Maternal effects on reproductive potential of fishes: evidence of hyper-allometric fecundity and implications for three flatfishes

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NEFSC

Why we are interested in Maternal Effects?

- Hyper-allometry in the fecundity vs. fish weight indicates greater contribution by larger females (challenges assumption that straight SSB is an appropriate metric of population reproduction)

- Maternal effects can be:

→Larger fish produce more eggs- higher fecundity

→Larger fish produce better eggs- higher survival

→Larger fish spawn over a longer time period- bet hedging to ensure some larvae encounter 'good' environment for survival

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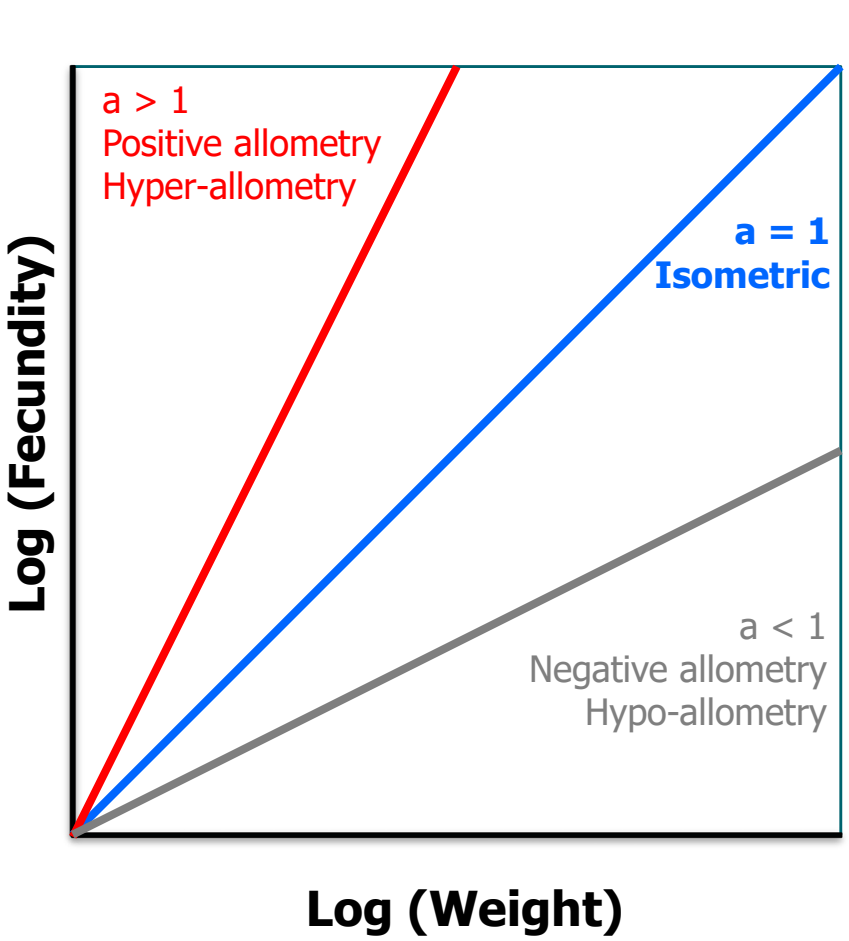
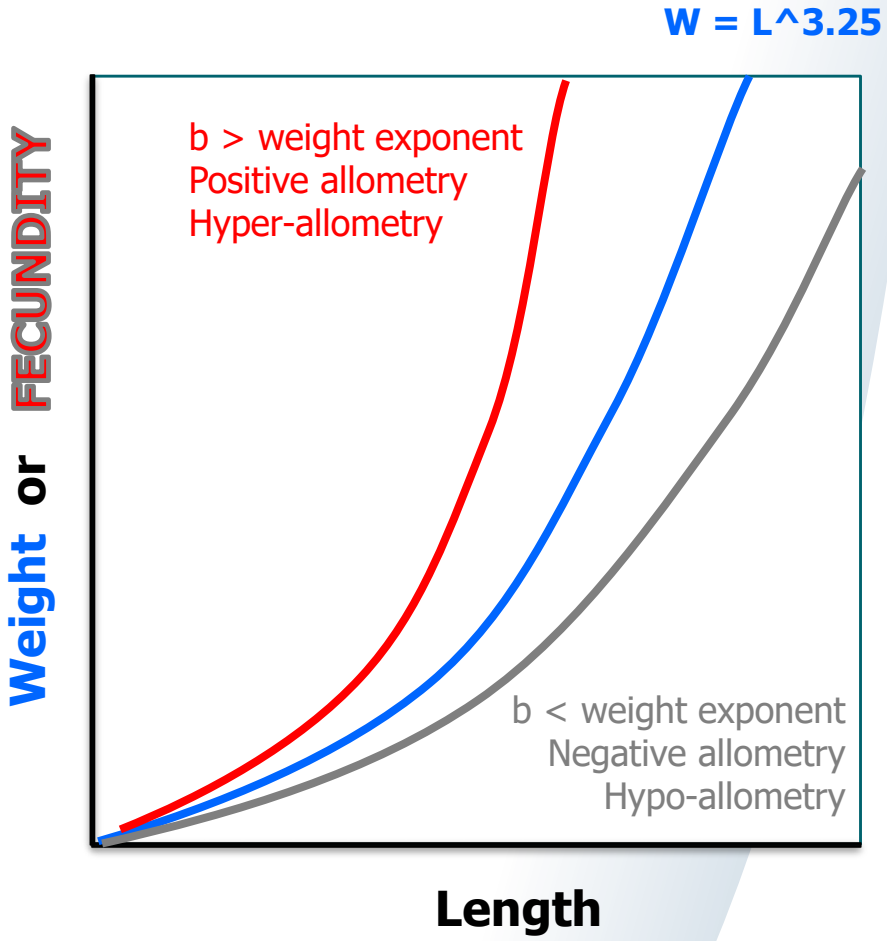
Isometry, Allometry, Hyper-allometry





