Selection for small size affects the pace-of-life syndrome in medaka impacting the invertebrate community

Beatriz Diaz-Pauli, Eric Edeline, Charlotte Evangelista

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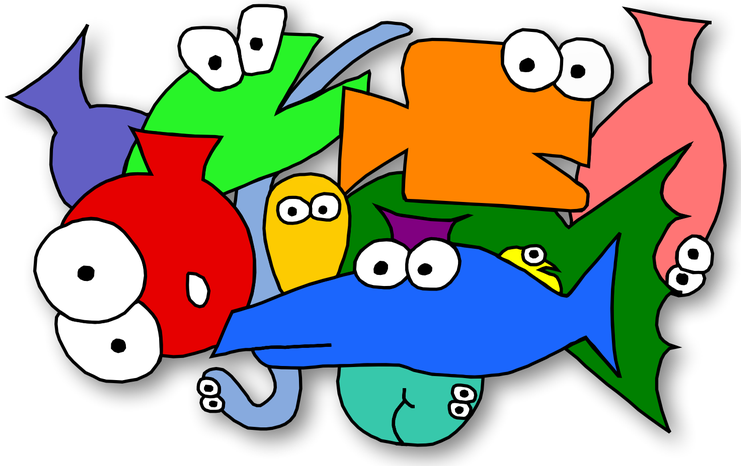
Laboratoire d'Analyses des Sols

Fisheries-induced evolution



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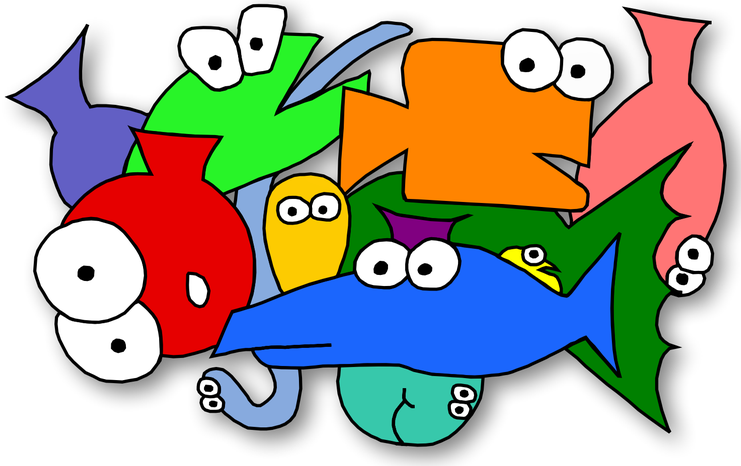
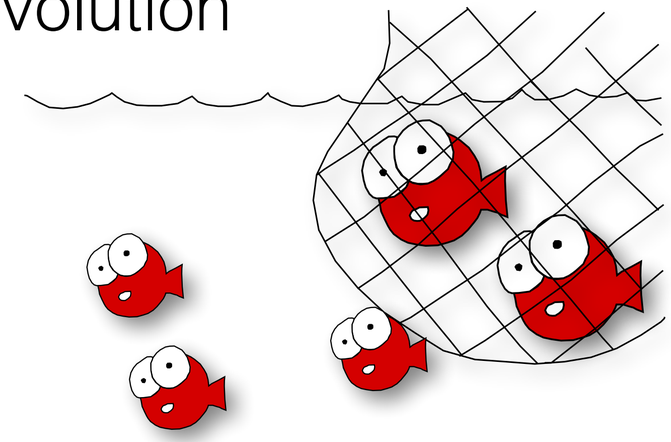
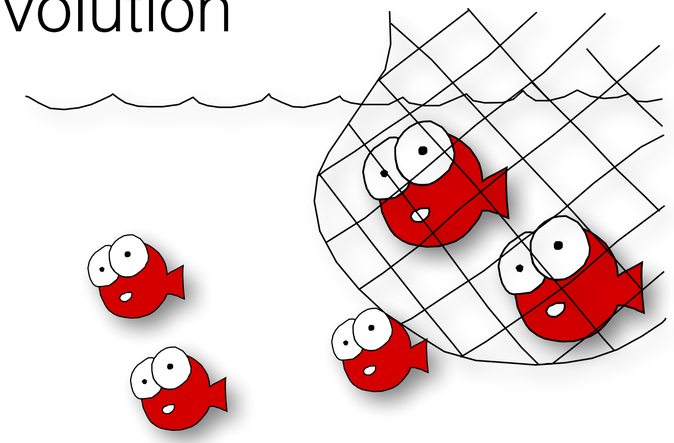


