Presentation to: San Diego Water Board

State of the Ocean, 2016 – 2017

Highlights from the City of San Diego Ocean Monitoring Program for the Point Loma and South Bay Ocean Outfalls

October 10, 2018

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The City of SAN DIEGO

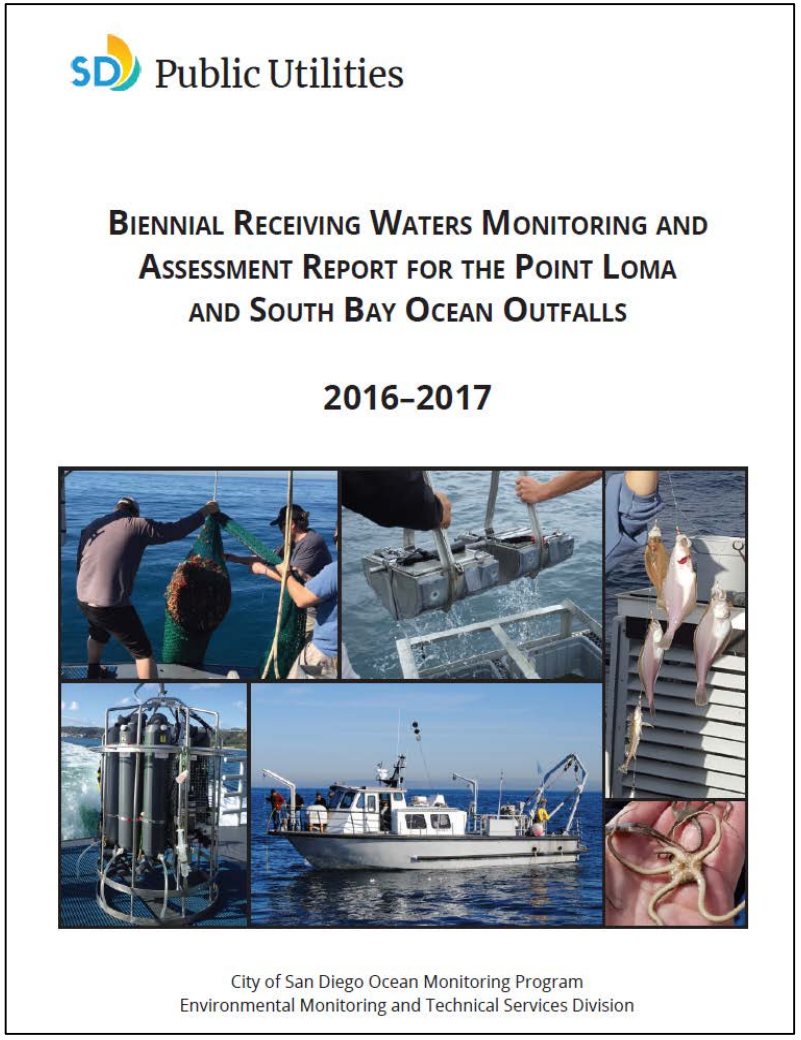
State of the Ocean Report

New Permit Requirement

- *Effective October – December 2017*
- *Follows new biennial monitoring and assessment report for the PLOO and SBOO regions*

Organization of Presentation

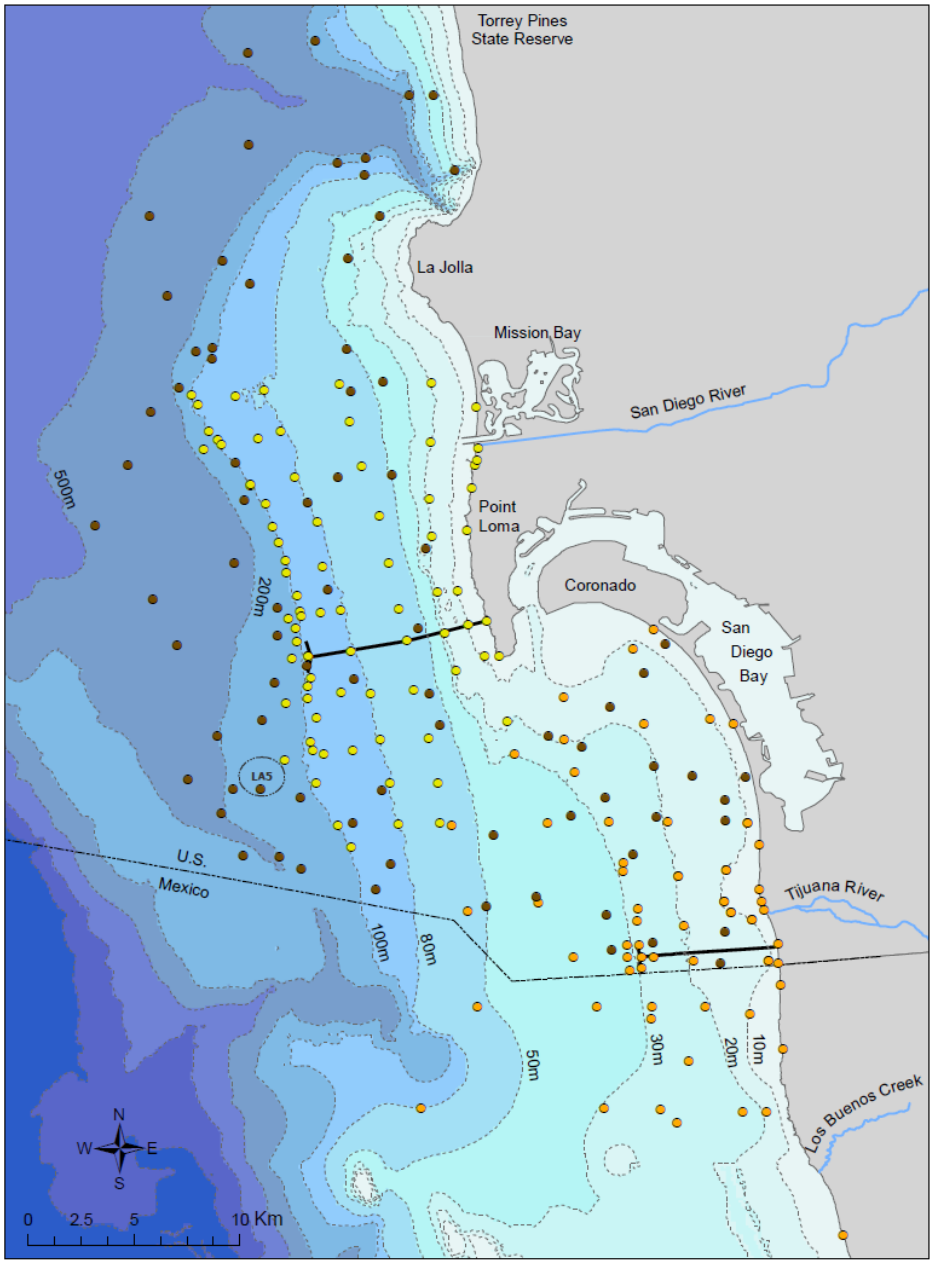
- *Evolution of the Program*
- *Program Scope & Effort*
- *Status and Trends*
- *Enhanced & Improved Monitoring*
- *Conclusions*
- *Questions*



Program Evolution — *How Did We Get Here?*

Years	Key Event or Program Modification
1991/1995	Pre-discharge monitoring began for present PLOO/SBOO monitoring regions.
2002	Model Monitoring Program (MMP) developed beginning 15-year alignment process.
2003	PLWTP Ocean Monitoring Program (OMP) amended to MMP standards.
2004	External review of PLWTP program = Point Loma Outfall Project (PLOP).
2006	OMP for SBWRP modified to MMP standards.
2007	RWQCB authorizes simultaneous changes to SBWRP/SBIWTP requirements.
2009	PLWTP permit and OMP further modified.
2009/2012	SBOO/PLOO plume behavior studies completed by Scripps.
2013/2014	SBWRP/SBIWTP permits and OMP further modified.
2015	Sediment Toxicity Monitoring Plan for PLOO and SBOO approved.
2017	Alignment of PLOO/SBOO programs completed with new/amended permits.

City of San Diego Ocean Monitoring Program



Combined PLOO/SBOO Program

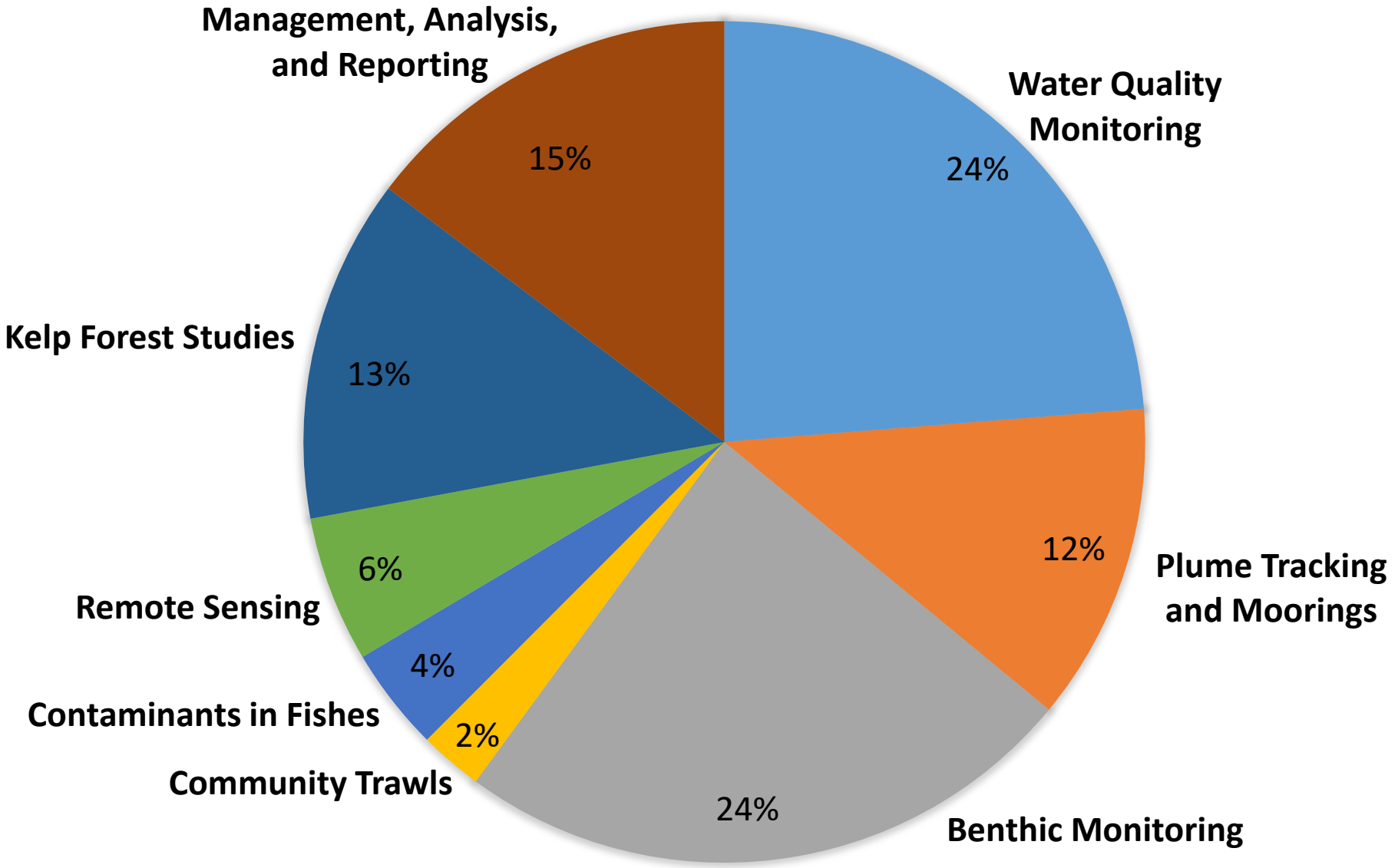
- *One of largest and most comprehensive programs of its kind*
- *Sampling ~200 days per year*
- *Beaches to offshore depths ≥500 m at ~160 distinct monitoring stations*
- *Northern San Diego to Northern Baja*
- *Total area ~340 mi²*

Monitoring Effort (2016 – 2017)

Monitoring Component	Stations (or Zones)	Sample Days	Total Samples	Total Analyses
Water Quality (WQ)*				
Shore (Beaches)	18	271	2,132	6,396
Nearshore (Kelp Beds)	15	119	6,889	30,933
Offshore	69	48	2,184	7,608
Benthic Condition				
Sediment Chemistry	129	30	1,192	31,828
Sediment Toxicity	28	30	36	36
Benthic Infauna	129	30	276	276
Demersal Fishes & Inverts	13	18	52	52
Fish Tissue Chemistry	13	13	78	8,736
TOTAL	**200†**	**504**	**12,766**	**85,460**

* Shore WQ = seawater samples for fecal indicator bacteria (FIB) analysis.
* Nearshore/Offshore WQ = seawater samples for FIB + CTD casts for water column profiles of multiple parameters.
† Total number of distinct stations.

