



**NOAA
FISHERIES**

**NWFSC
SWFSC**

Data-limited models for informing groundfish management

**Jason Cope
E.J. Dick
Alec MacCall
Chantell Wetzel**

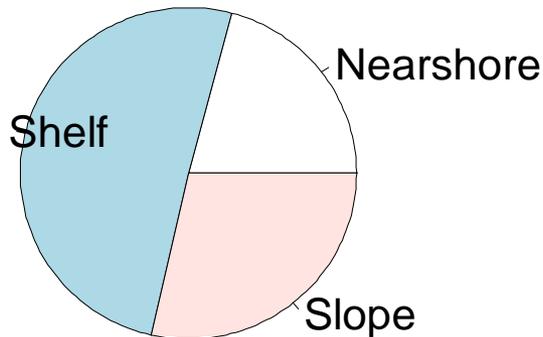
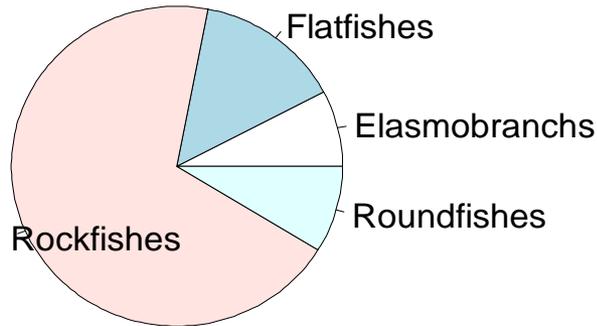
10 June, 2014

Groundfish FMP (est. 1982)



90+ species

Longevity: 5-200+



Fishery

- **Lat. range: 32°-49° N**
- **Multiple factors**
 - **States**
 - **Sectors**
 - **Vessels**
 - **Gear types**
- **Data**
 - **Types**
 - **Quality**
 - **Quantity**

Limitations to conducting stock assessments

- **#/diversity of stocks**
- **Data availability**
- **Large stock ranges**
- **Trained analysts**
- **Reviewers**
- **Council time**
- **Maintaining “current” assessments**
- **General funding**

Informing catch limits

Stock category	Default OFL uncertainty	Affiliated assessment type	Data types
1	$\sigma=0.36$	Statistical Catch at Age	Catch, detailed life history, indices, length/age comps.
2	$\sigma=0.72$	Index-based methods	Catch, basic life history, abundance indices
3	$\sigma=1.44$	Catch-only	Catch , basic life history

Timeline and context

Years of the Groundfish FMP

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Cat. 1	0	0	0	0	1	1	1	4	6	3	4	5	8	3	4	6	5	8	6	4	4	7	1	22	2	14	1	11	1	15	1	7	
Cat. 2	0	0	7	4	7	3	2	1	2	0	0	1	0	0	12	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	
Cat. 3	2	3	7	3	3	3	2	3	4	4	2	4	2	2	3	3	3	2	2	2	2	2	2	2	2	2	2	2	50	0	0		

-  Groundfish Fishery Management Plan implemented
-  Low data, simple methods (avg catch, YPR, VPA, SRA)
-  SS1, average catches for other stocks
-  Rogers “ $ABC = M \cdot B_{avg}$ ” applied to some “remaining rockfish”
-  SS2+, average catches for other stocks
-  DCAC
-  DB-SRA; MSA requirement to end overfishing, set ACLs
-  First data-limited methods review panel: DB-SRA and SSS
-  Data-limited methods review panel: XDB-SRA and XSSS
-  First data-moderate STAR panel: XDB-SRA and XSSS for
-  Continued research (e.g., status prior) on data-moderate methods

Methods: Depletion-Corrected Average Catch DCAC

□ Sustainable Yield Calculated as:

$$Harvest = \frac{\sum Catch}{n + \left(\frac{\Delta}{\frac{B_{MSY}}{B_0} * \frac{F_{MSY}}{M} * M} \right)}$$

where:

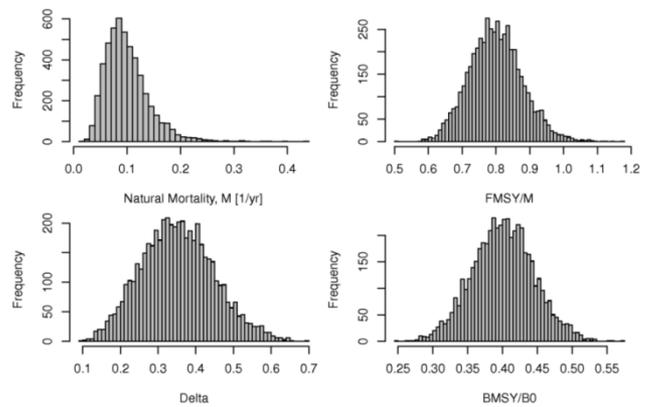
n is the number of years,

Δ is the relative stock status to starting conditions ($\Delta = 1$ -depletion),

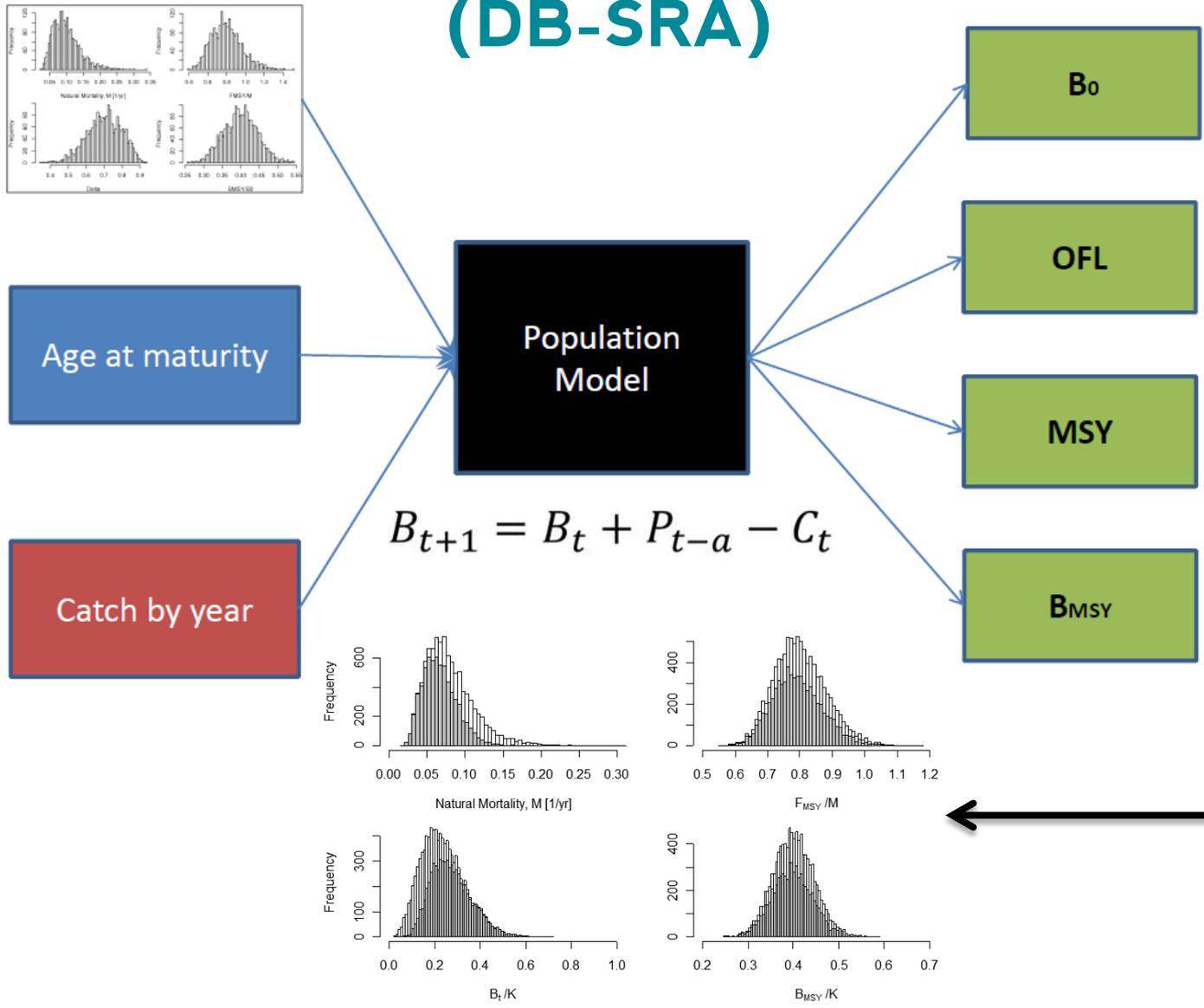
$\frac{B_{MSY}}{B_0}$ is the relative stock size where maximum sustainable yield (MSY) occurs,

M is natural mortality, and

