Marine mammals, fisheries, and a changing climate in the eastern Gulf of Alaska

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Introduction

- coastal marine mammals & fisheries often target same species
- this creates scope for competition, depredation, entanglement
- eastern Gulf of Alaska supports important commercial fisheries
- however, it also hosts protected & recovering marine mammals
- fisheries & mammals impacted by marine heatwaves & El Niño
- need to reconcile fisheries catch & mammal conservation goals

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Research goals

1. quantify ecological connections between marine mammals & fisheries
2. assess resulting potential for problematic interactions between them

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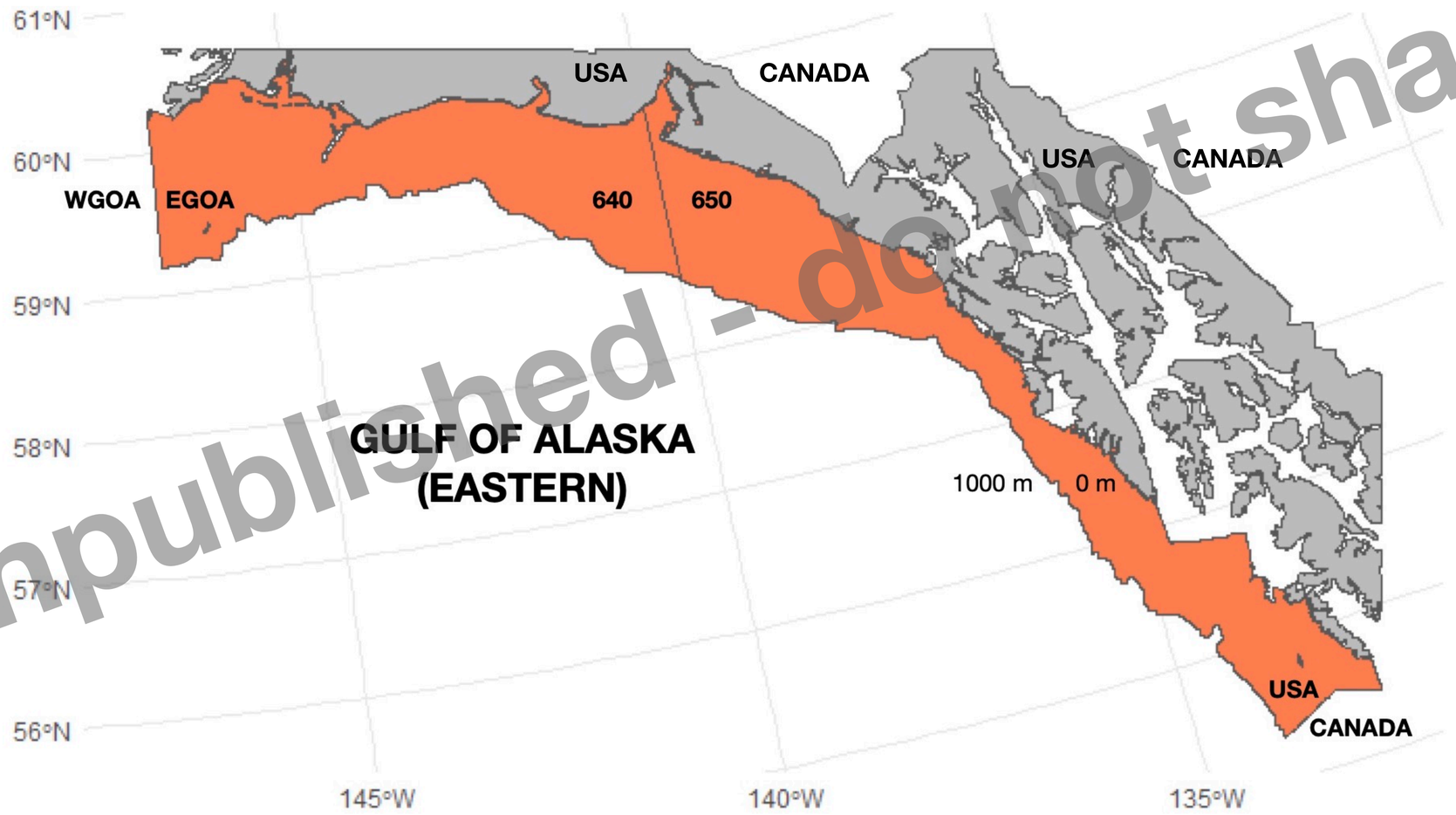
Study area



