Gulf of Alaska Climate Integrated Modeling Project

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Climate Scenarios

Policy-makers

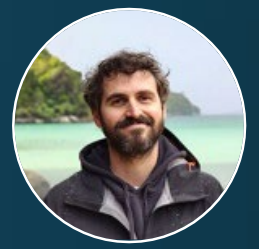
Communities

Individuals

GOA-CLIM is developing and synthesizing results from multiple climate-enhanced ecosystem modeling platforms to support the climate adaptation and resilience of fisheries management and fishing-dependent communities in the Gulf of Alaska

- Dynamic Ecosystem model (Atlantis)
- Mass-balance ecosystem model (Ecopath with Ecosim or Rpath)
- Biologically-linked 3-species model (Rceattle)
- Size-spectrum model (mizer)
- Single species models
- Community economic model

CAFA Climate and Fisheries Adaptation



A. Rovellini

Atlantis

- Spatial- and depth-stratified model
- Forced using temperature, salinity, and currents from ROMS in historical period
- 78 functional groups
- Age-structured vertebrate populations
- Includes detritus, primary production, groundfish, forage fish, seabirds, and marine mammals
- Ontogenetic, size-based predator-prey interactions that consider spatial overlap of predator and prey
- Deterministic

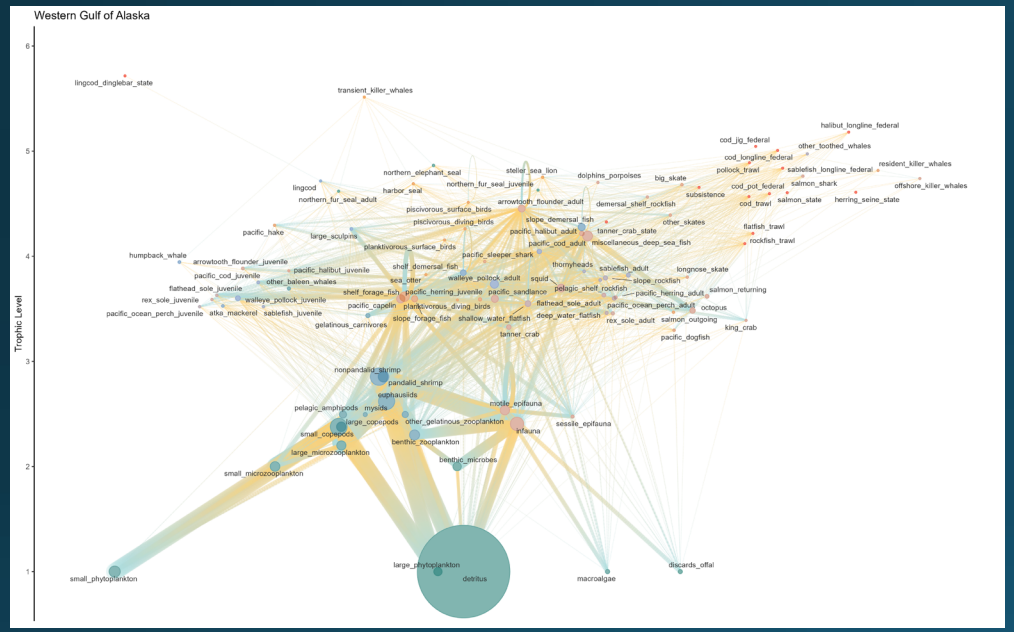
Ecopath


B. Dias


B. Ferriss

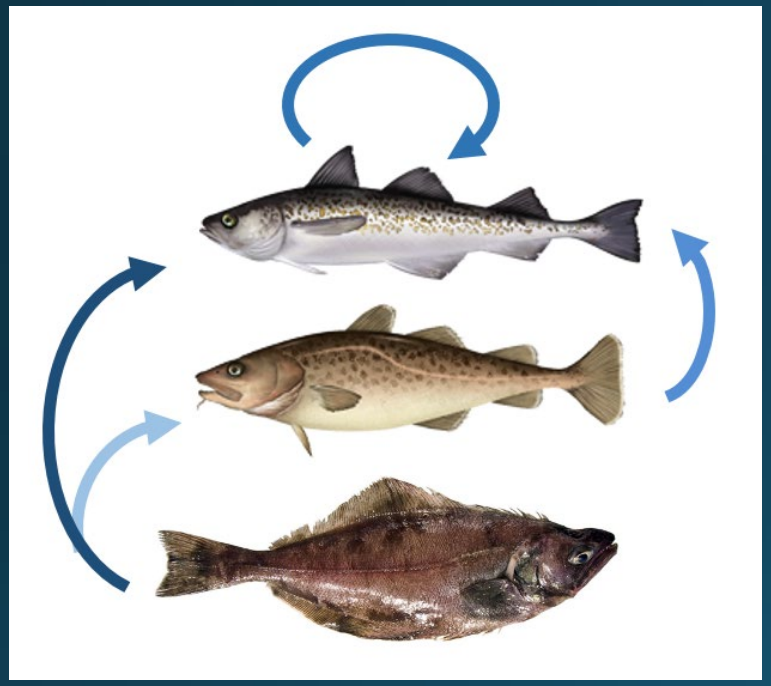

S. Surma


K. Aydin



- Two single-area models: Western and Eastern GOA models split at 147W, depths 0-1000m
