

NOAA
FISHERIES

NEFSC

Management Strategy Evaluation (MSE)

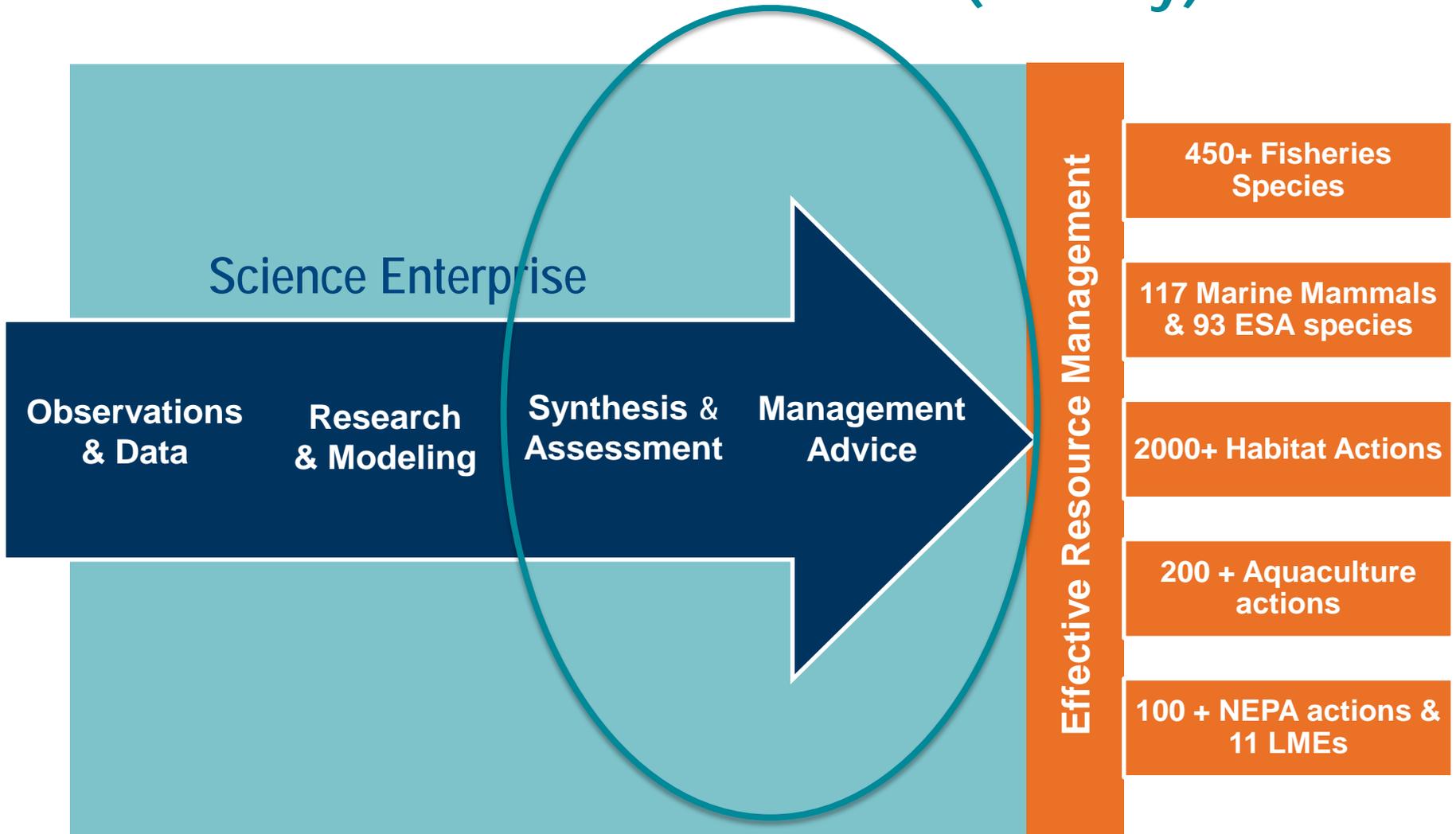
Sarah Gaichas

NEFSC Ecosystem and Climate Science Program Review

Modeling and Analysis Session

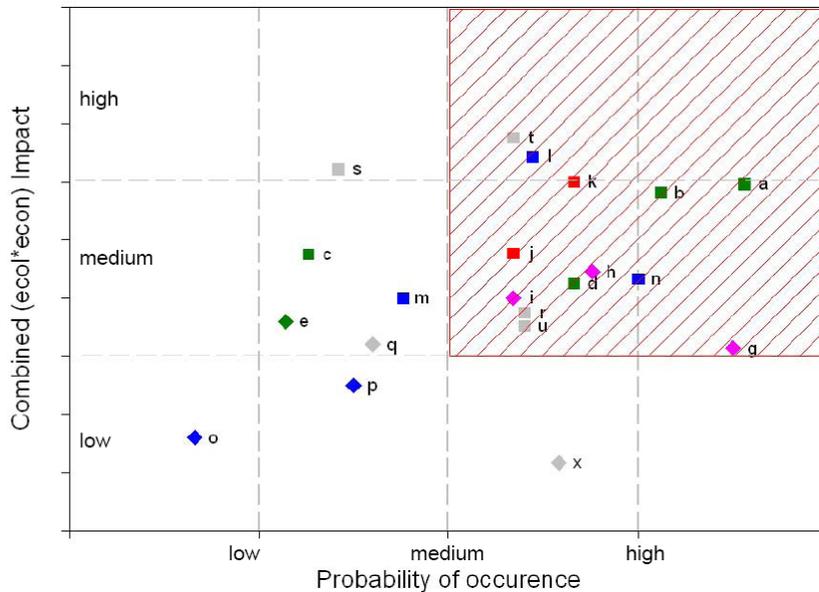
June 7, 2016

You are here: Themes 3 and 4 (mostly)

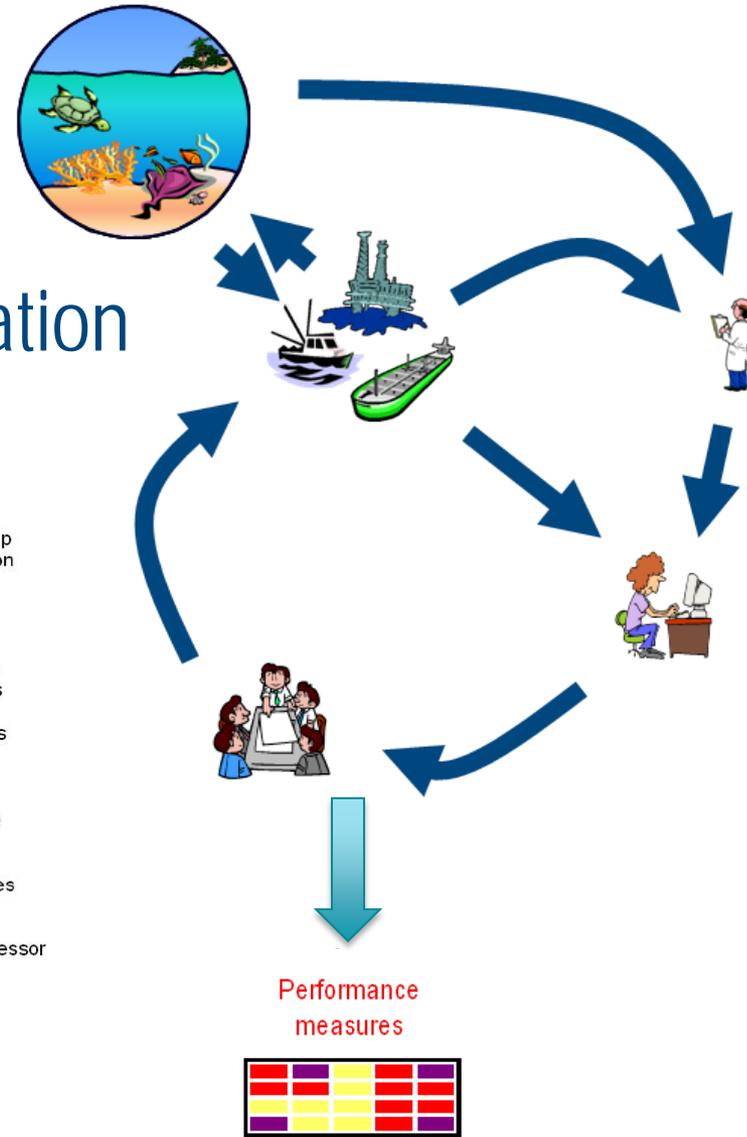


Powerful strategic tools

- Risk assessment methods
- Management Strategy Evaluation



- a - CP-Water temp
- b - CP-Acidification
- c - CP-Nutrient
- d - CP-Weather
- e - CP-Seismic
- g - PP-Predation
- h - PP-Prey base
- i - PP-Apex Preds
- j - ESA-Seabirds
- k - ESA-Mammals
- l - F-Removals
- m - F-Habitat
- n - F-Bycatch
- o - F-Subsistence
- p - F-ltd entry
- q - SE-Military
- r - SE-communities
- s - SE-oil&gas
- t - SE-Shipping
- u - SE-Adak processor
- x - SE-Research



Redrawn with permission of Beth Fulton

NEFSC: Assessment and MSE Capability

- See 2014 Stock Assessment Program Review
- NEFSC MSE working group established 2015
 - Expertise: Fish, Marine mammals, Ecosystems, Economics, Social policy
 - Charge: Develop NEFSC MSE plan
 - Contacted Councils/Commission; Initial project Atlantic herring
- NEFSC MSE FTE shared 50:50 (PopDy:EcoAP)
- SPERS MSE Activity plan developed 2016

For the Review Panel—this addresses Theme 1: Management Context and Strategic Planning

