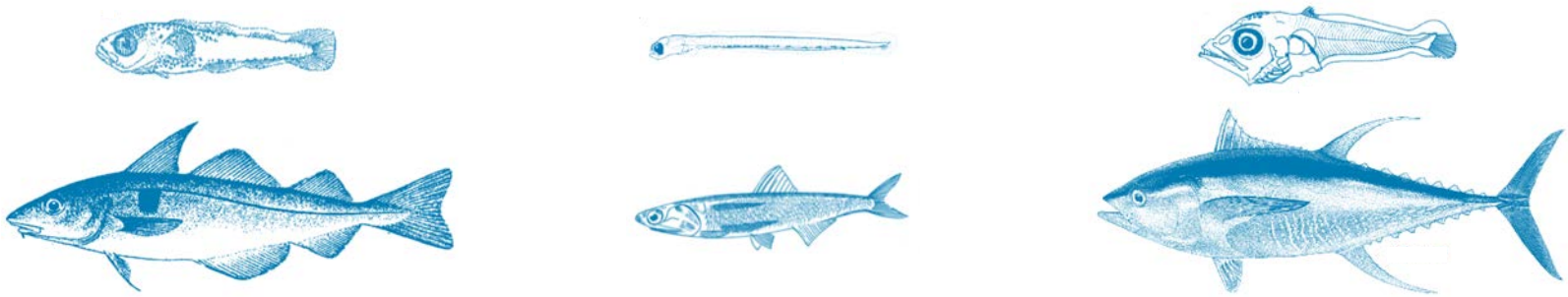
The Princeton Ocean Ecosystem Model (POEM) v2.0



COLLEEN PETRIK

ECCWO

3 JUNE 2018

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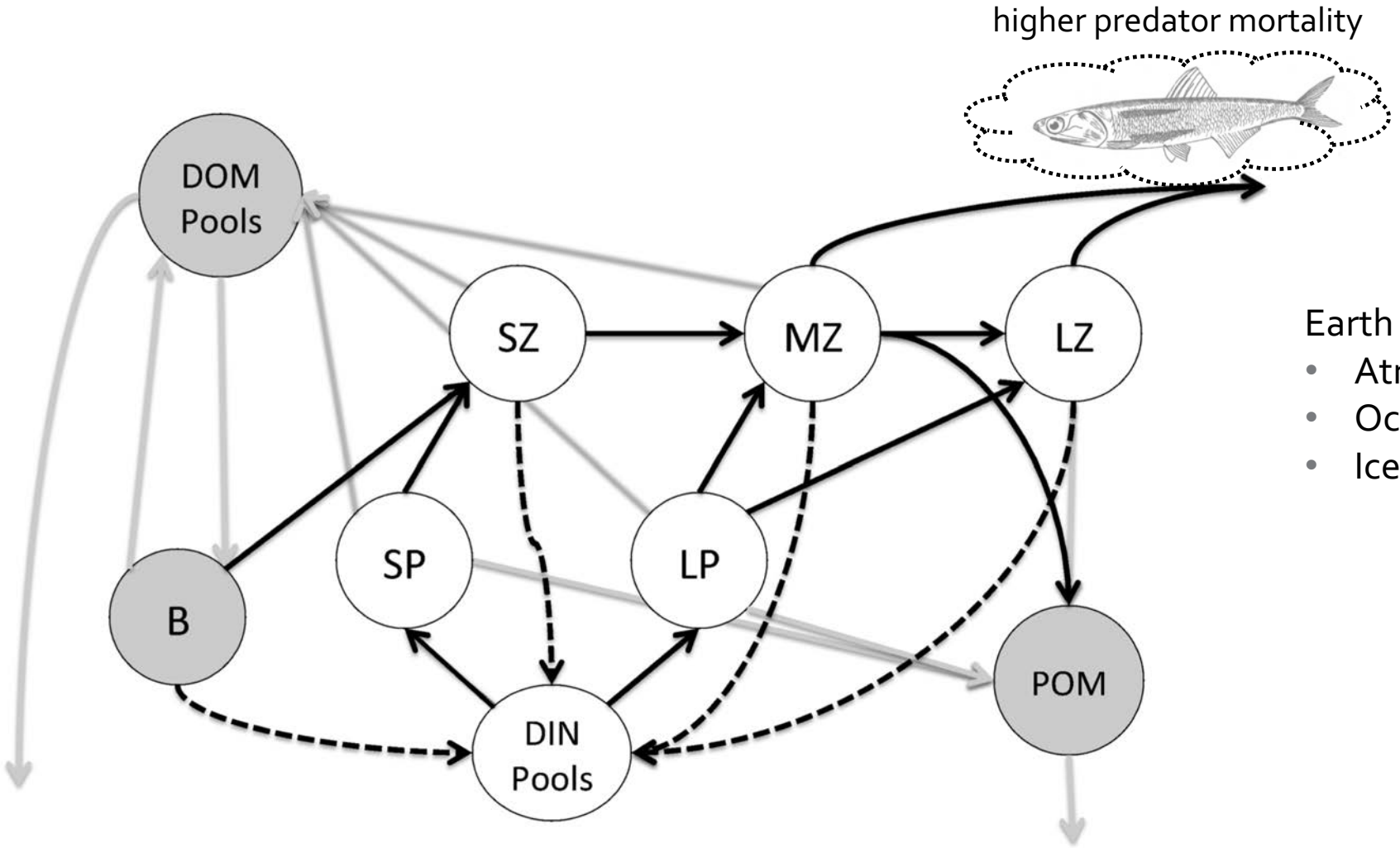
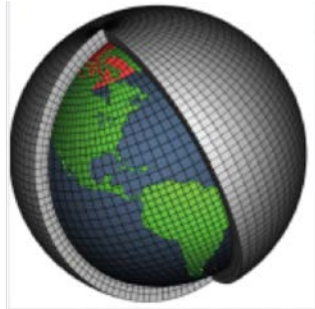
GFDL ESM-COBALT

Carbon, Ocean Biogeochemistry and Lower Trophics ecosystem model



Earth System Model coupled to:

- Atmosphere
- Ocean
- Ice



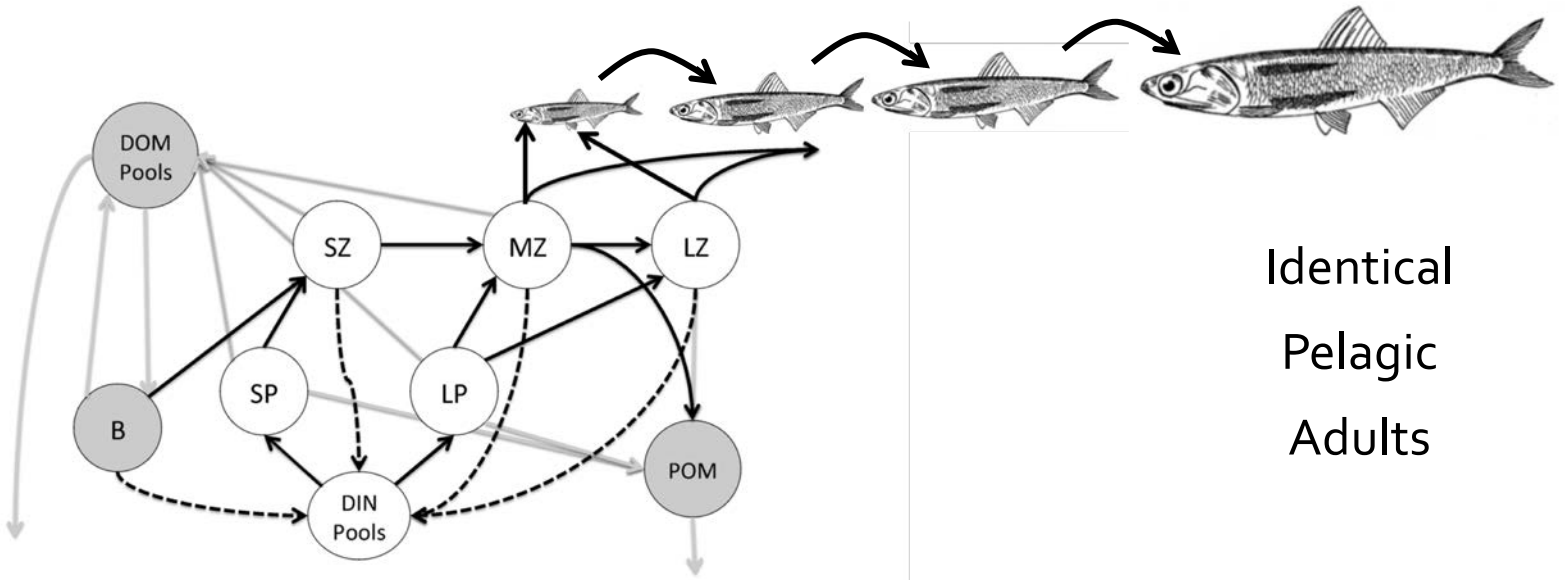
grid size varies by ESM

Stock et al. 2014

GFDL ESM2M-COBALT & POEM V1.0

Global size-based fish model (15 size classes)

