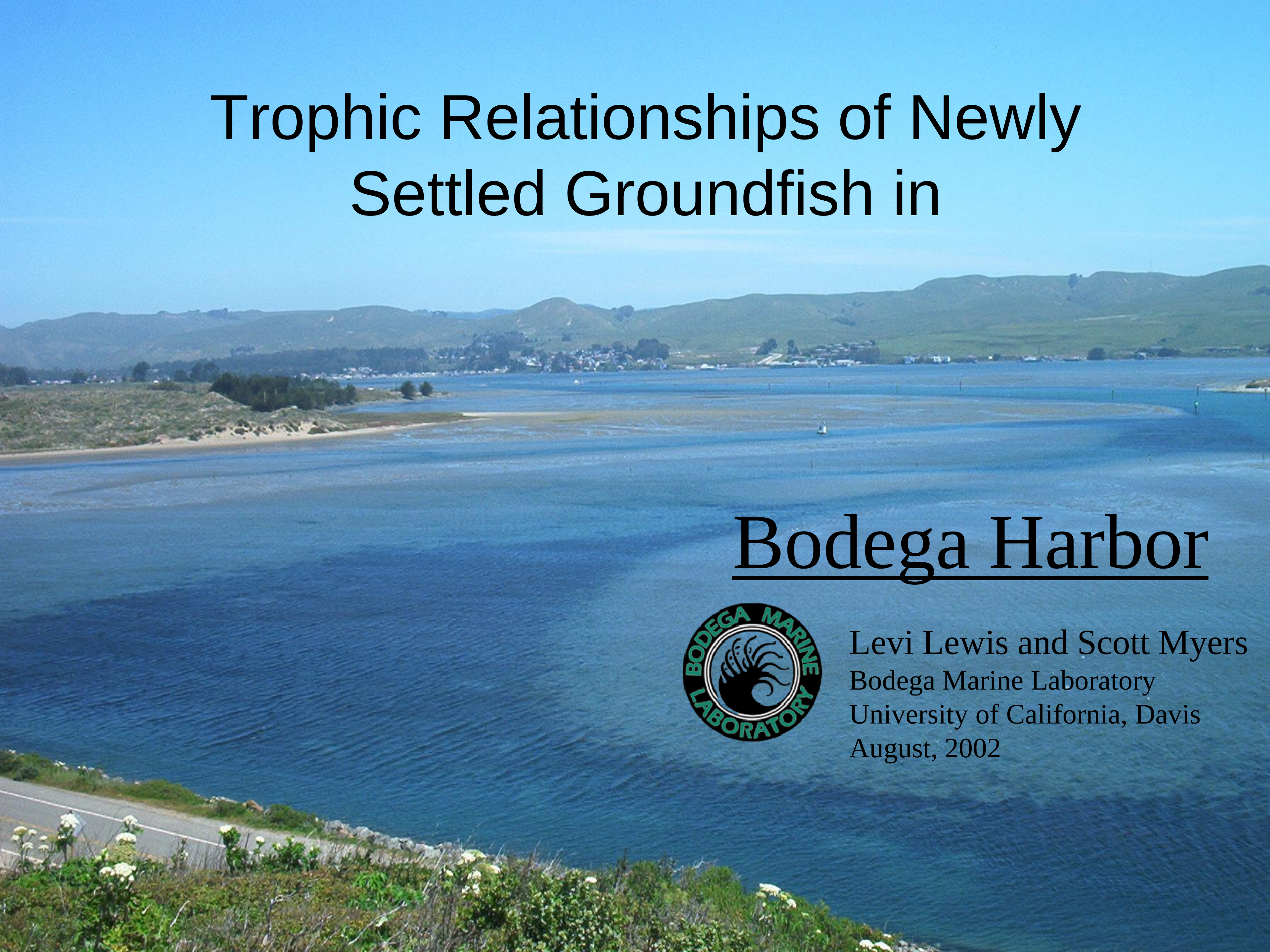


# Trophic Relationships of Newly Settled Groundfish in

# Bodega Harbor

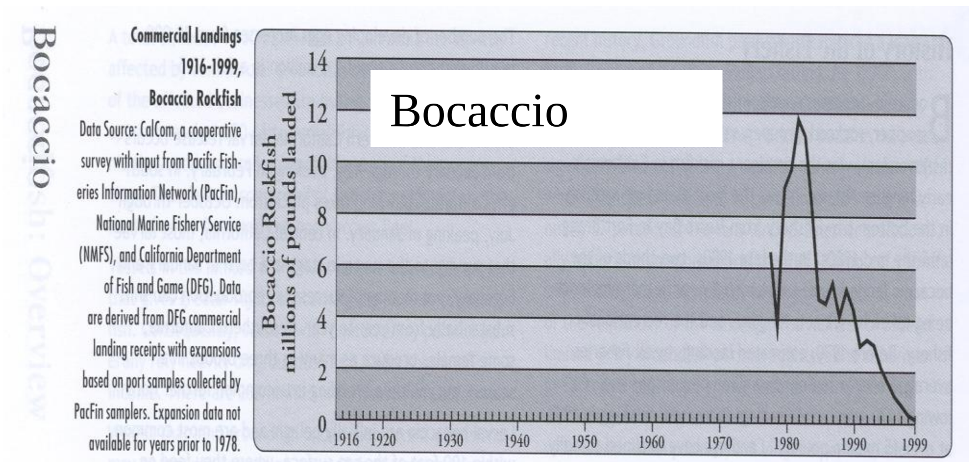
Levi Lewis and Scott Myers
Bodega Marine Laboratory
University of California, Davis
August, 2002

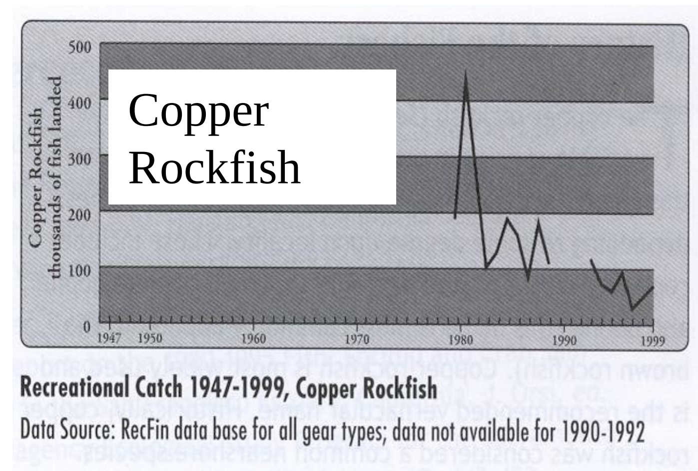
# Intro

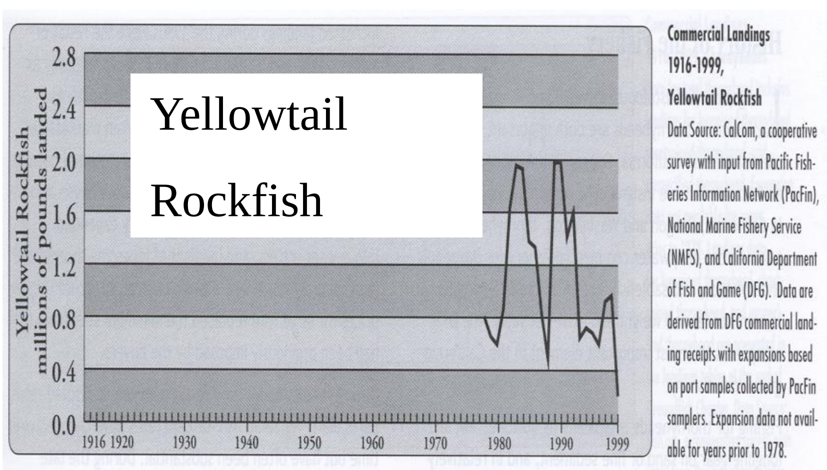
- Much on restoring Zostera beds known on east coast.  Recently being applied to west coast though new efforts (NOAA/BCDC/CALTRANS)
- Assumtion:  restoring structure = restoring community = spp. Relationships/functions—benefits of grass community.
- Can’t evaluate success of restoration if we don’t know what processes/spp. Relationships occur—specific benefits to look for. (e.g. large sterile grass beds do not perform desired function/give desired benefit).
- Numerous levels to look at:  infauna, epiphauna, nitrogen/carbon cycles, fish (residents/recruits density/diversity/interactions).
- Eelgrass has intrinsic and economic value.  Intrinsic-endemic spp. in native habitats-complexity-stability-etc.  Economic value:  Rockfish, lingcod, cabezon, dungeness, herring, perch.
- NSF funds research for intrinsic/scientific values.
- Resource agencies fund research for economic value.
- Look at economically important spp. (maximize value = intrinsic + economic)
  - Rockfish, lingcod, bocaccio recruits.
  - Little known about early life stages in eelgrass beds.
  - Look at timing of settlement, trophic interactions, ontogeny of these spp.

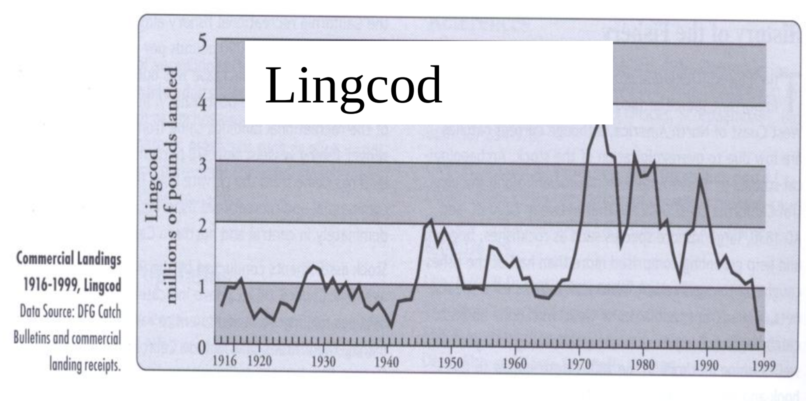
# Why Groundfish?

