Ocean variability and recruitment in Norwegian spring-spawning herring

Frode Vikebø, Husebø Å, Slotte A, Stenevik E.K. et al.
frovik@imr.no

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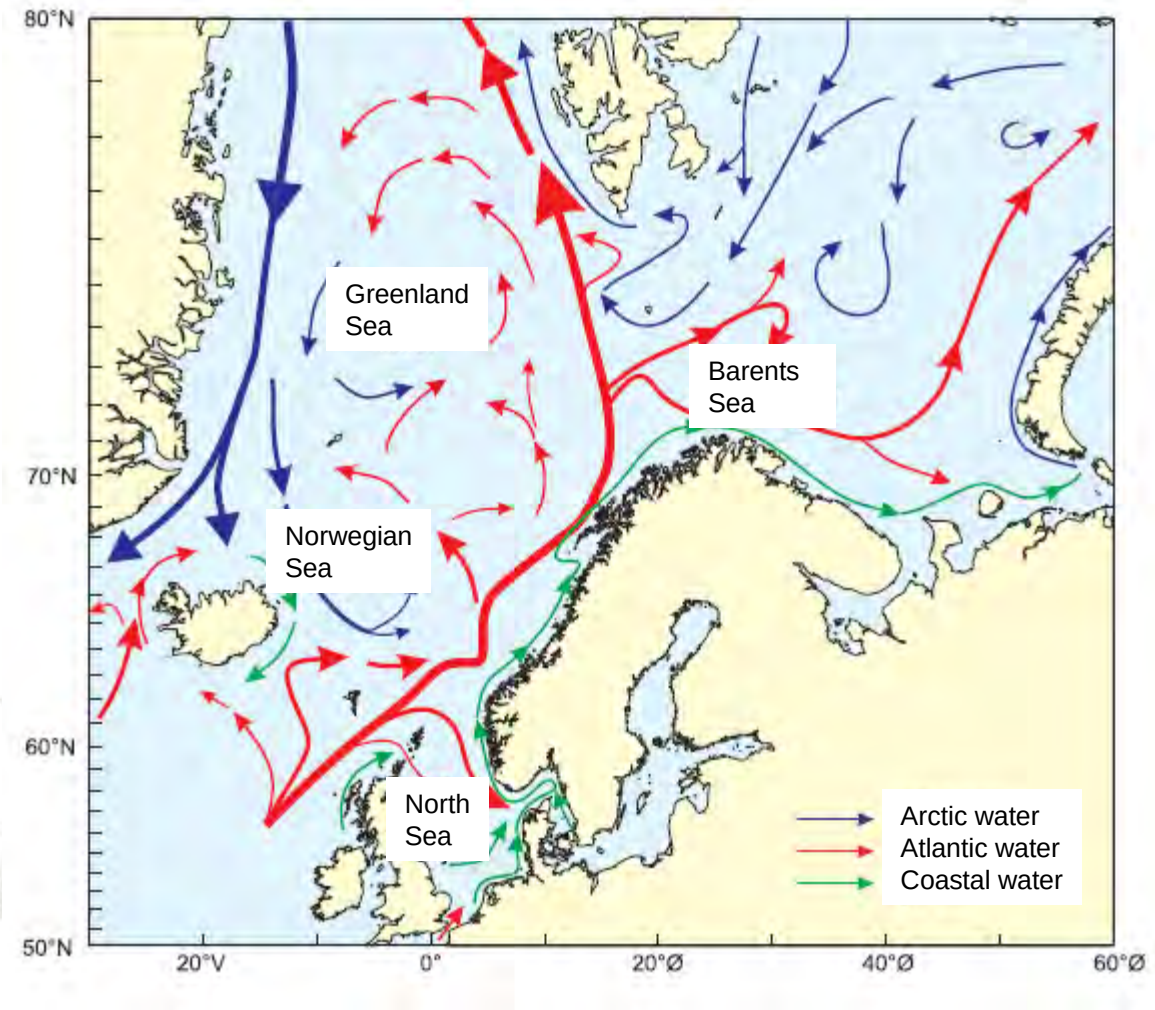
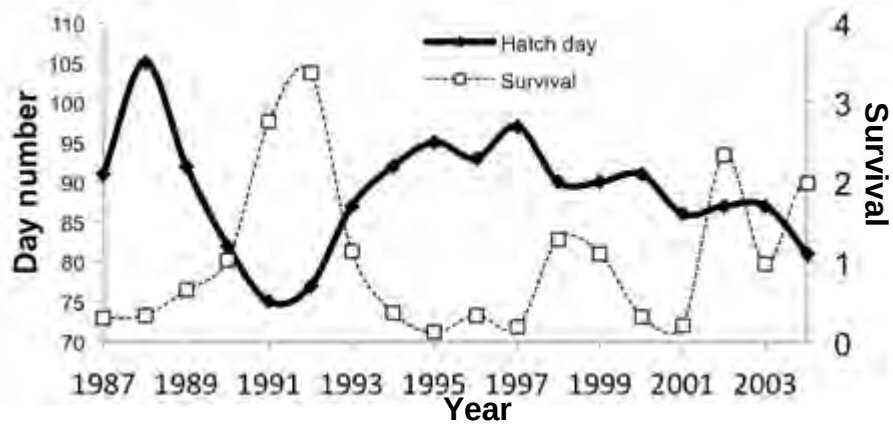


Early hatching favourable for survival

Husebø,Å., Stenevik, E. K., Slotte, A., Fossum, P., Salthaug, A., Vikebø, F., Aanes, S., and Folkvord, A. 2009. Effects of hatching time on year-class strength in Norwegian spring-spawning herring (Clupea harengus). – ICES JMS, 66: 1710–1717.

