

**NOAA  
FISHERIES**

Northeast  
Fisheries  
Science  
Center

# Critical Research Areas/Needs

## TOR VIII Research Opportunities

*By*

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*and Colleagues*

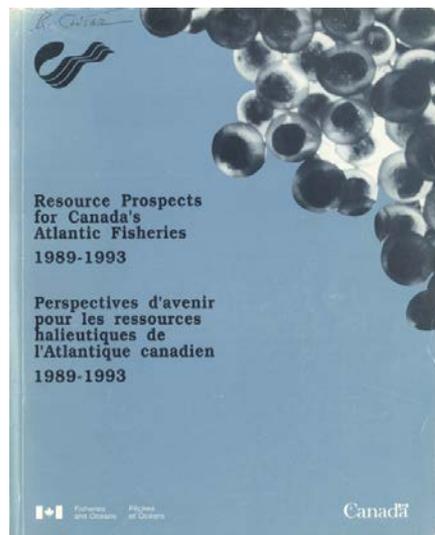
May 22, 2014



**NOAA FISHERIES**

# Term of Reference VIII Research Opportunities

Are there opportunities for improving stock assessments and the stock assessment process?



Commenting on the failure of the ICNAF quotas

“The catch statistics reported were often incomplete (particularly with respect to incidental catch and discards), the adherence to the TACs was poor, the collection of biological data was inadequate, and the scientific advice was based on the status of the stock two years earlier than the year in which the TAC was being applied, so that the population had declined further in the meantime.”

(emphasis added)

Report Published June 1988

Year	1987	1988	1989	1990	1991	1992	1993	Année
Upper limit (95%)			435	466	477	471	492	Limite supérieure (95%)
Median	256	266	331	339	354	360	358	Médiane
Lower limit (95%)			248	244	245	254	260	Limite inférieure (95%)

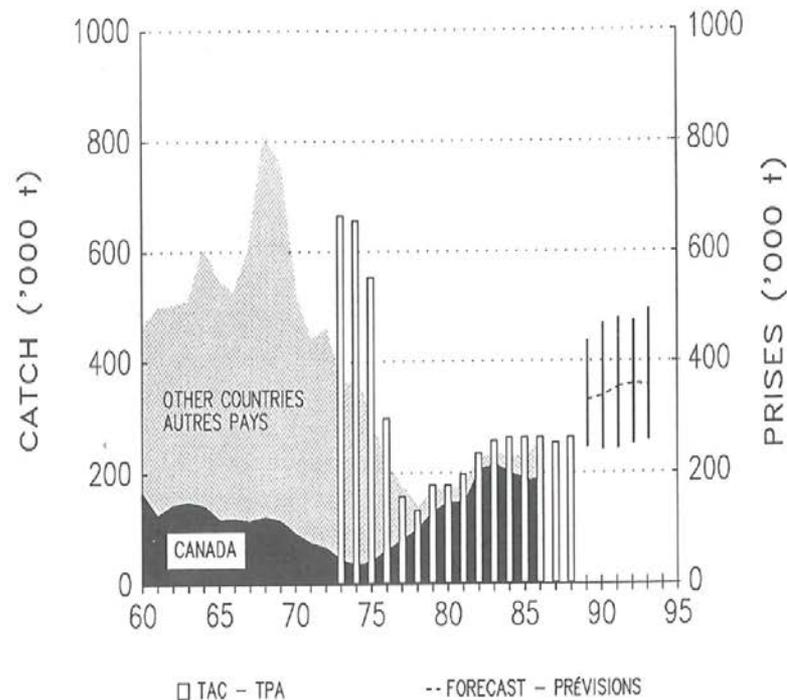


FIGURE 18. COD IN SOUTHERN LABRADOR AND NORTHERN GRAND BANK (2J-3KL) - Nominal catch for 1960-1986, TAC for 1973-1988, and projected TAC for 1989-1993.

FIGURE 18. MORUE, SUD DU LABRADOR ET NORD DES BANCS DE TERRE-NEUVE (2J-3KL) - Prises nominales de 1960 à 1986, TPA de 1973 à 1988, et projection des TPA jusqu'à 1993.

# Increasing Demand: Quantity and Resolution

# A Perspective on Modeling

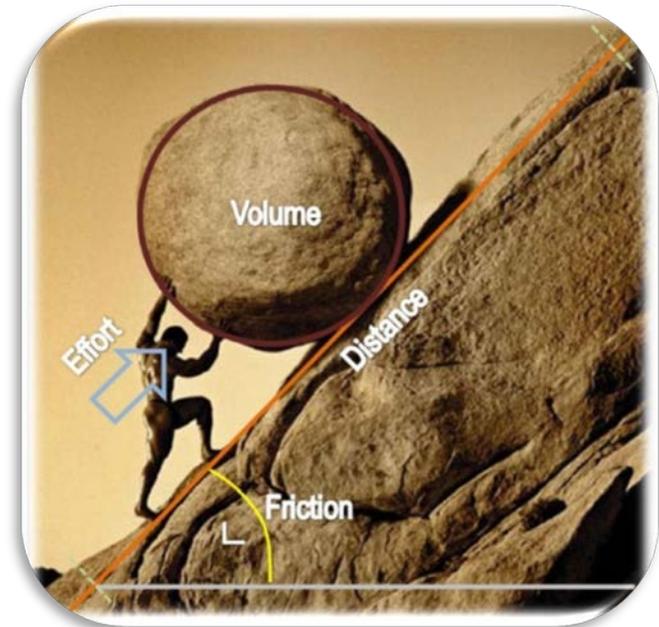
“In the end, all models fail to capture the surprises that man and nature have in store for the manager. This criticism holds equally true for complex computer schemes as for the intuitive models represented by gut feelings of the managers.”

“The failures can come from three basic directions: inadequate *detail* of representation, inadequate *breadth* of representation, and inadequate consideration of *institutional constraints* on action.”

Argue, Hilborn, Peterman, Staley and Walters. 1983. Strait of Georgia Chinook and Coho Fishery. *Can. Bull. Fish Aquat. Sci.* 211. Ottawa.