$\frac{F_{MSY}}{M}$ is the ratio of the fishing mortality rate associated with MSY and natural mortality.



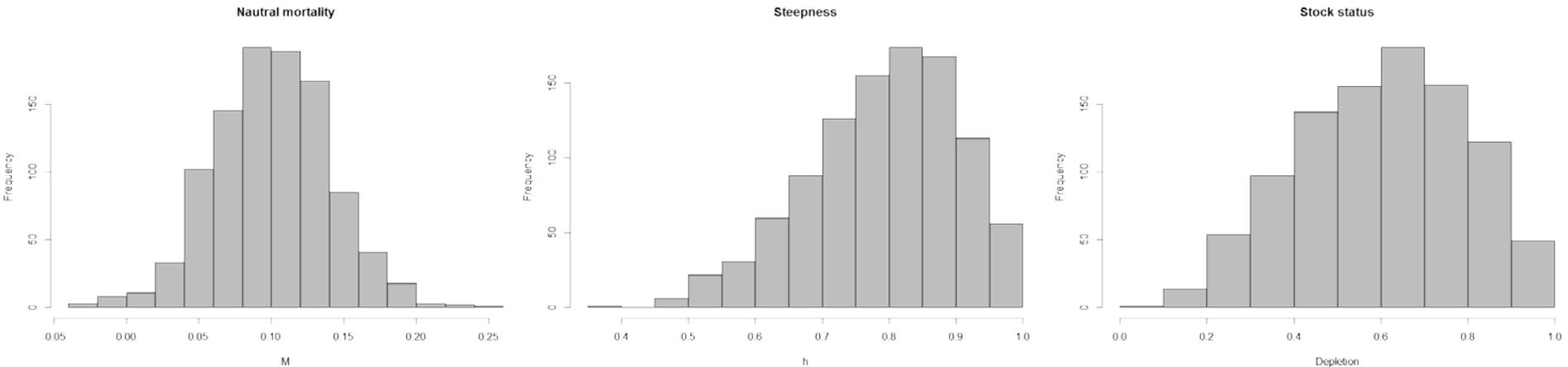
Methods: Depletion-Based Stock Reduction Analysis (DB-SRA)



Dick and MacCall 2010. Dick and MacCall 2011

Simple and extended Stock Synthesis SSS & XSSS

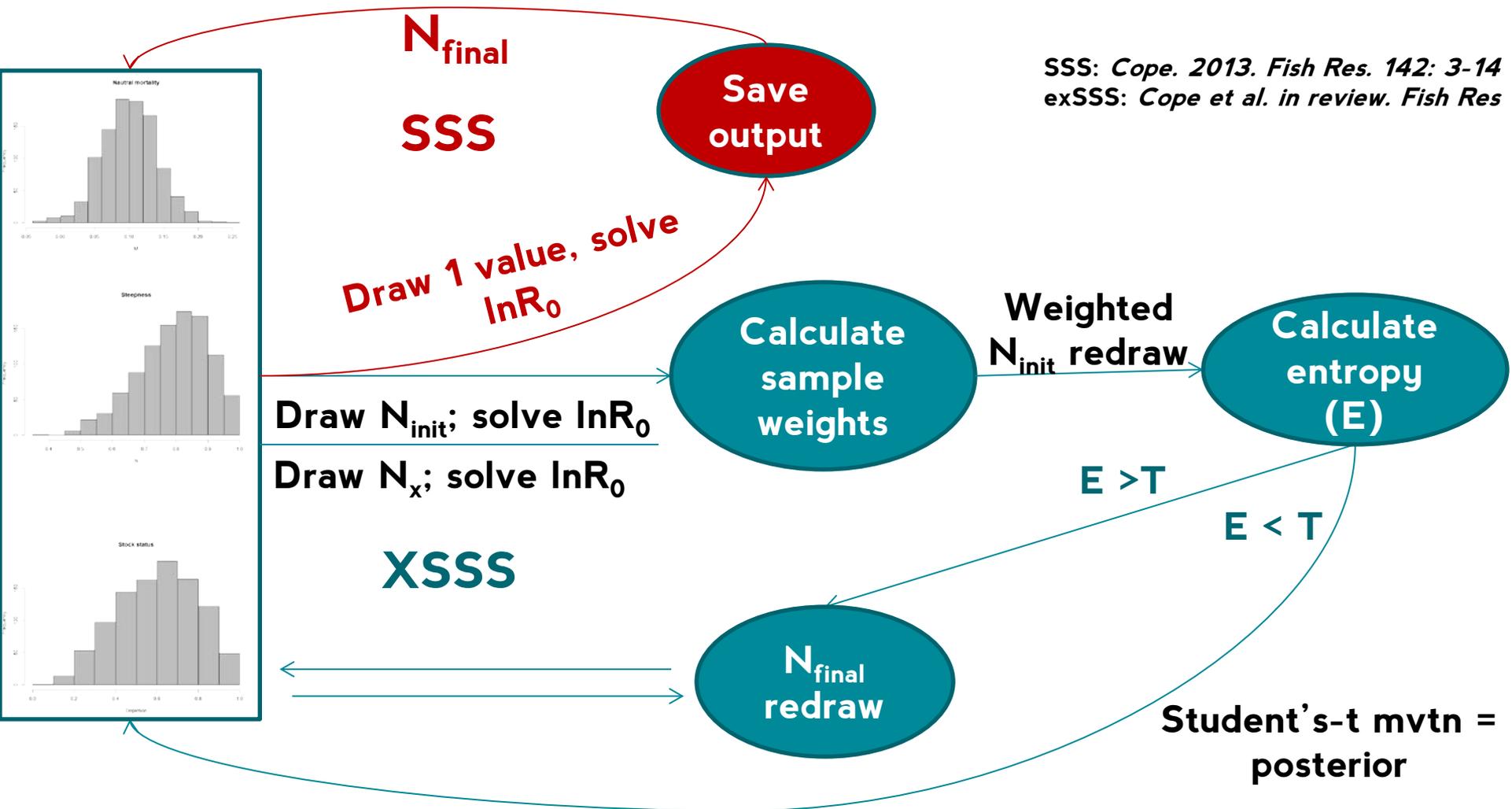
- Priors defined for M , h , and depletion



