Predicting the consequences of climate-driven temperature shifts on the US summer flounder fishery

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4/21/14

IIFET 2014
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Summer flounder – the fishery

Also called fluke, most valuable commercially-fished flatfish species in eastern US

Top ten recreational fishery (by weight) in US

Stock considered rebuilt as of 2011

This project

Part of larger, multi-disciplinary effort to examine how climate change is affecting the summer flounder fishery

Primary goals

- Better understand stock structure (e.g., is it a single stock)
- Predict how stock age structure, latitudinal distribution, and inshore-offshore movement will change as oceans warm
- Predict changes to spatial pattern of commercial harvests
- Predict changes to recreational fishing mortality

This talk

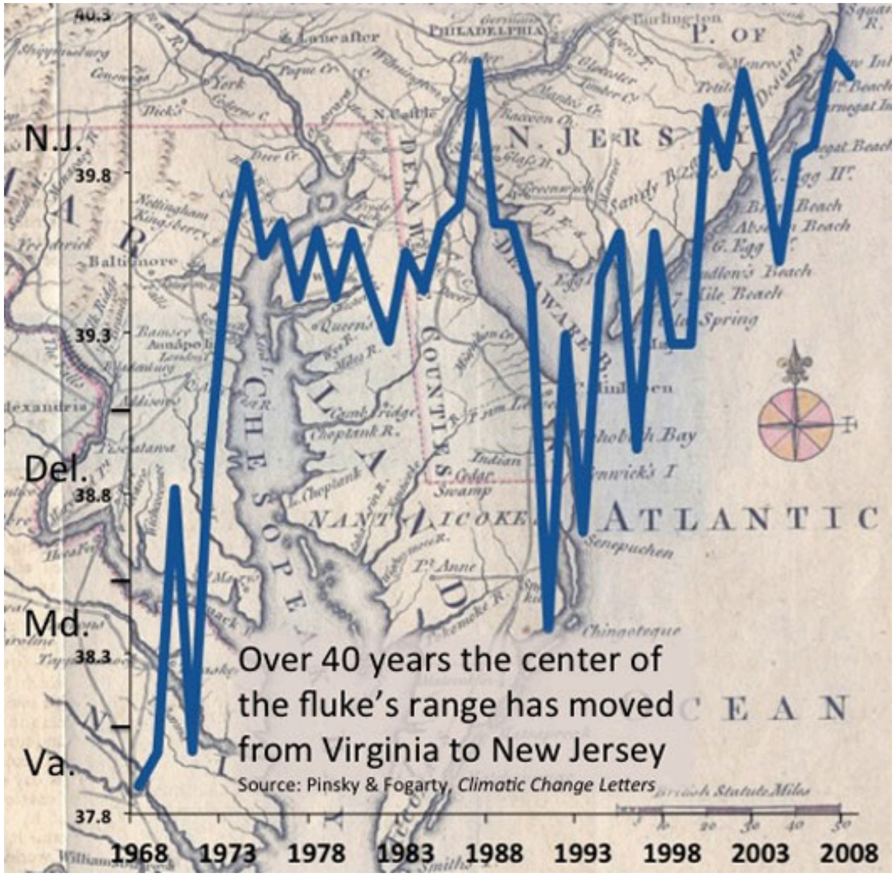
- Focus on approach to predicting recreational harvests
- Waiting on data, some confounding factors that must be addressed by other investigators
- Present results of some exploratory analysis

Climate change and summer flounder

Mid-Atlantic waters have experienced warming at about 2x global average for last ~40 years

Concurrent poleward shift in center of biomass (COB)

Meeting recreational targets has been challenging



Summer flounder – management

Managed jointly by NOAA, the Atlantic States Marine Fisheries Commission (ASMFC), the Mid-Atlantic Fisheries Management Council (MAFMC), and states

Managed as a single stock from North Carolina to Maine

Commercial fishery (60% of quota)

