

**Long-term hydrological and ecological observations  
along the eastern Beaufort Sea coast of Alaska:  
Linkages to regional climate and subsistence**



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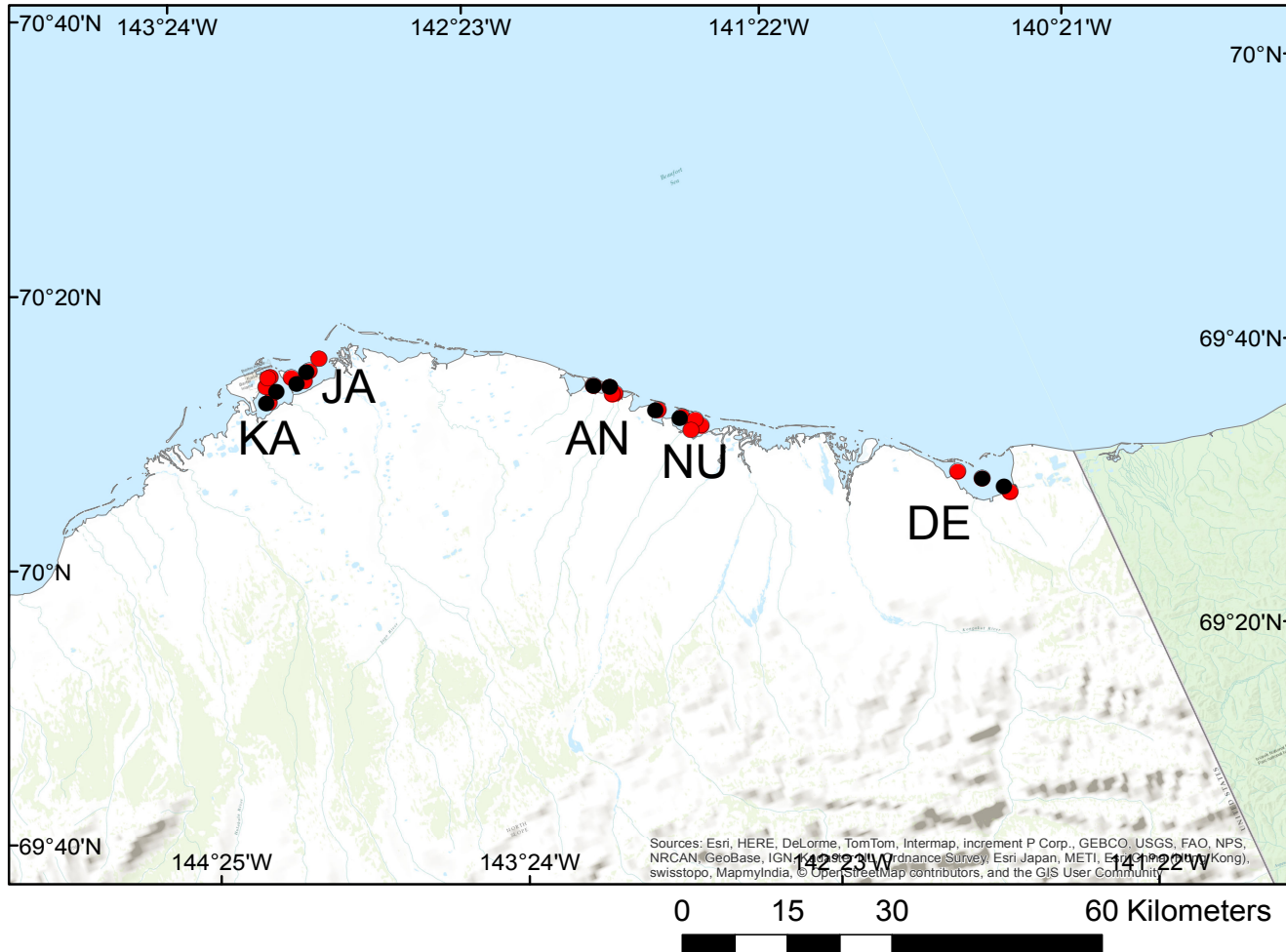
# Alaskan Beaufort Sea Lagoons

- Estuarine lagoon system > 50% coastline
  - Shallow (<4 m)
  - Short, productive summer
  - How does the hydrography of these lagoons vary spatially and temporally? What are the source waters?
- Terrestrial inputs
  - River discharge
  - Coastal erosion
  - Are they important subsidies of organic-C to lagoon food webs?