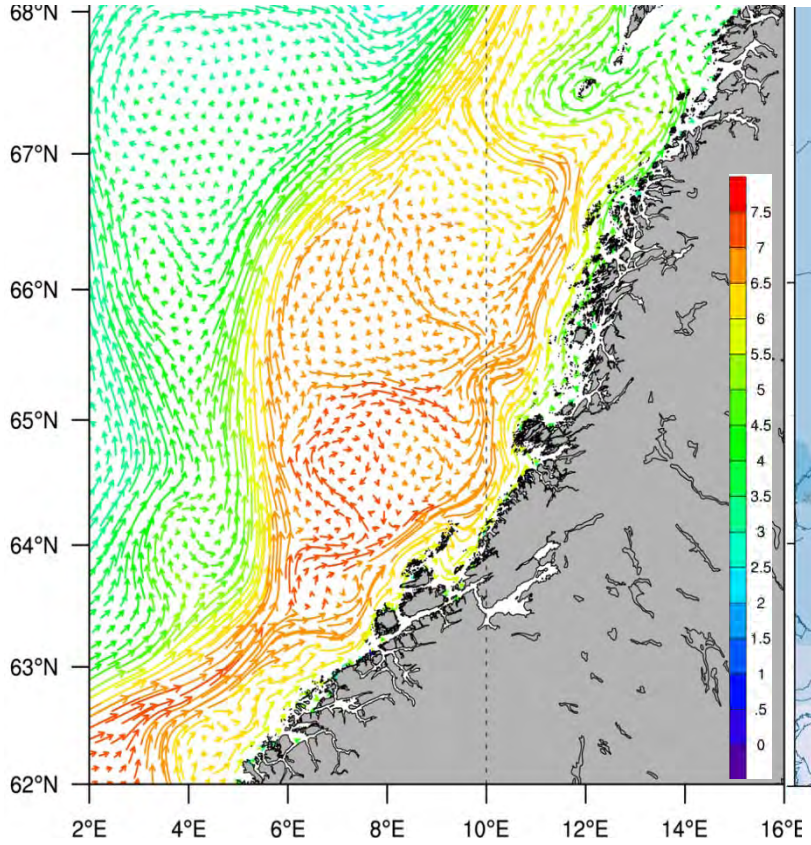
- Survival and hatching date
  r =-0.73, p<0.01

- Early hatching could be favourable due to decreased overlap with predators.

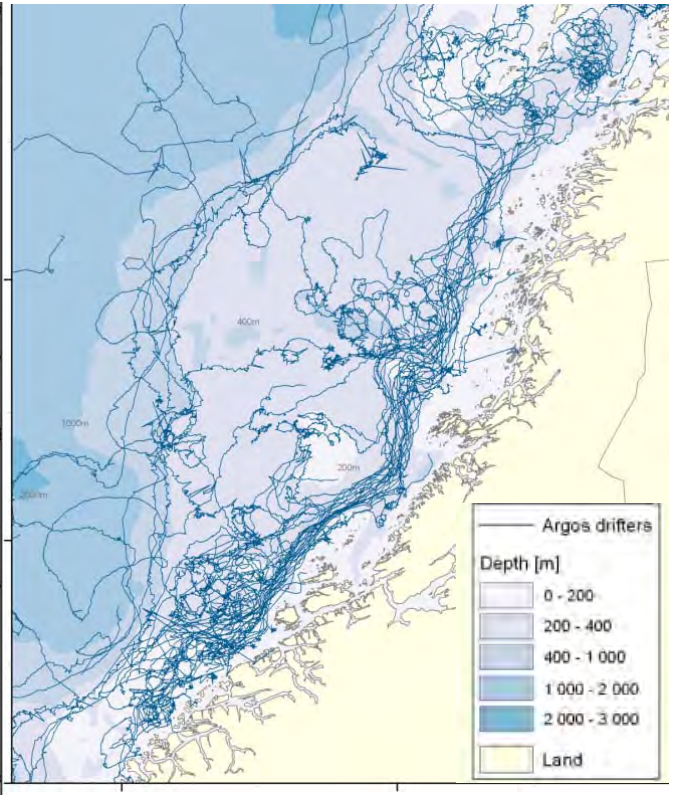


- Hatching date affected by
  i) wintering temperature during gonad development (r=0.54, p=0.02)
  ii) percent recruit spawners (r=-0.41, n.s.)
  iii) hatching temperature (r=0.53, p=0.03)

Modeled oceanography in herring habitat



Model, 4x4 km, mean April 1989-2008.



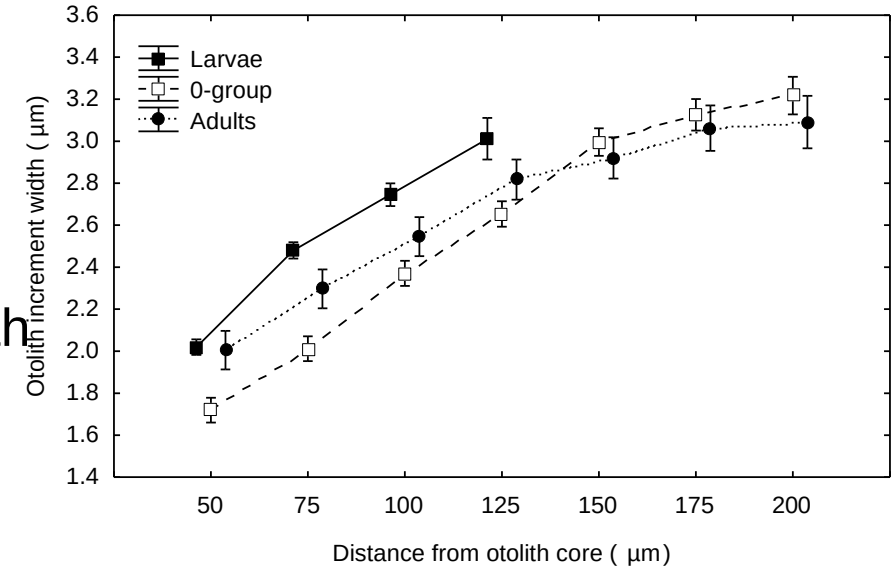
Drifters covering several years

Will early hatching ensure rapid tranport along the Norwegian Coast?

