Science, Service, Stewardship

# Alternating Climate Conditions Influence Walleye Pollock Early Life Stages in the Southeastern Bering Sea

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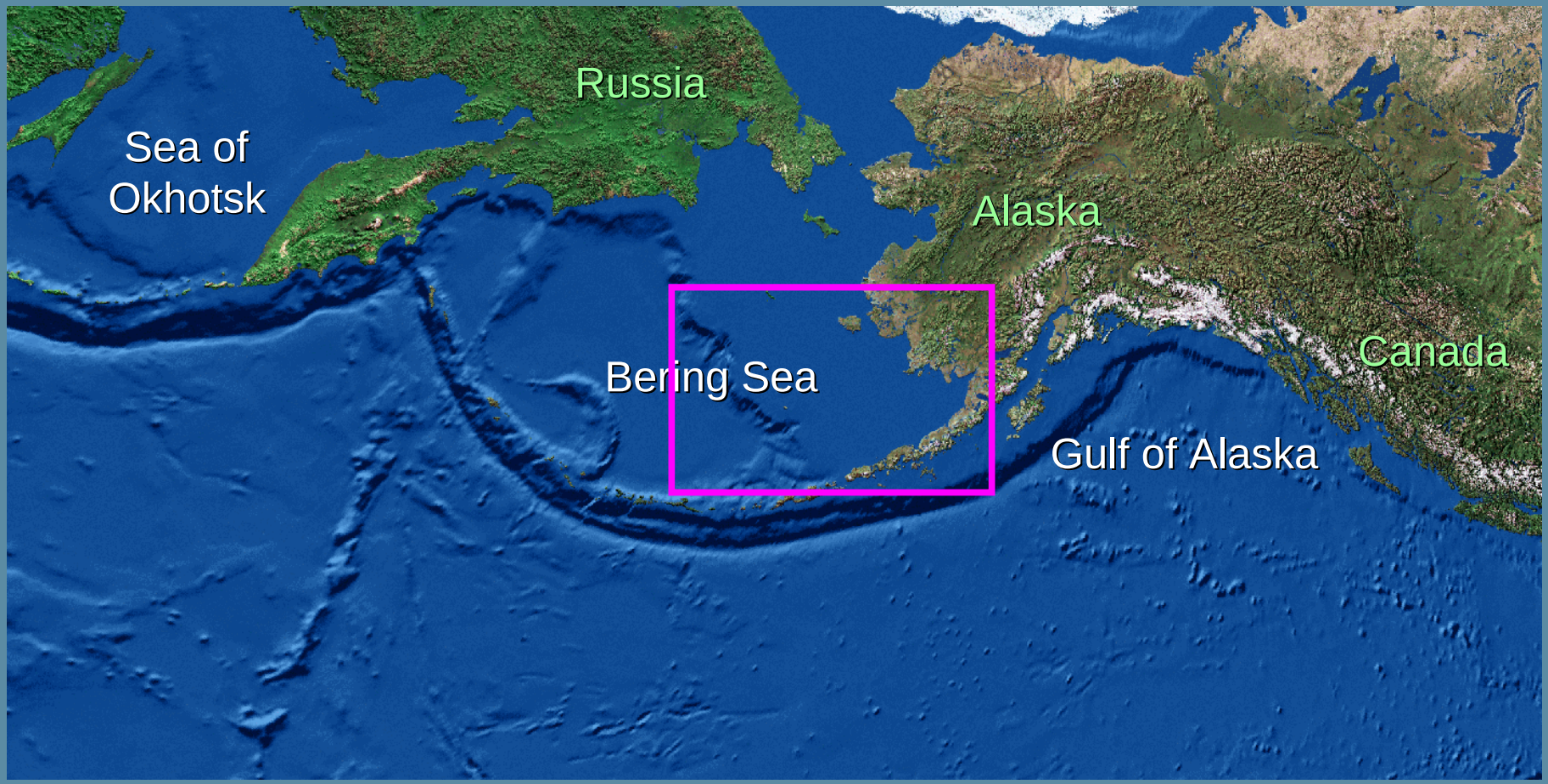
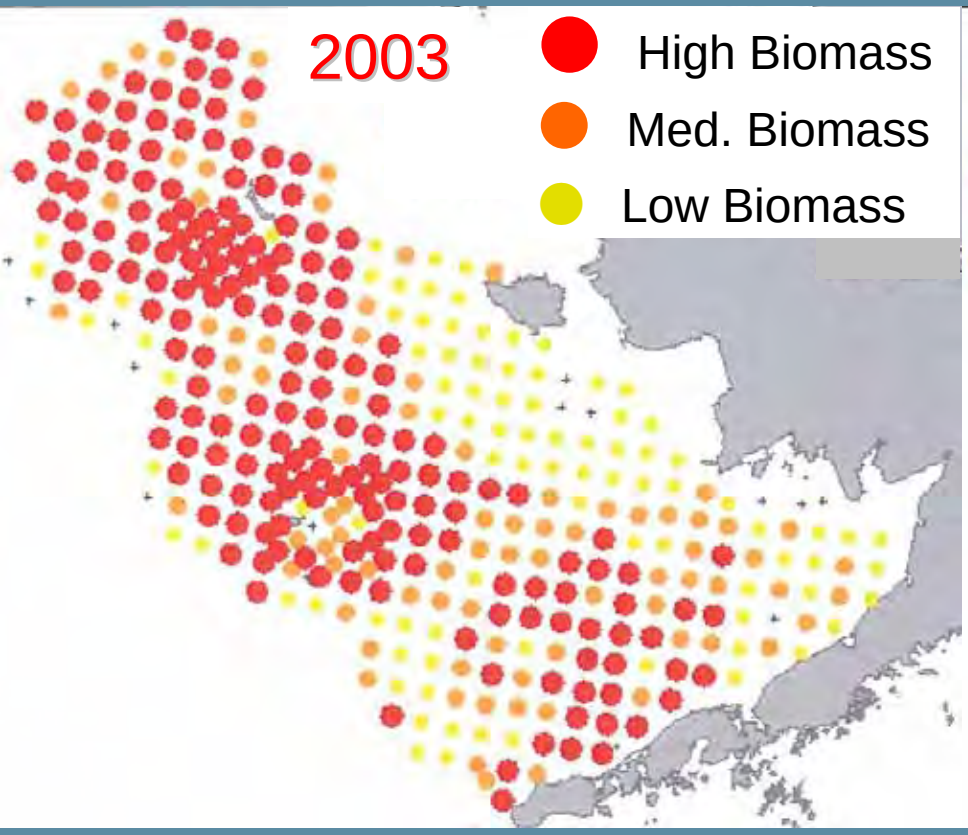
NOAA FISHERIES SERVICE