1. Highly exploited (yokalvich data?)



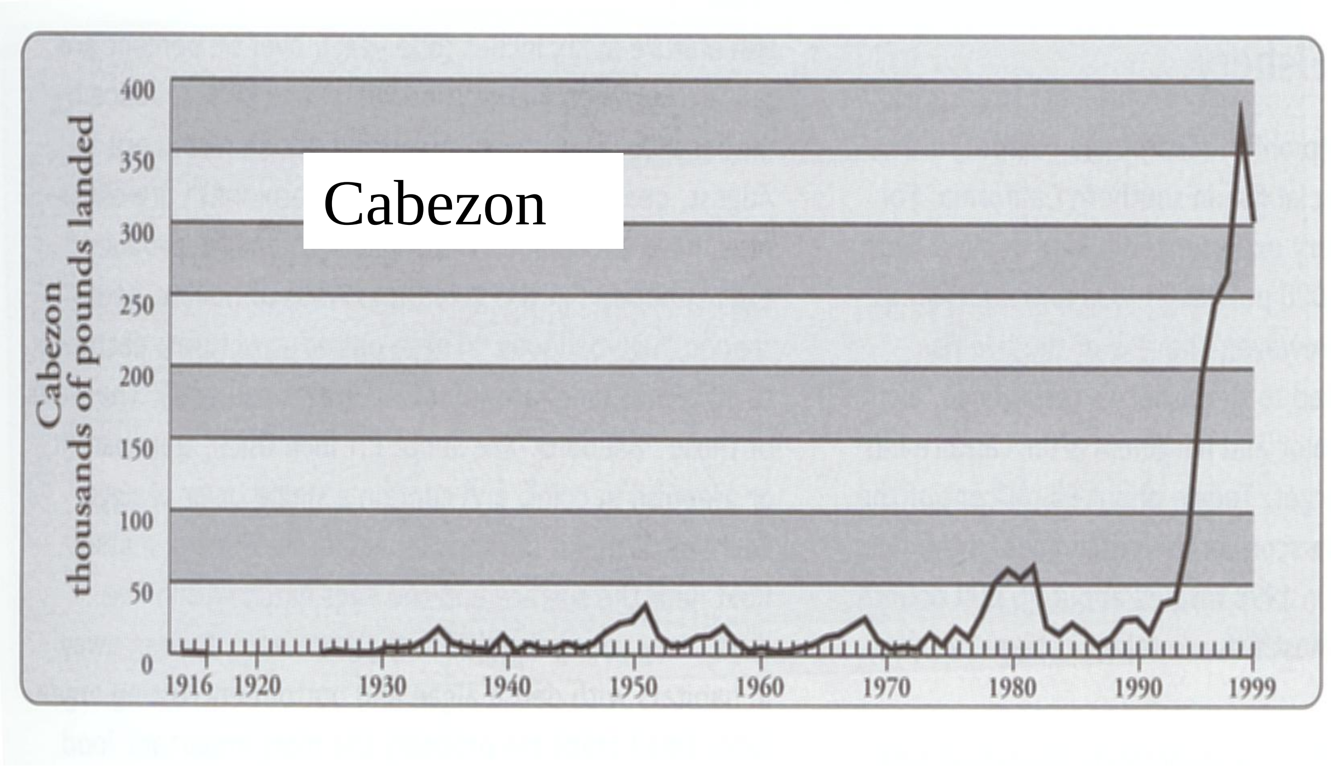



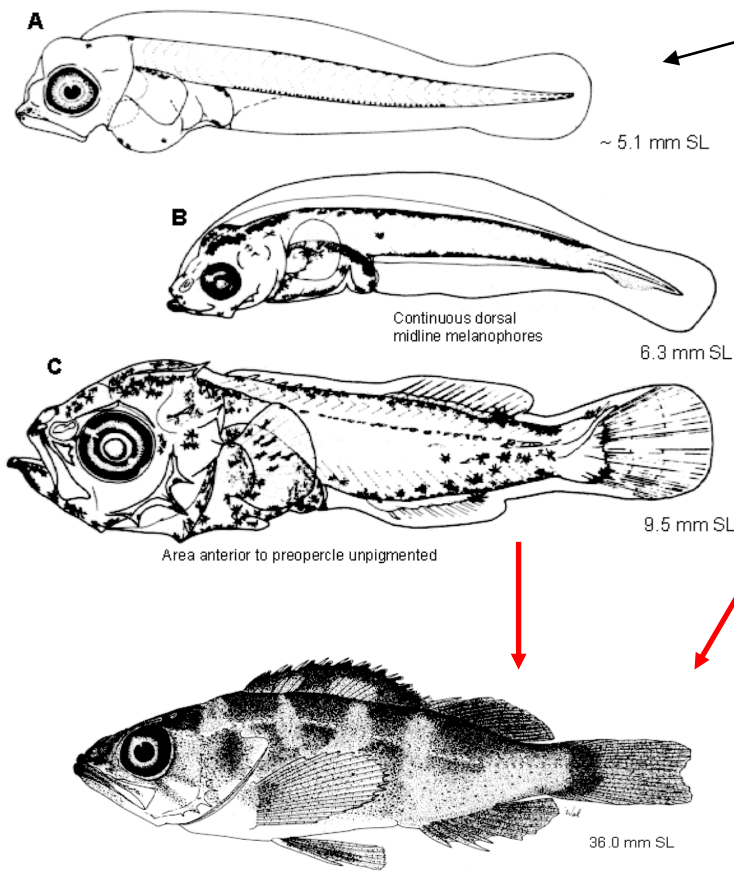
# Why Groundfish?

2. Increases in exploitation?



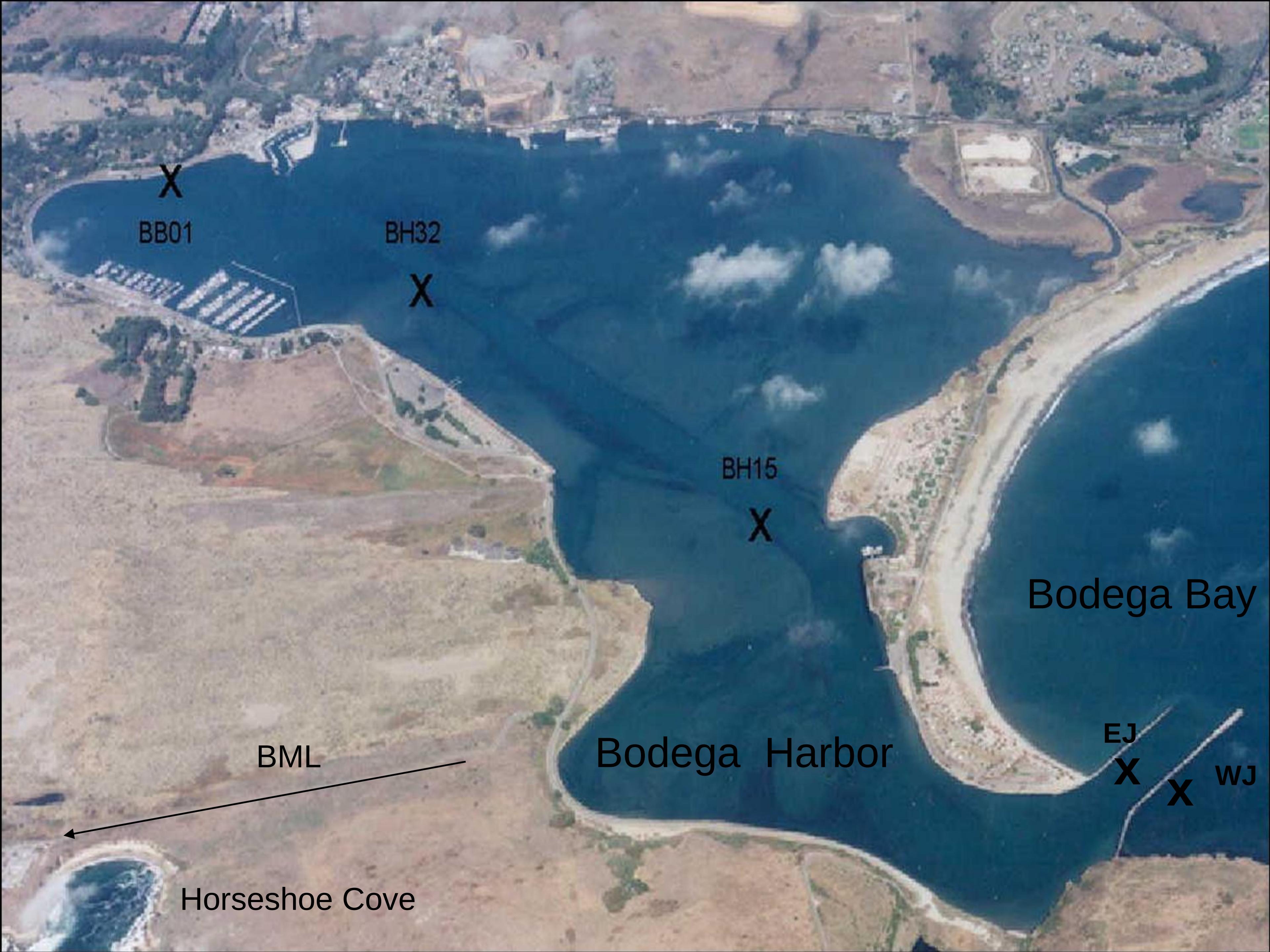

**Commercial Landings 1916-1999, Cabezon**
Data Source: DFG Catch Bulletins and commercial landing receipts.

# Life-History of Nearshore Scorpaeniform Fishes




Copper Rockfish (from www.fishbase.com)

