NOAA FISHERIES
Northeast Fisheries Science Center

Ecosystem Production Potential

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Ecosystem Based Fishery Management Strategy Review

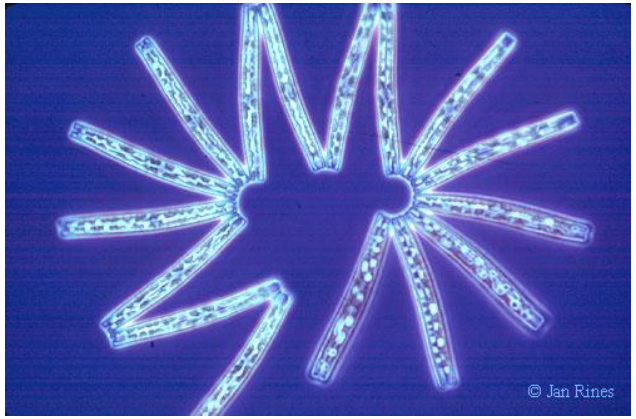
TOR 2: Evaluate the Methods for Estimating Ecosystem Productivity

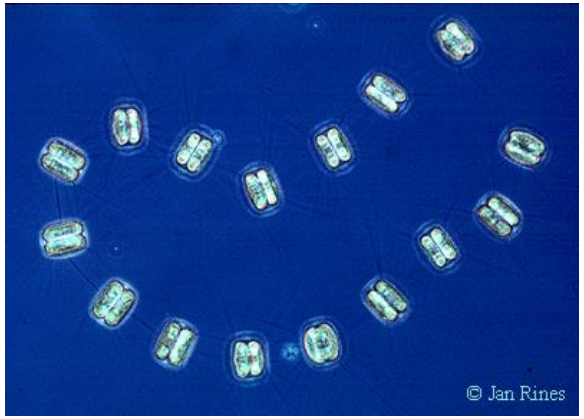
April 30-May 2 ,2018
Woods Hole MA

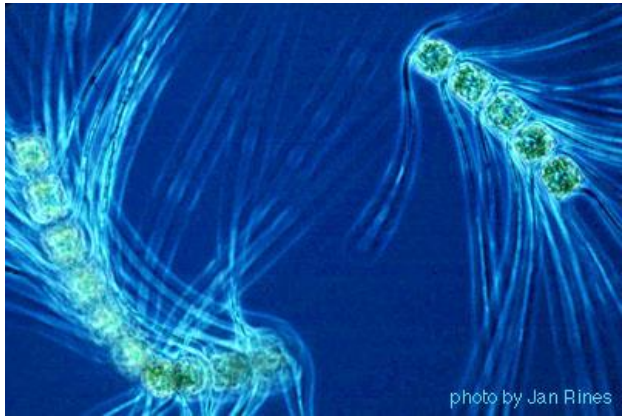
Fisher Production Potential

Goal: Use a bottom-up approach to determine fisheries production potential and exploitation for various ecosystem components.

Question: How efficiently is primary production transferred to higher trophic levels?





