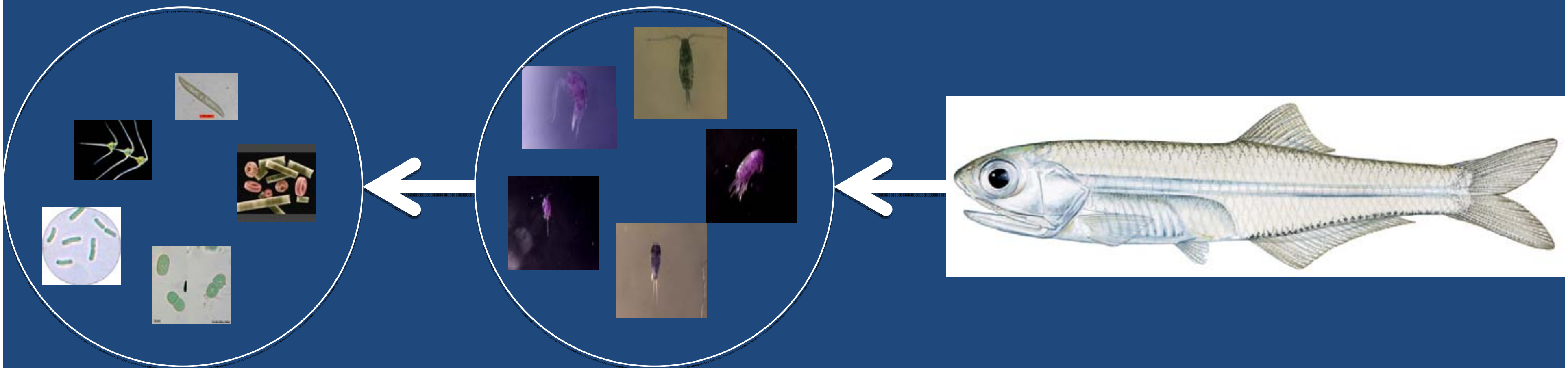
A Bay Anchovy, *A. mitchilli,* Induced Trophic Cascade in Florida Bay



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Outline

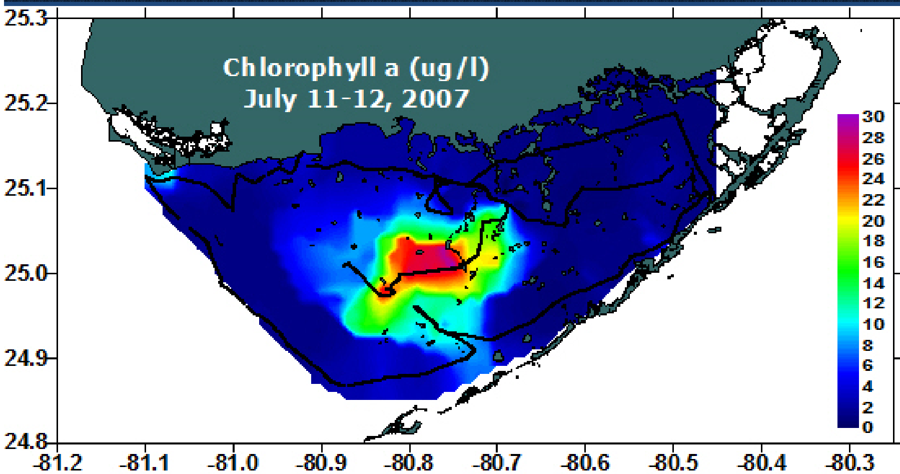
- Background on Florida Bay Trophic Structure & Management Goals
- Evidence of Trophic Cascade
  – Modeled
  – Observations
- Management Implications

