Modeling the importance of prey quality to endothermic predators in the Northeast Pacific

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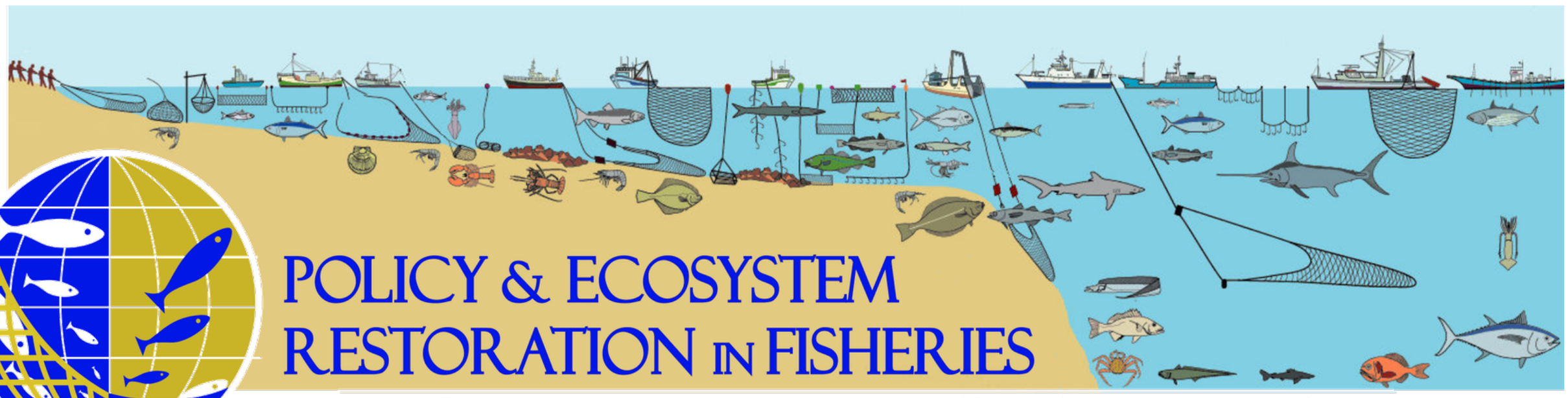


Biomass and energy

- animals acquire energy by consuming biomass
- biomass is often measured in ecology, fisheries
- but biomass energy content varies across taxa
- $E_{(\text{adult Pacific herring})}$ (7-10 kJ/g) > $E_{(\text{AK pollock})}$ (3-4 kJ/g)
- **energy content: good measure of prey quality**

Pacific herring

- important forage fish in North Pacific ecosystems
- predators: many marine mammals and seabirds
- adult energy content 2nd only to eulachon (rare)
- **how does this affect trophic role of herring?**

Food web modeling

- framework: Ecopath with Ecosim (EwE)
- basis: mass balance
- 80 functional groups (15 endotherms)
- study area: N British Columbia, SE Alaska

