Larval Decapod Assemblages of the Northern California Current are modulated by upwelling-driven frontal dynamics

Juan G. Gutierrez Bravo, Lorenzo Ciannelli, Rose Von Eckartsberg
Oregon State University – CEOAS
Fisheries Oceanography Laboratory

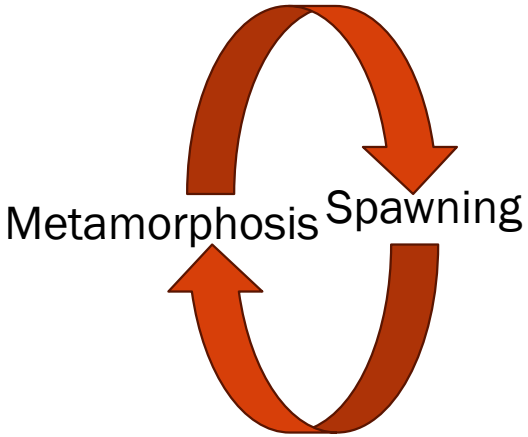


Oregon State University
College of Earth, Ocean, and Atmospheric Sciences

The life cycle of decapod crustaceans from the Northern California Current (NCC)



Adult

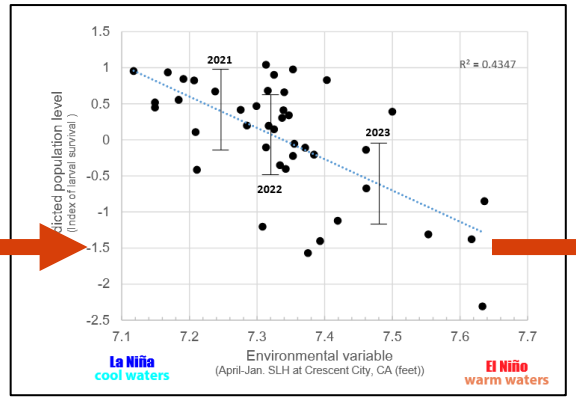


Larva

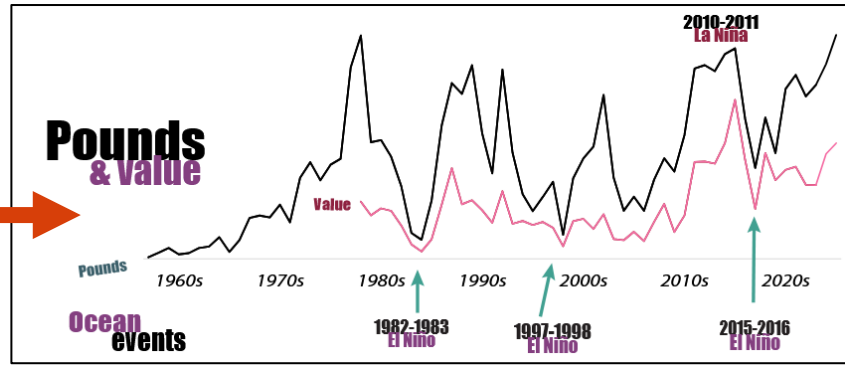


- Marine decapods have complex life cycles
- Spawning time and pelagic larval duration are linked to the upwelling period in the NCC
- Variations in upwelling phenology/intensity affect larval survival → recruitment → catch
- **How** does this relation occur?

