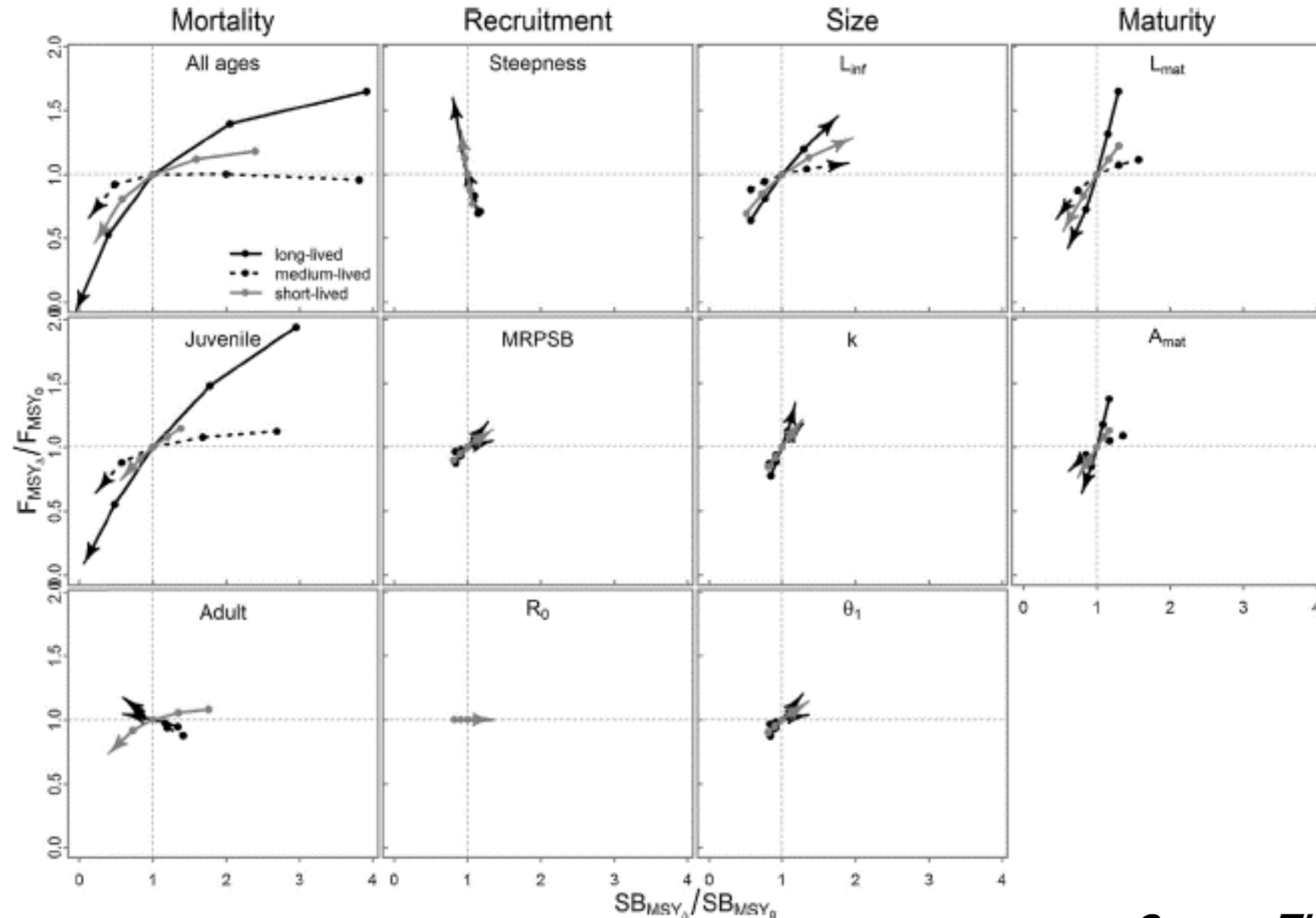


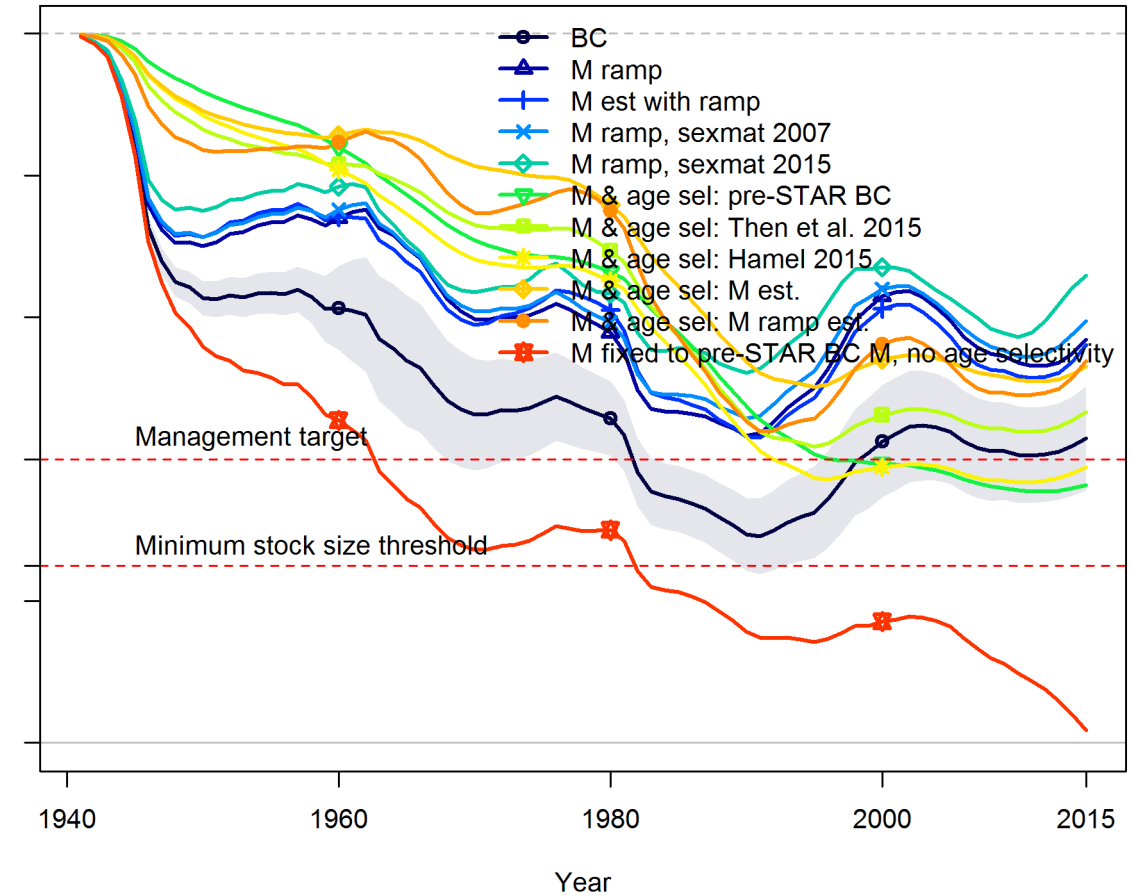