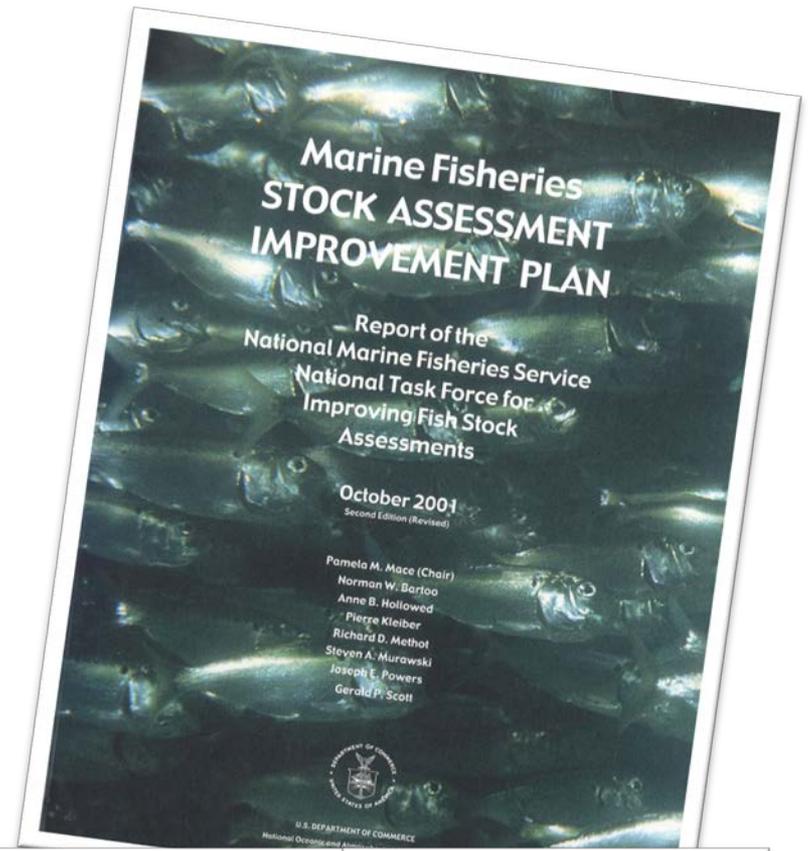
# Key Challenges for Stock Assessment Process

- Improve Detail of Representation
  - Improve Breadth of Representation
  - Reduce Institutional Constraints on Action
- 
- Doesn't this just say –Do everything?
    - Not exactly
    - Consilience



# SAIP 2001

“Because of reductions in fishing effort, the closure of large areas of productive fishing grounds, trip limits and other measures, managers want to know the incremental effect of these measures on attaining required fishing mortality and biomass targets”



# Increasing demand for survey and catch information

## Finer scale management with respect to:

- Timing of information, feedback loop for managers
- Sector management issues
- Spatial management measures (long-term and real-time)
- Preparing for the unexpected (in real time)
  - Discards due to year-class events?
  - Can we avoid discards—reduce technical interactions among fisheries?
  - Can we implement ACLs in real time for all species?
  - Changes in growth, natural mortality, maturity?

# Increasing demands for stock assessments

- Meeting the demands for stock assessments under MSA
- As  $F$  declines  $M$  becomes more important, no longer a negligible fraction. Reductions in  $F$  increase lifespan and reveal traits obscured by high exploitation.
- Rebuilding depleted stocks
  - Bioeconomics
  - Forecasting
  - Environmental change
- Can we blame everything on climate change?

*“Who naught suspects is easily deceived.”*

[Francesco Petrarca](#), 14<sup>th</sup> century philosopher/poet/theologian

# Presentation Overview

Investing in people

Stock-based Research Priorities

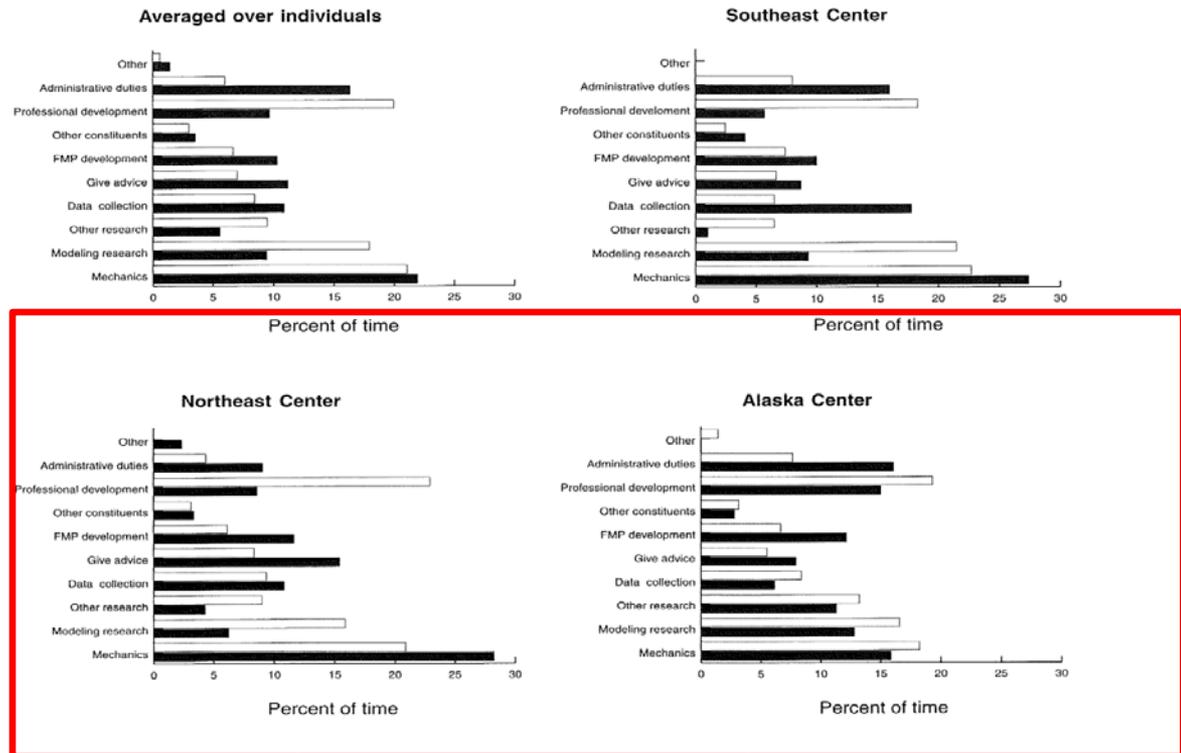
Research Opportunities

Strengths, challenges, solutions

# NMFS Stock Assessment Improvement Plan 2001, p. 31

## Results of Time and Motion Survey

### Time & Motion Analysis



% of Staff Time	Northeast		Alaska	
	<i>Actual</i>	<i>Ideal</i>	<i>Actual</i>	<i>Ideal</i>
Professional Development	8	23	15	20
Model Research	6	17	13	17
Mechanics	28	22	16	18

