Forging the trident: modelling open subarctic Pacific ecosystems in three currencies

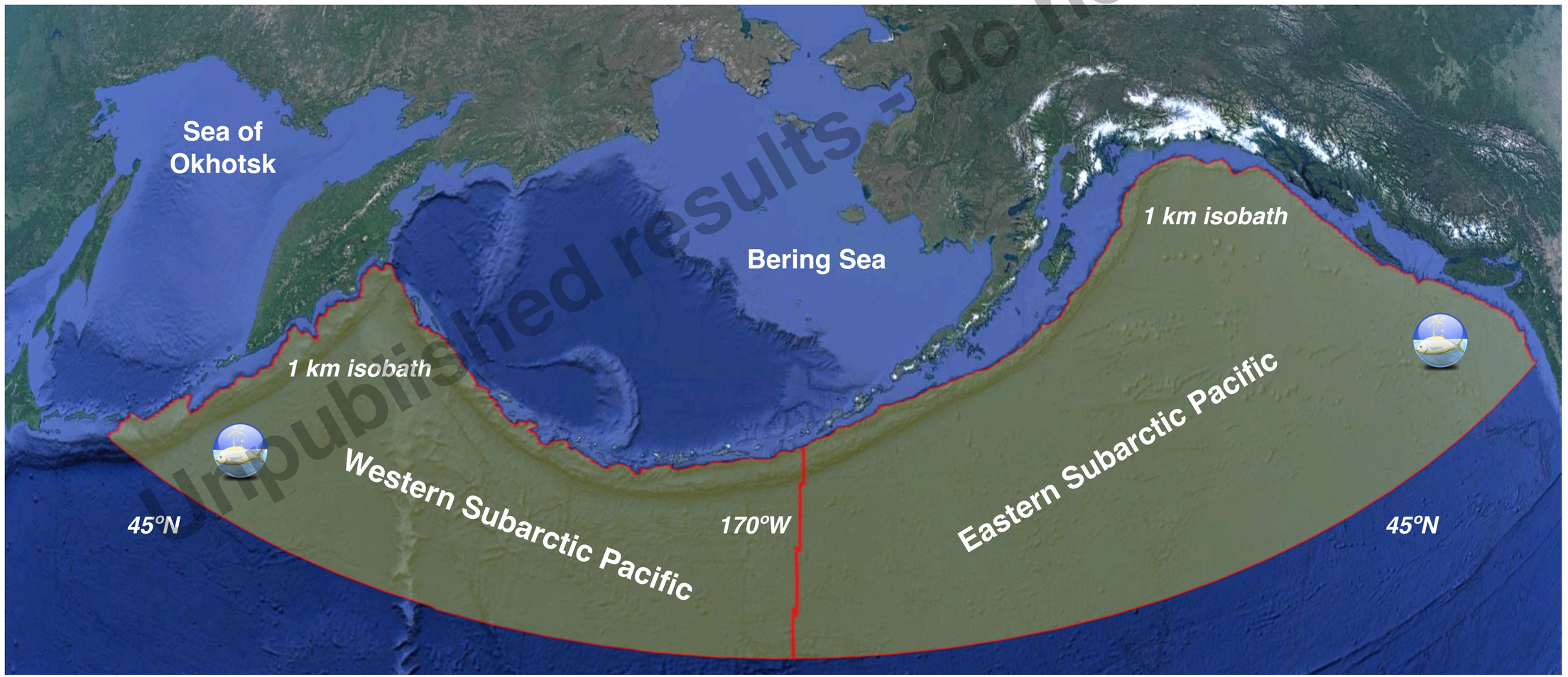
Szymon Surma[1,2], Evgeny A. Pakhomov[1,2], Brian P. V. Hunt[1,2], and Kerim Y. Aydin[3]

[1]Institute for the Oceans and Fisheries, University of British Columbia
[2]Department of Earth, Ocean, and Atmospheric Sciences, University of British Columbia
[3]Alaska Fisheries Science Center, National Oceanic and Atmospheric Administration

Introduction

- PICES: Eastern Subarctic (ESA) and Western Subarctic (WSA)
- high nutrient, low chlorophyll (HNLC), Fe-limited productivity
- strong seasonal pulses of primary and secondary production
- few commercial fisheries, but important for salmon foraging
- seasonal feeding grounds for seabirds and marine mammals
- ecosystem structure and dynamics still under active study