Overview of NEFSC MSE projects

	A	B	C	D	E	F	G	H	I
1	N	Who	What	Where	When	Stage	Why	Full closed-loop MSE?	Reference
2	1	Brooks and Legault	Retrospective forecasting	New England groundfish	2011-present	revision of manuscript	Evaluate sources of uncertainty in short term forecasts	no	manuscript accepted by CJFAS with major revisions
3	2	Deroba	WCSAM/SISAM	ICES world conference	2014	Done	test assessment model frameworks	No	Deroba et al 2015 ICES
4	3	Deroba	retrospective MSE	NEFSC	2014	Done	inform management about use of Mohn's Rho	Yes	Deroba 2014 NAJFM
5	4	Deroba	herring control rule	NEFSC/NEFMC	ongoing	Middle	concern over herring as forage	Yes	Council working doc
6	5	Deroba	test assessment model frameworks	NMFS Assessment Methods Working Group	just conceived	less than infancy	Do something like SISAM (2 above) but more controlled and more US centric	No	None
7	6	Deroba	test assessment performance with low catch and process errors	NEFSC	just conceived	less than infancy	See if assessment models and retros are worse with low catch because process errors that we typically ignore become the main drivers of dynamics	Unknown	None
8	7	Deroba	test age/length composition iterative reweighting methods	NEFSC	just conceived	less than infancy	Multiple competing philosophies exist on how to weight input data for assessments. Arguments are theoretical and would benefit from sims.	No	None
9	8	Fay, Large, Link, Gamble	Ecosystem indicator performance testing	Northeast US Shelf	2012	complete	Testing systemic fishing responses with ecosystem indicators	No	Fay et al 2013 Ecological Modelling
10	9	Fay, Link, Hare	Ocean acidification impacts	Northeast US Shelf	2015	in review	Assessing the effects of ocean acidification in the Northeast US using an end-to-end marine ecosystem model	No ?	Fay et al in review MEPS
11	10	Fay, Link, Large, Gamble	Performance of ecosystem indicator based control rules	Northeast US Shelf	2014	complete	Management performance of ecological indicators in the Georges Bank finfish fishery	Yes	Fay et al in press ICES
12	11	Gaichas, Gamble, Fay, Fog	Multispecies management procedure testing	Georges Bank	2015+	just starting	Evaluate performance of total system and aggregate species catch caps combined with individual species minimum stock size thresholds	Yes	will be presented at NSAW 2015, ICES ASC
13	12	Gaichas, Gamble, Fogarty	Multispecies model testing	Georges Bank	2013-present	Ongoing	Simulate multispecies biomass and catch data to test production and delay difference model estimation performance	no	in prep
14	13	ICES WGMG	MSE and retrospective bias	various	2008	complete	examined a number of issues related to retrospective patterns through MSE	yes	ICES WGMG 2008 report
15	14	Legault	Splitting surveys to "fix" retros	Simulation	NSAW 11 (2011)	presented	Evaluate ability of splitting surveys to address retrospective patterns caused by changes in q, M, and catch	yes	NSAW 11 abstract and presentation
16	15	McBride, Miller, et al.	Otolith Sample Size Working Group	NMFS	2015+	just starting	Identified as a national action item from the 2013 Assessment Data Reviews; potentially an MSE (tbd at our impending first meeting)		
17									
18									

Towards Ecosystem Level Assessment, MSE

Theme 3: Tool Development

- Diverse operating models (see modeling presentation)
- Multispecies assessment model performance testing and multi-model inference (see poster)

Theme 3: Analyses

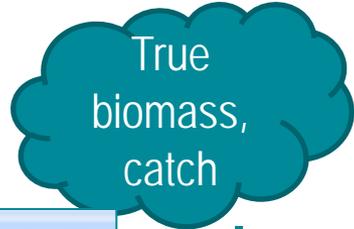
- Evaluating multispecies management procedures
- Identifying ecosystem thresholds
- Evaluating climate change impacts
- MSE for Integrated Ecosystem Assessment

Multispecies Assessment Model Performance Testing

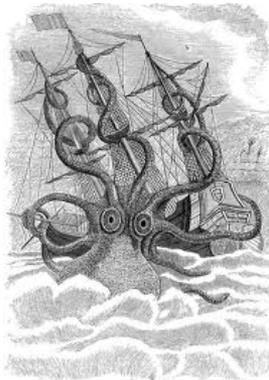


Hydra: ADMB Size structured, 10 species, 3 fleet operating model

"Survey" biomass, catch



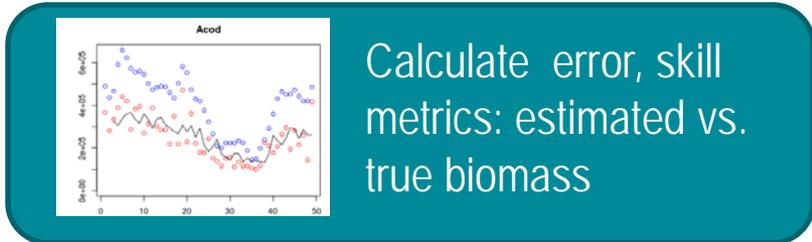
Kraken: C++ Production model, Genetic Algorithm estimation

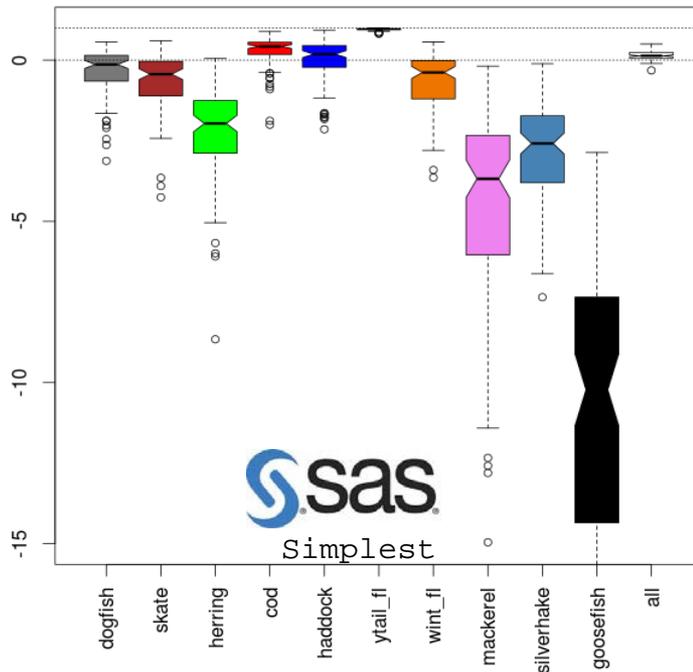
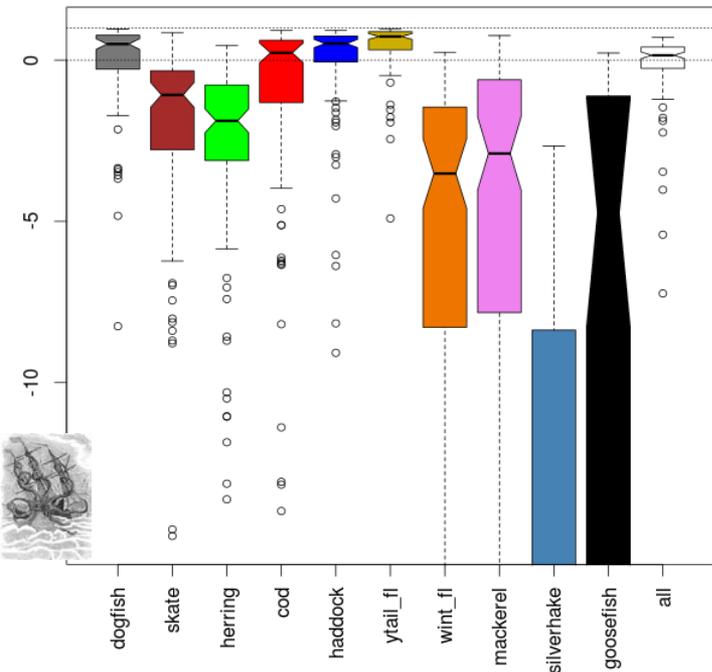


SAS LV: Production model, FIML estimation



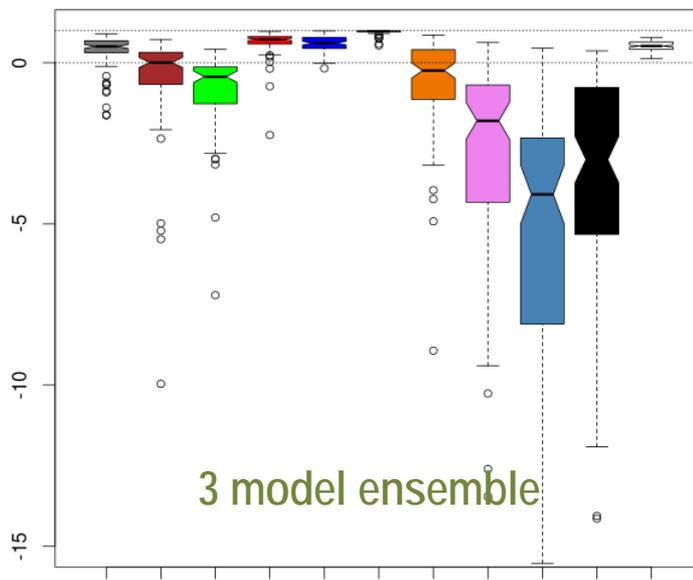
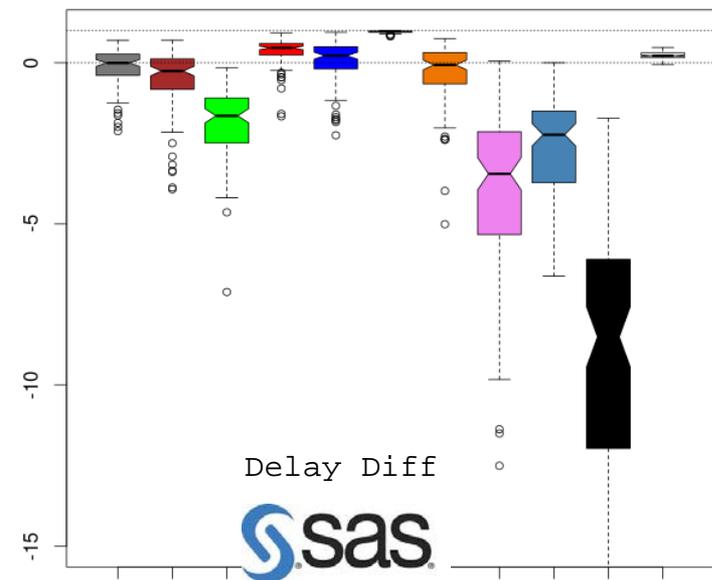
SAS DD: Delay-difference model, FIML estimation