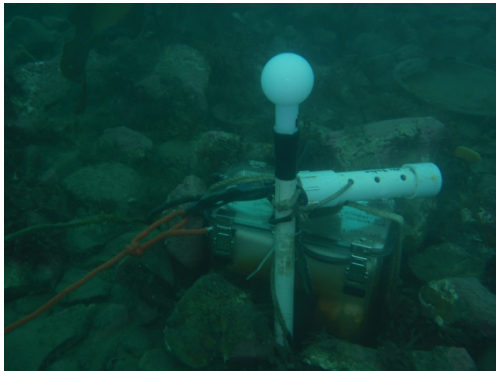
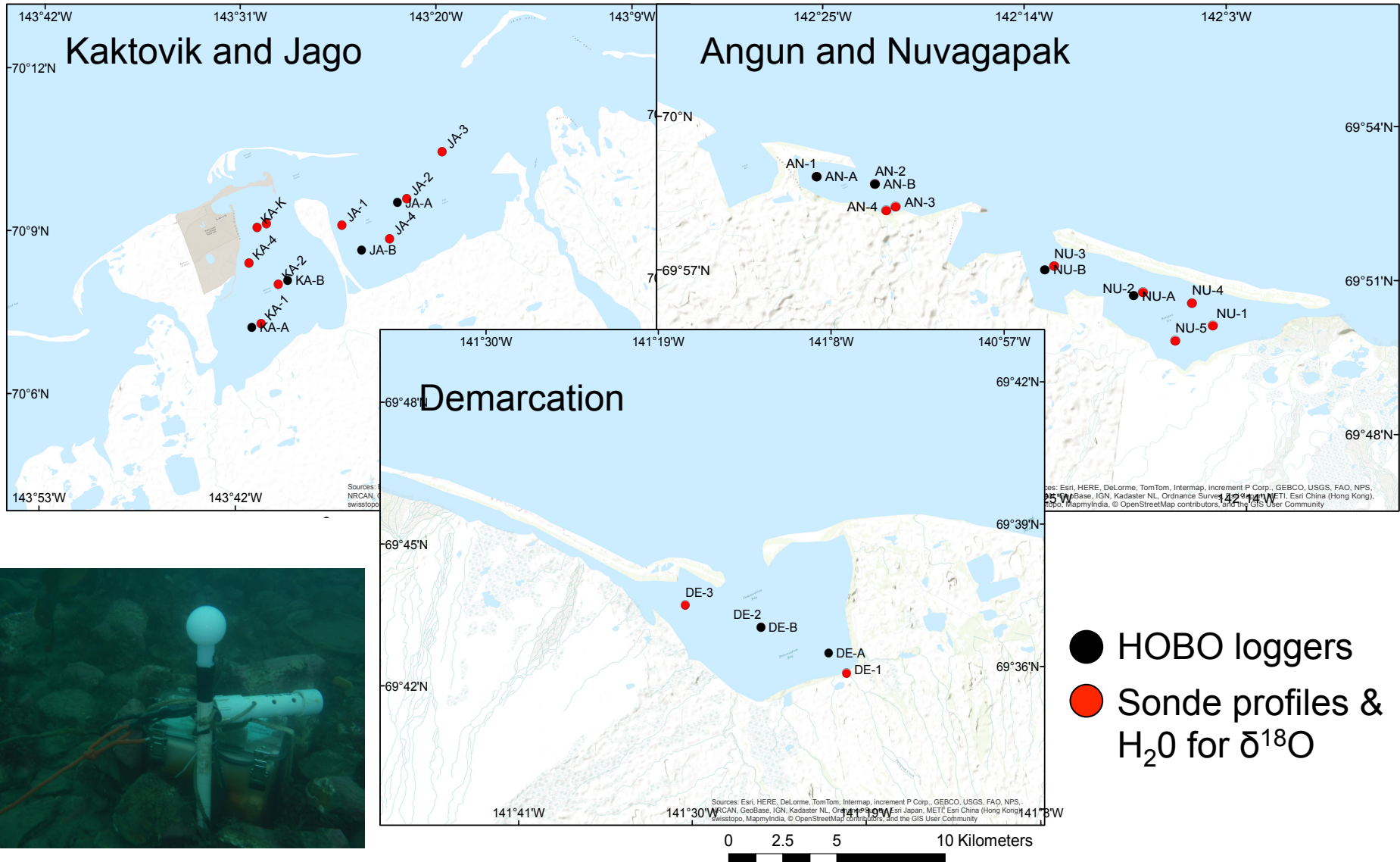