Program Cost Breakdown



Total program cost ~$4.4 million/year

Water Quality Monitoring & Compliance

Shore (beaches)

- *19 stations, weekly*
- *Seawater samples collected to measure FIB concentrations*

Sandy beaches

Rocky shores

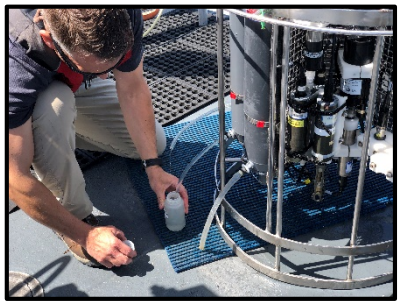
Kelp beds and offshore

- *15 kelp/nearshore stations, weekly*
- *69 offshore stations, quarterly*
- *Seawater samples collected at multiple depths to measure FIB levels*
- *CTD casts to create water column profiles of key parameters*
  - *Temperature, depth, light, dissolved oxygen, pH, salinity, chlorophyll a, colored dissolved organic matter (CDOM)*

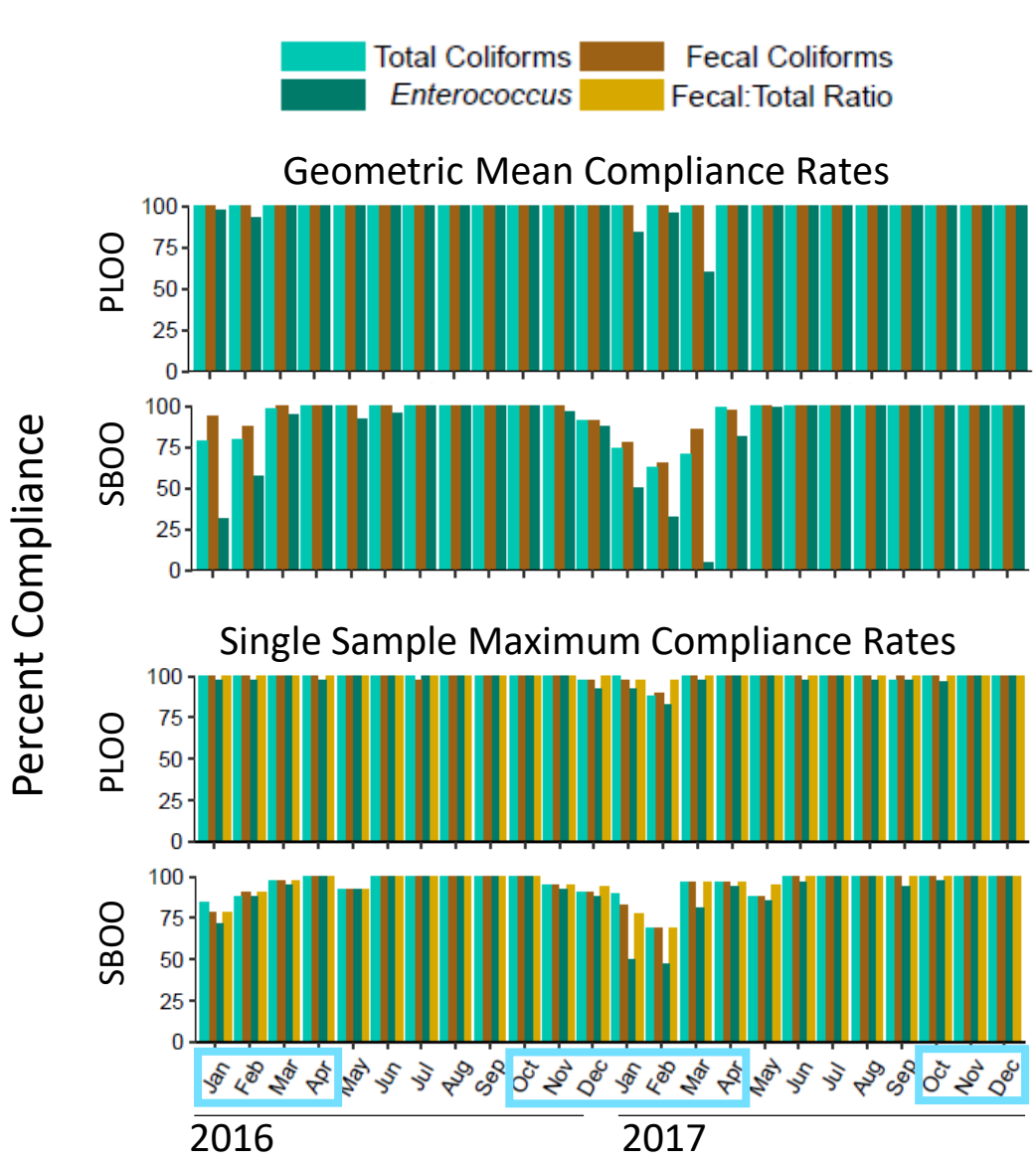
Kelp forests

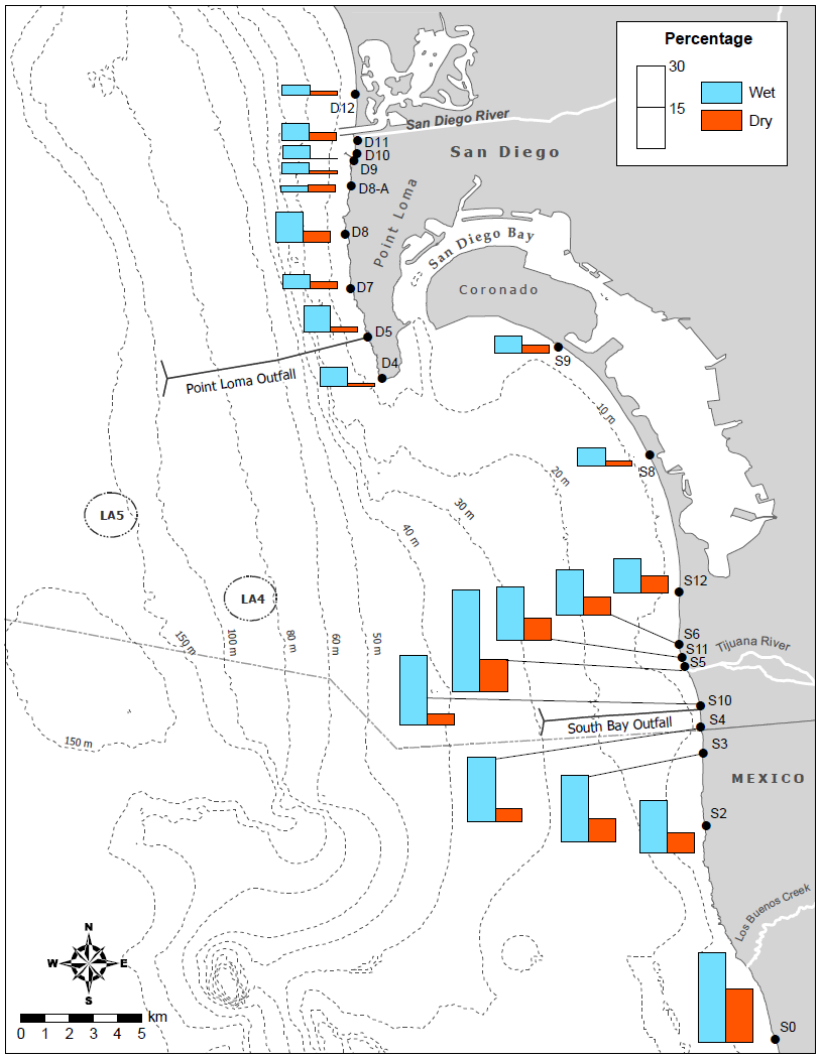
FIB = Fecal Indicator Bacteria

