

Testing a new hypothesis on the persistence of *Calanus finmarchicus* in the Gulf of Maine:

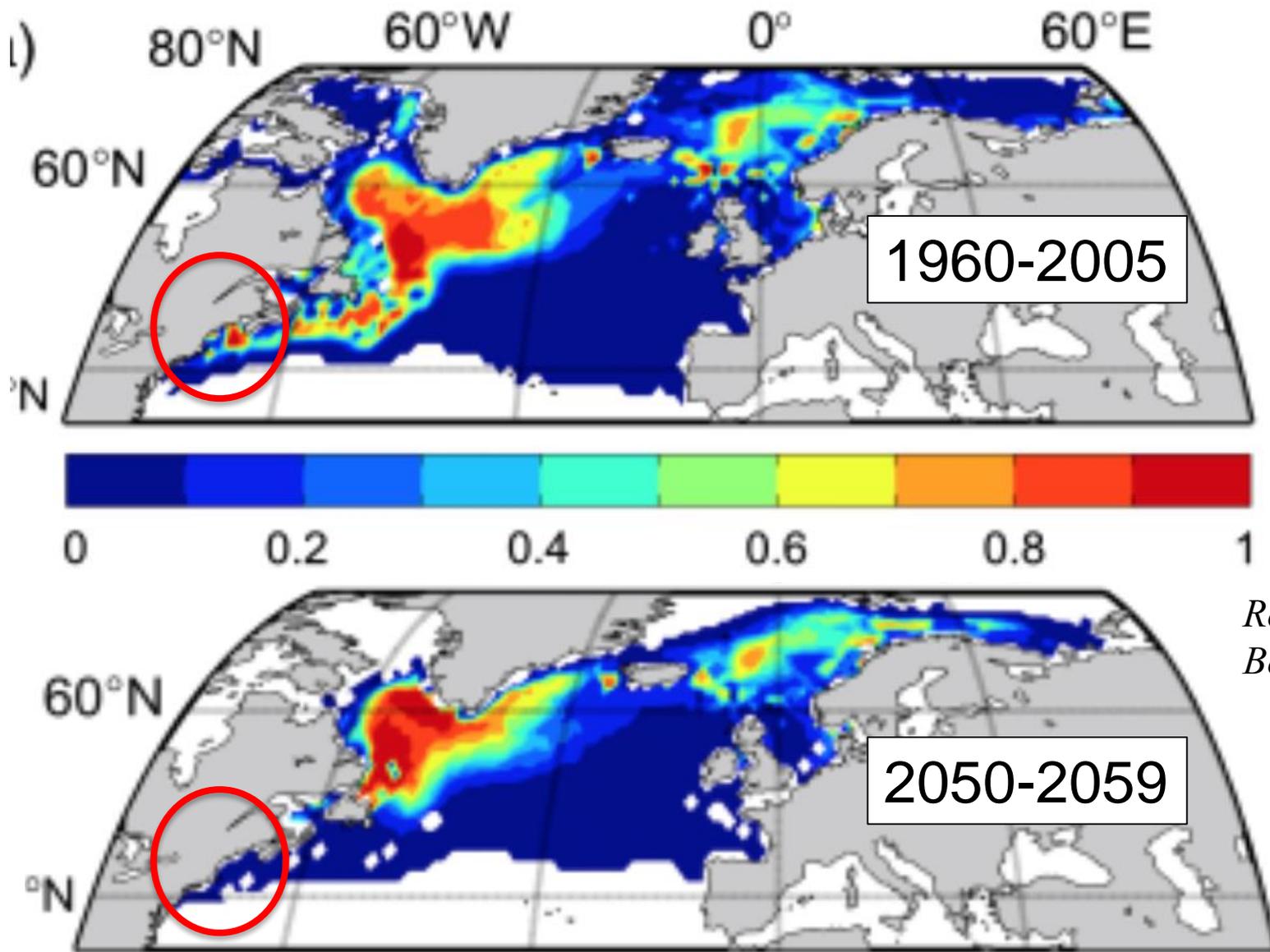
Coastal Amplification of Supply and Transport (CAST)

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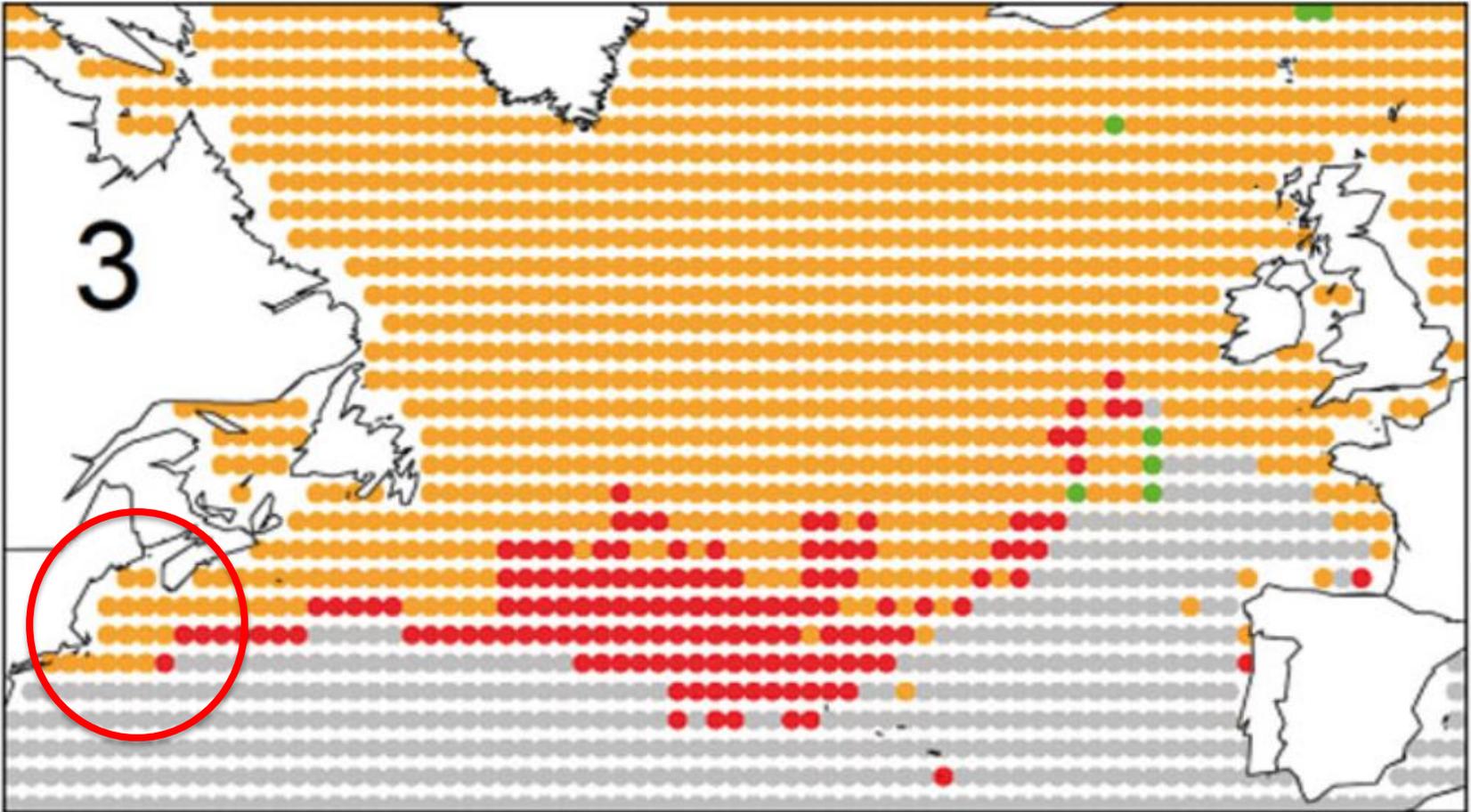
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2. *University of Maine, GMRI, USA*
3. *University of Massachusetts Dartmouth, USA*
4. *Bigelow Laboratory for Ocean Sciences, USA*