Barter Island, AK

# Study Sites: Hydrological Studies

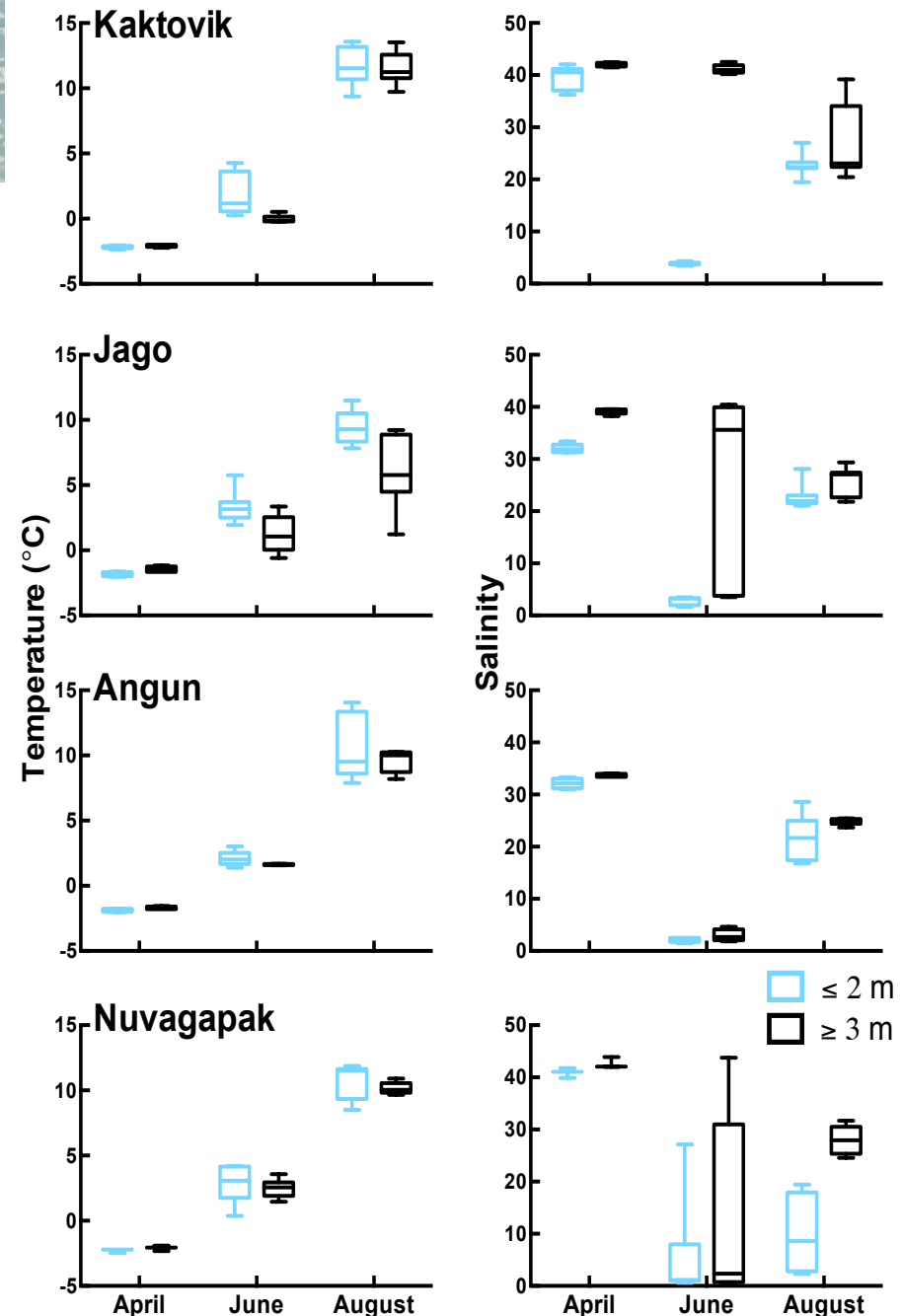


# Methods: Instruments & Sampling



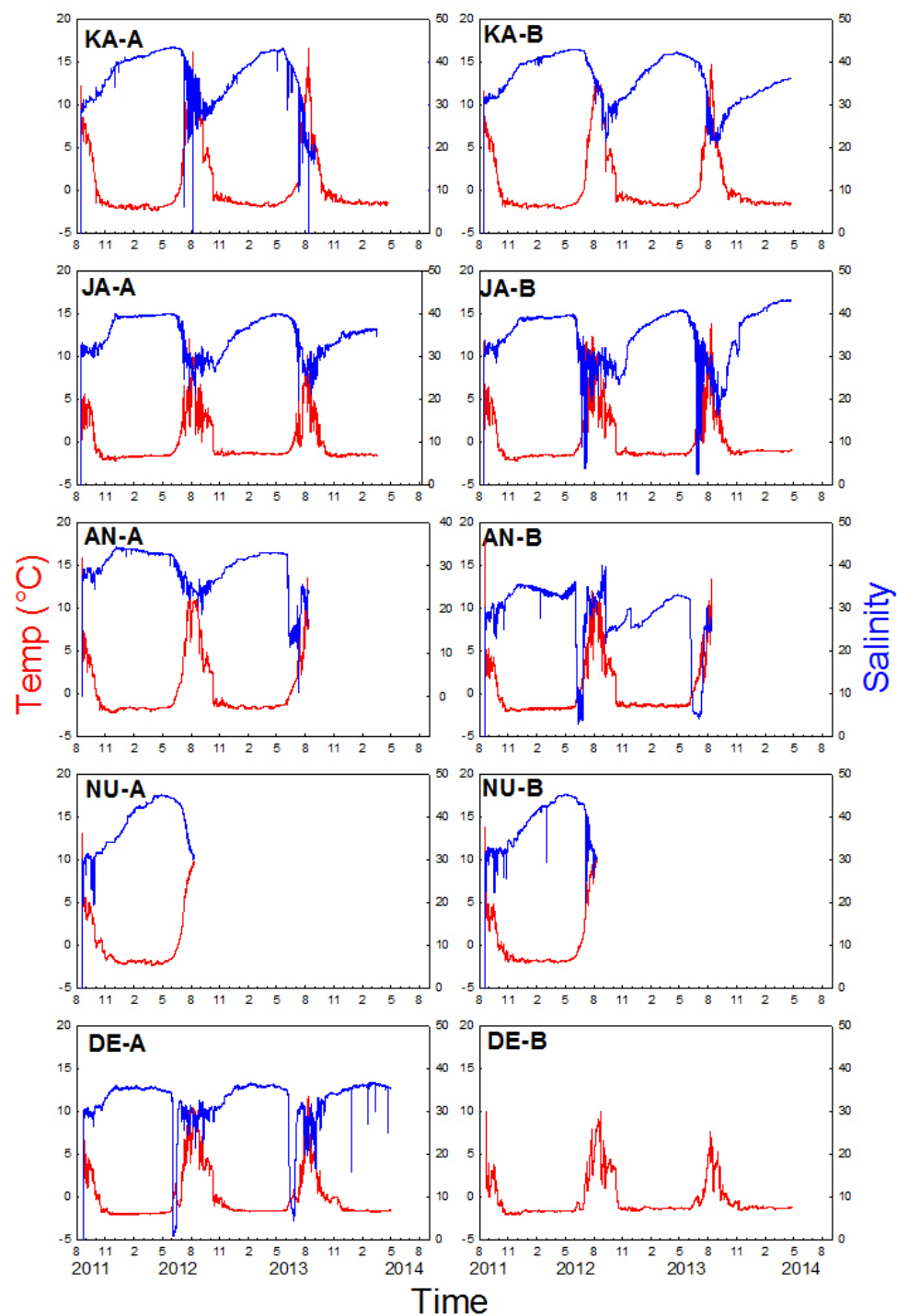
# Water Column Structure

- April
  - Cold ( $-2^{\circ}\text{C}$ ), hypersaline (40+)
- June
  - Warmer ( $0-5^{\circ}\text{C}$ ), halocline
  - Fresh surface layer
  - Bottom layer salinity varies
- August
  - Warm ( $12^{\circ}\text{C}$ )
  - Estuarine, variable salinities