Survey bias +
obs. error
scenario

Best Modeling
Efficiency
performance:
 $0 < \text{MEF} \leq 1$



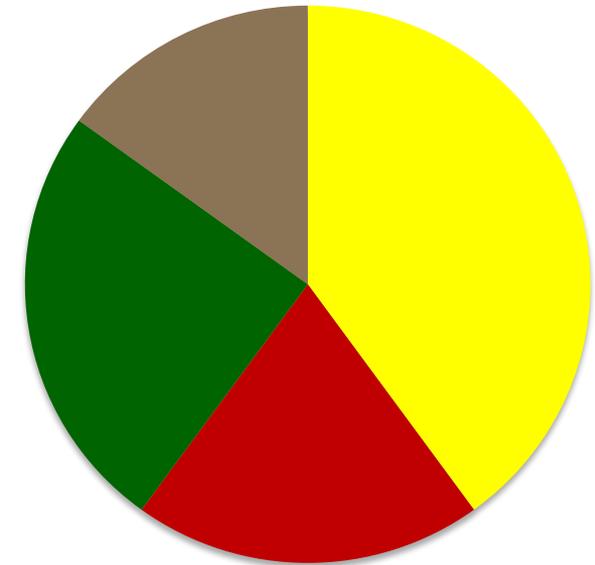
Evaluating multispecies management procedures

Four component management procedure:

1. a limit on total removals for the ecosystem;
2. an allocation of the total removals limit to aggregate species groups;
3. minimum stock size thresholds for individual species; and
4. guidance for optimizing the species mix (within aggregates) based on bio-economic portfolio analysis.

- Manage fewer catch limits—simple, flexible
- Integrated assessment of species status

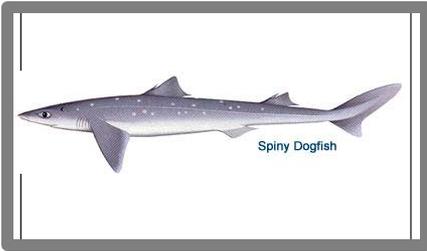
Total catch limit



■ flatfish ■ groundfish

■ forage fish ■ elasmobranchs

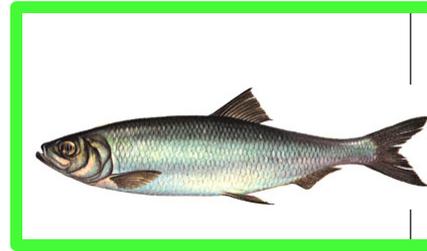
dogfish



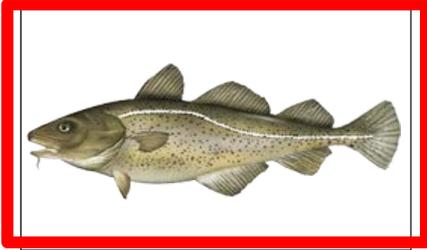
skate



herring



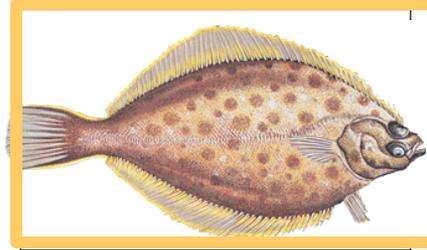
cod



haddock



ytail_fl



wint_fl



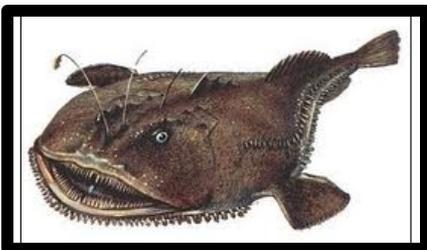
mackerel



silverhake



goosefish



Example Species Yield Curves

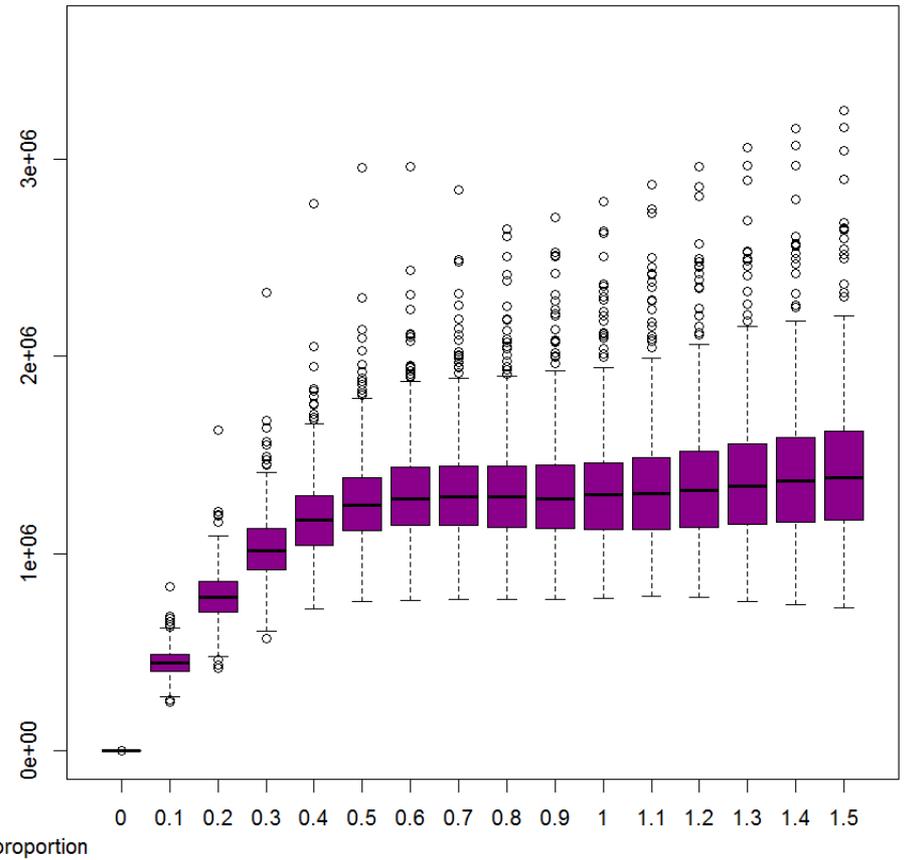
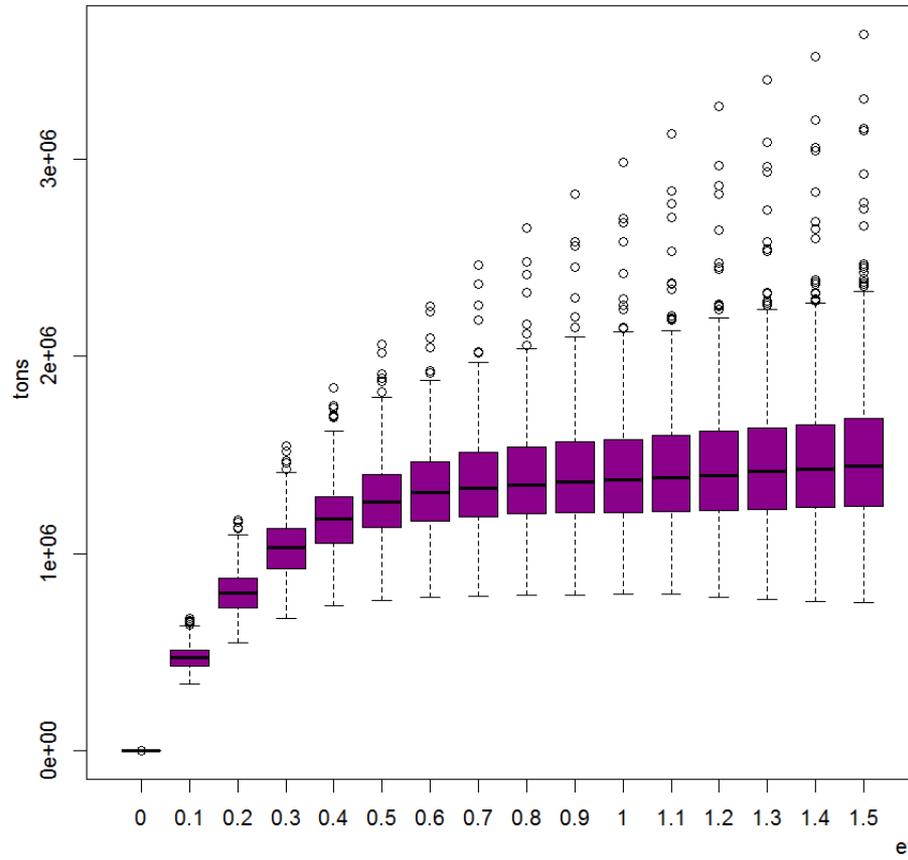
Distribution of catches over 500 iterations

