scale oceanic temperature fluctuations (Miller and Schiff 2012; Montagne and Cadien 2001) and current shifts have been documented in the Bight. Sato et al. (2017) documented habitat compression and expansion and shifts in populations of trawl-caught sea urchins in the SCB. The trends may have been linked to variability in environmental conditions such as oxygen and pH associated with El Niño, frontal weather patterns, upwelling intensity, and ocean warming.

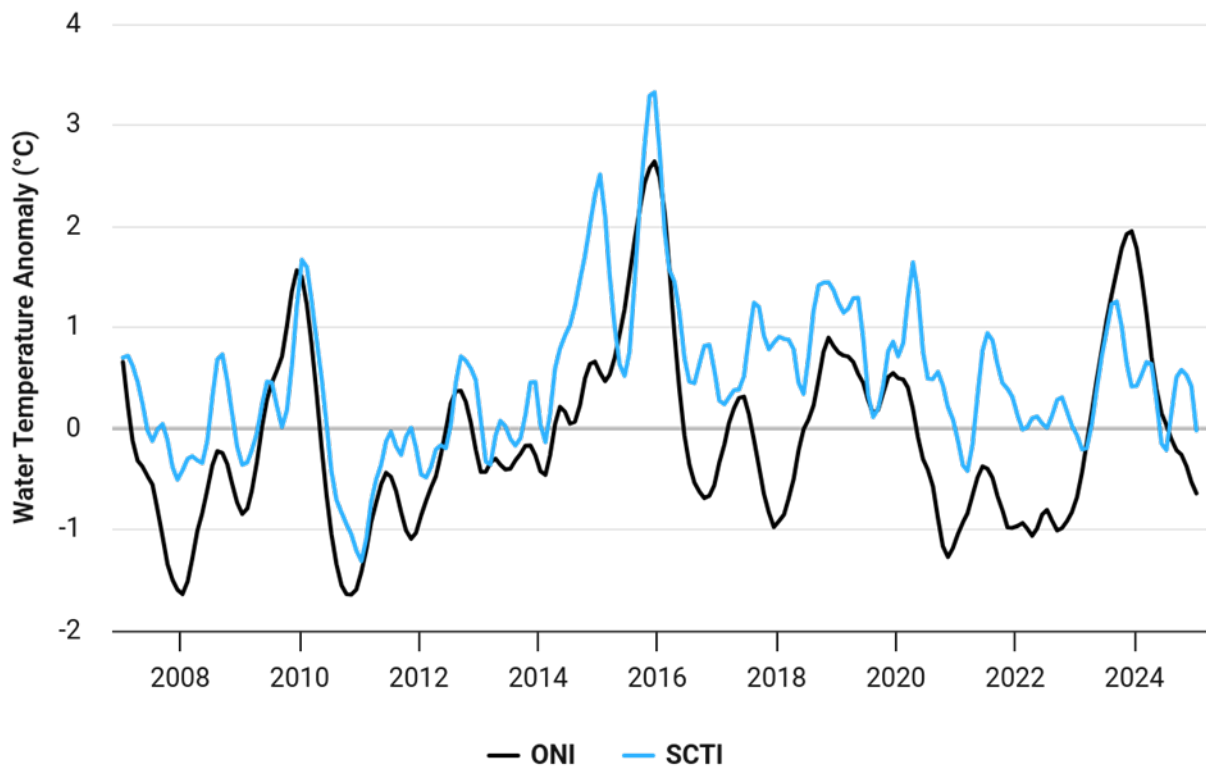
The coastal ocean of the Southern California Bight is heavily influenced by cyclical trends in the physical oceanography of the Pacific Ocean. The El Niño Southern Oscillation (ENSO) is a cyclical environmental condition that occurs across the Pacific Ocean (Lindsey 2013). ENSO is composed of two different conditions, known as “El Niño” and “La Niña,” and is measured by the Oceanic Niño Index (ONI). In the ENSO, margins are displayed at +/- 0.5 °C to reflect the neutral sea surface temperatures. El Niño occurs when the equatorial Pacific Ocean develops warmer waters than average, but easterly winds are weaker than normal and can actually reverse direction to become westerly. When that happens, warmer-than-normal water often moves as far north as the coast of California, bringing unusual conditions to local habitats. La Niña, the opposite phase of El Niño in the ENSO climate pattern, produces strong winds and cooler ocean waters. ENSO events take place approximately every 3 to 5 years. In southern California, El Niños often cause above-average rainfall, reduced upwelling, and increased water temperatures. Conversely, La Niñas can result in an increased upwelling of nutrient-rich water, enhancing fisheries activities along the coast of Southern California (Zhang 1997).

To put the cycles of ENSO into regional context, researchers at the Scripps Institution of Oceanography’s Southern California Coastal Ocean Observing System (SCCOOS) and California Underwater Glider Network (CUGN) created the Southern California Temperature Index (SCTI) to track the relationship of the ONI to ocean temperatures in the Southern California Bight (Rudnick et al. 2017a, 2017b). The SCTI represents the ocean water temperature anomaly near the coast of California at a 50-meter depth with a 3-month running mean applied, measured using 16 years of Spray underwater glider measurements. It is provided with the same temporal averaging as the ONI (Figure 37).

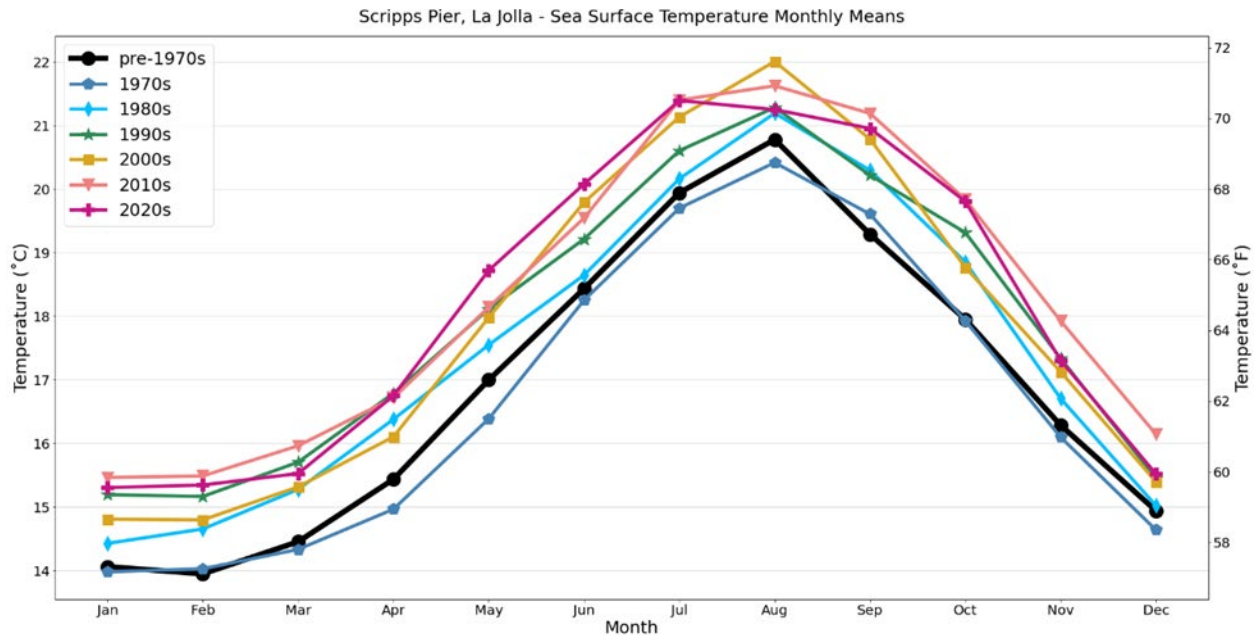
An assessment of regional climate patterns can help interpret biological community data with knowledge of temperature tolerances for certain species or general associations (e.g., the presence of tropical species expanding their range as water temperature increases). The 2008 and 2013 Bight surveys were conducted during weak La Niña years (average ONI of -0.78 °C and -0.32 °C, respectively), with near zero average SCTI (0.03 and 0.01, respectively). The 2018 Bight

was conducted during a year that transitioned from La Niña in January 2018 (-0.92 °C) to El Niño by November 2018 (0.90 °C; annual average ONI of 0.01 °C) with an average SCTI of 0.98 °C and a maximum SCTI of 1.44 °C in October and November 2018. The 2023 Bight also occurred during a year that started in La Niña in January 2023 (-0.68 °C) to El Niño by December 2023 (1.95 °C; annual average ONI of 0.81 °C) with an average SCTI of 0.51 °C and a maximum SCTI of 1.25 °C in September 2023. These indications of strong El Niño conditions in 2023 may help explain the unusually intense rainfall event in the summer (tropical storm Hilary) and high summer sea surface temperatures.

Long-term average sea surface temperatures recorded off the pier at the University of California, San Diego Scripps Institution of Oceanography are summarized in Figure 38, showing a steady increase since records began in 1916. Notably, the years from 2010 through 2023 have been the warmest on record. In 2023, surface temperatures reached a maximum of 23.6°C in August and a minimum of 12.4°C in April, with an annual average of 17.6°C (Carter et al. 2024).



**Figure 36. Southern California Temperature Index (SCTI) and Oceanic Niño Index (ONI).**  
 Source: <https://spraydata.ucsd.edu/products/socal-index/>



**Figure 37. Historical Sea Surface Temperature at Scripps Pier (1916–2023). Source: <https://shorestations.ucsd.edu/about/scripps-pier/>**

Climate change is expected to intensify ocean warming, hypoxia, and acidification, and decrease productivity in the SCB, which may result in habitat range shifts for fish and invertebrate species (Bograd et al. 2008; Bednaršek et al. 2014; Howard et al. 2020). Continued monitoring of demersal species in light of global changes in ocean habitats will continue to provide important contextual information for Southern California coastal managers.

## V. CONCLUSIONS

The Bight '23 Program provided a regional assessment of trawled demersal fish and megabenthic invertebrates in the SCB. Based on the results of this survey, the Demersal Fishes and Megabenthic Invertebrates Technical Committee concluded:

- Southern California Bight trawl-caught fish communities are in good condition.** Approximately 95% of SCB inner and middle continental shelf areas (3 – 120 m depth) had Fish Response Index (FRI) values indicative of reference conditions. Unlike previous Bight surveys, we could not assess the Outer Shelf stratum (120 – 200 m depth) and Upper Slope stratum (200 – 500 m depth) because of an incomplete sampling effort. Additional compelling evidence of healthy fish communities was the particularly low incidence of pollutant-related stress anomalies such as external tumors, lesions or fin erosion. These anomalies were prevalent in some fish species from polluted locations during the 1970s and now comprise <0.03% of 52,585 fish examined during Bight '23.

- **Extent of reference-like fish communities has remained comparably high over the three decades of the Bight Program.** Percent of reference area from the inner and middle continental shelf based on the FRI has ranged from 91% to 100% since Bight '94, well within the range of error for the Bight Program. When comparing across 30 years of surveys, the few “non-reference” sites based on FRI have clustered in the shallow mainland waters of the Santa Barbara Channel. The Technical Committee has agreed this is more likely an artifact of the FRI than actual degradation of the fish community.
- **Fish anomalies have decreased over the three decades of the Bight Program.** Though low in all surveys, pollutant-related fish anomalies have decreased from ~0.10% in Bight '94 to ~0.025% in Bight '23 on the inner and middle continental shelf. Moreover, no fin erosion or lesions were observed in Bight '23 like they were in the five previous Bight surveys.
- **Invertebrate anomalies have remained infrequent.** The occurrence of invertebrate anomalies in Bight '23 (~0.02%) was within the range of observations reported for previous Bight surveys (Wisembaker et al. 2021).
- **There were no discernible patterns in demersal fish or megabenthic invertebrate assemblages that could be associated with potential stressors (e.g., proximity to wastewater or stormwater discharge sites).** Instead, communities appeared to be influenced primarily by depth, followed by habitat differences, and the occasional occurrence of unique assemblages likely attributable to natural variability inherent to demersal fish and megabenthic invertebrate populations.

## VI. RECOMMENDATIONS

Based on the work during Bight '23, the Demersal Fishes and Megabenthic Invertebrates Technical Committee agreed on the following recommendations to follow up on current survey results and/or to improve the next regional survey implementation.

- **Secure sufficient effort to sample priority Bight habitats.**  
For the first time in three decades, an insufficient level of effort was applied to make Bight-wide assessments of the continental shelf and slope. This QA deviation occurred for several reasons: (1) insufficient field effort for sampling the northern Bight and the upper slope strata, (2) instances where agencies did not follow up trawling at contingency overdraw sites when trawl failures occurred at original sites, (3) some agencies were unable to complete their trawling during the sampling window, even after extending the window to accommodate field challenges, and (4) lack of communication among field teams when deviations occurred in order to correct course and achieve the

desired level of effort to meet defined QA objectives. While there are many potential solutions to overcome these deviations, the Planning Committee and Field Committee must take these factors, and others, into consideration during planning so this does not happen again.

- **Eliminate the collection of parasite data for demersal fishes and megabenthic invertebrates.** Currently, the sampling protocols for ectoparasites and endoparasites are insufficient for a full quantification of fish and megabenthic invertebrate parasitism. This likely leads to an underestimate of parasitism across the region. Methods to fully quantify parasitism will require significantly more effort. Therefore, we recommend discontinuing this aspect of Bight trawl sampling. Field teams should continue to focus on identifying indicators of potential environmental stress such as tumors, fin erosion and lesions.
- **Research new thresholds that can apply to all Bight habitats for both demersal fishes and invertebrates.** An adequate biointegrity assessment tool for demersal fish and megabenthic invertebrate communities that covers all habitats (strata) of interest is currently lacking. Despite the recommendation for improving our current assessment tools since Bight '13, this recommendation has not yet been remedied. Addressing this recommendation is a long-term project, as it is not a trivial task. Limitations include, amongst other needs, budget and time contributions from stakeholders. All future surveys – both regional and local – will be limited until this recommendation is implemented. It may be that trawl alternatives represent a more efficient and effective path forward (see below).
- **Use local environmental context data to characterize species distribution changes over time.** Trawl caught species have experienced distribution shifts over time. Previous efforts have illustrated these changes may be related to local environmental changes in temperature, dissolved oxygen and pH. Additional work to interpret population fluctuations in light of these environmental changes would be beneficial to both future Bight trawl reports and site-specific, local monitoring assessments. Examining species and population shifts relative to environmental changes becomes even more important as shifts in temperature, dissolved oxygen, and pH are predicted to be more pronounced into the future. The Sediment Quality Planning Committee should specifically target effort to collect or collate the environmental data and conduct this analysis during Bight '28.
- **Explore modifications to trawl monitoring to increase effectiveness, improve efficiencies, and reduce fish and megabenthic invertebrate mortality.** For 30 years, the

Regional Monitoring Program results have indicated that healthy demersal fish and megabenthic communities are widespread across the Bight. One drawback to continually re-answering important monitoring questions about these communities is the trauma trawling has on individual organisms because some specimens cannot be returned to the ocean alive. The consistency in the monitoring results – especially based on the lack of impact – provide an opportunity for optimizing trawl monitoring to ensure we can continue to answer monitoring questions about community health without traumatizing so many animals. This temporal and/or spatial monitoring optimization can occur through statistical power analysis, ensuring confidence and scientific robustness in the answers. A second approach is to find alternatives to trawling which help address some of our monitoring questions but do not traumatize organisms. Examples of new technology that could be tested side-by-side with trawling during the next Regional Survey include quantifying environmental DNA (eDNA) or using *in-situ* cameras (e.g., via ROV) mated with artificial intelligence (AI) to automate species detection and/or quantification. SCCWRP’s Commission’s Technical Advisory Group (CTAG) currently has a subcommittee evaluating these and other technologies to supplement or replace trawl sampling. A third approach might be to shift effort towards other endpoints, such as cell bioassays or other sublethal endpoints. The multiple approaches are not mutually exclusive.

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# APPENDIX A

## Appendix A-1. Station coordinates, depths, stratum classification, area weight, and QAQC flags for each station.

Station ID	Type	Target		Strata	Date/Time	Sample Org	Trawl minutes	Occupation			Fail	Abandoned	Area Weight	Dist. to Target (m)	QA/QC Flag	Station In Analysis
		Latitude	Longitude					Latitude	Longitude	Dep (m)						
B23-12008	Revisit	32.646936	-	Bay	2023-08-25 09:55:00	WSP	5	32.647306	117.117812	11.3	No	No	2.20285694	57.28	Good	Yes
B23-12009	Revisit	32.658339	-	Bay	2023-08-25 09:00:00	WSP	5	32.658435	117.145122	4.7	No	No	2.20285694	85.47	Good	Yes
B23-12011	Revisit	32.665184	-	Bay	2023-08-25 07:58:00	WSP	5	32.665927	117.149715	4.7	No	No	2.20285694	82.82	Good	Yes
B23-12012	Revisit	32.675472	-	Bay	2023-08-24 14:00:00	WSP	5	32.675368	117.143644	5.5	No	No	2.20285694	21.78	Good	Yes
B23-12014	New	32.699541	-	Bay	2023-08-24 08:50:00	WSP	5	32.699150	117.229960	14.6	No	No	2.20285694	49.20	Good	Yes
B23-12019	Revisit	32.714963	-	Bay	2023-08-24 11:35:00	WSP	5	32.715396	117.183399	12.5	No	No	2.20285694	66.58	Good	Yes
B23-12020	New	32.715218	-	Bay	2023-08-24 13:11:00	WSP	5	32.715358	117.189915	16.2	No	No	2.20285694	16.02	Good	Yes
B23-12021	Revisit	32.724148	-	Bay	2023-08-24 10:44:00	WSP	5	32.724770	117.183440	11.2	No	No	2.20285694	81.20	Good	Yes
B23-12022	Revisit	32.767905	-	Bay	2023-08-23 10:16:00	WSP	5	32.767581	117.241800	7.5	No	No	2.20285694	46.74	Good	Yes
B23-12023	New	32.784007	-	Bay	2023-08-23 11:44:00	WSP	5	32.784220	117.245920	4	No	No	2.20285694	24.06	Good	Yes
B23-12024	Revisit	32.784475	-	Bay	2023-08-23 13:33:00	WSP	5	32.784670	117.215133	4	No	No	2.20285694	30.20	Good	Yes
B23-12027	Revisit	33.712420	-	Bay	2023-07-17 12:01:00	WSP	5	33.716140	118.262080	26.2	No	No	2.20285694	566.01	Good	Yes
B23-12028	Revisit	33.713450	-	Bay	2023-07-17 10:22:00	WSP	5	33.712610	118.240520	15.2	No	No	2.20285694	118.50	Good	Yes
B23-12030	New	33.722423	-	Bay	2023-08-24 07:51:00	CLAEMD	5	33.722270	118.226120	14	No	No	2.20285694	38.93	Good	Yes
B23-12031	Revisit	33.724210	-	Bay	2023-07-17 08:28:00	WSP	5	33.723510	118.221900	16.2	No	No	2.20285694	241.73	Good	Yes

Station ID	Type	Target		Strata	Date/Time	Sample Org	Trawl minutes	Occupation			Fail	Abandoned	Area Weight	Dist. to Target (m)	QA/QC Flag 100m circle*	Station In Analysis
		Latitude	Longitude					Latitude	Longitude	Dep (m)						
B23-12032	New	33.726297	118.207675	Bay	2023-08-24 09:09:00	CLAEMD	5	33.726180	118.207940	20	No	No	2.20285694	27.78	Good	Yes
B23-12033	Revisit	33.728683	118.157000	Bay	2023-08-22 08:36:00	CLAEMD	5	33.728530	118.157050	14.5	No	No	2.20285694	17.59	Good	Yes
B23-12034	New	33.730170	118.132382	Bay	2023-08-23 12:30:00	CLAEMD	5	33.729880	118.132500	11.5	No	No	2.20285694	33.97	Good	Yes
B23-12035	Revisit	33.731680	118.204150	Bay	2023-08-24 10:29:00	CLAEMD	5	33.731670	118.204020	21	No	No	2.20285694	12.10	Good	Yes
B23-12036	New	33.732107	118.147171	Bay	2023-09-05 10:04:00	CLAEMD	5	33.731970	118.147330	13	No	No	2.20285694	21.17	Good	Yes
B23-12037	New	33.732107	118.157928	Bay	2023-08-22 10:18:00	CLAEMD	5	33.732150	118.158370	14	No	No	2.20285694	41.33	Good	Yes
B23-12038	New	33.735980	118.222465	Bay	2023-08-24 11:58:00	CLAEMD	5	33.736050	118.222020	12	No	No	2.20285694	41.96	Good	Yes
B23-12039	Revisit	33.739800	118.171317	Bay	2023-08-22 11:41:00	CLAEMD	5	33.740000	118.171350	13	No	No	2.20285694	22.39	Good	Yes
B23-12040	Revisit	33.742717	118.153200	Bay	2023-09-05 12:49:00	CLAEMD	5	33.743020	118.152950	11	No	No	2.20285694	40.82	Good	Yes
B23-12041	Revisit	33.744217	118.168733	Bay	2023-09-06 08:26:00	CLAEMD	5	33.744320	118.168490	11	No	No	2.20285694	25.25	Good	Yes
B23-12042	New	33.745663	118.140449	Bay	2023-09-05 11:32:00	CLAEMD	5	33.745750	118.140150	8	No	No	2.20285694	29.34	Good	Yes
B23-12043	New	33.751472	118.179440	Bay	2023-09-06 09:14:00	CLAEMD	5	33.751070	118.179670	8	No	No	2.20285694	49.42	Good	Yes
B23-12044	Revisit	33.759400	118.162667	Bay	2023-09-06 10:06:00	CLAEMD	5	33.759230	118.162570	6	No	No	2.20285694	20.89	Good	Yes
B23-12187	New	32.549680	117.187731	Inner Shelf	2023-08-24 08:02:00	CSD	10	32.549835	117.187583	29	No	No	36.64004814	22.11	Good	Yes
B23-12188	New	32.758893	117.264982	Inner Shelf	2023-09-06 13:10:00	CSD	10	32.759180	117.264750	13	No	No	36.64004814	38.54	Good	Yes
B23-12191	New	33.207838	117.441554	Inner Shelf	2023-09-20 13:19:00	CSD	10	33.207875	117.441333	25	No	No	36.64004814	21.01	Good	Yes
B23-12194	Revisit	33.627799	117.987516	Inner Shelf	2023-09-06 13:06:37	OC San	10	33.627799	117.987516	13	No	No	36.64004814	0.00	Good	Yes
B23-12195	Revisit	33.643400	118.078743	Inner Shelf	2023-09-06 12:19:32	OC San	10	33.643400	118.078743	29	No	No	36.64004814	0.00	Good	Yes

Station ID	Type	Target		Strata	Date/Time	Sample Org	Trawl minutes	Occupation			Fail	Abandoned	Area Weight	Dist. to Target (m)	QA/QC Flag	Station In Analysis
		Latitude	Longitude					Latitude	Longitude	Dep (m)						
B23-12196	New	33.654493	-	Inner Shelf	2023-09-19 11:23:49	OC San	10	33.654493	-	28	No	No	36.64004814	0.00	Good	Yes
B23-12197	Revisit	33.659600	-	Inner Shelf	2023-09-07 09:31:39	OC San	10	33.659600	-	29	No	No	36.64004814	0.00	Good	Yes
B23-12198	New	33.662448	-	Inner Shelf	2023-09-07 08:12:03	OC San	10	33.662448	-	23	No	No	36.64004814	0.00	Good	Yes
B23-12199	Revisit	33.695200	-	Inner Shelf	2023-08-08 10:40:57	LACSD	10	33.695220	-	28	No	No	36.64004814	2.40	Good	Yes
B23-12200	New	33.702212	-	Inner Shelf	2023-08-23 08:47:00	CLAEMD	10	33.702730	-	21	No	No	36.64004814	77.50	Good	Yes
B23-12201	Revisit	33.733383	-	Inner Shelf	2023-08-23 10:28:00	CLAEMD	10	33.733020	-	6.5	No	No	36.64004814	40.27	Good	Yes
B23-12202	Revisit	33.962433	-	Inner Shelf	2023-08-03 07:25:00	CLAEMD	10	33.962340	-	14.5	No	No	36.64004814	63.05	Good	Yes
B23-12203	New	34.003818	-	Inner Shelf	2023-08-03 13:29:00	CLAEMD	10	34.003440	-	17	No	No	36.64004814	49.86	Good	Yes
B23-12204	Revisit	34.023300	-	Inner Shelf	2023-08-03 11:38:00	CLAEMD	10	34.022850	-	23	No	No	36.64004814	50.03	Good	Yes
B23-12206	Revisit	34.101020	-	Inner Shelf	2023-07-19 15:39:53	LACSD	10	34.100980	-	14	No	No	36.64004814	8.61	Good	Yes
B23-12207	Revisit	34.124880	-	Inner Shelf	2023-07-19 14:31:37	LACSD	10	34.124870	-	14	No	No	36.64004814	4.74	Good	Yes
B23-12208	New	34.162130	-	Inner Shelf	2023-08-07 07:18:00	ABC	10	34.162130	-	9.1	No	No	36.64004814	0.00	Good	Yes
B23-12209	Revisit	34.178630	-	Inner Shelf	2023-08-07 08:50:00	ABC	10	34.178600	-	25.1	No	No	36.64004814	3.45	Good	Yes
B23-12210	New	34.193757	-	Inner Shelf	2023-08-07 10:37:00	ABC	10	34.193642	-	27	No	No	36.64004814	12.79	Good	Yes
B23-12211	New	34.256975	-	Inner Shelf	2023-08-08 07:03:00	ABC	10	34.256951	-	16.6	No	No	36.64004814	2.66	Good	Yes
B23-12212	Revisit	34.283680	-	Inner Shelf	2023-08-08 08:31:00	ABC	10	34.283910	-	17.3	No	No	36.64004814	33.81	Good	Yes
B23-12213	New	34.351713	-	Inner Shelf	2023-08-08 10:34:00	ABC	10	34.351713	-	21.1	No	No	36.64004814	0.00	Good	Yes
B23-12214	Revisit	34.396139	-	Inner Shelf	2023-08-29 14:34:00	ABC	10	34.396252	-	23.5	No	No	36.64004814	13.42	Good	Yes
B23-12216	New	34.406928	-	Inner Shelf	2023-08-30 07:30:00	ABC	10	34.406984	-	17	No	No	36.64004814	8.07	Good	Yes

Station ID	Type	Target		Strata	Date/Time	Sample Org	Trawl minutes	Occupation			Fail	Abandoned	Area Weight	Dist. to Target (m)	QA/QC Flag	Station In Analysis
		Latitude	Longitude					Latitude	Longitude	Dep (m)						
B23-12217	Revisit	32.551480	117.199500	Mid Shelf	2023-08-24 09:50:00	CSD	10	32.551453	117.199550	34	No	No	56.10508368	5.57	Good	Yes
B23-12218	New	32.576677	117.317497	Mid Shelf	2023-08-29 12:02:00	CSD	10	32.576567	117.317083	119	No	No	56.10508368	40.74	Good	Yes
B23-12219	Revisit	32.589690	117.264290	Mid Shelf	2023-08-29 09:40:00	CSD	10	32.589717	117.264267	58	No	No	56.10508368	3.69	Good	Yes
B23-12220	New	32.925241	117.295744	Mid Shelf	2023-09-13 08:41:00	CSD	10	32.925307	117.296200	68	No	No	56.10508368	43.27	Good	Yes
B23-12221	Revisit	33.087640	117.350970	Mid Shelf	2023-09-19 08:01:00	CSD	10	33.087425	117.350933	73	No	No	56.10508368	24.09	Good	Yes
B23-12222	Revisit	33.105260	117.362160	Mid Shelf	2023-09-19 10:27:00	CSD	10	33.105057	117.362283	84	No	No	56.10508368	25.27	Good	Yes
B23-12223	New	33.125309	117.361003	Mid Shelf	2023-09-19 12:19:00	CSD	10	33.125370	117.360900	57	No	No	56.10508368	11.75	Good	Yes
B23-12224	Revisit	33.265584	117.533447	Mid Shelf	2023-09-21 10:01:00	CSD	10	33.265717	117.533467	63	No	No	56.10508368	14.87	Good	Yes
B23-12228	Revisit	33.601949	118.056462	Mid Shelf	2023-09-06 09:19:35	OC San	10	33.601949	118.056462	39	No	No	56.10508368	0.00	Good	Yes
B23-12229	Revisit	33.621000	118.195000	Mid Shelf	2023-09-25 08:19:52	OC San	10	33.621000	118.195000	43	No	No	56.10508368	0.00	Good	Yes
B23-12230	Revisit	33.648100	118.149000	Mid Shelf	2023-09-19 08:42:45	OC San	10	33.648100	118.149000	32	No	No	56.10508368	0.00	Good	Yes
B23-12231	New	33.680986	118.296381	Mid Shelf	2023-08-08 08:33:06	LACSD	10	33.680960	118.296390	46	No	No	56.10508368	3.00	Good	Yes
B23-12235	New	33.868896	118.470404	Mid Shelf	2023-08-15 09:15:37	LACSD	10	33.868920	118.470450	69	No	No	56.10508368	5.02	Good	Yes
B23-12236	Revisit	33.934860	118.539760	Mid Shelf	2023-08-02 13:57:00	CLAEMD	10	33.935170	118.539910	56	No	No	56.10508368	37.08	Good	Yes
B23-12237	New	34.035581	118.992476	Mid Shelf	2023-07-20 14:41:32	LACSD	10	34.035600	118.992460	56	No	No	56.10508368	2.57	Good	Yes
B23-12238	New	34.222711	119.500045	Mid Shelf	2023-08-07 13:55:00	ABC	10	34.222689	119.500018	82.8	No	No	56.10508368	3.48	Good	Yes
B23-12239	New	34.316120	119.565304	Mid Shelf	2023-08-08 11:56:25	ABC	10	34.316165	119.565343	65.9	No	No	56.10508368	6.15	Good	Yes
B23-12240	Revisit	34.344060	119.562530	Mid Shelf	2023-08-08 14:48:52	ABC	10	34.344146	119.562543	44.1	No	No	56.10508368	9.61	Good	Yes
B23-12242	New	34.388700	119.616061	Mid Shelf	2023-08-30 08:15:00	ABC	10	34.388797	119.616068	36.2	No	No	56.10508368	10.78	Good	Yes

Station ID	Type	Target		Strata	Date/Time	Sample Org	Trawl minutes	Occupation			Fail	Abandoned	Area Weight	Dist. to Target (m)	QA/QC Flag	Station In Analysis
		Latitude	Longitude					Latitude	Longitude	Dep (m)						
B23-12244	Revisit	34.400981	-	Mid Shelf	2023-08-29 12:57:00	ABC	10	34.401086	-	28.6	No	No	56.10508368	11.72	Good	Yes
B23-12247	Revisit	32.585740	-	Outer Shelf	2023-08-30 07:59:00	CSD	10	32.585447	-	185	No	No	NA	37.53	Did not meet MQO	No
B23-12248	New	32.749516	-	Outer Shelf	2023-09-12 09:18:00	CSD	10	32.749173	-	218	No	No	NA	39.80	Did not meet MQO	No
B23-12249	New	32.873447	-	Outer Shelf	2023-09-12 11:37:00	CSD	10	32.873782	-	188	No	No	NA	38.87	Did not meet MQO	No
B23-12250	New	33.188127	-	Outer Shelf	2023-09-26 07:38:00	CSD	10	33.188107	-	127	No	No	NA	5.25	Did not meet MQO	No
B23-12251	Revisit	33.221016	-	Outer Shelf	2023-09-26 09:21:00	CSD	10	33.220695	-	188	No	No	NA	35.61	Did not meet MQO	No
B23-12255	New	33.557553	-	Outer Shelf	2023-09-21 08:05:41	OC San	10	33.557553	-	164	No	No	NA	0.00	Did not meet MQO	No
B23-12256	New	33.568723	-	Outer Shelf	2023-09-25 12:23:22	OC San	10	33.568723	-	145	No	No	NA	0.00	Did not meet MQO	No
B23-12258	Revisit	33.767100	-	Mid Shelf	2023-08-10 10:08:48	LACSD	10	33.767090	-	118	No	No	56.10508368	8.41	Good	Yes
B23-12259	Revisit	33.767450	-	Mid Shelf	2023-08-10 11:24:57	LACSD	10	33.767380	-	90	No	No	56.10508368	8.25	Good	Yes
B23-12260	New	33.853074	-	Outer Shelf	2023-08-15 12:32:59	LACSD	10	33.853080	-	148	No	No	NA	0.67	Did not meet MQO	No
B23-12261	Revisit	33.912233	-	Outer Shelf	2023-08-15 10:44:49	LACSD	10	33.912260	-	172	No	No	NA	4.28	Did not meet MQO	No
B23-12262	New	33.997675	-	Outer Shelf	2023-07-21 09:09:58	LACSD	10	33.997670	-	180	No	No	NA	0.92	Did not meet MQO	No
B23-12263	New	34.014344	-	Outer Shelf	2023-07-20 13:13:39	LACSD	10	34.014320	-	161	No	No	NA	2.66	Did not meet MQO	No
B23-12264	Revisit	34.044130	-	Upper Slope	2023-07-20 11:34:48	LACSD	10	34.044100	-	209	No	No	NA	3.81	Did not meet MQO	No
B23-12267	Revisit	34.107170	-	Outer Shelf	2023-07-19 07:09:54	LACSD	10	34.107100	-	194	No	No	NA	10.71	Did not meet MQO	No
B23-12269	Revisit	34.122810	-	Outer Shelf	2023-07-19 08:37:04	LACSD	10	34.122850	-	127	No	No	NA	8.61	Did not meet MQO	No

Station ID	Type	Target		Strata	Date/Time	Sample Org	Trawl minutes	Occupation			Fail	Abandoned	Area Weight	Dist. to Target (m)	QA/QC Flag	Station In Analysis
		Latitude	Longitude					Latitude	Longitude	Dep (m)						
B23-12270	New	34.130935	-	Outer Shelf	2023-07-19 11:01:35	LACSD	10	34.130840	-	200	No	No	NA	11.43	Did not meet MQO	No
B23-12271	Revisit	34.132675	-	Outer Shelf	2023-07-19 09:50:40	LACSD	10	34.132670	-	173	No	No	NA	6.39	Did not meet MQO	No
B23-12272	Revisit	34.132900	-	Outer Shelf	2023-07-18 15:17:38	LACSD	10	34.132890	-	187	No	No	NA	1.11	Did not meet MQO	No
B23-12278	New	34.247365	-	Outer Shelf	2023-08-10 10:47:13	ABC	10	34.247593	-	134	No	No	NA	27.79	Did not meet MQO	No
B23-12283	New	34.313824	-	Outer Shelf	2023-08-09 11:45:00	ABC	10	34.313985	-	178	No	No	NA	18.78	Did not meet MQO	No
B23-12285	Revisit	32.692900	-	Upper Slope	2023-09-07 08:12:00	CSD	10	32.692820	-	368	No	No	NA	23.06	Did not meet MQO	No
B23-12288	Revisit	33.093830	-	Upper Slope	2023-09-20 08:10:00	CSD	10	33.093948	-	402	No	No	NA	39.57	Did not meet MQO	No
B23-12289	New	33.209751	-	Upper Slope	2023-09-21 12:49:00	CSD	10	33.209542	-	455	No	No	NA	23.38	Did not meet MQO	No
B23-12296	Revisit	33.556099	-	Upper Slope	2023-09-26 08:16:25	OC San	10	33.556099	-	231	No	No	NA	0.00	Did not meet MQO	No
B23-12298	Revisit	33.694200	-	Upper Slope	2023-08-10 08:16:13	LACSD	10	33.694210	-	277	No	No	NA	6.58	Did not meet MQO	No
B23-12301	New	34.116124	-	Upper Slope	2023-07-18 12:02:41	LACSD	10	34.116160	-	236	No	No	NA	5.63	Did not meet MQO	No
B23-12302	Revisit	34.118280	-	Upper Slope	2023-07-18 07:47:17	LACSD	10	34.118360	-	257	Yes	Yes	NA	8.92	Did not meet MQO	No
B23-12507	New	34.272772	-	Inner Shelf	2023-08-07 17:00:00	ABC	10	34.272772	-	23.3	No	No	36.64004814	0.00	Good	Yes
B23-12523	New	34.233095	-	Mid Shelf	2023-08-30 10:08:00	ABC	10	34.233159	-	50.9	No	No	56.10508368	7.41	Good	Yes
B23-12534	New	34.241824	-	Outer Shelf	2023-08-10 13:36:20	ABC	10	34.241768	-	183	No	No	NA	8.82	Did not meet MQO	No
B23-12535	New	34.225200	-	Outer Shelf	2023-08-29 09:17:51	ABC	10	34.225205	-	171	No	No	NA	0.55	Did not meet MQO	No
B23-12572	New	33.806305	-	Mid Shelf	2023-08-01 08:42:00	CLAEMD	10	33.806190	-	77	No	No	56.10508368	16.98	Good	Yes

Station ID	Type	Target		Strata	Date/Time	Sample Org	Trawl minutes	Occupation			Fail	Abandoned	Area Weight	Dist. to Target (m)	QA/QC Flag	Station In Analysis	
		Latitude	Longitude					Latitude	Longitude	Dep (m)							
B23-12575	New	33.868896	-118.528412	Mid Shelf	2023-08-02 10:16:00	CLAEMD	10	33.868950	-118.528580	68	No	No	56.10508368	16.66	Good	Yes	
B23-12590	New	32.638253	-117.160142	Inner Shelf	2023-08-29 08:04:00	CSD	10	32.638315	-117.160183	15	No	No	36.64004814	7.93	Good	Yes	
B23-12591	New	32.589951	-117.193249	Inner Shelf	2023-08-24 11:14:00	CSD	10	32.589753	-117.193133	27	No	No	36.64004814	24.51	Good	Yes	
B23-12610	New	32.566094	-117.266740	Mid Shelf	2023-09-28 08:00:00	CSD	10	32.565973	-117.266600	63	No	No	56.10508368	18.79	Good	Yes	
B23-12612	New	32.597841	-117.244987	Mid Shelf	2023-09-28 10:06:00	CSD	10	32.597838	-117.245167	46	No	No	56.10508368	16.90	Good	Did not meet MQO	Yes
B23-12630	New	32.648269	-117.375910	Upper Slope	2023-09-06 07:54:00	CSD	10	32.648365	-117.375783	229	No	No	NA	15.98	Did not meet MQO	No	
B23-12631	New	32.805320	-117.375910	Upper Slope	2023-09-27 09:10:00	CSD	10	32.805405	-117.375867	217	No	No	NA	10.25	Did not meet MQO	No	
B23-12632	New	32.739916	-117.384892	Upper Slope	2023-09-27 11:43:00	CSD	10	32.739998	-117.384883	368	No	No	NA	9.13	Did not meet MQO	No	
B23-12647	New	33.702212	-118.225096	Inner Shelf	2023-08-08 09:42:02	LACSD	10	33.702250	-118.225090	21	No	No	36.64004814	4.24	Good	Yes	
B23-12667	New	33.618258	-118.165863	Mid Shelf	2023-08-16 12:44:38	LACSD	10	33.618260	-118.165820	42	No	No	56.10508368	4.00	Good	Did not meet MQO	Yes
B23-12674	New	34.053225	-119.164163	Outer Shelf	2023-07-20 09:41:42	LACSD	10	34.053250	-119.164180	130	No	No	NA	3.19	Did not meet MQO	No	
B23-12679	New	33.830806	-118.560484	Outer Shelf	2023-08-16 09:32:09	LACSD	10	33.830700	-118.560580	175	No	No	NA	14.74	Did not meet MQO	No	
B23-12685	New	33.664131	-118.310032	Upper Slope	2023-08-10 13:49:23	LACSD	10	33.664160	-118.310050	321	No	No	NA	3.67	Did not meet MQO	No	
B23-12750	New	33.654493	-118.136809	Inner Shelf	2023-09-07 11:08:33	OC San	10	33.654493	-118.136809	28	No	No	36.64004814	0.00	Good	Yes	
B23-12755	New	33.455378	-117.722967	Inner Shelf	2023-09-27 10:29:18	OC San	10	33.455380	-117.723000	23	No	No	36.64004814	3.09	Good	Yes	
B23-12770	New	33.597338	-117.977337	Mid Shelf	2023-09-19 13:56:19	OC San	10	33.597338	-117.977337	30	No	No	56.10508368	0.00	Good	Yes	
B23-12819	New	32.664260	-117.130714	Bay	2023-08-25 11:12:00	WSP	5	32.664461	-117.131039	4.9	No	No	2.20285694	37.77	Good	Yes	
B23-12884	New	32.646007	-117.123439	Bay	2023-08-25 10:30:00	WSP	5	32.646019	-117.123376	12.2	No	No	2.20285694	6.06	Good	Yes	

\*Trawl over coordinates were mistakenly entered as Occupation coordinates



## Appendix A-2. Station Trawl Statistics.

Station ID	Date	Trawl Number	Trawl Start (TS)			Fail	Trawl Dist. (m)	Speed (m/sec)	Sensor (PT)			Dist. To Target (m)	Event Flag	Station In Analysis
			Time	Latitude	Longitude				Bottom Time (min)	Avg Temp (degC)	Avg Dep (m)			
B23-12008	2023-08-25	1	10:04:00	32.647796	-117.115757	No	227.0	0.8	6.5	21.7	10.5	26.2		Yes
B23-12009	2023-08-25	1	09:04:00	32.657541	-117.144045	No	311.8	1.0	6.5	23.6	4.5	90.0		Yes
B23-12011	2023-08-25	1	08:01:00	32.664254	-117.149621	No	304.9	1.0	6.0	22.6	4.3	104.6	Trawl outside 100m circle	Yes
B23-12012	2023-08-24	1	14:04:00	32.674495	-117.143521	No	297.1	1.0	6.0	22.6	5.3	33.6		Yes
B23-12014	2023-08-24	1	08:58:00	32.699123	-117.229977	No	306.2	1.0	6.0	15.5	14.4	51.2		Yes
B23-12019	2023-08-24	1	11:41:00	32.714765	-117.182982	No	292.4	1.0	6.5	15.9	12.3	14.5		Yes
B23-12020	2023-08-24	1	13:15:00	32.715608	-117.191002	No	302.0	1.0	6.0	15.6	16.1	114.4	Trawl outside 100m circle	Yes
B23-12021	2023-08-24	1	10:48:00	32.723284	-117.182368	No	356.9	1.5	4.5	16.6	11.0	111.8	Trawl outside 100m circle	Yes
B23-12022	2023-08-23	1	10:26:00	32.767084	-117.242200	No	323.9	1.1	5.5	14.7	7.9	113.3	Trawl outside 100m circle	Yes
B23-12023	2023-08-23	1	11:46:00	32.784295	-117.245916	No	292.4	1.0	6.0	16.9	4.2	7.3		Yes
B23-12024	2023-08-23	1	13:36:00	32.783585	-117.215299	No	306.8	1.0	5.5	20.9	3.8	98.9		Yes
B23-12027	2023-07-17	1	12:08:00	33.714140	-118.259740	No	298.3	1.0	8.0	12.5	26.4	4.9		Yes
B23-12028	2023-07-17	1	10:27:00	33.714170	-118.242050	No	266.5	0.9	7.0	12.6	24.5	105.3	Trawl outside 100m circle	Yes
B23-12030	2023-08-24	1	08:08:26	33.721050	-118.227570	No	316.5	1.0	6.0	16.3	13.9	24.7		Yes
B23-12031	2023-07-17	1	08:49:00	33.724380	-118.223570	No	254.9	0.8	6.5	13.6	16.9	19.2		Yes

Station ID	Date	Trawl Number	Trawl Start (TS)			Fail	Trawl Dist. (m)	Speed (m/sec)	Sensor (PT)			Dist. To Target (m)	Event Flag	Station In Analysis
			Time	Latitude	Longitude				Bottom Time (min)	Avg Temp (degC)	Avg Dep (m)			
B23-12032	2023-08-24	1	09:16:13	33.726150	-118.208900	No	320.4	1.0	5.9	15.6	19.8	45.9		Yes
B23-12033	2023-08-22	1	08:51:20	33.729250	-118.158020	No	305.8	1.0	5.1	15.3	14.0	49.6		Yes
B23-12034	2023-08-23	1	12:47:04	33.729150	-118.129610	No	251.6	0.8	7.8	18.0	11.1	32.5		Yes
B23-12035	2023-08-24	1	10:38:44	33.730980	-118.203470	No	298.7	1.0	6.4	15.8	20.5	12.1		Yes
B23-12036	2023-09-05	1	10:15:31	33.732120	-118.148190	No	315.9	1.0	6.2	16.3	13.6	50.2		Yes
B23-12037	2023-08-22	1	10:25:38	33.732550	-118.160530	No	344.0	1.0	6.8	15.8	13.5	2.5		Yes
B23-12038	2023-08-24	1	12:05:19	33.735050	-118.223190	No	283.1	0.9	6.4	16.9	11.5	62.4		Yes
B23-12039	2023-08-22	1	11:52:09	33.740220	-118.173670	No	339.3	1.1	5.7	17.2	12.5	27.3		Yes
B23-12040	2023-09-05	1	12:56:24	33.742200	-118.151890	No	277.1	0.9	6.6	17.0	12.3	2.8		Yes
B23-12041	2023-09-06	1	08:33:18	33.744280	-118.170820	No	315.2	1.0	4.9	17.9	12.5	0.2		Yes
B23-12042	2023-09-05	1	11:38:27	33.746930	-118.141780	No	293.8	1.0	5.9	18.6	8.4	24.0		Yes
B23-12043	2023-09-06	1	09:19:25	33.750720	-118.178610	No	252.8	0.8	6.9	18.1	9.5	43.8		Yes
B23-12044	2023-09-06	1	10:11:40	33.758920	-118.161000	No	266.0	0.9	7.3	19.7	6.9	10.8		Yes
B23-12187	2023-08-24	1	08:26:00	32.547343	-117.187233	No	525.3	0.8	12.3	14.9	30.1	4.5		Yes
B23-12188	2023-09-06	1	13:24:00	32.761877	-117.264600	No	664.4	1.1	13.2	16.3	14.7	12.1		Yes
B23-12191	2023-09-20	2	14:24:00	33.204877	-117.438233	No	514.5	0.9	13.7	15.6	24.9	5.4		Yes
B23-12194	2023-09-06	1	13:36:41	33.626950	-117.985690	No	442.1	1.0	8.6	18.2	15.0	4.8		Yes
B23-12195	2023-09-06	1	11:34:48	33.644410	-118.077160	No	550.8	1.0	12.4	15.6	28.2	10.9		Yes

Station ID	Date	Trawl Number	Trawl Start (TS)			Fail	Trawl Dist. (m)	Speed (m/sec)	Sensor (PT)			Dist. To Target (m)	Event Flag	Station In Analysis
			Time	Latitude	Longitude				Bottom Time (min)	Avg Temp (degC)	Avg Dep (m)			
B23-12196	2023-09-19	1	11:55:30	33.654700	-118.218160	No	610.5	1.0	12.1	13.9	28.6	34.1		Yes
B23-12197	2023-09-07	1	09:58:24	33.659620	-118.129540	No	462.6	1.0	10.7	14.9	28.5	27.5		Yes
B23-12198	2023-09-07	1	08:39:50	33.661770	-118.085560	No	485.7	1.0	9.3	15.6	23.1	22.4		Yes
B23-12199	2023-08-08	1	12:31:32	33.694970	-118.293610	No	537.6	0.9	10.1	14.6	27.6	15.6		Yes
B23-12200	2023-08-23	1	08:55:22	33.699880	-118.158010	No	575.1	0.9	10.5	15.3	20.7	182.4	Trawl outside 100m circle*	Yes
B23-12201	2023-08-23	1	10:51:16	33.732150	-118.121350	No	498.9	0.8	11.8	18.3	6.4	11.9		Yes
B23-12202	2023-08-03	1	07:44:18	33.962360	-118.476480	No	491.1	0.8	9.8	16.0	16.1	34.5		Yes
B23-12203	2023-08-03	1	13:39:50	34.003560	-118.523270	No	520.7	0.9	11.7	15.1	18.7	34.5		Yes
B23-12204	2023-08-03	1	11:50:50	34.023230	-118.594510	No	558.4	0.9	9.3	14.0	24.7	26.8		Yes
B23-12206	2023-07-19	1	15:52:35	34.098760	-119.147410	No	486.1	0.8	11.9	13.5	13.3	18.9		Yes
B23-12207	2023-07-19	1	14:48:38	34.125210	-119.193350	No	585.6	1.0	10.6	13.5	13.6	14.1		Yes
B23-12208	2023-08-07	1	07:45:00	34.156178	-119.234552	No	849.6	1.4	9.8	18.8	11.9	2.2		Yes
B23-12209	2023-08-07	1	09:07:00	34.180415	-119.348890	No	758.9	1.3	12.7	14.9	26.3	11.3		Yes
B23-12210	2023-08-07	1	10:50:00	34.195444	-119.362305	No	591.1	1.1	11.2	14.4	28.2	26.0		Yes
B23-12211	2023-08-08	1	07:13:00	34.255857	-119.293238	No	929.6	1.5	9.2	19.0	16.5	1.3		Yes
B23-12212	2023-08-08	1	08:40:53	34.282779	-119.351287	No	929.3	1.5	11.8	17.2	18.7	8.6		Yes
B23-12213	2023-08-08	1	10:50:02	34.350859	-119.469429	No	857.0	1.4	10.7	15.8	22.1	26.3		Yes

Station ID	Date	Trawl Number	Trawl Start (TS)			Fail	Trawl Dist. (m)	Speed (m/sec)	Sensor (PT)			Dist. To Target (m)	Event Flag	Station In Analysis
			Time	Latitude	Longitude				Bottom Time (min)	Avg Temp (degC)	Avg Dep (m)			
B23-12214	2023-08-29	1	14:59:58	34.395783	-119.663610	No	896.2	1.5	10.0	13.3	24.9	6.1		Yes
B23-12216	2023-08-30	1	07:31:00	34.405665	-119.649859	No	797.3	1.2	11.3	18.3	18.3	44.9		Yes
B23-12217	2023-08-24	1	10:07:00	32.549918	-117.199117	No	555.6	0.9	11.7	14.6	35.0	8.6		Yes
B23-12218	2023-08-29	1	12:22:00	32.574455	-117.315667	No	600.1	1.0	9.8	11.2	118.7	16.3		Yes
B23-12219	2023-08-29	1	09:58:00	32.588418	-117.263667	No	621.5	1.0	12.8	11.8	57.3	13.1		Yes
B23-12220	2023-09-13	1	09:04:00	32.924552	-117.295217	No	551.4	0.9	12.3	12.9	69.9	2.9		Yes
B23-12221	2023-09-19	1	08:22:00	33.084603	-117.349233	No	558.7	0.9	11.3	12.2	71.8	10.8		Yes
B23-12222	2023-09-19	1	10:49:00	33.102020	-117.360550	No	504.3	0.8	11.3	11.9	81.8	3.8		Yes
B23-12223	2023-09-19	1	12:36:00	33.124897	-117.360517	No	476.9	0.8	12.0	11.8	86.2	2.3		Yes
B23-12224	2023-09-21	1	10:17:00	33.264870	-117.532067	No	631.0	1.1	12.2	12.3	63.2	28.3		Yes
B23-12228	2023-09-06	1	09:57:26	33.601010	-118.055650	No	663.8	1.1	11.8	14.9	39.3	8.3		Yes
B23-12229	2023-09-25	3	09:49:27	33.621240	-118.191960	No	597.6	1.0	9.4	13.2	42.9	10.9		Yes
B23-12230	2023-09-19	1	09:15:20	33.647790	-118.148230	No	652.9	1.1	11.0	14.2	31.6	27.8		Yes
B23-12231	2023-08-08	1	08:54:31	33.678180	-118.295400	No	557.4	0.9	10.3	12.1	47.6	83.2		Yes
B23-12235	2023-08-15	1	09:37:45	33.870880	-118.471540	No	541.5	0.9	10.3	11.5	69.6	12.9		Yes
B23-12236	2023-08-02	1	14:14:27	33.931860	-118.537630	No	397.7	0.6	11.3	11.9	58.1	99.0		Yes
B23-12237	2023-07-20	1	15:01:00	34.037270	-118.996570	No	588.5	1.0	9.8	11.3	57.1	61.2		Yes
B23-12238	2023-08-07	2	14:56:00	34.224749	-119.501142	No	671.3	1.1	13.8	10.7	83.9	24.3		Yes

Station ID	Date	Trawl Number	Trawl Start (TS)			Fail	Trawl Dist. (m)	Speed (m/sec)	Sensor (PT)			Dist. To Target (m)	Event Flag	Station In Analysis
			Time	Latitude	Longitude				Bottom Time (min)	Avg Temp (degC)	Avg Dep (m)			
B23-12239	2023-08-08	1	12:20:09	34.317513	-119.563262	No	707.7	1.2	NA	NA	NA	59.5	Sensor data not submitted	Yes
B23-12240	2023-08-08	1	15:06:00	34.344212	-119.558179	No	766.8	1.2	11.8	12.8	45.4	12.5		Yes
B23-12242	2023-08-30	1	08:33:00	34.390683	-119.618070	No	804.5	1.3	11.2	12.5	37.2	5.4		Yes
B23-12244	2023-08-29	1	13:24:00	34.399937	-119.837782	No	733.9	1.2	13.7	12.7	30.7	49.6		Yes
B23-12247	2023-08-30	2	10:07:00	32.584043	-117.338467	No	690.8	1.2	10.0	10.9	171.3	7.0		Yes
B23-12248	2023-09-12	3	10:01:00	32.747897	-117.371467	No	536.5	0.9	12.3	10.4	215.8	2.2		Yes
B23-12249	2023-09-12	1	12:12:00	32.873540	-117.333733	No	640.3	1.1	7.7	10.6	191.7	11.1	BT < 8 minutes	Yes
B23-12250	2023-09-26	1	08:09:00	33.187202	-117.464017	No	576.0	1.0	13.5	10.8	130.0	11.6		Yes
B23-12251	2023-09-26	1	10:19:00	33.216985	-117.507600	No	632.0	0.9	14.3	10.2	188.7	1.2		Yes
B23-12255	2023-09-21	1	08:58:53	33.558330	-118.128470	No	476.3	0.8	11.2	10.1	169.8	10.5		Yes
B23-12256	2023-09-25	1	13:18:48	33.567780	-118.027310	No	585.0	1.0	9.0	10.9	140.9	15.7		Yes
B23-12258	2023-08-10	1	10:37:08	33.765370	-118.458180	No	477.3	0.8	13.0	10.4	120.0	28.6		Yes
B23-12259	2023-08-10	1	12:18:18	33.765680	-118.457620	No	517.8	0.9	12.0	11.2	92.1	60.1		Yes
B23-12260	2023-08-15	1	13:16:32	33.851010	-118.602360	No	534.3	0.9	18.7	10.0	148.9	51.5	Bottom time between 15-20 minutes	Yes
B23-12261	2023-08-15	1	11:27:22	33.911640	-118.591320	No	552.5	0.9	13.8	9.8	172.0	9.9		Yes
B23-12262	2023-07-21	1	11:55:12	33.998140	-118.935300	No	524.9	0.9	13.2	9.5	191.7	45.1		Yes
B23-12263	2023-07-20	1	13:53:35	34.014020	-119.037770	No	533.7	0.9	12.2	9.5	166.5	3.3		Yes

Station ID	Date	Trawl Number	Trawl Start (TS)			Fail	Trawl Dist. (m)	Speed (m/sec)	Sensor (PT)			Dist. To Target (m)	Event Flag	Station In Analysis
			Time	Latitude	Longitude				Bottom Time (min)	Avg Temp (degC)	Avg Dep (m)			
B23-12264	2023-07-20	1	12:18:46	34.044510	-119.053860	No	536.9	0.9	9.3	9.3	226.7	14.6		Yes
B23-12267	2023-07-19	1	07:43:09	34.107950	-119.320720	No	526.2	0.9	15.9	9.7	194.8	6.5	Bottom time between 15-20 minutes	Yes
B23-12269	2023-07-19	1	09:00:26	34.124420	-119.335620	No	524.9	0.9	13.8	9.9	129.3	1.1		Yes
B23-12270	2023-07-19	1	12:54:16	34.131990	-119.385390	No	519.5	0.9	8.3	9.5	201.5	6.2		Yes
B23-12271	2023-07-19	2	11:42:07	34.131940	-119.368840	No	494.4	0.8	16.7	9.7	173.2	37.2	Bottom time between 15-20 minutes	Yes
B23-12272	2023-07-18	1	15:54:19	34.133100	-119.380880	No	519.5	0.9	12.3	9.7	187.9	18.0		Yes
B23-12278	2023-08-10	1	11:17:42	34.244450	-119.630609	No	936.6	1.7	10.7	10.1	138.0	55.3		Yes
B23-12283	2023-08-09	1	12:19:13	34.313623	-119.745687	No	818.4	1.4	15.2	9.8	175.7	0.3	Bottom time between 15-20 minutes	Yes
B23-12285	2023-09-07	2	08:57:00	32.690538	-117.397050	No	453.1	0.8	5.7	8.4	360.7	7.5	BT < 8 minutes	Yes
B23-12288	2023-09-20	2	11:08:00	33.091977	-117.416300	No	516.9	0.9	7.7	7.7	405.4	0.4	BT < 8 minutes	Yes
B23-12289	2023-09-21	1	13:33:00	33.208622	-117.545983	No	746.1	0.8	9.7	7.0	465.4	15.3		Yes
B23-12296	2023-09-26	2	10:10:28	33.554820	-118.015740	No	586.6	1.0	9.4	9.7	231.9	2.1		Yes
B23-12298	2023-08-10	2	08:53:52	33.693470	-118.345800	No	492.3	0.8	12.5	9.4	293.1	11.4		Yes
B23-12301	2023-07-18	1	13:27:36	34.117970	-119.543330	No	556.3	0.9	13.0	9.2	237.3	2.0		Yes
B23-12302	2023-07-18	1	10:51:44	34.118910	-119.632280	No	518.0	0.9	21.7	9.2	260.5	4.8	Bottom time over 20 minutes**	No
B23-12507	2023-08-07	1	17:10:00	34.274730	-119.362382	No	647.8	1.0	9.3	15.8	24.4	2.6		Yes

Station ID	Date	Trawl Number	Trawl Start (TS)			Fail	Trawl Dist. (m)	Speed (m/sec)	Sensor (PT)			Dist. To Target (m)	Event Flag	Station In Analysis
			Time	Latitude	Longitude				Bottom Time (min)	Avg Temp (degC)	Avg Dep (m)			
B23-12523	2023-08-30	1	10:23:37	34.230265	-119.445493	No	639.0	1.1	11.3	12.6	51.4	58.5		Yes
B23-12534	2023-08-10	1	14:01:23	34.240952	-119.735361	No	836.2	1.4	14.0	9.7	182.8	17.7		Yes
B23-12535	2023-08-29	1	09:56:49	34.227977	-119.654182	No	664.2	1.2	13.7	9.7	177.7	24.6		Yes
B23-12572	2023-08-01	1	09:01:47	33.805320	-118.442580	No	583.9	0.8	10.2	11.2	77.9	43.4		Yes
B23-12575	2023-08-02	1	10:36:52	33.865630	-118.530080	No	525.7	0.8	10.4	11.6	71.8	56.3		Yes
B23-12590	2023-08-29	1	08:20:00	32.632305	-117.156283	No	688.1	1.1	10.0	13.9	14.7	64.3		Yes
B23-12591	2023-08-24	1	11:36:00	32.585782	-117.192983	No	662.0	1.1	12.7	15.3	28.3	3.5		Yes
B23-12610	2023-09-28	1	08:20:00	32.564273	-117.266267	No	531.2	0.9	13.3	12.0	63.1	37.0		Yes
B23-12612	2023-09-28	2	11:01:00	32.597078	-117.245200	No	629.5	1.0	11.5	13.2	46.9	15.2		Yes
B23-12630	2023-09-06	1	09:31:00	32.645537	-117.375867	No	458.7	0.8	10.3	10.2	228.5	25.7		Yes
B23-12631	2023-09-27	1	09:41:00	32.804985	-117.376217	No	468.9	0.8	15.8	9.7	228.0	17.5	Bottom time between 15-20 minutes	Yes
B23-12632	2023-09-27	1	13:15:00	32.736480	-117.383450	No	586.3	1.0	7.0	8.4	357.2	0.6	BT < 8 minutes	Yes
B23-12647	2023-08-08	1	10:01:48	33.702670	-118.222880	No	511.8	0.8	10.6	15.8	21.2	13.9		Yes
B23-12667	2023-08-16	2	13:36:19	33.617740	-118.162450	No	472.4	0.8	9.8	13.9	41.5	12.3		Yes
B23-12674	2023-07-20	1	10:35:06	34.054770	-119.164930	No	544.6	0.9	11.2	9.9	133.9	39.7		Yes
B23-12679	2023-08-16	1	10:08:38	33.831800	-118.564290	No	502.2	0.8	13.2	10.0	174.4	20.5		Yes
B23-12685	2023-08-10	1	14:25:33	33.665440	-118.312290	No	486.4	0.8	9.9	9.1	328.0	43.9		Yes

Station ID	Date	Trawl Number	Trawl Start (TS)			Fail	Trawl Dist. (m)	Speed (m/sec)	Sensor (PT)			Dist. To Target (m)	Event Flag	Station In Analysis
			Time	Latitude	Longitude				Bottom Time (min)	Avg Temp (degC)	Avg Dep (m)			
B23-12750	2023-09-07	1	11:28:46	33.653970	-118.134540	No	472.4	1.0	9.3	14.8	30.1	30.8		Yes
B23-12755	2023-09-27	2	12:14:03	33.453180	-117.721660	No	607.9	1.0	10.6	14.6	22.8	43.3		Yes
B23-12770	2023-09-19	1	14:26:41	33.598960	-117.974240	No	562.0	1.0	11.8	15.0	32.2	25.2		Yes
B23-12819	2023-08-25	1	11:13:00	32.664712	-117.131277	No	293.9	1.0	6.0	23.7	4.7	72.8		Yes
B23-12884	2023-08-25	1	10:39:00	32.646562	-117.123413	No	310.4	1.0	6.5	21.1	11.8	61.6		Yes

\*CLAEMD trawl into the target circle then veer east to avoid encroaching on anchored container ship (distance to the target coordinates was 78m).

\*\*LACSD workuped site and left area before realizing it was greater than 20 minute trawl bottom time, selected an overdraw site to replace it if not acceptable.

## APPENDIX B - MISCELLANEOUS STATISTICS

Appendix B1.1. B'23 fish abundance by stratum. Area weights and asterisk (total) represents the three strata only.