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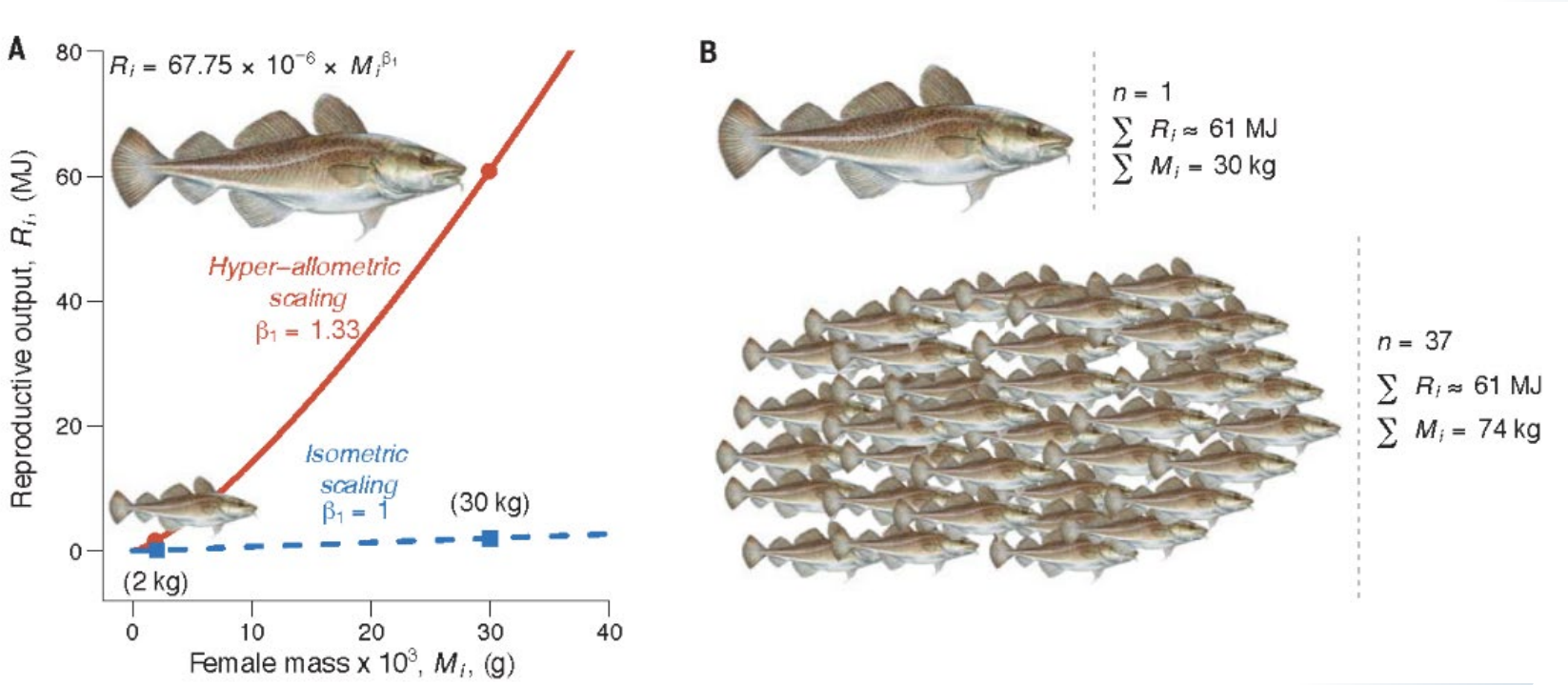
Barneche et al. 2018 *Science*