Predicted future looks grim

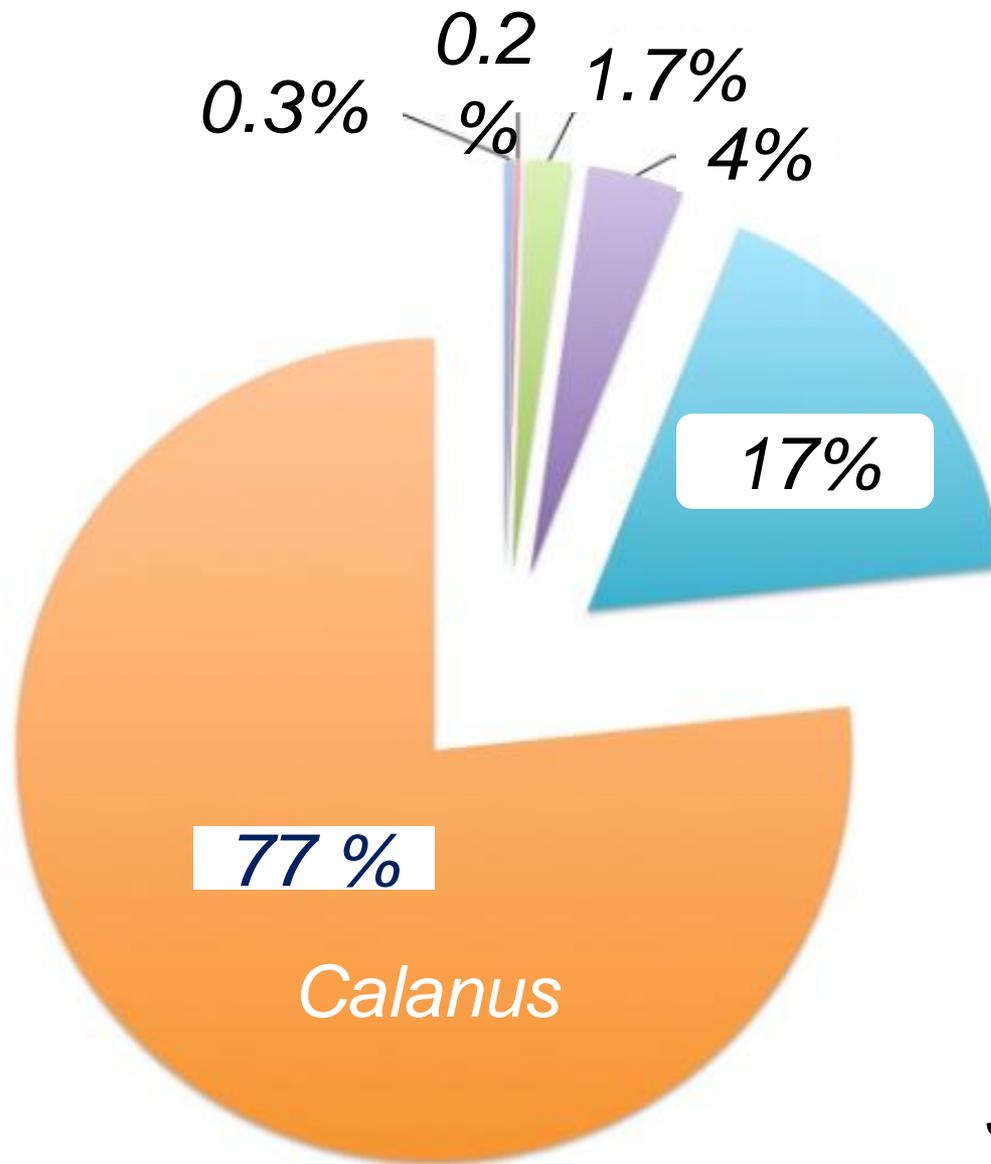


*Reygondeau &
Beaugrand, 2011*

... but also uncertain



Villarino et al., 2015



Diet of Atlantic herring in June in the western Gulf of Maine

- Other
- Krill
- Pseudocalanus
- Metridia
- Copepod
- Calanus

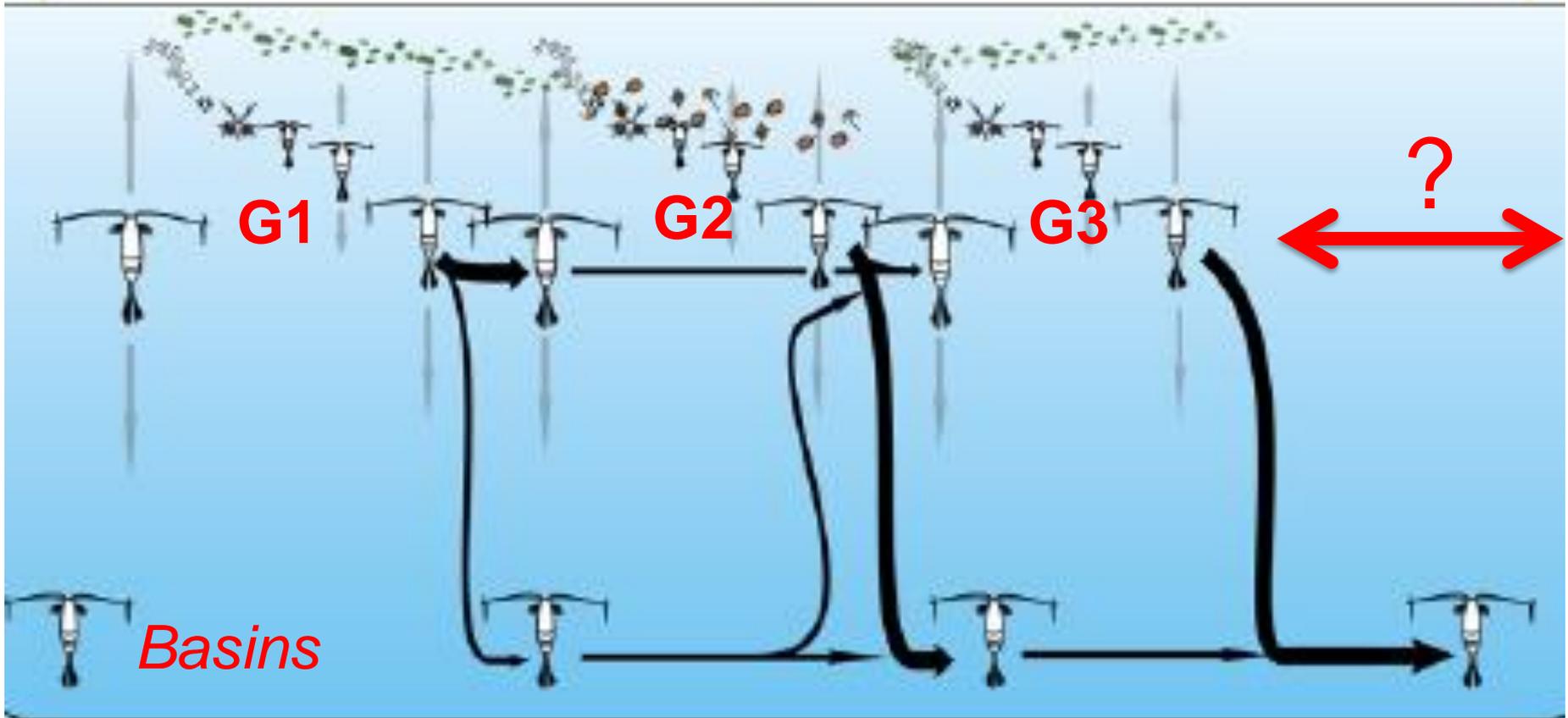
Classical paradigm

Winter

Spring

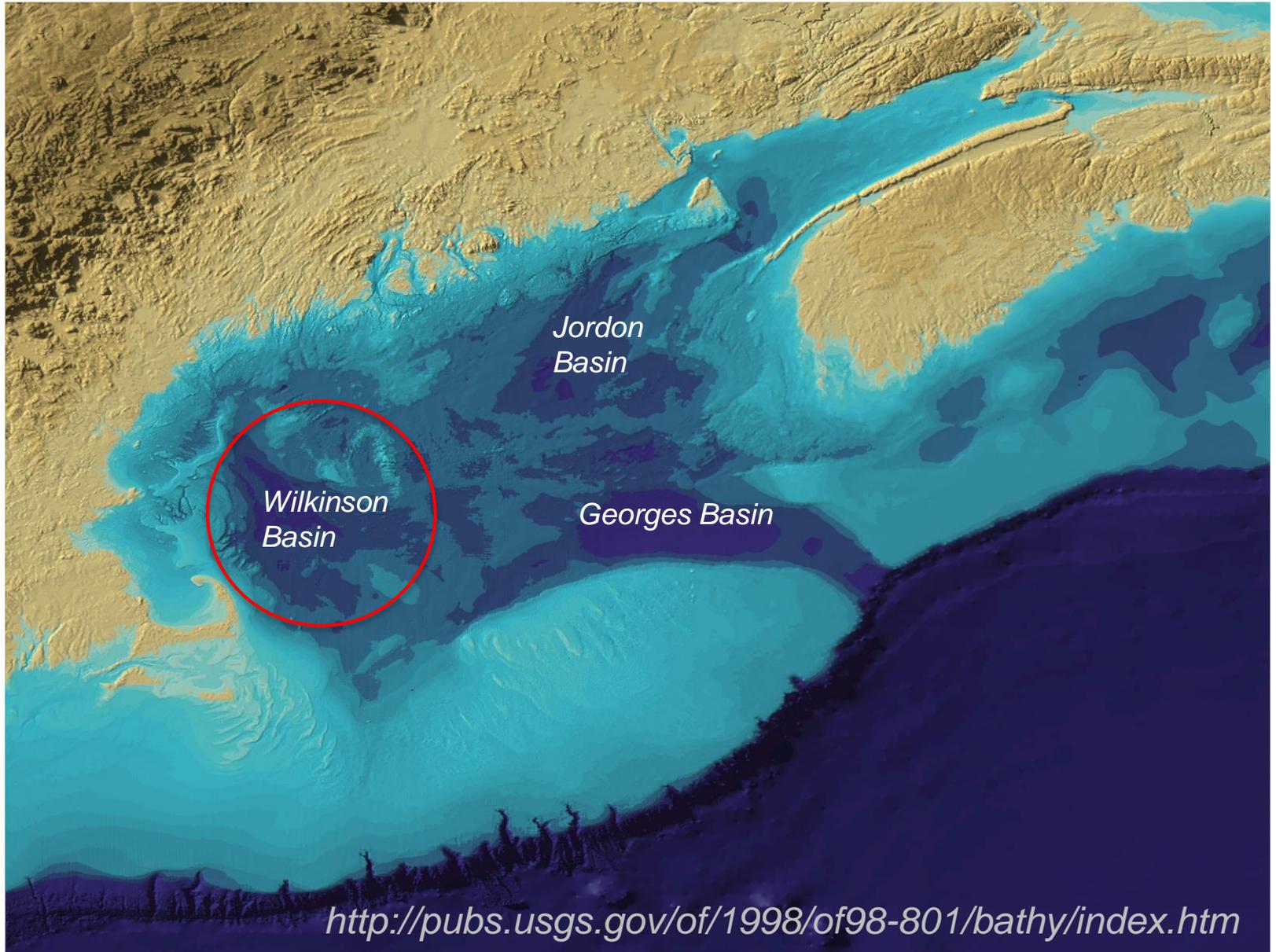
Summer

Fall