Total & fecal coliforms, Enterococcus



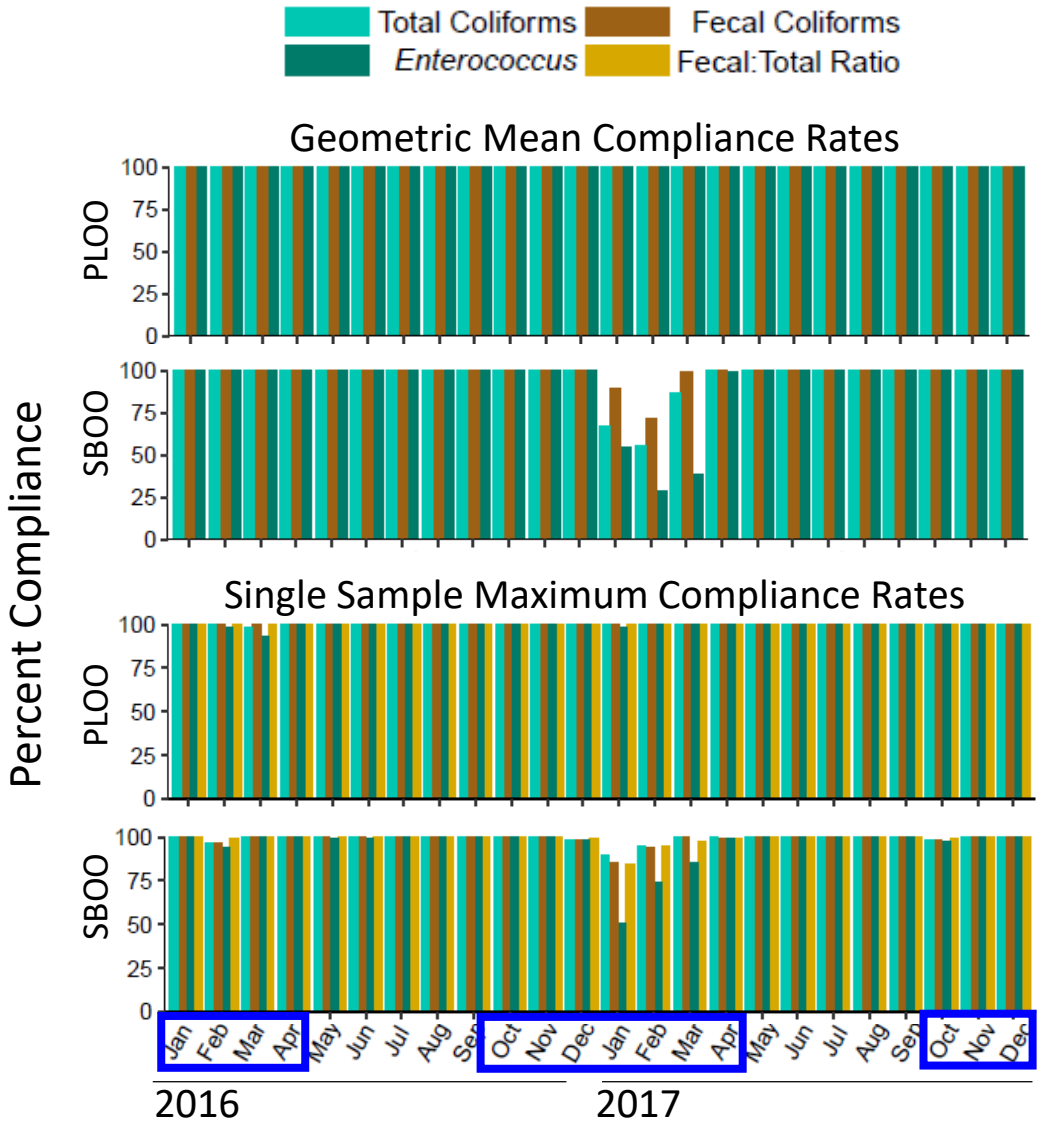
Beach Water Quality

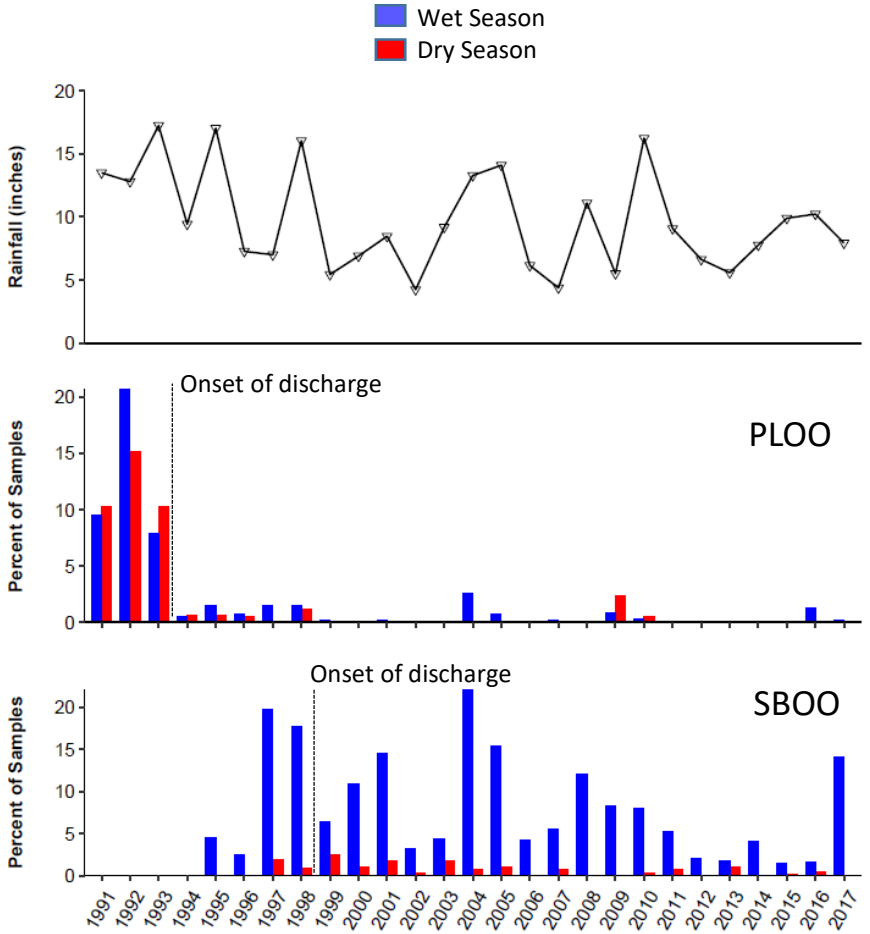




Percent of samples with elevated FIB densities in wet vs. dry seasons from 1991/1995 through 2017.

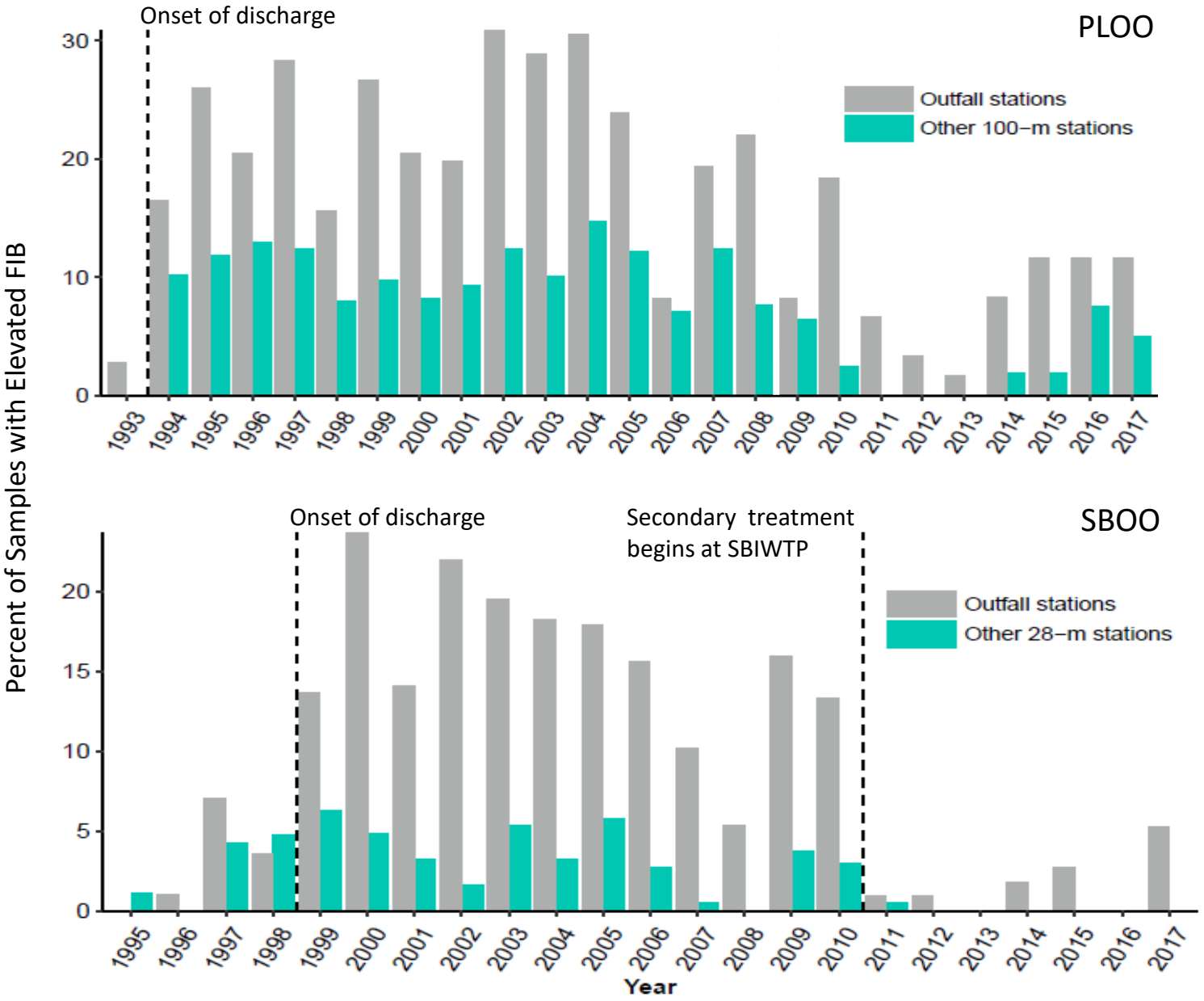
Nearshore Water Quality





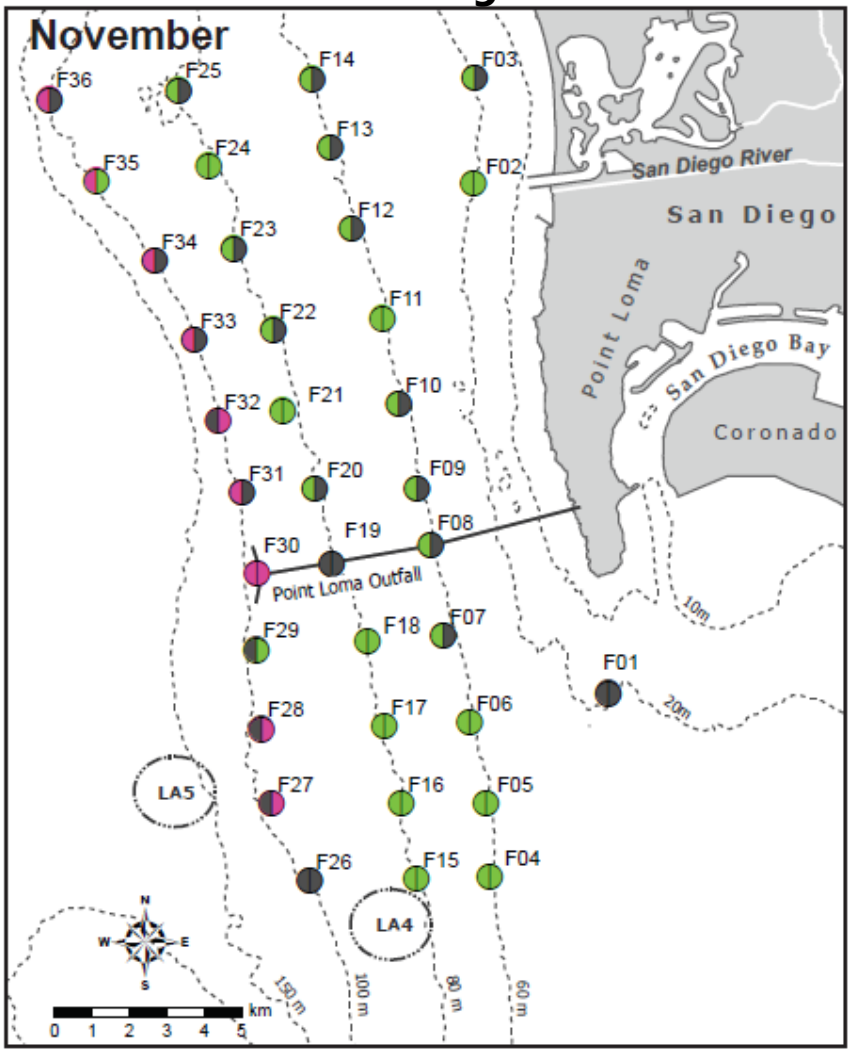
Comparison of annual rainfall to percent of samples with elevated FIB densities in wet vs. dry seasons from 1991/1995 through 2017.

Offshore Water Quality

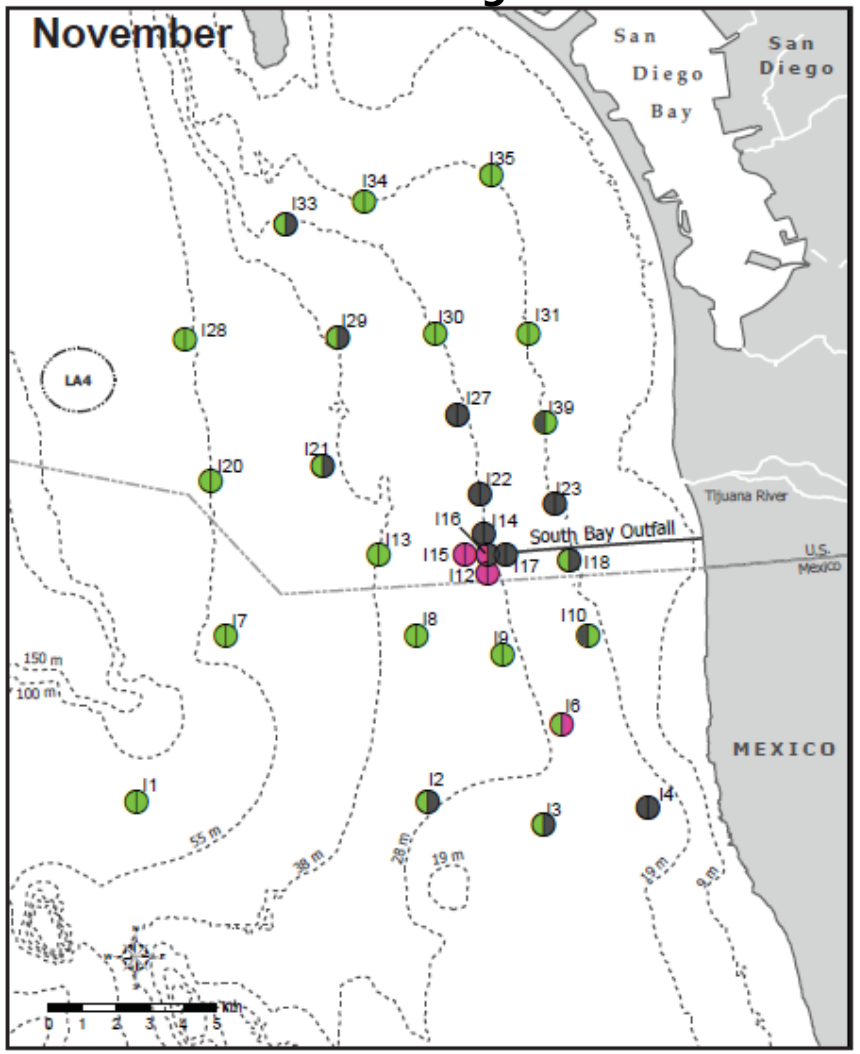


Plume Dispersion (2016 – 2017)

PLOO Region



SBOO Region

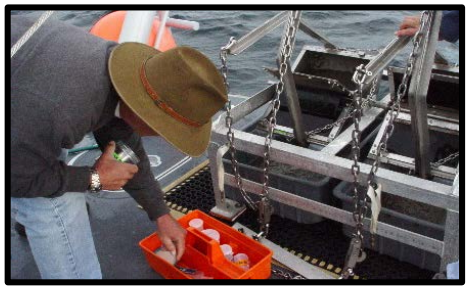


Stations indicating potential plume shown in pink (●), and those used as reference stations shown in green (●).