POEM v1.0

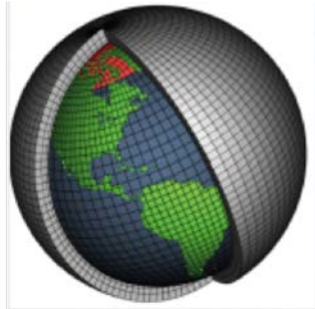


GFDL ESM2M COBALT

Identical

Pelagic

Adults



1° X 1°

Stock et al. 2014; Watson et al. 2015

POEM V2.0

Global size- and type based fish model

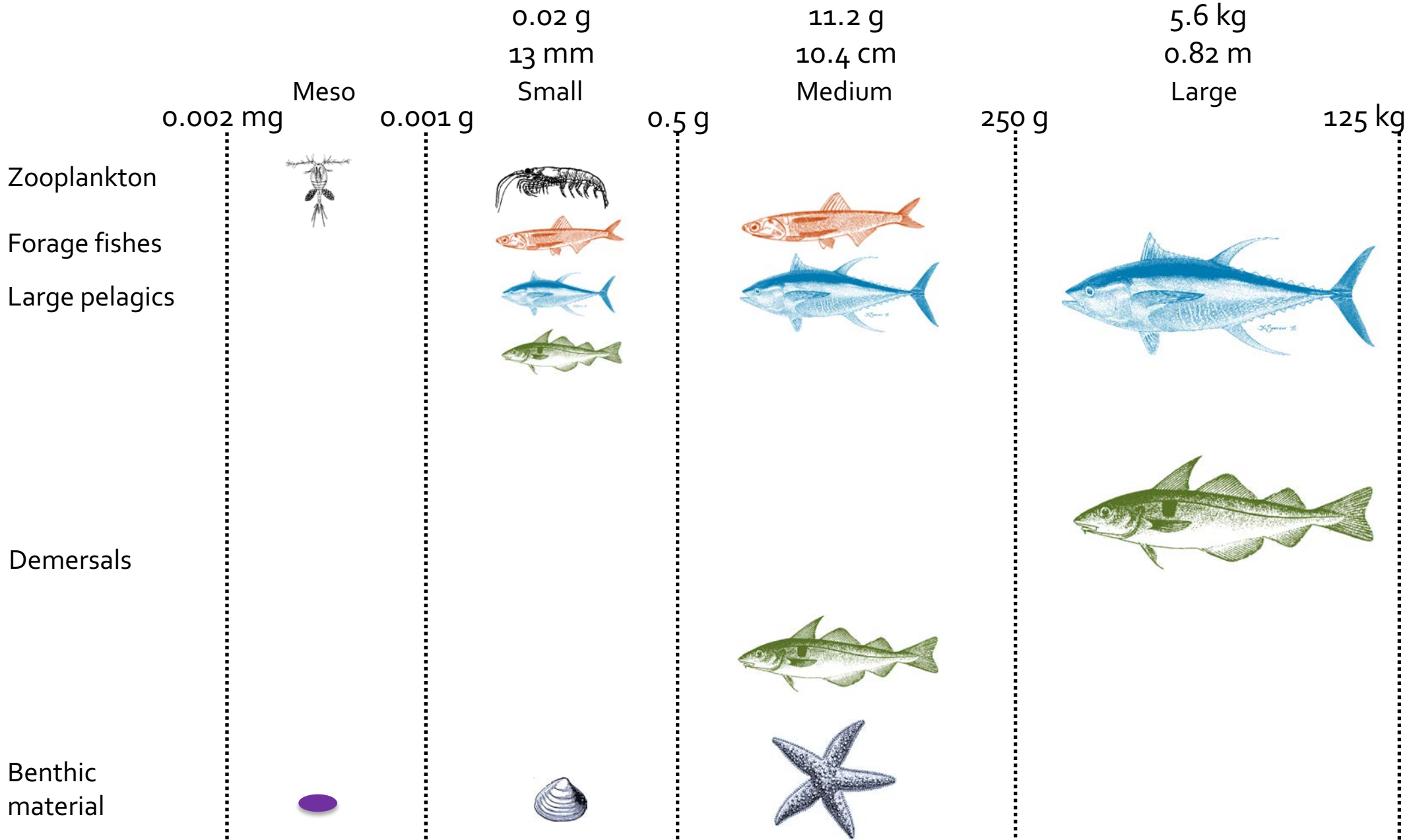
Structured by:

Feeding & habitat "functional type"
- forage fishes
- large pelagics
- demersals

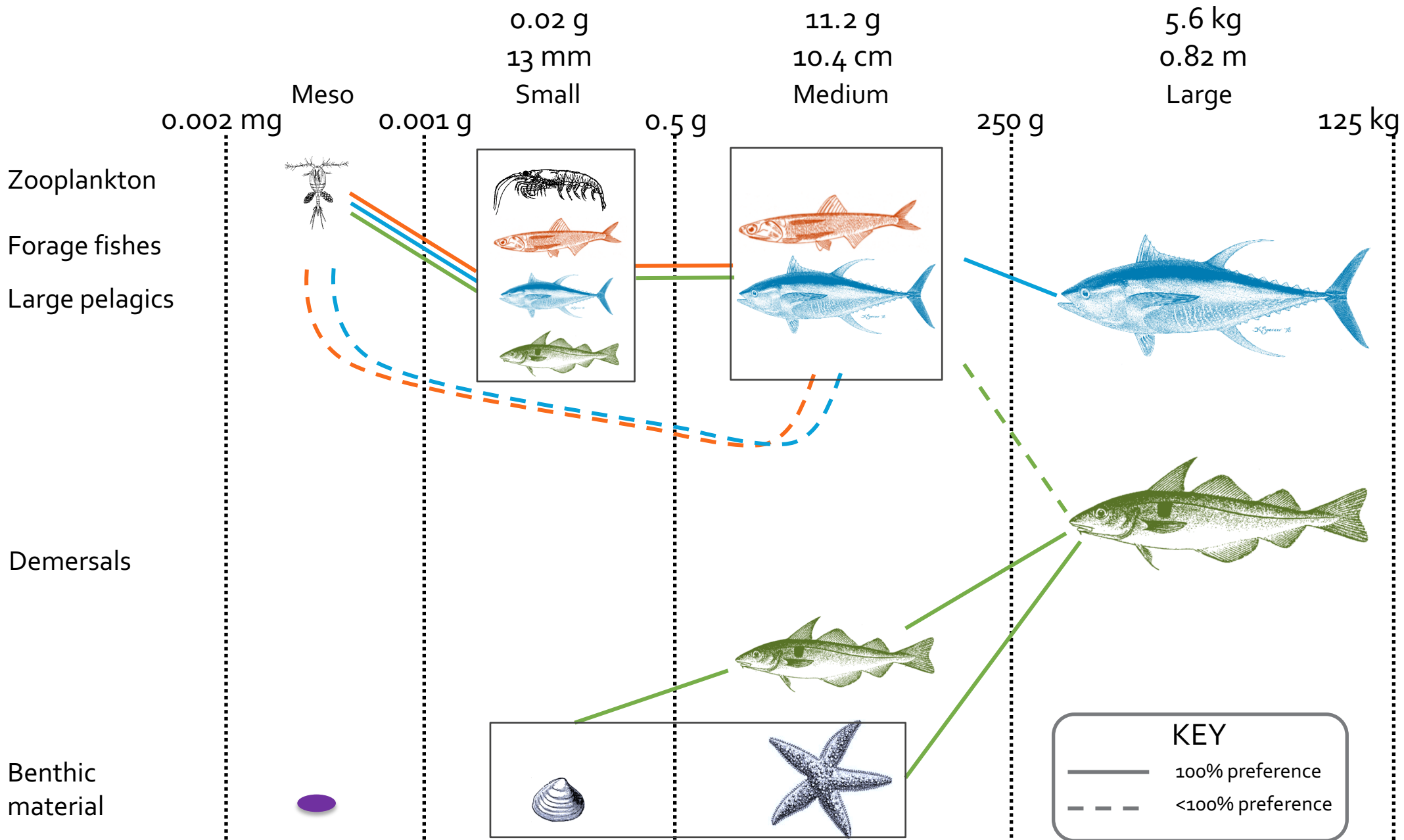
Maturity stage
- larvae
- juveniles
- adults