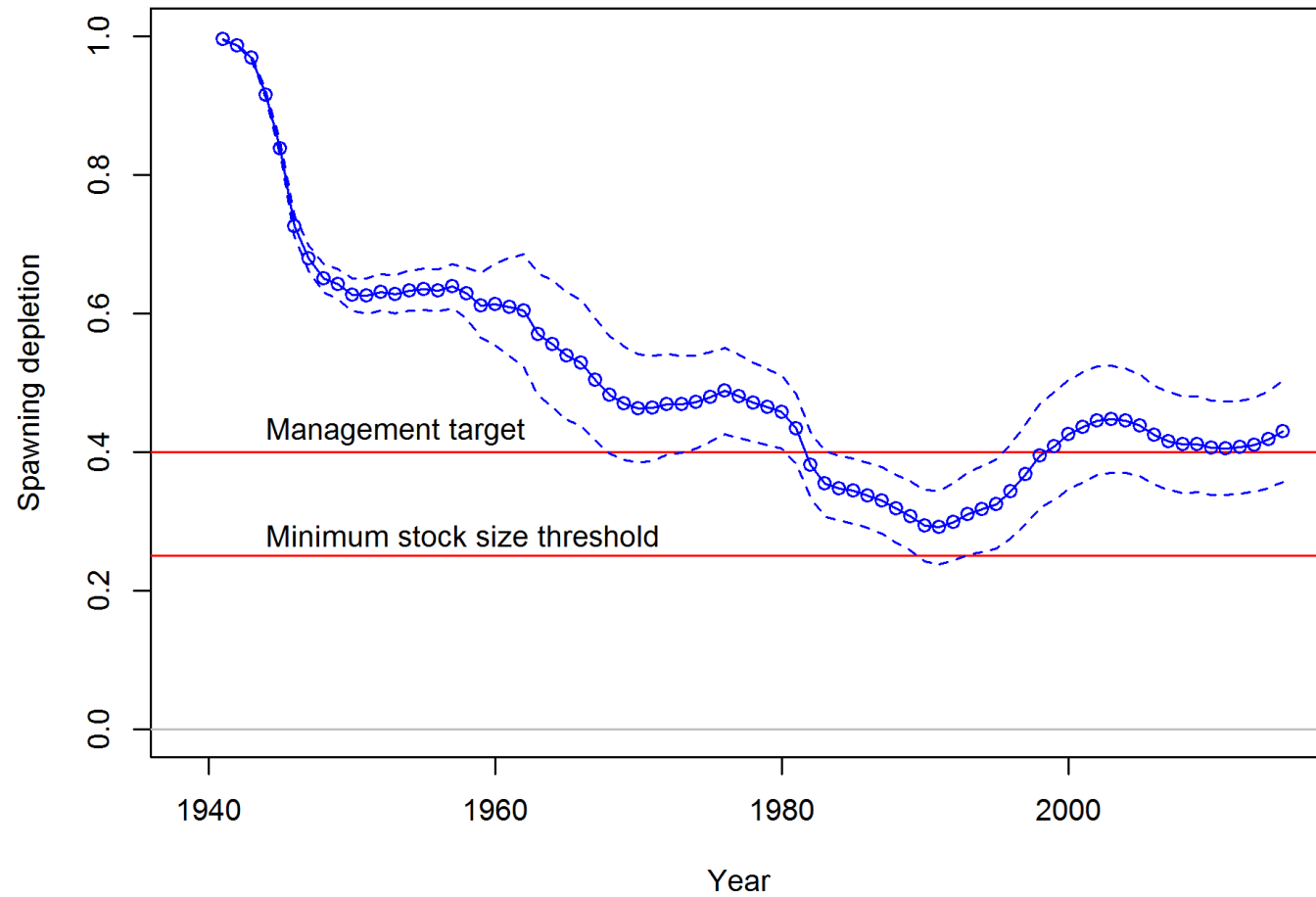
Data-limited fundamentals: Characterizing uncertainty