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Ecopath with Ecosim

basic principle: mass balance

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



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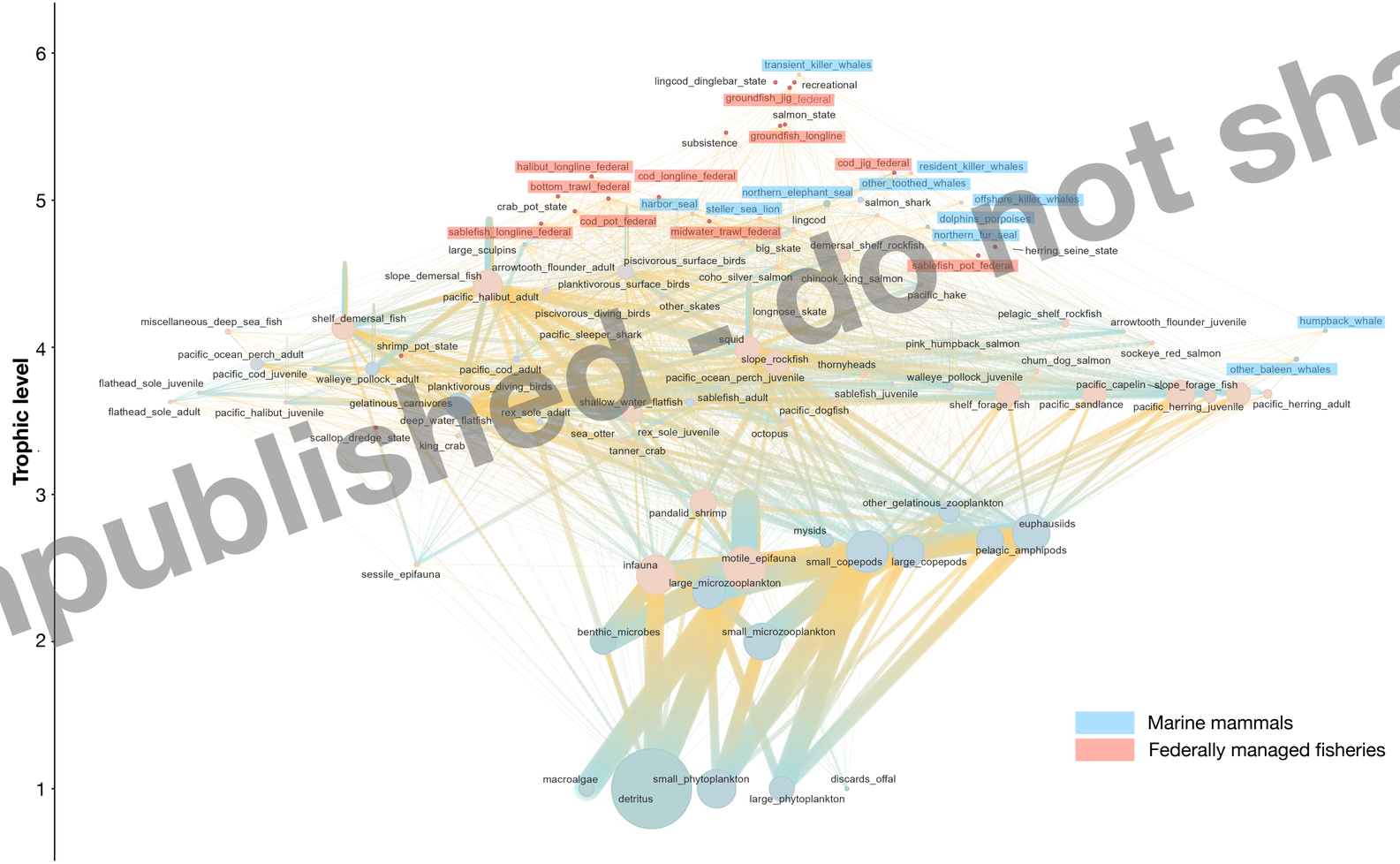
Eastern Gulf of Alaska food web