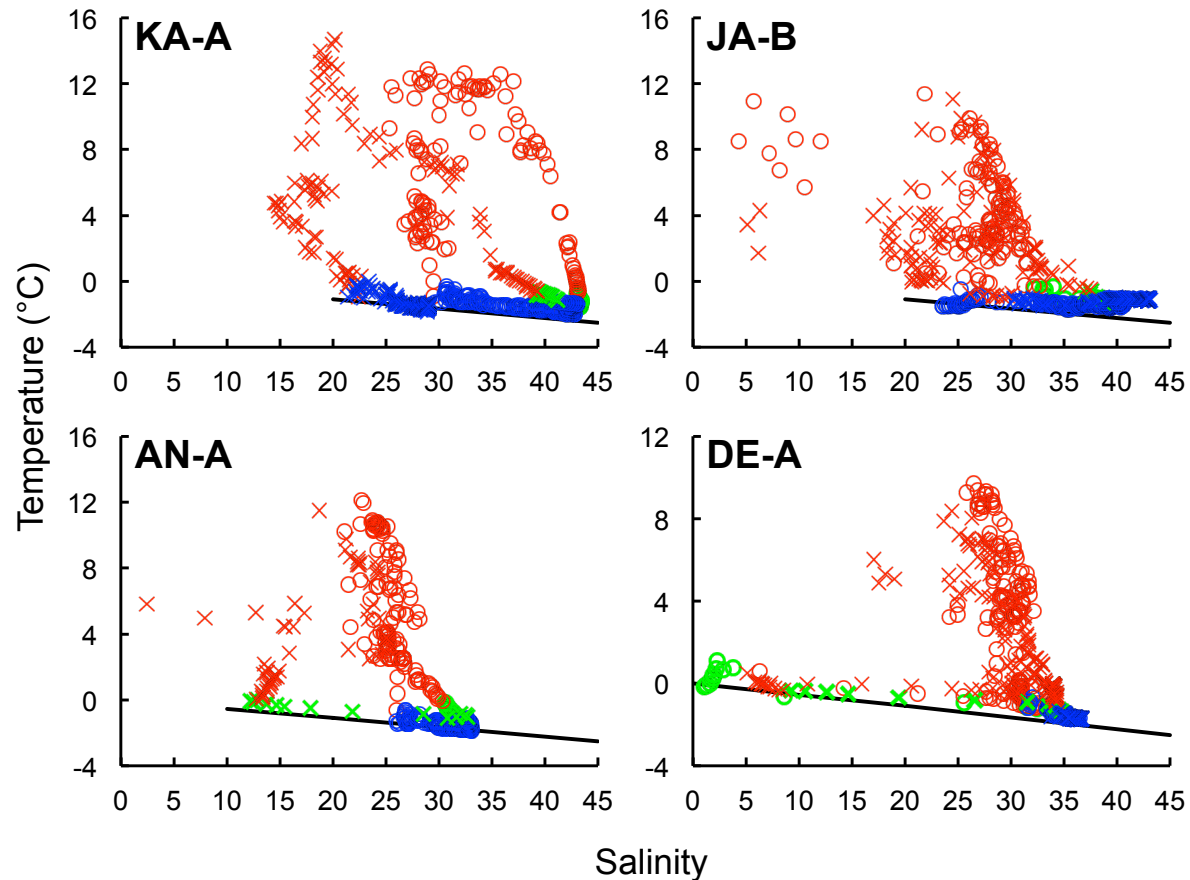
# HOBO data

- Salinity sensors failed at KA-A (3<sup>rd</sup> year only) and DE-B
- Minimum temps reached mid-Oct
- Hypersaline conditions at all lagoons
  - > adjacent marine salinity (32)
- JA and DE salinities plateau → exchange with marine waters
- Summer salinity and temp. variable, effected by rate and magnitude of FW inputs



# T-S Diagrams

- Daily averages from mid-lagoon loggers
- Summer temp/salinity variable
  - Several days of extreme freshening
- Winter values fall on freezing point curve
- Suggests loggers maintained calibrations during ice-covered period