To match the reproductive energy of a **single** very large female cod requires **37** smaller females and more overall biomass (74 vs 30 kg)

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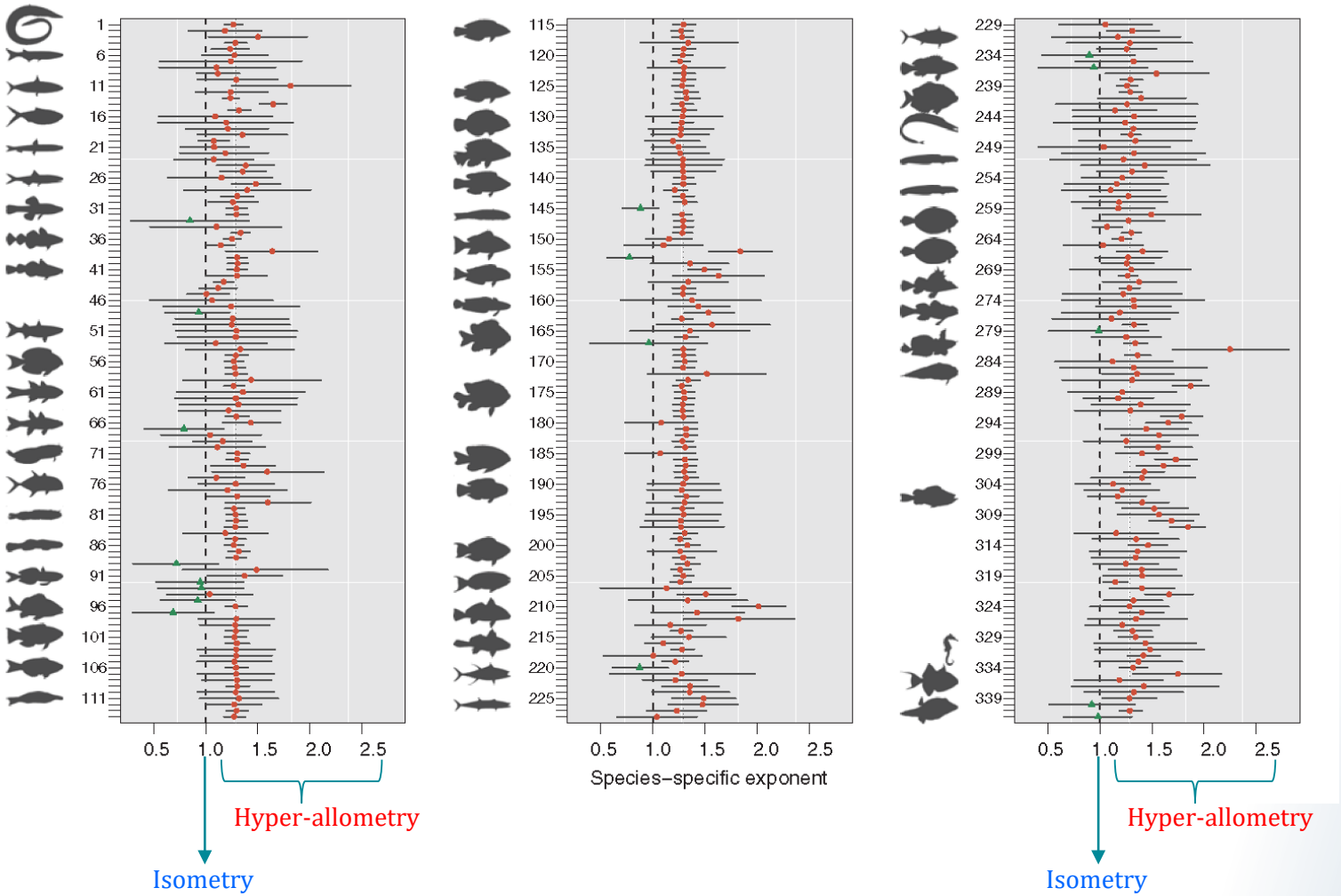