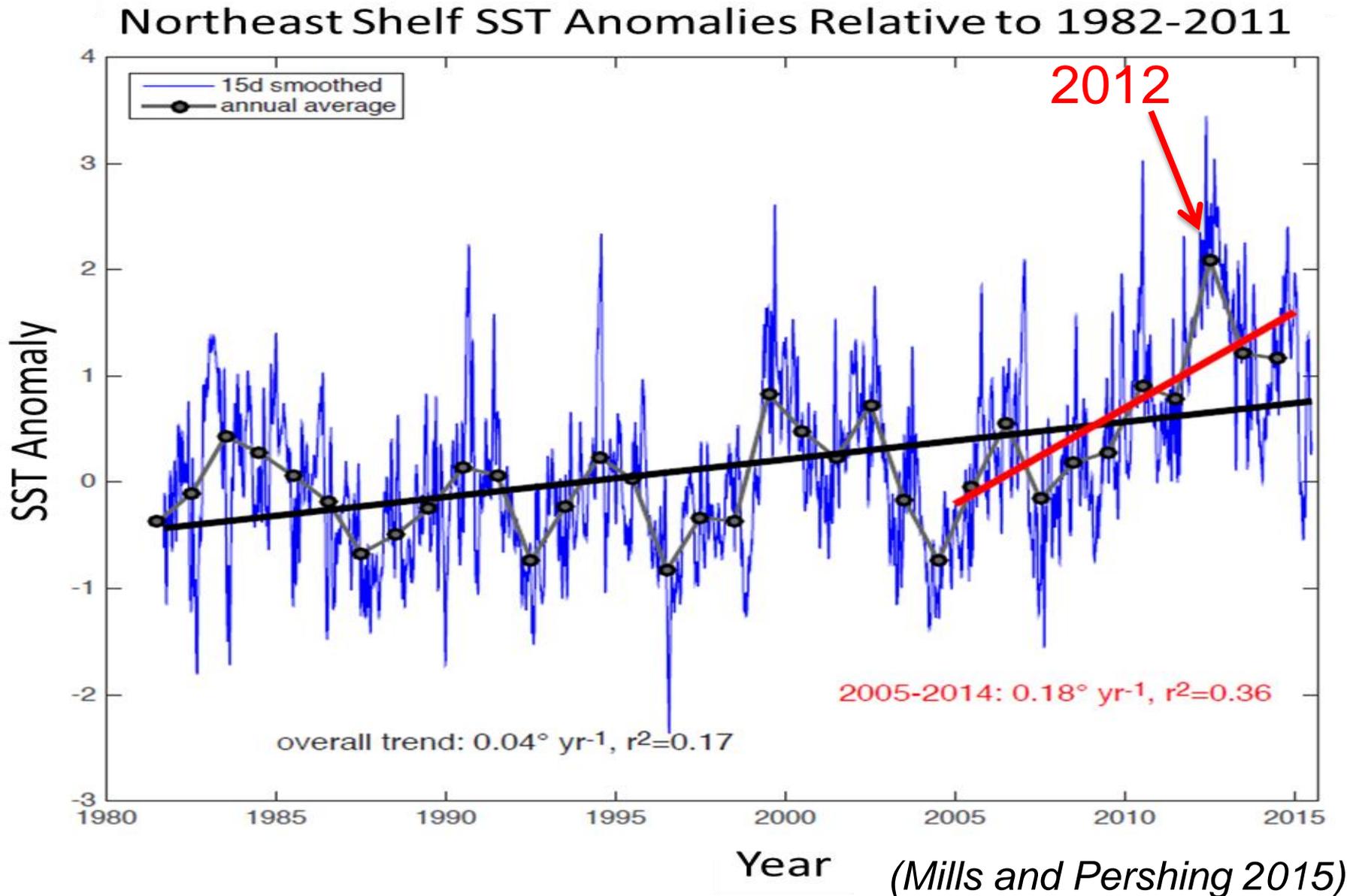


13 Life Stages: Egg; NI-NVI; CI-CVI

Classical paradigm

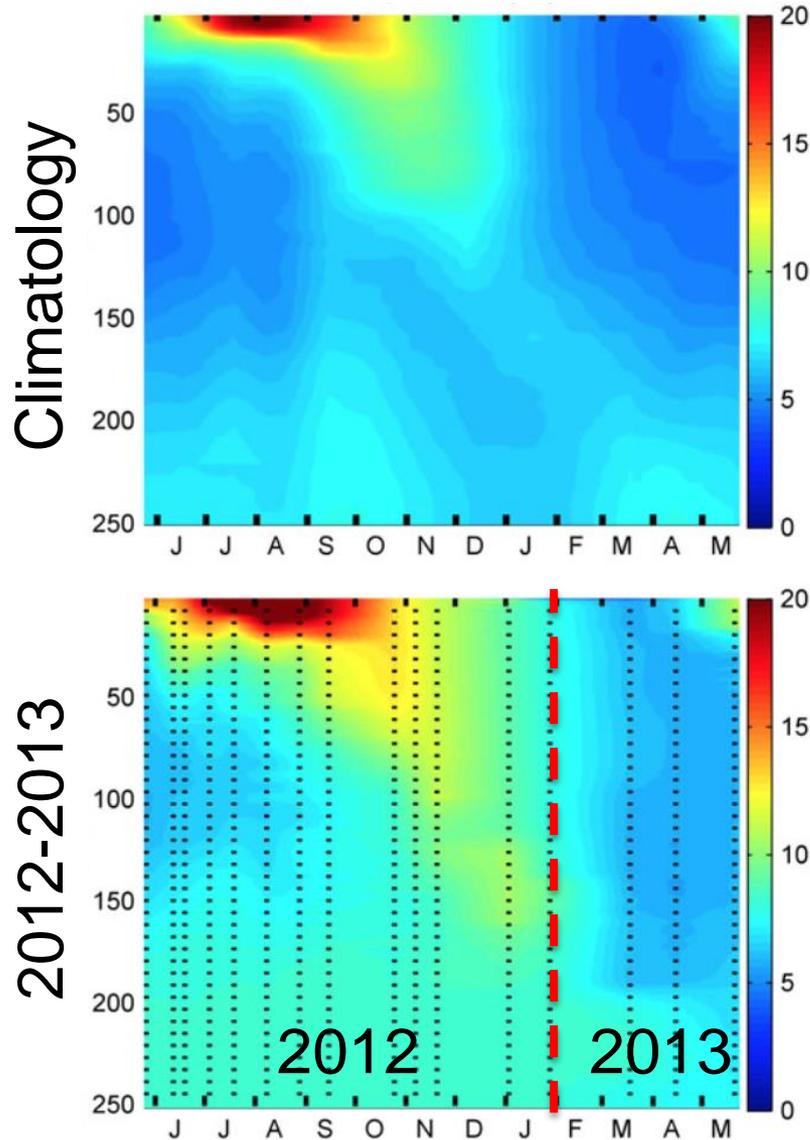


Warming as the main threat

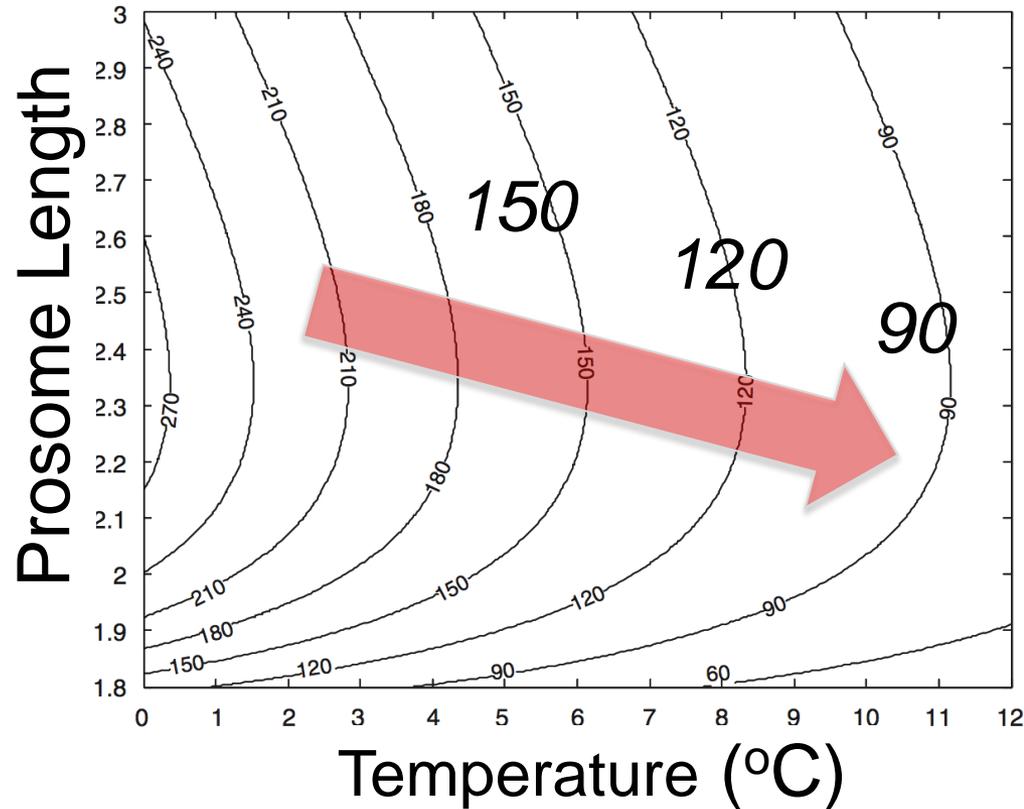


Hot 2012 and expected impact

Temperature

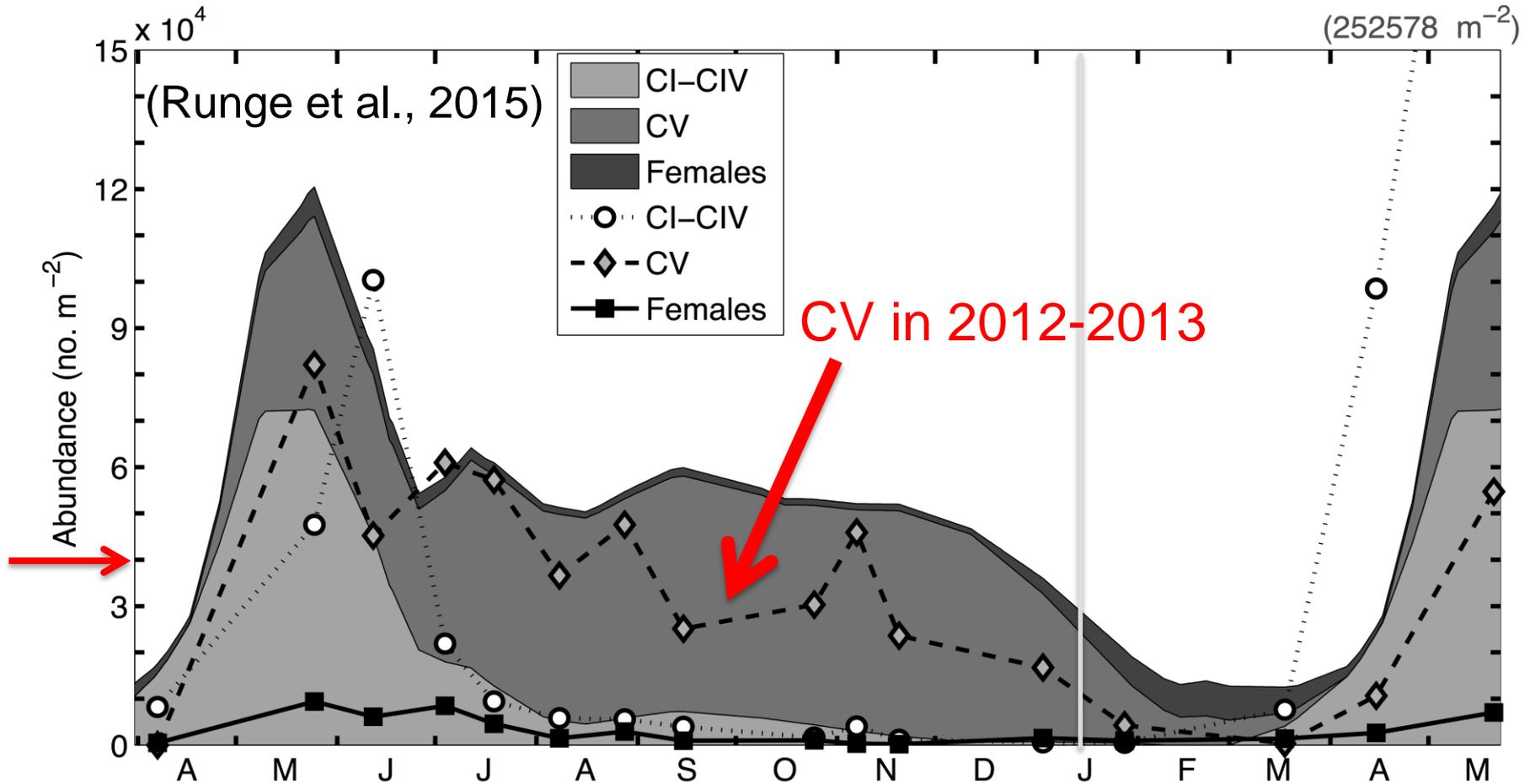


**Growth rate; size;
Diapause duration**



Saumweber & Durbin 2006; Pierson et al., 2013

To our surprise ...