Upwelling variability



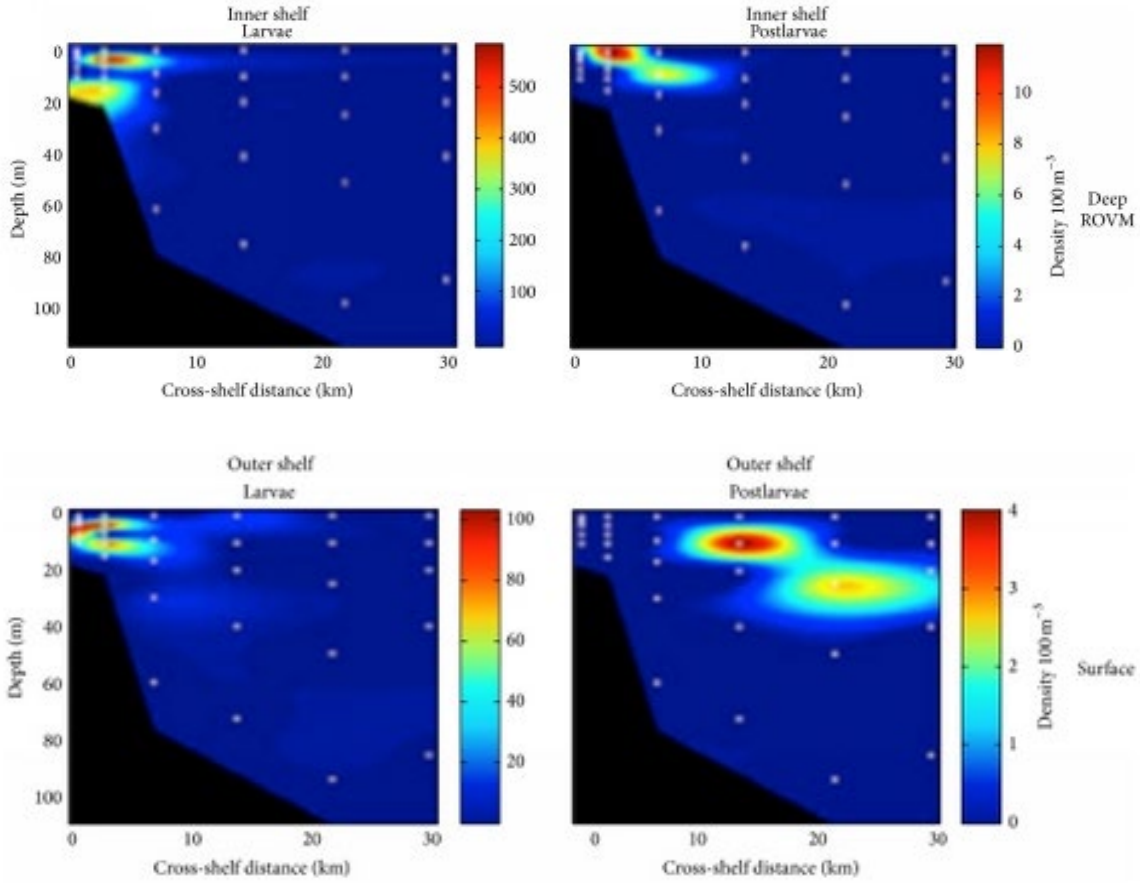
Population variability



Decapod larval ecology in the CC

- Further south, diel/ontogenetic vertical movements seem to be larval retention mechanisms
- However, distributions of decapod larvae are not reported for the NCC
- In fact, most decapod larvae remain undescribed

Bodega Bay, CA

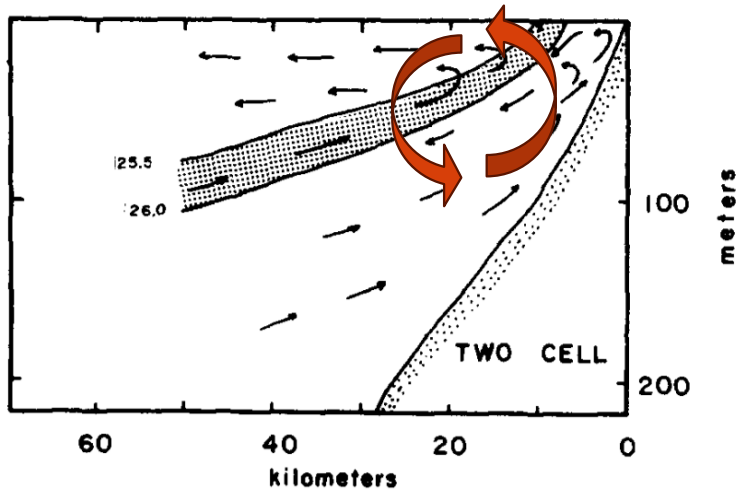


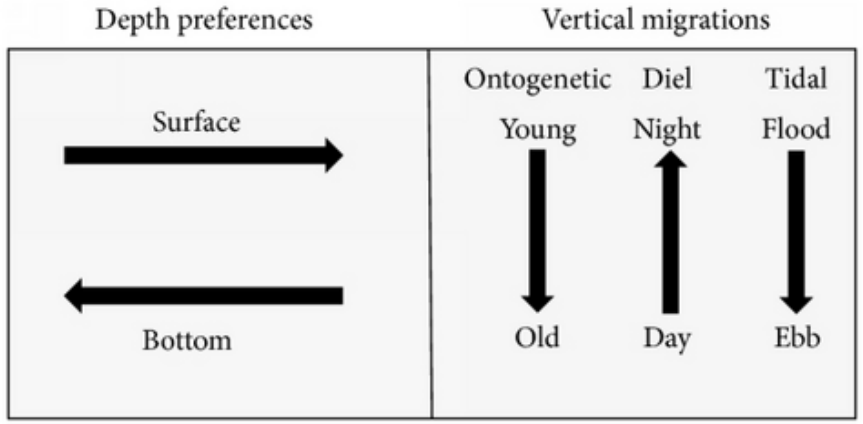
Morgan et al. 2009

Coastal retention in upwelling regions

- Upwelling-driven cross-shore transport is depth-dependent:
  - Offshore near surface
  - Onshore near bottom
- Vertical motions could achieve larval retention

Peterson, Miller and Hutcinson 1979





Morgan 2014

Research structure

Objective: To characterize taxon- and stage- specific vertical and cross-shelf distribution of larval decapods during an upwelling season (May-July 2025).

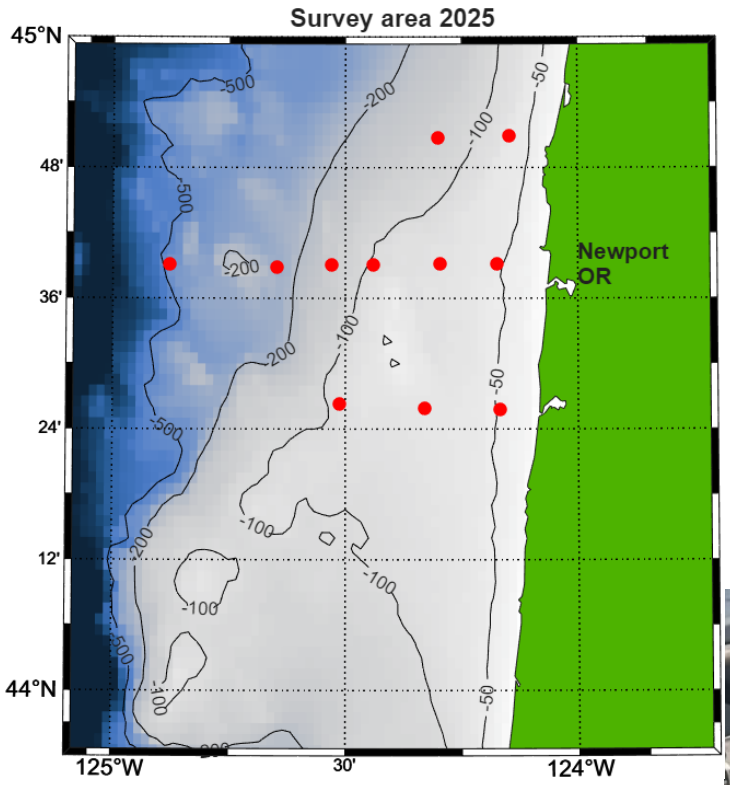
H1: Horizontally, an **upwelling front** will define a **boundary** between **coastal/oceanic communities**

H2: Vertically, later larval stages should have a **wider vertical distribution** than earlier zoea stages.