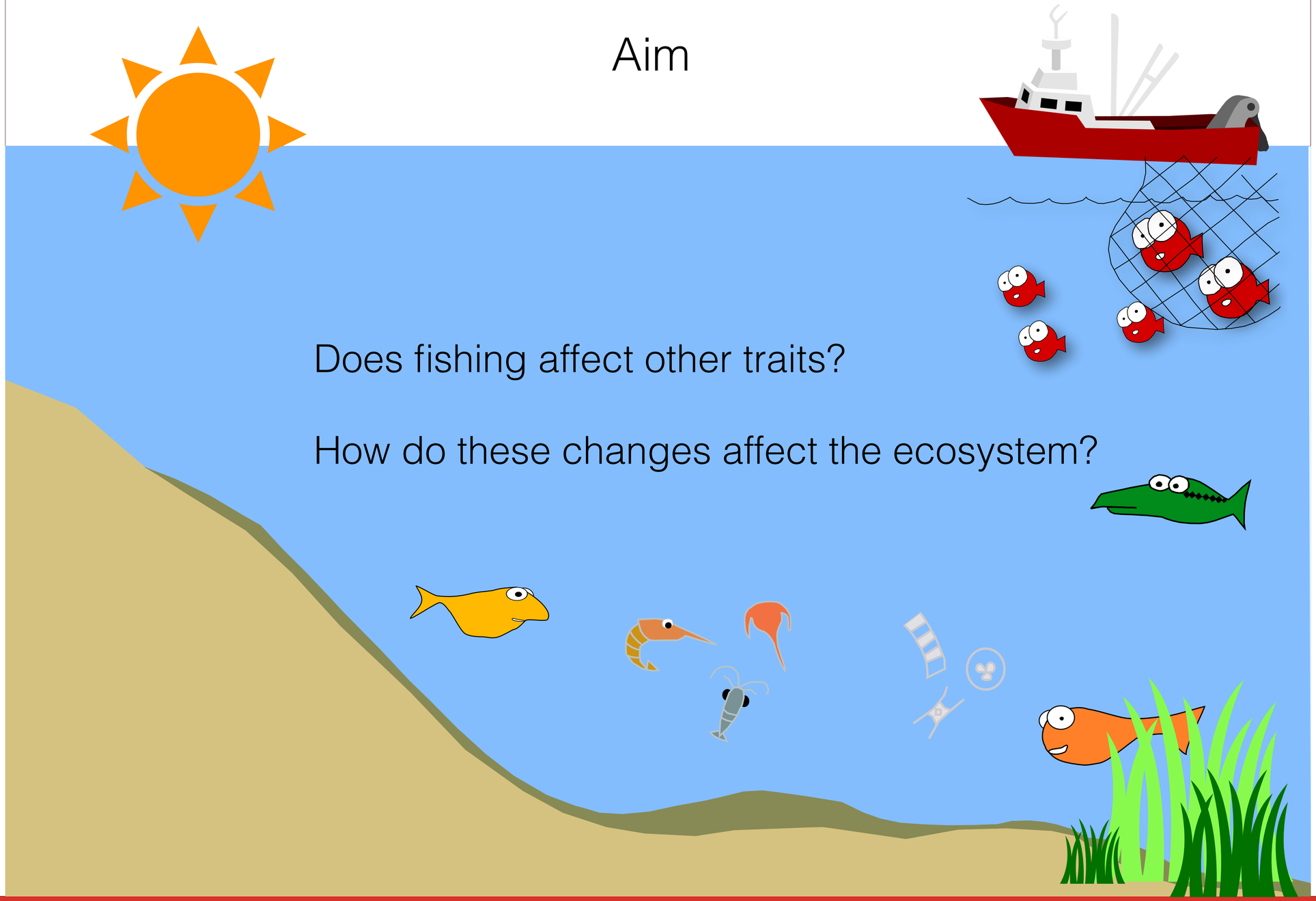


Fisheries-induced evolution

Faster life history
Early maturation



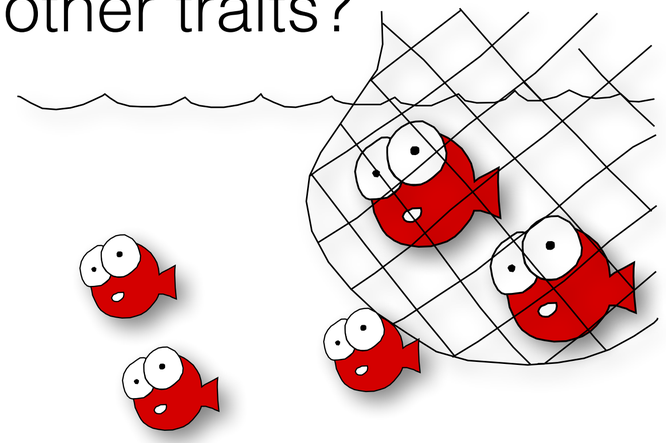
Aim



Does fishing affect other traits?

