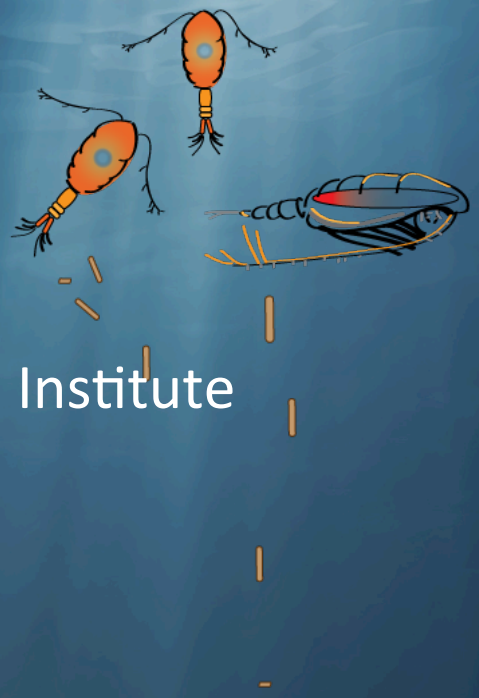
Changes in North Atlantic copepod community size structure and fecal pellet carbon flux over 55 years



Karen Stamieszkin, University of Maine
Andrew Pershing, Gulf of Maine Research Institute

Trait-Based Approaches to Ocean Life: Size as a Master Trait, October 6, 2015

Many thanks to:

Andrew Pershing
Nick Record
Traits Meeting Steering Committee

This material is based upon work supported by the National Science Foundation Graduate Research Fellowship Program, Grant No. DGE-1144205

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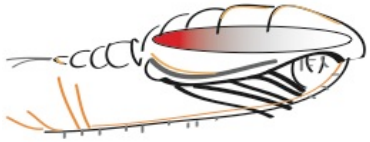
School of MARINE SCIENCES