H3: Temporally, we expect a **winter ⟶ spring spawner shift**

Methods: On board sampling at NH Line

- *RV Pacific Storm*
  - May 15-16
  - June 23-24
  - July 23-26
- Vertical sampling with Multinet MIDI 300 µm
  - 0-25 m
  - 25-50 m
  - 50-75 m
  - 75-100 m
  - 100-150 m
- Samples fixed in formalin

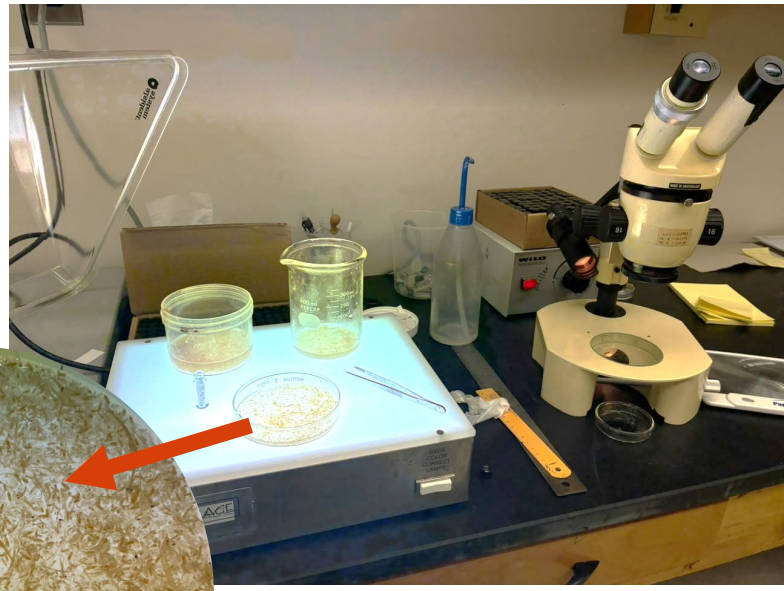






Methods: Sorting, ID and data analysis

- Decapod were isolated on a backlit tray
- Identified under a stereoscopic microscope
- Zoea and megalopa stages were treated as independent ‘larval forms’
- COI-genotyping of larval types (pending)
- Abundances were standardized (larvae m^{-3})
- The Bray Curtis distance was calculated (4th root)
- Groups were formed in a dendrogram
- Data was scaled to 2D (NMDS)







Key ID Refs:

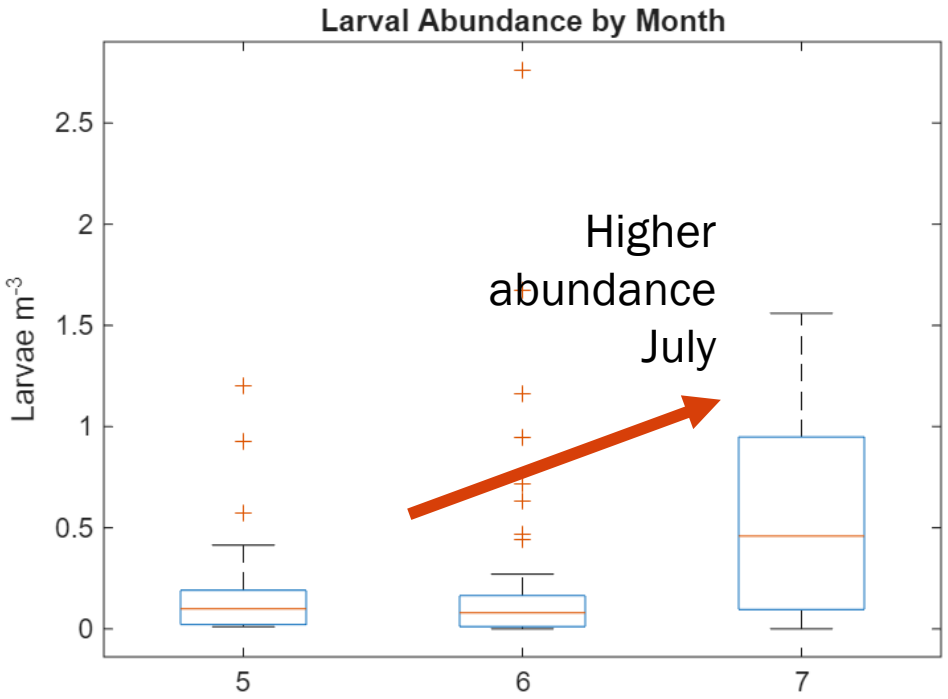
Shanks, A. An identification guide to the larval marine invertebrates of the Pacific Northwest. (2001).