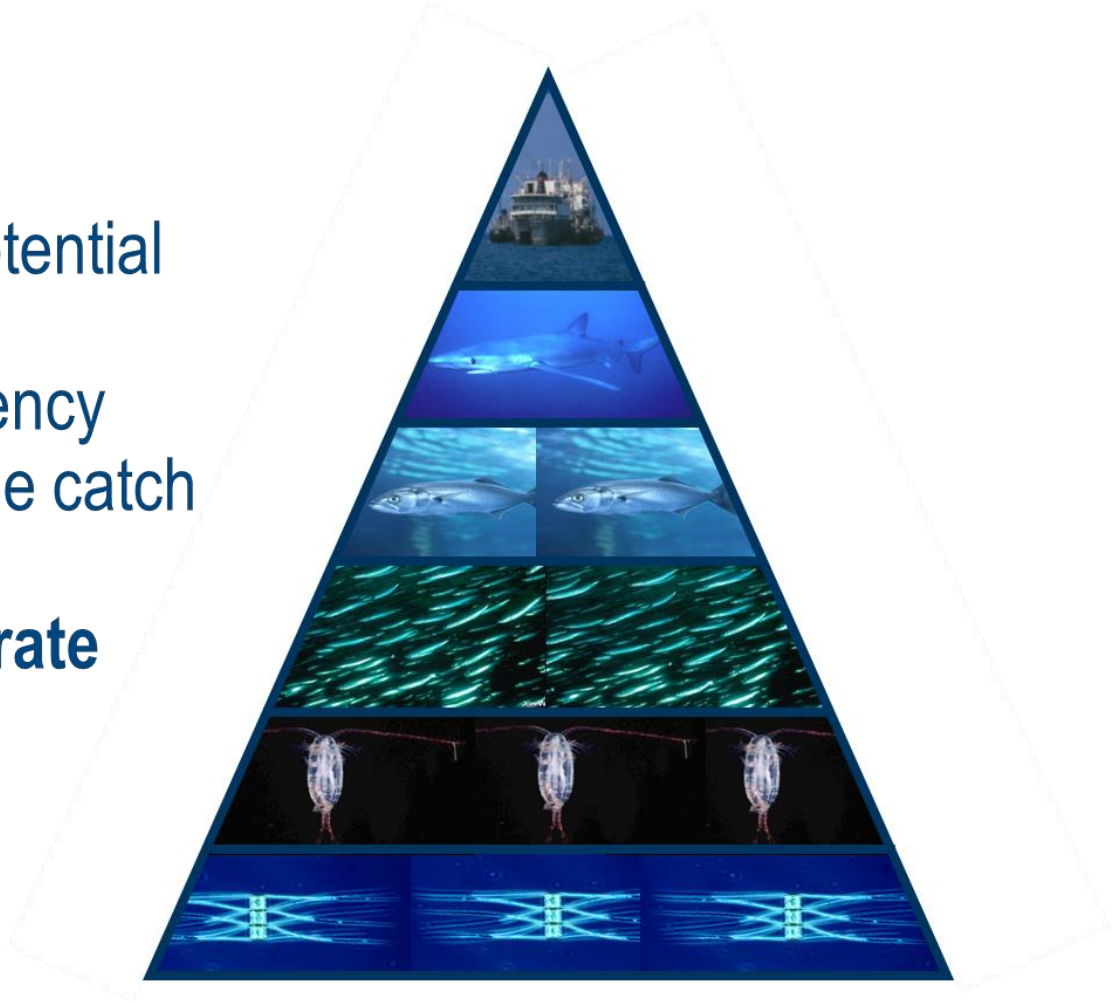


Ryther Fishery Production Potential

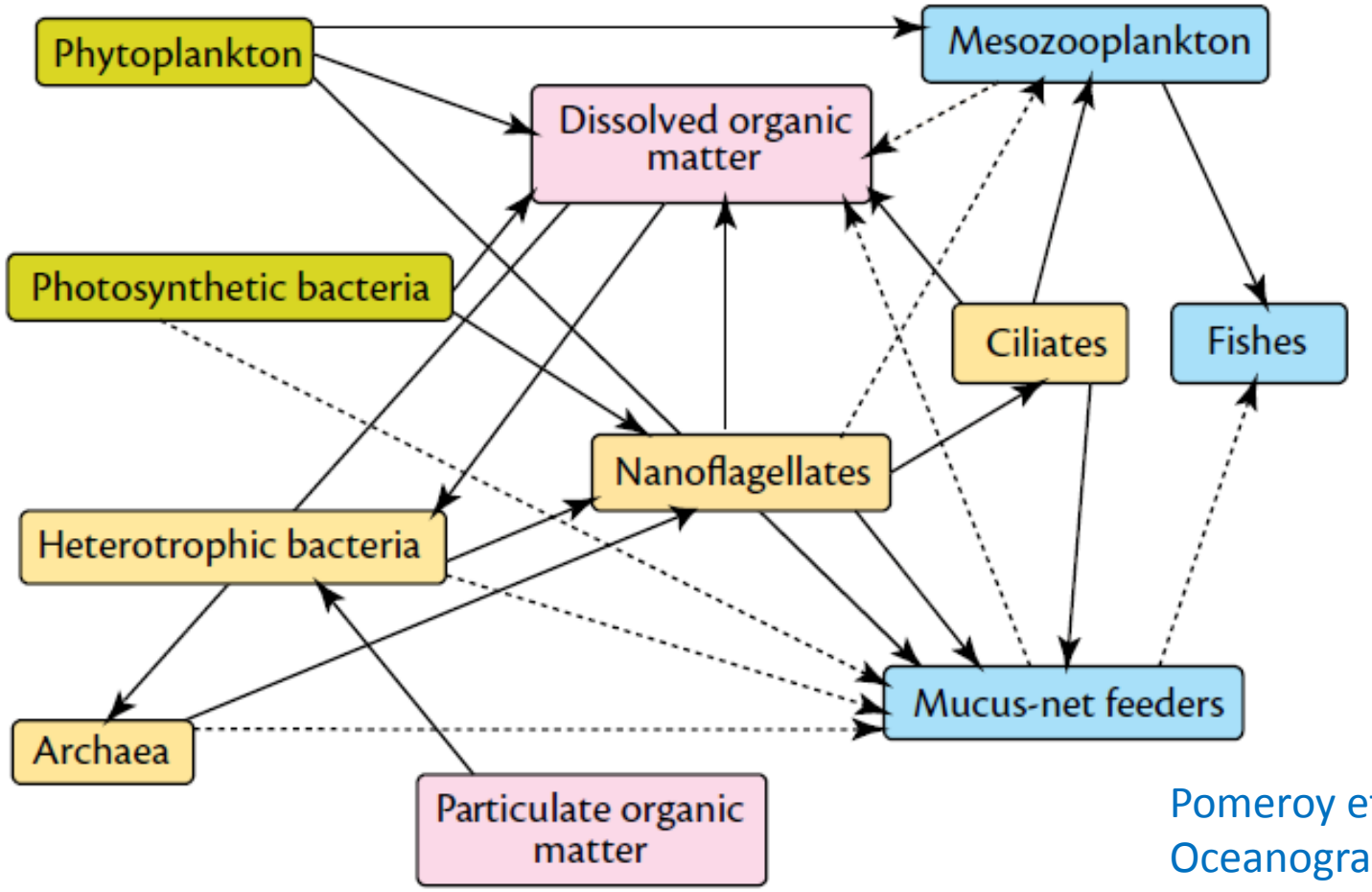
$$FPP = PP \cdot \tau^{TL-1}$$

- ***FPP:*** Fishery production potential
- ***PP:*** Primary production
- ***τ***: Ecological transfer efficiency
- **TL:** Mean trophic level of the catch

*** Typically an exploitation rate of 50% of the total primary production was assumed to be sustainable.**



Modify to Allow Expanded Food Web Structure and Energy Pathways through the Microbial Food Web