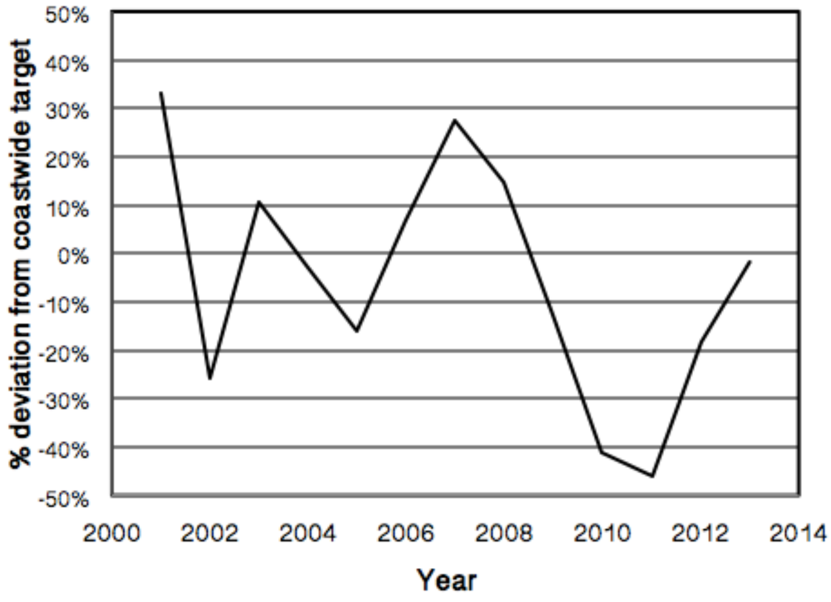
- State-by-state allocations based on 1980-1989 averages
- Common rules on min size, gear; states have some autonomy to manage fleets
- Relatively successful in meeting prescribed quotas