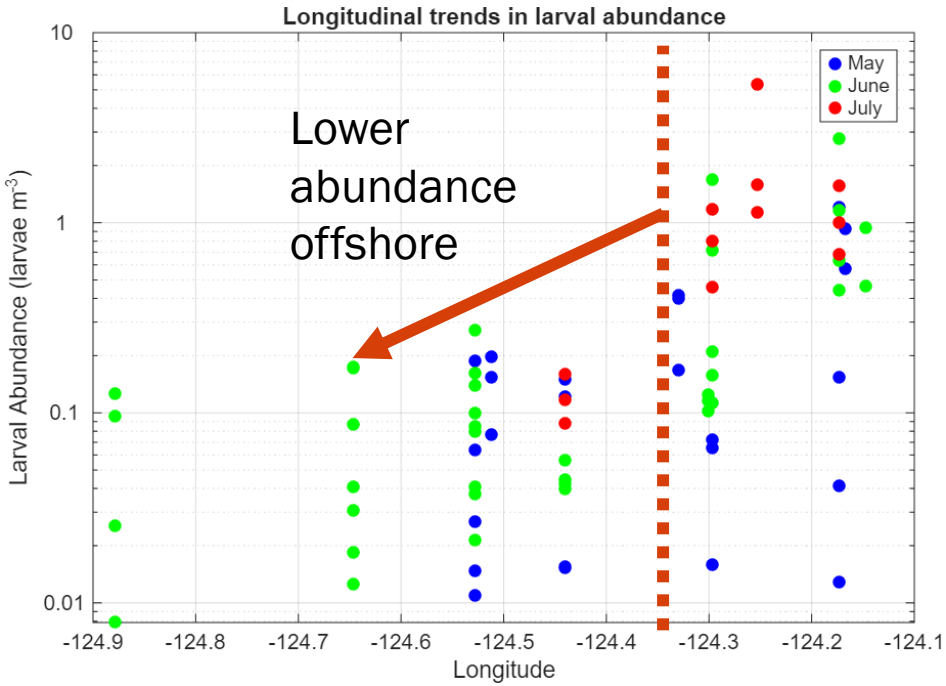
Haynes, E. B. Morphological development, identification, and biology of larvae of Pandalidae, Hippolytidae, and Crangonidae (Crustacea, Decapoda) of the northern north Pacific Ocean. Fishery Bulletin 83, 253–288 (1985).

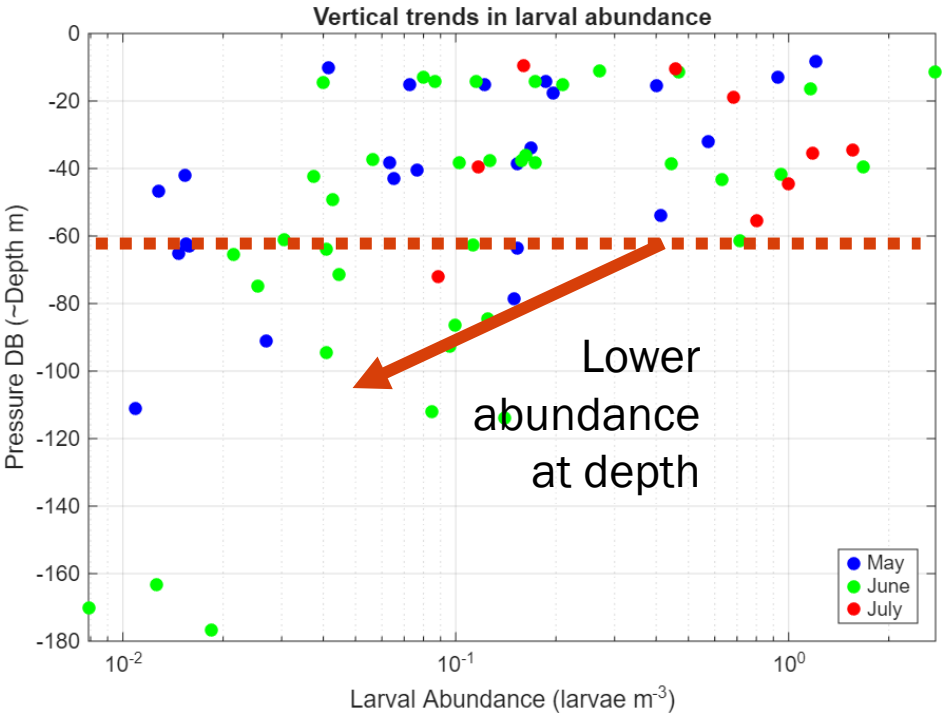
Lough, R. G. Dynamics of Crab Larvae (Anomura, Brachyura) off the Central Oregon Coast, 1969-1971. (Oregon SU, 1975).

