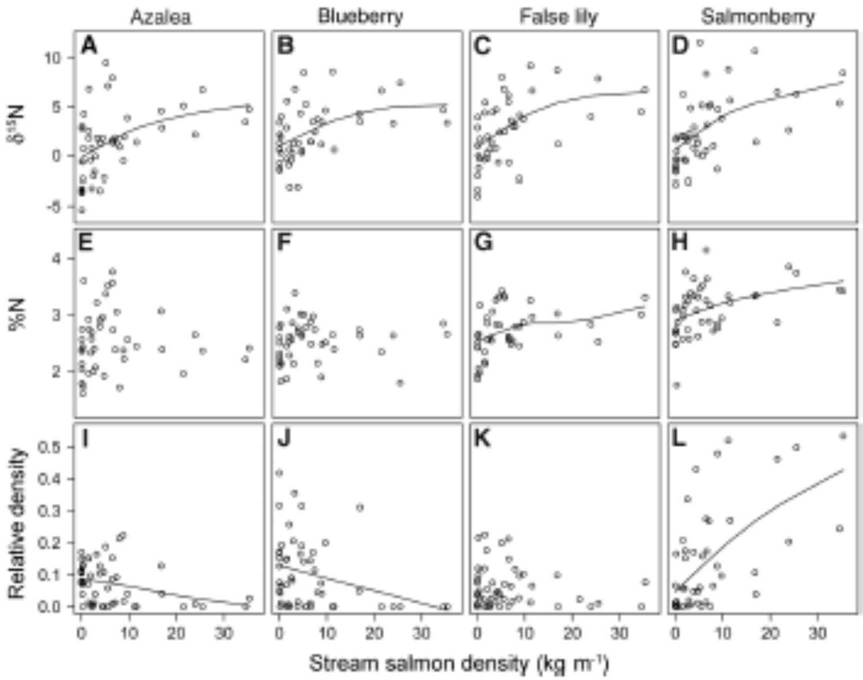
Stable isotopes in carbon flux

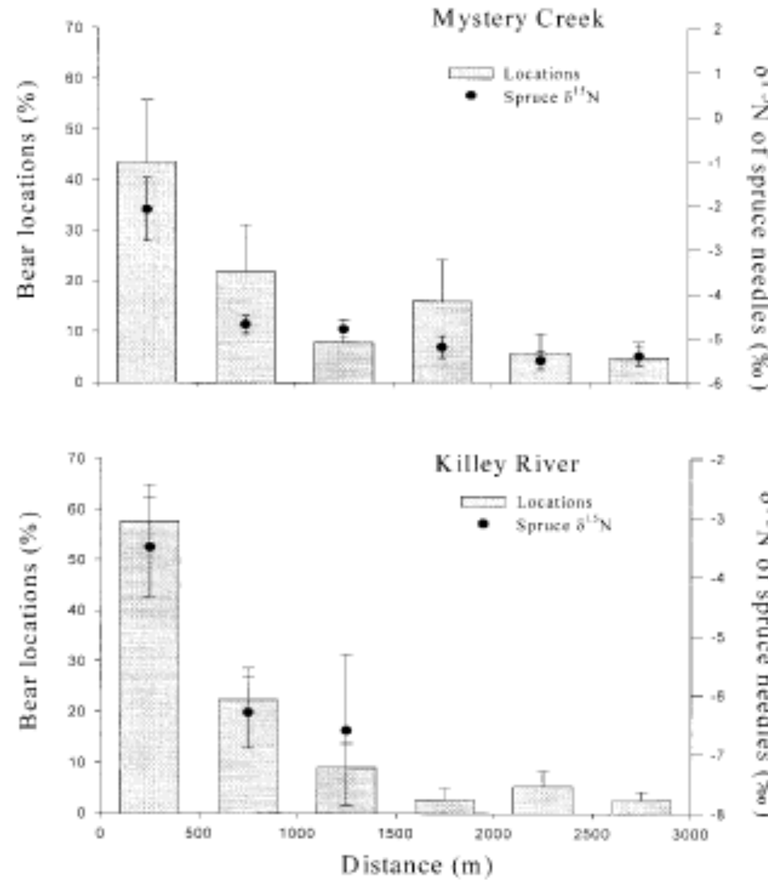
Movement of carbon across isotopic gradients