Understanding & characterizing uncertainty



Source: Thorson et al. 2015

Understanding & characterizing uncertainty

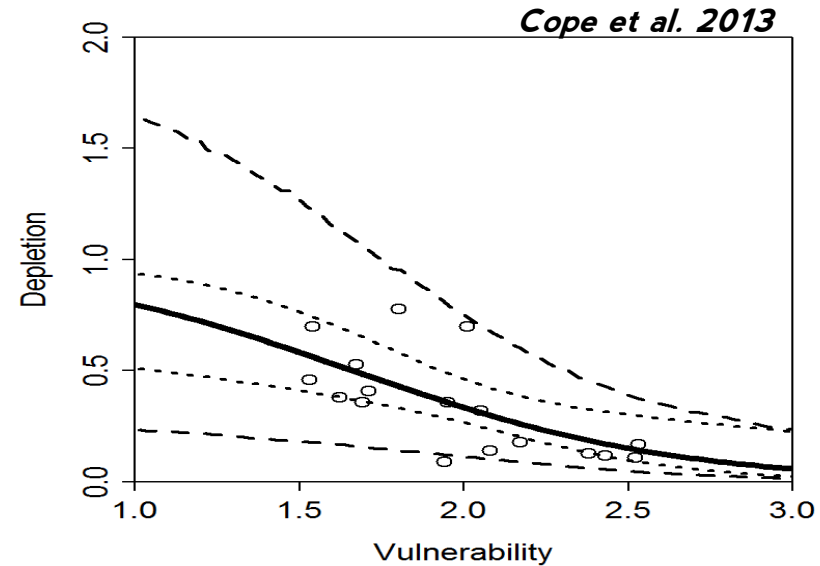
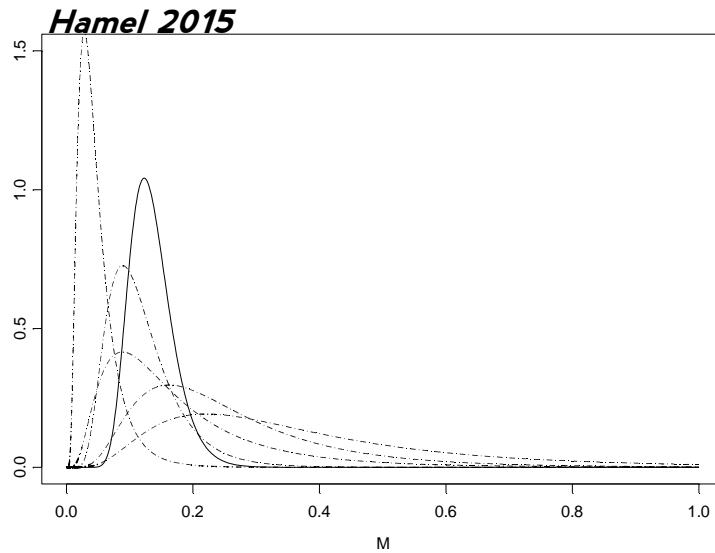
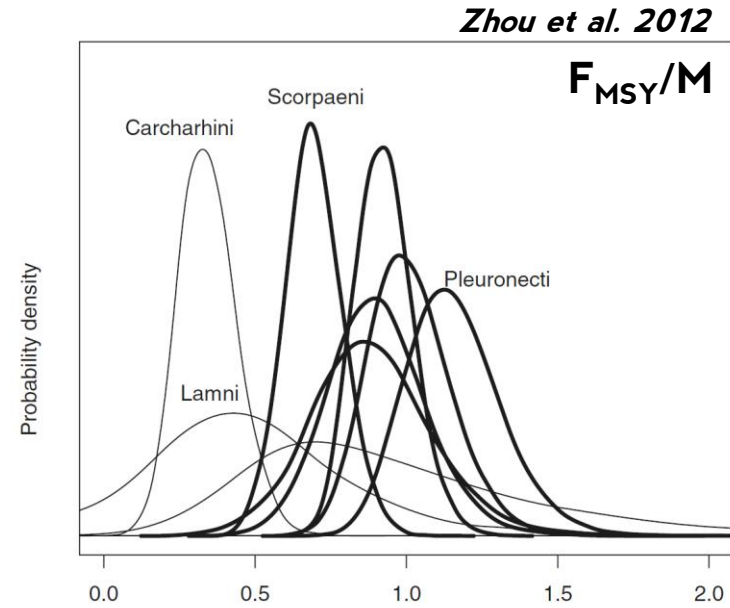
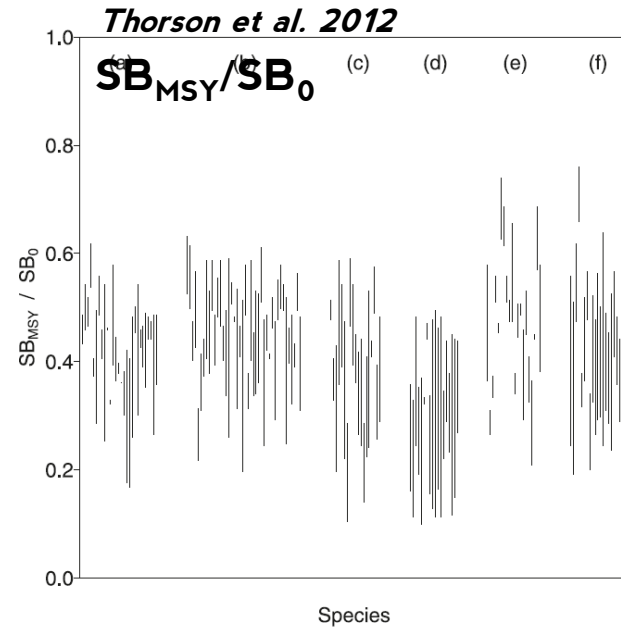