Stratum	No. of Stations	Total	Min	Max	Area Weighted Values				% Above Median
					Median	Mean	SD	95 % CL	
Bays	30	14,356	12	1,766	283	479	504	180	-15.8
Inner Shelf	30	10,328	7	1,418	280	344	268	96	-16.8
Middle Shelf	29	20,609	20	2,863	536	711	535	195	59.5
Total (all stations)*	89	45,293	7	2,863	459	561	482	127	

Appendix B1.2. B'23 fish biomass (kg) by stratum. Area weights and asterisk (total) represent the three strata only.

Stratum	No. of Stations	Total	Min	Max	Area Weighted Values				% Above Median
					Median	Mean	SD	95 % CL	
Bays	30	469.2667	0.06	40.9	13.9	15.6	12.8	4.6	137.7
Inner Shelf	30	160.512	0.3	24.7	4.2	5.4	4.5	1.6	-28.4
Middle Shelf	29	497.158	0.44	72	13.6	17.1	17.1	6.2	133.2
Total (all stations)*	89	1,126.94	0.06	72	6.8	12.5	14.7	4	

Appendix B1.3. B'23 fish Shannon Weiner H' diversity index by stratum. Area weights and asterisk (total) represent the three strata only.

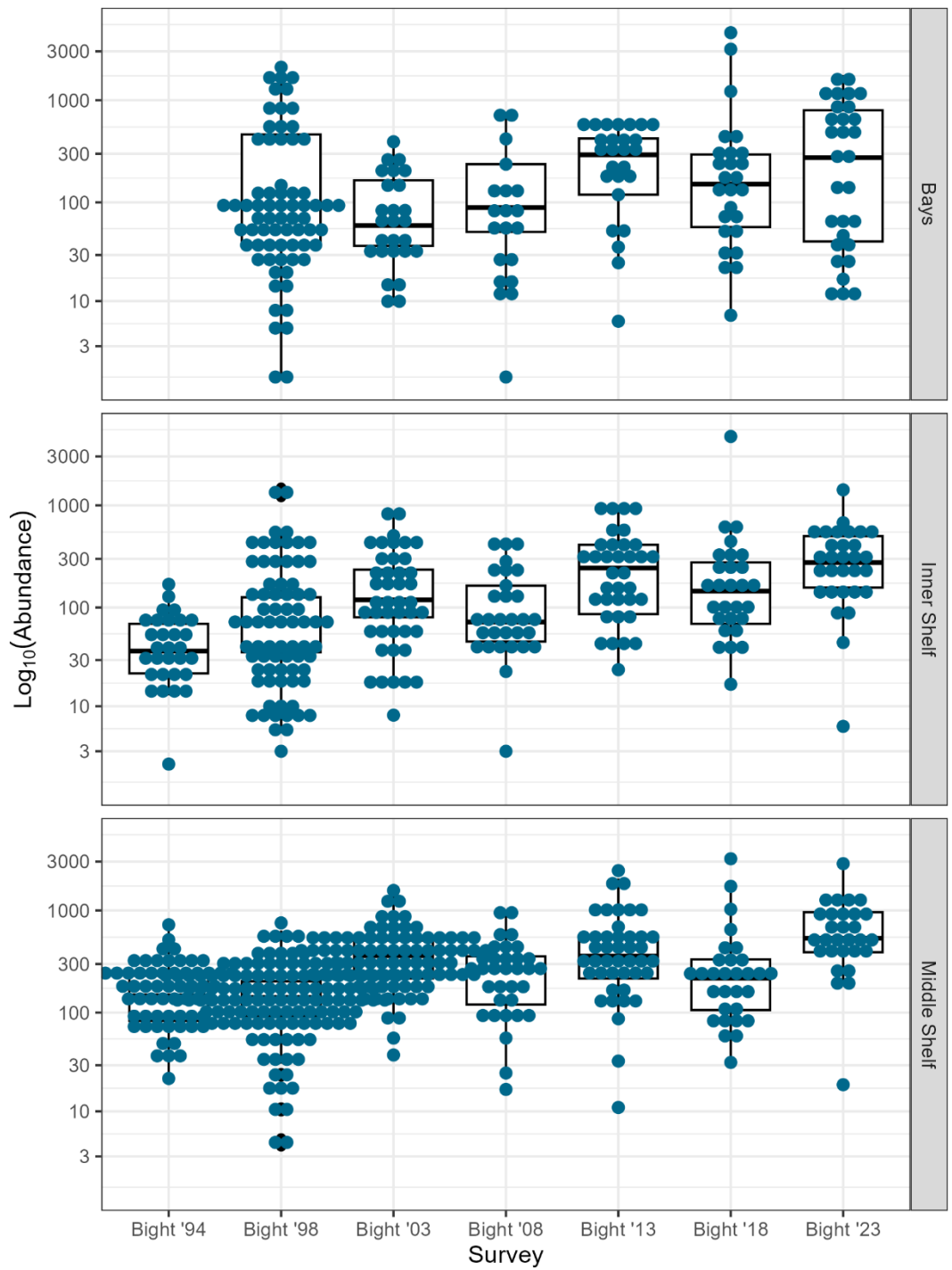
Stratum	No. of Stations	Min	Max	Area Weighted Values				% Above Median
				Median	Mean	SD	95 % CL	
Bays	30	0.21	3.22	1.61	1.54	0.64	0.23	9.2
Inner Shelf	30	0.22	1.94	1.18	1.17	0.33	0.12	-19.9
Middle Shelf	29	0.95	2.26	1.7	1.62	0.31	0.11	15.3
Total (all stations)*	89	0.21	3.22	1.46	1.44	0.4	0.1	

Appendix B1.4. B'23 fish taxonomic richness by stratum. Area weights and asterisk (total) represent the three strata only.

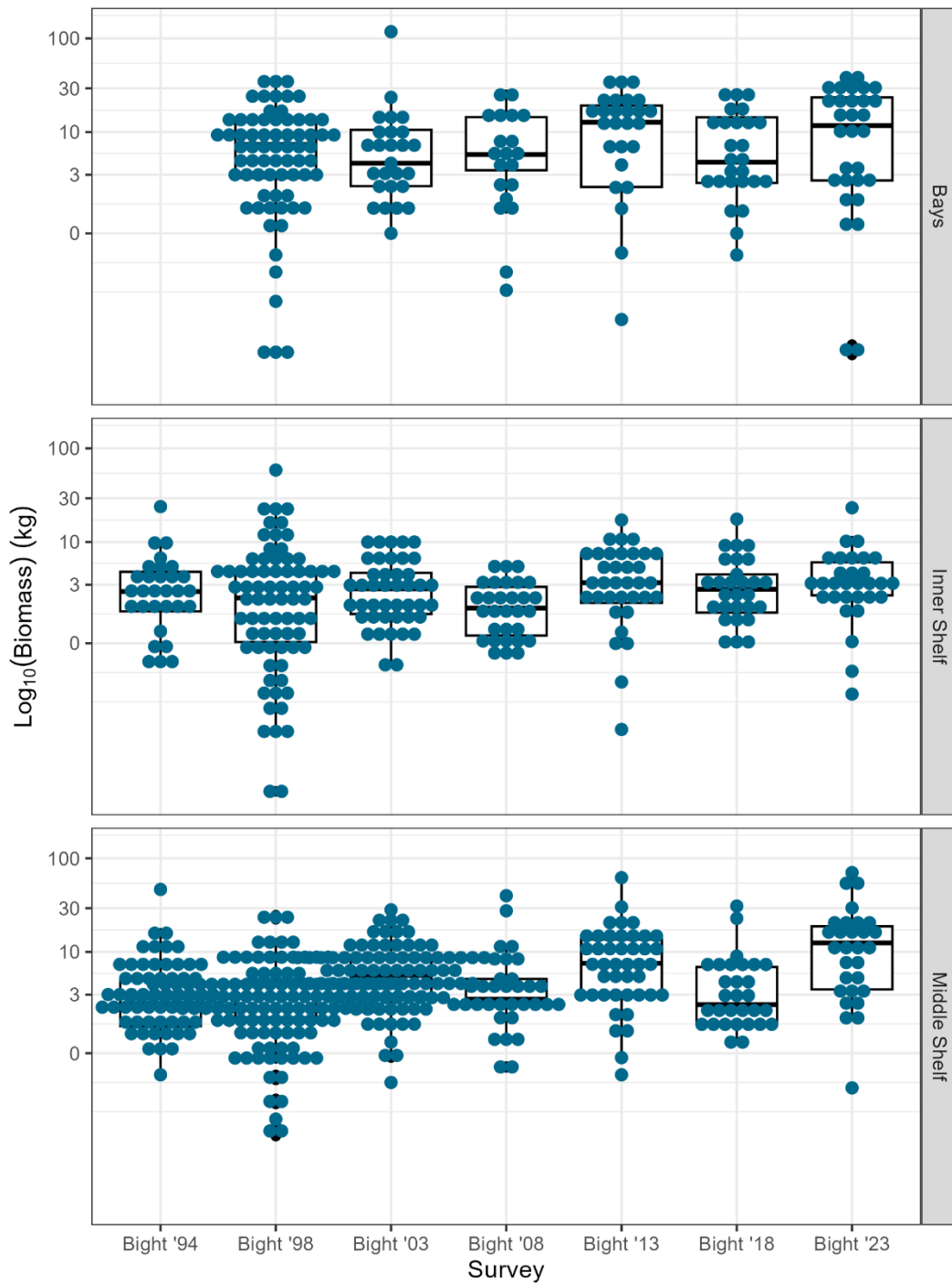
Stratum	No. of Stations	Total	Min	Max	Area Weighted Values				% Above Median
					Median	Mean	SD	95 % CL	
Bays	30	50	2	17	8	8.5	3.9	1.4	-38.5
Inner Shelf	30	46	5	17	11	10.3	3	1.1	-15.4
Middle Shelf	29	71	6	32	17	16.8	4.7	1.7	30.8
Total (all stations)*	89	102	2	32	14	14	5.3	1.3	

**Appendix B1.5. Fish Response Index (FRI) by 2 strata during the Bight'23 survey. FRI scores higher than 45 (in red) are associated with non-reference fish community. Area weights and asterisk (total) represent the two strata only.**

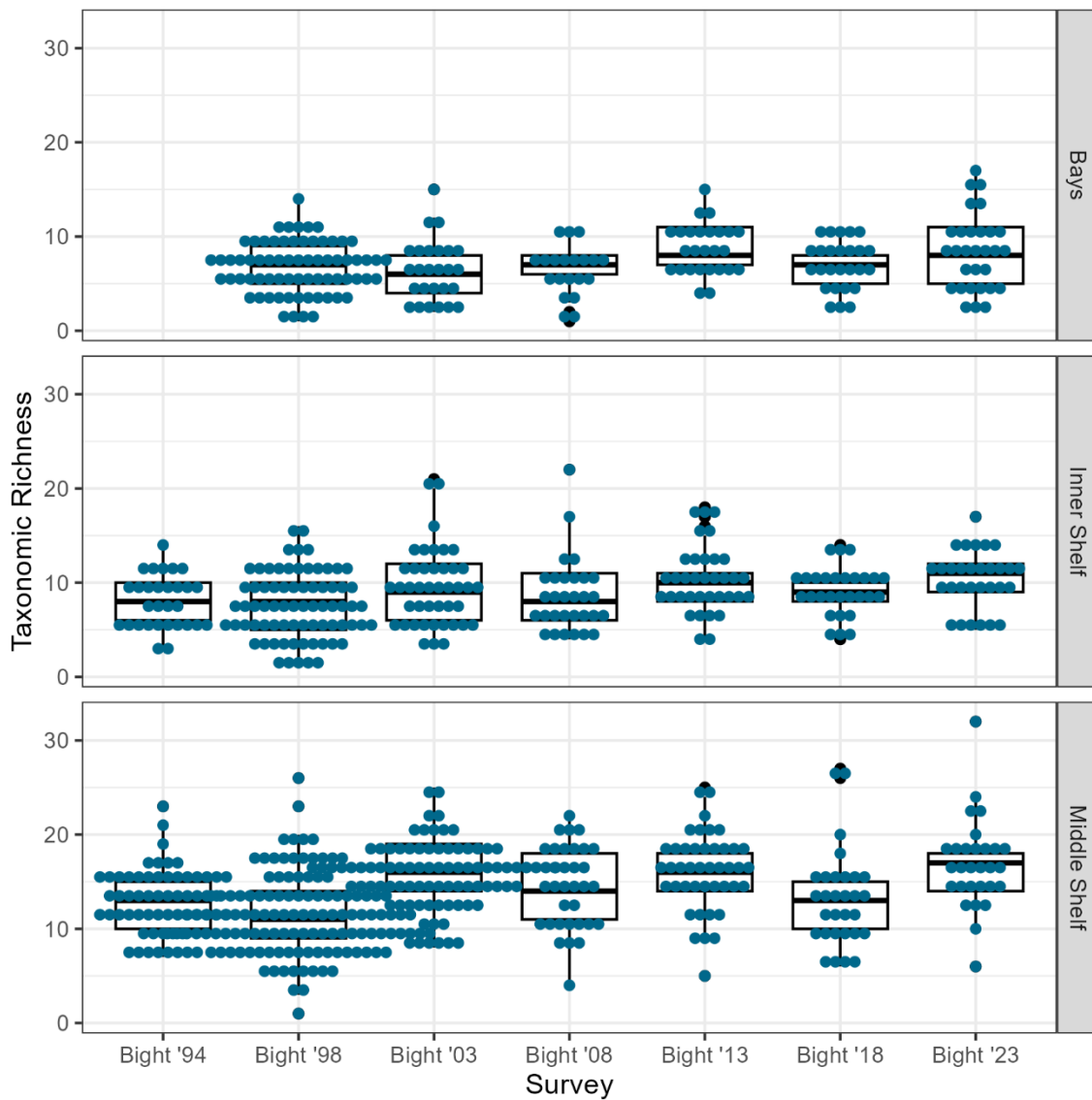
Stratum	No. of Stations	Area Weighted Values								
		Min	Max	Median	Mean	SD	95 % CL	% Above Median	% Reference Sites	% Reference Area
Inner Shelf	30	20.4	65.1	31.4	32.9	10.3	3.7	23.7	86.7	86.7
Middle Shelf	29	13.4	40.1	23.8	24	5.2	1.9	-6.2	100	100
Total (all stations)*	59	13.4	65.1	25.6	27.6	8.8	2.2		93.2	94.6



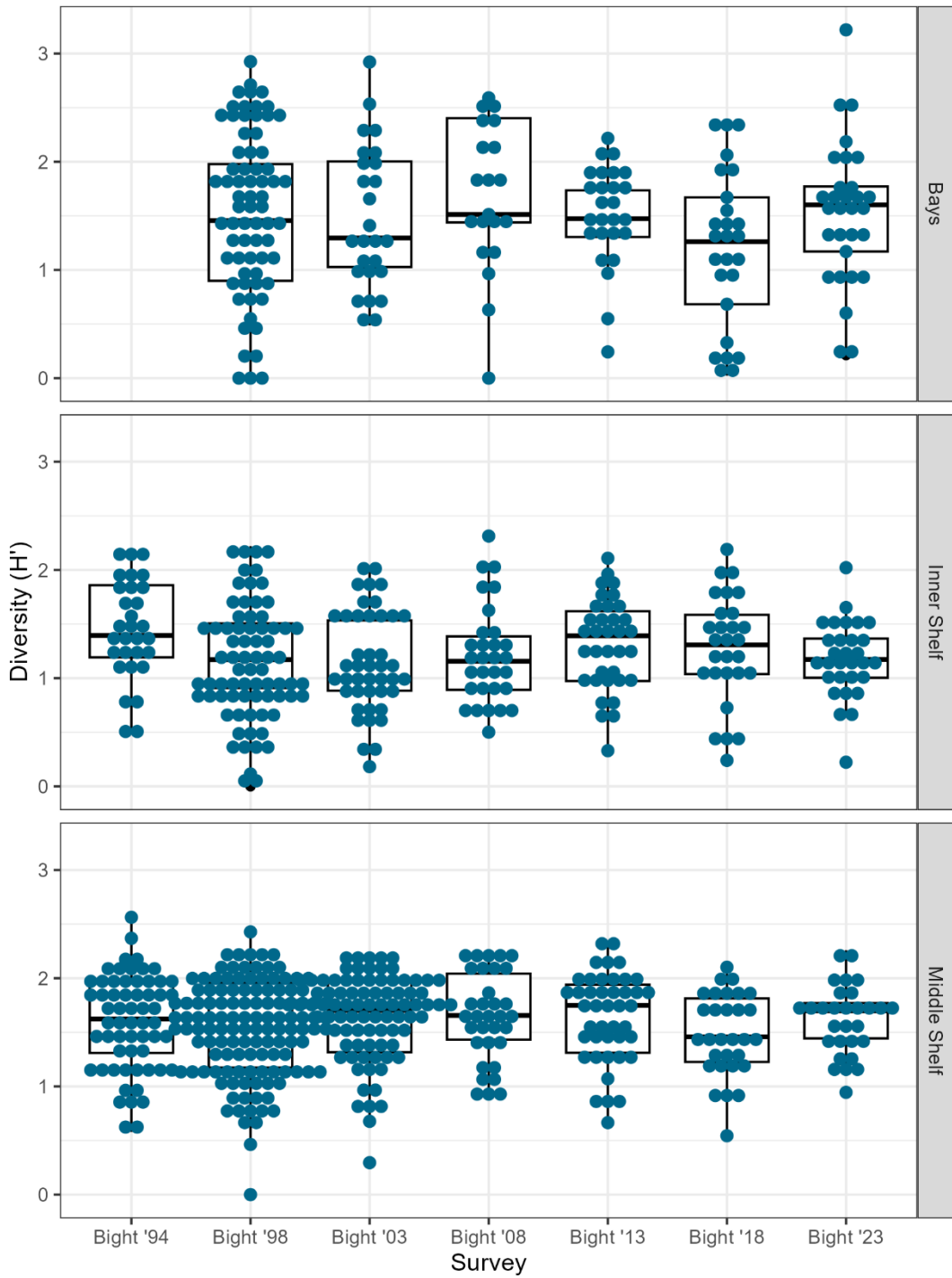
**Appendix B1.6. Demersal fish log abundance by stratum and survey for three strata. Data are area weighted median, upper and lower quantiles, and results (represented by blue dots).**



**Appendix B1.7. Demersal fish log biomass by stratum and survey for three strata. Data are area weighted median, upper and lower quantiles, and results (represented by blue dots).**



**Appendix B1.8. Demersal fish taxonomic richness by stratum and survey for three strata. Data are area weighted median, upper and lower quantiles, and results (represented by blue dots).**



**Appendix B1.9. Demersal fish Shannon diversity ( $H'$ ) by stratum and survey for three strata. Data are area weighted median, upper and lower quantiles, and results (represented by blue dots).**

**Appendix B1.10. Summary of area weighted demersal fish abundance by stratum and survey for three strata. Note that slight differences from previous report are due to different inclusions/exclusions. See QAQC section for details.**

Survey	Stratum	Abundance				
		Mean	Standard Deviation	Minimum	Maximum	Median
Bight '94	Inner Shelf	50.41	37.37	3	170	38
	Middle Shelf	167.33	109.29	23	726	147
Bight '98	Bays	346.81	510.20	2	2102	94
	Inner Shelf	111.17	138.64	4	1491	73
	Middle Shelf	166.89	107.03	5	757	142
Bight '03	Bays	102.12	98.39	10	394	61
	Inner Shelf	180.77	144.32	9	852	120
	Middle Shelf	413.36	283.14	39	1569	363
Bight '08	Bays	209.84	243.00	2	738	90
	Inner Shelf	128.00	123.28	4	467	74
	Middle Shelf	292.82	221.92	18	1005	272
Bight '13	Bays	292.37	192.87	7	652	294
	Inner Shelf	322.66	296.39	25	1013	245
	Middle Shelf	512.19	538.94	12	2450	359
Bight '18	Bays	487.81	1101.47	8	4563	157
	Inner Shelf	349.29	852.37	18	4699	148
	Middle Shelf	392.00	616.56	33	3196	221
Bight '23	Bays	478.53	507.85	12	1766	283
	Inner Shelf	344.27	268.24	7	1418	279.5
	Middle Shelf	710.66	534.87	20	2863	536

**Appendix B1.11. Summary of area weighted demersal fish biomass by stratum and survey for three strata. Note that slight differences from previous report are due to different inclusions/exclusions. See QAQC section for details.**

Survey	Stratum	Biomass (kg)				
		Mean	Standard Deviation	Minimum	Maximum	Median
Bight '94	Inner Shelf	4.64	4.77	0.60	25.43	3.40
Bight '94	Middle Shelf	4.67	5.06	0.60	48.30	3.20
Bight '98	Bays	9.85	8.68	0.06	40.28	8.20
Bight '98	Inner Shelf	3.56	3.62	0.03	60.40	2.93
Bight '98	Middle Shelf	4.42	3.81	0.14	26.33	3.75
Bight '03	Bays	11.70	22.26	1.00	118.46	6.23
Bight '03	Inner Shelf	4.02	2.62	0.60	12.20	3.63
Bight '03	Middle Shelf	7.69	5.68	0.50	29.80	6.30
Bight '08	Bays	10.18	8.50	0.26	30.10	6.46
Bight '08	Inner Shelf	2.64	1.62	0.70	6.50	2.35
Bight '08	Middle Shelf	6.49	8.07	0.72	41.67	3.60
Bight '13	Bays	14.08	10.93	0.13	40.20	13.86
Bight '13	Inner Shelf	5.35	4.12	0.13	18.50	4.20
Bight '13	Middle Shelf	11.43	11.85	0.60	63.80	8.40
Bight '18	Bays	9.60	8.86	0.60	30.00	5.75
Bight '18	Inner Shelf	4.65	3.83	0.97	18.90	3.58
Bight '18	Middle Shelf	5.88	6.67	0.97	32.57	3.41
Bight '23	Bays	15.64	12.85	0.06	40.90	13.87
Bight '23	Inner Shelf	5.35	4.53	0.30	24.74	4.18
Bight '23	Middle Shelf	17.14	17.14	0.44	71.98	13.61

**Appendix B1.12. Summary of area weighted demersal fish Shannon Diversity (H') by stratum and survey for three strata. Note that slight differences from previous report are due to different inclusions/exclusions. See QAQC section for details.**

Survey	Stratum	Shannon Diversity (H')				
		Mean	Standard Deviation	Minimum	Maximum	Median
Bight '94	Inner Shelf	1.45	0.45	0.50	2.18	1.39
Bight '94	Middle Shelf	1.61	0.43	0.58	2.56	1.66
Bight '98	Bays	1.48	0.76	0.00	2.93	1.46
Bight '98	Inner Shelf	1.23	0.47	0.00	2.22	1.17
Bight '98	Middle Shelf	1.57	0.44	0.00	2.43	1.62
Bight '03	Bays	1.47	0.65	0.49	2.92	1.31
Bight '03	Inner Shelf	1.12	0.47	0.18	2.04	1.00
Bight '03	Middle Shelf	1.61	0.44	0.30	2.22	1.70
Bight '08	Bays	1.79	0.55	0.00	2.59	1.51
Bight '08	Inner Shelf	1.21	0.45	0.50	2.31	1.16
Bight '08	Middle Shelf	1.64	0.41	0.88	2.26	1.66
Bight '13	Bays	1.43	0.52	0.24	2.22	1.47
Bight '13	Inner Shelf	1.31	0.42	0.33	2.11	1.39
Bight '13	Middle Shelf	1.65	0.43	0.67	2.35	1.75
Bight '18	Bays	1.20	0.77	0.02	2.39	1.29
Bight '18	Inner Shelf	1.28	0.49	0.24	2.19	1.35
Bight '18	Middle Shelf	1.48	0.37	0.54	2.10	1.47
Bight '23	Bays	1.54	0.64	0.21	3.22	1.61
Bight '23	Inner Shelf	1.18	0.34	0.22	2.02	1.18
Bight '23	Middle Shelf	1.62	0.31	0.95	2.26	1.70

**Appendix B1.13. Summary of area weighted demersal fish richness by stratum and survey for three strata. Note that slight differences from previous report are due to different species inclusions/exclusions. See QAQC section for details.**

Survey	Stratum	Taxonomic Richness				
		Mean	Standard Deviation	Minimum	Maximum	Median
Bight '94	Inner Shelf	7.85	2.76	3	14	8
Bight '94	Middle Shelf	12.54	3.38	7	23	13
Bight '98	Bays	6.80	2.79	1	14	7
Bight '98	Inner Shelf	7.81	3.10	1	16	8
Bight '98	Middle Shelf	11.58	3.99	1	26	11
Bight '03	Bays	6.35	3.20	2	15	6
Bight '03	Inner Shelf	9.49	4.26	3	21	9
Bight '03	Middle Shelf	15.88	3.88	8	25	16
Bight '08	Bays	7.48	2.18	1	11	7
Bight '08	Inner Shelf	8.63	3.87	4	22	8.5
Bight '08	Middle Shelf	14.42	4.38	4	22	14
Bight '13	Bays	9.02	2.65	4	15	8
Bight '13	Inner Shelf	10.12	3.37	4	18	10
Bight '13	Middle Shelf	15.47	3.64	5	25	16
Bight '18	Bays	7.00	2.76	2	11	7
Bight '18	Inner Shelf	9.14	2.42	4	14	9
Bight '18	Middle Shelf	13.23	4.91	6	27	13.5
Bight '23	Bays	8.50	3.94	2	17	8
Bight '23	Inner Shelf	10.30	3.08	5	17	11
Bight '23	Middle Shelf	16.83	4.68	6	32	17

**Appendix B2.1. B'23 invertebrate abundance by stratum. Area weights and asterisk (total) represent the three strata only.**

Stratum	No. of Stations	Total	Min	Max	Area Weighted Values				% Above Median
					Median	Mean	SD	95 % CL	
Bays	30	37,150	4	25,986	169	1,238	4,667	1,670	-55.4
Inner Shelf	29	3,082	11	388	91	106	102	37	-76
Middle Shelf	29	15,287	33	5,269	170	527	992	361	-55.1
Total (all stations)*	88	55,519	4	25,986	112	382	1,080	223	

**Appendix B2.2. B'23 invertebrate biomass (kg) by stratum. Area weights and asterisk (total) represent the three strata only.**

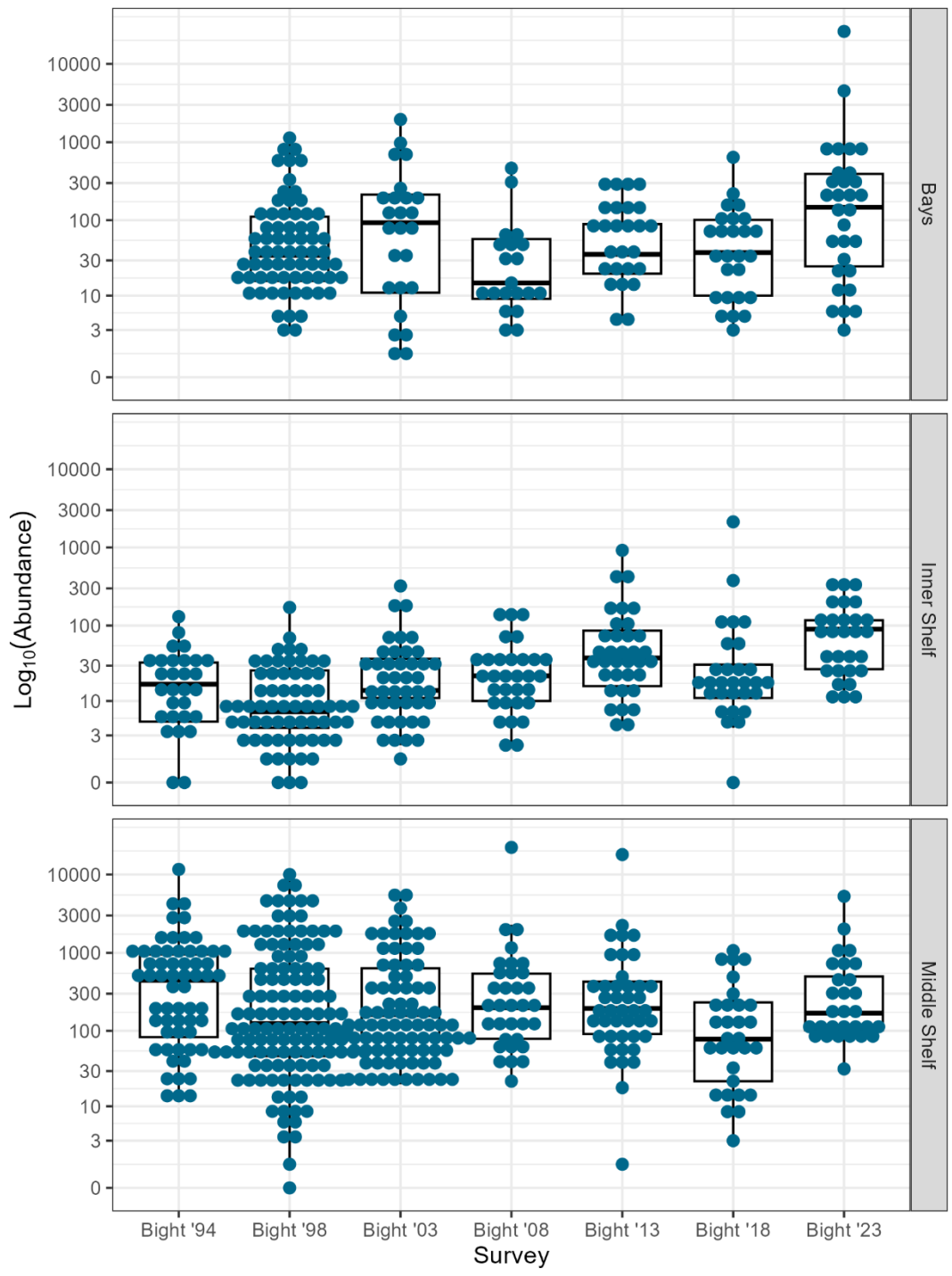
Stratum	No. of Stations	Total	Min	Max	Area Weighted Values				% Above Median
					Median	Mean	SD	95 % CL	
Bays	30	461.08	0.01	270.4	3.6	15.4	48.3	17.3	41.1
Inner Shelf	29	26.684	0.06	4.5	0.3	0.9	1.2	0.4	-87.4
Middle Shelf	29	97.851	0.23	20.9	1.3	3.4	5	1.8	-50.7
Total (all stations)*	88	585.615	0.01	270.4	0.9	2.7	8.7	1.2	

**Appendix B2.3. B'23 invertebrate Shannon-Weiner H' diversity index by stratum. Area weights and asterisk (total) represent the three strata only.**

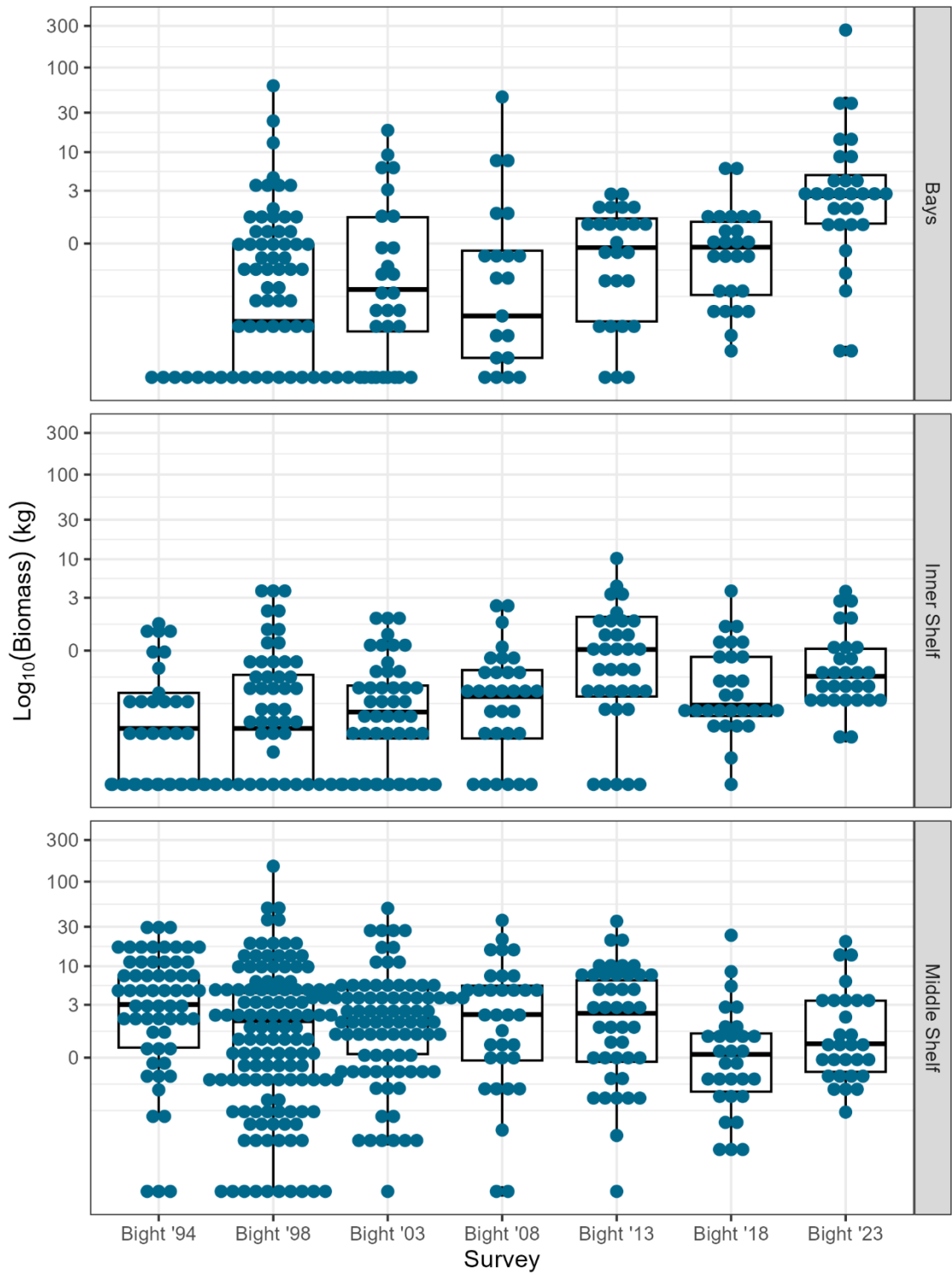
Stratum	No. of Stations	Min	Max	Area Weighted Values				
				Median	Mean	SD	95 % CL	% Above Median
Bays	30	0.01	1.8	0.86	0.79	0.54	0.19	-21.5
Inner Shelf	29	0.17	2.08	1.09	1.12	0.47	0.17	-0.6
Middle Shelf	29	0.17	2.29	1.26	1.19	0.62	0.22	14.1
Total (all stations)*	88	0.01	2.29	1.19	1.15	0.57	0.15	

**Appendix B2.4. B'23 invertebrate taxonomic richness by stratum. Area weights and asterisk (total) represents the two strata only.**

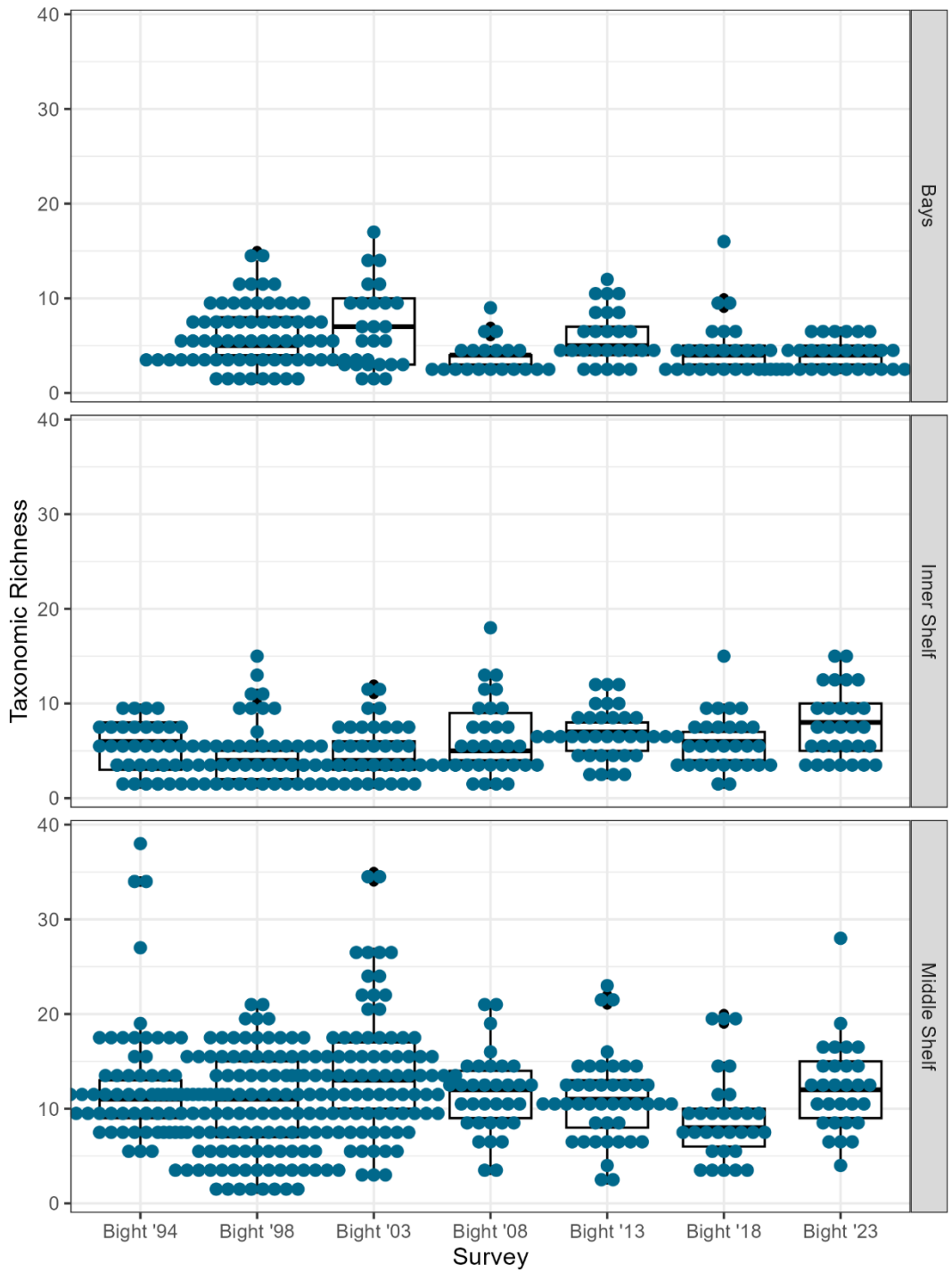
Stratum	No. of Stations	Total	Min	Max	Area Weighted Values				
					Median	Mean	SD	95 % CL	% Above Median
Bays	30	35	2	7	4	3.9	1.5	0.5	-63.6
Inner Shelf	29	62	3	15	8	7.7	3.6	1.3	-27.3
Middle Shelf	29	90	4	28	12	12.2	4.7	1.7	9.1
Total (all stations)*	88	137	2	28	10	10.3	4.9	1.3	



**Appendix B2.5. Megabenthic invertebrate log abundance by stratum and survey for three strata. Data are area weighted median, upper and lower quantiles, and results (represented by blue dots).**



**Appendix B2.6. Megabenthic invertebrate log biomass by stratum and survey for three strata. Data are area weighted median, upper and lower quantiles, and results (represented by blue dots).**



**Appendix B2.7. Megabenthic invertebrate taxonomic richness in the SCB by stratum and survey for three strata. Data are area weighted median, upper and lower quantiles, and results (represented by blue dots).**

**Appendix B2.8. Summary of area weighted megabenthic invertebrate abundance by stratum and survey for three strata. Note that slight differences from previous report are due to different inclusions/exclusions. See QAQC section for details.**

Survey	Stratum	Abundance				
		Mean	Standard Deviation	Minimum	Maximum	Median
Bight '94	Inner Shelf	26.86	27.90	1	131	18
Bight '94	Middle Shelf	880.66	1888.58	14	11617	447
Bight '98	Bays	121.98	218.85	4	1134	36
Bight '98	Inner Shelf	16.85	18.17	1	172	8
Bight '98	Middle Shelf	614.29	1205.99	1	10005	125
Bight '03	Bays	246.28	429.49	2	1950	94
Bight '03	Inner Shelf	32.29	38.98	2	323	15
Bight '03	Middle Shelf	668.97	1133.10	21	5617	163
Bight '08	Bays	53.80	96.60	4	466	16
Bight '08	Inner Shelf	34.97	37.47	3	160	23
Bight '08	Middle Shelf	1055.91	3767.10	23	22179	200
Bight '13	Bays	80.17	85.99	5	316	37
Bight '13	Inner Shelf	88.75	170.61	5	921	39
Bight '13	Middle Shelf	1048.94	3221.21	2	17970	195
Bight '18	Bays	81.23	134.97	4	642	39.5
Bight '18	Inner Shelf	114.38	387.23	1	2128	19
Bight '18	Middle Shelf	210.37	285.37	4	1069	81
Bight '23	Bays	1238.33	4703.11	4	25986	169
Bight '23	Inner Shelf	105.10	102.60	11	388	91
Bight '23	Middle Shelf	526.86	992.76	33	5269	170

**Appendix B2.9. Summary of area weighted megabenthic invertebrate biomass by stratum and survey for three strata. Note that slight differences from previous reports are due to different inclusions/exclusions. See QAQC section for details.**

Survey	Stratum	Biomass (kg)				
		Mean	Standard Deviation	Minimum	Maximum	Median
Bight '94	Inner Shelf	0.41	0.58	0.03	2.03	0.13
Bight '94	Middle Shelf	6.65	7.23	0.03	31.83	4.03
Bight '98	Bays	1.76	7.25	0.03	62.70	0.13
Bight '98	Inner Shelf	0.64	1.28	0.03	5.31	0.13
Bight '98	Middle Shelf	4.89	9.85	0.03	151.53	2.63
Bight '03	Bays	2.30	4.47	0.03	19.50	0.30
Bight '03	Inner Shelf	0.41	0.56	0.03	2.60	0.20
Bight '03	Middle Shelf	6.39	9.50	0.03	50.20	3.50
Bight '08	Bays	2.67	8.69	0.03	46.73	0.15
Bight '08	Inner Shelf	0.58	0.82	0.03	3.50	0.30
Bight '08	Middle Shelf	6.08	7.89	0.03	36.68	3.10
Bight '13	Bays	1.29	1.23	0.03	4.03	0.90
Bight '13	Inner Shelf	1.70	2.31	0.03	11.23	1.03
Bight '13	Middle Shelf	4.81	5.38	0.03	35.80	3.20
Bight '18	Bays	1.38	1.96	0.06	7.65	0.87
Bight '18	Inner Shelf	0.67	0.94	0.03	4.78	0.24
Bight '18	Middle Shelf	2.39	4.61	0.09	24.77	1.03
Bight '23	Bays	15.39	48.70	0.06	270.40	3.68
Bight '23	Inner Shelf	0.99	1.18	0.09	4.74	0.51
Bight '23	Middle Shelf	3.52	4.98	0.24	21.01	1.44

**Appendix B2.10. Summary of area weighted megabenthic invertebrate taxonomic richness by stratum and survey for three strata. Note that slight differences from previous reports are due to different inclusions/exclusions. See QAQC section for details.**

Survey	Stratum	Taxonomic Richness				
		Mean	Standard Deviation	Minimum	Maximum	Median
Bight '94	Inner Shelf	5.69	2.59	1	10	6
Bight '94	Middle Shelf	12.12	6.26	5	38	11
Bight '98	Bays	5.85	3.08	1	15	5
Bight '98	Inner Shelf	4.43	2.99	1	15	4
Bight '98	Middle Shelf	11.11	4.94	1	21	11
Bight '03	Bays	7.04	4.38	1	17	7
Bight '03	Inner Shelf	4.50	2.35	1	12	4
Bight '03	Middle Shelf	14.66	6.63	3	35	13
Bight '08	Bays	3.93	1.89	2	9	4
Bight '08	Inner Shelf	6.35	3.97	1	18	5
Bight '08	Middle Shelf	11.61	4.16	3	21	12
Bight '13	Bays	5.67	2.56	2	12	5
Bight '13	Inner Shelf	6.91	2.55	2	12	7
Bight '13	Middle Shelf	11.28	4.50	2	23	11
Bight '18	Bays	4.81	3.27	2	16	4.5
Bight '18	Inner Shelf	5.97	2.81	1	15	6
Bight '18	Middle Shelf	9.00	4.58	3	20	8
Bight '23	Bays	3.97	1.55	2	7	4
Bight '23	Inner Shelf	7.66	3.64	3	15	8
Bight '23	Middle Shelf	12.24	4.73	4	28	12

**Appendix B2.11. Summary of area weighted megabenthic invertebrate Shannon diversity (H') by stratum and survey for three strata. Note that slight differences from previous reports are due to different inclusions/exclusions. See QAQC section for details.**

Survey	Stratum	Shannon Diversity (H')				
		Mean	Standard Deviation	Minimum	Maximum	Median
Bight '94	Inner Shelf	1.14	0.54	0.00	1.93	1.24
Bight '94	Middle Shelf	0.97	0.60	0.03	2.37	0.78
Bight '98	Bays	1.51	0.64	0.00	3.27	1.51
Bight '98	Inner Shelf	1.02	0.50	0.00	2.30	1.07
Bight '98	Middle Shelf	1.10	0.66	0.00	2.34	1.02
Bight '03	Bays	1.51	0.83	0.00	3.24	1.54
Bight '03	Inner Shelf	0.92	0.55	0.00	2.02	0.85
Bight '03	Middle Shelf	1.24	0.75	0.07	2.75	1.17
Bight '08	Bays	1.24	0.62	0.08	2.56	1.33
Bight '08	Inner Shelf	1.24	0.62	0.00	2.22	1.30
Bight '08	Middle Shelf	1.02	0.66	0.04	2.22	1.16
Bight '13	Bays	1.08	0.55	0.12	2.29	0.95
Bight '13	Inner Shelf	1.23	0.47	0.11	1.98	1.39
Bight '13	Middle Shelf	1.10	0.65	0.09	2.49	1.13
Bight '18	Bays	1.13	0.76	0.10	3.04	0.98
Bight '18	Inner Shelf	1.16	0.55	0.00	2.12	1.12
Bight '18	Middle Shelf	1.15	0.53	0.35	2.57	1.05
Bight '23	Bays	0.80	0.55	0.01	1.80	0.86
Bight '23	Inner Shelf	1.12	0.47	0.17	2.14	1.09
Bight '23	Middle Shelf	1.19	0.62	0.17	2.29	1.26

## APPENDIX C - TAXONOMIC LISTINGS WITH ASSOCIATED DATA

Appendix C-1. Taxonomic listing of demersal fish species collected during the Bight '23 trawl survey with size information. Data are fish abundance (N), mean length (cm), standard deviation (Std Dev), and minimum (Min) and maximum (Max) standard length (cm). Taxonomic classification and scientific names from Love and Passarelli (2020) with Elasmobranchii elevated to Class for clarity. Asterisk means totals are only for the three strata.

Class	Order	Family	Species	Common	N*	Mean	StdDev	Min	Max
<b>Elasmobranchii</b>									
	<b>Heterodontiformes</b>								
		Heterodontidae	<i>Heterodontus francisci</i>	Horn Shark	1	77		77	77
	<b>Carcharhiniformes</b>								
		Scyliorhinidae	<i>Cephaloscyllium ventriosum</i>	Swell Shark	1	19		19	19
		Triakidae	<i>Mustelus henlei</i>	Brown Smoothhound	1	57		57	57
	<b>Squatiniformes</b>								
		Squatinidae	<i>Squatina californica</i>	Pacific Angel Shark	3	100	10	92	111
	<b>Torpediniformes</b>								
		Torpedinidae	<i>Torpedo californica</i>	Pacific Electric Ray	1	21		21	21
	<b>Rhinopristiformes</b>								
		Rhinobatidae	<i>Rhinobatos productus</i>	Shovelnose Guitarfish	3	83	33	56	119
	<b>Rajiformes</b>								
		Rajidae	<i>Beringraja inornata</i>	California Skate	26	32	10	14	52
			<i>Beringraja binoculata</i>	Big Skate	2	32	9	25	38
	<b>Myliobatiformes</b>								
		Platyrrhinidae	<i>Platyrrhinoidis triseriata</i>	Thornback	2	34	2	32	35
		Urotrygonidae	<i>Urobatis halleri</i>	Round Stingray	33	27	6	17	38
		Gymnuridae	<i>Gymnura marmorata</i>	California Butterfly Ray	2	29	6	25	33
		Myliobatidae	<i>Myliobatis californica</i>	Bat Ray	1	97		97	97
<b>Actinopterygii</b>									
	<b>Clupeiformes</b>								
		Engraulidae	<i>Anchoa compressa</i>	Deepbody Anchovy	3	11	2	10	13
			<i>Anchoa delicatissima</i>	Slough Anchovy	12	6	1	3	7
			<i>Engraulis mordax</i>	Northern Anchovy	25	10	1	8	12
		Clupeidae	<i>Sardinops sagax</i>	Pacific Sardine	6	15	1	13	17
	<b>Argentiniformes</b>								
		Argentinidae	<i>Argentina sialis</i>	Pacific Argentine	10	6	1	4	8
	<b>Aulopiformes</b>								
		Synodontidae	<i>Synodus lucioceps</i>	California Lizardfish	381	12	2	8	20
	<b>Gadiformes</b>								
		Merlucciidae	<i>Merluccius productus</i>	Pacific Hake	1	27		27	27
	<b>Ophidiiformes</b>								
		Ophidiidae	<i>Chilara taylori</i>	Spotted Cusk-eel	4	18	2	15	21
	<b>Batrachoidiformes</b>								
		Batrachoididae	<i>Porichthys myriaster</i>	Specklefin Midshipman	41	14	6	5	28
			<i>Porichthys notatus</i>	Plainfin Midshipman	42	13	2	10	19
	<b>Atheriniformes</b>								
		Atherinopsidae	<i>Atherinops affinis</i>	Topsmelt	1	13		13	13
			<i>Atherinopsis californiensis</i>	Jacksmelt	1	21		21	21
	<b>Gasterosteiformes</b>								
		Syngnathidae	<i>Syngnathus californiensis</i>	Kelp Pipefish	29	21	4	13	28
			<i>Syngnathus exilis</i>	Barcheek Pipefish	23	20	4	15	28
			<i>Syngnathus leptorhynchus</i>	Bay Pipefish	1	14		14	14
			<i>Syngnathus sp.</i>	Unknown Pipefish	3	20	1	19	21
	<b>Scorpaeniformes</b>								
		Scorpaenidae	<i>Scorpaena guttata</i>	California Scorpionfish	93	19	4	9	28
			<i>Sebastes chlorostictus</i>	Greenspotted Rockfish	7	12	2	9	15

	<i>Sebastes dallii</i>	Calico Rockfish	19	12	2	9	14
	<i>Sebastes elongatus</i>	Greenstriped Rockfish	3	13	1	12	14
	<i>Sebastes eos</i>	Pink Rockfish	1	12		12	12
	<i>Sebastes goodei</i>	Chilipepper	18	11	3	7	17
	<i>Sebastes helvomaculatus</i>	Rosethorn Rockfish	2	12	1	12	13
	<i>Sebastes hopkinsi</i>	Squarespot Rockfish	3	11	4	7	14
	<i>Sebastes jordani</i>	Shortbelly Rockfish	2	10	1	9	11
	<i>Sebastes levis</i>	Cowcod	11	10	3	6	17
	<i>Sebastes miniatus</i>	Vermilion Rockfish	53	12	5	6	25
	<i>Sebastes paucispinis</i>	Bocaccio	8	10	2	7	12
	<i>Sebastes rosaceus</i>	Rosy Rockfish	4	14	3	10	16
	<i>Sebastes rosenblatti</i>	Greenblotched Rockfish	7	10	2	7	13
	<i>Sebastes rubrivinctus</i>	Flag Rockfish	9	11	2	8	13
	<i>Sebastes saxicola</i>	Stripetail Rockfish	63	8	2	4	14
	<i>Sebastes semicinctus</i>	Halfbanded Rockfish	71	10	3	4	16
	<i>Sebastes umbrosus</i>	Honeycomb Rockfish	2	10	1	9	11
	<i>Sebastes sp.</i>	Unknown Rockfish	2	4	1	3	4
Triglidae	<i>Prionotus stephanophrys</i>	Lumptail Searobin	2	22	2	21	24
Hexagrammidae	<i>Ophiodon elongatus</i>	Lingcod	1	19		19	19
	<i>Oxylebius pictus</i>	Painted Greenling	1	14		14	14
	<i>Zaniolepis frenata</i>	Shortspine Combfish	56	12	3	7	18
	<i>Zaniolepis latipinnis</i>	Longspine Combfish	131	12	3	5	16
Psychrolutidae	<i>Chitonotus pugetensis</i>	Roughback Sculpin	69	9	2	5	13
	<i>Icelinus limbaughi</i>	Canyon Sculpin	1	8		8	8
	<i>Icelinus quadriseriatus</i>	Yellowchin Sculpin	89	7	1	4	9
	<i>Icelinus tenuis</i>	Spotfin Sculpin	4	9	2	7	11
Cottidae	<i>Leptocottus armatus</i>	Pacific Staghorn Sculpin	8	12	2	10	15
	<i>Scorpaenichthys marmoratus</i>	Cabezon	1	7		7	7
Agonidae	<i>Agonopsis sterletus</i>	Southern Spearnose Poacher	8	10	2	6	12
	<i>Odontopyxis trispinosa</i>	Pygmy Poacher	29	8	1	4	9
	<i>Xeneretmus latifrons</i>	Blacktip Poacher	1	14		14	14
	<i>Xeneretmus triacanthus</i>	Bluespotted Poacher	1	14		14	14
<b>Perciformes</b>							
Serranidae	<i>Paralabrax clathratus</i>	Kelp Bass	2	12	1	12	13
	<i>Paralabrax maculatofasciatus</i>	Spotted Sand Bass	24	24	4	19	32
	<i>Paralabrax nebulifer</i>	Barred Sand Bass	28	14	5	8	27
Malacanthidae	<i>Caulolatilus princeps</i>	Ocean Whitefish	3	13	3	10	15
Carangidae	<i>Trachurus symmetricus</i>	Jack Mackerel	2	12	1	12	13
Haemulidae	<i>Haemulon californiense</i>	Salema	1	9		9	9
Sciaenidae	<i>Cheilotrema saturnum</i>	Black Croaker	3	21	2	19	23
	<i>Genyonemus lineatus</i>	White Croaker	208	14	4	4	22
	<i>Menticirrhus undulatus</i>	California Corbina	1	23		23	23
	<i>Seriphus politus</i>	Queenfish	57	12	3	7	20
	<i>Umbrina roncadore</i>	Yellowfin Croaker	2	14	1	14	15
Embiotocidae	<i>Cymatogaster aggregata</i>	Shiner Perch	52	8	2	4	12
	<i>Embiotoca jacksoni</i>	Black Perch	2	7	0	7	7
	<i>Phanerodon furcatus</i>	White Seaperch	7	13	3	8	16
	<i>Zalembeius rosaceus</i>	Pink Seaperch	104	9	2	5	15
Labridae	<i>Oxyjulis californica</i>	Senorita	1	22		22	22
	<i>Bodianus pulcher</i>	California Sheephead	1	25		25	25
Bathymasteridae	<i>Rathbunella hypoplecta</i>	Bluebanded Ronquil	1	14		14	14
Zoarcidae	<i>Lycodes cortezianus</i>	Bigfin Eelpout	2	24	1	23	25
	<i>Lycodes pacificus</i>	Blackbelly Eelpout	10	20	3	13	25
Stichaeidae	<i>Plectobanchus evides</i>	Bluebarred Prickleback	1	11		11	11
Uranoscopidae	<i>Kathetostoma averruncus</i>	Smooth Stargazer	2	14	2	13	16
Blenniidae	<i>Hypsoblennius gentilis</i>	Bay Blenny	1	10		10	10
Clinidae	<i>Heterostichus rostratus</i>	Giant Kelpfish	4	10	2	7	12

Gobiidae	<i>Lepidogobius lepidus</i>	Bay Goby	5	8	1	6	9	
Stromateidae	<i>Peprilus simillimus</i>	Pacific Pompano	4	10	1	9	12	
<b>Pleuronectiformes</b>								
Paralichthyidae	<i>Citharichthys fragilis</i>	Gulf Sanddab	1	11		11	11	
	<i>Citharichthys sordidus</i>	Pacific Sanddab	470	11	5	3	27	
	<i>Citharichthys stigmaeus</i>	Speckled Sanddab	297	7	2	3	18	
	<i>Citharichthys xanthostigma</i>	Longfin Sanddab	297	12	4	4	22	
	<i>Hippoglossina stomata</i>	Bigmouth Sole	74	16	4	8	25	
	<i>Paralichthys californicus</i>	California Halibut	75	22	10	8	68	
	<i>Xystreurus liolepis</i>	Fantail Sole	56	15	4	10	27	
	Pleuronectidae	<i>Lyopsetta exilis</i>	Slender Sole	32	12	3	8	18
		<i>Microstomus pacificus</i>	Dover Sole	110	13	4	5	24
<i>Parophrys vetulus</i>		English Sole	119	17	6	6	29	
<i>Pleuronichthys coenosus</i>		C-O Sole	1	19		19	19	
<i>Pleuronichthys decurrens</i>		Curlfin Sole	14	14	3	6	18	
<i>Pleuronichthys guttulatus</i>		Diamond Turbot	8	19	4	11	23	
<i>Pleuronichthys ritteri</i>		Spotted Turbot	36	16	3	11	25	
<i>Pleuronichthys verticalis</i>		Hornyhead Turbot	218	14	4	4	25	
Cynoglossidae		<i>Symphurus atricaudus</i>	California Tonguefish	247	12	3	6	18

**Appendix C-2. Summary of demersal fish species collected in Bays during the Bight '23 trawl survey. Data are % abundance, % biomass, frequency of occurrence and Ecological Index.**

Species Name	Common Name	Bays			Ecological Index
		% Abundance	% Biomass	% Frequency	
<i>Genyonemus lineatus</i>	White Croaker	65.80	63.33	50.00	6456.56
<i>Synodus lucioceps</i>	California Lizardfish	7.63	2.74	70.00	726.24
<i>Citharichthys stigmaeus</i>	Speckled Sanddab	8.76	1.99	53.33	573.33
<i>Paralichthys californicus</i>	California Halibut	1.06	4.41	76.67	419.03
<i>Urobatis halleri</i>	Round Stingray	0.60	4.36	33.33	165.16
<i>Seriphus politus</i>	Queenfish	2.40	1.44	36.67	140.58
<i>Paralabrax maculatofasciatus</i>	Spotted Sand Bass	0.39	3.84	26.67	112.69
<i>Symphurus atricaudus</i>	California Tonguefish	1.70	0.20	56.67	107.71
<i>Anchoa delicatissima</i>	Slough Anchovy	5.02	0.26	16.67	87.95
<i>Cymatogaster aggregata</i>	Shiner Perch	1.60	0.52	40.00	84.71
<i>Porichthys myriaster</i>	Specklefin Midshipman	0.52	0.63	50.00	57.30
<i>Paralabrax nebulifer</i>	Barred Sand Bass	0.59	0.57	40.00	46.32
<i>Rhinobatos productus</i>	Shovelnose Guitarfish	0.04	4.10	10.00	41.46
<i>Xystreureys liolepis</i>	Fantail Sole	0.35	0.74	36.67	39.75
<i>Engraulis mordax</i>	Northern Anchovy	1.00	0.28	26.67	34.34
<i>Pleuronichthys guttulatus</i>	Diamond Turbot	0.08	0.56	20.00	12.87
<i>Squatina californica</i>	Pacific Angel Shark	0.01	3.62	3.33	12.12
<i>Pleuronichthys ritteri</i>	Spotted Turbot	0.20	0.32	20.00	10.25
<i>Pleuronichthys verticalis</i>	Hornyhead Turbot	0.20	0.33	16.67	8.78
<i>Sebastes miniatus</i>	Vermilion Rockfish	0.43	0.19	13.33	8.27
<i>Sebastes goodei</i>	Chilipepper	0.49	0.13	10.00	6.17
<i>Heterodontus francisci</i>	Horn Shark	0.01	1.84	3.33	6.17
<i>Myliobatis californica</i>	Bat Ray	0.01	1.61	3.33	5.40
<i>Citharichthys xanthostigma</i>	Longfin Sanddab	0.13	0.34	10.00	4.66
<i>Beringraja inornata</i>	California Skate	0.06	0.36	10.00	4.18
<i>Cheilotrema saturnum</i>	Black Croaker	0.04	0.25	10.00	2.89
<i>Sebastes paucispinis</i>	Bocaccio	0.18	0.08	10.00	2.62
<i>Zaniolepis latipinnis</i>	Longspine Combfish	0.21	0.13	6.67	2.29
<i>Gymnura marmorata</i>	California Butterfly Ray	0.01	0.47	3.33	1.61
<i>Anchoa compressa</i>	Deepbody Anchovy	0.07	0.03	6.67	0.64
<i>Parophrys vetulus</i>	English Sole	0.03	0.04	6.67	0.48
<i>Leptocottus armatus</i>	Pacific Staghorn Sculpin	0.03	0.04	6.67	0.46
<i>Menticirrhus undulatus</i>	California Corbina	0.01	0.09	3.33	0.33
<i>Paralabrax clathratus</i>	Kelp Bass	0.04	0.05	3.33	0.31
<i>Embiotoca jacksoni</i>	Black Perch	0.03	0.01	6.67	0.28
<i>Umbrina roncadore</i>	Yellowfin Croaker	0.03	0.00	6.67	0.21
<i>Icelinus quadriseriatus</i>	Yellowchin Sculpin	0.04	0.02	3.33	0.20
<i>Phanerodon furcatus</i>	White Seaperch	0.01	0.02	3.33	0.12
<i>Hypsoblennius gentilis</i>	Bay Blenny	0.03	0.00	3.33	0.10
<i>Syngnathus californiensis</i>	Kelp Pipefish	0.03	0.00	3.33	0.10
<i>Sardinops sagax</i>	Pacific Sardine	0.01	0.02	3.33	0.10
<i>Atherinops affinis</i>	Topsmelt	0.01	0.02	3.33	0.10
<i>Lepidogobius lepidus</i>	Bay Goby	0.01	0.01	3.33	0.08
<i>Syngnathus exilis</i>	Barcheek Pipefish	0.01	0.00	3.33	0.05
<i>Syngnathus leptorhynchus</i>	Bay Pipefish	0.01	0.00	3.33	0.05
<i>Scorpaena guttata</i>	California Scorpionfish	0.01	0.00	3.33	0.05
<i>Heterostichus rostratus</i>	Giant Kelpfish	0.01	0.00	3.33	0.05
<i>Zalembius rosaceus</i>	Pink Seaperch	0.01	0.00	3.33	0.05
<i>Porichthys notatus</i>	Plainfin Midshipman	0.01	0.00	3.33	0.05
<i>Haemulon californiensis</i>	Salema	0.01	0.00	3.33	0.05