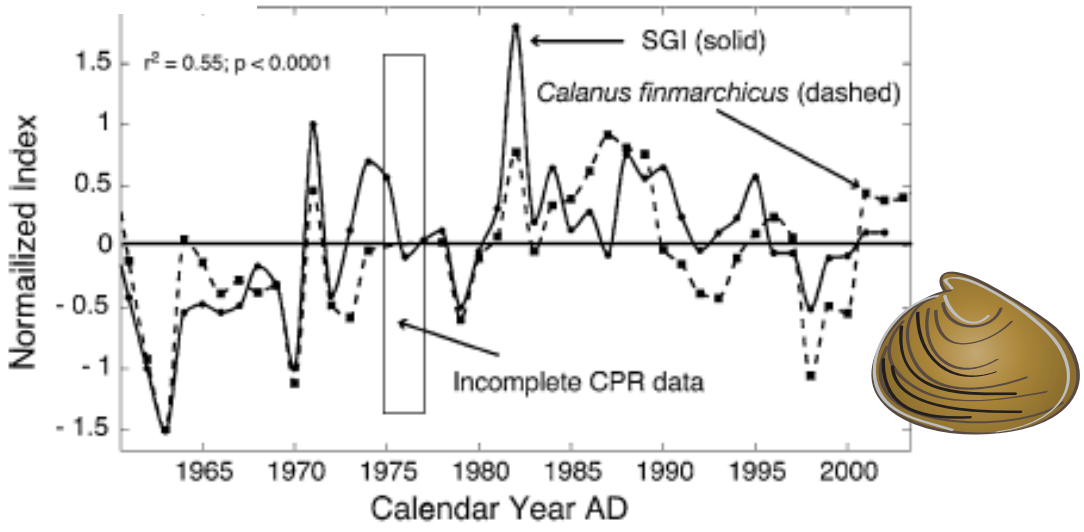
Gulf of Maine Research Institute

NSF Graduate Research Fellowship Program

Project Background

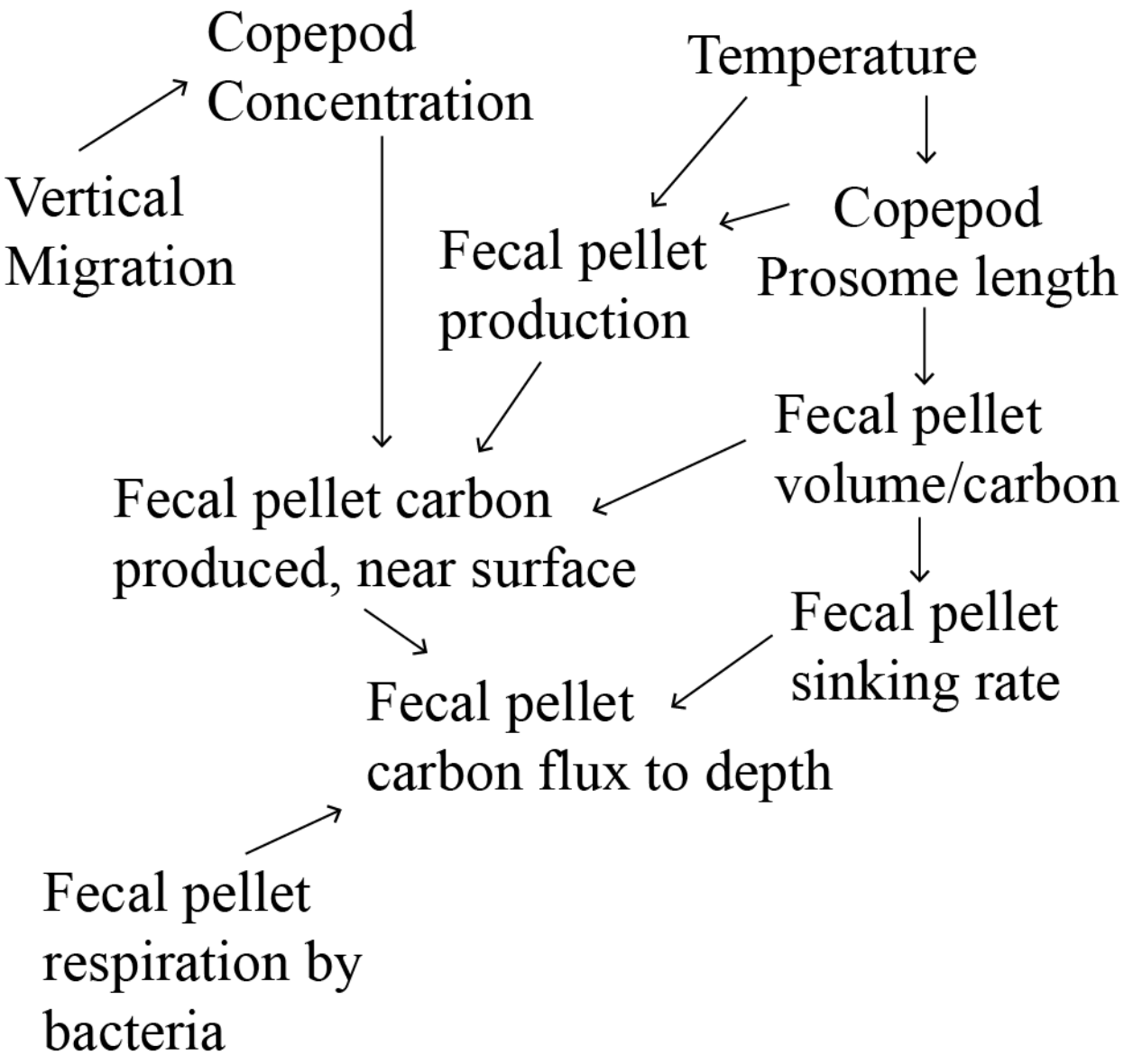
Gulf of Maine,
North America





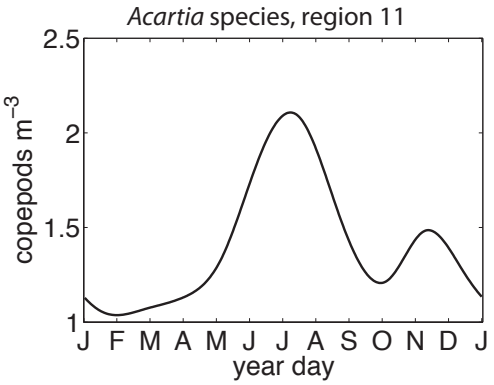
Wanamaker et al. 2009 *Int J Earth Sci*

Which traits can be used to understand and predict variability in carbon flux from copepods?

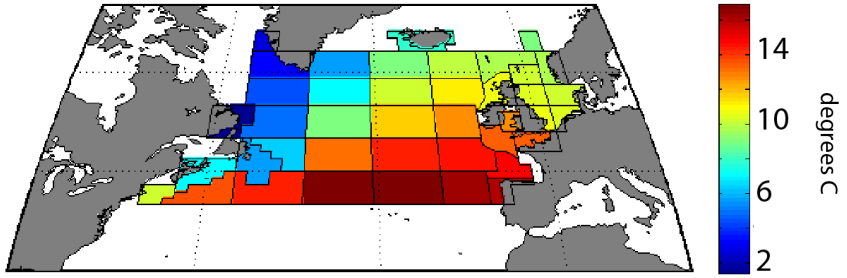

Copepod Concentration
Temperature
Vertical Migration
Fecal pellet production
Copepod Prosome length
Fecal pellet volume/carbon
Fecal pellet carbon produced, near surface
Fecal pellet sinking rate
Fecal pellet carbon flux to depth
Fecal pellet respiration by bacteria