Size
- small
- medium
- large

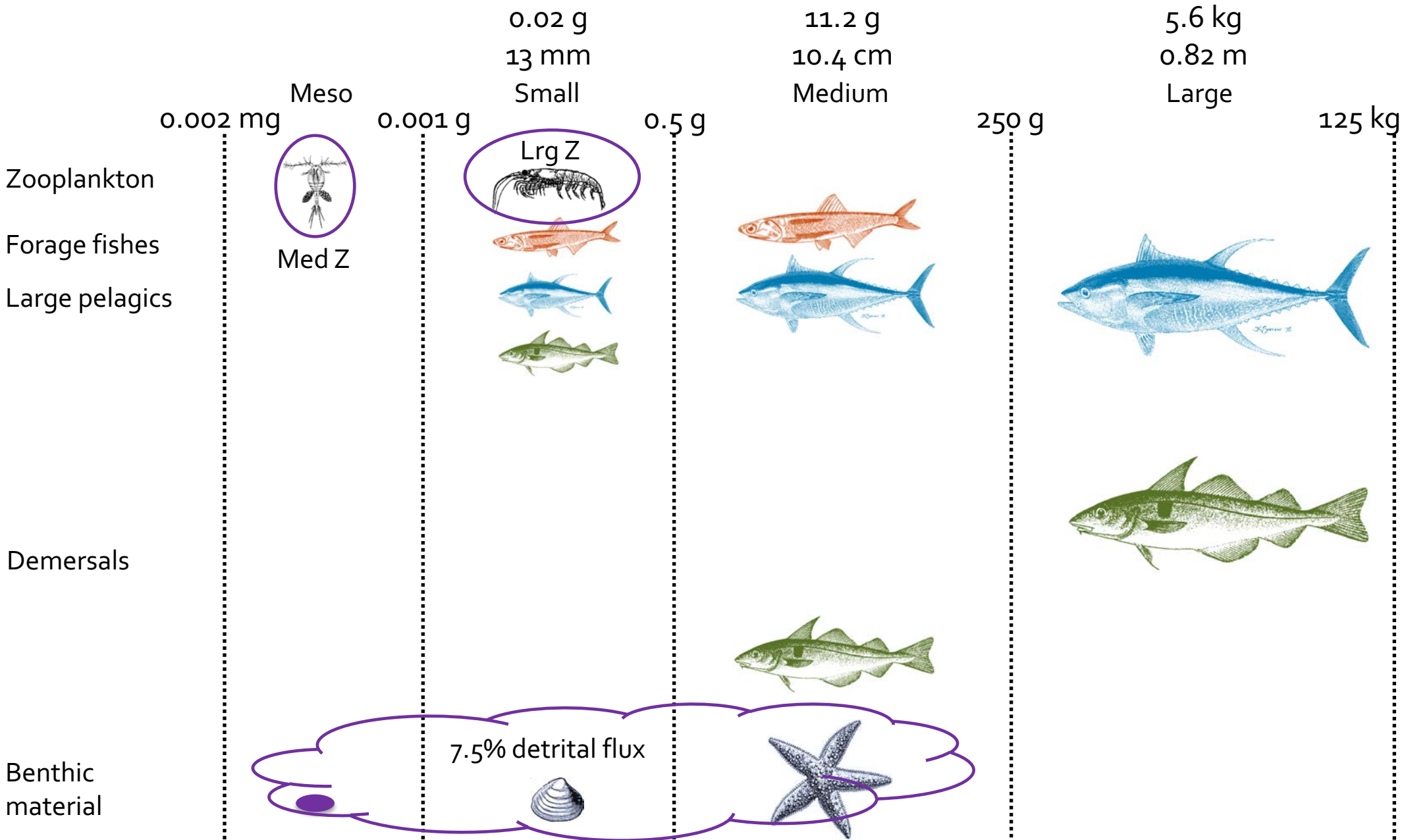
FUNCTIONAL TYPES AND SIZES



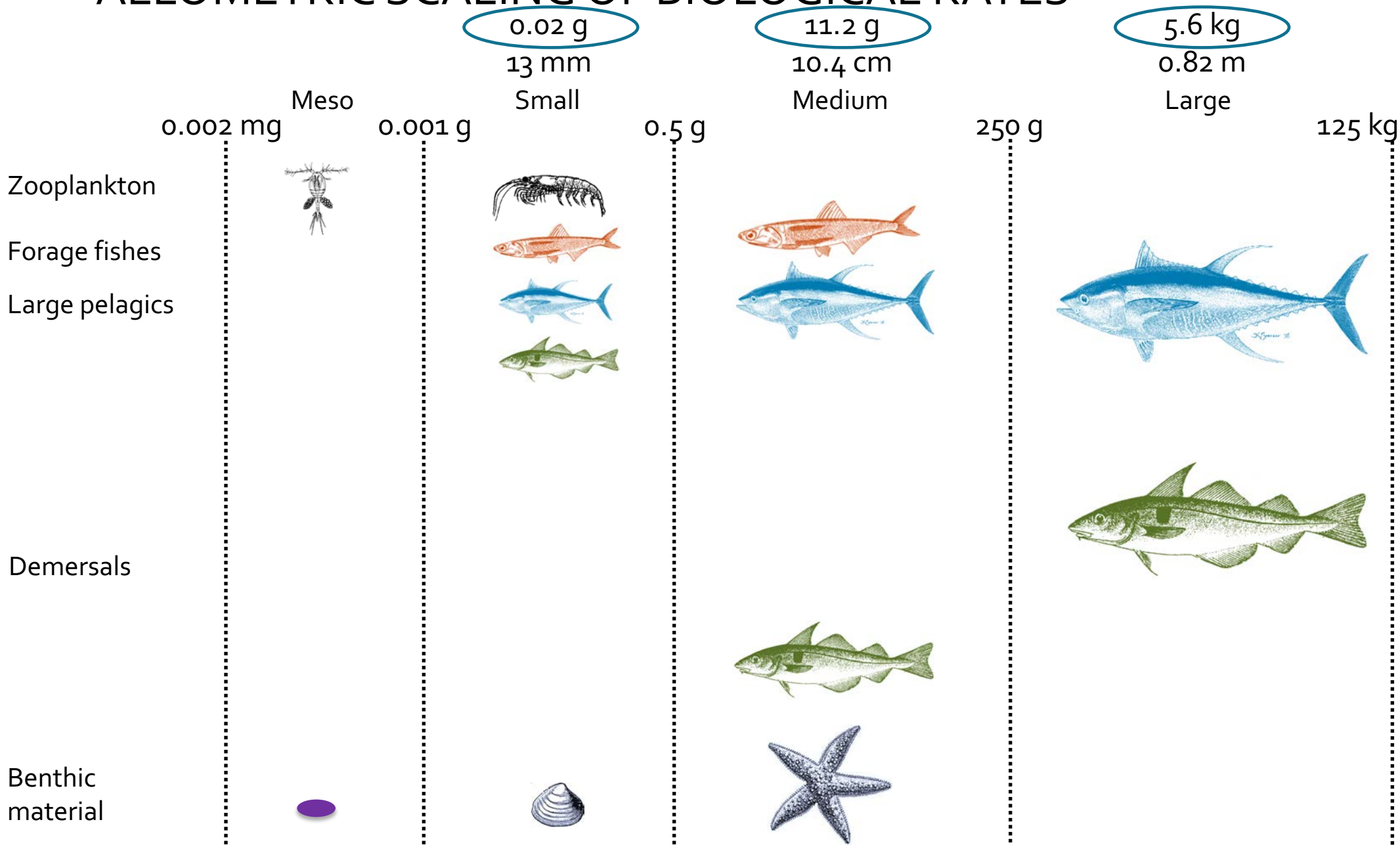
SIZE-BASED TROPHIC INTERACTIONS



ESM-COBALT LINKAGE



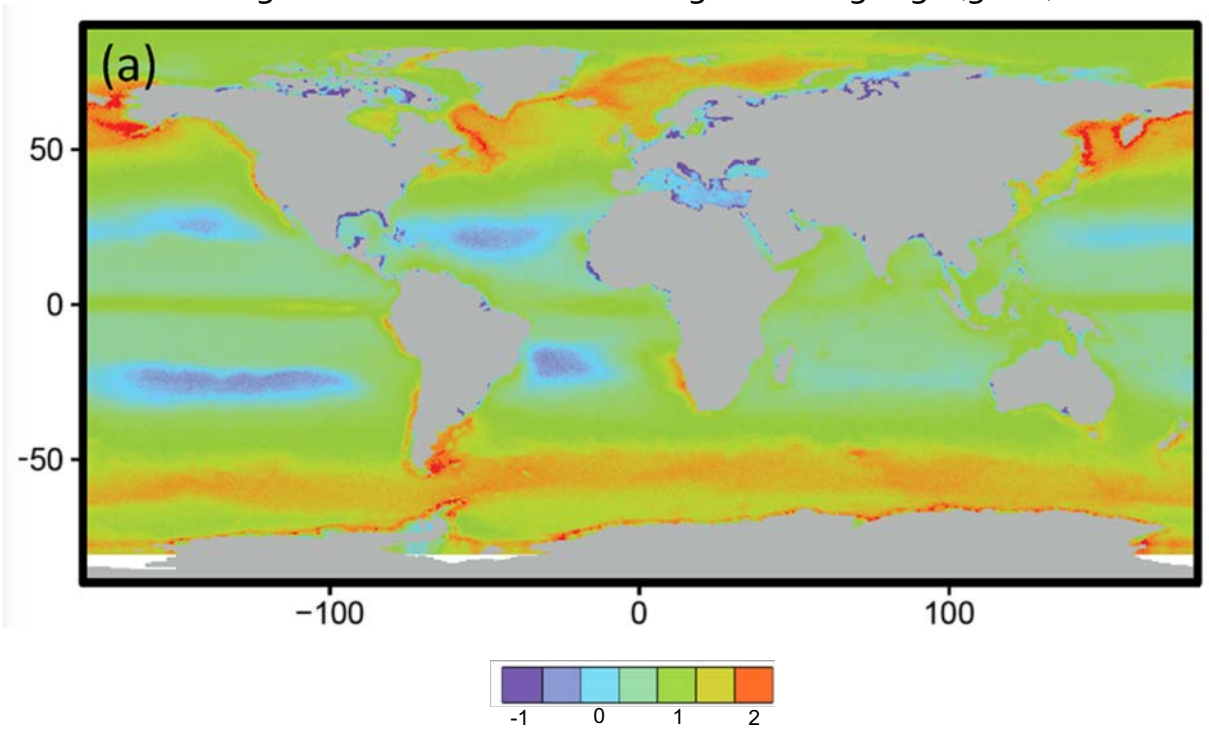
ALLOMETRIC SCALING OF BIOLOGICAL RATES



COMPARISONS TO OTHER ESTIMATES

All consumers

log10 mean biomass of Jennings & Collingridge (g m^{-2})