- Forced with temperature and primary production outputs from ROMS historical period
- 86 species groups
- Age-structured modeling for 9 fish species
- Includes detritus, primary production, groundfish, forage fish, seabirds, and marine mammals
- Mass-balanced food web models
- Tracks monthly cohorts of fish with density dependent predation mortality
- Deterministic
- Uses with Rpath or Ecosim for simulation

Rceattle (in TMB)

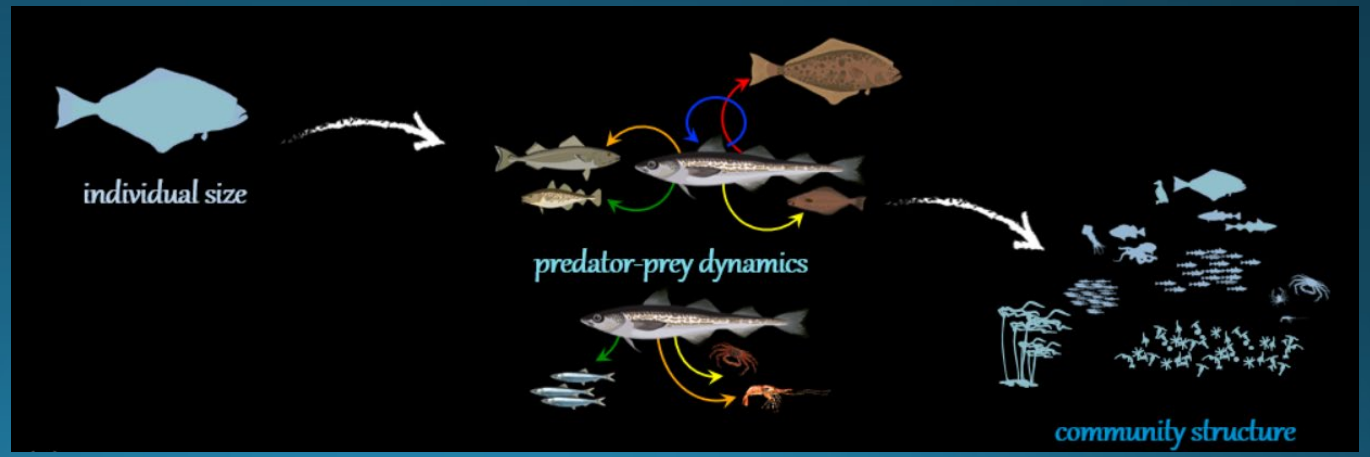


- Single-area model
- Single- and multi-species age-structured assessment and simulation model
- 3-species model: pollock, Pacific cod, arrowtooth flounder
- Links species through age- and time-varying predation mortality
- Utilizes bioenergetics and diets to inform climate-specific consumption and prey preference of predators
- Environmental covariates can be linked to catchability, recruitment, bioenergetic consumption, residual M
- Stochastic, can do full management strategy evaluation

mizer

C. Barnes

- Single-region model
- Can be forced using phytoplankton and zooplankton anomalies from the historical period, bottom temperature can be linked to consumption and respiration
- 11 of the most abundant groundfish species modeled
- Multi-species size spectrum model
- Size informs metabolic rates, functional relationships, trophic niche, vital rates, and fishing
- Deterministic