- ❑ CV abundance in Wilkinson Basin in 2012 were high and not significantly different from the historical average.
- ❑ CV population in Wilkinson Basin comprised individuals entering diapause later in summer

Coastal Amplification of Supply and Transport (CAST) hypothesis

Adult female reproduction in the upstream source.

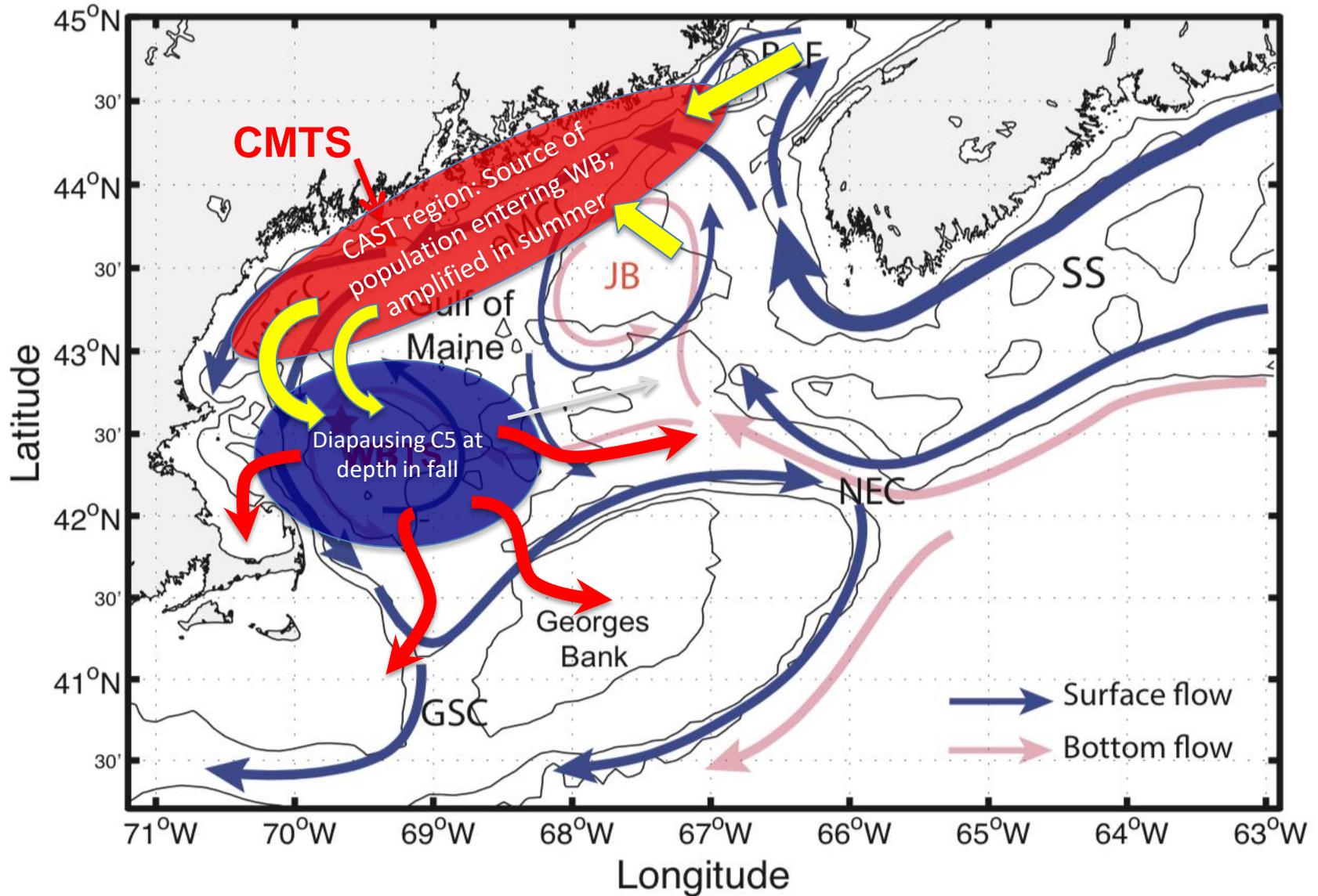
Amplify coastal production to feed copepods.

Physical forcing conducive to advective supply.