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https://github.com/biadias/rpathviz

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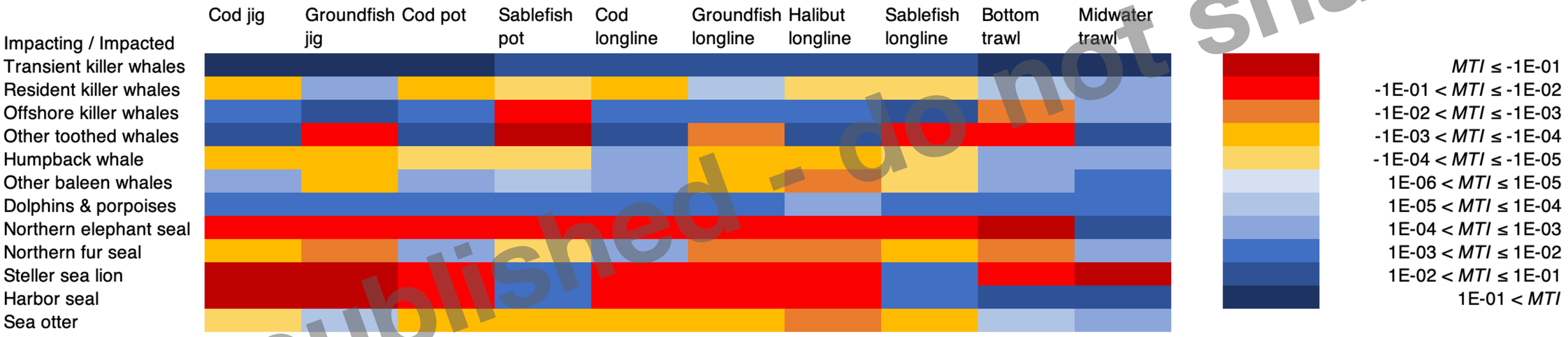
Mammal impacts on fisheries