Russia
Sea of
Okhotsk
Alaska
Canada
Bering Sea
Gulf of Alaska

# Adult Walleye Pollock in the Bering Sea


Kotwicki et al. 2005:

Adult biomass and distribution influenced by temperature



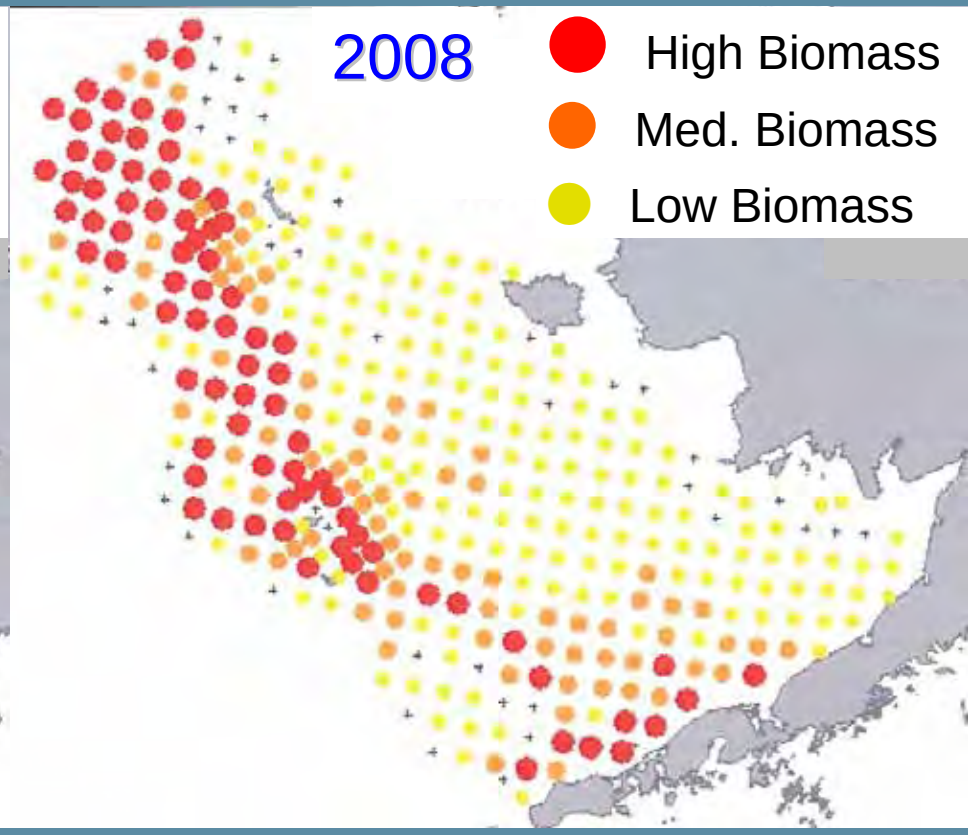




Photo Credit: D. Blood


Photo Credit: Matt Wilson

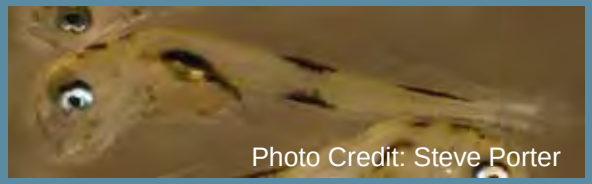


Photo Credit: Steve Porter

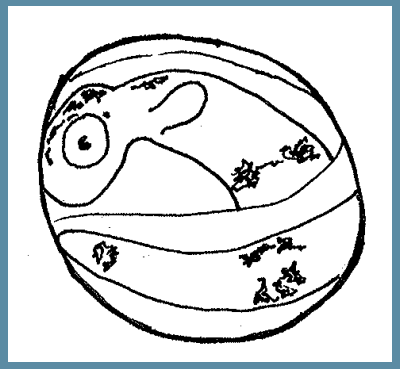

Photo Credit: Matt Wilson

Are pollock early life stages influenced by temperature?