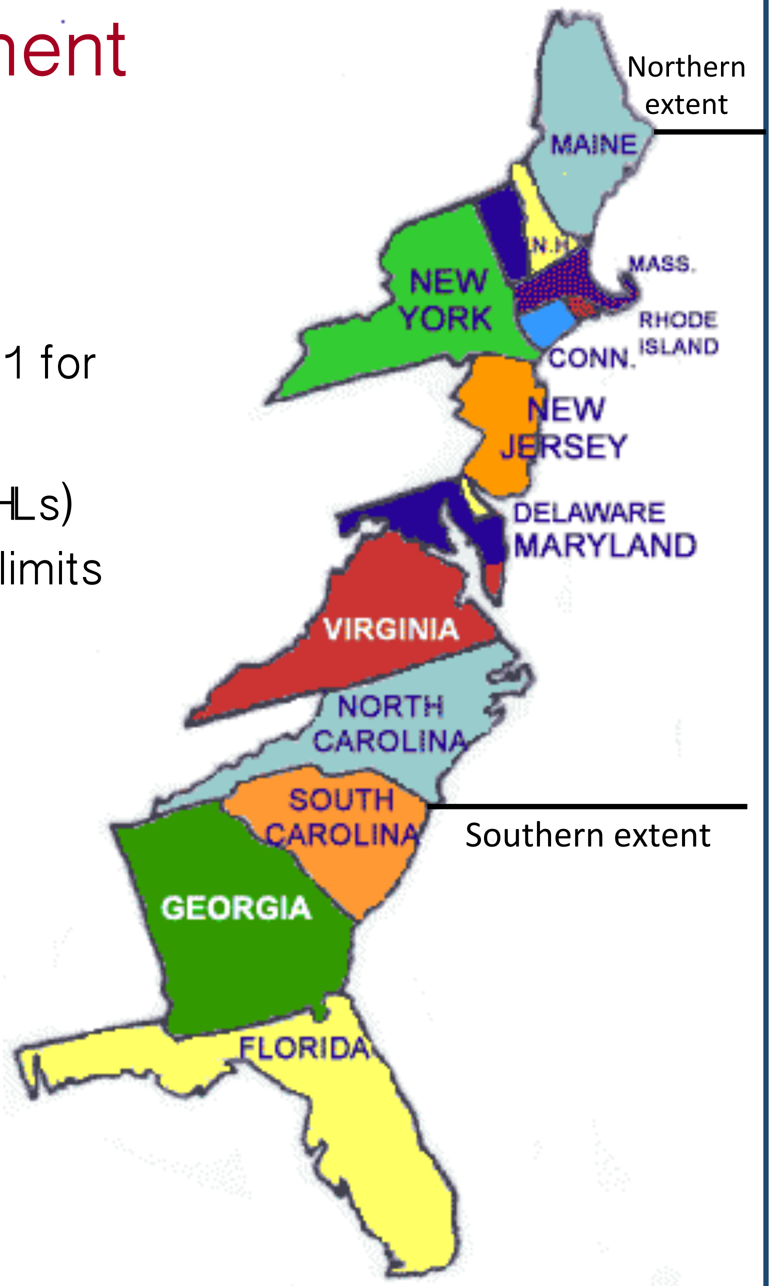
Summer flounder – management

Recreational fishery (40% of quota)

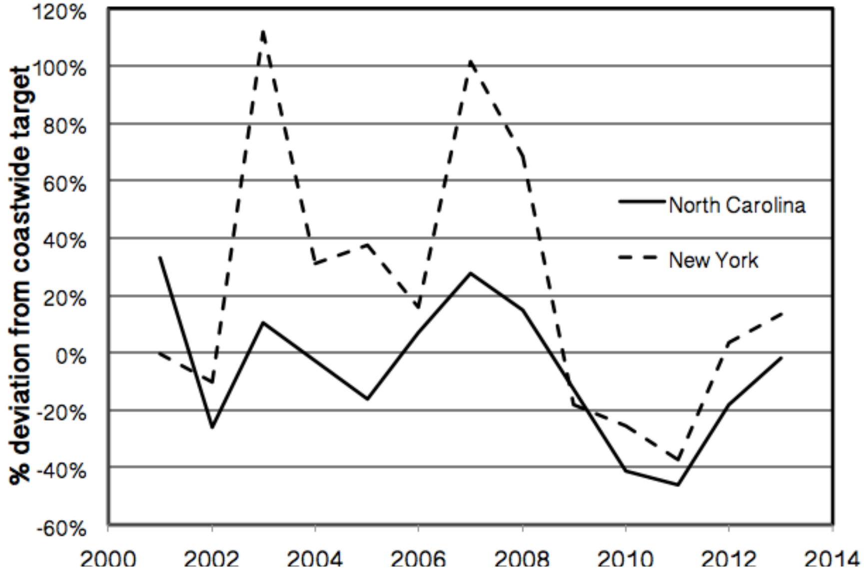
- Minimum size limits, bag limits, seasons
- Uniform coastwide regs abandoned in 2001 for "conservation equivalency"
- States given recreational harvest limits (RHLs) based on 1998; set size, bag, and season limits