Yield curve, all species combined, all gears

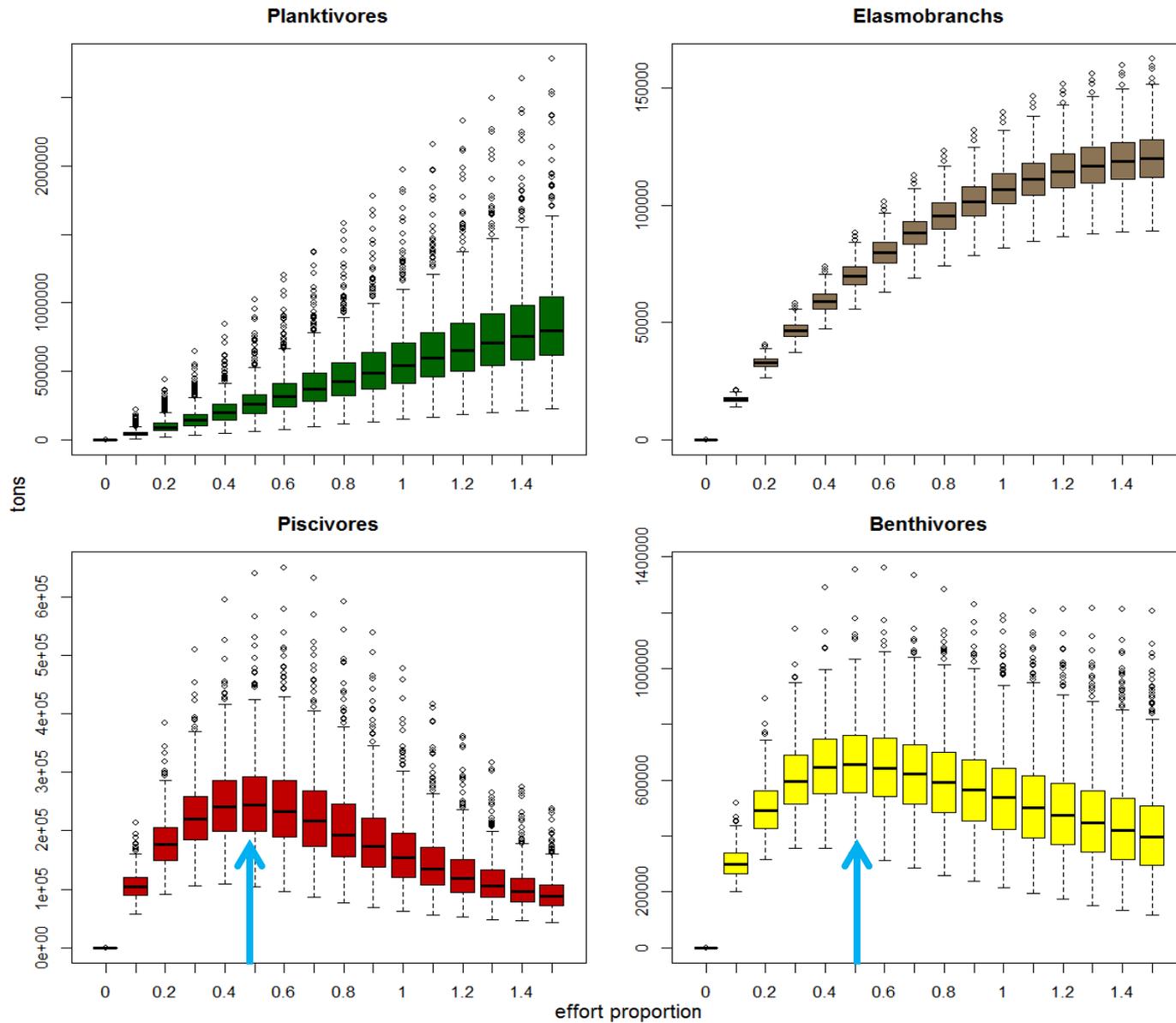
Year 20

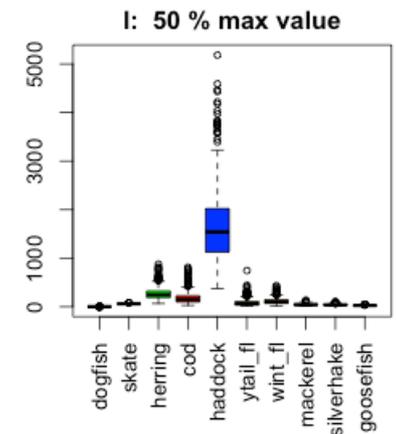
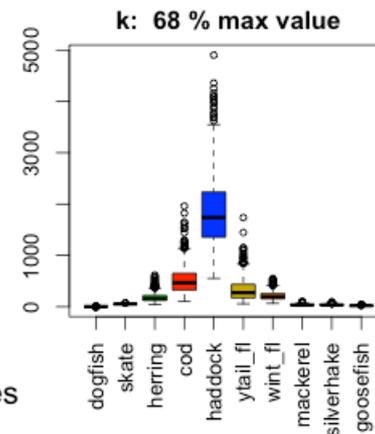
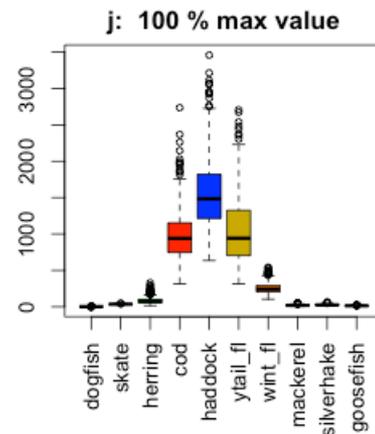
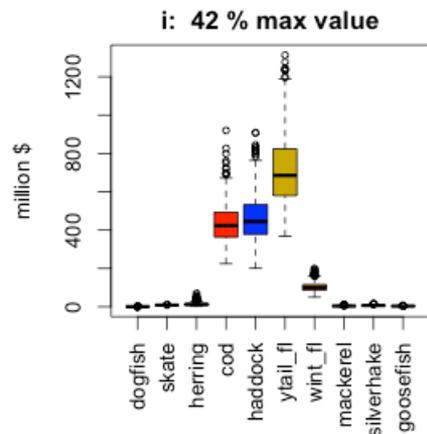
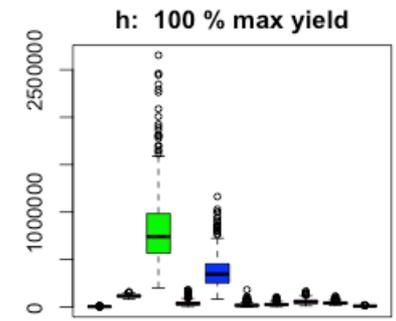
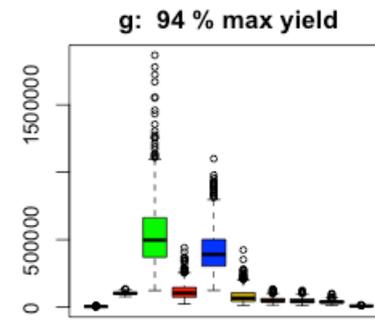
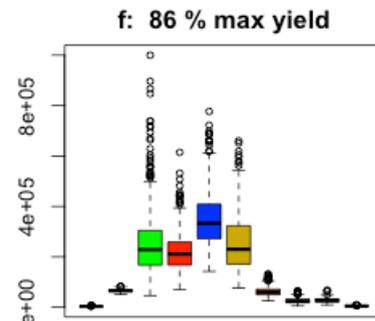
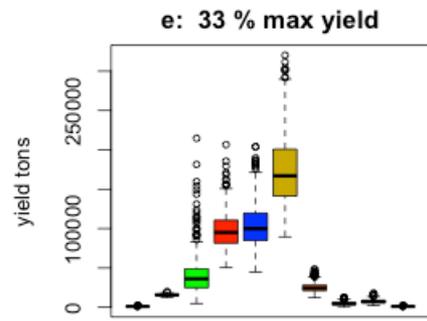
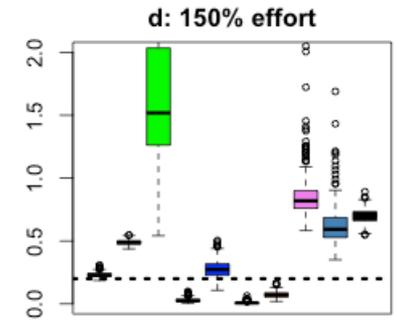
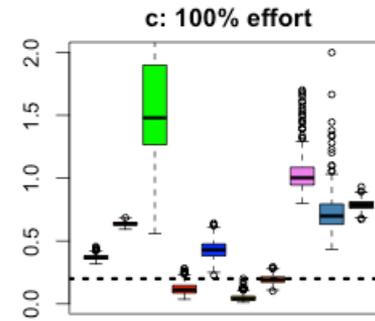
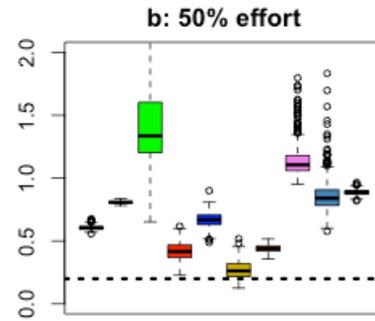
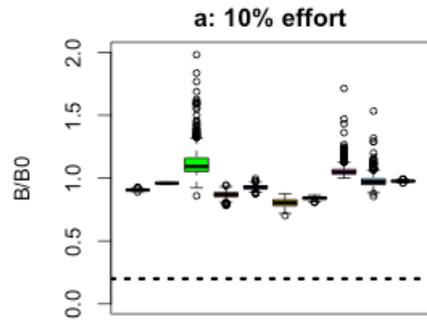
Years 20 and 50 total yield, all gears

Year 50



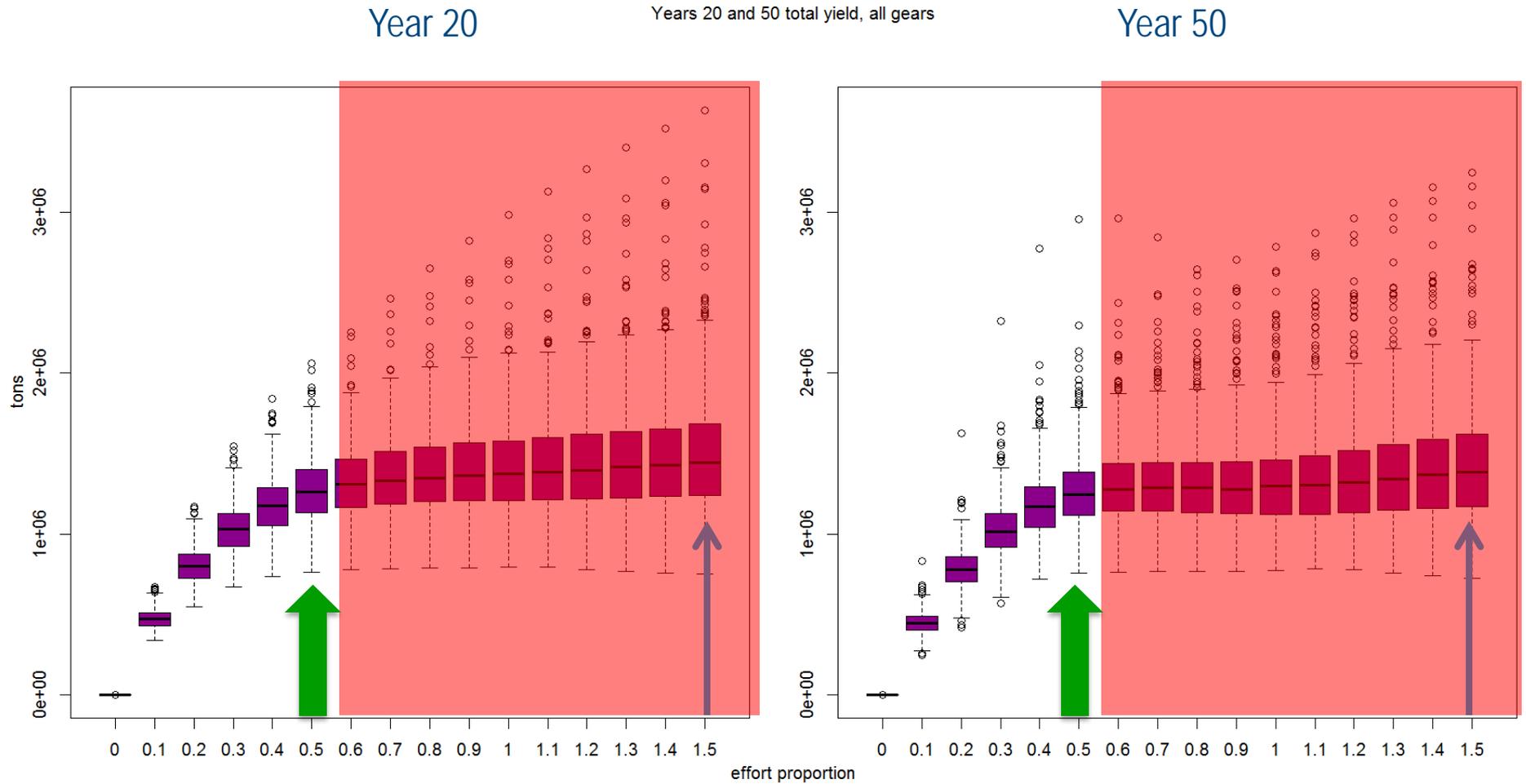
Year 20 aggregate yield, all gears Other food on