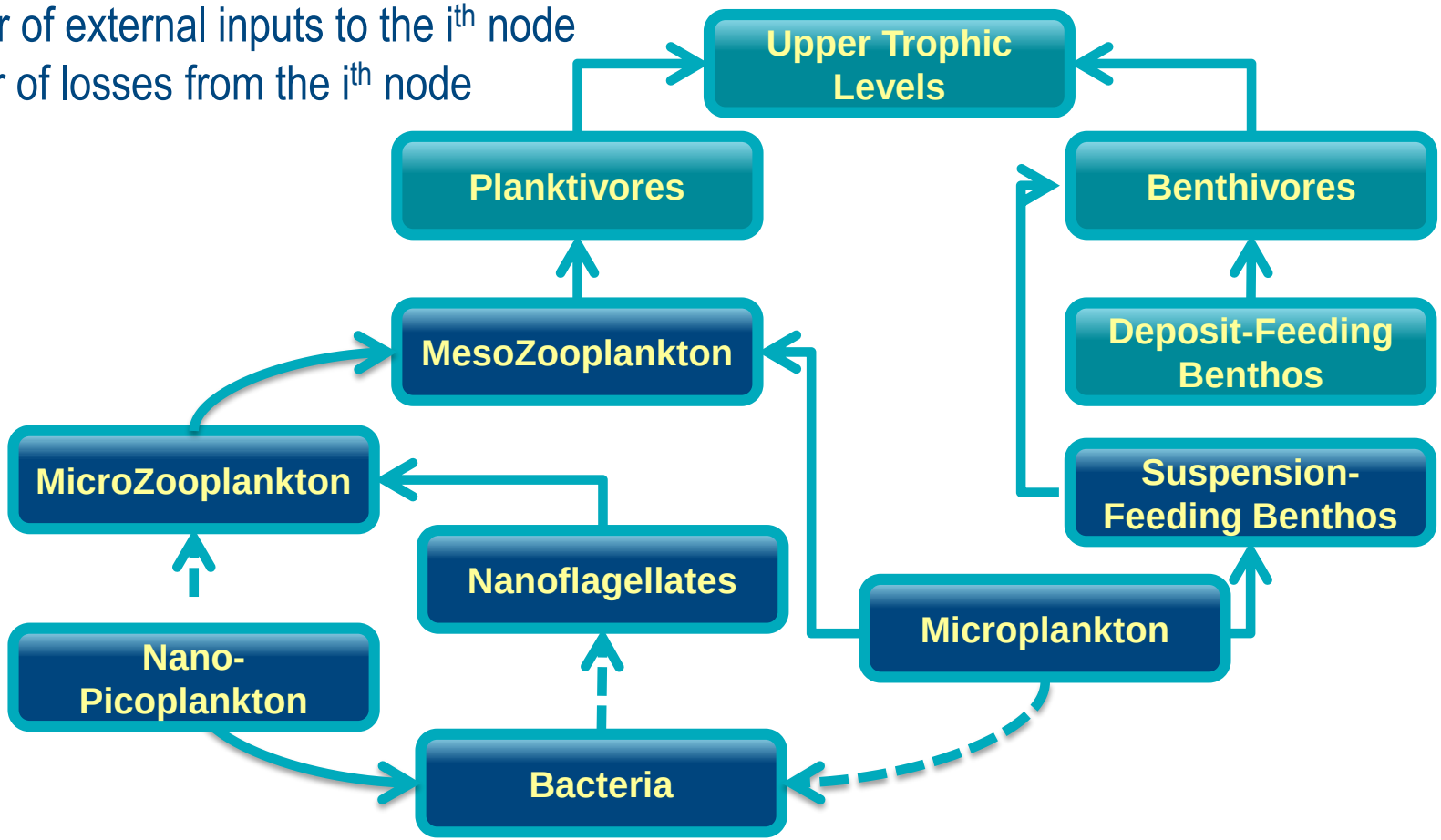


Pomeroy et al. 2007. Oceanography 20(2):28-33

Ryther Revisited

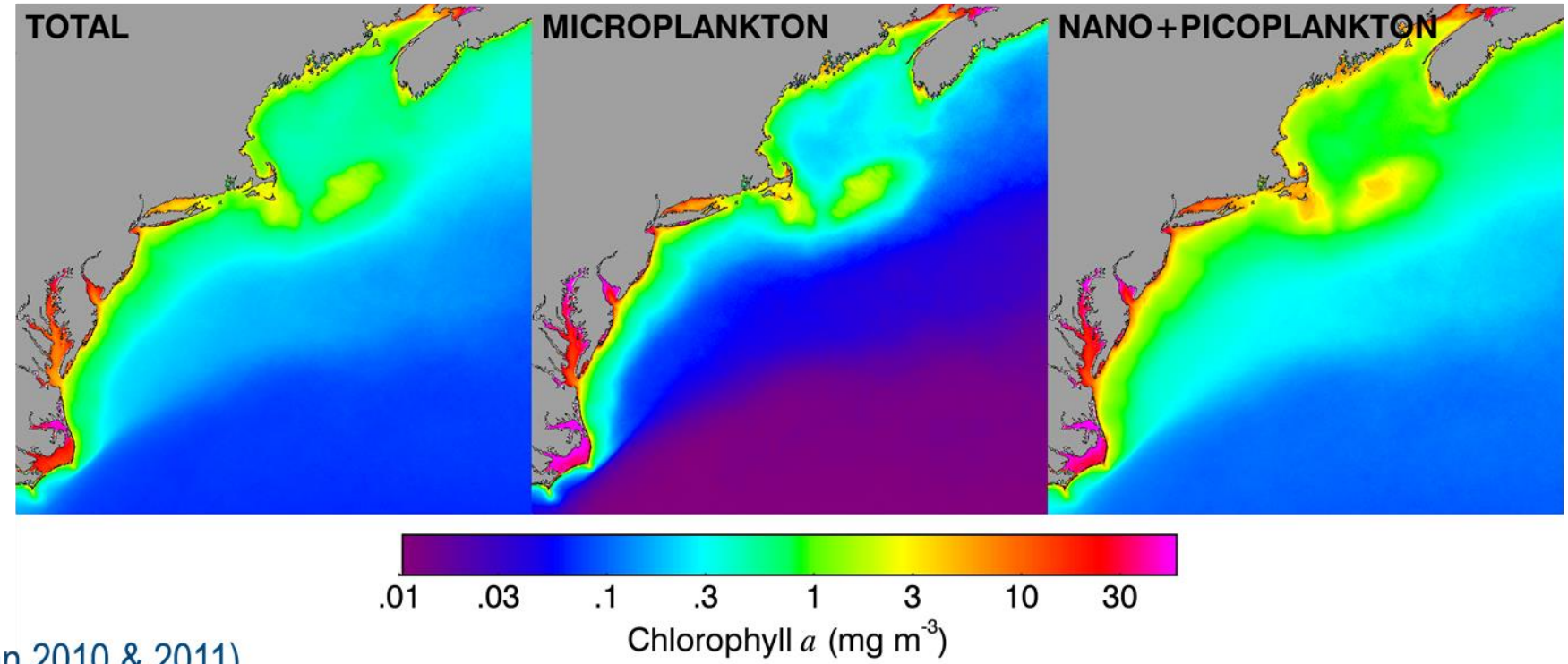
$$P_i = T \cdot P_j + A_i - F_i$$

- P_i: Production at the ith node
- T: Matrix of ecological transfer efficiencies
- A_i: Vector of external inputs to the ith node
- F_i: Vector of losses from the ith node