Metabolic physiology

Marine derived protein in terrestrial riparian ecosystems

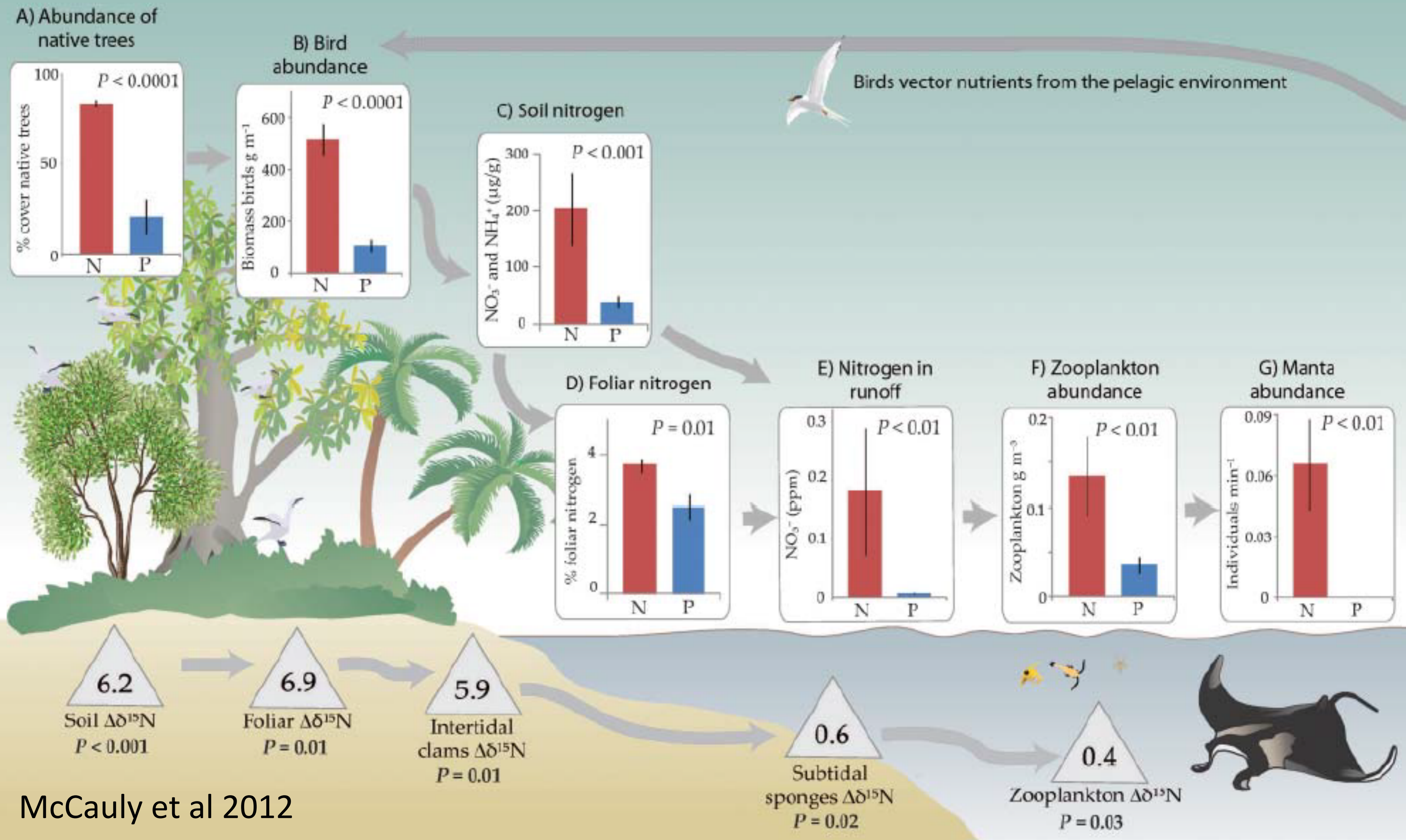


Hocking and Reynolds 2011. Science 331: 1609-1612

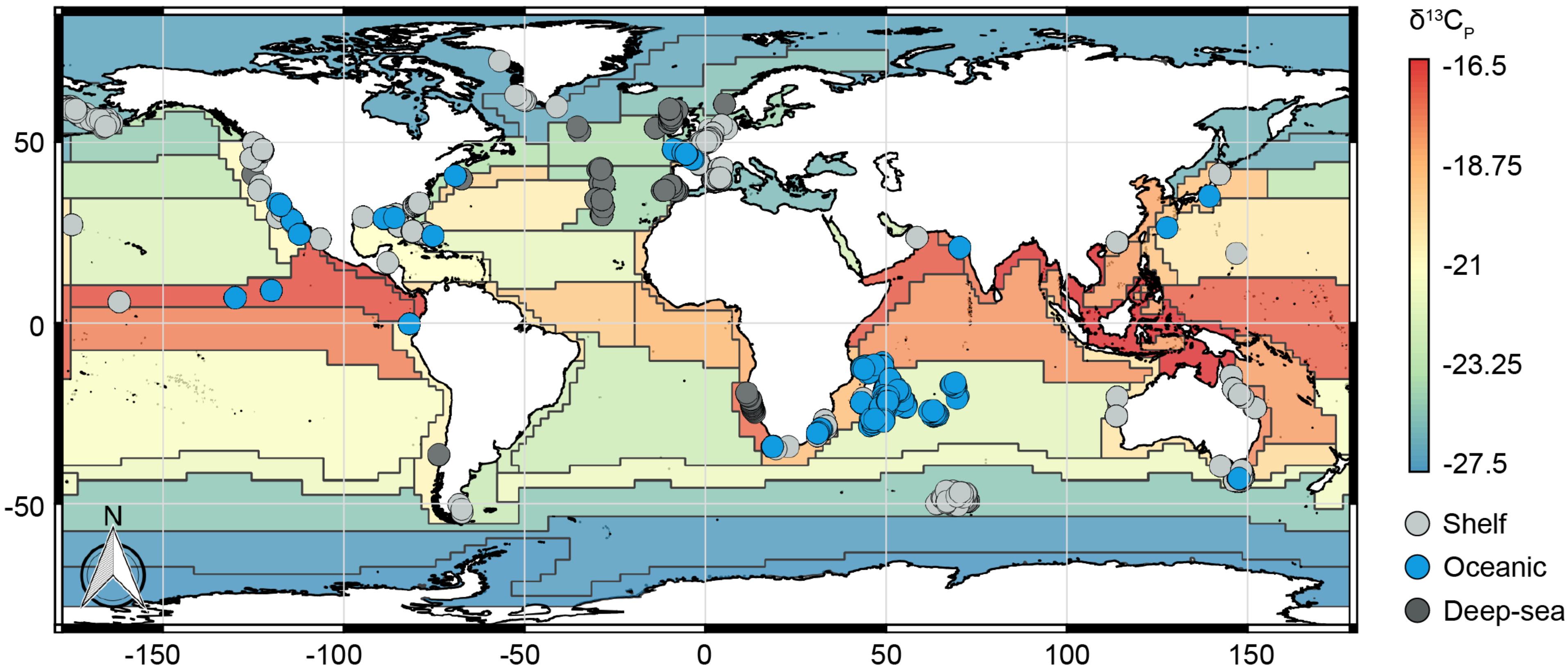


Hilderbarnd et al. 1999. Oecologia 121 546-550

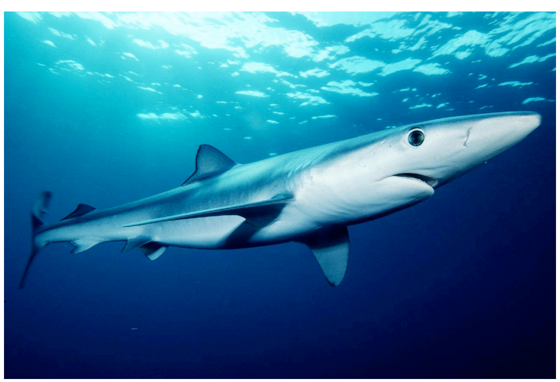
Isotopes – tracking structural nutrients