Understanding & characterizing uncertainty

- **Uncertainty analysis attempts to quantify what we don't know**
- **Uncertainty analysis is not bad, but a necessary part of stock assessment**

For data-limited methods, consider uncertainty in inputs and across methods

Improving inputs: parameters



What else can we improve? What should we focus on?

Expert elicitation: stock status

Prior for stock depletion

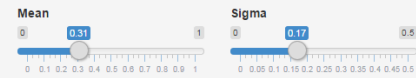
Select species

Species 1

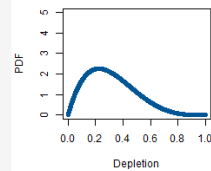
Select dataset

Dataset a

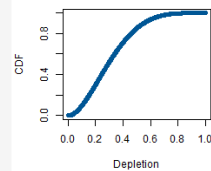
Scroll the bars to adjust depletion



Beta distribution



Cumulative distribution



Update Table

Table for depletion

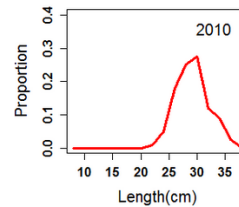
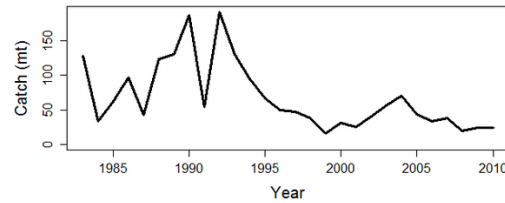
Species_Scenario	mean	std
------------------	------	-----

Instructions:

From the sidebar panel first select the species and then the dataset. Progress from dataset a to dataset d. Background information for the selected species is provided on the top of the main panel. Based on the selected species and dataset the respective graphs of catches and length composition of the stock will appear. Use the scroll bars to capture your belief about stock depletion with the Beta distribution. Once you are 100% sure that the distribution describes your belief, press the Update Table button and your answer will be saved in the table below. Continue same way for the rest of the species. Once you have completed the task, press the download button and save the csv file.

Background info for the species:

Family:Sebastidae, M: 0.035, VBF K: 0.09, Linf: 31 cm, Amax: 80 yrs, L50mat: 25.5 cm, Management started: 1963



[Download](#)



Expert elicitation: stock status

Prior for stock depletion

Select species

Species 1

Select dataset

Dataset a

Scroll the bars to adjust depletion

Mean

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

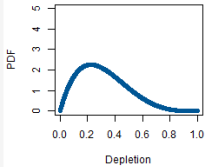
0.31

Sigma

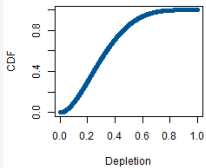
0 0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5

0.17

Beta distribution



Cumulative distribution



Update Table

Table for depletion

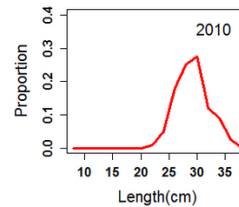
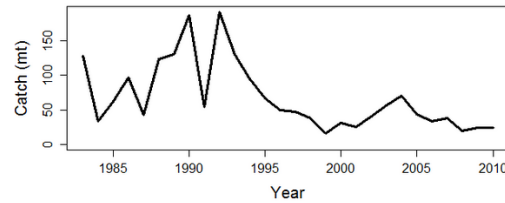
Species_Scenario	mean	std
------------------	------	-----