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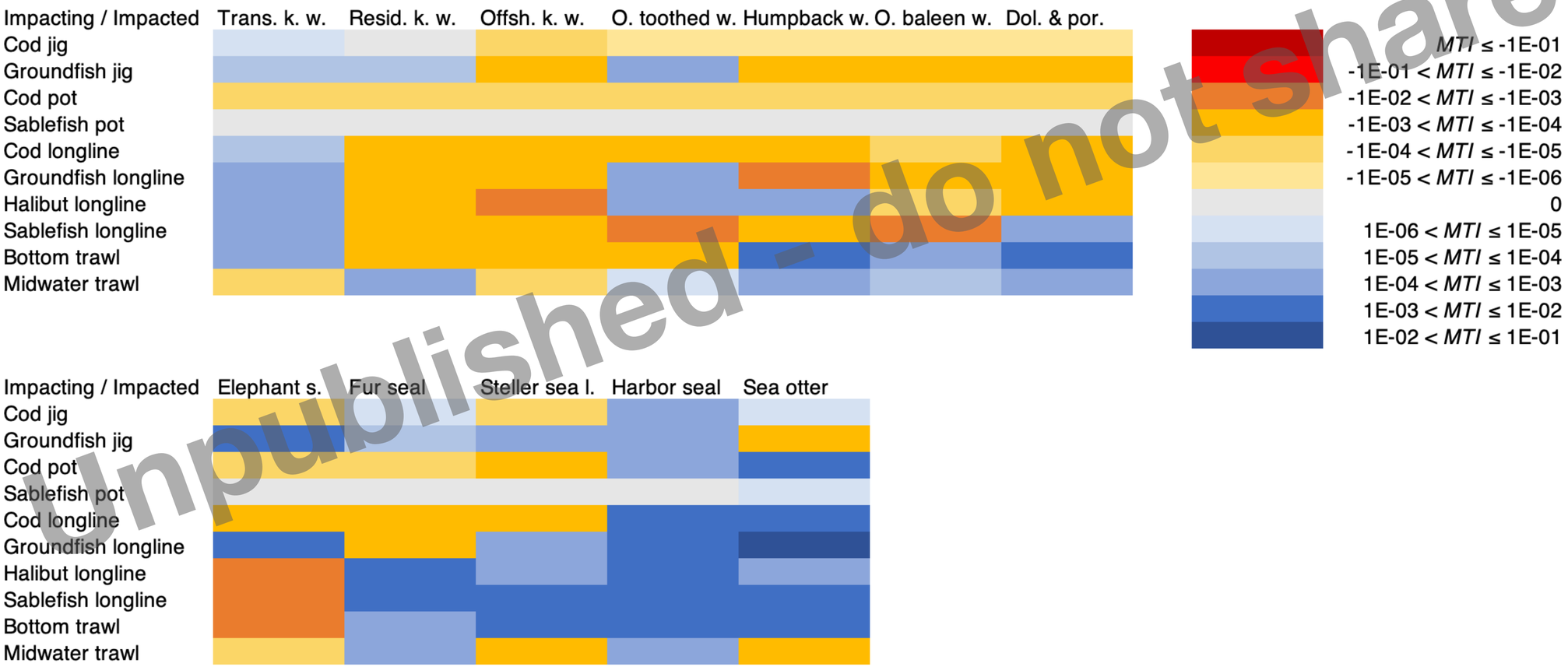
Fisheries impacts on mammals



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Dynamic simulations

hindcast & forecast in Ecosim with input (°C) from NE Pacific ROMS

- model fitted to biomass, catch, & temperature time series (1990-2024)
- surface & bottom temperature: CMIP -> NE Pacific ROMS -> Ecosim
- model base: 1990-93, climate & fishing mortality baseline: 1991-2020
- forecast simulations: 2021-2099, results evaluated: 2045-49 & 2095-99
- 3 SSPs (1-2.6, 2-4.5, 4-8.5) + status quo $*$ $F = 0$ or base -> 8 scenarios