McCauly et al 2012



δ13CP
-16.5
-18.75
-21
-23.25
-27.5
Shelf
Oceanic
Deep-sea
N
50
0
-50
-150
-100
-50
0
50
100
150



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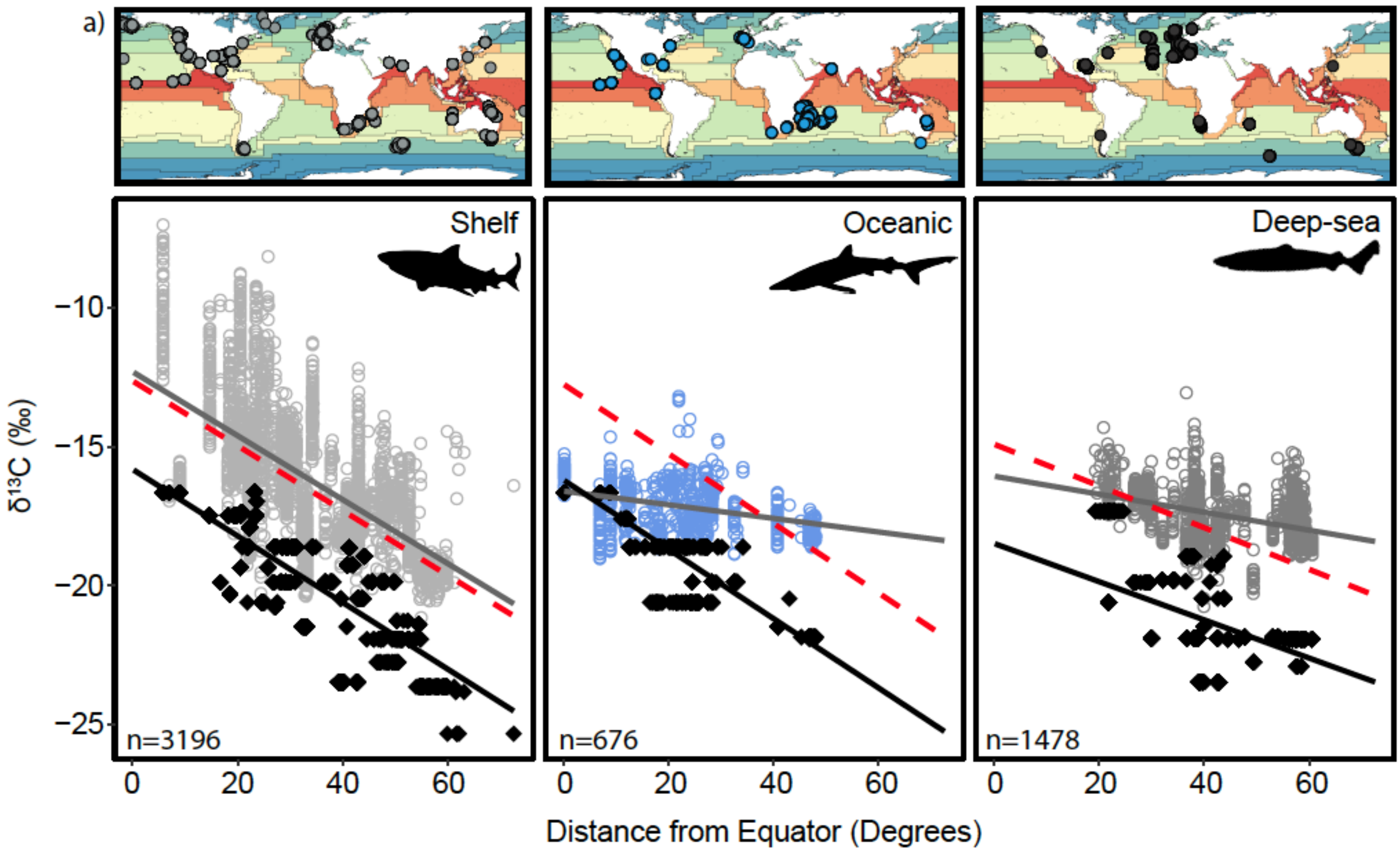
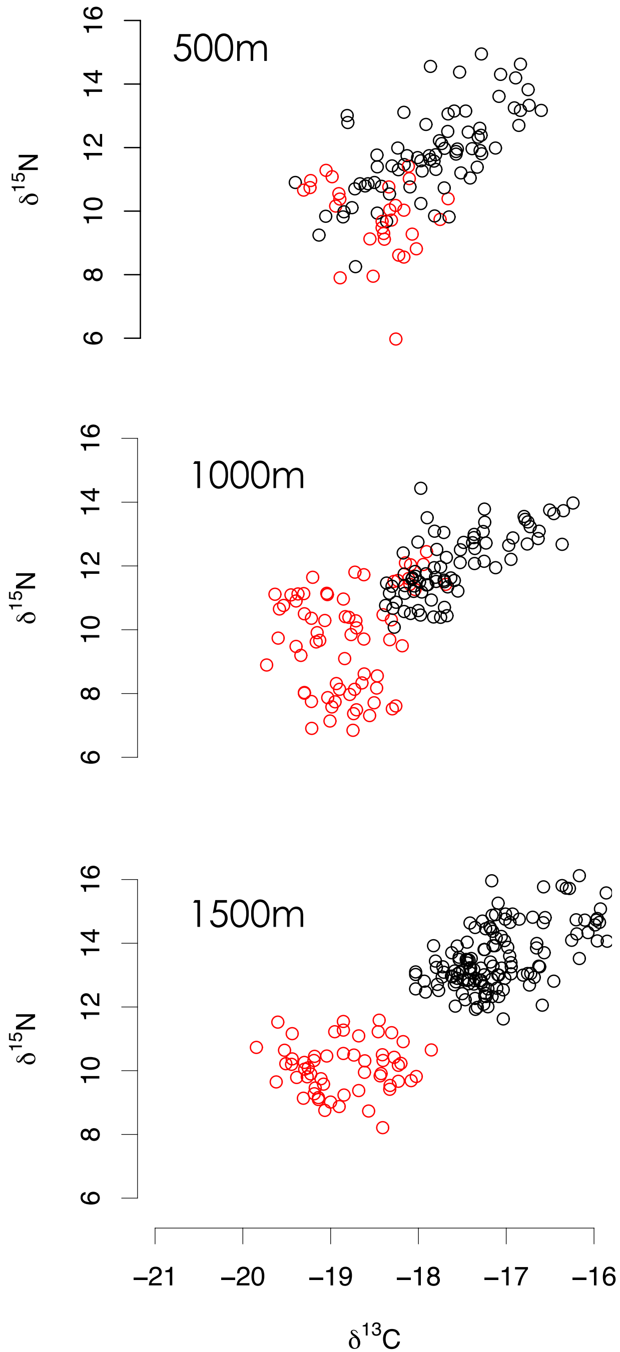
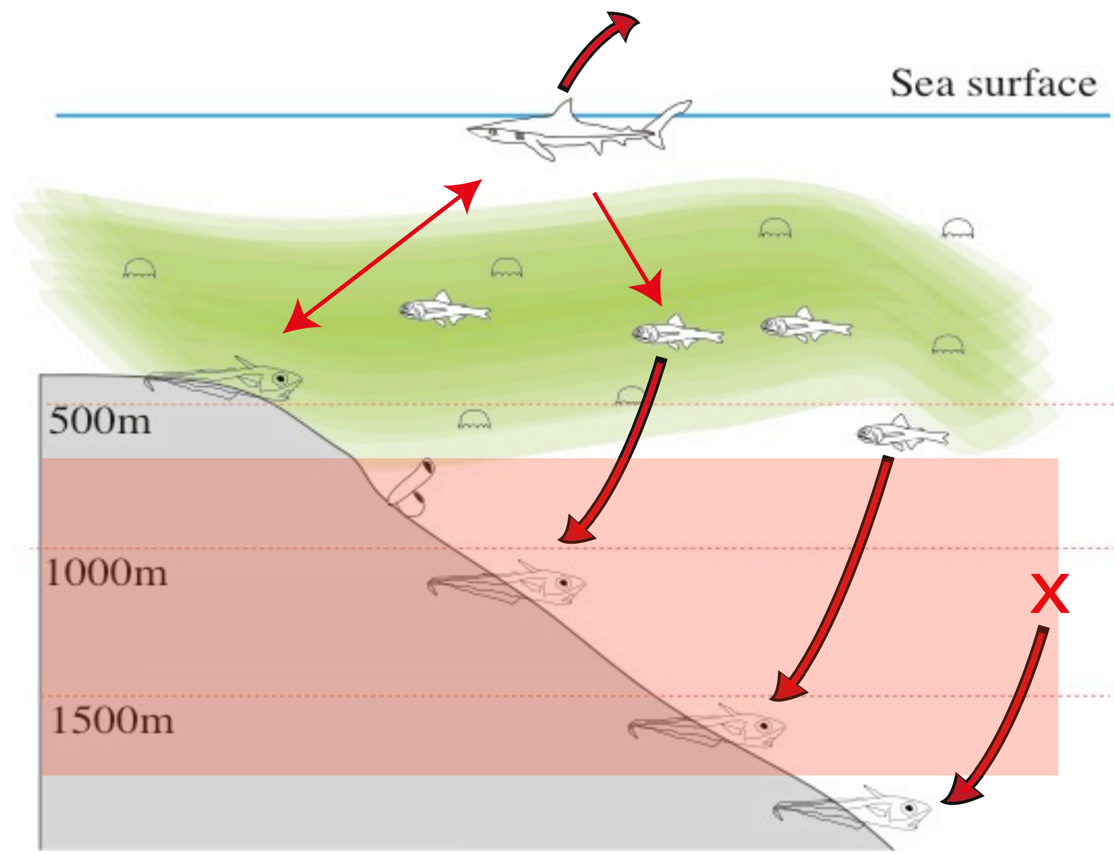