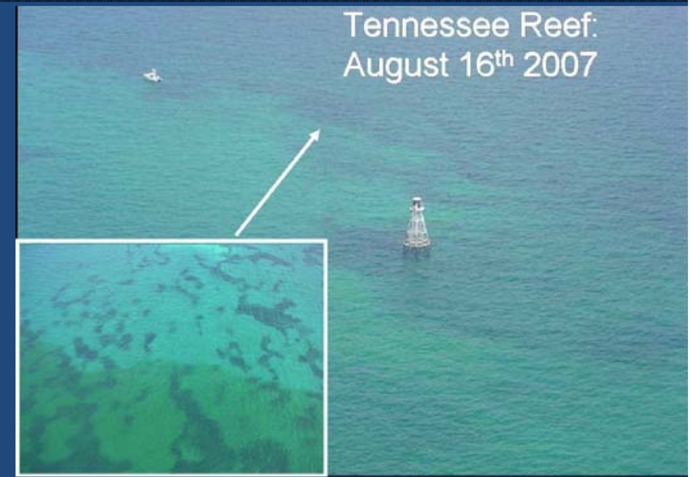
Florida Bay Small Fish Community

1984-85 **1994-96**

- *A. mitchilli* dominance is not persistent
- Hypothesized shift from benthic to pelagic primary producers lead to shift in fish (Thayer et al. 1999)
- Shift in primary producers is not evident in subsequent analyses (Chasar et al. 2005)
- H_1: Shift in fish community could have resulted in a trophic cascade

Current Algal Bloom Management





- Concern that changing nutrients associated with CERP will alter nutrient loads and increase algal blooms (CROGEE)
- These blooms can be advected into the FKNMS
- The entire focus is on bottom-up control
  - This is important, but may only be half of the story

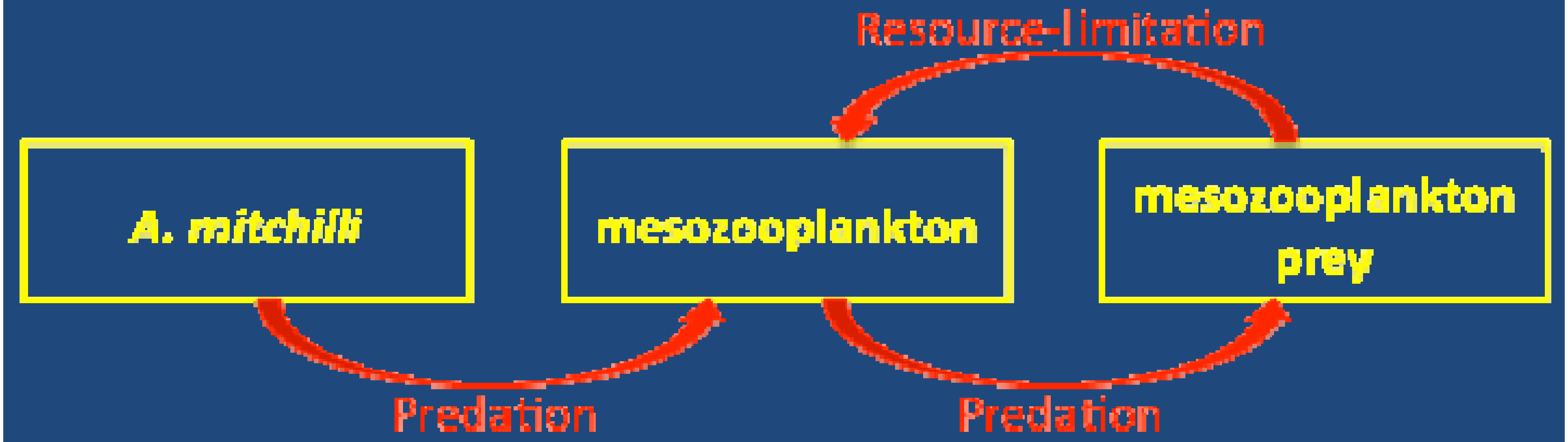
A. mitchilli Background

- Related species occupy wasp-waist niche
- Salinity cue for juvenile recruitment (Peebles et al. 2007)
- Dominant planktivorous fish in Florida Bay
  – >87% of the planktivorous fish community in trawls