How do these changes affect the ecosystem?

Aim: Does fishing affect other traits?



Faster life history
Early maturation

Behaviour

Physiology

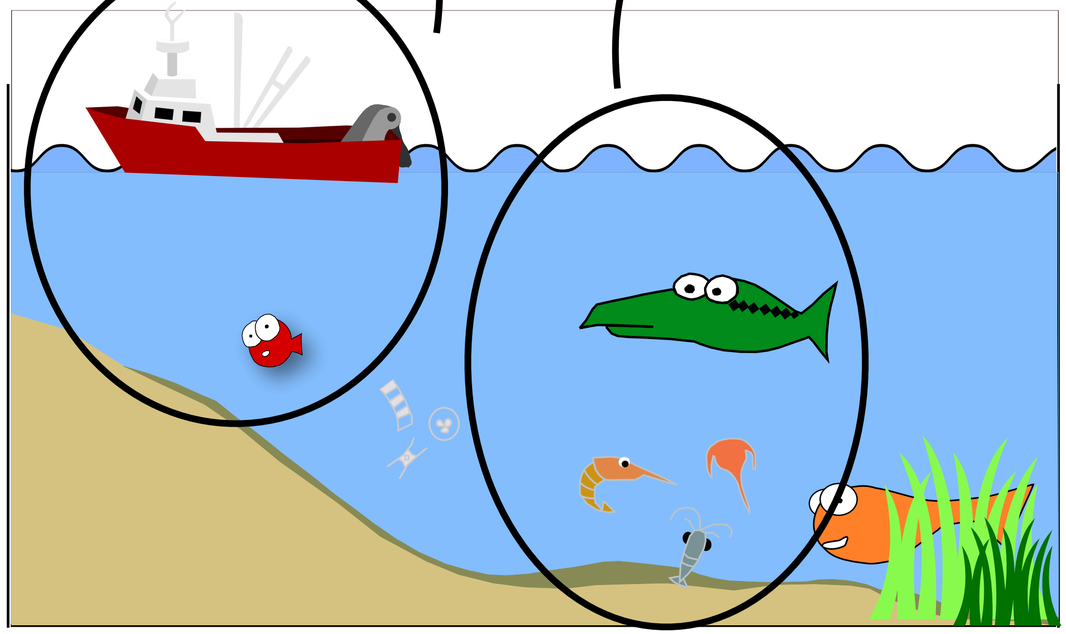
Pace-of-life syndrome
Life-histories traits coevolve
with a of suit of behavioural and physiological traits