Bird et al (2018) Nature Ecology Evolution

Trueman et al Proc Roy Soc B 2014





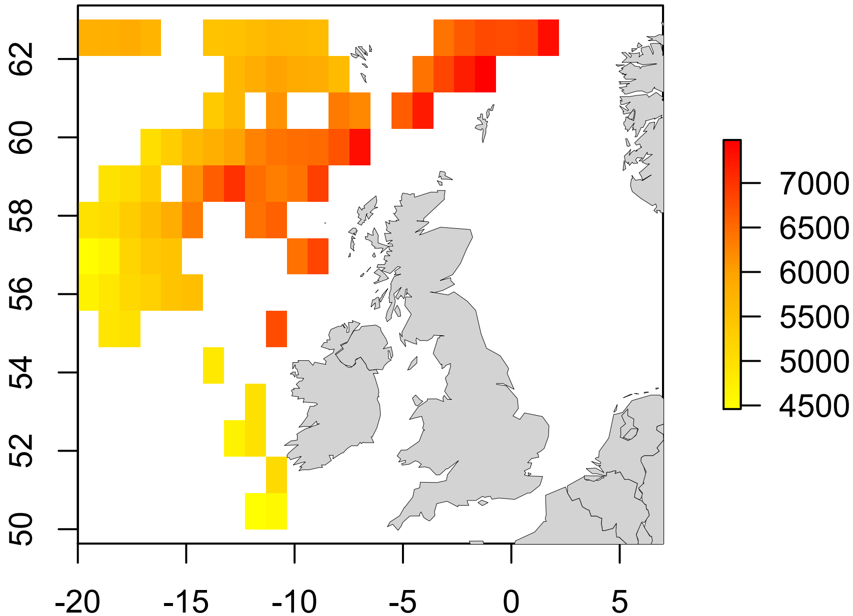
Trueman et al 2014

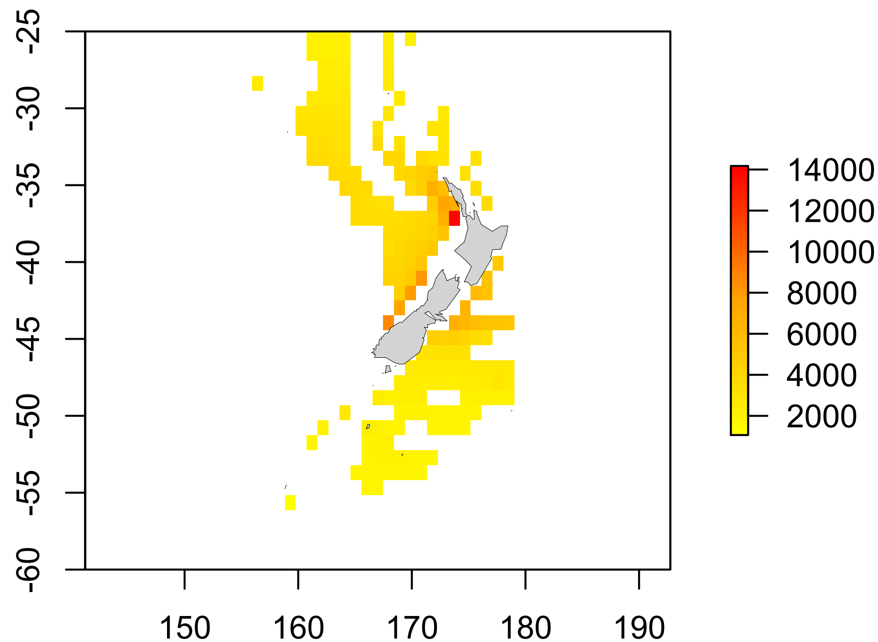
Carbon capture for NE Atlantic

- Area of slope between 500 and 2000m
- Fish biomass in slope area (500mgC m^{-2})
- Demersal pelagic feeders c. 50-75% of biomass
- Estimate annual consumption rate (2.1:3.65*biomass)
- Carbon content of prey captured (0.45*(dry)biomass)