# Need to Invest in Colleagues

- Our jobs are intrinsically interesting, meaningful and rewarding, however....
- Present workload is not rewarding, not sustainable, and limits professional development of staff.
- Without improvements in efficiency, there will be less time to address critical research needs and develop methods useful to managers.
- Valuable research at the interfaces of disciplines.

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Research Opportunities

Strengths, challenges, solutions

# What is a Species Prospectus ?

- In business and finance a stock prospectus is
- “A formal legal document, that provides details about an investment offering for sale to the public. A **prospectus** should contain the facts that an investor needs to make an informed investment decision.”
- From a research and management standpoint, the fish stock prospectus serves a similar function. Investment in assessments.

# A Few Prospectus Highlights

Spatial dynamics of black sea bass

Growth of monkfish

Movements of Atlantic mackerel

Habitat of butterfish

Application of new monitoring for sea scallops

# Research Forgone

- Number of stock assessments is high but costly.
- Inefficient use of resources for scientists, managers, policy makers, and industry.
- Important research opportunities are being sacrificed.
- This isn't a lament for ivory tower research—it's a request for time to address cross-cutting research that will benefit all stock assessments and partners.

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# A Useful Perspective for Stock Assessment Research

- Consilience: The Unity of Knowledge—E.O. Wilson. 1998.
- "Literally a 'jumping together' of knowledge by the linking of facts and fact-based theory across disciplines to create a common groundwork of explanation."
- "...interfaces between disciplines become as important as the disciplines themselves."
- Future progress relies on exploiting the information at the interfaces among disciplines.
- But, as they say in the GEICO ads—"Everybody knows that!"



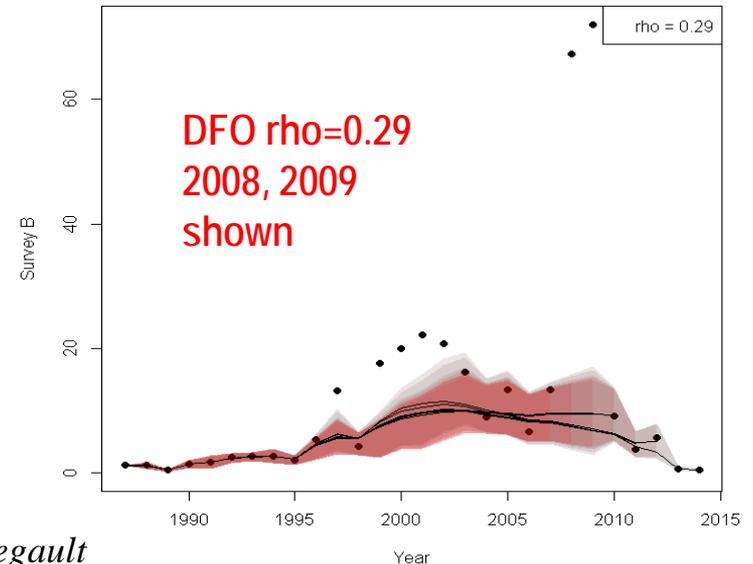
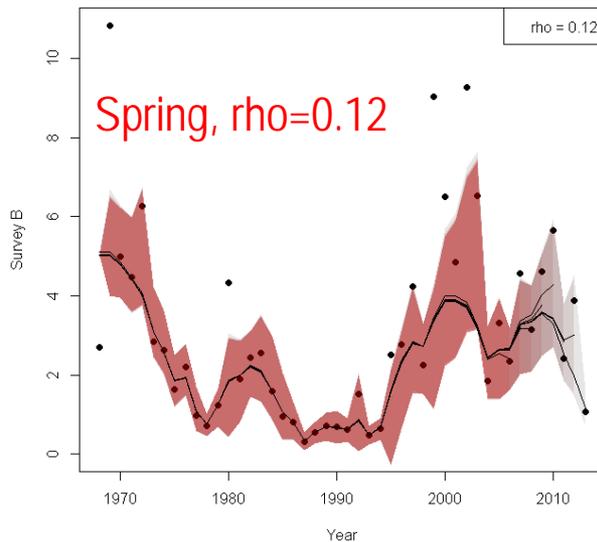
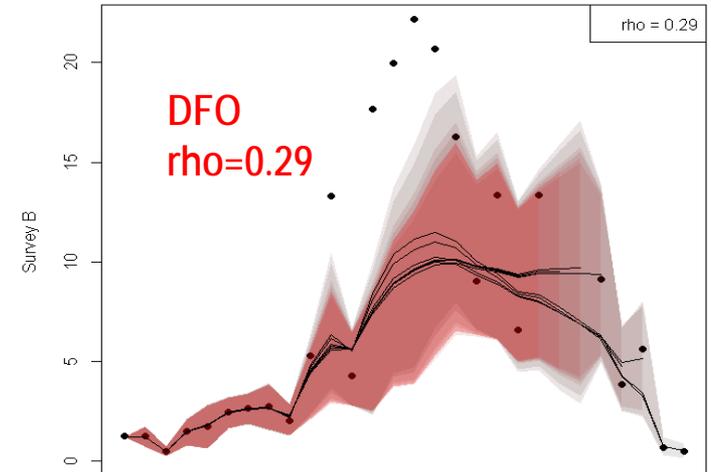
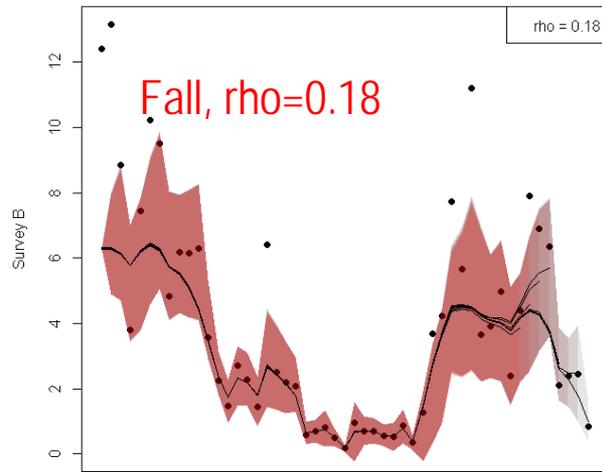
# Research at the Interface: Catchability $Q$