1. Abundance
2. Growth
3. Mortality
4. Temporal Shifts
5. Spatial Shifts

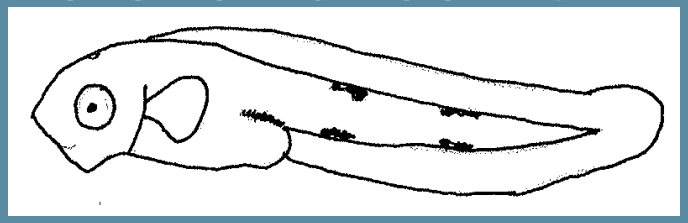
# Pollock Developmental Stages

Eggs

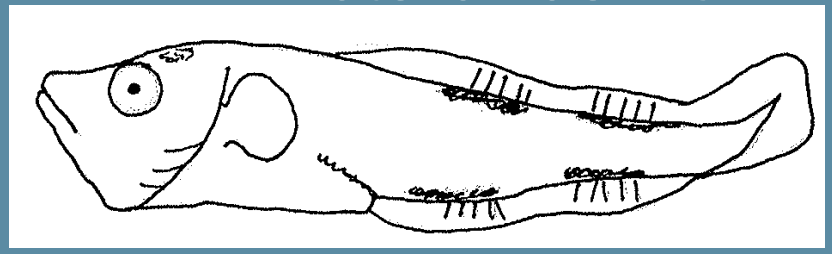


Yolksac larvae <5 mm

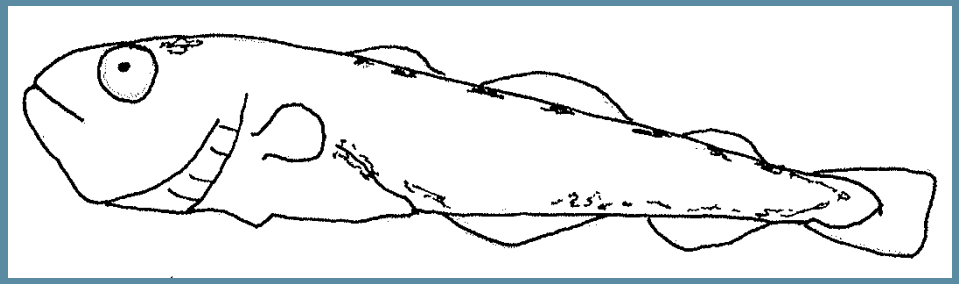
Preflexion larvae <10 mm



Late larvae <25 mm



Juveniles <65 mm



# Approach

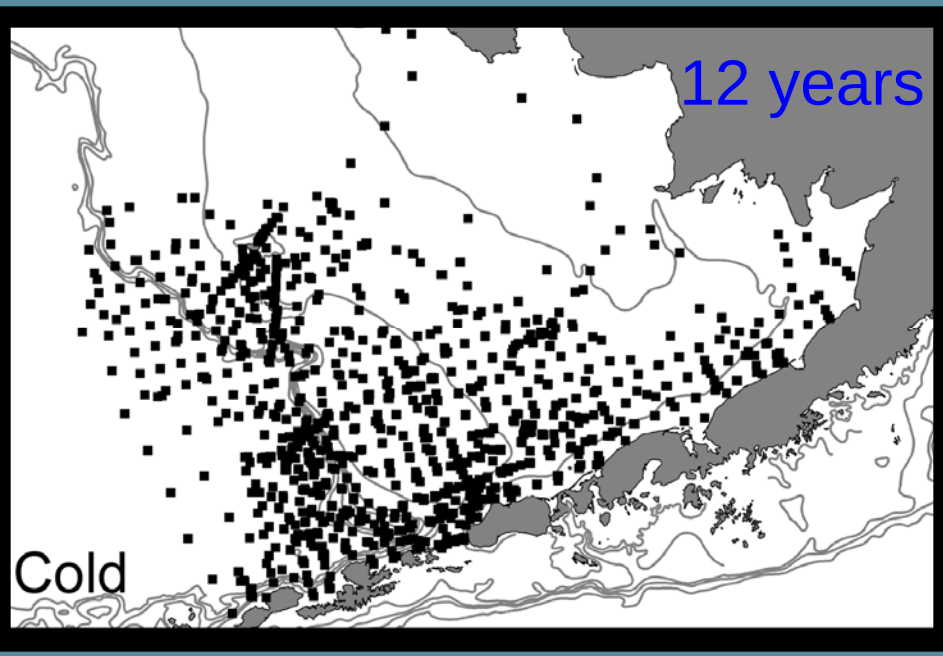
Classified years as cold or warm by spring SST anomaly (– / +)

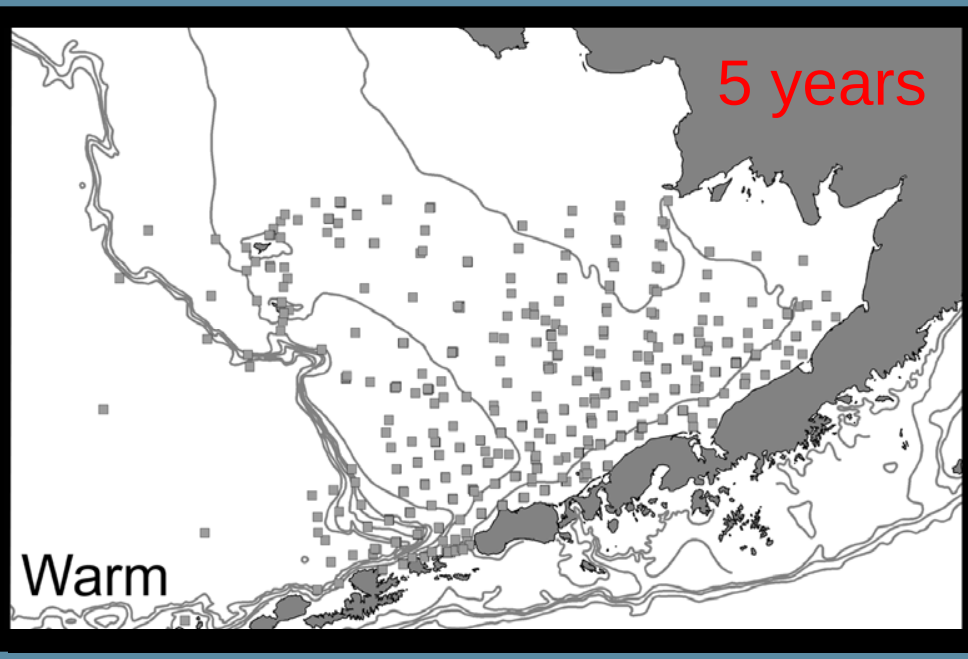
21-year time series of ichthyoplankton surveys

Selection criteria:

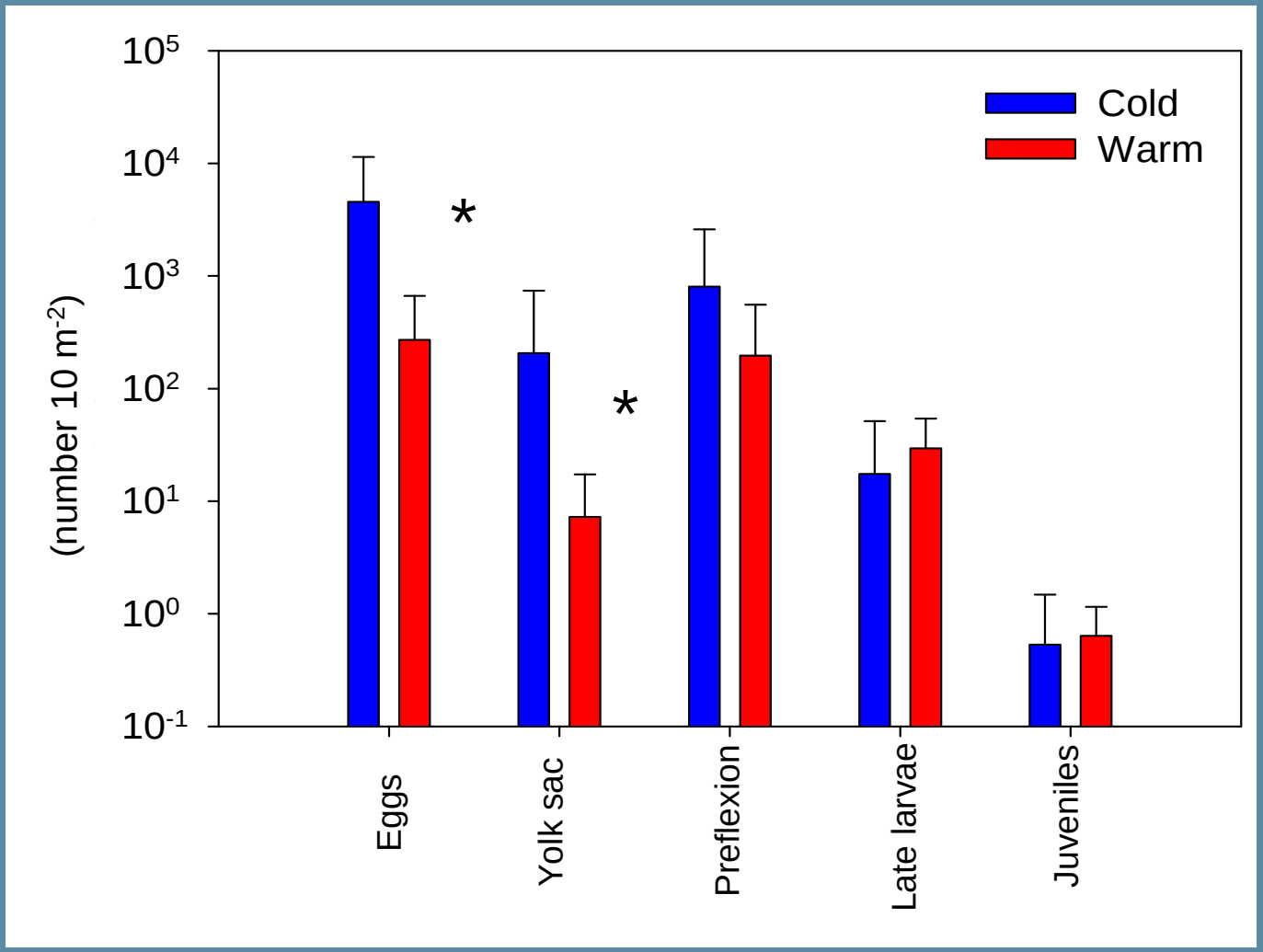
Cover known spawning grounds

Cover known spawning season



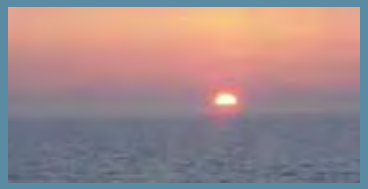



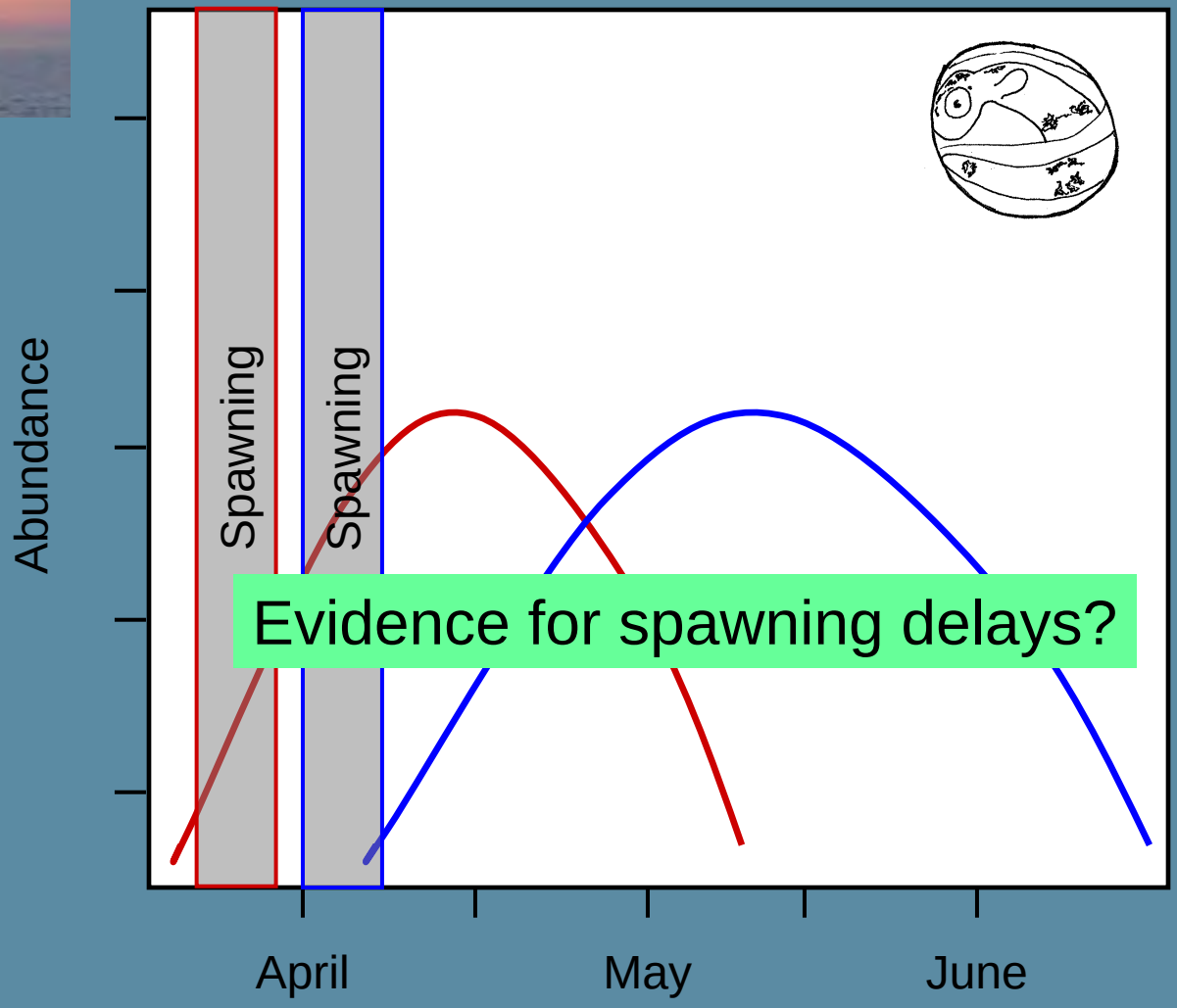
# 1. Abundance




Non-parametric Jonckheere-Terpstra test, $\alpha = 0.05$