Open subarctic Pacific



Ecopath with Ecosim

basic principle: balance of mass or energy flows

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

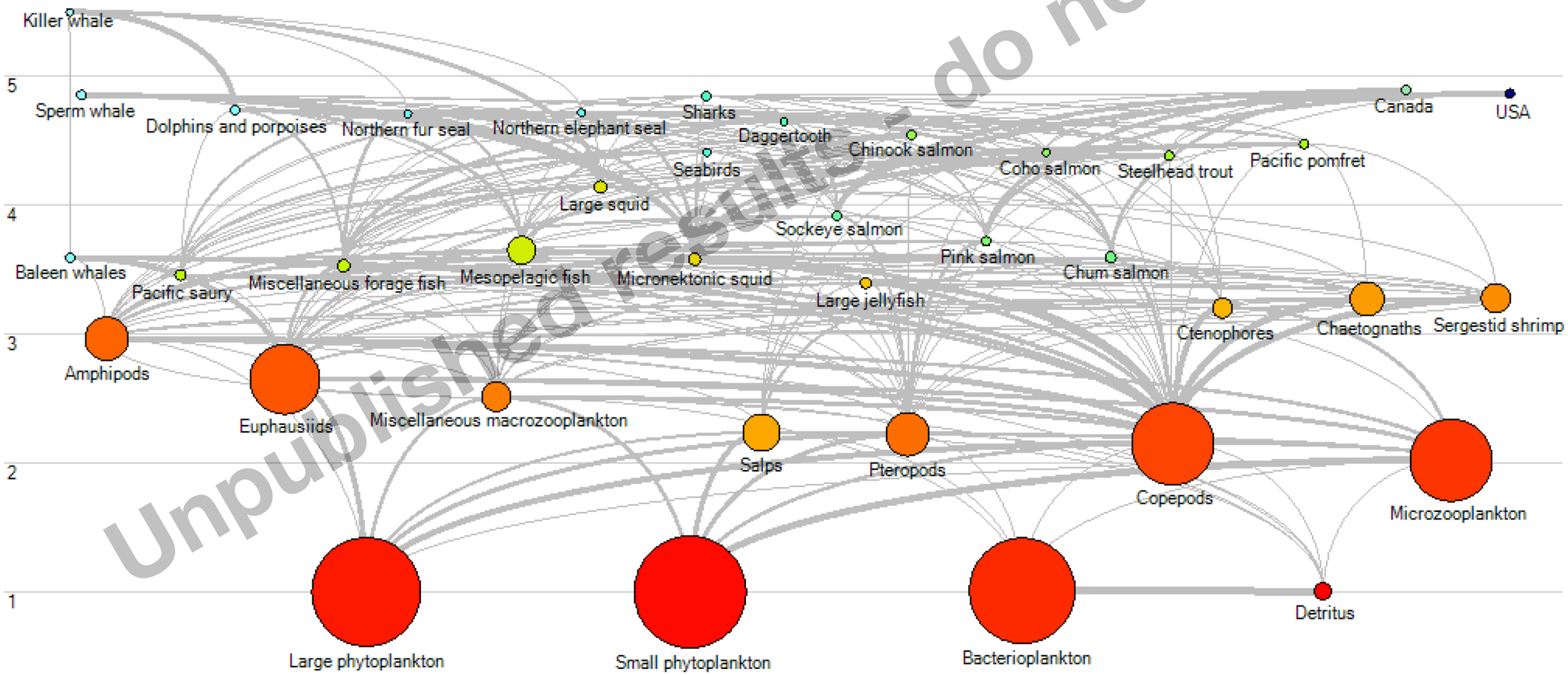