**Appendix C-3. Summary of demersal fish species collected on the Inner Shelf during the Bight '23 trawl survey. Data are % abundance, % biomass, frequency of occurrence and Ecological Index.**

Species Name	Common Name	Inner Shelf			Ecological Index
		% Abundance	% Biomass	% Frequency	
<i>Citharichthys stigmaeus</i>	Speckled Sanddab	37.54	16.17	90.00	4833.52
<i>Synodus lucioceps</i>	California Lizardfish	32.70	18.88	93.33	4813.75
<i>Pleuronichthys verticalis</i>	Hornyhead Turbot	1.63	11.00	83.33	1052.27
<i>Citharichthys xanhostigma</i>	Longfin Sanddab	3.46	9.44	56.67	730.66
<i>Citharichthys sordidus</i>	Pacific Sanddab	3.18	2.52	50.00	284.89
<i>Icelinus quadriseriatus</i>	Yellowchin Sculpin	4.88	1.14	40.00	240.93
<i>Symphurus atricaudus</i>	California Tonguefish	1.54	1.45	76.67	229.06
<i>Parophrys vetulus</i>	English Sole	1.23	2.97	53.33	224.12
<i>Xystreurus liolepis</i>	Fantail Sole	0.39	2.36	56.67	155.89
<i>Pleuronichthys ritteri</i>	Spotted Turbot	0.28	2.24	40.00	100.94
<i>Squatina californica</i>	Pacific Angel Shark	0.02	10.90	6.67	72.81
<i>Genyonemus lineatus</i>	White Croaker	2.79	4.28	10.00	70.69
<i>Paralichthys californicus</i>	California Halibut	0.11	4.24	13.33	57.91
<i>Syngnathus californiensis</i>	Kelp Pipefish	1.33	0.29	30.00	48.52
<i>Zaniolepis latipinnis</i>	Longspine Combfish	0.63	0.93	20.00	31.21
<i>Beringraja inornata</i>	California Skate	0.10	1.68	16.67	29.55
<i>Engraulis mordax</i>	Northern Anchovy	5.33	2.77	3.33	26.99
<i>Hippoglossina stomata</i>	Bigmouth Sole	0.11	1.00	23.33	25.92
<i>Cymatogaster aggregata</i>	Shiner Perch	0.65	0.39	23.33	24.16
<i>Porichthys myriaster</i>	Specklefin Midshipman	0.13	0.76	23.33	20.58
<i>Zalembeus rosaceus</i>	Pink Seaperch	0.38	0.29	16.67	11.07
<i>Syngnathus exilis</i>	Barcheek Pipefish	0.29	0.08	23.33	8.75
<i>Scorpaena guttata</i>	California Scorpionfish	0.05	0.53	13.33	7.74
<i>Seriphus politus</i>	Queenfish	0.21	0.55	10.00	7.61
<i>Pleuronichthys decurrens</i>	Curlfin Sole	0.08	0.37	16.67	7.52
<i>Chitonotus pugetensis</i>	Roughback Sculpin	0.18	0.13	20.00	6.26
<i>Paralabrax nebulifer</i>	Barred Sand Bass	0.03	0.58	10.00	6.11
<i>Odontopyxis trispinosa</i>	Pygmy Poacher	0.19	0.05	16.67	4.07
<i>Leptocottus armatus</i>	Pacific Staghorn Sculpin	0.07	0.16	10.00	2.26
<i>Sebastes miniatus</i>	Vermilion Rockfish	0.15	0.05	10.00	1.92
<i>Platyrrhinoidis triseriata</i>	Thornback	0.02	0.22	6.67	1.58
<i>Mustelus henlei</i>	Brown Smoothhound	0.01	0.40	3.33	1.38
<i>Gymnura marmorata</i>	California Butterfly Ray	0.01	0.34	3.33	1.17
<i>Pleuronichthys guttulatus</i>	Diamond Turbot	0.02	0.14	6.67	1.08
<i>Heterostichus rostratus</i>	Giant Kelpfish	0.05	0.03	10.00	0.79
<i>Urobatis halleri</i>	Round Stingray	0.01	0.19	3.33	0.66
<i>Pleuronichthys coenosus</i>	C-O Sole	0.01	0.12	3.33	0.45
<i>Peprilus simillimus</i>	Pacific Pompano	0.11	0.02	3.33	0.44
<i>Torpedo californica</i>	Pacific Electric Ray	0.01	0.09	3.33	0.34
<i>Trachurus symmetricus</i>	Jack Mackerel	0.04	0.06	3.33	0.34
<i>Atherinopsis californiensis</i>	Jacksmelt	0.01	0.07	3.33	0.26
<i>Beringraja binoculata</i>	Big Skate	0.01	0.06	3.33	0.22
<i>Agonopsis sterletus</i>	Southern Spearnose Poacher	0.02	0.00	6.67	0.16
<i>Syngnathus sp.</i>	Unknown Pipefish	0.04	0.00	3.33	0.14
<i>Phanerodon furcatus</i>	White Seaperch	0.01	0.02	3.33	0.12
<i>Caulolatilus princeps</i>	Ocean Whitefish	0.01	0.00	3.33	0.04
<i>Porichthys notatus</i>	Plainfin Midshipman	0.01	0.00	3.33	0.04

**Appendix C-4. Summary of demersal fish species collected on the Middle Shelf during the Bight '23 trawl survey. Data are % abundance, % biomass, frequency of occurrence and Ecological Index.**

Species Name	Common Name	Middle Shelf			Ecological Index
		% Abundance	% Biomass	% Frequency	
<i>Citharichthys sordidus</i>	Pacific Sanddab	26.33	16.32	100.00	4265.63
<i>Sebastes semicinctus</i>	Halfbanded Rockfish	18.50	17.94	55.17	2010.59
<i>Synodus lucioceps</i>	California Lizardfish	14.68	4.82	96.55	1883.01
<i>Citharichthys xanthostigma</i>	Longfin Sanddab	9.48	12.07	86.21	1857.68
<i>Scorpaena guttata</i>	California Scorpionfish	1.88	19.10	62.07	1302.36
<i>Zalemnius rosaceus</i>	Pink Seaperch	3.44	3.15	79.31	523.06
<i>Icelinus quadriseriatus</i>	Yellowchin Sculpin	4.03	0.72	82.76	392.83
<i>Symphurus atricaudus</i>	California Tonguefish	2.28	1.70	89.66	356.52
<i>Microstomus pacificus</i>	Dover Sole	2.20	2.88	55.17	280.61
<i>Parophrys vetulus</i>	English Sole	0.65	3.13	68.97	260.86
<i>Sebastes saxicola</i>	Stripetail Rockfish	2.84	1.76	55.17	253.84
<i>Zaniolepis latipinnis</i>	Longspine Combfish	2.28	1.09	68.97	232.38
<i>Pleuronichthys verticalis</i>	Hornyhead Turbot	0.66	2.17	75.86	214.34
<i>Citharichthys stigmaeus</i>	Speckled Sanddab	3.47	0.93	37.93	167.01
<i>Sebastes miniatus</i>	Vermilion Rockfish	0.57	2.79	34.48	115.67
<i>Zaniolepis frenata</i>	Shortspine Combfish	1.74	1.15	37.93	109.57
<i>Hippoglossina stomata</i>	Bigmouth Sole	0.50	1.00	68.97	103.75
<i>Chitonotus pugetensis</i>	Roughback Sculpin	0.96	0.70	51.72	85.48
<i>Porichthys notatus</i>	Plainfin Midshipman	0.38	0.34	41.38	29.74
<i>Beringraja inornata</i>	California Skate	0.06	0.80	34.48	29.49
<i>Sebastes goodei</i>	Chilipepper	1.20	1.96	6.90	21.83
<i>Lyopsetta exilis</i>	Slender Sole	0.46	0.31	24.14	18.54
<i>Paralichthys californicus</i>	California Halibut	0.02	1.13	13.79	15.87
<i>Sebastes dallii</i>	Calico Rockfish	0.17	0.15	41.38	13.23
<i>Odontopyxis trispinosa</i>	Pygmy Poacher	0.16	0.03	37.93	7.32
<i>Sebastes levis</i>	Cowcod	0.05	0.06	24.14	2.81
<i>Sebastes rubrivinctus</i>	Flag Rockfish	0.06	0.08	13.79	2.04
<i>Sebastes rosenblatti</i>	Greenblotched Rockfish	0.06	0.08	13.79	1.95
<i>Pleuronichthys decurrens</i>	Curlfin Sole	0.04	0.12	10.34	1.65
<i>Argentina sialis</i>	Pacific Argentine	0.10	0.02	13.79	1.64
<i>Xystreureys liolepis</i>	Fantail Sole	0.03	0.10	10.34	1.39
<i>Lycodes pacificus</i>	Blackbelly Eelpout	0.05	0.06	10.34	1.19
<i>Sebastes chlorostictus</i>	Greenspotted Rockfish	0.08	0.12	3.45	0.68
<i>Agonopsis sterletus</i>	Southern Spearnose Poacher	0.03	0.01	17.24	0.66
<i>Cymatogaster aggregata</i>	Shiner Perch	0.06	0.00	10.34	0.65
<i>Porichthys myriaster</i>	Specklefin Midshipman	0.01	0.07	6.90	0.57
<i>Sebastes rosaceus</i>	Rosy Rockfish	0.02	0.06	6.90	0.56
<i>Phanerodon furcatus</i>	White Seaperch	0.03	0.12	3.45	0.52
<i>Sardinops sagax</i>	Pacific Sardine	0.05	0.08	3.45	0.44
<i>Paralabrax nebulifer</i>	Barred Sand Bass	0.00	0.12	3.45	0.43
<i>Sebastes elongatus</i>	Greenstriped Rockfish	0.02	0.04	6.90	0.42
<i>Pleuronichthys ritteri</i>	Spotted Turbot	0.02	0.10	3.45	0.41
<i>Lepidogobius lepidus</i>	Bay Goby	0.05	0.01	6.90	0.40
<i>Prionotus stephanophrys</i>	Lumptail Searobin	0.01	0.10	3.45	0.38
<i>Chilara taylori</i>	Spotted Cusk-eel	0.02	0.03	6.90	0.34
<i>Icelinus tenuis</i>	Spotfin Sculpin	0.06	0.04	3.45	0.34
<i>Sebastes hopkinsi</i>	Squarespot Rockfish	0.02	0.03	6.90	0.33
<i>Kathetostoma avarruncus</i>	Smooth Stargazer	0.01	0.08	3.45	0.31
<i>Beringraja binoculata</i>	Big Skate	0.00	0.08	3.45	0.29
<i>Bodianus pulcher</i>	California Sheephead	0.00	0.06	3.45	0.22

Species Name	Common Name	Middle Shelf			Ecological Index
		% Abundance	% Biomass	% Frequency	
<i>Merluccius productus</i>	Pacific Hake	0.00	0.06	3.45	0.22
<i>Sebastes jordani</i>	Shortbelly Rockfish	0.02	0.02	3.45	0.15
<i>Rathbunella hypoplecta</i>	Bluebanded Ronquil	0.00	0.02	3.45	0.09
<i>Oxyjulis californica</i>	Senorita	0.00	0.02	3.45	0.09
<i>Xeneretmus triacanthus</i>	Bluespotted Poacher	0.00	0.02	3.45	0.08
<i>Sebastes umbrosus</i>	Honeycomb Rockfish	0.01	0.00	6.90	0.08
<i>Sebastes sp.</i>	Unknown Rockfish	0.01	0.00	6.90	0.08
<i>Lycodes cortezianus</i>	Bigfin Eelpout	0.01	0.00	3.45	0.06
<i>Ophiodon elongatus</i>	Lingcod	0.00	0.01	3.45	0.05
<i>Syngnathus californiensis</i>	Kelp Pipefish	0.01	0.00	3.45	0.04
<i>Caulolatilus princeps</i>	Ocean Whitefish	0.01	0.00	3.45	0.04
<i>Sebastes helvomaculatus</i>	Rosethorn Rockfish	0.01	0.00	3.45	0.04
<i>Engraulis mordax</i>	Northern Anchovy	0.00	0.00	3.45	0.02
<i>Xeneretmus latifrons</i>	Blacktip Poacher	0.00	0.00	3.45	0.02
<i>Plectobranchnus evides</i>	Bluebarred Prickleback	0.00	0.00	3.45	0.02
<i>Sebastes paucispinis</i>	Bocaccio	0.00	0.00	3.45	0.02
<i>Scorpaenichthys marmoratus</i>	Cabazon	0.00	0.00	3.45	0.02
<i>Icelinus limbaughi</i>	Canyon Sculpin	0.00	0.00	3.45	0.02
<i>Citharichthys fragilis</i>	Gulf Sanddab	0.00	0.00	3.45	0.02
<i>Oxylebius pictus</i>	Painted Greenling	0.00	0.00	3.45	0.02
<i>Sebastes eos</i>	Pink Rockfish	0.00	0.00	3.45	0.02
<i>Cephaloscyllium ventriosum</i>	Swell Shark	0.00	0.00	3.45	0.02

**Appendix C-5. Abundance of demersal fish species collected during the Bight '23 trawl survey by stratum. Asterisk means SCB represents totals for the three strata. Five-minute trawl abundances were doubled (Bays) for comparison to Inner shelf and upper slope.**

Common	Family	Abundance			
		SCB*	Bays	Inner Shelf	Middle Shelf
White Croaker	Sciaenidae	9734	9446	288	-
California Lizardfish	Synodontidae	7499	1096	3377	3026
Speckled Sanddab	Paralichthyidae	5850	1258	3877	715
Pacific Sanddab	Paralichthyidae	5755	-	328	5427
Halfbanded Rockfish	Scorpaenidae	3813	-	-	3813
Longfin Sanddab	Paralichthyidae	2328	18	357	1953
Yellowchin Sculpin	Psychrolutidae	1340	6	504	830
California Tonguefish	Cynoglossidae	873	244	159	470
Pink Seaperch	Embiotocidae	750	2	39	709
Slough Anchovy	Engraulidae	720	720	-	-
Northern Anchovy	Engraulidae	695	144	550	1
Stripetail Rockfish	Scorpaenidae	585	-	-	585
Longspine Combfish	Hexagrammidae	565	30	65	470
Dover Sole	Pleuronectidae	454	-	-	454
California Scorpionfish	Scorpaenidae	394	2	5	387
Queenfish	Sciaenidae	366	344	22	-
Shortspine Combfish	Hexagrammidae	358	-	-	358
Hornyhead Turbot	Pleuronectidae	332	28	168	136
Chilipepper	Scorpaenidae	318	70	-	248
Shiner Perch	Embiotocidae	309	230	67	12
English Sole	Pleuronectidae	265	4	127	134
Roughback Sculpin	Psychrolutidae	216	-	19	197
Vermilion Rockfish	Scorpaenidae	194	62	15	117
California Halibut	Paralichthyidae	168	152	11	5
Kelp Pipefish	Syngnathidae	143	4	137	2
Bigmouth Sole	Paralichthyidae	115	-	11	104
Fantail Sole	Paralichthyidae	97	50	40	7
Slender Sole	Pleuronectidae	94	-	-	94
Specklefin Midshipman	Batrachoididae	89	74	13	2
Barred Sand Bass	Serranidae	88	84	3	1
Round Stingray	Urotrygonidae	87	86	1	-
Plainfin Midshipman	Batrachoididae	81	2	1	78
Spotted Turbot	Pleuronectidae	61	28	29	4
Spotted Sand Bass	Serranidae	56	56	-	-
Pygmy Poacher	Agonidae	53	-	20	33
Calico Rockfish	Scorpaenidae	35	-	-	35
Barcheek Pipefish	Syngnathidae	32	2	30	-
California Skate	Rajidae	30	8	10	12
Bocaccio	Scorpaenidae	27	26	-	1
Pacific Argentine	Argentinidae	21	-	-	21
Curlfin Sole	Pleuronectidae	16	-	8	8
Greenspotted Rockfish	Scorpaenidae	16	-	-	16

Diamond Turbot	Pleuronectidae	14	12	2	-
Flag Rockfish	Scorpaenidae	13	-	-	13
Spotfin Sculpin	Psychrolutidae	12	-	-	12
Bay Goby	Gobiidae	12	2	-	10
Pacific Sardine	Clupeidae	12	2	-	10
Greenblotched Rockfish	Scorpaenidae	12	-	-	12
Pacific Staghorn Sculpin	Cottidae	11	4	7	-
Blackbelly Eelpout	Zoarcidae	11	-	-	11
Pacific Pompano	Stromateidae	11	-	11	-
Cowcod	Scorpaenidae	11	-	-	11
Deepbody Anchovy	Engraulidae	10	10	-	-
White Seaperch	Embiotocidae	10	2	1	7
Southern Spearnose Poacher	Agonidae	8	-	2	6
Giant Kelpfish	Clinidae	7	2	5	-
Black Croaker	Sciaenidae	6	6	-	-
Kelp Bass	Serranidae	6	6	-	-
Shovelnose Guitarfish	Rhinobatidae	6	6	-	-
Spotted Cusk-eel	Ophidiidae	5	-	-	5
Shortbelly Rockfish	Scorpaenidae	5	-	-	5
Black Perch	Embiotocidae	4	4	-	-
Bay Blenny	Blenniidae	4	4	-	-
Greenstriped Rockfish	Scorpaenidae	4	-	-	4
Squarespot Rockfish	Scorpaenidae	4	-	-	4
Rosy Rockfish	Scorpaenidae	4	-	-	4
Pacific Angel Shark	Squatinae	4	2	2	-
Unknown Pipefish	Syngnathidae	4	-	4	-
Jack Mackerel	Carangidae	4	-	4	-
Yellowfin Croaker	Sciaenidae	4	4	-	-
Ocean Whitefish	Malacanthidae	3	-	1	2
California Butterfly Ray	Gymnuridae	3	2	1	-
Bigfin Eelpout	Zoarcidae	3	-	-	3
Topsmelt	Atherinopsidae	2	2	-	-
Big Skate	Rajidae	2	-	1	1
Salema	Haemulidae	2	2	-	-
Horn Shark	Heterodontidae	2	2	-	-
Smooth Stargazer	Uranoscopidae	2	-	-	2
California Corbina	Sciaenidae	2	2	-	-
Bat Ray	Myliobatidae	2	2	-	-
Thornback	Platyrrhynidae	2	-	2	-
Lumptail Searobin	Triglidae	2	-	-	2
Rosethorn Rockfish	Scorpaenidae	2	-	-	2
Unknown Rockfish	Scorpaenidae	2	-	-	2
Honeycomb Rockfish	Scorpaenidae	2	-	-	2
Bay Pipefish	Syngnathidae	2	2	-	-
Jacksmelt	Atherinopsidae	1	-	1	-
California Sheephead	Labridae	1	-	-	1
Swell Shark	Scyliorhinidae	1	-	-	1
Gulf Sanddab	Paralichthyidae	1	-	-	1

Canyon Sculpin	Psychrolutidae	1	-	-	1
Pacific Hake	Merlucciidae	1	-	-	1
Brown Smoothhound	Triakidae	1	-	1	-
Lingcod	Hexagrammidae	1	-	-	1
Senorita	Labridae	1	-	-	1
Painted Greenling	Hexagrammidae	1	-	-	1
Bluebarred Prickleback	Stichaeidae	1	-	-	1
C-O Sole	Pleuronectidae	1	-	1	-
Bluebanded Ronquil	Bathymasteridae	1	-	-	1
Cabezon	Cottidae	1	-	-	1
Pink Rockfish	Scorpaenidae	1	-	-	1
Pacific Electric Ray	Torpedinidae	1	-	1	-
Blacktip Poacher	Agonidae	1	-	-	1
Bluespotted Poacher	Agonidae	1	-	-	1

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**Appendix C-6. Biomass (kg) of demersal fish species collected during the Bight '23 trawl survey by stratum. Asterisk means SCB represents totals for the three strata.**

Common Name	Family	Biomass (kg)			
		SCB*	Bays	Inner Shelf	Middle Shelf
White Croaker	Sciaenidae	304.1	297.2	6.9	-
California Scorpionfish	Scorpaenidae	95.8	0	0.9	95
Halfbanded Rockfish	Scorpaenidae	89.2	-	-	89.2
Pacific Sanddab	Paralichthyidae	85.2	-	4	81.2
Longfin Sanddab	Paralichthyidae	76.8	1.6	15.1	60
California Lizardfish	Synodontidae	67.1	12.9	30.3	24
Speckled Sanddab	Paralichthyidae	39.9	9.3	26	4.6
Pacific Angel Shark	Squatinae	34.5	17	17.5	-
California Halibut	Paralichthyidae	33.1	20.7	6.8	5.6
Hornyhead Turbot	Pleuronectidae	30	1.6	17.7	10.8
Round Stingray	Urotrygonidae	20.7	20.4	0.3	-
English Sole	Pleuronectidae	20.6	0.2	4.8	15.6
Shovelnose Guitarfish	Rhinobatidae	19.3	19.3	-	-
Spotted Sand Bass	Serranidae	18	18	-	-
Pink Seaperch	Embiotocidae	16.2	0	0.5	15.7
Vermilion Rockfish	Scorpaenidae	14.8	0.9	0.1	13.9
Dover Sole	Pleuronectidae	14.3	-	-	14.3
California Tonguefish	Cynoglossidae	11.7	0.9	2.3	8.4
Chilipepper	Scorpaenidae	10.4	0.6	-	9.8
Stripetail Rockfish	Scorpaenidae	8.8	-	-	8.8
Horn Shark	Heterodontidae	8.6	8.6	-	-
California Skate	Rajidae	8.4	1.7	2.7	4
Fantail Sole	Paralichthyidae	7.7	3.5	3.8	0.5
Queenfish	Sciaenidae	7.6	6.7	0.9	-
Longspine Combfish	Hexagrammidae	7.5	0.6	1.5	5.4
Bat Ray	Myliobatidae	7.5	7.5	-	-
Bigmouth Sole	Paralichthyidae	6.6	-	1.6	5
Northern Anchovy	Engraulidae	5.8	1.3	4.4	0
Shortspine Combfish	Hexagrammidae	5.7	-	-	5.7
Spotted Turbot	Pleuronectidae	5.6	1.5	3.6	0.5
Yellowchin Sculpin	Psychrolutidae	5.5	0.1	1.8	3.6
Specklefin Midshipman	Batrachoididae	4.5	3	1.2	0.4
Barred Sand Bass	Serranidae	4.2	2.7	0.9	0.6
Roughback Sculpin	Psychrolutidae	3.7	-	0.2	3.5
Shiner Perch	Embiotocidae	3.1	2.4	0.6	0
Diamond Turbot	Pleuronectidae	2.9	2.6	0.2	-
California Butterfly Ray	Gymnuridae	2.8	2.2	0.6	-
Plainfin Midshipman	Batrachoididae	1.7	0	0	1.7
Slender Sole	Pleuronectidae	1.6	-	-	1.6
Slough Anchovy	Engraulidae	1.2	1.2	-	-
Curfin Sole	Pleuronectidae	1.2	-	0.6	0.6
Black Croaker	Sciaenidae	1.2	1.2	-	-
Calico Rockfish	Scorpaenidae	0.7	-	-	0.7

White Seaperch	Embiotocidae	0.7	0.1	0	0.6
Brown Smoothhound	Triakidae	0.7	-	0.7	-
Greenspotted Rockfish	Scorpaenidae	0.6	-	-	0.6
Lumptail Searobin	Triglidae	0.5	-	-	0.5
Kelp Pipefish	Syngnathidae	0.5	0	0.5	0
Pacific Sardine	Clupeidae	0.5	0.1	-	0.4
Big Skate	Rajidae	0.5	-	0.1	0.4
Pacific Staghorn Sculpin	Cottidae	0.4	0.2	0.3	-
Flag Rockfish	Scorpaenidae	0.4	-	-	0.4
Greenblotched Rockfish	Scorpaenidae	0.4	-	-	0.4
Smooth Stargazer	Uranoscopidae	0.4	-	-	0.4
California Corbina	Sciaenidae	0.4	0.4	-	-
Bocaccio	Scorpaenidae	0.4	0.4	-	0
Thornback	Platyrrhynidae	0.3	-	0.3	-
Cowcod	Scorpaenidae	0.3	-	-	0.3
Blackbelly Eelpout	Zoarcidae	0.3	-	-	0.3
Rosy Rockfish	Scorpaenidae	0.3	-	-	0.3
California Sheephead	Labridae	0.3	-	-	0.3
Pacific Hake	Merlucciidae	0.3	-	-	0.3
Pygmy Poacher	Agonidae	0.2	-	0.1	0.2
Kelp Bass	Serranidae	0.2	0.2	-	-
Greenstriped Rockfish	Scorpaenidae	0.2	-	-	0.2
Spotfin Sculpin	Psychrolutidae	0.2	-	-	0.2
C-O Sole	Pleuronectidae	0.2	-	0.2	-
Pacific Electric Ray	Torpedinidae	0.1	-	0.1	-
Barcheek Pipefish	Syngnathidae	0.1	0	0.1	-
Squarespot Rockfish	Scorpaenidae	0.1	-	-	0.1
Spotted Cusk-eel	Ophidiidae	0.1	-	-	0.1
Deepbody Anchovy	Engraulidae	0.1	0.1	-	-
Jacksmelt	Atherinopsidae	0.1	-	0.1	-
Senorita	Labridae	0.1	-	-	0.1
Bluebanded Ronquil	Bathymasteridae	0.1	-	-	0.1
Shortbelly Rockfish	Scorpaenidae	0.1	-	-	0.1
Jack Mackerel	Carangidae	0.1	-	0.1	-
Bay Goby	Gobiidae	0.1	0	-	0
Bluespotted Poacher	Agonidae	0.1	-	-	0.1
Pacific Argentine	Argentinidae	0.1	-	-	0.1
Topsmelt	Atherinopsidae	0.1	0.1	-	-
Black Perch	Embiotocidae	0.1	0.1	-	-
Giant Kelpfish	Clinidae	0.1	0	0	-
Southern Spearnose Poacher	Agonidae	0.1	-	0	0
Lingcod	Hexagrammidae	0	-	-	0
Pacific Pompano	Stromateidae	0	-	0	-
Bay Blenny	Blenniidae	0	0	-	-
Yellowfin Croaker	Sciaenidae	0	0	-	-
Ocean Whitefish	Malacanthidae	0	-	0	0
Bigfin Eelpout	Zoarcidae	0	-	-	0
Salema	Haemulidae	0	0	-	-

Rosethorn Rockfish	Scorpaenidae	0	-	-	0
Unknown Rockfish	Scorpaenidae	0	-	-	0
Honeycomb Rockfish	Scorpaenidae	0	-	-	0
Bay Pipefish	Syngnathidae	0	0	-	-
Unknown Pipefish	Syngnathidae	0	-	0	-
Swell Shark	Scyliorhinidae	0	-	-	0
Gulf Sanddab	Paralichthyidae	0	-	-	0
Canyon Sculpin	Psychrolutidae	0	-	-	0
Painted Greenling	Hexagrammidae	0	-	-	0
Bluebarred Prickleback	Stichaeidae	0	-	-	0
Cabezon	Cottidae	0	-	-	0
Pink Rockfish	Scorpaenidae	0	-	-	0
Blacktip Poacher	Agonidae	0	-	-	0

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**Appendix C-7. Frequency of occurrence (%) of demersal fish species collected during the Bight '23 trawl survey by stratum. Asterisk means SCB represents totals for the three strata**

Common Name	Family	Frequency			
		SCB*	Bays	Inner Shelf	Middle Shelf
California Lizardfish	Synodontidae	50.5	70	93.3	96.6
California Tonguefish	Cynoglossidae	44.7	56.7	76.7	89.7
Pacific Sanddab	Paralichthyidae	41.6	-	50	100
Hornyhead Turbot	Pleuronectidae	41.3	16.7	83.3	75.9
Longfin Sanddab	Paralichthyidae	38.8	10	56.7	86.2
Yellowchin Sculpin	Psychrolutidae	34.2	3.3	40	82.8
English Sole	Pleuronectidae	32.7	6.7	53.3	69
Speckled Sanddab	Paralichthyidae	31.4	53.3	90	37.9
Pink Seaperch	Embiotocidae	28.2	3.3	16.7	79.3
Bigmouth Sole	Paralichthyidae	26.3	-	23.3	69
Longspine Combfish	Hexagrammidae	25.7	6.7	20	69
California Scorpionfish	Scorpaenidae	22.1	3.3	13.3	62.1
Roughback Sculpin	Psychrolutidae	20.3	-	20	51.7
Dover Sole	Pleuronectidae	17.1	-	-	55.2
Stripetail Rockfish	Scorpaenidae	17.1	-	-	55.2
Halfbanded Rockfish	Scorpaenidae	17.1	-	-	55.2
Fantail Sole	Paralichthyidae	15.6	36.7	56.7	10.3
Pygmy Poacher	Agonidae	15.3	-	16.7	37.9
California Skate	Rajidae	14.3	10	16.7	34.5
Plainfin Midshipman	Batrachoididae	13.6	3.3	3.3	41.4
Vermilion Rockfish	Scorpaenidae	13	13.3	10	34.5
Calico Rockfish	Scorpaenidae	12.9	-	-	41.4
Shortspine Combfish	Hexagrammidae	11.8	-	-	37.9
Spotted Turbot	Pleuronectidae	9.7	20	40	3.4
Shiner Perch	Embiotocidae	8.6	40	23.3	10.3
California Halibut	Paralichthyidae	8.1	76.7	13.3	13.8
Specklefin Midshipman	Batrachoididae	7.7	50	23.3	6.9
Slender Sole	Pleuronectidae	7.5	-	-	24.1
Cowcod	Scorpaenidae	7.5	-	-	24.1
Kelp Pipefish	Syngnathidae	7.4	3.3	30	3.4
Southern Spearnose Poacher	Agonidae	6.8	-	6.7	17.2
Curlfin Sole	Pleuronectidae	6.7	-	16.7	10.3
Barcheek Pipefish	Syngnathidae	4.9	3.3	23.3	-
Pacific Argentine	Argentinidae	4.3	-	-	13.8
Greenblotched Rockfish	Scorpaenidae	4.3	-	-	13.8
Flag Rockfish	Scorpaenidae	4.3	-	-	13.8
Barred Sand Bass	Serranidae	3.7	40	10	3.4
Blackbelly Eelpout	Zoarcidae	3.2	-	-	10.3
White Croaker	Sciaenidae	2.7	50	10	-
Queenfish	Sciaenidae	2.6	36.7	10	-
Chilipepper	Scorpaenidae	2.3	10	-	6.9
Bay Goby	Gobiidae	2.2	3.3	-	6.9

Pacific Staghorn Sculpin	Cottidae	2.2	6.7	10	-
Spotted Cusk-eel	Ophidiidae	2.1	-	-	6.9
Greenstriped Rockfish	Scorpaenidae	2.1	-	-	6.9
Squarespot Rockfish	Scorpaenidae	2.1	-	-	6.9
Rosy Rockfish	Scorpaenidae	2.1	-	-	6.9
Unknown Rockfish	Scorpaenidae	2.1	-	-	6.9
Honeycomb Rockfish	Scorpaenidae	2.1	-	-	6.9
Giant Kelpfish	Clinidae	2.1	3.3	10	-
Northern Anchovy	Engraulidae	2.1	26.7	3.3	3.4
White Seaperch	Embiotocidae	1.8	3.3	3.3	3.4
Big Skate	Rajidae	1.8	-	3.3	3.4
Ocean Whitefish	Malacanthidae	1.8	-	3.3	3.4
Diamond Turbot	Pleuronectidae	1.7	20	6.7	-
Pacific Angel Shark	Squatinae	1.4	3.3	6.7	-
Thornback	Platyrrhynidae	1.4	-	6.7	-
Bocaccio	Scorpaenidae	1.2	10	-	3.4
Round Stingray	Urotrygonidae	1.1	33.3	3.3	-
Pacific Sardine	Clupeidae	1.1	3.3	-	3.4
California Sheephead	Labridae	1.1	-	-	3.4
Swell Shark	Scyliorhinidae	1.1	-	-	3.4
Gulf Sanddab	Paralichthyidae	1.1	-	-	3.4
Canyon Sculpin	Psychrolutidae	1.1	-	-	3.4
Spotfin Sculpin	Psychrolutidae	1.1	-	-	3.4
Smooth Stargazer	Uranoscopidae	1.1	-	-	3.4
Bigfin Eelpout	Zoarcidae	1.1	-	-	3.4
Pacific Hake	Merlucciidae	1.1	-	-	3.4
Lingcod	Hexagrammidae	1.1	-	-	3.4
Senorita	Labridae	1.1	-	-	3.4
Painted Greenling	Hexagrammidae	1.1	-	-	3.4
Bluebarred Prickleback	Stichaeidae	1.1	-	-	3.4
Lumptail Searobin	Triglidae	1.1	-	-	3.4
Bluebanded Ronquil	Bathymasteridae	1.1	-	-	3.4
Cabazon	Cottidae	1.1	-	-	3.4
Greenspotted Rockfish	Scorpaenidae	1.1	-	-	3.4
Pink Rockfish	Scorpaenidae	1.1	-	-	3.4
Rosethorn Rockfish	Scorpaenidae	1.1	-	-	3.4
Shortbelly Rockfish	Scorpaenidae	1.1	-	-	3.4
Blacktip Poacher	Agonidae	1.1	-	-	3.4
Bluespotted Poacher	Agonidae	1.1	-	-	3.4
California Butterfly Ray	Gymnuridae	0.7	3.3	3.3	-
Jacksmelt	Atherinopsidae	0.7	-	3.3	-
Brown Smoothhound	Triakidae	0.7	-	3.3	-
Pacific Pompano	Stromateidae	0.7	-	3.3	-
C-O Sole	Pleuronectidae	0.7	-	3.3	-
Unknown Pipefish	Syngnathidae	0.7	-	3.3	-
Pacific Electric Ray	Torpedinidae	0.7	-	3.3	-
Jack Mackerel	Carangidae	0.7	-	3.3	-
Spotted Sand Bass	Serranidae	0.3	26.7	-	-

Slough Anchovy	Engraulidae	0.2	16.7	-	-
Black Croaker	Sciaenidae	0.1	10	-	-
Shovelnose Guitarfish	Rhinobatidae	0.1	10	-	-
Deepbody Anchovy	Engraulidae	0.1	6.7	-	-
Black Perch	Embiotocidae	0.1	6.7	-	-
Yellowfin Croaker	Sciaenidae	0.1	6.7	-	-
Topsmelt	Atherinopsidae	< 0.1	3.3	-	-
Salema	Haemulidae	< 0.1	3.3	-	-
Horn Shark	Heterodontidae	< 0.1	3.3	-	-
Bay Blenny	Blenniidae	< 0.1	3.3	-	-
California Corbina	Sciaenidae	< 0.1	3.3	-	-
Bat Ray	Myliobatidae	< 0.1	3.3	-	-
Kelp Bass	Serranidae	< 0.1	3.3	-	-
Bay Pipefish	Syngnathidae	< 0.1	3.3	-	-

Appendix C-8. Taxonomic listing of megabenthic invertebrate species collected during the Bight '23 trawl survey. Data are total abundance with 5-minute trawls doubled; taxonomic hierarchies from SCAMIT ed. 14. SCB= Southern California Bight. Asterisk means totals are only for the three strata.

Phylum	Class	Order	Family	Species	Abundances			
					SCB*	Bays	Inner Shelf	Middle Shelf
<b>PORIFERA</b>								
	<b>Calcarea</b>							
		Leucosolenida						
			Amphoriscidae	<i>Leucilla nuttingi</i>	2	-	1	1
	<b>Demospongiae</b>							
		Bubarida						
			Bubaridae	<i>Obruta collector</i>	1	-	-	1
		Tetractinellida						
			Tetillidae	Tetillidae	4	4	-	-
			Geodiidae	<i>Geodia</i> sp	1	-	-	1
		Suberitida						
			Suberitidae	<i>Suberites</i> sp	12	12	-	-
			Halichondriidae	Halichondriidae	2	2	-	-
<b>CNIDARIA</b>								
	<b>Octocorallia</b>							
		Malacalcyonacea						
			Gorgoniidae	<i>Adelogorgia phyllosclera</i>	25	-	-	25
				<i>Eugorgia ljubenkovia</i>	2	-	-	2
				<i>Eugorgia rubens</i>	9	-	-	9
				<i>Leptogorgia chilensis</i>	2	-	-	2
			Plexauridae	<i>Muricea californica</i>	1	-	1	-
				<i>Thesea</i> sp	1	-	-	1
				<i>Thesea</i> sp B	127	-	4	123
			Tubiporidae	<i>Telesto californica</i>	50	-	-	50
		Scleralcyonacea						
				<i>Pennatuloides</i> sp HYP1	1	-	-	1
			Renillidae	<i>Renilla koellikeri</i>	58	-	58	-
			Virgulariidae	Virgulariidae	2	2	-	-
				<i>Acanthoptilum</i> sp	176	156	-	20
				<i>Stylatula</i> sp	1	-	-	1
				<i>Stylatula elongata</i>	24	-	2	22
				<i>Virgularia agassizii</i>	2	-	-	2
	<b>Hexacorallia</b>							
		Scleractinia						
			Caryophylliidae	<i>Paracyathus stearnsii</i>	4	-	-	4
		Actiniaria						
				Actiniaria	6	-	6	-
		Zoantharia						
			Parazoanthidae	<i>Savalia lucifica</i>	2	-	-	2
<b>MOLLUSCA</b>								
	<b>Gastropoda</b>							
		Seguenziida						
			Chilodontaidae	<i>Turcica coffea</i>	1	-	-	1

Trochida						
	Calliostomatidae	<i>Calliostoma supragranosum</i>	2	-	-	2
		<i>Calliostoma tricolor</i>	4	-	4	-
Littorinimorpha						
	Velutinidae	<i>Lamellaria diegoensis</i>	1	-	1	-
	Bursidae	<i>Crossata ventricosa</i>	6	-	4	2
Neogastropoda						
	Austrosiphonidae	<i>Kelletia kelletii</i>	4	-	-	4
	Fascioliariidae	<i>Araiofusus araios</i>	4	-	-	4
	Nassariidae	<i>Phrontis tiarula</i>	66	66	-	-
		<i>Tritia insculpta</i>	1	-	-	1
	Muricidae	<i>Babelomurex oldroydi</i>	2	-	2	-
		<i>Paciocinebrina circumtexta</i>	1	-	1	-
		<i>Pteropurpura festiva</i>	6	2	3	1
		<i>Pteropurpura vokesae</i>	1	-	1	-
	Mitridae	<i>Atrimitra idae</i>	2	-	1	1
	Conidae	<i>Californiconus californicus</i>	1	-	1	-
	Pseudomelatomidae	<i>Burchia semiinflata</i>	1	-	-	1
Nudibranchia						
		Nudibranchia	3	-	2	1
	Facelinidae	<i>Hermisenda opalescens</i>	2	2	-	-
	Arminidae	<i>Armina californica</i>	29	-	19	10
	Dendronotidae	<i>Dendronotus</i> sp	1	-	1	-
		<i>Dendronotus albopunctatus</i>	1	-	1	-
		<i>Dendronotus iris</i>	6	-	-	6
		<i>Dendronotus subramosus</i>	16	-	16	-
		<i>Dendronotus venustus</i>	191	-	11	180
	Tethydidae	<i>Melibe leonina</i>	4	4	-	-
	Apataidae	<i>Apata pricei</i>	1	-	1	-
	Flabellinopsidae	<i>Flabellinopsis iodinea</i>	24	-	16	8
	Tritoniidae	<i>Tochuina gigantea</i>	3	-	-	3
		<i>Tritonia festiva</i>	2	-	-	2
		<i>Tritonia exsulans</i>	1	-	1	-
	Discodorididae	<i>Platydoris macfarlandi</i>	1	-	-	1
	Dorididae	<i>Doris montereyensis</i>	1	-	-	1
	Onchidorididae	<i>Acanthodoris brunnea</i>	42	-	22	20
	Dendrodorididae	<i>Doriopsilla albopunctata</i>	3	-	-	3
	Polyceridae	<i>Triopha maculata</i>	3	2	1	-
Pleurobranchida						
	Pleurobranchaeidae	<i>Pleurobranchaea californica</i>	115	-	19	96
Cephalaspidea						
	Bullidae	<i>Bulla gouldiana</i>	74	74	-	-
	Aglajidae	<i>Aglaja ocelligera</i>	8	-	8	-
	Philinidae	<i>Philine auriformis</i>	1111	300	663	148
	Philinorbidae	<i>Philinorbis albus</i>	16	-	-	16
<b>Bivalvia</b>						
Pectinida						
	Pectinidae	<i>Leptopecten latiauratus</i>	24	24	-	-
<b>Cephalopoda</b>						
Sepiida						
	Sepiolidae	<i>Rossia pacifica</i>	3	-	-	3

	Octopoda						
		Enteroctopodidae	<i>Enteroctopus dofleini</i>	1	-	-	1
		Octopodidae	<i>Octopus bimaculatus</i>	2	2	-	-
			<i>Octopus bimaculoides</i>	2	2	-	-
			<i>Octopus rubescens</i>	78	2	25	51
			<i>Octopus veligero</i>	3	-	-	3
<b>ANNELIDA</b>							
	<b>Polychaeta</b>						
		Phyllodocida					
		Aphroditidae	<i>Aphrodita</i> sp	3	2	1	-
			<i>Aphrodita armifera</i>	1	-	1	-
			<i>Aphrodita refulgida</i>	2	-	-	2
<b>ARTHROPODA</b>							
	<b>Pycnogonida</b>						
		Pantopoda					
		Phoxichilidiidae	<i>Anoplodactylus erectus</i>	1	-	-	1
	<b>Malacostraca</b>						
		Stomatopoda					
		Squillidae	<i>Schmittius politus</i>	2	-	-	2
		Decapoda					
		Penaeidae	<i>Penaeus californiensis</i>	20	16	4	-
		Sicyoniidae	<i>Sicyonia ingentis</i>	934	312	1	621
			<i>Sicyonia penicillata</i>	31820	31234	558	28
		Thoridae	<i>Heptacarpus stimpsoni</i>	8	8	-	-
		Pandalidae	<i>Pandalus platyceros</i>	1	-	-	1
		Crangonidae	Crangonidae	1	-	1	-
			<i>Crangon alaskensis</i>	60	-	-	60
			<i>Crangon nigromaculata</i>	217	88	128	1
			<i>Neocrangon resima</i>	2	-	2	-
			<i>Neocrangon zacaе</i>	28	-	-	28
		Palinuridae	<i>Panulirus interruptus</i>	12	12	-	-
		Diogenidae	<i>Paguristes bakeri</i>	4	-	-	4
			<i>Paguristes turgidus</i>	8	-	3	5
		Paguridae	<i>Orthopagurus minimus</i>	1	-	-	1
			<i>Pagurus armatus</i>	1	-	-	1
			<i>Pagurus spilocarpus</i>	7	2	-	5
		Munididae	<i>Antillamunida hispida</i>	1	-	-	1
		Calappidae	<i>Platymera gaudichaudii</i>	3	-	1	2
		Leucosiidae	<i>Randallia ornata</i>	2	-	2	-
		Epialtidae	<i>Pugettia dalli</i>	2	-	2	-
			<i>Pugettia richii</i>	1	-	-	1
			<i>Loxorhynchus</i> sp	3	-	3	-
			<i>Loxorhynchus crispatus</i>	3	-	1	2
			<i>Loxorhynchus grandis</i>	5	-	5	-
		Inachidae	<i>Coryrhynchus lobifrons</i>	8	-	-	8
			<i>Ericerodes hemphillii</i>	6	-	3	3
		Inachoididae	<i>Pyromaia tuberculata</i>	138	36	91	11
		Parthenopidae	<i>Latulambrus occidentalis</i>	3	-	1	2
		Cancridae	<i>Cancer productus</i>	3	-	3	-
			<i>Metacarcinus anthonyi</i>	14	6	4	4
			<i>Metacarcinus gracilis</i>	50	2	48	-

		<i>Romaleon antennarium</i>	4	4	-	-
	Portunidae	<i>Achelous xantusii</i>	311	220	91	-
	Panopeidae	<i>Lophopanopeus bellus</i>	1	-	1	-
	<b>Hexanauplia</b>					
	Scalpelliformes					
	Scalpellidae	<i>Hamatoscalpellum californicum</i>	472	-	184	288
<b>ECHINODERMATA</b>						
	<b>Crinoidea</b>					
	Comatulida					
	Antedonidae	<i>Florometra serratissima</i>	38	-	-	38
	<b>Asteroidea</b>					
	Paxillosida					
	Luidiidae	<i>Luidia</i> sp	7	-	1	6
		<i>Luidia armata</i>	151	-	24	127
		<i>Luidia asthenosoma</i>	17	-	-	17
		<i>Luidia foliolata</i>	66	-	2	64
	Astropectinidae	<i>Astropecten</i> sp	32	-	30	2
		<i>Astropecten armatus</i>	39	20	19	-
		<i>Astropecten californicus</i>	1322	-	570	752
	Valvatida					
	Goniasteridae	<i>Mediaster aequalis</i>	2	-	-	2
	Spinulosida					
	Echinasteridae	<i>Henricia</i> sp	6	-	-	6
	Forcipulatida					
	Asteriidae	<i>Sclerasterias heteropaes</i>	6	-	2	4
	<b>Ophiuroidea</b>					
	Ophiurida					
	Ophiuridae	<i>Ophiura luetkenii</i>	2435	-	22	2413
	Ophiacanthida					
	Ophiopteridae	<i>Ophiopteris papillosa</i>	29	-	6	23
	Amphilepidida					
	Ophiopholidae	<i>Ophiopholis bakeri</i>	5	-	-	5
	Ophiotrichidae	<i>Ophiothrix spiculata</i>	1392	14	299	1079
	<b>Echinoidea</b>					
	Camarodonta					
	Toxopneustidae	<i>Lytechinus pictus</i>	8715	-	72	8643
	Strongylocentrotidae	<i>Mesocentrotus franciscanus</i>	2	-	-	2
		<i>Strongylocentrotus fragilis</i>	6	-	-	6
		<i>Strongylocentrotus purpuratus</i>	11	10	-	1
	Clypeasteroidea					
	Dendrasteridae	<i>Dendraster excentricus</i>	4430	4430	-	-
	Spatangoida					
	Spatangidae	<i>Spatangus californicus</i>	1	-	-	1
	<b>Holothuroidea</b>					
	Synallactida					
	Stichopodidae	<i>Apostichopus californicus</i>	172	-	-	172
		<i>Apostichopus parvimensis</i>	1	-	-	1
<b>BRACHIOPODA</b>						
	<b>Rhynchonellata</b>					

		Terebratulida							
			Terebrataliidae	Terebrataliinae	2	-	-	2	
<b>CHORDATA</b>									
		<b>Ascidiacea</b>							
			Phlebobranchia						
				Cionidae	<i>Ciona robusta</i>	2	2	-	-
				Ascidiidae	<i>Asciella aspersa</i>	48	48	-	-
			Stolidobranchia						
				Styelidae	<i>Styela gibbsii</i>	1	-	-	1
				Pyuridae	<i>Halocynthia igaboja</i>	1	-	-	1
				Molgulidae	<i>Molgula ficus</i>	28	28	-	-
<b>Counts/Totals</b>									
	8	18	39	88	140	55519	37150	3082	15287

**Appendix C-9. Biomass (KG) of megabenthic invertebrate species collected during the Bight'23 trawl survey by strata. Asterisk means total (SCB) represents the three strata only. Five-minute trawls (bays) were doubled for comparison to inner and middle shelf.**

Species	Phylum:Family	Biomass (kg)			
		SCB*	Bays	Inner Shelf	Middle Shelf
<i>Sicyonia penicillata</i>	ARTHROPODA:Sicyoniidae	341.04	330.4	10.18	0.42
<i>Suberites</i> sp	PORIFERA:Suberitidae	72	72	-	-
<i>Apostichopus californicus</i>	ECHINODERMATA:Stichopodidae	63.44	-	-	63.44
<i>Dendraster excentricus</i>	ECHINODERMATA:Dendrasteridae	40.6	40.6	-	-
<i>Lytechinus pictus</i>	ECHINODERMATA:Toxopneustidae	9.56	-	0.14	9.42
<i>Sicyonia ingentis</i>	ARTHROPODA:Sicyoniidae	9.4	2.7	< 0.01	6.73
<i>Achelous xantusii</i>	ARTHROPODA:Portunidae	6.18	4.6	1.55	-
<i>Loxorhynchus grandis</i>	ARTHROPODA:Epialtidae	5	-	5	-
<i>Panulirus interruptus</i>	ARTHROPODA:Palinuridae	4.2	4.2	-	-
<i>Metacarcinus gracilis</i>	ARTHROPODA:Cancriidae	3.3	0.4	2.9	-
<i>Ophiura luetkenii</i>	ECHINODERMATA:Ophiuridae	3.2	-	0.04	3.15
<i>Astropecten californicus</i>	ECHINODERMATA:Astropectinidae	2.79	-	1.38	1.41
<i>Pleurobranchaea californica</i>	MOLLUSCA:Pleurobranchaeidae	2.32	-	0.05	2.27
<i>Philine auriformis</i>	MOLLUSCA:Philinidae	2.01	0.6	1.12	0.29
<i>Adelogorgia phyllosclera</i>	CNIDARIA:Gorgoniidae	1.8	-	-	1.8
<i>Octopus rubescens</i>	MOLLUSCA:Octopodidae	1.77	0	0.27	1.49
<i>Luidia armata</i>	ECHINODERMATA:Luidiidae	1.75	-	0.05	1.7
<i>Metacarcinus anthonyi</i>	ARTHROPODA:Cancriidae	1.27	0	0.36	0.9
<i>Ophiothrix spiculata</i>	ECHINODERMATA:Ophiotrichidae	1.09	0	0.61	0.45
<i>Hamatoscalpellum californicum</i>	ARTHROPODA:Scalpellidae	0.94	-	0.37	0.58
<i>Penaeus californiensis</i>	ARTHROPODA:Penaeidae	0.9	0.8	0.1	-
<i>Crossata ventricosa</i>	MOLLUSCA:Bursidae	0.8	-	0.7	0.1
<i>Octopus bimaculatus</i>	MOLLUSCA:Octopodidae	0.8	0.8	-	-
<i>Romaleon antennarium</i>	ARTHROPODA:Cancriidae	0.8	0.8	-	-
Tetillidae	PORIFERA:Tetillidae	0.8	0.8	-	-
<i>Acanthoptilum</i> sp	CNIDARIA:Virgulariidae	0.79	0.8	-	0.04
<i>Enteroctopus dofleini</i>	MOLLUSCA:Enteroctopodidae	0.7	-	-	0.7
<i>Crangon nigromaculata</i>	ARTHROPODA:Crangonidae	0.52	0.2	0.34	< 0.01
<i>Luidia foliolata</i>	ECHINODERMATA:Luidiidae	0.49	-	< 0.01	0.48
<i>Bulla gouldiana</i>	MOLLUSCA:Bullidae	0.44	0.4	-	-
<i>Platymera gaudichaudii</i>	ARTHROPODA:Calappidae	0.4	-	0.2	0.2
<i>Octopus bimaculoides</i>	MOLLUSCA:Octopodidae	0.4	0.4	-	-
<i>Dendronotus venustus</i>	MOLLUSCA:Dendronotidae	0.38	-	0.02	0.36
<i>Philinorbis albus</i>	MOLLUSCA:Philinorbidae	0.31	-	-	0.31
<i>Florometra serratissima</i>	ECHINODERMATA:Antedonidae	0.3	-	-	0.3
<i>Pyromaia tuberculata</i>	ARTHROPODA:Inachoididae	0.28	0.1	0.18	0.02
<i>Thesea</i> sp B	CNIDARIA:Plexauridae	0.25	-	0.01	0.25
<i>Cancer productus</i>	ARTHROPODA:Cancriidae	0.23	-	0.23	-
<i>Kelletia kelletii</i>	MOLLUSCA:Austrosiphonidae	0.2	-	-	0.2
<i>Randallia ornata</i>	ARTHROPODA:Leucosiidae	0.2	-	0.2	-
<i>Astropecten armatus</i>	ECHINODERMATA:Astropectinidae	0.17	0	0.13	-
<i>Phrontis tiarula</i>	MOLLUSCA:Nassariidae	0.13	0.1	-	-

<i>Crangon alaskensis</i>	ARTHROPODA:Crangonidae	0.12	-	-	0.12
<i>Renilla koellikeri</i>	CNIDARIA:Renillidae	0.12	-	0.12	-
<i>Paguristes turgidus</i>	ARTHROPODA:Diogenidae	0.11	-	0.1	0.01
<i>Octopus veligero</i>	MOLLUSCA:Octopodidae	0.1	-	-	0.1
<i>Telesto californica</i>	CNIDARIA:Tubiporidae	0.1	-	-	0.1
<i>Ascidiella aspersa</i>	CHORDATA:Ascidiidae	0.1	0.1	-	-
<i>Acanthodoris brunnea</i>	MOLLUSCA:Onchidorididae	0.08	-	0.04	0.04
<i>Astropecten</i> sp	ECHINODERMATA:Astropectinidae	0.06	-	0.06	< 0.01
<i>Armina californica</i>	MOLLUSCA:Arminidae	0.06	-	0.04	0.02
<i>Rossia pacifica</i>	MOLLUSCA:Sepiolidae	0.06	-	-	0.06
<i>Ophiopteris papillosa</i>	ECHINODERMATA:Ophiopteridae	0.06	-	0.01	0.05
<i>Molgula ficus</i>	CHORDATA:Molgulidae	0.06	0.1	-	-
<i>Flabellinopsis iodinea</i>	MOLLUSCA:Flabellinopsidae	0.05	-	0.03	0.02
<i>Leptopecten latiauratus</i>	MOLLUSCA:Pectinidae	0.05	0	-	-
<i>Luidia asthenosoma</i>	ECHINODERMATA:Luidiidae	0.03	-	-	0.03
<i>Dendronotus subramosus</i>	MOLLUSCA:Dendronotidae	0.03	-	0.03	-
<i>Strongylocentrotus purpuratus</i>	ECHINODERMATA:Strongylocentrotidae	0.02	0	-	< 0.01
<i>Eugorgia rubens</i>	CNIDARIA:Gorgoniidae	0.02	-	-	0.02
<i>Aglaja ocelligera</i>	MOLLUSCA:Aglajidae	0.02	-	0.02	-
<i>Coryrhynchus lobifrons</i>	ARTHROPODA:Inachidae	0.02	-	-	0.02
<i>Heptacarpus stimpsoni</i>	ARTHROPODA:Thoridae	0.02	0	-	-
<i>Stylatula elongata</i>	CNIDARIA:Virgulariidae	0.01	-	< 0.01	0.01
<i>Luidia</i> sp	ECHINODERMATA:Luidiidae	0.01	-	< 0.01	0.01
<i>Pagurus spilocarpus</i>	ARTHROPODA:Paguridae	0.01	0	-	0.01
Actiniaria	CNIDARIA:	0.01	-	0.01	-
<i>Dendronotus iris</i>	MOLLUSCA:Dendronotidae	0.01	-	-	0.01
<i>Ericerodes hemphillii</i>	ARTHROPODA:Inachidae	0.01	-	0.01	0.01
<i>Henricia</i> sp	ECHINODERMATA:Echinasteridae	0.01	-	-	0.01
<i>Pteropurpura festiva</i>	MOLLUSCA:Muricidae	0.01	0	0.01	< 0.01
<i>Sclerasterias heteropaes</i>	ECHINODERMATA:Asteriidae	0.01	-	< 0.01	0.01
<i>Strongylocentrotus fragilis</i>	ECHINODERMATA:Strongylocentrotidae	0.01	-	-	0.01
<i>Ophiopholis bakeri</i>	ECHINODERMATA:Ophiopholidae	0.01	-	-	0.01
<i>Araiofusus araios</i>	MOLLUSCA:Fascioliidae	0.01	-	-	0.01
<i>Calliostoma tricolor</i>	MOLLUSCA:Calliostomatidae	0.01	-	0.01	-
<i>Melibe leonina</i>	MOLLUSCA:Tethydidae	0.01	0	-	-
<i>Paguristes bakeri</i>	ARTHROPODA:Diogenidae	0.01	-	-	0.01
<i>Paracyathus stearnsii</i>	CNIDARIA:Caryophylliidae	0.01	-	-	0.01
<i>Aphrodita</i> sp	ANNELIDA:Aphroditidae	0.01	0	< 0.01	-
<i>Doriopsilla albopunctata</i>	MOLLUSCA:Dendrodorididae	0.01	-	-	0.01
<i>Latulambrus occidentalis</i>	ARTHROPODA:Parthenopidae	0.01	-	< 0.01	< 0.01
<i>Loxorhynchus crispatus</i>	ARTHROPODA:Epialtidae	0.01	-	< 0.01	< 0.01
<i>Loxorhynchus</i> sp	ARTHROPODA:Epialtidae	0.01	-	0.01	-
Nudibranchia	MOLLUSCA:	0.01	-	< 0.01	< 0.01
<i>Tochuina gigantea</i>	MOLLUSCA:Tritoniidae	0.01	-	-	0.01
<i>Triopha maculata</i>	MOLLUSCA:Polyceridae	0.01	0	< 0.01	-
<i>Aphrodita refulgida</i>	ANNELIDA:Aphroditidae	< 0.01	-	-	< 0.01
<i>Atrimitra idae</i>	MOLLUSCA:Mitridae	< 0.01	-	< 0.01	< 0.01

<i>Babelomurex oldroydi</i>	MOLLUSCA:Muricidae	< 0.01	-	< 0.01	-
<i>Calliostoma supragranosum</i>	MOLLUSCA:Calliostomatidae	< 0.01	-	-	< 0.01
<i>Ciona robusta</i>	CHORDATA:Cionidae	< 0.01	0	-	-
<i>Eugorgia ljuvenkovia</i>	CNIDARIA:Gorgoniidae	< 0.01	-	-	< 0.01
Halichondriidae	PORIFERA:Halichondriidae	< 0.01	0	-	-
<i>Hermisenda opalescens</i>	MOLLUSCA:Facelinidae	< 0.01	0	-	-
<i>Leptogorgia chilensis</i>	CNIDARIA:Gorgoniidae	< 0.01	-	-	< 0.01
<i>Leucilla nuttingi</i>	PORIFERA:Amphoriscidae	< 0.01	-	< 0.01	< 0.01
<i>Mediaster aequalis</i>	ECHINODERMATA:Goniasteridae	< 0.01	-	-	< 0.01
<i>Mesocentrotus franciscanus</i>	ECHINODERMATA:Strongylocentrotidae	< 0.01	-	-	< 0.01
<i>Neocrangon resima</i>	ARTHROPODA:Crangonidae	< 0.01	-	< 0.01	-
<i>Pugettia dalli</i>	ARTHROPODA:Epialtidae	< 0.01	-	< 0.01	-
<i>Savalia lucifica</i>	CNIDARIA:Parazoanthidae	< 0.01	-	-	< 0.01
<i>Schmittius politus</i>	ARTHROPODA:Squillidae	< 0.01	-	-	< 0.01
Terebrataliinae	BRACHIOPODA:Terebrataliidae	< 0.01	-	-	< 0.01
<i>Tritonia festiva</i>	MOLLUSCA:Tritoniidae	< 0.01	-	-	< 0.01
<i>Virgularia agassizii</i>	CNIDARIA:Virgulariidae	< 0.01	-	-	< 0.01
Virgulariidae	CNIDARIA:Virgulariidae	< 0.01	0	-	-
<i>Neocrangon zacae</i>	ARTHROPODA:Crangonidae	< 0.01	-	-	< 0.01
<i>Pugettia richii</i>	ARTHROPODA:Epialtidae	< 0.01	-	-	< 0.01
<i>Anoplodactylus erectus</i>	ARTHROPODA:Phoxichilidiidae	< 0.01	-	-	< 0.01
<i>Antillamunida hispida</i>	ARTHROPODA:Munididae	< 0.01	-	-	< 0.01
<i>Apata pricei</i>	MOLLUSCA:Apataidae	< 0.01	-	< 0.01	-
<i>Aphrodita armifera</i>	ANNELIDA:Aphroditidae	< 0.01	-	< 0.01	-
<i>Apostichopus parvimensis</i>	ECHINODERMATA:Stichopodidae	< 0.01	-	-	< 0.01
<i>Burchia semiinflata</i>	MOLLUSCA:Pseudomelatomidae	< 0.01	-	-	< 0.01
<i>Californiconus californicus</i>	MOLLUSCA:Conidae	< 0.01	-	< 0.01	-
Crangonidae	ARTHROPODA:Crangonidae	< 0.01	-	< 0.01	-
<i>Dendronotus albopunctatus</i>	MOLLUSCA:Dendronotidae	< 0.01	-	< 0.01	-
<i>Dendronotus</i> sp	MOLLUSCA:Dendronotidae	< 0.01	-	< 0.01	-
<i>Doris montereyensis</i>	MOLLUSCA:Dorididae	< 0.01	-	-	< 0.01
<i>Geodia</i> sp	PORIFERA:Geodiidae	< 0.01	-	-	< 0.01
<i>Halocynthia igaboja</i>	CHORDATA:Pyuridae	< 0.01	-	-	< 0.01
<i>Lamellaria diegoensis</i>	MOLLUSCA:Velutinidae	< 0.01	-	< 0.01	-
<i>Lophopanopeus bellus</i>	ARTHROPODA:Panopeidae	< 0.01	-	< 0.01	-
<i>Muricea californica</i>	CNIDARIA:Plexauridae	< 0.01	-	< 0.01	-
<i>Obruta collector</i>	PORIFERA:Bubaridae	< 0.01	-	-	< 0.01
<i>Orthopagurus minimus</i>	ARTHROPODA:Paguridae	< 0.01	-	-	< 0.01
<i>Paciocinebrina circumtexta</i>	MOLLUSCA:Muricidae	< 0.01	-	< 0.01	-
<i>Pagurus armatus</i>	ARTHROPODA:Paguridae	< 0.01	-	-	< 0.01
<i>Pandalus platyceros</i>	ARTHROPODA:Pandalidae	< 0.01	-	-	< 0.01
<i>Pennatuloides</i> sp HYP1	CNIDARIA:	< 0.01	-	-	< 0.01
<i>Platydoris macfarlandi</i>	MOLLUSCA:Discodorididae	< 0.01	-	-	< 0.01
<i>Pteropurpura vokesae</i>	MOLLUSCA:Muricidae	< 0.01	-	< 0.01	-
<i>Spatangus californicus</i>	ECHINODERMATA:Spatangidae	< 0.01	-	-	< 0.01
<i>Styela gibbsii</i>	CHORDATA:Styelidae	< 0.01	-	-	< 0.01
<i>Stylatula</i> sp	CNIDARIA:Virgulariidae	< 0.01	-	-	< 0.01