Benthic Sediment Quality

Field Sampling

- *89 stations, semiannual/annual*
- *Double Van Veen grab (0.1 m^2)*

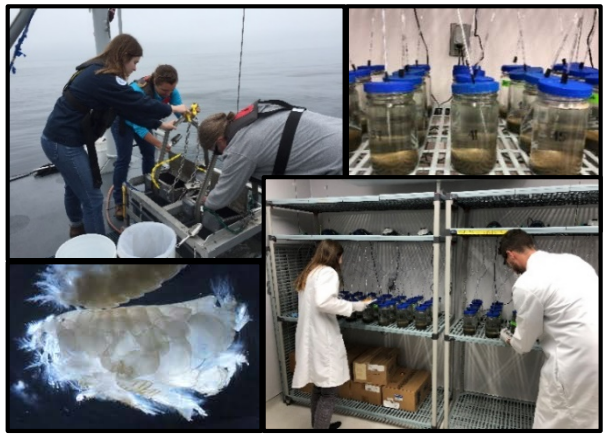


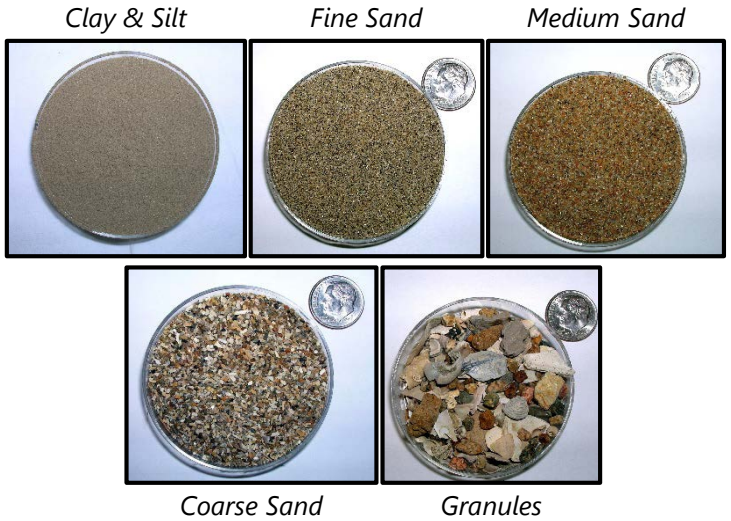
Sediment Type & Chemistry

- *Particle size (sand, silt, clay)*
- *Chemistry (total organic carbon and nitrogen, sulfides, metals, PCBs, pesticides, PAHs)*

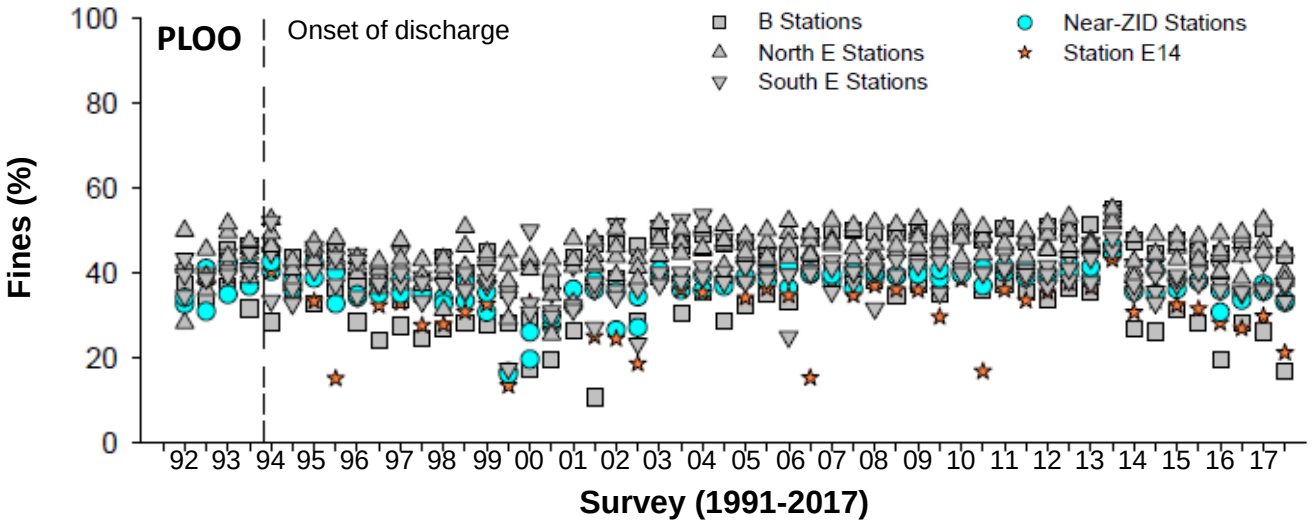
Sediment Toxicity

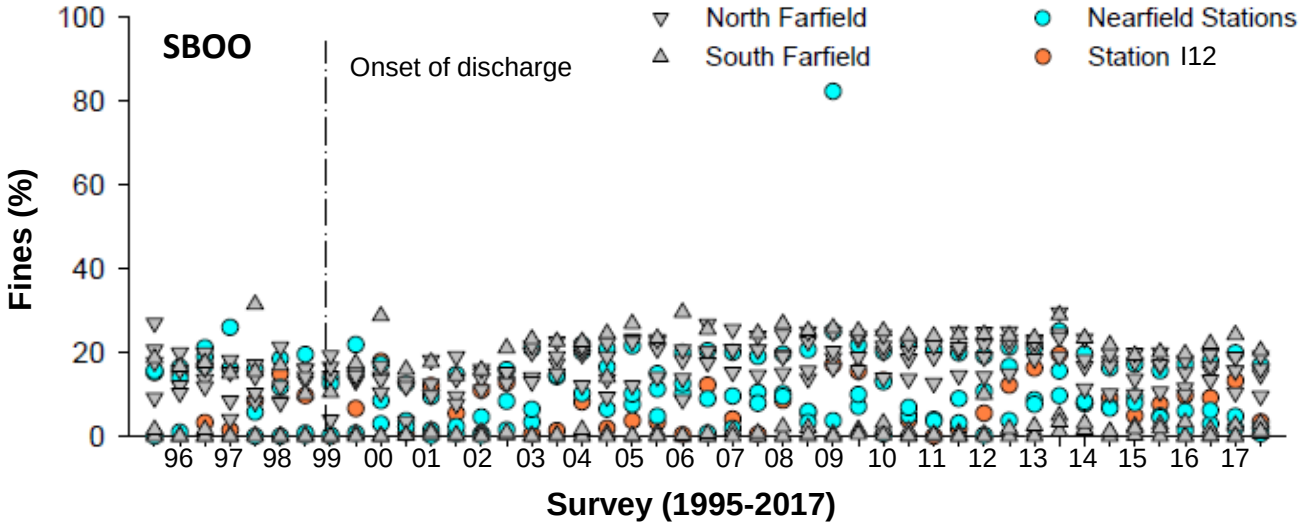
- *8-28 stations/year*
- *10-day amphipod tests*

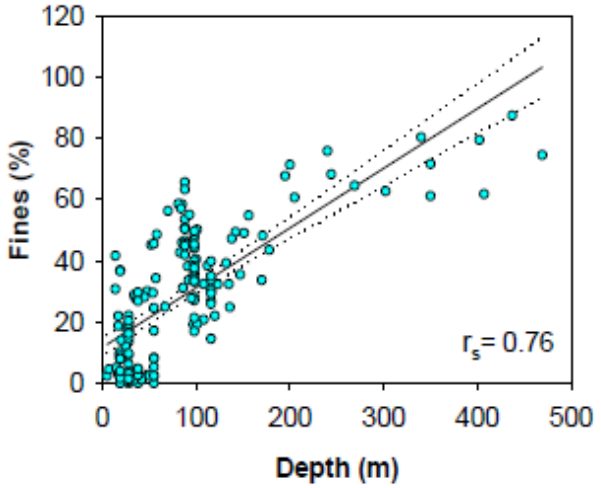




Sediment Quality – Particle Size Effects

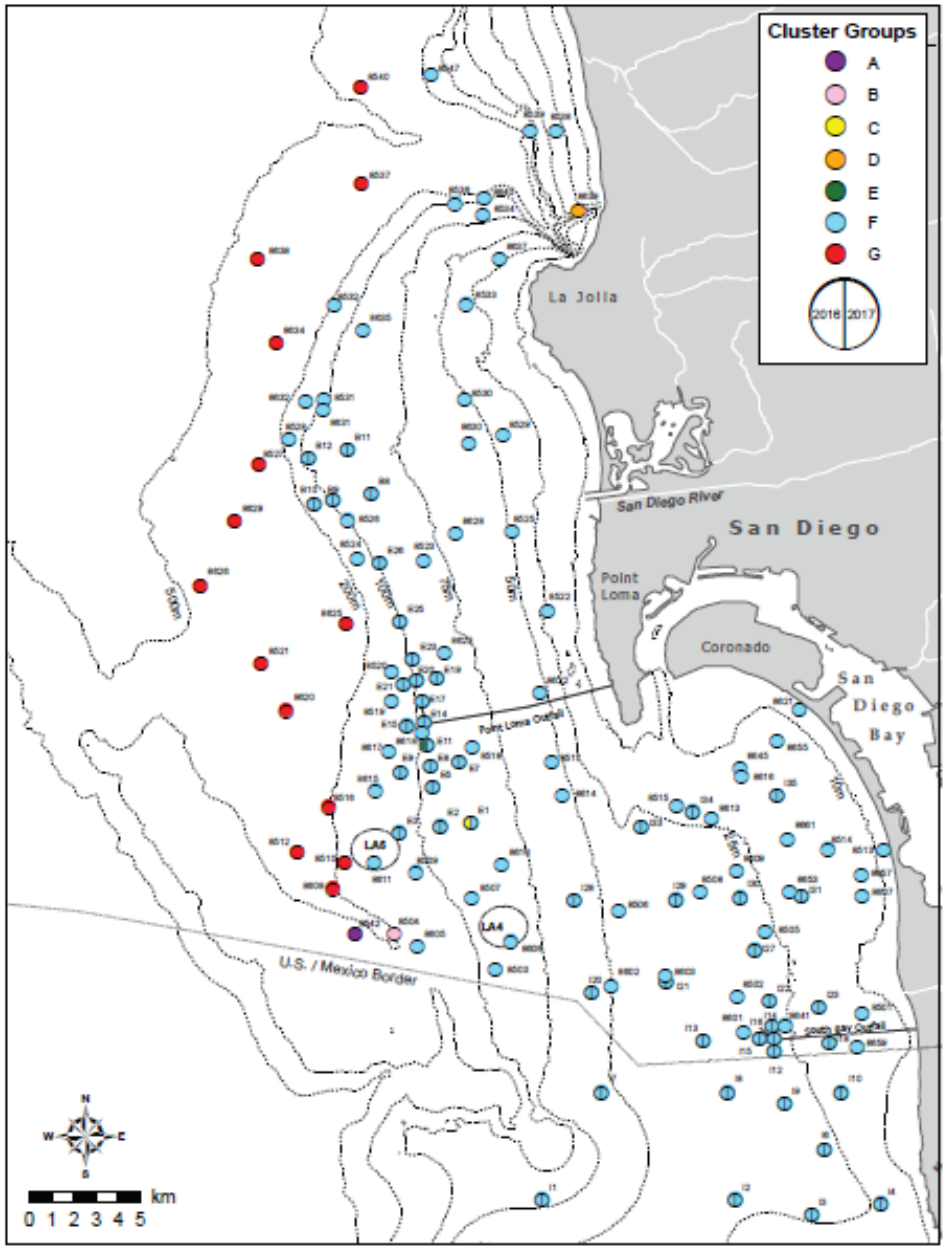






Parameter	n	r_s w Fines
Sulfides	175	0.23
Total Nitrogen	**153**	**0.84**
Total Organic Carbon	164	0.51
Al	**176**	**0.88**
Sb	**102**	**0.77**
As	176	-0.13
Ba	**176**	**0.80**
Cr	**176**	**0.85**
Cu	**151**	**0.81**
Fe	**176**	**0.77**
Pb	176	0.22
Mn	**176**	**0.83**
Hg	**132**	**0.72**
Ni	**176**	**0.88**
Sn	109	0.08
Zn	**176**	**0.85**