Community economic model


C. Seung

- Dynamic, multi-regional computable generalized equilibrium model
- Currently uses Rceattle projected catches of pollock, Pacific cod, and arrowtooth flounder for a suite of scenarios
- Accounts for geographic flow of fisheries benefits
- Predicts long-term economic outcomes from future catches for 10 regions

GOA-CLIM Modelers

Alberto Rovellini and Isaac Kaplan (Atlantis GOA)

Bridget Ferriss, Bia Dias, Szymon Surma, Kerim Aydin (Ecopath)

Grant Adams and Kirstin Holsman (Rceattle)

Cheryl Barnes and Jon Reum (mizer)

Chang Seung (Economic model)

Elizabeth McHuron (Top predator parameterization)

Al Hermann, Kelly Kearney (Physical oceanographic modeling/ROMS)

This work builds on that of ACLIM with numerous contributors, initiated and led by Anne Hollowed and Kirstin Holsman

GOA-CLIM Additional Co-PIs

Melissa Haltuch

Sara Cleaver

Brian Fadely

Mike Litzow

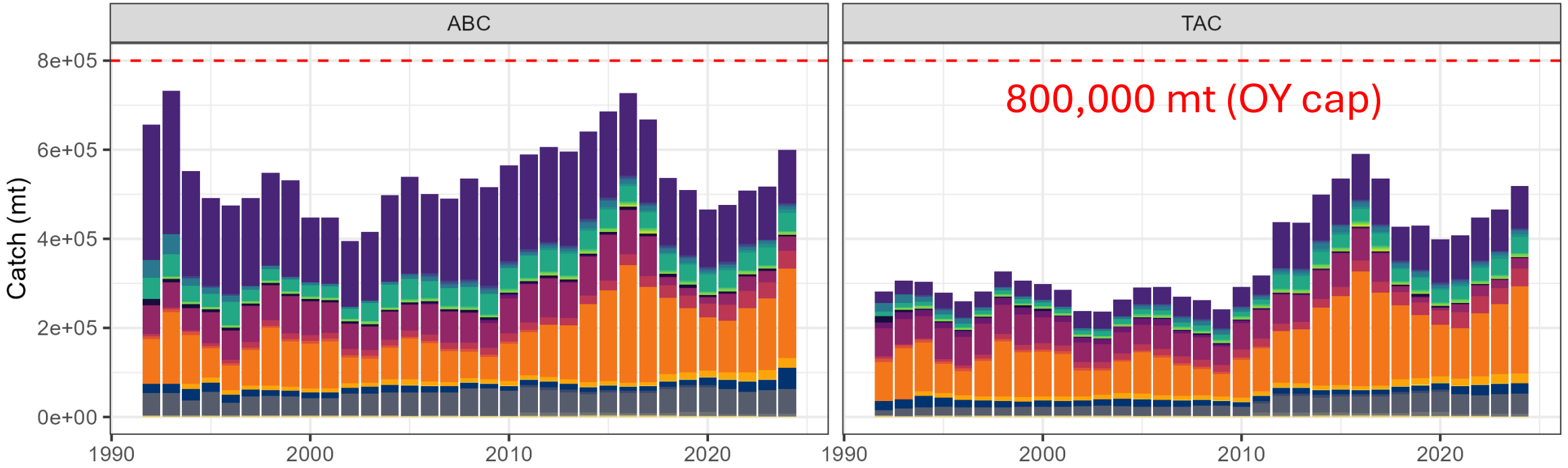
Kristin Marshall

Robert Suryan

Marjorie Mooney-Seus

Katie Sweeney

GOA historical harvest specifications



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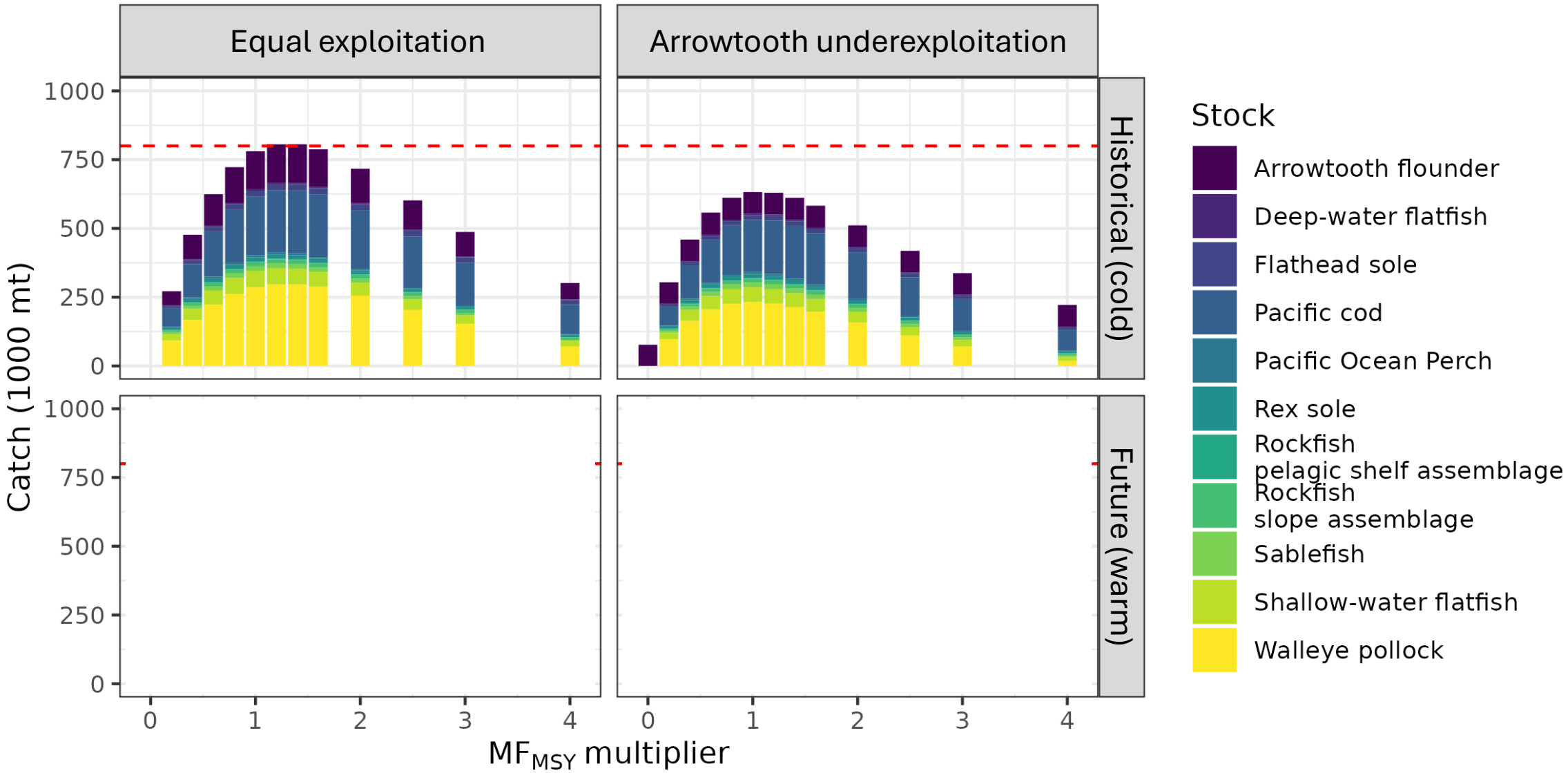
Atlantis simulations – Multispecies yield