Daily mean modeled circulation and temperatures utilized in IBM larvae model

Early hatching - slower growth but enhanced survival

Husebø,Å., Slotte, A. , Stenevik, E. K., Vikebø, F., Folkvord, A., Fossum, P. and Mosegaard, H. (Submitted). Use of otolith microstructure analyses to study the relation between larval growth and survival in Norwegian spring spawning herring. JMS.



- Higher daily otolith growth in larvae than for surviving 0-group and adults.
- Early hatched larvae had otolith growth comparable to 0-group and adults.
- Larval otolith growth comparable to 0-group otolith growth found close to the coast.
- Model simulations suggest that near shore larval drift is associated with early hatching and colder ambient temperatures compared with more offshore drift.

Early hatching
- slower growth but enhanced survival

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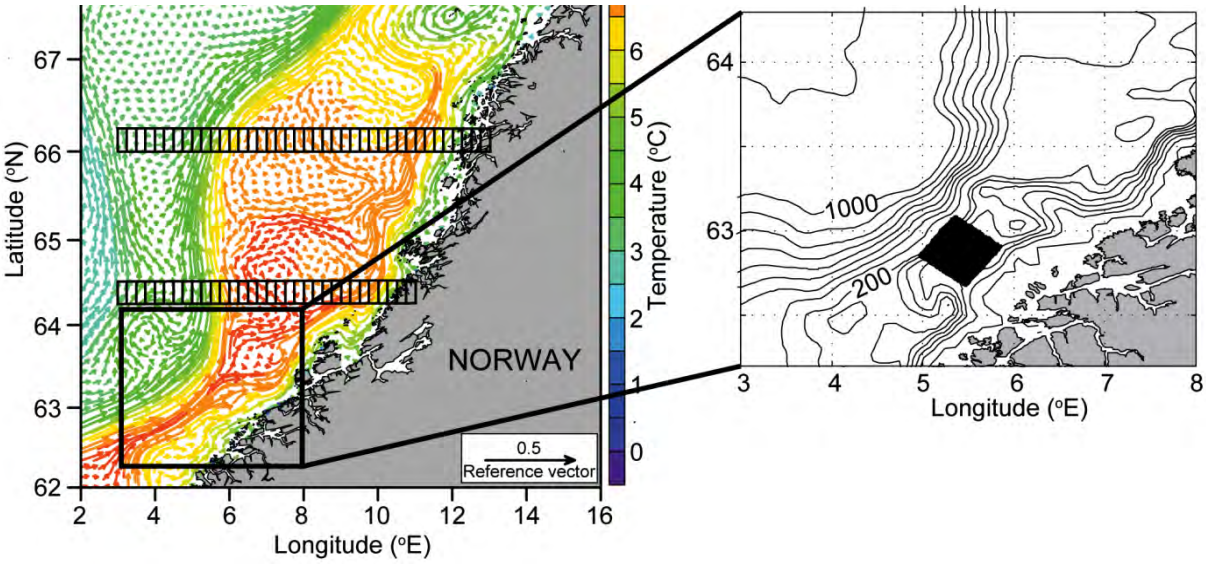
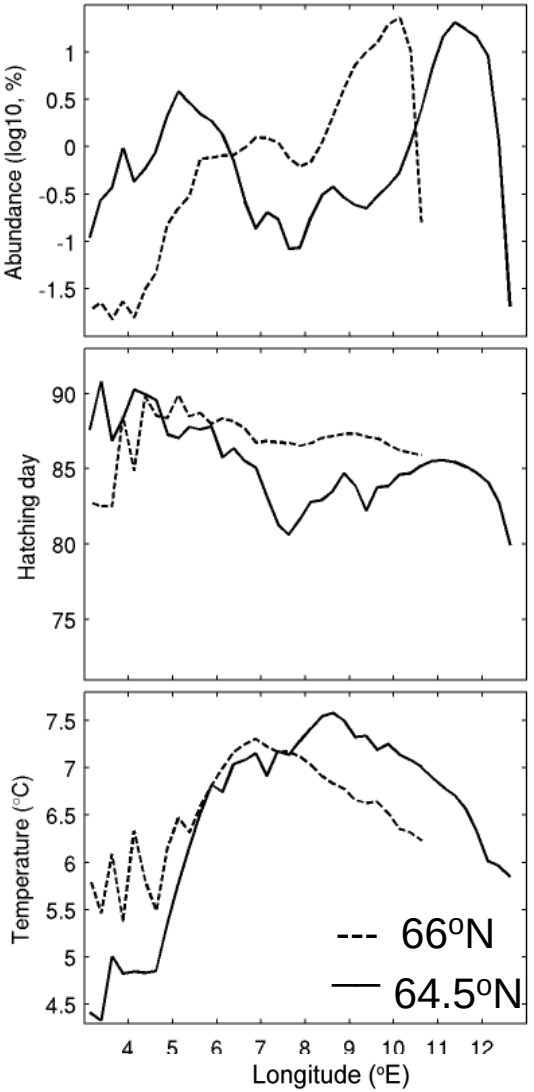