- Larvae
  - Planktonic/Pelagic
  - Feed on zooplankton
- Juveniles ← SETTLEMENT
  - Demersal or pelagic
  - Near shore kelp, grass, or rocky habitat (bays)
- Adults
  - Offshore or inshore
  - Demersal or pelagic
  - Size generally increases with depth (Heincke's Law)

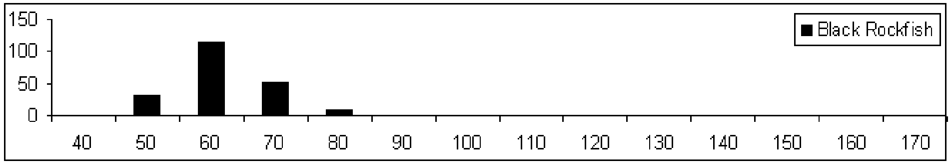

BB01
BH32
BH15
Bodega Bay
EJ
WJ
BML
Bodega  Harbor
Horseshoe Cove

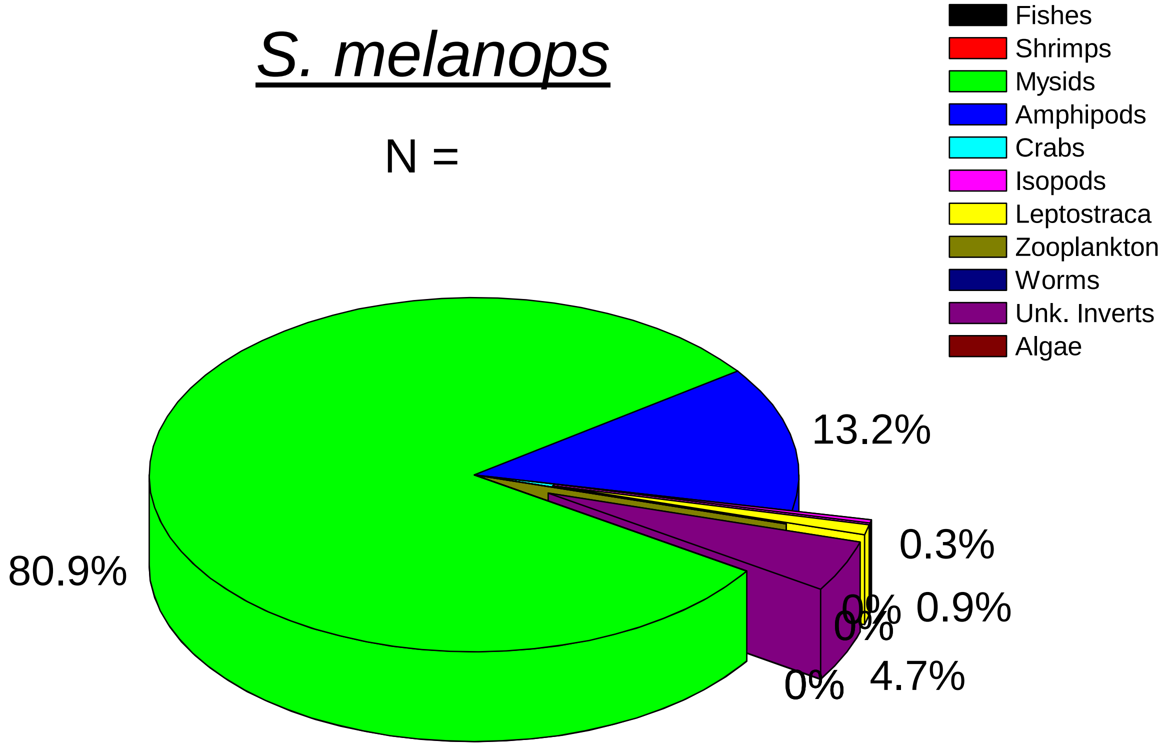
# Juvenile Groundfish Diet Study

Common invertebrate prey items (e.g. worms, amphipods, shrimps, isopods, zooplankton, etc.)

*S. melanops* juveniles

# Juvenile Groundfish Diet Study



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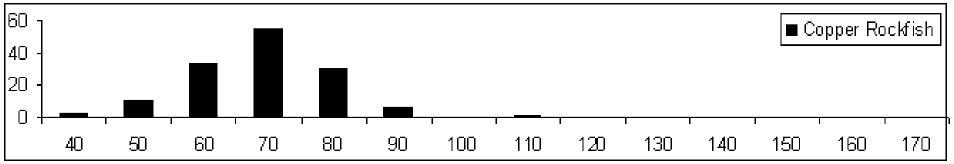


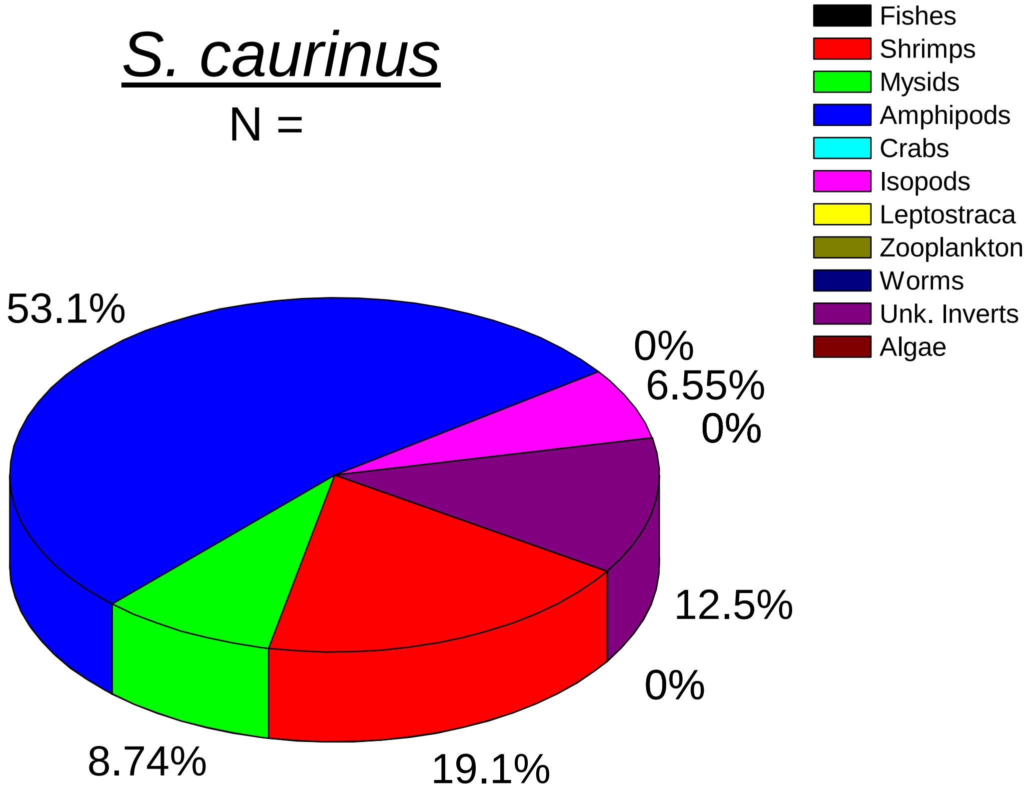

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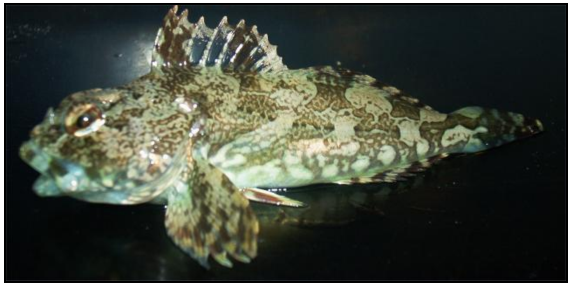

