Ecological importance of forage groups in the pelagic ecosystems of the subarctic Pacific

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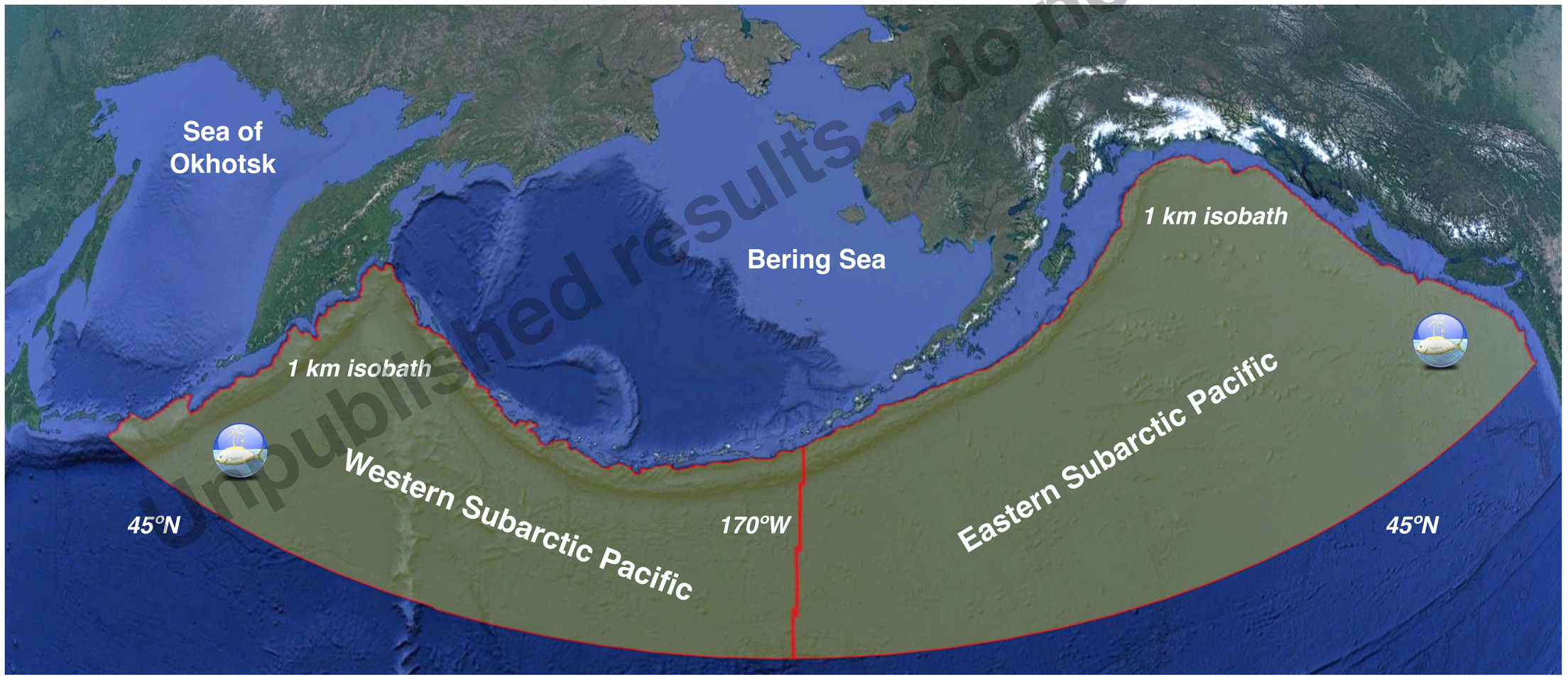
Introduction

- the open subarctic Pacific supports a diverse predator guild
- it is vital to the pelagic foraging and growth of Pacific salmon
- provides a seasonal feeding ground for seabirds and mammals
- the main forage groups are mesopelagic fish and small squid
- Pacific saury, Japanese sardine and anchovy occur in summer
- trophic roles of various forage groups still under active study