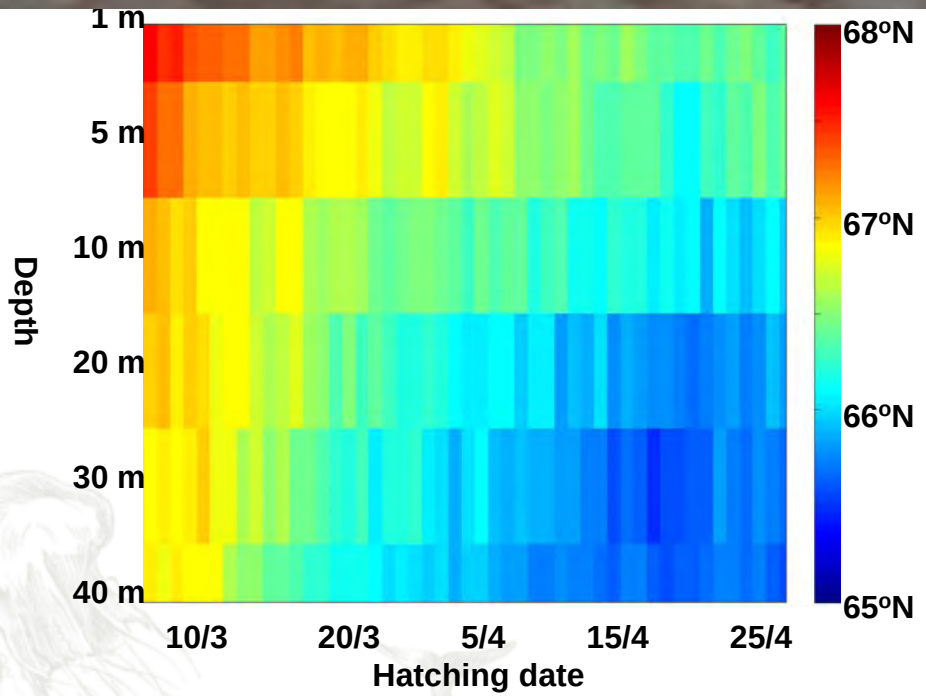


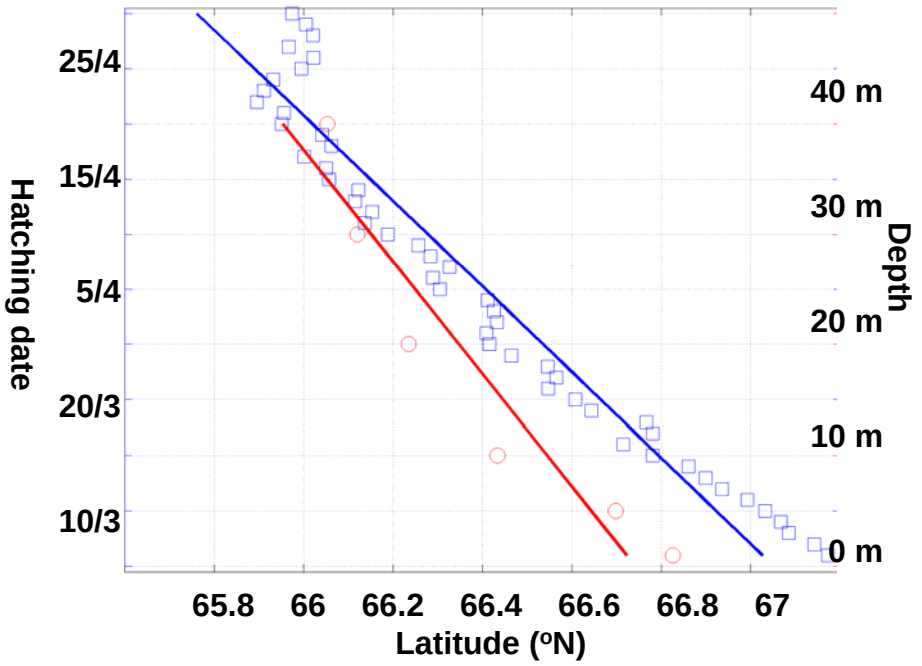
Early hatching
- slower growth but enhanced survival

- Lower otolith growth in the juveniles and adults compared to larvae is in contrast to most other studies.
- Indicate a selection for early hatching.
- Is it due to earlier/faster northward displacement of larvae and possibly reduced predation?