Sediment Quality – Chemistry Effects



Organic Loading & Trace Metals 2016 – 2017

PCA & Cluster Analysis of Summer Samples

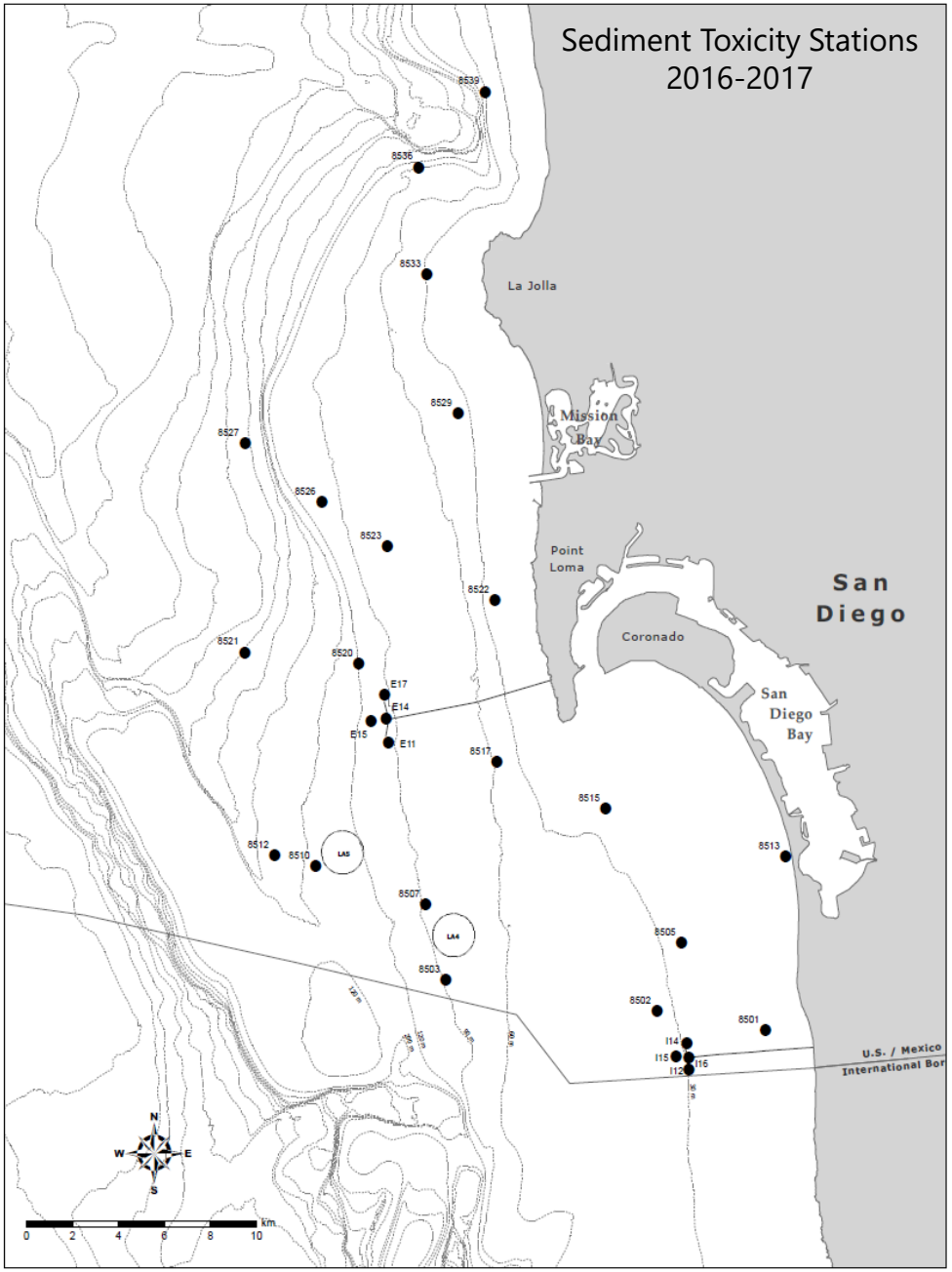
Group F: Continental Shelf (n = 159)
- Depth = 5 to 178 m
- Includes 17/18 near-ZID sites

Group G: Outer Shelf/Upper Slope (n = 14)
- Depth = 196 to 469 m
- Highest proportion fine particles (61-87%)
- Elevated total nitrogen, aluminum, antimony, barium, chromium, copper, iron, manganese, mercury, nickel, zinc

Outliers (1 sample each) with elevated parameters

- Group A: total organic carbon, antimony, iron, tin
- Group B: beryllium, cadmium, selenium
- Group C: lead
- Group D: sulfides
- Group E: silver

Sediment Quality – Toxicity



Sediment Toxicity

- *Monitoring Plan approved 2015*
- *3-year pilot study (2016-2018)*
  - *8 near-ZID stations each year*
  - *20 randomized stations years 1 & 3*
  - *10-day amphipod survival tests*
- *Results = no observed toxicity*
- *Final project report due 12/31/2018*

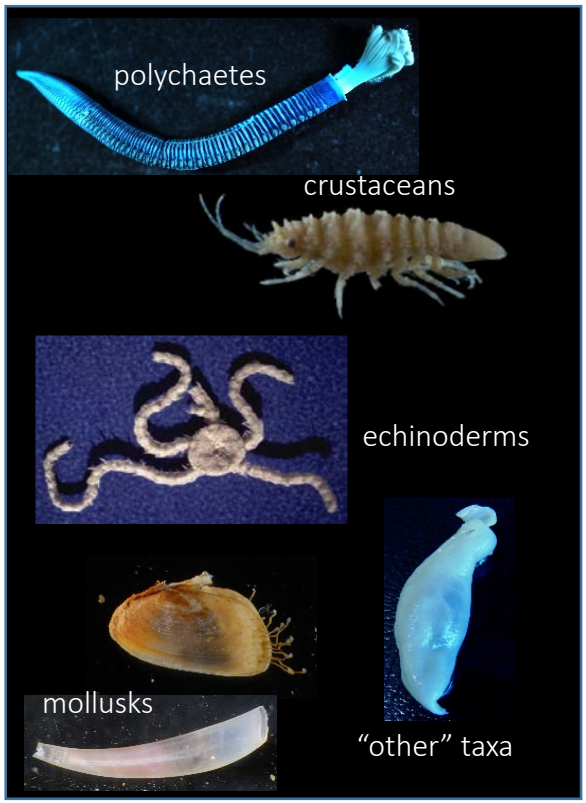
Benthic Macroinvertebrate Communities

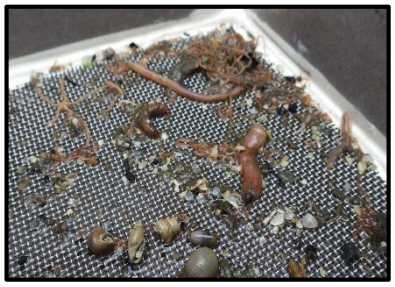
Field Sampling

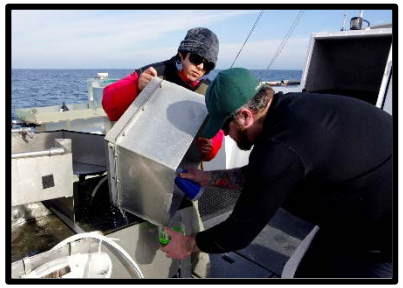
- *89 stations, semiannual/annual*
- *Double Van Veen grab (0.1 m^2)*