Open subarctic Pacific

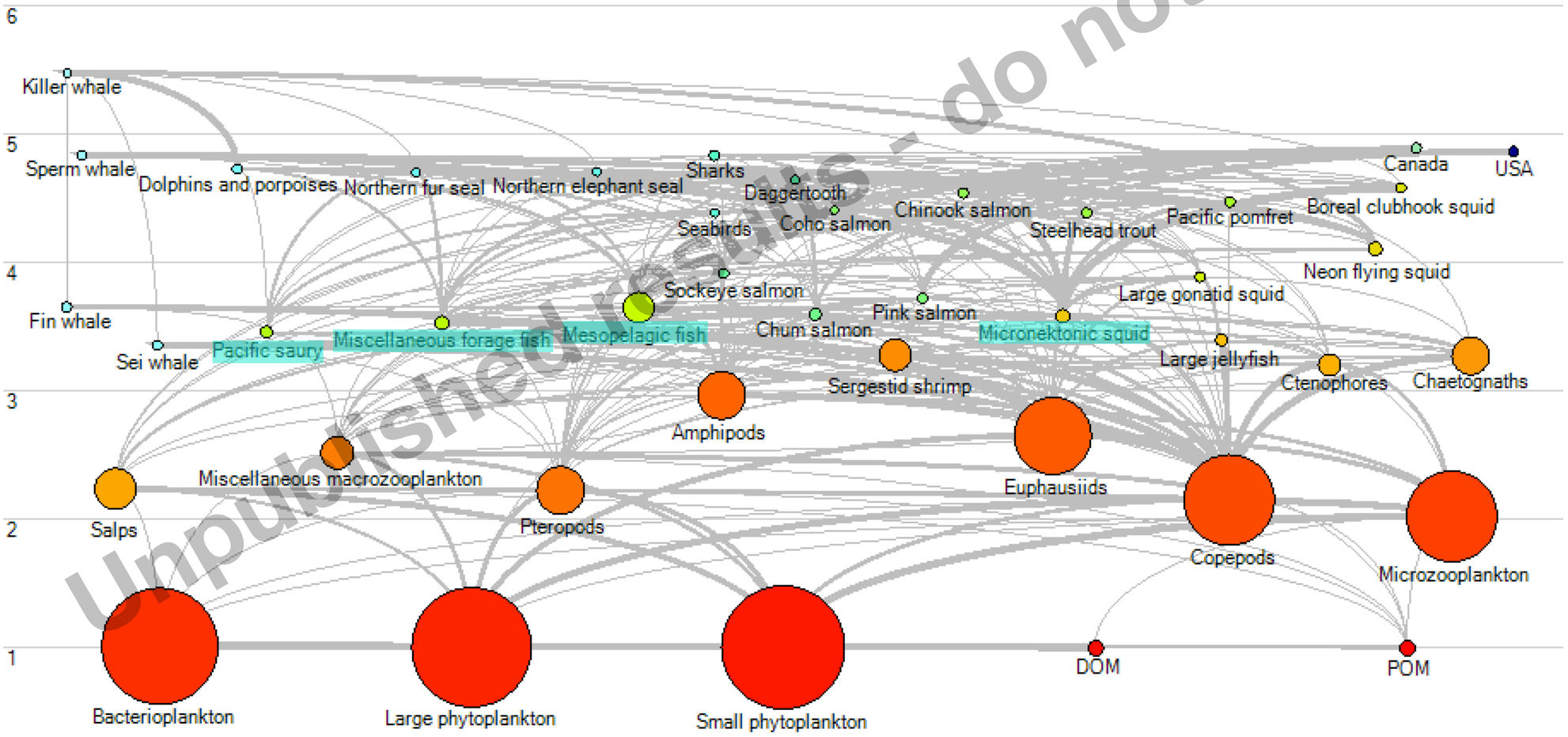


Ecopath with Ecosim

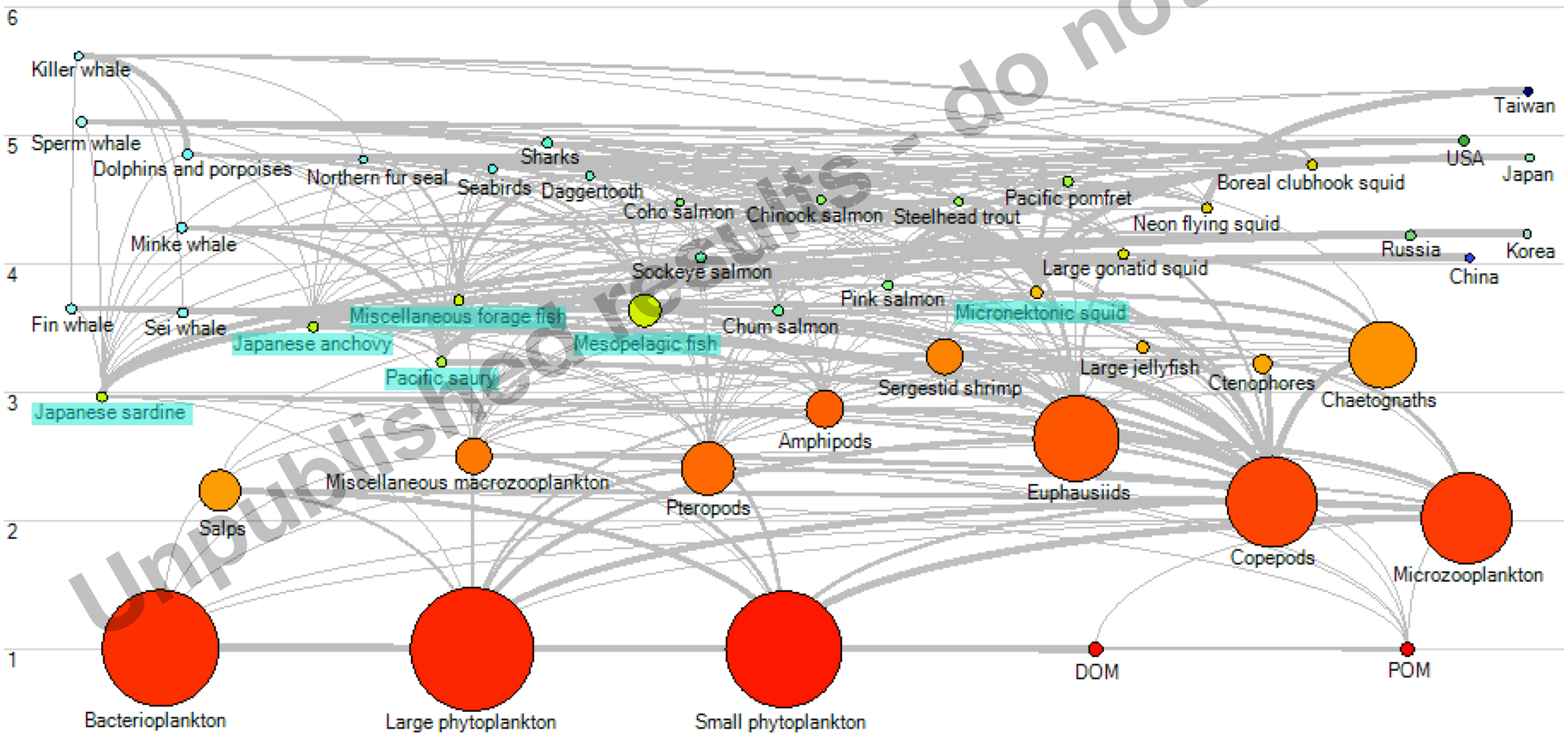
basic principle: mass balance

- **Ecopath**: static food web snapshot (nodes; pools & fluxes)
- **Ecosim**: dynamic ecosystem simulation (hindcast & forecast)