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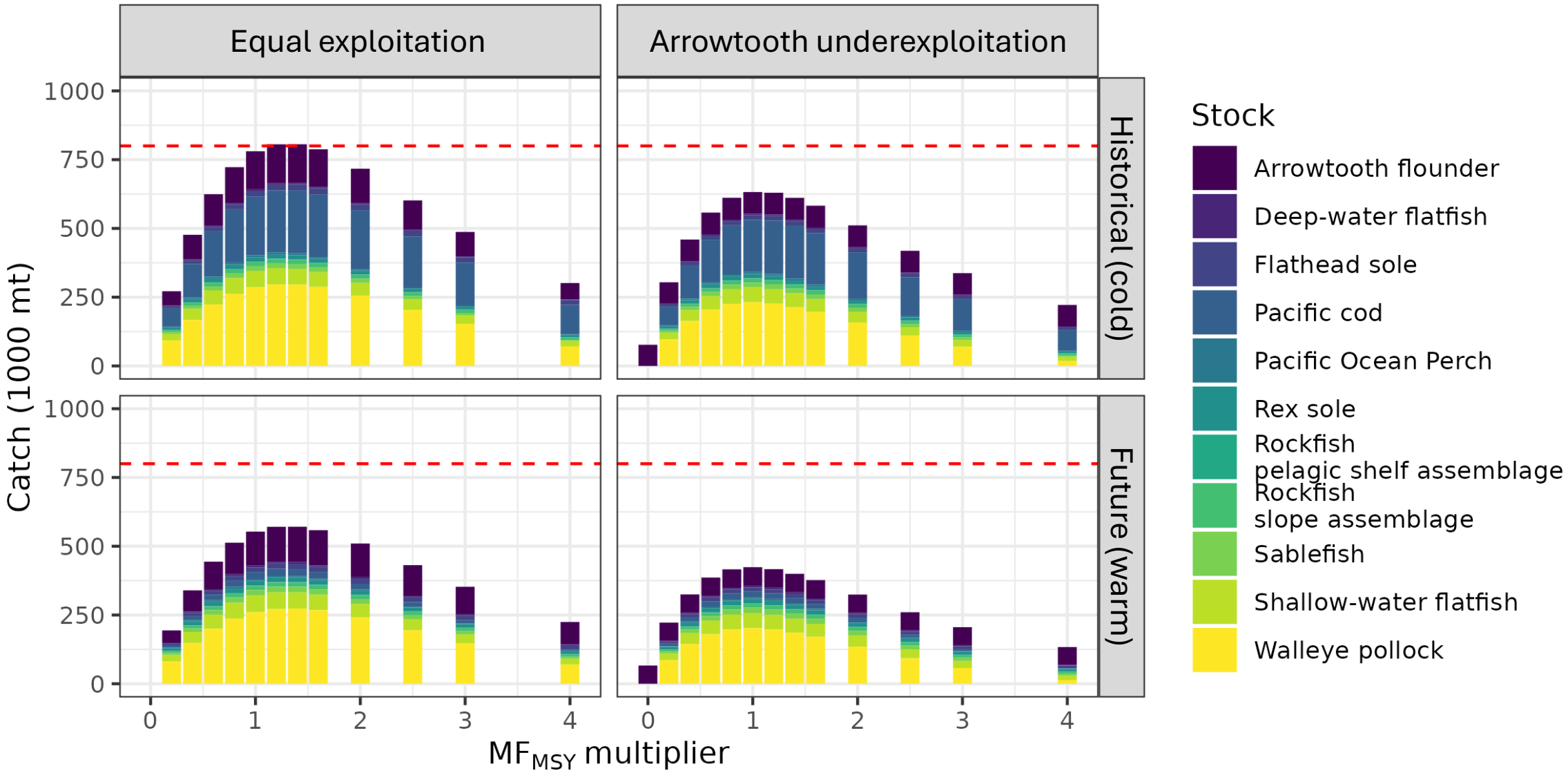
Atlantis simulations – Multispecies yield