<i>Thesea</i> sp	CNIDARIA:Plexauridae	< 0.01	-	-	< 0.01
<i>Tritia insculpta</i>	MOLLUSCA:Nassariidae	< 0.01	-	-	< 0.01
<i>Tritonia exsulans</i>	MOLLUSCA:Tritoniidae	< 0.01	-	< 0.01	-
<i>Turcica coffea</i>	MOLLUSCA:Chilodontidae	< 0.01	-	-	< 0.01

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**Appendix C-10. Frequency of occurrence (%) of megabenthic invertebrate species collected during the Bight'23 trawl survey by strata. Asterisk means total (SCB) represents the three strata only. Five-minute trawls (bays) were doubled for comparison to inner and middle shelf.**

Species	Phylum:Family	Frequency of Occurrence (%)			
		SCB*	Bays	Inner Shelf	Middle Shelf
<i>Astropecten californicus</i>	ECHINODERMATA:Astropectinidae	35.9	-	70	72.41
<i>Octopus rubescens</i>	MOLLUSCA:Octopodidae	27.5	3.33	33.33	68.97
<i>Ophiura luetkenii</i>	ECHINODERMATA:Ophiuridae	26.2	-	6.67	82.76
<i>Pleurobranchaea californica</i>	MOLLUSCA:Pleurobranchaeidae	26.1	-	26.67	68.97
<i>Lytechinus pictus</i>	ECHINODERMATA:Toxopneustidae	24.4	-	13.33	72.41
<i>Ophiothrix spiculata</i>	ECHINODERMATA:Ophiotrichidae	23.5	10	23.33	62.07
<i>Luidia armata</i>	ECHINODERMATA:Luidiidae	20.6	-	30	48.28
<i>Sicyonia ingentis</i>	ARTHROPODA:Sicyoniidae	20.5	10	3.33	65.52
<i>Apostichopus californicus</i>	ECHINODERMATA:Stichopodidae	17.6	-	-	58.62
<i>Luidia foliolata</i>	ECHINODERMATA:Luidiidae	17.2	-	3.33	55.17
<i>Philine auriformis</i>	MOLLUSCA:Philinidae	16.1	3.33	33.33	31.03
<i>Sicyonia penicillata</i>	ARTHROPODA:Sicyoniidae	15.7	63.33	53.33	13.79
<i>Hamatoscalpellum californicum</i>	ARTHROPODA:Scalpellidae	15.1	-	23.33	34.48
<i>Pyromaia tuberculata</i>	ARTHROPODA:Inachoididae	12	33.33	36.67	13.79
<i>Crangon nigromaculata</i>	ARTHROPODA:Crangonidae	11.5	23.33	50	3.45
<i>Thesea</i> sp B	CNIDARIA:Plexauridae	10.7	-	6.67	31.03
<i>Acanthodoris brunnea</i>	MOLLUSCA:Onchidorididae	10.6	-	16.67	24.14
<i>Acanthoptilum</i> sp	CNIDARIA:Virgulariidae	9.5	13.33	-	31.03
<i>Metacarcinus gracilis</i>	ARTHROPODA:Cancriidae	8.2	3.33	40	-
<i>Luidia asthenosoma</i>	ECHINODERMATA:Luidiidae	6.2	-	-	20.69
<i>Astropecten armatus</i>	ECHINODERMATA:Astropectinidae	5	20	23.33	-
<i>Sclerasterias heteropaes</i>	ECHINODERMATA:Asteriidae	4.8	-	3.33	13.79
<i>Achelous xantusii</i>	ARTHROPODA:Portunidae	4.6	46.67	20	-
<i>Flabellinopsis iodinea</i>	MOLLUSCA:Flabellinopsidae	4.4	-	16.67	3.45
<i>Strongylocentrotus fragilis</i>	ECHINODERMATA:Strongylocentrotidae	4.1	-	-	13.79
<i>Armina californica</i>	MOLLUSCA:Arminidae	4.1	-	10	6.9
<i>Luidia</i> sp	ECHINODERMATA:Luidiidae	3.8	-	3.33	10.34
<i>Paguristes turgidus</i>	ARTHROPODA:Diogenidae	3.8	-	3.33	10.34
<i>Metacarcinus anthonyi</i>	ARTHROPODA:Cancriidae	3.5	10	6.67	6.9
<i>Crossata ventricosa</i>	MOLLUSCA:Bursidae	3.4	-	6.67	6.9
<i>Ophiopteris papillosa</i>	ECHINODERMATA:Ophiopteridae	3.4	-	6.67	6.9
<i>Stylatula elongata</i>	CNIDARIA:Virgulariidae	3.4	-	6.67	6.9
<i>Renilla koellikeri</i>	CNIDARIA:Renillidae	3.4	-	16.67	-
<i>Coryrhynchus lobifrons</i>	ARTHROPODA:Inachidae	3.1	-	-	10.34
<i>Eugorgia rubens</i>	CNIDARIA:Gorgoniidae	3.1	-	-	10.34
<i>Paguristes bakeri</i>	ARTHROPODA:Diogenidae	3.1	-	-	10.34
<i>Rossia pacifica</i>	MOLLUSCA:Sepiolidae	3.1	-	-	10.34
<i>Astropecten</i> sp	ECHINODERMATA:Astropectinidae	3.1	-	10	3.45
<i>Latulambrus occidentalis</i>	ARTHROPODA:Parthenopidae	2.7	-	3.33	6.9
<i>Loxorhynchus crispatus</i>	ARTHROPODA:Epialtidae	2.7	-	3.33	6.9
<i>Platymera gaudichaudii</i>	ARTHROPODA:Calappidae	2.7	-	3.33	6.9

<i>Loxorhynchus grandis</i>	ARTHROPODA:Epialtidae	2.7	-	13.33	-
<i>Pteropurpura festiva</i>	MOLLUSCA:Muricidae	2.4	3.33	6.67	3.45
<i>Ericerodes hemphillii</i>	ARTHROPODA:Inachidae	2.4	-	6.67	3.45
<i>Pagurus spilocarpus</i>	ARTHROPODA:Paguridae	2.1	3.33	-	6.9
<i>Aphrodita refulgida</i>	ANNELIDA:Aphroditidae	2.1	-	-	6.9
<i>Crangon alaskensis</i>	ARTHROPODA:Crangonidae	2.1	-	-	6.9
<i>Eugorgia ljubenkovia</i>	CNIDARIA:Gorgoniidae	2.1	-	-	6.9
<i>Florometra serratissima</i>	ECHINODERMATA:Antedonidae	2.1	-	-	6.9
<i>Henricia</i> sp	ECHINODERMATA:Echinasteridae	2.1	-	-	6.9
<i>Kelletia kelletii</i>	MOLLUSCA:Austrosiphonidae	2.1	-	-	6.9
<i>Octopus veligero</i>	MOLLUSCA:Octopodidae	2.1	-	-	6.9
<i>Ophiopholis bakeri</i>	ECHINODERMATA:Ophiophilidae	2.1	-	-	6.9
<i>Philinorbis albus</i>	MOLLUSCA:Philinorbidae	2.1	-	-	6.9
<i>Schmittius politus</i>	ARTHROPODA:Squillidae	2.1	-	-	6.9
<i>Aglaja ocelligera</i>	MOLLUSCA:Aglajidae	2	-	10	-
<i>Atrimitra idae</i>	MOLLUSCA:Mitridae	1.7	-	3.33	3.45
<i>Dendronotus venustus</i>	MOLLUSCA:Dendronotidae	1.7	-	3.33	3.45
<i>Leucilla nuttingi</i>	PORIFERA:Amphoriscidae	1.7	-	3.33	3.45
<i>Nudibranchia</i>	MOLLUSCA:	1.7	-	3.33	3.45
<i>Calliostoma tricolor</i>	MOLLUSCA:Calliostomatidae	1.4	-	6.67	-
<i>Cancer productus</i>	ARTHROPODA:Cancriidae	1.4	-	6.67	-
<i>Pugettia dalli</i>	ARTHROPODA:Epialtidae	1.4	-	6.67	-
<i>Randallia ornata</i>	ARTHROPODA:Leucosiidae	1.4	-	6.67	-
<i>Strongylocentrotus purpuratus</i>	ECHINODERMATA:Strongylocentrotidae	1.1	3.33	-	3.45
<i>Adelogorgia phyllosclera</i>	CNIDARIA:Gorgoniidae	1	-	-	3.45
<i>Anoplodactylus erectus</i>	ARTHROPODA:Phoxichilidiidae	1	-	-	3.45
<i>Antillamunida hispida</i>	ARTHROPODA:Munididae	1	-	-	3.45
<i>Apostichopus parvimensis</i>	ECHINODERMATA:Stichopodidae	1	-	-	3.45
<i>Araiofusus araios</i>	MOLLUSCA:Fascioliidae	1	-	-	3.45
<i>Burchia semiinflata</i>	MOLLUSCA:Pseudomelatomidae	1	-	-	3.45
<i>Calliostoma supragranosum</i>	MOLLUSCA:Calliostomatidae	1	-	-	3.45
<i>Dendronotus iris</i>	MOLLUSCA:Dendronotidae	1	-	-	3.45
<i>Doriopsisilla albopunctata</i>	MOLLUSCA:Dendrodorididae	1	-	-	3.45
<i>Doris montereyensis</i>	MOLLUSCA:Dorididae	1	-	-	3.45
<i>Enteroctopus dofleini</i>	MOLLUSCA:Enteroctopodidae	1	-	-	3.45
<i>Geodia</i> sp	PORIFERA:Geodiidae	1	-	-	3.45
<i>Halocynthia igaboja</i>	CHORDATA:Pyuridae	1	-	-	3.45
<i>Leptogorgia chilensis</i>	CNIDARIA:Gorgoniidae	1	-	-	3.45
<i>Mediaster aequalis</i>	ECHINODERMATA:Goniasteridae	1	-	-	3.45
<i>Mesocentrotus franciscanus</i>	ECHINODERMATA:Strongylocentrotidae	1	-	-	3.45
<i>Neocrangon zacae</i>	ARTHROPODA:Crangonidae	1	-	-	3.45
<i>Obruta collector</i>	PORIFERA:Bubaridae	1	-	-	3.45
<i>Orthopagurus minimus</i>	ARTHROPODA:Paguridae	1	-	-	3.45
<i>Pagurus armatus</i>	ARTHROPODA:Paguridae	1	-	-	3.45
<i>Pandalus platyceros</i>	ARTHROPODA:Pandalidae	1	-	-	3.45
<i>Paracyathus stearnsii</i>	CNIDARIA:Caryophylliidae	1	-	-	3.45
<i>Pennatuloides</i> sp HYP1	CNIDARIA:	1	-	-	3.45

<i>Platydoris macfarlandi</i>	MOLLUSCA:Discodorididae	1	-	-	3.45
<i>Pugettia richii</i>	ARTHROPODA:Epialtidae	1	-	-	3.45
<i>Savalia lucifica</i>	CNIDARIA:Parazoanthidae	1	-	-	3.45
<i>Spatangus californicus</i>	ECHINODERMATA:Spatangiidae	1	-	-	3.45
<i>Styela gibbsii</i>	CHORDATA:Styelidae	1	-	-	3.45
<i>Stylatula</i> sp	CNIDARIA:Virgulariidae	1	-	-	3.45
<i>Telesto californica</i>	CNIDARIA:Tubiporidae	1	-	-	3.45
<i>Terebrataliinae</i>	BRACHIOPODA:Terebrataliidae	1	-	-	3.45
<i>Thesea</i> sp	CNIDARIA:Plexauridae	1	-	-	3.45
<i>Tochuina gigantea</i>	MOLLUSCA:Tritoniidae	1	-	-	3.45
<i>Tritia insculpta</i>	MOLLUSCA:Nassariidae	1	-	-	3.45
<i>Tritonia festiva</i>	MOLLUSCA:Tritoniidae	1	-	-	3.45
<i>Turcica coffea</i>	MOLLUSCA:Chilodontaidae	1	-	-	3.45
<i>Virgularia agassizii</i>	CNIDARIA:Virgulariidae	1	-	-	3.45
<i>Penaeus californiensis</i>	ARTHROPODA:Penaeidae	0.8	10	3.33	-
<i>Aphrodita</i> sp	ANNELIDA:Aphroditidae	0.7	3.33	3.33	-
<i>Triopha maculata</i>	MOLLUSCA:Polyceridae	0.7	3.33	3.33	-
Actiniaria	CNIDARIA:	0.7	-	3.33	-
<i>Apata pricei</i>	MOLLUSCA:Apataidae	0.7	-	3.33	-
<i>Aphrodita armifera</i>	ANNELIDA:Aphroditidae	0.7	-	3.33	-
<i>Babelomurex oldroydi</i>	MOLLUSCA:Muricidae	0.7	-	3.33	-
<i>Californiconus californicus</i>	MOLLUSCA:Conidae	0.7	-	3.33	-
Crangonidae	ARTHROPODA:Crangonidae	0.7	-	3.33	-
<i>Dendronotus albopunctatus</i>	MOLLUSCA:Dendronotidae	0.7	-	3.33	-
<i>Dendronotus</i> sp	MOLLUSCA:Dendronotidae	0.7	-	3.33	-
<i>Dendronotus subramosus</i>	MOLLUSCA:Dendronotidae	0.7	-	3.33	-
<i>Lamellaria diegoensis</i>	MOLLUSCA:Velutinidae	0.7	-	3.33	-
<i>Lophopanopeus bellus</i>	ARTHROPODA:Panopeidae	0.7	-	3.33	-
<i>Loxorhynchus</i> sp	ARTHROPODA:Epialtidae	0.7	-	3.33	-
<i>Muricea californica</i>	CNIDARIA:Plexauridae	0.7	-	3.33	-
<i>Neocrangon resima</i>	ARTHROPODA:Crangonidae	0.7	-	3.33	-
<i>Paciocinebrina circumtexta</i>	MOLLUSCA:Muricidae	0.7	-	3.33	-
<i>Pteropurpura vokesae</i>	MOLLUSCA:Muricidae	0.7	-	3.33	-
<i>Tritonia exsulans</i>	MOLLUSCA:Tritoniidae	0.7	-	3.33	-
<i>Bulla gouldiana</i>	MOLLUSCA:Bullidae	0.3	23.33	-	-
<i>Suberites</i> sp	PORIFERA:Suberitidae	0.2	20	-	-
<i>Phrontis tiarula</i>	MOLLUSCA:Nassariidae	0.2	13.33	-	-
<i>Asciidiella aspersa</i>	CHORDATA:Asciidiidae	0.1	10	-	-
<i>Heptacarpus stimpsoni</i>	ARTHROPODA:Thoridae	0.1	10	-	-
<i>Leptopecten latiauratus</i>	MOLLUSCA:Pectinidae	0.1	6.67	-	-
<i>Panulirus interruptus</i>	ARTHROPODA:Palinuridae	0.1	6.67	-	-
Tetillidae	PORIFERA:Tetillidae	0.1	6.67	-	-
<i>Ciona robusta</i>	CHORDATA:Cionidae	0	3.33	-	-
<i>Dendraster excentricus</i>	ECHINODERMATA:Dendrasteridae	0	3.33	-	-
Halichondriidae	PORIFERA:Halichondriidae	0	3.33	-	-
<i>Hermisenda opalescens</i>	MOLLUSCA:Facelinidae	0	3.33	-	-
<i>Melibe leonina</i>	MOLLUSCA:Tethyidae	0	3.33	-	-
<i>Molgula ficus</i>	CHORDATA:Molgulidae	0	3.33	-	-

<i>Octopus bimaculatus</i>	MOLLUSCA:Octopodidae	0	3.33	-	-
<i>Octopus bimaculoides</i>	MOLLUSCA:Octopodidae	0	3.33	-	-
<i>Romaleon antennarium</i>	ARTHROPODA:Cancriidae	0	3.33	-	-
Virgulariidae	CNIDARIA:Virgulariidae	0	3.33	-	-

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**Appendix C-11. Summary of megabenthic invertebrate species collected in Bays during the Bight '23 trawl survey. Data are % abundance, % biomass, frequency of occurrence and Ecological Index.**

Invertebrate Species	Bays			Ecological Index
	% Abundance	% Biomass	% Frequency	
<i>Sicyonia penicillata</i>	84.08	71.67	63.33	9863.71
<i>Suberites</i> sp	0.03	15.62	20.00	312.96
<i>Achelous xantusii</i>	0.59	1.00	46.67	74.52
<i>Dendraaster excentricus</i>	11.92	8.81	3.33	69.10
<i>Sicyonia ingentis</i>	0.84	0.58	10.00	14.18
<i>Acanthoptilum</i> sp	0.42	0.16	13.33	7.77
<i>Bulla gouldiana</i>	0.20	0.10	23.33	6.87
<i>Crangon nigromaculata</i>	0.24	0.04	23.33	6.42
<i>Panulirus interruptus</i>	0.03	0.91	6.67	6.29
<i>Pyromaia tuberculata</i>	0.10	0.02	33.33	3.75
<i>Philine auriformis</i>	0.81	0.13	3.33	3.13
<i>Phrontis tiarula</i>	0.18	0.03	13.33	2.75
<i>Penaeus californiensis</i>	0.04	0.17	10.00	2.17
<i>Asciidiella aspersa</i>	0.13	0.02	10.00	1.50
<i>Astropecten armatus</i>	0.05	0.01	20.00	1.25
Tetillidae	0.01	0.17	6.67	1.23
<i>Romaleon antennarium</i>	0.01	0.17	3.33	0.61
<i>Octopus bimaculatus</i>	0.01	0.17	3.33	0.60
<i>Leptopecten latiauratus</i>	0.06	0.01	6.67	0.50
<i>Ophiothrix spiculata</i>	0.04	0.01	10.00	0.44
<i>Metacarcinus gracilis</i>	0.01	0.09	3.33	0.31
<i>Octopus bimaculoides</i>	0.01	0.09	3.33	0.31
<i>Molgula ficus</i>	0.08	0.01	3.33	0.29
<i>Heptacarpus stimpsoni</i>	0.02	0.00	10.00	0.25
<i>Metacarcinus anthonyi</i>	0.02	0.00	10.00	0.19
<i>Strongylocentrotus purpuratus</i>	0.03	0.00	3.33	0.10
<i>Melibe leonina</i>	0.01	0.00	3.33	0.04
<i>Aphrodita</i> sp	0.01	0.00	3.33	0.02
<i>Ciona robusta</i>	0.01	0.00	3.33	0.02
Halichondriidae	0.01	0.00	3.33	0.02
<i>Hermisenda opalescens</i>	0.01	0.00	3.33	0.02
<i>Octopus rubescens</i>	0.01	0.00	3.33	0.02
<i>Pagurus spilocarpus</i>	0.01	0.00	3.33	0.02
<i>Pteropurpura festiva</i>	0.01	0.00	3.33	0.02
<i>Triopha maculata</i>	0.01	0.00	3.33	0.02
Virgulariidae	0.01	0.00	3.33	0.02

**Appendix C-12. Summary of megabenthic invertebrate species collected on the Inner Shelf during the Bight '23 trawl survey. Data are % abundance, % biomass, frequency of occurrence and Ecological Index.**

Invertebrate Species	Inner Shelf			Ecological Index
	% Abundance	% Biomass	% Frequency	
<i>Sicyonia penicillata</i>	18.11	38.14	55.17	3102.92
<i>Astropecten californicus</i>	18.49	5.16	72.41	1712.67
<i>Philine auriformis</i>	21.51	4.19	34.48	886.14
<i>Metacarcinus gracilis</i>	1.56	10.86	41.38	513.84
<i>Ophiothrix spiculata</i>	9.70	2.29	24.14	289.53
<i>Crangon nigromaculata</i>	4.15	1.29	51.72	281.50
<i>Loxorhynchus grandis</i>	0.16	18.75	13.79	260.79
<i>Achelous xantusii</i>	2.95	5.82	20.69	181.42
<i>Hamatoscalpellum californicum</i>	5.97	1.38	24.14	177.40
<i>Pyromaia tuberculata</i>	2.95	0.68	37.93	137.87
<i>Octopus rubescens</i>	0.81	1.02	34.48	63.12
<i>Renilla koellikeri</i>	1.88	0.43	17.24	39.94
<i>Lytechinus pictus</i>	2.34	0.52	13.79	39.46
<i>Luidia armata</i>	0.78	0.18	31.03	29.75
<i>Astropecten armatus</i>	0.62	0.48	24.14	26.46
<i>Pleurobranchaea californica</i>	0.62	0.19	27.59	22.28
<i>Crossata ventricosa</i>	0.13	2.62	6.90	18.99
<i>Acanthodoris brunnea</i>	0.71	0.16	17.24	15.15
<i>Astropecten sp</i>	0.97	0.22	10.34	12.40
<i>Flabellinopsis iodinea</i>	0.52	0.12	17.24	11.02
<i>Metacarcinus anthonyi</i>	0.13	1.33	6.90	10.10
<i>Armina californica</i>	0.62	0.14	10.34	7.85
<i>Cancer productus</i>	0.10	0.86	6.90	6.62
<i>Ophiura luetkenii</i>	0.71	0.16	6.90	6.06
<i>Randallia ornata</i>	0.06	0.76	6.90	5.67
<i>Aglaja ocelligera</i>	0.26	0.06	10.34	3.31
<i>Platymera gaudichaudii</i>	0.03	0.75	3.45	2.70
<i>Dendronotus subramosus</i>	0.52	0.12	3.45	2.20
<i>Penaeus californiensis</i>	0.13	0.37	3.45	1.74
<i>Ophiopteris papillosa</i>	0.19	0.04	6.90	1.65
<i>Paguristes turgidus</i>	0.10	0.37	3.45	1.63
<i>Dendronotus venustus</i>	0.36	0.08	3.45	1.52
<i>Calliostoma tricolor</i>	0.13	0.03	6.90	1.10
<i>Thesea sp B</i>	0.13	0.03	6.90	1.10
Actiniaria	0.19	0.04	3.45	0.83
<i>Ericerodes hemphillii</i>	0.10	0.02	6.90	0.83
<i>Pteropurpura festiva</i>	0.10	0.02	6.90	0.83
<i>Pugettia dalli</i>	0.06	0.01	6.90	0.55
<i>Stylatula elongata</i>	0.06	0.01	6.90	0.55
<i>Loxorhynchus sp</i>	0.10	0.02	3.45	0.41
<i>Babelomurex oldroydi</i>	0.06	0.01	3.45	0.28
<i>Luidia foliolata</i>	0.06	0.01	3.45	0.28
<i>Neocrangon resima</i>	0.06	0.01	3.45	0.28
Nudibranchia	0.06	0.01	3.45	0.28
<i>Sclerasterias heteropaes</i>	0.06	0.01	3.45	0.28
<i>Apata pricei</i>	0.03	0.01	3.45	0.14
<i>Aphrodita armifera</i>	0.03	0.01	3.45	0.14
<i>Aphrodita sp</i>	0.03	0.01	3.45	0.14
Atrimitraidae	0.03	0.01	3.45	0.14

Invertebrate Species	Inner Shelf			Ecological Index
	% Abundance	% Biomass	% Frequency	
<i>Californiconus californicus</i>	0.03	0.01	3.45	0.14
Crangonidae	0.03	0.01	3.45	0.14
<i>Dendronotus albopunctatus</i>	0.03	0.01	3.45	0.14
<i>Dendronotus</i> sp	0.03	0.01	3.45	0.14
<i>Lamellaria diegoensis</i>	0.03	0.01	3.45	0.14
<i>Latulambrus occidentalis</i>	0.03	0.01	3.45	0.14
<i>Leucilla nuttingi</i>	0.03	0.01	3.45	0.14
<i>Lophopanopeus bellus</i>	0.03	0.01	3.45	0.14
<i>Loxorhynchus crispatus</i>	0.03	0.01	3.45	0.14
<i>Luidia</i> sp	0.03	0.01	3.45	0.14
<i>Muricea californica</i>	0.03	0.01	3.45	0.14
<i>Paciocinebrina circumtexta</i>	0.03	0.01	3.45	0.14
<i>Pteropurpura vokesae</i>	0.03	0.01	3.45	0.14
<i>Sicyonia ingentis</i>	0.03	0.01	3.45	0.14
<i>Triopha maculata</i>	0.03	0.01	3.45	0.14
<i>Tritonia exsulans</i>	0.03	0.01	3.45	0.14

**Appendix C-13. Summary of megabenthic invertebrate species collected on the Middle Shelf during the Bight '23 trawl survey. Data are % abundance, % biomass, frequency of occurrence and Ecological Index.**

Invertebrate Species	Middle Shelf			Ecological Index
	% Abundance	% Biomass	% Frequency	
<i>Lytechinus pictus</i>	56.30	9.62	72.41	4773.52
<i>Apostichopus californicus</i>	1.12	64.84	58.62	3866.48
<i>Ophiura luetkenii</i>	15.72	3.22	82.76	1567.45
<i>Sicyonia ingentis</i>	4.47	6.88	68.97	783.00
<i>Ophiothrix spiculata</i>	7.03	0.46	62.07	464.63
<i>Astropecten californicus</i>	4.90	1.44	72.41	459.18
<i>Pleurobranchaea californica</i>	0.63	2.32	68.97	202.90
<i>Octopus rubescens</i>	0.33	1.52	68.97	128.00
<i>Luidia armata</i>	0.83	1.74	48.28	124.00
<i>Hamatoscalpellum californicum</i>	1.88	0.59	34.48	84.98
<i>Luidia foliolata</i>	0.42	0.49	55.17	50.29
<i>Philine auriformis</i>	0.96	0.30	31.03	39.15
<i>Thesea</i> sp B	0.80	0.25	31.03	32.67
<i>Sicyonia penicillata</i>	0.18	0.43	13.79	8.39
<i>Adelogorgia phyllosclera</i>	0.16	1.84	3.45	6.90
<i>Metacarcinus anthonyi</i>	0.03	0.92	6.90	6.52
<i>Acanthoptilum</i> sp	0.13	0.04	31.03	5.31
<i>Dendronotus venustus</i>	1.17	0.37	3.45	5.31
<i>Acanthodoris brunnea</i>	0.13	0.04	24.14	4.06
<i>Florometra serratissima</i>	0.25	0.31	6.90	3.84
<i>Crangon alaskensis</i>	0.39	0.13	6.90	3.56
<i>Luidia asthenosoma</i>	0.11	0.03	20.69	3.01
<i>Philinorbis albus</i>	0.10	0.31	6.90	2.88
<i>Enteroctopus dofleini</i>	0.01	0.72	3.45	2.49
<i>Kelletia kelletii</i>	0.03	0.21	6.90	1.60
<i>Platymera gaudichaudii</i>	0.01	0.21	6.90	1.51
<i>Telesto californica</i>	0.33	0.10	3.45	1.48
<i>Ophiopteris papillosa</i>	0.15	0.05	6.90	1.36
<i>Pyromaia tuberculata</i>	0.07	0.02	13.79	1.30
<i>Stylatula elongata</i>	0.14	0.01	6.90	1.07
<i>Octopus veligero</i>	0.02	0.11	6.90	0.87
<i>Rossia pacifica</i>	0.02	0.06	10.34	0.86
<i>Crossata ventricosa</i>	0.01	0.10	6.90	0.81
<i>Eugorgia rubens</i>	0.06	0.02	10.34	0.80
<i>Coryrhynchus lobifrons</i>	0.05	0.02	10.34	0.71
<i>Strongylocentrotus fragilis</i>	0.04	0.01	13.79	0.71
<i>Neocrangon zacaе</i>	0.18	0.00	3.45	0.64
<i>Armina californica</i>	0.07	0.03	6.90	0.63
<i>Luidia</i> sp	0.04	0.01	10.34	0.53
<i>Sclerasterias heteropaes</i>	0.03	0.01	13.79	0.47
<i>Paguristes turgidus</i>	0.03	0.01	10.34	0.44
<i>Paguristes bakeri</i>	0.03	0.01	10.34	0.35
<i>Henricia</i> sp	0.04	0.01	6.90	0.35
<i>Ophiopholis bakeri</i>	0.03	0.01	6.90	0.30
<i>Pagurus spilocarpus</i>	0.03	0.01	6.90	0.30
<i>Flabellinopsis iodinea</i>	0.05	0.02	3.45	0.24
<i>Dendronotus iris</i>	0.04	0.01	3.45	0.18
<i>Aphrodita refulgida</i>	0.01	0.00	6.90	0.12
<i>Araiofusus araios</i>	0.03	0.01	3.45	0.12

Invertebrate Species	Middle Shelf			Ecological Index
	% Abundance	% Biomass	% Frequency	
<i>Eugorgia ljubenkovia</i>	0.01	0.00	6.90	0.12
<i>Latulambrus occidentalis</i>	0.01	0.00	6.90	0.12
<i>Loxorhynchus crispatus</i>	0.01	0.00	6.90	0.12
<i>Paracyathus stearnsii</i>	0.03	0.01	3.45	0.12
<i>Schmittius politus</i>	0.01	0.00	6.90	0.12
<i>Doriopsilla albopunctata</i>	0.02	0.01	3.45	0.09
<i>Ericerodes hemphillii</i>	0.02	0.01	3.45	0.09
<i>Tochuina gigantea</i>	0.02	0.01	3.45	0.09
<i>Astropecten</i> sp	0.01	0.00	3.45	0.06
<i>Calliostoma supragranosum</i>	0.01	0.00	3.45	0.06
<i>Leptogorgia chilensis</i>	0.01	0.00	3.45	0.06
<i>Mediaster aequalis</i>	0.01	0.00	3.45	0.06
<i>Mesocentrotus franciscanus</i>	0.01	0.00	3.45	0.06
<i>Savalia lucifica</i>	0.01	0.00	3.45	0.06
Terebrataliinae	0.01	0.00	3.45	0.06
<i>Tritonia festiva</i>	0.01	0.00	3.45	0.06
<i>Virgularia agassizii</i>	0.01	0.00	3.45	0.06
<i>Pugettia richii</i>	0.01	0.00	3.45	0.03
<i>Anoplodactylus erectus</i>	0.01	0.00	3.45	0.03
<i>Antillamunida hispida</i>	0.01	0.00	3.45	0.03
<i>Apostichopus parvimensis</i>	0.01	0.00	3.45	0.03
Atrimitraidae	0.01	0.00	3.45	0.03
<i>Burchia semiinflata</i>	0.01	0.00	3.45	0.03
<i>Crangon nigromaculata</i>	0.01	0.00	3.45	0.03
<i>Doris montereyensis</i>	0.01	0.00	3.45	0.03
<i>Geodia</i> sp	0.01	0.00	3.45	0.03
<i>Halocynthia igaboja</i>	0.01	0.00	3.45	0.03
<i>Leucilla nuttingi</i>	0.01	0.00	3.45	0.03
<i>Nudibranchia</i>	0.01	0.00	3.45	0.03
<i>Obruta collector</i>	0.01	0.00	3.45	0.03
<i>Orthopagurus minimus</i>	0.01	0.00	3.45	0.03
<i>Pagurus armatus</i>	0.01	0.00	3.45	0.03
<i>Pandalus platyceros</i>	0.01	0.00	3.45	0.03
<i>Pennatuloides</i> sp HYP1	0.01	0.00	3.45	0.03
<i>Platydoris macfarlandi</i>	0.01	0.00	3.45	0.03
<i>Pteropurpura festiva</i>	0.01	0.00	3.45	0.03
<i>Spatangus californicus</i>	0.01	0.00	3.45	0.03
<i>Strongylocentrotus purpuratus</i>	0.01	0.00	3.45	0.03
<i>Styela gibbsii</i>	0.01	0.00	3.45	0.03
<i>Stylatula</i> sp	0.01	0.00	3.45	0.03
<i>Thesea</i> sp	0.01	0.00	3.45	0.03
<i>Tritia insculpta</i>	0.01	0.00	3.45	0.03
<i>Turcica coffea</i>	0.01	0.00	3.45	0.03

**Appendix C-14. Top ten species of megabenthic invertebrate species collected over all surveys in Bays. Data are the sum of the species for a particular survey year.**

Species	Survey	Stratum	Total Abundance
<i>Sicyonia penicillata</i>	'94	Bays	0
<i>Sicyonia penicillata</i>	'98	Bays	3
<i>Sicyonia penicillata</i>	'03	Bays	0
<i>Sicyonia penicillata</i>	'08	Bays	4
<i>Sicyonia penicillata</i>	'13	Bays	1208
<i>Sicyonia penicillata</i>	'18	Bays	853
<i>Sicyonia penicillata</i>	'23	Bays	31234
<i>Dendraster excentricus</i>	'98	Bays	0
<i>Dendraster excentricus</i>	'03	Bays	0
<i>Dendraster excentricus</i>	'08	Bays	6
<i>Dendraster excentricus</i>	'13	Bays	0
<i>Dendraster excentricus</i>	'18	Bays	618
<i>Dendraster excentricus</i>	'23	Bays	4430
<i>Pyromaia tuberculata</i>	'98	Bays	1706
<i>Pyromaia tuberculata</i>	'03	Bays	162
<i>Pyromaia tuberculata</i>	'08	Bays	340
<i>Pyromaia tuberculata</i>	'13	Bays	155
<i>Pyromaia tuberculata</i>	'18	Bays	66
<i>Pyromaia tuberculata</i>	'23	Bays	36
<i>Crangon nigromaculata</i>	'98	Bays	757
<i>Crangon nigromaculata</i>	'03	Bays	820
<i>Crangon nigromaculata</i>	'08	Bays	114
<i>Crangon nigromaculata</i>	'13	Bays	160
<i>Crangon nigromaculata</i>	'18	Bays	42
<i>Crangon nigromaculata</i>	'23	Bays	88
<i>Arcuatula senhousia</i>	'98	Bays	1032
<i>Arcuatula senhousia</i>	'03	Bays	508
<i>Arcuatula senhousia</i>	'08	Bays	2
<i>Arcuatula senhousia</i>	'13	Bays	134
<i>Arcuatula senhousia</i>	'18	Bays	39
<i>Arcuatula senhousia</i>	'23	Bays	0
<i>Bulla gouldiana</i>	'98	Bays	716
<i>Bulla gouldiana</i>	'03	Bays	584
<i>Bulla gouldiana</i>	'08	Bays	44
<i>Bulla gouldiana</i>	'13	Bays	3
<i>Bulla gouldiana</i>	'18	Bays	17
<i>Bulla gouldiana</i>	'23	Bays	74
<i>Philine auriformis</i>	'98	Bays	608
<i>Philine auriformis</i>	'03	Bays	309
<i>Philine auriformis</i>	'08	Bays	16
<i>Philine auriformis</i>	'13	Bays	34
<i>Philine auriformis</i>	'18	Bays	48
<i>Philine auriformis</i>	'23	Bays	300
<i>Acanthoptilum</i> sp	'98	Bays	2
<i>Acanthoptilum</i> sp	'03	Bays	370
<i>Acanthoptilum</i> sp	'08	Bays	490

<i>Acanthoptilum</i> sp	'13	Bays	6
<i>Acanthoptilum</i> sp	'18	Bays	44
<i>Acanthoptilum</i> sp	'23	Bays	156
Asciacea	'98	Bays	0
Asciacea	'03	Bays	1004
Asciacea	'08	Bays	0
Asciacea	'13	Bays	0
Asciacea	'18	Bays	0
Asciacea	'23	Bays	0
<i>Sicyonia ingentis</i>	'98	Bays	10
<i>Sicyonia ingentis</i>	'03	Bays	0
<i>Sicyonia ingentis</i>	'08	Bays	56
<i>Sicyonia ingentis</i>	'13	Bays	472
<i>Sicyonia ingentis</i>	'18	Bays	16
<i>Sicyonia ingentis</i>	'23	Bays	312

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**Appendix C-15. Top ten species of megabenthic invertebrate species collected over all surveys on the Inner Shelf. Data are the sum of the species for a particular survey year.**

Species	Survey	Stratum	Total Abundance
<i>Astropecten californicus</i>	'94	Inner Shelf	363
<i>Astropecten californicus</i>	'98	Inner Shelf	176
<i>Astropecten californicus</i>	'03	Inner Shelf	604
<i>Astropecten californicus</i>	'08	Inner Shelf	334
<i>Astropecten californicus</i>	'13	Inner Shelf	1588
<i>Astropecten californicus</i>	'18	Inner Shelf	293
<i>Astropecten californicus</i>	'23	Inner Shelf	570
<i>Dendraster excentricus</i>	'94	Inner Shelf	1
<i>Dendraster excentricus</i>	'98	Inner Shelf	171
<i>Dendraster excentricus</i>	'03	Inner Shelf	0
<i>Dendraster excentricus</i>	'08	Inner Shelf	0
<i>Dendraster excentricus</i>	'13	Inner Shelf	0
<i>Dendraster excentricus</i>	'18	Inner Shelf	2117
<i>Dendraster excentricus</i>	'23	Inner Shelf	0
<i>Crangon nigromaculata</i>	'94	Inner Shelf	41
<i>Crangon nigromaculata</i>	'98	Inner Shelf	180
<i>Crangon nigromaculata</i>	'03	Inner Shelf	358
<i>Crangon nigromaculata</i>	'08	Inner Shelf	97
<i>Crangon nigromaculata</i>	'13	Inner Shelf	935
<i>Crangon nigromaculata</i>	'18	Inner Shelf	145
<i>Crangon nigromaculata</i>	'23	Inner Shelf	128
<i>Philine auriformis</i>	'94	Inner Shelf	0
<i>Philine auriformis</i>	'98	Inner Shelf	15
<i>Philine auriformis</i>	'03	Inner Shelf	5
<i>Philine auriformis</i>	'08	Inner Shelf	109
<i>Philine auriformis</i>	'13	Inner Shelf	2
<i>Philine auriformis</i>	'18	Inner Shelf	21
<i>Philine auriformis</i>	'23	Inner Shelf	663
<i>Sicyonia penicillata</i>	'94	Inner Shelf	0
<i>Sicyonia penicillata</i>	'98	Inner Shelf	0
<i>Sicyonia penicillata</i>	'03	Inner Shelf	0
<i>Sicyonia penicillata</i>	'08	Inner Shelf	4
<i>Sicyonia penicillata</i>	'13	Inner Shelf	54
<i>Sicyonia penicillata</i>	'18	Inner Shelf	148
<i>Sicyonia penicillata</i>	'23	Inner Shelf	558
<i>Ophiothrix spiculata</i>	'94	Inner Shelf	1
<i>Ophiothrix spiculata</i>	'98	Inner Shelf	33
<i>Ophiothrix spiculata</i>	'03	Inner Shelf	9
<i>Ophiothrix spiculata</i>	'08	Inner Shelf	12
<i>Ophiothrix spiculata</i>	'13	Inner Shelf	52
<i>Ophiothrix spiculata</i>	'18	Inner Shelf	249
<i>Ophiothrix spiculata</i>	'23	Inner Shelf	299
<i>Lytechinus pictus</i>	'94	Inner Shelf	20
<i>Lytechinus pictus</i>	'98	Inner Shelf	16
<i>Lytechinus pictus</i>	'03	Inner Shelf	228
<i>Lytechinus pictus</i>	'08	Inner Shelf	123

<i>Lytechinus pictus</i>	'13	Inner Shelf	77
<i>Lytechinus pictus</i>	'18	Inner Shelf	104
<i>Lytechinus pictus</i>	'23	Inner Shelf	72
<i>Metacarcinus gracilis</i>	'94	Inner Shelf	16
<i>Metacarcinus gracilis</i>	'98	Inner Shelf	9
<i>Metacarcinus gracilis</i>	'03	Inner Shelf	38
<i>Metacarcinus gracilis</i>	'08	Inner Shelf	49
<i>Metacarcinus gracilis</i>	'13	Inner Shelf	223
<i>Metacarcinus gracilis</i>	'18	Inner Shelf	32
<i>Metacarcinus gracilis</i>	'23	Inner Shelf	48
<i>Octopus rubescens</i>	'94	Inner Shelf	1
<i>Octopus rubescens</i>	'98	Inner Shelf	11
<i>Octopus rubescens</i>	'03	Inner Shelf	60
<i>Octopus rubescens</i>	'08	Inner Shelf	47
<i>Octopus rubescens</i>	'13	Inner Shelf	178
<i>Octopus rubescens</i>	'18	Inner Shelf	26
<i>Octopus rubescens</i>	'23	Inner Shelf	25
<i>Pyromaia tuberculata</i>	'94	Inner Shelf	48
<i>Pyromaia tuberculata</i>	'98	Inner Shelf	73
<i>Pyromaia tuberculata</i>	'03	Inner Shelf	9
<i>Pyromaia tuberculata</i>	'08	Inner Shelf	23
<i>Pyromaia tuberculata</i>	'13	Inner Shelf	42
<i>Pyromaia tuberculata</i>	'18	Inner Shelf	15
<i>Pyromaia tuberculata</i>	'23	Inner Shelf	91

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**Appendix C-16. Top ten species of megabenthic invertebrate species collected over all surveys on the Middle Shelf. Data are the sum of the species for a particular survey year.**

<b>Species</b>	<b>Survey</b>	<b>Stratum</b>	<b>Total Abundance</b>
<i>Lytechinus pictus</i>	'94	Middle Shelf	27660
<i>Lytechinus pictus</i>	'98	Middle Shelf	69462
<i>Lytechinus pictus</i>	'03	Middle Shelf	32696
<i>Lytechinus pictus</i>	'08	Middle Shelf	29366
<i>Lytechinus pictus</i>	'13	Middle Shelf	8137
<i>Lytechinus pictus</i>	'18	Middle Shelf	2012
<i>Lytechinus pictus</i>	'23	Middle Shelf	8643
<i>Ophiura luetkenii</i>	'94	Middle Shelf	12301
<i>Ophiura luetkenii</i>	'98	Middle Shelf	192
<i>Ophiura luetkenii</i>	'03	Middle Shelf	475
<i>Ophiura luetkenii</i>	'08	Middle Shelf	708
<i>Ophiura luetkenii</i>	'13	Middle Shelf	21697
<i>Ophiura luetkenii</i>	'18	Middle Shelf	1709
<i>Ophiura luetkenii</i>	'23	Middle Shelf	2413
<i>Sicyonia ingentis</i>	'94	Middle Shelf	8440
<i>Sicyonia ingentis</i>	'98	Middle Shelf	8836
<i>Sicyonia ingentis</i>	'03	Middle Shelf	468
<i>Sicyonia ingentis</i>	'08	Middle Shelf	2146
<i>Sicyonia ingentis</i>	'13	Middle Shelf	1661
<i>Sicyonia ingentis</i>	'18	Middle Shelf	1377
<i>Sicyonia ingentis</i>	'23	Middle Shelf	621
<i>Laqueus californicus</i>	'94	Middle Shelf	41
<i>Laqueus californicus</i>	'98	Middle Shelf	12226
<i>Laqueus californicus</i>	'03	Middle Shelf	3
<i>Laqueus californicus</i>	'08	Middle Shelf	467
<i>Laqueus californicus</i>	'13	Middle Shelf	0
<i>Laqueus californicus</i>	'18	Middle Shelf	0
<i>Laqueus californicus</i>	'23	Middle Shelf	0
<i>Astropecten californicus</i>	'94	Middle Shelf	542
<i>Astropecten californicus</i>	'98	Middle Shelf	1728
<i>Astropecten californicus</i>	'03	Middle Shelf	1152
<i>Astropecten californicus</i>	'08	Middle Shelf	489
<i>Astropecten californicus</i>	'13	Middle Shelf	334
<i>Astropecten californicus</i>	'18	Middle Shelf	171
<i>Astropecten californicus</i>	'23	Middle Shelf	752
<i>Acanthoptilum</i> sp	'94	Middle Shelf	1396
<i>Acanthoptilum</i> sp	'98	Middle Shelf	559
<i>Acanthoptilum</i> sp	'03	Middle Shelf	2768
<i>Acanthoptilum</i> sp	'08	Middle Shelf	253
<i>Acanthoptilum</i> sp	'13	Middle Shelf	32
<i>Acanthoptilum</i> sp	'18	Middle Shelf	11
<i>Acanthoptilum</i> sp	'23	Middle Shelf	20
<i>Ophiothrix spiculata</i>	'94	Middle Shelf	270
<i>Ophiothrix spiculata</i>	'98	Middle Shelf	1094
<i>Ophiothrix spiculata</i>	'03	Middle Shelf	1414
<i>Ophiothrix spiculata</i>	'08	Middle Shelf	67

<i>Ophiothrix spiculata</i>	'13	Middle Shelf	485
<i>Ophiothrix spiculata</i>	'18	Middle Shelf	106
<i>Ophiothrix spiculata</i>	'23	Middle Shelf	1079
<i>Apostichopus californicus</i>	'94	Middle Shelf	605
<i>Apostichopus californicus</i>	'98	Middle Shelf	719
<i>Apostichopus californicus</i>	'03	Middle Shelf	550
<i>Apostichopus californicus</i>	'08	Middle Shelf	185
<i>Apostichopus californicus</i>	'13	Middle Shelf	344
<i>Apostichopus californicus</i>	'18	Middle Shelf	107
<i>Apostichopus californicus</i>	'23	Middle Shelf	172
<i>Thesea</i> sp B	'94	Middle Shelf	23
<i>Thesea</i> sp B	'98	Middle Shelf	266
<i>Thesea</i> sp B	'03	Middle Shelf	1571
<i>Thesea</i> sp B	'08	Middle Shelf	73
<i>Thesea</i> sp B	'13	Middle Shelf	205
<i>Thesea</i> sp B	'18	Middle Shelf	140
<i>Thesea</i> sp B	'23	Middle Shelf	123
<i>Ophionereis eurybrachioplax</i>	'94	Middle Shelf	4
<i>Ophionereis eurybrachioplax</i>	'98	Middle Shelf	1
<i>Ophionereis eurybrachioplax</i>	'03	Middle Shelf	1653
<i>Ophionereis eurybrachioplax</i>	'08	Middle Shelf	10
<i>Ophionereis eurybrachioplax</i>	'13	Middle Shelf	0
<i>Ophionereis eurybrachioplax</i>	'18	Middle Shelf	0
<i>Ophionereis eurybrachioplax</i>	'23	Middle Shelf	0

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**Appendix C-17. Top ten Ecological Index megabenthic invertebrate species collected over all surveys in Bays. Calculated index is percent frequency of occurrence times the sum of percent abundance and percent biomass of a species for a particular survey year.**

Species	Survey	Stratum	% Abundance	% Biomass	% Freq Of Occurrence	Ecological Index
<i>Sicyonia penicillata</i>	'98	Bays	0.04	0.06	2.90	0.30
<i>Sicyonia penicillata</i>	'08	Bays	0.33	0.13	10.00	4.60
<i>Sicyonia penicillata</i>	'13	Bays	41.80	34.19	46.15	3507.21
<i>Sicyonia penicillata</i>	'18	Bays	28.96	24.37	46.15	2461.48
<i>Sicyonia penicillata</i>	'23	Bays	84.08	71.59	63.33	9858.60
Porifera	'98	Bays	0.74	71.97	17.39	1264.50
Porifera	'03	Bays	2.40	48.75	40.00	2045.82
Porifera	'08	Bays	0.98	11.48	30.00	373.85
<i>Suberites latus</i>	'08	Bays	0.65	82.56	20.00	1664.25
<i>Suberites latus</i>	'13	Bays	0.97	24.38	15.38	390.04
<i>Pyromaia tuberculata</i>	'98	Bays	24.61	1.79	55.07	1453.83
<i>Pyromaia tuberculata</i>	'03	Bays	2.37	1.55	44.00	172.55
<i>Pyromaia tuberculata</i>	'08	Bays	27.78	0.46	35.00	988.48
<i>Pyromaia tuberculata</i>	'13	Bays	5.88	1.72	50.00	380.26
<i>Pyromaia tuberculata</i>	'18	Bays	2.50	0.83	38.46	128.39
<i>Pyromaia tuberculata</i>	'23	Bays	0.10	0.06	33.33	5.40
<i>Acanthoptilum</i> sp	'98	Bays	0.02	0.03	1.45	0.08
<i>Acanthoptilum</i> sp	'03	Bays	5.10	0.42	12.00	66.30
<i>Acanthoptilum</i> sp	'08	Bays	40.03	0.40	15.00	606.46
<i>Acanthoptilum</i> sp	'13	Bays	0.42	0.21	7.69	4.83
<i>Acanthoptilum</i> sp	'18	Bays	2.98	0.50	23.08	80.26
<i>Acanthoptilum</i> sp	'23	Bays	0.42	0.15	13.33	7.59
<i>Crangon nigromaculata</i>	'98	Bays	9.37	0.67	31.88	319.95
<i>Crangon nigromaculata</i>	'03	Bays	21.70	1.83	24.00	564.86
<i>Crangon nigromaculata</i>	'08	Bays	9.31	0.40	30.00	291.36
<i>Crangon nigromaculata</i>	'13	Bays	5.54	1.59	46.15	328.92
<i>Crangon nigromaculata</i>	'18	Bays	1.42	0.33	15.38	27.00
<i>Crangon nigromaculata</i>	'23	Bays	0.24	0.05	23.33	6.59
<i>Craniella</i> sp	'13	Bays	2.28	10.60	11.54	148.68
<i>Craniella</i> sp	'18	Bays	0.34	27.99	19.23	544.80
<i>Penaeus californiensis</i>	'98	Bays	5.31	4.25	43.48	415.52
<i>Penaeus californiensis</i>	'08	Bays	0.82	0.20	15.00	15.24
<i>Penaeus californiensis</i>	'13	Bays	0.62	0.80	15.38	21.81
<i>Penaeus californiensis</i>	'18	Bays	0.95	1.09	19.23	39.08
<i>Penaeus californiensis</i>	'23	Bays	0.04	0.18	10.00	2.23
<i>Sicyonia ingentis</i>	'98	Bays	0.11	0.09	4.35	0.87
<i>Sicyonia ingentis</i>	'08	Bays	4.58	0.53	10.00	51.06
<i>Sicyonia ingentis</i>	'13	Bays	16.33	6.23	15.38	347.09
<i>Sicyonia ingentis</i>	'18	Bays	0.54	0.17	7.69	5.45
<i>Sicyonia ingentis</i>	'23	Bays	0.84	0.58	10.00	14.18
<i>Suberites</i> sp	'18	Bays	0.14	7.79	7.69	60.97
<i>Suberites</i> sp	'23	Bays	0.03	15.60	20.00	312.57

**Appendix C-18. Top ten Ecological Index megabenthic invertebrate species collected over all surveys on the Inner Shelf. Calculated index is percent frequency of occurrence times the sum of percent abundance and percent biomass of a species for a particular survey year.**

Species	Survey	Stratum	% Abundance	% Biomass	% Freq Of Occurrence	Ecological Index
<i>Astropecten californicus</i>	'94	Inner Shelf	47.20	12.24	79.31	4714.30
<i>Astropecten californicus</i>	'98	Inner Shelf	15.60	3.19	40.63	763.55
<i>Astropecten californicus</i>	'03	Inner Shelf	37.45	6.53	55.81	2454.19
<i>Astropecten californicus</i>	'08	Inner Shelf	30.81	7.99	70.97	2753.41
<i>Astropecten californicus</i>	'13	Inner Shelf	46.53	7.81	77.14	4191.92
<i>Astropecten californicus</i>	'18	Inner Shelf	5.40	4.85	68.97	706.54
<i>Astropecten californicus</i>	'23	Inner Shelf	18.70	4.96	72.41	1713.23
<i>Sicyonia penicillata</i>	'08	Inner Shelf	0.37	0.64	9.68	9.80
<i>Sicyonia penicillata</i>	'13	Inner Shelf	1.58	2.50	57.14	233.29
<i>Sicyonia penicillata</i>	'18	Inner Shelf	2.73	14.29	48.28	821.26
<i>Sicyonia penicillata</i>	'23	Inner Shelf	18.31	36.00	55.17	2996.18
<i>Metacarcinus gracilis</i>	'94	Inner Shelf	2.08	1.38	17.24	59.74
<i>Metacarcinus gracilis</i>	'98	Inner Shelf	0.80	0.57	7.81	10.66
<i>Metacarcinus gracilis</i>	'03	Inner Shelf	2.36	4.60	23.26	161.85
<i>Metacarcinus gracilis</i>	'08	Inner Shelf	4.52	9.45	38.71	540.64
<i>Metacarcinus gracilis</i>	'13	Inner Shelf	6.53	26.81	54.29	1810.36
<i>Metacarcinus gracilis</i>	'18	Inner Shelf	0.59	10.11	24.14	258.22
<i>Metacarcinus gracilis</i>	'23	Inner Shelf	1.57	10.41	41.38	495.72
<i>Crangon nigromaculata</i>	'94	Inner Shelf	5.33	2.77	34.48	279.32
<i>Crangon nigromaculata</i>	'98	Inner Shelf	15.96	2.72	40.63	758.64
<i>Crangon nigromaculata</i>	'03	Inner Shelf	22.19	6.45	60.47	1731.71
<i>Crangon nigromaculata</i>	'08	Inner Shelf	8.95	4.29	58.06	768.89
<i>Crangon nigromaculata</i>	'13	Inner Shelf	27.40	5.60	42.86	1414.27
<i>Crangon nigromaculata</i>	'18	Inner Shelf	2.67	2.48	55.17	283.94
<i>Crangon nigromaculata</i>	'23	Inner Shelf	4.20	1.78	51.72	309.32
<i>Pisaster brevispinus</i>	'94	Inner Shelf	1.30	39.87	27.59	1135.66
<i>Pisaster brevispinus</i>	'98	Inner Shelf	0.44	6.23	6.25	41.68
<i>Pisaster brevispinus</i>	'03	Inner Shelf	0.74	21.82	23.26	524.68
<i>Pisaster brevispinus</i>	'08	Inner Shelf	1.66	20.82	22.58	507.72
<i>Pisaster brevispinus</i>	'13	Inner Shelf	1.29	26.56	31.43	875.14
<i>Philine auriformis</i>	'98	Inner Shelf	1.33	0.79	10.94	23.21
<i>Philine auriformis</i>	'03	Inner Shelf	0.31	0.40	4.65	3.30
<i>Philine auriformis</i>	'08	Inner Shelf	10.06	1.07	16.13	179.50
<i>Philine auriformis</i>	'13	Inner Shelf	0.06	0.17	5.71	1.32
<i>Philine auriformis</i>	'18	Inner Shelf	0.39	0.77	17.24	20.01
<i>Philine auriformis</i>	'23	Inner Shelf	21.75	0.98	34.48	783.78
<i>Octopus rubescens</i>	'94	Inner Shelf	0.13	0.28	3.45	1.40
<i>Octopus rubescens</i>	'98	Inner Shelf	0.98	0.68	7.81	12.92
<i>Octopus rubescens</i>	'03	Inner Shelf	3.72	5.76	44.19	419.08
<i>Octopus rubescens</i>	'08	Inner Shelf	4.34	5.15	22.58	214.25
<i>Octopus rubescens</i>	'13	Inner Shelf	5.22	6.64	62.86	745.14
<i>Octopus rubescens</i>	'18	Inner Shelf	0.48	2.17	20.69	54.72
<i>Octopus rubescens</i>	'23	Inner Shelf	0.82	1.61	34.48	83.67

<i>Dendraster excentricus</i>	'94	Inner Shelf	0.13	0.28	3.45	1.40
<i>Dendraster excentricus</i>	'98	Inner Shelf	15.16	2.60	3.13	55.51
<i>Dendraster excentricus</i>	'18	Inner Shelf	77.97	20.78	6.90	681.06
<i>Achelous xantusii</i>	'98	Inner Shelf	2.48	3.33	21.88	127.10
<i>Achelous xantusii</i>	'03	Inner Shelf	0.06	0.40	2.33	1.08
<i>Achelous xantusii</i>	'08	Inner Shelf	0.83	1.07	6.45	12.28
<i>Achelous xantusii</i>	'13	Inner Shelf	0.59	0.52	8.57	9.46
<i>Achelous xantusii</i>	'18	Inner Shelf	0.90	14.39	27.59	421.83
<i>Achelous xantusii</i>	'23	Inner Shelf	2.99	5.55	20.69	176.63
<i>Pyromaia tuberculata</i>	'94	Inner Shelf	6.24	3.32	41.38	395.76
<i>Pyromaia tuberculata</i>	'98	Inner Shelf	6.47	1.92	26.56	223.02
<i>Pyromaia tuberculata</i>	'03	Inner Shelf	0.56	1.20	13.95	24.54
<i>Pyromaia tuberculata</i>	'08	Inner Shelf	2.12	1.93	29.03	117.69
<i>Pyromaia tuberculata</i>	'13	Inner Shelf	1.23	0.78	25.71	51.60
<i>Pyromaia tuberculata</i>	'18	Inner Shelf	0.26	1.08	24.14	32.37
<i>Pyromaia tuberculata</i>	'23	Inner Shelf	2.99	1.15	37.93	156.95

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**Appendix C-19. Top ten Ecological Index megabenthic invertebrate species collected over all surveys on the Middle Shelf. Calculated index is percent frequency of occurrence times the sum of percent abundance and percent biomass of a species for a particular survey year.**

Species	Survey	Stratum	% Abundance	% Biomass	% Freq Of Occurrence	Ecological Index
<i>Lytechinus pictus</i>	'94	Middle Shelf	50.30	11.65	73.33	4542.66
<i>Lytechinus pictus</i>	'98	Middle Shelf	71.00	19.86	66.13	6008.38
<i>Lytechinus pictus</i>	'03	Middle Shelf	71.04	18.15	68.60	6118.49
<i>Lytechinus pictus</i>	'08	Middle Shelf	84.28	23.45	66.67	7181.55
<i>Lytechinus pictus</i>	'13	Middle Shelf	23.54	6.74	60.47	1830.71
<i>Lytechinus pictus</i>	'18	Middle Shelf	29.29	7.62	63.33	2337.52
<i>Lytechinus pictus</i>	'23	Middle Shelf	56.32	9.09	72.41	4737.23
<i>Ophiura luetkenii</i>	'94	Middle Shelf	24.02	2.96	58.33	1573.50
<i>Ophiura luetkenii</i>	'98	Middle Shelf	0.20	0.18	24.19	9.10
<i>Ophiura luetkenii</i>	'03	Middle Shelf	1.03	0.60	66.28	108.08
<i>Ophiura luetkenii</i>	'08	Middle Shelf	2.03	0.43	48.48	119.16
<i>Ophiura luetkenii</i>	'13	Middle Shelf	62.76	12.16	81.40	6098.64
<i>Ophiura luetkenii</i>	'18	Middle Shelf	24.88	3.63	40.00	1140.22
<i>Ophiura luetkenii</i>	'23	Middle Shelf	15.72	3.46	82.76	1587.36
<i>Apostichopus californicus</i>	'94	Middle Shelf	1.18	53.20	68.33	3715.88
<i>Apostichopus californicus</i>	'98	Middle Shelf	0.73	23.49	47.58	1152.78
<i>Apostichopus californicus</i>	'03	Middle Shelf	1.19	48.99	55.81	2801.24
<i>Apostichopus californicus</i>	'08	Middle Shelf	0.53	39.29	60.61	2413.14
<i>Apostichopus californicus</i>	'13	Middle Shelf	1.00	48.39	55.81	2756.28
<i>Apostichopus californicus</i>	'18	Middle Shelf	1.56	42.29	36.67	1607.92
<i>Apostichopus californicus</i>	'23	Middle Shelf	1.12	62.13	58.62	3707.98
<i>Sicyonia ingentis</i>	'94	Middle Shelf	16.41	12.40	83.33	2400.98
<i>Sicyonia ingentis</i>	'98	Middle Shelf	9.03	7.77	65.32	1097.42
<i>Sicyonia ingentis</i>	'03	Middle Shelf	1.02	2.21	33.72	108.66
<i>Sicyonia ingentis</i>	'08	Middle Shelf	6.16	16.06	60.61	1346.52
<i>Sicyonia ingentis</i>	'13	Middle Shelf	4.80	5.45	74.42	763.49
<i>Sicyonia ingentis</i>	'18	Middle Shelf	28.18	27.41	53.33	2965.09
<i>Sicyonia ingentis</i>	'23	Middle Shelf	4.48	6.65	65.52	728.81
<i>Ophiothrix spiculata</i>	'94	Middle Shelf	0.52	0.31	50.00	41.61
<i>Ophiothrix spiculata</i>	'98	Middle Shelf	1.12	0.38	29.03	43.51
<i>Ophiothrix spiculata</i>	'03	Middle Shelf	3.07	0.50	36.05	128.91
<i>Ophiothrix spiculata</i>	'08	Middle Shelf	0.19	0.28	36.36	17.32
<i>Ophiothrix spiculata</i>	'13	Middle Shelf	1.40	0.44	51.16	94.14
<i>Ophiothrix spiculata</i>	'18	Middle Shelf	1.54	0.63	50.00	108.55
<i>Ophiothrix spiculata</i>	'23	Middle Shelf	7.03	0.79	62.07	485.66
<i>Astropecten californicus</i>	'94	Middle Shelf	1.06	0.83	85.00	160.85
<i>Astropecten californicus</i>	'98	Middle Shelf	1.77	1.00	82.26	227.70
<i>Astropecten californicus</i>	'03	Middle Shelf	2.50	0.85	75.58	253.47
<i>Astropecten californicus</i>	'08	Middle Shelf	1.40	1.09	84.85	211.41
<i>Astropecten californicus</i>	'13	Middle Shelf	0.97	0.78	60.47	105.53
<i>Astropecten californicus</i>	'18	Middle Shelf	2.49	1.03	63.33	223.06
<i>Astropecten californicus</i>	'23	Middle Shelf	4.90	1.48	72.41	461.91
<i>Acanthoptilum sp</i>	'94	Middle Shelf	2.73	0.26	31.67	94.47

<i>Acanthoptilum</i> sp	'98	Middle Shelf	0.57	0.29	32.26	27.64
<i>Acanthoptilum</i> sp	'03	Middle Shelf	6.01	0.61	60.47	400.46
<i>Acanthoptilum</i> sp	'08	Middle Shelf	0.73	0.45	51.52	60.56
<i>Acanthoptilum</i> sp	'13	Middle Shelf	0.09	0.19	23.26	6.57
<i>Acanthoptilum</i> sp	'18	Middle Shelf	0.16	0.29	23.33	10.58
<i>Acanthoptilum</i> sp	'23	Middle Shelf	0.13	0.26	31.03	12.25
<i>Luidia foliolata</i>	'94	Middle Shelf	0.45	2.31	60.00	165.11
<i>Luidia foliolata</i>	'98	Middle Shelf	0.17	0.52	30.65	21.05
<i>Luidia foliolata</i>	'03	Middle Shelf	0.48	1.74	54.65	121.76
<i>Luidia foliolata</i>	'08	Middle Shelf	0.36	3.61	72.73	289.20
<i>Luidia foliolata</i>	'13	Middle Shelf	1.18	4.69	65.12	382.72
<i>Luidia foliolata</i>	'18	Middle Shelf	0.45	0.31	16.67	12.64
<i>Luidia foliolata</i>	'23	Middle Shelf	0.42	0.75	55.17	64.60
<i>Pleurobranchaea californica</i>	'94	Middle Shelf	0.20	1.19	51.67	72.21
<i>Pleurobranchaea californica</i>	'98	Middle Shelf	0.12	0.24	23.39	8.45
<i>Pleurobranchaea californica</i>	'03	Middle Shelf	0.15	1.79	33.72	65.26
<i>Pleurobranchaea californica</i>	'08	Middle Shelf	0.18	0.92	51.52	56.99
<i>Pleurobranchaea californica</i>	'13	Middle Shelf	0.73	4.09	74.42	358.55
<i>Pleurobranchaea californica</i>	'18	Middle Shelf	0.58	2.48	40.00	122.68
<i>Pleurobranchaea californica</i>	'23	Middle Shelf	0.63	2.55	68.97	218.68
<i>Laqueus californicus</i>	'94	Middle Shelf	0.08	0.07	3.33	0.51
<i>Laqueus californicus</i>	'98	Middle Shelf	12.50	26.84	4.84	190.32
<i>Laqueus californicus</i>	'03	Middle Shelf	0.01	0.01	1.16	0.02
<i>Laqueus californicus</i>	'08	Middle Shelf	1.34	3.62	6.06	30.06

## APPENDIX D - ANOMALIES

Appendix D-1. Demersal fish anomalies by type, species and stratum during the Bight '23 trawl survey. Asterisk means total and percentages based on the three strata.