Eastern subarctic Pacific food web



Western subarctic Pacific food web

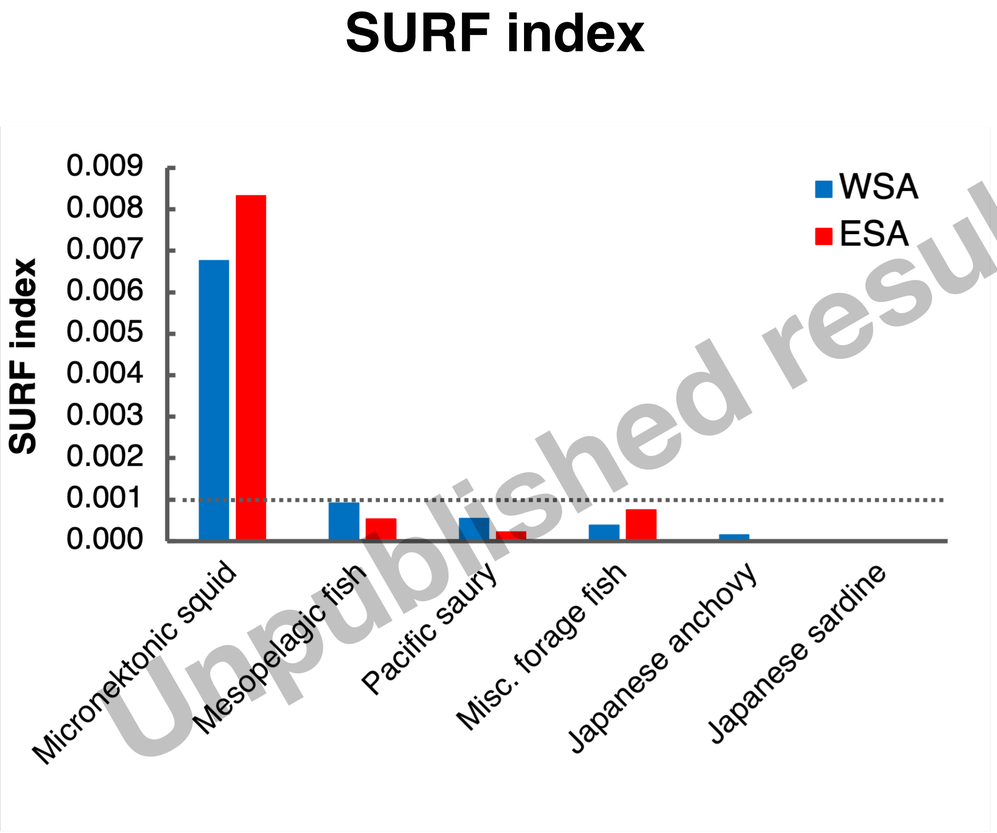


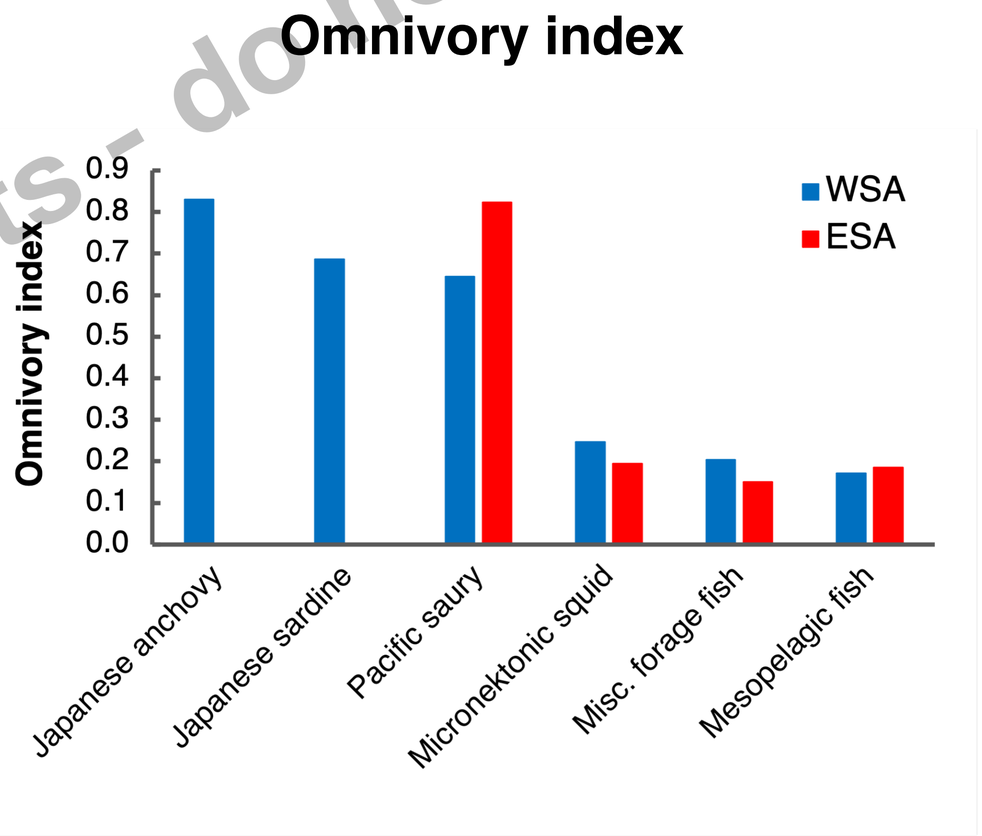
Trophic indicators

metrics of the position and importance of each node in a food web

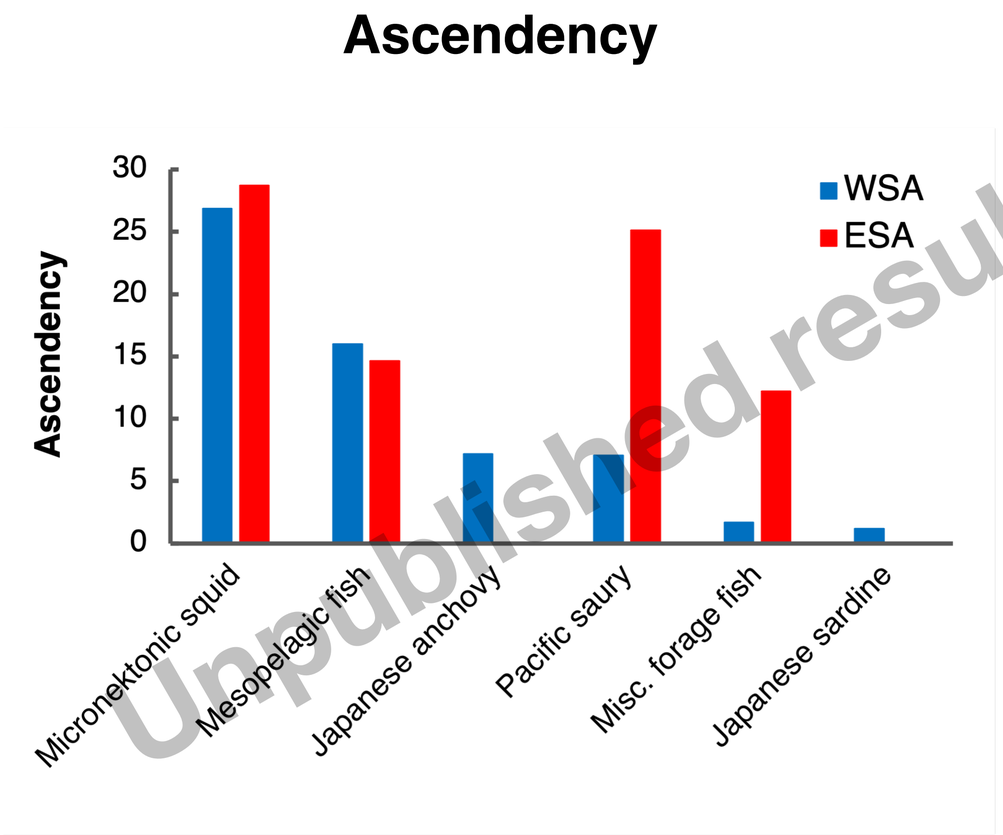
- SURF index: overall importance of forage node across all predators
- omnivory index: evenness of prey distribution across trophic levels
- ascendency: information content of interactions involving each node
- PPR: % of total primary production required to support each node
- mixed trophic impact (MTI): net total impact of one node on another

