



UiO : **Department of Biosciences**
University of Oslo

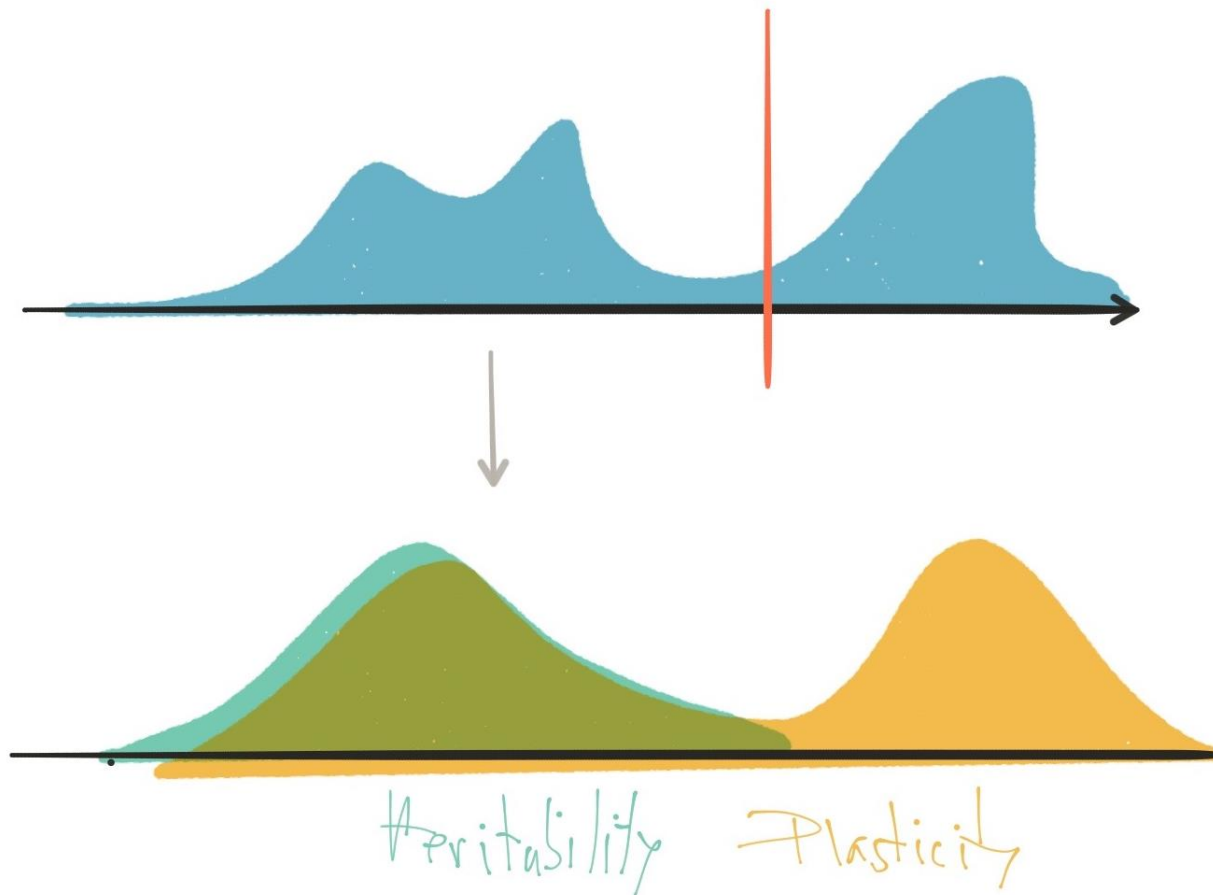
Individual level responses to risk (& other environmental cues)

Josefin Titelman
Jan Heuschele
Oda Bjærke

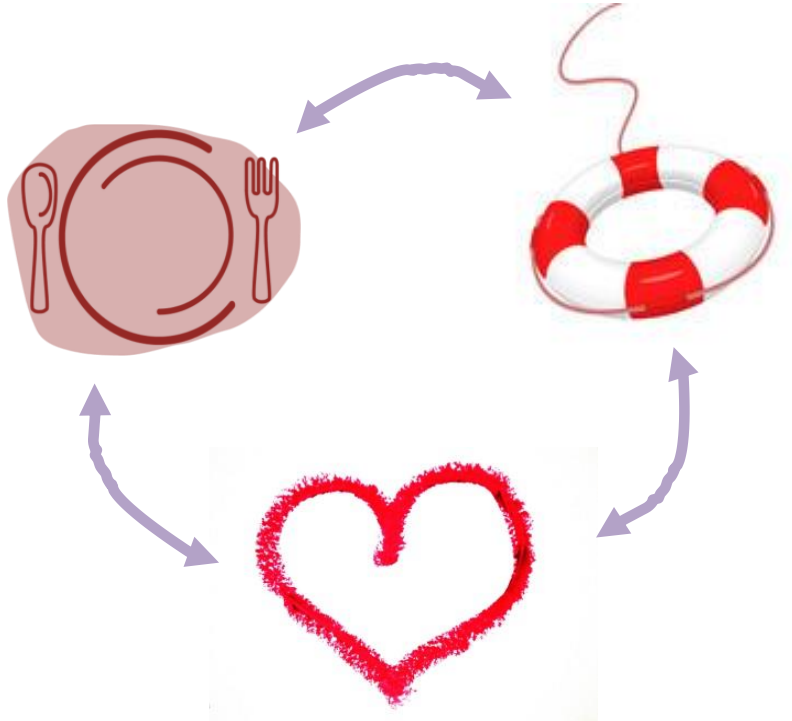


populations consist of individuals

- Natural selection acts on individuals, not on groups

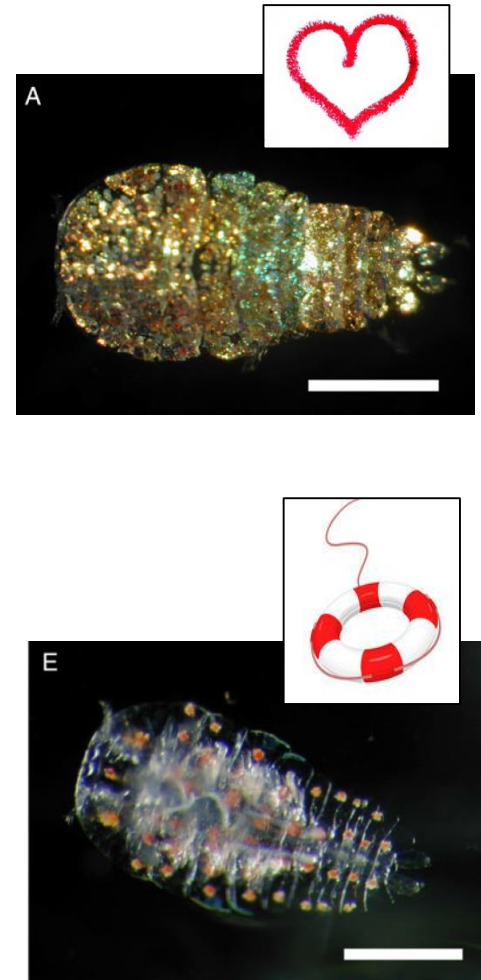
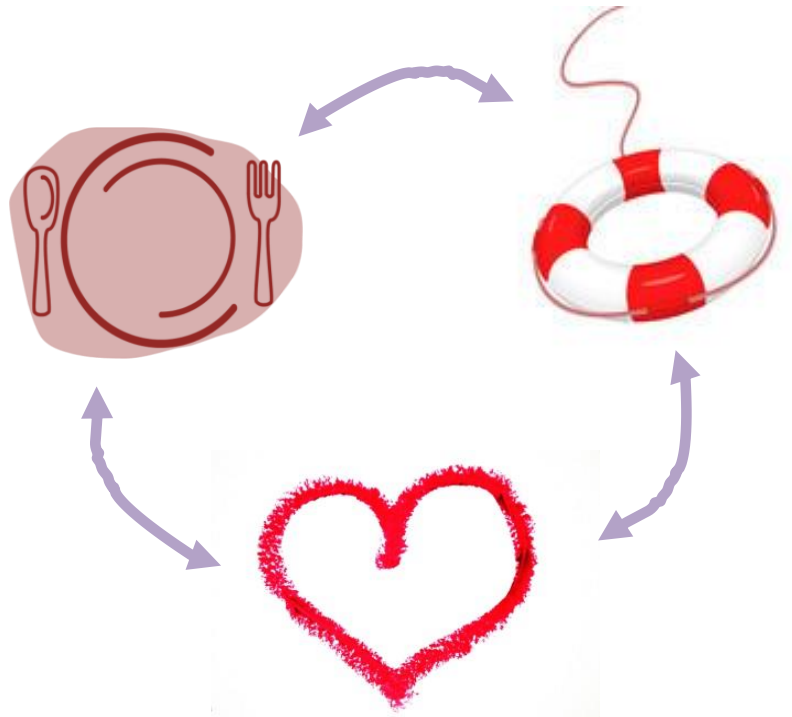


individuals balance life



- Many traits involved, including **size** & **behavior**

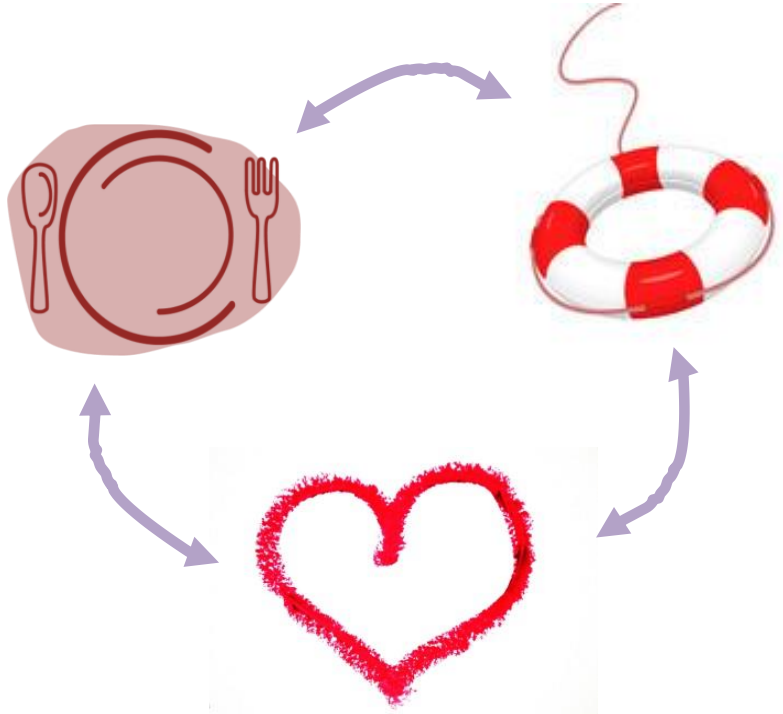
individuals balance life



(Takahashi et al 2015)