Barneche et al. 2018 *Science*

Hyper-allometry in reproductive energy is common across a broad range of fishes with different life histories

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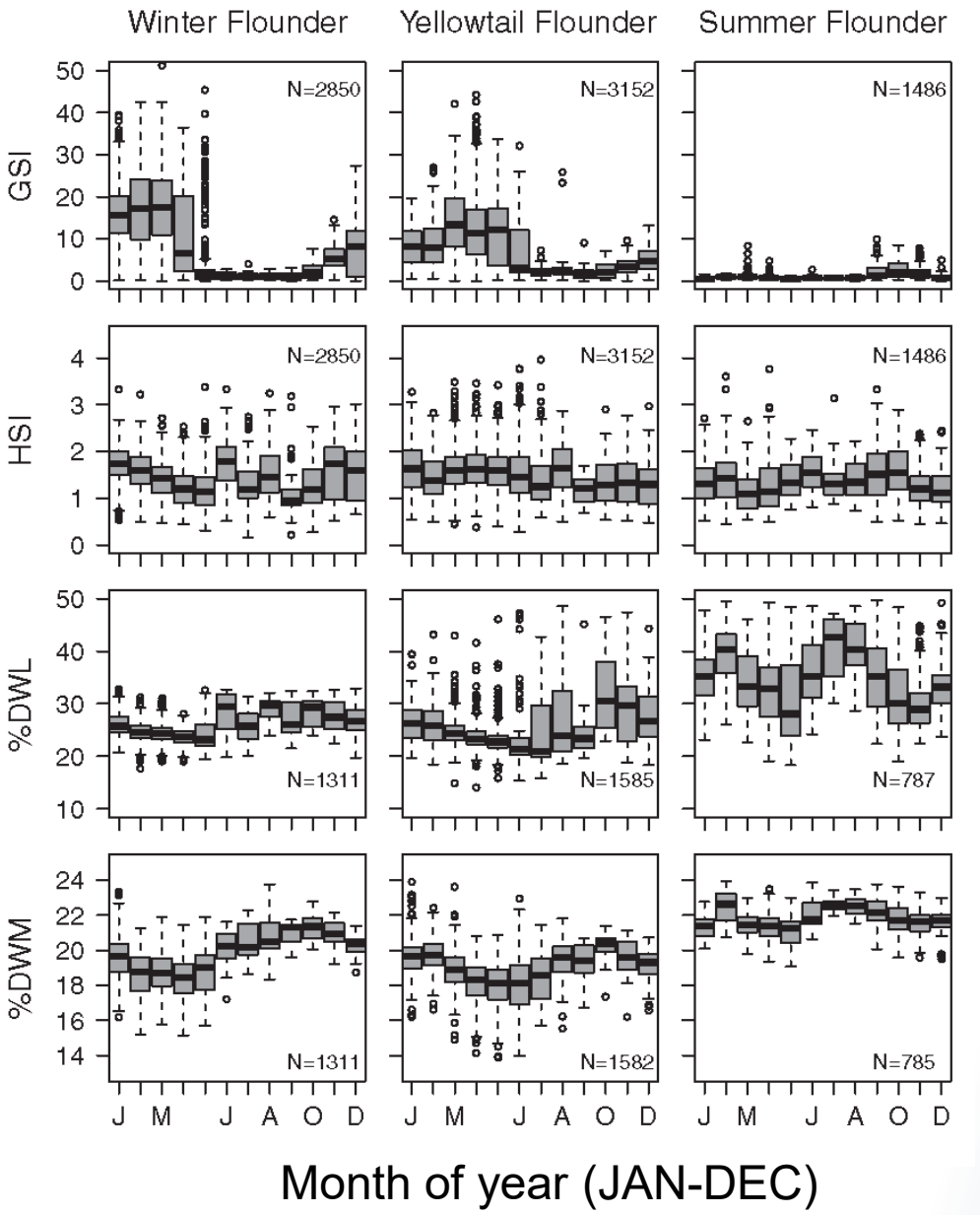
Winter and Yellowtail flounder have group synchronous oocyte development and determinate fecundity- can count all eggs for the season just before spawning

