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# Catchability in Stock Synthesis

FISH 576, Week 8

# CPUE (i.e., index) options in stock synthesis (data file)

0 = Numbers

**1 = Biomass**

2 = F (only for fishery-dependent indices)

>= 30: Special survey types. See SS3 manual.

33 = Age-0 recruits

- Can also specify normal, **lognormal**, or student's-t error distributions

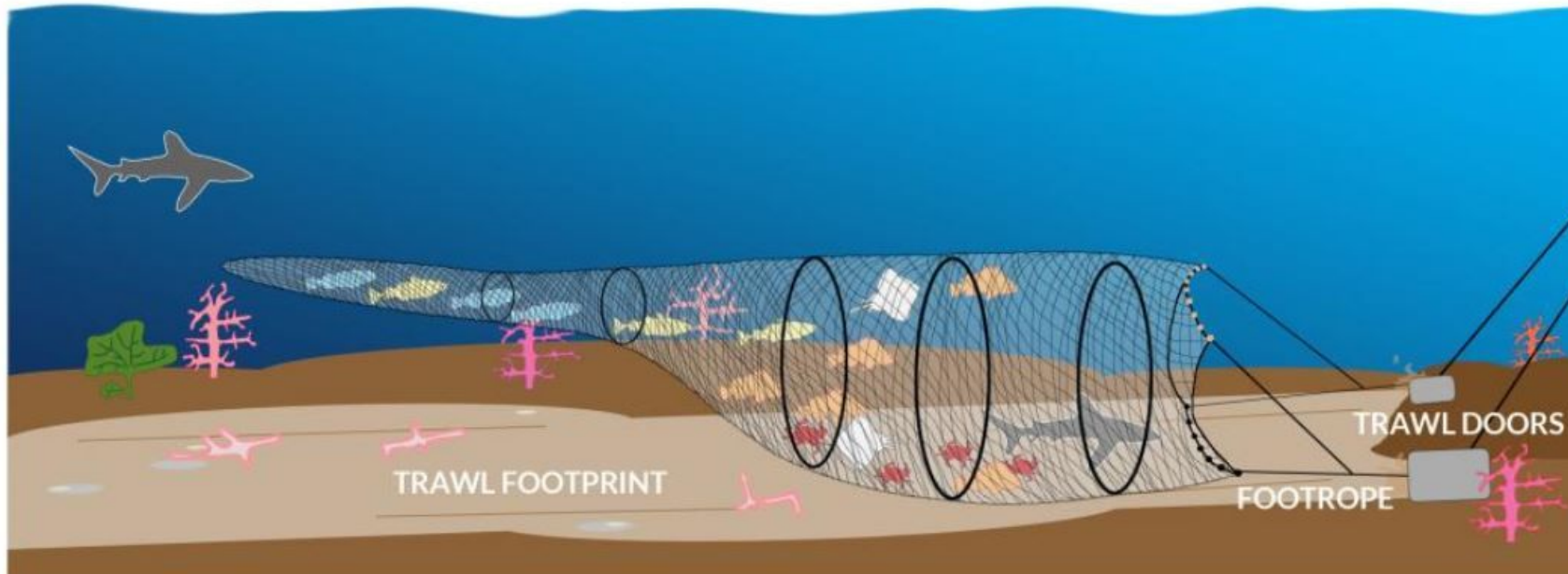


# Catchability

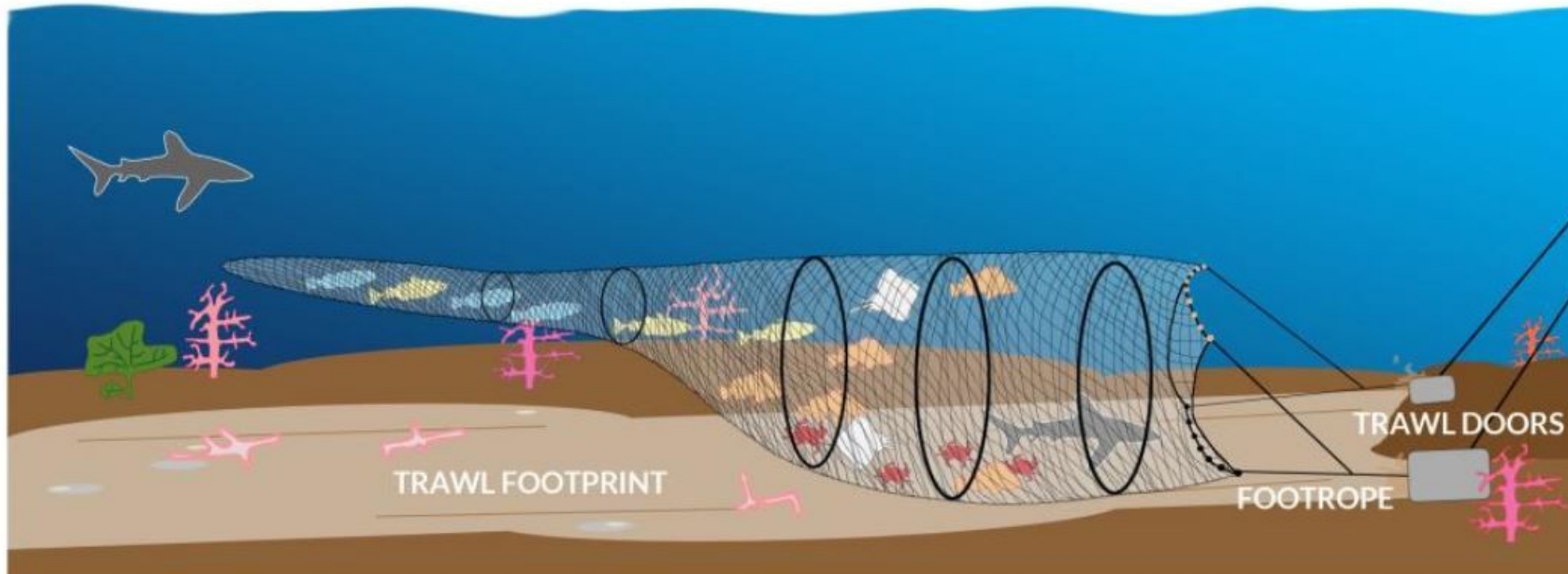
- The scaling factor ( $q$ ) that relates the expected observed abundance by the survey fleet ( $I$ ) to the available population abundance ( $B$ ).

$$\hat{I}_t = q_t \hat{B}_t e^{\varepsilon_t} \quad \varepsilon_t \sim \text{N}\left(0, \sigma_\varepsilon^2\right)$$