Early hatching results in quicker drift

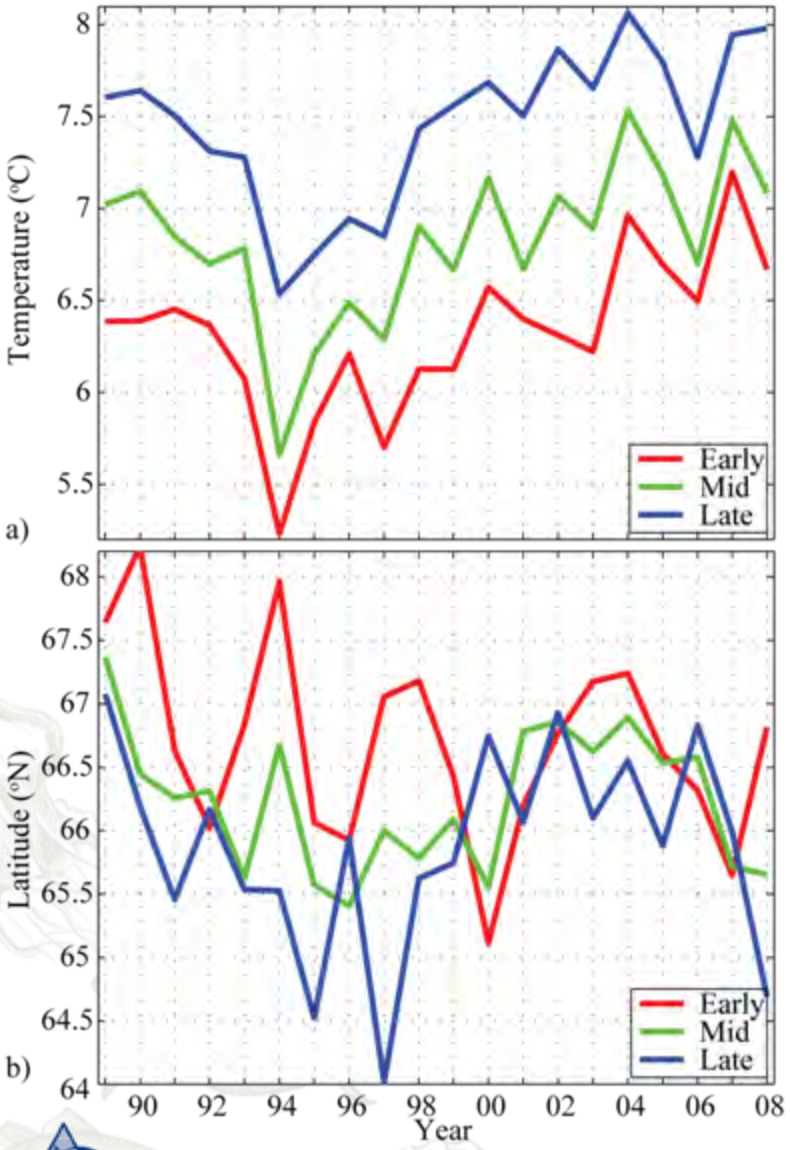
Vikebø, F. B, Husebø, Å., Slotte, A., Stenevik, E. K. and Lien V. 2010. Impact of hatching date, vertical distribution and inter-annual variation in physical forcing on northward displacement and temperature exposure of Norwegian spring spawning herring larvae (*Clupea harengus* L.) – ICES JMS, 67.

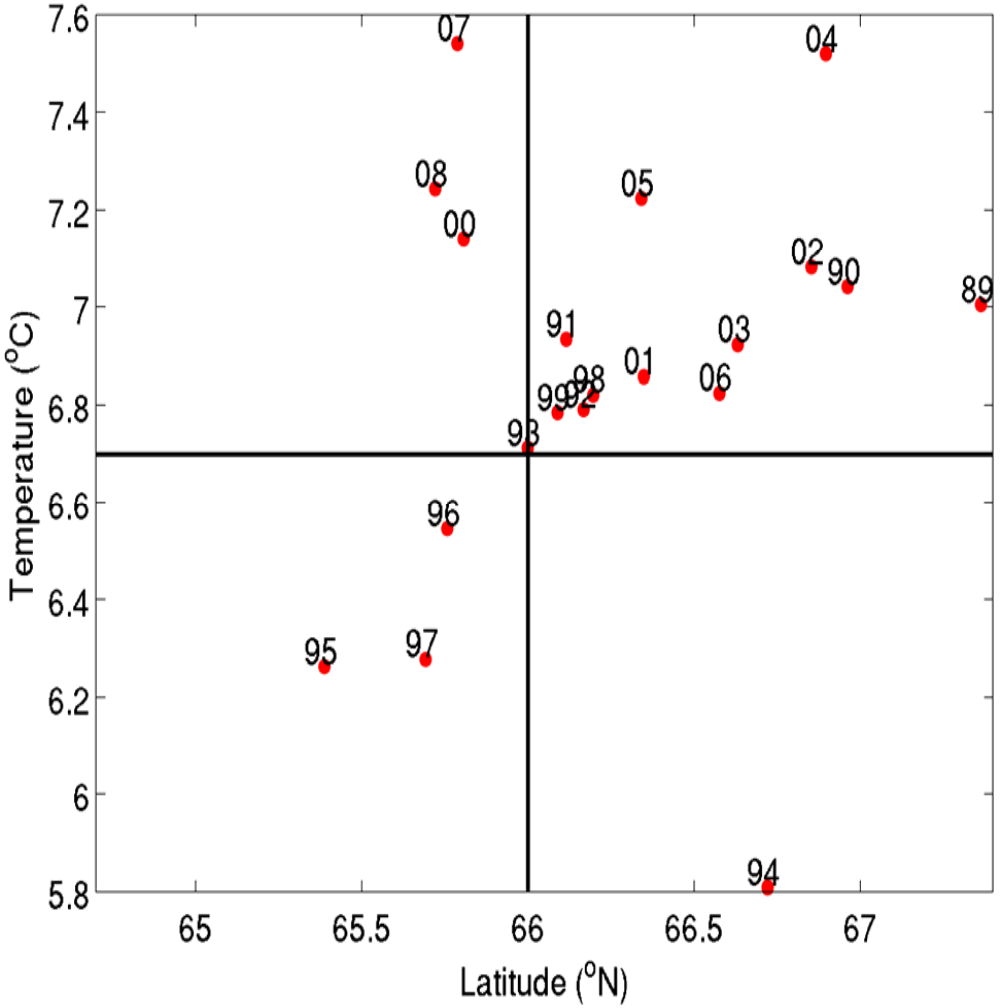




Northward displacement of larvae in 60 days related to drift depth and hatching date