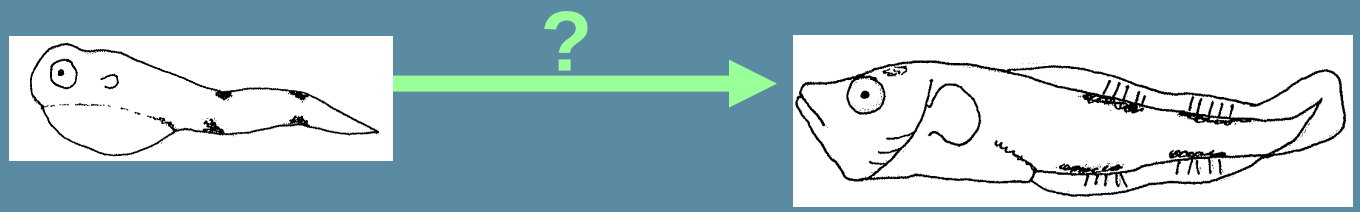
# Why higher abundances of eggs in cold years?



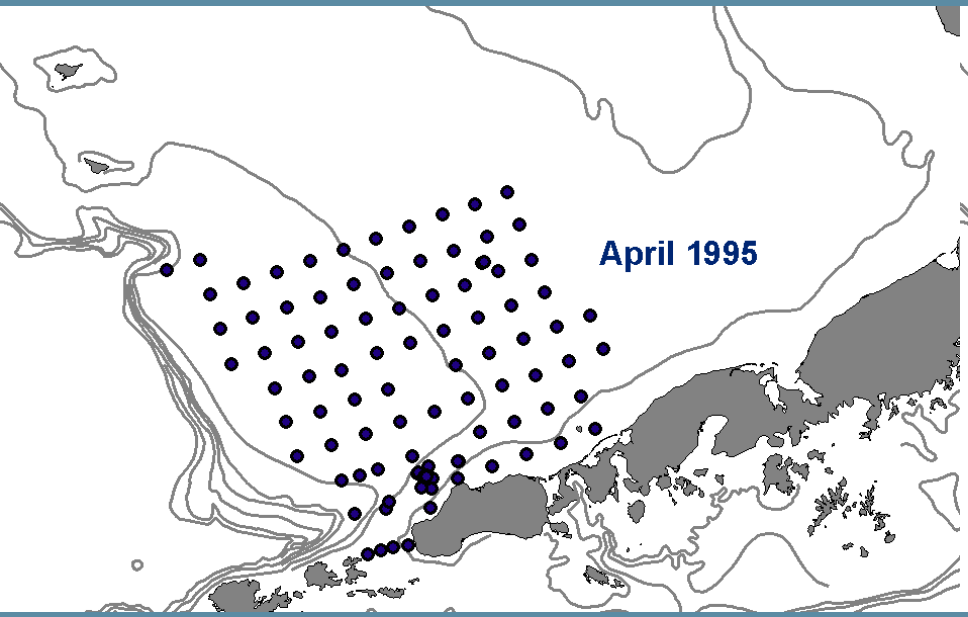


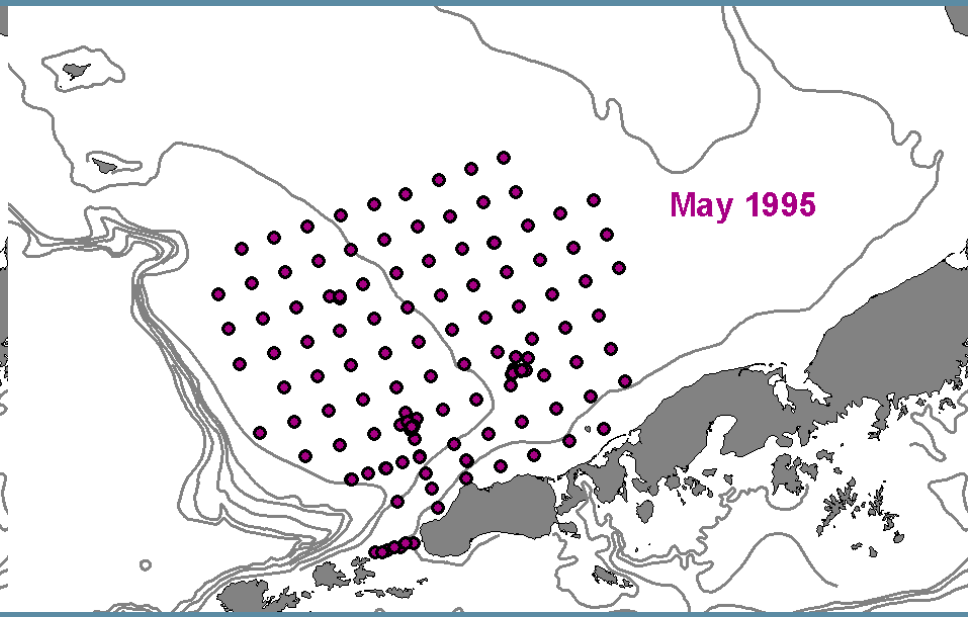

Evidence for spawning delays?