Model currencies

i) **biomass** (t/km^2): default, most commonly measured and used

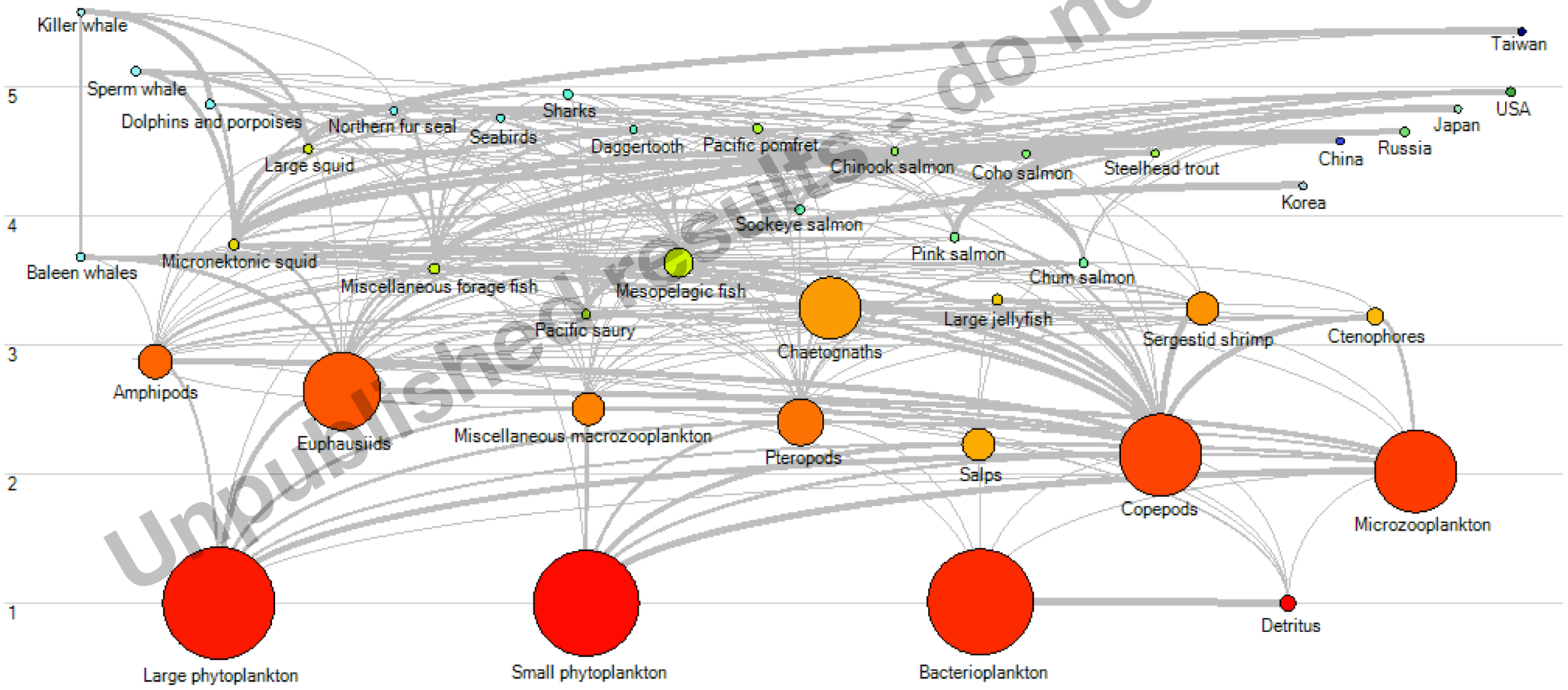
ii) **energy** (J/m^2): accounts for tissue energy content variability