# What factors affect catchability?

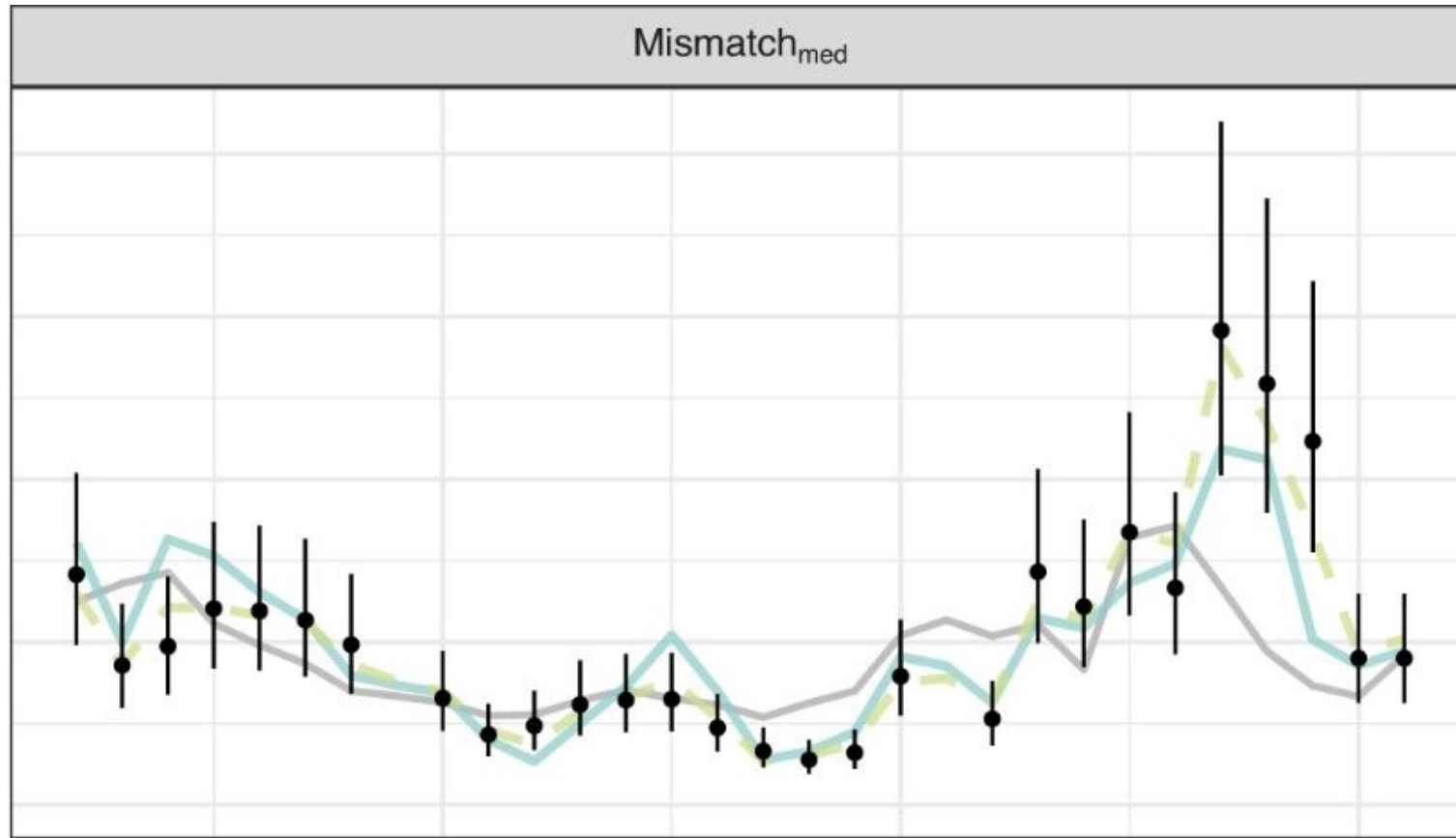


# What factors affect catchability?



- Depth availability
- Latitudinal availability
- Vertical availability
- Habitat availability
- Temporal availability
- Probability of capture (in the net path)

# In reality, catchability may change through time



## Catchability formulation

- constant q
- fixed RW
- RW
- mismatch
- mismatch + RW

Covariates measure how effectively survey sampled pre-spawning aggregations

Rogers et al. (2025) *ICES-JMS*

# Catchability in Stock Synthesis (ctl file)

- Q can be specified as
  - An internally calculated “scaling factor”: float option
  - An estimated model parameter
- If it is a parameter:
  - Can be time varying or environmentally linked
  - Can be density-dependent (e.g., hook saturation)
- Can estimate an extra SE parameter
  - Effectively downweights the index relative to input SE.

# Q link options

1. **Proportional:  $I = Q * B$**
2. Mirror Q from a fleet with lower fleet number
3. Power function:  $I = Q * B^{1 + c}$
4. Mirror Q with scaling factor (two parameters)
  - a. Ex: same “unit effort” for two surveys, but one has a larger sampling area (so you fix the scaling factor)
5. Offset:  $I = Q * (B + b)$ 
  - a. Useful for surveys that “sample” recruitment deviations
6. Offset and power:  $I = Q * (B + b)^{1 + c}$



# Catchability in the control file

**For a setup with a single survey, the Q setup matrix could be:**

Fleet	Link	Link	Extra	Bias		
Num.	Type	Info	sd	Adjust	Float	Label
3	1	0	1	1	0	#Survey
-9999	0	0	0	0	0	#End Read

LO	HI	INIT	<other entries>	PHASE	<other entries>	Block Fxn	Parameter Label
-5	5	-0.12	...	1	...	0	#Survey1 LnQ base
0	0.5	0.1	...	-1	...	0	#Survey1 Extra sd

# In these assessments:

The assessments both include an added SE parameter for every index

- But some SEs are fixed at zero. Which?

Yelloweye includes a time block on Q for the triennial survey. Will need to change “float” from to 0 for this to actually be applied.