Mechanisms supporting persistence of a key plankton species during climate change on the Northwest Atlantic continental shelf

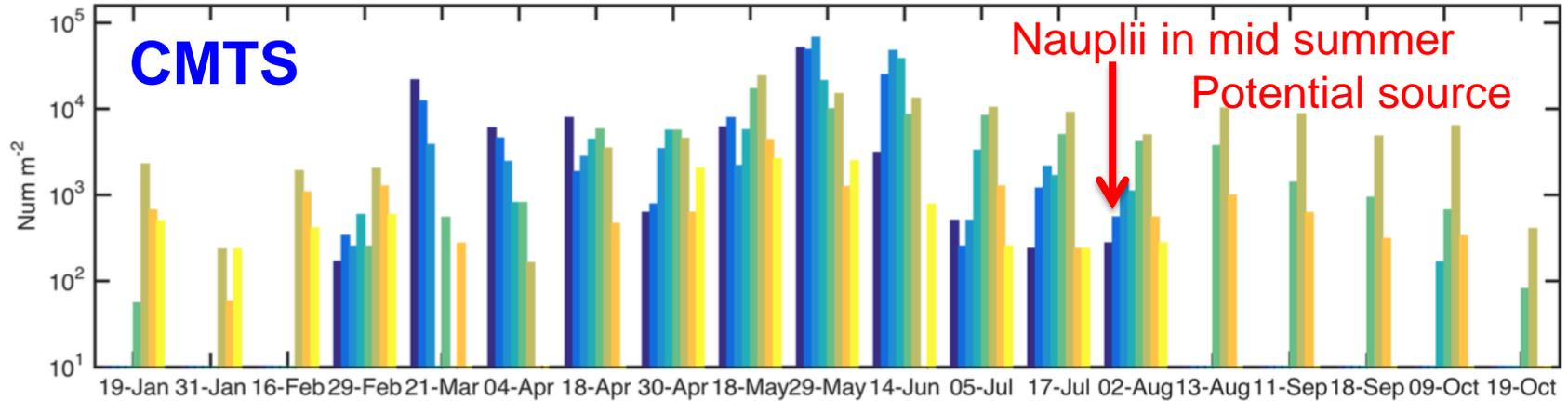
Lead to new hypothesis



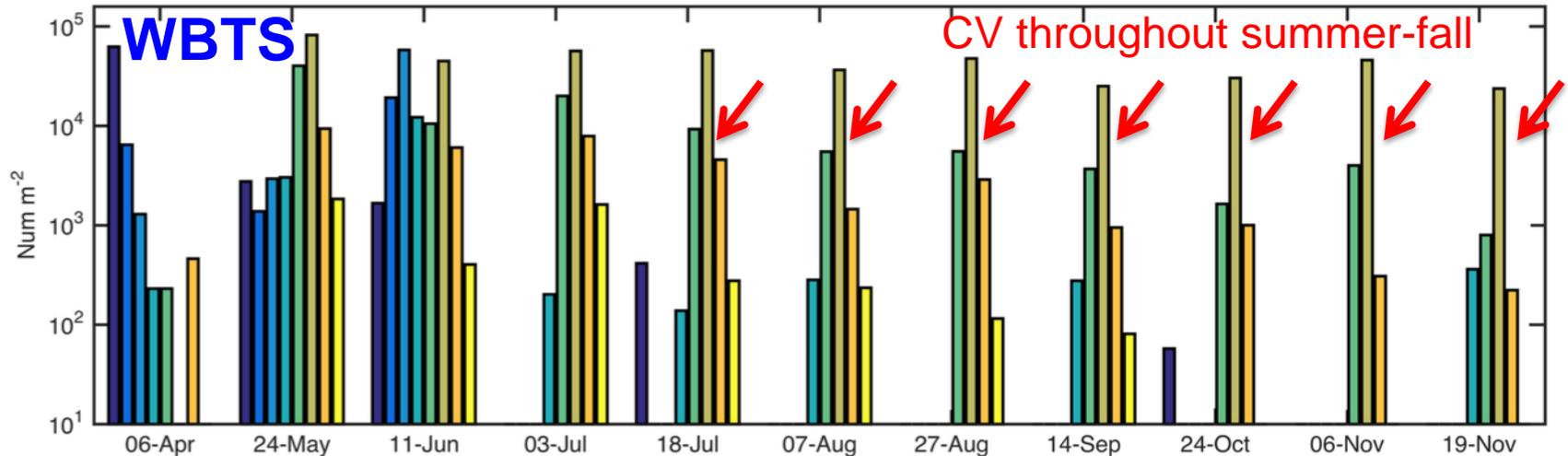
Supporting evidence from data



CMTS *C. finmarchicus* abundance in 2012

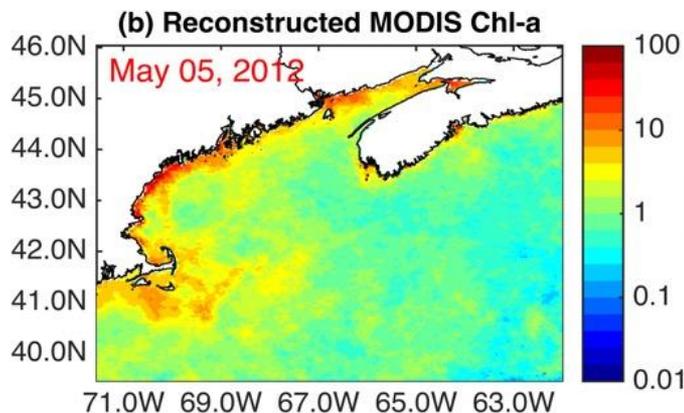
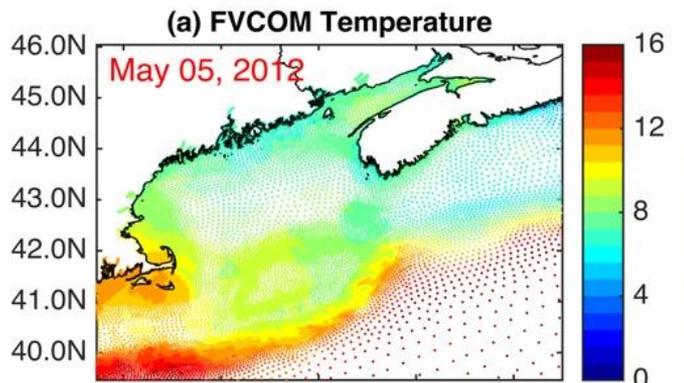