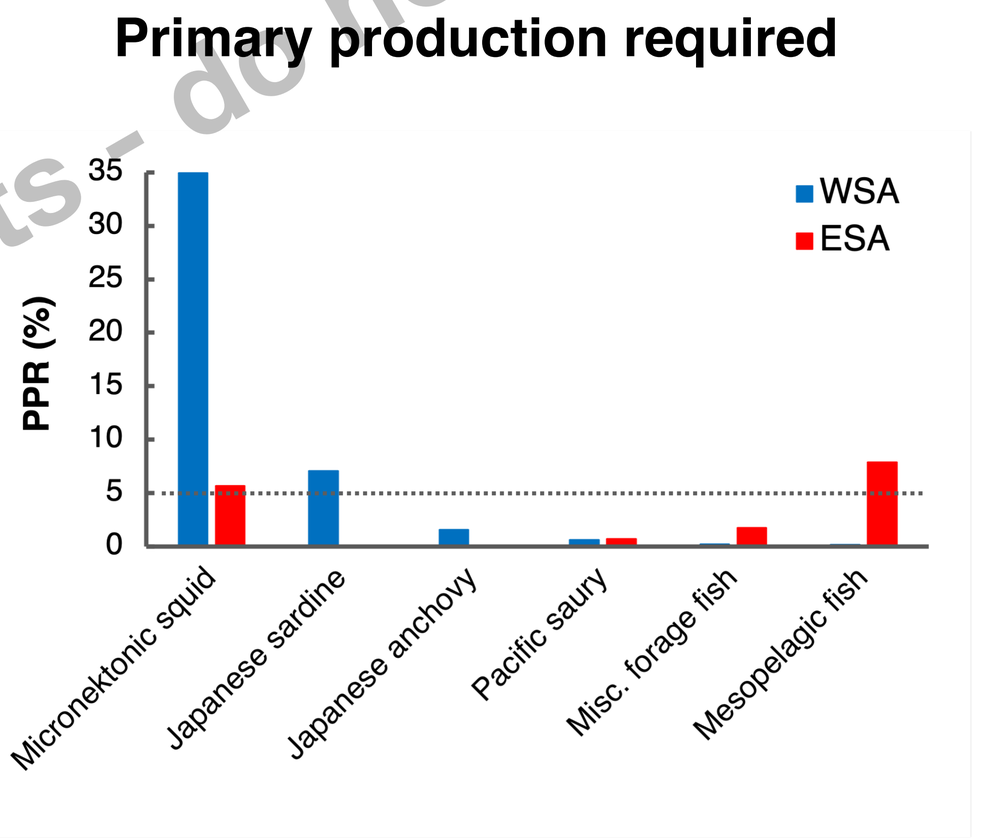
Trophic indicators (part 1)