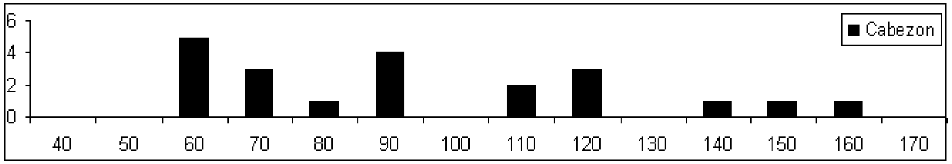


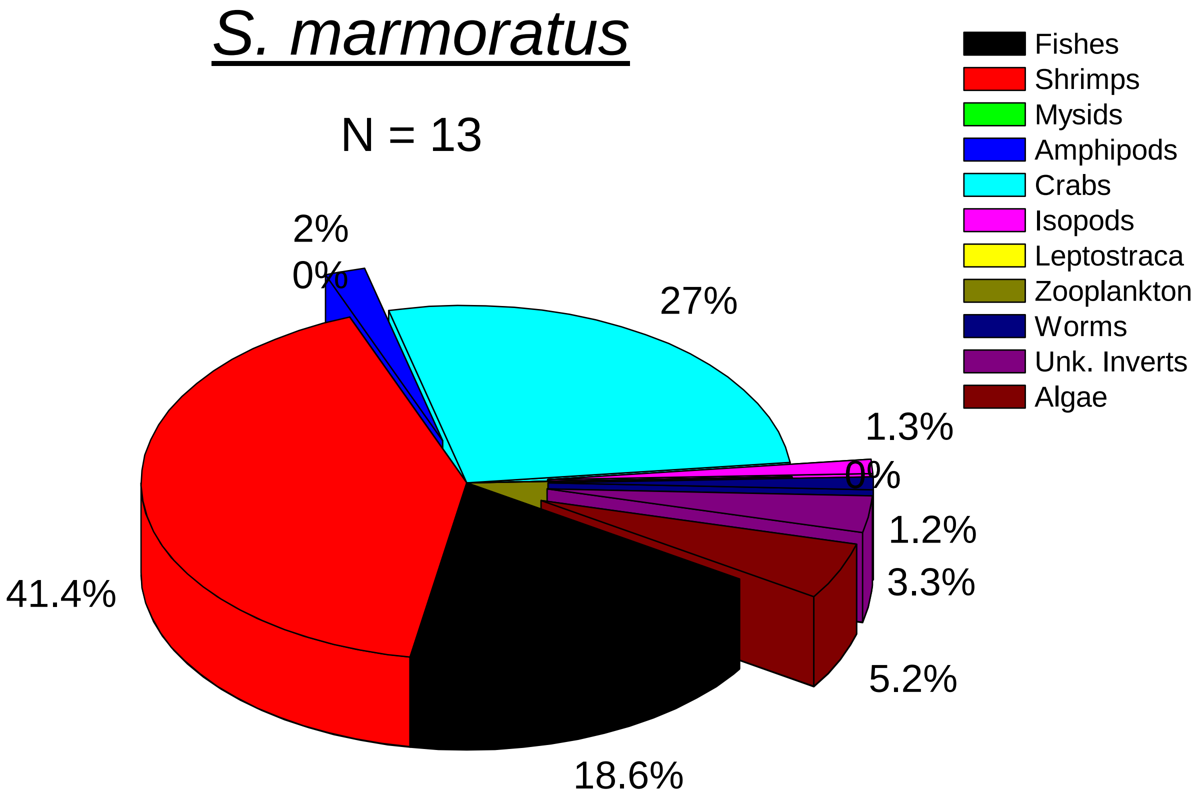

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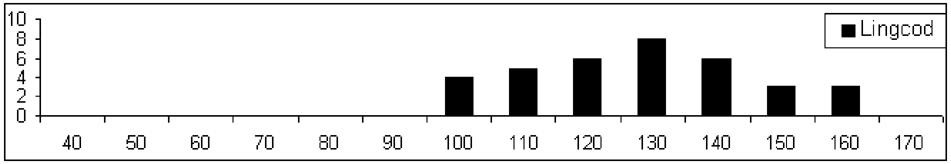
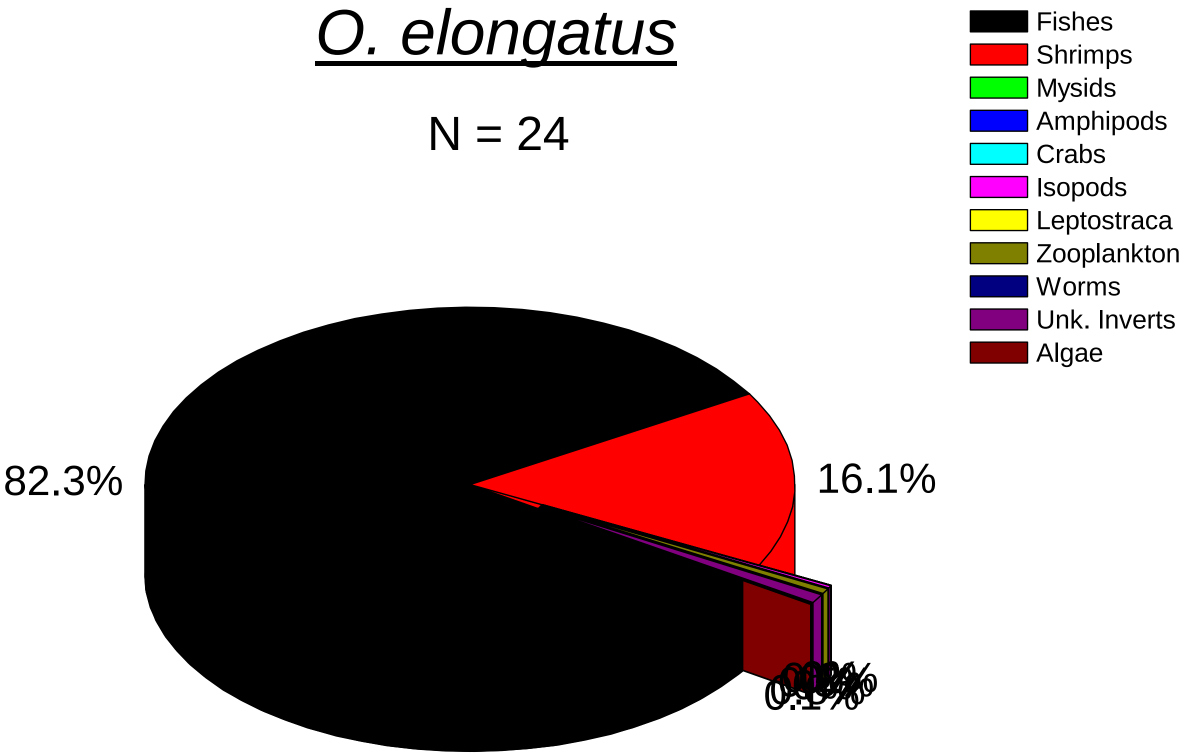
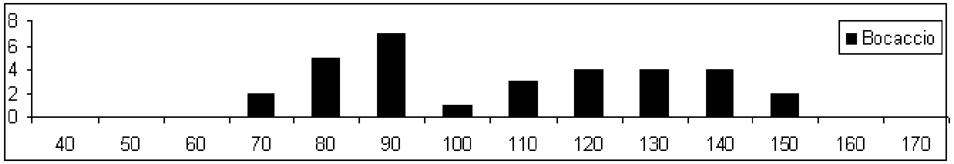
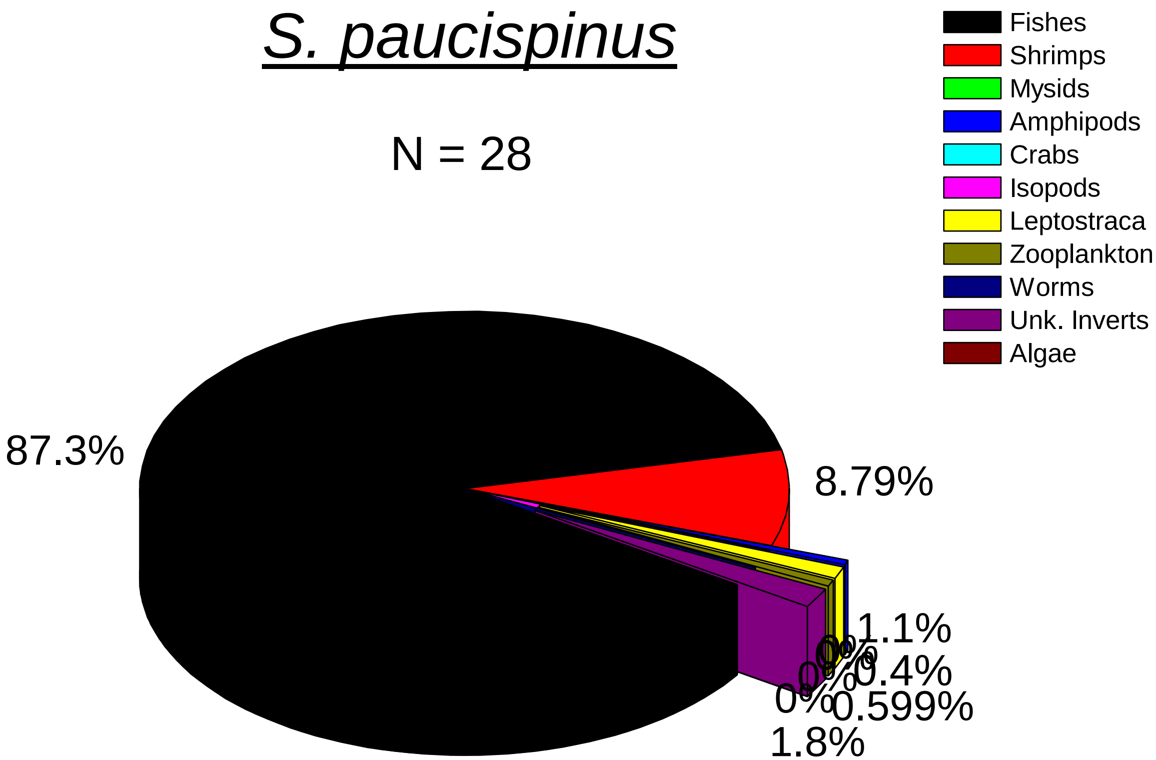