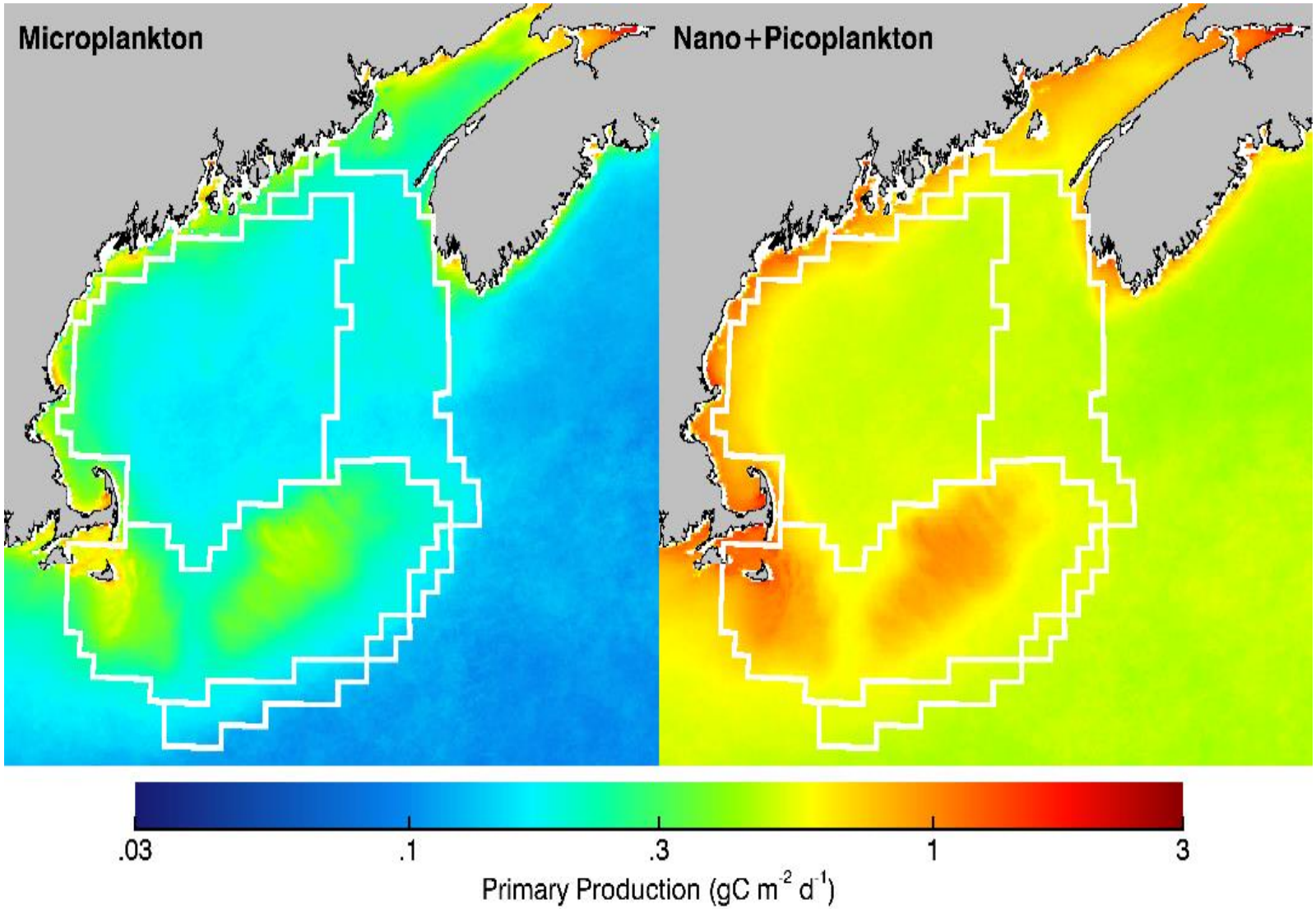
Phytoplankton

Satellite ocean color data is used to derived phytoplankton functional groups a series of Remote Sensing Reflectance (R_{RS}) band ratio algorithms at 490, 555 and 670 nm.