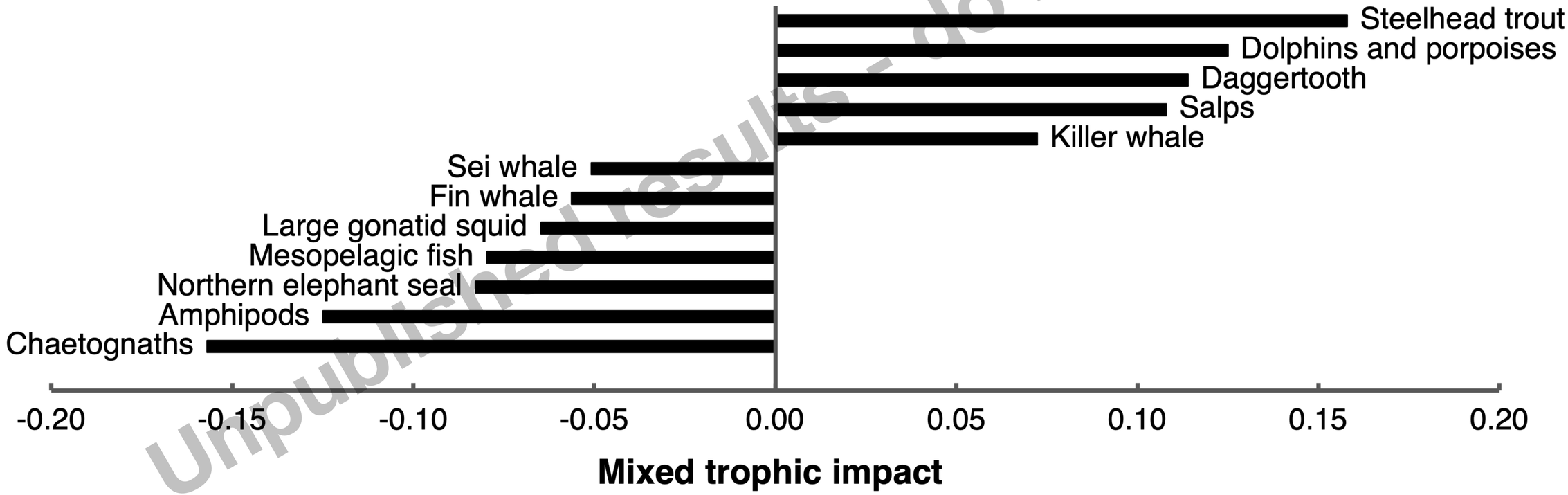


Trophic indicators (part 2)