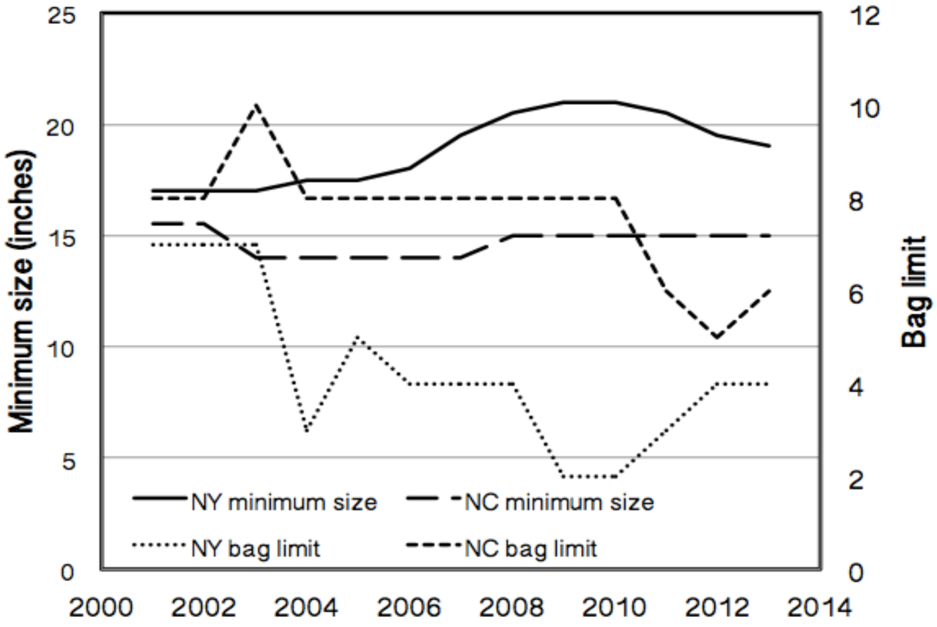
Meeting targets has been challenging

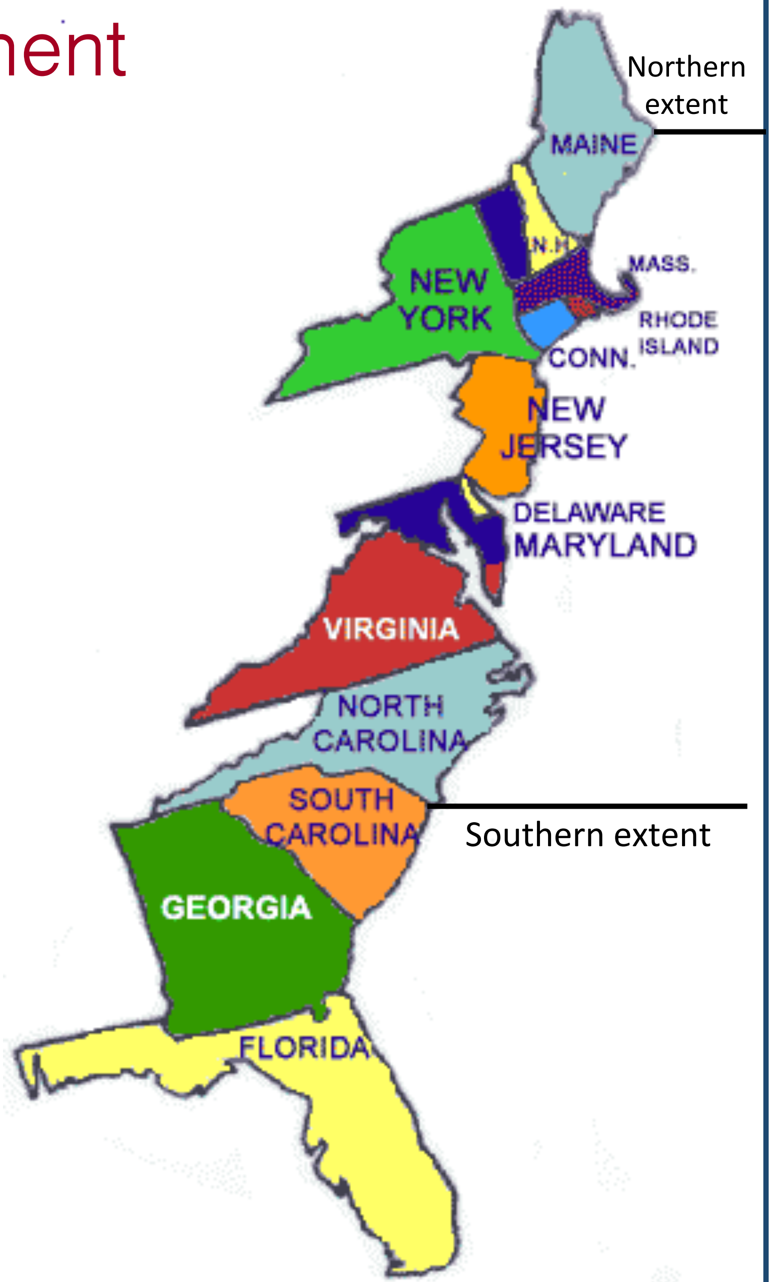