Infaunal Invertebrates

- *Species IDs and abundance*
- *Community analysis*

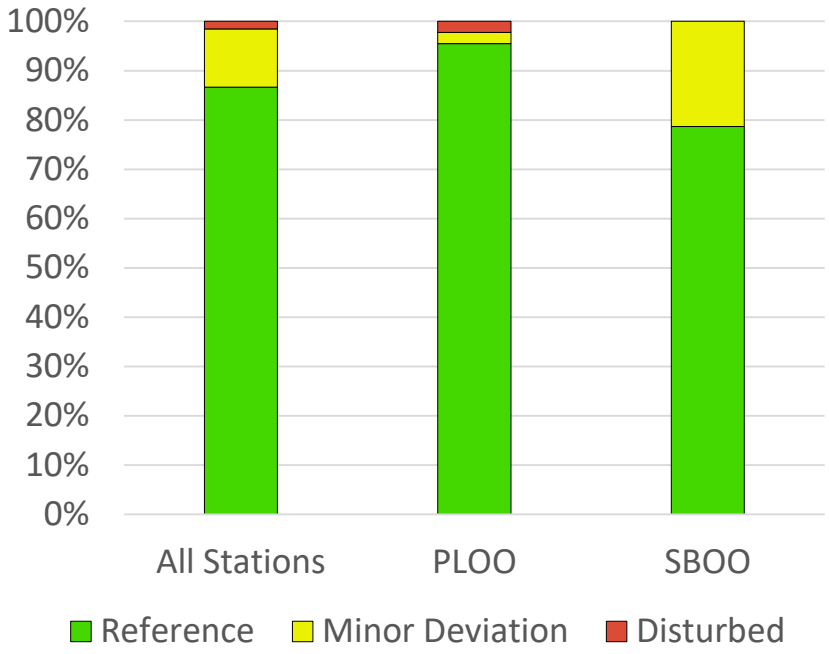


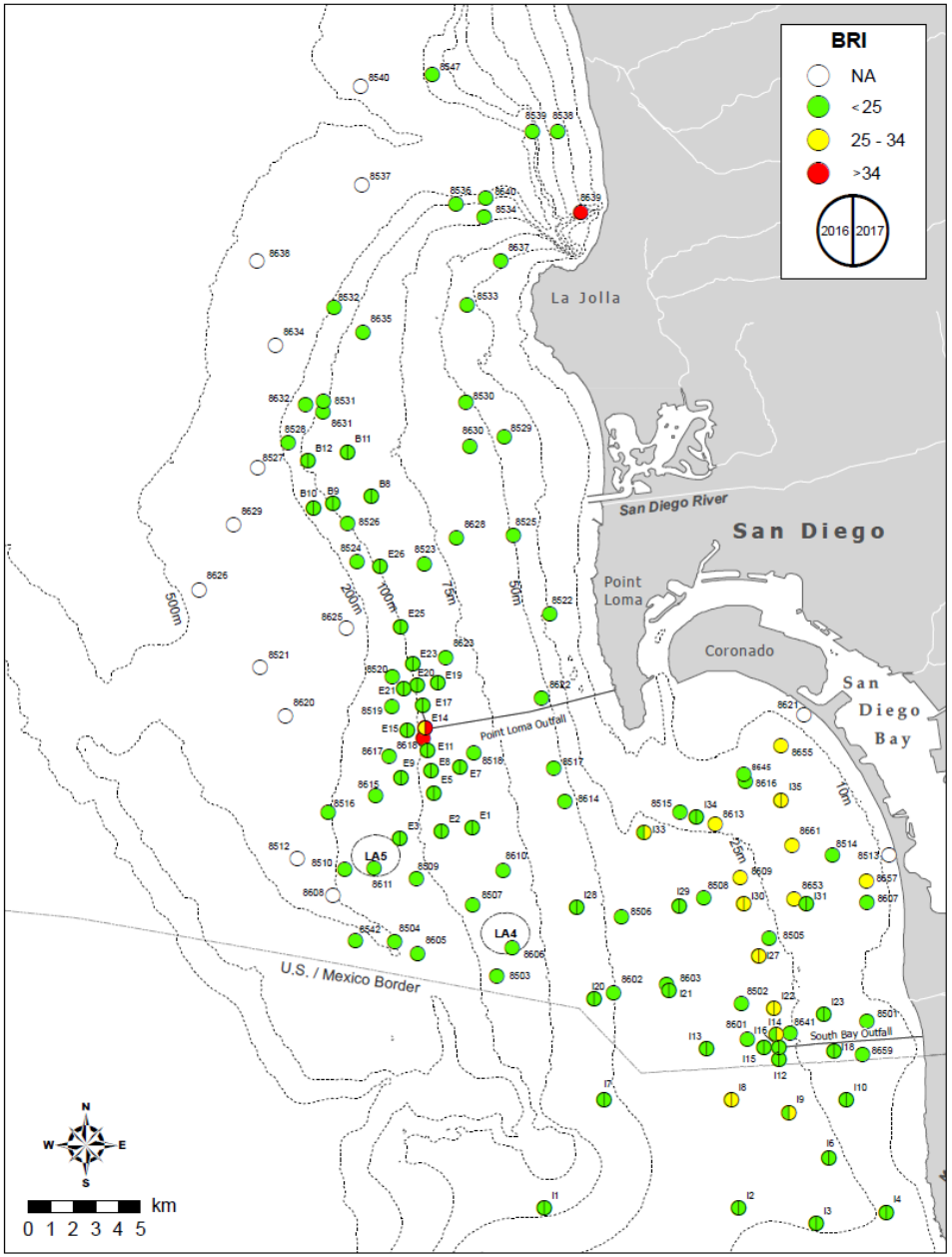




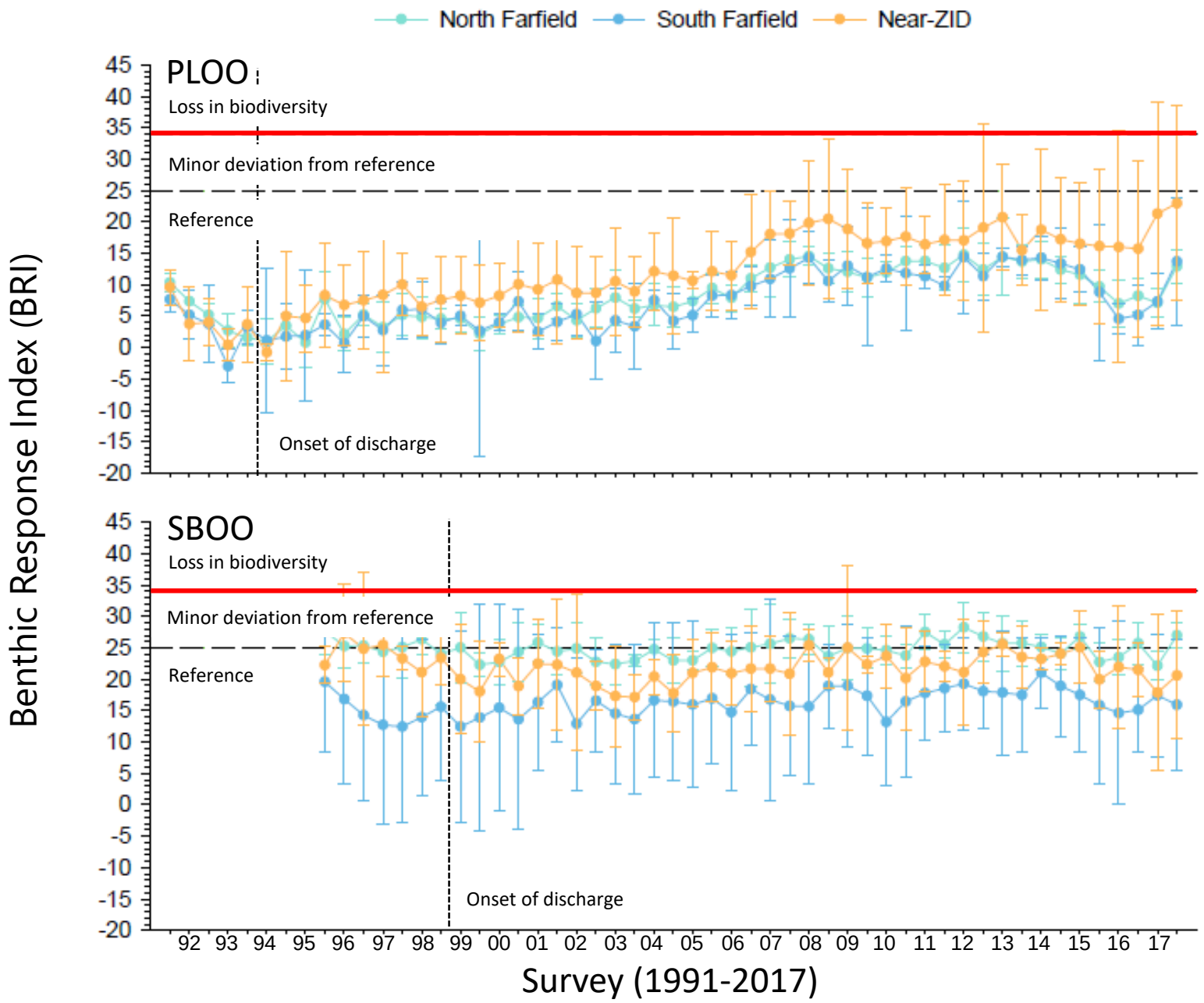
Benthic Community Condition (2016 – 2017)

Benthic Response Index (BRI)





Benthic Community Condition (1991 – 2017)



Trawl-Caught Fish & Invertebrate Communities

Field Sampling

- *13 stations, semiannual*
- *Otter trawls (25 ft long)*
- *10 minute bottom time*

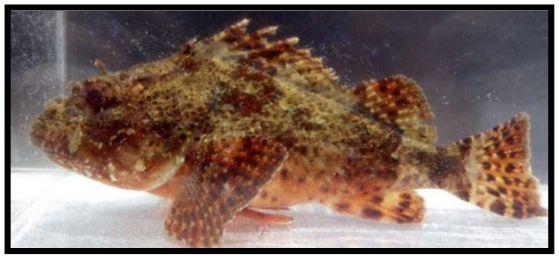
Community Analysis

- *Bottom dwelling (demersal) fishes*
- *Large epibenthic invertebrates*

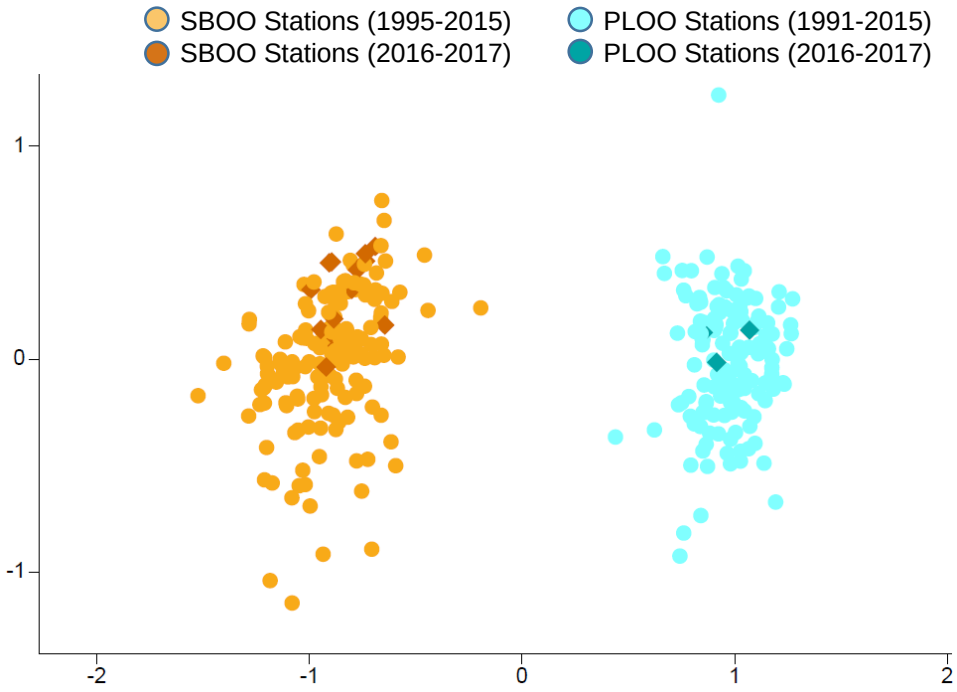








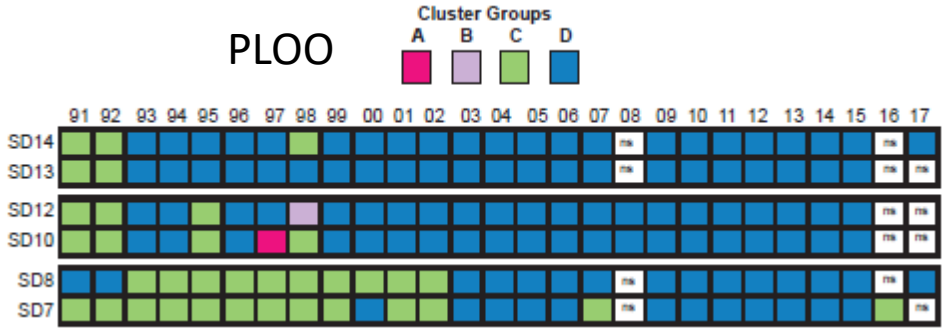
Demersal Fish Assemblages



Ordination and Cluster Analysis Results

- Summer surveys only, 1991-2017
- Total # 10 minute trawls = 310
- PLOO vs. SBOO assemblages = significantly different

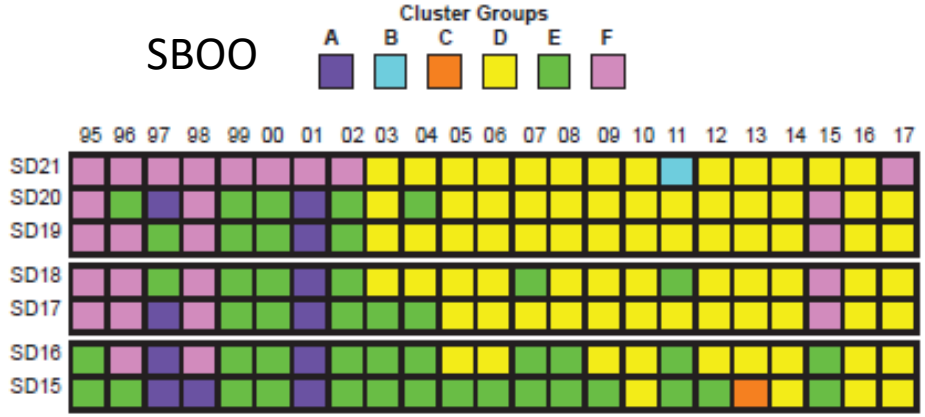
PLOO



Characteristic PLOO Fish

Pacific Sanddab
Dover Sole
Shortspine Combfish
Pink Seaperch

SBOO



Characteristic SBOO Fish

Speckled Sanddab
California Lizardfish
Hornyhead Turbot

Contaminants in Marine Fishes

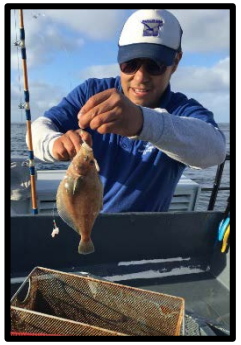
Field Sampling

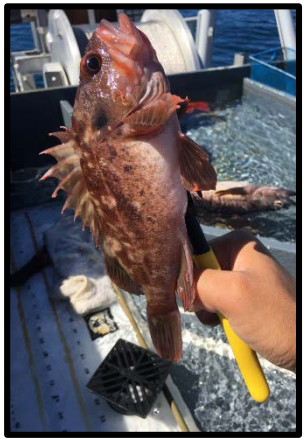
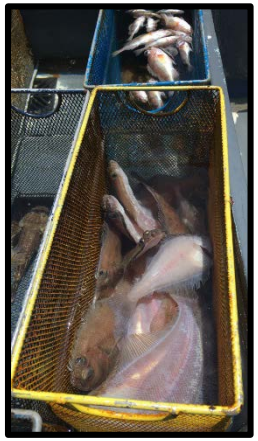
- *13 zones, annual*
- *Otter trawls (9 zones)*
- *Rig fishing (4 zones)*

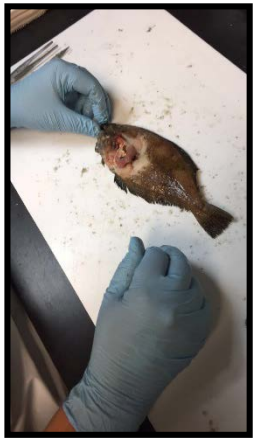
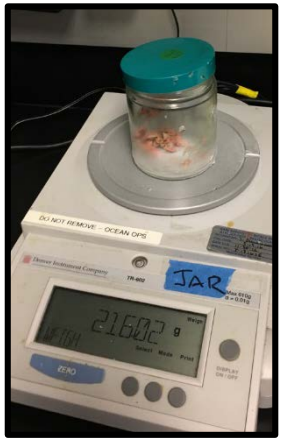
Contaminant Bioaccumulation

- *Liver tissues (trawl zones)*
  - *Target species = flatfishes*
- *Muscle tissues (rig fishing zones)*
  - *Target species = rockfishes*