iii) **iron** (mg Fe/m^2): limiting nutrient for ecosystem productivity

Eastern subarctic Pacific food web

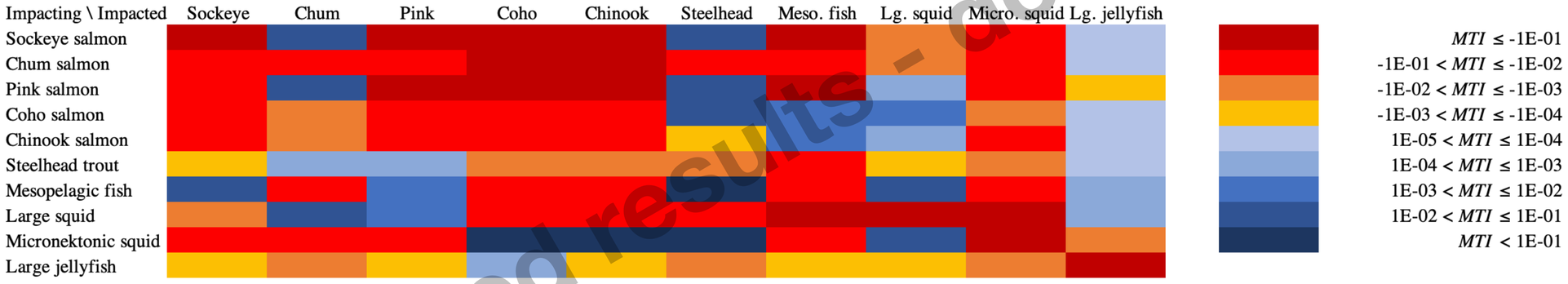


Western subarctic Pacific food web

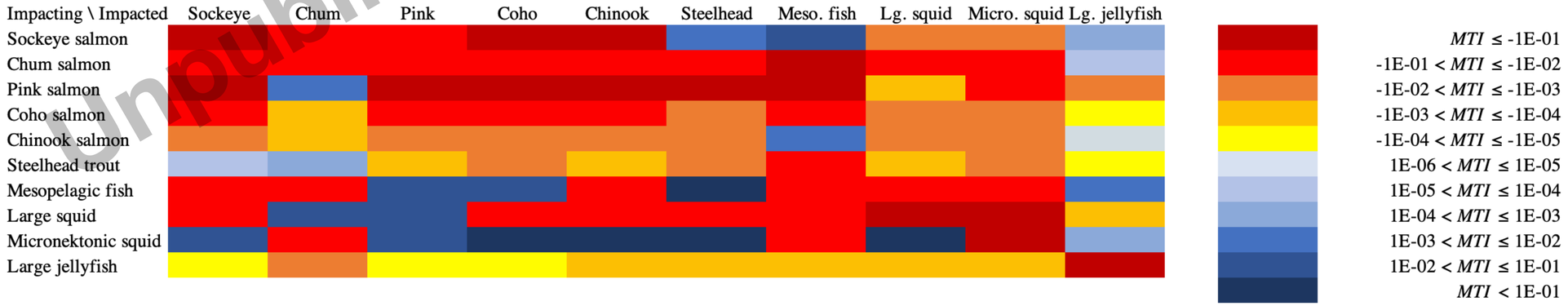


Mixed trophic impacts (biomass)