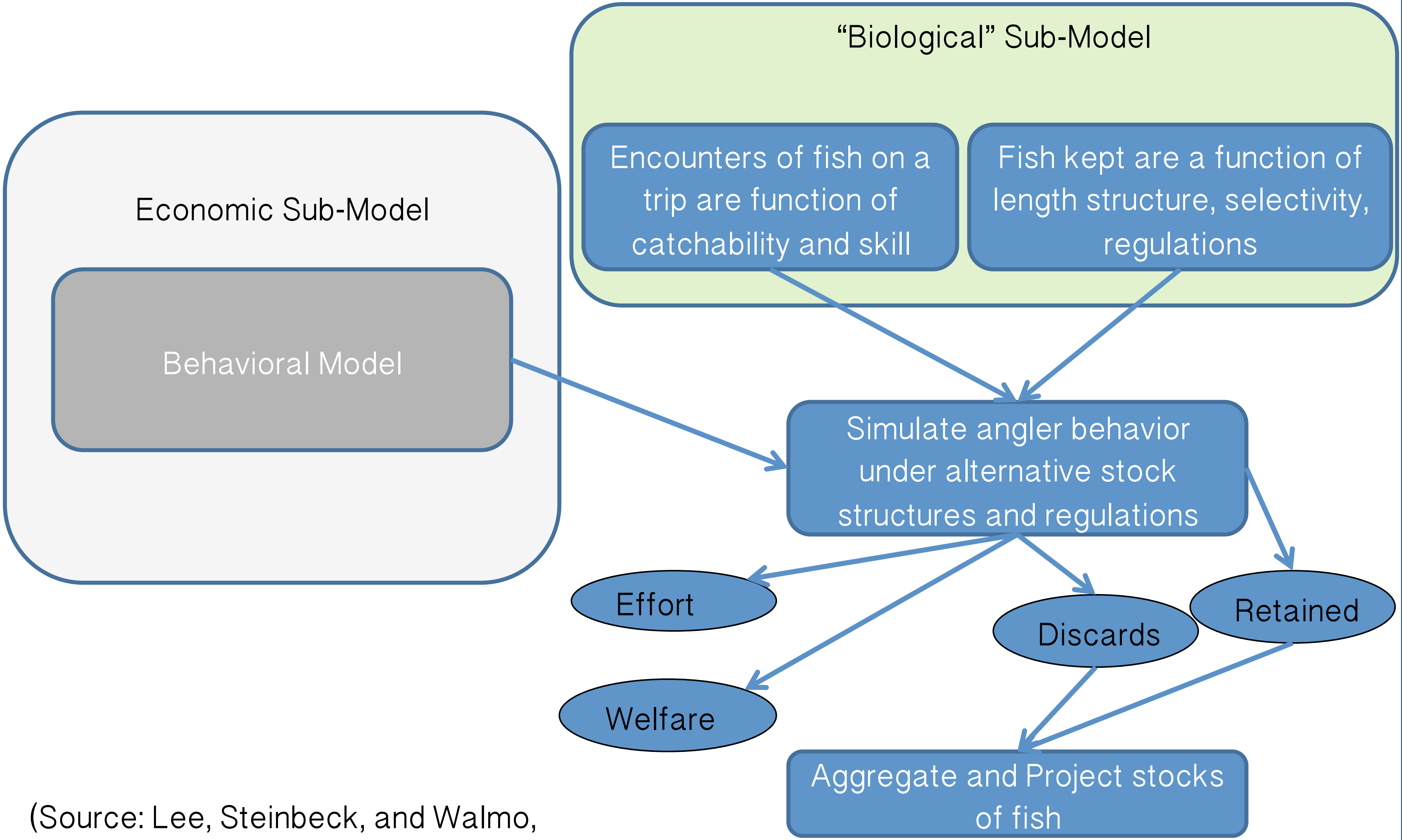
Summer flounder – management







Summer flounder – management



(Source: Lee, Steinbeck, and Walmo, 2013)