- From this, estimate carbon captured annually as CO_2 equivalent

Case areas

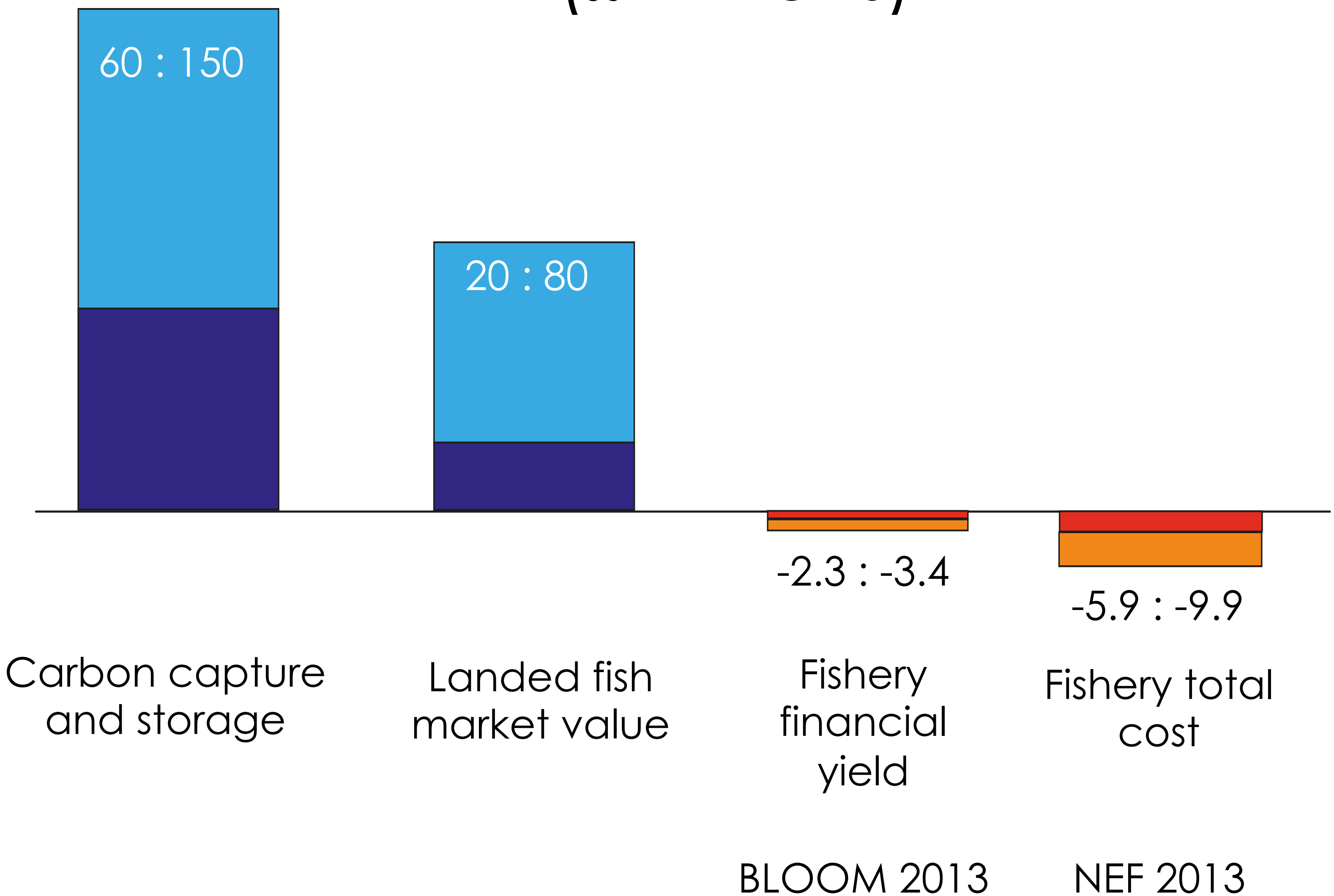




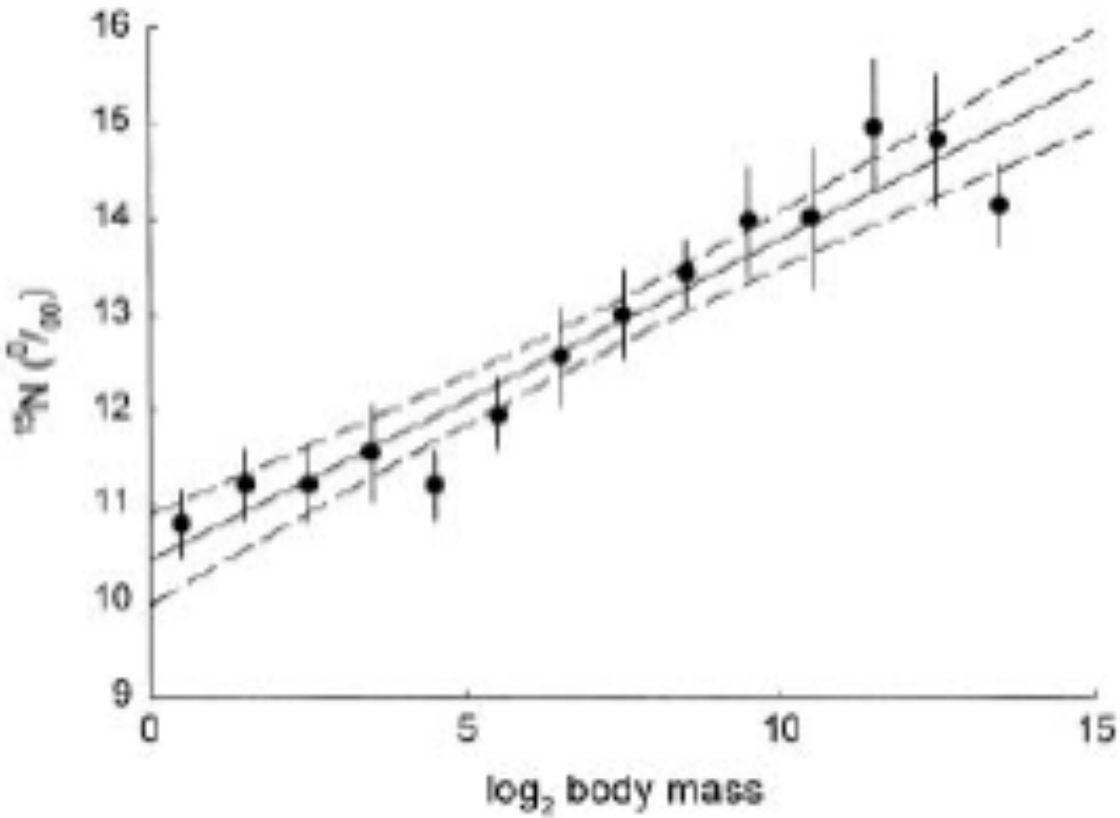
0.5Million Km2
Estimated CO_2 capture:
1.7 - 5 million tonnes

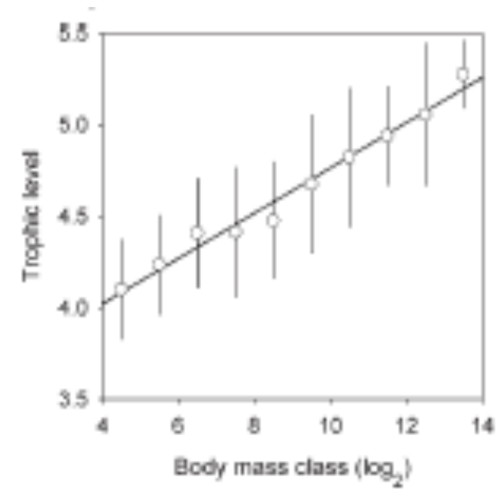
2 Million Km2
Estimated CO_2 capture:
2.5 – 7.5 million tonnes

Estimated annual value or cost of deep water fish ecosystem services (£ Millions)