Energy-based models

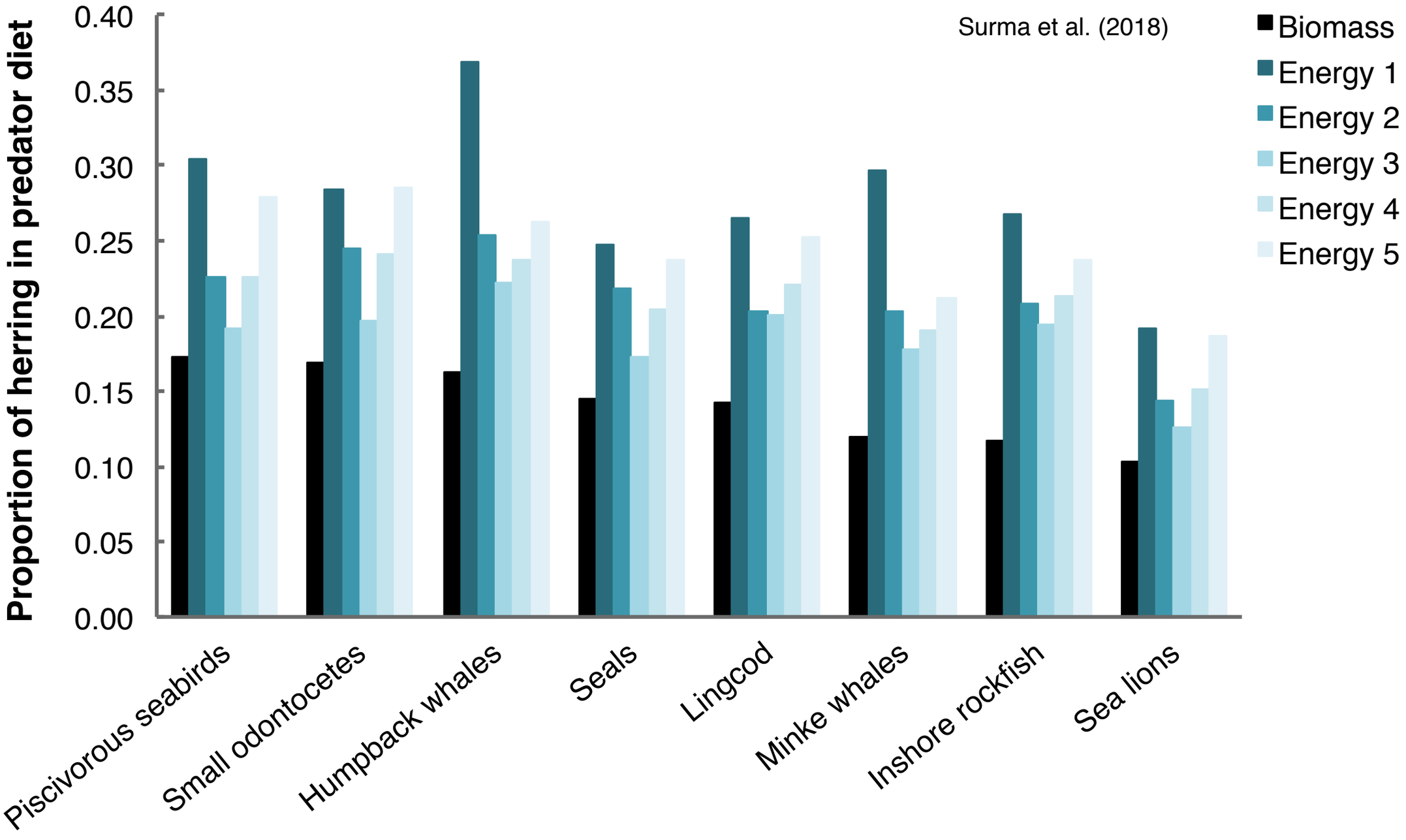
functional group energy content estimate ranges