- Summer open-water
- Spring break-up
- Winter ice-cover

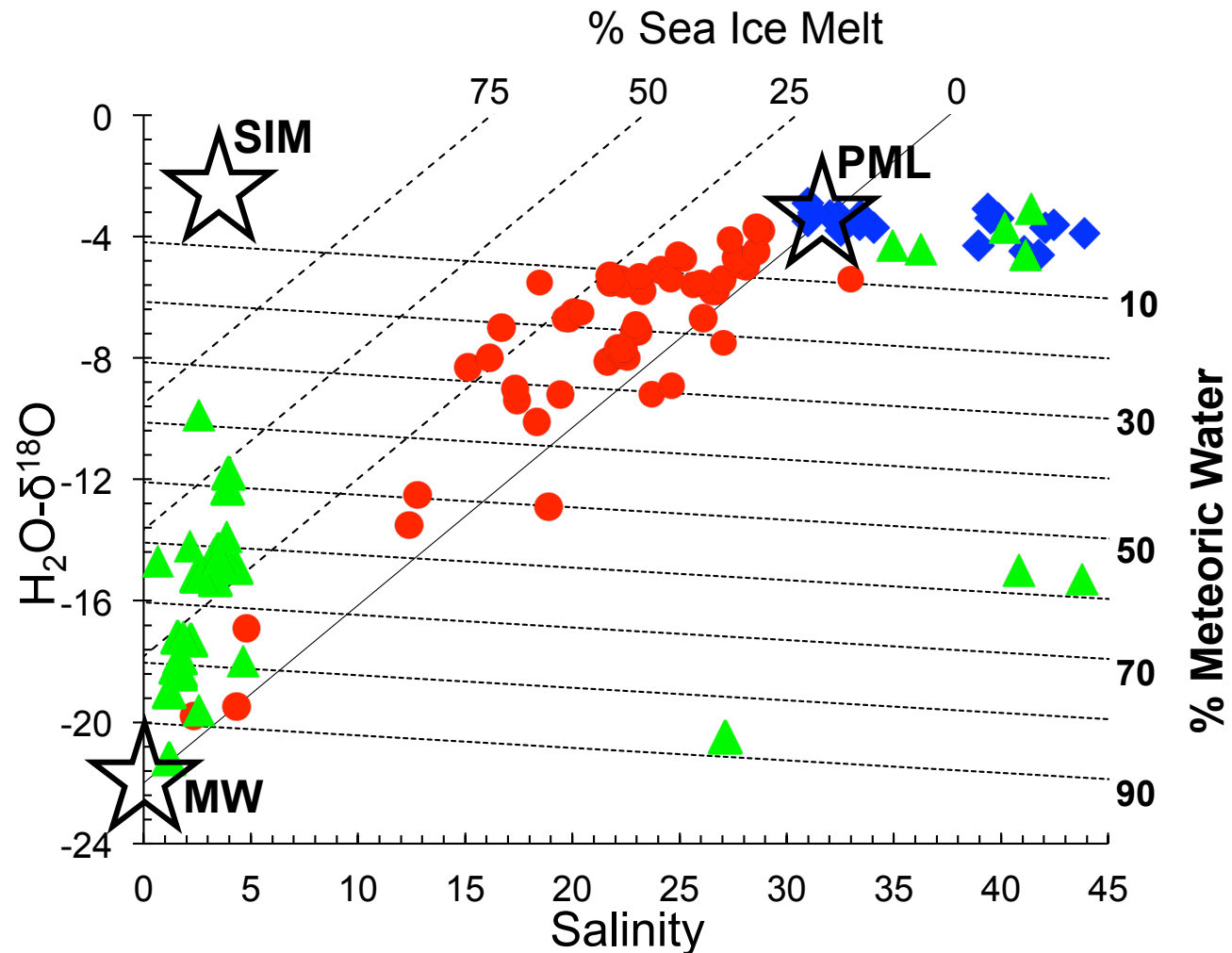
- 2012
- ✖ 2013

# Source Water Partitioning

- Summer open-water
- ▲ Spring break-up
- ◆ Winter ice-cover

## Sources

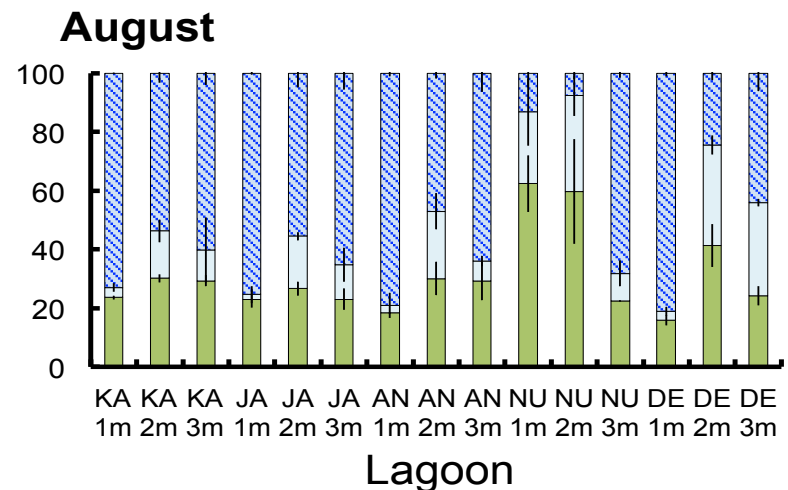
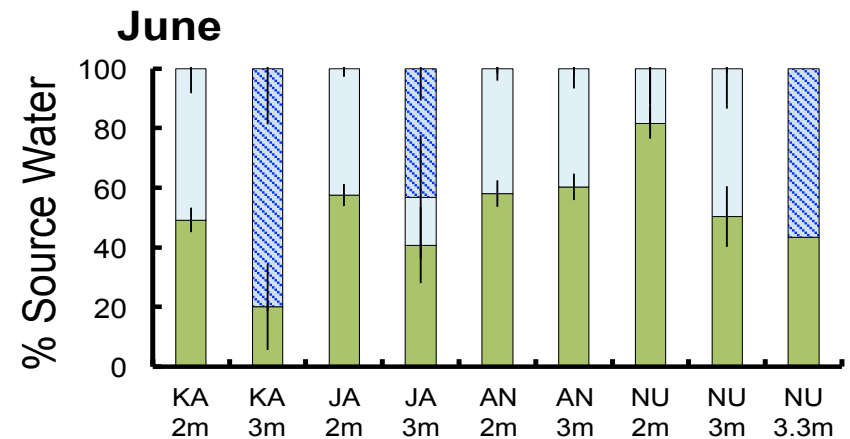
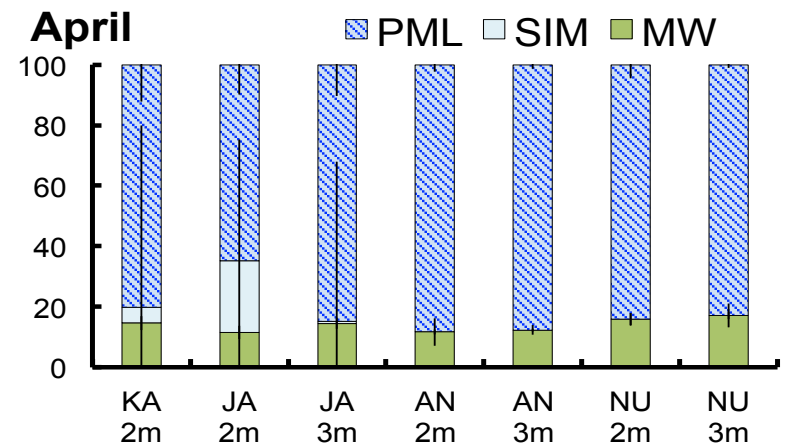
- Polar Mixed Layer (PML)
- Sea ice melt (SIM)
- Meteoric water (MW)





# Source Water Contributions

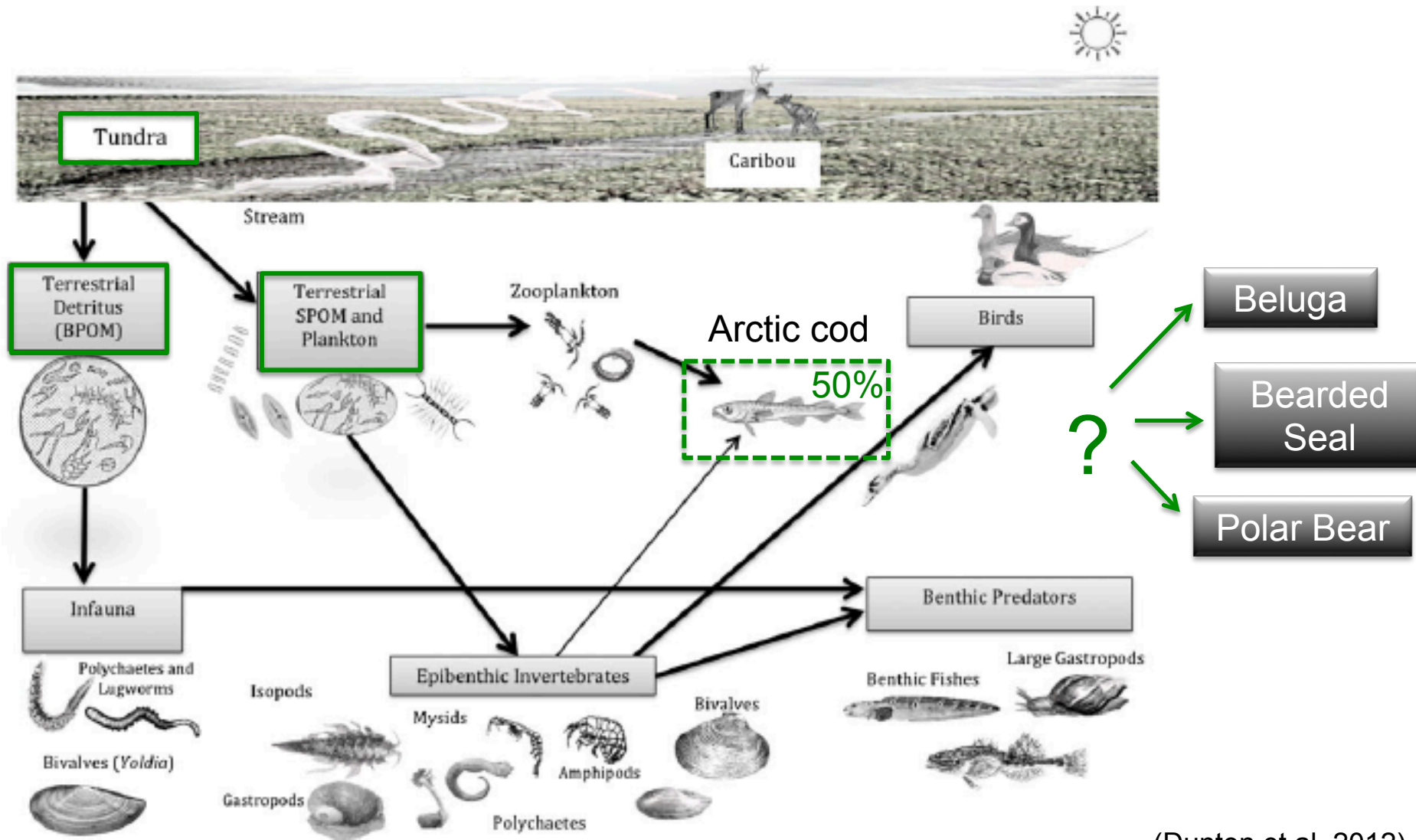
- Modeled % of source waters (rounded and normalized to 100)
- April
  - Marine waters dominate
  - All sites, all depths >80% PML
- June
  - Freshwater sources dominate
  - Mostly MW, SIM inputs significant
  - PML only present at  $\geq 3$  m
- August
  - Mix of sources
  - $\geq 50\%$  PML, except NU surface layer