Estimate potential annual fecundity of individuals and relate to size



Summer flounder have asynchronous oocyte development and indeterminate fecundity- can't count all eggs for the season just before spawning

Estimate batch fecundity and the number of batches of individuals and relate to size

Wuenschel et al. 2019 CJFAS

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Winter Flounder

Journal of Sea Research 75 (2013) 52–61

Contents lists available at SciVerse ScienceDirect

Journal of Sea Research

journal homepage: www.elsevier.com/locate/seares

Differences in female individual reproductive potential among three stocks of winter flounder, *Pseudopleuronectes americanus*

W. David McElroy *, Mark J. Wuenschel, Yvonna K. Press, Emilee K. Towle, Richard S. McBride

Recent analysis of 10 years of data (2010-2019)
Hyper-allometry in Fecundity vs Weight- Slope= **1.20**

Yellowtail Flounder

Journal of Sea Research xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Journal of Sea Research

journal homepage: www.elsevier.com/locate/seares

Spatial and annual variation in fecundity and oocyte atresia of yellowtail flounder, *Limanda ferruginea*, in U.S. waters

W. David McElroy [a,b,*], Mark J. Wuenschel [b], Emilee K. Towle [a,b], Richard S. McBride [b]

Recent analysis of 10 years of data (2010-2019)
Hyper-allometry in Fecundity vs Weight- Slope= **1.33**