species

Yield curve, all species combined, all gears

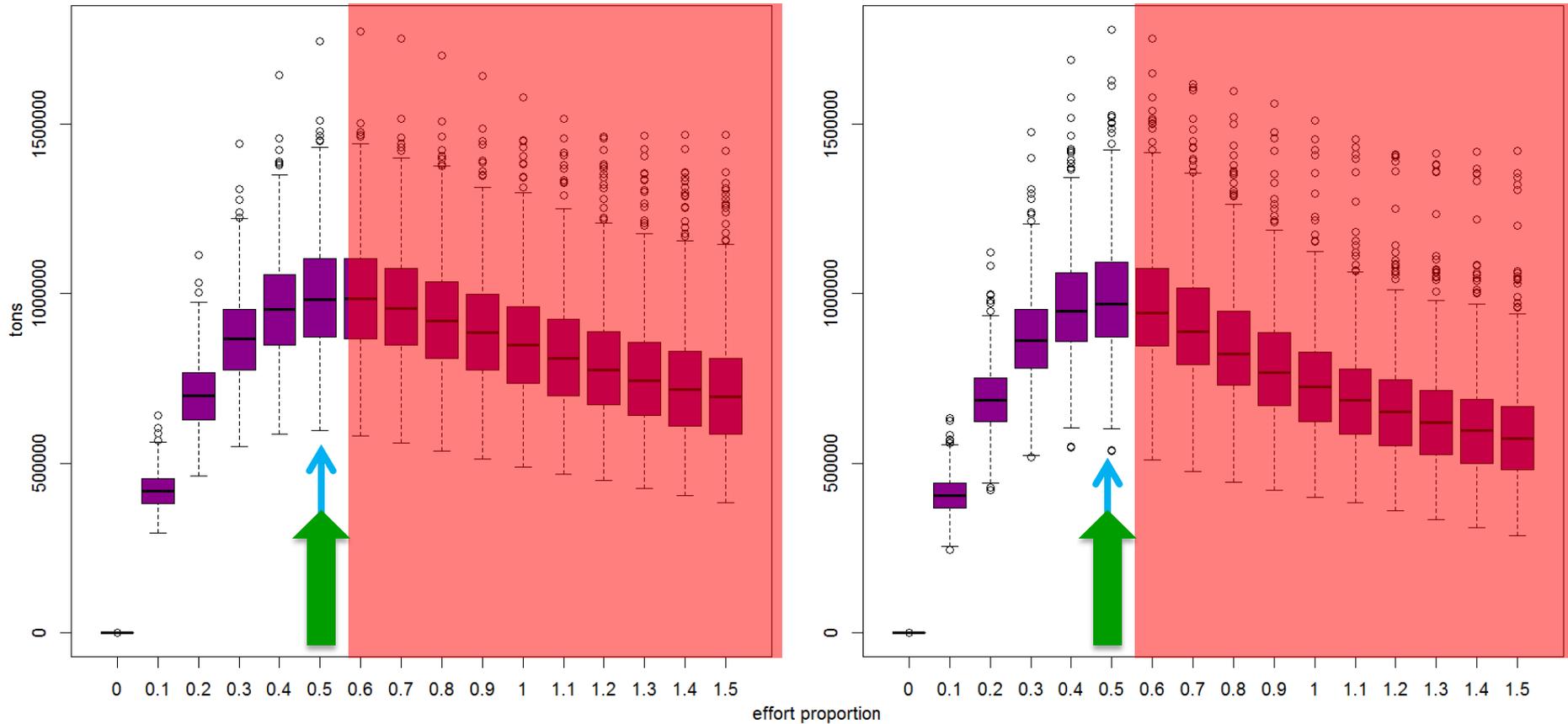


Yield curve, all species combined, bottom trawl only

Year 20

Years 20 and 50 total yield, bottom trawl

Year 50

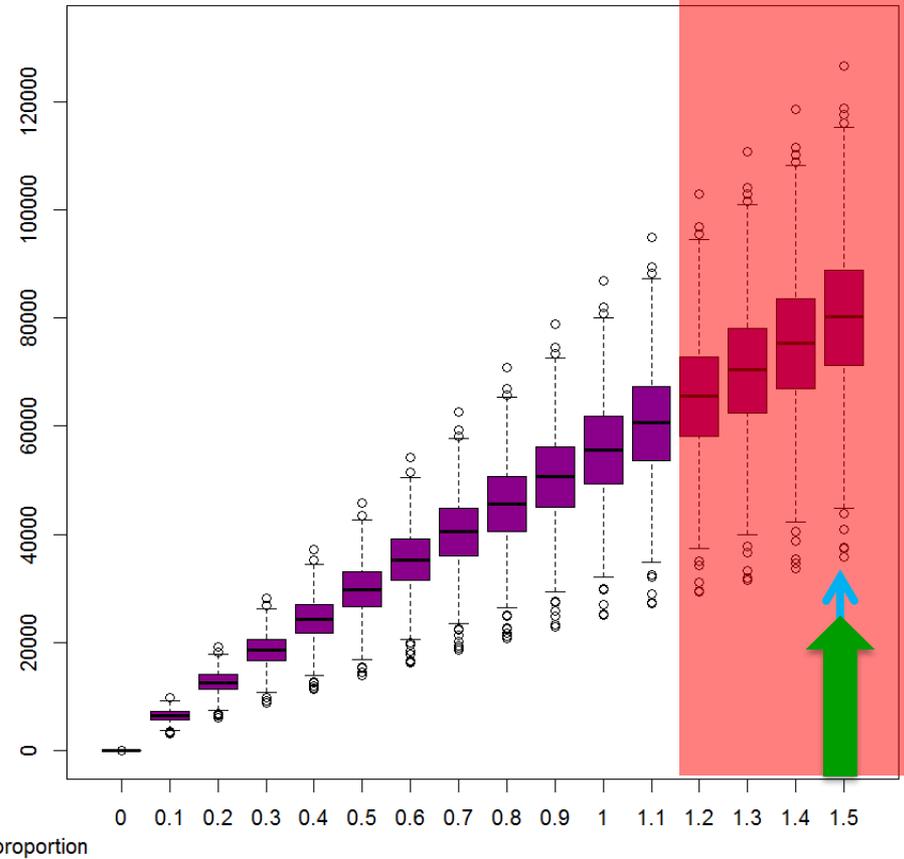
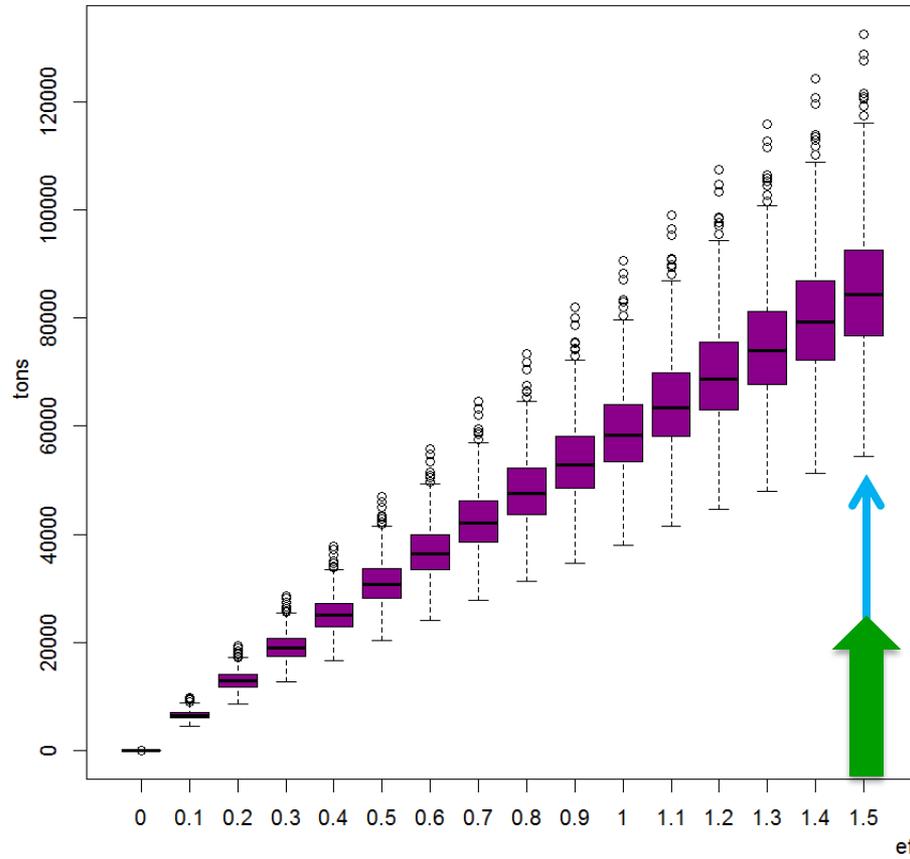