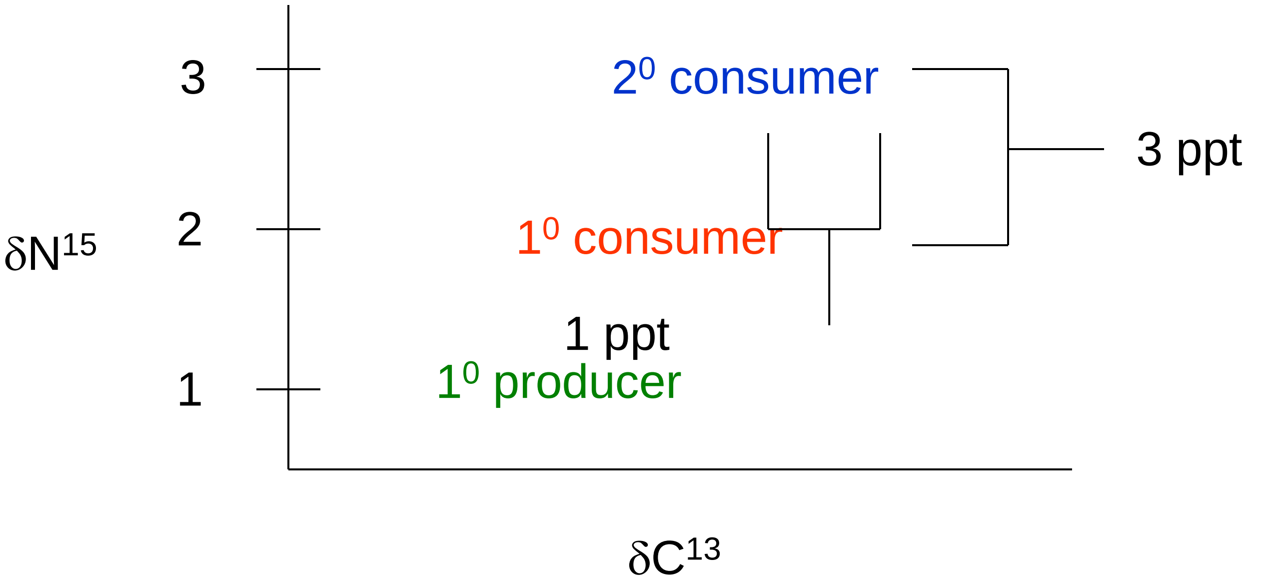
# Juvenile Groundfish Diet Study

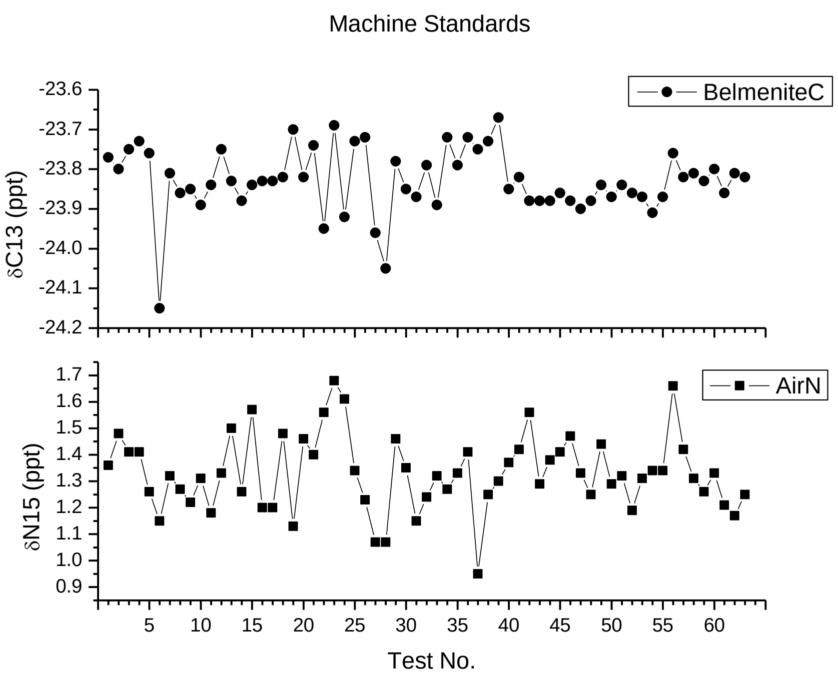



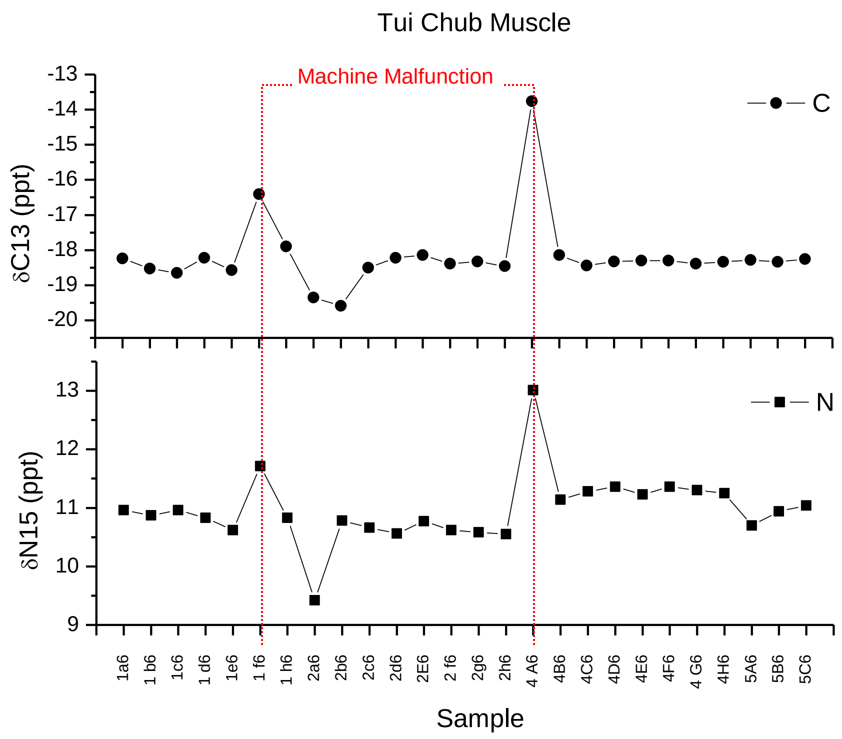
# Stable Isotope Refresher

- ✓ Tissue - dried, ground - analyzed in inductively-coupled plasma mass spectrometer (ICPMS Lab; UC Davis)
- ✓ Ratios of stable isotopes of nitrogen ($N^{15/14}$) and carbon ($C^{13/12}$) are measured and reported as $\delta N^{15}$ and $\delta C^{13}$ values.
- ✓ $\delta N^{15}$ reflects trophic position; $\delta C^{13}$ values reflect source of primary production.



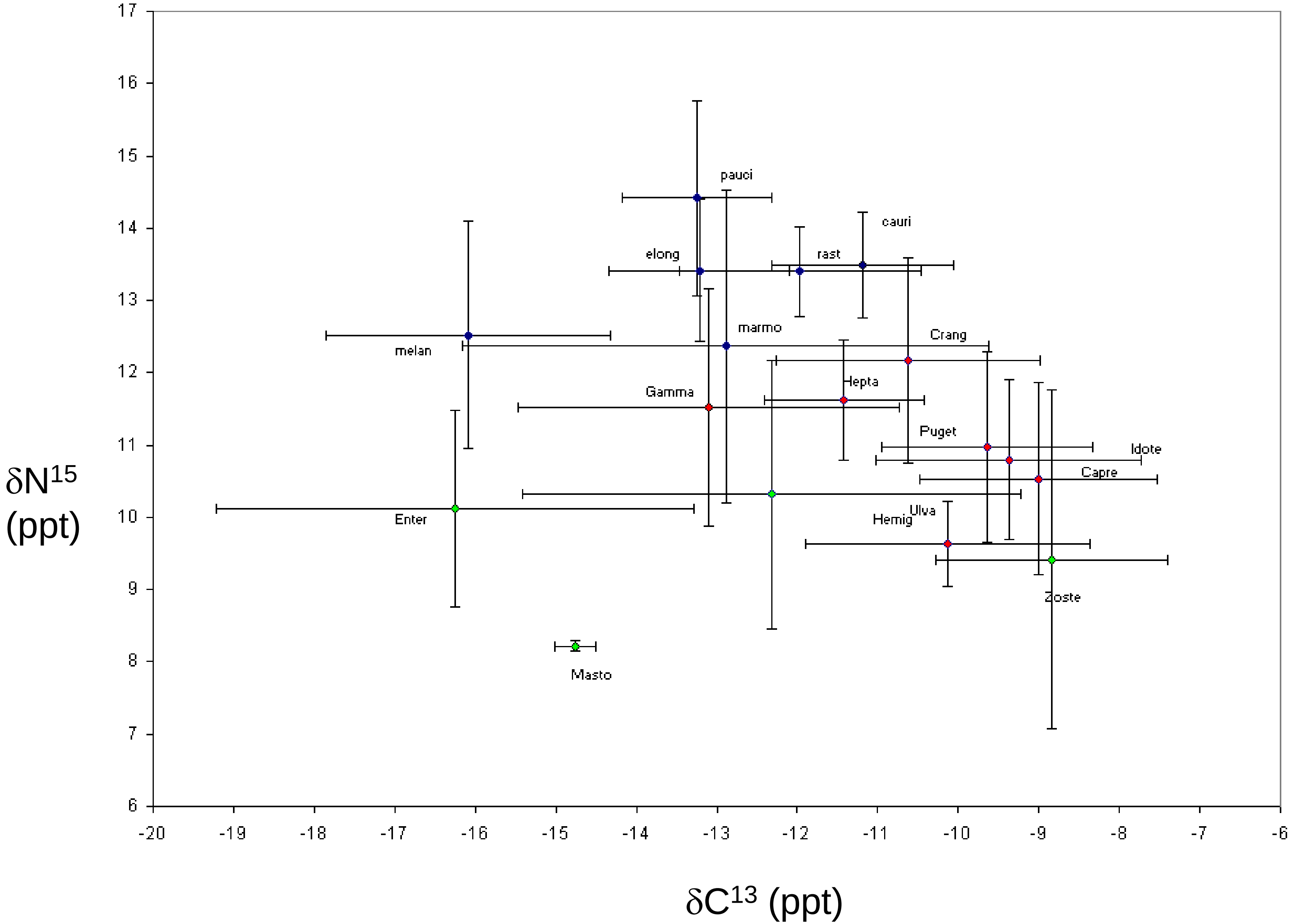
# Isotope Variability




| Sample | Isotope | Mean | STDEV |
|---|---|---|---|
| Machine Standard | N (air) | 1.33 | 0.14 |
| | C (Belmenite) | -23.83 | 0.08 |
| Tui Chub Standard | N (muscle) | 10.86 | 0.41 |
| | C (muscle) | -18.43 | 0.36 |
| Replicate Error | N (var) | 0.28 | 0.45 |
| | C (var) | 0.12 | 0.14 |