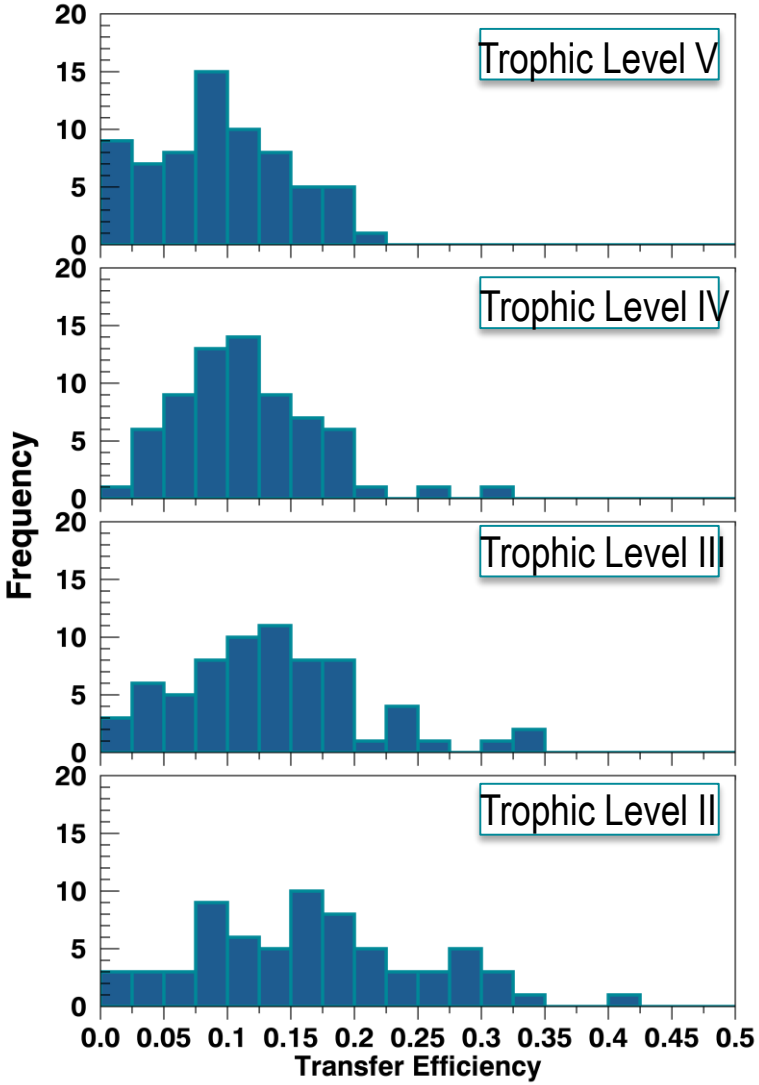
(Pan 2010 & 2011)

A Closer Look at Georges Bank

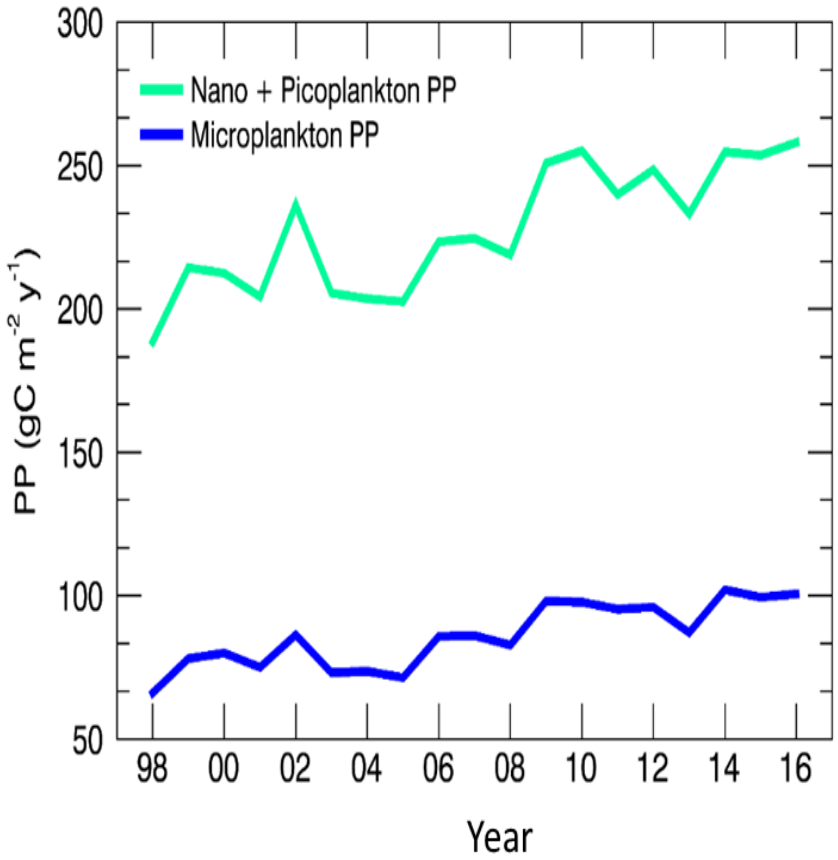


Ecological Transfer Efficiencies

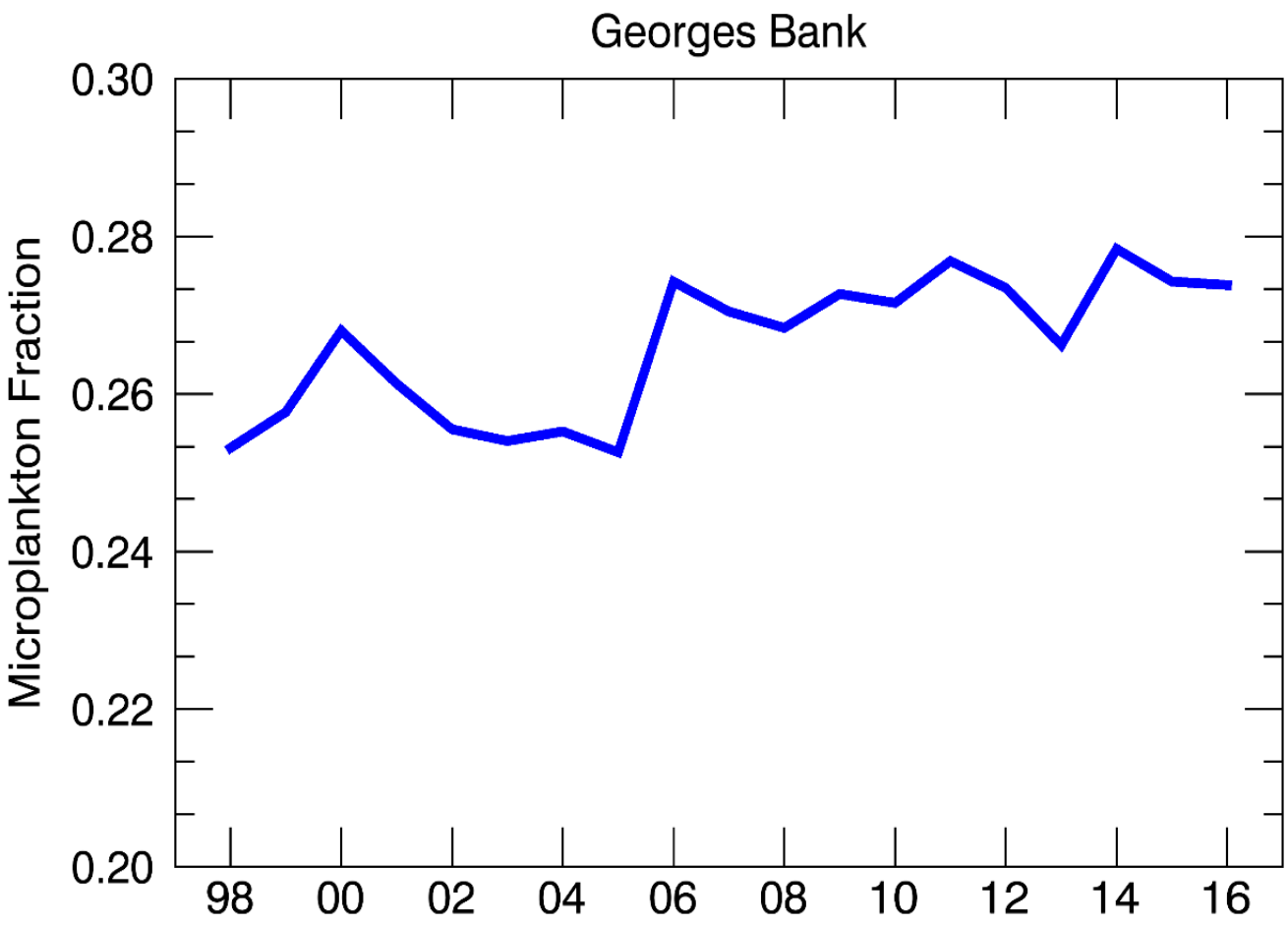
Meta-analysis of network models to determine ecological transfer efficiencies