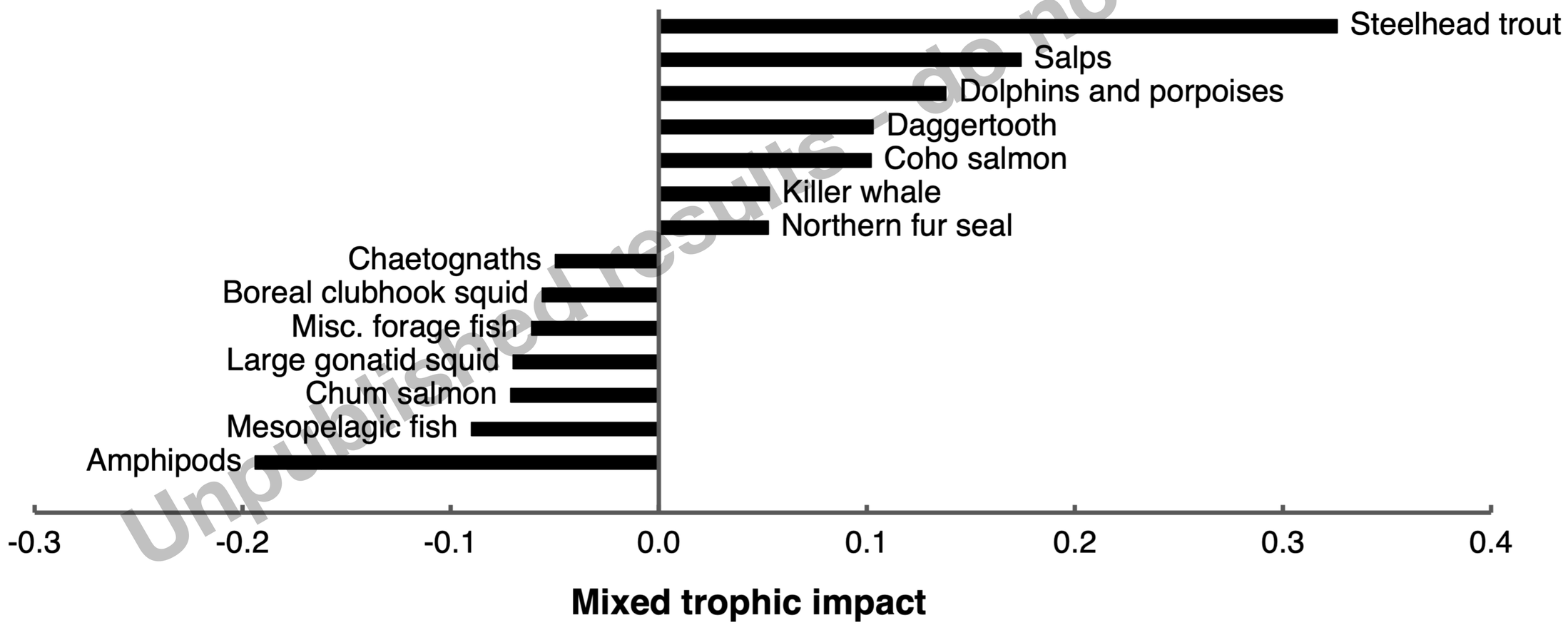




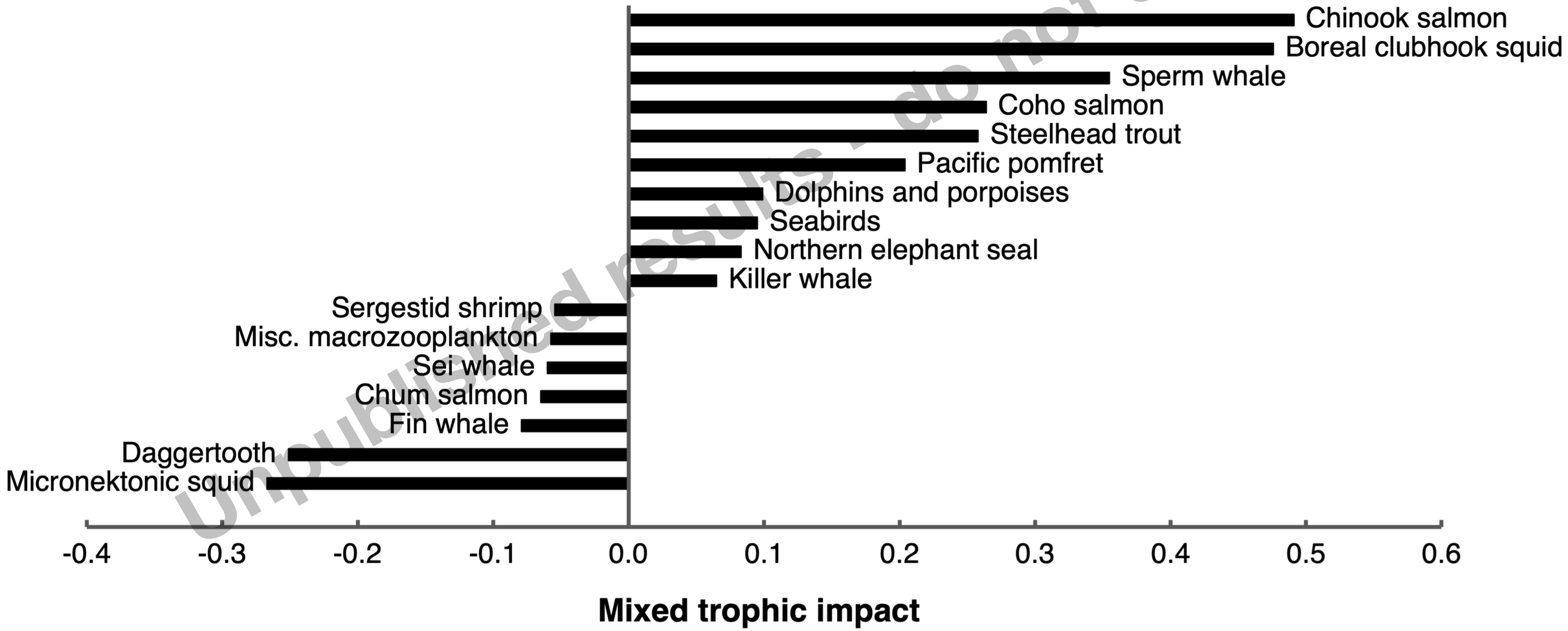