Yield curve, all species combined, fixed gear only

Year 20

Years 20 and 50 total yield, fixed gear

Year 50

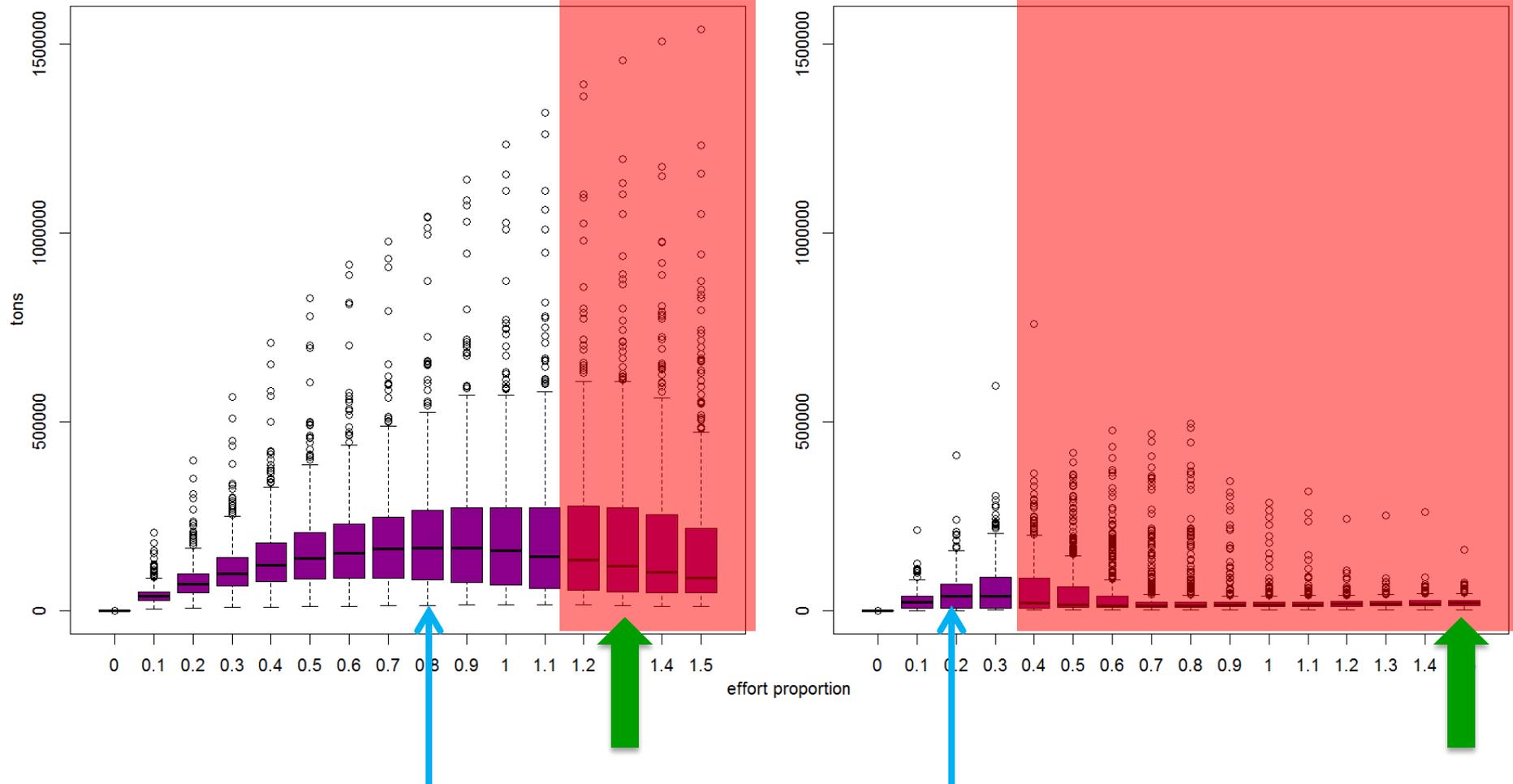


Yield curve, all species combined, pelagic trawl gear only

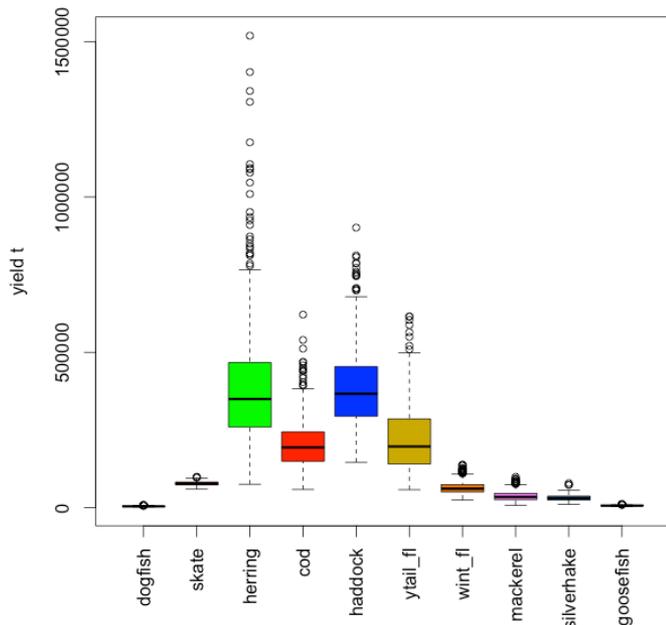
Year 20

Years 20 and 50 total yield, pelagic trawl

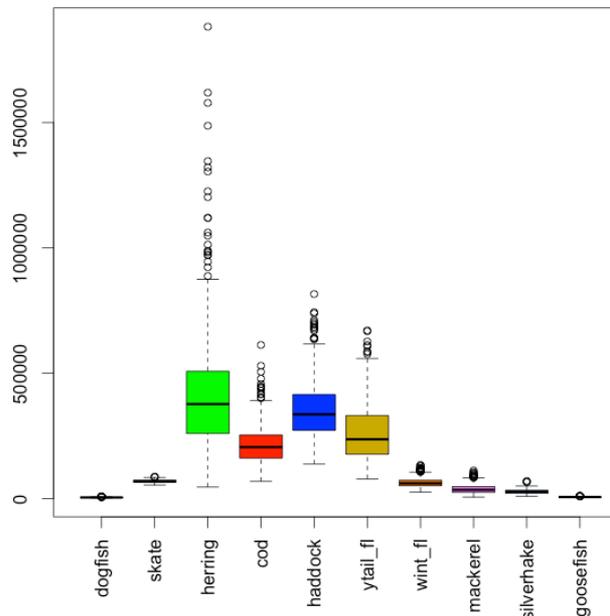
Year 50



60% bt, 80% pt, 150% fg effort: 96 % max yield

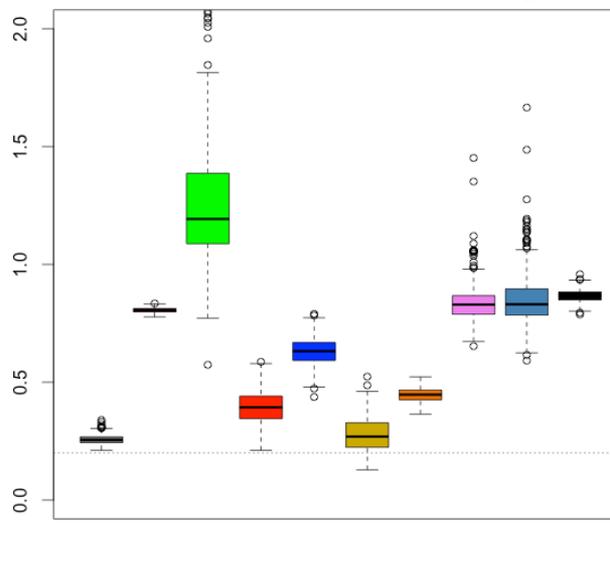
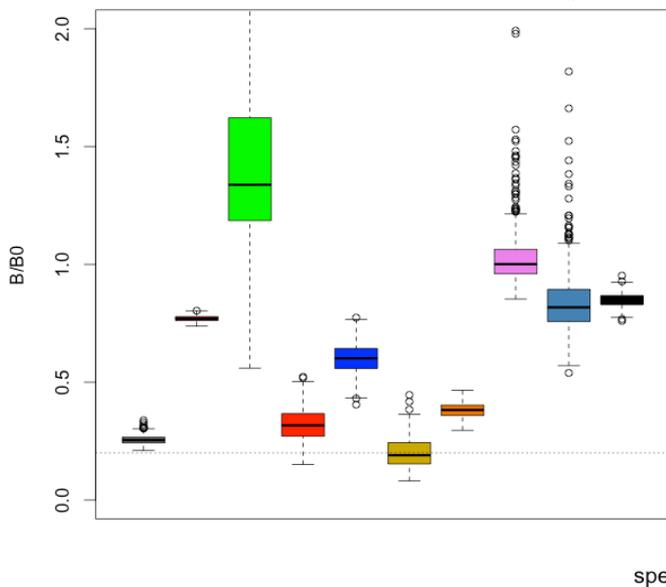


50% bt, 100% pt, 150% fg effort: 98 % max yield



Can an improved mix of gears → higher yields?