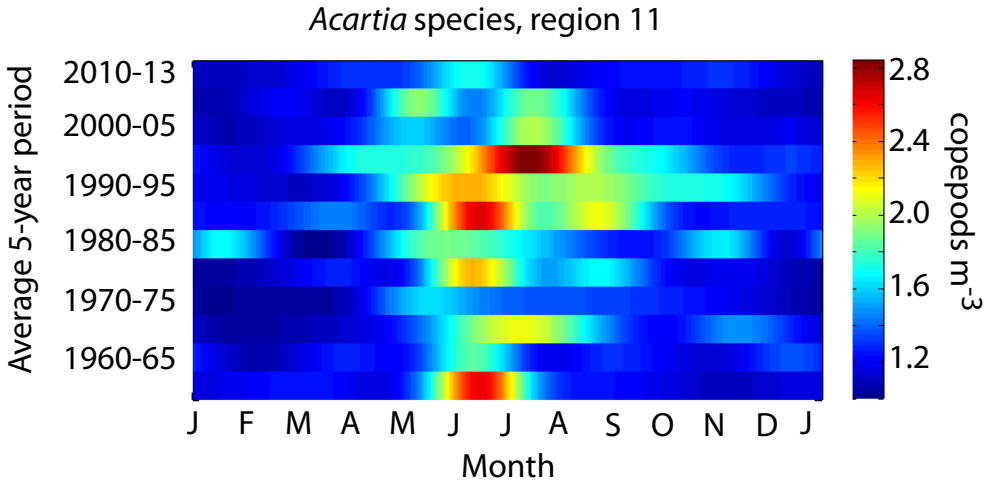
Copepod Concentration

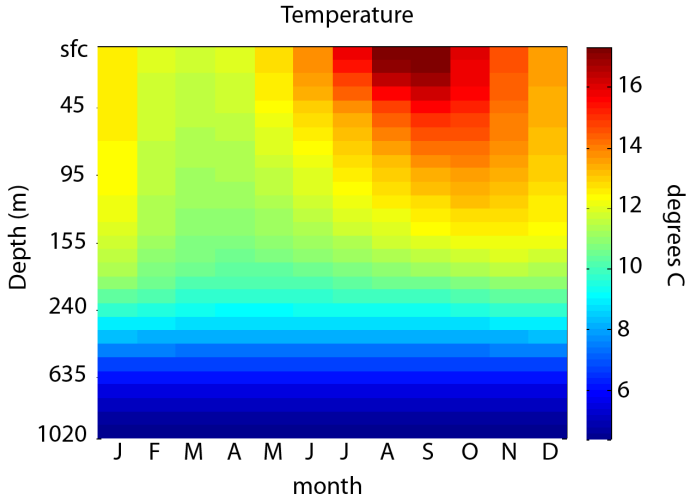
Temperature



CPR regions





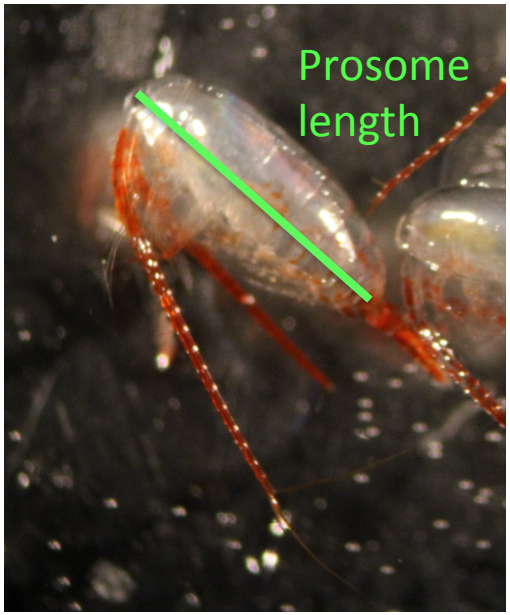


Temperature

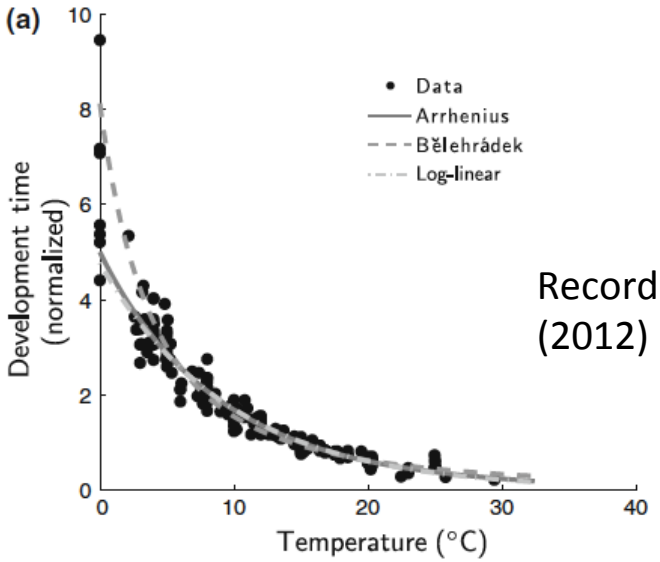
↓

Copepod
Prosome length

$PL_i = m_i(T) + b_i$



Temperature affects size at age

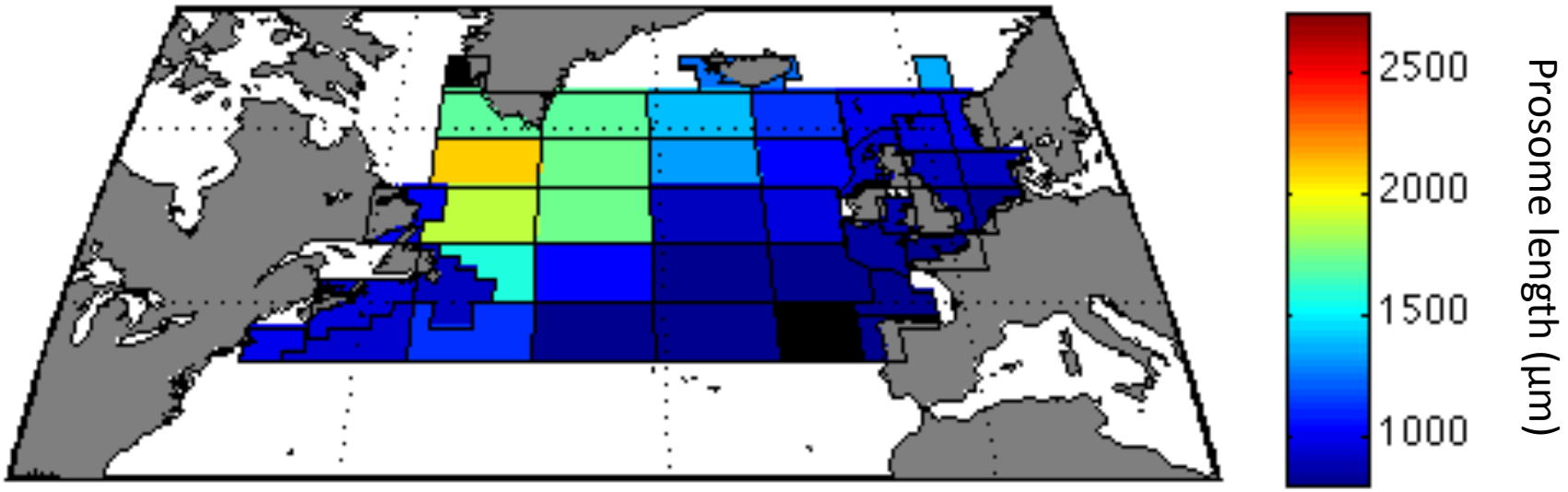


Record et al. (2012) *Oecologia*

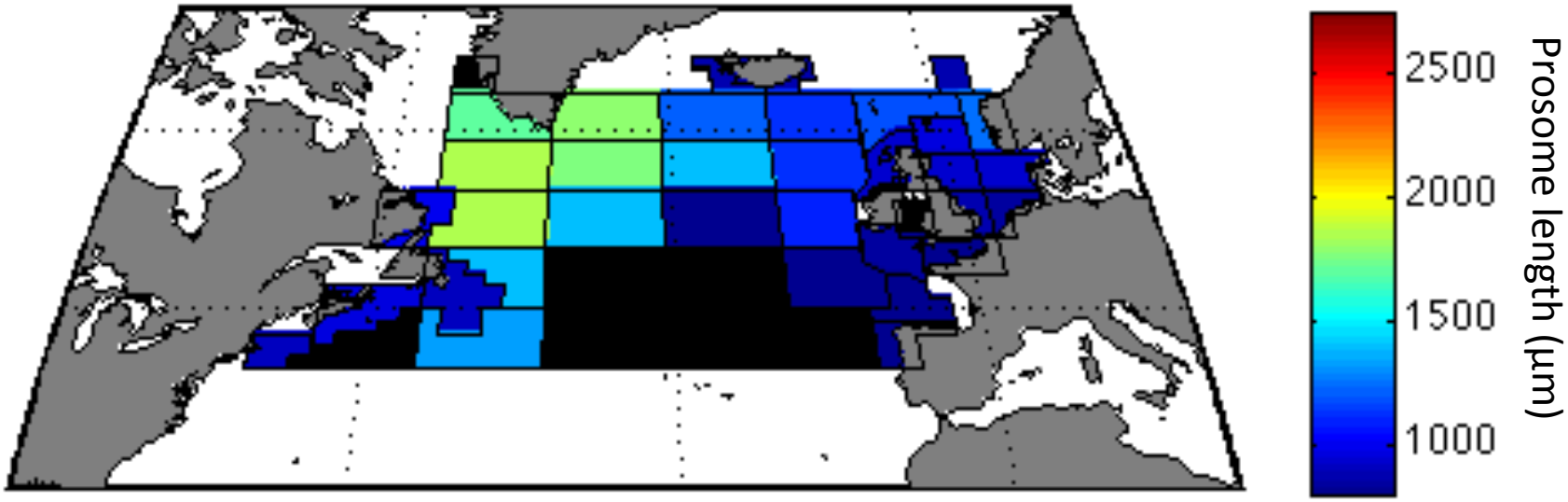
Temperature also affects species distributions

