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Zooplankton Monitoring in the Eelgrass Dominated Padilla Bay: A Baseline for Examining Future Changes

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Padilla Bay

- Approx. 8000 acre eelgrass bed
  - 1 of the largest contiguous eelgrass beds in North America
  - *Zostera marina* and *japonica*
- Shallow bay
  - 12 ft tidal range
  - Most of the bay is exposed at low tide
**Zooplankton Monitoring**

- Limited previous zooplankton work in Padilla Bay
- Compliments long term water quality and nutrient monitoring
- Serve as baseline

- Started mid 2007
- Once a month at 3 sites
- 153 µm mesh
- Identified to broad categories
• COPEPODite
  – Interactive Time-series Explorer module of the COPEPOD global plankton database project

• Online plankton time-series visualization toolkit
• Plankton, water quality and nutrient data
Total Zooplankton

- Ploeg
- Bayview
- Gong


Total Zooplankton per m³

0 10k 20k 30k 40k 50k 60k 70k 80k 150.0k
Data Analysis

- COPEPODite
Total Zooplankton

Ploeg

Bayview

Gong
Plankton ID Categories

- Copepods
- Crabs
- Barnacles
- Other Arthropods
- Annelids
- Gelatinous
- Mollusks
- Larvaceans
- Echinoderms
- Chaetognaths
- Unknown
Dominant Plankton Categories

- Annelids
- Copepods
- Larvaceans

Graph showing the dominance of these categories over the years 2008 to 2013 at different locations.
Annelid

Yearly Anomalies

- Ploeg
- Bayview
- Gong

Season Anomalies

- Jan + Feb + Mar
- Apr + May + Jun
- Jul + Aug + Sep
- Oct + Nov + Dec
Barnacles

- Ploeg
- Bayview
- Gong

Seasonal Anomaly

- Jan + Feb + Mar
- Apr + May + Jun
- Jul + Aug + Sep
- Oct + Nov + Dec
Crab Larvae
Data Analysis

- COPEPODite

![Diagram](image)
## Zooplankton Relationships

| SST | Total Zoo | Annelid | Crab Larvae | Barnacle Larvae | Copepod + Nauplii | Other Arthro | Chaetognatha | Larvaceans | Hydrozoans | Ctenophores | Unk Gel Zoo | Echinoderms | Mollusca | Other unkn | Chla | PO4 | NH4 | NO2 | NO3 | NO23 | temp at depth | sal | DO | pH | Turbidity | Hadley Sal | SAT Chl | Sur Winds |
|-----|-----------|---------|-------------|----------------|-------------------|--------------|--------------|-------------|------------|-------------|-------------|-------------|-----------|---------|-----------|-----|-----|-----|------|-----|------|-------------|-----|-----|-----|-----------|-----------|--------|----------|
| SST |           |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Total Zoo |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Annelid |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Crab Larvae |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Barnacle Larvae |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Copepod + Nauplii |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Other Arthro |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Chaetognatha |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Larvaceans |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Hydrozoans |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Ctenophores |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Unk Gel Zoo |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Echinoderms |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Mollusca |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Other unkn |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Chla |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| PO4 |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| NH4 |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| NO2 |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| NO3 |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| NO23 |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| temp at depth |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| sal |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| DO |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| pH |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Turbidity |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Hadley Sal |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| SAT Chl |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
| Sur Winds |         |         |             |                |                   |              |              |             |            |             |             |            |          |          |       |     |     |      |     |      |             |     |     |     |          |          |        |          |
Summary

Shallow Eelgrass Sites

• Total zooplankton has significantly increased since 2007

• Copepods and annelids are the dominant groups
  – vary year to year in which groups blooms and intensity of the bloom

Deep Water Site

• Increasing trend of zooplankton but not significant

• Copepods and Larvaceans are the dominant groups
  – Little variation in annual pattern

Comparative Analysis

• Few consistencies between or among sites

• Inconclusive results with water quality and nutrient data
Take Home Messages

- COPEPOdite is a great tool for analysis
- Longer time-scale to pick up trends with abiotic factors
- Even with broad categories and limited resources, community trends can be detected