- Determination of scale is greatest challenge for both single species and ecosystem models
- Greater interaction with gear technologists and stock assessment scientists
- Ability to estimate changes in  $M$  is dependent on ability to fix  $Q$
- E.g. see Somerton et al. 1999. ICES JMS

# Research at the Interface: Retrospective Pattern

- Retrospective patterns arise due to conflicts in the signals from the underlying data.
- Investigations into the processes giving rise to it have been useful (e.g., Georges Bank yellowtail flounder)
- What is best approach for catch advice? MSE?
- In the absence of a formal resolution, can statistical filters reduce the false positives?

# Retrospective Patterns and Kalman Filter: Can simpler models avoid misleading signals?



*Courtesy of Chris Legault*

# Research at the Interface: Discards

- Can we detect bias in based on data from observed and unobserved vessels?
- “Market basket” analyses from economists
- Economic incentives to discard
- If detected then what?
- Implications for stock size

# Research at the Interface: Invertebrate Species

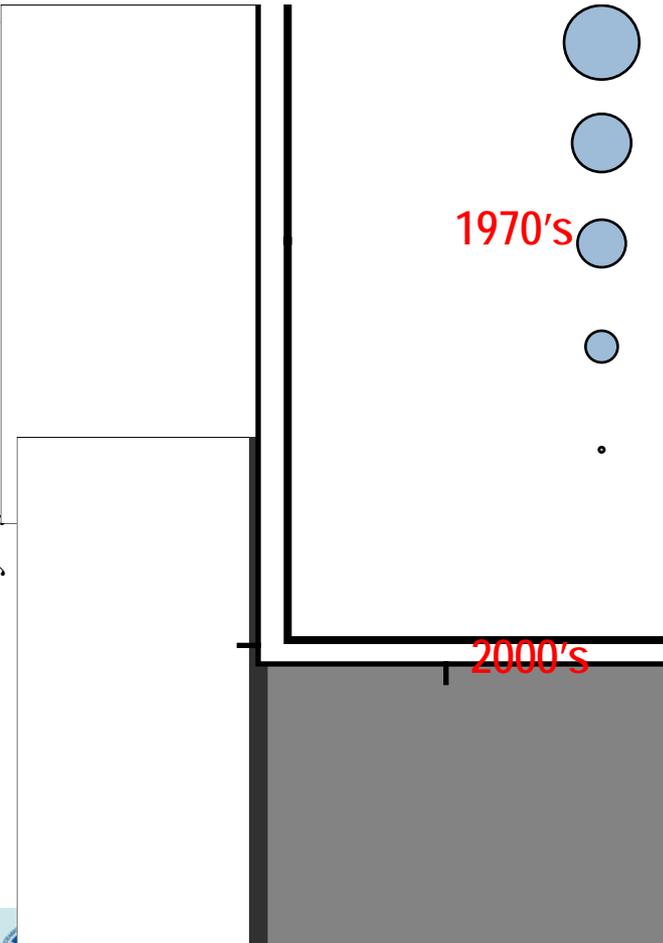
- Sessile (mostly)
- Shortest and longest longevities
- Most difficult to age
- Durable (→effective management measures for discards, reducing discard mortality)
- Implications for spatial management, rotational fisheries, biological reference points, and for short-lived species—real-time abundance.

# Research at the Interface: Spatial Management

# GOM cod example

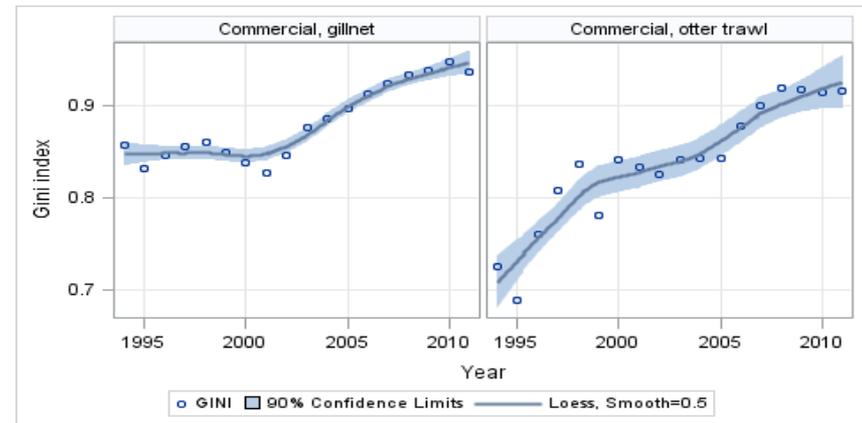
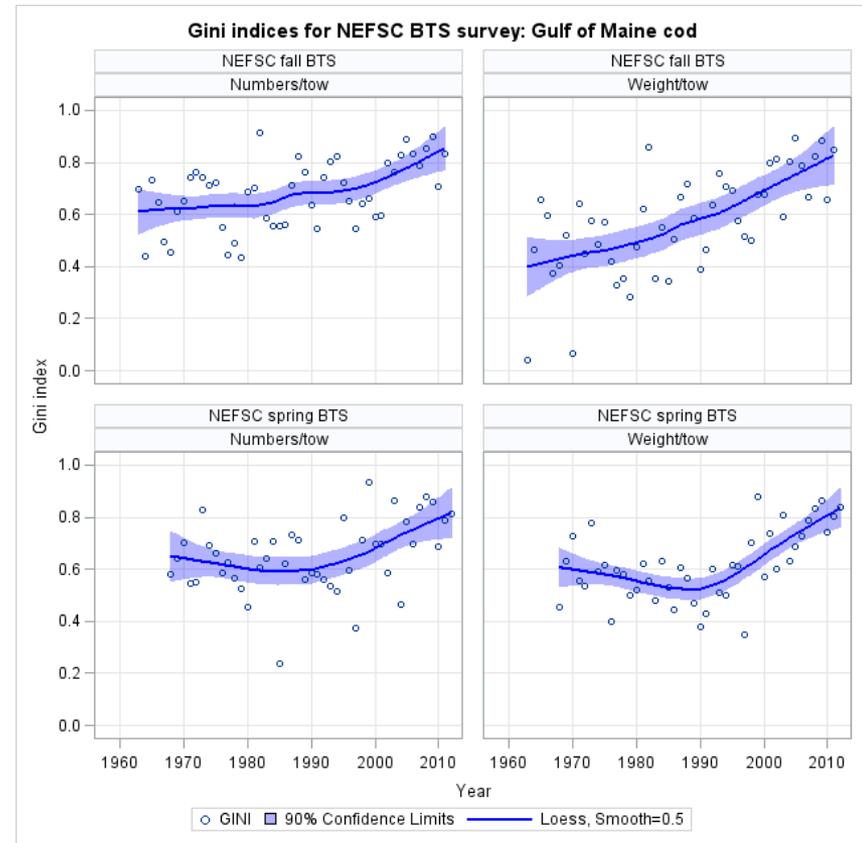
- Increasing concentration of resource and fisheries should be causes for concern. Pretty maps are nice but it is the distillation of objective, meaningful and robust metrics that allow scientists