Eastern subarctic Pacific

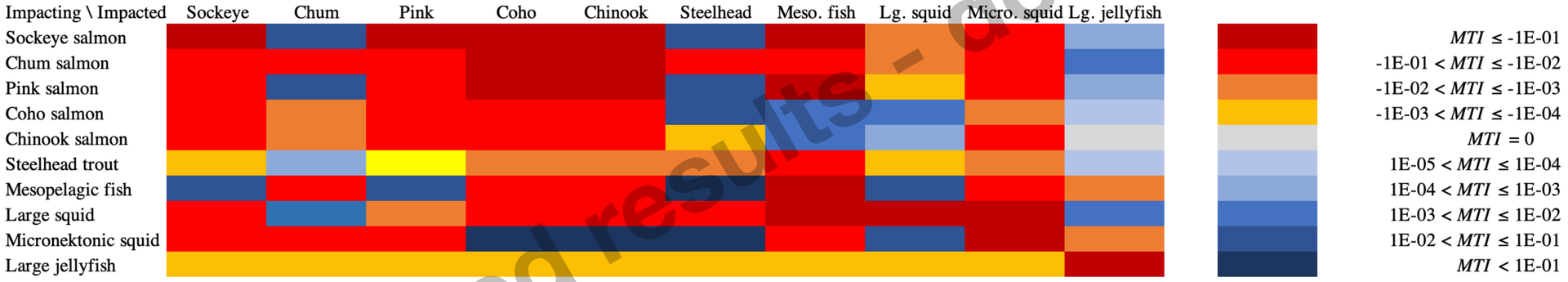


Western subarctic Pacific

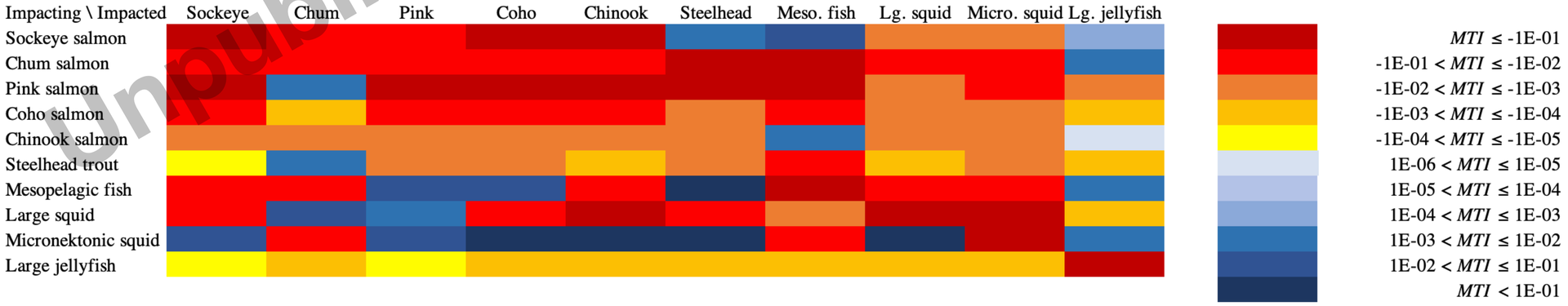


Mixed trophic impacts (high energy)

Eastern subarctic Pacific

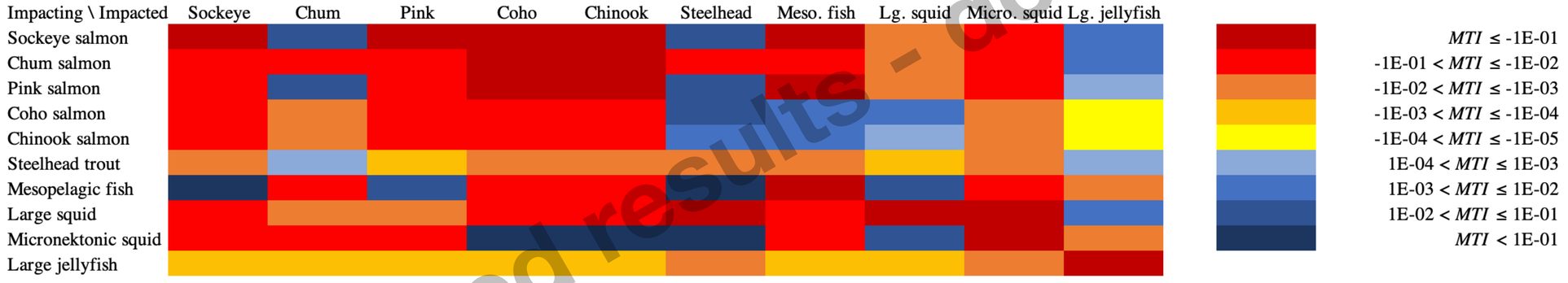


Western subarctic Pacific

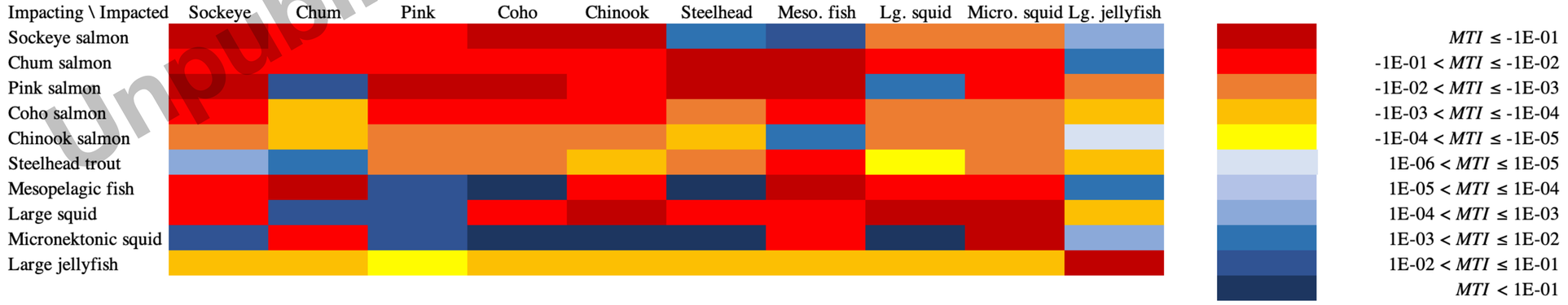


Mixed trophic impacts (low energy)