# 2. Growth Rates

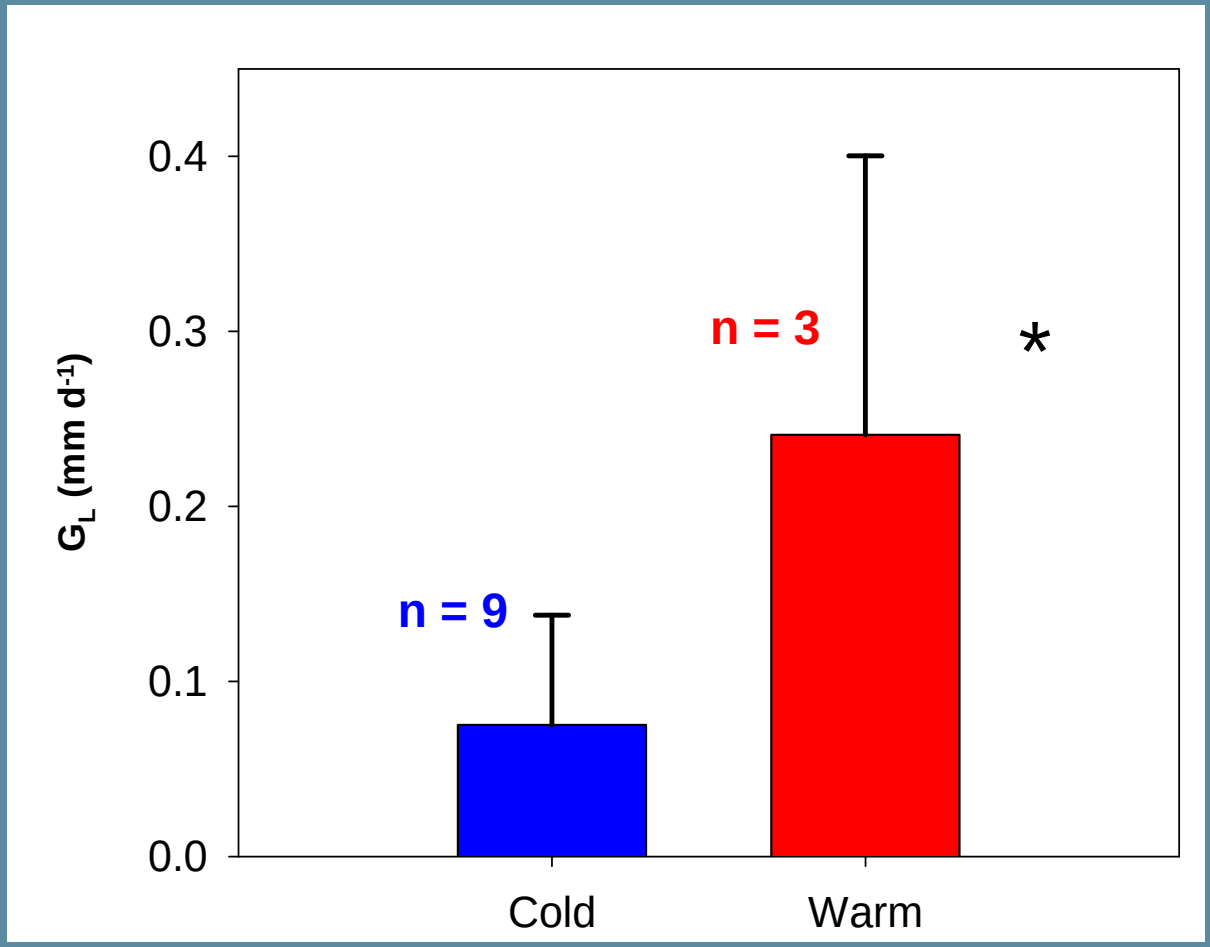



Cruises with overlapping spatial coverage each year



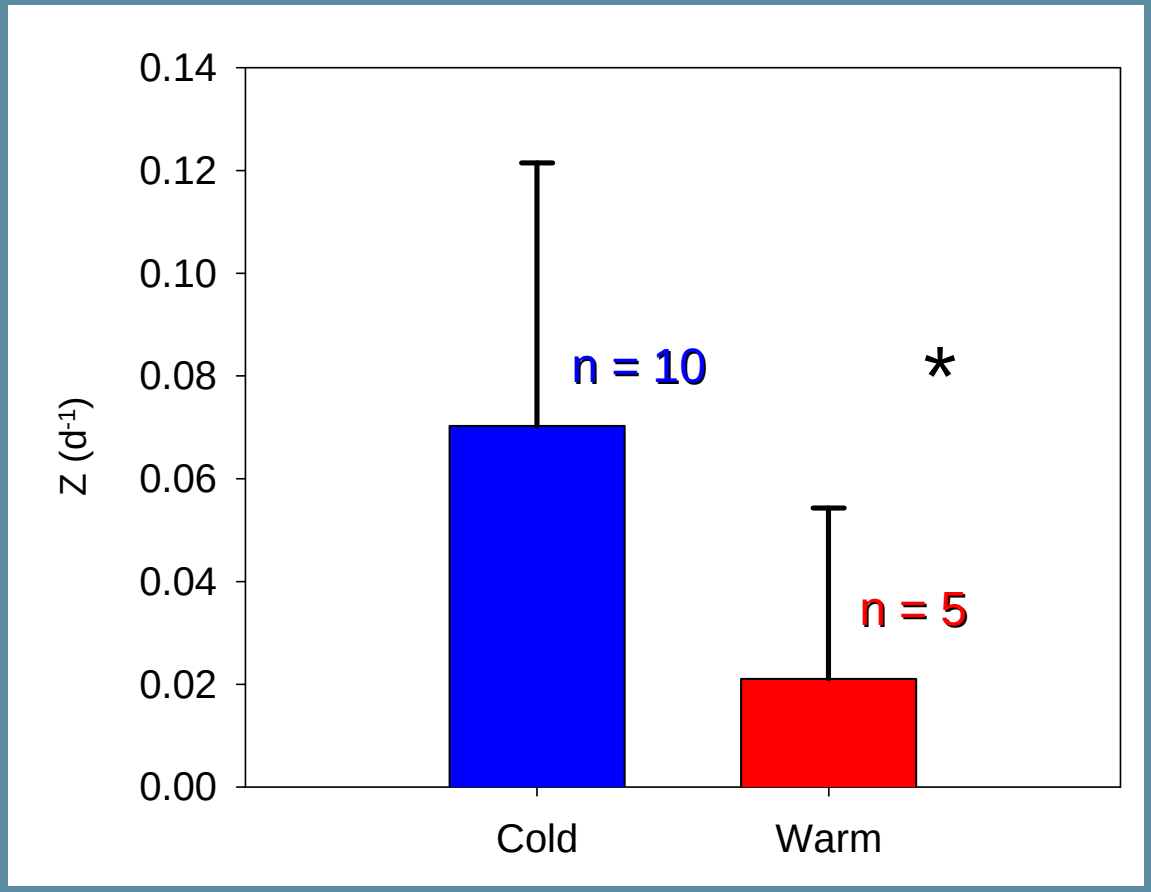
# 2. Growth Rates




Non-parametric Jonckheere-Terpstra test: J = 1.66, p = 0.048

Slower growth rates in cold conditions