Hypotheses

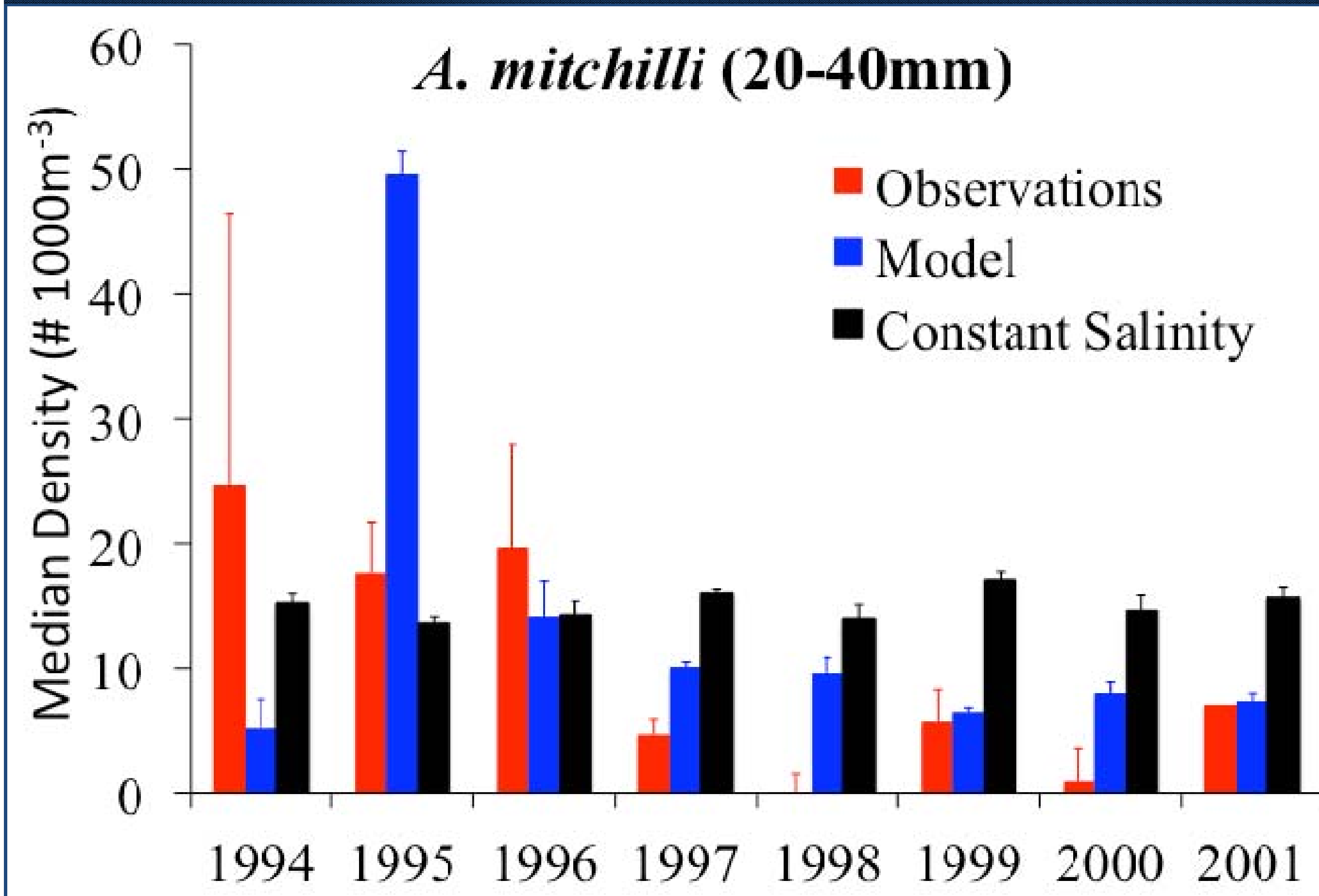
1. *A. mitchilli* population and thus its predation pressure varies over time and is correlated with salinity
2. *A. mitchilli* predation significantly alters the mesozooplankton community in Florida
3. The variable *A. mitchilli* population results in a transient trophic cascade that alters phytoplankton biomass
4. Altering freshwater flow will alter this trophic cascade

MODEL (BAMZO)



- Dynamic, mechanistic, cohort model
- Daily time-step from 1994-2001
- inputs: bay-wide median salinity and temp.
- mesozooplankton prey =
  phytoplankton + microzooplankton