- Set-up SS files with catches and indices (XSSS)
- Solve for $\ln R_0$ and extra SD on indices (XSSS)

Methods: SSS and XSSS protocol: estimation

- Priors defined for M , h , and depletion



Extended/Depletion- based Stock Reduction Analysis (X/DB-SRA)

Extended/Simple Stock Synthesis (X/SSS)

Common data (Catch, indices)

Selectivity = maturity

Natural mortality

Depletion prior

Delay-difference

Age-structured

Single-sex

Two-sex

Growth: none (no SPR)

VBGF parameters

Productivity: F_{MSY}/M ;
 B_{MSY}/B_0

Productivity: Steepness (h)

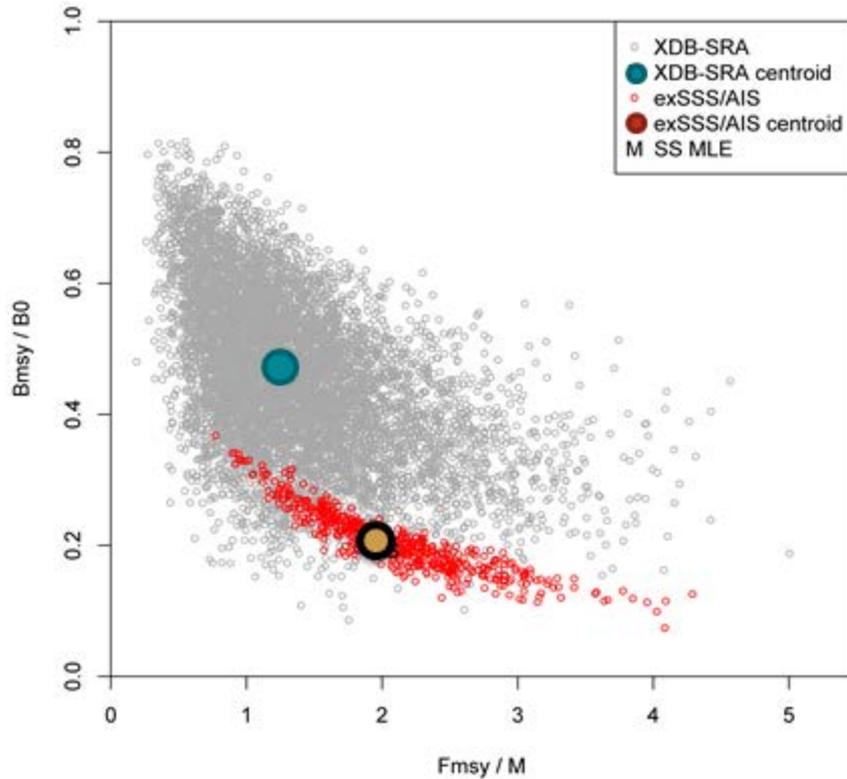
Applications

- **2010: DCAC or DB-SRA applied to 50 species/stocks.**
- **2013: XDB-SRA and XSSS applied to 8 species in 2013**
- **2015: More applications...**