# Conclusions: Hydrology

- Differences in salinity regimes may be attributed to multiple factors
  - Fraction of lagoon water that freezes each winter (intensity of brine rejection)
  - Greater salinity at the onset of freeze-up as a result of less summer flushing (legacy effect)
  - Greater exchange with marine waters via channels during winter (exchange capacity)

# Nearshore Food Webs



# Purpose

**Question:** Do upper trophic consumers assimilate terrestrially-derived organic matter?

- **Objective 1:** Use bulk  $\delta^{15}\text{N}$  analysis to determine trophic structure



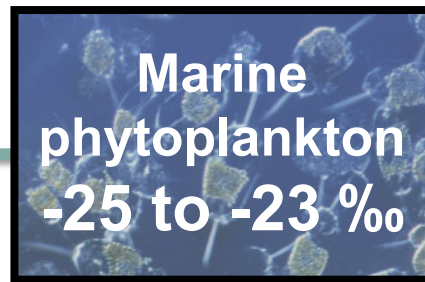
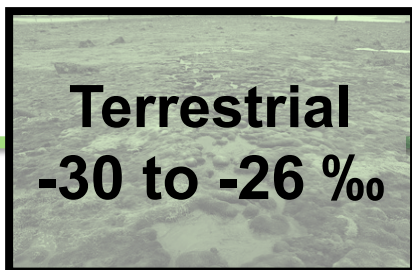
~3.4 ‰



~3.4 ‰



- determine the extent to which terrestrial organic matter is incorporated into secondary consumers



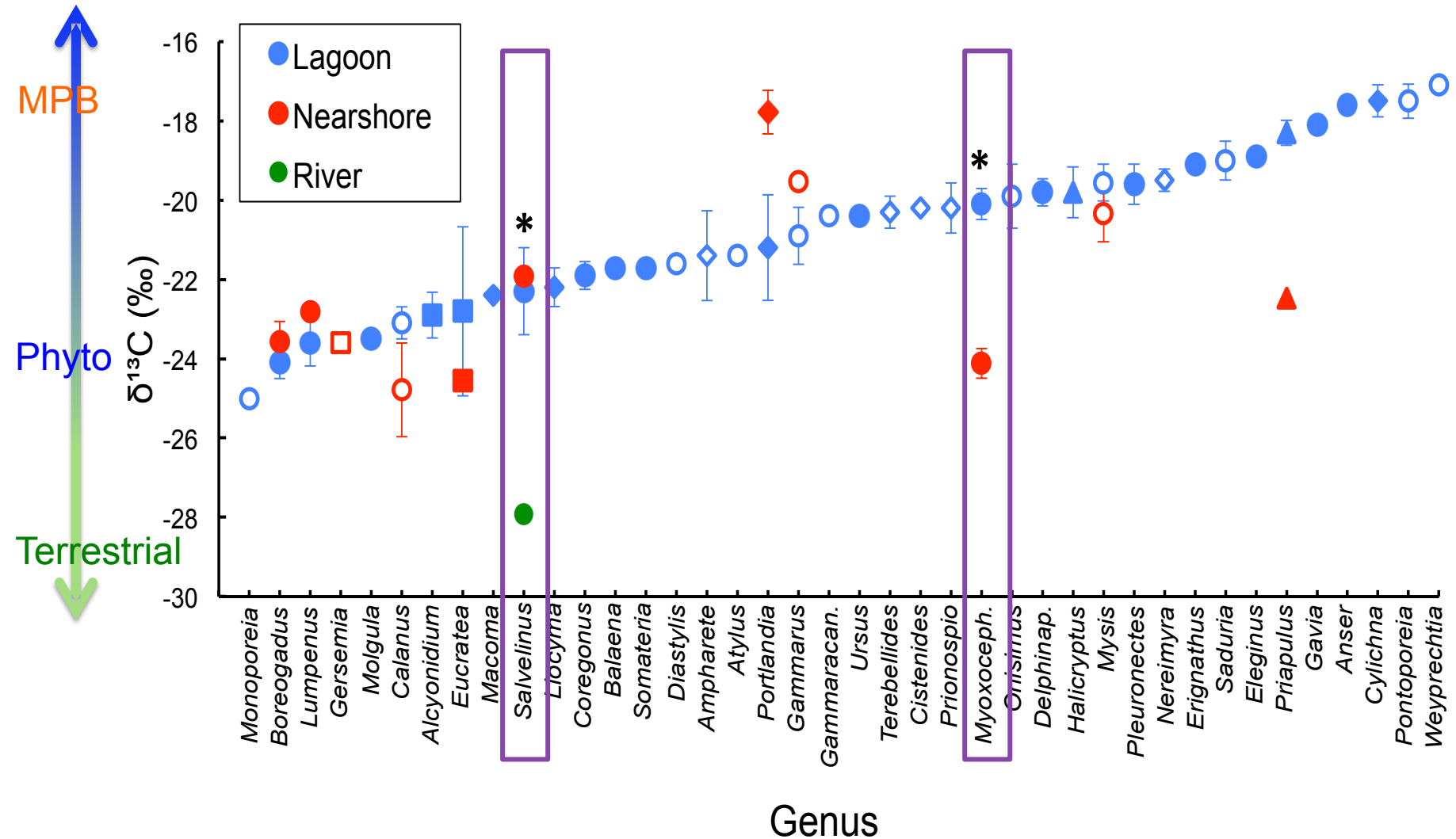
# Isotope Sample Collection

- Field Collections
  - 2011 – 2014
  - Summer open-water period
- River sites
  - Suspended POM
  - Arctic char (*Salvelinus alpinus*)
- Marine sites
  - Phytoplankton (20 um net)
  - Benthic and Suspended POM
- Lagoon/ nearshore sites
  - BPOM, SPOM
  - Prey Species
    - Benthic grabs, net trawls
  - Upper Trophic Species
    - Opportunistic
    - Donated from local fishers, hunters
  - **200+ individuals, 51 genera, 7 phyla**