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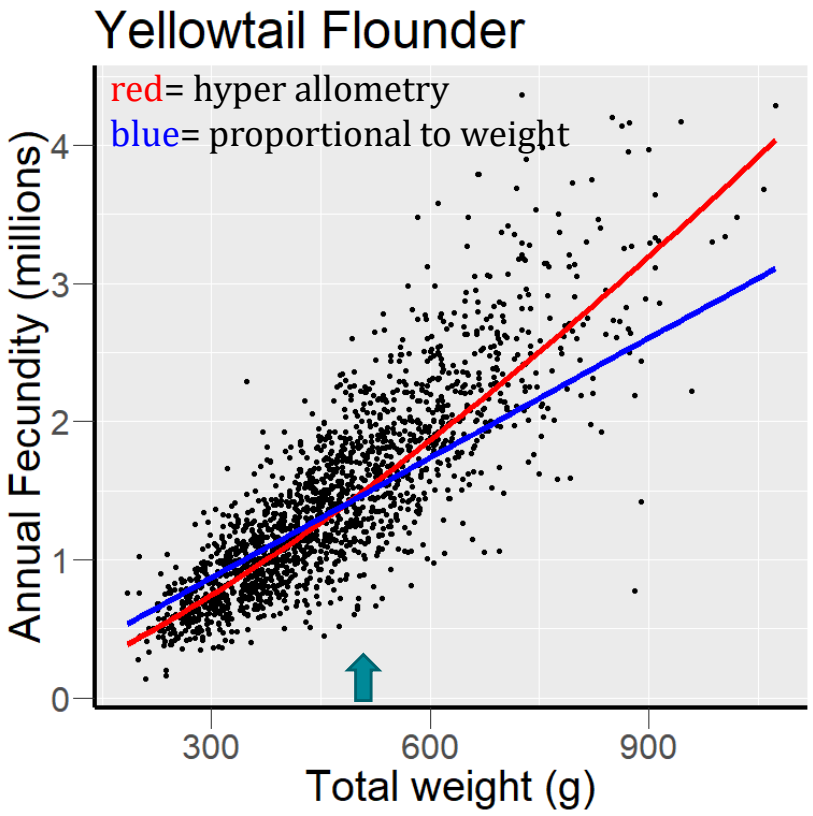
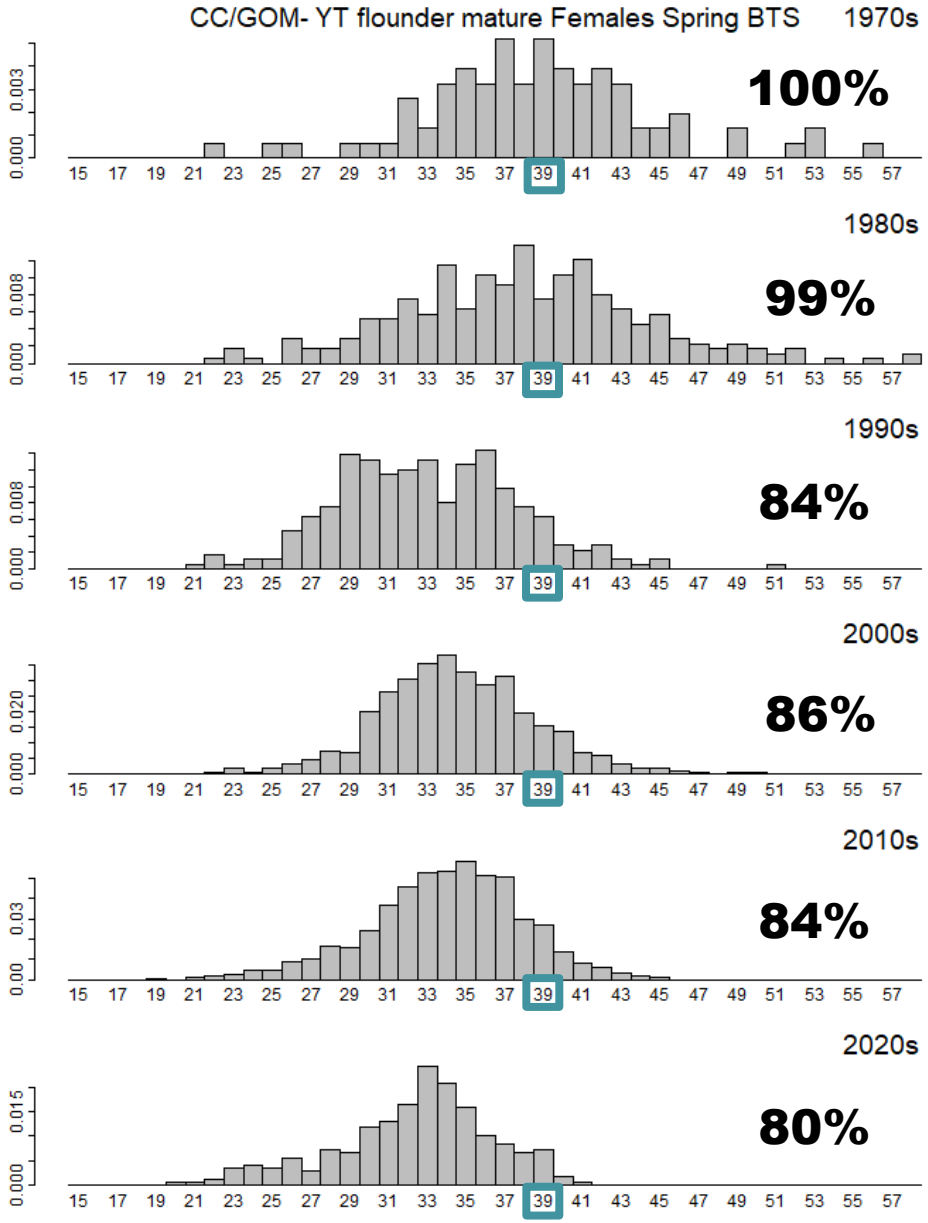




Proportions at Length scaled to equal biomass for each decade

- Decline in **reproductive value** (Fecundity) relative to 1970s
- Besides concurrent declines in SSB, the quality of remaining SSB has decreased