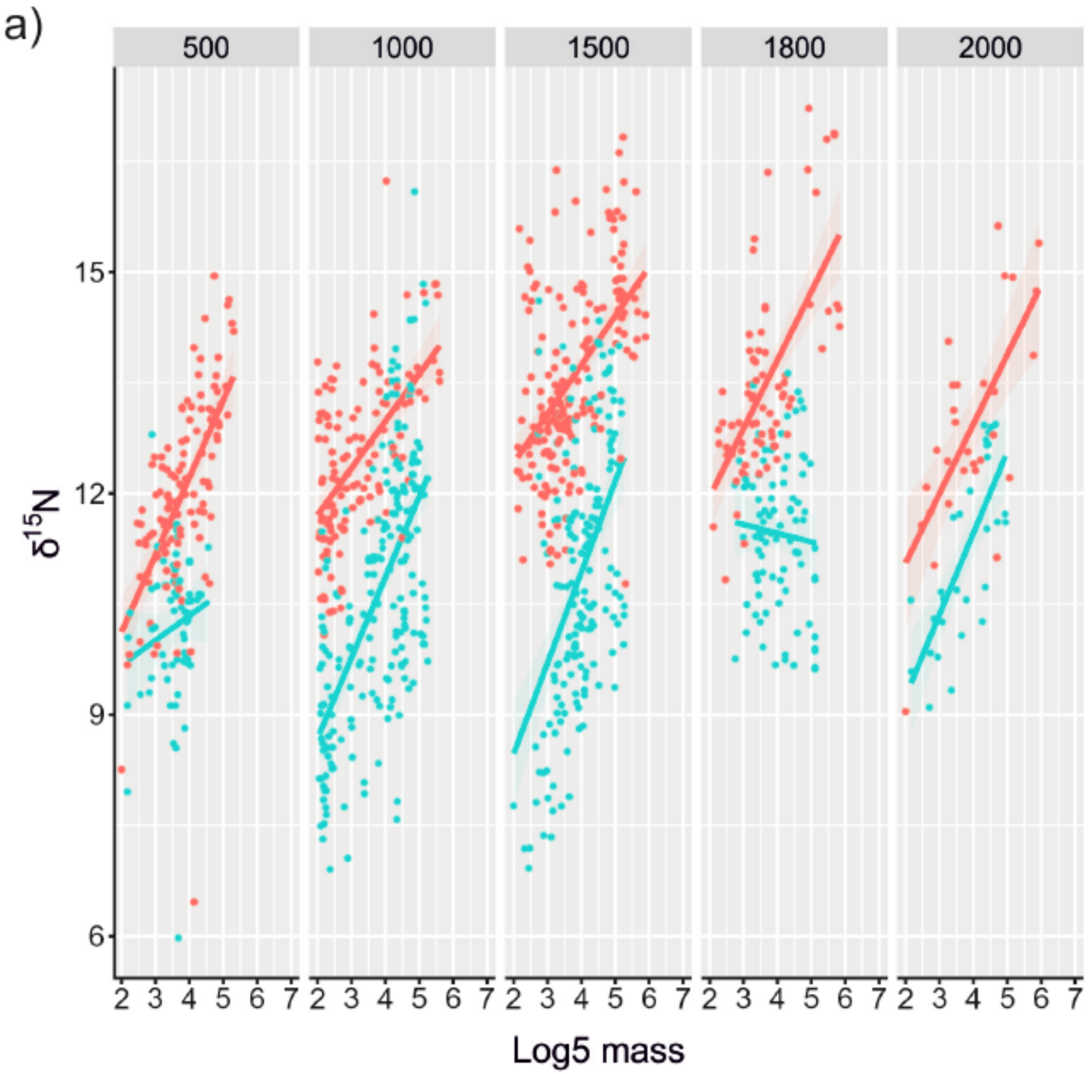
Calculating PPMR





Jennings et al., 2001. J. Animal Ecol. 70, 934-944

System-level metrics (PPMR)



Limited data so far on mesopelagic
Fishes:

Some hints that PPMR may be quite low (10^2) – perhaps suggesting high biomass or high TE to support higher pred biomass?

scope for targeted sampling and literature exploration

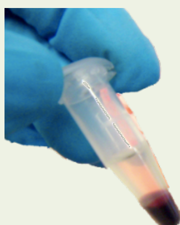
Carbon source

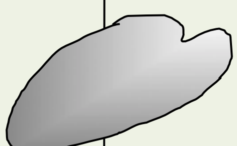
Respired

-17‰(benthic)
-22‰ (pelagic)