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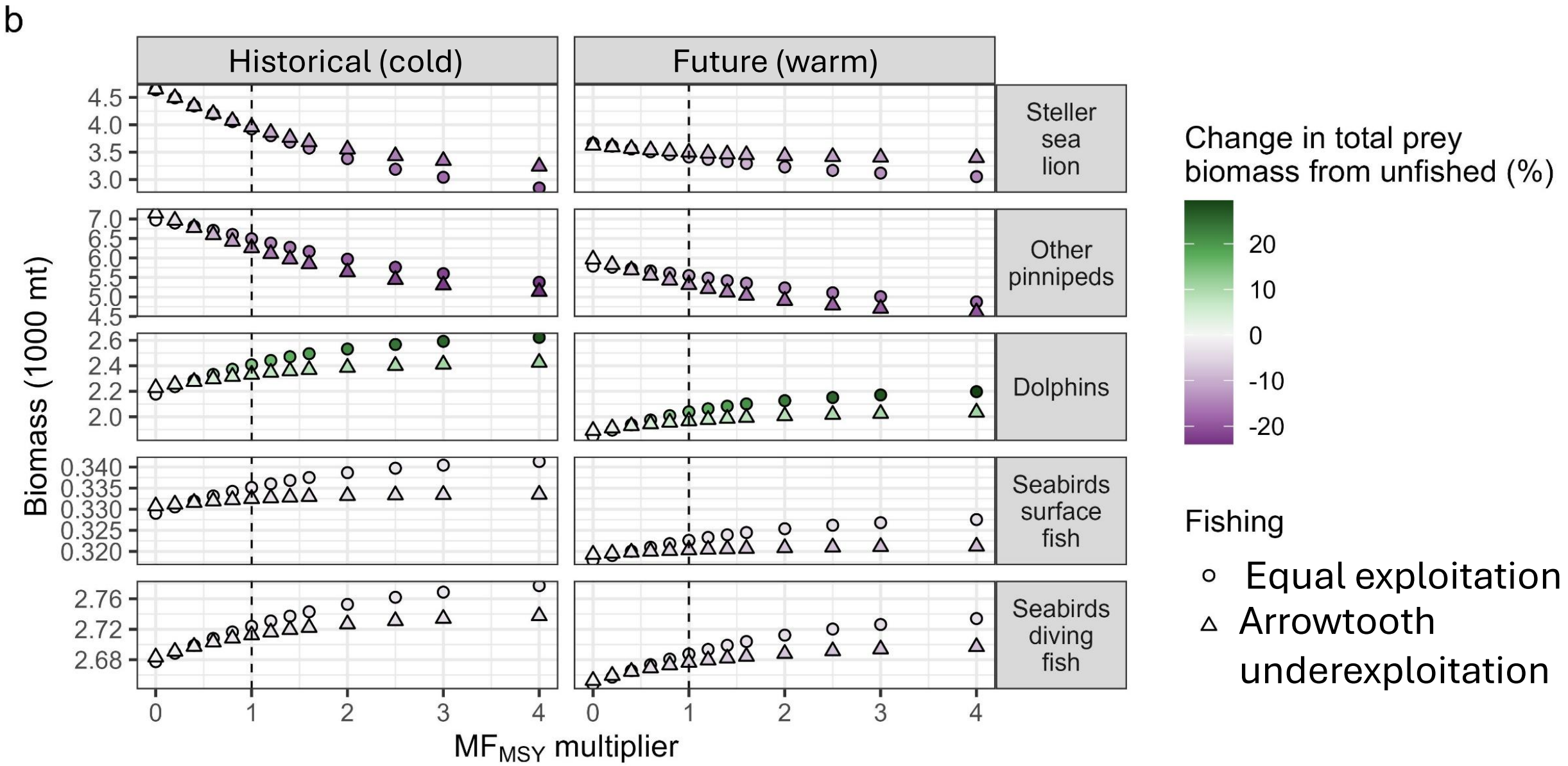
Atlantis simulations – ecosystem effects



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Summary and conclusions

- Recent aggregate TAC < ABC < OY cap (800,000 mt)
- Arrowtooth flounder underexploitation:
  - Increased predation on pollock
- Projected environment:
  - Possible decline of some groundfish stocks
- Can explore indirect effects on other species

→ Current OY cap unlikely to constrain GOA groundfish catch in the future

https://esajournals.onlinelibrary.wiley.com/doi/10.1002/eap.70036

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A method to rescale catch allocations under OY

GOAL: To simulate alternative OY cap values (e.g., with Atlantis GOA)

How to rescale catch allocations under a constraining cap?