- Many traits involved, including **size** & **behavior**

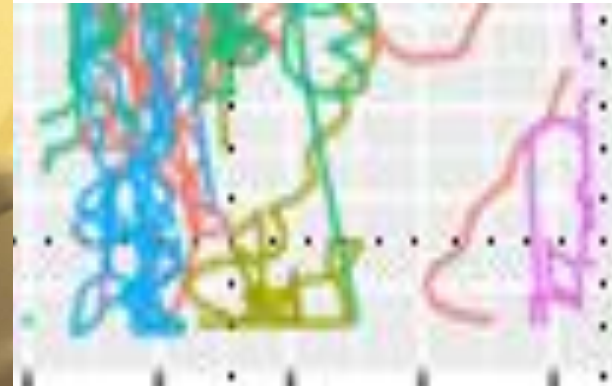
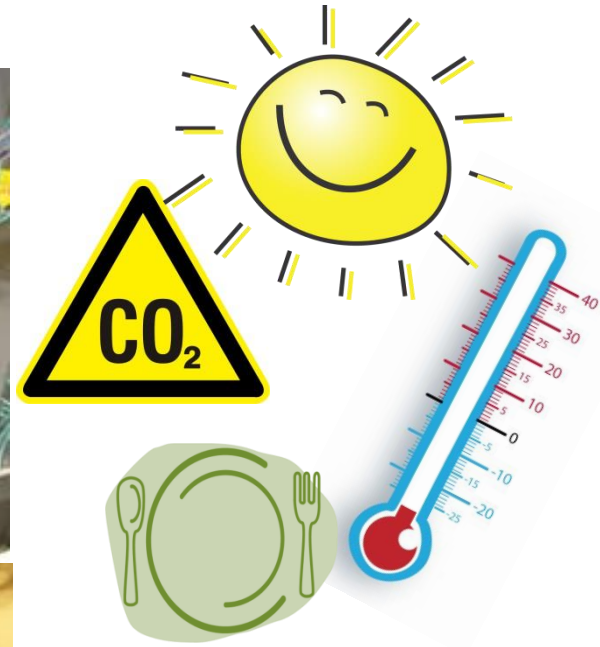
individuals balance life



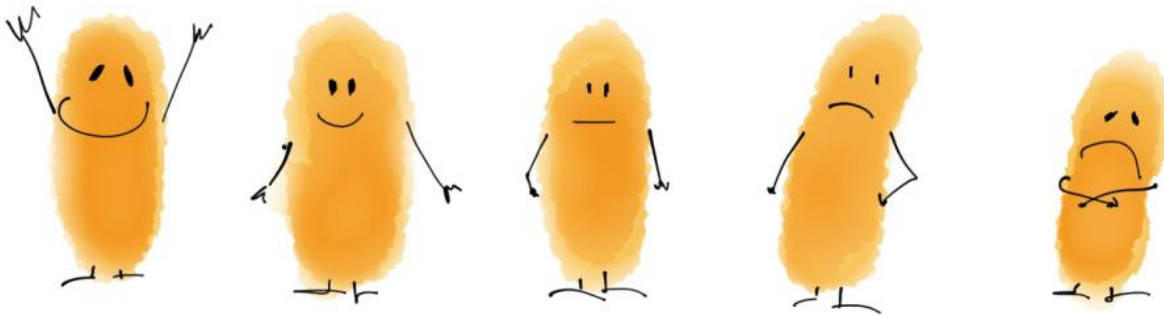
**PREDATION
RISK?**

- Many traits involved, including **size** & **behavior**

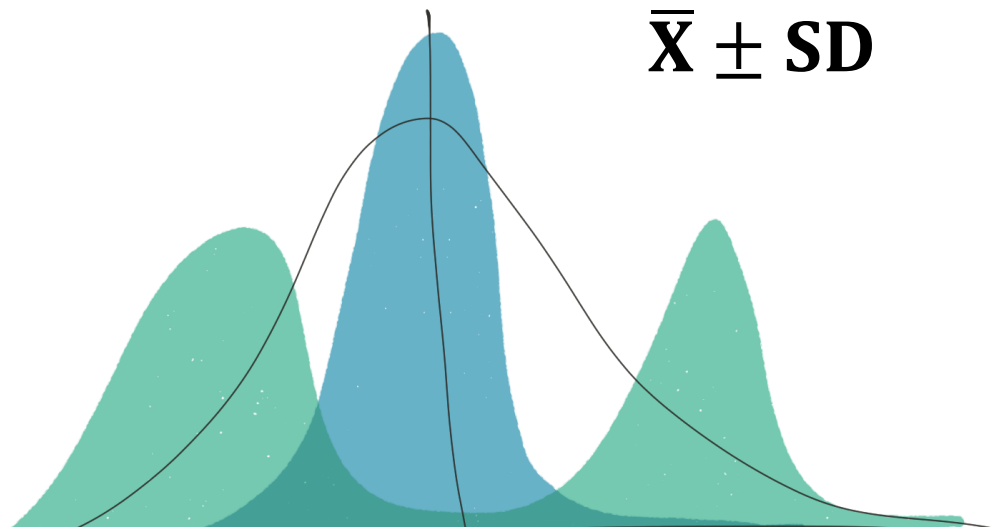
we examine some response to the environment



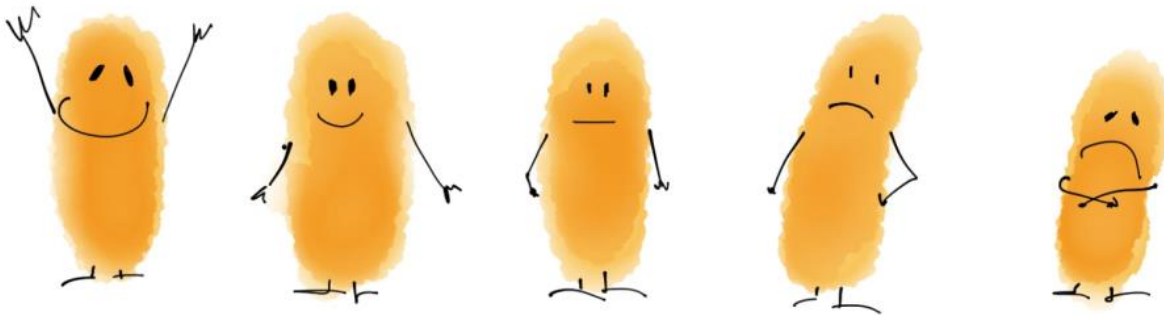
we examine some response to the environment

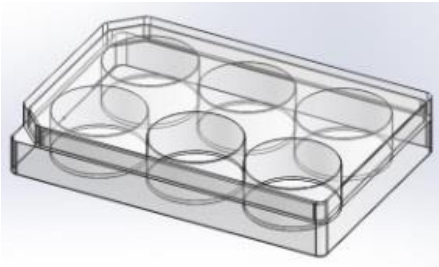


we assume that life is normally distributed & focus on the mean



- experiments often target **per capita** responses
- **BUT** we design away individual variation – to get significance- by using groups for our replication units