Instructions:

From the sidebar panel first select the species and then the dataset. Progress from dataset a to dataset d. Background information for the selected species is provided on the top of the main panel. Based on the selected species and dataset the respective graphs of catches and length composition of the stock will appear. Use the scroll bars to capture your belief about stock depletion with the Beta distribution. Once you are 100% sure that the distribution describes your belief, press the Update Table button and your answer will be saved in the table below. Continue same way for the rest of the species. Once you have completed the task, press the download button and save the csv file.

Background info for the species:

Family:Sebastidae, M: 0.035, VBF K: 0.09, Linf: 31 cm, Amax: 80 yrs, L50mat: 25.5 cm, Management started: 1983



[Download](#)

- Accessible
- Easy submission
- Expert calibration



Expert elicitation: stock status

Prior for stock depletion

Select species

Species 1

Select dataset

Dataset a

Scroll the bars to adjust depletion

Mean

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

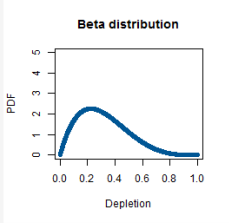
0.31

Sigma

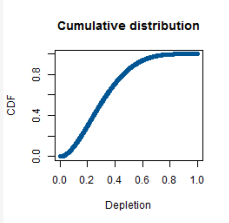
0 0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5

0.17

Beta distribution



Cumulative distribution



Update Table

Table for depletion

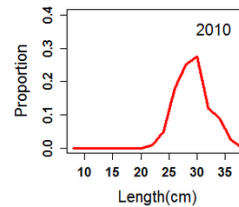
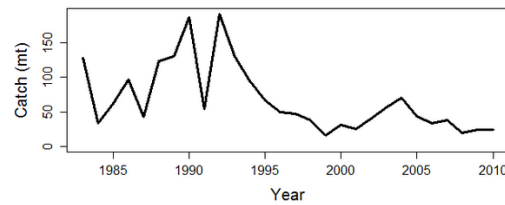
Species_Scenario	mean	std
------------------	------	-----

Instructions:

From the sidebar panel first select the species and then the dataset. Progress from dataset a to dataset d. Background information for the selected species is provided on the top of the main panel. Based on the selected species and dataset the respective graphs of catches and length composition of the stock will appear. Use the scroll bars to capture your belief about stock depletion with the Beta distribution. Once you are 100% sure that the distribution describes your belief, press the Update Table button and your answer will be saved in the table below. Continue same way for the rest of the species. Once you have completed the task, press the download button and save the csv file.

Background info for the species:

Family:Sebastidae, M: 0.035, VBF K: 0.09, Linf: 31 cm, Amax: 80 yrs, L50mat: 25.5 cm, Management started: 1963

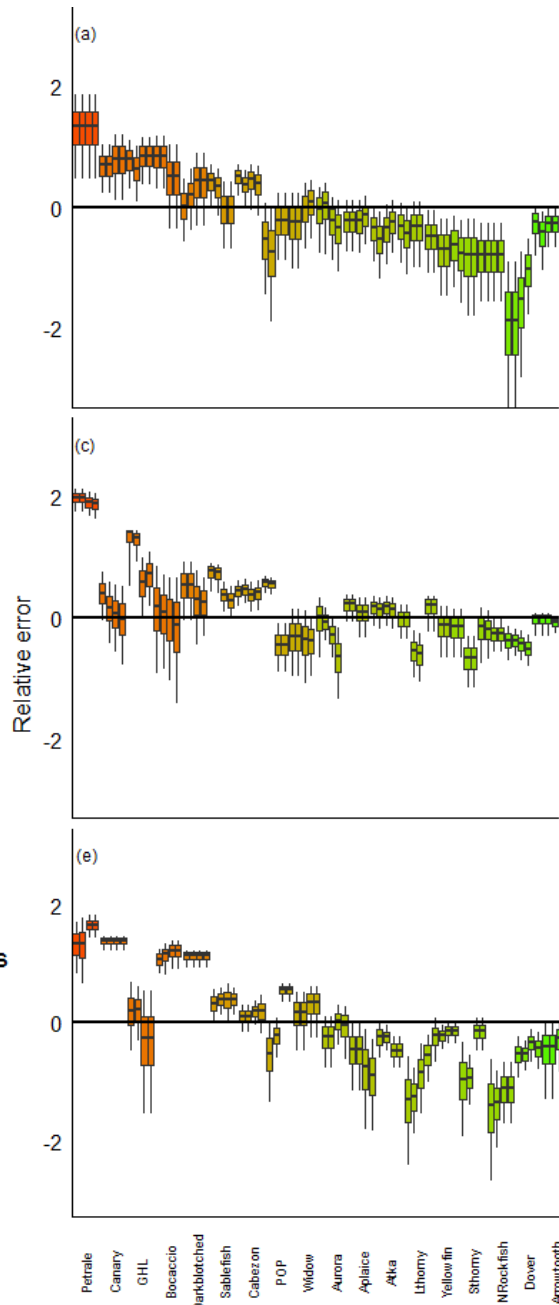


[Download](#)