Anomaly Code	Common Name	Bays	Inner Shelf	Middle Shelf	All Strata*	Total Observed*	Percent Anomaly*
Ambicoloration	Dover Sole	-	-	2	2	454	0.4
	All Species	-	-	2	2	45293	< 0.1
Deformity	Pacific Sanddab	-	-	1	1	5755	< 0.1
	Speckled Sanddab	-	2	-	2	5850	< 0.1
	White Croaker	10	-	-	10	9734	0.1
Eye Parasite	All Species	10	2	1	13	45293	< 0.1
	Pacific Sanddab	-	3	49	52	5755	0.9
Leeches	All Species	-	3	49	52	45293	0.1
	Hornyhead Turbot	-	7	1	8	332	2.4
Other	White Seaperch	-	-	1	1	10	1< 0.1
	All Species	-	7	2	9	45293	< 0.1
	Pacific Sanddab	-	-	2	2	5755	< 0.1
Parasite	All Species	-	-	2	2	45293	< 0.1
	California Halibut	12	-	-	12	168	7.1
	Hornyhead Turbot	-	1	-	1	332	0.3
	Northern Anchovy	-	1	-	1	695	0.1
	Shiner Perch	-	1	-	1	309	0.3
	Speckled Sanddab	-	1	-	1	5850	< 0.1
	All Species	12	4	-	16	45293	< 0.1
	Tumor	Dover Sole	-	-	7	7	454
Tumor	White Croaker	-	1	-	1	9734	< 0.1
	All Species	-	1	7	8	45293	< 0.1

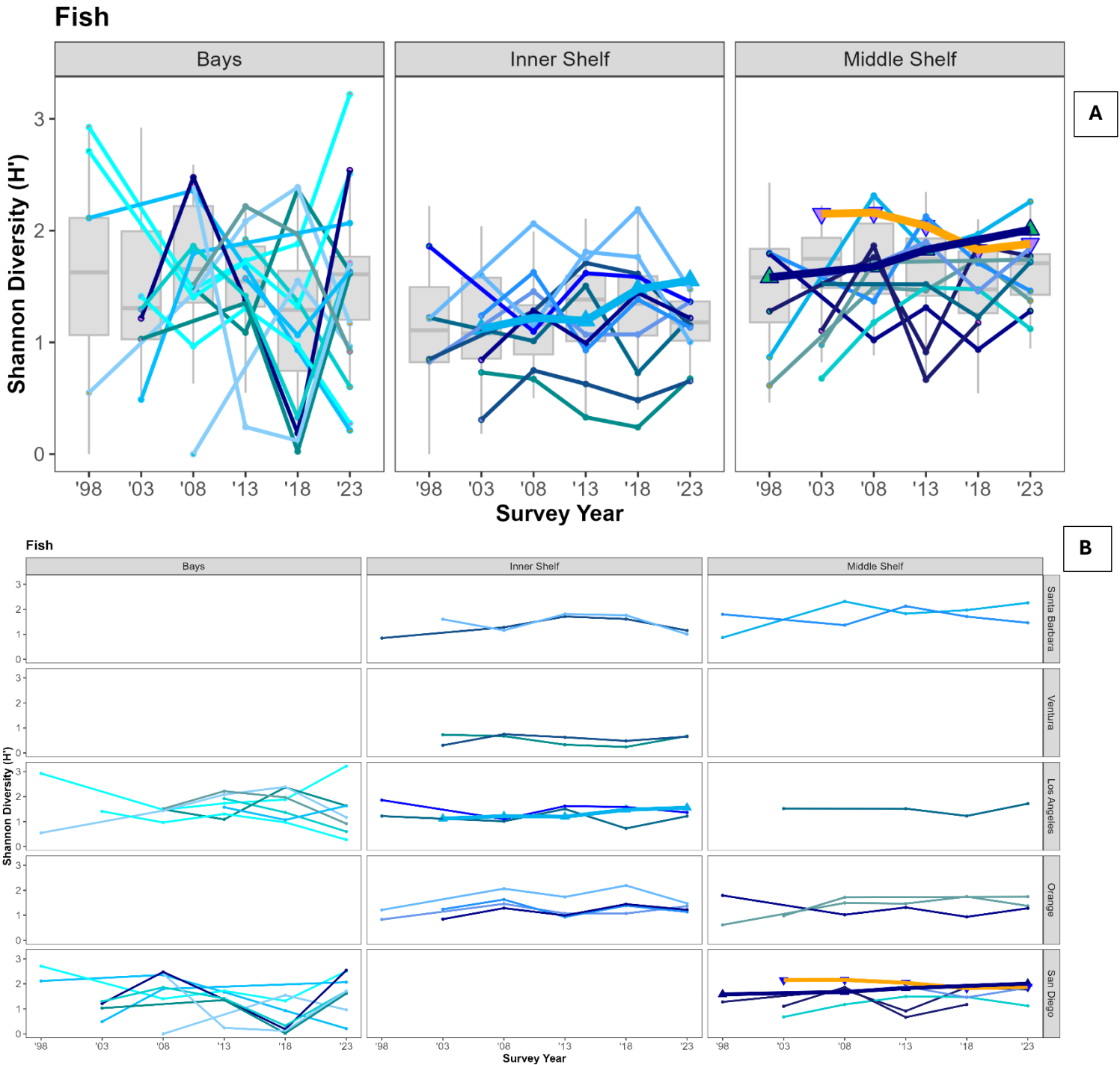
Appendix D-2. Total area (km<sup>2</sup>) of the three strata with demersal fish anomalies indicative of stress or disease, including fin erosion, tumors, or lesions by stratum during the Bight'23 trawl survey. Asterisk means total and affected area based on the three strata.

Stratum	Tumor*	Total Anomalies*	Affected Area*
Inner Shelf	11.0	11.0	129.0
Middle Shelf	47.6	47.6	961.4
All Strata	3.4	3.4	238

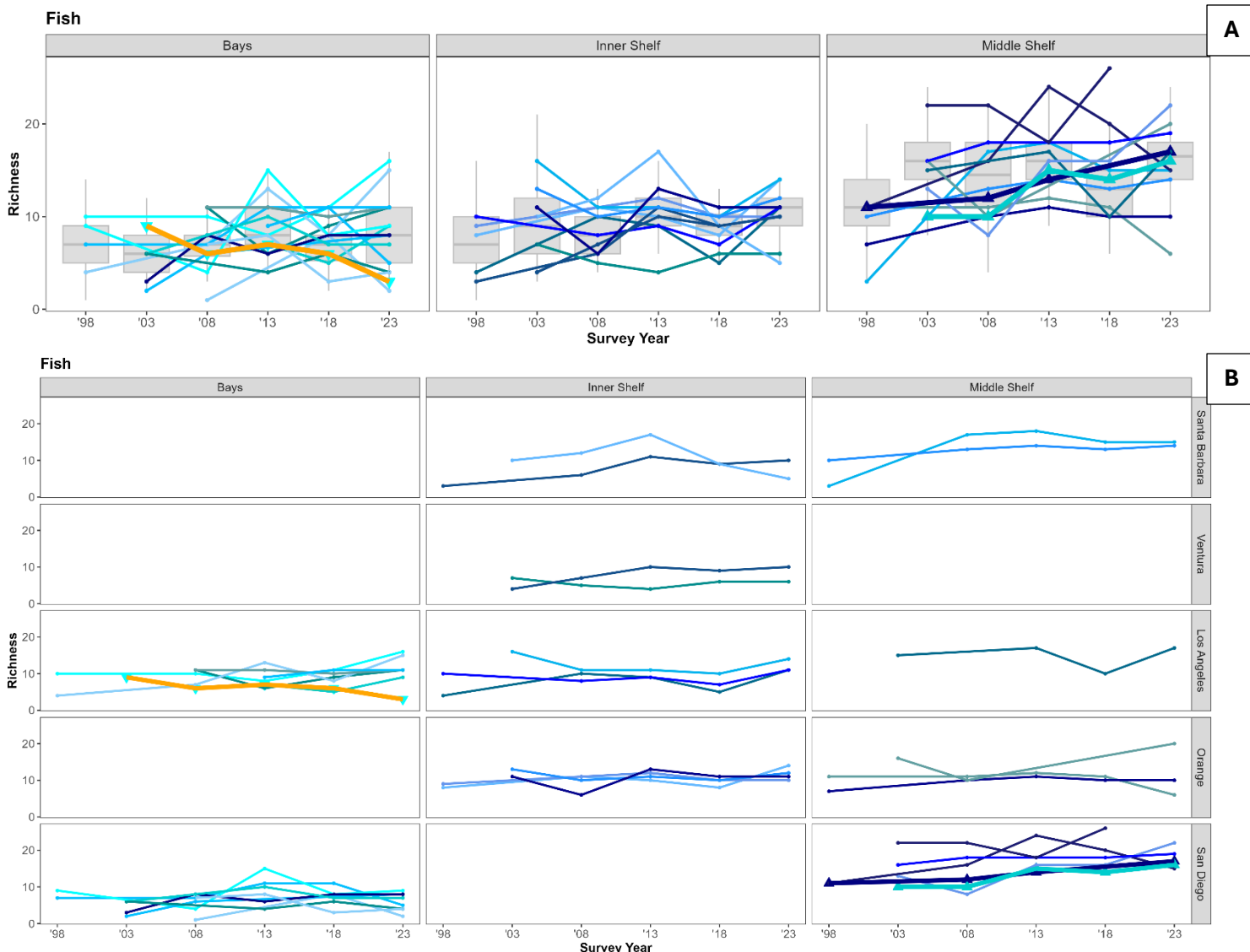
**Appendix D-3. Demersal fish anomalies by type and survey year. Asterisk means total and percentage are based on three strata (Bays, Inner Shelf, and Middle Shelf).**

Survey	Anomaly	Anomaly Abundance*	Total Fish Examined*	Percent Anomaly*
Bight '94	Albinism	4	12917	0.031
Bight '98	Albinism	1	51861	0.002
Bight '08	Albinism	1	16531	0.006
Bight '94	Ambicoloration	37	12917	0.286
Bight '98	Ambicoloration	27	51861	0.052
Bight '03	Ambicoloration	12	45788	0.026
Bight '08	Ambicoloration	9	16531	0.054
Bight '13	Ambicoloration	51	41628	0.123
Bight '18	Ambicoloration	4	34223	0.012
Bight '23	Ambicoloration	2	45293	0.004
Bight '94	Deformity	1	12917	0.008
Bight '98	Deformity	4	51861	0.008
Bight '03	Deformity	3	45788	0.007
Bight '08	Deformity	5	16531	0.030
Bight '13	Deformity	4	41628	0.010
Bight '23	Deformity	13	45293	0.029
Bight '94	Fin Erosion	1	12917	0.008
Bight '03	Fin Erosion	1	45788	0.002
Bight '13	Fin Erosion	3	41628	0.007
Bight '18	Fin Erosion	3	34223	0.009
Bight '94	Lesion	6	12917	0.046
Bight '98	Lesion	4	51861	0.008
Bight '03	Lesion	20	45788	0.044
Bight '13	Lesion	3	41628	0.007
Bight '98	Other	1	51861	0.002
Bight '03	Other	1	45788	0.002
Bight '13	Other	3	41628	0.007
Bight '23	Other	2	45293	0.004
Bight '94	Parasite	70	12917	0.542
Bight '98	Parasite	228	51861	0.440
Bight '03	Parasite	459	45788	1.002
Bight '08	Parasite	24	16531	0.145
Bight '13	Parasite	107	41628	0.257
Bight '18	Parasite	17	34223	0.050
Bight '23	Parasite	77	45293	0.170
Bight '94	Tumor	5	12917	0.039
Bight '98	Tumor	12	51861	0.023
Bight '03	Tumor	24	45788	0.052
Bight '08	Tumor	1	16531	0.006
Bight '13	Tumor	3	41628	0.007
Bight '18	Tumor	7	34223	0.020
Bight '23	Tumor	8	45293	0.018

# APPENDIX E - REVISIT SITES TEMPORAL TRENDS DATA



**Appendix E-1. Fish diversity trends in individual revisited sites across surveys. (A) Grey box plots represent all Bight data collected during each survey, excluding outer shelf and upper slope. Blue lines are individual revisited sites, where circles represent “stable” condition, upward triangles indicate “increasing diversity” (positive slope, p-value  $\leq 0.05$ ), and downward triangles (orange line) indicate “decreasing diversity” (negative slope, p-value  $\leq 0.05$ ). (B) Expanded by region.**



**Appendix E-2. Fish species richness trends in individual revisited sites across surveys. (A) Grey box plots represent all Bight data collected during each survey, excluding outer shelf and upper slope. Blue lines are individual revisited sites, where circles represent “stable” condition, upward triangles indicate “increasing diversity” (positive slope,  $p$ -value  $\leq 0.05$ ), and downward triangles (orange line) indicate “decreasing diversity” (negative slope,  $p$ -value  $\leq 0.05$ ). (B) Expanded by region.**

**Appendix E-3. Percent of area characterized as having increasing, stable or decreasing demersal fish Shannon diversity ( $H'$ ) based on the trend values between 1998 to 2023 for select stratum (Bays, Inner and Middle shelves) and their totals (asterisk).**

Stratum	Number of Sites	Increasing	Stable	Decreasing
Bays	15	0	100	0
Inner Shelf	11	9.09	90.91	0
Mid Shelf	12	8.33	83.33	8.33
All Stratum*	38	5.26	92.11	2.63

**Appendix E-4. Slope, P-values, and trend designations for demersal fish Shannon diversity (H') at revisit sites with three or more occupations. Shaded areas indicate P-values  $\leq 0.05$ . Data represents three strata (Bays, Inner and Middle shelves) only.**

Original Station ID	Number of Sites	Stratum	Slope	P-value	Trend
2242	5	Bays	-0.08	0.06	Stable
2156	3	Bays	-0.13	0.06	Stable
4098	5	Bays	-0.05	0.1	Stable
2162	5	Bays	0.04	0.32	Stable
4028	3	Bays	0.06	0.41	Stable
4020	3	Bays	0.08	0.46	Stable
4242	4	Bays	-0.04	0.54	Stable
2157	4	Bays	0.03	0.59	Stable
2436	5	Bays	-0.02	0.68	Stable
4228	4	Bays	-0.04	0.75	Stable
4116	5	Bays	-0.01	0.76	Stable
4092	5	Bays	0.01	0.93	Stable
2152	5	Bays	0	0.93	Stable
4370	3	Bays	0.01	0.94	Stable
4148	4	Bays	0	0.95	Stable
4042	5	Inner Shelf	0.02	0.02	Improving
4090	5	Inner Shelf	0.02	0.28	Stable
2376	5	Inner Shelf	0.02	0.36	Stable
2325	5	Inner Shelf	0.01	0.37	Stable
4061	5	Inner Shelf	0.01	0.51	Stable
2382	5	Inner Shelf	-0.01	0.52	Stable
4003	5	Inner Shelf	-0.01	0.53	Stable
4058	5	Inner Shelf	-0.01	0.66	Stable
4047	5	Inner Shelf	-0.01	0.68	Stable
2320	5	Inner Shelf	0.01	0.78	Stable
2307	5	Inner Shelf	-0.01	0.78	Stable
2408	4	Mid Shelf	0.02	0.02	Improving
4080	5	Mid Shelf	-0.02	0.04	Declining
2301	5	Mid Shelf	0.05	0.13	Stable
2208	5	Mid Shelf	0.03	0.14	Stable
2396	5	Mid Shelf	-0.02	0.25	Stable
4000	5	Mid Shelf	0.02	0.32	Stable
2419	5	Mid Shelf	0.02	0.48	Stable
4026	3	Mid Shelf	0.03	0.49	Stable
4048	5	Mid Shelf	0.01	0.7	Stable
4096	4	Mid Shelf	-0.02	0.74	Stable
2365	5	Mid Shelf	-0.01	0.76	Stable
4045	4	Mid Shelf	0	0.88	Stable

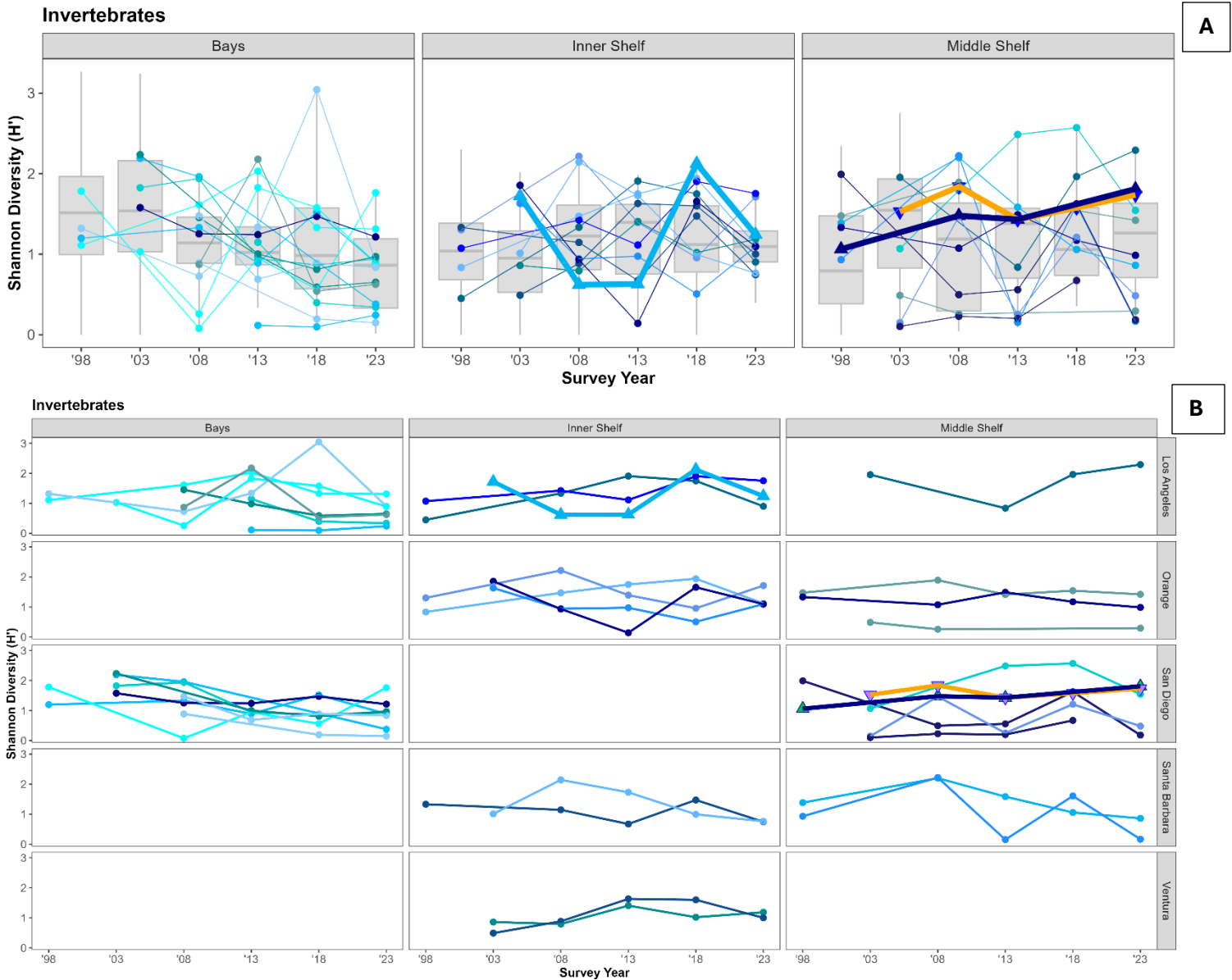
**Appendix E-5. Percent of area characterized as having increasing, stable or decreasing demersal fish taxonomic richness based on the trend values between 1998 to 2023 for select stratum (Bays, Inner and Middle shelves) and their totals (asterisk).**

Stratum	Number of Sites	Increasing	Stable	Decreasing
Bays	15	0	93.33	6.67
Inner Shelf	11	0	100	0
Mid Shelf	12	16.67	83.33	0
All Stratum*	38	5.26	92.11	2.63

**Appendix E-6. Slope, P-values, and trend designations for demersal fish taxonomic richness at revisit sites with three or more occupations. Shaded areas indicate P-values <= 0.05. Data represents three strata (Bays, Inner and Middle shelves) only.**

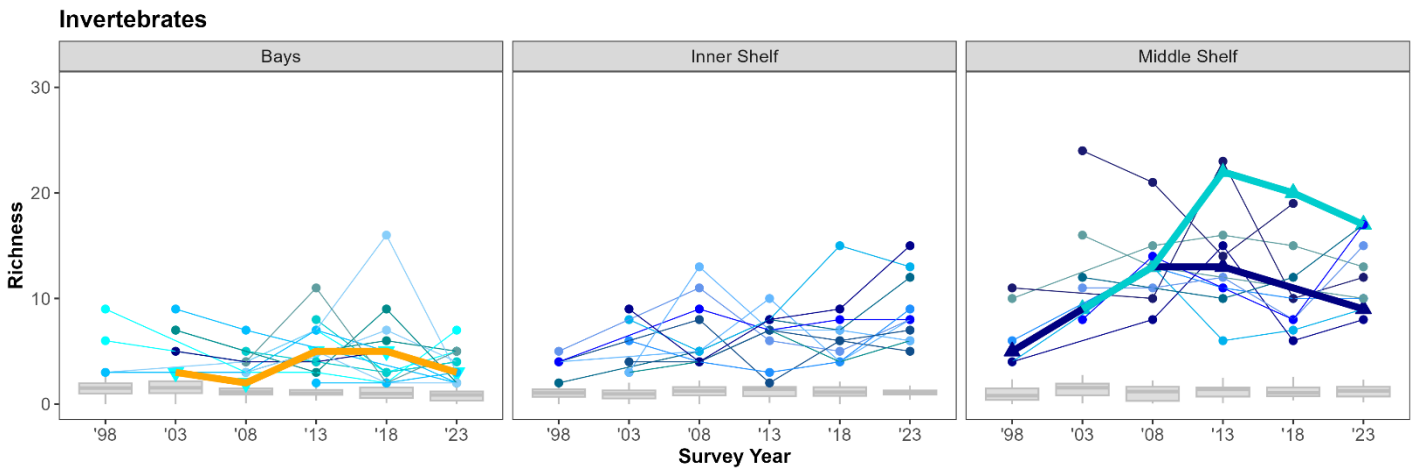
Original Station ID	Number of Sites	Stratum	Slope	P-value	Trend
4098	5	Bays	-0.24	0.05	Declining
2162	5	Bays	0.38	0.09	Stable
4092	5	Bays	0.2	0.17	Stable
4228	4	Bays	-0.28	0.24	Stable
2152	5	Bays	0.19	0.28	Stable
4028	3	Bays	0.26	0.3	Stable
4370	3	Bays	0.2	0.33	Stable
4148	4	Bays	-0.07	0.49	Stable
2156	3	Bays	0.2	0.67	Stable
4242	4	Bays	-0.02	0.74	Stable
4020	3	Bays	0.16	0.79	Stable
2436	5	Bays	0.05	0.83	Stable
2157	4	Bays	0.06	0.84	Stable
4116	5	Bays	0.02	0.87	Stable
2242	5	Bays	0.02	0.93	Stable
4061	5	Inner Shelf	0.28	0.06	Stable
2376	5	Inner Shelf	0.29	0.06	Stable
2320	5	Inner Shelf	0.15	0.3	Stable
2307	5	Inner Shelf	0.17	0.35	Stable
4047	5	Inner Shelf	-0.26	0.43	Stable
4042	5	Inner Shelf	-0.1	0.61	Stable
4090	5	Inner Shelf	0.1	0.62	Stable
2325	5	Inner Shelf	0.03	0.66	Stable
4058	5	Inner Shelf	-0.04	0.69	Stable
4003	5	Inner Shelf	-0.02	0.82	Stable
2382	5	Inner Shelf	0	1	Stable
2408	4	Mid Shelf	0.25	0.03	Improving
4000	5	Mid Shelf	0.32	0.04	Improving
4080	5	Mid Shelf	0.12	0.06	Stable
2365	5	Mid Shelf	0.15	0.07	Stable
4048	5	Mid Shelf	0.52	0.1	Stable

2396	5	Mid Shelf	0.12	0.16	Stable
2301	5	Mid Shelf	0.44	0.19	Stable
2208	5	Mid Shelf	-0.15	0.3	Stable
2419	5	Mid Shelf	0.25	0.42	Stable
4026	3	Mid Shelf	0.31	0.56	Stable
4096	4	Mid Shelf	0.16	0.68	Stable
4045	4	Mid Shelf	-0.02	0.96	Stable

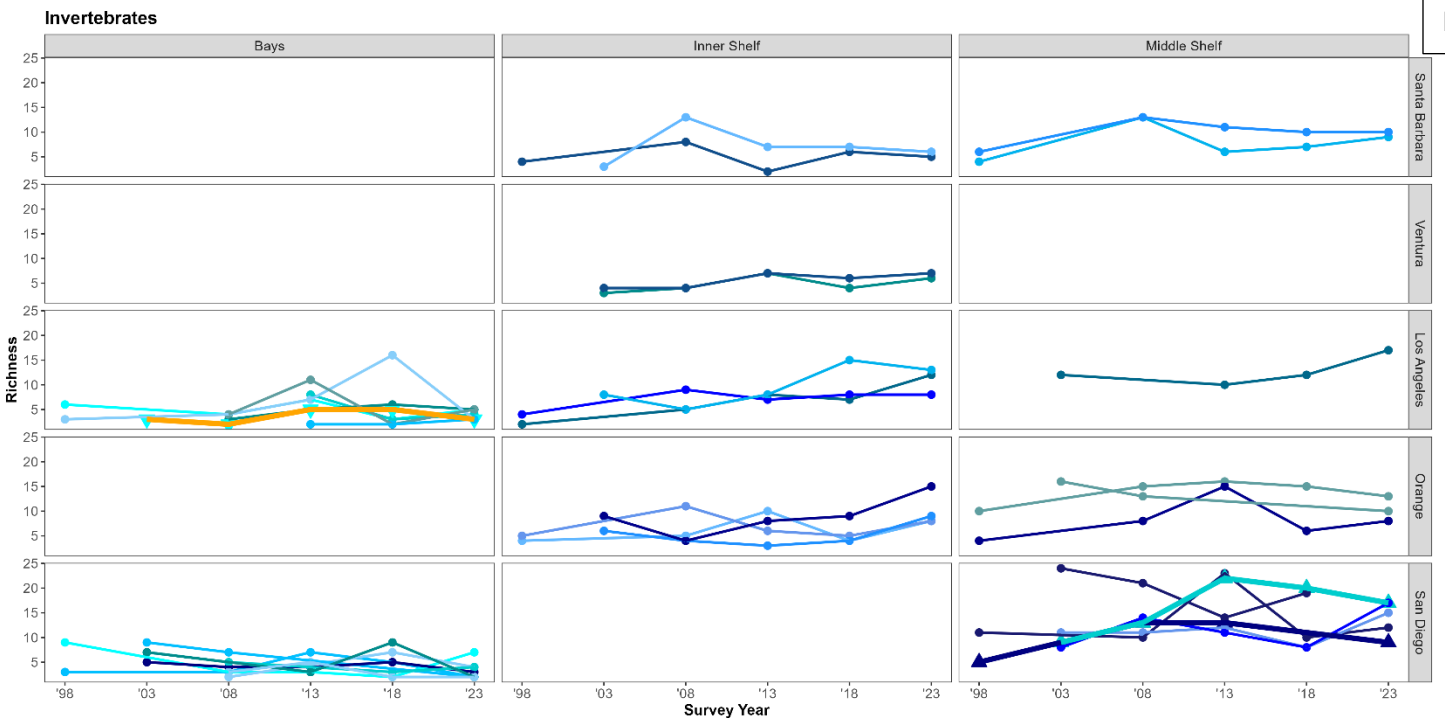


**Appendix E-7. Megabenthic invertebrate Shannon diversity ( $H'$ ) trends in individual revisited sites across surveys. (A) Grey box plots represent all Bight data collected during each survey, excluding outer shelf and upper slope. Blue lines are individual revisited sites, where circles represent “stable” condition, upward triangles indicate “increasing diversity” (positive slope,  $p$ -value  $\leq 0.05$ ), and downward triangles (orange line) indicate “decreasing diversity” (negative slope,  $p$ -value  $\leq 0.05$ ). (B) Expanded by region.**

**A**



**B**



**Appendix E-8. Megabenthic invertebrate species richness trends in individual revisited sites across surveys. (A) Grey box plots represent all Bight data collected during each survey, excluding outer shelf and upper slope. Blue lines are individual revisited sites, where circles represent “stable” condition, upward triangles indicate “increasing diversity” (positive slope, p-value  $\leq 0.05$ ), and downward triangles (orange line) indicate “decreasing diversity” (negative slope, p-value  $\leq 0.05$ ). (B) Expanded by region.**

**Appendix E-9. Percent of area characterized as having increasing, stable or decreasing megabenthic invertebrate Shannon diversity ( $H'$ ) based on the trend values between 1998 to 2023 for select stratum (Bays, Inner and Middle shelves) and their totals (asterisk).**

Stratum	Number of Sites	Increasing	Stable	Decreasing
Bays	15	0	100	0
Inner Shelf	11	9.09	90.91	0
Mid Shelf	12	8.33	83.33	8.33
All Stratum*	38	5.26	92.11	2.63

**Appendix E-10. Slope, P-values, and trend designations for megabenthic invertebrate Shannon diversity (H') at revisit sites with three or more occupations. Shaded areas indicate P-values <= 0.05. Data represents three strata (Bays, Inner and Middle shelves) only.**

Original Station ID	Number of Sites	Stratum	Slope	P-value	Trend
2242	5	Bays	-0.08	0.06	Stable
2156	3	Bays	-0.13	0.06	Stable
4098	5	Bays	-0.05	0.1	Stable
2162	5	Bays	0.04	0.32	Stable
4028	3	Bays	0.06	0.41	Stable
4020	3	Bays	0.08	0.46	Stable
4242	4	Bays	-0.04	0.54	Stable
2157	4	Bays	0.03	0.59	Stable
2436	5	Bays	-0.02	0.68	Stable
4228	4	Bays	-0.04	0.75	Stable
4116	5	Bays	-0.01	0.76	Stable
4092	5	Bays	0.01	0.93	Stable
2152	5	Bays	0	0.93	Stable
4370	3	Bays	0.01	0.94	Stable
4148	4	Bays	0	0.95	Stable
4042	5	Inner Shelf	0.02	0.02	Improving
4090	5	Inner Shelf	0.02	0.28	Stable
2376	5	Inner Shelf	0.02	0.36	Stable
2325	5	Inner Shelf	0.01	0.37	Stable
4061	5	Inner Shelf	0.01	0.51	Stable
2382	5	Inner Shelf	-0.01	0.52	Stable
4003	5	Inner Shelf	-0.01	0.53	Stable
2320	5	Inner Shelf	0.02	0.53	Stable
4058	5	Inner Shelf	-0.01	0.66	Stable
4047	5	Inner Shelf	-0.01	0.68	Stable
2307	5	Inner Shelf	-0.01	0.78	Stable
2408	4	Mid Shelf	0.02	0.02	Improving
4080	5	Mid Shelf	-0.02	0.04	Declining
2301	5	Mid Shelf	0.05	0.13	Stable
2208	5	Mid Shelf	0.03	0.14	Stable
2396	5	Mid Shelf	-0.02	0.25	Stable
4000	5	Mid Shelf	0.02	0.32	Stable
2419	5	Mid Shelf	0.02	0.48	Stable
4026	3	Mid Shelf	0.03	0.49	Stable
4048	5	Mid Shelf	0.01	0.7	Stable
4096	4	Mid Shelf	-0.02	0.74	Stable
2365	5	Mid Shelf	-0.01	0.76	Stable
4045	4	Mid Shelf	0	0.88	Stable

**Appendix E-11. Percent of area characterized as having increasing, stable or decreasing megabenthic invertebrate species richness based on the trend values between 1998 to 2023 for select stratum (Bays, Inner and Middle Shelf) and their totals (asterisk).**

Stratum	Number of Sites	Increasing	Stable	Decreasing
Bays	15	0	93.33	6.67
Inner Shelf	11	0	100	0
Mid Shelf	12	16.67	83.33	0
All Stratum*	38	5.26	92.11	2.63

**Appendix E-12. Slope, P-values, and trend designations for megabenthic invertebrate species richness at revisit sites with three or more occupations. Shaded areas indicate P-values <= 0.05. Data represents three strata (Bays, Inner and Middle Shelf) only.**

Original Station ID	Number of Sites	Stratum	Slope	P-value	Trend
4098	5	Bays	-0.24	0.05	Declining
2162	5	Bays	0.38	0.09	Stable
4092	5	Bays	0.2	0.17	Stable
4228	4	Bays	-0.28	0.24	Stable
2152	5	Bays	0.19	0.28	Stable
4028	3	Bays	0.26	0.3	Stable
4370	3	Bays	0.2	0.33	Stable
4148	4	Bays	-0.07	0.49	Stable
2156	3	Bays	0.2	0.67	Stable
4242	4	Bays	-0.02	0.74	Stable
4020	3	Bays	0.16	0.79	Stable
2436	5	Bays	0.05	0.83	Stable
2157	4	Bays	0.06	0.84	Stable
4116	5	Bays	0.02	0.87	Stable
2242	5	Bays	0.02	0.93	Stable
4061	5	Inner Shelf	0.28	0.06	Stable
2376	5	Inner Shelf	0.29	0.06	Stable
2320	5	Inner Shelf	0.15	0.3	Stable
2307	5	Inner Shelf	0.17	0.35	Stable
4047	5	Inner Shelf	-0.26	0.43	Stable
4042	5	Inner Shelf	-0.1	0.61	Stable
4090	5	Inner Shelf	0.1	0.62	Stable
2325	5	Inner Shelf	0.03	0.66	Stable
4058	5	Inner Shelf	-0.04	0.69	Stable
4003	5	Inner Shelf	-0.02	0.82	Stable
2382	5	Inner Shelf	0	1	Stable
2408	4	Mid Shelf	0.25	0.03	Improving
4000	5	Mid Shelf	0.32	0.04	Improving
4080	5	Mid Shelf	0.12	0.06	Stable
2365	5	Mid Shelf	0.15	0.07	Stable
4048	5	Mid Shelf	0.52	0.1	Stable
2396	5	Mid Shelf	0.12	0.16	Stable
2301	5	Mid Shelf	0.44	0.19	Stable
2208	5	Mid Shelf	-0.15	0.3	Stable
2419	5	Mid Shelf	0.25	0.42	Stable
4026	3	Mid Shelf	0.31	0.56	Stable
4096	4	Mid Shelf	0.16	0.68	Stable
4045	4	Mid Shelf	-0.02	0.96	Stable

**Appendix E-13. Cross-reference station table for Bight'23 revisit sites.**

Station ID	Original Survey Yr	Original Station ID	B98 Site ID	B03 Site ID	B08 Site ID	B13 Site ID	B18 Site ID	Stratum	Abandoned
B23-12044	1998	2152	B98-2152	NA	B08-6478	B13-8388	B18-10000	Bay	No
B23-12041	2003	4098	NA	B03-4098	B08-6448	B13-8358	B18-10002	Bay	No
B23-12040	1998	2157	B98-2157	NA	B08-6444	B13-8355	B18-10004	Bay	No
B23-12039	1998	2156	B98-2156	NA	B08-6437	B13-8350	B18-10006	Bay	No
B23-12035	2003	4370	NA	B03-4370	NA	B13-8335	B18-10008	Bay	No
B23-12033	2003	4274	NA	B03-4274	B08-6411	B13-8325	B18-10009	Bay	No
B23-12031	2003	4242	NA	B03-4242	B08-6404	B13-8318	B18-10011	Bay	No
B23-12028	1998	2162	B98-2162	NA	B08-6387	B13-8304	B18-10012	Bay	No
B23-12027	2003	4178	NA	B03-4178	B08-6386	B13-8302	B18-10013	Bay	No
B23-12024	2003	4228	NA	B03-4228	B08-6217	B13-8159	B18-10017	Bay	No
B23-12022	2003	4020	NA	B03-4020	B08-6212	B13-8152	B18-10019	Bay	No
B23-12021	2003	4092	NA	B03-4092	B08-6172	B13-8122	B18-10022	Bay	No
B23-12019	1998	2436	B98-2436	NA	B08-6152	B13-8109	B18-10024	Bay	No
B23-12012	2003	4028	NA	B03-4028	B08-6093	B13-8068	B18-10032	Bay	No
B23-12011	1998	2242	B98-2242	NA	B08-6080	B13-8060	B18-10034	Bay	No
B23-12009	2003	4116	NA	B03-4116	B08-6071	B13-8052	B18-10036	Bay	No
B23-12008	2003	4148	NA	B03-4148	B08-6040	B13-8029	B18-10037	Bay	No
B23-12214	2003	4047	NA	B03-4047	B08-7728	B13-9466	B18-10207	Inner Shelf	No
B23-12212	2003	4043	NA	B03-4043	B08-7681	B13-9434	B18-10209	Inner Shelf	No
B23-12209	1998	2376	B98-2376	NA	B08-7629	B13-9397	B18-10213	Inner Shelf	No
B23-12207	2003	4003	NA	B03-4003	B08-7596	B13-9383	B18-10214	Inner Shelf	No
B23-12206	2003	4061	NA	B03-4061	B08-7572	B13-9372	B18-10215	Inner Shelf	No
B23-12205	2003	4069	NA	B03-4069	B08-7522	B13-9346	B18-10216	Inner Shelf	Yes
B23-12204	1998	2382	B98-2382	NA	B08-7517	B13-9341	B18-10218	Inner Shelf	No
B23-12202	1998	2307	B98-2307	NA	B08-7474	B13-9303	B18-10219	Inner Shelf	No
B23-12201	1998	2320	B98-2320	NA	B08-7355	B13-9245	B18-10220	Inner Shelf	No
B23-12199	2003	4042	NA	B03-4042	B08-7321	B13-9229	B18-10224	Inner Shelf	No

B23-12197	2003	4090	NA	B03-4090	B08-7305	B13-9221	B18-10225	Inner Shelf	No
B23-12195	2003	4058	NA	B03-4058	B08-7300	B13-9214	B18-10226	Inner Shelf	No
B23-12194	1998	2325	B98-2325	NA	B08-7293	B13-9204	B18-10227	Inner Shelf	No
B23-12244	1998	2301	B98-2301	NA	B08-7741	B13-9470	B18-10243	Mid Shelf	No
B23-12240	1998	2365	B98-2365	NA	B08-7708	B13-9449	B18-10246	Mid Shelf	No
B23-12236	2003	4045	NA	B03-4045	NA	B13-9286	B18-10254	Mid Shelf	No
B23-12234	2018	10255	NA	NA	NA	NA	B18-10255	Mid Shelf	Yes
B23-12233	2003	4089	NA	B03-4089	B08-7410	B13-9263	B18-10257	Mid Shelf	Yes
B23-12230	1998	2396	B98-2396	NA	B08-7301	B13-9217	B18-10258	Mid Shelf	No
B23-12229	2003	4026	NA	B03-4026	B08-7287	B13-9202	B18-10259	Mid Shelf	No
B23-12228	1998	2208	B98-2208	NA	B08-7269	B13-9199	B18-10260	Mid Shelf	No
B23-12225	2003	4096	NA	B03-4096	B08-7167	B13-9131	B18-10265	Mid Shelf	Yes
B23-12224	2003	4080	NA	B03-4080	B08-7166	B13-9129	B18-10266	Mid Shelf	No
B23-12222	1998	2408	B98-2408	NA	B08-7128	B13-9111	B18-10268	Mid Shelf	No
B23-12221	2003	4048	NA	B03-4048	B08-7122	B13-9105	B18-10269	Mid Shelf	No
B23-12219	1998	2419	B98-2419	NA	B08-7009	B13-9012	B18-10277	Mid Shelf	No
B23-12217	2003	4000	NA	B03-4000	B08-7002	B13-9007	B18-10278	Mid Shelf	No

## **APPENDIX F - SUPPLEMENTAL MULTIVARIATE ANALYSIS**

The following section describes supplemental results of multivariate analyses performed on demersal fish and megabenthic invertebrate trawls conducted during Bight '94 - '23. As stated in Section II under Data Analyses/Multivariate Analyses, analyses included ordination (non-metric multidimensional scaling; nMDS), as well as hierarchical agglomerative clustering (cluster analysis) with group-average linking, and additional one-way ANOSIM tests to look for significant differences between groups. The Bray-Curtis measure of similarity was used as the basis for the ordination and cluster analysis, and abundance data were transformed to lessen the influence of the most abundant species and increase the importance of rare species. Similarity profile analysis (SIMPROF) was used to confirm the non-random structure of the resultant cluster dendrogram (Clarke et al. 2008), with major ecologically-relevant clusters receiving SIMPROF support retained as cluster groups. A BEST test using the BVSTEP procedure was conducted to determine which subset of species best described patterns within the resulting cluster dendrograms. Similarity percentages analysis (SIMPER) was used to determine which species were responsible for > 70% of the contributions to within-group similarity (i.e., characteristic species) by location (to support ANOSIM tests) and by cluster group (to support cluster group selection).

For each dataset, trawls with no fish or invertebrates present were removed from ordination and cluster analysis to better resolve community groups. These included four trawls with no demersal fishes (B08-7620, B08-7194, B98-2106, and B18-10838) and 14 trawls with no megabenthic invertebrates (B94-1684, B98-2273, B98-2276, B98-2279, B98-2286, B98-2328, B98-2338, B98-2361, B98-2377, B98-2379, B03-4180, B03-4419, B08-6295, and B08-7620). Multivariate analysis of fish and megabenthic invertebrates only included sites categorized as bays and harbors, limited to the Ports of Los Angeles/Long Beach (POLA/POLB), Mission Bay and San Diego Bay (SDB). Temporal trends exclude numerous small marinas and bays sites sampled during previous Bight surveys since most have not been revisited on a regular basis and generally do not have enough stations for robust historical analysis. Given the low replication of sampling, it was determined that these stations should be removed from analysis. Recognizing that there are different ecoregions within San Diego Bay (Williams et al. 2019; Amec Foster Wheeler 2016), analysis split San Diego Bay into North, Central and South ecoregions.

### **Multivariate Analyses of Demersal Fish Assemblages**

#### **Fish in Bays**

Multivariate analysis of fish abundance data assessed community patterns across bays in the SCB. Abundance data was visualized using an nMDS ordination plot (Figure F1) and one-way ANOSIM tests were run to look for significant differences between years and embayments. This analysis revealed the following observations:

- 2023 was significantly different from all surveys years except for 2018, with 1998 the only survey that is significantly different from all subsequent survey years..
- All bays/ecoregions were significantly different from one another.

Differences between years may in part be driven by the distribution and number of stations within each bay. Table F1 shows the number of trawls in POLA/POLB, SDB and Mission Bay across years. Surveys in 1998, 2013, 2018, and 2023 more heavily sampled POLA/POLB compared to SDB and Mission Bay. Additionally, surveys in 1998 sampled areas of POLA/POLB (main shipping channels, basins, slips and marinas) that were not revisited in subsequent surveys. Based on similar long-term monitoring studies within the Port Complex (MBC 2016; Wood E&IS 2021), it has been shown that these areas have distinct fish communities compared to the outer harbor areas near the breakwater and east San Pedro Bay which may account for the statistical difference between 1998 and all other survey years.

Using similarity percentages (SIMPER) analysis shows the species that best represent the spatial community differences across bays and ecoregions (Table F2). The analysis identifies the relative contribution of each species within the group, as well as the cumulative contribution of the top species that make up at least 70% of the community composition within that group. It is notable that most groups have a different species that contributes most to the community, with the exception of Mission Bay and SDB South sharing Slough Anchovy as the largest contributor. White Croaker (*Genyonemus lineatus*) in POLA/POLB was the most dominant member of any group, contributing 35% of the community composition. The two species that compose the largest share of the POLA/POLB group are also not large contributors to any other bay/ecoregion group, while there is considerable overlap between Mission Bay and SDB ecoregion groups as seen in the nMDS plot (Figure F1)

**Table F1. Trawls in Ports of LA/LB, San Diego Bay, and Mission Bay across survey years**

Year	POLA/POLB	San Diego Bay	Mission Bay
1998	30 Trawls	17 Trawls	2 Trawls
2003	7 Trawls	8 Trawls	1 Trawl
2008	6 Trawls	9 Trawls	3 Trawls
2013	15 Trawls	13 Trawls	3 Trawls
2018	16 Trawls	10 Trawls	4 Trawls
2023	17 Trawls	10 Trawls	3 Trawls

**Table F2. Community similarity percentages (SIMPER) results for fish captured in Ports of LA/LB, Mission Bay, and the three ecoregions of San Diego Bay**

Bay	Species	Community Contribution (%)	Cumulative Contribution (%)
-----	---------	----------------------------	-----------------------------

POLA/POLB	White Croaker	35.3	35.3
	California Tonguefish	15.9	51.2
	California Lizardfish	12.3	63.5
	Queenfish	7.9	71.4
Mission Bay	Slough Anchovy	20.8	20.8
	California Halibut	19.4	40.2
	Barred Sand Bass	19.3	59.5
	Shiner Perch	17.3	76.8
San Diego Bay – North	Spotted Sand Bass	22.0	22.0
	California Halibut	18.7	40.7
	Barred Sand Bass	17.6	58.3
	California Lizardfish	12.1	70.4
San Diego Bay – Central	Round Stingray	29.3	29.3
	Spotted Sand Bass	21.4	50.7
	California Halibut	18.9	69.6
	Barred Sand Bass	16.9	86.5
San Diego Bay – South	Slough Anchovy	33.3	33.3
	Spotted Sand Bass	23.1	56.4
	Barred Sand Bass	17.2	73.6

Similarity profile analysis (SIMPROF) resulted in 7 ecologically-relevant SIMPROF- supported cluster groups, or fish assemblages (cluster groups A-G; Table 17 in main report; Figure 18 in main report; Figure F2 through Figure F6), which were overlaid on station maps to examine spatial distribution. These assemblages represented from 1 to 86 trawls ranging from 32% to 50% similarity (mean = 40%) for cluster with n>1.

The largest cluster group was Group D, which was located in the outer areas of POLA/POLB and east San Pedro Bay and were distinguished by White Croaker, California Lizardfish, Queenfish, Northern Anchovy and California Tonguefish (Table F3, Figure F3). Group F was the second largest cluster, representative primarily of Central and South San Diego Bay as well as the inner portion of Mission Bay (Figures F4 and F6). Group B was the only cluster group that spanned all three bays, with stations representing POLB West Basin, the outer portion of Mission Bay near the mouth, and stations near the mouth of North San Diego Bay (Figures F3, F4, and F5). Group E was entirely within Mission Bay in the portion called Sail Bay that is shallow with extensive eelgrass beds, with a relatively unique community assemblage represented by Shiner Perch, Kelp Bass, Black Perch, and Spotted Sand Bass (Table F3, Figure F4). Group G was composed of two stations near Quivera Basin at the mouth of Mission Bay as well as one station in Northern San Diego Bay (Figures F4 and F5).

**Table F3. Composition of bays and harbors fish cluster groups A–P. For groups with n>1, highlighted values indicate the most characteristic species according to SIMPER analysis and the cumulative percent contribution (C%C) is included at the bottom. For groups with n=1, highlighted values are top five most abundant species, and N/A (not applicable) is included for C%C.**

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>
<b>Number of Trawls</b>	1	5	1	86	3	67	3
<b>Species</b>	<b>Mean Abundance</b>						
White Seaperch	2	0	0	1	1	0	0
White Croaker	0	2	2	297	0	<1	0
Speckled Sanddab	0	2	0	22	0	0	0
California Lizardfish	0	8	0	52	0	3	0
Barred Sand Bass	0	2	0	2	1	5	1
Spotted Turbot	0	2	0	1	0	1	0
Fantail Sole	0	<1	4	2	0	<1	0
Specklefin Midshipman	0	0	2	5	0	1	0
Northern Anchovy	0	0	0	42	0	66	0
Queenfish	0	0	0	23	0	6	0
Spotted Sand Bass	0	0	0	0	5	7	0
California Halibut	0	0	0	4	1	4	3
Shiner Perch	0	0	0	4	37	<1	2
Bay Blenny	0	0	0	0	1	0	0
Kelp Bass	0	0	0	<1	11	<1	0
Black Perch	0	0	0	<1	3	0	0
Slough Anchovy	0	0	0	<1	1	111	0
Round Stingray	0	0	0	<1	0	11	0
Black Croaker	0	<1	0	<1	0	1	4
California Tonguefish	0	<1	0	14	0	1	1
<b>C%C</b>	NA	32	NA	45	50	39	34

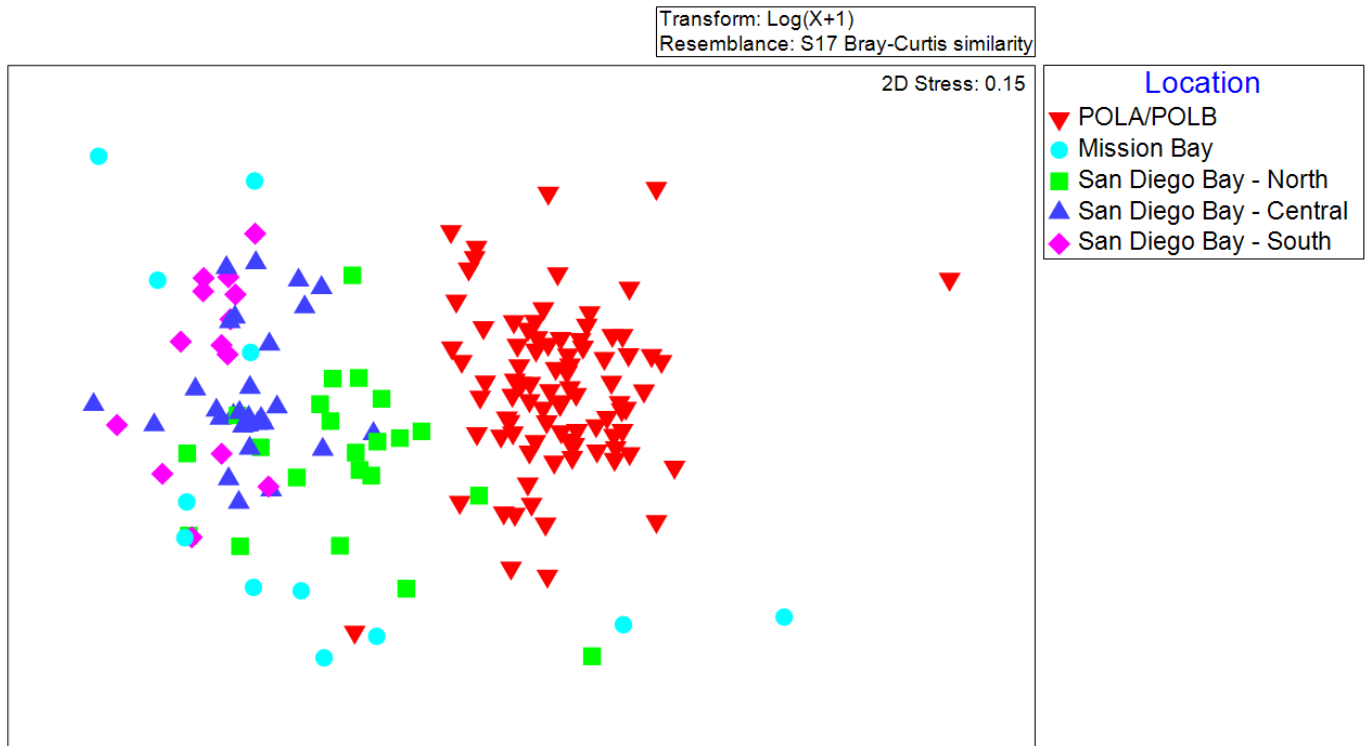


Figure F1. nMDS plot of fish abundance by Bay/Harbor.

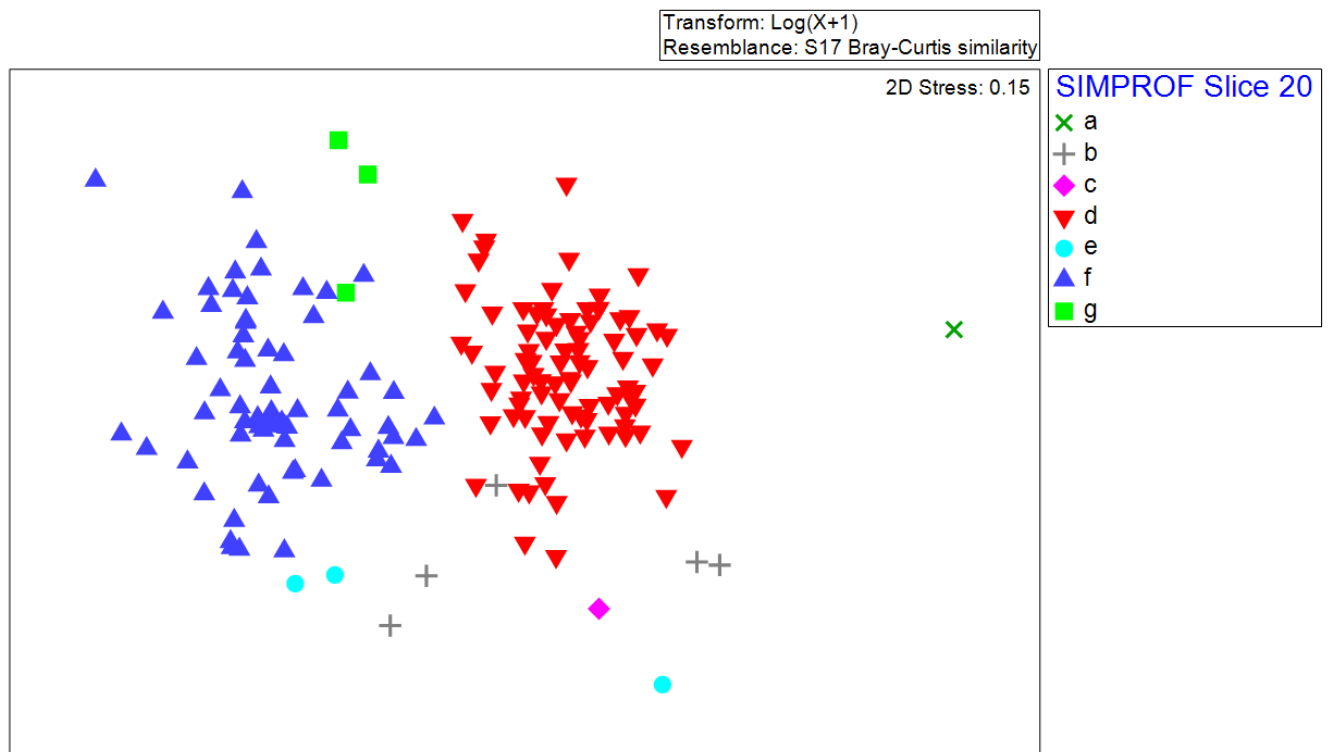


Figure F2. nMDS plot of fish abundance by Similarity Profile (SIMPROF) analysis.



Figure F3. Demersal fish SIMPROF groups in Bays and Harbors – POLA/POLB.

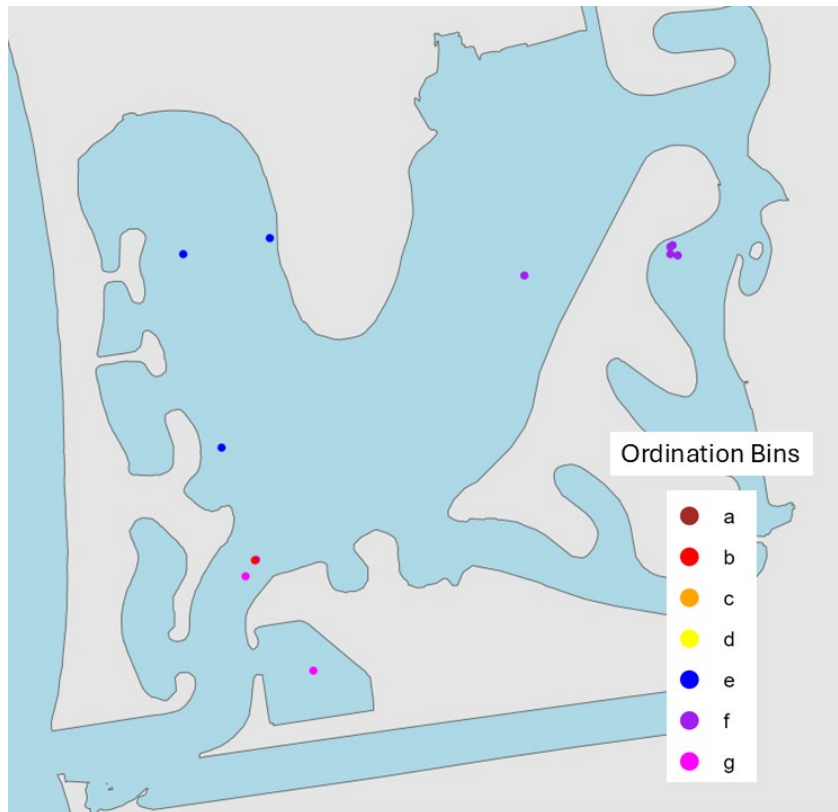
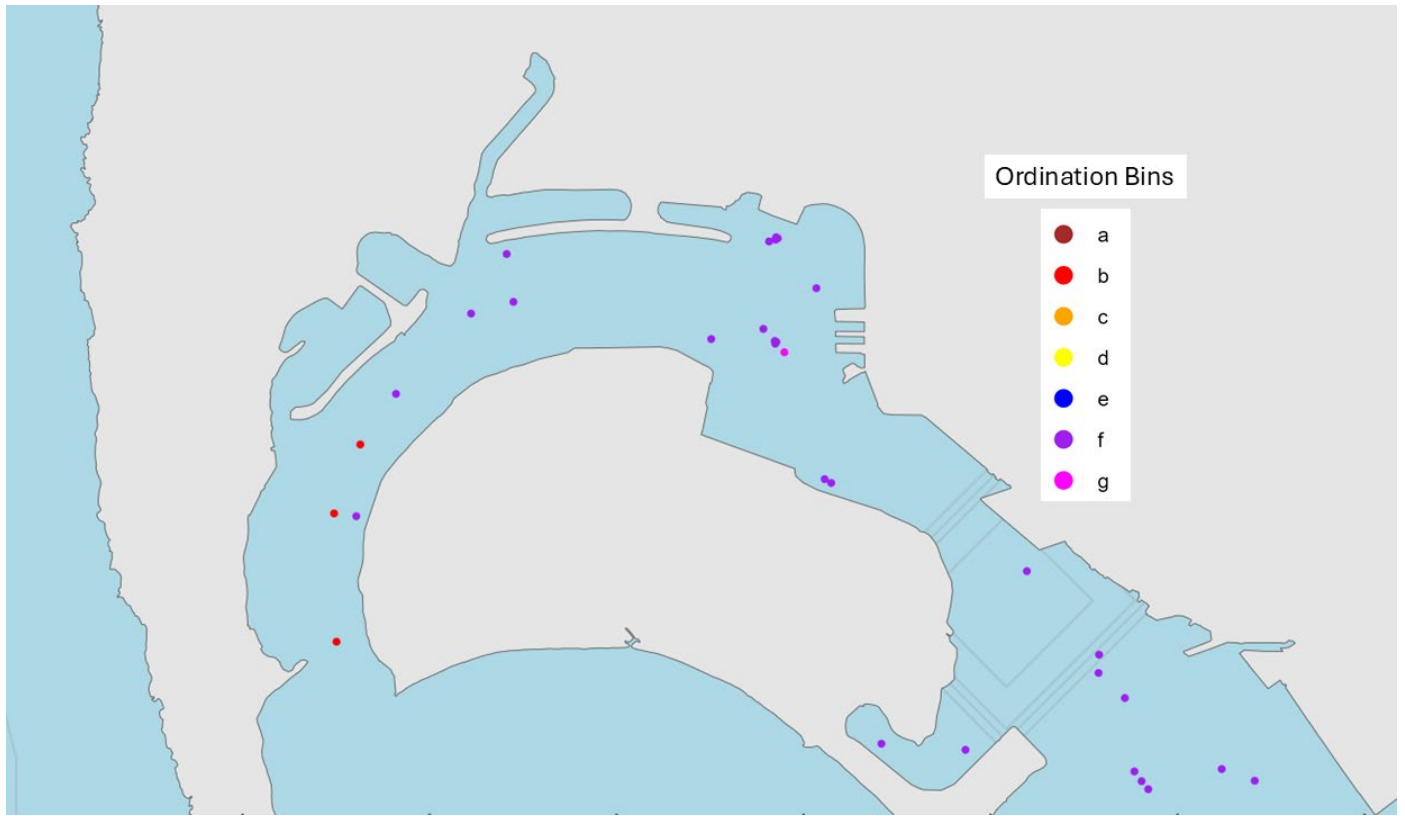
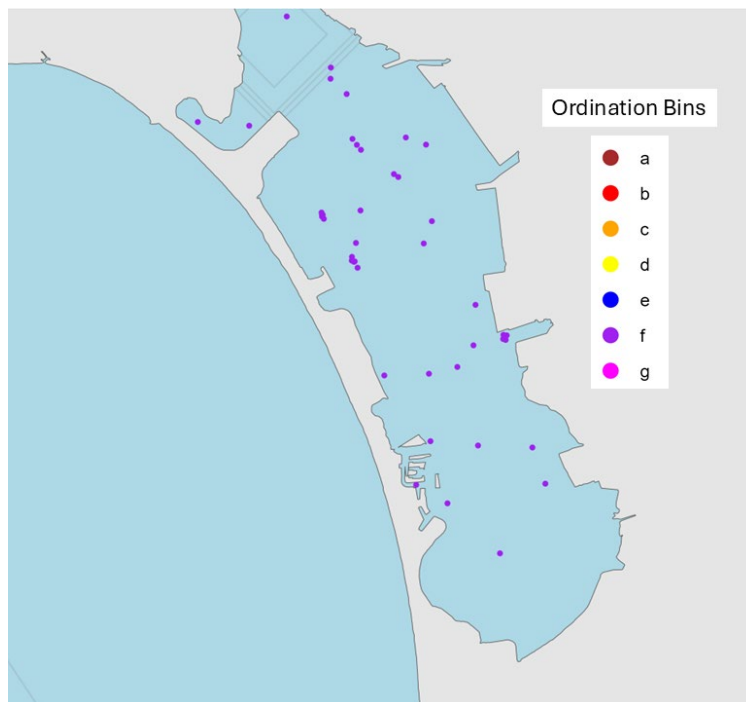


Figure F4. Demersal fish SIMPROF groups in Bays and Harbors – Mission Bay.