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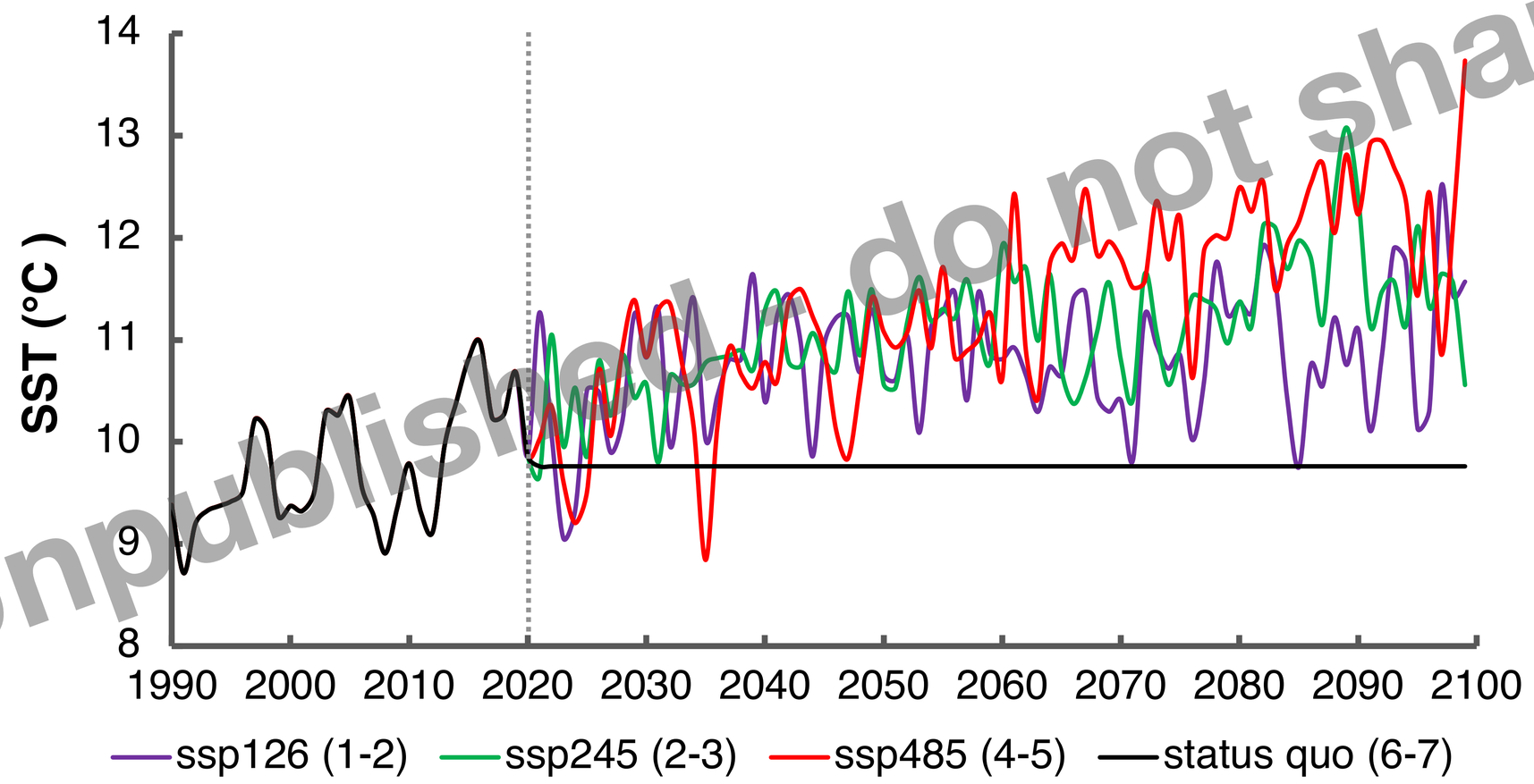
Surface temperature projections