Dueling temperature effects on size…

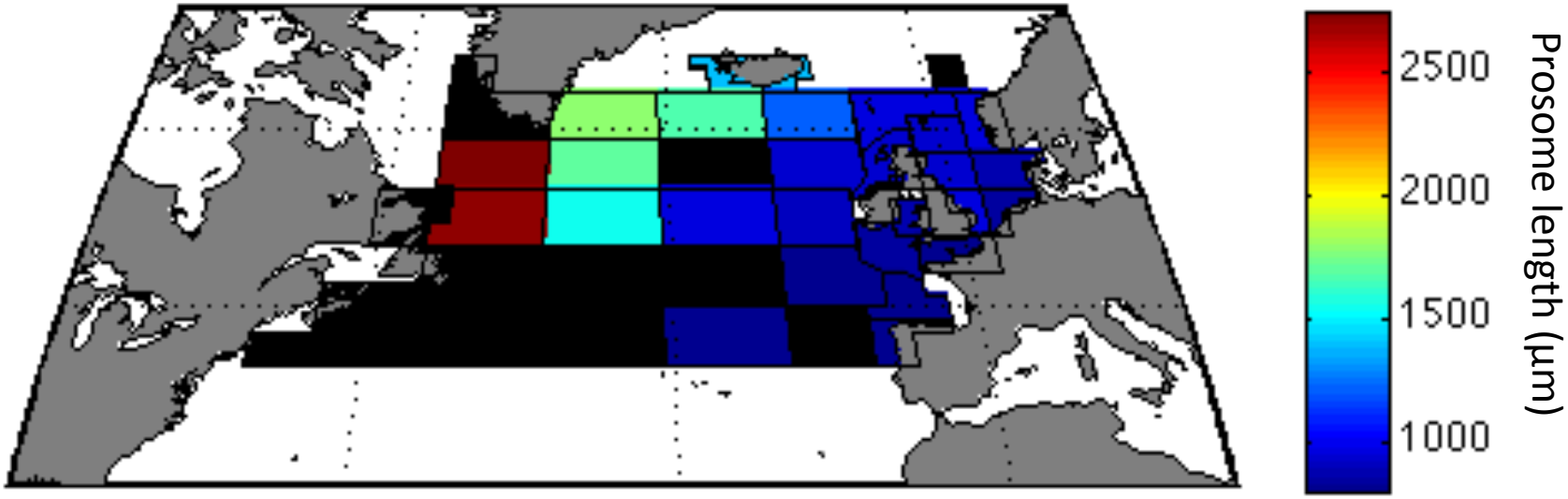
Mean copepod size 1958-2013

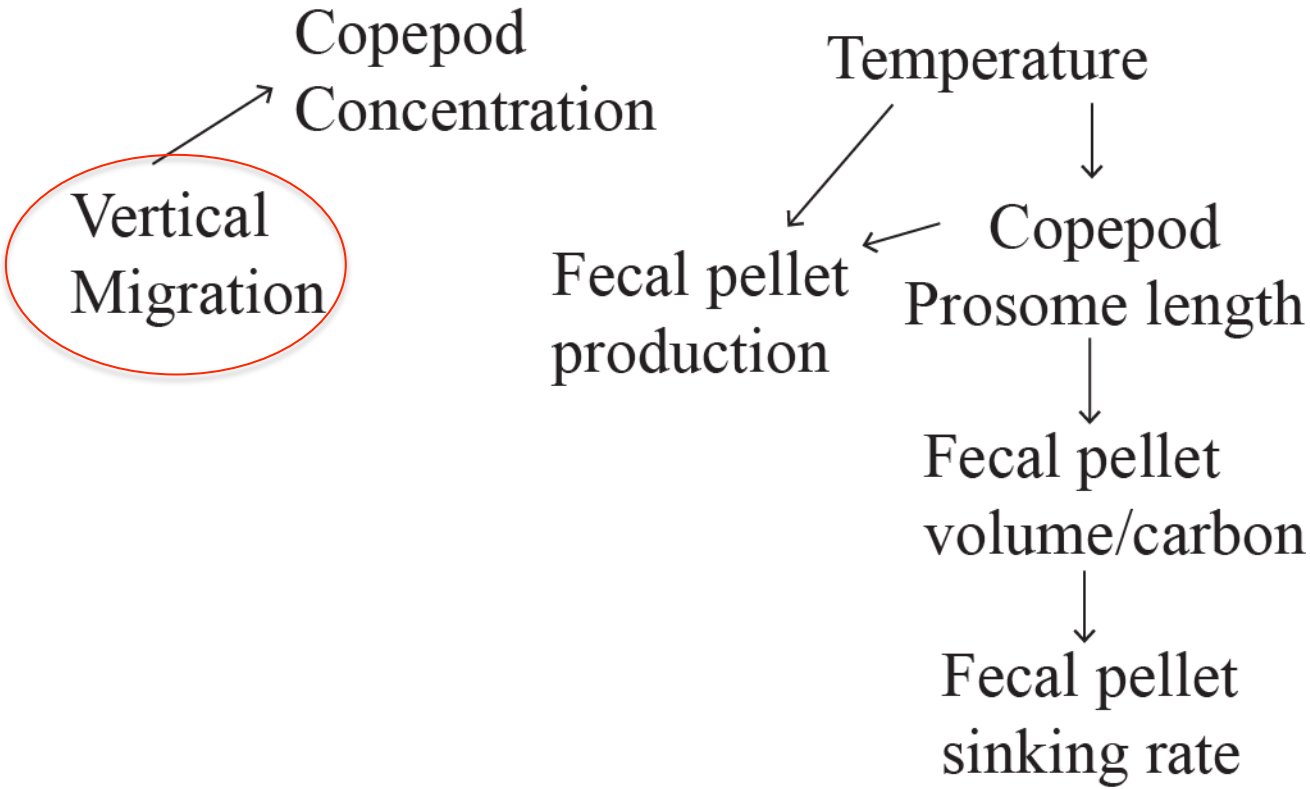


Mean copepod size 1960s



Mean copepod size 2000s

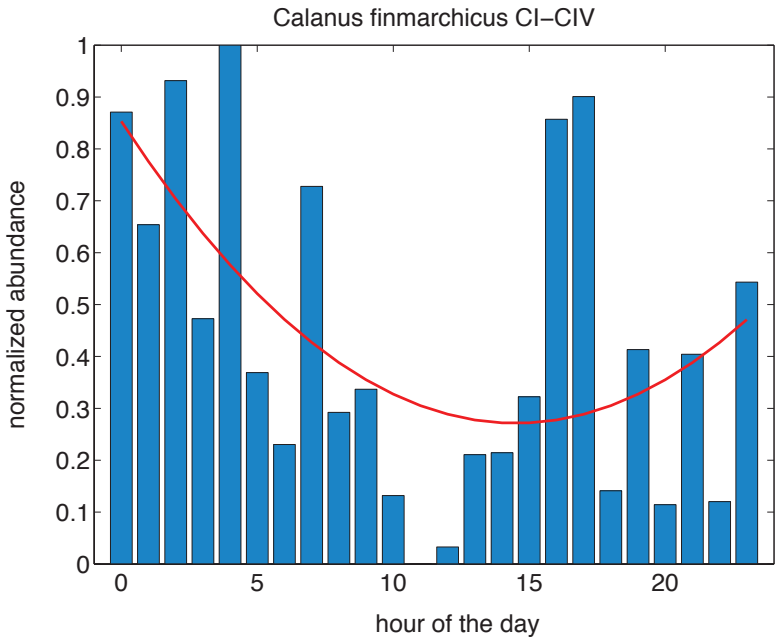



Copepod
Concentration
Vertical
Migration
Temperature
Fecal pellet
production
Copepod
Prosome length
Fecal pellet
volume/carbon
Fecal pellet
sinking rate