- Done using ATTACH (data-based) for ACLIM models
- No ATTACH (nor data) for the GOA

Building a mechanistic method (work in progress)

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A method to rescale catch allocations under OY

- Conditions to satisfy:

1. $\sum_{i=1}^{n} Catch_{final,i} \leq OY$
2. $Catch_{final,i} \leq Catch_{init,i}$
3. If $Catch_{init,i} > 0$, then $Catch_{final,i} > 0$

- Based on user-defined stock-specific weights (tuning parameters)
- Higher weights → less rescaling
- Allows for preferential rescaling (e.g., less rescaling for high-value stocks)
- Working to include PSC and groundfish bycatch considerations
- Shiny tool for exploration and details (development in progress): https://swzlz7-alberto-rovellini.shinyapps.io/oy_rescaling_app/

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Mimicking TAC setting in simulation testing scenarios

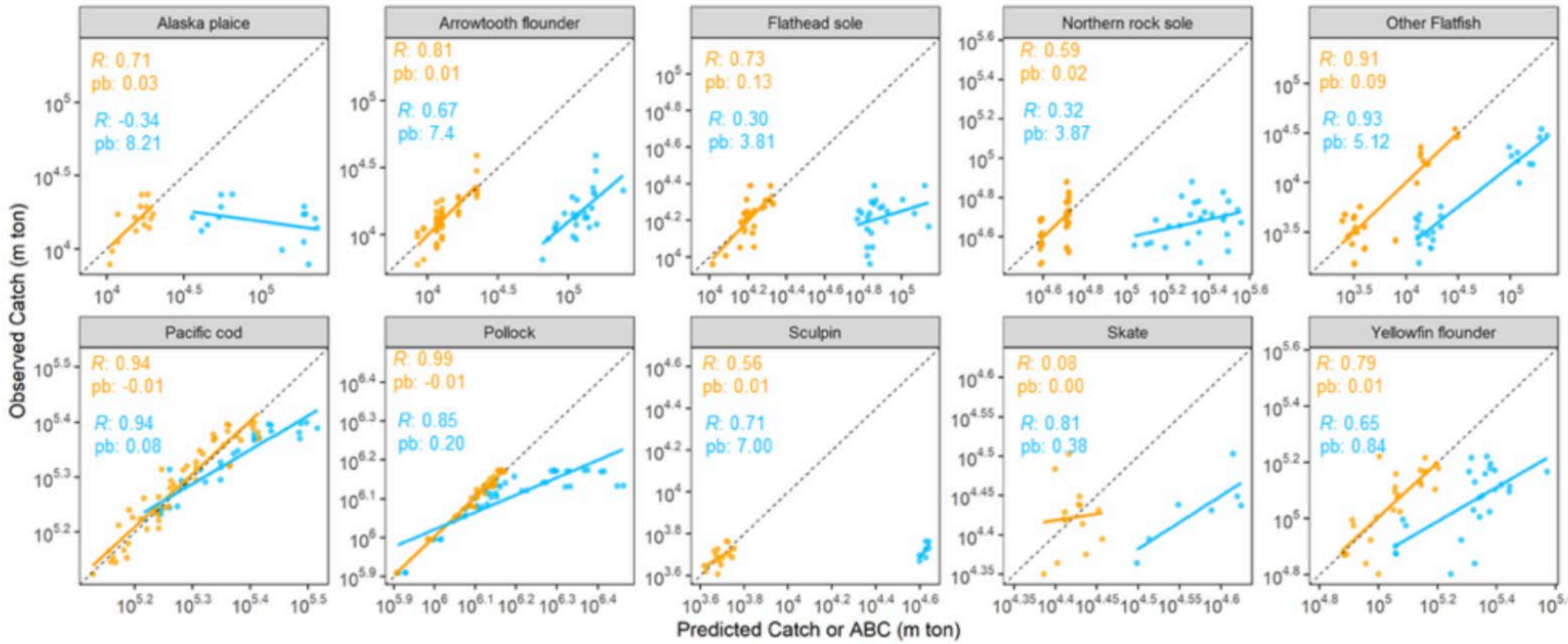
Historically constrained optimization for programmatic SEIS

Shortcut methods needed

Developments by Alan Haynie and Amanda Faig

Methodology on TAC modeling to explore cap alternatives

Modeling Total Allowable Catch (TAC) alternatives in simulation settings



Methodology on TAC modeling to explore cap alternatives

Further updates underway and development of a more generalized tool