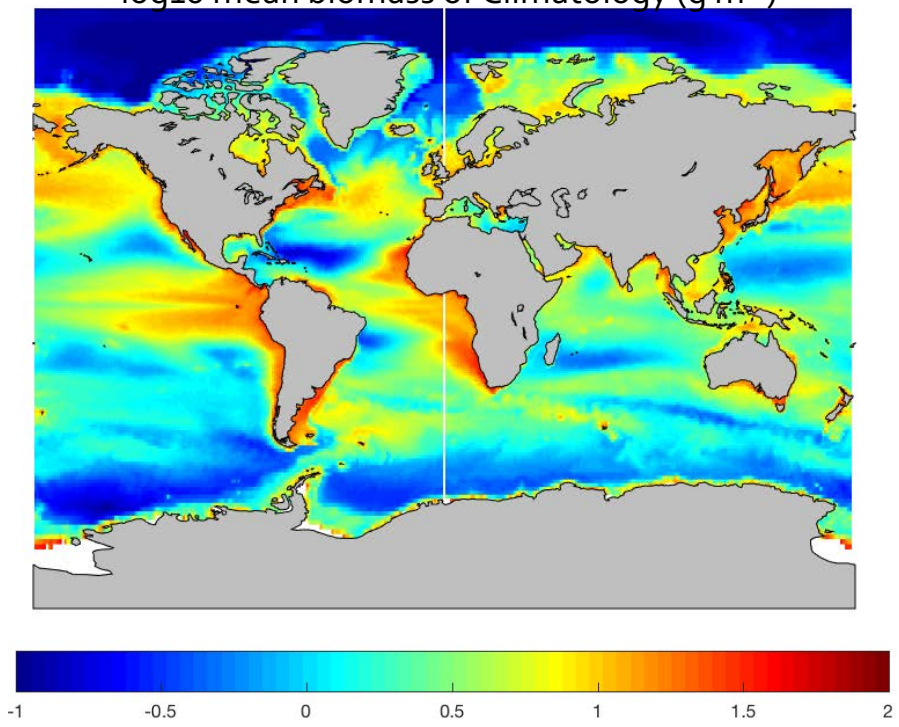


Macroecological model

4.9 10^9 MT

weight = 10 – 10^6 g

log10 mean biomass of Climatology (g m^{-2})



POEM v2.0

1.6 10^9 MT

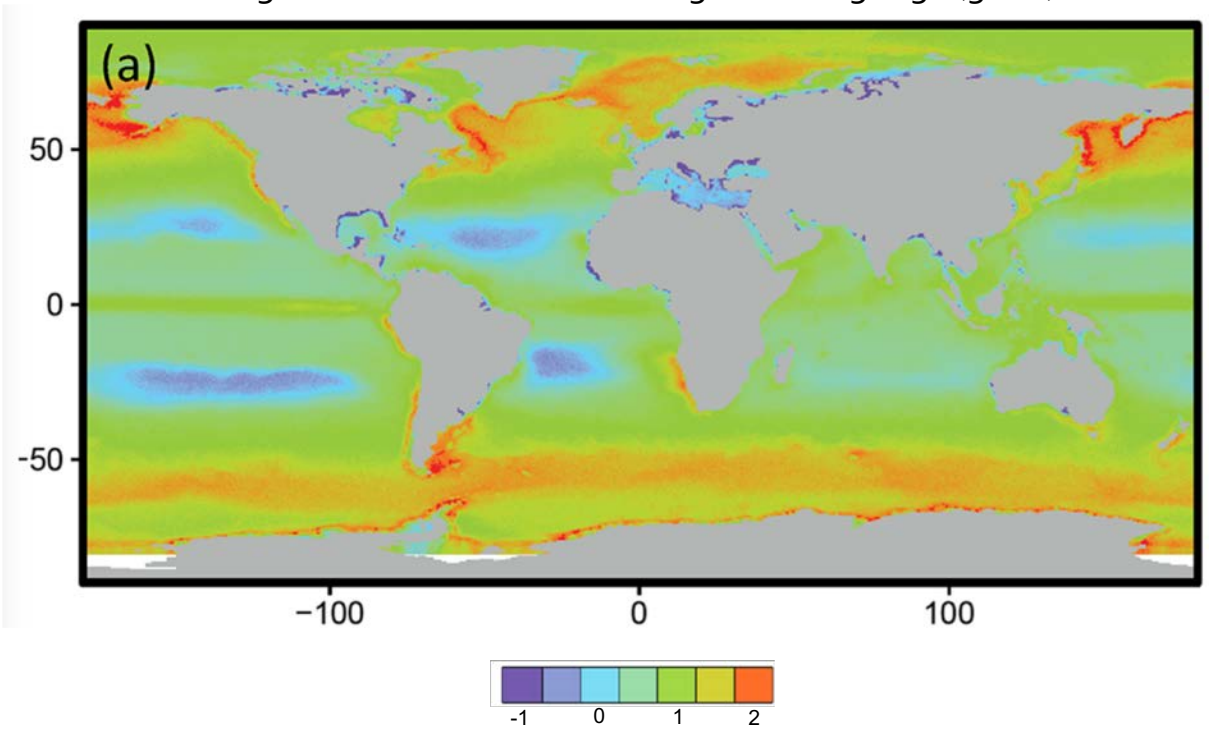
Jennings & Collingridge 2015

C. Petrik et al. in prep

COMPARISONS TO OTHER ESTIMATES

All consumers

log10 mean biomass of Jennings & Collingridge (g m^{-2})

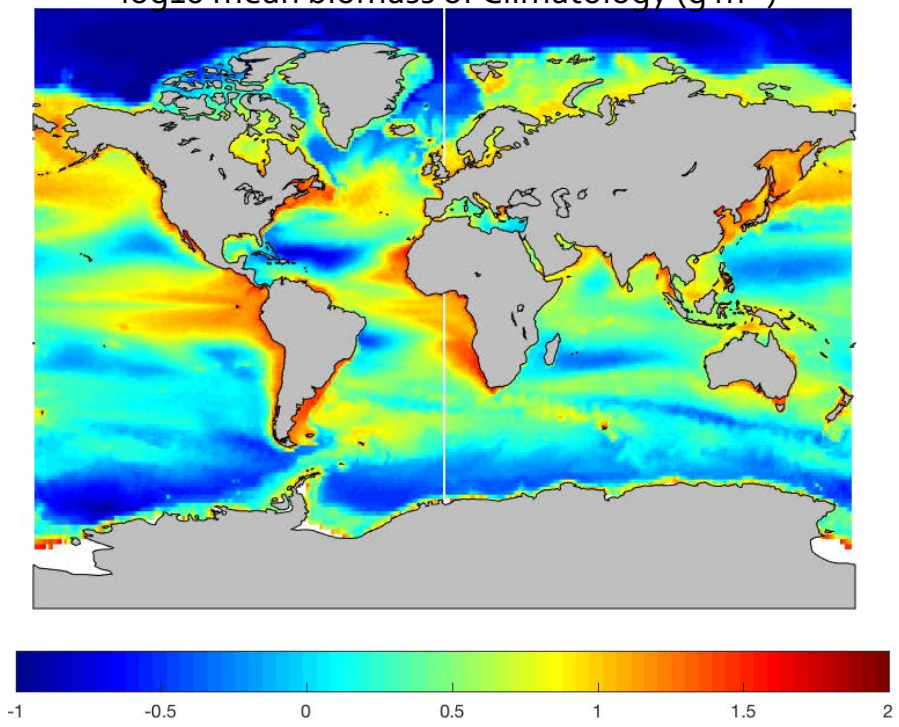


Macroecological model

0.3 – 26.1 10^9 MT

weight = 10 – 10^6 g

log10 mean biomass of Climatology (g m^{-2})