Results: Decapod larval abundance

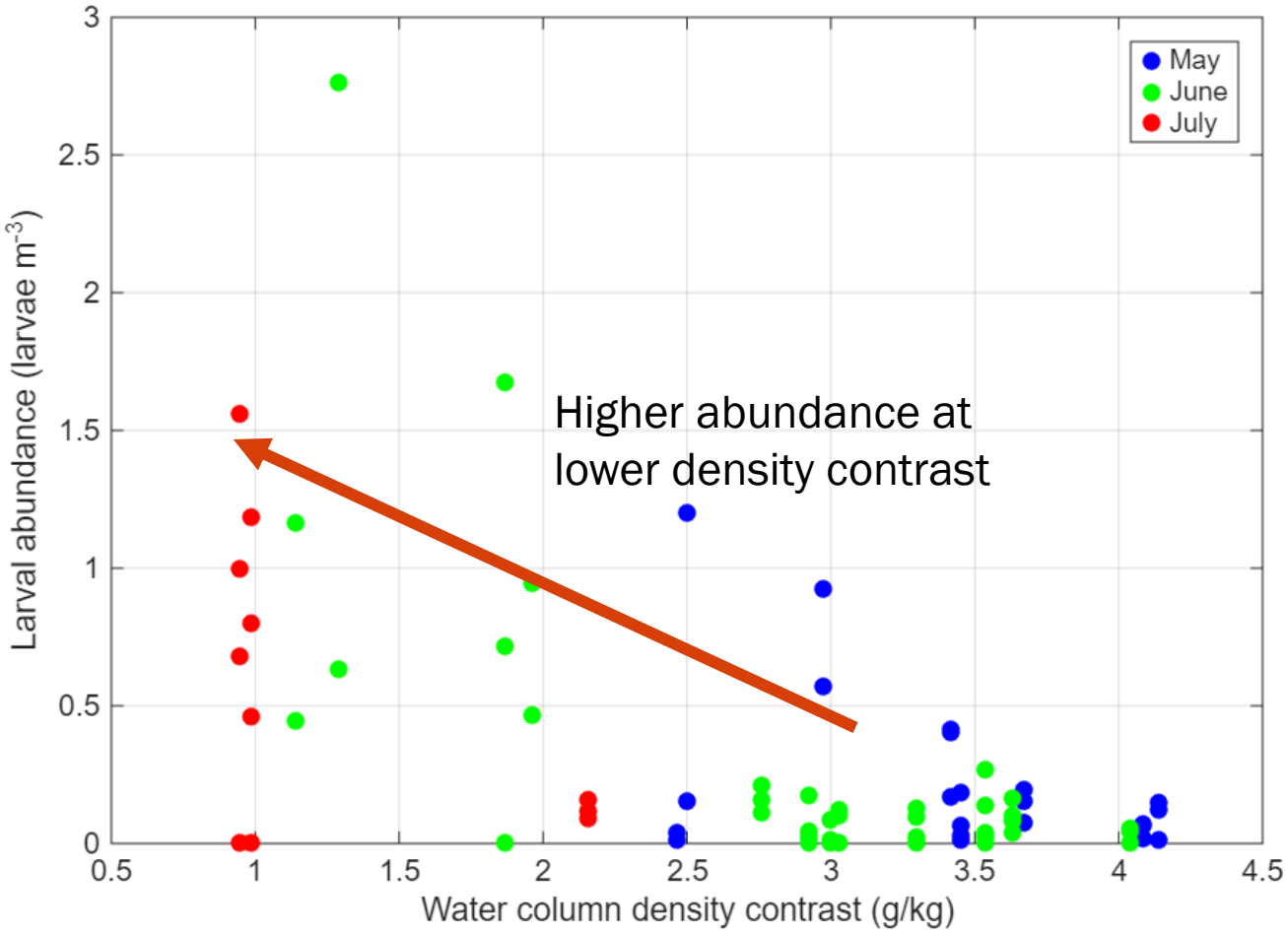
- Temporal abundance gradient
- Cross-shore abundance gradient
- Vertical abundance gradient