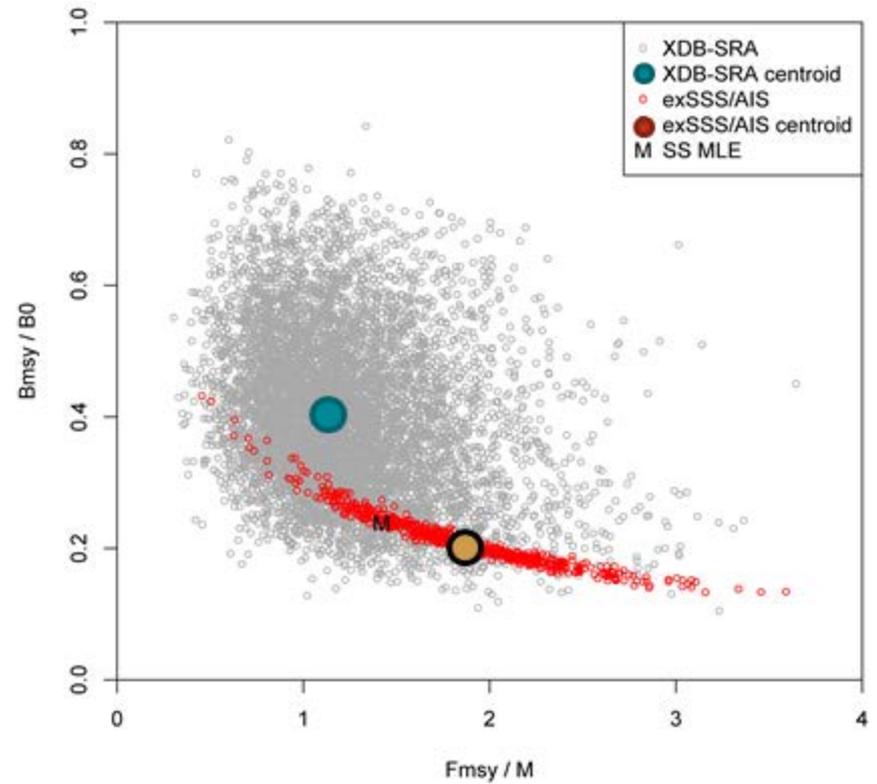
Ongoing research & development

Comparing parameterization: productivity

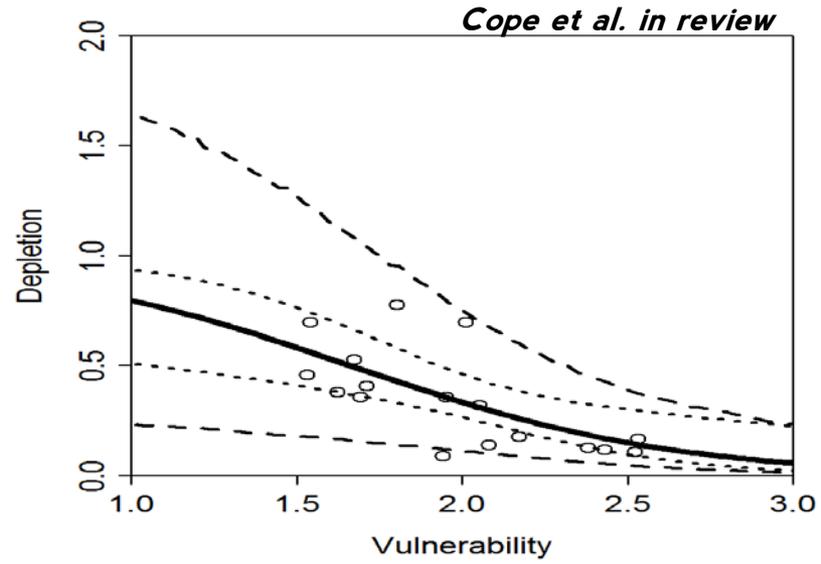
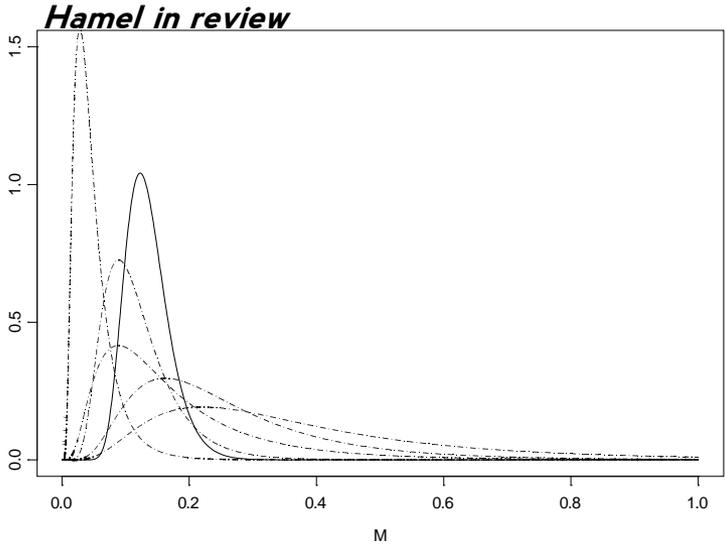
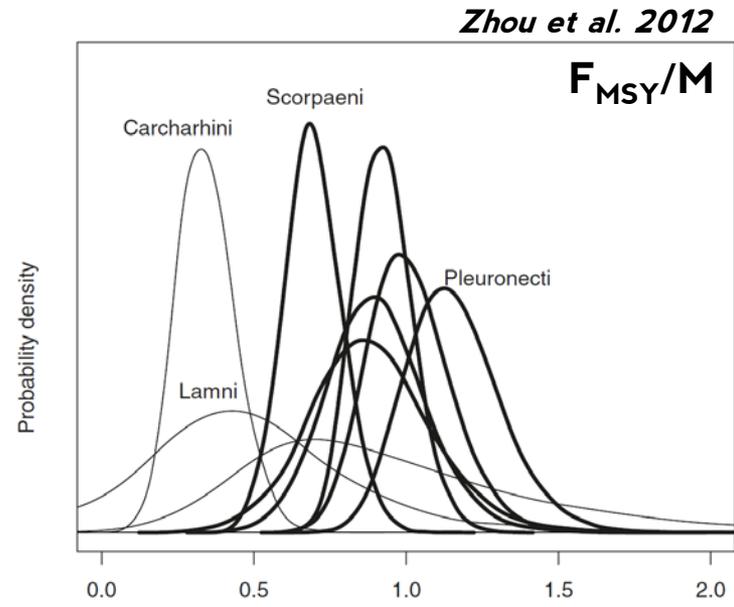
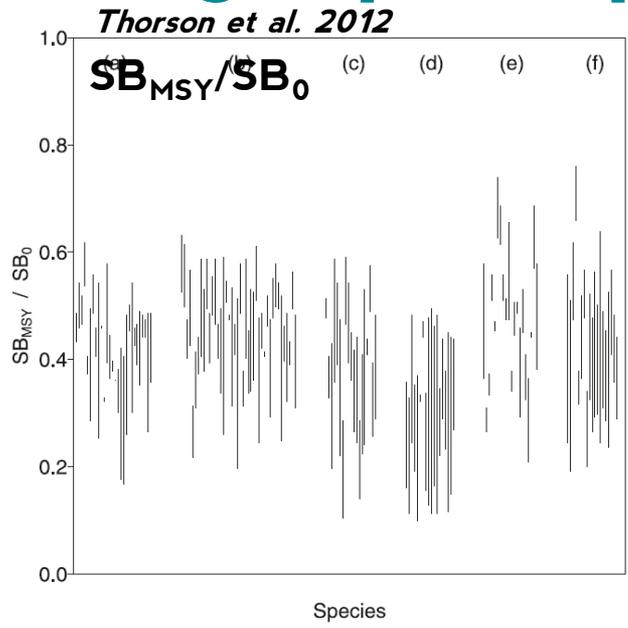
flatfish