Mesopelagic fish MTI (east)



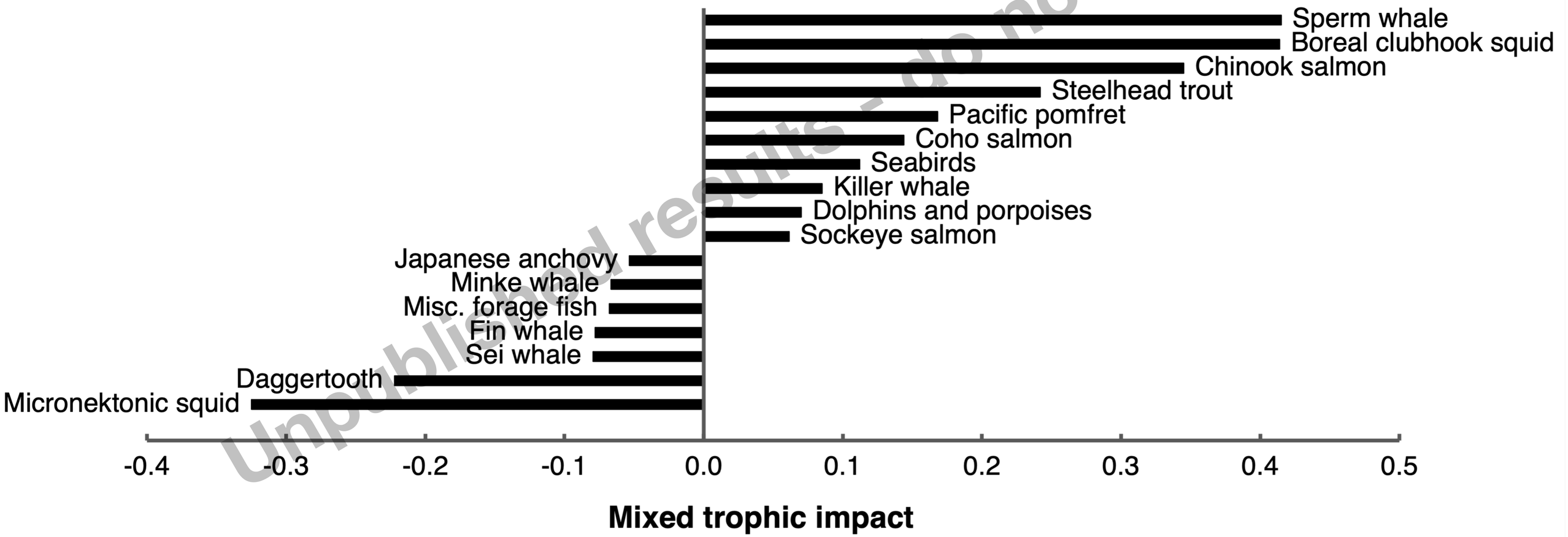
Mesopelagic fish MTI (west)