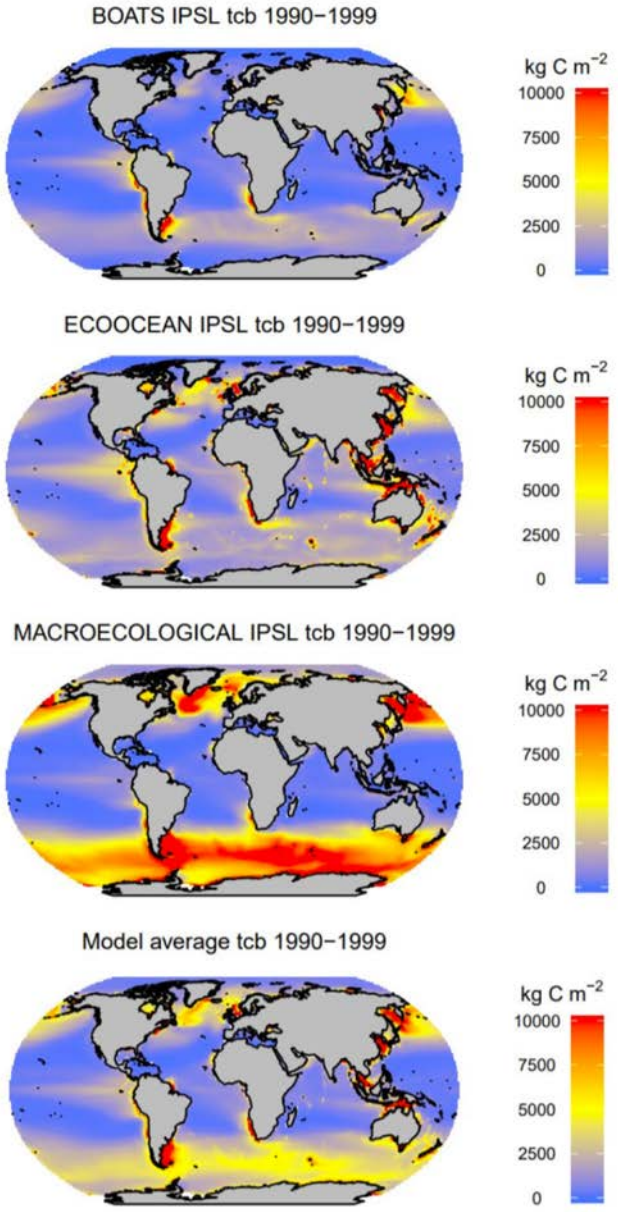
POEM v2.0

1.6 10^9 MT

Jennings & Collingridge 2015

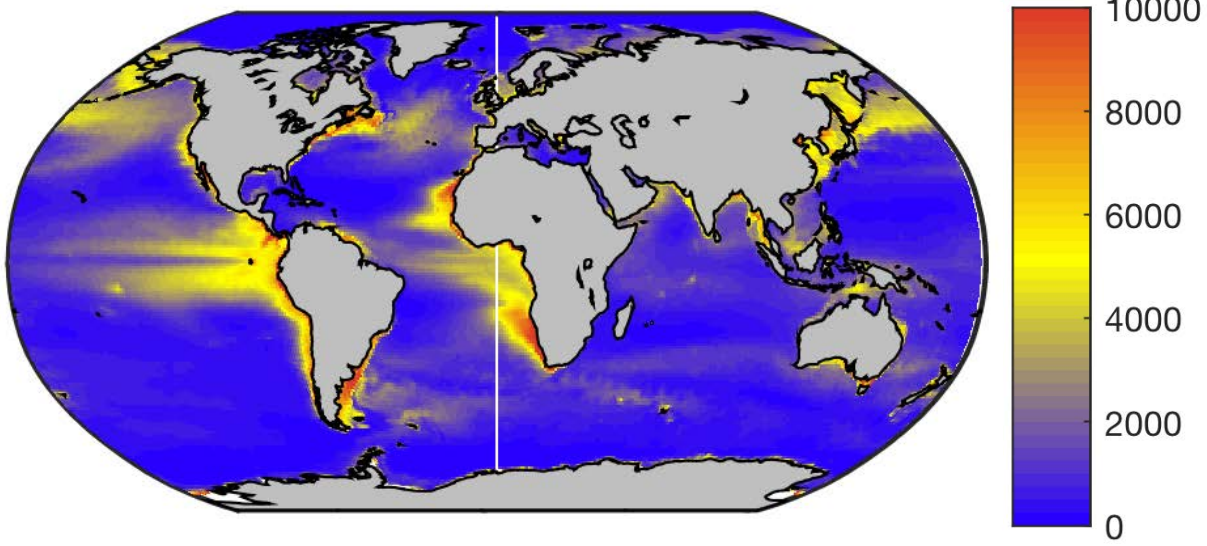
C. Petrik et al. in prep

COMPARISONS TO OTHER ESTIMATES



All consumers

POEM GFDL tcb 1990-1995



Fish-MIP

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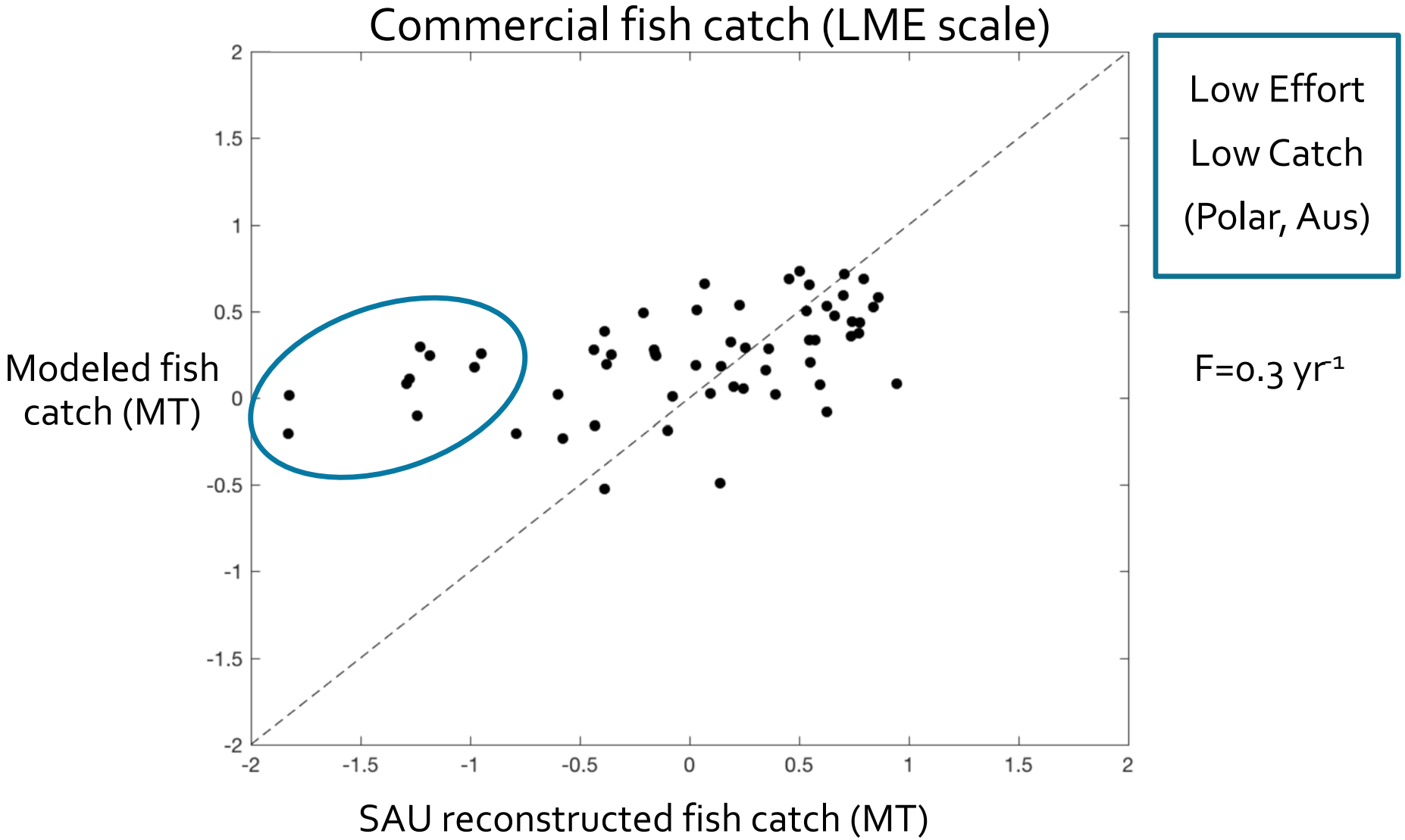
COMPARISONS TO OTHER ESTIMATES



Low Effort
Low Catch
(Polar, Aus)

$F=0.3\ yr^{-1}$

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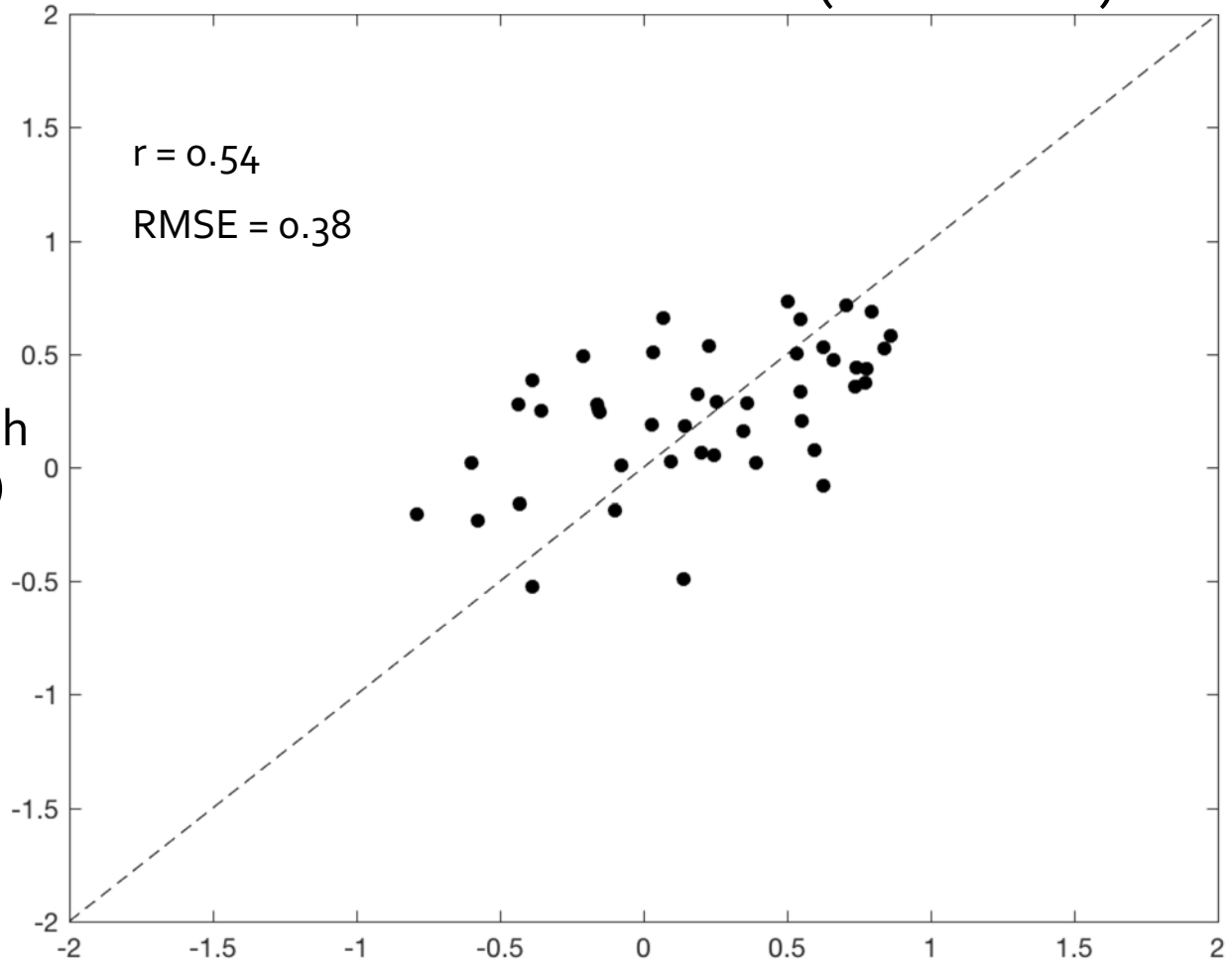
COMPARISONS TO OTHER ESTIMATES