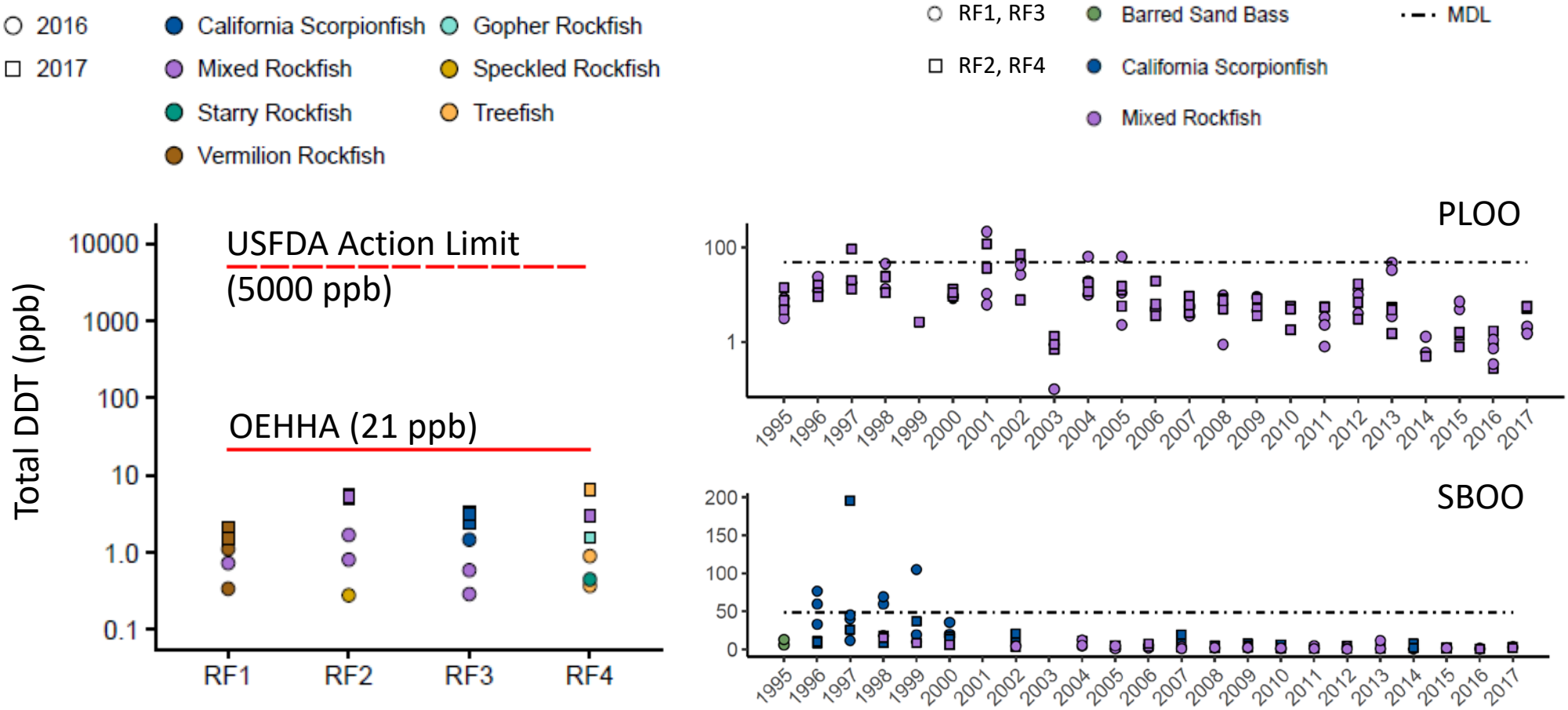




Contaminants in Fish Muscle Tissues

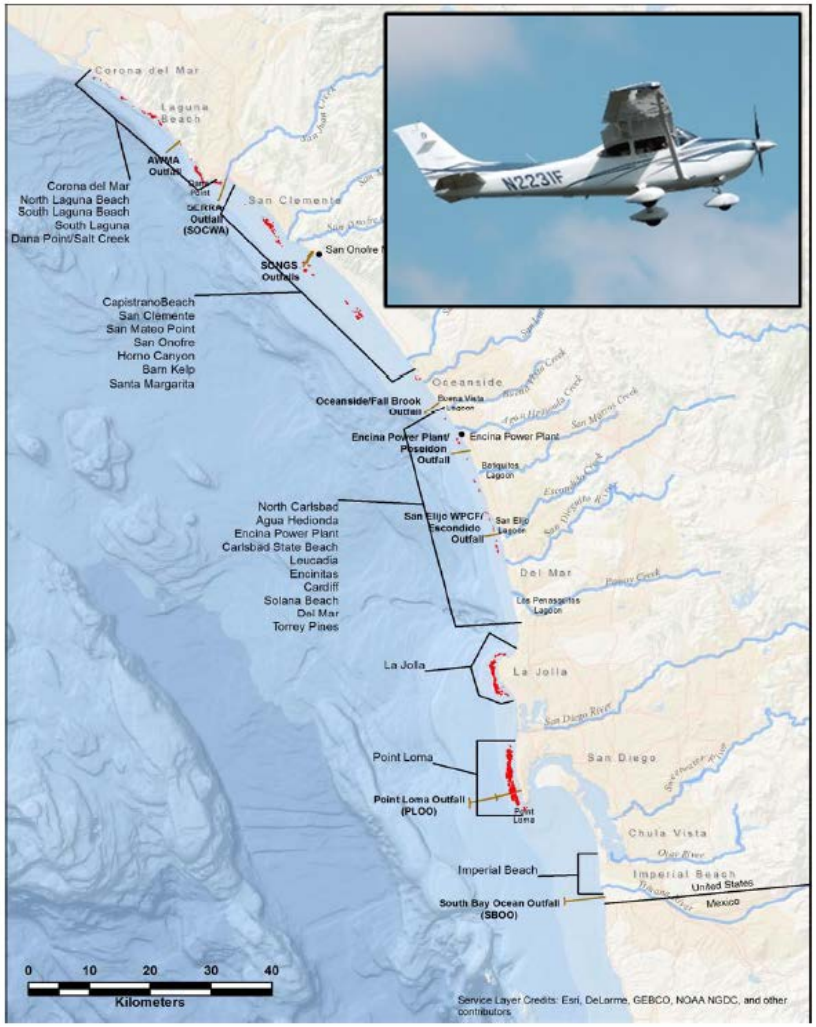


San Diego Kelp Forests

San Diego Kelp Forest Ecosystem Monitoring Project

Dive surveys of Pt Loma and La Jolla kelp forests to assess kelp and invertebrate communities

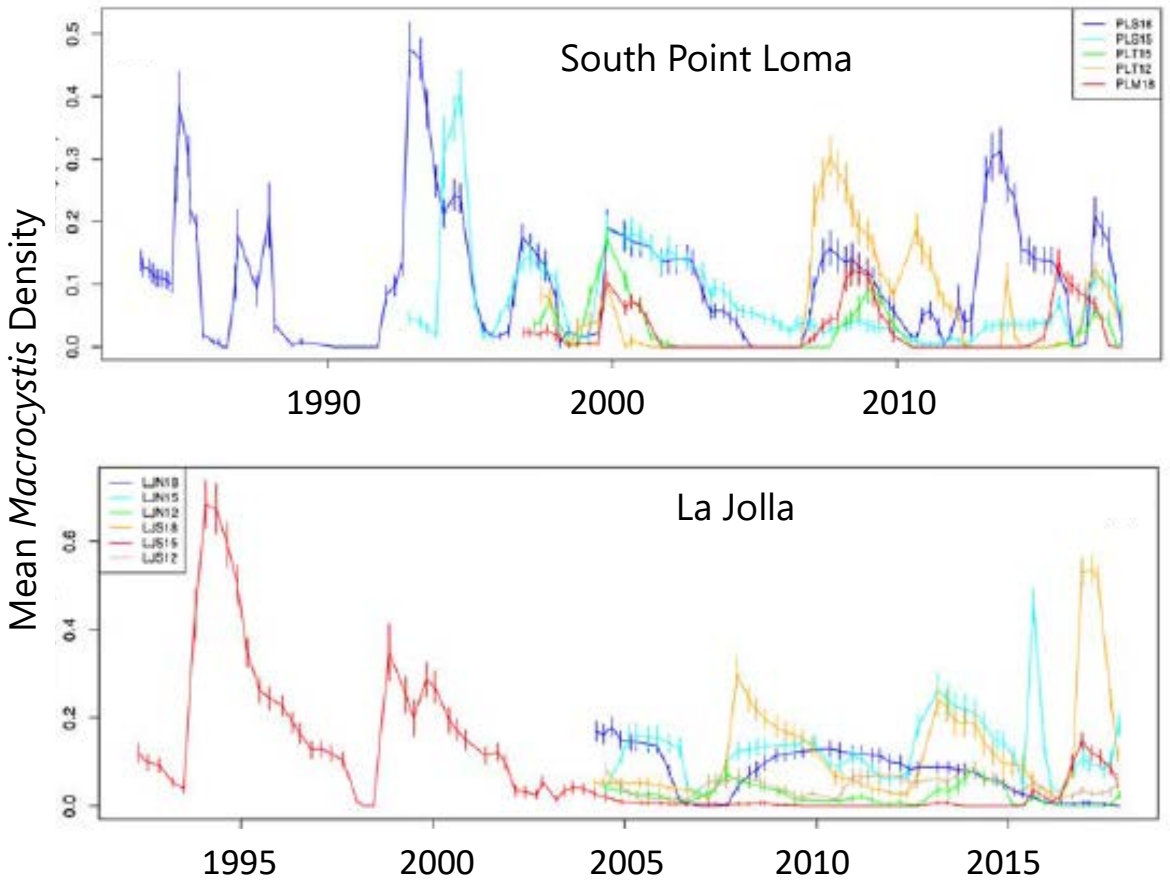
Region Nine Aerial Kelp Survey Program



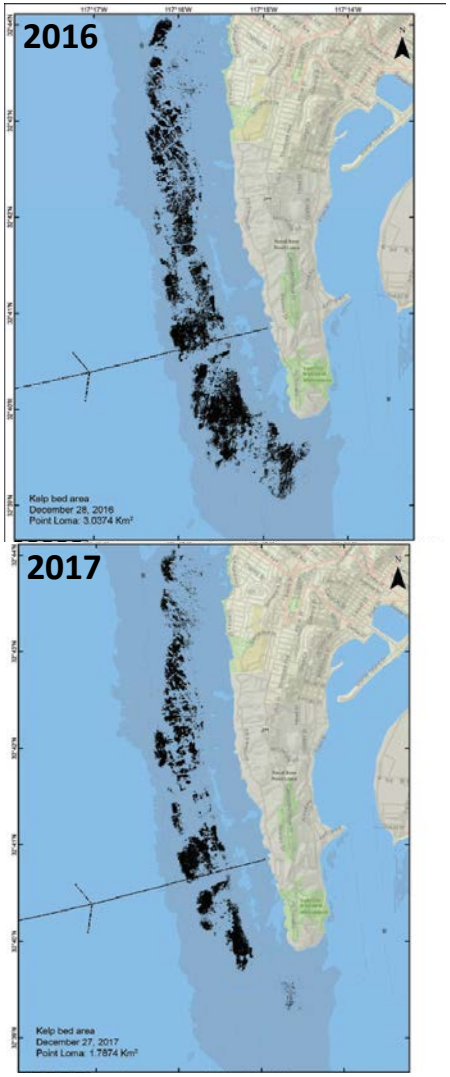
Quarterly overflights to photograph and quantify surface area of kelp bed canopies

Kelp Forest Density and Canopy Cover

Pt Loma and La Jolla Kelp Forest Density over Time



Pt Loma Kelp Forest Canopy Area



Enhanced & Improved Monitoring

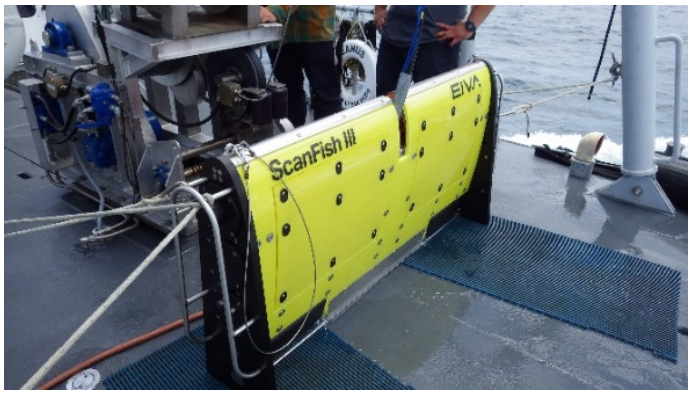
New Plume Tracking Monitoring Plan (2018)

- *Developed for combined PLOO and SBOO regions (approved April 25, 2018)*

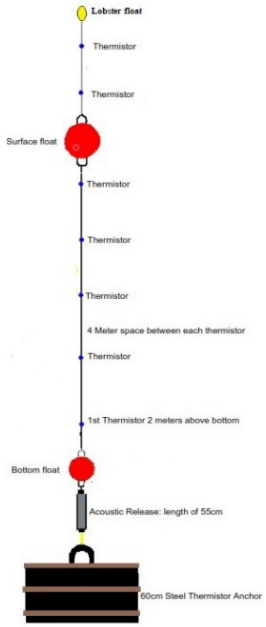
Three main elements

1. *Real-Time Ocean Observing System (3 Mooring Network)*
2. *ROTV Operations (Adaptive Sampling)*
3. *Static Current Meter (ADCP) and Thermistor Moorings*

Real-Time Mooring Buoy



Remotely Operated Towed Vehicle (ROTV)



Static Mooring System

New Plume Tracking (continued)

New real-time moorings

- *Collaboration with Scripps*
- *PLOO, SBOO, and Del Mar systems*
- *Multiple oceanographic parameters*
  - *Ocean currents*
  - *Temperature*
  - *Salinity*
  - *Dissolved oxygen*
  - *pH*
  - *Chlorophyll*
  - *Nutrients*