Vertical Migration

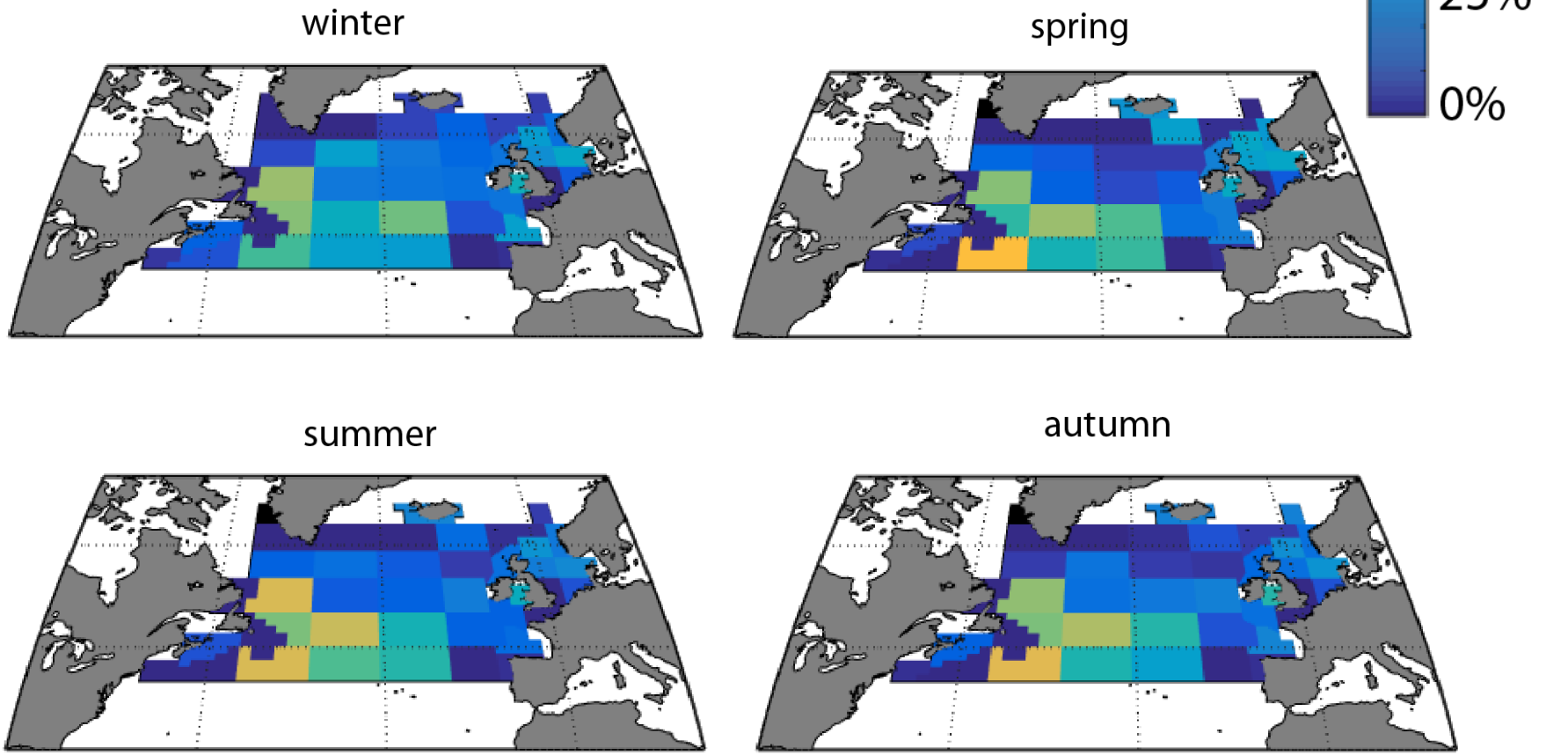
Qualifications

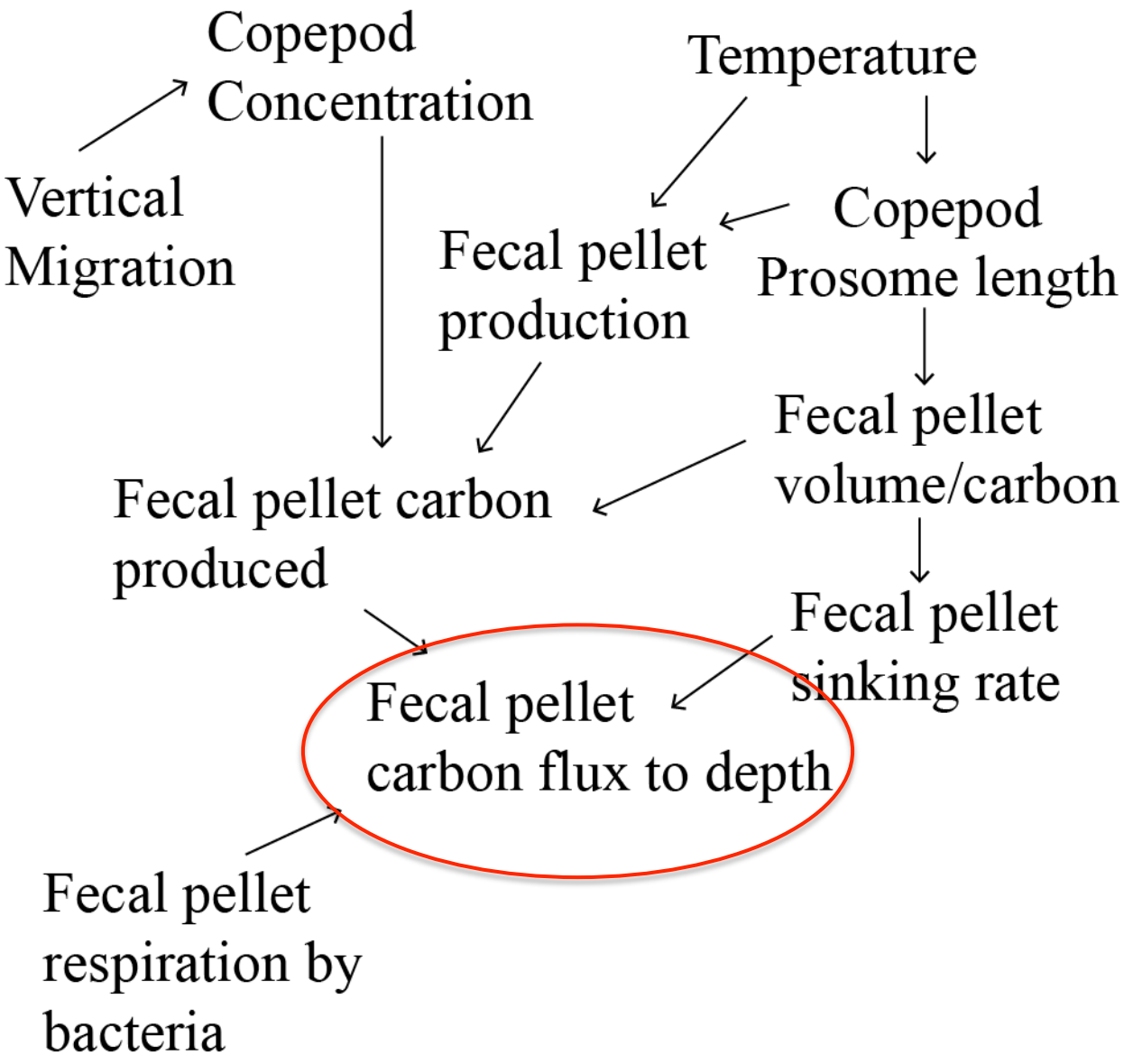
1) You occur more than 5% of the time in a region, otherwise who knows
2) A 2nd order polynomial fits your mean abundance profile over 24 hours
3) Your first polynomial coefficient is positive (i.e. no “reverse migration”)