<u>Caveats/assumptions</u>

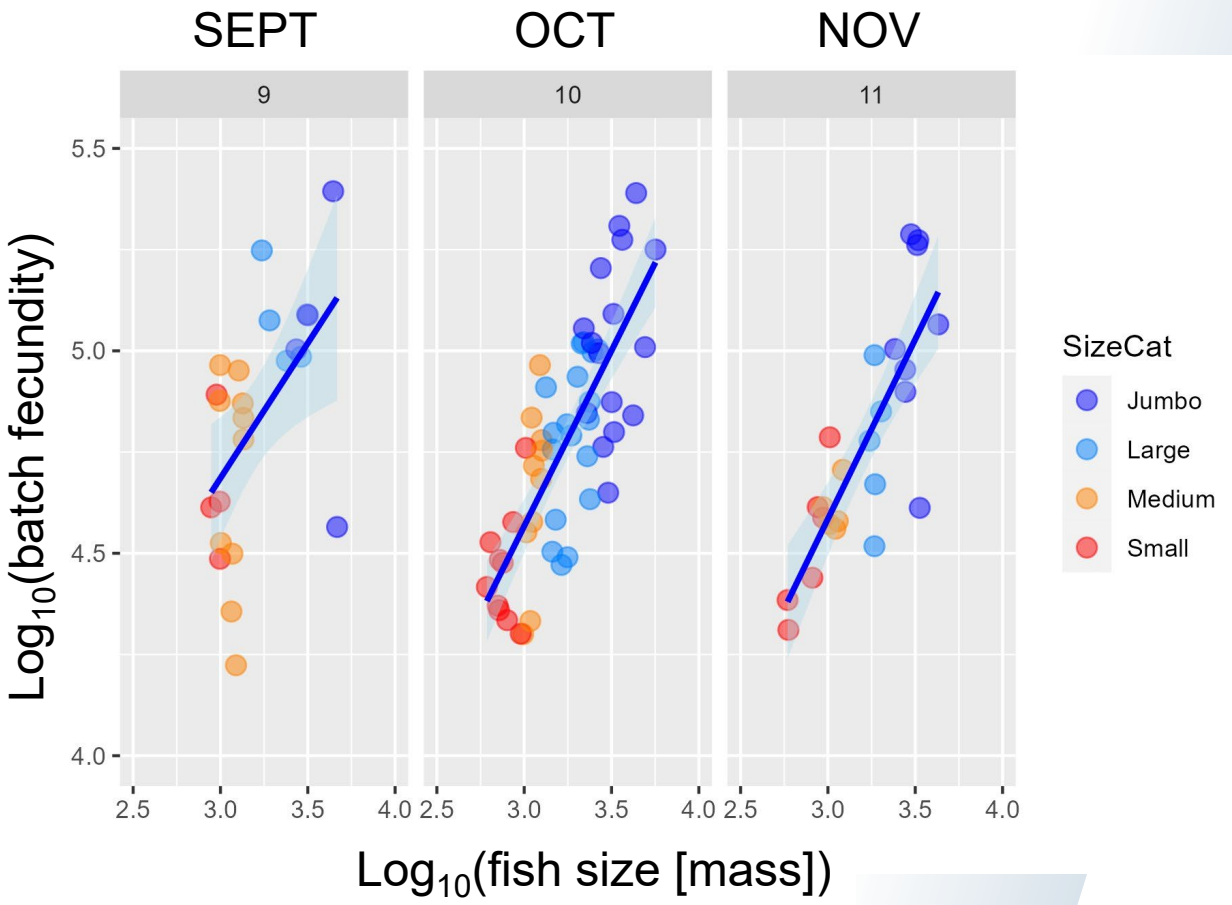
- Fecundity at length hasn't changed
- Survey catches representative of popn
- Only accounts for # of eggs, not quality of eggs

Summer Flounder

Batch fecundity is higher for larger fish
- Jumbo (>60 cm)
- large (50.5-60 cm)
- medium (46-50 cm)
- small (<46 cm)

But batch fecundity is isometric with fish size (mass)

Slope not different from 1 (95% confidence limits)