15 mL

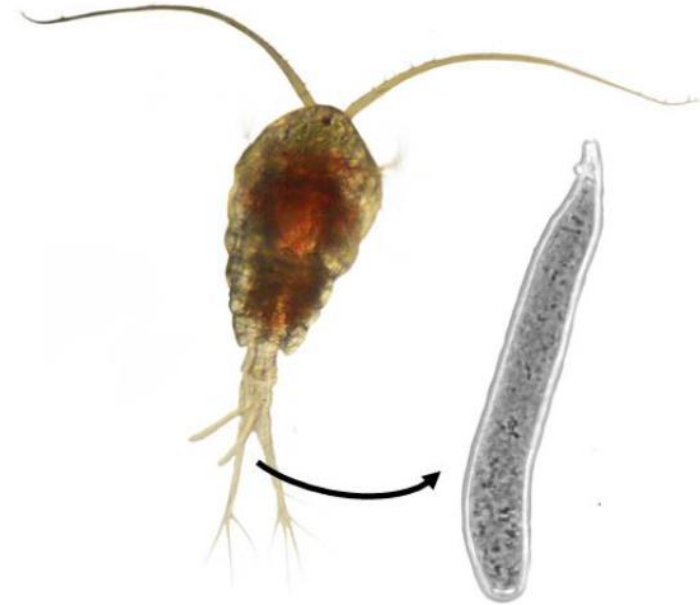
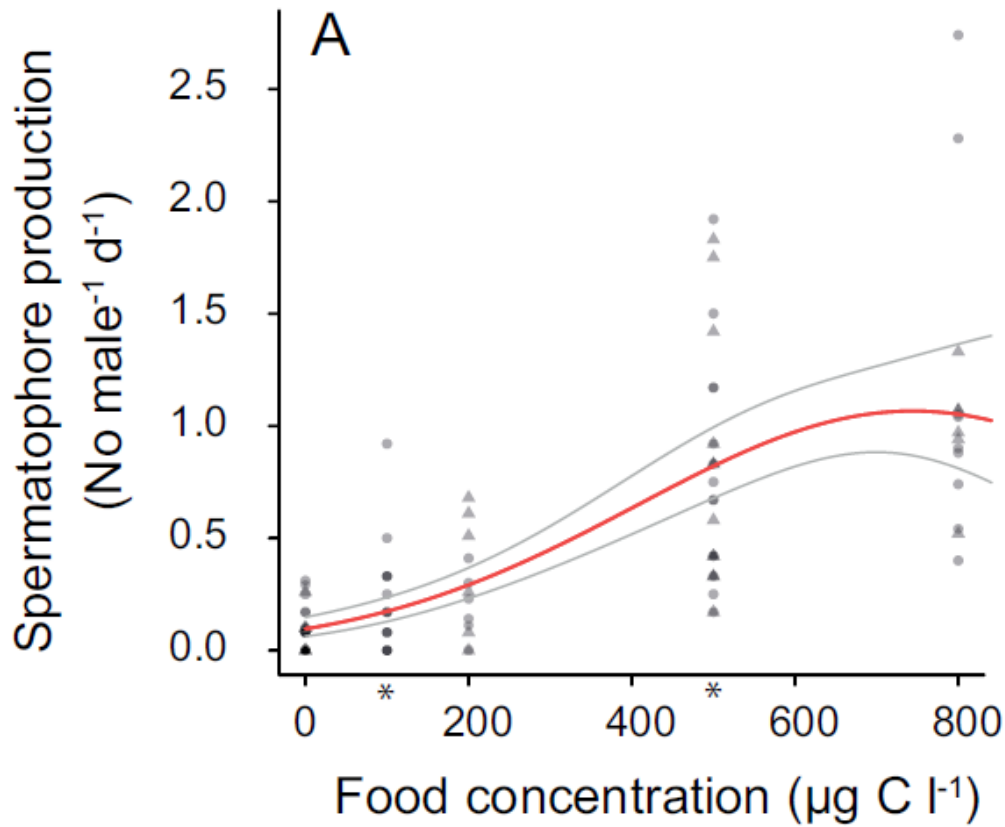
Volume

2000 L

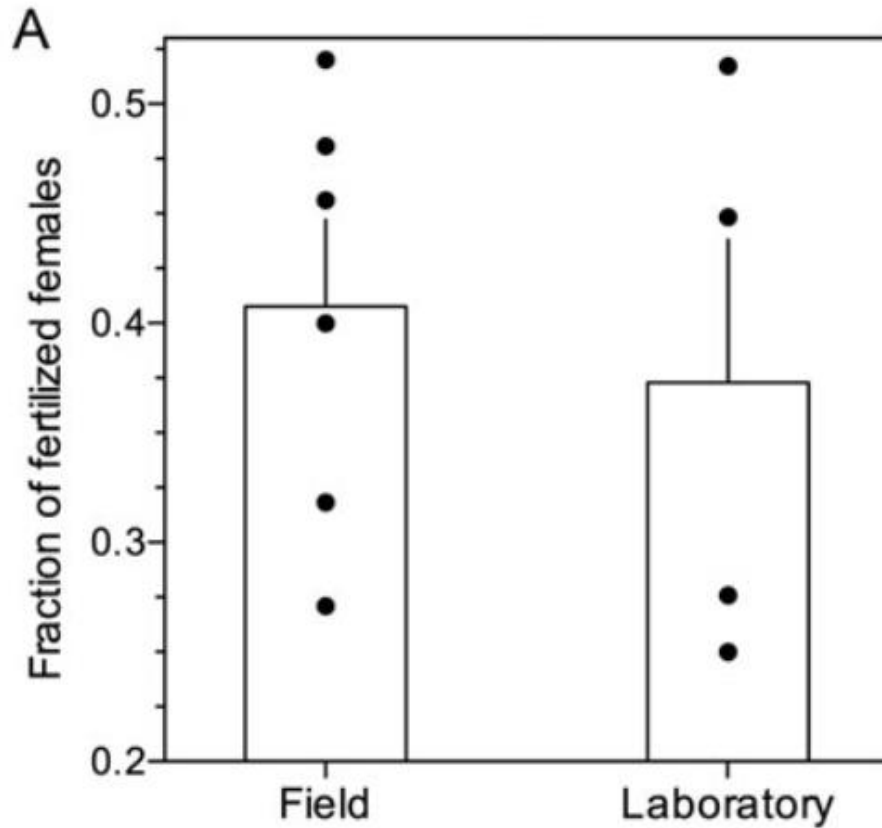
Control

Realism

...but individual variation drives evolution...



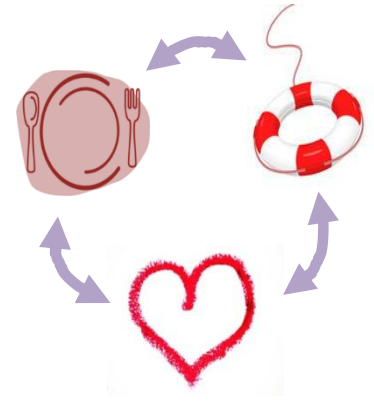
.. & individuals don't contribute equally to populations



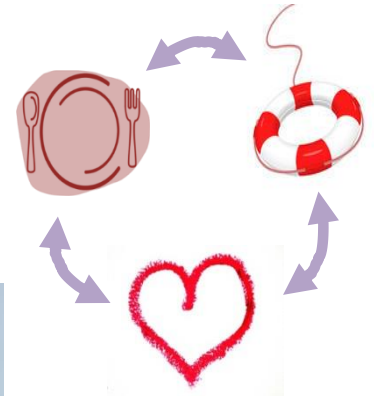
(Ceballos et al 2014)

Predation risk

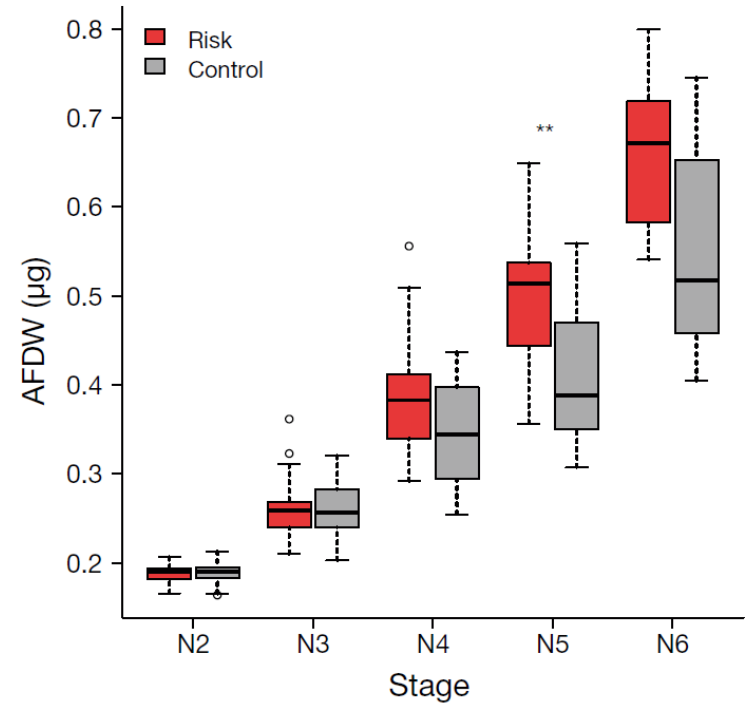
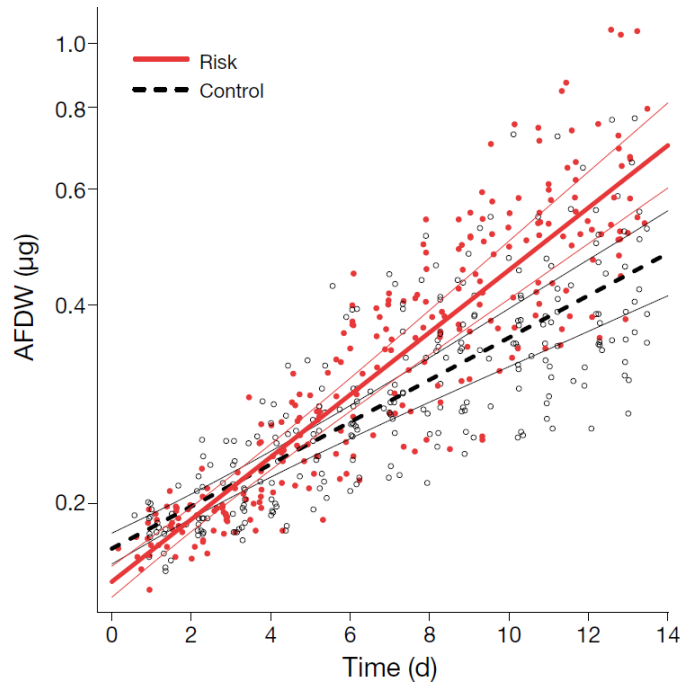
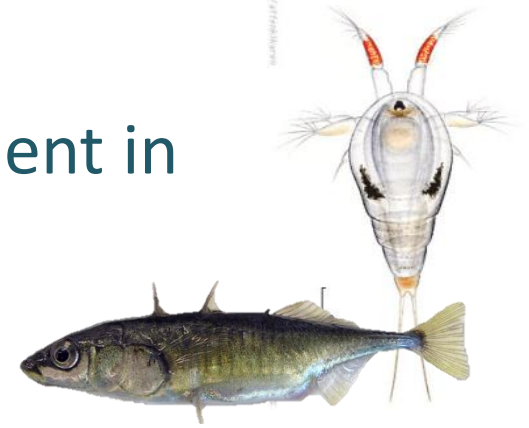
- Varies in time & space
- Prey detect & respond to cues
- Behavior has direct implications for encounter rates with predators
- May modulate trade-offs