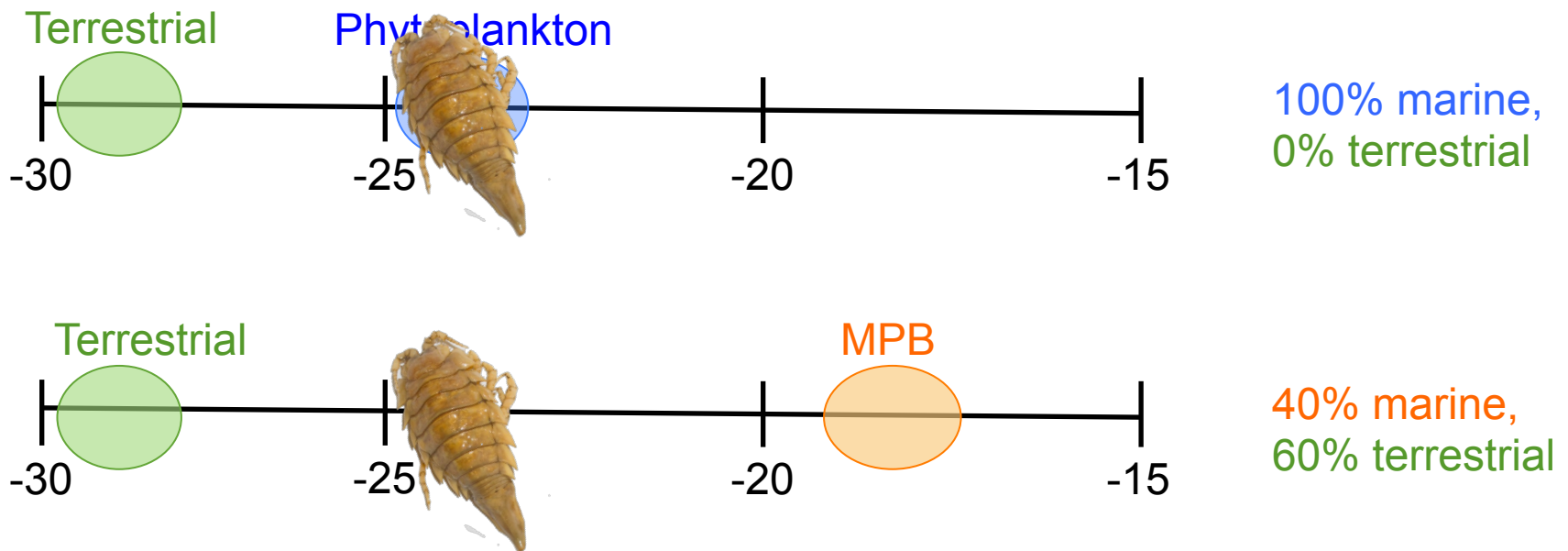
# Animals – $\delta^{13}\text{C}$ results

\*Lagoon fauna assimilate multiple carbon sources



# IsoError Mixing Model

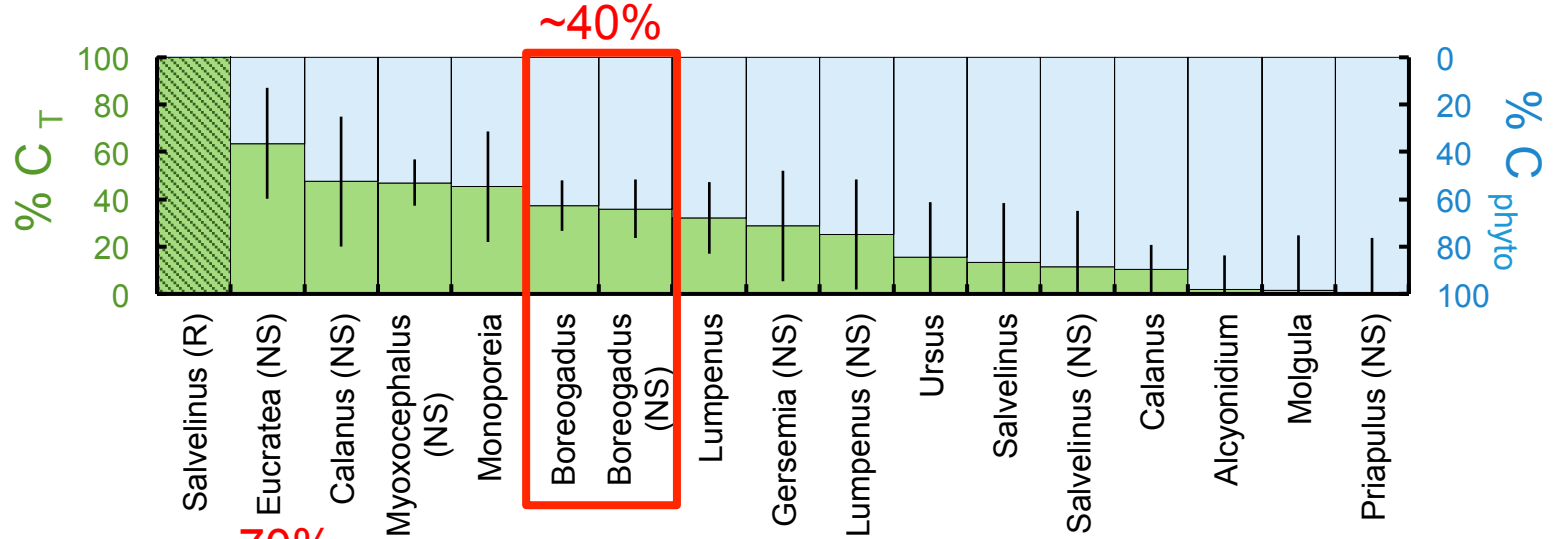
- Estimates importance of basal carbon sources
- Accounts for variance in end-member and animal  $\delta^{13}\text{C}$