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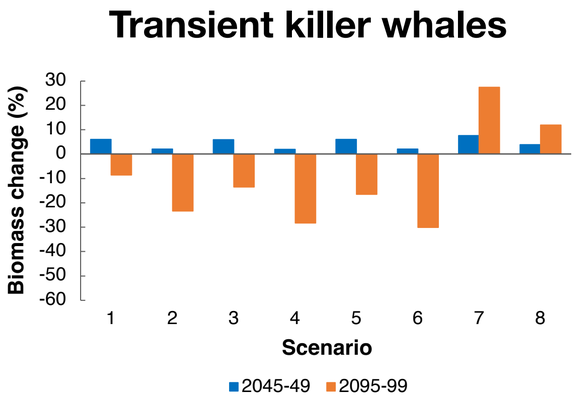
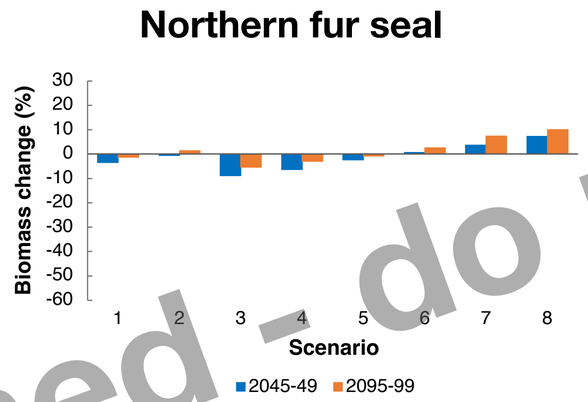
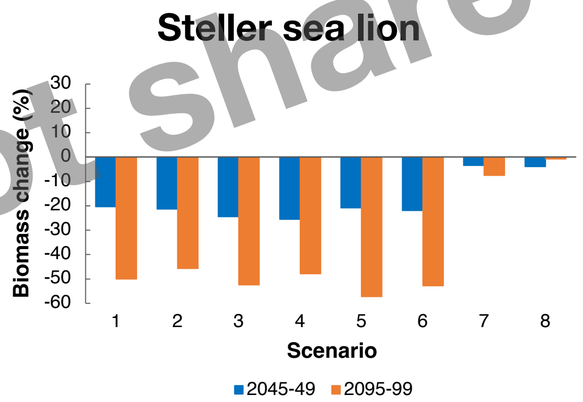
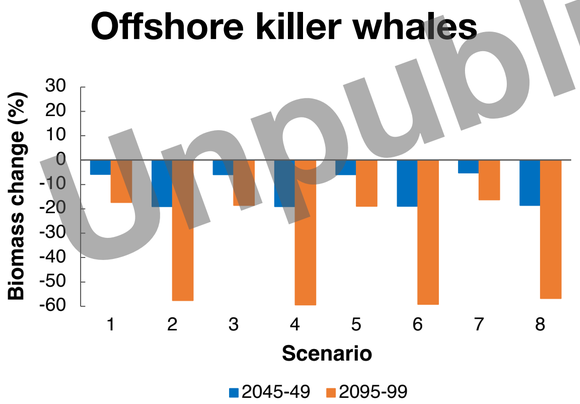
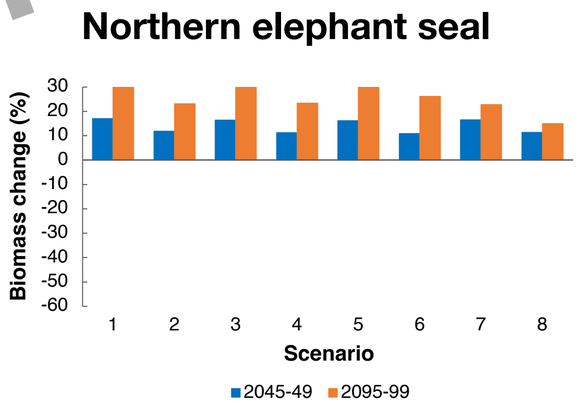
Mammal biomass projections

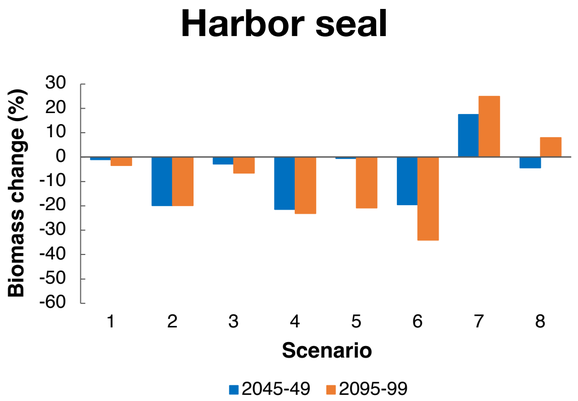












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Conclusions

- mammal impacts on fisheries generally weak, with a few exceptions
- fisheries impacts on mammals even weaker in base ecosystem model
- these impacts become stronger, highly variable in forecast simulations
- species the strongest factor in variability, followed by climate scenario
- biomass change does not scale linearly with scenario warming level
- negative impacts may point to risks of depredation & entanglement

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