Estimated Primary Production has been Increasing on Georges Bank



The Fractional Contribution of Microplankton Production to the Total has also been Increasing



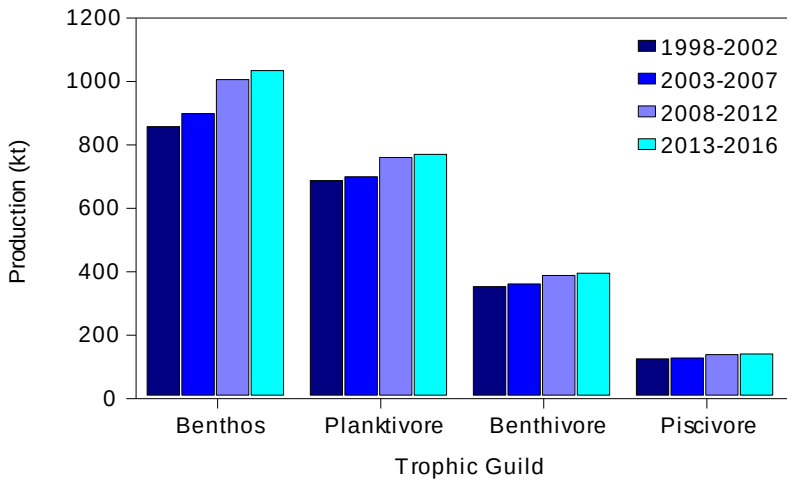
Accounting for Uncertainty

Probability distributions of input parameters to account for uncertainty.

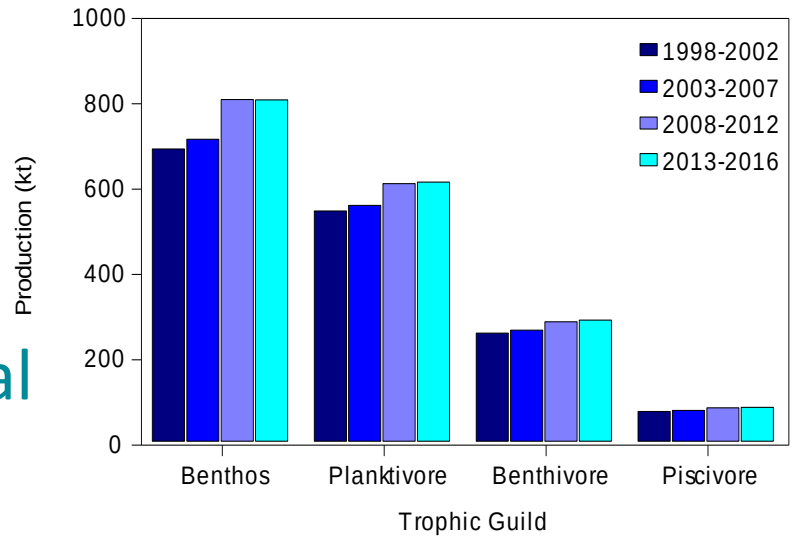
- Primary production: Truncated normal distribution
- Microplankton "split": Uniform distribution
  (Range: Upper and lower quartiles)
- Transfer efficiencies: Beta distribution
- Proportion suitable for harvest: Uniform distribution
  (Benthos and planktivores)