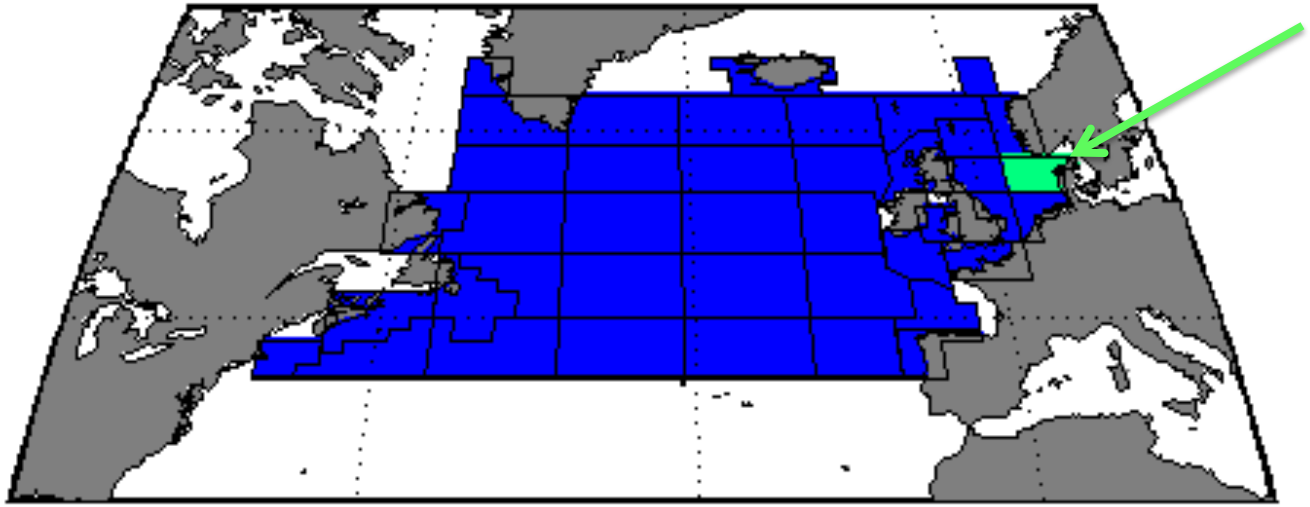
P = 0.006 ✔

Percent of copepod biomass performing diel vertical migration

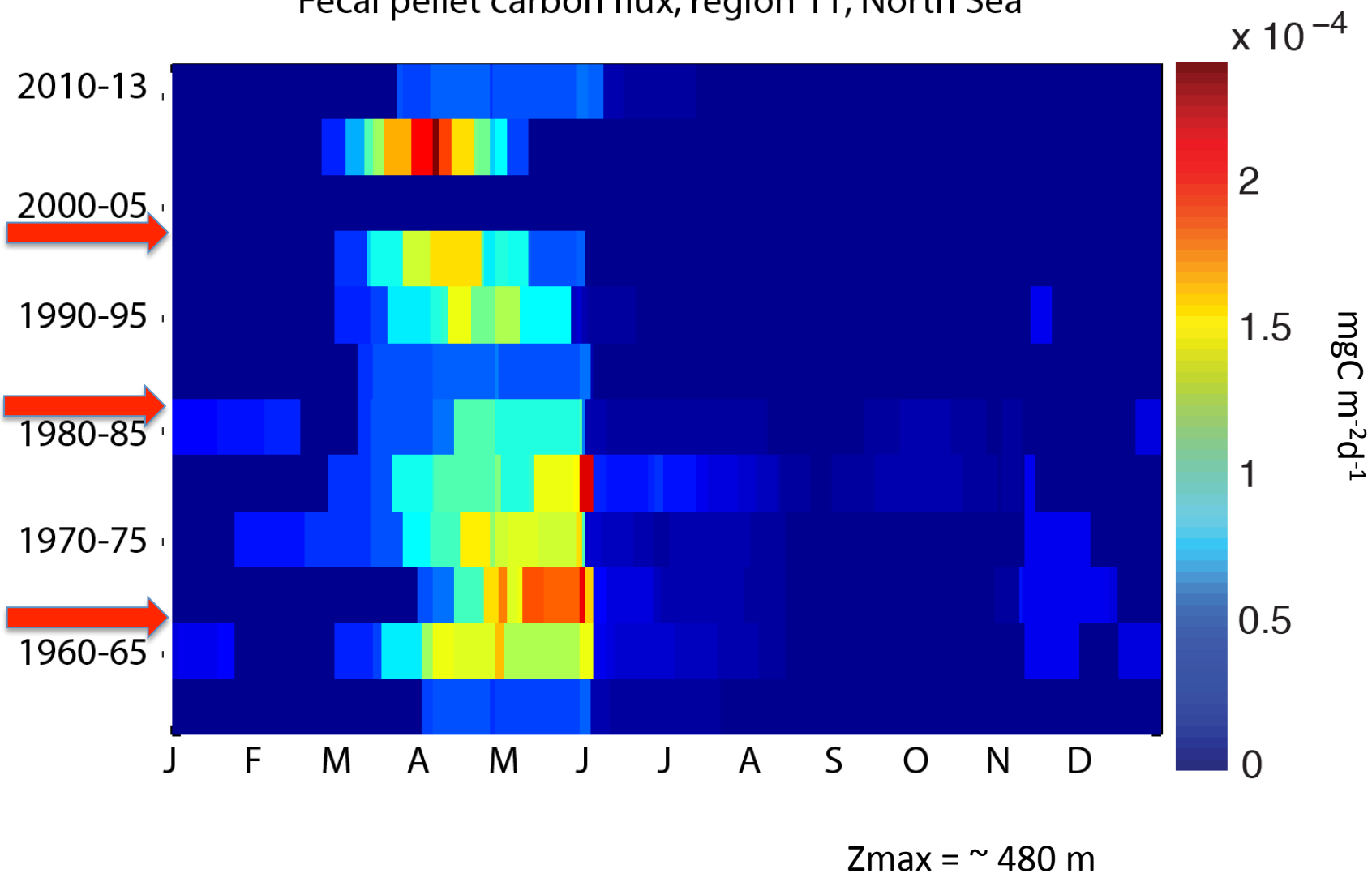


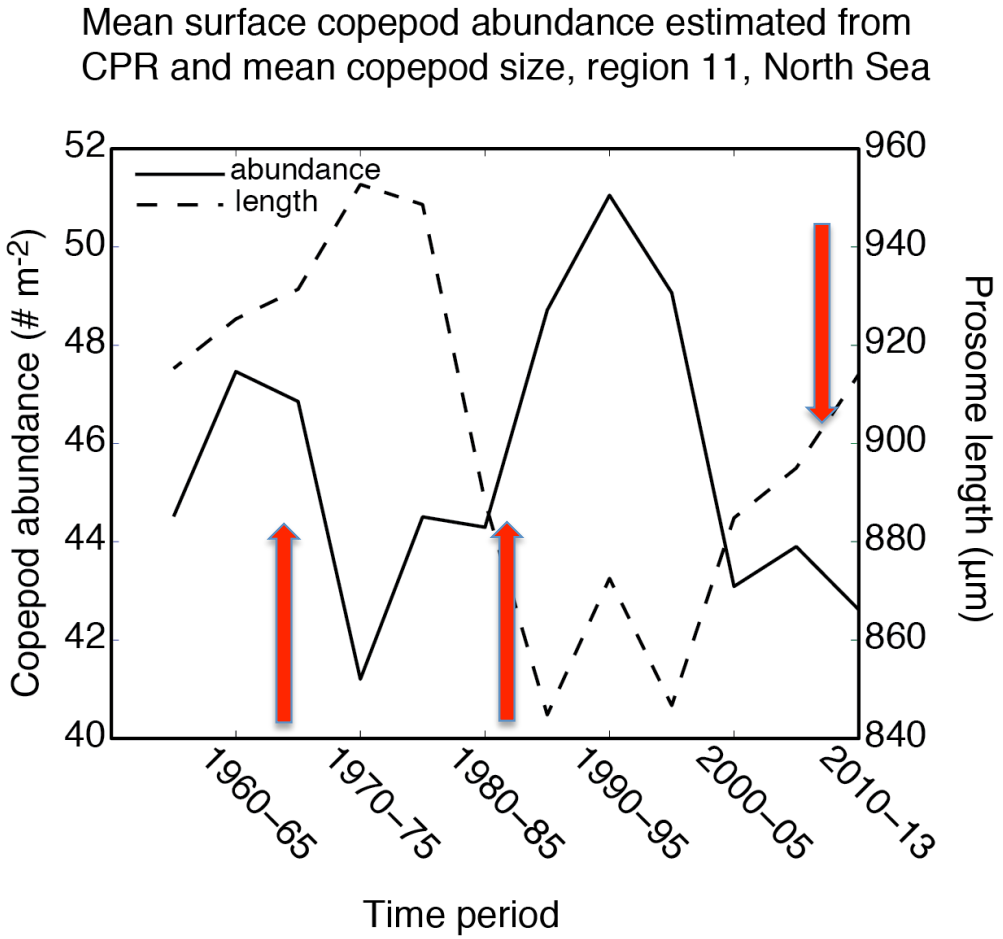

Copepod Concentration
Temperature
Vertical Migration
Fecal pellet production
Copepod Prosome length
Fecal pellet volume/carbon
Fecal pellet carbon produced
Fecal pellet sinking rate
Fecal pellet carbon flux to depth