Our approach – recreational fishery

Current approach (based on RUM of choice to participate) is a poor predictor of both participation rates and recreational fishing mortality

Relies on strong assumptions

- Anglers aware of wave-by-wave age structure
- Anglers able to predict probability of an encounter given age structure, running harvest totals, and regulations
- All anglers are the same (by mode of fishing)
- Many other issues related to biological assumptions

Our approach – simplify participation decision

- Conduct focus groups with anglers
- Develop set of proxy variables
- Consider regulatory interactions

Our approach – recreational fishery

Two focus areas for model of participation choice

Are participation decisions based on weighing information in a rational manner, or instead on simple heuristics?

- Regulations as proxies for stock health?
- Role of regulations on more commonly-caught, less valued species (scup)
- Broad weather/climate variables
- Price of fuel

How do decision patterns vary with mode of fishing?

- Sophistication of decisions may vary with mode of fishing
- Shore anglers > private boat > party boat ~ charter boat

Goal is to build simplified – perhaps reduced form – model of decision process, with potential for NEUtest using MRIP / commercial vessel records

Our approach – recreational fishery

Second component – predicting recreational mortality

Current NMFS model assumes common encounter rate / age structure facing anglers

- Angler experience matters, but perhaps in non-intuitive manner
- Encounter rates based on biomass / age structure, may vary from inshore to shelf and offshore

Important because of anticipated impacts of climate on spatial distribution of stock within jurisdictions

Example – New Jersey

- 40% of coastwide rec target
- Significant shore and boat fishing, latter growing more rapidly in recent years (Gentner et al., 2010)
- How does this interact with spatial stock structure?

Shore

-> Area = 1

Source	SS	df	MS
Model	10.9140827	3	3.63802758
Residual	3.91897679	20	.19594884
Total	14.8330595	23	.644915632

Number of obs	=	24
F(3, 20)	=	18.57
Prob > F	=	0.0000
R-squared	=	0.7358
Adj R-squared	=	0.6962
Root MSE	=	.44266

ab1b2cpue	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Year	.0972836	.0133957	7.26	0.000	.0693407	.1252265
DirectedTrips	-1.61e-07	1.02e-06	-0.16	0.876	-2.30e-06	1.97e-06
btemp	-.1398573	.0770614	-1.81	0.085	-.3006047	.02089
_cons	-194.8931	26.92851	-7.24	0.000	-251.065	-138.7212

Shelf

-> Area = 3

Source	SS	df	MS
Model	24.3559251	3	8.11864171
Residual	59.9448154	20	2.99724077
Total	84.3007405	23	3.66524959

Number of obs	=	24
F(3, 20)	=	2.71
Prob > F	=	0.0725
R-squared	=	0.2889
Adj R-squared	=	0.1823
Root MSE	=	1.7313

ab1b2cpue	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Year	.0784375	.0650156	1.21	0.242	-.0571826	.2140576
DirectedTrips	2.91e-07	6.78e-06	0.04	0.966	-.0000139	.0000144
btemp	.6166344	.2861826	2.15	0.044	.0196679	1.213601
_cons	-143.6584	130.0104	-1.10	0.282	-414.8554	127.5385

Future work

Commercial fishery and cost/efficiency

Role of institutions and uncertainty

- Scale and adaptive efficiency
- Rationalization, non-economic priorities, and environmental uncertainty (similar to Kroetz, 2014)

Stronger emphasis on multi-species aspect

Supplements to MRIP – Australia's RedMap and citizen science

We are grateful for support from NOAA / Sea Grant as part of the Sea Grant Mid-Atlantic Regional Research Program (funds for this project provided by New York, New Jersey, Virginia, and North Carolina). NOAA award NA14OAR4170093, and for preliminary advice from MAFMC, Mark Teciero, Min-Yang Lee, Scott Steinbeck, and members of our advisory panel.