Estimated Production (Live weight) on Georges Bank

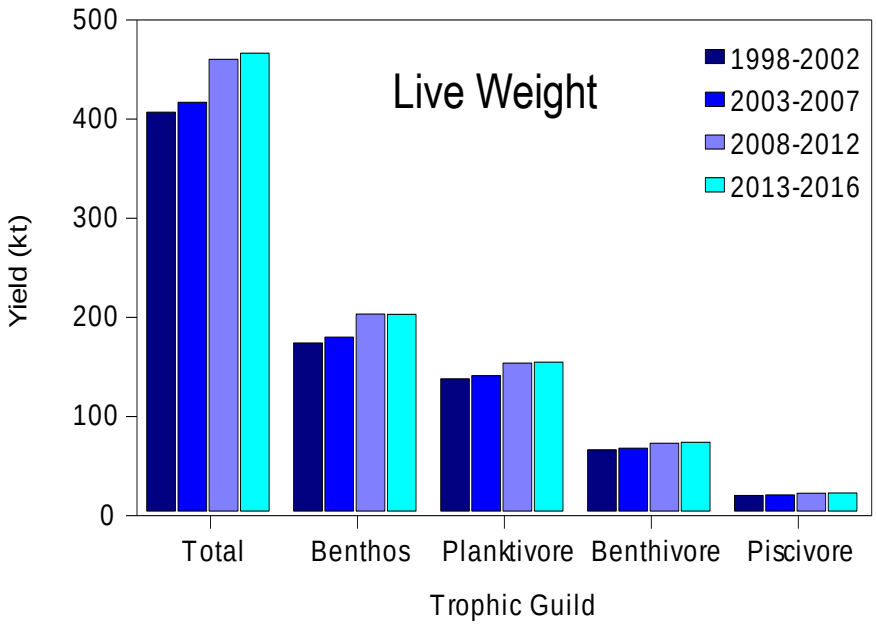
Unexploited



Exploitation Rate 20% on each functional group



Estimated Fisheries Production Potential 2012-2016

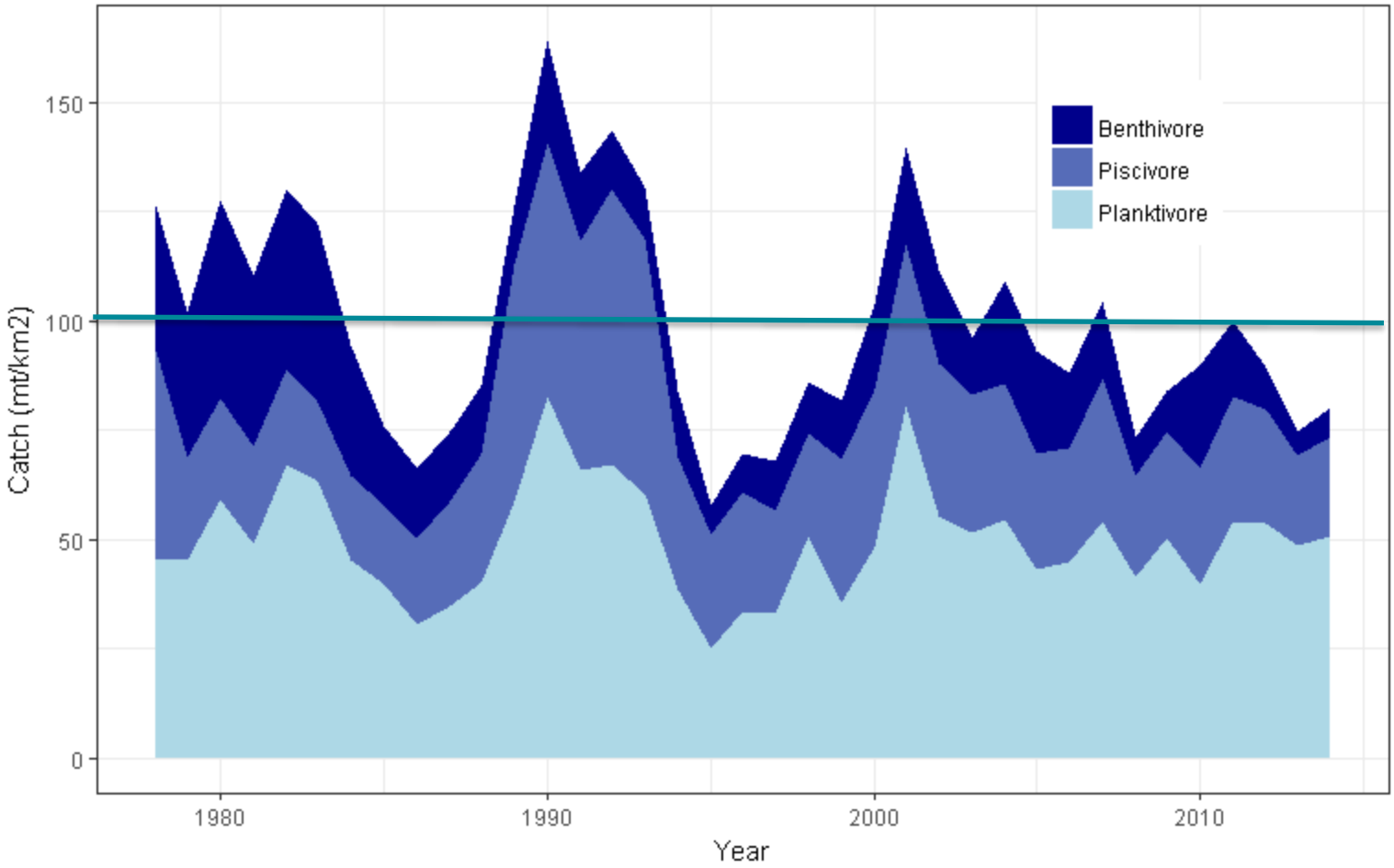


Median Production Potential for Bivalves ~ 20kt (Meat Weight)