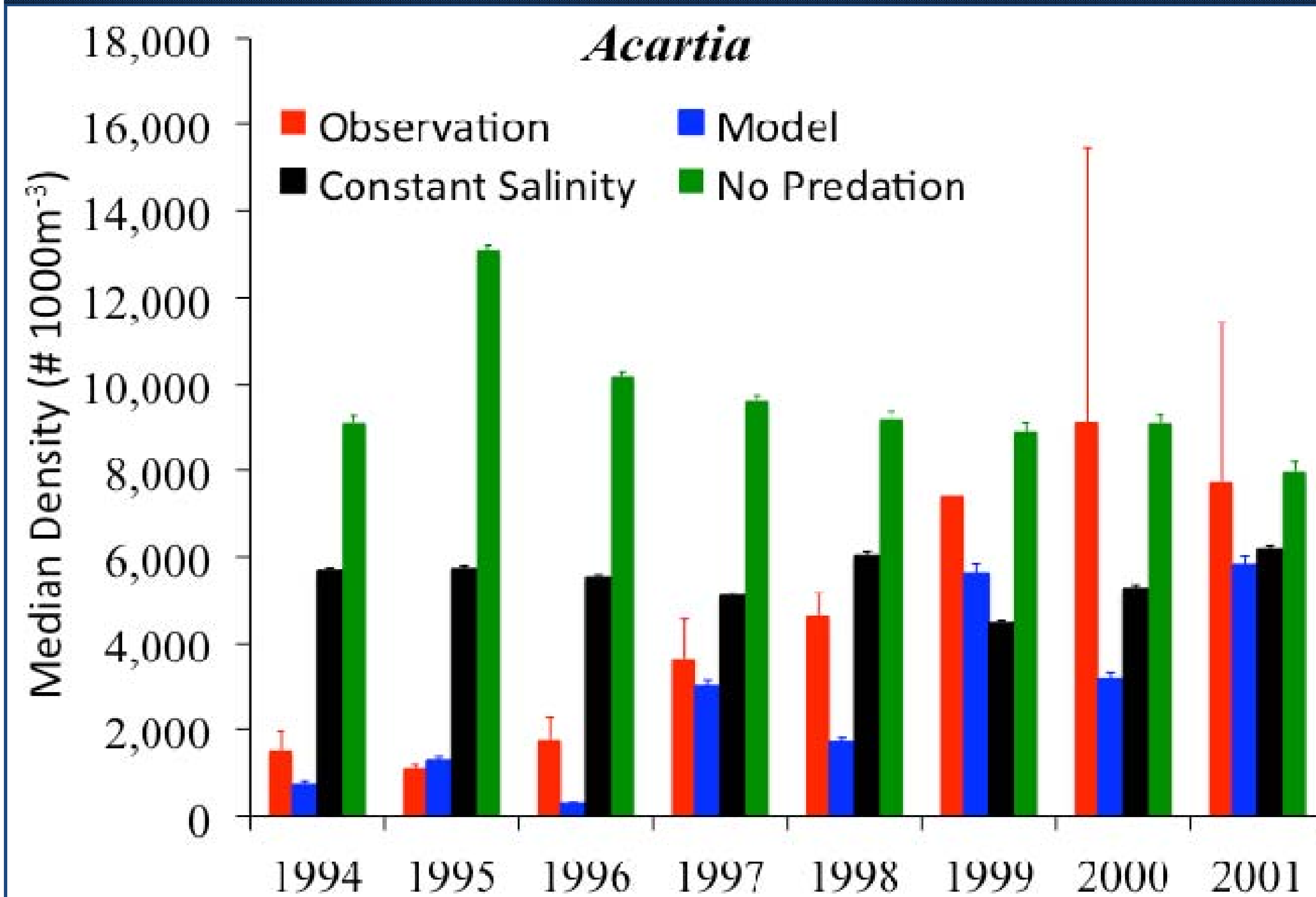
A. mitchilli Results



The model and observations had higher populations of *A. mitchilli* prior to May 1997

With salinity held constant, interannual variability is reduced and the population is lower prior to May 1997