rockfish

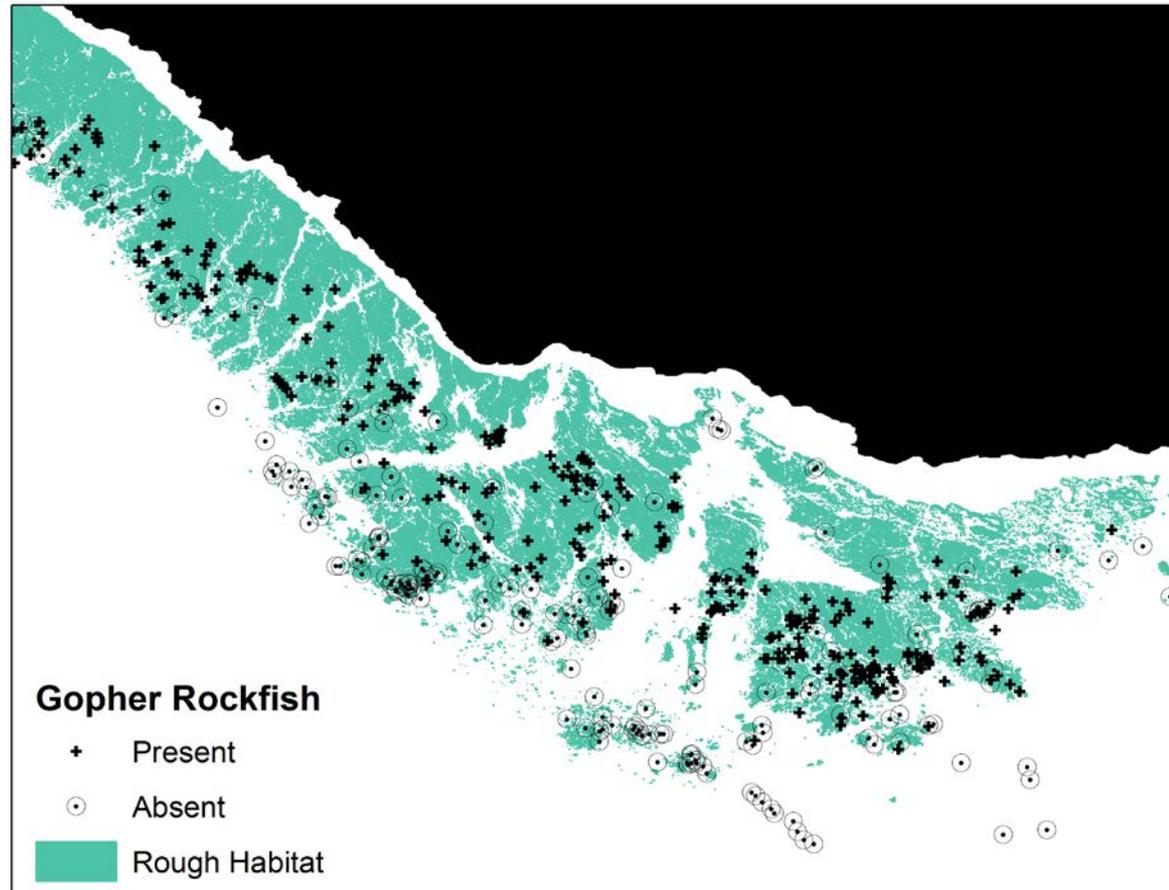


Improving inputs: parameters



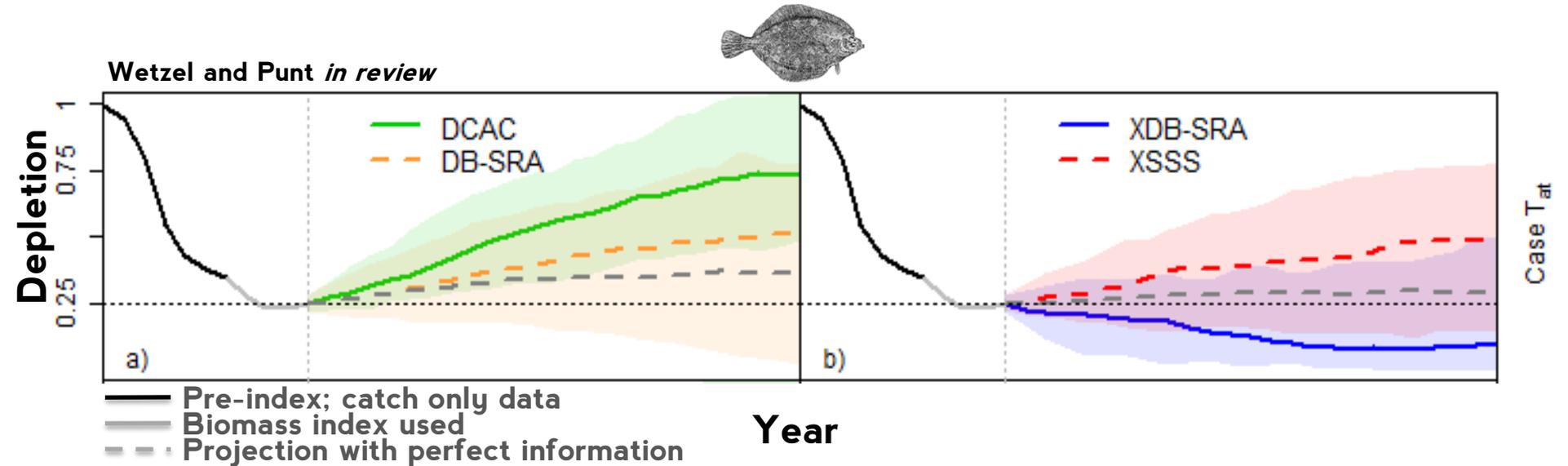
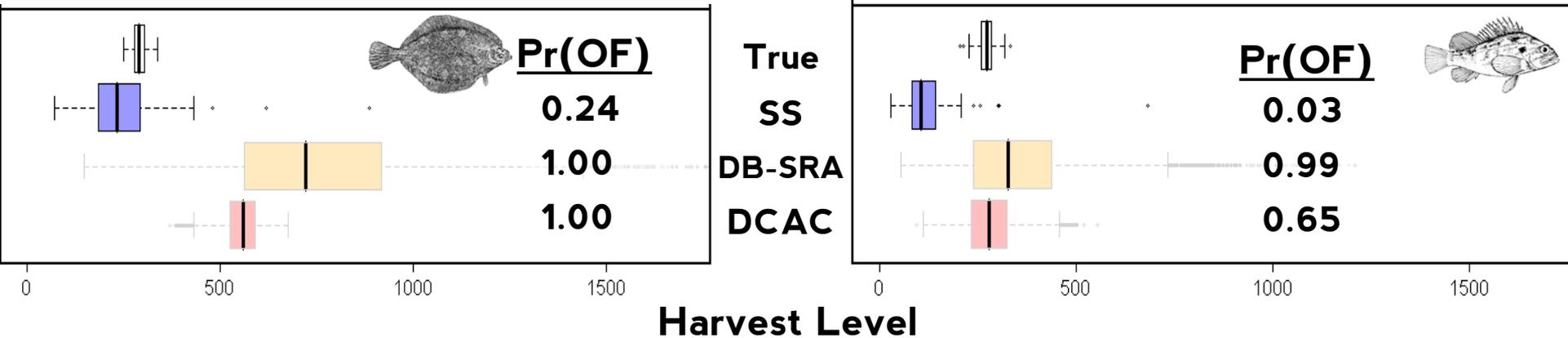
Improving inputs: indices

- **Commercial indices**
 - GLMM software
- **Recreational indices**
 - No survey for nearshore stocks (yet)
 - Dockside sampling collects aggregated (trip-level) catch, effort, & location information
 - Created relational databases for OR & CA onboard CPFV observer programs (Monk et al., 2013, in press)
 - Analysis underway of drift-level data in relation to habitat data for state waters (Monk et al., in prep.)