WBTS *C. finmarchicus* abundance in 2012



Supporting evidence from model

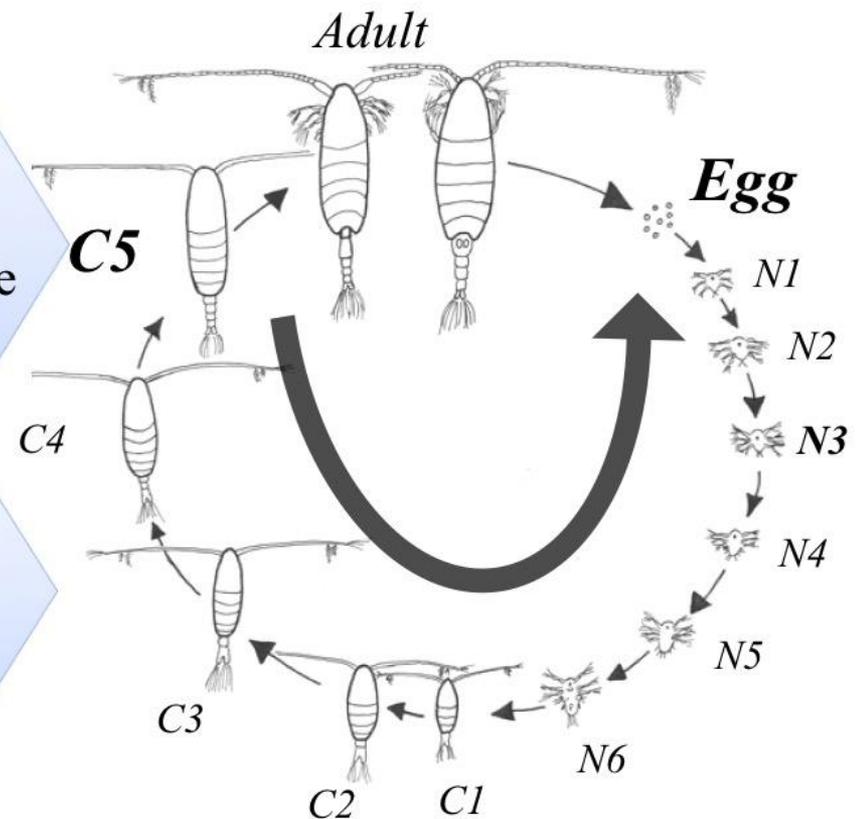
IBM backward tracking



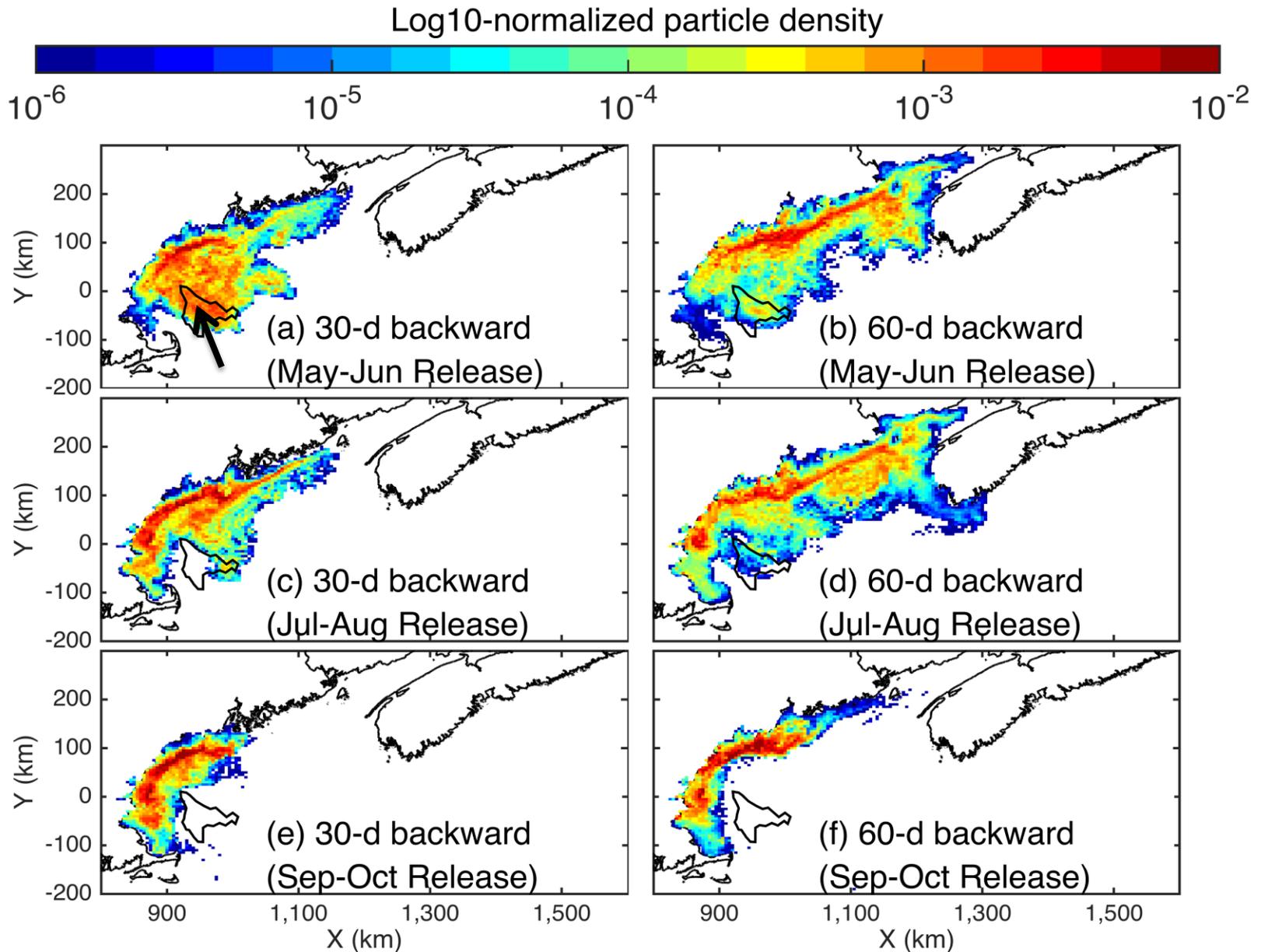
Flow field
Temperature

Food

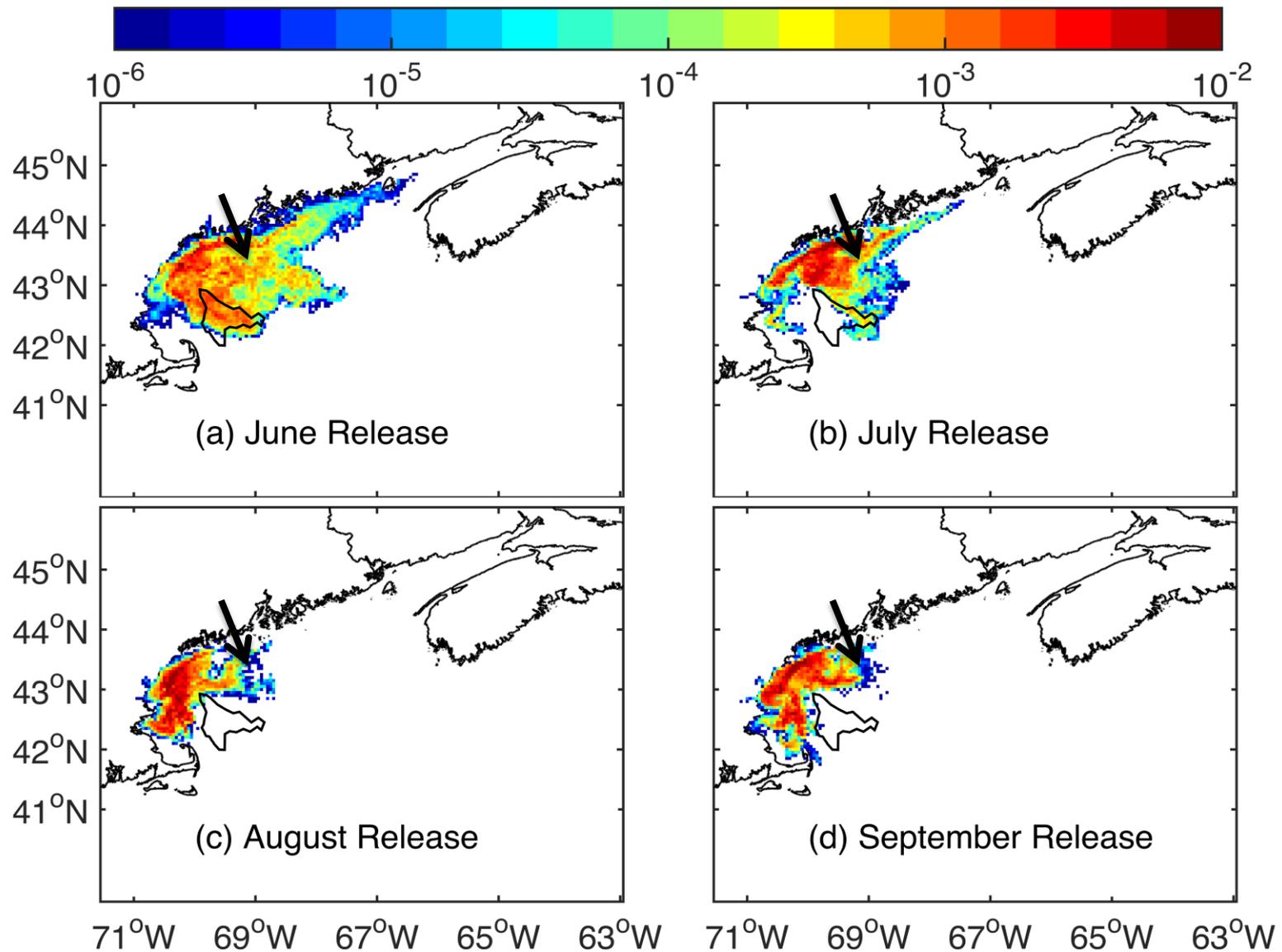
(c) *C. finmarchicus* life cycle



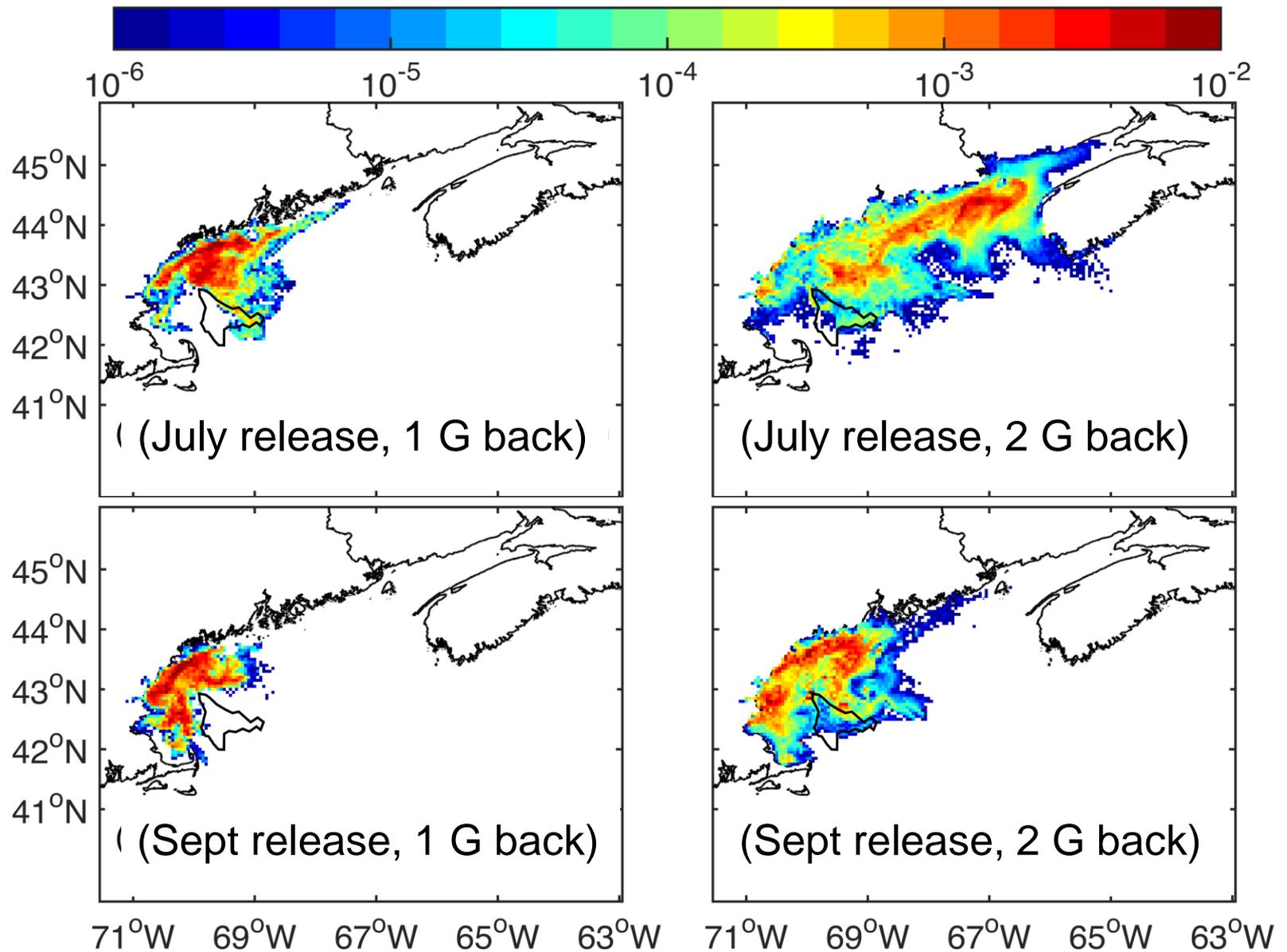
Supporting evidence from model: transport