Behavior & boldness



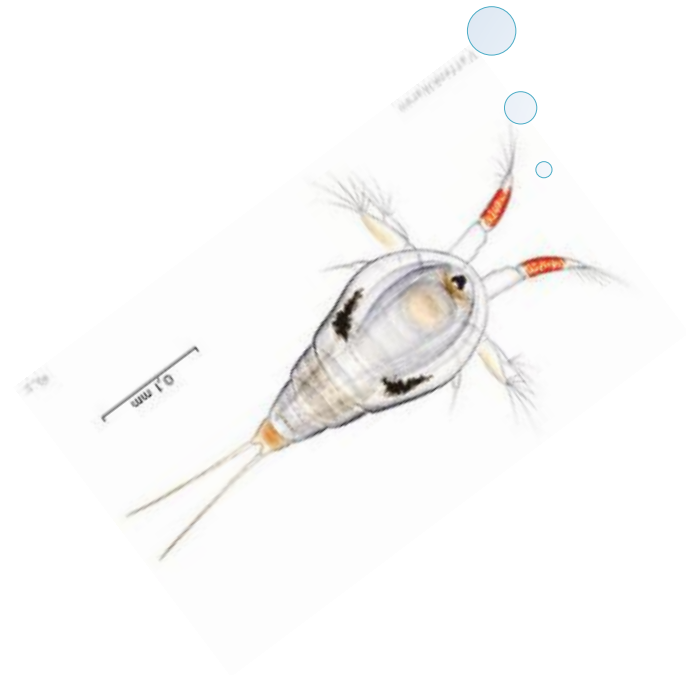
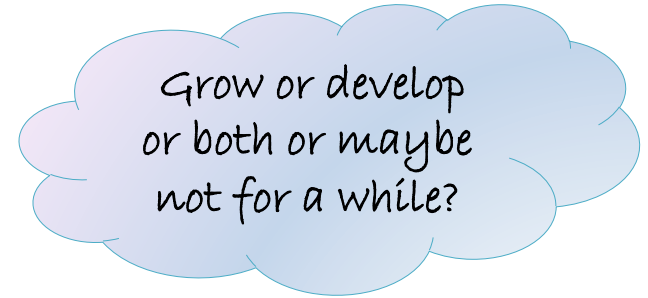
Stage specific altered growth & development in nauplii when exposed to fish smell



(Bjærke et al, 2014)

Differences in growth & development responses suggest effects on other fitness related parameters

- **Size (at stage) & stage** important for motility, detection, escape, mating, egg production, spermatophore production...
- complex signal environment with risk related cues acting on different scales



Plasticity in life history suggests importance of ecological context

- *Calanus finmarchicus*

Field: 1-2 year life cycle with diapause

Cultures: 3 month life cycle without diapause
(NTNU/SINTEF, Trondheim)

- *Cyclops scutifer*

1-3 yr life cycle in nearby lakes, no diapause
(e.g. Elgmork 2004)

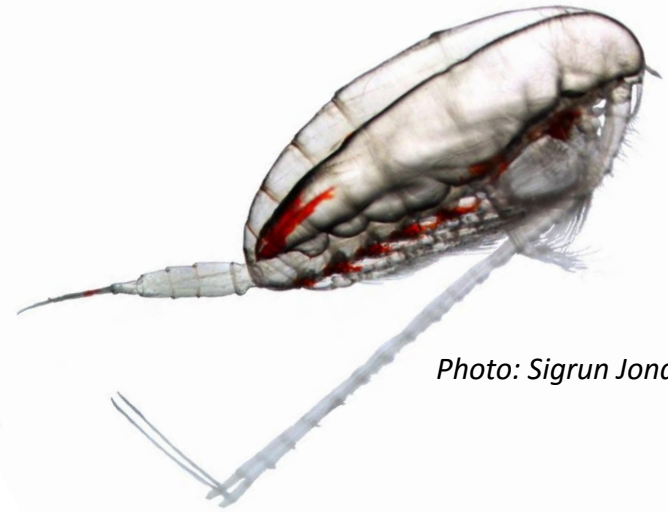
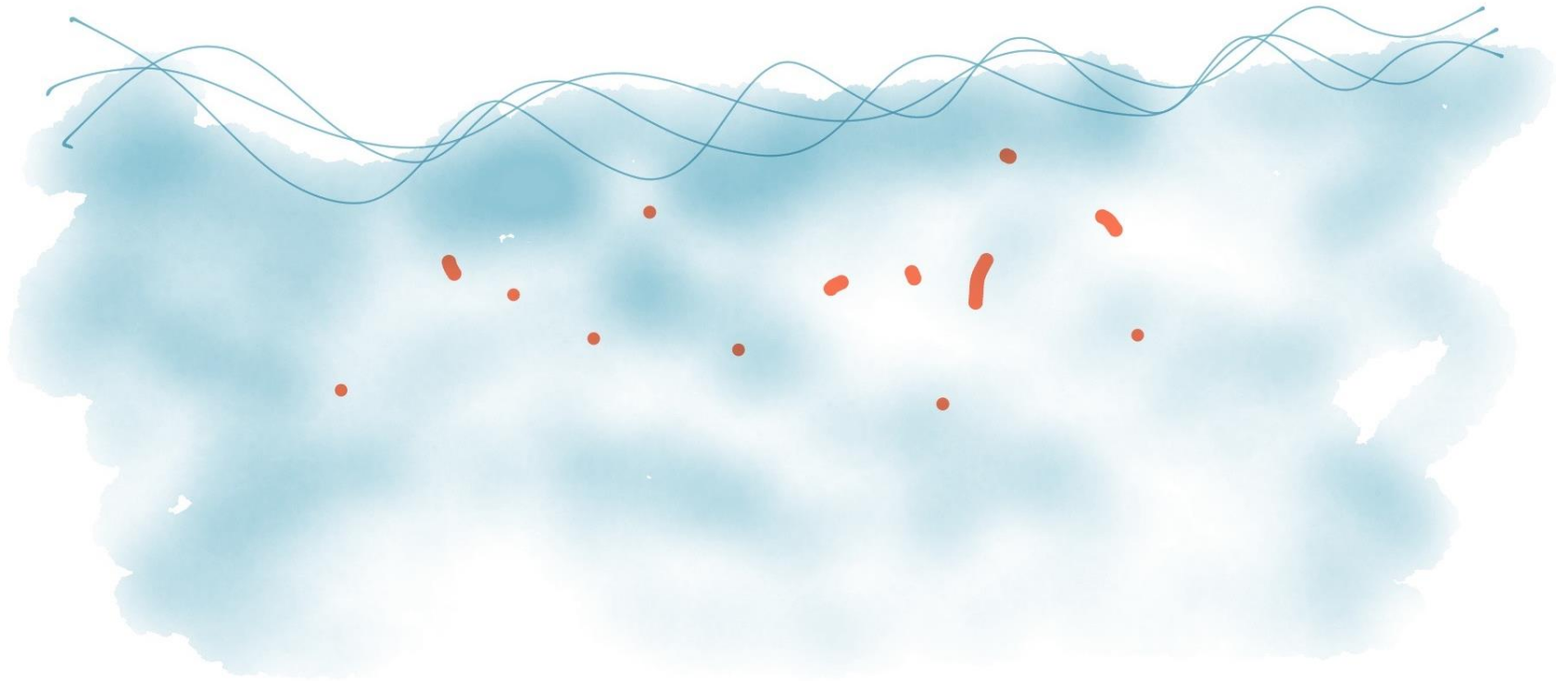