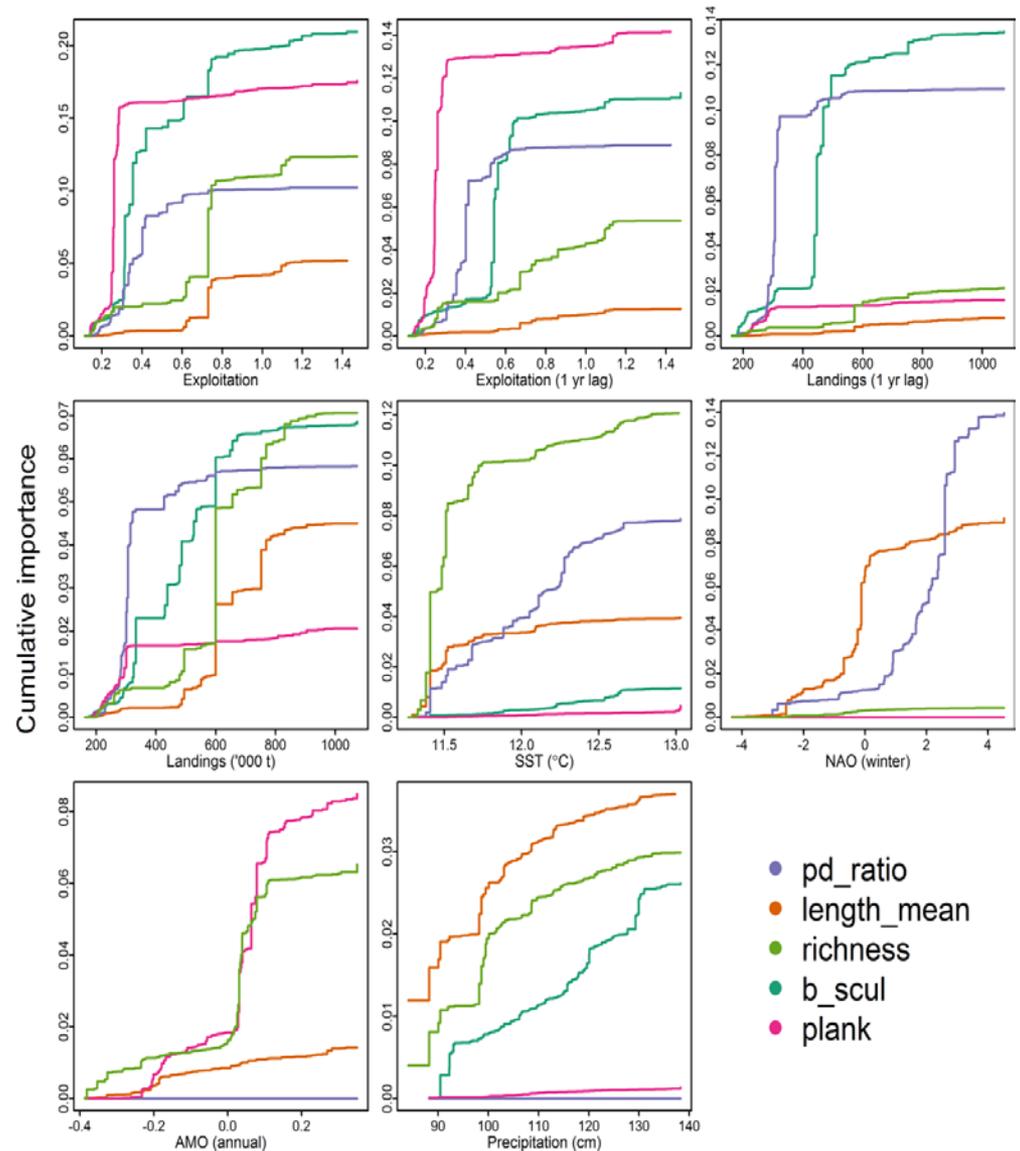
+ ~12%



Gaichas et al in review, ICES JMS

Identifying ecosystem indicators and thresholds

- Full system responses to climate and fishing
- Energy flow indicators most sensitive to fishing
- Diversity most sensitive to SST and precipitation



RESEARCH ARTICLE

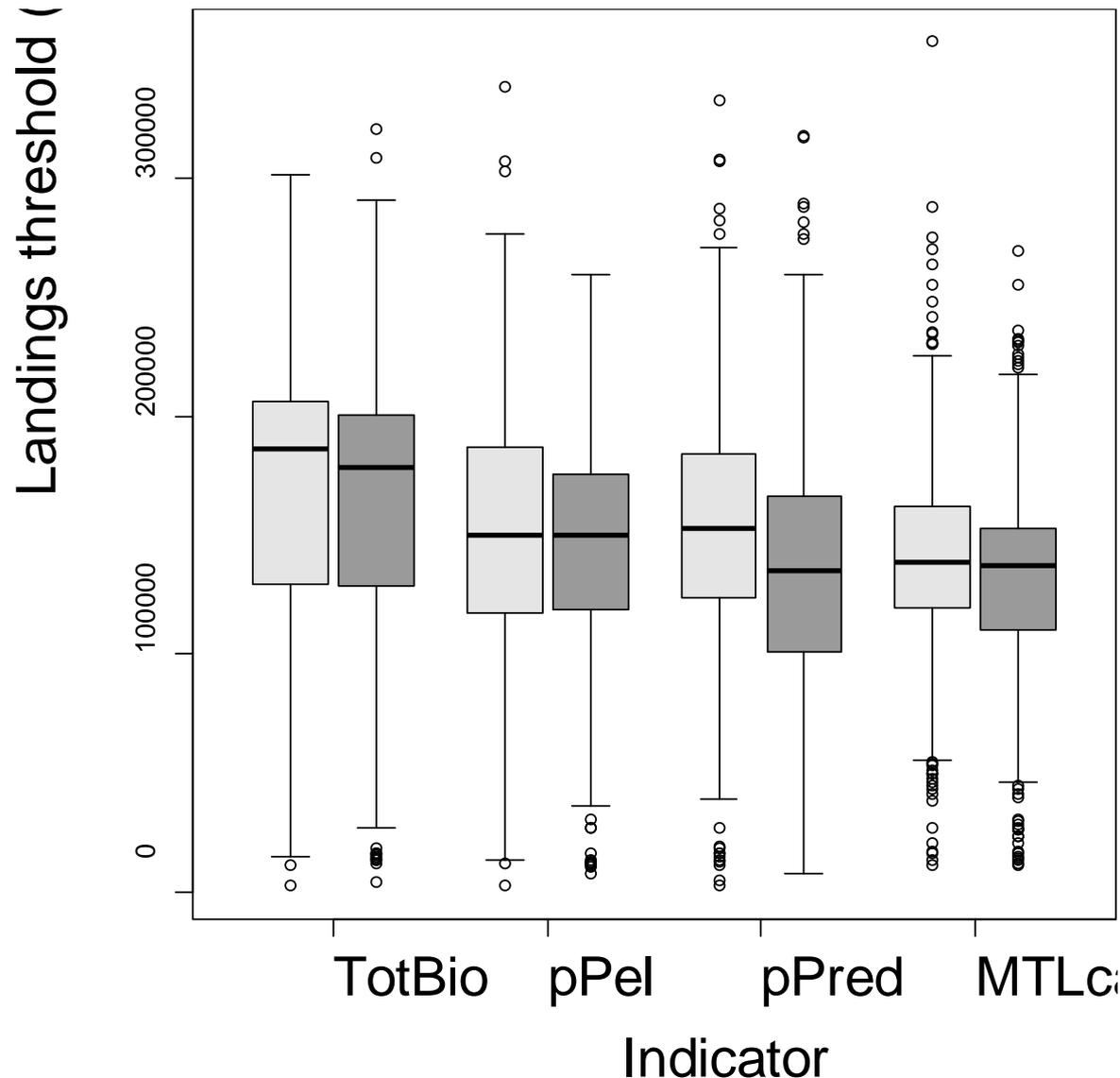
Quantifying Patterns of Change in Marine Ecosystem Response to Multiple Pressures

Scott I. Large^{1#a*}, Gavin Fay^{1#b}, Kevin D. Friedland², Jason S. Link¹

PLOS ONE | DOI:10.1371/journal.pone.0119922 March 17, 2015



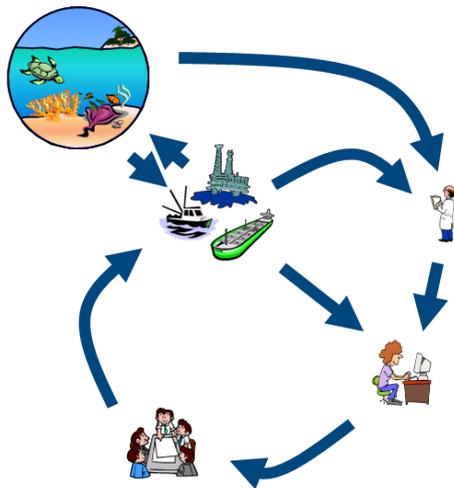
Sensitivity of thresholds to climate impact



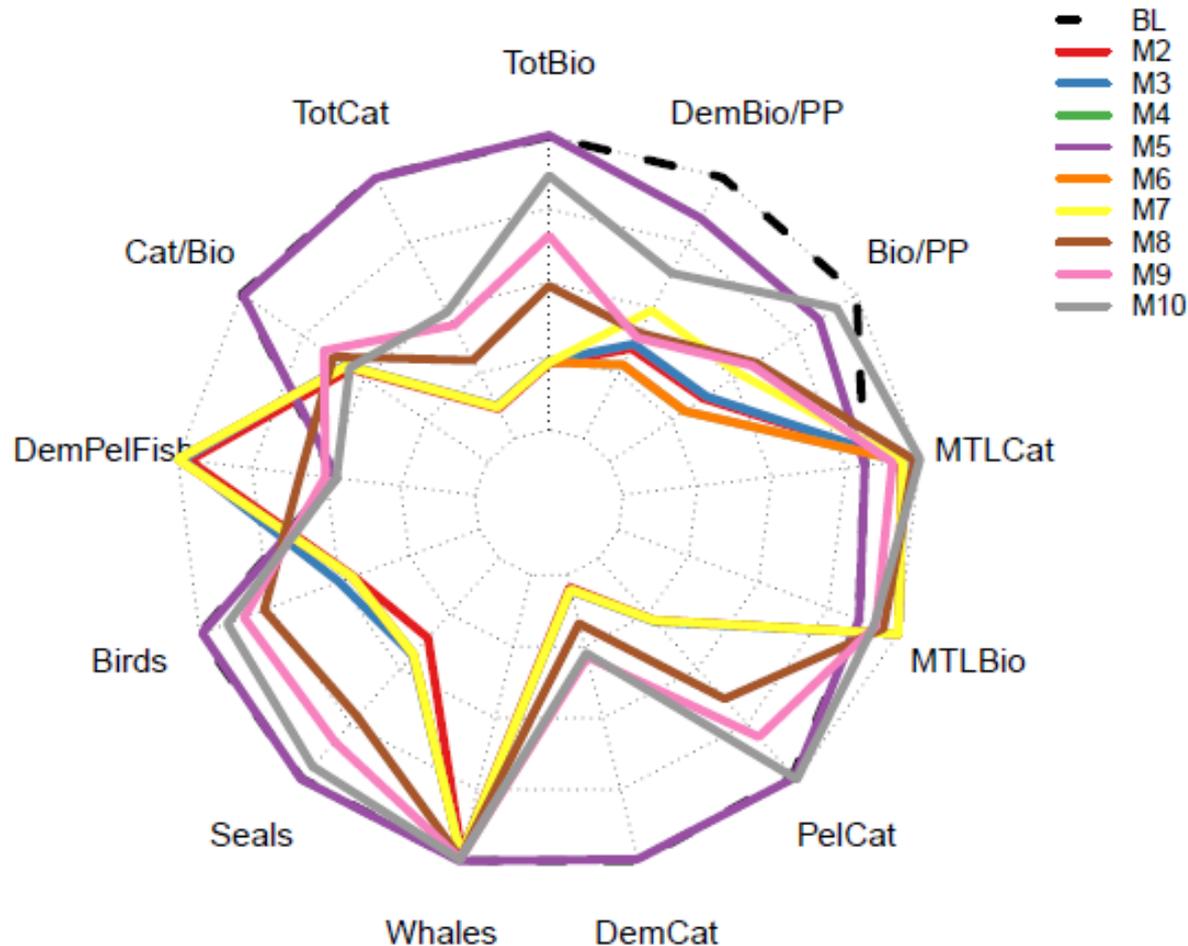
- Reduction in groundfish growth rate.
- Thresholds of response to fishing can be dependent on other system drivers.