Improved monitoring

- *Plume tracking & dispersion*
- *Ocean current patterns*
- *Climate change effects*

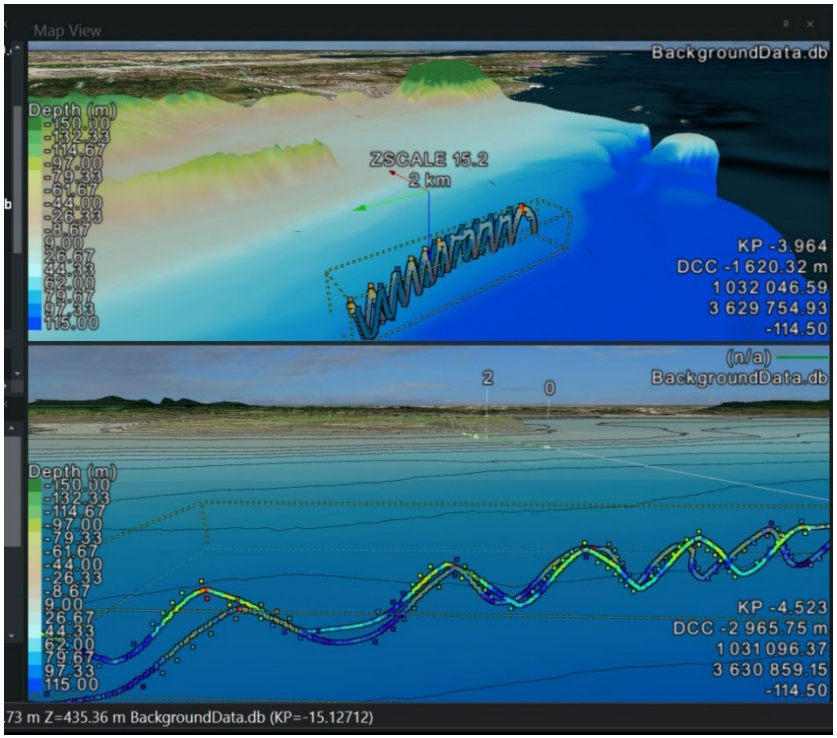
Location of PLOO, SBOO, and Del Mar real-time mooring systems.

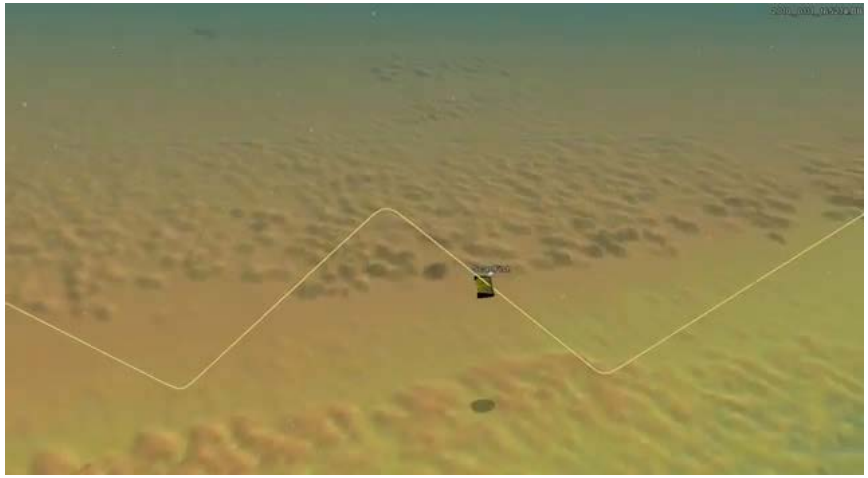
New Plume Tracking (continued)

New ROTV for improved water quality monitoring and plume tracking

- *Computer controlled "wing" can be programmed to undulate through water column while under tow*
- *Transmits continuous data streams*
- *Higher resolution data for improved plume modeling*
- *Allows for more adaptive plume tracking*

ScanFish III ROTV





Simulation of ROTV movement throughout water column.

Conclusions

1. Overall ocean conditions off San Diego in 2016-2017 were consistent with previous years.
2. Few changes observed that could be attributed to wastewater discharge.
3. Compliance with California Ocean Plan water quality bacterial standards was excellent.
4. Exceptions of reduced compliance with COP standards were driven by wet weather events and proximity to coastal sources of contamination.
5. No evidence that the PLOO or SBOO wastewater plumes were advected into nearshore recreational waters or beaches.
6. No clear wastewater discharge related patterns in terms of sediment quality or benthic invertebrate communities.
7. Benthic habitats surrounding both outfalls and throughout the region remained in good condition similar to much of the SCB continental shelf.
8. Local fish communities remained healthy and indicative of a healthy marine environment.

Questions

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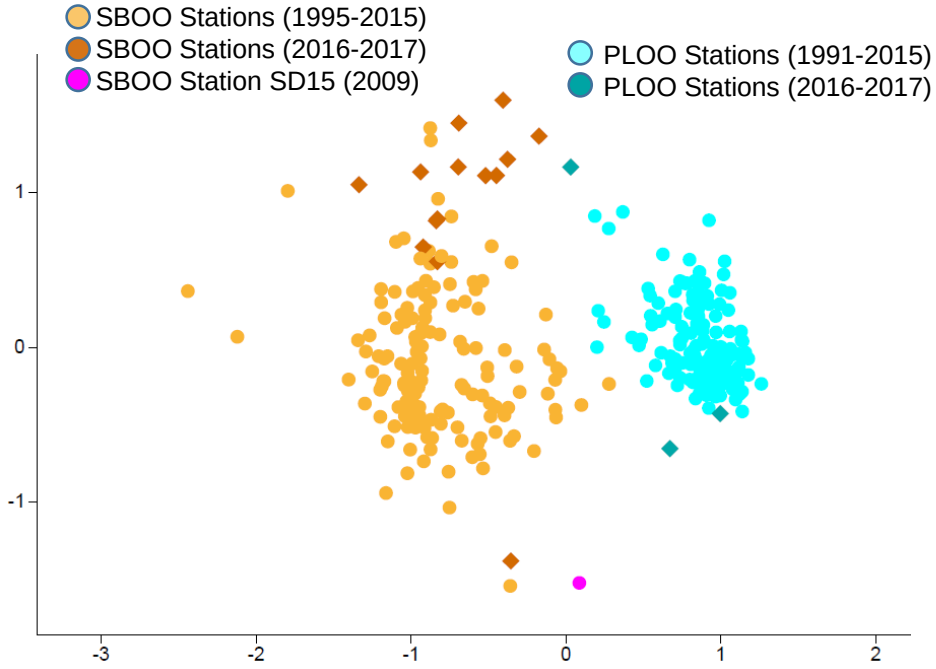
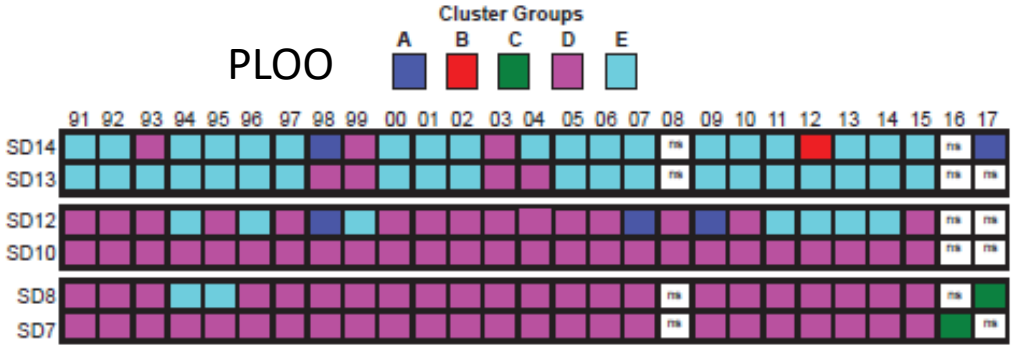
Public Utilities

Megabenthic Invertebrates



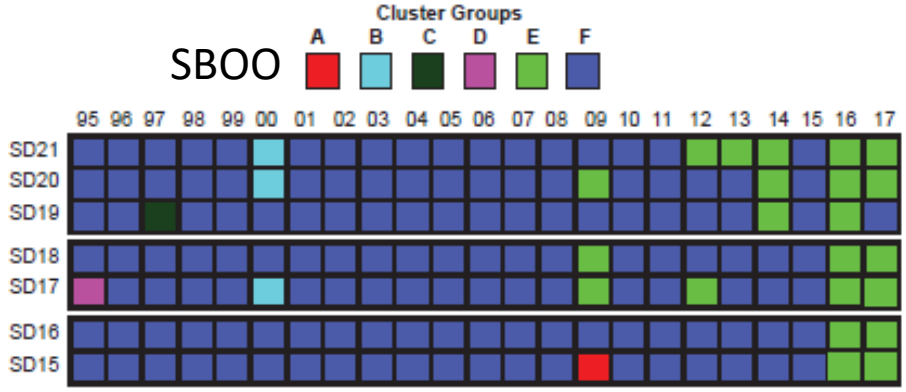
Ordination and Cluster Analysis Results

- 310 10-minute trawls
- summer surveys only, 1991-2017
- Total no. 10 min trawls = 310
- PLOO vs. SBOO assemblages = significantly different



PLOO assemblages characterized by:

- *Lytechinus pictus*
- *Stronglyocentrotus fragilis*
- *Luidia foliolata*
- *Parastichopus californicus*

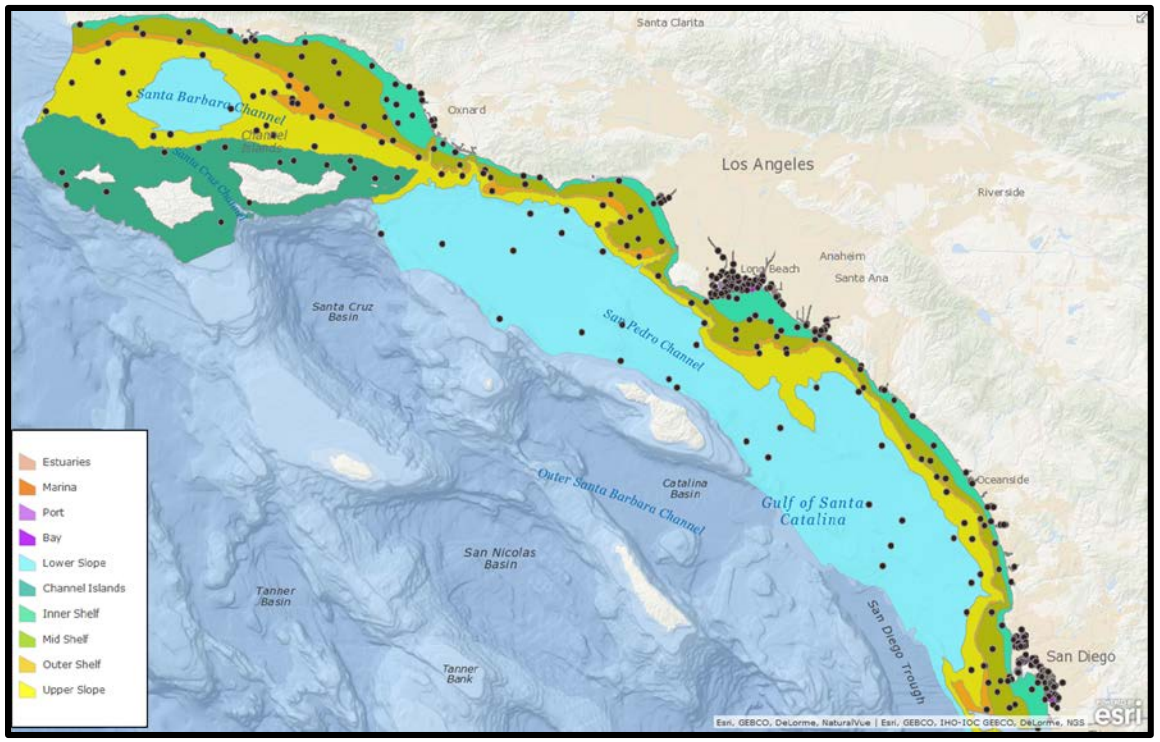


SBOO assemblages characterized by:

- *Elthusa vulgaris*
- *Pisaster brevispinus*

2018 Southern California Bight Regional Monitoring Program

- *Managed and coordinated by SCCWRP about every 5 years (1994 – present)*
- *Multiple agencies (e.g., City, IBWC, other dischargers, academic institutions)*
- *Multiple components per project*
- *Bight'18 underway*
  - *Sediment Quality*
  - *Ocean Acidification*
  - *Harmful Algal Blooms*
  - *Trash & Debris*
  - *Microbiology*



Bight'18 Sediment Quality Monitoring Stations