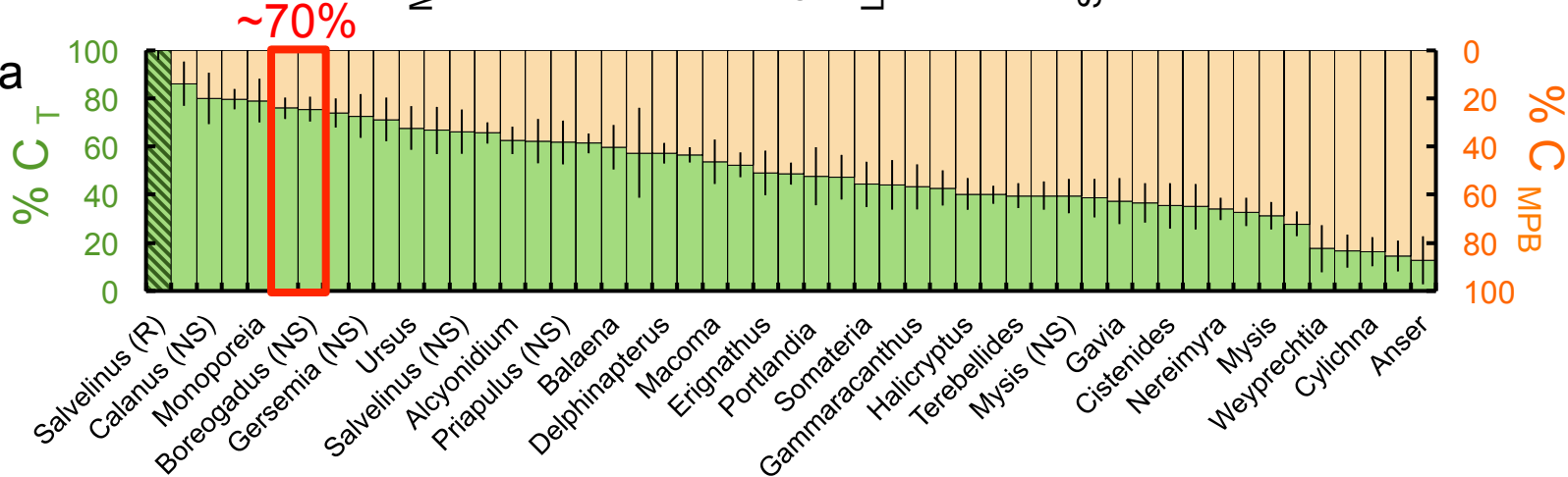
- 2 model runs = upper and lower limits

# Model Results

\*25% genera  
(17/51)



\*100% genera

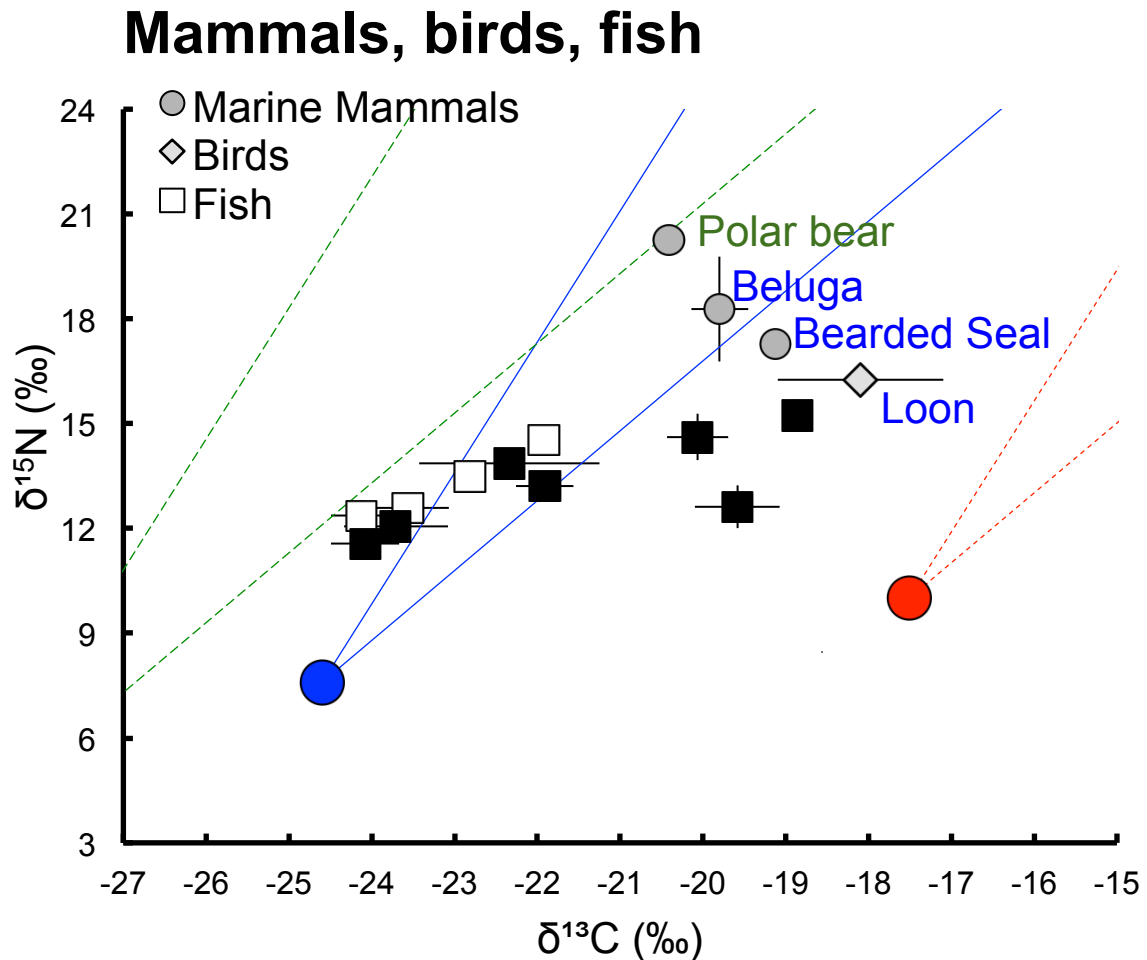


**\*Terrestrial subsidies can be traced to all TLs of the food web**



# Conclusions: Trophics

- Lagoon-nearshore systems support up to 5 TLs
- Terrestrial carbon is assimilated by a vast number of lower trophic species and fish, and accounts for a small, but measurable subsidy to some upper trophic species
  - Fishes = transfer link?





QUESTIONS?



Barter Island, AK

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