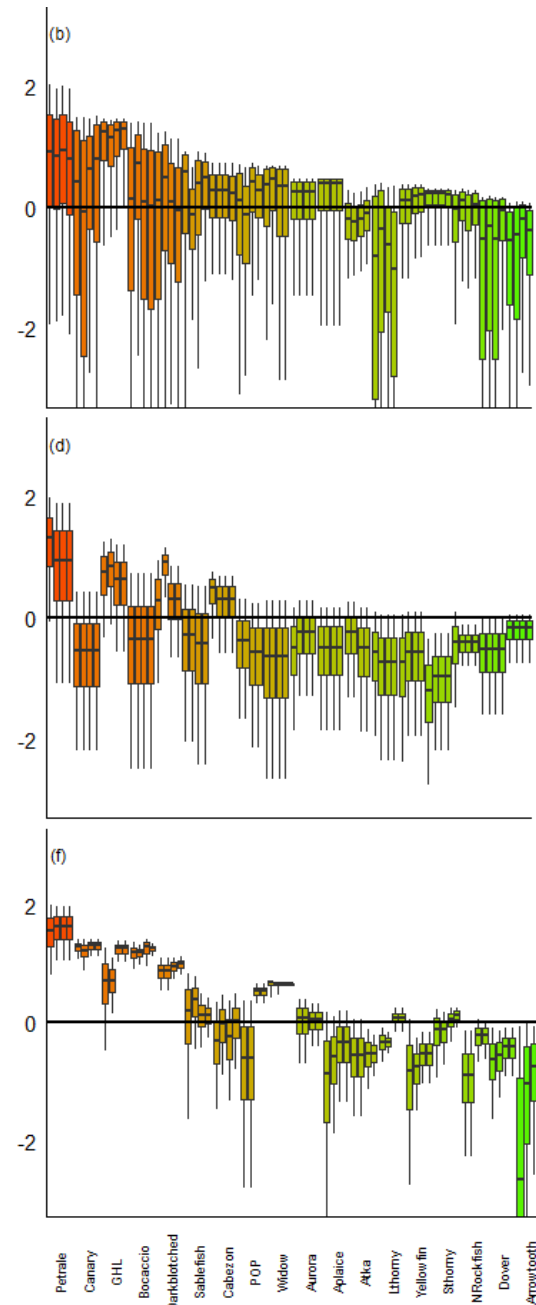
- Natural mortality
- Growth
- Selectivity



Expert 1



Expert 2



Expert

Novice

Inexperienced

For stock status:

- Low status overestimated; high status underestimated
- Similar pattern in bias among expert level
- More expert, more uncertainty recorded

Demo:

Natural mortality tool

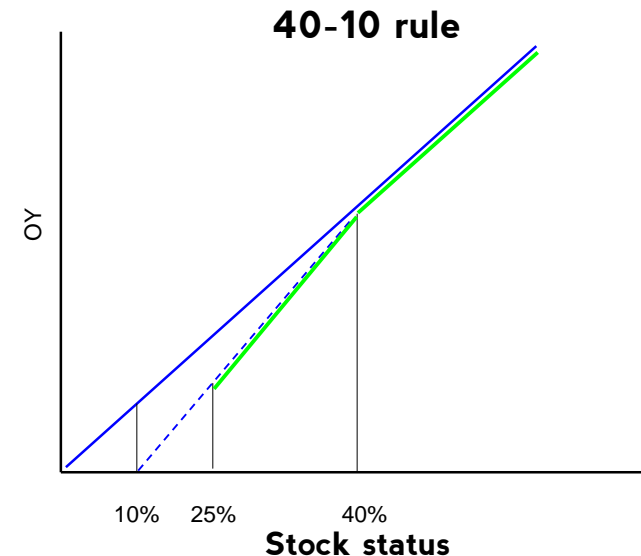
Summary: Uncertainty

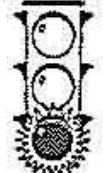

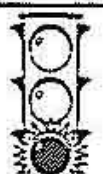


- **A necessary and critical element of assessing stocks and informing management**
 - **Uncertain input values**
 - **Method sensitivity**
- **In data-limited approaches, summarize over two dimensions**
 - **Parameter uncertainty**
 - **Methods uncertainty**
- **Look to improve input values through prioritized research**

**Data-limited fundamental:
Reference points and risk**

Reference points

- Embodies management objectives
 - Biomass (e.g., B_{MSY})
 - Fishing rate (e.g., F_{MSY})
- Target reference points (TRP)- where you want to be
- Limit reference points (LRP)- where you don't want to go
- Proxy RPs (e.g., $F=M$)