Photo: Sigrun Jonasdottir

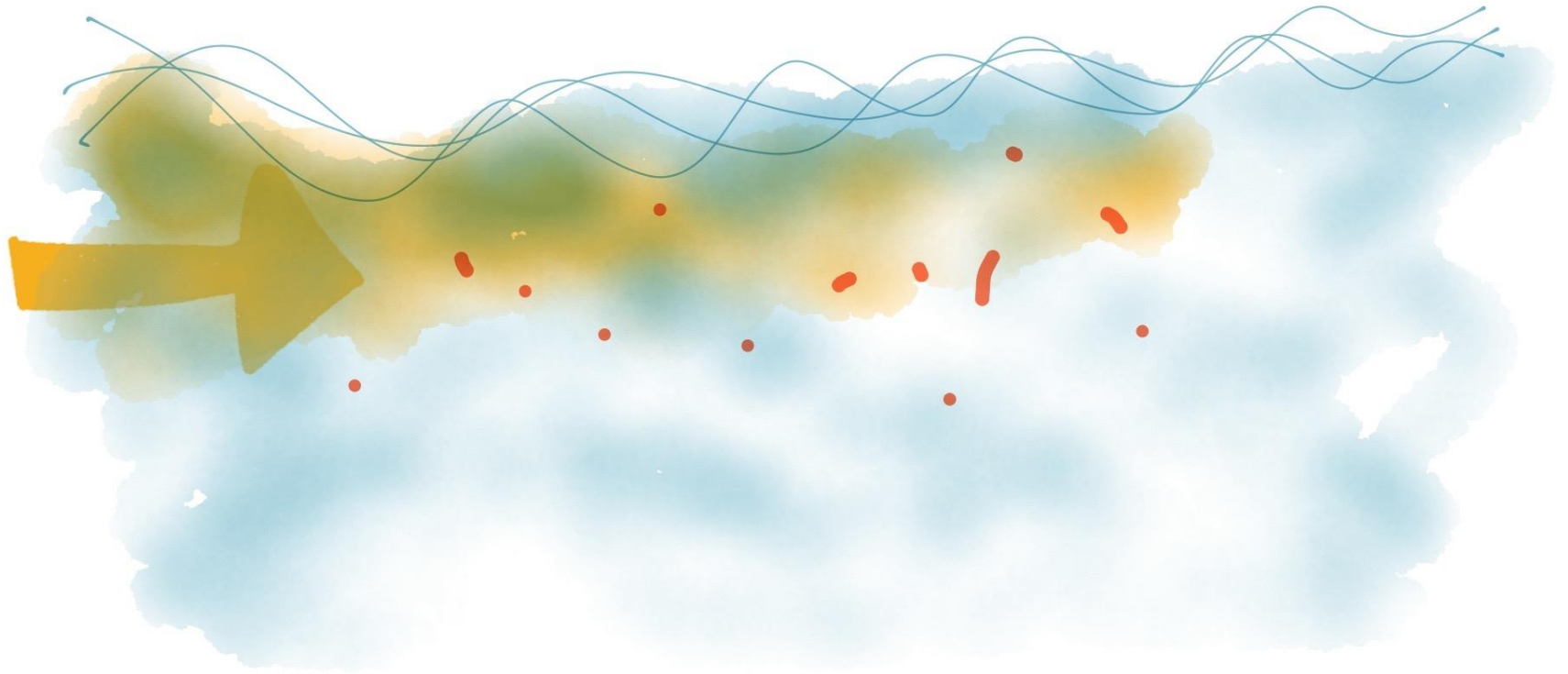


Does perceived risk matter?

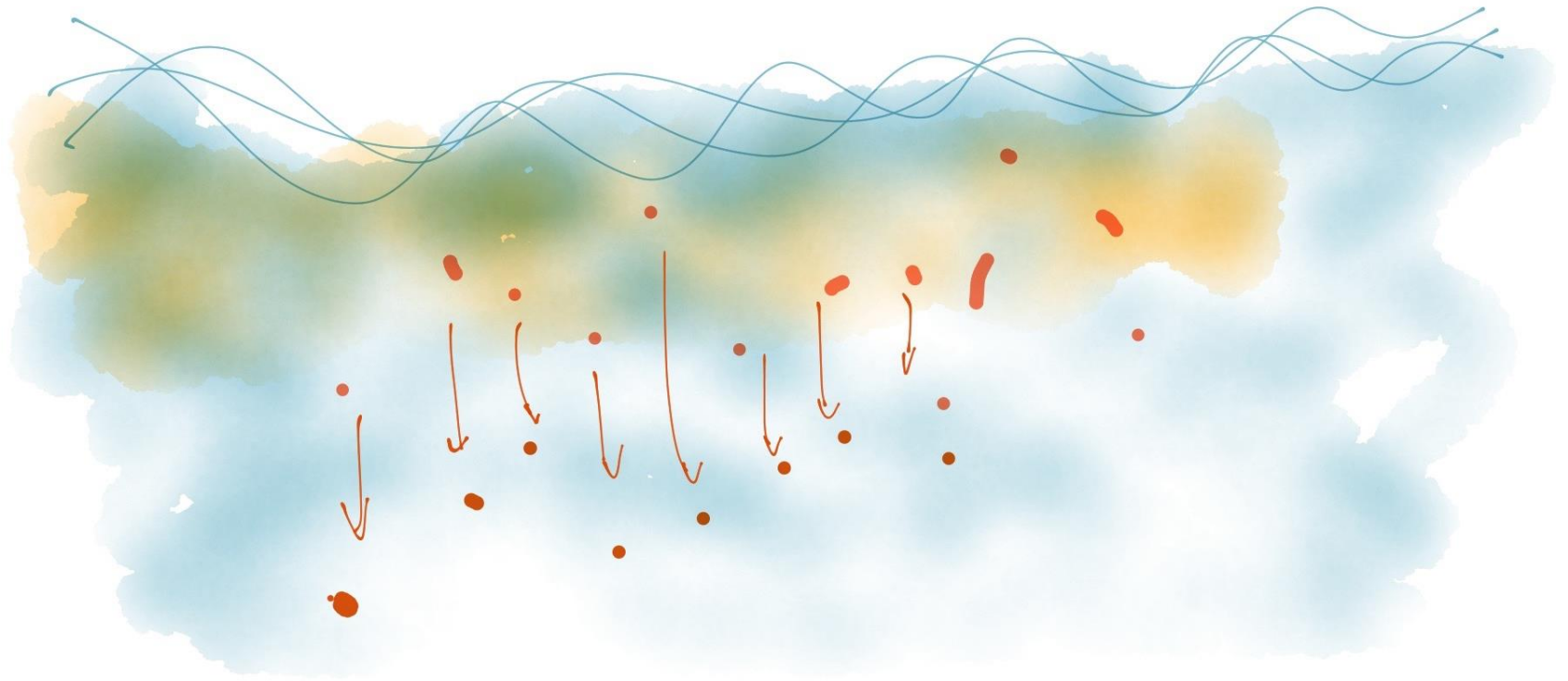
Behavior responds first



Behavior



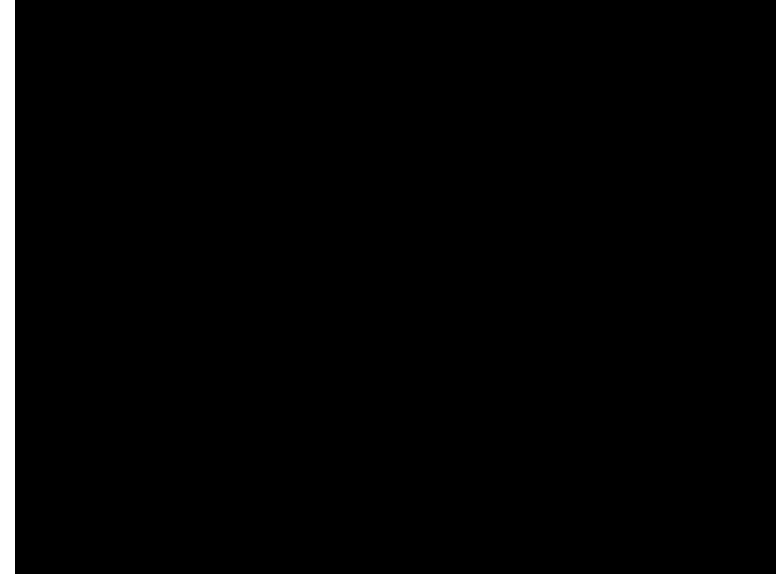
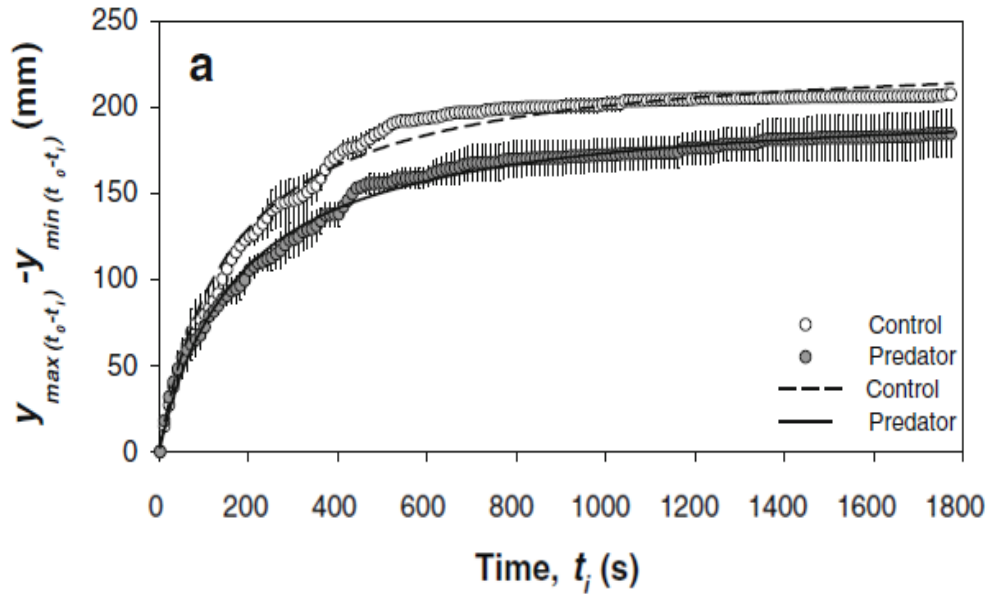
Behavior