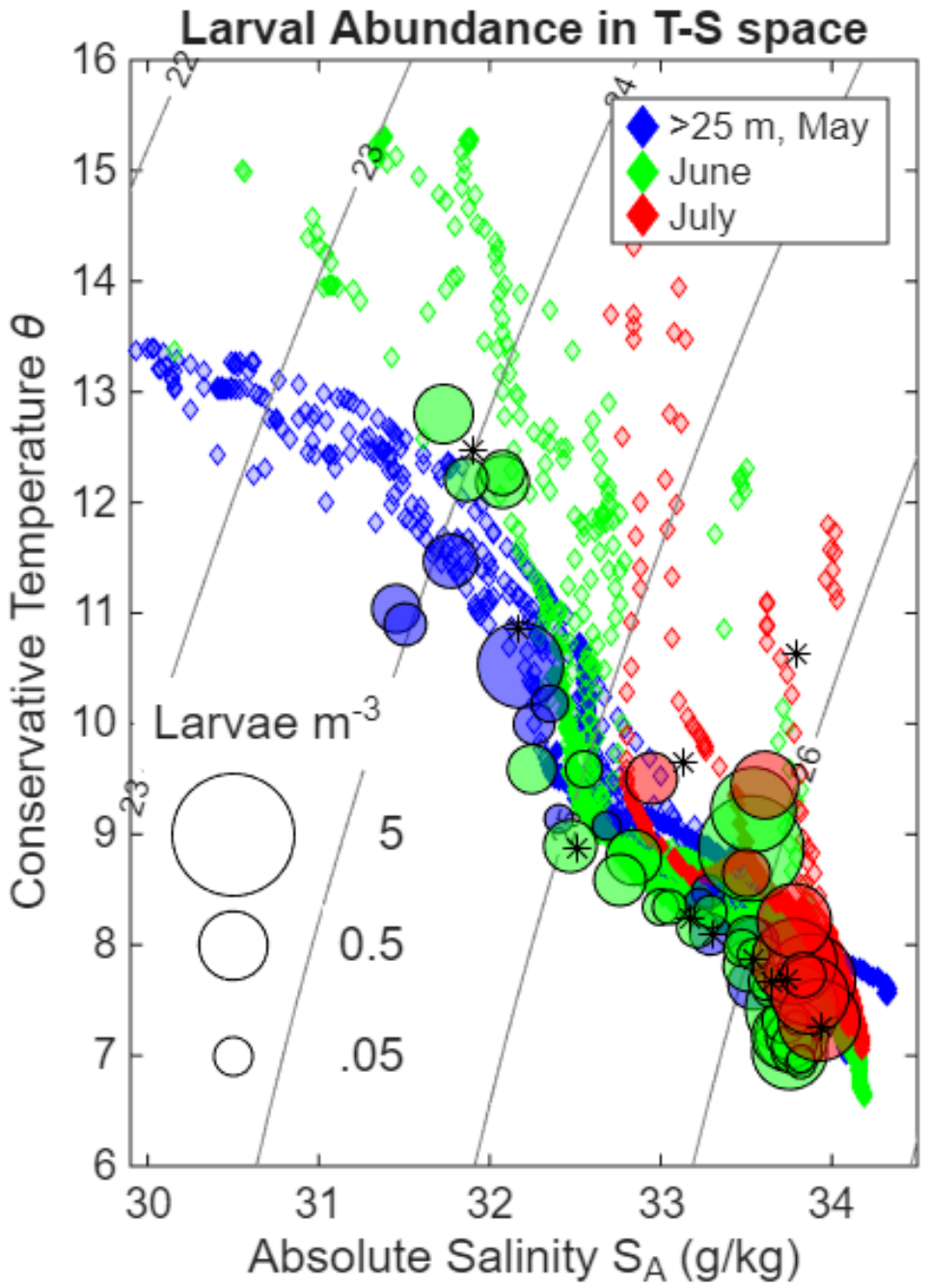




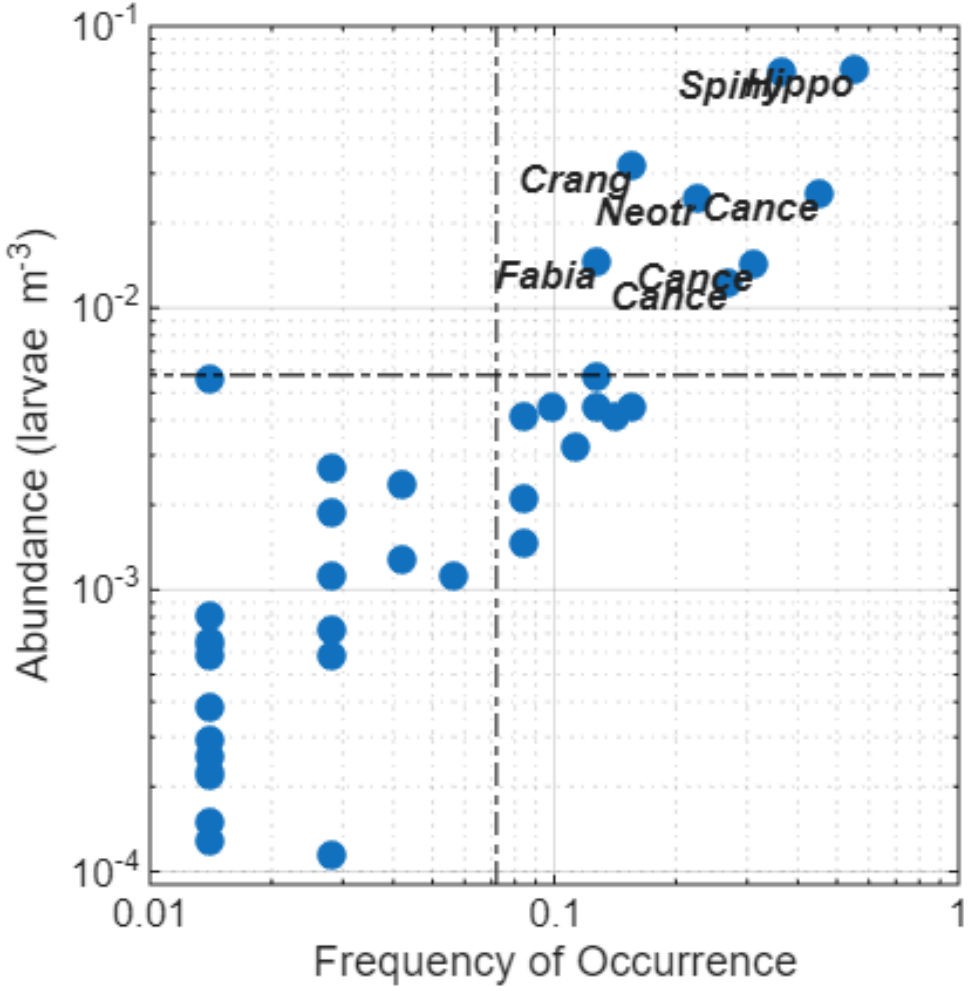


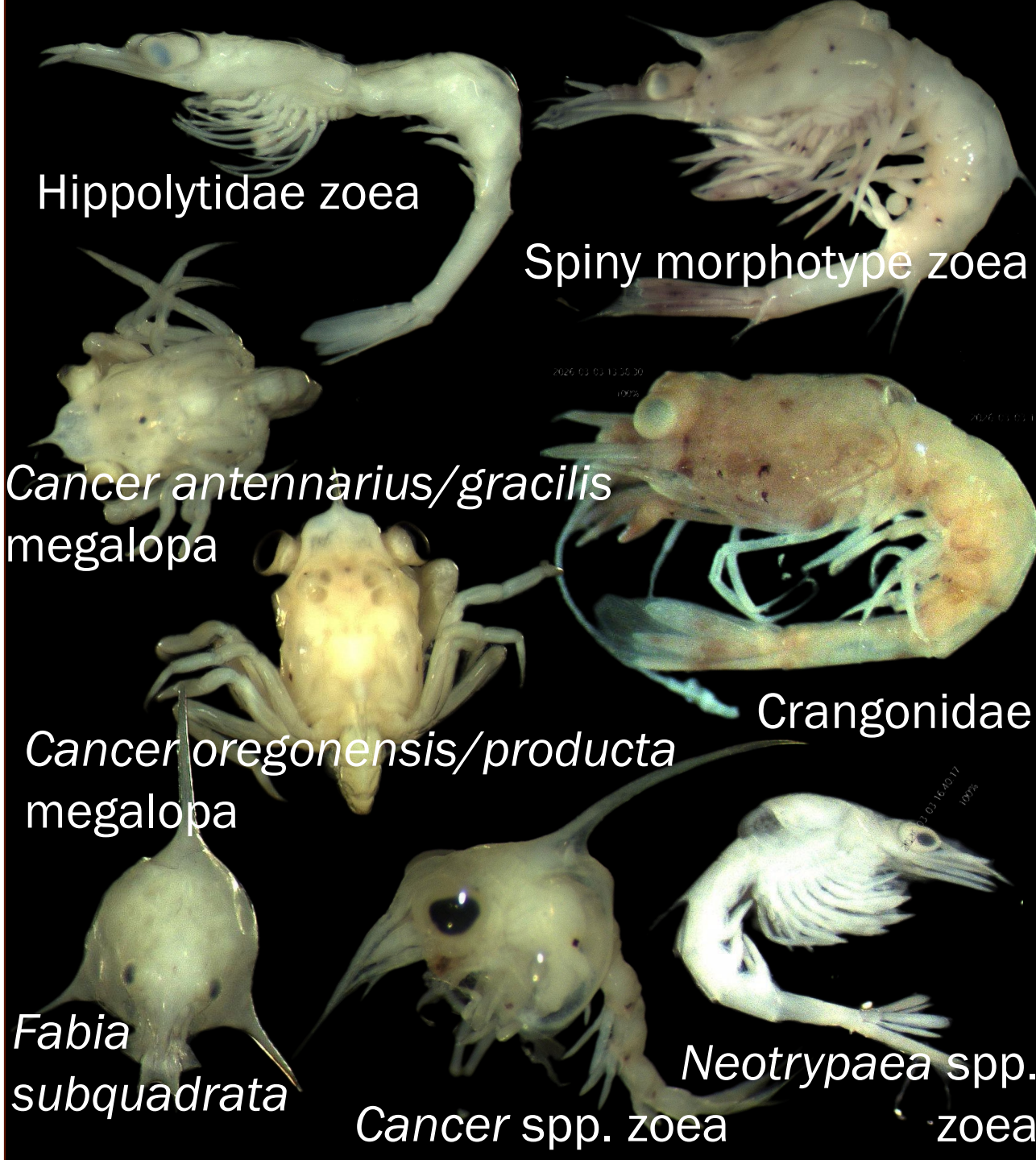
Results: Hydrographic dist. patterns





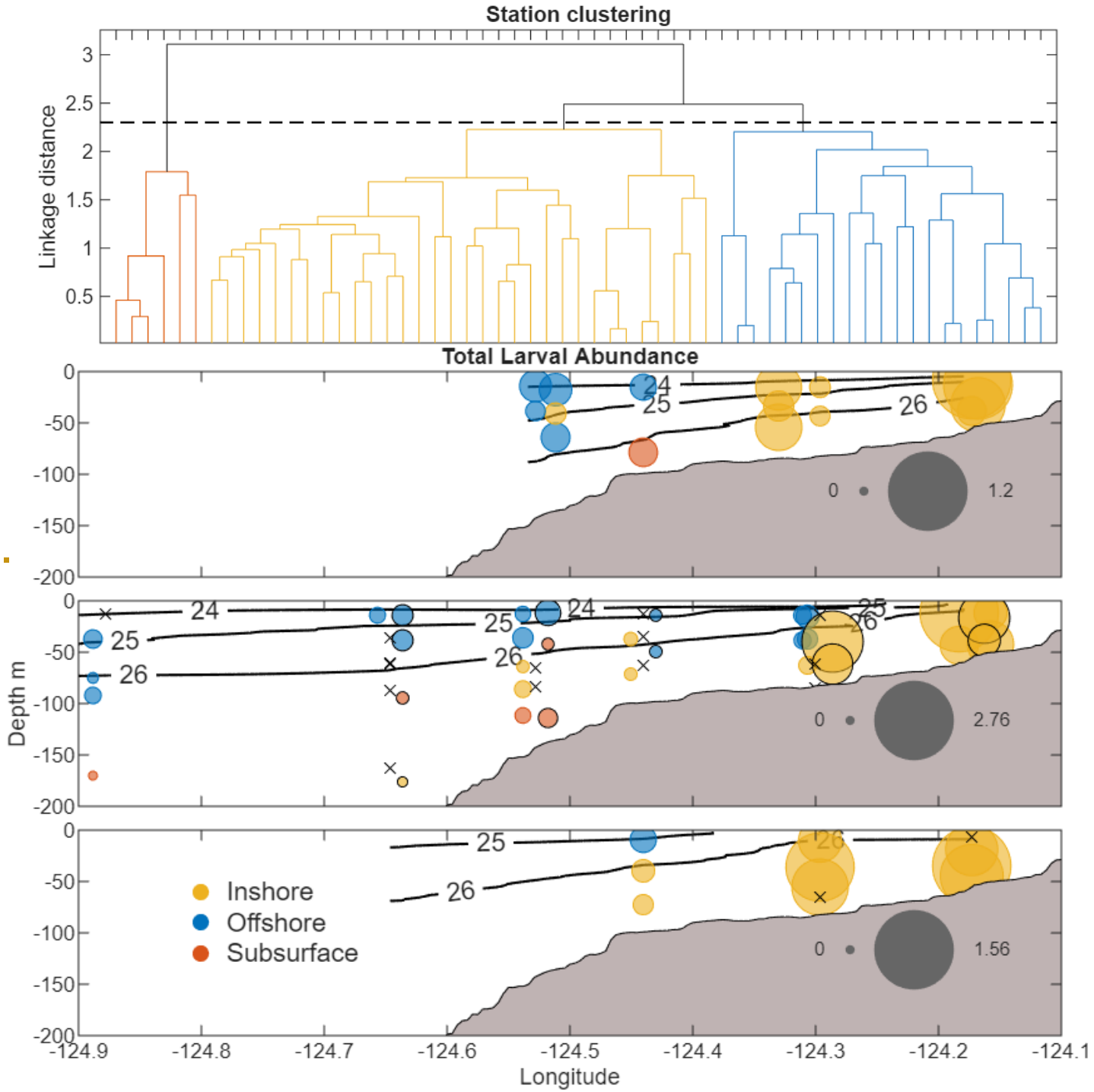
Results: Community composition





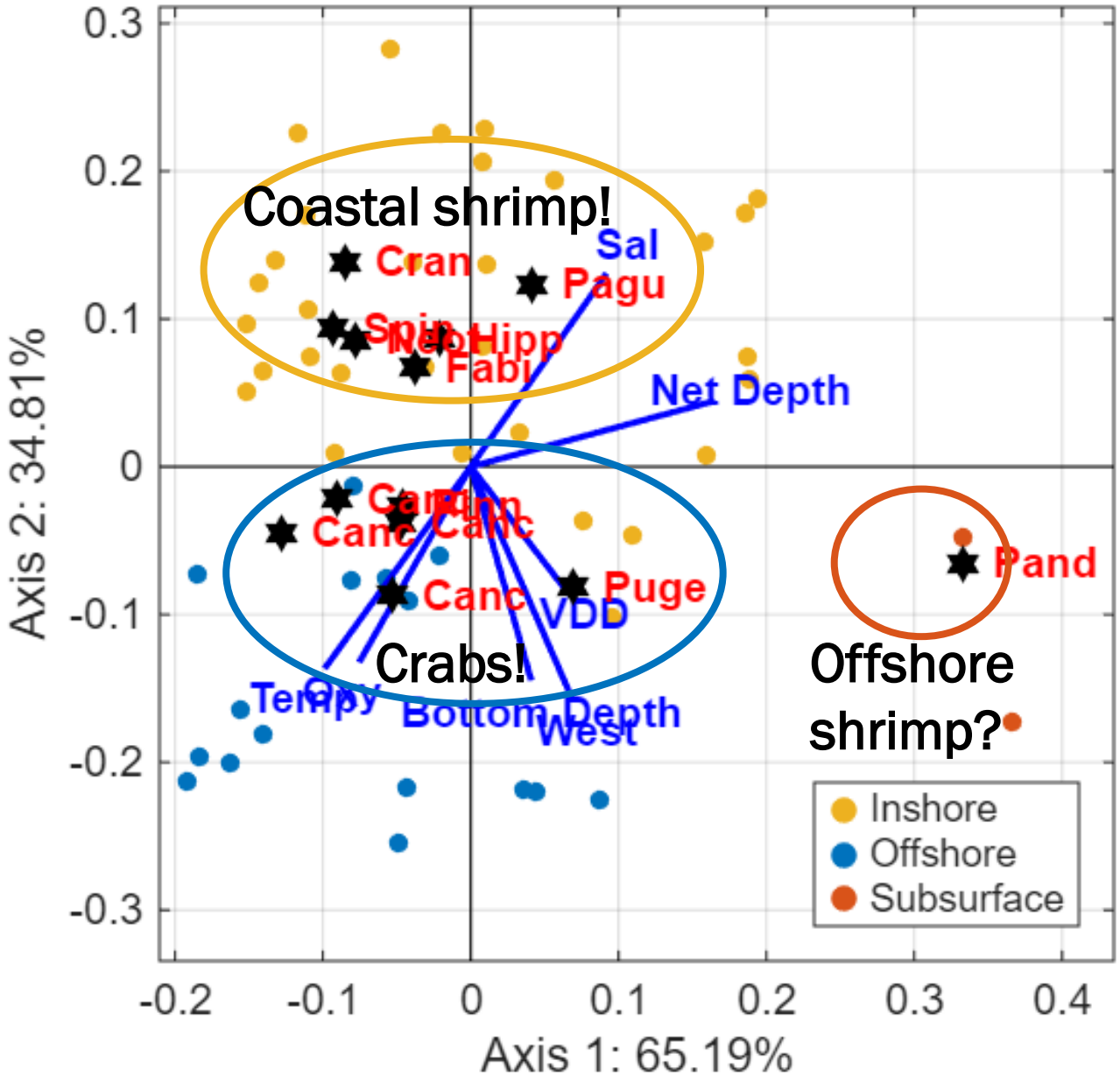
Results: Larval Decapod Assemblages (LDAs)

- Inshore (n = 32)
  - ~0.6 larvae m^{-3}
  - Hippolytidae zoea, Spiny morph. zoea, *Neotrypaea* spp.
- Offshore (n = 21)
  - 0.13 larvae m^{-3}
  - *Cancer* zoea, megalopa
- Subsurface? (n = 6)
  - 0.07 larvae m^{-3}
  - *Pandalus* spp.



Results: Environmental Relations of LDAs

- Inshore
  - + Salinity
    - Bottom depth, West
- Offshore
  - + DO, T, Δρ, West
  - - Salinity, Net Depth
- Subsurface?
  - + Net depth



Conclusions

- Larval decapods of the NCC remain poorly described
  Three dominant larval forms remain problematic:
  Crangonidae, Hippolytidae, Spiny morphotype
- **Distinct Inshore** (shrimp) / **Offshore** (crab) assemblages
  Offshore stratification (Sal ⟶ Temp) = vertical zonation
- **Abundance increases,** especially for the **Inshore LDA** < 5 NM inshore. State waters are a key habitat.
- **Ontogenetic vertical distribution trends are yet unresolved**

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