# 3. Mortality Rates

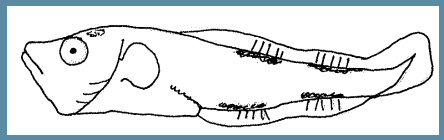



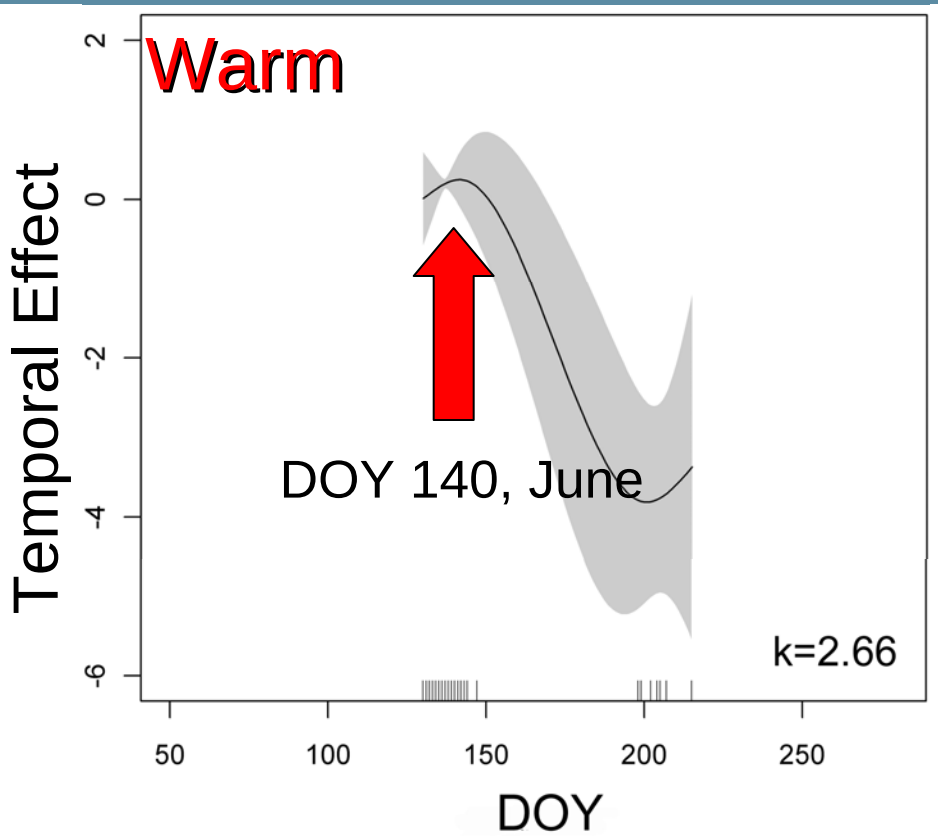

Non-parametric Jonckheere-Terpstra test: J = 1.96, p = 0.025

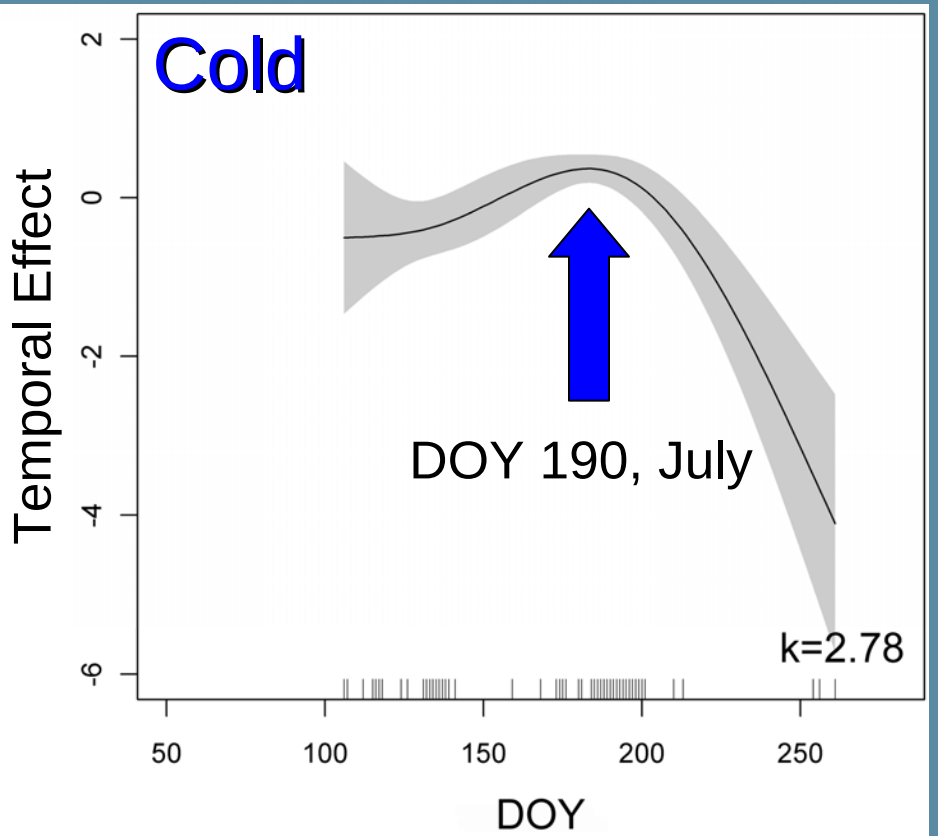
**Higher mortality rates in cold conditions**