Micronektonic squid MTI (east)



Micronektonic squid MTI (west)

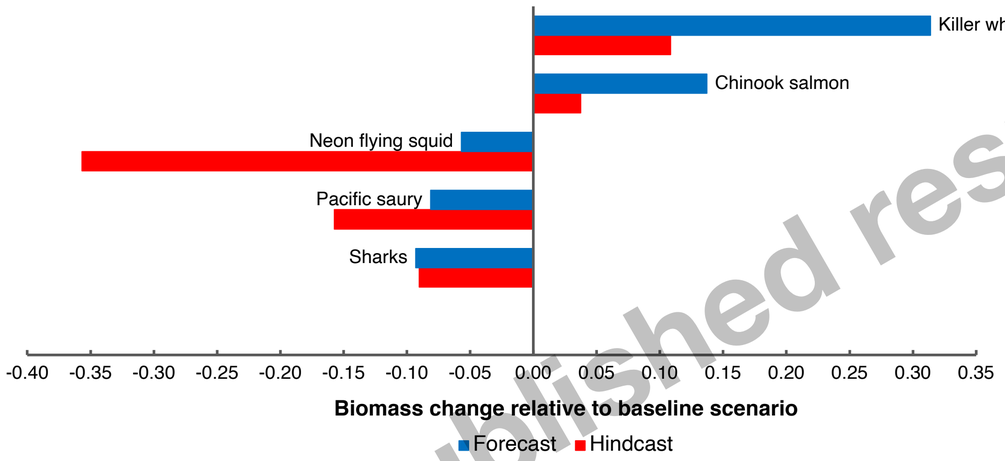


Baleen whale recovery impacts

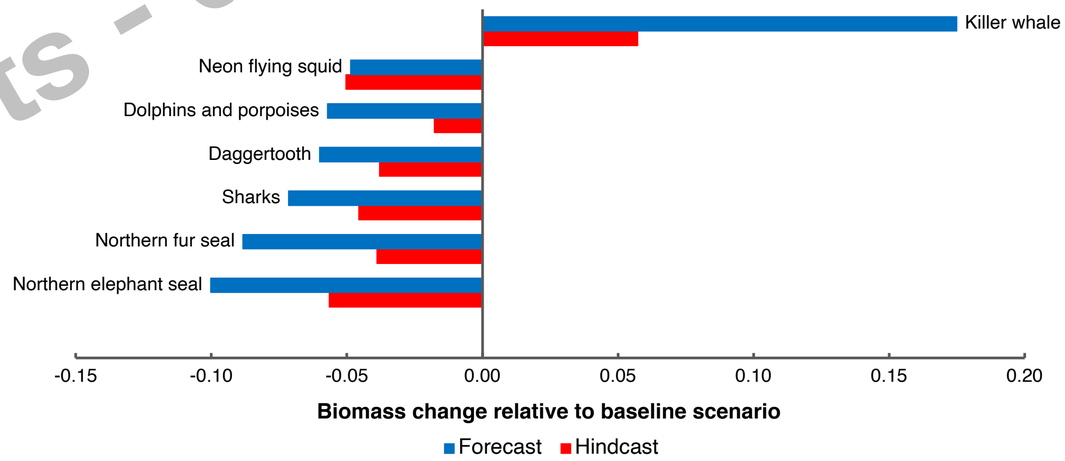
- North Pacific whale populations depleted by commercial whaling
- many of these populations now recovering from historical depletion
- as large mammals, whales exhibit substantial consumption rates
- consumption by recovering whales could impact prey biomasses
- baleen whales consume forage species in the subarctic Pacific
- thus, whale recovery could affect forage biomass and availability

Baleen whale recovery impacts

Western subarctic Pacific



Eastern subarctic Pacific



Conclusions

- multiple forage groups play important roles in the subarctic Pacific
- mesopelagic fish and especially micronektonic squid are key groups
- they may both exercise wasp-waist control over predators and prey
- they might also mediate interspecific competition among salmonids
- Pacific saury, Japanese anchovy and sardine play secondary role
- baleen whale recovery may have cascading impacts on forage fish

Acknowledgments