**Figure F5. Demersal fish SIMPROF groups in Bays and Harbors – North San Diego Bay (SDB).**



**Figure F6. Demersal fish SIMPROF groups in Bays and Harbors – Central and South San Diego Bay (SDB).**

## Demersal Fish on the Coastal Shelf and Slope

Initial multivariate analyses of demersal fish communities on the SCB shelf and slope included a total of 997 trawls conducted during Bight surveys (Bight '94 – Bight '23). Two additional significant outliers, B13-9396 and B13-9435, were removed to enhance examination of shelf assemblages. Both stations were located on the Upper Slope at 461 and 414 m depth, respectively. Trawl B13-9396 consisted of 6 Filetail Cat Sharks, while trawl B13-9435 consisted of a single Pacific Hagfish. Following the removal of these significant outliers, subsequent analyses of 995 trawls resulted in 12 main ecologically-relevant SIMPROF-supported groups, or types of demersal fish assemblages (cluster groups A-L; Table 18, Figure 21, Figure 22). These assemblages represented from 1 to 507 trawls each and ranged from 20 to 40% similarity (mean = 33%) for cluster groups with more than one trawl.

Eleven of the cluster groups (groups A, C, E, F, H, I, J, L) were small “outlier” clusters with  $\leq 5$  trawls in each group (Table 18, Figure 21, Figure 22). Group A sites ( $n = 5$ ) and Group C sites ( $n = 5$ ) were scattered throughout the SCB on the inner shelf at depths  $\leq 28$  m. Three of these trawls (30%) had FRI values possibly indicative of non-reference conditions ( $FRI > 45$ ). Assemblages represented by group A were characterized by low numbers (mean abundance  $\leq 3$  per haul) of California Halibut, Speckled Sanddab, and Shovelnose Guitarfish (Table F4). Group C assemblages were characterized by low numbers (mean abundance  $\leq 1$  per haul) of Barred Sand Bass and Fantail Sole. Group E sites ( $n = 4$ ) and Group F sites ( $n = 3$ ) were located north of Point Dume, far offshore towards Santa Barbara Island, and off Los Angeles/Long Beach Harbors at depths up to 150 m. None had FRI values indicative of non-reference conditions. Group E assemblages were characterized by large numbers of Northern Anchovy (mean abundance = 1,328 per haul). Group F assemblages were characterized by small numbers of Pacific Sanddab (mean abundance = 2 per haul). The majority (70%) of sites included in cluster groups H, I, J, L were located on the upper slope at depths of 200 – 475 m, while the remaining 30% were located on the outer shelf at depths of 132 – 152 m. Of the three sites included in these groups that were located at depths where the FRI can be calculated, only one (33%) had a FRI value  $> 45$ . Characteristic or abundant species were limited to Stripetail Rockfish for Group H (mean abundance = 8 per haul), Plainfin Midshipman for Group I ( $n = 1$ ), Slender Sole and Dover Sole for Group J (mean abundance = 4, 2 per haul, respectively), and Shortspine Thornyhead, Black Eelpout, Bigfin Eelpout, and Aurora Rockfish for Group L ( $n \leq 2$ ).

The remaining clusters (groups B, D, G, K) each spanned the entire SCB, representing the transition of common fish assemblages from the inner shelf to the upper slope (Table 18, Figure 21, Figure 22). Group B comprised 40 trawls from inner shelf sites located in small clusters at depths  $\leq 30$  m (mean depth = 14 m), primarily adjacent to embayments or lagoons. Forty percent of these trawls had FRI values  $> 45$ , likely due to the high proportion of White Croaker (mean abundance = 170 per haul) and Queenfish (mean abundance = 68 per haul) that

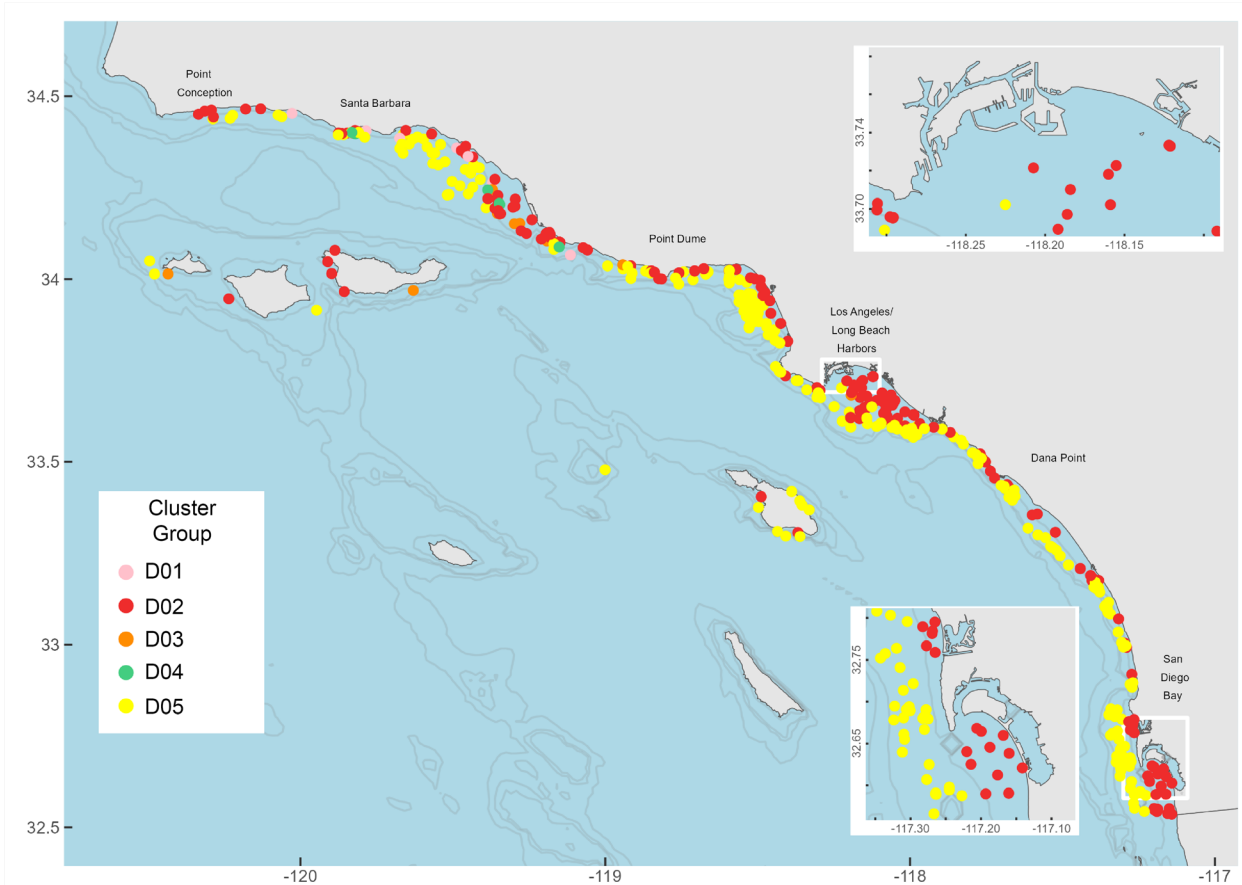
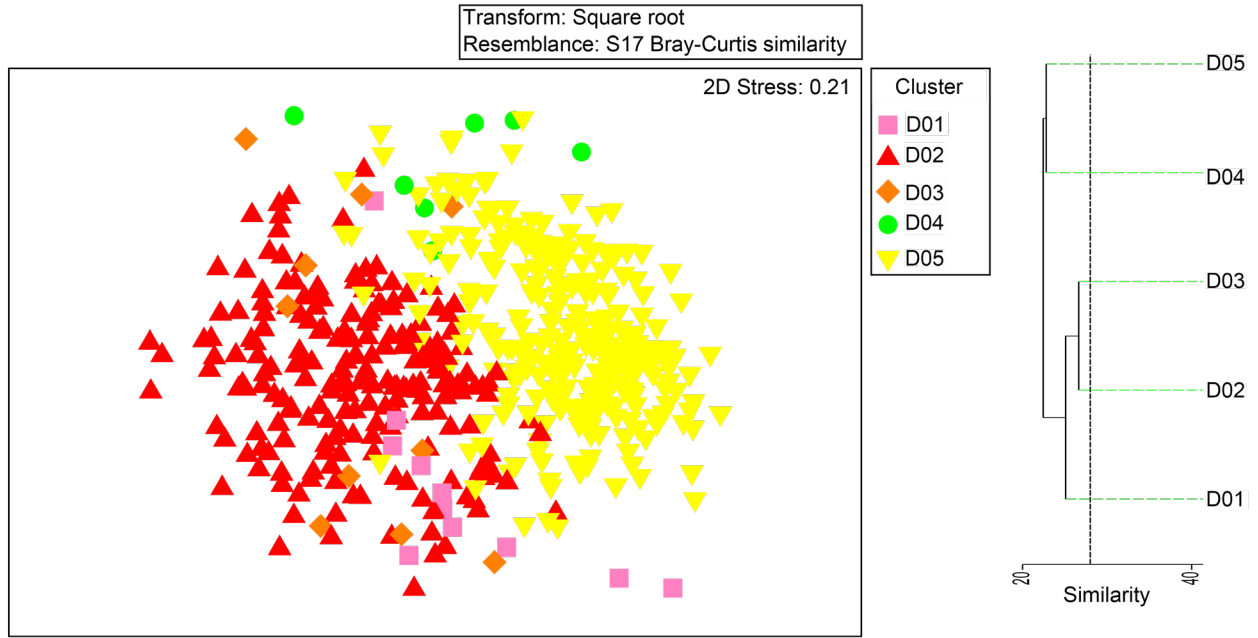
characterized this group (Table F4). Group D comprised 507 trawls from inner and middle shelf sites located at depths of 7-98 m (mean = 39 m). Just 5% of these trawls had FRI values > 45. These assemblages were characterized by the highest number of California Lizardfish (mean abundance = 43 per haul), Yellowchin Sculpin (mean abundance = 23 per haul), and Longfin Sanddab (mean abundance = 17 per haul), and the second highest number of Speckled Sanddab (mean abundance = 46 per haul), Pacific Sanddab (mean abundance = 43 per haul), and Hornyhead Turbot (mean abundance = 4 per haul). Group G comprised 327 trawls from mid-shelf, outer shelf and upper slope sites located at depths of 43-304 m (mean = 145 m). Similar to Group D, just 1% of these trawls had FRI values > 45. Assemblages represented by Group G were characterized by the highest numbers of Pacific Sanddab (mean abundance = 146 per haul), Dover Sole (mean abundance = 37 per haul), Stripetail Rockfish (mean abundance = 35 per haul), and Shortspine Combfish (mean abundance = 19 per haul), and the second highest numbers of Slender Sole (mean abundance = 56 per haul). Group K comprised 94 trawls from mostly upper slope sites located at depths of 181-479 m (mean = 375 m). The FRI was not calculated for these depths. Group K assemblages were characterized by the highest numbers of Slender Sole (mean abundance = 67 per haul), Shortspine Thornyhead (mean abundance = 6 per haul), Pacific Hake (mean abundance = 5 per haul), and the second highest number of Dover Sole (mean abundance = 28 per haul).

**Table F4. Composition of offshore fish cluster groups A-L. For groups with more than one trawl, highlighted values indicate the most characteristic species according to SIMPER analysis and the cumulative percent contribution (C%C) in included at the bottom. For groups with one trawl, highlighted values are top five most abundance species, and N/A (not applicable) is included for C%C.**

	Cluster Group												
	A	B	C	D	E	F	G	H	I	J	K	L	
<b>Number of Trawls</b>	5	40	5	507	4	3	327	3	1	5	94	1	
<b>Species</b>	<b>Mean Abundance</b>												
California Halibut	3	2	0	1	1	0	0	0	0	0	0	0	
Speckled Sanddab	2	6	1	46	70	0	1	0	0	0	0	0	
Shovelnose Guitarfish	1	<1	0	0	0	0	0	0	0	0	0	0	
Shiner Perch	1	6	0	<1	0	0	0	0	0	0	0	0	
White Croaker	1	170	0	1	43	0	<1	0	0	0	0	0	
Queenfish	<1	68	0	<1	10	0	0	0	0	0	0	0	
Barred Sand Bass	<1	<1	1	<1	<1	0	0	0	0	0	0	0	
Fantail Sole	0	<1	1	1	3	0	0	0	0	0	0	0	
California Lizardfish	<1	9	<1	43	27	0	2	0	0	0	0	0	
Pacific Sanddab	0	0	0	43	7	2	146	0	0	0	<1	0	
Yellowchin Sculpin	0	<1	0	23	0	1	4	0	0	0	0	0	
Longfin Sanddab	<1	1	0	17	<1	0	2	0	0	0	0	0	
Hornyhead Turbot	0	2	0	4	22	<1	1	0	0	0	0	0	
Northern Anchovy	0	5	0	1	1328	0	3	0	0	<1	<1	0	
Slender Sole	0	0	0	<1	1	0	56	0	0	4	67	0	

	Cluster Group											
	A	B	C	D	E	F	G	H	I	J	K	L
<b>Number of Trawls</b>	5	40	5	507	4	3	327	3	1	5	94	1
<b>Species</b>	<b>Mean Abundance</b>											
Dover Sole	0	0	0	2	5	0	37	0	0	2	28	0
Stripetail Rockfish	0	0	0	3	1	0	35	8	0	0	1	0
Shortspine Combfish	0	0	0	<1	8	0	19	<1	0	0	<1	0
Plainfin Midshipman	0	0	0	3	<1	0	12	0	1	0	0	0
Shortspine Thornyhead	0	0	0	0	0	0	<1	0	0	0	6	2
Pacific Hake	0	0	0	0	0	0	2	<1	0	0	5	0
Black Eelpout	0	0	0	0	0	0	0	0	0	<1	4	2
Bigfin Eelpout	0	0	0	0	0	0	<1	0	0	<1	2	1
Aurora Rockfish	0	0	0	0	0	0	0	0	0	0	1	1
<b>C%C</b>	69	77	70	71	73	100	75	100	NA	96	75	NA

Additional analyses of the three largest offshore fish clusters (groups D, G, K) revealed subgroups that also spanned much of the SCB and revealed no discernible patterns in demersal fish assemblages that could be associated with proximity to known pollution sources (Figure F7, Figure F8, Figure F9). As with the 12 main cluster groups A-L, assemblages represented by subgroups D01-D05, G01-G04, and K01-K02 varied in terms of habitat differences and/or the unique composition of fish assemblages. Cluster group D subgroups represented from 7 to 275 trawls conducted primarily on the shallow Middle Shelf (mean depth = 33 m), and ranged from 35 to 41% similarity (mean = 39%) (Table F5). The proportion of trawls with FRI values > 45 ranged from 1 - 27% for these subgroups. A BEST/BVSTEP test ( $p = 0.951$ ,  $p \leq 0.001$ , number of permutations = 999) implicated California Lizardfish, California Tonguefish, Hornyhead Turbot, Longfin Sanddab, Longspine Combfish, Pacific Sanddab, Pink Seaperch, Speckled Sanddab, and Yellowchin Sculpin as being influential to the overall pattern (gradient) of the cluster dendrogram (Figure F7b). Cluster group G subgroups represented from 2 to 296 trawls conducted primarily across the Middle Shelf (mean depth = 120 m), and ranged from 36 to 54% similarity (mean = 45). The proportion of trawls with FRI values > 45 ranged from 0 - 2% for these subgroups. A BEST/BVSTEP test ( $p = 0.956$ ,  $p \leq 0.001$ , number of permutations = 999) implicated Blackbelly Eelpout, Blacktip Poacher, Dover Sole, Halfbanded Rockfish, Longspine Combfish, Pacific Sanddab, Plainfin Midshipman, Shortspine Combfish, Slender Sole, Splitnose Rockfish, Stripetail Rockfish, and Yellowchin Sculpin implicated as being influential to the overall pattern (gradient) of the cluster dendrogram (Figure F8b). Cluster group K subgroups represented from 5 to 89 trawls conducted primarily on the Upper Slope (mean depth = 409), and ranged from 40 to 43% similarity (mean = 41%). A BEST/BVSTEP test ( $p = 0.954$ ,  $p \leq 0.001$ , number of permutations = 999) implicated Bearded Eelpout, Bigfin Eelpout, Black Eelpout, Blackbelly Eelpout, Blacktail Snailfish, Blacktip Poacher, Dogface Witcheel, Dover Sole, Filetail Catshark, Hundred Fathom Codling, Pacific Hake, Rex Sole, Shortspine Thronyhead, Slender Sole, Splitnose Rockfish as being influential to the overall pattern (gradient) of the cluster dendrogram (Figure F9b).



**Figure F7a. Results of ordination and cluster analysis of trawls from offshore fish cluster group D presented as a nMDS ordination, dendrogram of main subgroups, and a map of subgroups overlaid on station locations.**

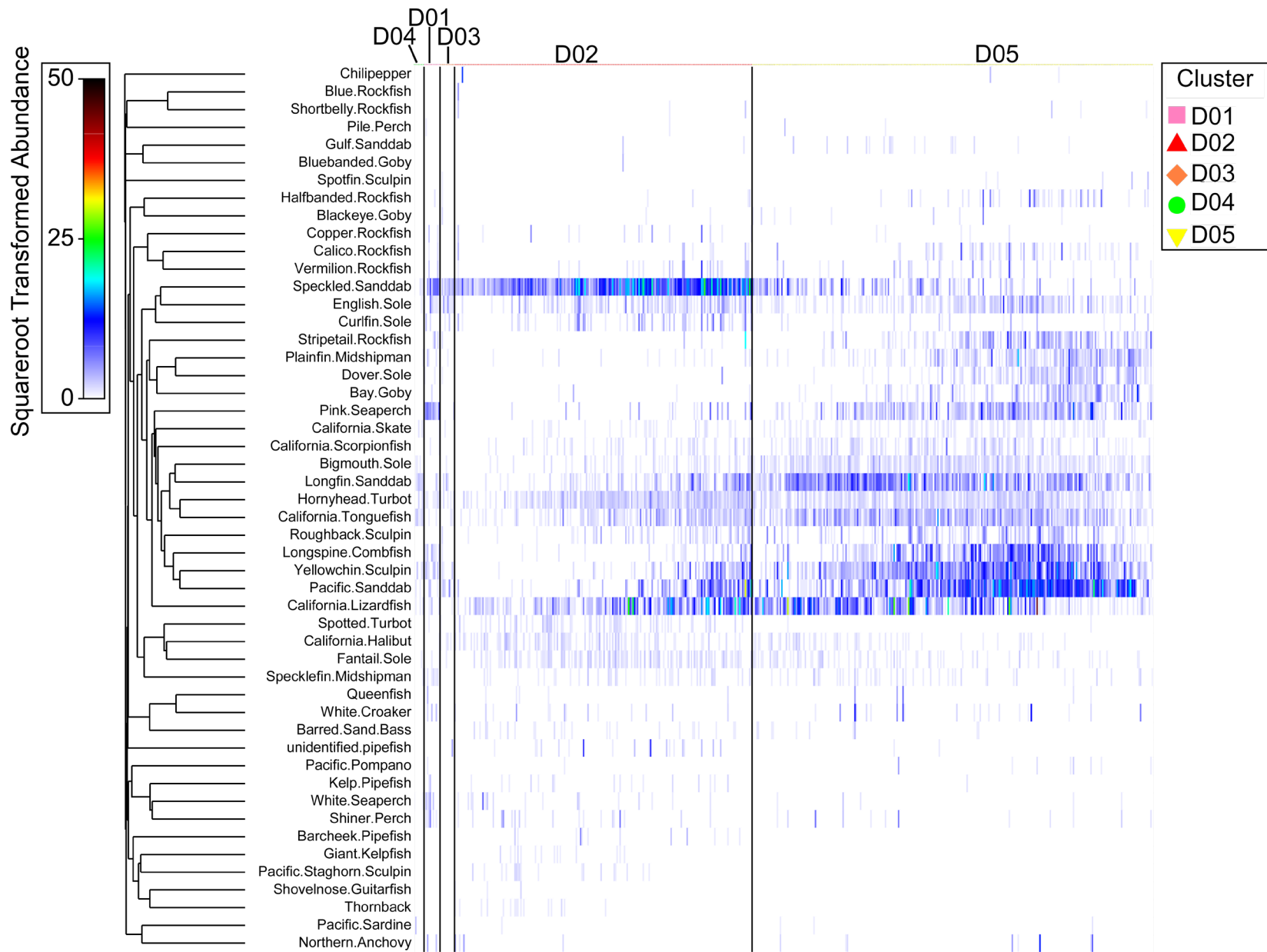
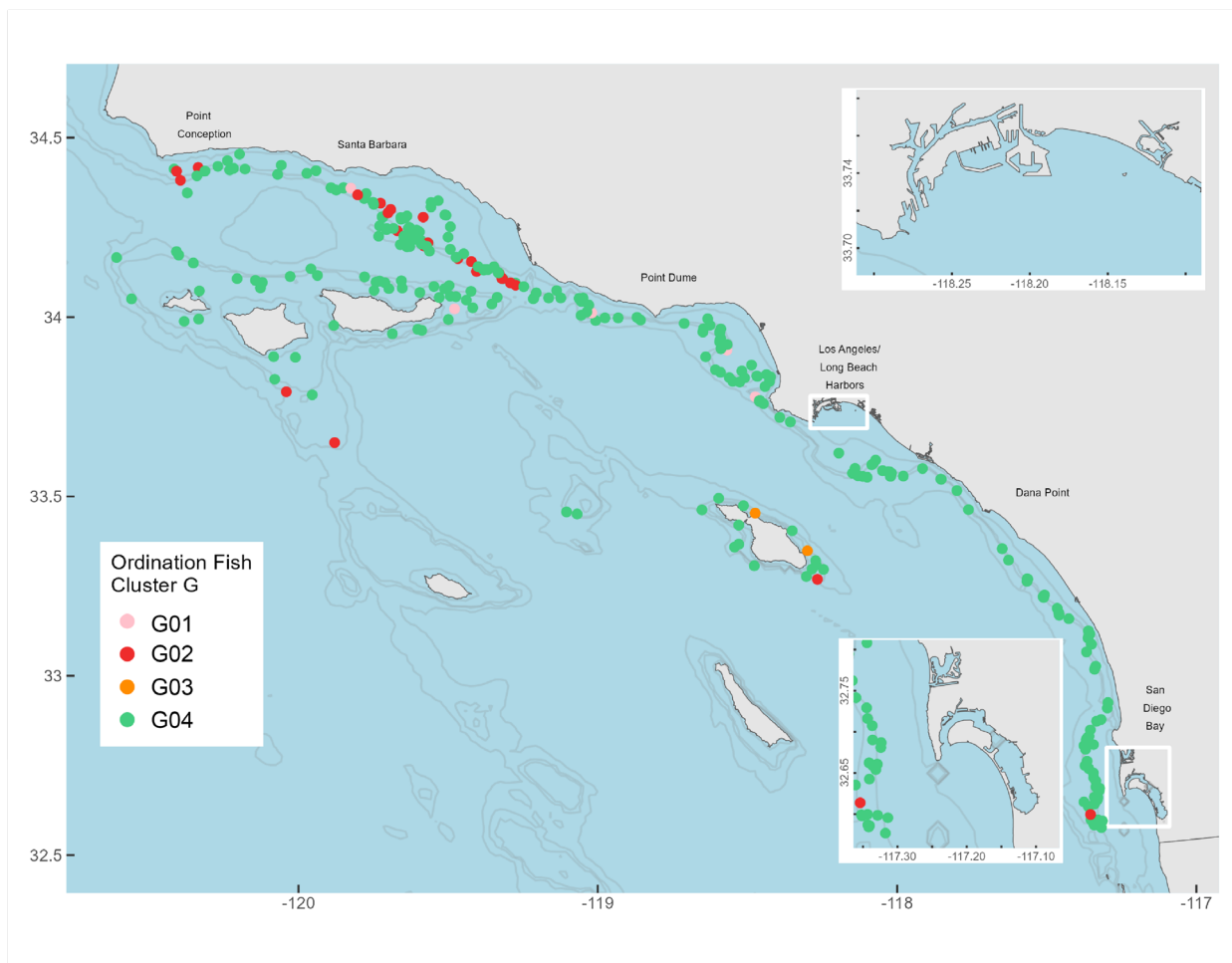
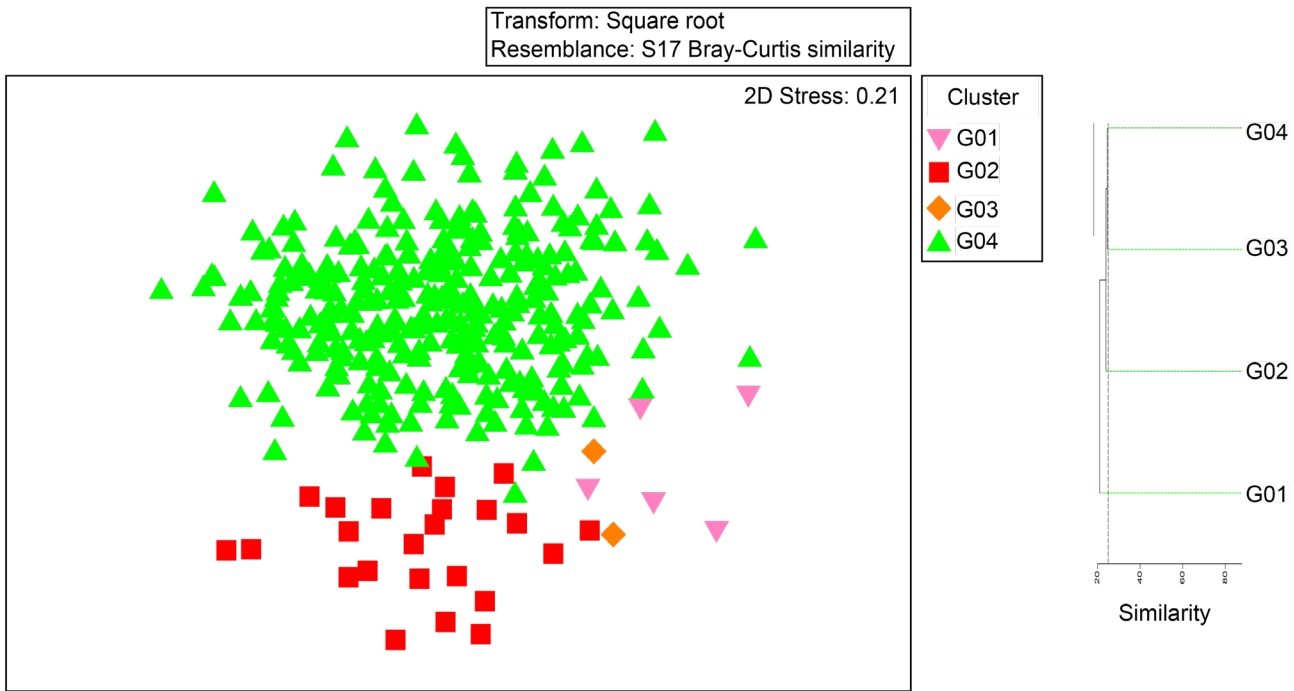


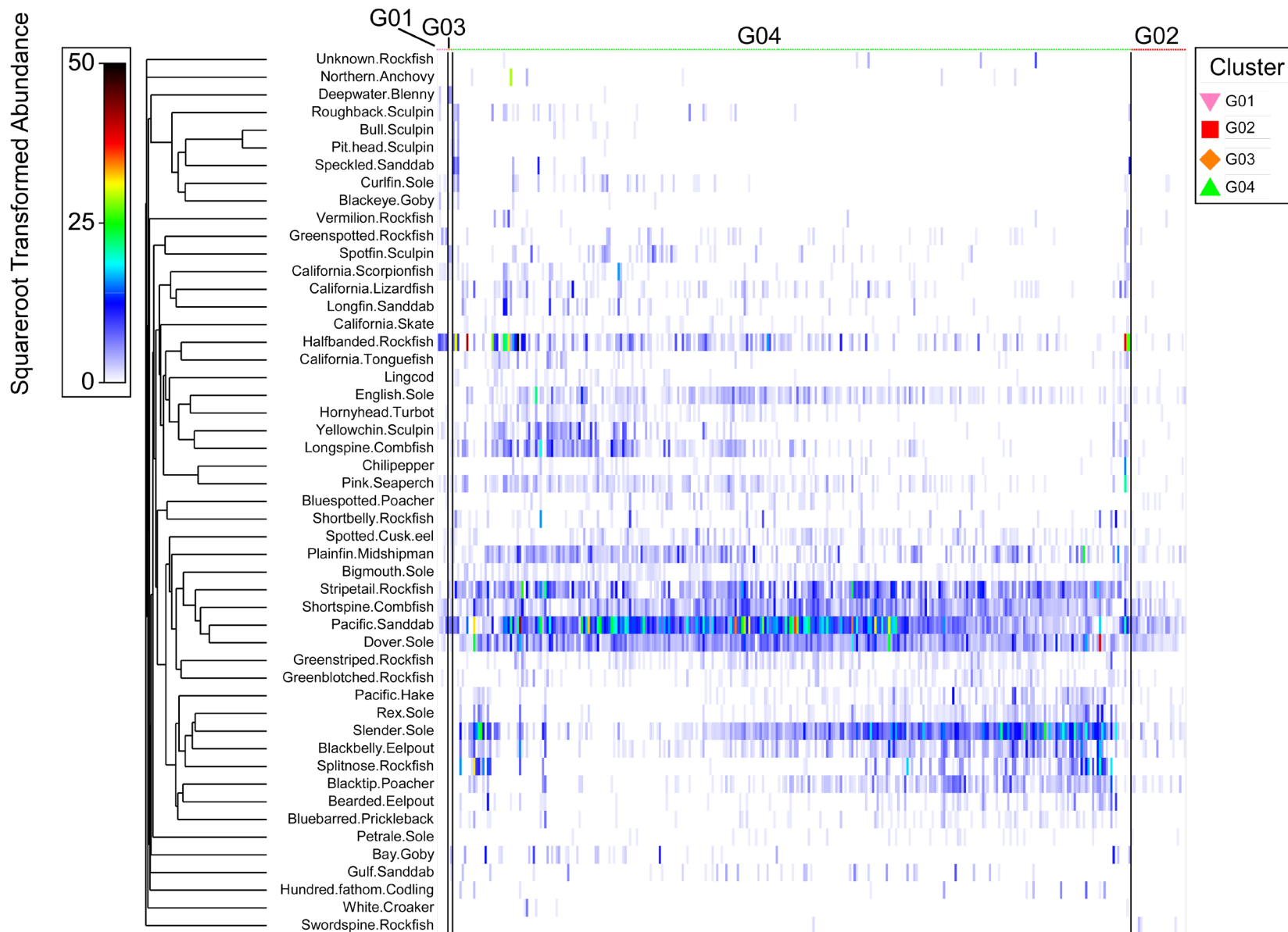
Figure F7b. Results \*of ordination and cluster analysis of trawls from offshore fish cluster group D. Data are presented as a shade plot of top 50 species by subgroup.

**Table F5. Description of offshore fish cluster D, G, K subgroups as defined in Figure F7a, 8a, 9a.**

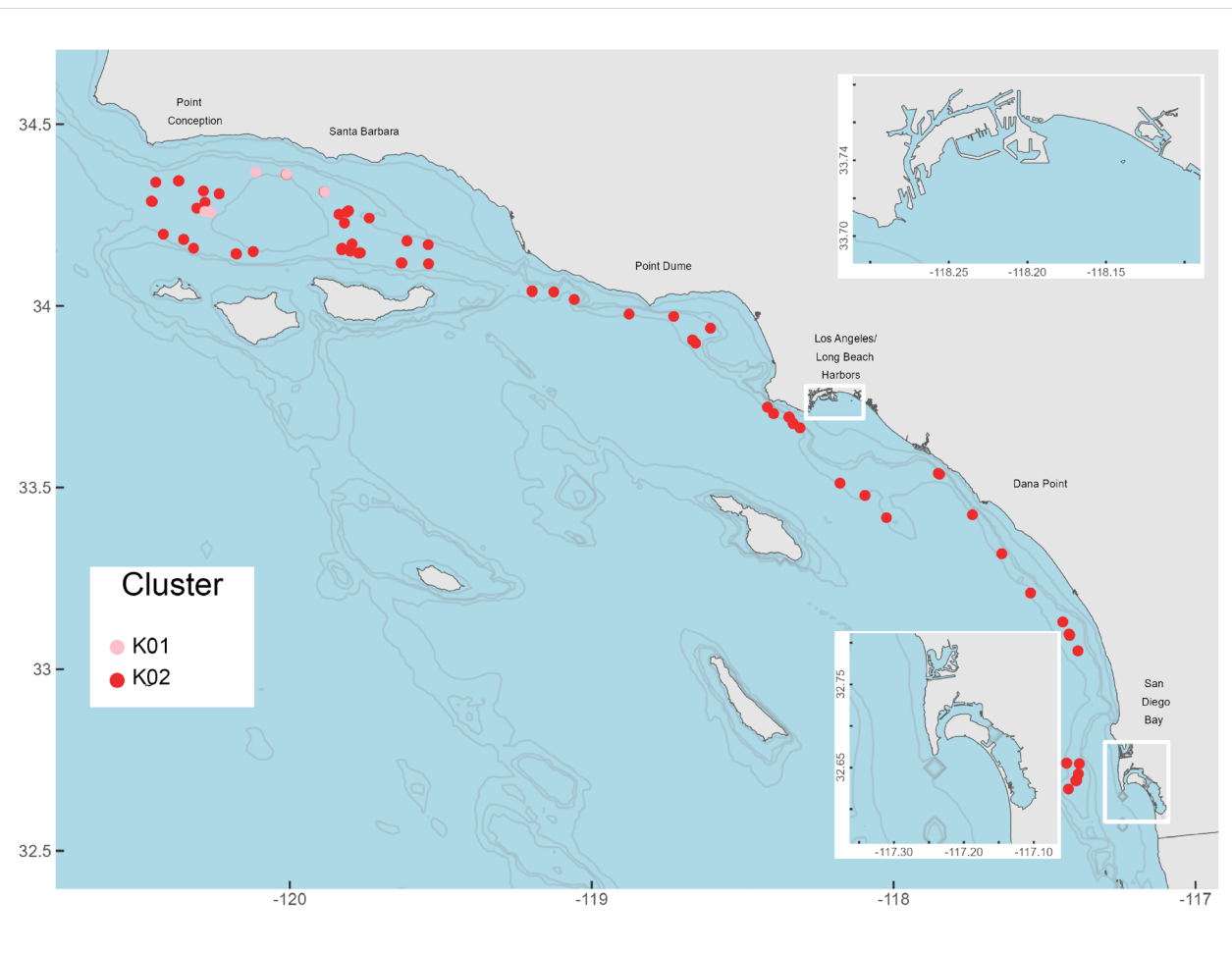
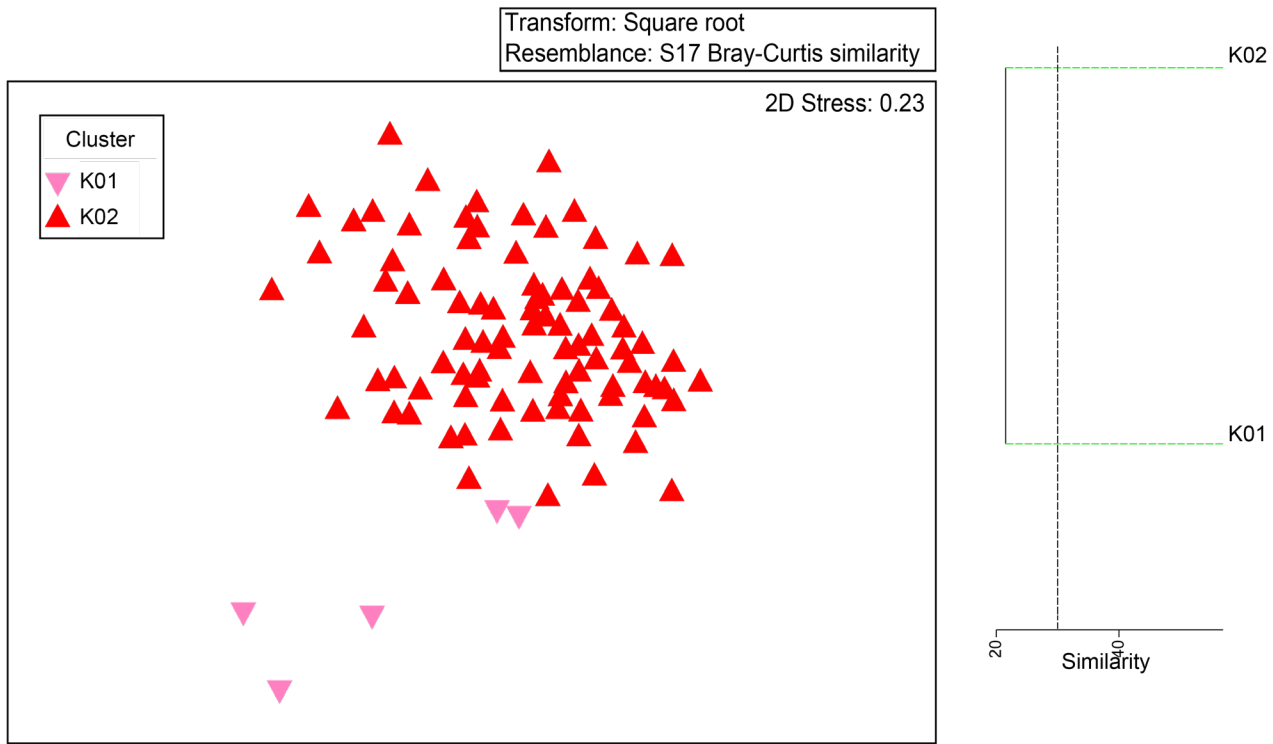
	Cluster Group D					Cluster Group G				Cluster Group K	
	D01	D02	D03	D04	D05	G01	G02	G03	G04	K01	K02
No of Trawls	11	204	10	7	275	5	24	2	296	5	89
Avg Similarity %	40	39	35	41	40	51	36	54	40	43	40
Mean Sp Richness	11	9	6	6	13	11	7	14	15	5	10
Mean Abundance	99	204	30	17	274	107	31	104	484	156	161
Depth (m)											
Min	16	7	19	24	20	60	71	86	43	420	181
Max	63	56	69	42	98	89	227	87	304	477	479
Mean	28	22	32	30	53	82	165	87	145	447	370
FRI Scores											
N/A	0	0	0	0	0	0	1	0	30	5	88
n>45	3	24	1	1	2	0	0	0	5	0	0
%Non Reference	27	12	10	14	1	0	0	0	2	NA	0
%Trawls/Survey											
1994	45	12	20	29	13	0	21	0	11	0	1
1998	0	16	30	43	36	20	29	100	19	0	0
2003	36	15	30	0	17	20	17	0	22	0	20
2008	18	14	10	0	8	20	4	0	12	0	27
2013	0	18	10	0	11	0	8	0	13	80	24
2018	0	11	0	14	8	40	17	0	11	20	19
2023	0	14	0	14	6	0	4	0	11	0	9



**Figure F8a. Results of ordination and cluster analysis of trawls from offshore fish cluster group G presented as a nMDS ordination, dendrogram of main subgroups, and a map of subgroups overlaid on station locations.**



**Figure F8b. Results of ordination and cluster analysis of trawls from offshore fish cluster group G. Data are presented as a shade plot of top 50 species by subgroup.**



**Figure F9a. Results of ordination and cluster analysis of trawls from offshore fish cluster group K presented as a nMDS ordination, dendrogram of main subgroups, and a map of subgroups overlaid on station locations.**

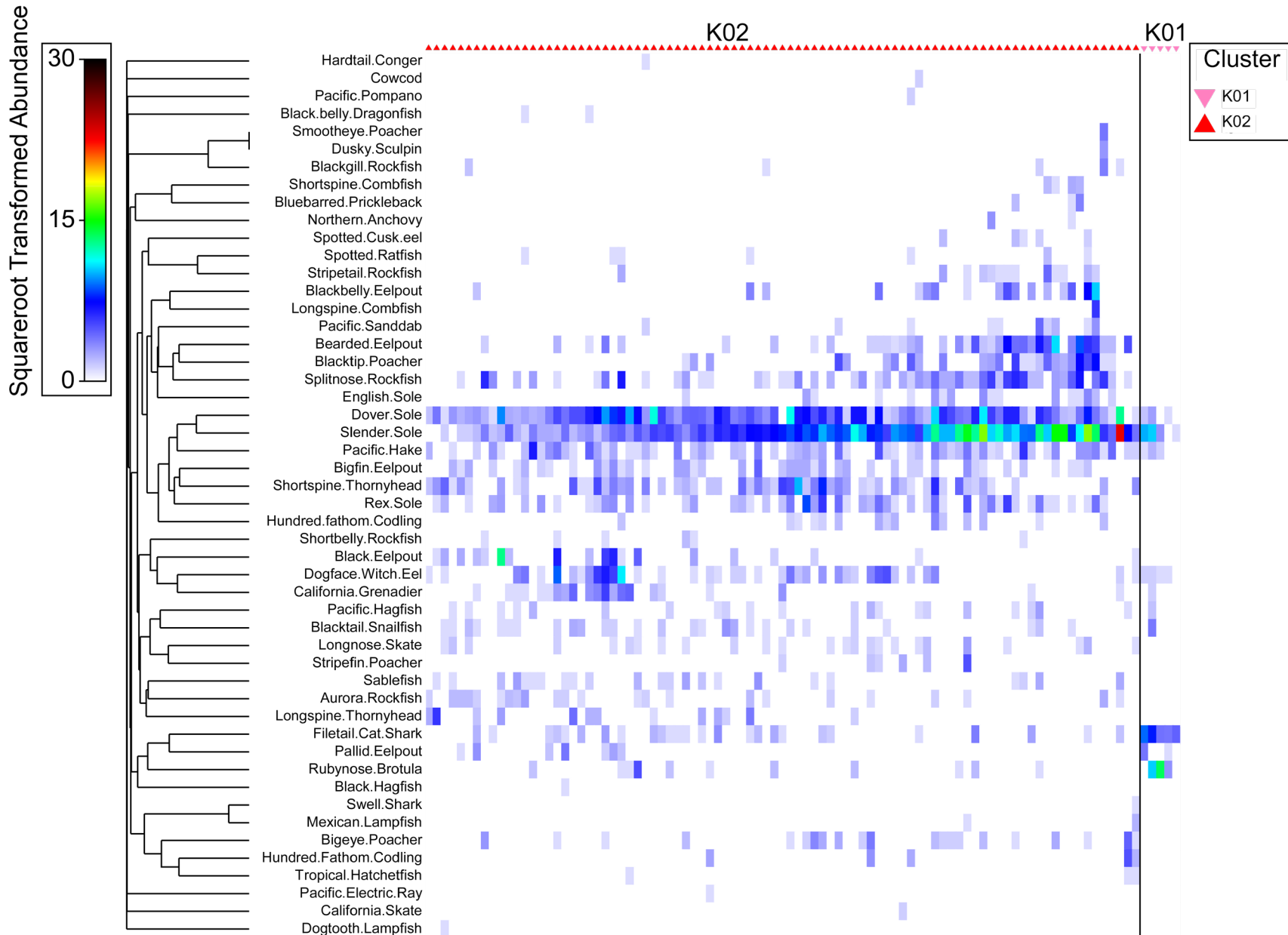


Figure F9b. Results of ordination and cluster analysis of trawls from offshore fish cluster group K. Data are presented as a shade plot of top 50 species by subgroup.

## Multivariate Analyses of Megabenthic Invertebrate Assemblages

Megabenthic Invertebrates in Bays across bays in the SCB. Abundance data was visualized using an nMDS ordination plot (Figure F10) and ANOSIM tests were run to look for significant differences between years and embayments. This analysis revealed the following observations:

- All years were significantly different from one another except for 2013 and 2018, which were not significantly different from one another.
- POLA/POLB was significantly different from all SDB ecoregions and Mission Bay.
- SDB ecoregions were significantly different from one another and from Mission Bay except for SDB - South and SDB – Central, which were not significantly different from one another.

Using similarity percentages (SIMPER) analysis shows the species that best represent the spatial community differences across bays and ecoregions (Table F6). The analysis identifies the relative contribution of each species within the group, as well as the cumulative contribution of the top species that make up at least 70% of the community composition within that group. The difference between POLA/POLB and other bay communities is evident in that none of the species that contribute most to the community at POLA/POLB stations are large contributors any of the other bays. Mission Bay and all ecoregions of SDB share at least one species, notably *Arcuatula senhousia* (Asian Date Mussel) and *Acanthoptilum sp* (Sea Pen).

**Table F6. Community similarity percentages (SIMPER) results for fish captured in Ports of LA/LB, Mission Bay, and the three ecoregions of San Diego Bay**

Bay	Species	Community Contribution (%)	Cumulative Contribution (%)
POLA/POLB	<i>Sicyonia penicillata</i>	31.2	31.2
	<i>Pyromaia tuberculata</i>	23.9	55.1
	<i>Crangon nigromaculata</i>	19.7	74.8
Mission Bay	<i>Arcuatula senhousia</i>	37.1	37.1
	<i>Dendraster excentricus</i>	13.6	50.7
	<i>Acanthoptilum sp</i>	8.5	59.2
	<i>Bulla gouldiana</i>	7.9	67.1
	<i>Leptopecten latiauratus</i>	7.8	74.9
San Diego Bay – North	<i>Acanthoptilum sp</i>	36.3	36.3
	<i>Pyromaia tuberculata</i>	22.3	58.6
	<i>Panulirus interruptus</i>	8.0	66.6
	<i>Suberites latus</i>	7.4	74.0
San Diego Bay – Central	<i>Arcuatula senhousia</i>	30.3	30.3
	<i>Bulla gouldiana</i>	24.0	54.3
	<i>Porifera</i>	14.1	68.4
	<i>Phrontis tiarula</i>	10.3	78.7
San Diego Bay – South	<i>Arcuatula senhousia</i>	43.6	43.6
	<i>Porifera</i>	14.9	58.5
	<i>Navanax inermis</i>	13.5	72.0

Similarity profile analysis (SIMPROF) was used to confirm the non-random structure of the resultant cluster dendrogram (Clarke et al. 2008), with major ecologically-relevant clusters receiving SIMPROF support retained as cluster groups. These analyses resulted in a total of seven SIMPROF-supported cluster groups, or types of trawl invertebrate assemblages (cluster groups A-G; Table F70, Figure 28), which were overlaid on station maps to examine spatial distribution. These assemblages represented from 3 to 94 trawls each and ranged from 14 to 31% similarity (mean = 21%) for clusters with n>1. Results of similarity percentages (SIMPER) analysis for each SIMPROF group is shown in Table F7. An nMDS ordination was overlaid on station maps and a shade plot of the 35 species that best resolve groups was created to assist in interpretation of spatial patterns (Figure F11). Group D included the most stations and primarily consisted of POLA/POLB stations, although two stations in Mission Bay and four stations in North SDB also fell into this group (Figures F12, F13, and F14). This group was distinct in its species composition from others by the dominance of target rock shrimp, blackspot shrimp and tuberculate pear crabs. Group C was the other large group that had clear spatial definition as it was located primarily within SDB – Central, SDB – South and inner Mission Bay and may help explain why these ecoregions did not statistically differ from one another. Group E was distinct in the dominance of sand dollars and sea pens, with stations located in the outer region of Mission Bay and North San Diego Bay (Figures F13 and F14). Cluster group F was isolated to one station in outer POLA/POLB and two stations in Northern San Diego Bay that were characterized by the presence of sponges, Olympia oysters, and small shrimps and crabs.

**Table F7. Composition of bays and harbors megabenthic invertebrate cluster groups A–I. For groups with more than one trawl, highlighted values indicate the most characteristic species according to SIMPER analysis and the cumulative percent contribution (C%C) is included at the bottom. For groups with one trawl, highlighted values are top five most abundant species, and N/A (not applicable) is included for C%C.**

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>
<b>Number of Trawls</b>	1	1	54	94	12	3	1
<b>Species</b>	<b>Mean Abundance</b>						
<i>Kelletia kelletii</i>	1	0	0	<1	0	0	0
<i>Pisaster brevispinus</i>	1	0	0	<1	0	0	0
<i>Dendraster excentricus</i>	0	3	0	0	421	0	0
<i>Renilla koellikeri</i>	0	1	0	0	0	0	0
<i>Stylatula elongata</i>	0	1	0	<1	0	0	0
<i>Arcuatula senhousia</i>	0	0	16	<1	<1	0	0
Ascidiacea	0	0	9	0	0	0	0
<i>Microcosmus squamiger</i>	0	0	4	0	0	0	0
<i>Molgula verrucifera</i>	0	0	4	0	0	0	1
<i>Styela plicata</i>	0	0	4	0	0	0	0
<i>Sicyonia penicillata</i>	0	0	<1	343	1	0	0
<i>Crangon nigromaculata</i>	0	0	0	16	0	0	0

	A	B	C	D	E	F	G
<b>Number of Trawls</b>	1	1	54	94	12	3	1
<b>Species</b>	<b>Mean Abundance</b>						
<i>Pyromaia tuberculata</i>	0	0	1	14	13	0	0
<i>Philine auriformis</i>	0	0	1	9	0	0	0
<i>Sicyonia ingentis</i>	0	0	0	6	0	1	0
<i>Acanthoptilum</i> sp	0	0	<1	<1	37	0	0
<i>Asciella aspersa</i>	0	0	<1	<1	4	0	0
<i>Molgula ficus</i>	0	0	0	0	2	0	0
<i>Suberites latus</i>	0	0	<1	<1	<1	4	0
<i>Ostrea lurida</i>	0	0	0	0	<1	2	0
<i>Penaeus californiensis</i>	0	0	<1	2	0	1	0
<i>Lophopanopeus frontalis</i>	0	0	<1	0	0	1	0
<b>C%C</b>	NA	NA	14	23	31	14	NA

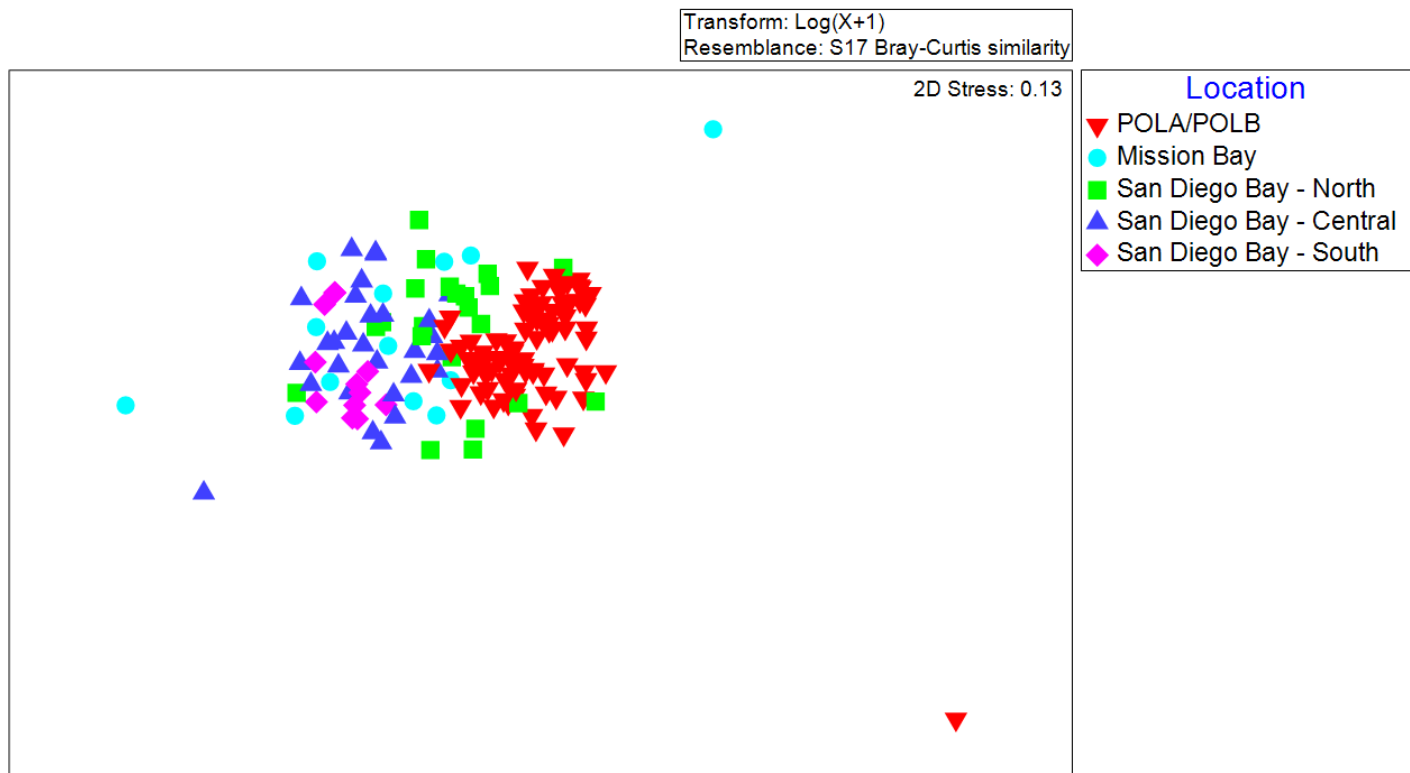


Figure F10. nMDS plot of invertebrate abundance by Bay/Harbor.

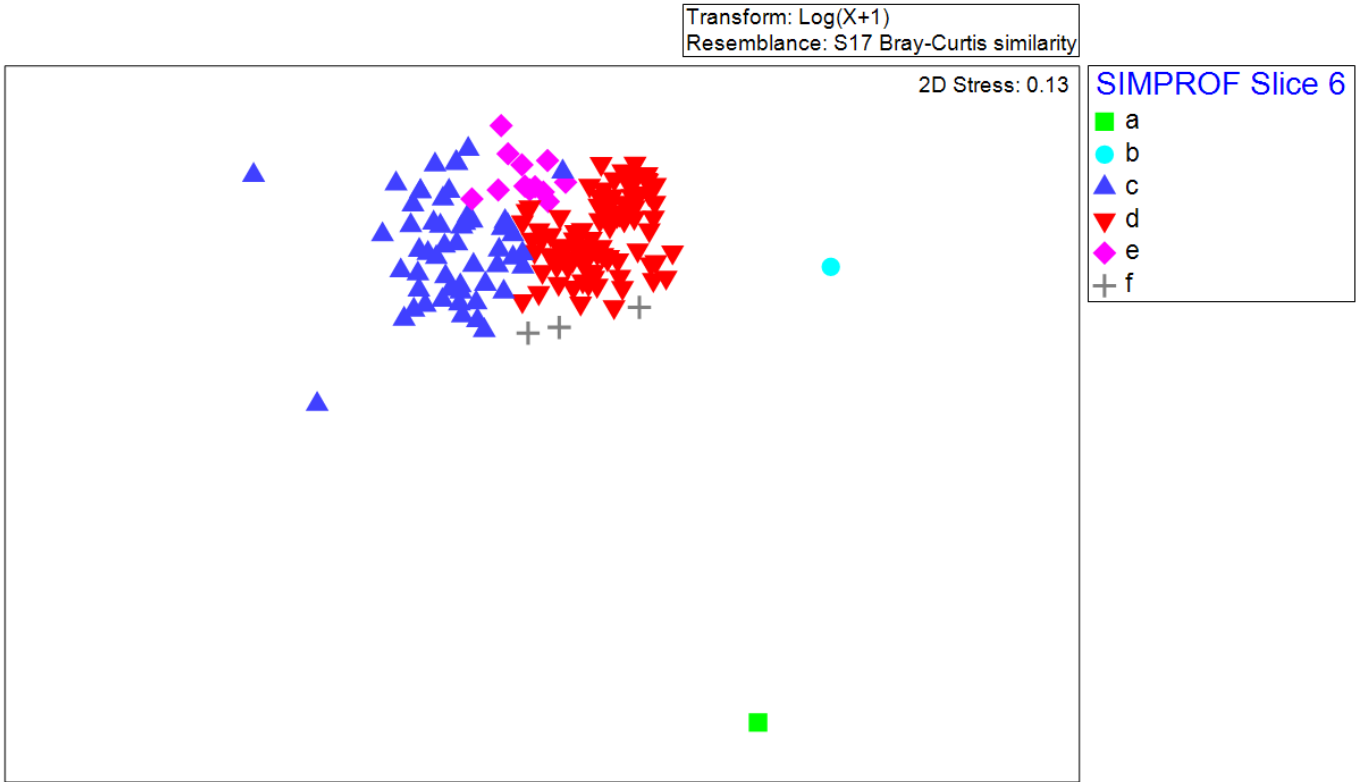


Figure F11. nMDS plot of invertebrate abundance by Similarity Profile (SIMPROF) analysis. Group G excluded for better visualization.



Figure F12. Demersal invertebrate SIMPROF groups in Bays and Harbors – Ports of Los Angeles/Long Beach.

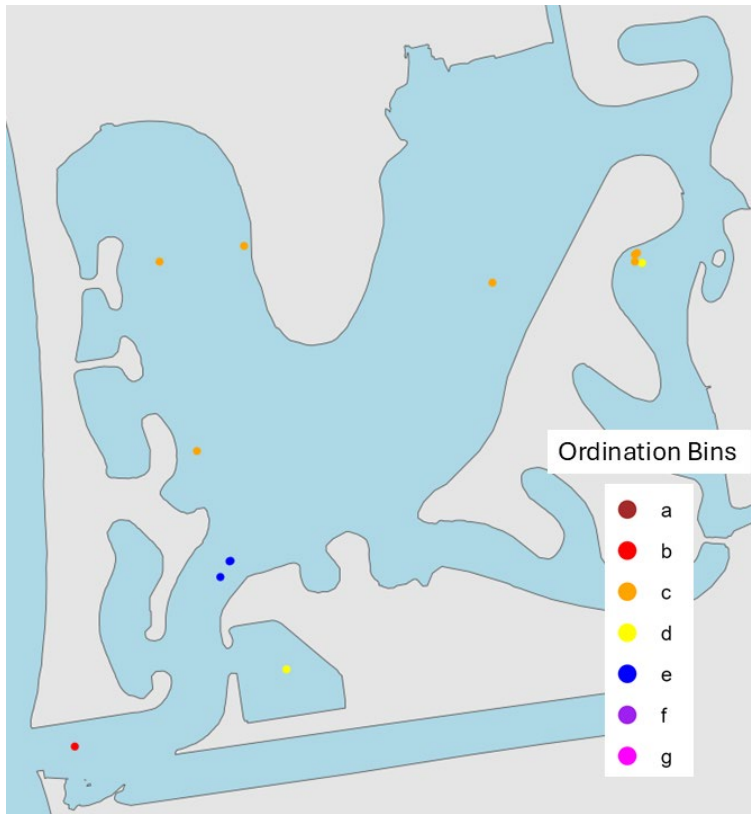


Figure F13. Demersal invertebrate SIMPROF groups in Bays and Harbors – Mission Bay.

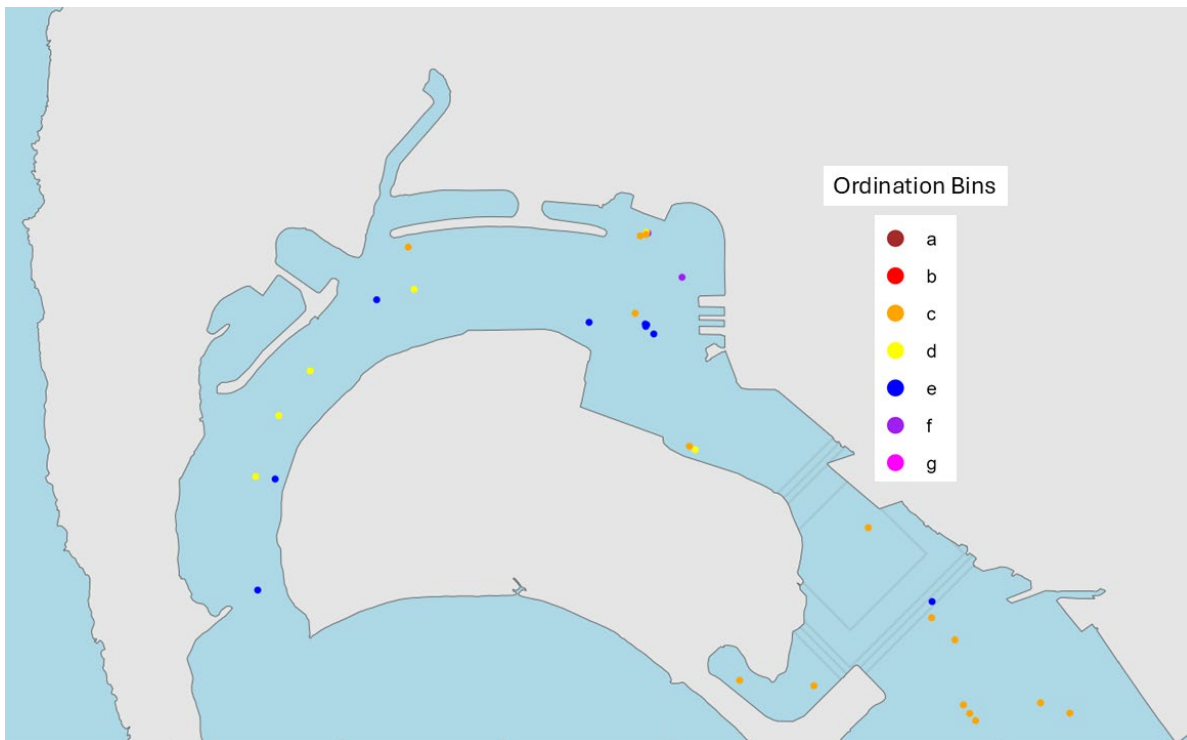
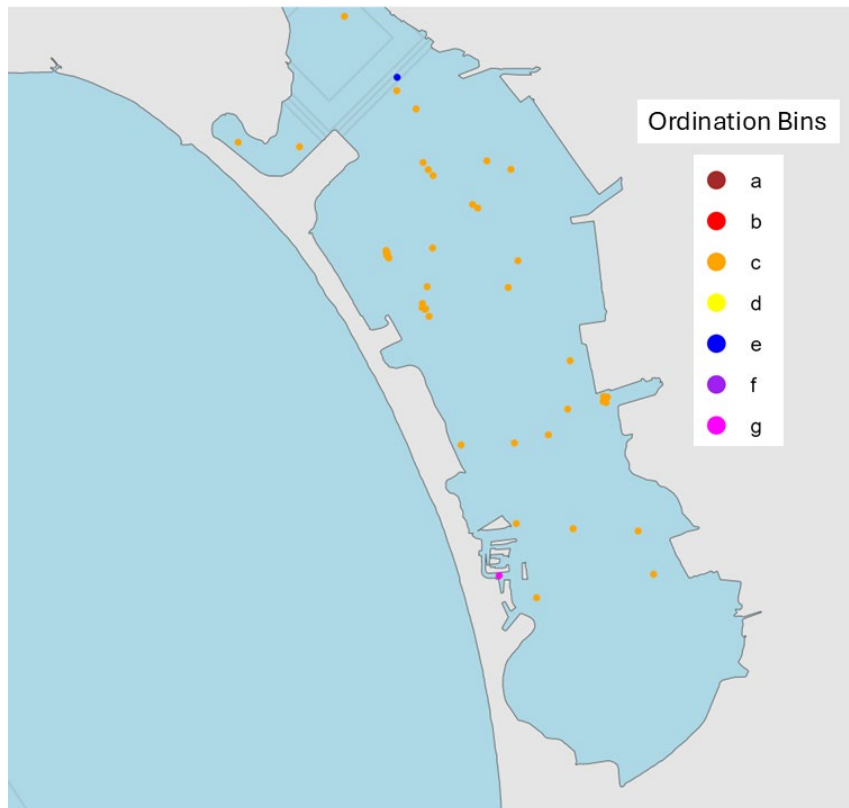


Figure F14. Demersal invertebrate SIMPROF groups in Bays and Harbors – North San Diego Bay (SDB).