A plankton can easily change its behavior to adapt to a novel stressor

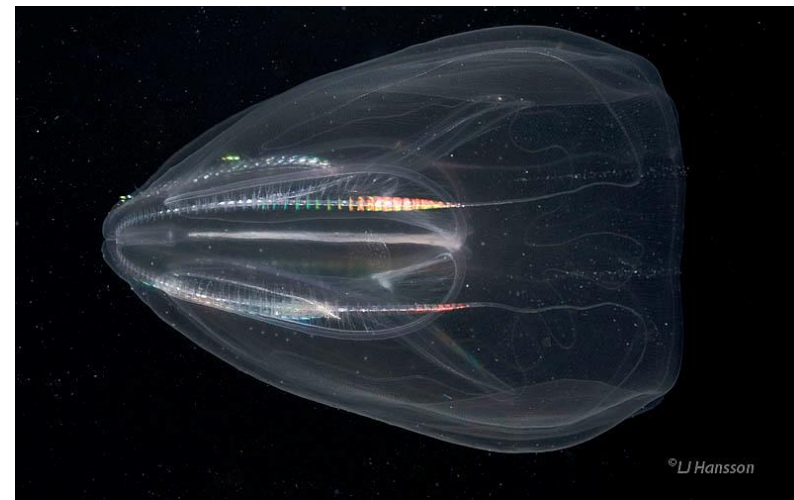
Vertical habit use decreases in response to risky smell

(*Mnemiopsis* & *Beroe*)

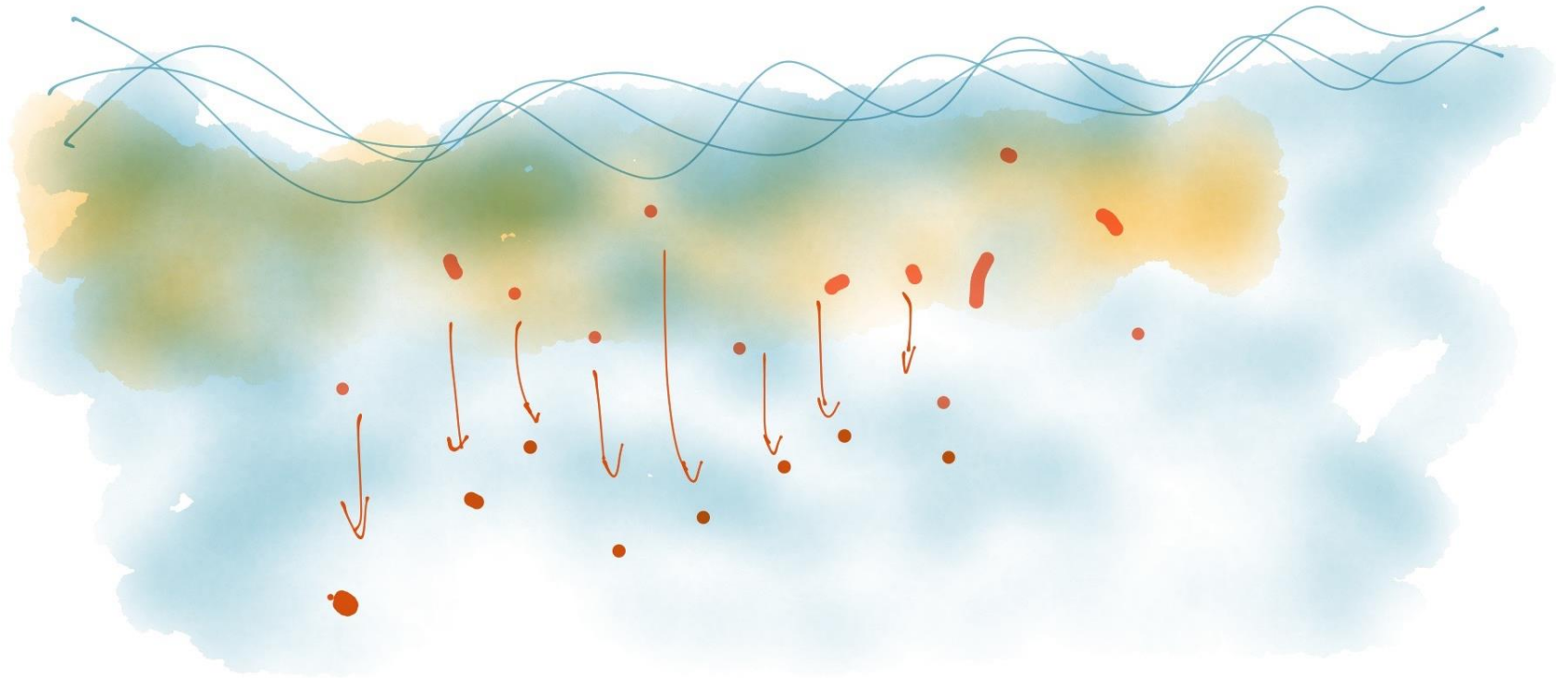


(photo: LJ Hansson)

(Titelman et al 2012)

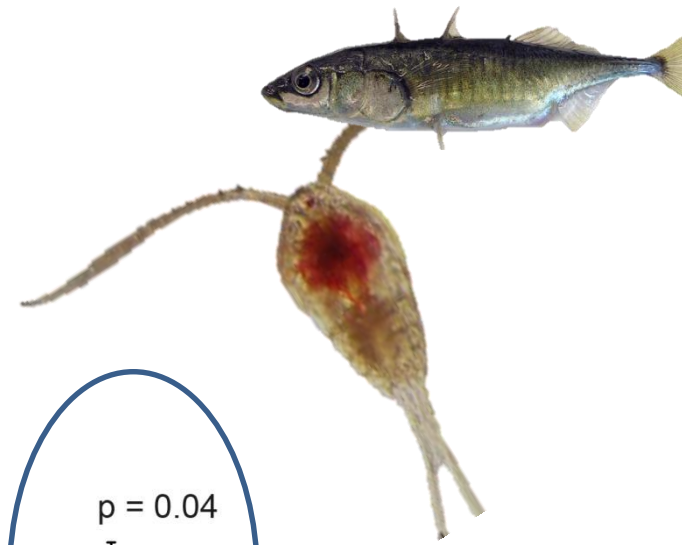


Behavior

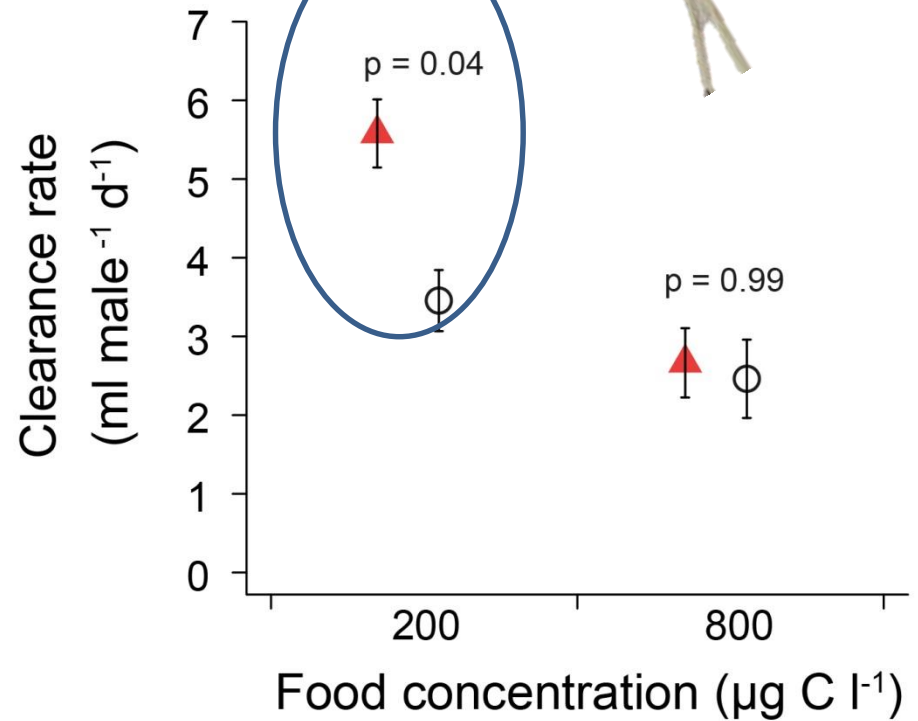
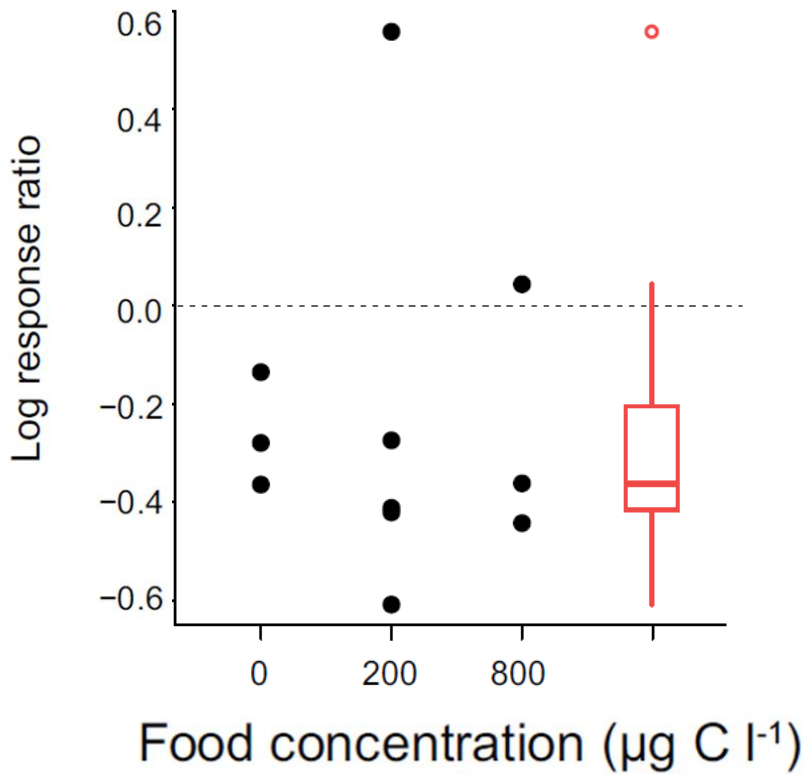


... effects on other traits?