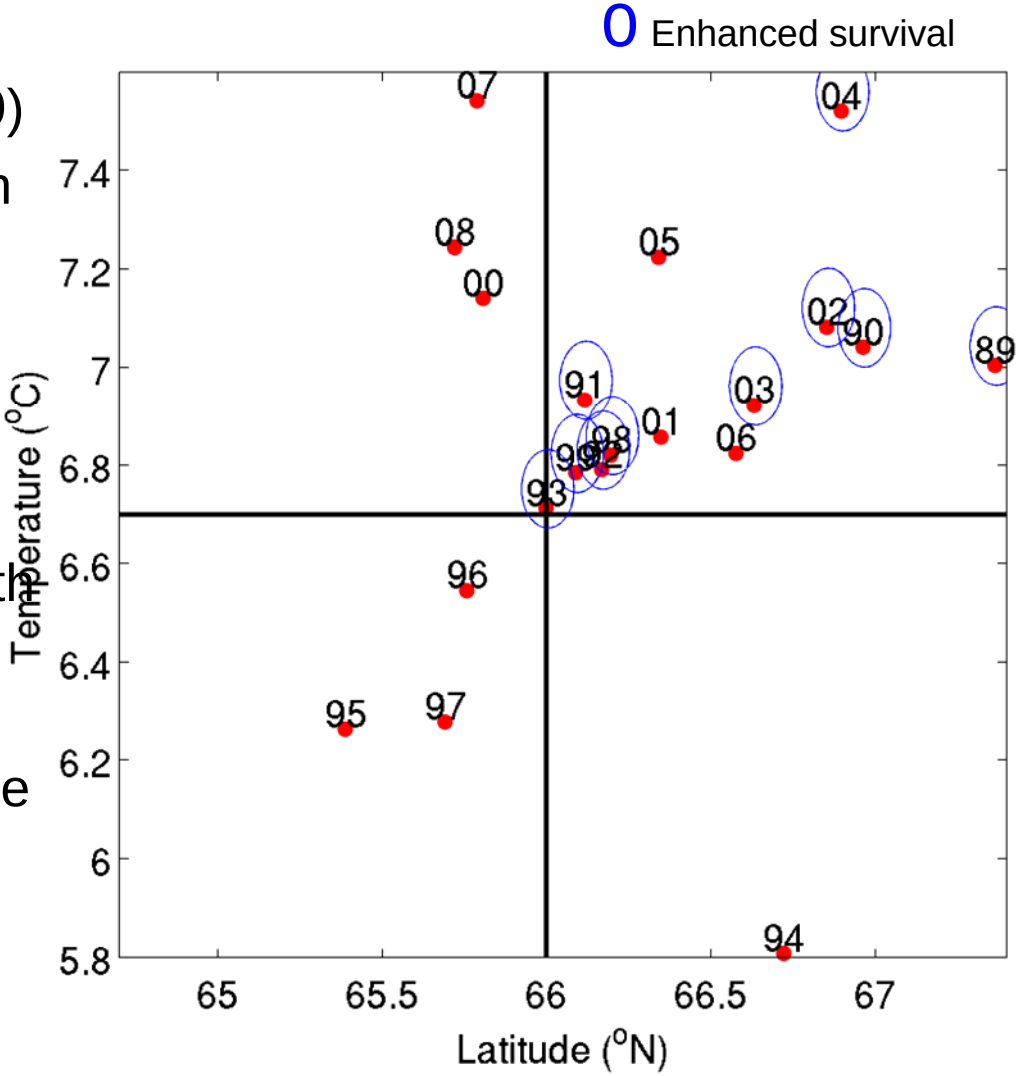
Interannual variation in ambient temperature and drift…





… relative to recruitment

- Early hatching is favorable for larval survival (Husebø et al. 2009)
- Coastal current is stronger early in the season and enhance the importance of early hatching for rapid northward transport and predator avoidance
- However, inter-annual variations in temperature and current strength may modify this.
- But what about feeding opportunities? Which predators are the most important? Important processes remains to be studied!