- based on published bomb calorimetry data

mass-balanced model -> energy-balanced models

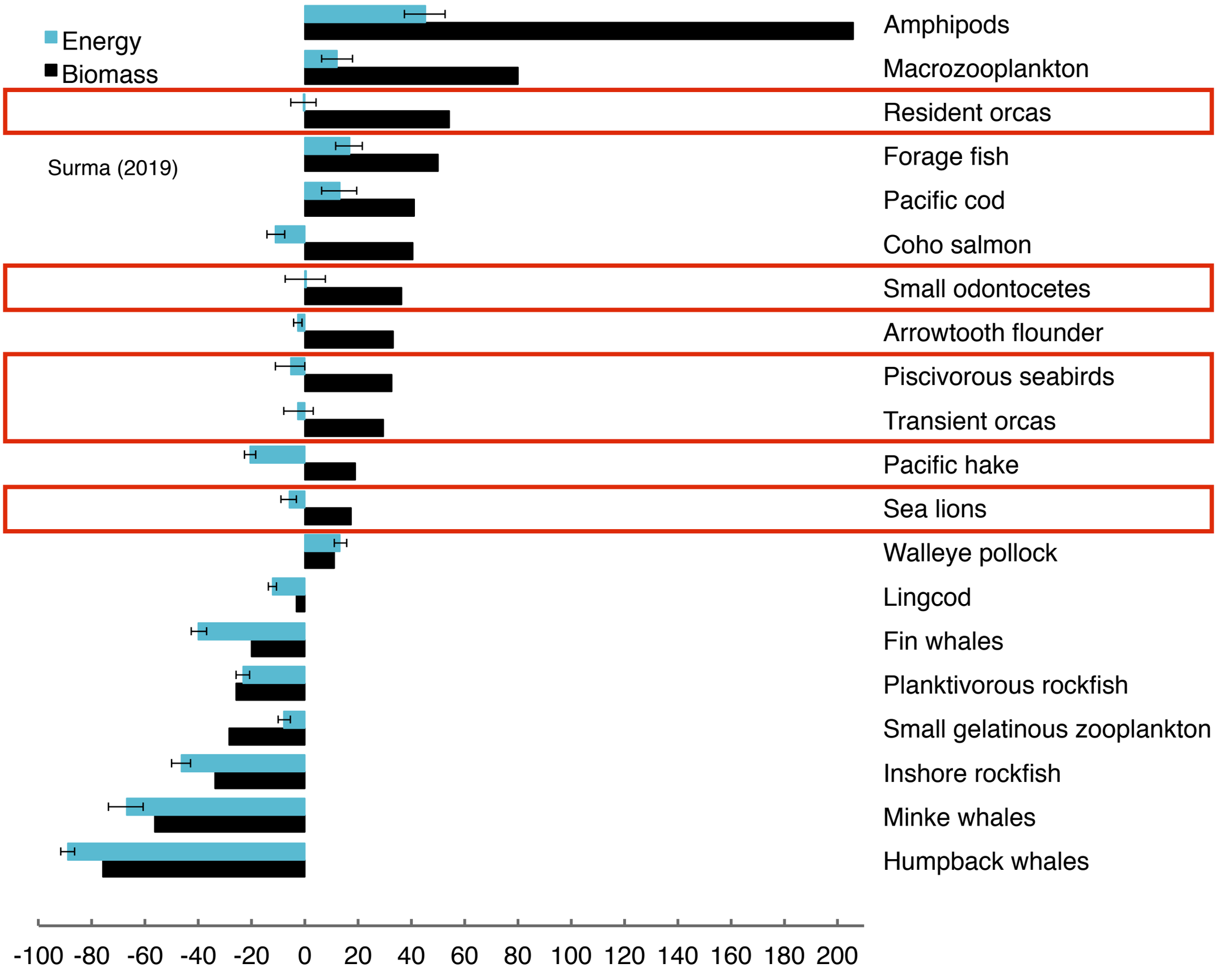
- random resampling from energy content ranges