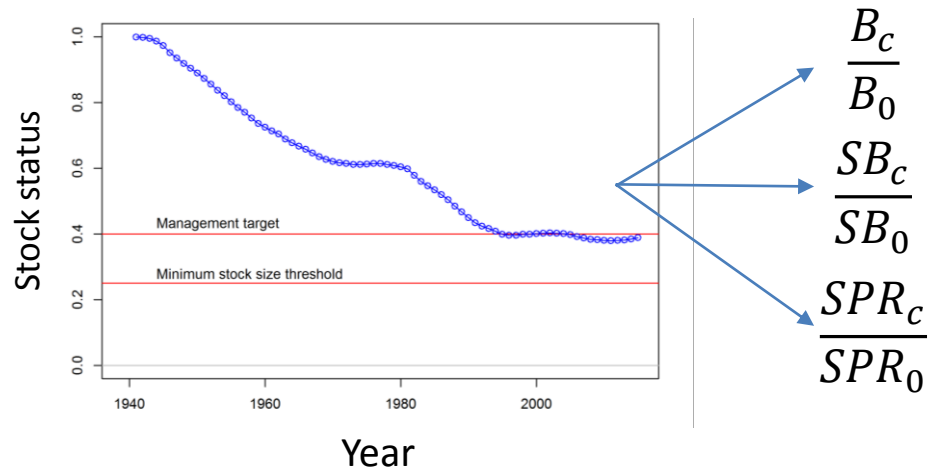


LRP's	STOCK "TRAFFIC" LIGHT
$Z \geq Z^*$?	
$B \leq 0.2B_0$?	
$F \geq xM$?	
$R_t \ll \bar{R}$?	
$F > \begin{cases} 2/3 F_{MSY} ? \\ F_{0.1} ? \end{cases}$	

Spawning Potential Ratio (SPR) Goodyear 1993; MacCall 2012

The ratio of current to unfished spawning output per recruit

$$SPR = \frac{N_0 e^{\sum_{s=1}^r -(M_s + \text{Sel}_s F)} \sum_t m_t f_t}{N_0 e^{\sum_{s=1}^r -(M_s)} \sum_t m_t f_t}$$

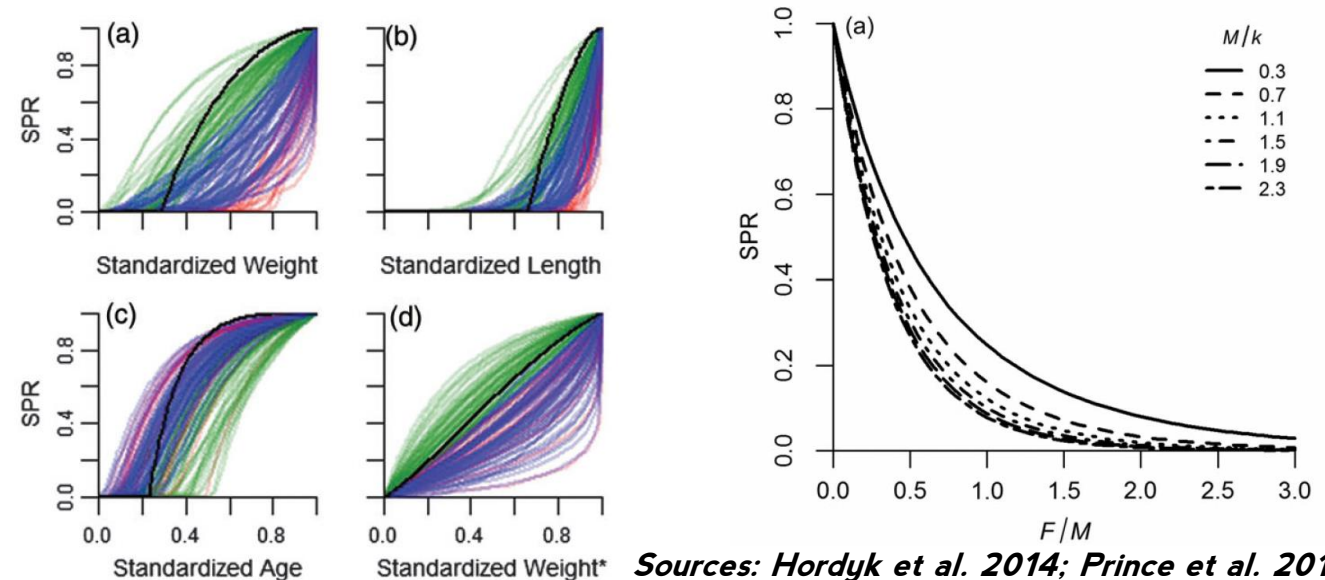
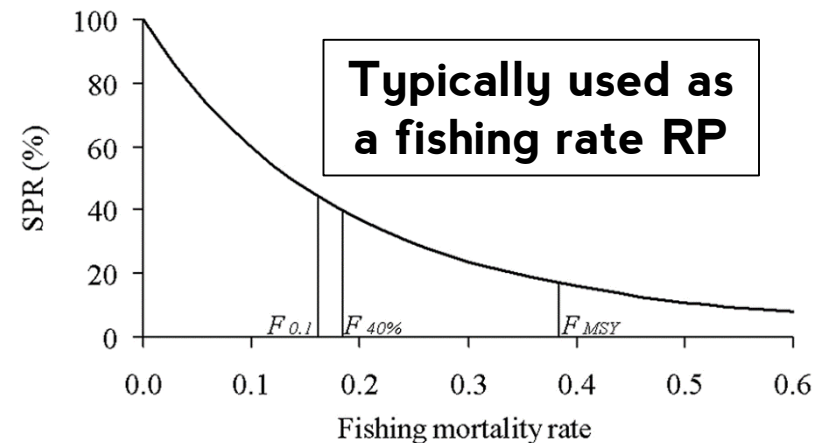