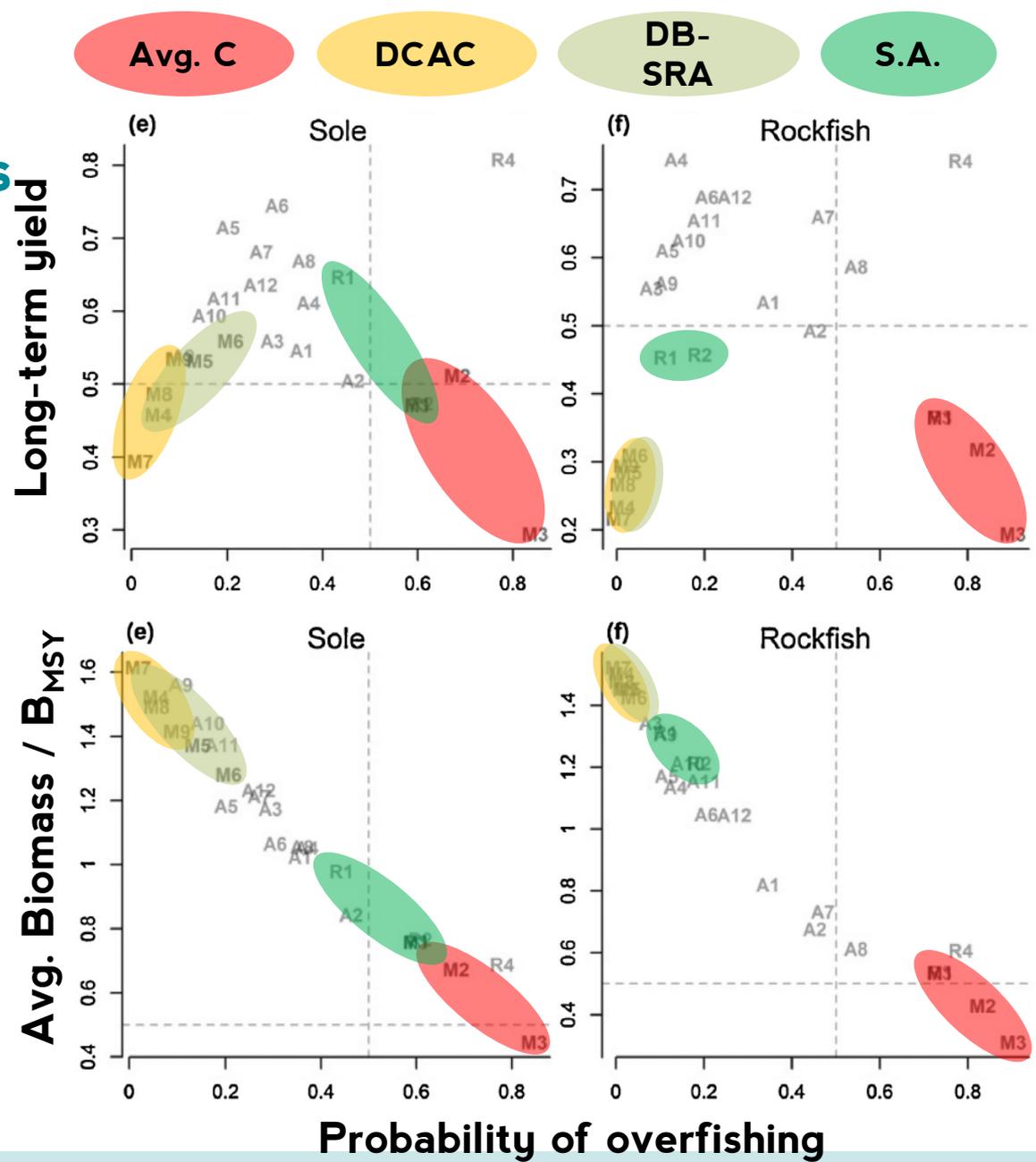
Testing methods: Simulation testing

Wetzel & Punt 2011



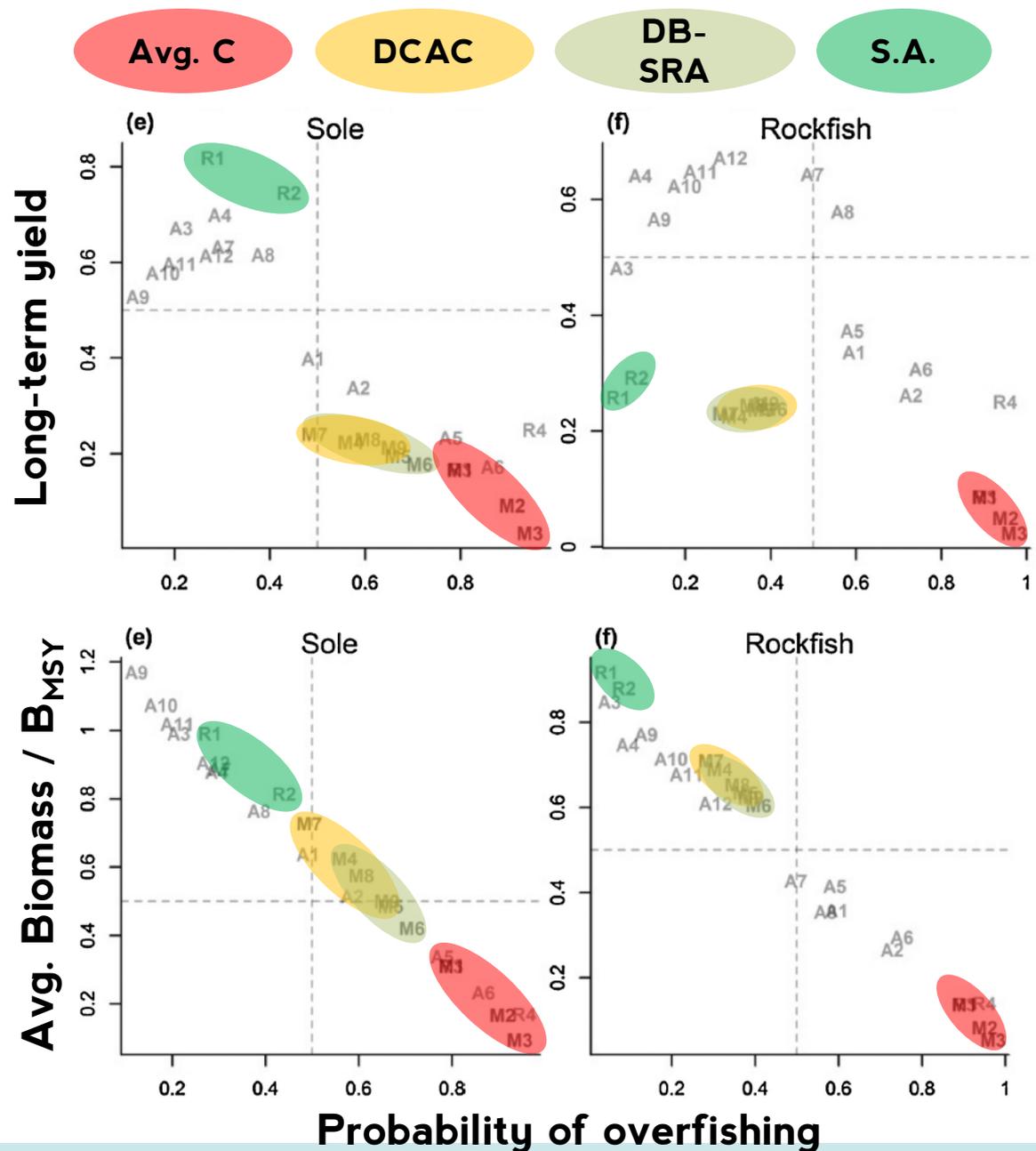
Performance of Data-Limited Models: “Precautionary” stocks (50-100% B_{MSY})

- Relative to average catch method, DCAC and DB-SRA reduce the probability of overfishing, while increasing or maintaining long-term yield
- Dynamic methods further improve performance (e.g. XDB-SRA & XSSS)



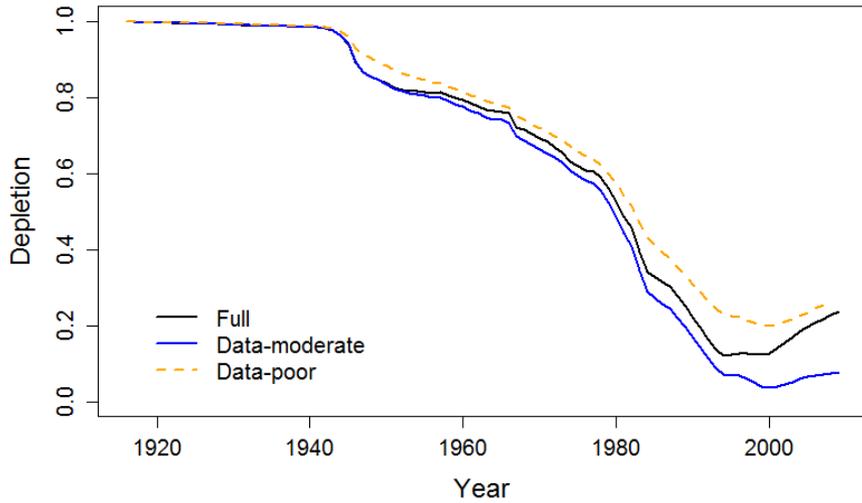
Performance of Data-Limited Models: “Overfished” stocks (<50% B_{MSY})

- Reduction in POF is less dramatic when applied to severely depleted stocks
- Long-term yield is consistently higher than average catch
- Take-home message: simple models are easy to apply, and perform better than average catch