Commercial fish catch (LME scale)



Modeled fish catch (MT)

F=0.3 yr^{-1}

SAU reconstructed fish catch (MT)

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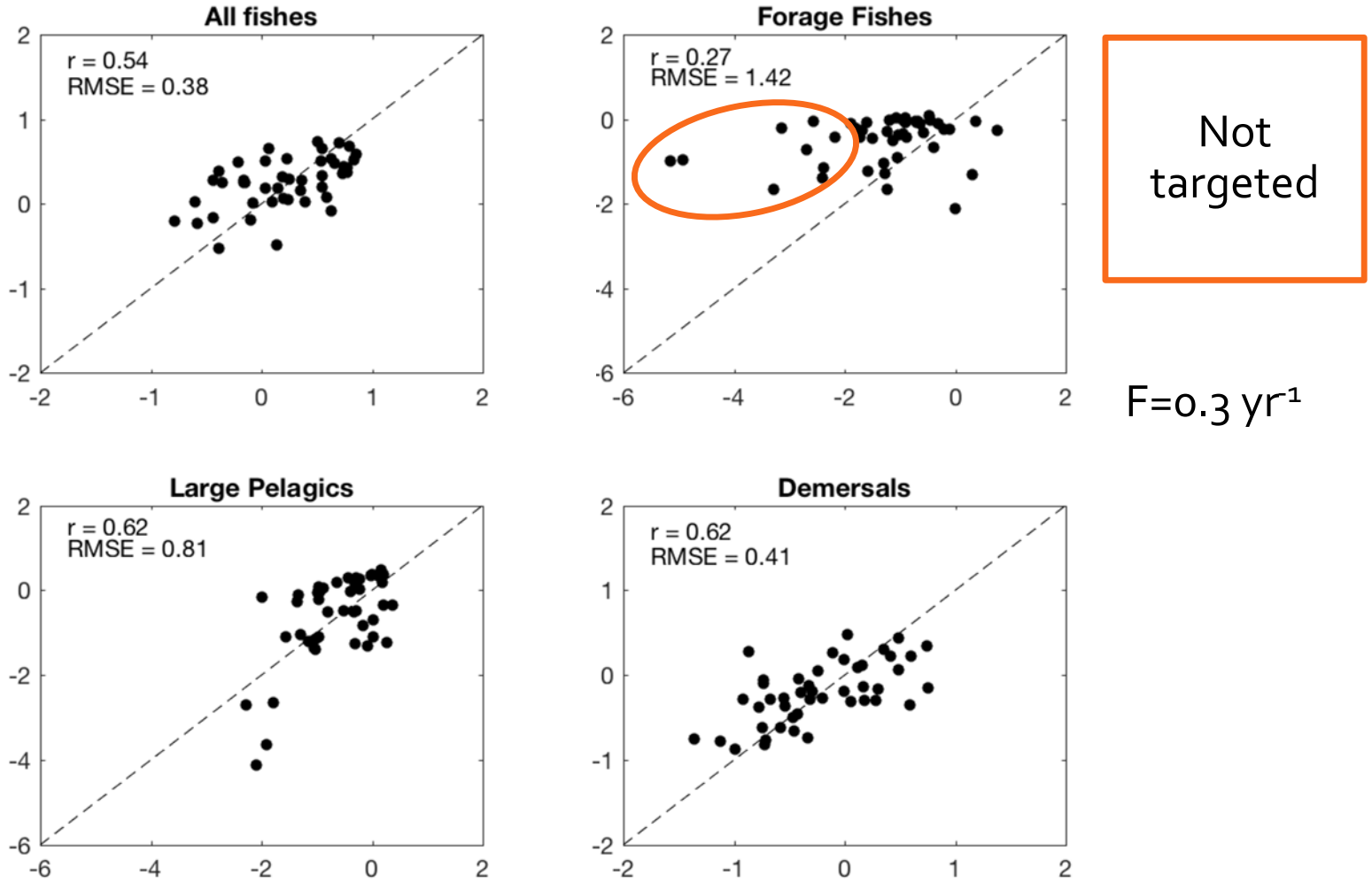
COMPARISONS TO OTHER ESTIMATES



Not targeted

F=0.3 yr^{-1}

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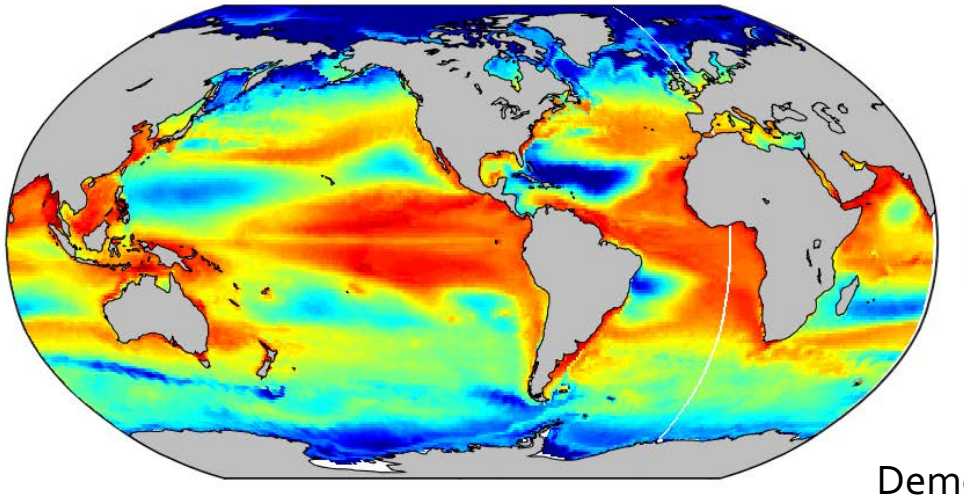
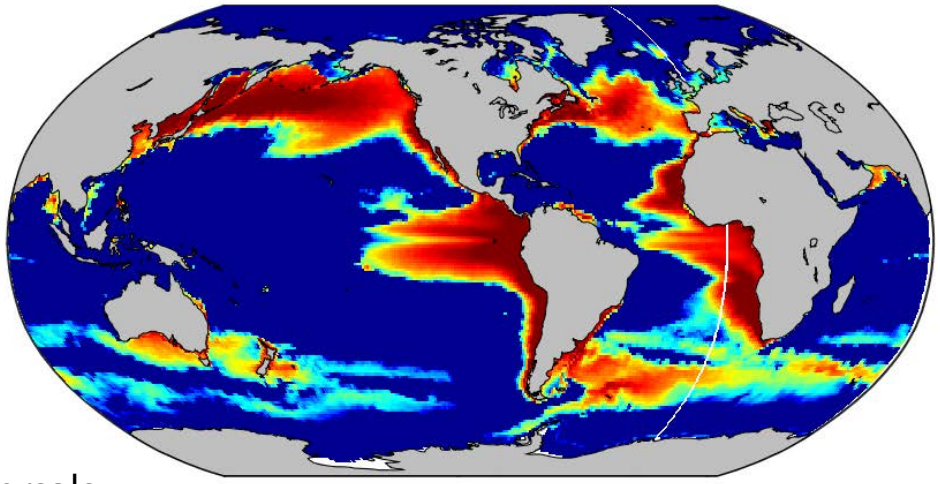
RECENT HISTORIC GLOBAL TYPE DISTRIBUTION