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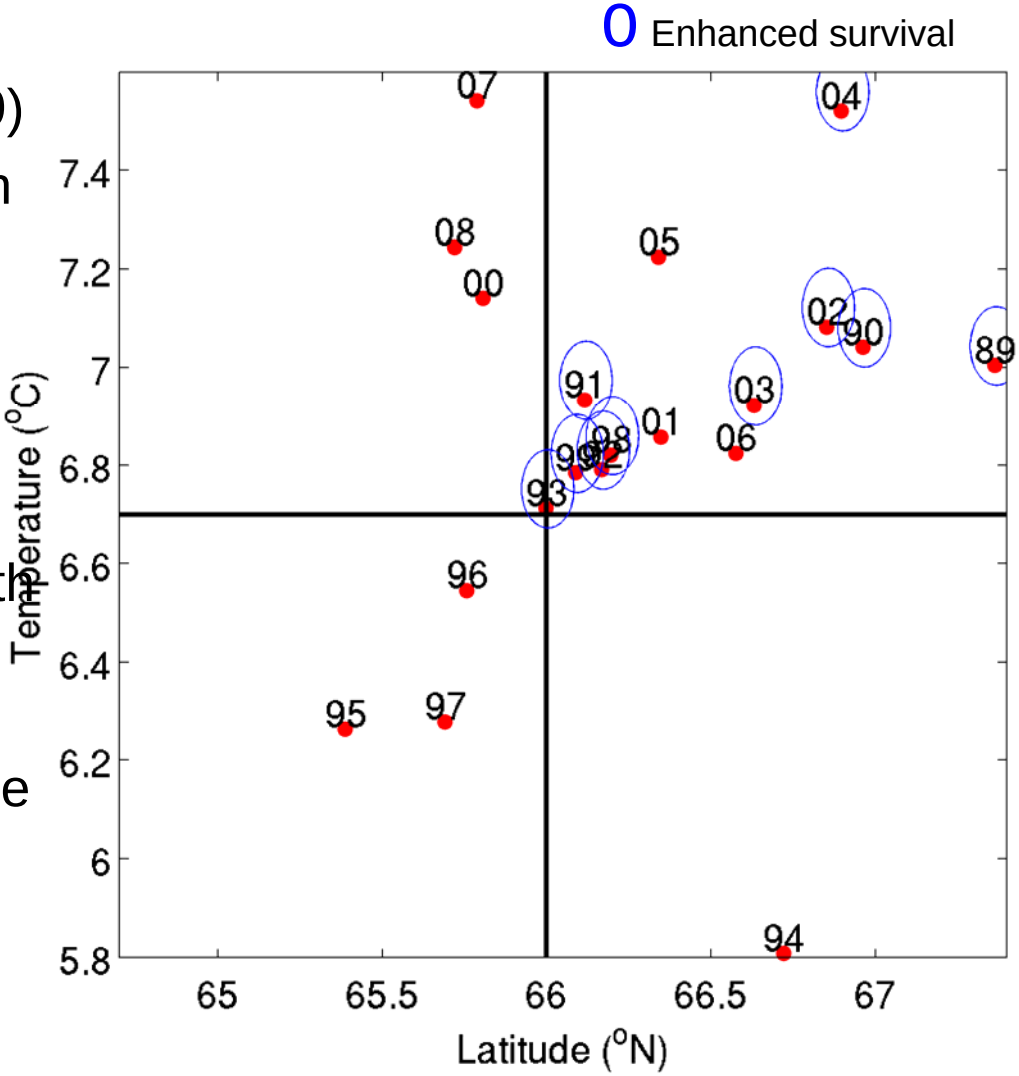
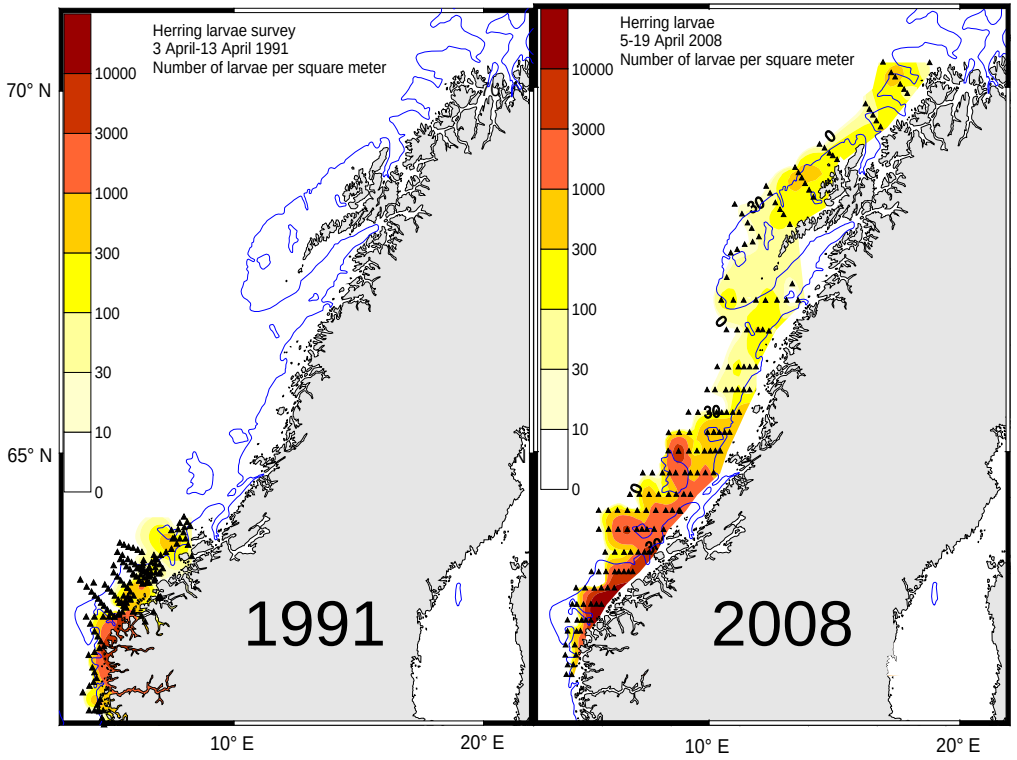


Environmental exposure when starting from year-specific hatching distribution

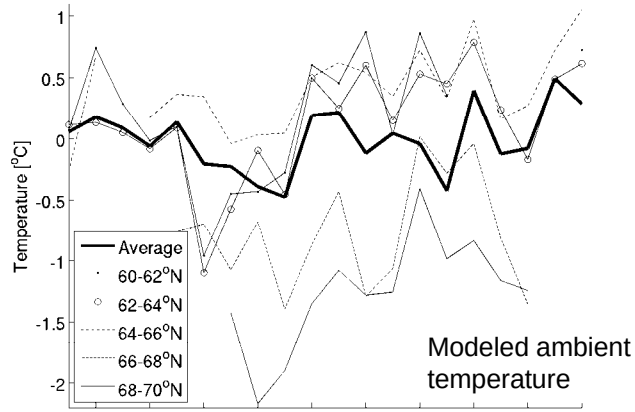
Vikebø, F.B., Slotte, A., Stenevik, E.K. et al. (In prep.)