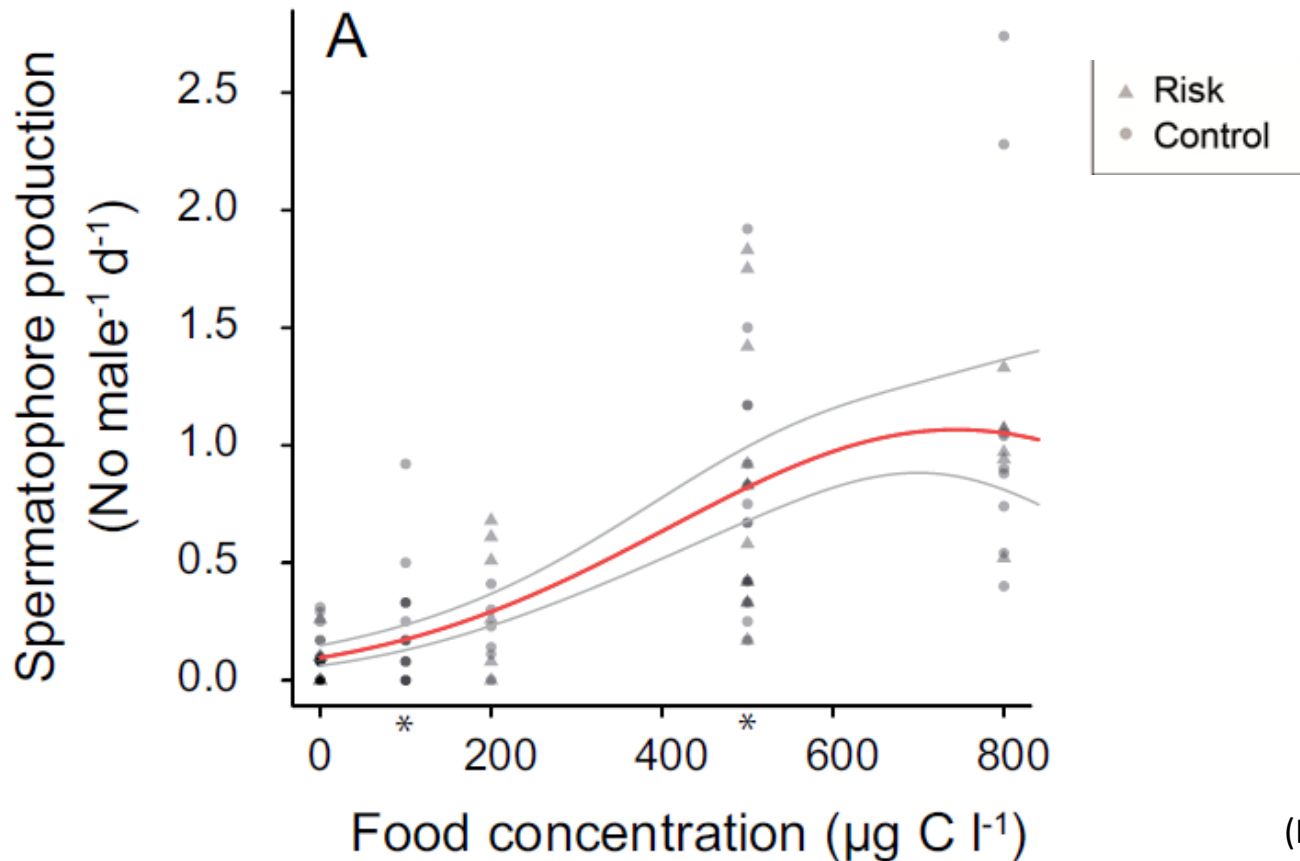
Risk affects how copepod males spend their time & feeding rates



B Total track duration

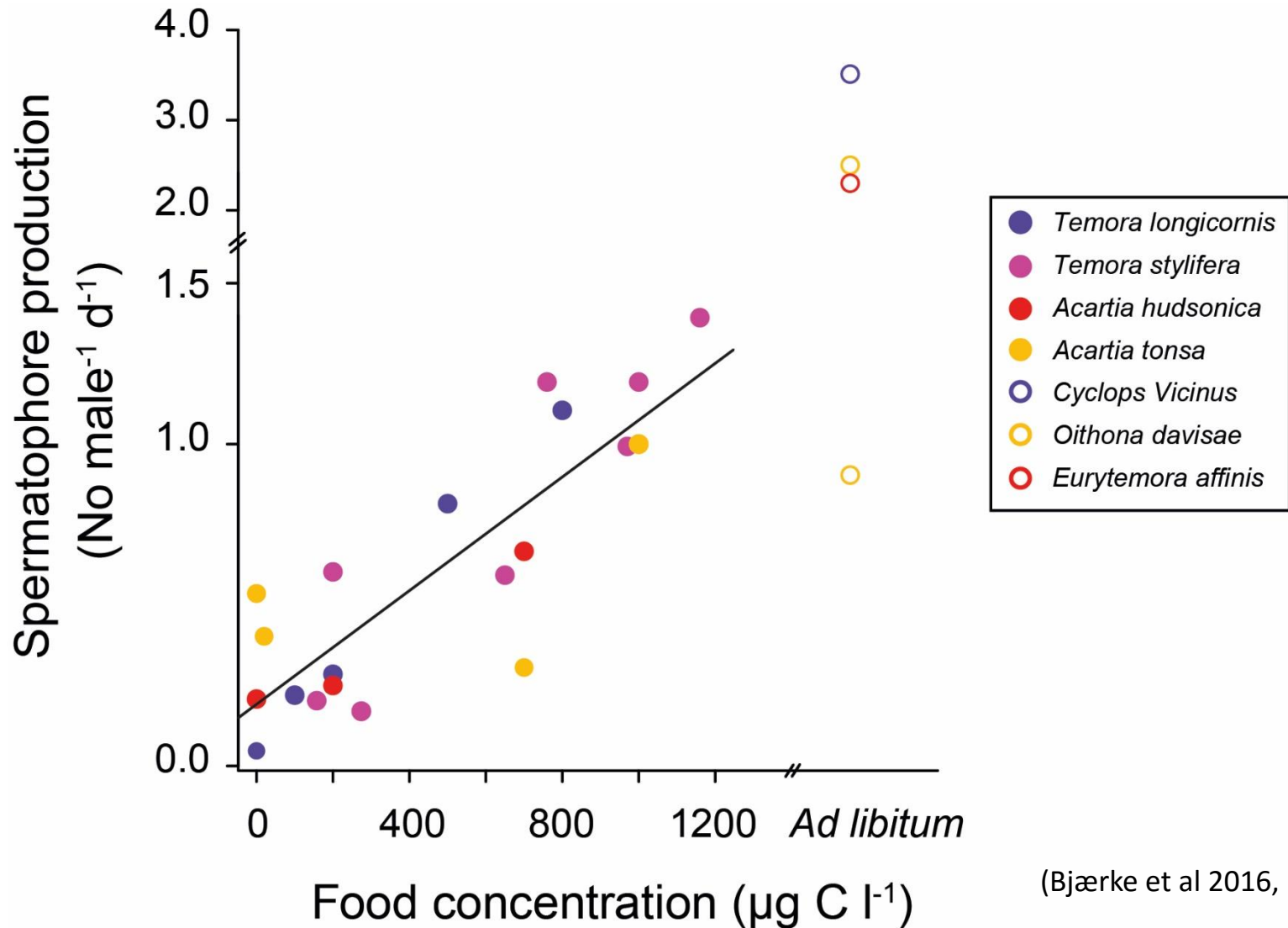


But food more important than risk for spermatophore production



(Bjærke et al 2016, L&O)

A general pattern?



(Bjærke et al 2016, L&O)