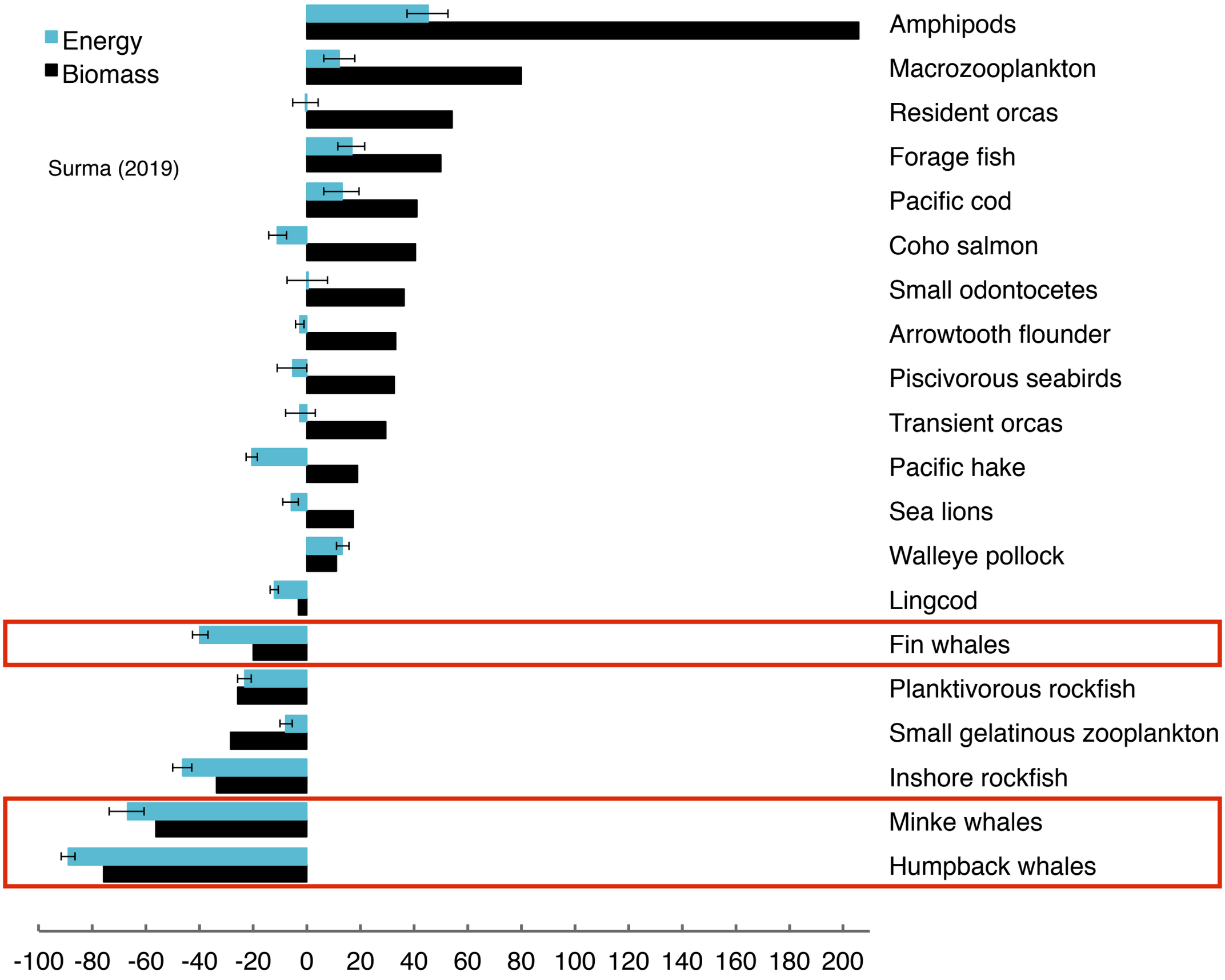
Herring as prey



Herring depletion simulation

- reduce herring biomass to ~5% of unfished level
- maintain reduced herring biomass for 100 years
- same run in mass- and energy-balanced models
- compare strength of functional group responses


Energy
Biomass
Surma (2019)
Amphipods
Macrozooplankton
Resident orcas
Forage fish
Pacific cod
Coho salmon
Small odontocetes
Arrowtooth flounder
Piscivorous seabirds
Transient orcas
Pacific hake
Sea lions
Walleye pollock
Lingcod
Fin whales
Planktivorous rockfish
Small gelatinous zooplankton
Inshore rockfish
Minke whales
Humpback whales
-100 -80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180 200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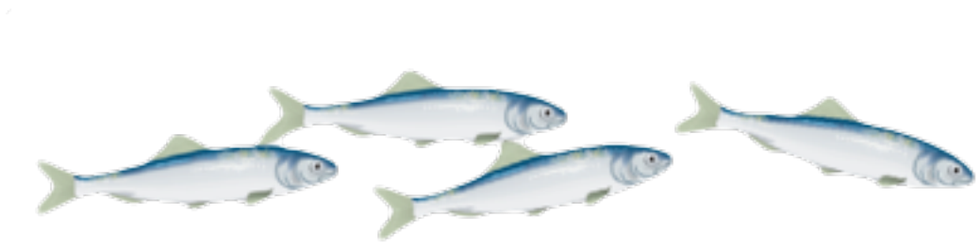
Conclusions

- energy and mass-balanced models broadly similar
- energy content enhances role of herring as prey
- negative effects of herring depletion on endotherms
- other forage fish gains fail to offset herring losses
- energy-balanced modelling a promising approach

Acknowledgements

- Dr. Andrew Trites
- Dr. Villy Christensen
- Dr. Robert de Wreede
- PERF lab members

NSERC
CRSNG



Thank you!