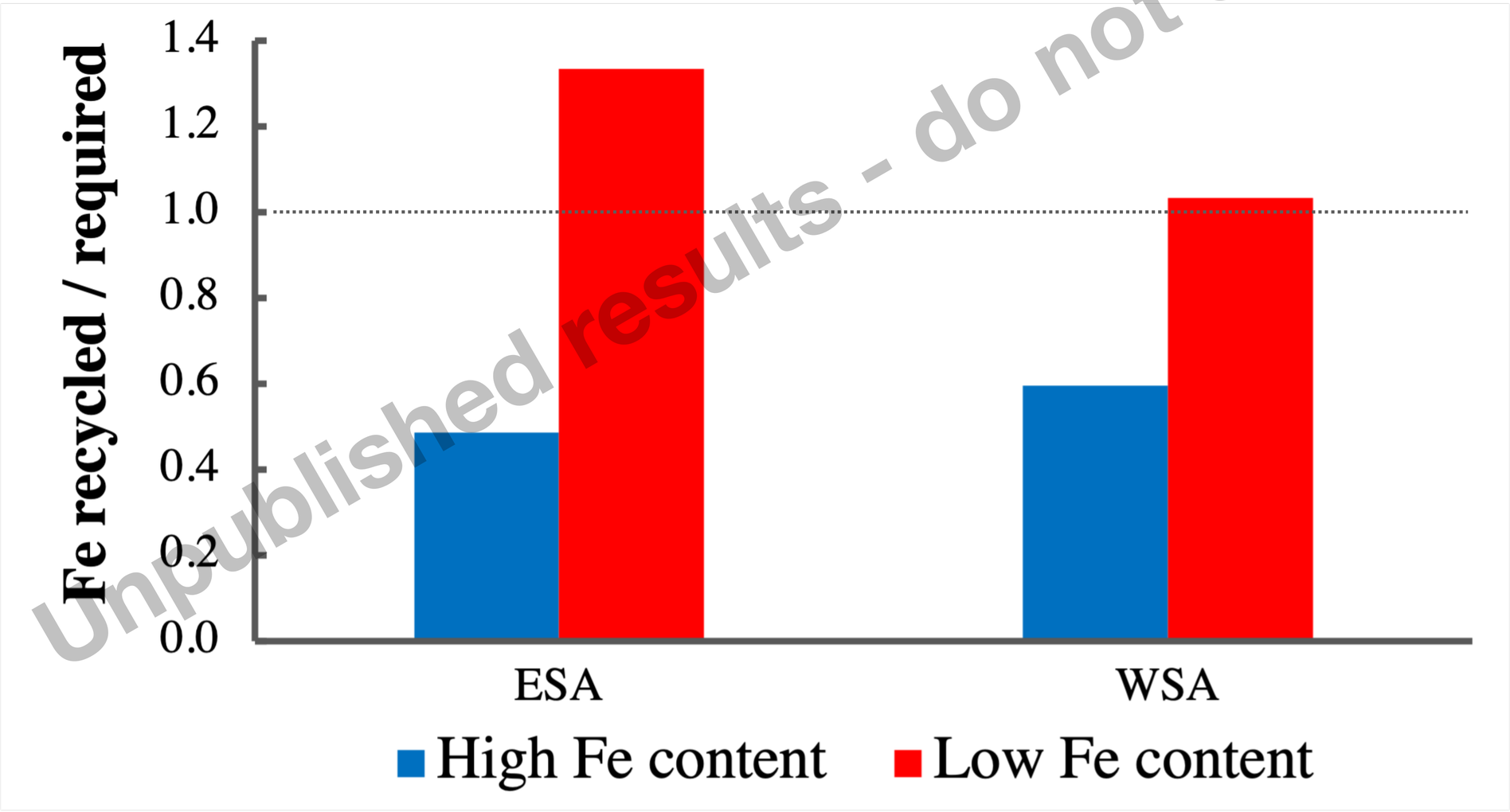
Eastern subarctic Pacific



Western subarctic Pacific



Ecosystem iron balance



Conclusions

- strong trophic interactions exist among subarctic Pacific nekton
- these could include interspecific competition among salmonids
- mass and energy balance model results are in general agreement
- interactions among nekton are mediated by prey energy content
- recycling may meet substantial part of phytoplankton Fe demand

Further directions

thermal niche functions:

- based on observed optima and tolerance limits for ectotherms
- permit simulation of salmonid responses to warming and MHWs

habitat suitability maps:

- based on outputs of pelagic surveys and predictive modelling
- allow estimation of spatiotemporal niche overlap among salmonids

Acknowledgments