DVM – average behavior in the field

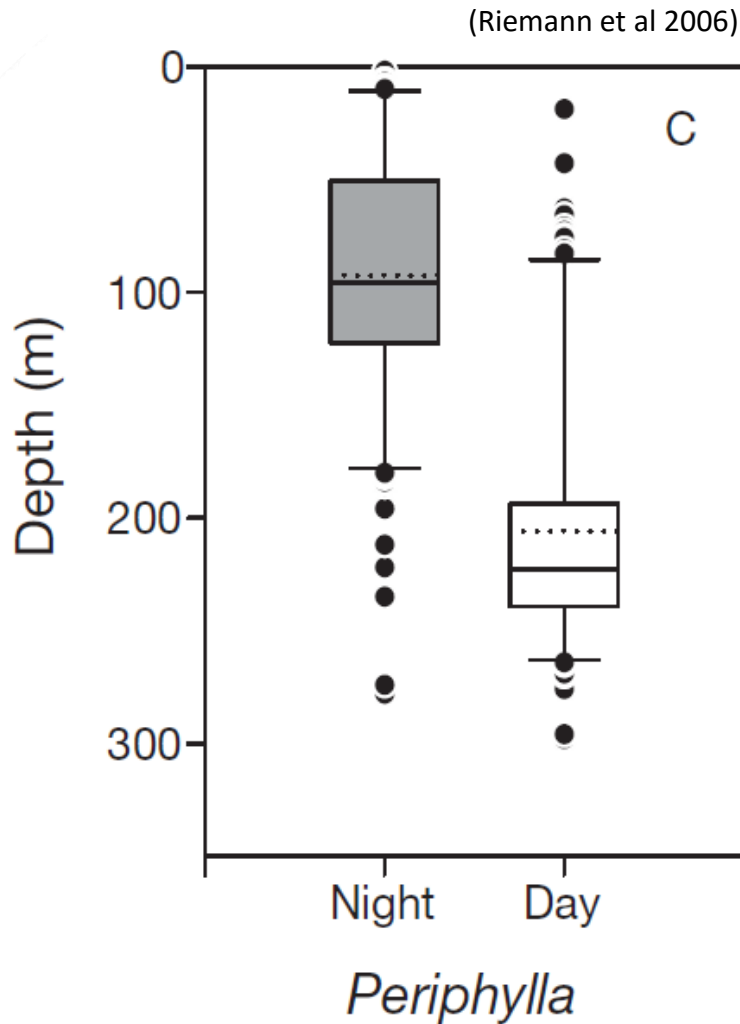
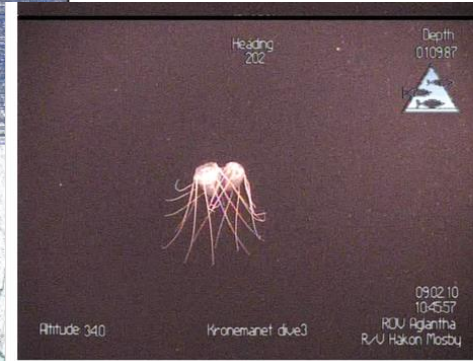
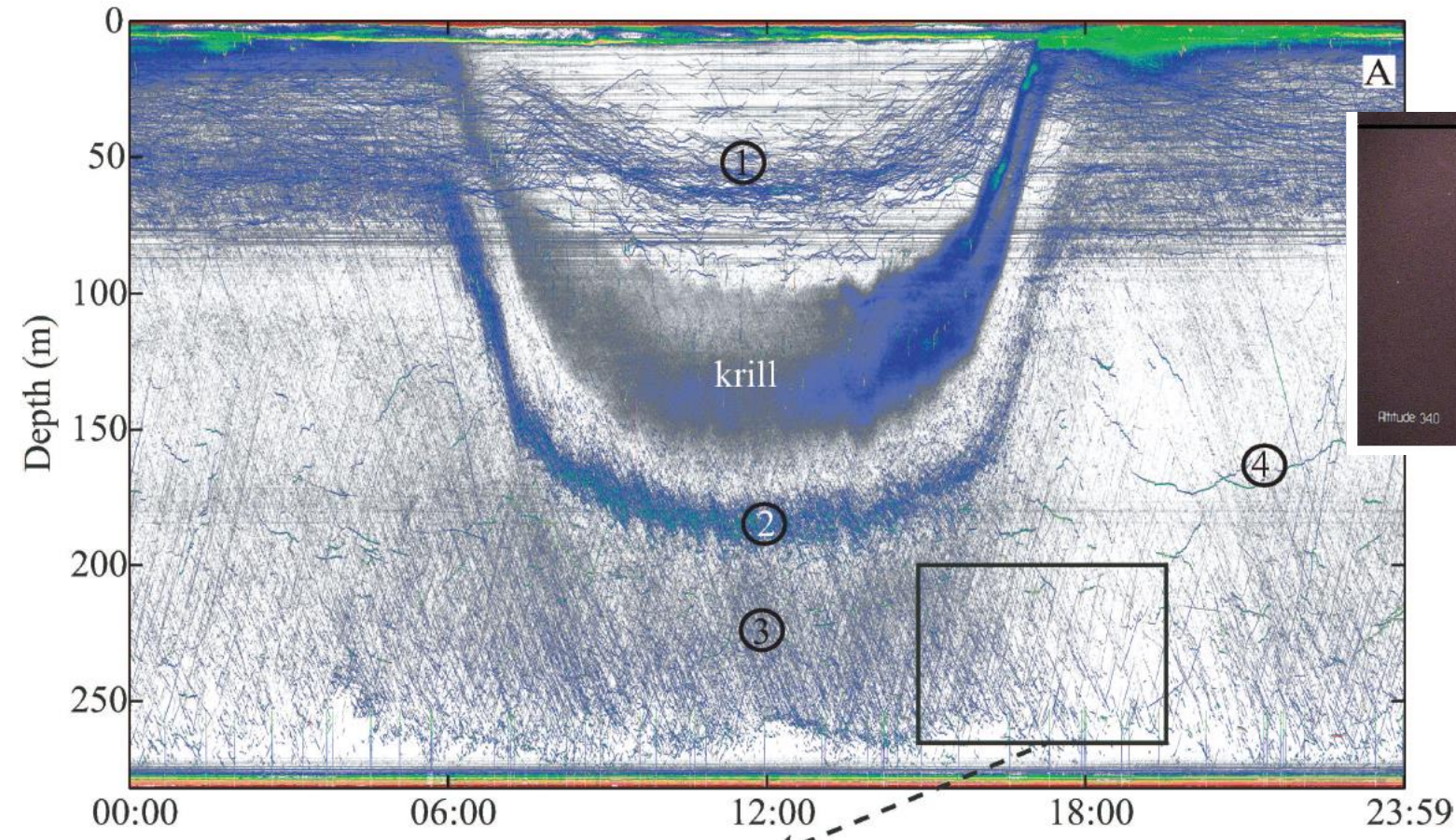


Photo: Robert Reinlund

Beyond the average



(Kaartvedt et al 2015)

(Kaartvedt et al 2011)

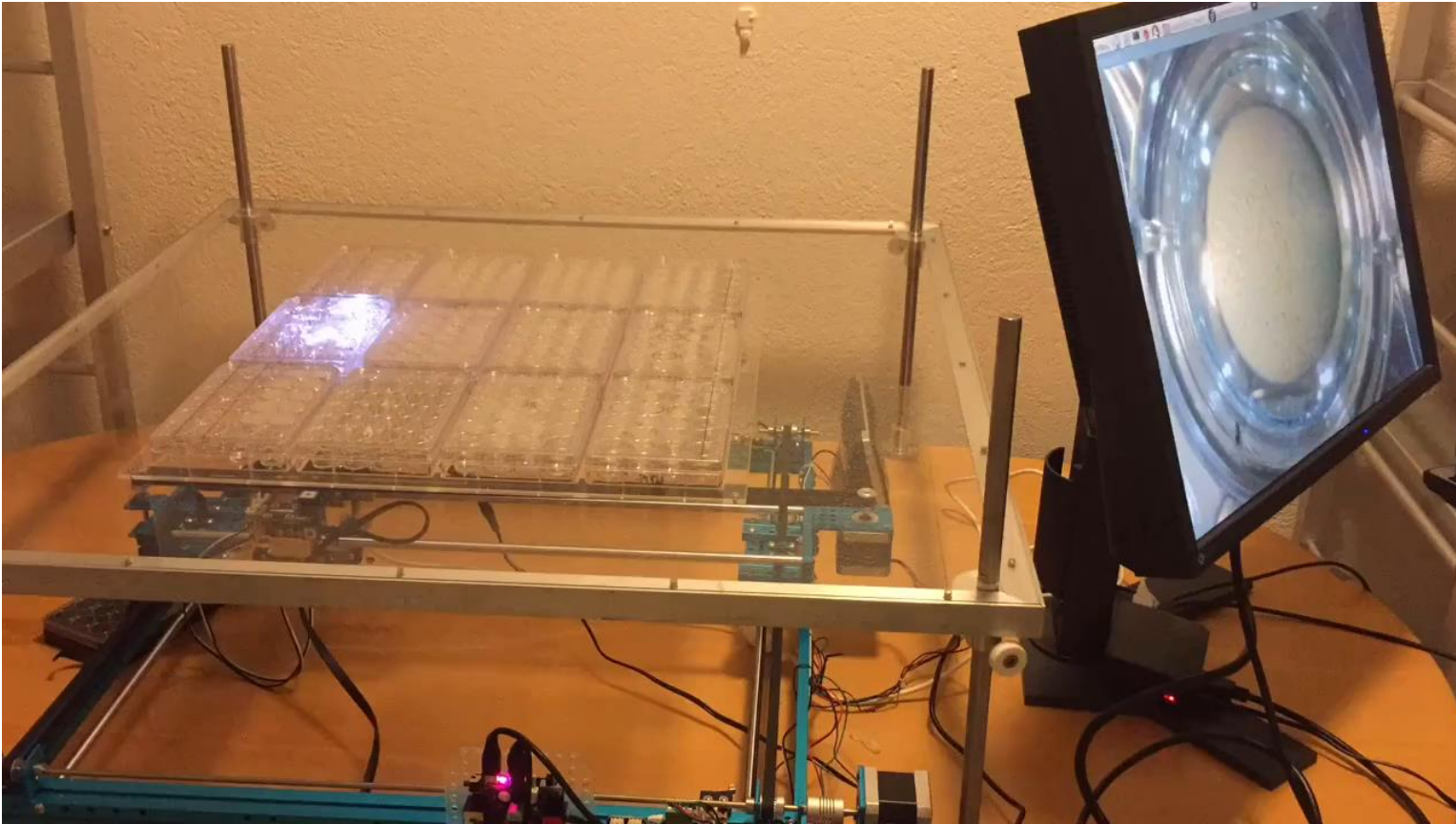
- Consistent patterns for ~3months
- How representative are average DVM patterns?



boldness? average behavior?



Robots to sample and resample individuals quickly



Take home

- Life history traits are influenced by **predation risk**—also in zooplankton (Behavior, reproductive investment, growth, development, size plasticity)
- The average is not all
- studying individuals allows for detecting allocation patterns that may be masked in groups
- **Variation is not noise**, but indicates that there is more to the story.
- Don't forget plasticity



(jellyfish larvae feeding on cod larvae)