**Figure F15. Demersal invertebrate SIMPROF groups in Bays and Harbors – Central and South San Diego Bay (SDB).**

#### Megabenthic Invertebrates on the Coastal Shelf and Slope

Multivariate analyses of megabenthic invertebrate communities on the SCB shelf and slope included a total of 987 trawls conducted during Bight Surveys (Bight '94 – Bight '23). These analyses resulted in 13 main ecologically-relevant SIMPROF-supported groups, or types of megabenthic invertebrate assemblages (Table 20, Figure 31, Figure 32 in main report). These assemblages represented from 1 to 565 trawls each and ranged from 17 to 70% similarity (mean = 31%) for clusters with more than one trawl. Ten of the invertebrate cluster groups (groups A, C, D, E, G, H, I, J, K, M) were small “outlier” clusters of 1 to 4 trawls. Groups A (n = 4 trawls), C (n = 3 trawls), D (n = 1 trawl), and E (n = 1 trawl) included sites located on the inner shelf and shallow middle shelf at depths  $\leq 31$  m off various beaches and lagoons in San Diego, Ventura, and Santa Barbara Counties. Assemblages represented by Group A were characterized by the highest numbers of the Sand Dollar *Dendraster excentricus* (mean abundance = 571 per haul) and the crab *Portunus xantusii* (mean abundance = 2 per haul), while Group C assemblages were characterized by the highest numbers of the Kelp Crab *Pugettia producta* (mean abundance = 8 per haul) and the Spanish Shawl Nudibranch *Flabellina iodinea* (mean abundance = 3 per haul) (Table F8). The trawl represented by group D included just one specimen of the sea pen *Stylatula elongata*. The trawl represented by group E included just one

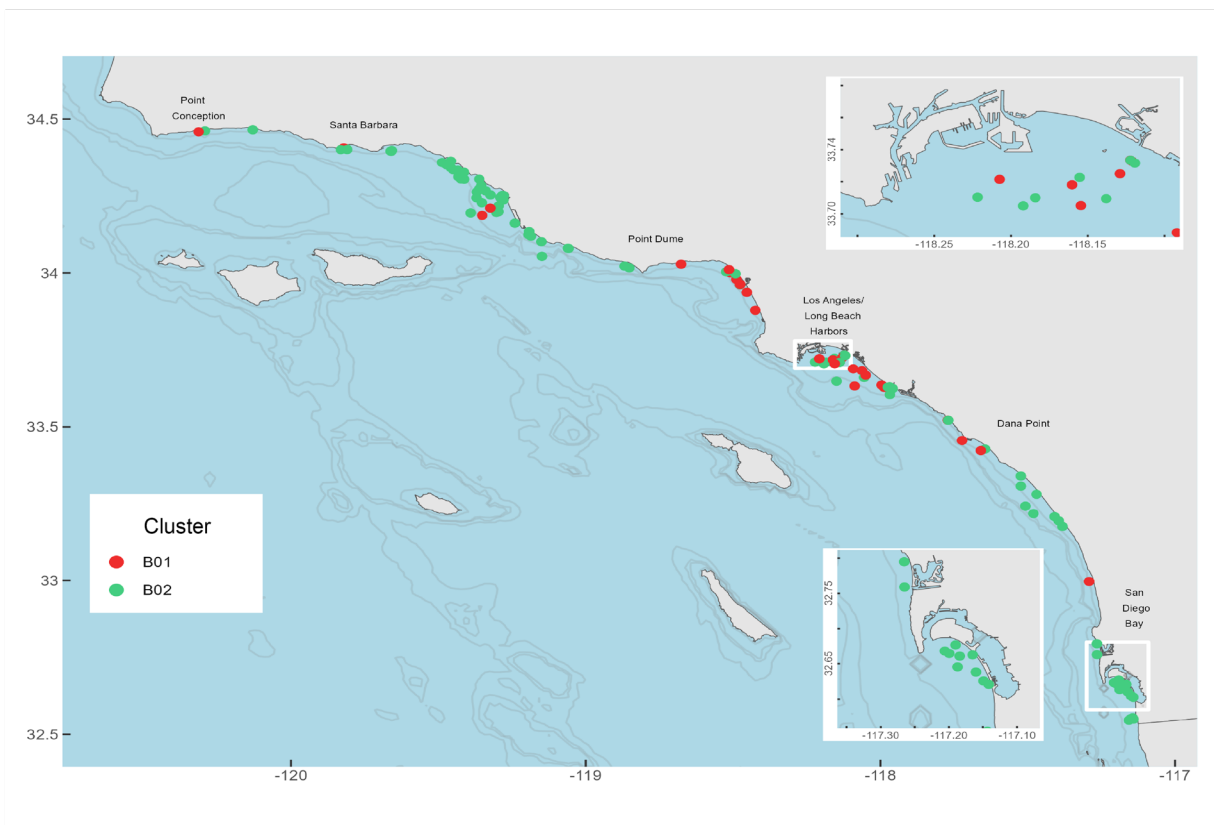
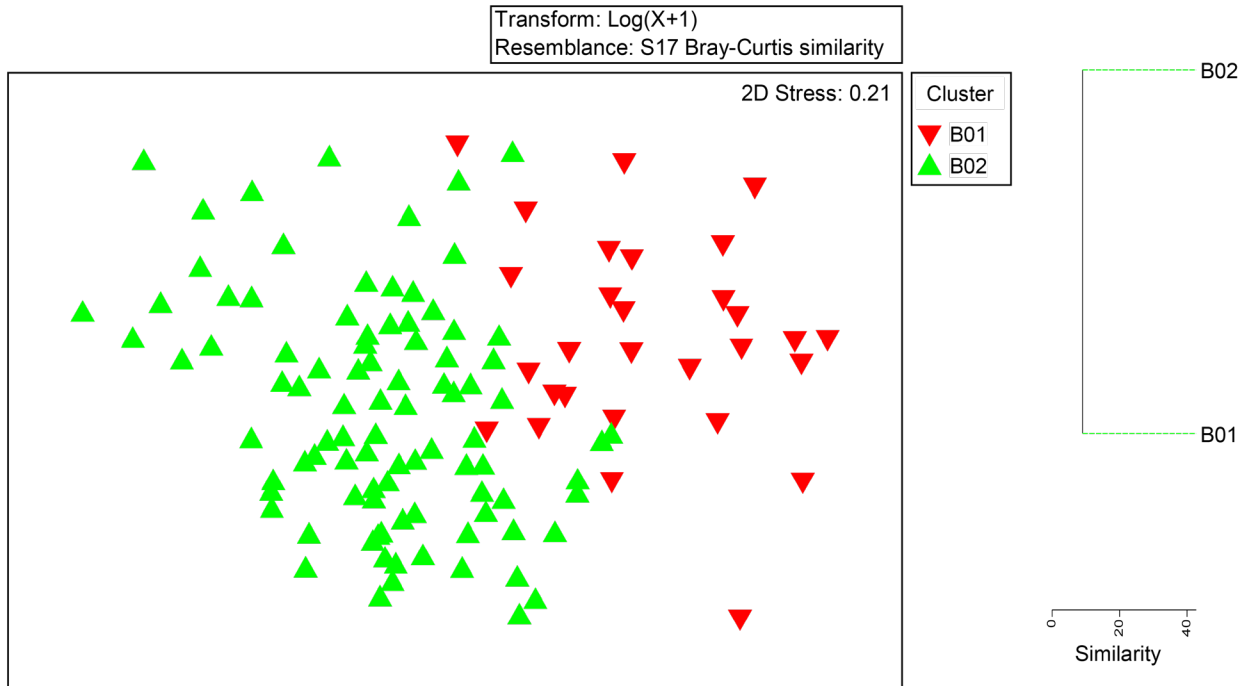
specimen of the Spider Crab *Loxorhynchus grandis*. Groups G (n = 2), H (n = 2), I (n = 2), J (n = 2), K (n = 1), and M (n = 2) included sites located on the middle shelf, outer shelf, and upper slope at depths of 41-477 m, primarily off the northern Channel Islands, or elsewhere in the Santa Barbara Basin. Group G assemblages were characterized by the Yellow Sea Twig *Thesea* sp B (mean abundance = 1 per haul), Group H assemblages were characterized by the Sea Slug *Pleurobranchaea californica* (mean abundance = 3 per haul), Group I assemblages were characterized by the highest number of the Brittle Star *Ophiopholis bakeri* (mean abundance = 191 per haul), Group J assemblages were characterized by the highest number of the Brown Box Crab *Echidnocerus foraminatus* (mean abundance = 14 per haul), the sea star *Mediaster aequalis* (mean abundance = 8 per haul), and the Swollen Hermit Crab *Paguristes turgidus* (mean abundance = 3 per haul), Group K had a single specimen of the California Spot Prawn *Pandalus platyceros*, and Group M assemblages averaged 109 of the Modest Dove Snail *Astyris permodesta* per haul.

The remaining clusters (groups B, F, L) each spanned the entire SCB, representing the transition of common invertebrate assemblages from the inner shelf to the upper slope (Table 20, Figure 31, Figure 32 in main report). Group B comprised 121 trawls primarily from inner and shallow middle shelf sites (mean depth = 19 m). The assemblages represented by this group were characterized by the highest number of the Blackspotted Bay Shrimp *Crangon nigromaculata* (mean abundance = 14 per haul), the Graceful Rock Crab *Metacarcinus gracilis* (mean abundance = 2 per haul), the sea star *Astropecten armatus* (mean abundance = 1 per haul), as well as the Octopus *Octopus rubescens* (mean abundance = 1 per haul) (Table F8). Group F comprised 565 trawls from all offshore strata at depths of 9 – 227 m (mean depth = 59 m). These assemblages were characterized by the highest number of the White Sea Urchin *Lytechinus pictus* (mean abundance = 321 per haul), the brittle star *Ophiura luetkenii* (mean abundance = 70 per haul), the Ridgeback Prawn *Sicyonia ingentis* (mean abundance = 57 per haul), the Sea Star *Astropecten californicus* (mean abundance = 16 per haul) and the California Sea Cucumber *Apostichopus californicus* (mean abundance = 5 per haul). Group L comprised 281 trawls spanning shelf and upper slope sites at depths of 18 – 479 m (mean depth = 247 m). Assemblages represented by group L were characterized by the highest numbers of the Fragile Sea Urchin *Strongylocentrotus fragilis* (mean abundance = 319 per haul), the Pacific Heart Urchin *Brissopsis pacifica* (mean abundance = 241 per haul), the Sea Urchin *Brisaster latifrons* (mean abundance = 144 per haul), the Shrimp *Neocrangon zaca* (mean abundance = 17 per haul), and the Sand Star *Luidia foliolata* (mean abundance = 4 per haul), as well as the Ridgeback Prawn *Sicyonia ingentis* (mean abundance = 52 per haul) and the Sea Slug *Pleurobranchaea californica* (mean abundance = 3 per haul).

**Table F8. Composition of offshore invertebrate cluster groups A-M. For groups with more than one trawl, highlighted values indicate the most characteristic species according to SIMPER analysis and the cumulative percent contribution (C%C) is included at the bottom. For groups with one trawl, highlighted values are top five most abundance species, and N/A (not applicable) is included for C%C.**

	Cluster Group												
	A	B	C	D	E	F	G	H	I	J	K	L	M
<b>No. of Trawls</b>	4	121	3	1	1	565	2	2	2	2	1	281	2
<b>Species</b>	<b>Mean Abundance</b>												
<i>Dendroaster excentricus</i>	571	0	0	0	0	0	0	0	0	0	0	0	0
<i>Achelous xantusii</i>	2	1	0	0	0	0	0	0	0	0	0	0	0
<i>Crangon nigromaculata</i>	<1	14	0	0	0	<1	0	0	0	0	0	0	0
<i>Metacarcinus gracilis</i>	0	2	0	0	0	<1	0	0	0	0	0	0	0
<i>Astropecten armatus</i>	0	1	0	0	0	<1	0	0	0	0	0	0	0
<i>Octopus rubescens</i>	0	1	0	0	0	2	0	0	0	0	0	2	0
<i>Pugettia producta</i>	0	<1	10	0	0	0	0	0	0	0	0	0	0
<i>Flabellinopsis iodinea</i>	0	<1	3	0	0	<1	0	0	0	0	0	0	0
<i>Stylatula elongata</i>	0	0	0	1	0	1	0	0	0	0	0	0	0
<i>Loxorhynchus grandis</i>	0	<1	0	0	1	<1	0	0	0	0	0	0	0
<i>Lytechinus pictus</i>	0	<1	0	0	0	321	0	0	0	0	0	5	0
<i>Ophiura luetkenii</i>	0	<1	0	0	0	70	0	0	0	0	0	5	0
<i>Sicyonia ingentis</i>	0	<1	0	0	0	57	0	0	0	0	0	52	0
<i>Astropecten californicus</i>	0	1	2	0	0	16	0	0	0	0	0	<1	0
<i>Apostichopus californicus</i>	0	0	0	0	0	5	0	<1	0	0	0	1	0
<i>Thesea</i> sp B	0	0	0	0	0	5	1	0	0	0	0	3	0
<i>Pleurobranchaea californica</i>	0	0	0	0	0	2	0	3	0	0	0	3	0
<i>Ophiopholis bakeri</i>	0	0	0	0	0	<1	0	0	191	<1	0	1	0
<i>Echidnocerus foraminatus</i>	0	0	0	0	0	0	0	0	0	14	0	1	0
<i>Mediaster aequalis</i>	0	0	0	0	0	<1	0	0	1	8	0	1	0
<i>Paguristes turgidus</i>	0	<1	0	0	0	<1	1	0	0	3	0	<1	0
<i>Pandalus platyceros</i>	0	0	0	0	0	<1	0	0	0	<1	1	7	0
<i>Luidia foliolata</i>	0	0	0	0	0	2	0	0	0	<1	0	4	0
<i>Neocrangon zacaе</i>	0	0	0	0	0	<1	0	0	<1	0	0	17	0
<i>Strongylocentrotus fragilis</i>	0	0	0	0	0	<1	0	0	0	0	0	319	0
<i>Brissopsis pacifica</i>	0	0	0	0	0	<1	0	0	0	0	0	241	0
<i>Brisaster latifrons</i>	0	0	0	0	0	0	0	0	0	0	0	144	0
<i>Astyris permodesta</i>	0	0	0	0	0	0	0	0	0	0	0	17	109
<b>(C%C)</b>	100	75	74	N/A	N/A	74	100	100	78	78	N/A	73	100

Additional analyses of these three largest offshore megabenthic invertebrate clusters (groups B, F, L) revealed subgroups that also spanned much of the SCB and revealed no discernible patterns in invertebrate assemblages that could be associated with proximity to known pollution sources (Figure F16, Figure F17, Figure F18). As with the 13 main cluster groups A-M, assemblages represented by subgroups B01-B02, F01-F07, and L01-L08 varied in terms of habitat differences and/or the unique composition of invertebrate assemblages. Cluster group B subgroups represented from 29 to 92 trawls conducted on the Inner Shelf (mean depth = 23 m), and ranged from 21 to 24% similarity (mean = 23%) (Table F9). A BEST/BVSTEP test ( $p = 0.951$ ,  $p \leq 0.001$ , number of permutations = 999) implicated *Achelous xantusii*, *Astropecten armatus*, *Astropecten californicus*, *Crangon nigromaculata*, *Latulambrus occidentalis*, *Metacarcinus gracilis*, *Octopus rubescens*, *Penaeus californiensis*, *Pyromaia tuberculata*, and *Sicyonia penicillate* as being influential to the overall pattern (gradient) of the cluster dendrogram (Figure F16b). Cluster group F subgroups represented from 3 to 390 trawls conducted across the Middle Shelf (mean depth = 53 m), and ranged from 22 to 44% similarity (mean = 31%). A BEST/BVSTEP test ( $p = 0.952$ ,  $p \leq 0.001$ , number of permutations = 999) implicated *Acanthoptilum* sp., *Apostichopus californicus*, *Astropecten californicus*, *Crangon nigromaculata*, *Luidia foliolata*, *Lytechinus pictus*, *Mediaster aequalis*, *Octopus rubescens*, *Ophiothrix spiculata*, *Ophiura luetkenii*, *Philine auriformis*, *Pleurobranchaea californica*, *Pyromaia tuberculata*, *Sicyonia ingentis*, and *Thesea* sp B as being influential to the overall pattern (gradient) of the cluster dendrogram (Figure F17b). Cluster group L subgroups represented from 1 to 213 trawls conducted on the Outer Shelf and Upper Slope (mean depth = 240 m), and ranged from 30 to 40% similarity (mean = 35%) for clusters with more than one trawl. A BEST/BVSTEP test ( $p = 0.952$ ,  $p \leq 0.001$ , number of permutations = 999) implicated the Sea Pen *Acanthoptilum* sp, the Sea Urchins *Brisaster latifrons* and *Brisaster townsendi*, the Pacific Heart Urchin *Brissopsis pacifica*, the Basket Star *Gorgonocephalus eucnemis*, the Sand Star *Luidia foliolata*, the Sea Star *Myxoderma platyacanthum*, the Shrimp *Neocrangon resima* and *Neocrangon zaca*, the North Pacific Bigeye Octopus *Octopus californicus*, the Brittle Star *Ophiura luetkenii*, the Sea Slug *Pleurobranchaea californica*, the Ridgeback Prawn *Sicyonia ingentis*, the Heart Urchin *Spatangus californicus*, the Slender Blade Shrimp *Spirontocaris holmesi*, the Offshore Blade Shrimp *Spirontocaris sica*, and the Fragile Sea Urchin *Strongylocentrotus fragilis* as being influential to the overall pattern (gradient) of the cluster dendrogram (Figure F18b).



**Figure F16a. Results of ordination and cluster analysis of trawls from offshore invertebrate cluster group B presented as a nMDS ordination, dendrogram of main subgroups, and a map of subgroups overlaid on station locations.**

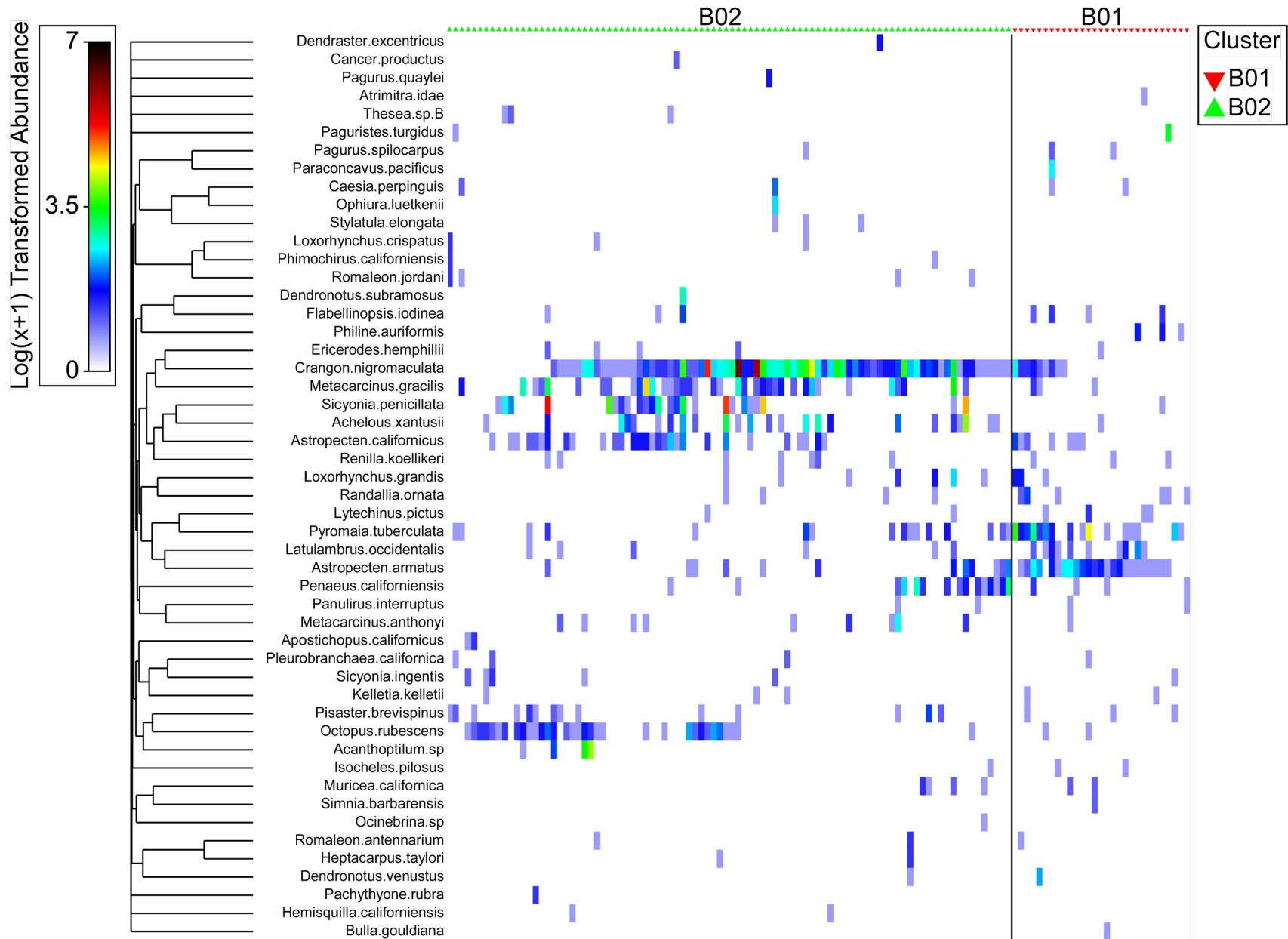
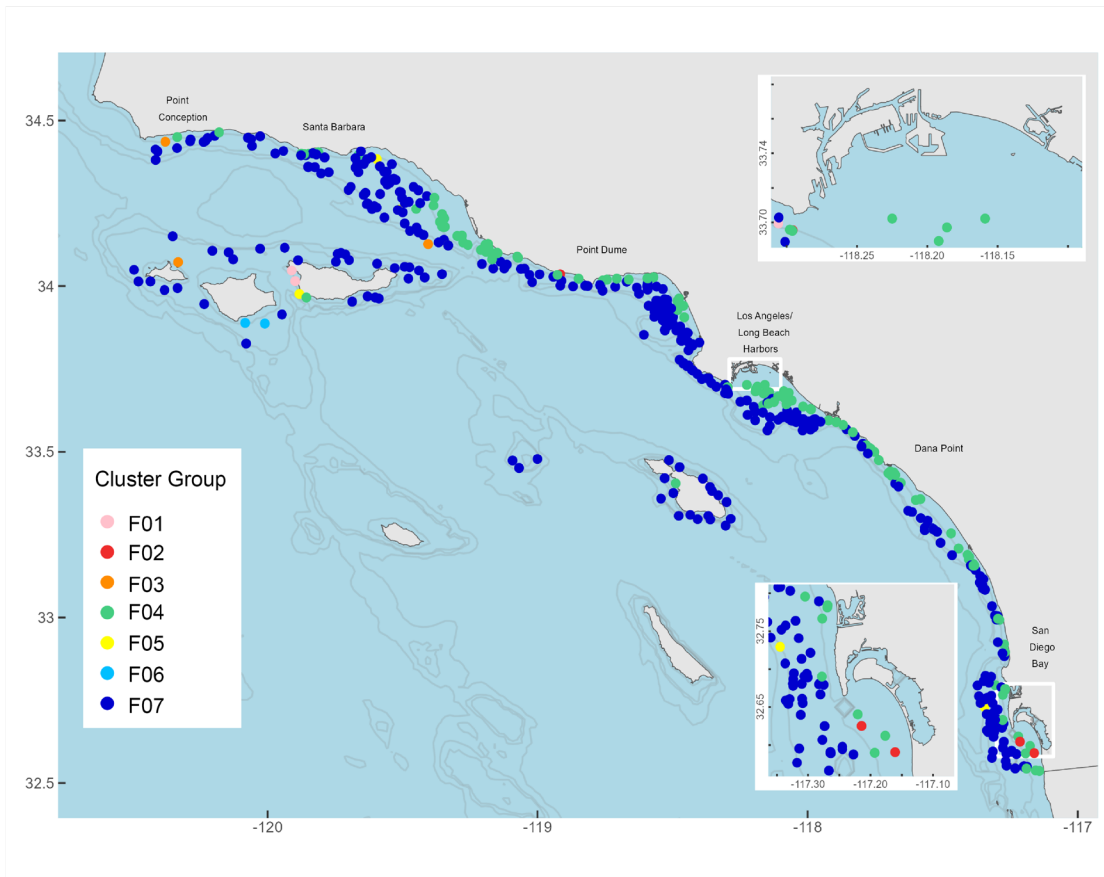
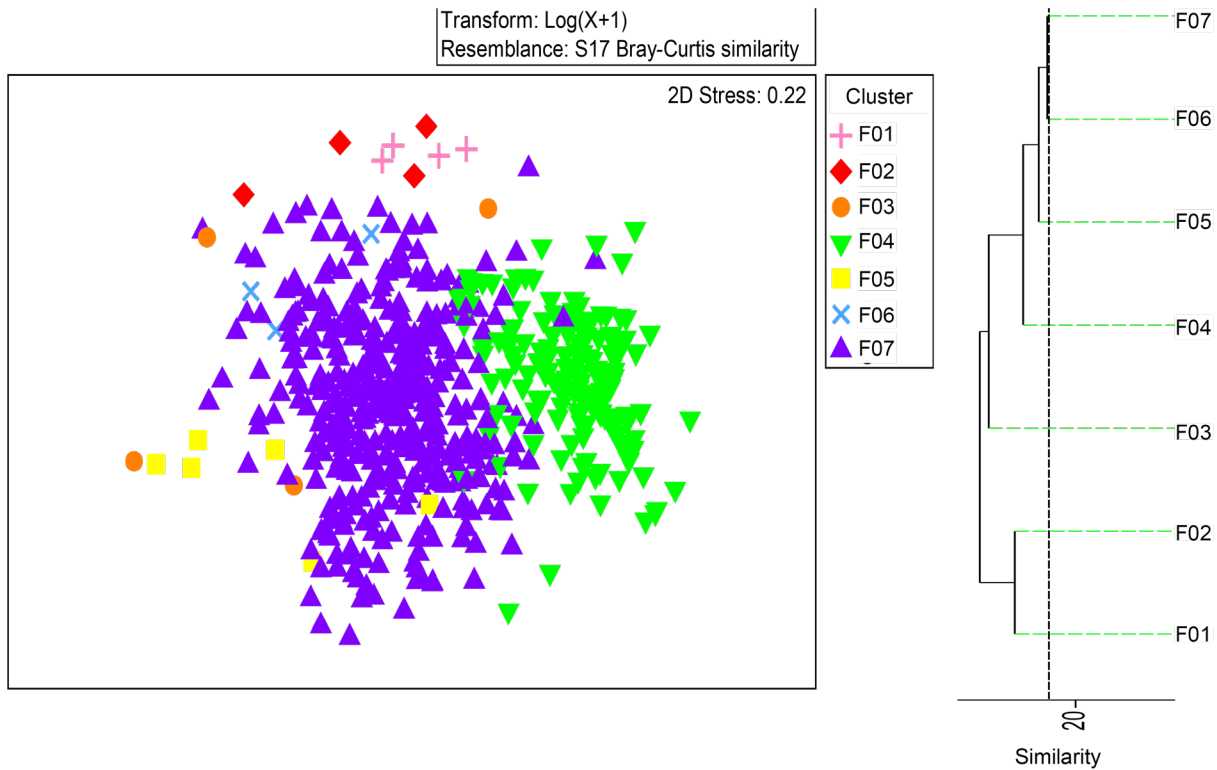


Figure F16b. Results of ordination and cluster analysis of trawls from offshore fish cluster group B. Data are presented as a shade plot of top 50 species by subgroup.

**Table F9. Description of offshore invertebrate cluster B, F, L subgroups as defined in Figure F17, Figure F18, Figure F19.**

Parameter	Subgroup B		Subgroup F							Subgroup L							
	B01	B02	F01	F02	F03	F04	F05	F06	F07	L01	L02	L03	L04	L05	L06	L07	L08
No. of Trawls	29	92	4	4	4	154	6	3	390	42	5	6	1	5	1	8	213
Avg Similarity (%)	21	24	31	27	22	31	44	31	29	39	36	30	N/A	30	N/A	40	32
Mean Species Richness	6	5	13	6	14	6	6	29	12	11	5	7	8	19	15	5	13
Mean Abundance	18	38	39	16	61	56	70	636	763	5799	1249	214	60	141	45	34	1662
Depth (m)																	
Min	7	7	25	15	22	9	37	38	18	287	406	18	139	164	198	139	86
Max	33	125	35	24	227	63	136	54	202	479	479	172	139	350	198	194	472
Mean	16	20	28	20	97	26	80	46	72	412	449	118	139	212	198	176	218
% Trawls by Survey																	
1994	17	3	0	25	0	13	0	0	15	0	0	17	0	0	0	13	10
1998	52	27	50	25	0	23	0	0	30	0	0	17	0	20	0	13	12
2003	10	21	25	25	75	14	83	100	18	29	20	17	100	40	100	25	15
2008	7	8	0	25	25	15	0	0	8	31	0	0	0	20	0	0	18
2013	3	12	0	0	0	18	17	0	10	26	40	17	0	0	0	13	20
2018	7	18	25	0	0	8	0	0	8	12	20	17	0	20	0	38	14
2023	3	11	0	0	0	9	0	0	10	2	20	17	0	0	0	0	12



**Figure F17a. Results of ordination and cluster analysis of trawls from offshore invertebrate cluster group F presented as a nMDS ordination, dendrogram of main subgroups, and a map of subgroups overlaid on station locations.**

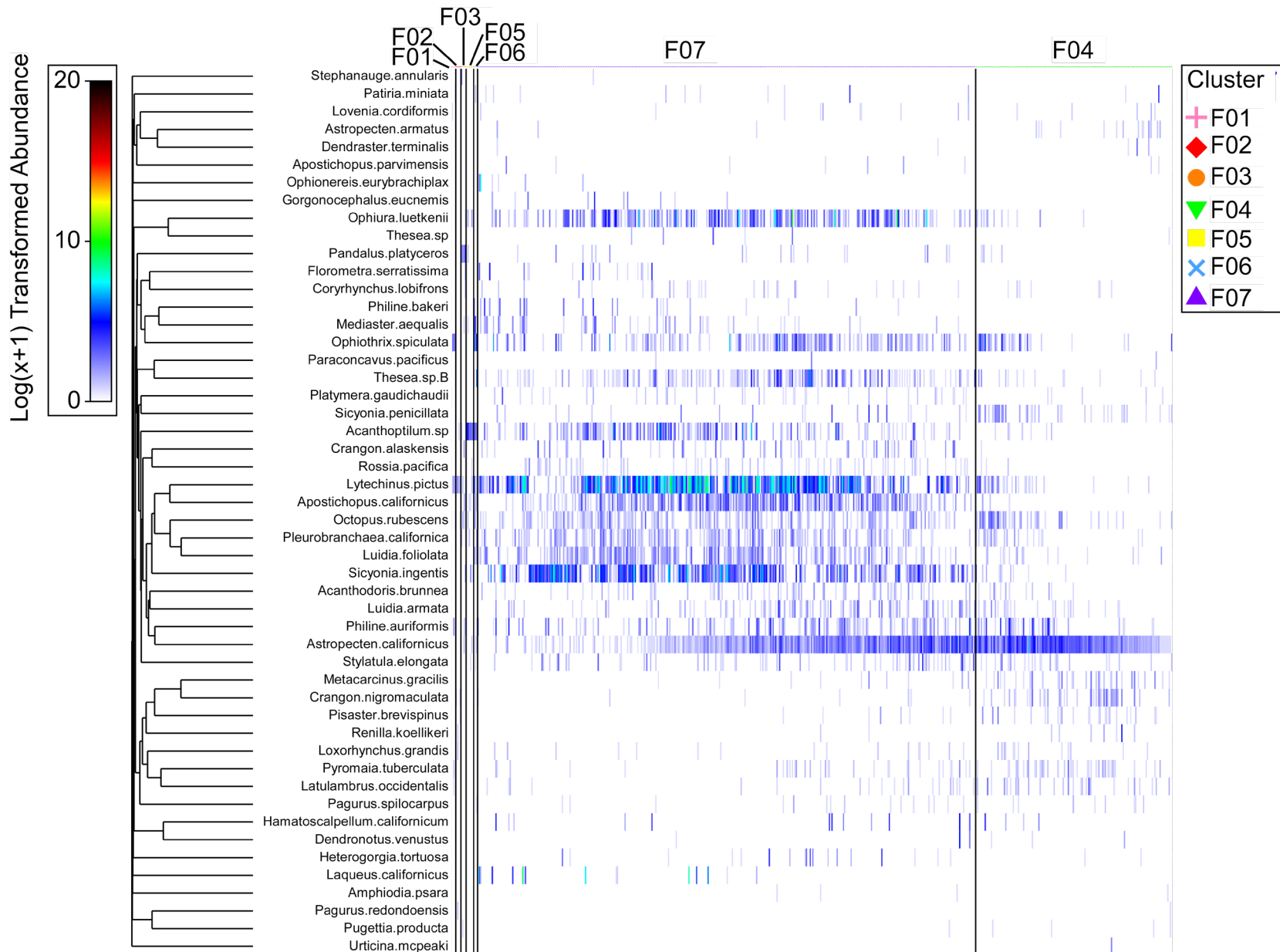
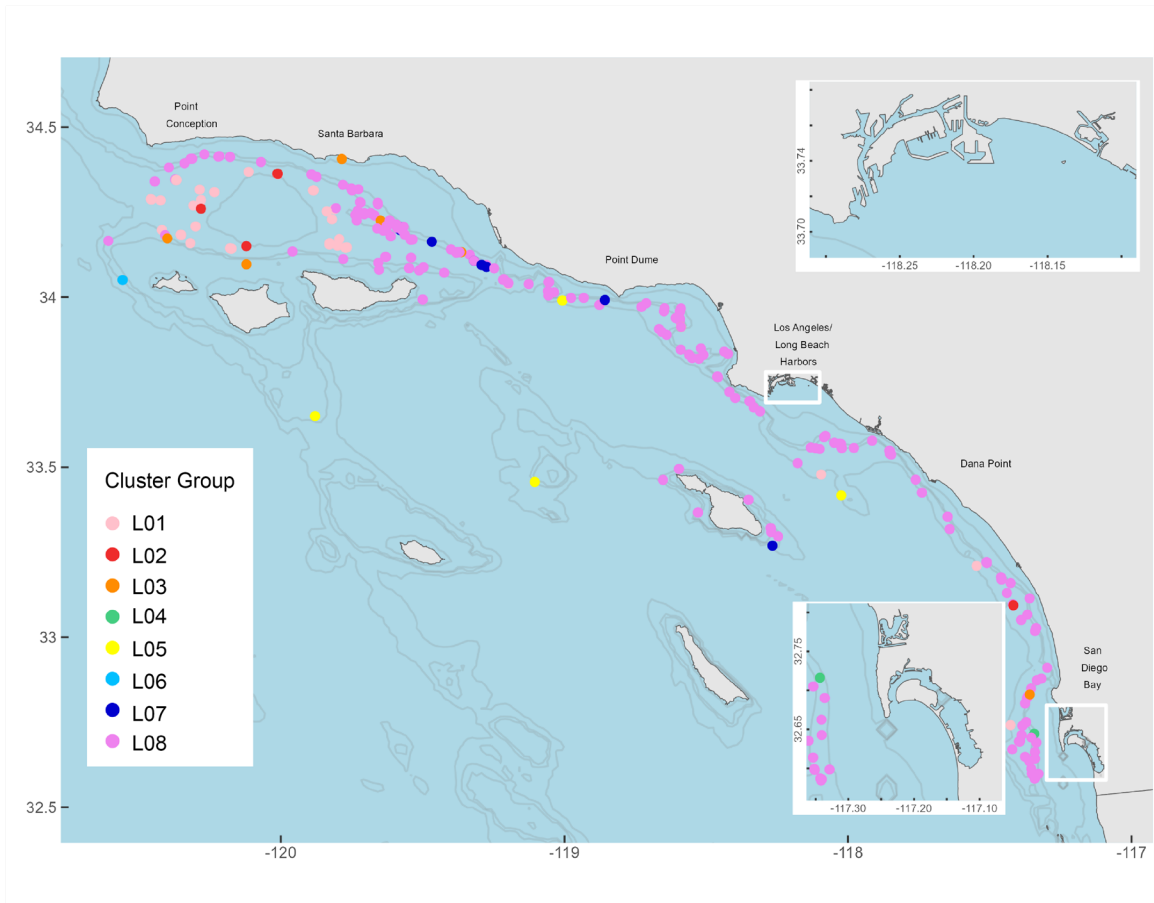
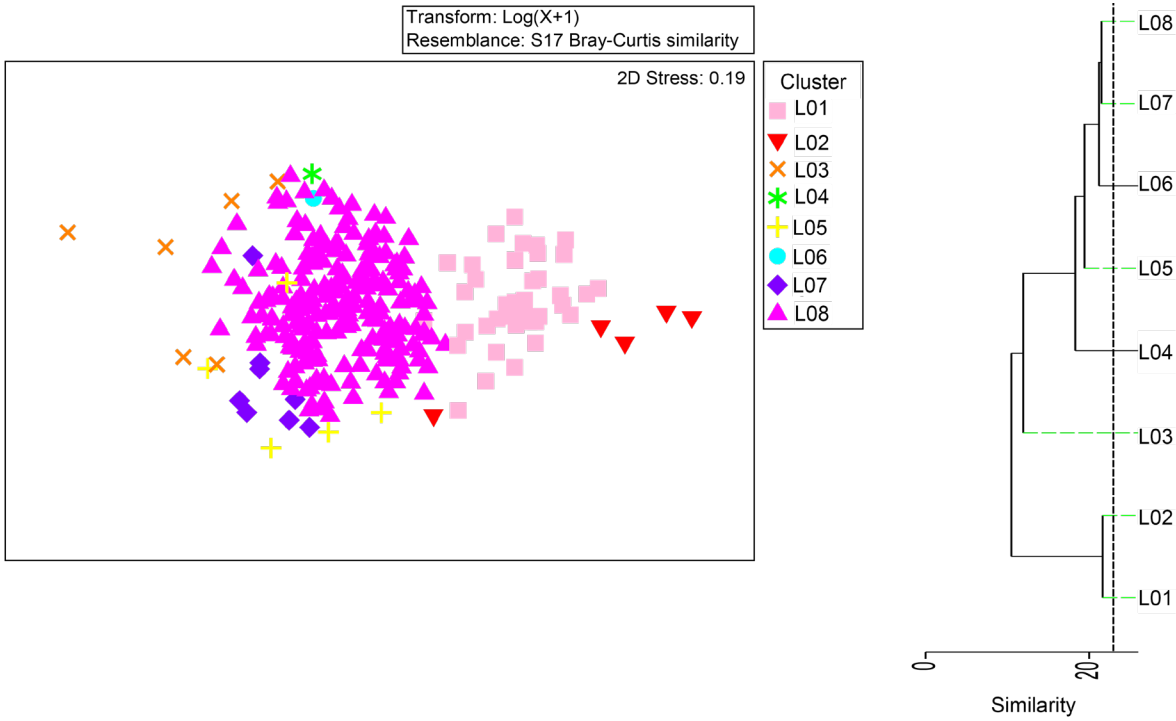


Figure F17b. Results of ordination and cluster analysis of trawls from offshore fish cluster group F. Data are presented as a shade plot of top 50 species by subgroup.



**Figure F18a. Results of ordination and cluster analysis of trawls from offshore invertebrate cluster group L presented as a nMDS ordination, dendrogram of main subgroups and a map of subgroups overlaid on station locations.**

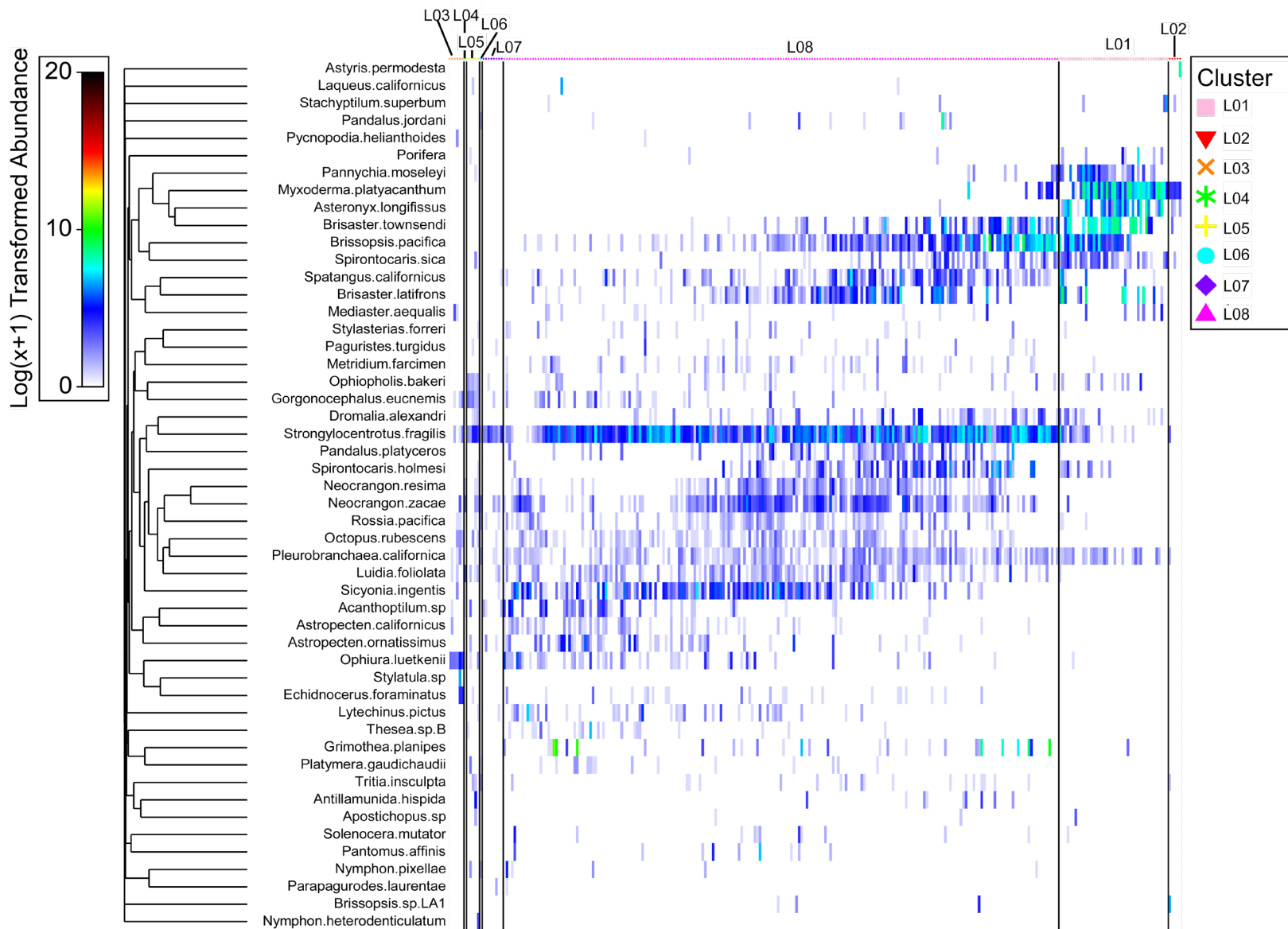


Figure F18b. Results of ordination and cluster analysis of trawls from offshore fish cluster group L. Data are presented as a shade plot of top 50 species by subgroup.

# APPENDIX G - OUTER SHELF AND UPPER SLOPE STRATA DATA

Appendix G-1. Outer Shelf fish abundance. Sum = Total for that species.

Station --->	San Diego to Santa Barbara – Outer Shelf Fish Abundance																					Outer Shelf Sum	
	171.3 32.585740 B23-12247	215.8 32.749516 B23-12248	191.7 32.873447 B23-12249	130 33.188127 B23-12250	188.7 33.221016 B23-12251	169.8 33.557553 B23-12255	140.9 33.568723 B23-12256	174.4 33.830806 B23-12679	148.9 33.853074 B23-12260	172 33.912233 B23-12261	191.7 33.997675 B23-12262	166.5 34.014344 B23-12263	133.9 34.053225 B23-12674	194.8 34.107170 B23-12267	129.3 34.122810 B23-12269	201.5 34.130935 B23-12270	173.2 34.132675 B23-12271	187.9 34.132900 B23-12272	177.7 34.225200 B23-12535	182.8 34.241824 B23-12534	138 34.247365 B23-12278		175.7 34.313824 B23-12283
Assigned Lat --->																							
Trawl Depth --->																							
<i>Citharichthys sordidus</i>	200	21	273	852	367	223	1193	228	71	41	154	83	176	42	89	65	177	54	166	2	139	11	4627
<i>Sebastes saxicola</i>	91	32	72	136	62	138	59	133	653	89	186	44		1	47	17	106	70	6	19		139	2100
<i>Lyopsetta exilis</i>	43	207	112	43	206	4	16	134	20	46	80	9	24		3	2	13	4	188	110	21	50	1335
<i>Microstomus pacificus</i>	27	14	127	185	156	17	36	20	28	2	40	49	54	9	49	36	62	34	89	28	55	143	1260
<i>Zaniolepis frenata</i>	7	9	1	77	37	91	116	38	152	130	31	88	2	1	11	3	20	12	37	4	3	47	917
<i>Sebastes semicinctus</i>				3				1	155	3	78	2	2	1	32	6	8	74			2	1	368
<i>Parophrys vetulus</i>	2		1	21	6		4	2	4		2		9	1	11	1	5	2	16		40		127
<i>Xeneretmus latifrons</i>	1					5		12		5	4		1			2			66	20			116
<i>Sebastes</i> sp		77	15		3																		95
<i>Synodus luciiceps</i>		2	53	21	4		5	3	1	1			1								2		93
<i>Sebastes elongatus</i>		1		3		6	3		23	8		13			2			6					65
<i>Lycnema barbatum</i>								13		1	4							1	10	24		3	56
<i>Lycodes pacificus</i>		5	1	4	6		3	3	1	1			3		4		2		6	5		11	55
<i>Chilara taylori</i>		4	1			6		1	6	2		6		2	2			3	14			3	50
<i>Zaniolepis latipinnis</i>				13			24						5						1		5		48
<i>Sebastes rosenblatti</i>	1	1	2	3	2				12	3		10					1	2	2	1		3	43
<i>Citharichthys fragilis</i>	35		4		2																		41
<i>Porichthys notatus</i>				34															4				38
<i>Sebastes rosaceus</i>						1			32														33
<i>Hippoglossina stomata</i>	2	5	3	2	1	6	6		1		1	1			1		1						30
<i>Glyptocephalus zachirus</i>	5	1	3	1		1					2							1	10	1	2		27
<i>Sebastes diploproa</i>								1			23								1				25

San Diego to Santa Barbara - Outer Shelf Fish Abundance

	171.3 32.585740 B23-12247	215.8 32.749516 B23-12248	191.7 32.873447 B23-12249	130 33.188127 B23-12250	188.7 33.221016 B23-12251	169.8 33.557553 B23-12255	140.9 33.568723 B23-12256	174.4 33.830806 B23-12679	148.9 33.853074 B23-12260	172 33.912233 B23-12261	191.7 33.997675 B23-12262	166.5 34.014344 B23-12263	133.9 34.053225 B23-12674	194.8 34.107170 B23-12267	129.3 34.122810 B23-12269	201.5 34.130935 B23-12270	173.2 34.132675 B23-12271	187.9 34.132900 B23-12272	177.7 34.225200 B23-12535	182.8 34.241824 B23-12534	138 34.247365 B23-12278	175.7 34.313824 B23-12283	Outer Shelf Sum
Station --->																							
Assigned Lat --->																							
Trawl Depth --->																							
<i>Zalembius rosaceus</i>				6				1	8	3		1			4	1		1				25	
<i>Citharichthys xanthostigma</i>				22							2											24	
<i>Bathyagonus pentacanthus</i>		16	2		3																1	1	23
<i>Argentina sialis</i>	12				1			1		1												1	16
<i>Merluccius productus</i>	1		1												1				8	1	4		16
<i>Sebastes macdonaldi</i>			2					1	4	2	3							1	3				16
<i>Hydrolagus colliei</i>						7												1		4			12
<i>Sebastes goodei</i>						1			2	2	5							1					11
<i>Sebastes chlorostictus</i>						4	2		3														9
<i>Chitonotus pugetensis</i>							8																8
<i>Xeneretmus triacanthus</i>						3									1		3	1					8
<i>Symphurus atricaudus</i>							5								2								7
<i>Plectobranthus evides</i>								2										1		2			5
<i>Scorpaena guttata</i>				3					2														5
<i>Sebastes eos</i>	2											1			1	1							5
<i>Sebastes helvomaculatus</i>	4		1																				5
<i>Beringraja rhina</i>			1					1									2						4
<i>Pleuronichthys verticalis</i>									2						1						1		4
<i>Sebastes rubrivinctus</i>				1					1			1			1								4
<i>Icelinus quadriseriatus</i>							1															2	3
<i>Sebastes hopkinsi</i>									3														3
<i>Sebastes miniatus</i>		3																					3
<i>Sebastes simulator</i>					1	2																	3
<i>Sebastes levis</i>				2																			2
<i>Careproctus melanurus</i>										1													1

	San Diego to Santa Barbara - Outer Shelf Fish Abundance																				Outer Shelf Sum			
Station -->	171.3 32.585740 <b>B23-12247</b>	215.8 32.749516 <b>B23-12248</b>	191.7 32.873447 <b>B23-12249</b>	130 33.188127 <b>B23-12250</b>	188.7 33.221016 <b>B23-12251</b>	169.8 33.557553 <b>B23-12255</b>	140.9 33.568723 <b>B23-12256</b>	174.4 33.830806 <b>B23-12679</b>	148.9 33.853074 <b>B23-12260</b>	172 33.912233 <b>B23-12261</b>	191.7 33.997675 <b>B23-12262</b>	166.5 34.014344 <b>B23-12263</b>	133.9 34.053225 <b>B23-12674</b>	194.8 34.107170 <b>B23-12267</b>	129.3 34.122810 <b>B23-12269</b>	201.5 34.130935 <b>B23-12270</b>	173.2 34.132675 <b>B23-12271</b>	187.9 34.132900 <b>B23-12272</b>	177.7 34.225200 <b>B23-12535</b>	182.8 34.241824 <b>B23-12534</b>	138 34.247365 <b>B23-12278</b>	175.7 34.313824 <b>B23-12283</b>		
Assigned Lat -->																								
Trawl Depth -->																								
<i>Eopsetta jordani</i>																					1		1	
<i>Porichthys myriaster</i>						1																		1
<i>Sebastes crameri</i>											1													1
<i>Squatina californica</i>																						1		1
<i>Xeneretmus ritteri</i>	1																							1

Appendix G-2. Outer Shelf fish biomass. Sum = Total for that species.

		San Diego to Santa Barbara – Outer Shelf Fish Biomass																				Outer Shelf Sum		
Stations -->	Assigned Lat ->	171.3	215.8	191.7	130.0	188.7	169.8	140.9	174.4	148.9	172.0	191.7	166.5	133.9	194.8	129.3	201.5	173.2	187.9	177.7	182.8		138.0	175.7
Trawl Depth -->		32.565740	32.749516	32.873447	33.188127	33.221016	33.557553	33.568723	33.830806	33.853074	33.912233	33.997675	34.014344	34.053225	34.107170	34.122810	34.130935	34.132675	34.132900	34.225200	34.241824	34.247365	34.313824	
<i>Argentina sialis</i>	8				0.00	4		4			0.00		4									0.00	4	0.064
<i>Bathyanonus pentacanthus</i>			0.2	0.00		0.01																0.01	0.00	0.234
<i>Beringraja rhina</i>				0.3					0.6									7.1						8
<i>Careproctus melanurus</i>											0.00		4											0.004
<i>Chilara taylori</i>		0.01	0.00			0.02		0.00	0.1	0.00			0.2		0.00	0.00				0.1	0.33		0.06	0.862
<i>Chitonotus pugetensis</i>								0.03			2													0.032
<i>Citharichthys fragilis</i>	1.2		0.2		0.00			8																1.408
<i>Citharichthys sordidus</i>	5.2	0.4	12.6	12.8	2	6.3	19.4	5.8	6.5	0.1	6.25	1.3	7	1.7	1.7	2.1	7	2.1	3.55	0.05	3.2	0.06		107.1
<i>Citharichthys xanthostigma</i>				2							0.00			8										2.008
<i>Eopsetta jordani</i>																						1.35		1.35
<i>Glyptocephalus zachirus</i>	0.8	0.00	0.1	0.00		0.1					0.1							0.1	0.18	0.01	0.04			1.438
<i>Hippoglossina stomata</i>	0.2	0.4	0.5	0.00	0.00	0.3	0.4		0.4		0.3	0.00			0.6		0.5							3.616
<i>Hydrolagus colliei</i>						0.02												0.2			0.08			0.308
<i>Icelinus quadriseriatus</i>							0.00																0.00	0.012
<i>Lycodes pacificus</i>		0.02	0.00	0.1	0.02	0.01	0.2	0.00	0.00				0.1		0.1			0.1		0.22	0.06		0.3	1.248
<i>Lycinema barbatum</i>								0.1		0.00	0.01							0.00	0.11	0.16		0.04		0.434
<i>Lyopsetta exilis</i>	0.7	3.1	1.5	1.3	3	0.01	0.3	1.6	0.4	0.9	1.5	0.3	0.7		0.1	0.00	0.3	0.2	3.5	2.7	0.3	1.1		23.52
<i>Merluccius productus</i>	0.2		0.1												0.2				0.27	0.00	0.53			1.304
<i>Microstomus pacificus</i>	1.5	0.7	3.3	5	2	0.6	0.9	1.1	1.8	0.2	1.7	2.9	2.9	0.7	3.2	2.2	4.2	2.3	3.5	2.6	2.6	5.75		51.65

San Diego to Santa Barbara – Outer Shelf Fish Biomass																						Outer Shelf Sum
Stations -->	171.3 B23-12247	215.8 B23-12248	191.7 B23-12249	130.0 B23-12250	188.7 B23-12251	169.8 B23-12255	140.9 B23-12256	174.4 B23-12679	148.9 B23-12260	172.0 B23-12261	191.7 B23-12262	166.5 B23-12263	133.9 B23-12674	194.8 B23-12267	129.3 B23-12269	201.5 B23-12270	173.2 B23-12271	187.9 B23-12272	177.7 B23-12535	182.8 B23-12534	138.0 B23-12278	
Assigned Lat ->																						
Trawl Depth -->																						
<i>Parophrys vetulus</i>	0.4		0.2	2.8	1.6		0.4	0.5	0.6		0.5		0.8	0.3	1.4	0.2	0.9	0.4	3		4	18
<i>Plectobranchnus evides</i>								0.008									0.004		0.008			0.02
<i>Pleuronichthys verticalis</i>									0.3						0.1						0.03	0.43
<i>Porichthys myriaster</i>							0.004															0.004
<i>Porichthys notatus</i>				0.6															0.14			0.74
<i>Scorpaena guttata</i>				0.9					0.6													1.5
<i>Sebastes chlorostictus</i>						0.1	0.008		0.2													0.308
<i>Sebastes crameri</i>											0.2											0.2
<i>Sebastes diploproa</i>								0.004			0.1								0.09			0.194
<i>Sebastes elongatus</i>		0.2		0.012		0.5	0.012		2.4	1.1		0.7			0.008			0.3				5.232
<i>Sebastes ensifer</i>						0.3																0.3
<i>Sebastes eos</i>	0.2											0.004			0.004	0.004						0.212
<i>Sebastes goodei</i>						0.004			0.3	0.2	0.5							0.004				1.008
<i>Sebastes helvomaculatus</i>	0.1		0.004																			0.104
<i>Sebastes hopkinsi</i>									0.2													0.2
<i>Sebastes levis</i>				0.008																		0.008
<i>Sebastes macdonaldi</i>			0.008					0.004	1.3	0.2	0.012							0.004	0.05			1.578
<i>Sebastes miniatus</i>		0.012																				0.012
<i>Sebastes rosaceus</i>						0.004			2.2													2.204
<i>Sebastes rosenblatti</i>	0.004	0.004	0.008	0.1	0.008				0.9	0.4		0.3					0.004	0.008	0.01	0.03	0.1	1.876



**Appendix G-3. Outer shelf invertebrate abundance. Sum = Total for that species.**

	San Diego to Santa Barbara – Outer Shelf Invertebrate Abundance																				Outer Shelf Sum			
	B23-12247	B23-12248	B23-12249	B23-12250	B23-12251	B23-12255	B23-12256	B23-12679	B23-12260	B23-12261	B23-12262	B23-12263	B23-12674	B23-12267	B23-12269	B23-12270	B23-12271	B23-12272	B23-12535	B23-12534		B23-12278	B23-12283	
Station --->																								
Assigned Lat --->	32.585740	32.749516	32.873447	33.188127	33.221016	33.557553	33.568723	33.830806	33.853074	33.912233	33.997675	34.014344	34.053225	34.107170	34.122810	34.130935	34.132675	34.132900	34.225200	34.241824	34.247365	34.313824		
Trawl Depth --->	171.3	215.8	191.7	130	188.7	169.8	140.9	174.4	148.9	172	191.7	166.5	133.9	194.8	129.3	201.5	173.2	187.9	177.7	182.8	138	175.7		
<i>Strongylocentrotus fragilis</i>	1815	843	588		3	1479	81	2		9	892	10	1	59	2	124	4	9	1	48			5970	
<i>Lytechinus pictus</i>				1978	2		2	2	83			7	11		137							8		2230
<i>Sicyonia ingentis</i>	19		100	94	954		3				2		2	2	68		37						23	1304
<i>Stylatula</i> sp																			702					702
<i>Neocrangon</i> sp																							512	512
<i>Astropecten ornatissimus</i>	217	2		2						2	4	1		164		6	24	16						438
<i>Brisaster townsendi</i>					3																		399	402
<i>Acanthoptilum</i> sp														7	60	39	78	135			1	11	2	333
<i>Ophiura luetkenii</i>									1	3		3	2	2		2	5	3	177	86	15	12		311
<i>Nymphon pixellae</i>										167														167
<i>Brissopsis pacifica</i>		1			16							1					1					1	108	128
<i>Gorgonocephalus eucnemis</i>	19					71			15	6		1		1	3		7		2					125
<i>Luidia foliolata</i>		11		3	12	10		5		7	1	11	2	1	7						14	17	2	103
<i>Neocrangon zacaе</i>	1				48			1			6					1	6		25	5	2	4		99
<i>Spatangus californicus</i>								1		2		35			1		1				32		9	81
<i>Spirontocaris holmesi</i>																					2		62	64
<i>Echidnocerus foraminatus</i>									1	7									55					63
<i>Octopus rubescens</i>	1	2	1	6	6	4	3		2	1		1		1	1	1	5		7	1	1	9		53
<i>Pleurobranchaea californica</i>	2		1	3	2	1	3	3	1	4	1	2	1	4	4		1	1	9	1	1	7		52
<i>Brisaster</i> sp					13					20	4	6					4	4						51
<i>Rossia pacifica</i>		3			3			10		6		7			2	3	1		1	4	1	8		49
<i>Pandalus platyceros</i>											23					3		12					4	42

San Diego to Santa Barbara – Outer Shelf Invertebrate Abundance

Station ---->	B23-12247	B23-12248	B23-12249	B23-12250	B23-12251	B23-12255	B23-12256	B23-12269	B23-12260	B23-12261	B23-12262	B23-12263	B23-12674	B23-12267	B23-12269	B23-12270	B23-12271	B23-12272	B23-12535	B23-12534	B23-12278	B23-12283	Outer Shelf Sum	
Assigned Lat ---->	32.585740	32.749516	32.873447	33.188127	33.221016	33.557553	33.568723	33.830806	33.853074	33.912233	33.997675	34.014344	34.053225	34.107170	34.122810	34.130935	34.132675	34.132900	34.225200	34.241824	34.247365	34.313824		
Trawl Depth ---->	171.3	215.8	191.7	130	188.7	169.8	140.9	174.4	148.9	172	191.7	166.5	133.9	194.8	129.3	201.5	173.2	187.9	177.7	182.8	138	175.7		
<i>Thesea</i> sp B								1	1						3	3	20	1					29	
<i>Astropecten californicus</i>	4			1	2	1	3						1	8		1	1	2						24
<i>Stylasterias forreri</i>		1							9	2		11						1						24
<i>Neocrangon resima</i>					12						1					2	1					2		18
<i>Brisaster latifrons</i>					5			8												2	1			16
<i>Acanthodoris brunnea</i>								3		2				1	1		2	3						12
<i>Luidia asthenosoma</i>										1		1						2		3	1			8
<i>Sclerasterias heteropaes</i>						4				2		2												8
<i>Apostichopus californicus</i>						3			1				1		2									7
<i>Ophiopholis bakeri</i>									5	2														7
<i>Doryteuthis opalescens</i>						4													2					6
<i>Florometra serratissima</i>				3					1	2														6
<i>Metacrangon spinosissima</i>																		1				5		6
<i>Ophiacantha diplasia</i>								5				1												6
<i>Philinorbis albus</i>						6																		6
<i>Aphrodita refulgida</i>	1	3																						4
<i>Hamatoscalpellum californicum</i>										4														4
<i>Metridium farcimen</i>		1		2						1														4
<i>Platymera gaudichaudii</i>		1				1											1							3
<i>Simnia vidleri</i>														1	1		1							3
<i>Aphrodita castanea</i>										1												1		2
<i>Brissopsis</i> sp																				2				2
<i>Ericerodes hemphilli</i>										2														2
<i>Henricia</i> sp										1							1							2

San Diego to Santa Barbara – Outer Shelf Invertebrate Abundance

Station --->	B23-12247	B23-12248	B23-12249	B23-12250	B23-12251	B23-12255	B23-12256	B23-12679	B23-12260	B23-12261	B23-12262	B23-12263	B23-12674	B23-12267	B23-12269	B23-12270	B23-12271	B23-12272	B23-12535	B23-12534	B23-12278	B23-12283	Outer Shelf Sum	
Assigned Lat --->	32.585740	32.749516	32.873447	33.188127	33.221016	33.557553	33.568723	33.830806	33.853074	33.912233	33.997675	34.014344	34.053225	34.107170	34.122810	34.130935	34.132675	34.132900	34.225200	34.241824	34.247365	34.313824		
Trawl Depth --->	171.3	215.8	191.7	130	188.7	169.8	140.9	174.4	148.9	172	191.7	166.5	133.9	194.8	129.3	201.5	173.2	187.9	177.7	182.8	138	175.7		
<i>Hippasteria phrygiana</i>	1								1														2	
<i>Philine auriformis</i>								1							1									2
<i>Simnia</i> sp																			1		1			2
<i>Tritonia exsulans</i>																	1			1				2
<i>Armina californica</i>																						1		1
<i>Brissopsis</i> sp LA1					1																			1
<i>Calinaticina oldroydii</i>												1												1
<i>Grimothea planipes</i>																						1		1
<i>Lamellaria diegoensis</i>										1														1
<i>Luidia armata</i>																		1						1
<i>Metacarcinus anthonyi</i>				1																				1
<i>Octopus californicus</i>								1																1
<i>Octopus veligero</i>							1																	1
<i>Odontaster crassus</i>									1															1
<i>Ophionereis eurybrachioplax</i>										1														1
<i>Ophiura</i> sp																					1			1
<i>Parapagurodes laurentae</i>										1														1
<i>Pteraster tessellatus</i>									1															1
<i>Ptilosarcus gurneyi</i>															1									1
<i>Rathbunaster californicus</i>															1									1
<i>Tochuina gigantea</i>																					1			1
<i>Tritia insculpta</i>											1													1
Virgulariidae																					1			1

Appendix G-4. Outer shelf invertebrate biomass. Sum = Total for that species.