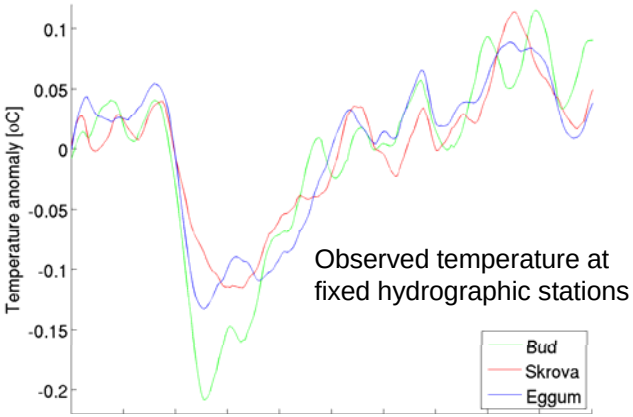
- Processed data for hatching distribution are not available.
- Data on early larval distribution are available, but time of survey varies by about a month between years.
- Initializing larvae from observed spatiotemporal distribution and tracking them until May 15th gives an impression of actual inter-annual variation in drift and ambient temperature.

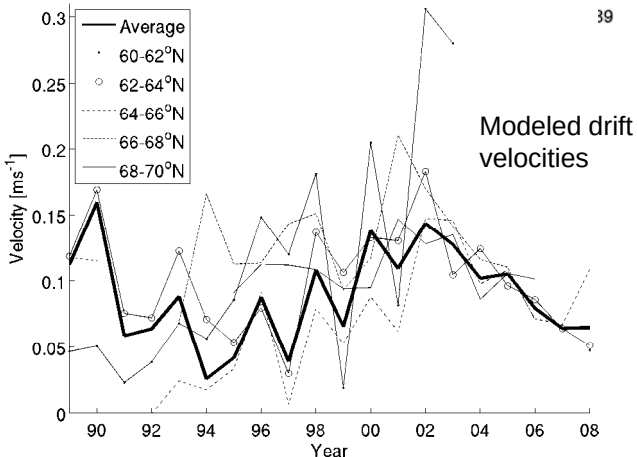


Ambient temperature and drift

- Modeled ambient temperature varies by up to about 0.9 degree between years.
- Observed temperatures at fixed hydrographic stations vary by up to about 0.3 degree between years
- Modeled drift velocity varies from below 5 cms^{-1} to above 15 cms^{-1} between years.
- All figures indicate a local minimum during mid 1990s. While temperatures tend to level out during the 2000s, drift velocities decrease through the 2000s.







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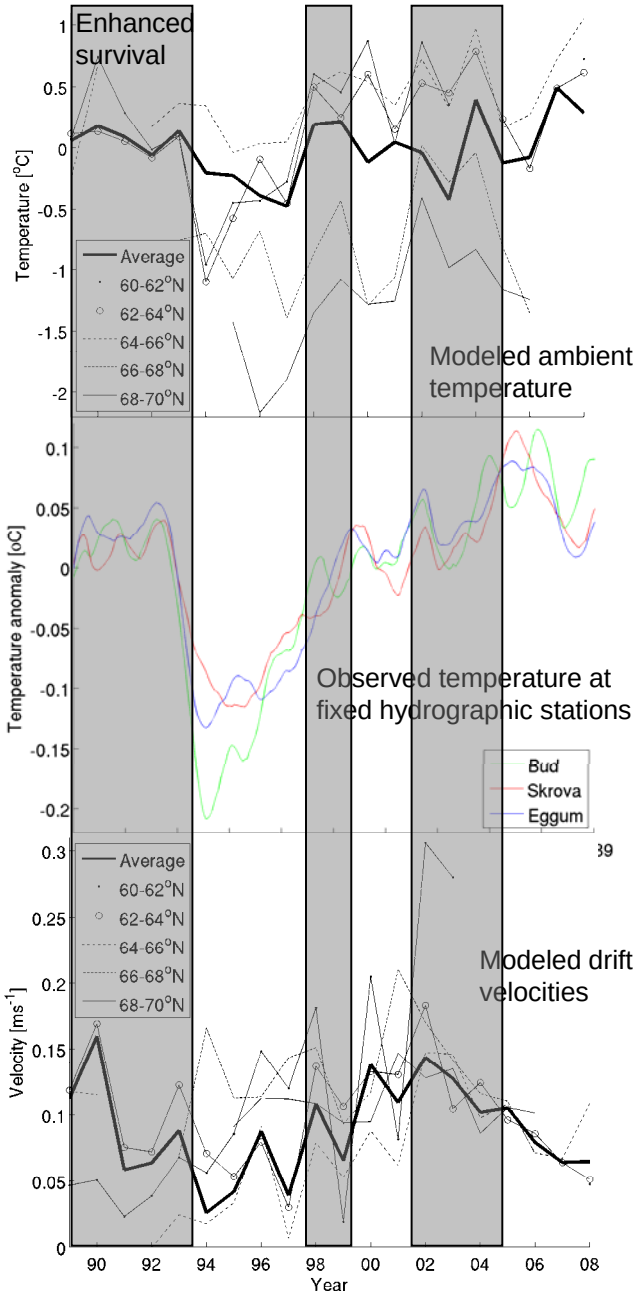
- All figures indicate a local minimum during mid 1990s. While temperatures tend to level out during the 2000s, drift velocities decrease through the 2000s.
- The low-frequency drift signals have a better explaining capability than ambient temperature.



Summary

- Early hatching is favourable for larval survival.
- Lower otolith growth in the juveniles and adults compared to larvae indicate a selection for early hatching.
- Early hatching is associated with near shore larval drift and colder ambient temperatures compared with more offshore drift.
- Early hatching and shallow drift give quicker northward transport mainly due to stronger southwesterlies early in the season.