Courtesy of Mike Palmer



Survey Indices

Commercial LPUE



# Research at the Interface: Protected, Rare, and Radioactive Species

- Atlantic salmon
- Cusk
- Atlantic Sturgeon
- River herring
- Ocean pout
- Wolffish
- Cod?!

# Research at the Interface: MSE

## Can it solve everything?

- Management Strategy Evaluation is neither stock assessment science nor management
- Rather, it is a formal process for evaluating decisions and their implications for resource management.
- Requires broad range of technical skills
- Requires very different approach to decision making.

# Relationship between Stock assessments and Ecosystem-Based Approaches

- **Stock Assessments**

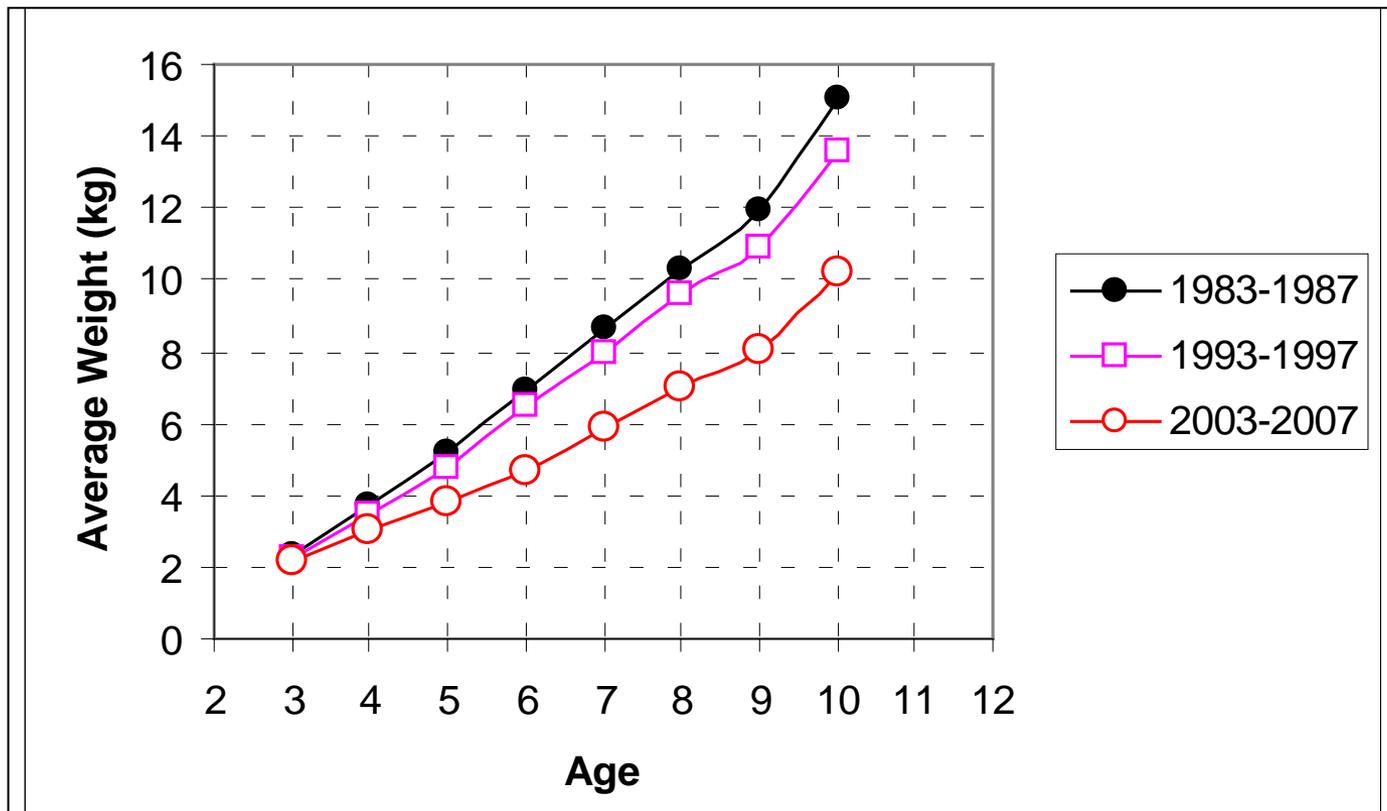
- Focus on estimation, measurement of scale, and catch advice
- Projections under alternative harvest policies, uncertainty of stock size, and recruitment variability.
- Incorporate the realization of ecosystem changes via change in ave. wt, maturity, recruitment etc.
- Reference points are rescaled in response to new information
- Effective management reduces  $F$  relative to  $M$ .
- Synthesis across species often difficult