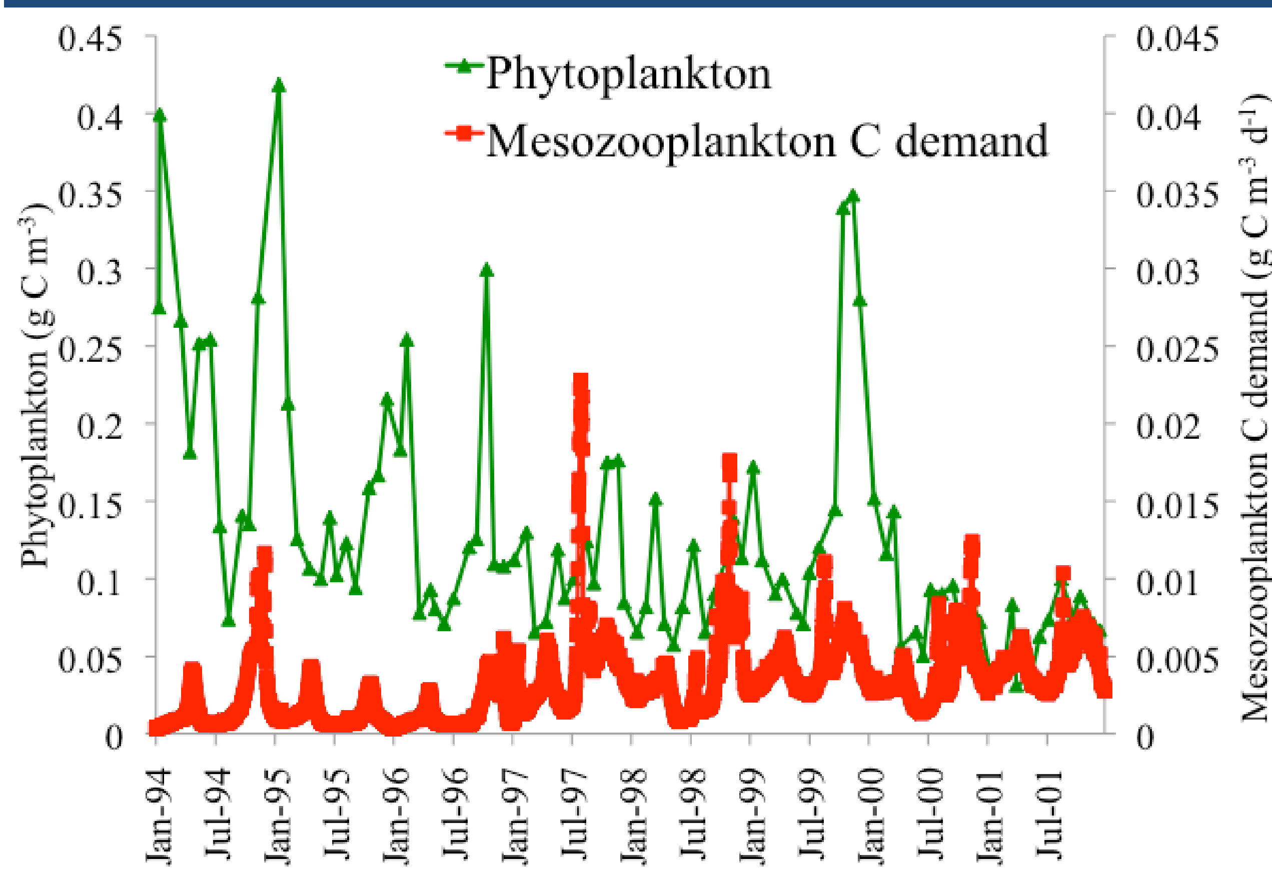
Mesozooplankton Results



The model and observations had lower populations of *Acartia* prior to May 1997

With predation removed, the population is greater prior to May 1997

Implications for Phytoplankton



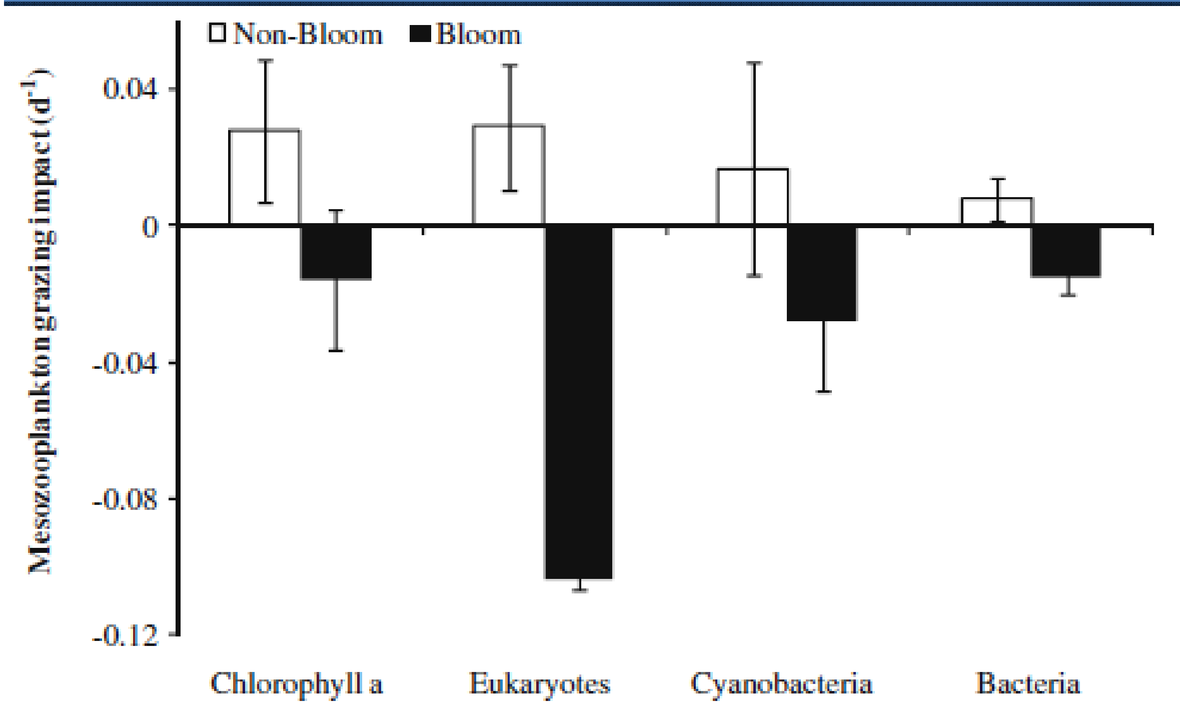
Mesozooplankton respiratory C demand ~10% of Phytoplankton Carbon after May 1997.