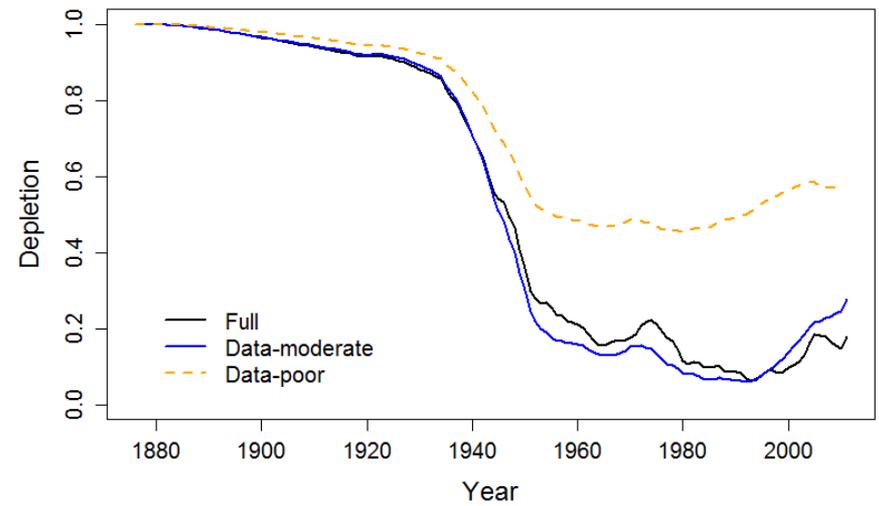


Comparing methods: BASI approach

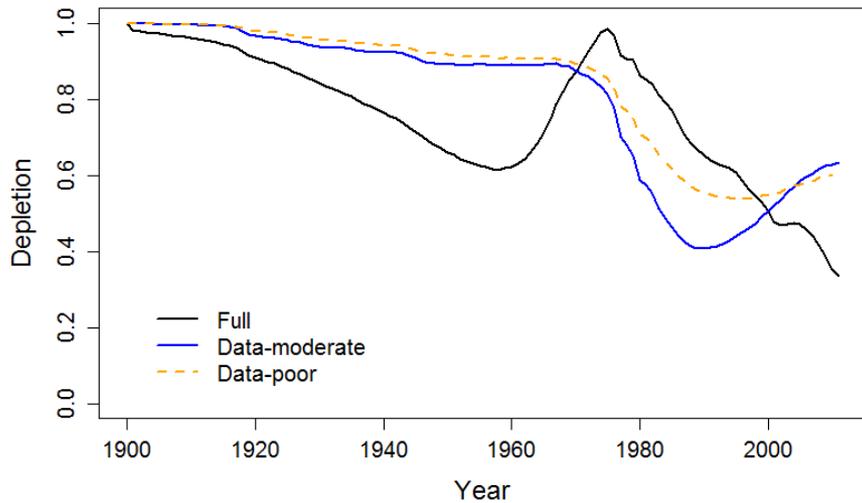
rockfish



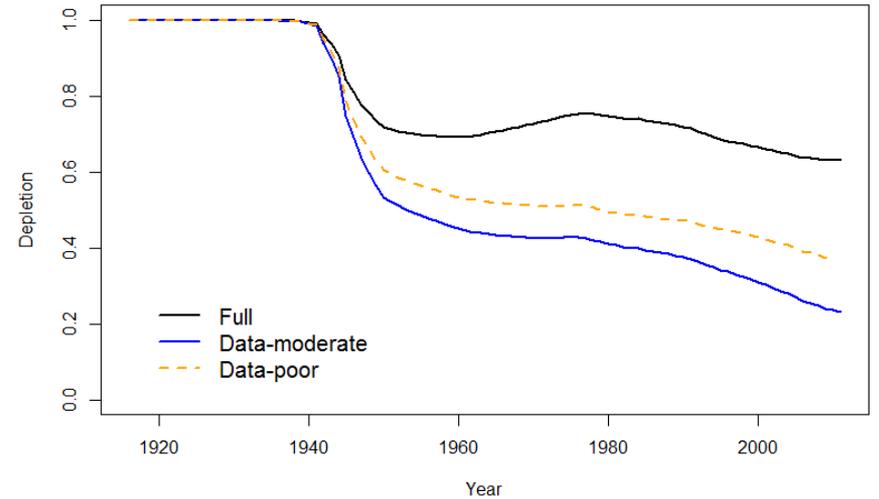
flatfish



roundfish

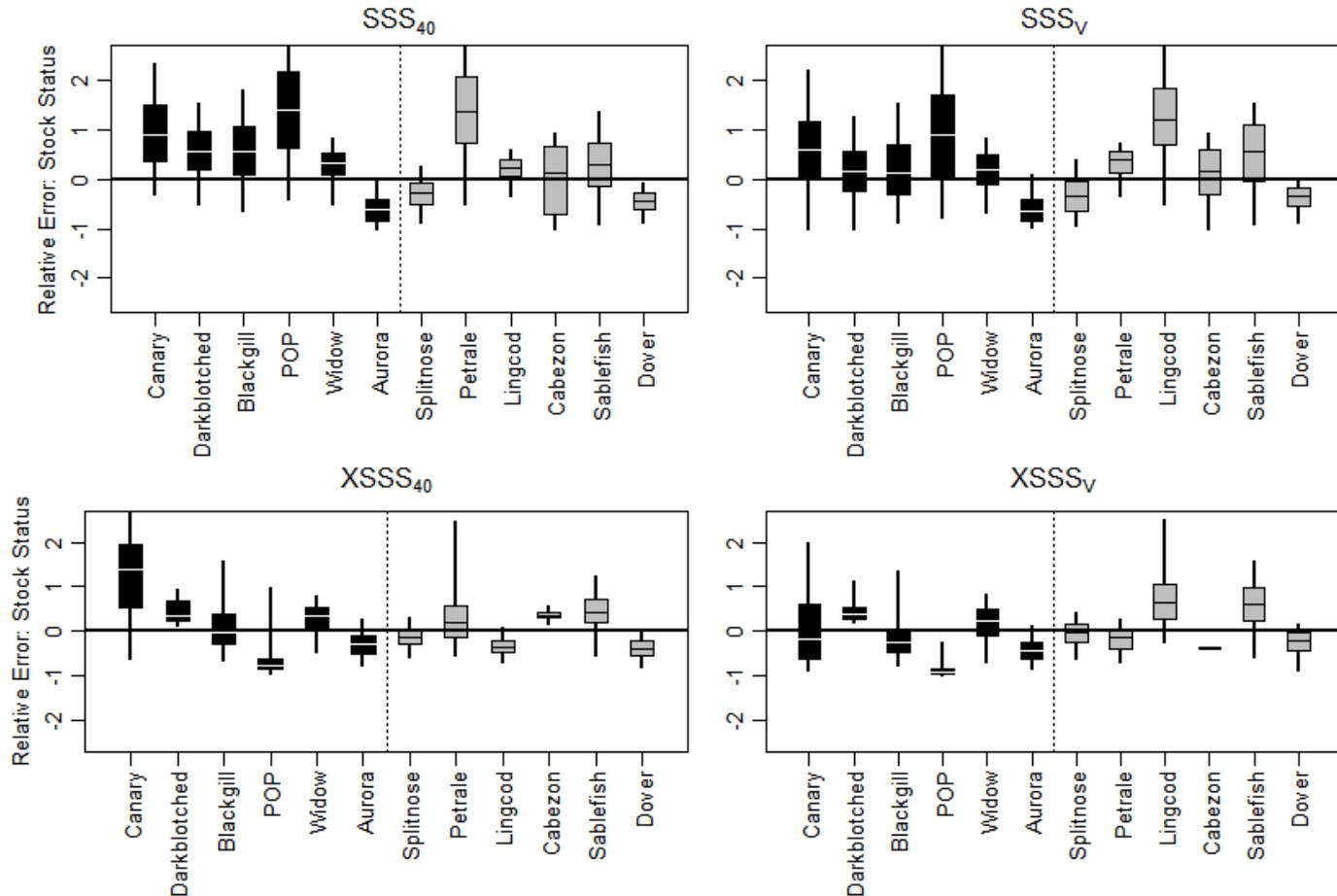


elasmobranch



Comparing inputs: BASI approach

Stock status



Cope et al. *in review*

Strengths

- Provide OFL and/or status when data limited
- Response: reactive to need for alternative analyses
- Increase throughput
 - Non-assessed stocks
 - Stocks previously assessed & of low priority
- Already applied in management
- Proactive
 - Improving methods
 - Better input priors
 - Modelling enhancements
 - Management applications
 - Testing methods
 - Simulation testing
 - BASI comparisons
 - Developing new methods

Challenges & Solutions

- **Resource limitations remain**
 - **Continued method exploration and development**
 - **Target data collection (e.g., indices)**
- **Large uncertainty in catch recommendations**
 - **Improve prior on model input values**
 - **Increase data in assessment (e.g., 1 year length compositions)**
- **Which stock category to apply?**
 - **Constraining catch and more available data**
 - **Prioritize “fuller” stock assessment**
- **MSA and data-limited toolbox**
 - **Explicit recognition in MSA/National Standards**
 - **“Living” TORs**