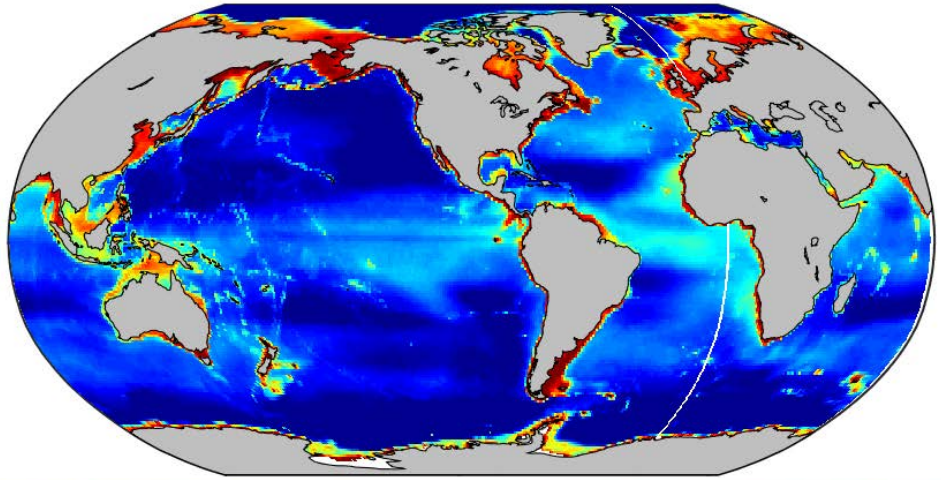
Forage fishes

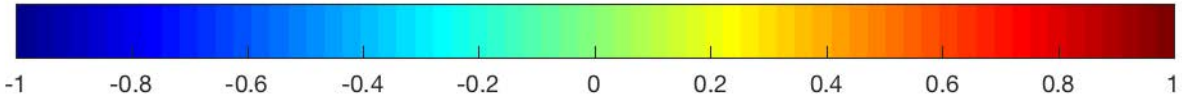


Large pelagics



Demersals





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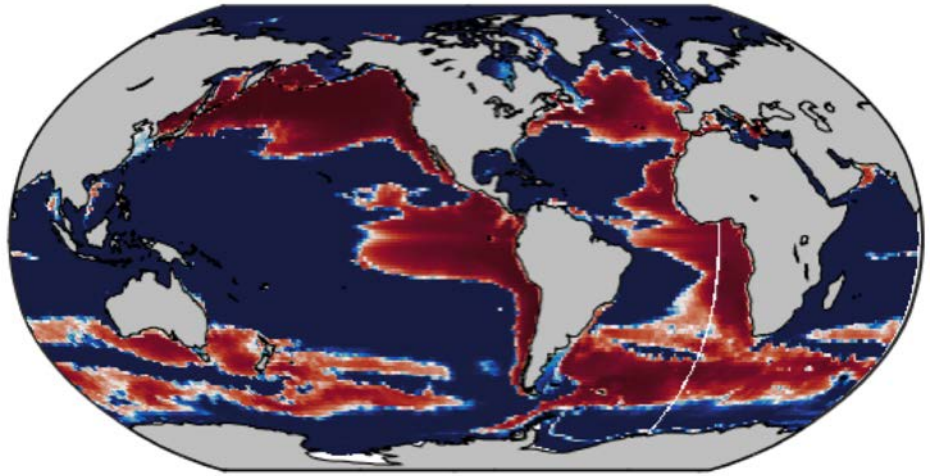
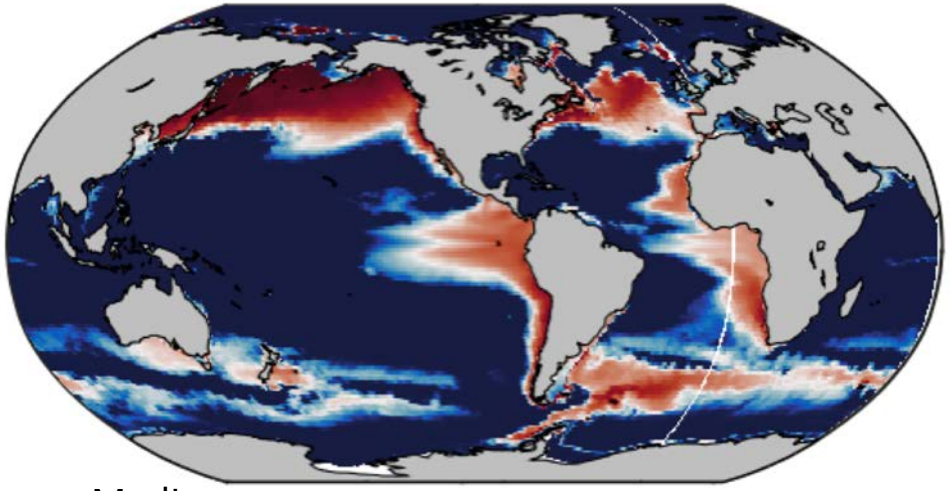
DOMINANCE OF DIFFERENT TYPES

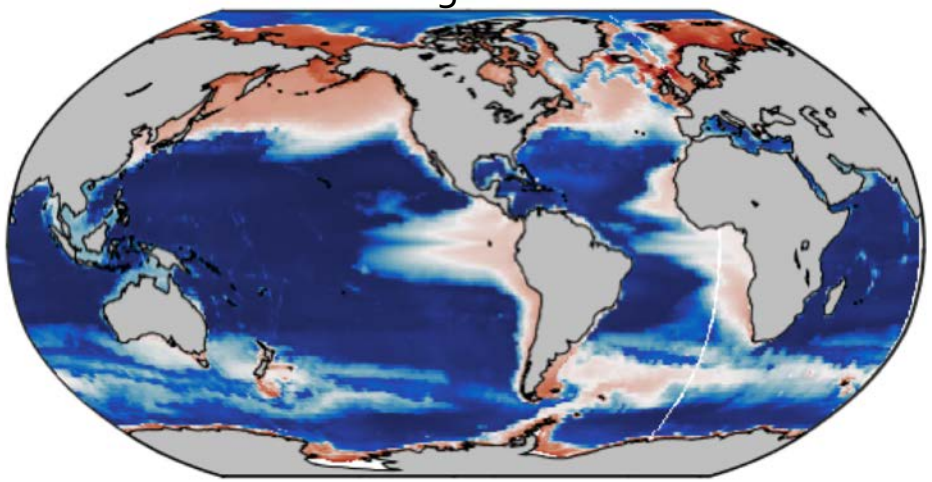
Fraction Large pelagics vs. Demersals



Fraction Large pelagics vs. Forage fishes



Fraction Large vs. Medium



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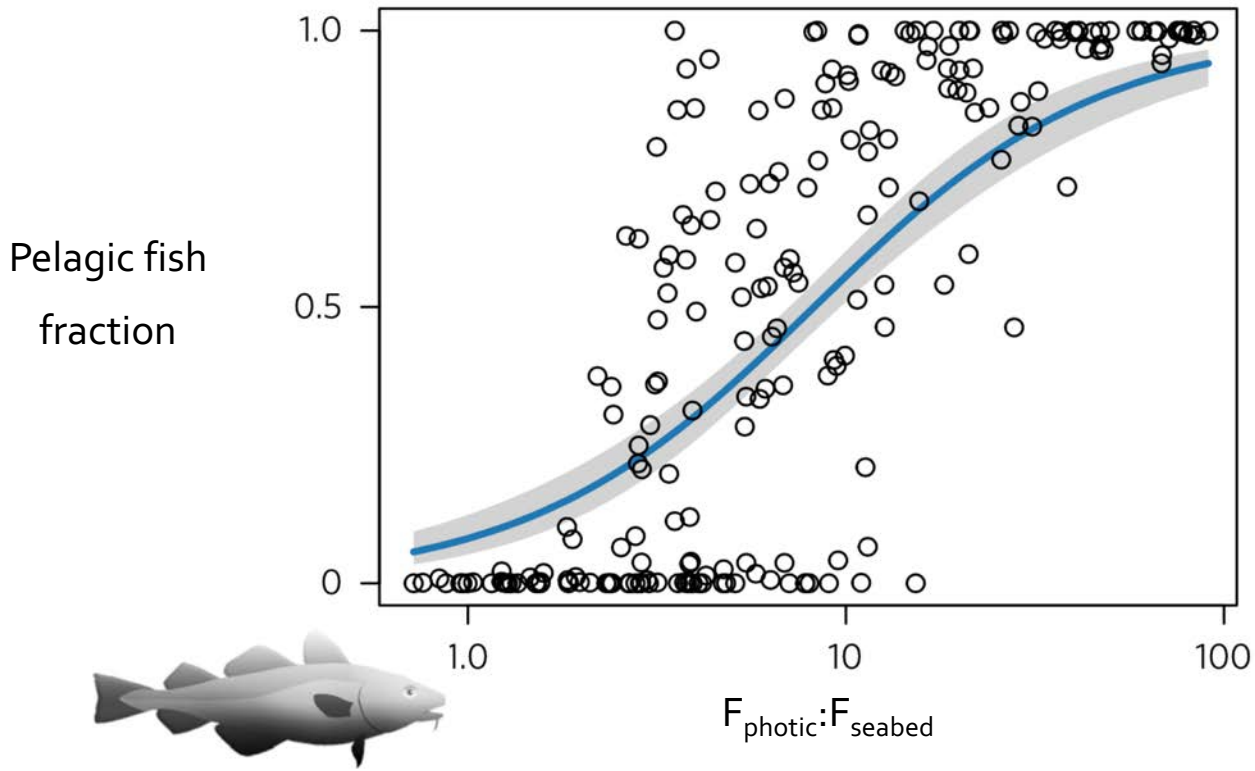
LARGE PELAGICS VS. DEMERSALS