# 4. Temporal Shifts

Ex. Late Larvae





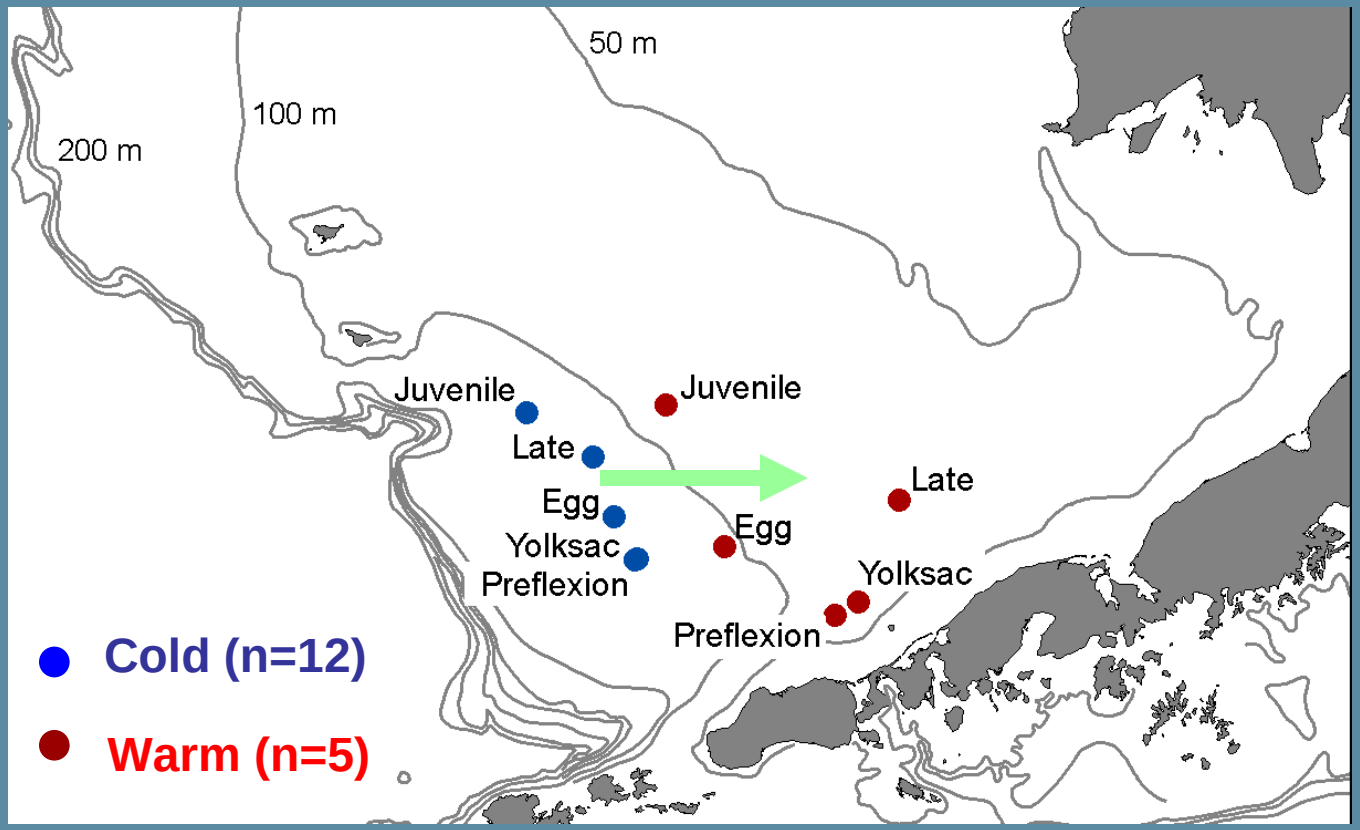
# Full Results: Temporal Shifts

| | Cold Peak DOY | Warm Peak DOY | Difference |
|---|---|---|---|
| Egg | 110 | 75 | 35 days* |
| Yolksac | 140 | 80 | 60 days |
| Preflexion | 150 | 80 | 70 days |
| Late larvae | 190 | 140 | 50 days |
| Juvenile | 230 | 220 | 10 days |

More evidence for shifts in spawning time

Delayed hatching and larval development

# 5. Spatial Shifts




## Longitude (E-W)

Temperature ($p<0.001$)

## Latitude (N-S)

No effect of Temperature

# Summary

| Hypothesis | Test | Support? | Consequence |
|---|---|---|---|
| Abundance | Stage-specific | YES early<br>NO late | |
| Growth | Growth rates<br>Temporal GAMs | YES<br>YES | Longer pelagic duration<br>Increased vulnerability |
| Mortality | Mortality rates | YES | Population loss |
| Temporal Shifts | Temporal GAMs | YES | Prey mis-match |
| Spatial Shifts | North-South<br>East-West | NO<br>YES | Nursery area suitability |

# Acknowledgements

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