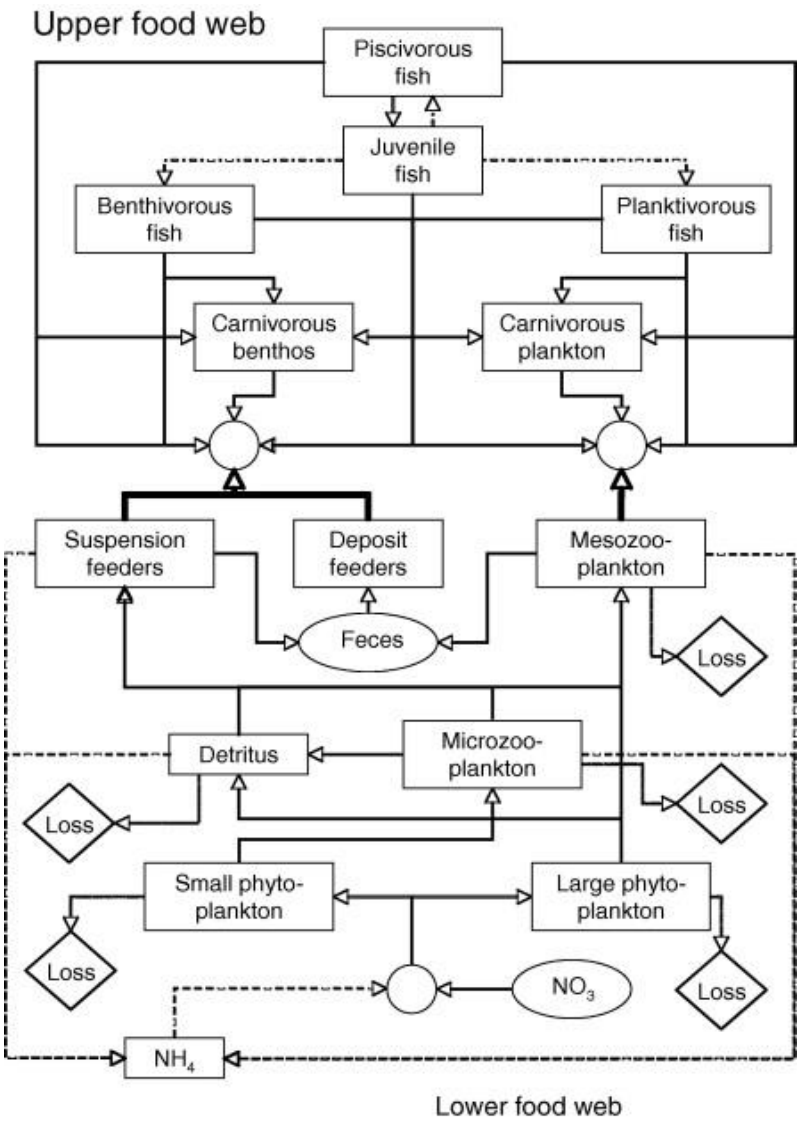
Median Production Potential all others ~ 220kt (Live Weight)

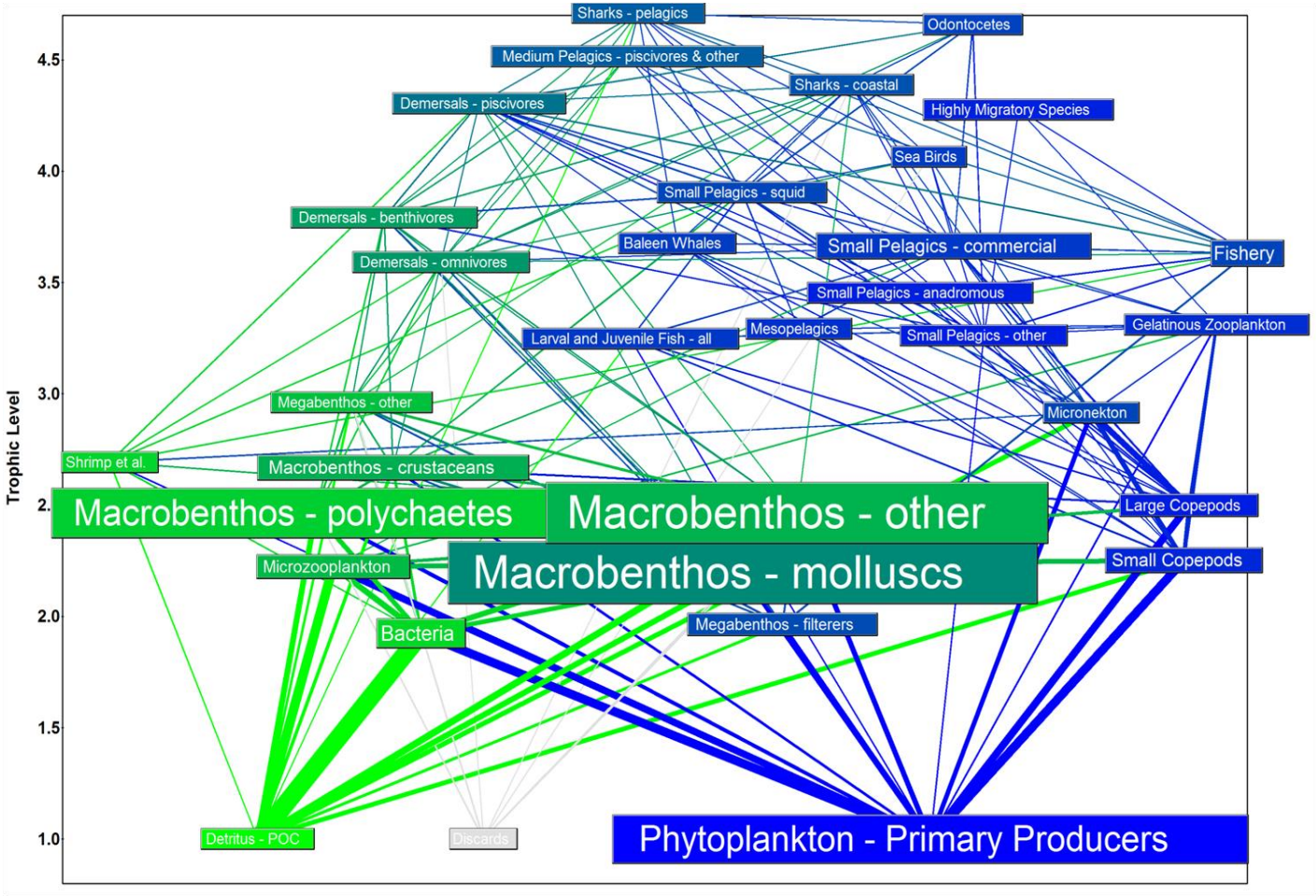
Exploitation Rate= 0.2 for each functional group. Production Potential includes all size classes and species within functional Groups

Catch of NEFMC-Managed Fish Species



Previous Network Models for the Georges Bank Ecosystem



Steele et al. (2007)

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