SAU catches

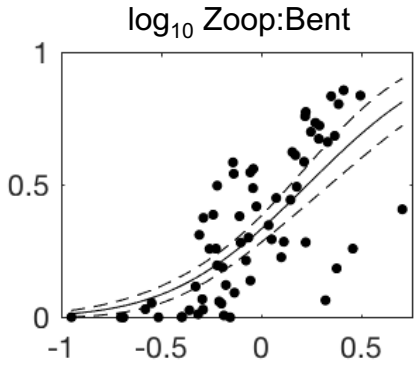


F= fraction NPP

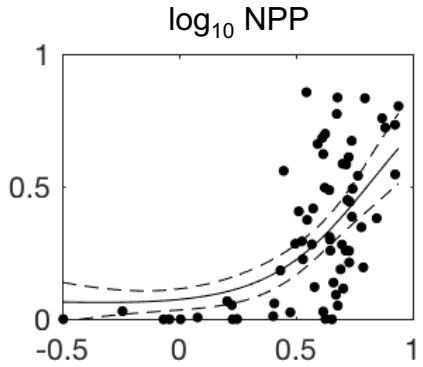
van Denderen et al. 2018

DOMINANCE OF DIFFERENT TYPES

Large pelagics vs. Demersals

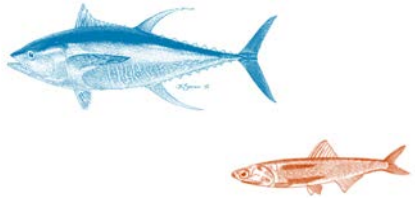


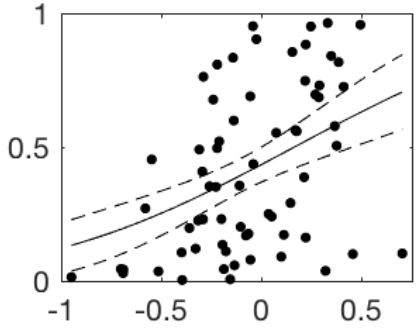
68%



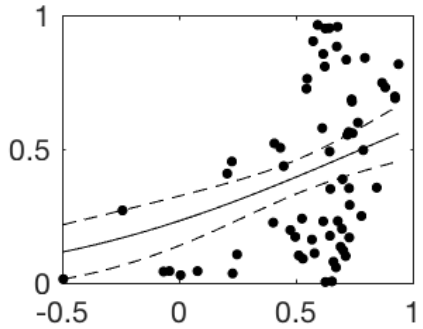
55%

Large pelagics vs. Forage fishes



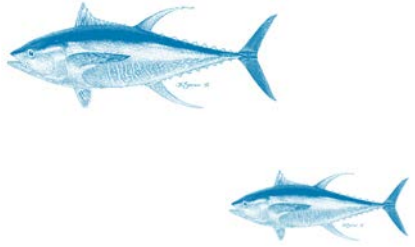


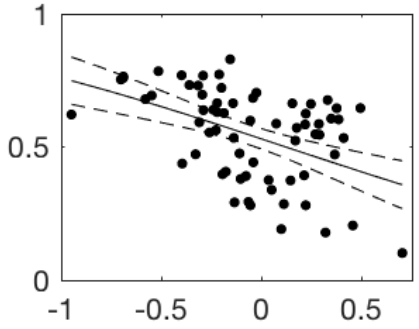
26%



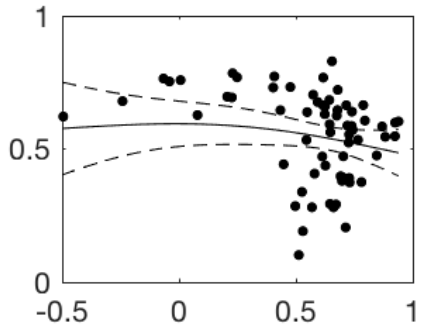
22%

Large vs. Medium fishes





24%



5%

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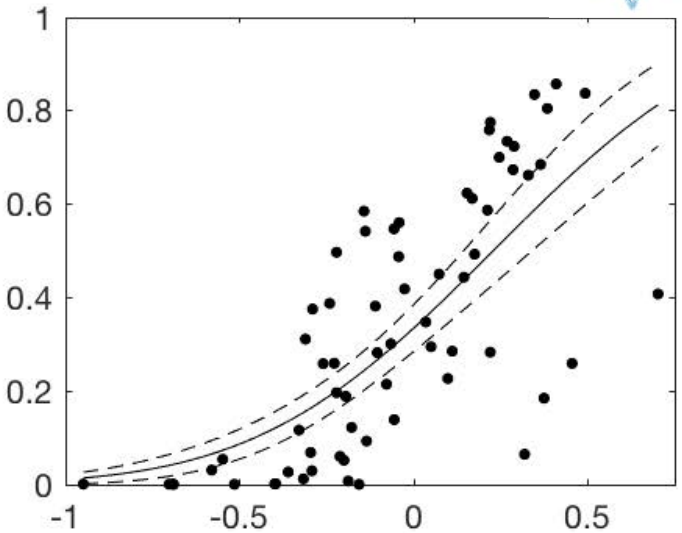
LARGE PELAGICS VS. DEMERSALS

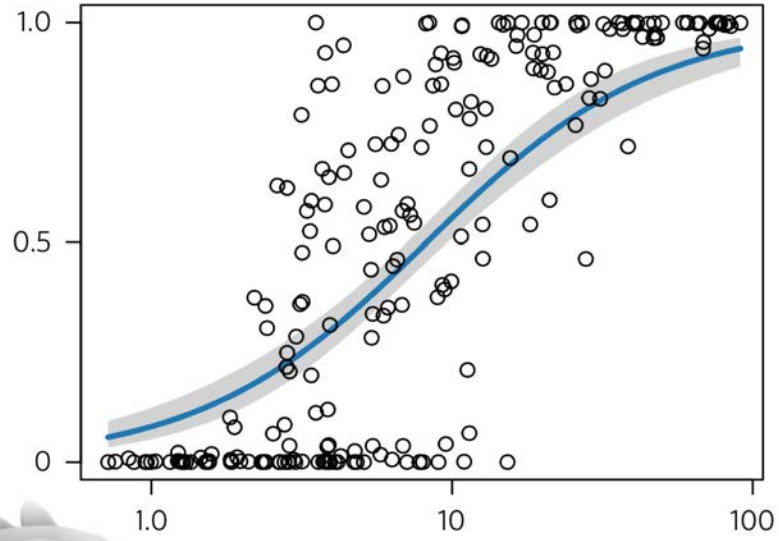
POEM v2.0

Pelagic fish fraction



log10 Zoop:Bent

SAU catches

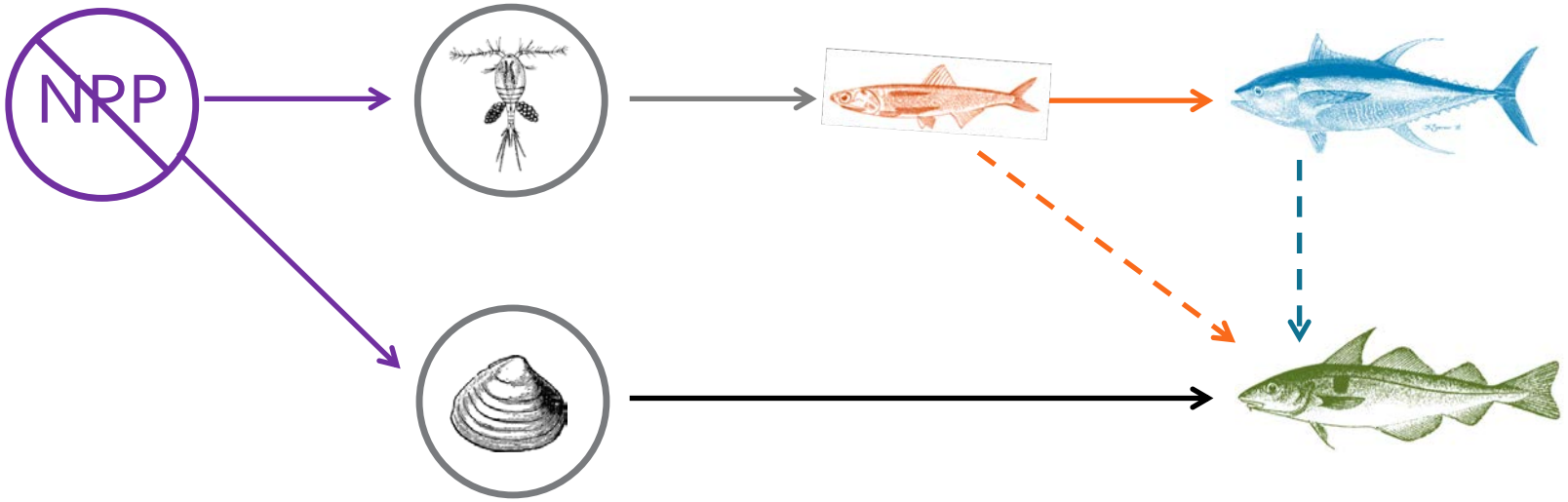


F_{photic}:F_{seabed}

F= fraction NPP

van Denderen et al. 2018

DRIVERS OF FISH PRODUCTION & DOMINANCE



Friedland et al. (2012): *pe*-ratio, *z*-ratio

Stock et al. (2017): bottom detritus flux, mesozooplankton production

van Denderen (2018): fraction NPP photic to fraction NPP benthic

POEM v2.0: zooplankton production to benthos production

Total fish catch

Large pelagic vs. Demersal

ACKNOWLEDGMENTS

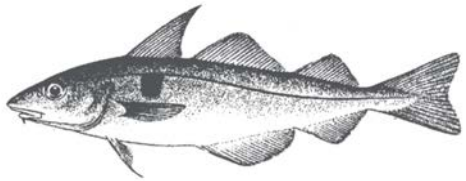
Ken Andersen, Charlie Stock, Daniël van Denderen, James Watson

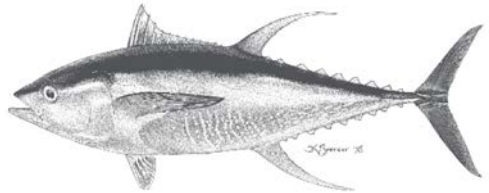
Nereus Program (Nippon Foundation)

NOAA Geophysical Fluid Dynamics Laboratory

Princeton University & Jorge Sarmiento

Sea Around Us Project





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