Mesozooplankotn Grazing 2-3x respiratory carbon demand =

20-30% of phytoplankton C

A conservative calculation since Microzooplankton not included

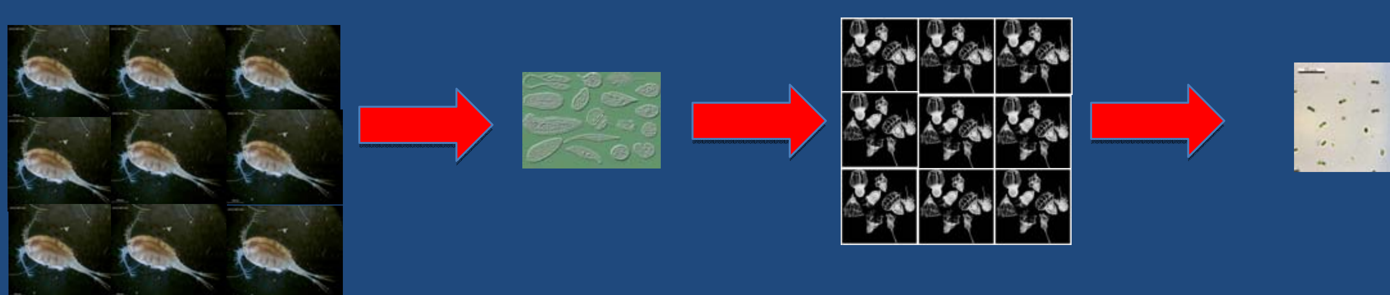
Link Mesozooplankton to Phytoplankton



During Cyanobacteria Blooms:

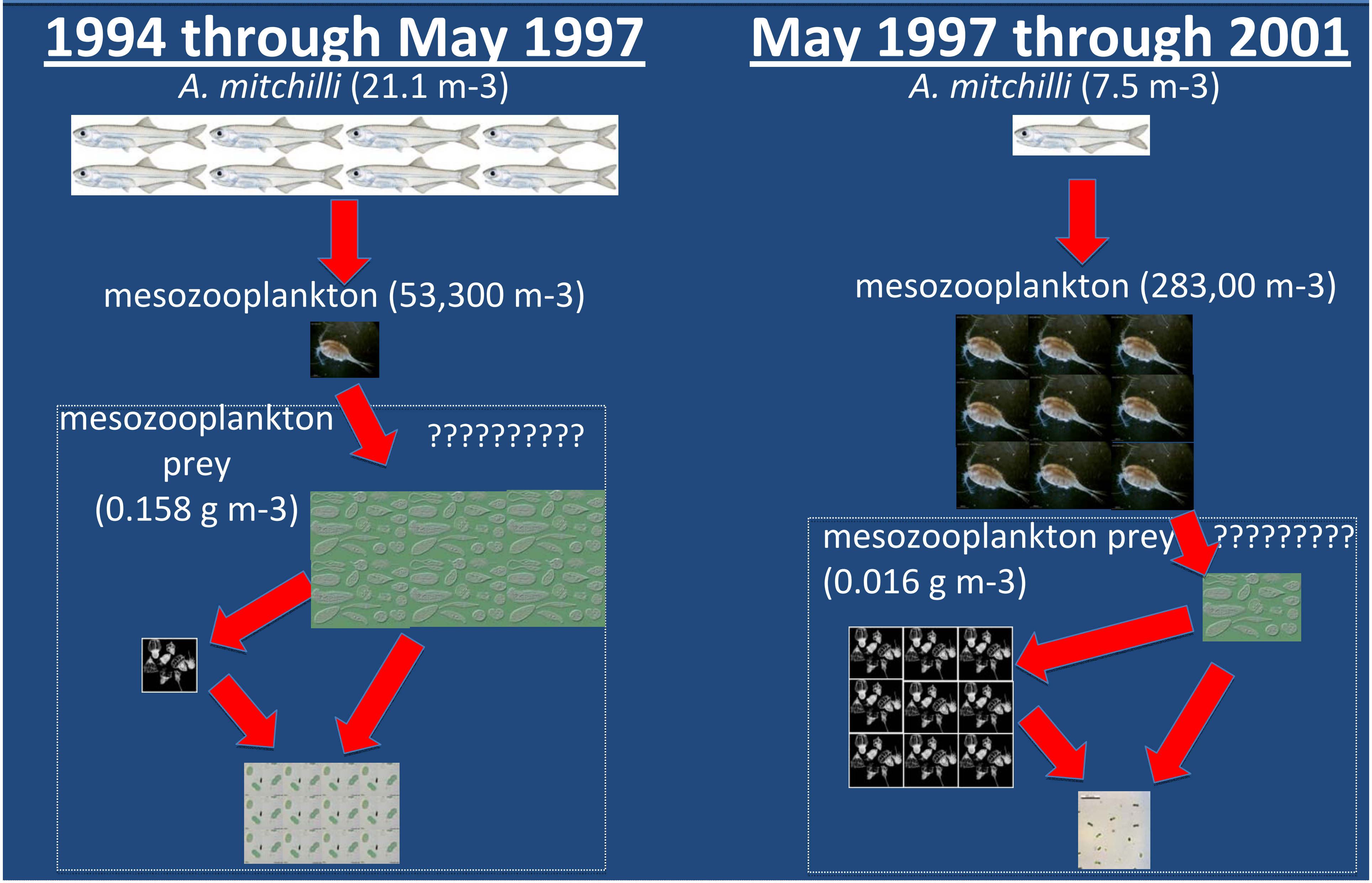
↑- mesozooplankton

↓-phytoplankton

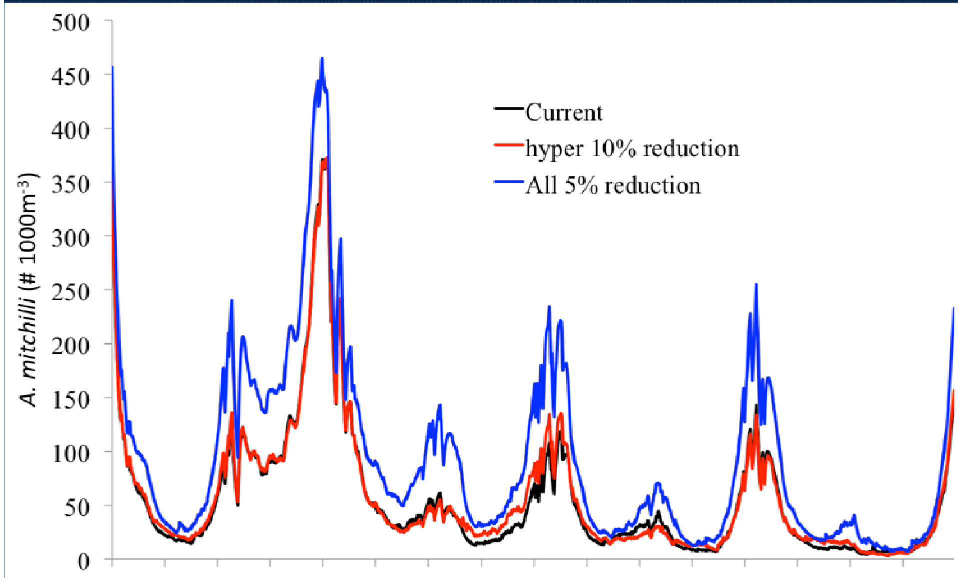


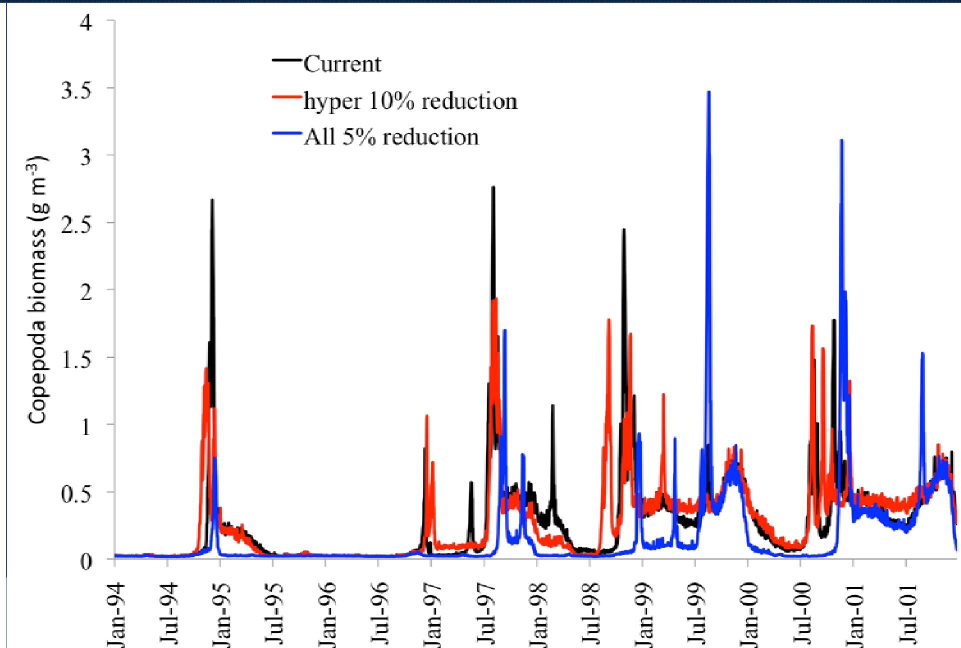
Goleski et al. 2010

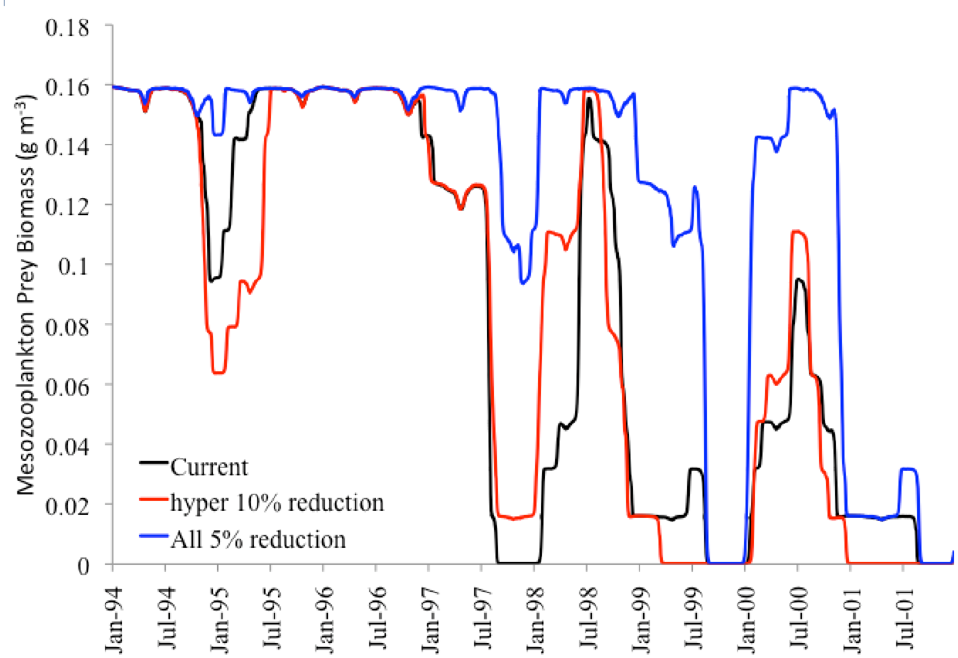
Conceptual Model of Trophic Web



Management Implications







Reduce salinity by 5% and model suggests

2X ↑ *A. mitchilli*

6X ↓ mesozooplankton

1.5X ↑ mesozoop. prey

Conclusions

- *A. mitchilli* abundance varies widely in correlation with salinity conditions
- ↑ *A. mitchilli* abundance during low salinities yields ↓ mesozooplankton abundance
- ↓ mesozooplankton abundance, ↑ phytoplankton
- Model output suggests lowering salinities results in ↑-*A. mitchilli*, ↓-mesozooplank., ↑-phytoplankton
- Management decisions should consider these top-down controls along with bottom-up contols of phytoplankton biomass

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Florida Bay Pelagic Trophic Structure