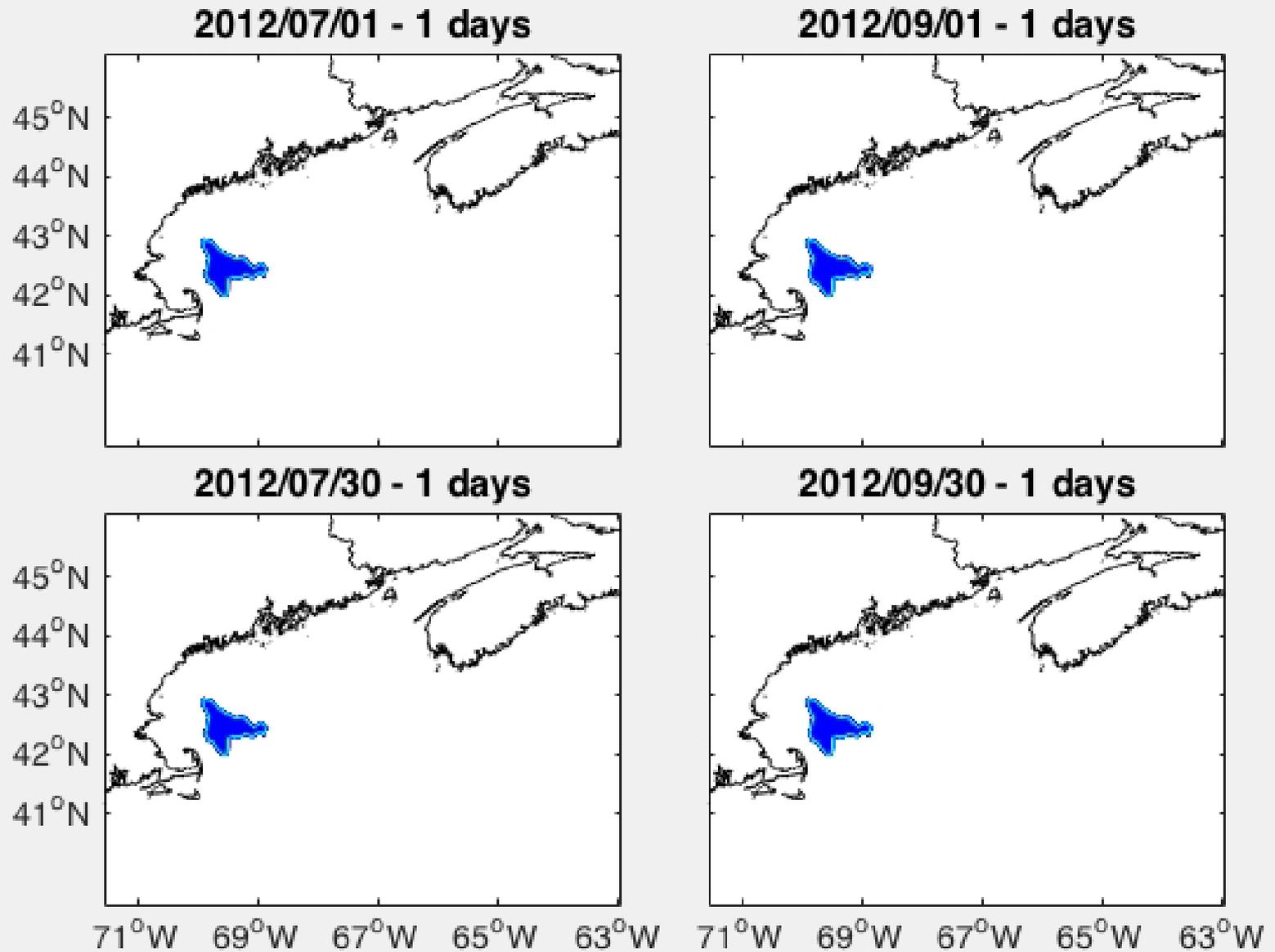
Supporting evidence from model: transport



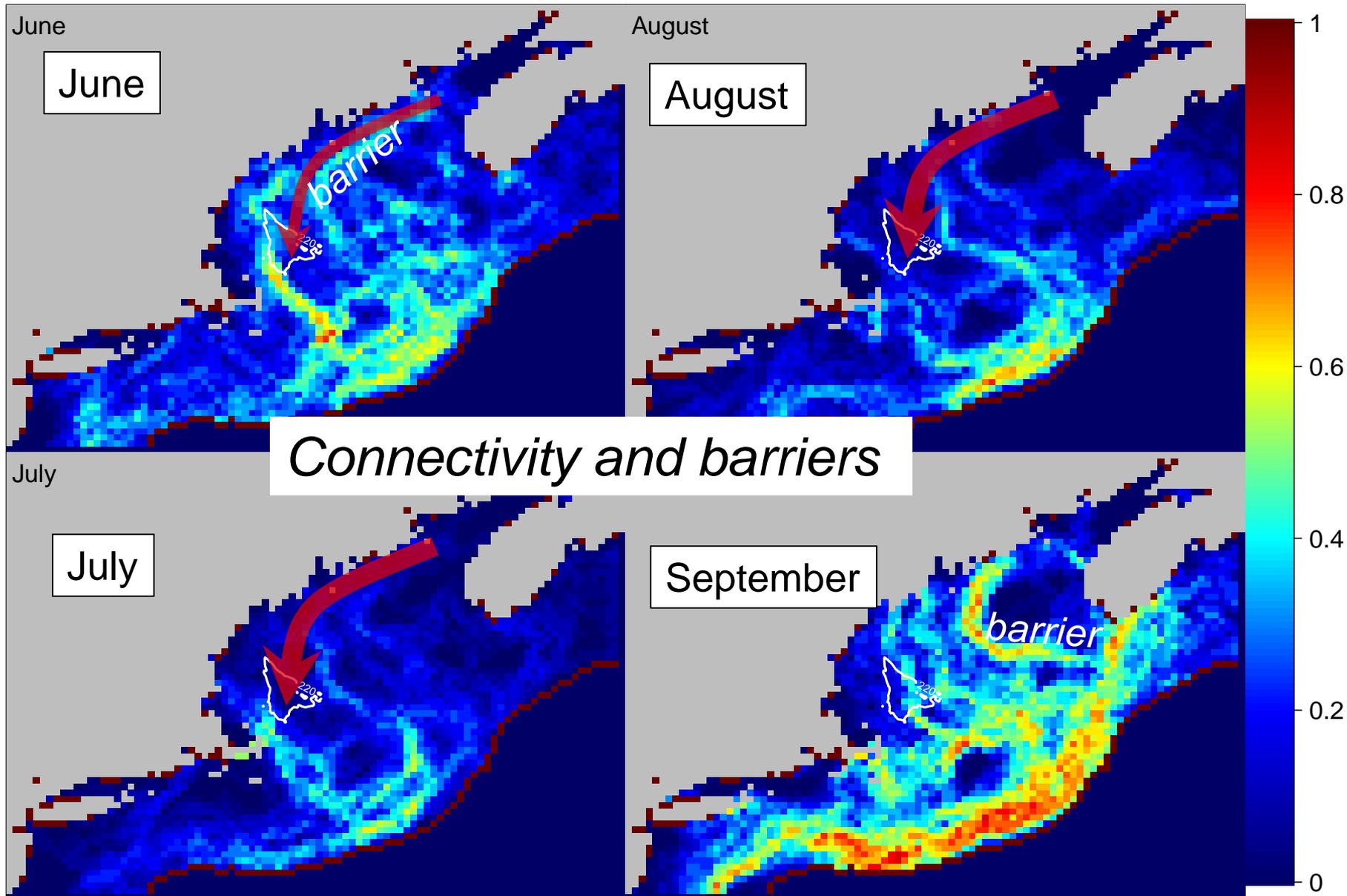
Supporting evidence from model: transport