Slide courtesy Gavin Fay

Full system climate impacts MSE

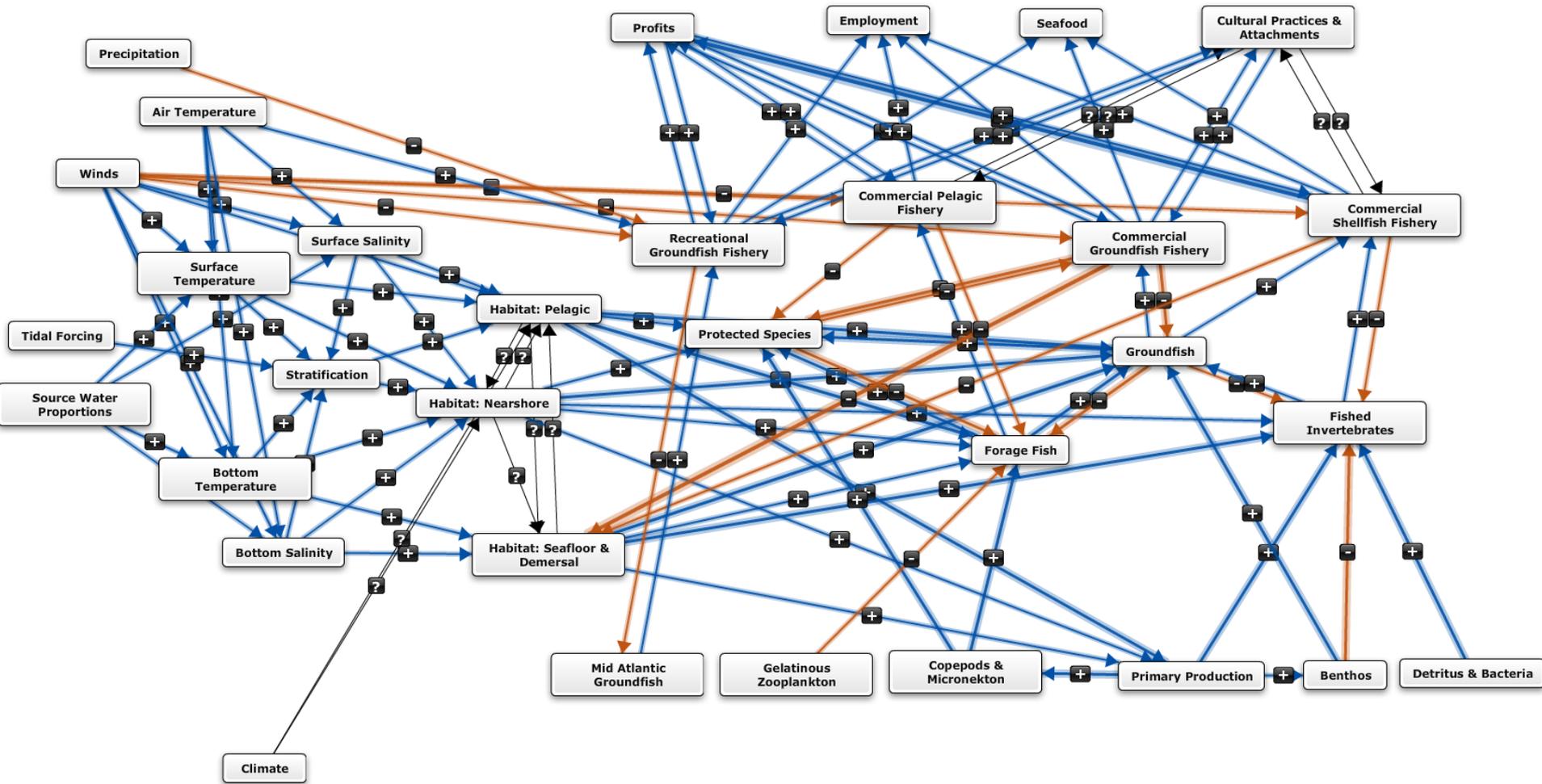


Performance measures



Fay, G., J.S. Link, and J.A. Hare. In Review. Assessing the effects of ocean acidification in the Northeast US using an end-to-end marine ecosystem model. Marine Ecology Progress Series.

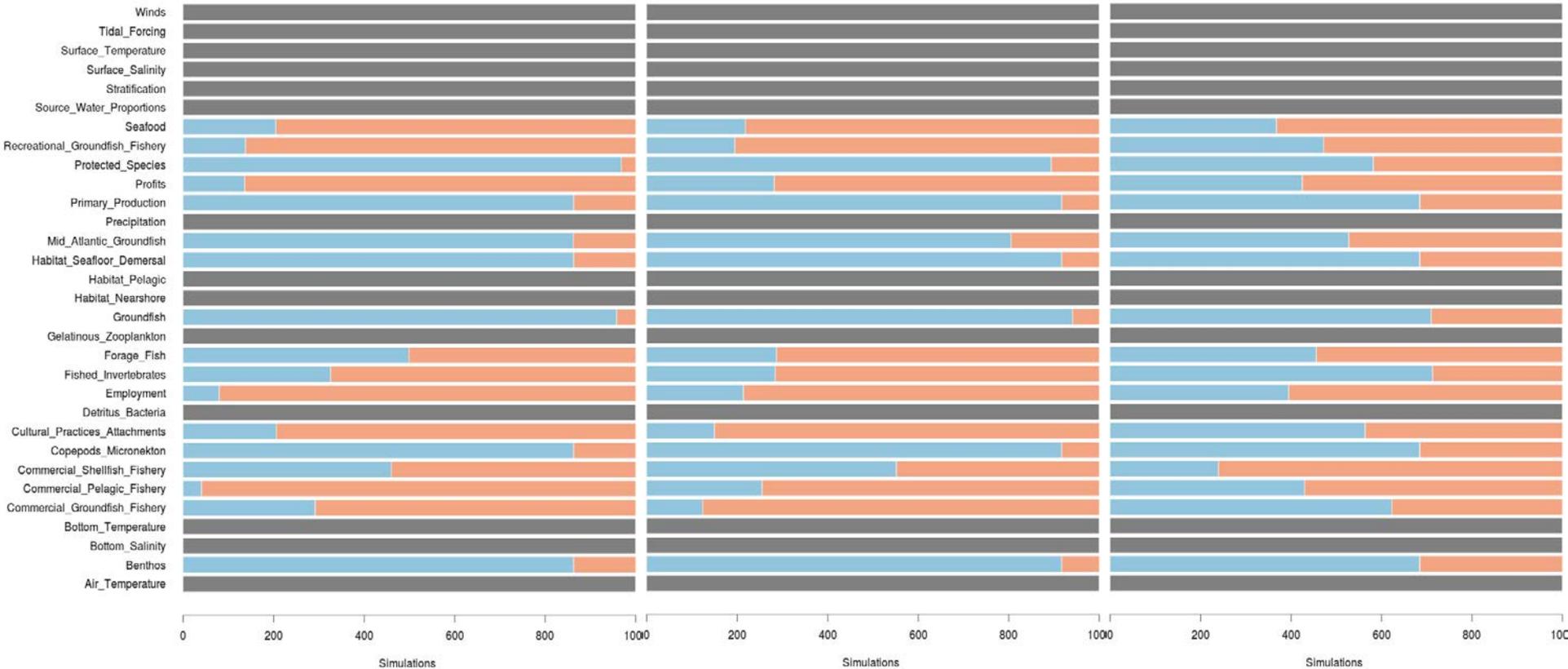
Integrated Ecosystem Assessment and MSE



Ecosystem tradeoffs: increasing individual fleets

Negative change

Positive change



Theme 4: New England Atlantic Herring MSE

- Develop herring ABC control rules that consider herring's role as forage within the ecosystem

<http://www.nefmc.org/calendar/may-16-17-2016-herring-workshop>

- First in US(?) to employ full stakeholder process to establish objectives prior to analysis
- Stakeholder process with Council in progress
- *Brief overview of workshop outcomes from report*

Theme 5: MSE Review and Communication

- Peer reviewed papers
- Outreach to Councils and Commission through Northeast Regional Coordination Council
- Incorporating MSE into Council initiatives
 - New England Herring management, EBFM
 - Mid Atlantic EAFM Policy Document
- Communication via MSE stakeholder process

Successes and Challenges

- World class analytical talent at NEFSC
- Multiple potential operating models available
- Interdisciplinary NEFSC MSE working group
- Stakeholders, Councils enthusiastic to use MSE
- Stakeholder processes for MSE in development
- MSE requires large resource and time investment
- NEFSC is resource limited (already over capacity)
- Tradeoffs between MSE and current analyses

Questions?