- **Ecosystem-based approaches**

- Estimates of interactions depend on estimation of scale
- Can identify factors affecting multiple stocks
- Single species models often serve as starting point for scale
  - **Parameterization (eg selectivity or recruitment stanzas) often aliases ecosystem changes**
- Strategic rather than tactical value to date (i.e., no catch advice)

# Incorporating Environmental Change into Single Species Models

Changes in Average Weight at Age for  
*Georges Bank Cod landings and discards*

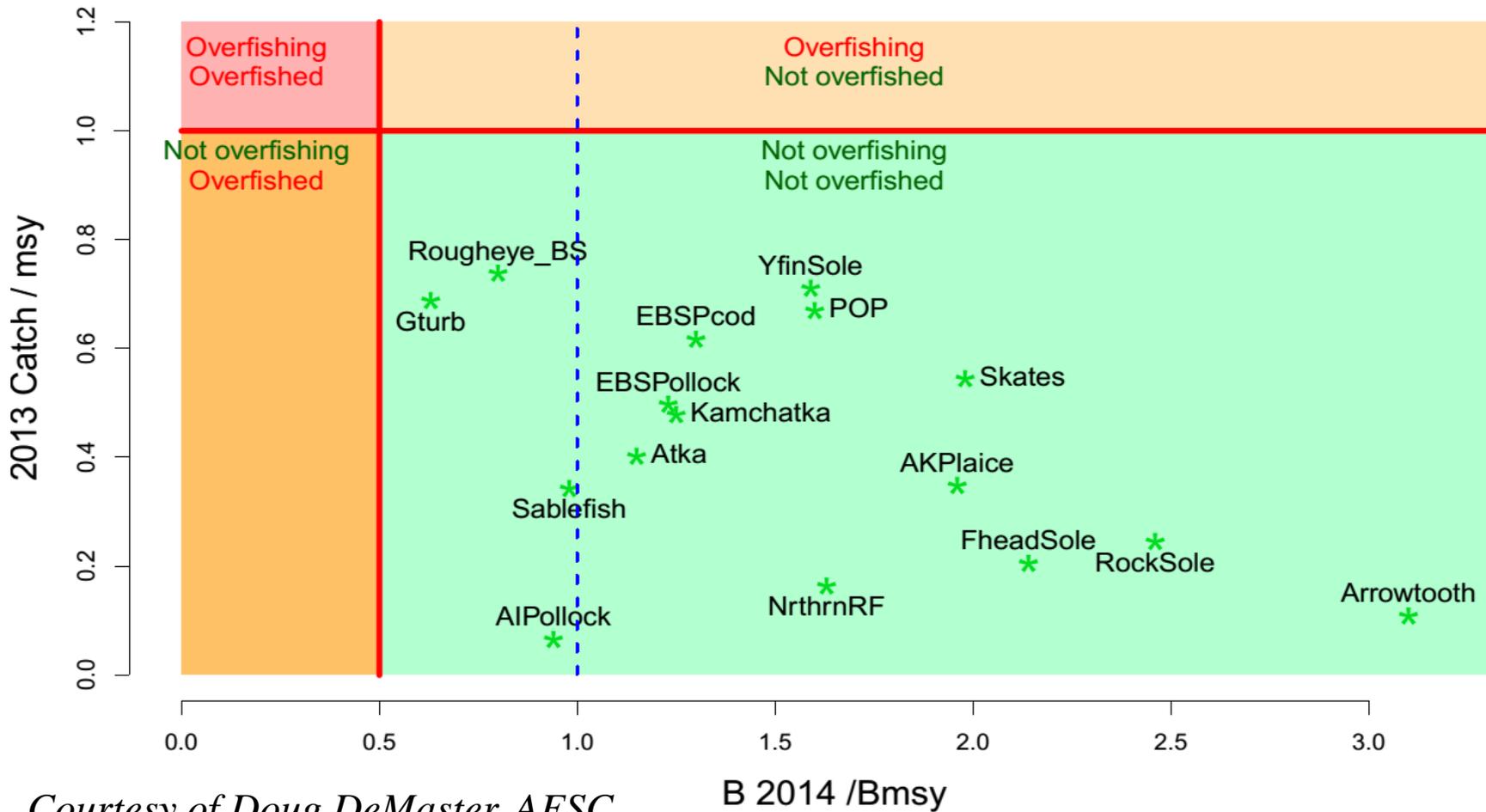


# Multispecies Harvest Problems: Drawing from ecological theory, fisheries science and observation

- Need to clarify the multispecies harvest problem, especially the premise that not all stocks can simultaneously be at  $B_{msy}$ :
  - Technical interactions: Non selective harvesting of stocks with varying productivity
  - Non-equilibrium induced by year class fluctuations
  - Thermodynamics—what is the cap on productivity?