# Trophic Sub-structure of Bodega Harbor Eelgrass



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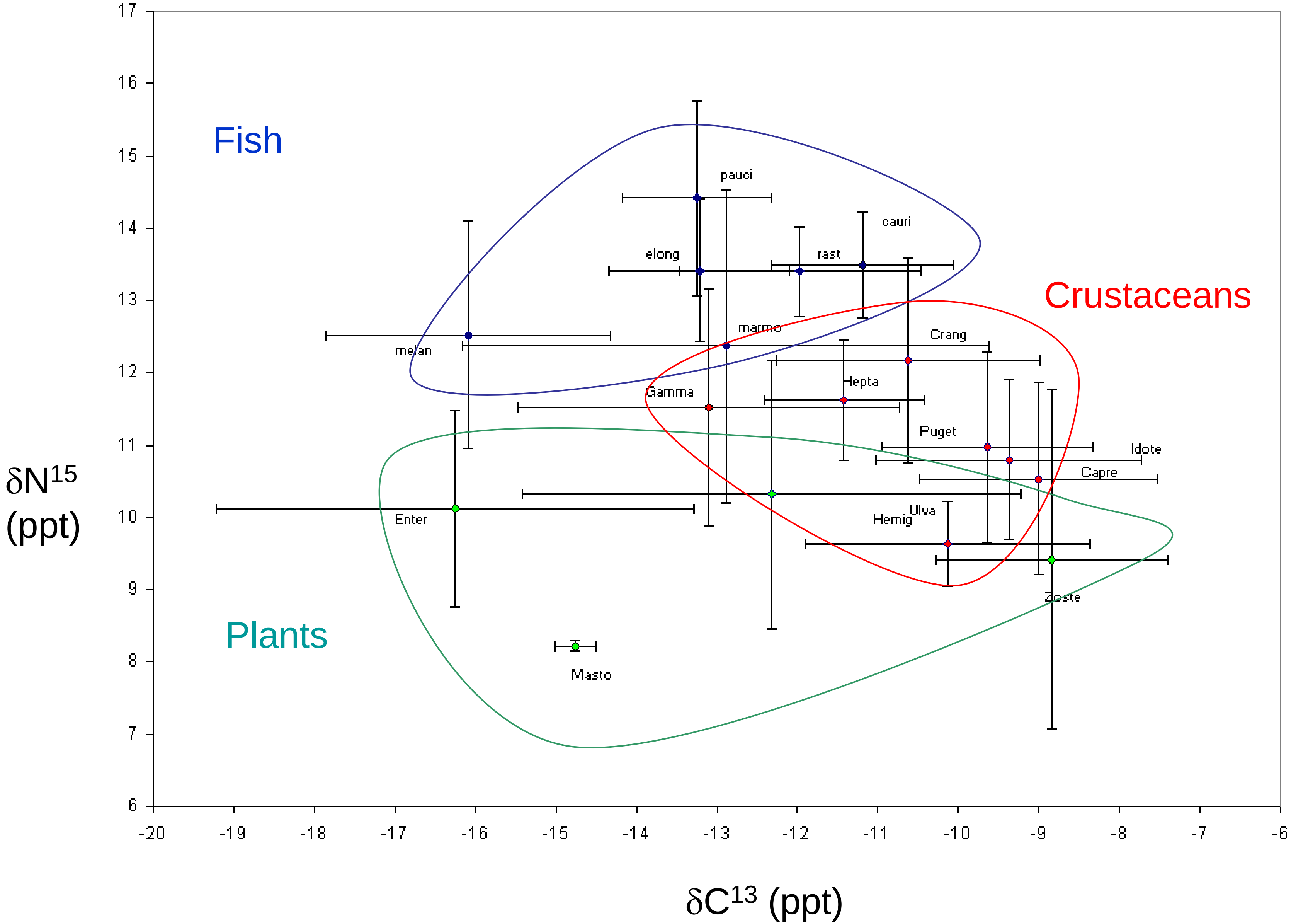

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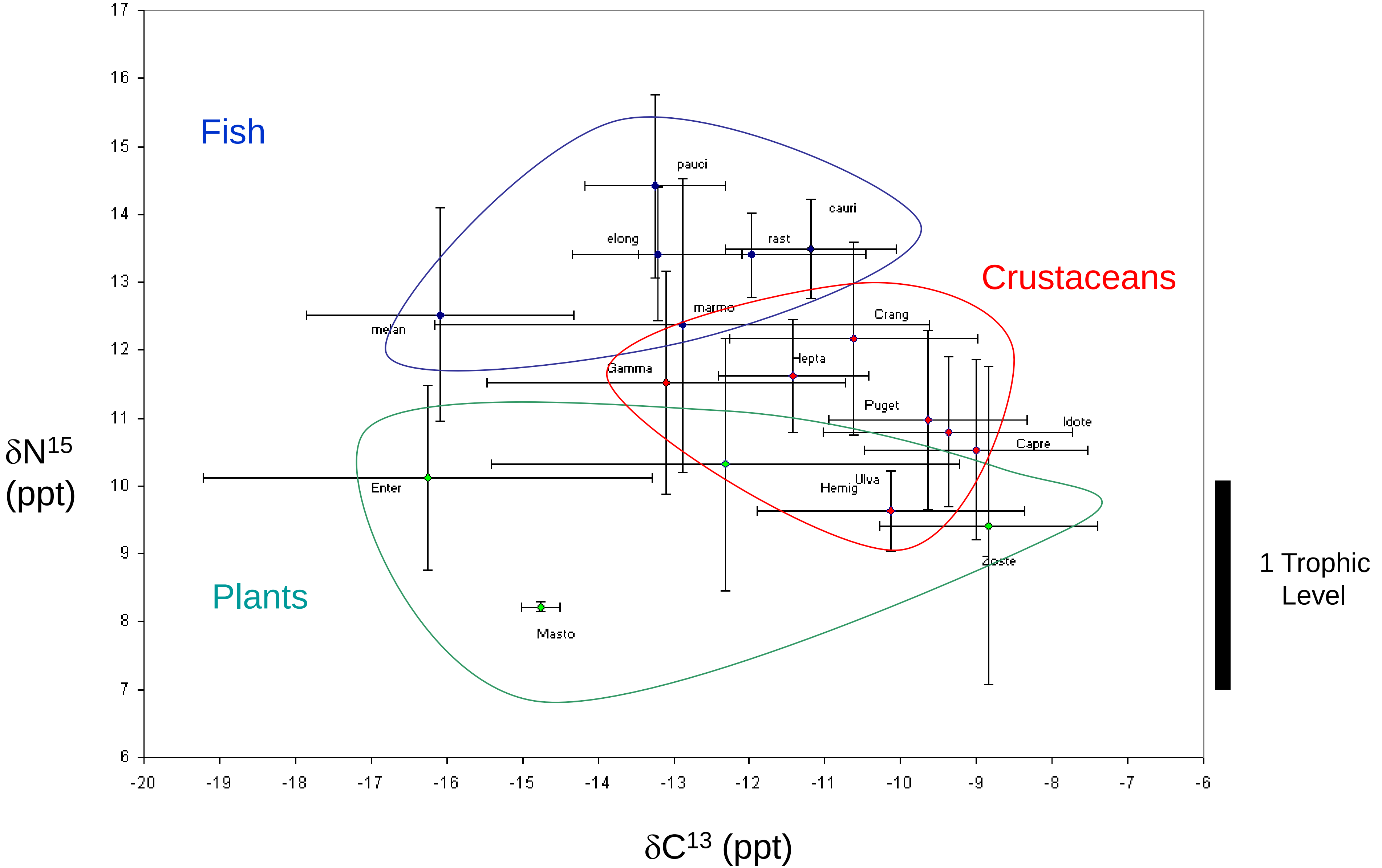