Fecal pellet respiration by bacteria

One well-sampled region, North Sea:

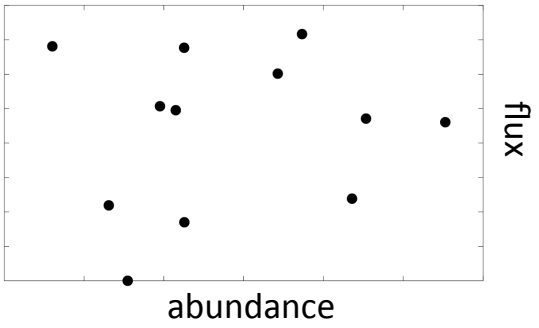


North Sea (Zmax ~480 m):
Abrupt shifts in the ‘60s, ’80s and 1996-2003
(Beaugrand et al. 2014 *MEPS*)

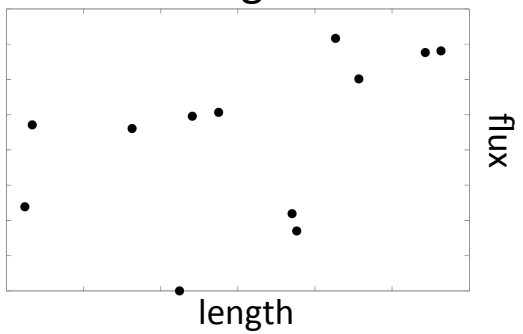

Fecal pellet carbon flux, region 11, North Sea
x 10 −4
2
1.5
1
0.5
0
mgC m-2d-1
2010-13
2000-05
1990-95
1980-85
1970-75
1960-65
J F M A M J J A S O N D
Zmax = ~ 480 m