Trait	Min.	Max.
Length	40 cm	75 cm
Mass	587 g	5647 g
Batch Fec.	16.7K	247K

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Summer Flounder

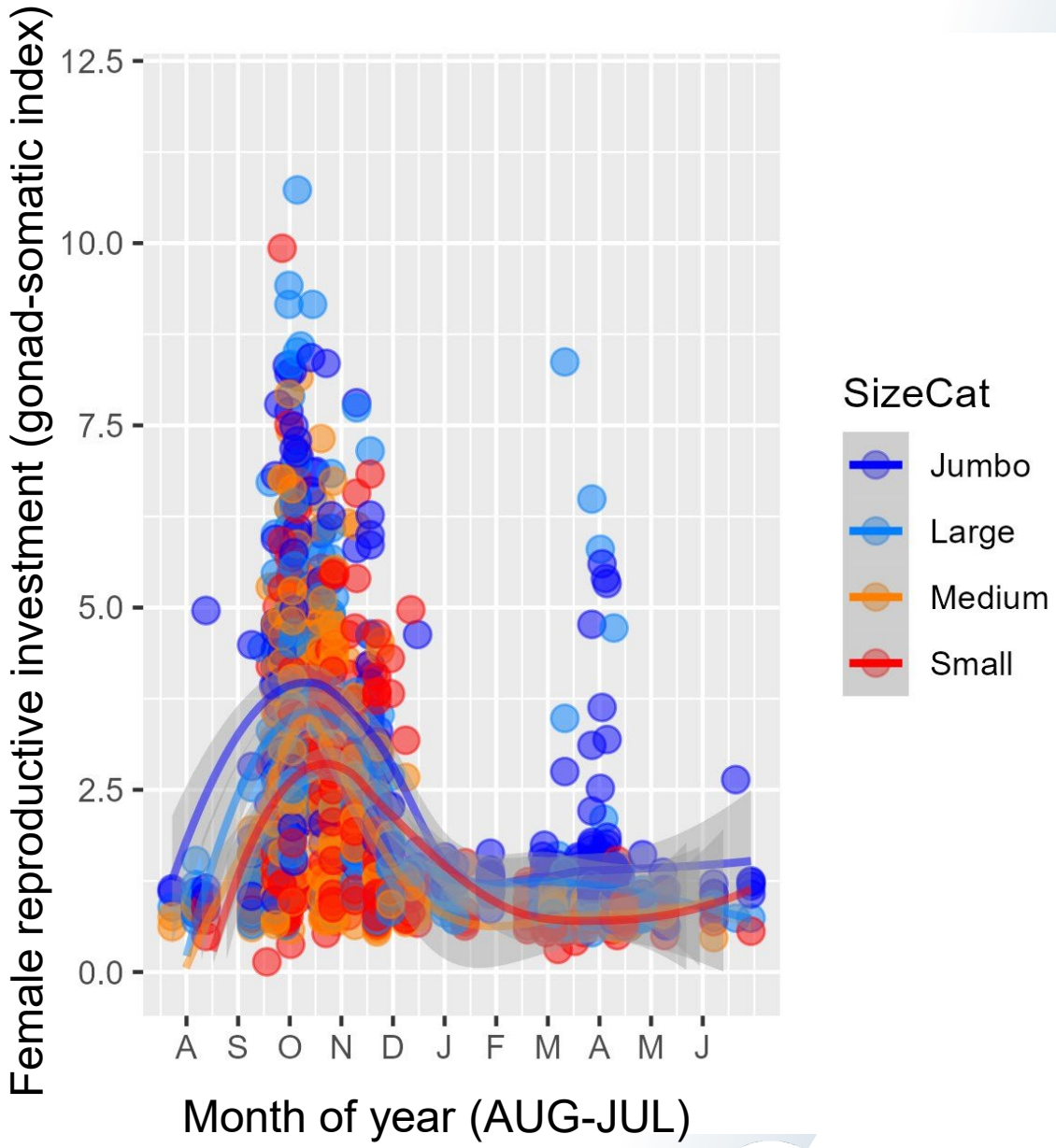
Spawning frequency is higher for the largest fish

Jumbo (36 days)
Large (34 days)
Medium(30 days)
Small (30 days)

Moreso, the large and jumbo females spawn in two seasons (Fall & Spring)

Preliminary estimate of Annual fecundity

40 cm – 79K eggs
75 cm – 574K eggs



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Implications for management

- Hyperallometry in the fecundity vs. fish weight indicates greater contribution by larger females
- → benefit to having diverse size/age structure

- Slot limits can be effective for recreational fisheries, but difficult to implement in many commercial fisheries

- Closed areas and/or seasons can protect a 'reservoir' of larger older females in a population

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Implications for management

- Hyperallometry in the fecundity vs. fish weight indicates greater contribution by larger females
- → benefit to having diverse size/age structure

- SSB alone may not a reliable index of reproductive potential – size structure matters, and truncated distributions may require more SSB to attain expected reproductive potential

- Total egg production can be calculated from numbers and sizes at age
  - incorporates maternal effects
  - can be used as an alternative to SSB
  - West Coast Rockfish examples

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Acknowledgements

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