Supporting evidence from model: transport

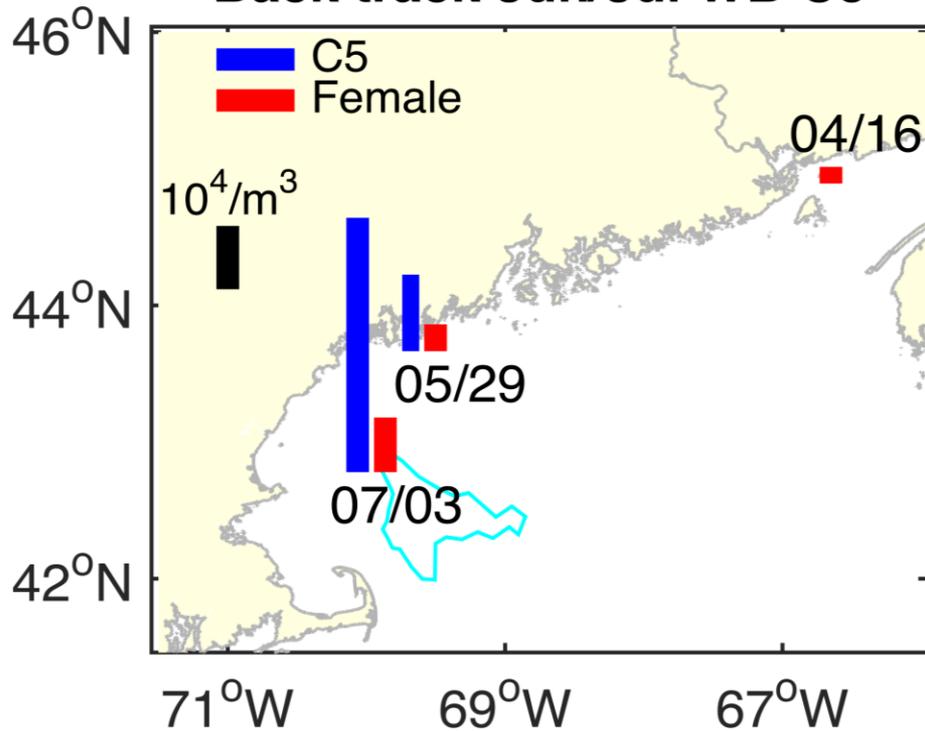


Supporting evidence from model: connectivity

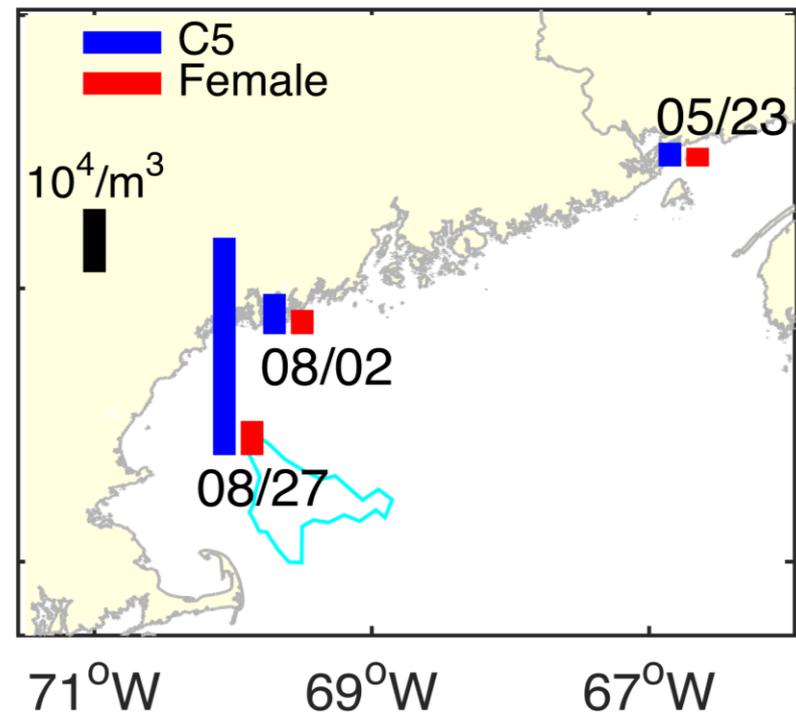


Supporting evidence from data: amplification

Back track Jun/Jul WB C5

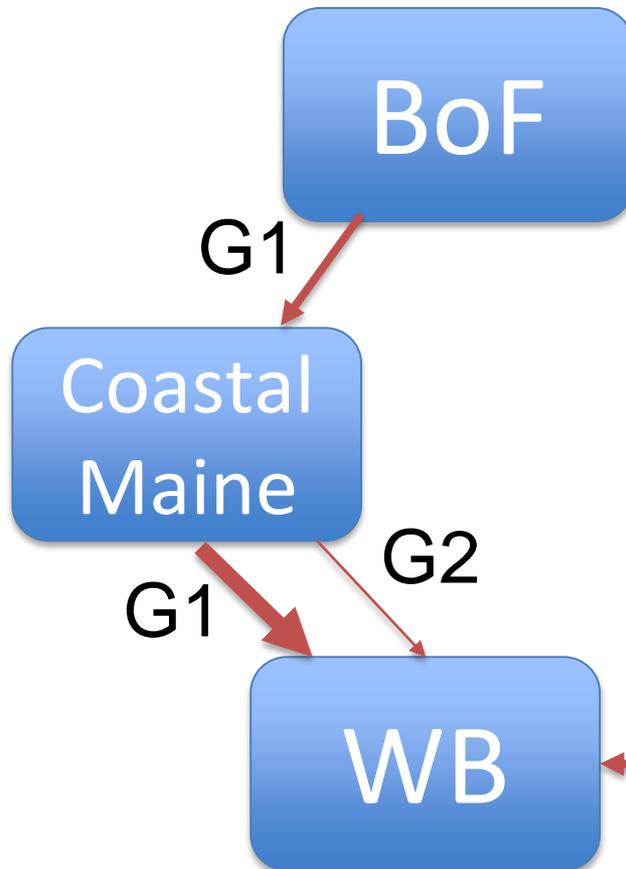


Back track Aug/Sep WB C5

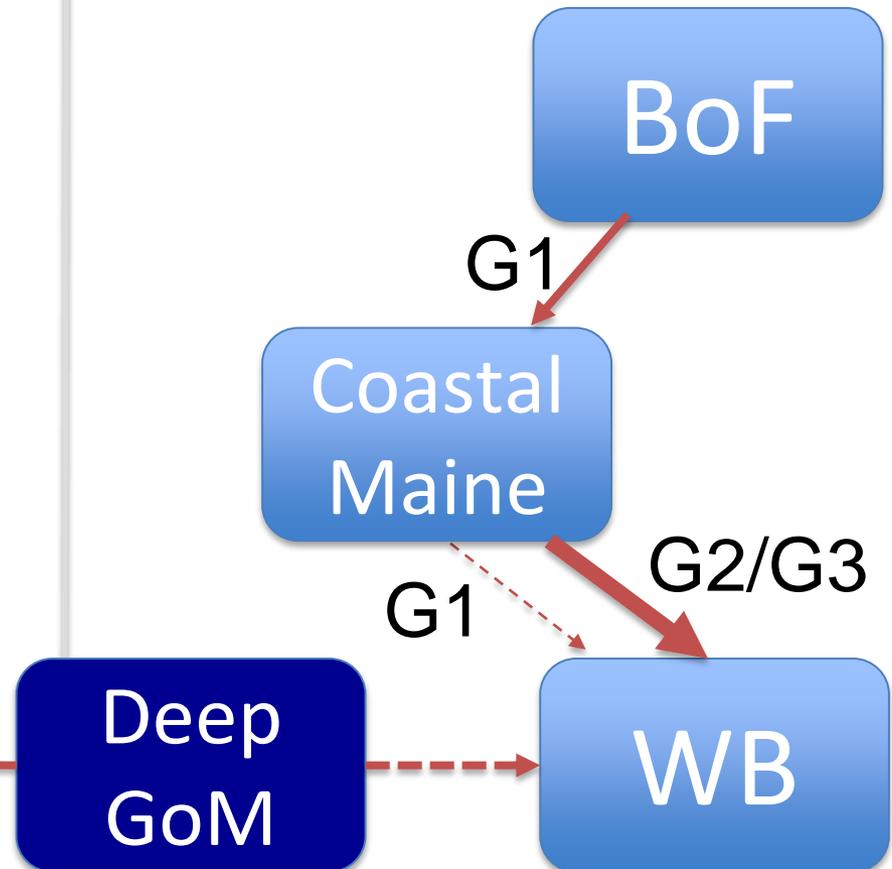


Conceptual framework

Early-mid summer scenario



Late summer - early fall scenario



Both data and model suggest that coastal waters including the Maine Coastal Current are major upstream sources for surface-released *C. finmarchicus* individuals in all cases simulated, although distribution patterns vary with release timing.

Role of coastal zone:

Amplification of supply (spring reproduction/summer growth in the food-rich coastal region) and transport to receiving basins (e.g. WB) capable of harboring the overwintering stock.

Implication for climate impact:

*Coastal dynamics and regional settings might allow the *C. finmarchicus* population to mitigate some climate impact. Needed to be considered for climate projection.*

Acknowledgement

Peter Wiebe & Carin Ashjian, WHOI, USA

Catherine Johnson, DFO, Canada

Frédéric Maps, U. Laval, Canada

Rebecca Jones, Normandeau Assoc. USA

Joe Salisbury, Doug Vandemark, Shawn Shellito, UNH, USA