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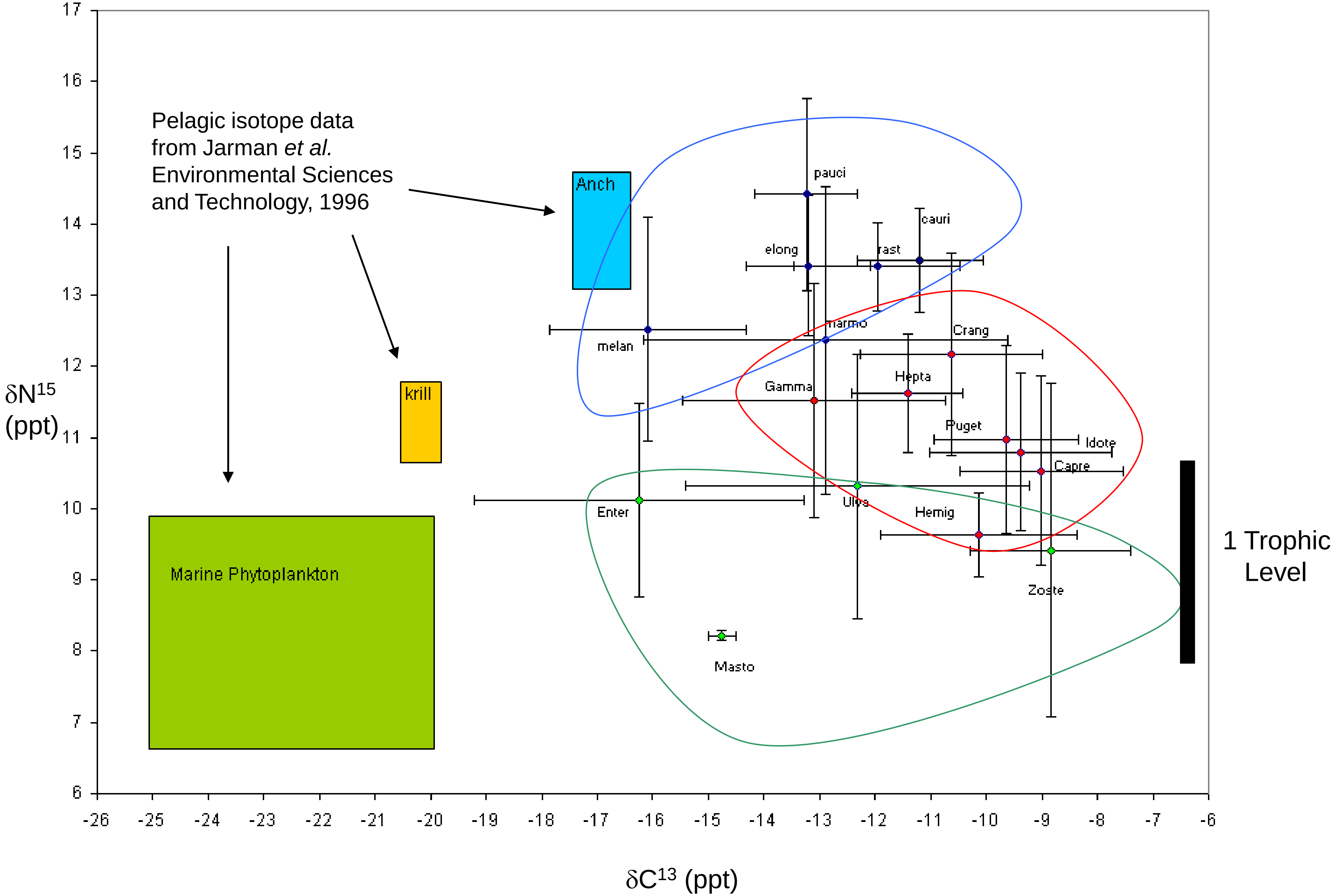

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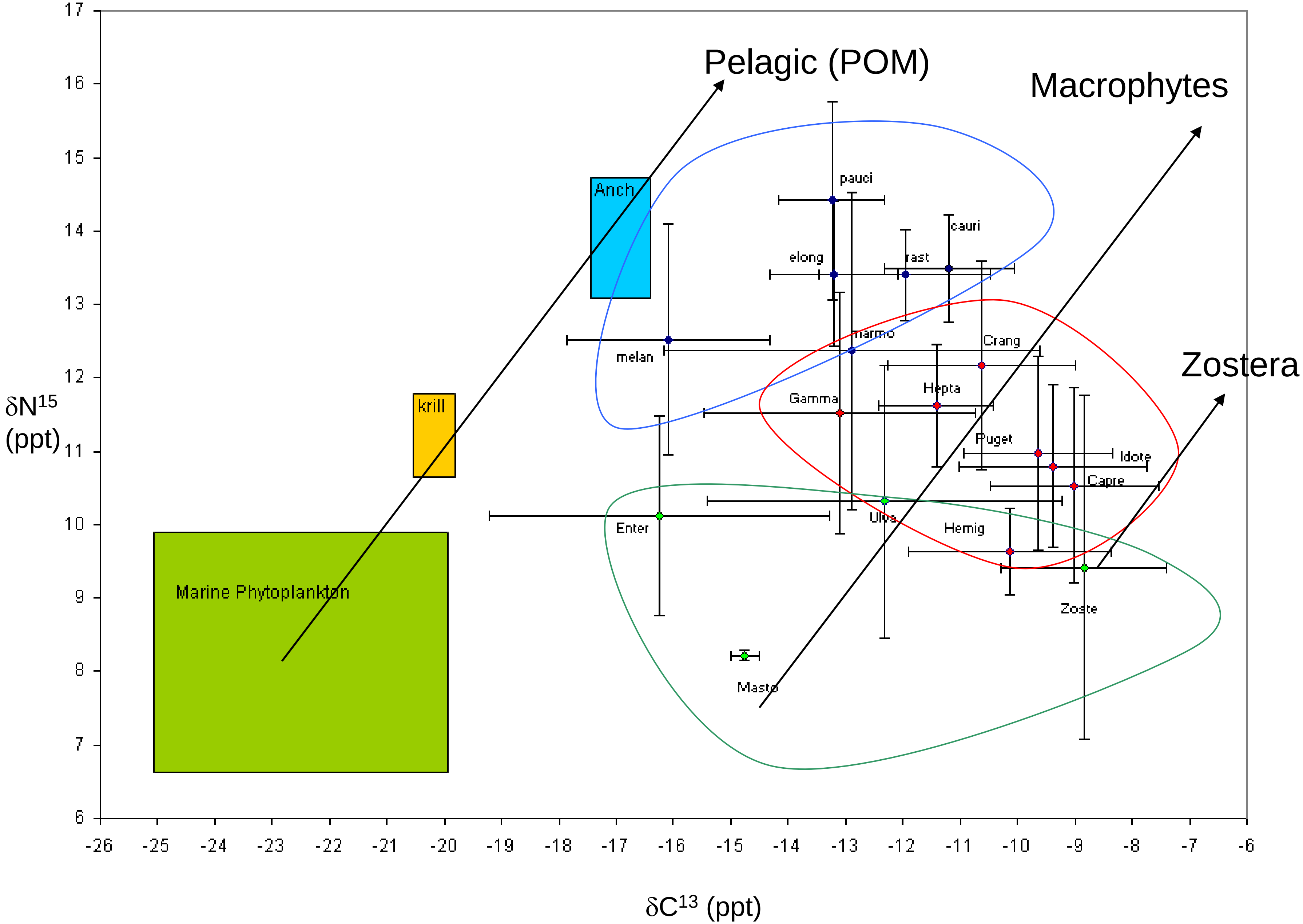