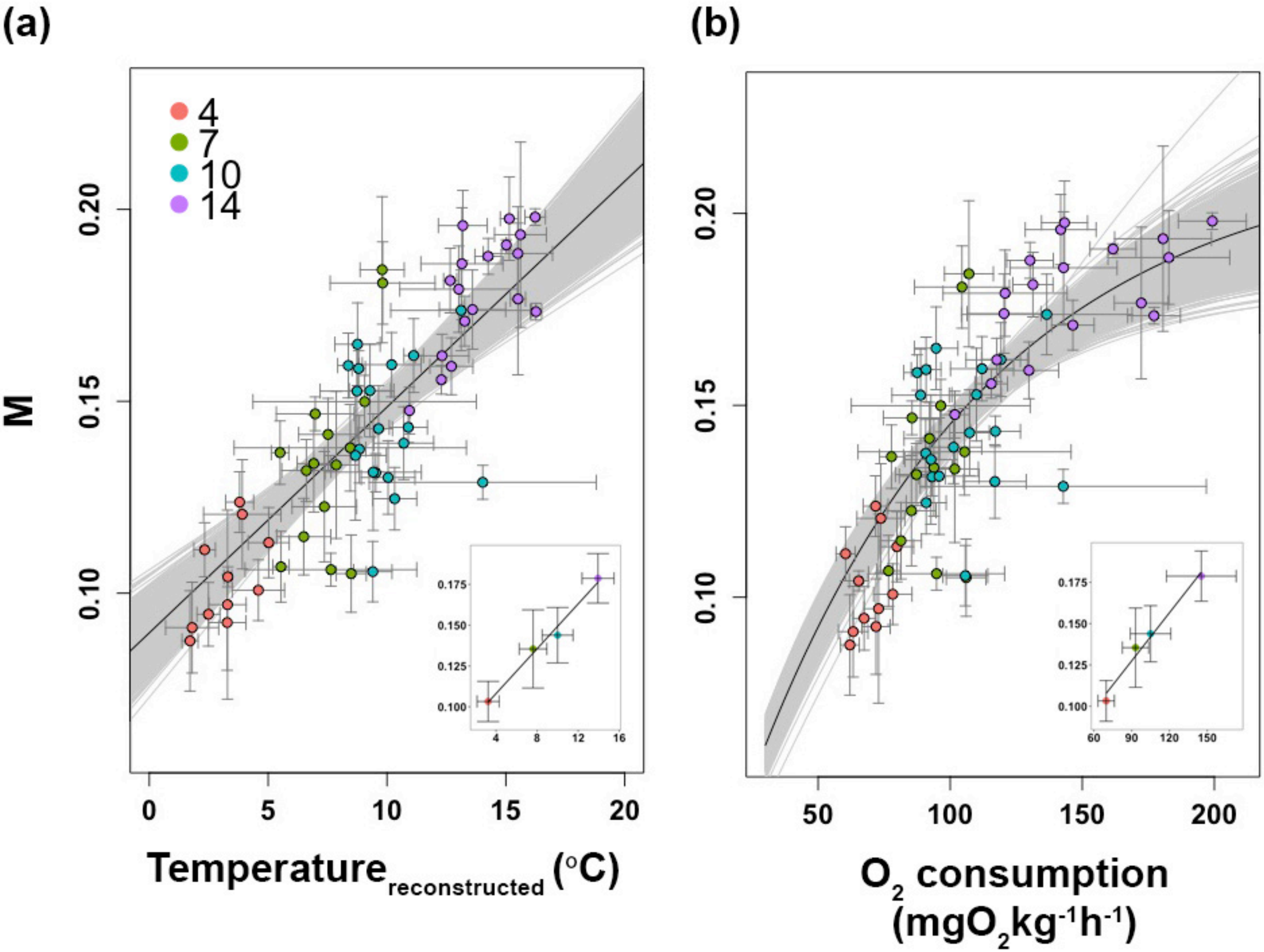
DIC

-1 to 1‰



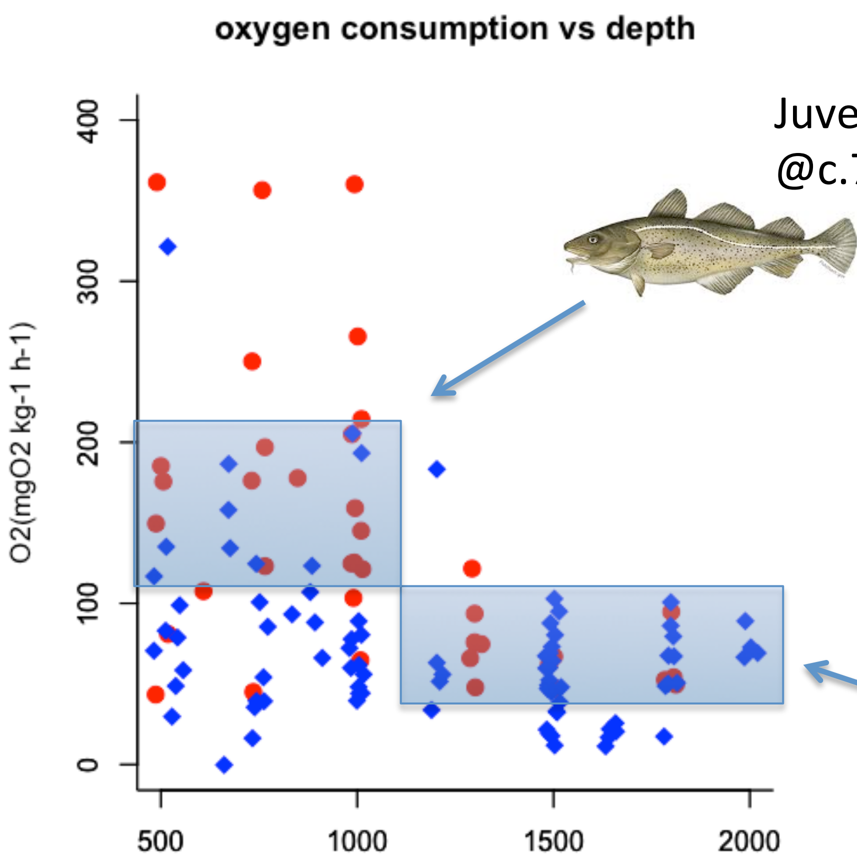


Otolith $\delta^{13}C$ typically -1 to -8‰

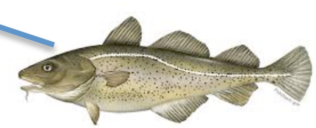


Chung et al 2019
Communications Biology

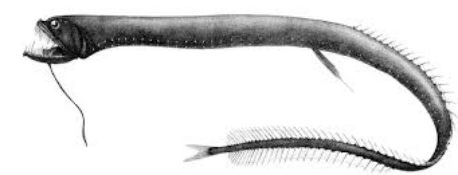
Metabolic rate of inaccessible fishes: 30 Species deep water fishes



Juvenile cod equivalent
@c.7-10 degrees



Juvenile cod equivalent
@c.2-4 degrees



Summary

- Isotopes useful for tracking movement of carbon where this occurs across natural isotopic gradients
- Combined with biomass data to quantify C flux
- Community level analyses can recover PPMR (combine with biomass size spectra to infer TE)
- New otolith-based proxy for field metabolic rate – apply to mesopelagic fishes