where **B** = biomass


where **SB** = spawning biomass

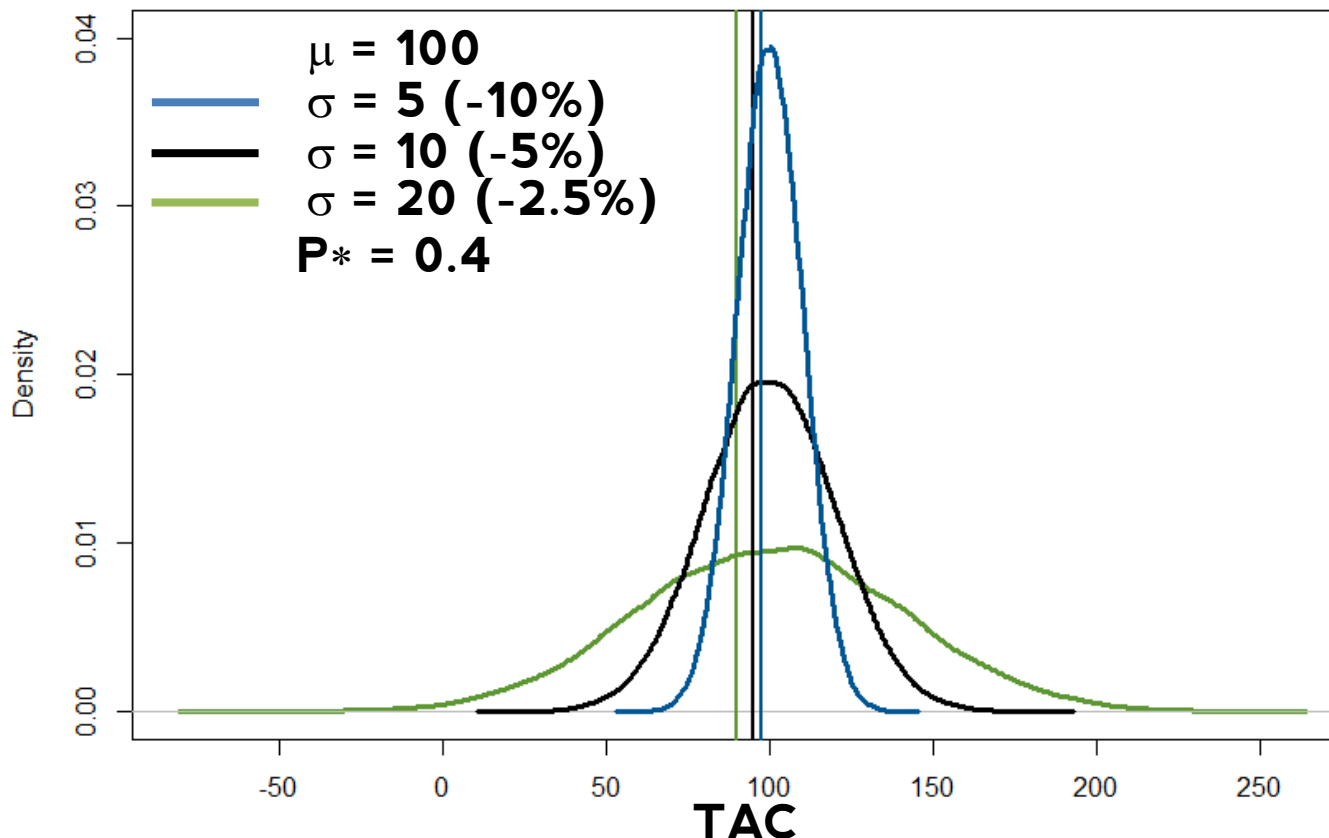
where SPR is in #s or biomass

SPR is tied to life history relationships



Quantifying risk for applied management

- Risk tolerance- willingness to be wrong
 - Depends on life history
 - Depends on data availability & quality
- Data-limited approaches should be risk averse
 - Method output/recommendation
 - Risk tolerance  Management option



Example: “P^{*} approach”

- Precautionary catch limit
- Uncertainty in catch (σ)
- P^{*}: Risk quantile