San Diego to Santa Barbara – Outer Shelf Invertebrate Biomass																								
Stations --->	B23-12247	B23-12248	B23-12249	B23-12250	B23-12251	B23-12255	B23-12256	B23-12679	B23-12260	B23-12261	B23-12262	B23-12263	B23-12674	B23-12267	B23-12269	B23-12270	B23-12271	B23-12272	B23-12535	B23-12534	B23-12278	B23-12283	Outer Shelf Sum	
Assigned Lat --->	32.585740	32.749516	32.873447	33.188127	33.221016	33.557553	33.568723	33.830806	33.853074	33.912233	33.997675	34.014344	34.053225	34.107170	34.122810	34.130935	34.132675	34.132900	34.225200	34.241824	34.247365	34.313824		
Trawl Depth --->	171.3	215.8	191.7	130.0	188.7	169.8	140.9	174.4	148.9	172.0	191.7	166.5	133.9	194.8	129.3	201.5	173.2	187.9	177.7	182.8	138.0	175.7		
<i>Acanthodoris brunnea</i>								0.006		0.004				0.002	0.002		0.004	0.006						0.024
<i>Acanthoptilum</i> sp														0.014	0.12	0.078	0.156	0.27		0.003	0.02	0.003		0.664
<i>Aphrodita castanea</i>										0.002														0.005
<i>Aphrodita refulgida</i>	0.002	0.006																						0.008
<i>Apostichopus californicus</i>						0.4			0.002				0.7		0.5									1.602
<i>Armina californica</i>																						0.003		0.003
<i>Astropecten californicus</i>	0.008			0.002	0.004	0.002	0.006						0.002	0.016		0.002	0.002	0.004						0.048
<i>Astropecten ornatissimus</i>	0.3	0.004		0.004						0.004	0.008	0.002		1.2		0.012	0.3	0.2						2.034
<i>Brisaster latifrons</i>					0.01			0.016												0.003	0.01			0.039
<i>Brisaster</i> sp					0.1					0.04	0.008	0.012					0.008	0.008						0.176
<i>Brisaster townsendi</i>					0.006																	4.15		4.156
<i>Brissopsis pacifica</i>		0.002			0.2							0.002					0.002				0.02	1.7		1.926
<i>Brissopsis</i> sp																				0.02				0.020
<i>Brissopsis</i> sp LA1					0.002																			0.002
<i>Calinaticina oldroydii</i>												0.2												0.200
<i>Echidnocerus foraminatus</i>									1	2.8									25.5					29.300
<i>Ericerodes hemphillii</i>										0.004														0.004
<i>Florometra serratissima</i>				0.006					0.002	0.004														0.012
<i>Gorgonocephalus eucnemis</i>	2.5					14.4			2.6	1.5		0.2		0.3	0.5		0.4		0.73					23.130
<i>Grimothea planipes</i>																						0.02		0.020
<i>Hamatoscalpellum californicum</i>										0.008														0.008
<i>Henricia</i> sp										0.002							0.002							0.004
<i>Hippasteria phrygiana</i>	0.7								0.002															0.702
<i>Lamellaria diegoensis</i>										0.002														0.002
<i>Luidia armata</i>																		0.002						0.002
<i>Luidia asthenosoma</i>										0.002		0.002						0.004		0.003	0.006			0.017
<i>Luidia foliolata</i>		0.4		0.2	0.8	1		0.3		0.014	0.002	0.022	0.004	0.002	0.3					0.003	0.01	0.003		3.060
<i>Lytechinus pictus</i>				1	0.004		0.004	0.004	0.166			0.014	0.022		0.4						0.006			1.620
<i>Metacarcinus anthonyi</i>				0.3																				0.300
<i>Metacrangon spinosissima</i>																		0.002				0.003		0.005
<i>Metridium farcimen</i>		0.002			0.6					3.2														3.802
<i>Neocrangon resima</i>					0.024						0.002					0.004	0.002					0.003		0.035

San Diego to Santa Barbara – Outer Shelf Invertebrate Biomass

Stations -->	B23-12247	B23-12248	B23-12249	B23-12250	B23-12251	B23-12255	B23-12256	B23-12679	B23-12260	B23-12261	B23-12262	B23-12263	B23-12674	B23-12267	B23-12269	B23-12270	B23-12271	B23-12272	B23-12535	B23-12534	B23-12278	B23-12283	Outer Shelf Sum
Assigned Lat -->	32.585740	32.749516	32.873447	33.188127	33.221016	33.557553	33.568723	33.830806	33.853074	33.912233	33.997675	34.014344	34.053225	34.107170	34.122810	34.130935	34.132675	34.132900	34.225200	34.241824	34.247365	34.313824	
Trawl Depth -->	171.3	215.8	191.7	130.0	188.7	169.8	140.9	174.4	148.9	172.0	191.7	166.5	133.9	194.8	129.3	201.5	173.2	187.9	177.7	182.8	138.0	175.7	
<i>Neocrangon</i> sp																							0.39
<i>Neocrangon zaca</i>	0.002				0.096			0.002			0.012					0.002	0.012		0.05	0.003	0.006	0.003	0.188
<i>Nymphon pixellae</i>										0.334													0.334
<i>Octopus californicus</i>								0.2															0.200
<i>Octopus rubescens</i>	0.002	0.004	0.002	0.3	0.1	0.008	0.006		0.004	0.002		0.002		0.002	0.002	0.1	0.1		0.08	0.1	0.006	0.1	0.920
<i>Octopus veligero</i>							0.002																0.002
<i>Odontaster crassus</i>									0.002														0.002
<i>Ophiacantha diplasia</i>									0.01			0.002											0.012
<i>Ophionereis eurybrachioplax</i>										0.002													0.002
<i>Ophiopholis bakeri</i>									0.01	0.004													0.014
<i>Ophiura luetkenii</i>									0.002	0.006		0.006	0.004	0.004		0.004	0.01	0.006	0.09	0.02	0.006	0.02	0.178
<i>Ophiura</i> sp																				0.003			0.003
<i>Pandalus platyceros</i>											1.3					0.1		0.7				0.08	2.180
<i>Parapagurodes laurentae</i>										0.002													0.002
<i>Philine auriformis</i>								0.002							0.002								0.004
<i>Phillinorbis albus</i>						0.012																	0.012
<i>Platymera gaudichaudii</i>		0.3				0.2											0.3						0.800
<i>Pleurobranchaea californica</i>	0.004		0.3	0.006	0.2	0.002	0.5	0.7	0.002	0.3	0.1	0.2	0.3	0.7	0.9		0.2	0.002	2	0.43	0.13	0.4	7.376
<i>Pteraster tessellatus</i>									0.3														0.300
<i>Ptilosarcus gurneyi</i>															0.1								0.100
<i>Rathbunaster californicus</i>															0.002								0.002
<i>Rossia pacifica</i>		0.006			0.006			0.02		0.012		0.1			0.004	0.1	0.002		0.02	0.03	0.006	0.11	0.416
<i>Sclerasterias heteropaes</i>						0.6				0.004		0.004											0.608
<i>Sicyonia ingentis</i>	0.3		1.9	0.6	1		0.006				0.004		0.004	0.004	0.8		0.8					0.69	6.108
<i>Simnia</i> sp																			0.002		0.006		0.008
<i>Simnia vidleri</i>														0.002	0.002		0.002						0.006
<i>Spatangus californicus</i>								0.002		0.004		0.7			0.002		0.002				0.12	0.8	1.630
<i>Spirontocaris holmesi</i>																				0.003		0.03	0.033
<i>Strongylocentrotus fragilis</i>	1	1	1		0.006	24.7	5.7	0.004		0.018	52.6	0.6	0.002	7.75	0.004	6.8	0.008	0.2	0.002	1.5			102.894
<i>Stylasterias forreri</i>		0.002							1	0.2		1.6						0.1					2.902
<i>Stylatula</i> sp																			0.6				0.600
<i>Thesea</i> sp B								0.002	0.002						0.006	0.006	0.04	0.002					0.058
<i>Tochuina gigantea</i>																					0.1		0.100
<i>Tritia insculpta</i>											0.002												0.002

San Diego to Santa Barbara – Outer Shelf Invertebrate Biomass

	171.3	215.8	191.7	130.0	188.7	169.8	140.9	174.4	148.9	172.0	191.7	166.5	133.9	194.8	129.3	201.5	173.2	187.9	177.7	182.8	138.0	175.7		
Stations -->	<b>B23-12247</b>	<b>B23-12248</b>	<b>B23-12249</b>	<b>B23-12250</b>	<b>B23-12251</b>	<b>B23-12255</b>	<b>B23-12256</b>	<b>B23-12679</b>	<b>B23-12260</b>	<b>B23-12261</b>	<b>B23-12262</b>	<b>B23-12263</b>	<b>B23-12674</b>	<b>B23-12267</b>	<b>B23-12269</b>	<b>B23-12270</b>	<b>B23-12271</b>	<b>B23-12272</b>	<b>B23-12535</b>	<b>B23-12534</b>	<b>B23-12278</b>	<b>B23-12283</b>		
Assigned Lat -->	32.585740	32.749516	32.873447	33.188127	33.221016	33.557553	33.568723	33.830806	33.853074	33.912233	33.997675	34.014344	34.053225	34.107170	34.122810	34.130935	34.132675	34.132900	34.225200	34.241824	34.247365	34.313824		<b>Outer Shelf Sum</b>
Trawl Depth -->	171.3	215.8	191.7	130.0	188.7	169.8	140.9	174.4	148.9	172.0	191.7	166.5	133.9	194.8	129.3	201.5	173.2	187.9	177.7	182.8	138.0	175.7		
<i>Tritonia exsulans</i>																	0.002			0.003				0.005
Virgulariidae																				0.003				0.003

# APPENDIX G - UPPER SLOPE STRATUM

## Appendix G-5. Upper slope fish abundance.

San Diego to Santa Barbara - Upper Slope Fish Abundance												
Stations --->	B23-12630	B23-12285	B23-12632	B23-12631	B23-12288	B23-12289	B23-12296	B23-12685	B23-12298	B23-12264	B23-12301	Upper Slope Sum
Assigned Lat --->	32.64826879	32.6929	32.73991552	32.80531983	33.09383	33.20975129	33.556099	33.66413116	33.6942	34.04413	34.11612372	
Trawl Depth --->	228.5	360.7	357.2	228	405.4	465.4	231.9	328	293.1	226.7	237.3	
<i>Lyopsetta exilis</i>	160	60	54	49	17	10	260	20	75	154	141	1000
<i>Sebastes saxicola</i>	50			178			136			7	1	372
<i>Citharichthys sordidus</i>				16			290		1	11	1	319
<i>Sebastes diploproa</i>			1					1	2	243	3	250
<i>Microstomus pacificus</i>	1	2		14	1	98	14	13	18	10	16	187
<i>Zaniolepis frenata</i>	4			39			59			8		110
<i>Physiculus rastrelliger</i>		10	25		5		2	7	6	13		68
<i>Xeneretmus latifrons</i>	11							8	22	4	15	60
<i>Bathyagonus pentacanthus</i>	1	15	21	10	1							48
<i>Lycinema barbatum</i>		2	27	1			1		5	1	8	45
<i>Lycodes pacificus</i>							8			12	6	26
<i>Sebastolobus alascanus</i>		1			11	9		3	1			25
<i>Glyptocephalus zachirus</i>	1	4				8	2		4	2	1	22
<i>Nezumia stelgidolepis</i>						21		1				22
<i>Facciolella equatorialis</i>		12			1			2	3	2		20
<i>Merluccius productus</i>			2		2	1	1	2	2	6	2	18
<i>Sebastes sp</i>				14								14
<i>Sebastes rosenblatti</i>	2			10								12
<i>Beringraja rhina</i>	1	2		1	1	2				1		8
<i>Lycodes cortezianus</i>		2				3			2			7
<i>Odontopyxis trispinosa</i>							7					7
<i>Sebastes semicinctus</i>										7		7
<i>Eptatretus stoutii</i>		5	1									6
<i>Triphoturus mexicanus</i>					5							5
<i>Argyropelecus lychnus</i>			1		1	1						3
<i>Parophrys vetulus</i>							1		1		1	3
<i>Plectobranchus evides</i>	2						1					3
<i>Sebastes eos</i>										3		3
<i>Xeneretmus ritteri</i>		3										3

San Diego to Santa Barbara - Upper Slope Fish Abundance												
Stations --->	B23-12630	B23-12285	B23-12632	B23-12631	B23-12288	B23-12289	B23-12296	B23-12685	B23-12298	B23-12264	B23-12301	Upper Slope Sum
Assigned Lat --->	32.64826879	32.6929	32.73991552	32.80531983	33.09383	33.20975129	33.556099	33.66413116	33.6942	34.04413	34.11612372	
Trawl Depth --->	228.5	360.7	357.2	228	405.4	465.4	231.9	328	293.1	226.7	237.3	
<i>Cataetyx rubrirostris</i>						1		1				2
<i>Peprius simillimus</i>									2			2
<i>Sebastes helvomaculatus</i>	1						1					2
<i>Sebastes jordani</i>	1			1								2
<i>Argyropelecus affinis</i>		1										1
<i>Cephaloscyllium ventriosum</i>					1							1
<i>Chilara taylori</i>				1								1
<i>Cyclothone pseudopallida</i>						1						1
<i>Hippoglossina stomata</i>				1								1
<i>Hydrolagus colliei</i>									1			1
<i>Icichthys lockingtoni</i>									1			1
<i>Lycodes diapterus</i>					1							1
<i>Parmaturus xaniurus</i>										1		1
<i>Sebastes aurora</i>		1										1
<i>Sebastes elongatus</i>				1								1
<i>Torpedo californica</i>								1				1

Appendix G-6. Upper slope fish biomass.

San Diego to Santa Barbara - Upper Slope Fish Biomass												
Stations --->	228.5 32.648269 B23-12630	360.7 32.692900 B23-12285	357.2 32.739916 B23-12632	228.0 32.805320 B23-12631	405.4 33.093830 B23-12288	465.4 33.209751 B23-12289	231.9 33.556099 B23-12296	328.0 33.664131 B23-12685	293.1 33.694200 B23-12298	226.7 34.044130 B23-12264	237.3 34.116124 B23-12301	Upper Slope Sum
Assigned Lat --->												
Trawl Depth --->												
<i>Argyrolepecus affinis</i>		0.004										0.004
<i>Argyrolepecus lychnus</i>			0.004		0.004	0.004						0.012
<i>BathYGONUS pentacanthus</i>	0.1	0.1	0.1	0.04	0.004							0.344
<i>Beringraja rhina</i>	0.6	0.3		0.2	2	1				0.2		4.3
<i>Cataetyx rubrirostris</i>						0.004		0.004				0.008
<i>Cephaloscyllium ventriosum</i>					0.1							0.1
<i>Chilara taylori</i>				0.004								0.004
<i>Citharichthys sordidus</i>				0.064			3.4		0.004	0.044	0.004	3.516
<i>Cyclothone pseudopallida</i>						0.004						0.004
<i>Eptatretus stoutii</i>		0.1	0.004									0.104
<i>Facciolella equatorialis</i>		0.2			0.004			0.008	0.012	0.008		0.232
<i>Glyptocephalus zachirus</i>	0.2	0.5				0.6	0.2		0.5	0.008	0.004	2.012
<i>Hippoglossina stomata</i>				0.004								0.004
<i>Hydrolagus colliei</i>									0.3			0.3
<i>Icichthys lockingtoni</i>									0.004			0.004
<i>Lycodes cortezianus</i>		0.1				0.2			0.1			0.4
<i>Lycodes diapterus</i>					0.004							0.004
<i>Lycodes pacificus</i>							0.032			0.5	0.3	0.832
<i>Lycinema barbatum</i>		0.2	0.108	0.004			0.004		0.1	0.004	0.032	0.452
<i>Lyopsetta exilis</i>	1.3	1	0.7	0.8	0.2	0.2	3.6	0.6	2.2	2.5	2.9	16
<i>Merluccius productus</i>			0.2		0.6	0.1	0.4	0.2	0.2	0.5	0.2	2.4
<i>Microstomus pacificus</i>	0.1	0.008		0.2	0.004	8.5	0.3	1.7	1.5	0.5	1.3	14.112
<i>Nezumia stelgidolepis</i>						0.6		0.004				0.604
<i>Odontopyxis trispinosa</i>							0.2					0.2
<i>Parmaturus xaniurus</i>										0.004		0.004
<i>Parophrys vetulus</i>							0.3		0.3		0.2	0.8
<i>Peprilus simillimus</i>									0.008			0.008
<i>Physiculus rastrelliger</i>		0.2	0.5		0.1		0.008	0.2	0.1	0.1		1.208
<i>Plectobranchnus evides</i>	0.008						0.004					0.012
<i>Sebastes aurora</i>		0.004										0.004

San Diego to Santa Barbara – Upper Slope Fish Biomass												
Stations --->	228.5 32.648269B23-12630	360.7 32.692900B23-12285	357.2 32.739916B23-12632	228.0 32.805320B23-12631	405.4 33.093830B23-12288	465.4 33.209751B23-12289	231.9 33.556099B23-12296	328.0 33.664131B23-12685	293.1 33.694200B23-12298	226.7 34.044130B23-12264	237.3 34.116124B23-12301	Upper Slope Sum
Assigned Lat --->												
Trawl Depth --->												
<i>Sebastes diploproa</i>			0.004					0.004	0.008	6.25	0.012	6.278
<i>Sebastes elongatus</i>				0.004								0.004
<i>Sebastes eos</i>										0.012		0.012
<i>Sebastes helvomaculatus</i>	0.004						0.004					0.008
<i>Sebastes jordani</i>	0.004			0.004								0.008
<i>Sebastes rosenblatti</i>	0.2			0.04								0.24
<i>Sebastes saxicola</i>	2.3			7			3.7			0.3	0.004	13.304
<i>Sebastes semicinctus</i>										0.4		0.4
<i>Sebastes sp</i>				0.056								0.056
<i>Sebastolobus alascanus</i>		0.004			0.2	1.4		0.1	0.3			2.004
<i>Torpedo californica</i>								2.6				2.6
<i>Triphoturus mexicanus</i>					0.02							0.02
<i>Xeneretmus latifrons</i>	0.044							0.2	0.2	0.016	0.1	0.56
<i>Xeneretmus ritteri</i>		0.1										0.1
<i>Zaniolepis frenata</i>	0.1			0.9			0.8			0.2		2

**Appendix G-7. Upper slope invertebrate abundance.**

San Diego to Santa Barbara - Upper Slope Invertebrate Abundance												
Stations --->	B23-12630	B23-12285	B23-12632	B23-12631	B23-12288	B23-12289	B23-12296	B23-12685	B23-12298	B23-12264	B23-12301	Upper Slope Sum
Assigned Lat --->	32.64826879	32.6929	32.73991552	32.80531983	33.09383	33.20975129	33.556099	33.66413116	33.6942	34.04413	34.11612372	
Trawl Depth --->	228.5	360.7	357.2	228	405.4	465.4	231.9	328	293.1	226.7	237.3	
<i>Strongylocentrotus fragilis</i>	464	206	510	1177	19	7	918	3	481	247	6	4038
<i>Brissopsis pacifica</i>	6	126	237	1		1409				5	153	1937
<i>Brisaster townsendi</i>	7	1	1					123	39	993	286	1450
<i>Brissopsis</i> sp LA1					826							826
<i>Spirontocaris holmesi</i>				1				4	3	7	625	640
<i>Myxoderma platyacanthum</i>					51	307						358
<i>Neocrangon zaca</i>	21	43	52	13			3	19	18	34	151	354
<i>Brisaster</i> sp	1	7	10		29					248		295
<i>Brisaster latifrons</i>	3						1			248		252
<i>Sicyonia ingentis</i>	12						84		5	2		103
<i>Gorgonocephalus eucnemis</i>				64						1		65
<i>Pandalus platyceros</i>				39				2	4	18	1	64
<i>Antillamunida hispida</i>								14	35			49
<i>Neocrangon resima</i>	10	4	5	2				3	4	3	12	43
<i>Spirontocaris sica</i>	1	5	30									36
<i>Pleurobranchaea californica</i>		1	2	3	3	10		2		6	2	29
<i>Luidia foliolata</i>		1	8	1			9	1	2	6		28
<i>Octopus rubescens</i>	10		1	5			1	1		2	1	21
<i>Rossia pacifica</i>	2		1	13							3	19
<i>Ophiopholis bakeri</i>				9							4	13
<i>Stylasterias forreri</i>				12						1		13
<i>Spatangus californicus</i>			1				8				1	10
<i>Spirontocaris</i> sp								2	3	4		9
<i>Dromalia alexandri</i>			1	2		1	2	2				8
<i>Metridium farcimen</i>				4							1	5
<i>Pseudarchaster pusillus</i>		1			3	1						5
<i>Araiofusus eueides</i>					4							4
<i>Astropecten ornatissimus</i>			2	1								3
<i>Cancellaria crawfordiana</i>		1			2							3
<i>Echidnocerus foraminatus</i>				3								3
<i>Hamatoscalpellum californicum</i>										3		3
<i>Tritia insculpta</i>					2			1				3
<i>Coryrhynchus lobifrons</i>								2				2
<i>Luidia asthenosoma</i>		2										2
<i>Ophiura luetkenii</i>						1		1				2
<i>Philine auriformis</i>		2										2
<i>Antiplanes catalinae</i>	1											1
<i>Apostichopus californicus</i>											1	1
<i>Brissopsis</i> sp							1					1
<i>Calinaticina oldroydii</i>							1					1
<i>Crossaster borealis</i>						1						1
<i>Glyptolithodes cristatipes</i>						1						1
<i>Grimothea planipes</i>			1									1
<i>Grimothea quadrispina</i>		1										1
<i>Heptacarpus decorus</i>								1				1
<i>Heptacarpus tenuissimus</i>								1				1
<i>Megasurcula carpenteriana</i>	1											1

San Diego to Santa Barbara - Upper Slope Invertebrate Abundance

	<b>B23-12630</b>	<b>B23-12285</b>	<b>B23-12632</b>	<b>B23-12631</b>	<b>B23-12288</b>	<b>B23-12289</b>	<b>B23-12296</b>	<b>B23-12685</b>	<b>B23-12298</b>	<b>B23-12264</b>	<b>B23-12301</b>	<b>Upper Slope Sum</b>
Stations -->												
Assigned Lat -->	228.5 32.64826879	360.7 32.6929	357.2 32.73991552	228 32.80531983	405.4 33.09383	465.4 33.20975129	231.9 33.556099	328 33.66413116	293.1 33.6942	226.7 34.04413	237.3 34.11612372	
Trawl Depth -->												
<i>Myxilla incrustans</i>											1	1
<i>Schmittius politus</i>								1				1
<i>Synallactes virgulasolida</i>						1						1
<i>Thesea</i> sp B										1		1

**Appendix G-8. Upper slope invertebrate biomass.**

San Diego to Santa Barbara – Upper Slope Invertebrate Biomass											Upper Slope Sum	
Stations --->	228.5 32.648269 B23-12630	360.7 32.692900 B23-12285	357.2 32.739916 B23-12632	228.0 32.805320 B23-12631	405.4 33.093830 B23-12288	465.4 33.209751 B23-12289	231.9 33.556099 B23-12296	328.0 33.664131 B23-12685	293.1 33.694200 B23-12298	226.7 34.044130 B23-12264		237.3 34.116124 B23-12301
Assigned Lat --->												
Trawl Depth --->												
<i>Antillamunida hispida</i>								0.2	2.1			2.300
<i>Antiplanes catalinae</i>	0.002											0.002
<i>Apostichopus californicus</i>											0.4	0.400
<i>Araiofusus eueides</i>					0.008							0.008
<i>Astropecten ornatissimus</i>			0.004	0.002								0.006
<i>Brisaster latifrons</i>	0.1						0.002			2.28		2.382
<i>Brisaster sp</i>	0.002	0.014	0.02		0.4					2.28		2.716
<i>Brisaster townsendi</i>	0.2	0.002	0.002					1.8	0.9	9.14	5.9	17.944
<i>Brissopsis pacifica</i>	0.2	1	1.7	0.002		1				0.1	4.4	8.402
<i>Brissopsis sp</i>							0.002					0.002
<i>Brissopsis sp LA1</i>					1							1.000
<i>Calinaticina oldroydii</i>							0.2					0.200
<i>Cancellaria crawfordiana</i>		0.002			0.004							0.006
<i>Coryrhynchus lobifrons</i>								0.004				0.004
<i>Crossaster borealis</i>						0.002						0.002
<i>Dromalia alexandri</i>			0.002	0.2		0.002	0.004	0.1				0.308
<i>Echidnocerus foraminatus</i>				0.9								0.900
<i>Glyptolithodes cristatipes</i>						0.2						0.200
<i>Gorgonocephalus eucnemis</i>				6						0.002		6.002
<i>Grimothea planipes</i>			0.002									0.002
<i>Grimothea quadrispina</i>		0.002										0.002
<i>Hamatoscalpellum californicum</i>										0.006		0.006
<i>Heptacarpus decorus</i>								0.002				0.002
<i>Heptacarpus tenuissimus</i>								0.002				0.002
<i>Luidia asthenosoma</i>		0.004										0.004
<i>Luidia foliolata</i>		0.002	0.016	0.002			0.5	0.002	0.004	0.012		0.538
<i>Megasurcula carpenteriana</i>	0.002											0.002
<i>Metridium farcimen</i>				1.6							0.5	2.100
<i>Myxilla incrustans</i>											0.002	0.002
<i>Myxoderma platyacanthum</i>					1.1	4.2						5.300
<i>Neocrangon resima</i>	0.02	0.008	0.01	0.004				0.006	0.008	0.006	0.024	0.086
<i>Neocrangon zacaе</i>	0.042	0.086	0.104	0.026			0.006	0.038	0.036	0.068	0.2	0.606
<i>Octopus rubescens</i>	0.6		0.002	0.1			0.002	0.002		0.1	0.002	0.808
<i>Ophiopholis bakeri</i>				0.018								0.026
<i>Ophiura luetkenii</i>						0.002		0.002				0.004
<i>Pandalus platyceros</i>				1.3				0.2	0.4	0.9	0.002	2.802
<i>Philine auriformis</i>		0.004										0.004
<i>Pleurobranchaea californica</i>		0.002	0.004	0.3	0.2	0.02		0.004		0.6	0.8	1.930
<i>Pseudarchaster pusillus</i>		0.002			0.006	0.002						0.010
<i>Rossia pacifica</i>	0.004		0.002	0.026							0.006	0.038
<i>Schmittius politus</i>								0.002				0.002
<i>Sicyonia ingentis</i>	0.1						1.4		0.1	0.004		1.604
<i>Spatangus californicus</i>			0.002				1				0.002	1.004
<i>Spirontocaris holmesi</i>				0.002				0.008	0.006	0.014	0.5	0.530

San Diego to Santa Barbara – Upper Slope Invertebrate Biomass												
Stations --->	228.5 32.648269 B23-12630	360.7 32.692900 B23-12285	357.2 32.739916 B23-12632	228.0 32.805320 B23-12631	405.4 33.093830 B23-12288	465.4 33.209751 B23-12289	231.9 33.556099 B23-12296	328.0 33.664131 B23-12685	293.1 33.694200 B23-12298	226.7 34.044130 B23-12264	237.3 34.116124 B23-12301	Upper Slope Sum
Assigned Lat --->												
Trawl Depth --->												
<i>Spirontocaris sica</i>	0.002	0.01	0.06									0.072
<i>Spirontocaris</i> sp								0.004	0.006	0.008		0.018
<i>Strongylocentrotus fragilis</i>	1	1	1	1	0.6	0.014	30.4	0.2	21.1	18.6	1	75.914
<i>Stylasterias forreri</i>				2.9						0.002		2.902
<i>Synallactes virgulasolida</i>						0.002						0.002
<i>Thesea</i> sp B										0.002		0.002
<i>Tritia insculpta</i>					0.004			0.002				0.006

## APPENDIX H - SUPPLEMENTAL FISH RESPONSE INDEX ANALYSES

This section describes supplemental analyses comparing Fish Response Index (FRI) results to other metrics of benthic habitat condition, including the Benthic Response Index (BRI), and various sediment chemistry parameter and index values. Due to delays in acquiring benthic and chemistry data, these analyses are limited to results from Bight '94 - '18. Please see Section II. Methods under Fish Response Index for the calculation of the FRI. The FRI, BRI, and various sediment chemistry parameter and index values have all been reported previously ([SCCWRP.org Regional Monitoring Documents](https://www.sccwrp.org/Regional-Monitoring-Documents)). A total of 790 trawls from the Inner, Middle, and Outer Shelf strata were included in this assessment. Stations selected for this analysis had paired FRI and BRI values and ranged in depth from 7 to 216 m. FRI scores from embayment and slope strata are excluded because the index was not calibrated for these strata. Pearson's Correlation Coefficient were fit to FRI values by parameter using the following packages in R 4.4.0 (R Core Team 2024): ggplot2 (Wickham 2009), ggpubr (Kassambara 2026), plyr (Wickham 2011), reshape2 (Wickham 2007).

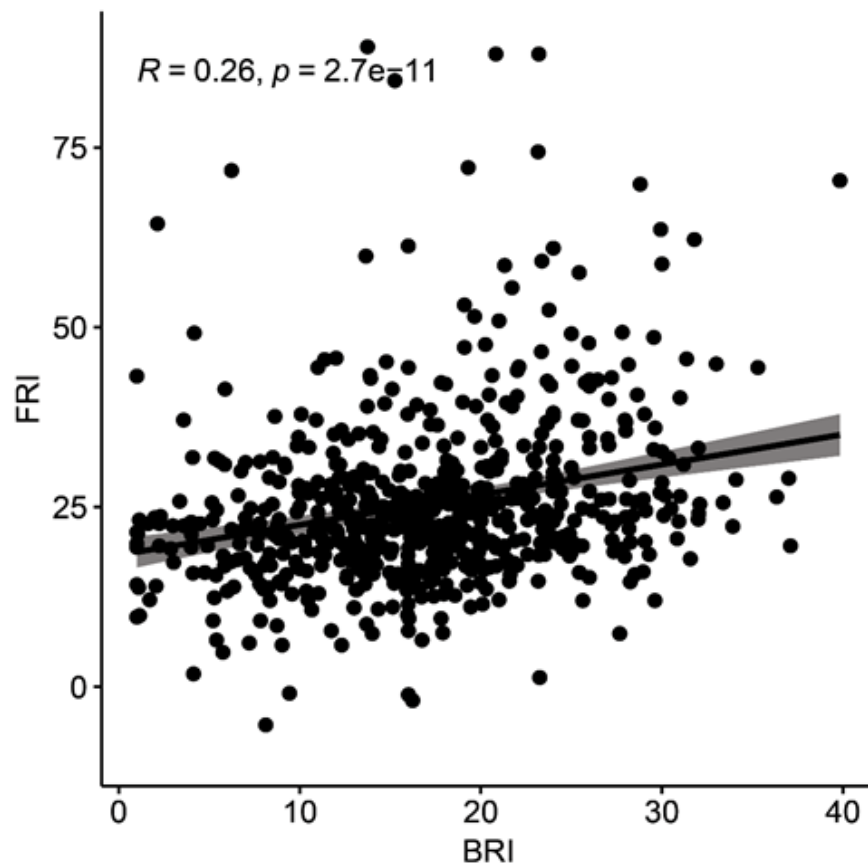
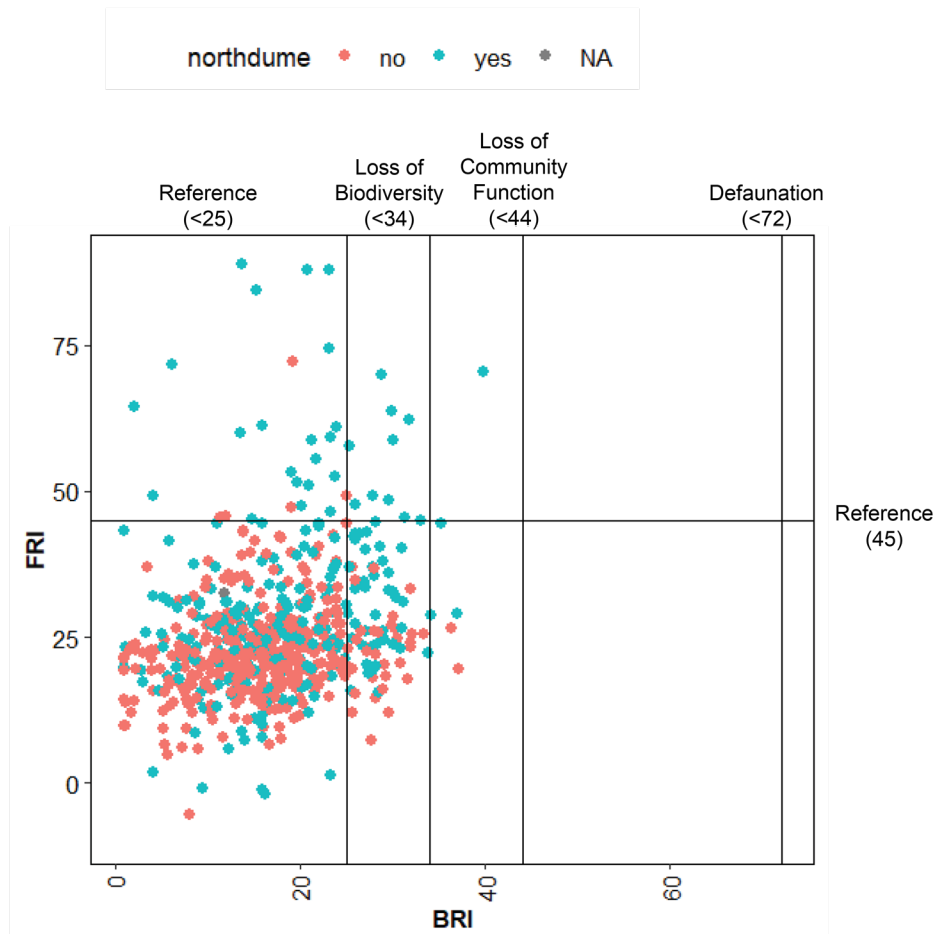


Figure H1. BRI values vs. FRI values for Bight data (n=790 trawls, 7-216 m, Bight '94 – Bight '18) collected on the coastal shelf from Point Conception south to the US/Mexico Border. Scatterplot fitted with simple linear regression, R = Pearson's Correlation Coefficient.



**Figure H2. BRI values vs. FRI values for Bight data (n=790 trawls, 7-216 m, Bight '94 – Bight '18) collected on the coastal shelf from Point Conception south to the US/Mexico Border. Northdume = stations sampled north of Point Dume ( $\geq$  latitude 34.000) identified as yes (i.e., located north of Point Dume) or no (i.e., located south of Point Dume). NA = latitude/longitude not available.**

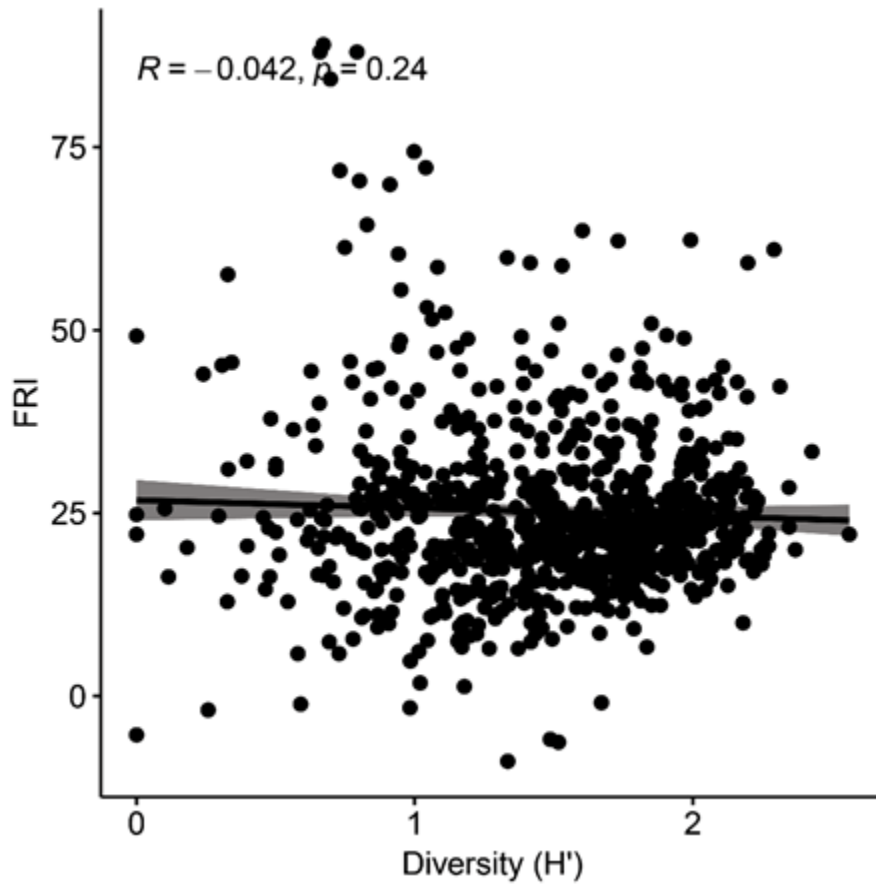
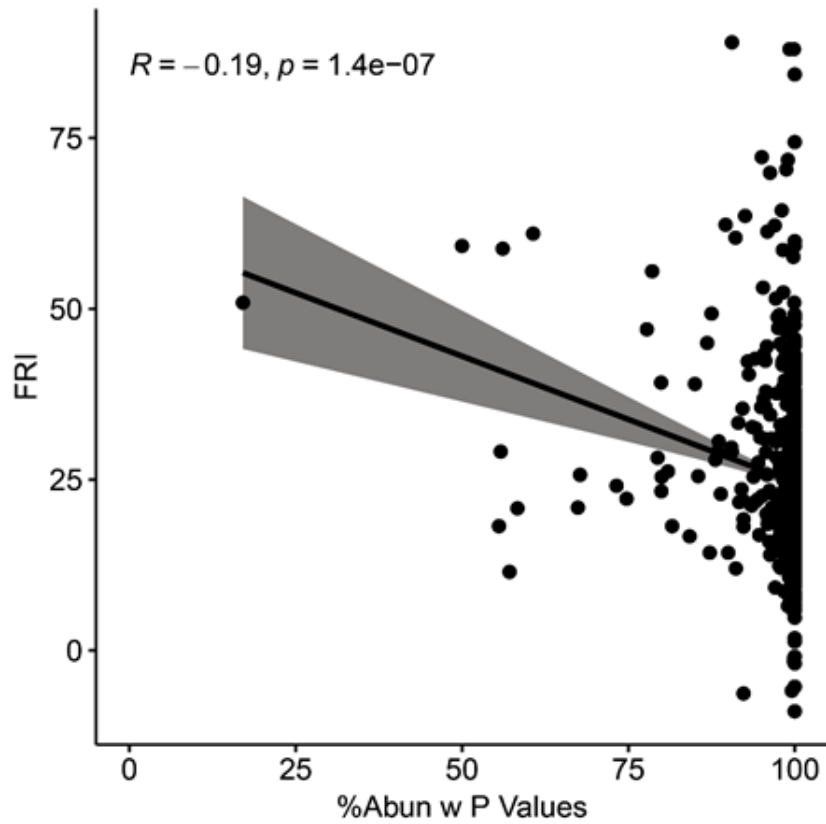
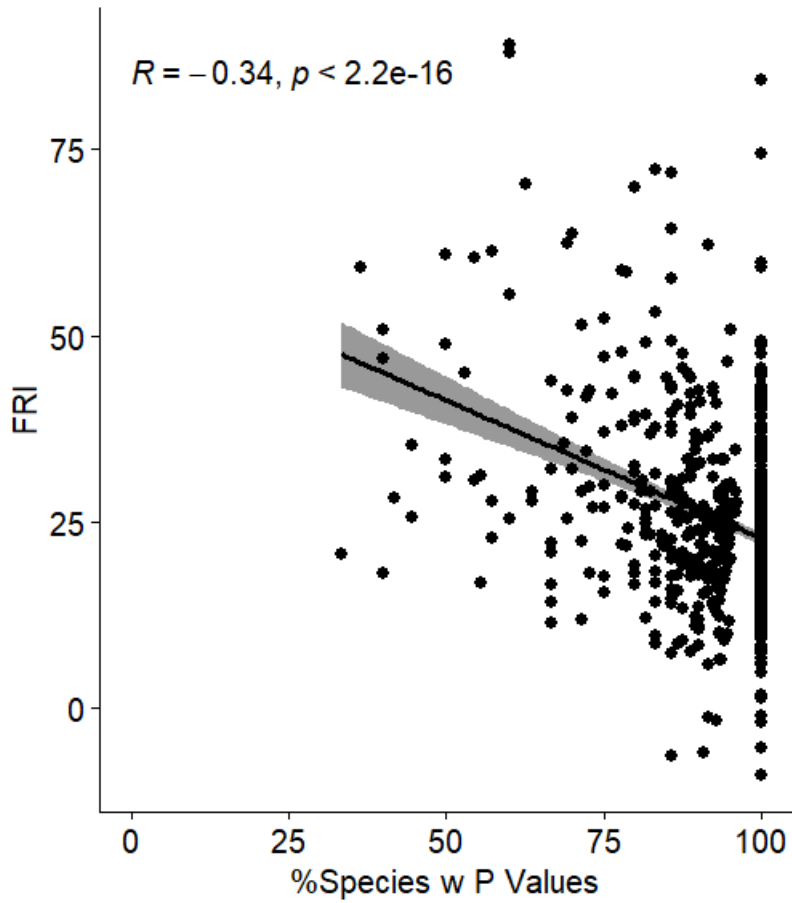


Figure H3. Shannon Diversity ( $H'$ ) values vs. FRI values for Bight data (n=790 trawls, 7-216 m, Bight '94 – Bight '18) collected on the coastal shelf from Point Conception south to the US/Mexico Border. Scatterplot fitted with simple linear regression, R = Pearson's Correlation Coefficient.



**Figure H4. Percent of abundance with associated P values vs. FRI values for Bight data (n=790 trawls, 7-216 m, Bight '94 – Bight '18) collected on the coastal shelf from Point Conception south to the US/Mexico Border. Scatterplot fitted with simple linear regression, R = Pearson's Correlation Coefficient.**



**Figure H5. Percent of species with associated P values vs. FRI values for Bight data (n=790 trawls, 7-216 m, Bight '94 – Bight '18) collected on the coastal shelf from Point Conception south to the US/Mexico Border. Scatterplot fitted with simple linear regression, R = Pearson's Correlation Coefficient.**

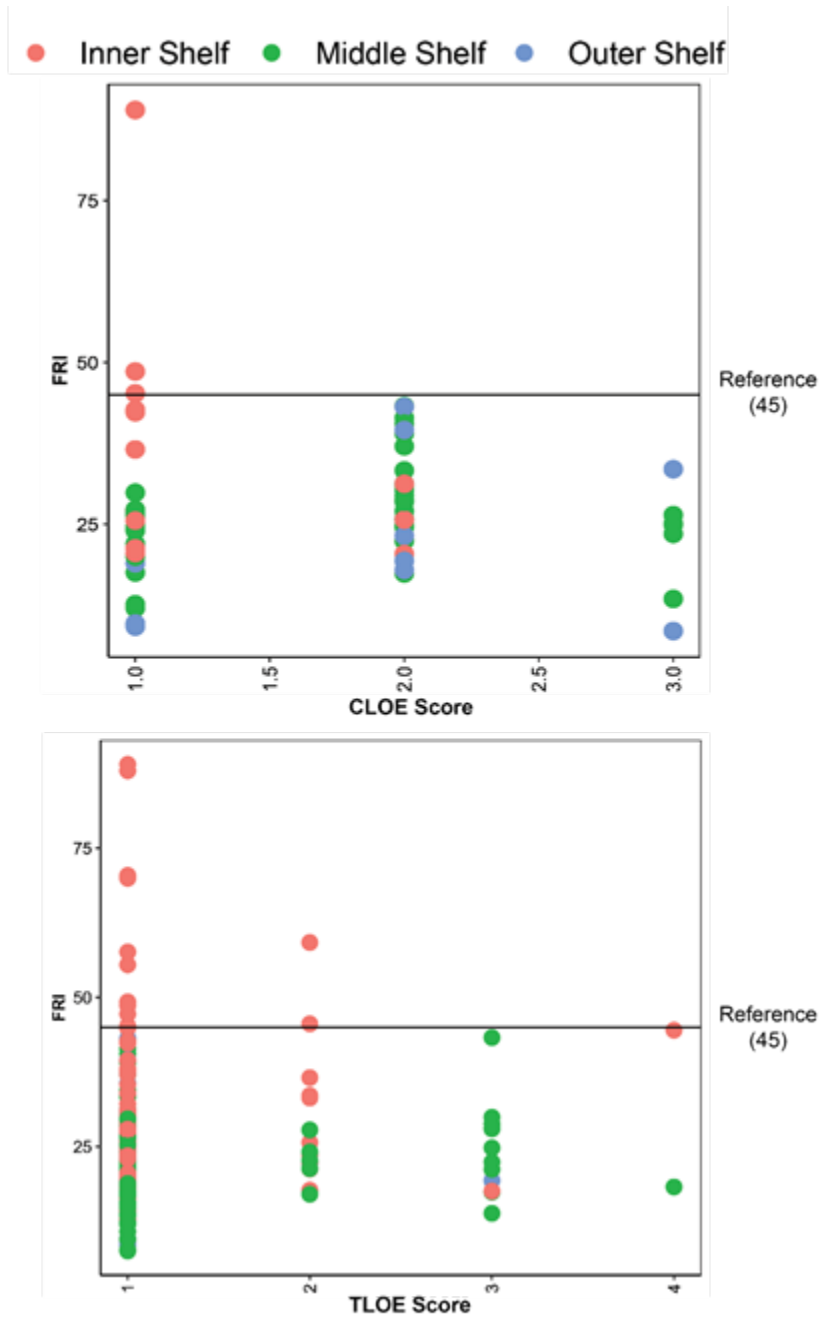


Figure H6. Chemistry Condition Scores (CLOE) and Toxicity Condition Scores vs. FRI values for Bight data (n=790 trawls, 7-216 m, Bight '94 – Bight '18) collected on the coastal shelf from Point Conception south to the US/Mexico Border.

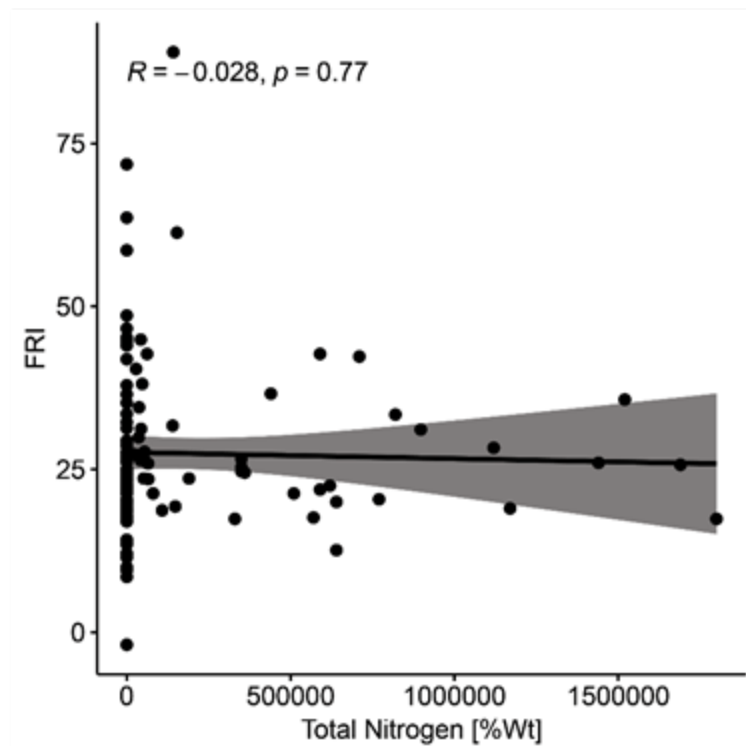
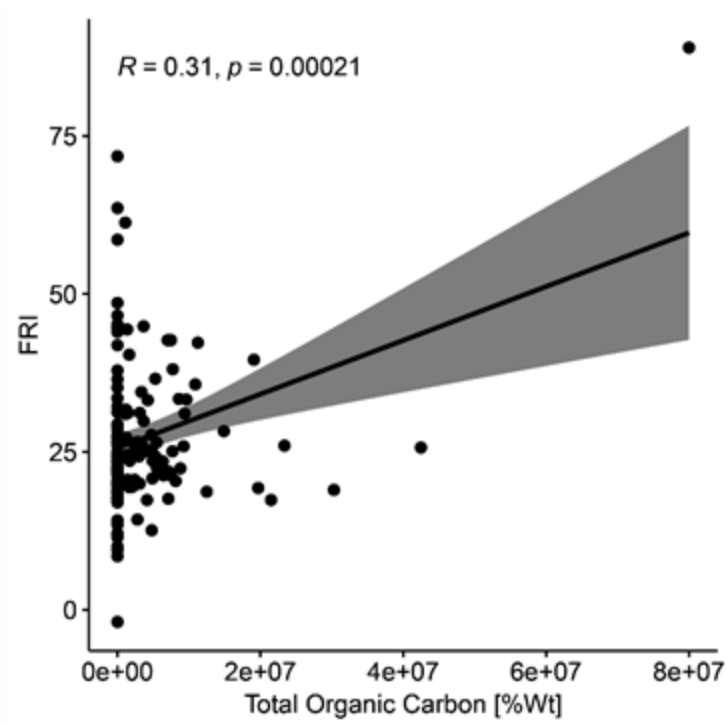


Figure H7. Total Organic Carbon and Total Nitrogen vs. FRI values for Bight data (n=790 trawls, 7-216 m, Bight '94 – Bight '18) collected on the coastal shelf from Point Conception south to the US/Mexico Border. Scatterplot fitted with simple linear regression, R = Pearson's Correlation Coefficient.

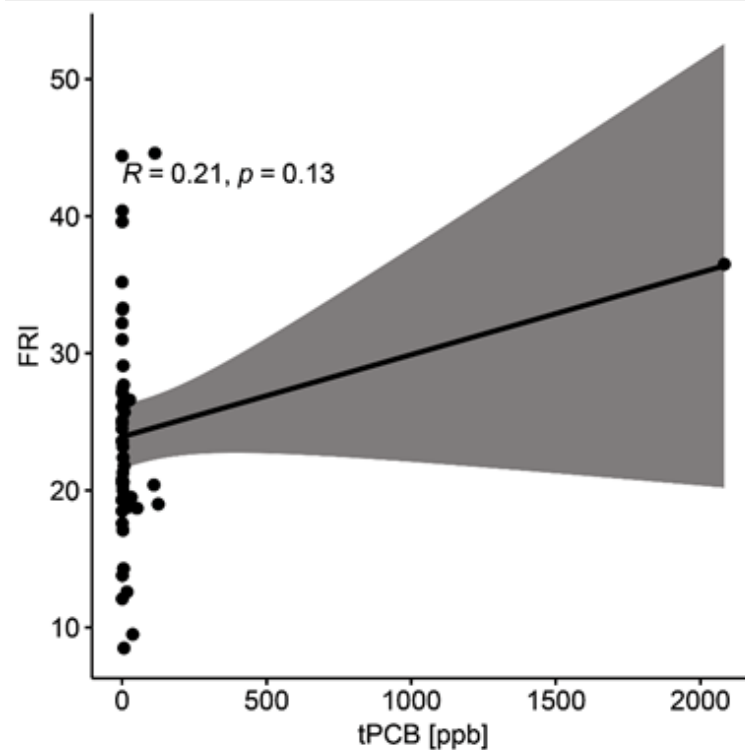
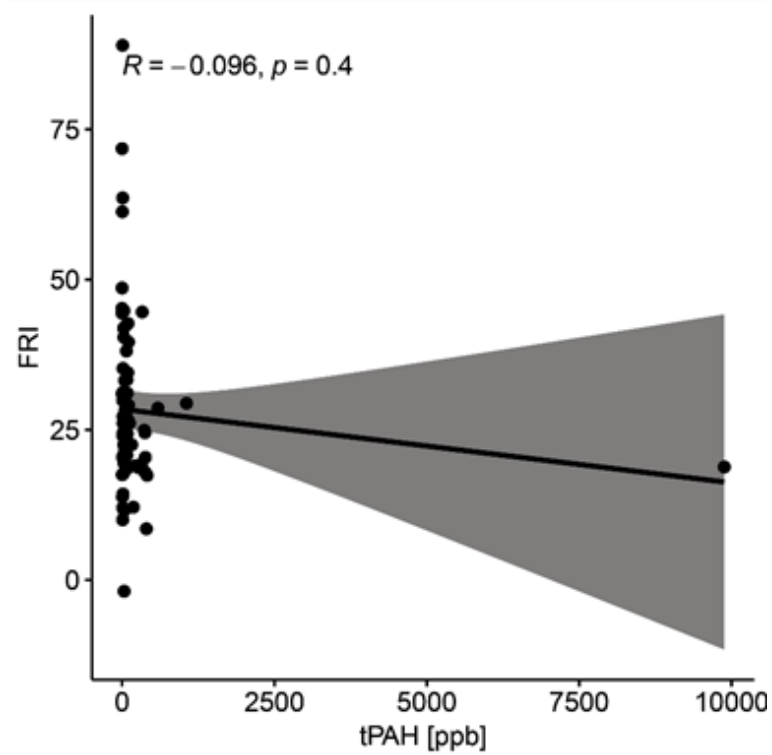


Figure H8. Total PAH (tPAH) and Total PCB (tPCB) concentrations vs. FRI values for Bight data (n=790 trawls, 7-216 m, Bight '94 – Bight '18) collected on the coastal shelf from Point Conception south to the US/Mexico Border. Scatterplot fitted with simple linear regression,  $R$  = Pearson's Correlation Coefficient.

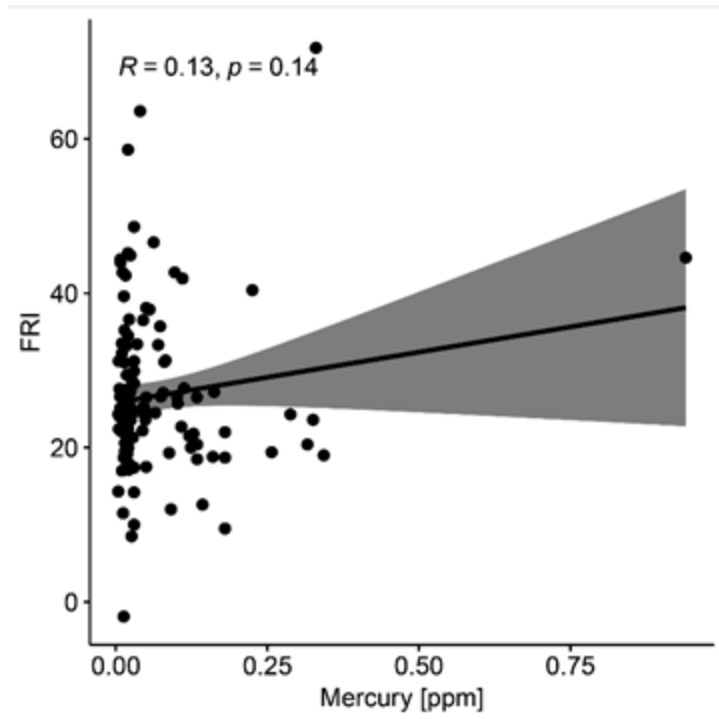
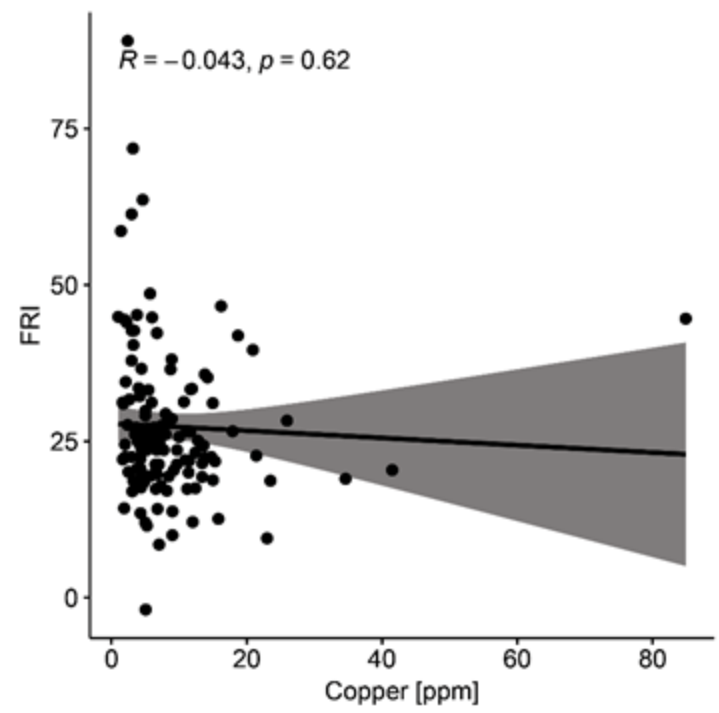


Figure H9. Copper and Mercury concentrations vs. FRI values for Bight data (n=790 trawls, 7-216 m, Bight '94 – Bight '18) collected on the coastal shelf from Point Conception south to the US/Mexico Border. Scatterplot fitted with simple linear regression, R = Pearson's Correlation Coefficient.

**Table H1. Fish abundance and p-values for select revisit stations. Species with p-values indicated with gray shading.**

<b>Species Common Name</b>	<b>B03-4003</b>	<b>B08-7596</b>	<b>B18-10214</b>	<b>p value 9-40 m</b>
Bonyhead Sculpin		1		NA
California Tonguefish			4	37.14
Curlfin Sole	2		2	92.94
Diamond Turbot			1	NA
English Sole	14			49.63
Giant Kelpfish			1	NA
Hornyhead Turbot	1		2	21.12
Pacific Staghorn Sculpin		4		NA
Rainbow Seaperch	1			NA
Shiner Perch	1	2		169.84
Speckled Sanddab	77	44	223	24.83
White Seaperch	1	2		72.37
FRI	72	89	44	Station Depth = 15 m
FRI Category	non-reference	non-reference	reference	
BRI	6.2	13.7	22.0	
# FRI spp	6	3	4	
Total Species	7	5	6	
Total Abundance	97	53	233	
	<b>B03-4061</b>	<b>B08-7572</b>	<b>B18-10215</b>	<b>p value 9-40 m</b>
Barcheek Pipefish			1	NA
California Lizardfish			1	16.23
California Tonguefish		1	4	37.14
Curlfin Sole	3		1	92.94
English Sole	3			49.63
Fantail Sole	1	1	1	13.55
Hornyhead Turbot			4	21.12
Kelp Pipefish		1		NA
Pacific Sanddab			1	59.29
Pacific Sardine		1		NA
Pacific Staghorn Sculpin		1	1	NA
Shiner Perch		10		169.84
Speckled Sanddab	100	58	136	24.83
FRI	45	61	38	Station Depth = 13.5-15 m
FRI Category	non-reference	non-reference	reference	

BRI	14.8	16.0	16.0
# FRI spp	4	4	7
Total Species	4	7	9
Total Abundance	107	73	150

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