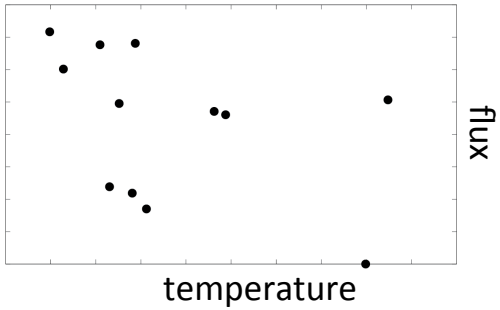
Mean abundance v. flux



Mean length v. flux

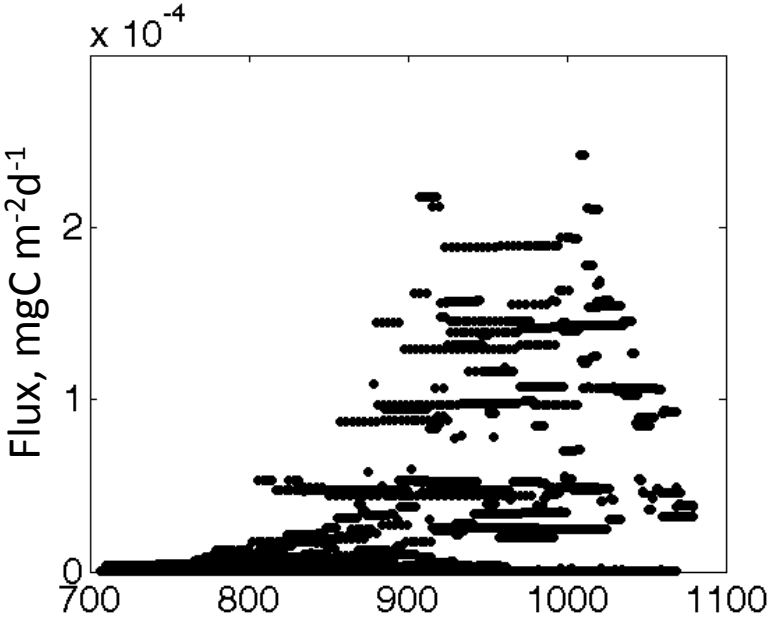


Mean temperature v. flux

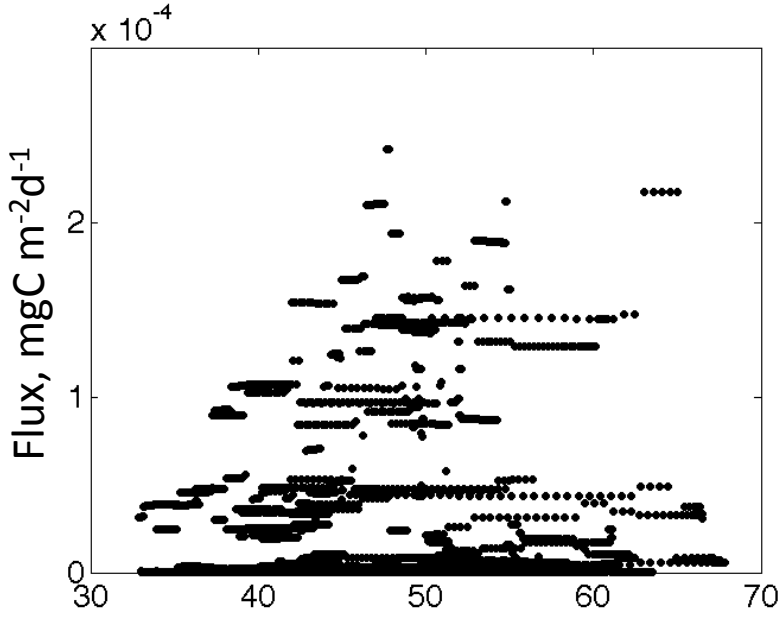


Length is inversely related to abundance, and connected more to fecal pellet carbon flux; temperature is inversely related to flux

Predicted copepod fecal pellet carbon flux versus key variables



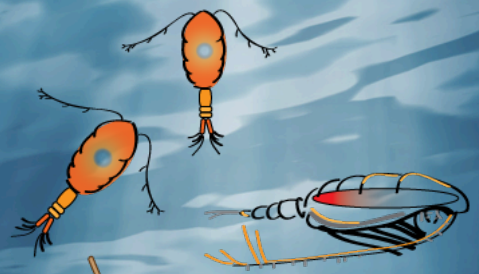
Mean copepod length (µm)



Mean copepod abundance (# m^{-2})

Where to go from here:

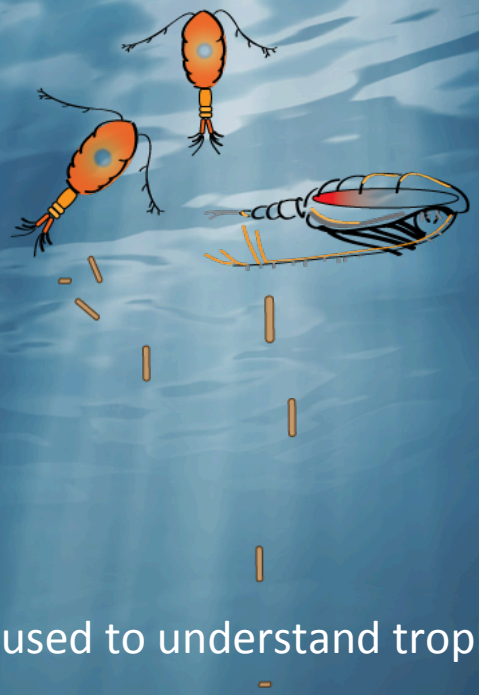
1) Tune the DVM submodel with new study by Ohman & Romagnan; Run model without DVM and compare
2) Analyze changing size for time/space patterns – what regions and time periods change together?
3) Respiration at depth compared to fecal pellet flux



Thank you!

Email: karen.stamieszkin@maine.edu

Thank you!



Email: karen.stamieszkin@maine.edu

Discussion:

Size diversity (like biodiversity) is a metric that could be used to understand trophic structure and seasonality

Plotting organisms in trade-off space should accompany plots of trait-space, for size or any trait. These trade-offs can teach as much as the traits themselves.

We learn different things from looking at deviations from mean size structure, rather than mean size structure alone.