# Can all stocks simultaneously be above Bmsy?

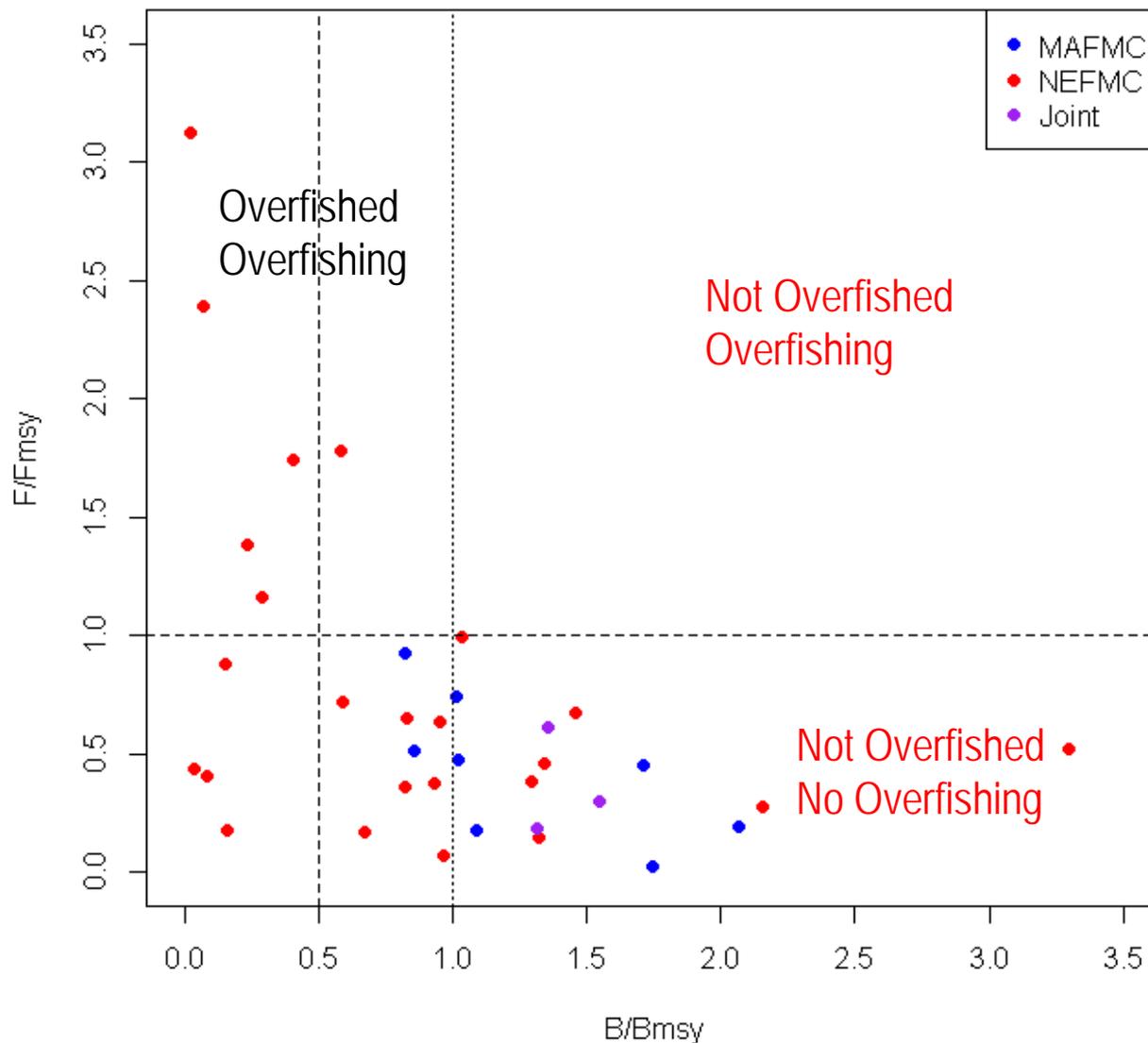
## Bering Sea and Aleutian Islands



Courtesy of Doug DeMaster, AFSC

B 2014 / Bmsy

# Scorecard for the Northeast

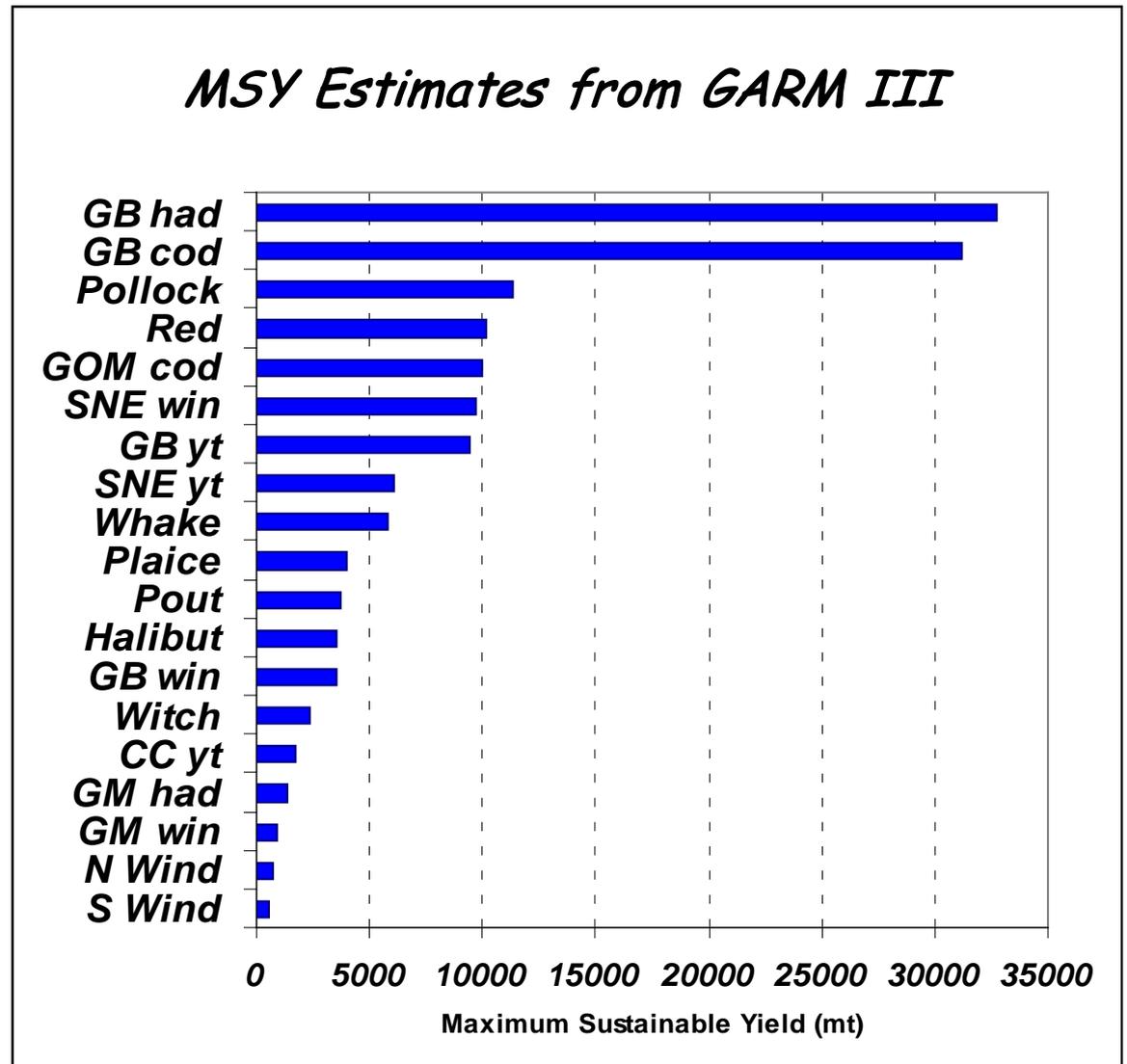


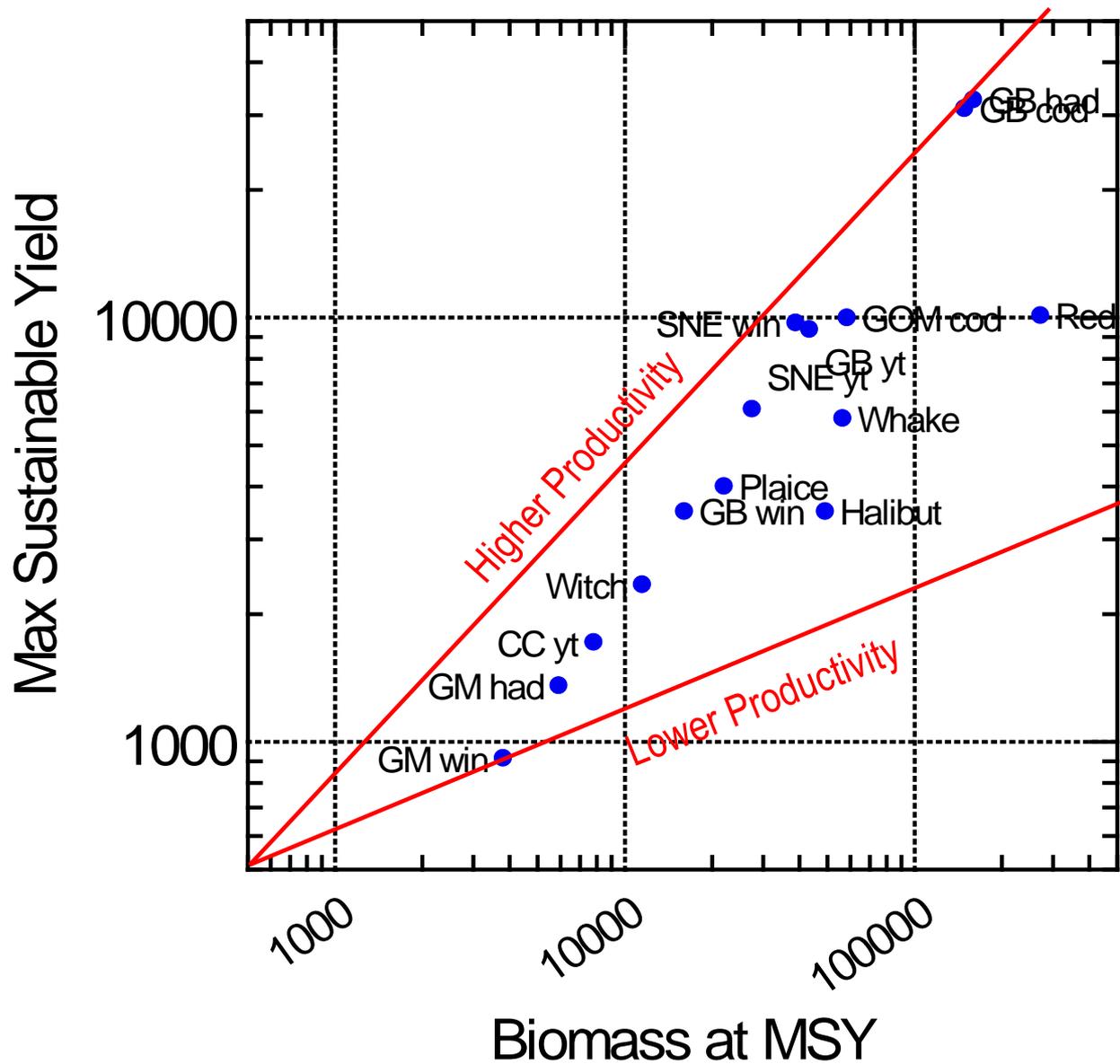
Unknown status:

- Red Crab
- Offshore Hake
- GOM winter flndr
- 7 skates
- Atlantic mackerel
- Longfin squid
- Shortfin squid

# Productivity of Groundfish Stocks

the mixed  
stock  
problem





# Incorporating Environmental data into stock assessments: Interpretation of Observations

## Interpretive Role

- Using environmental covariates to understand limitations of observations.
- Example—adjusting relative abundance indices for temperature, light intensity, salinity etc.
- What integral of space and time is appropriate for measuring impact of environmental data?

## Predictive Forecasting future conditions

- Can we forecast the environmental data in the future?
- If not, can we use decision theory to temper decisions on basis of expected outcomes (Markov methods for state change).

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# Strengths

Outstanding, highly motivated, and dedicated colleagues

Long time-series of fishery data

Extensive experience in the development and application of stock assessment models

Experience with challenges of rebuilding

Demonstrated ability to adapt to changing conditions and respond to management demands.

# Challenges

Improvements in infrastructure

- esp. Fishery dependent data

Cumbersome review process

Non Standardized assessment documents

Benchmarks independent of research advances

Asynchrony of data, assessments, and management needs.

# Solutions

Improved delivery of data

More Updates, fewer benchmarks, fewer terms of reference

Reserve benchmarks to capitalize on:

- Major research breakthroughs
  - New model paradigms
- Core research questions, e.g., retrospective patterns, change in M

Greater synchronization of assessment process with management needs

Standardized reports

More time for basic research and the interfaces of disciplines

# Questions

Fish moving in the right direction