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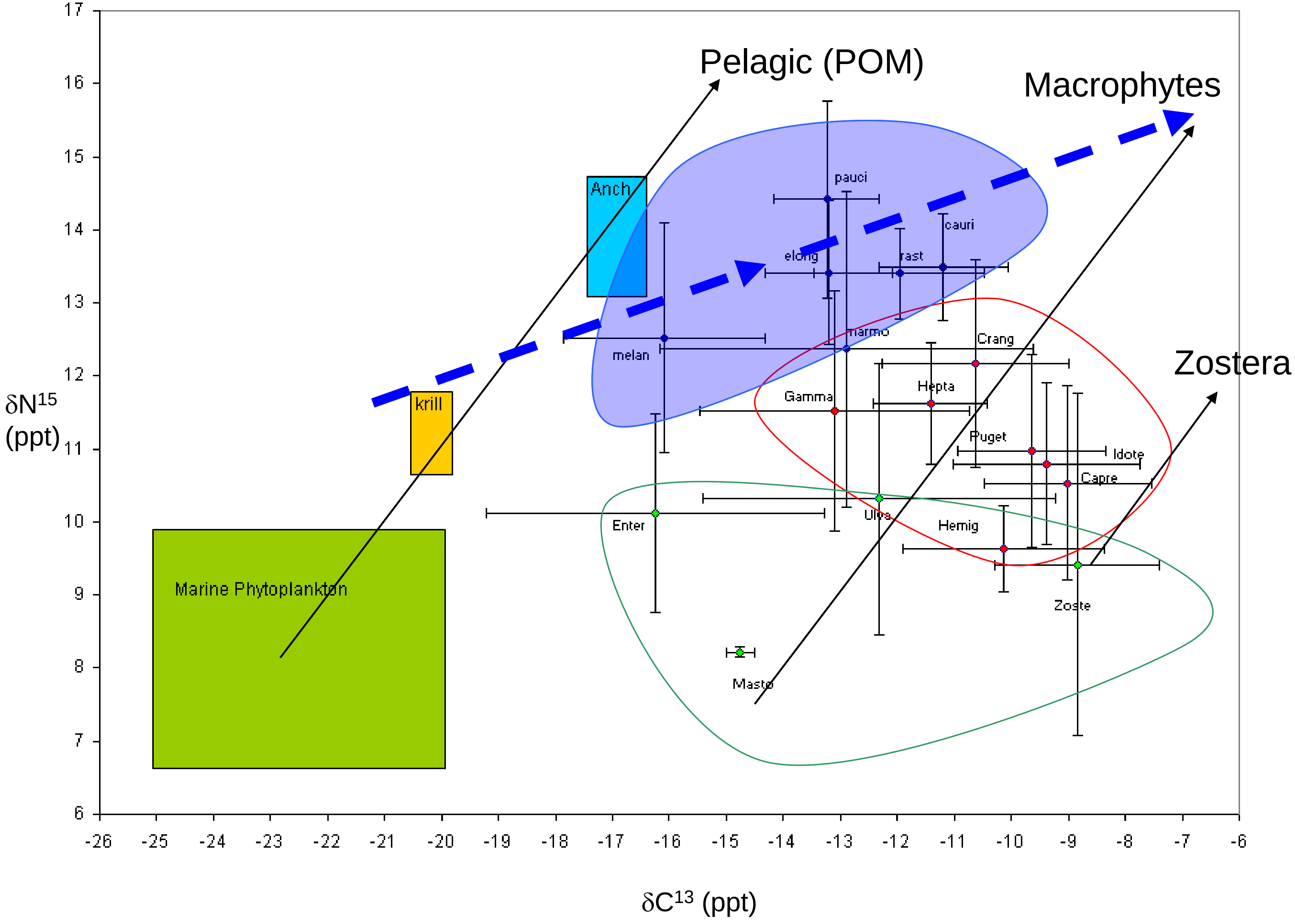
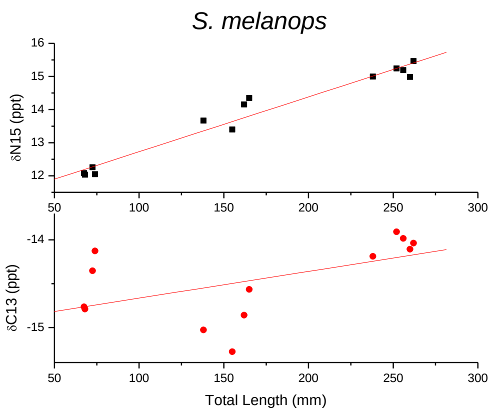
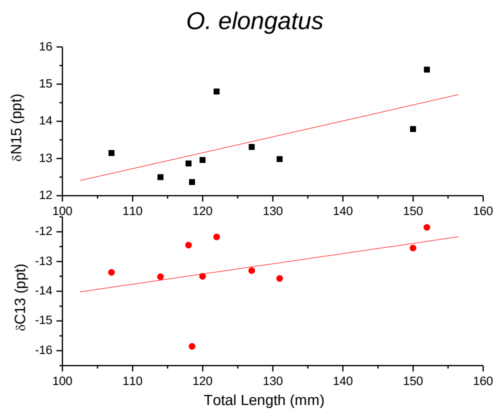
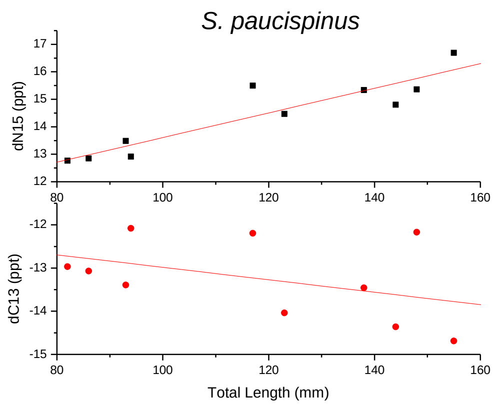
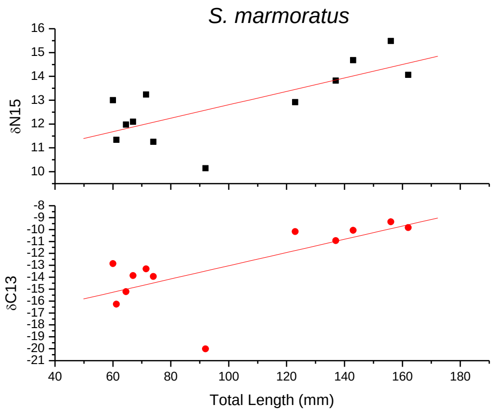


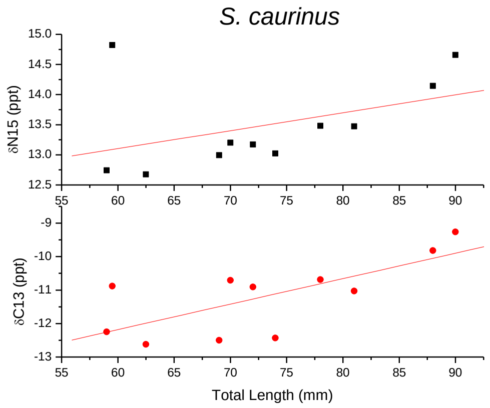
# Post-Settlement Ontogenetic Heavy Isotope Enrichment

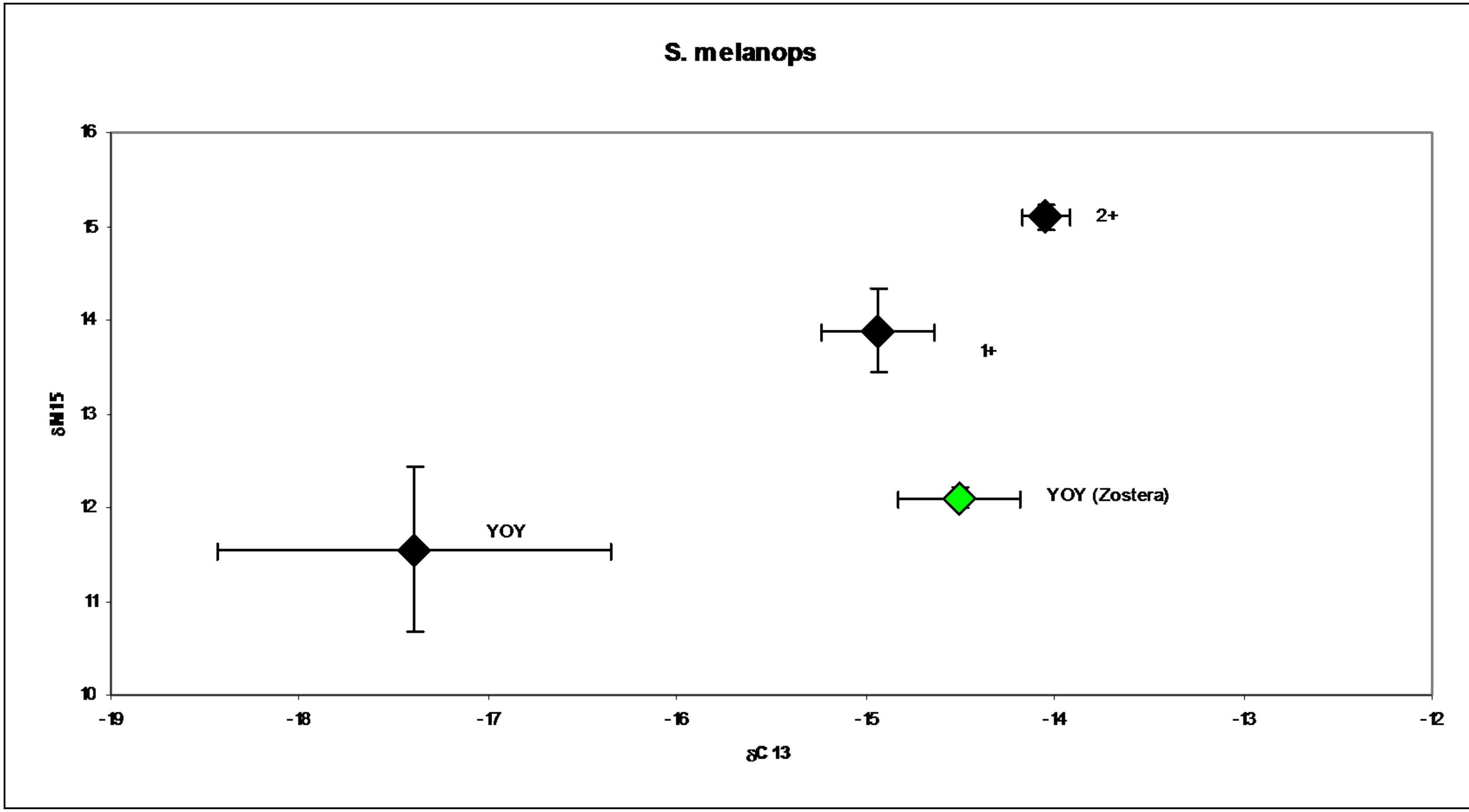



S. melanops
δN15
δC 13
16
15
14
13
12
11
10
-19
-18
-17
-16
-15
-14
-13
-12
2+
1+
YOY (Zostera)
YOY

# Isotopes vs. Gut Contents vs. Size

# Implications

- Herzka used isotopes to show time of settling (Hobbs and Julia showed we can validate with otolith settlement check).
- Maintaining mechanisms more important than maintaining numbers (can't account for stochasticity, but can maintain quality habitat for good recruitment years).
- Eelgrass beds with low productivity (lower fish growth) = slower rate of heavy isotopic enrichment.
- Eelgrass beds with anthro. nutrients may have faster rate of isotopic enrichment.
- Significance of micro-scale niche partitioning—radiation of sebastes?
- Eelgrass restorations. . .what is healthy? What is the target? (Caltrans/BCDC/NOAA fisheries)
- Quality of eelgrass as nursury habitat for one spp. may be HIGHLY compromised by good/poor recruitment years of other spp due to complex relationships (intraguild predation: holt/Gary Polis).

# Future

- Otoliths:  compare growth rates of individuals settling in/out harbor.
- Otoliths:  microchem-local recruitment?
- Eelgrass:  spatial patterns/fish patterns (density/annual-perennial beds)/genetics
- More spp. (residents-stickleback/pipefish/