Réale et al 2010

Methods

Selection experiment in the lab

Outdoor mesocosms experiment



Methods

Selection experiment in the lab

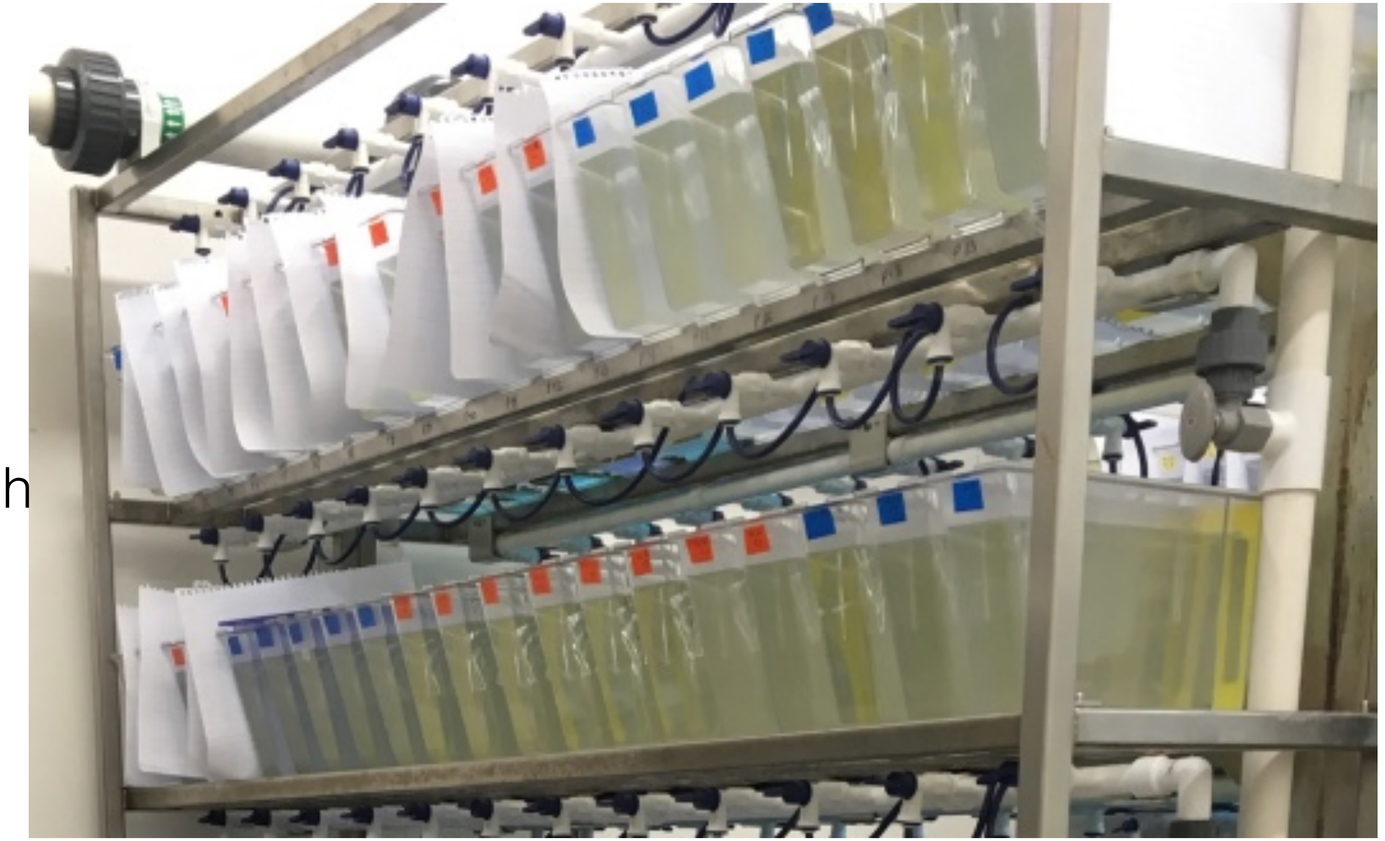
Outdoor mesocosms experiment

Medaka: *Oryzias latipes*

Methods

Selection experiment in the lab

- 2 lines
- 10 discrete generations
- Selection on size at 75 days post hatch



Methods

Selection experiment in the lab

- 2 lines
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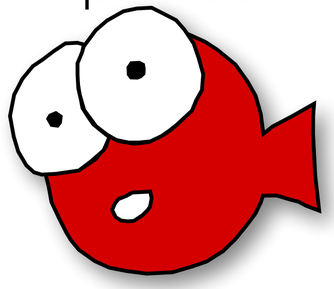
- Selection on size at 75 days post hatch

Large-selected for reproduction → **Late maturation**
Slow life history



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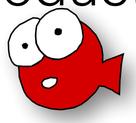
Fast life history



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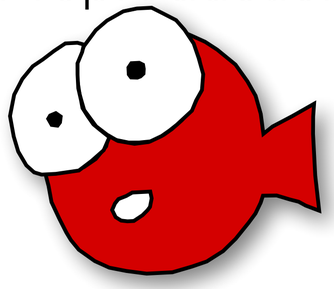
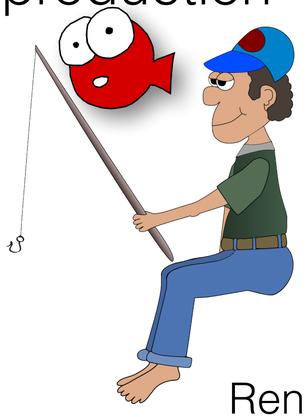


Small-selected for reproduction → **Early maturation**
Fast life history

Mimics fishing selection



Renneville et al 2018. bioRxiv

Renneville et al 2018. bioRxiv

Methods

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- 10 discrete generations
- Selection [illegible]st hatch

Renneville et al 2018. bioRxiv

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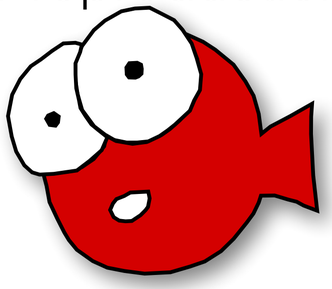

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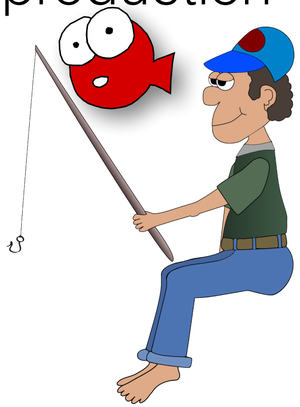


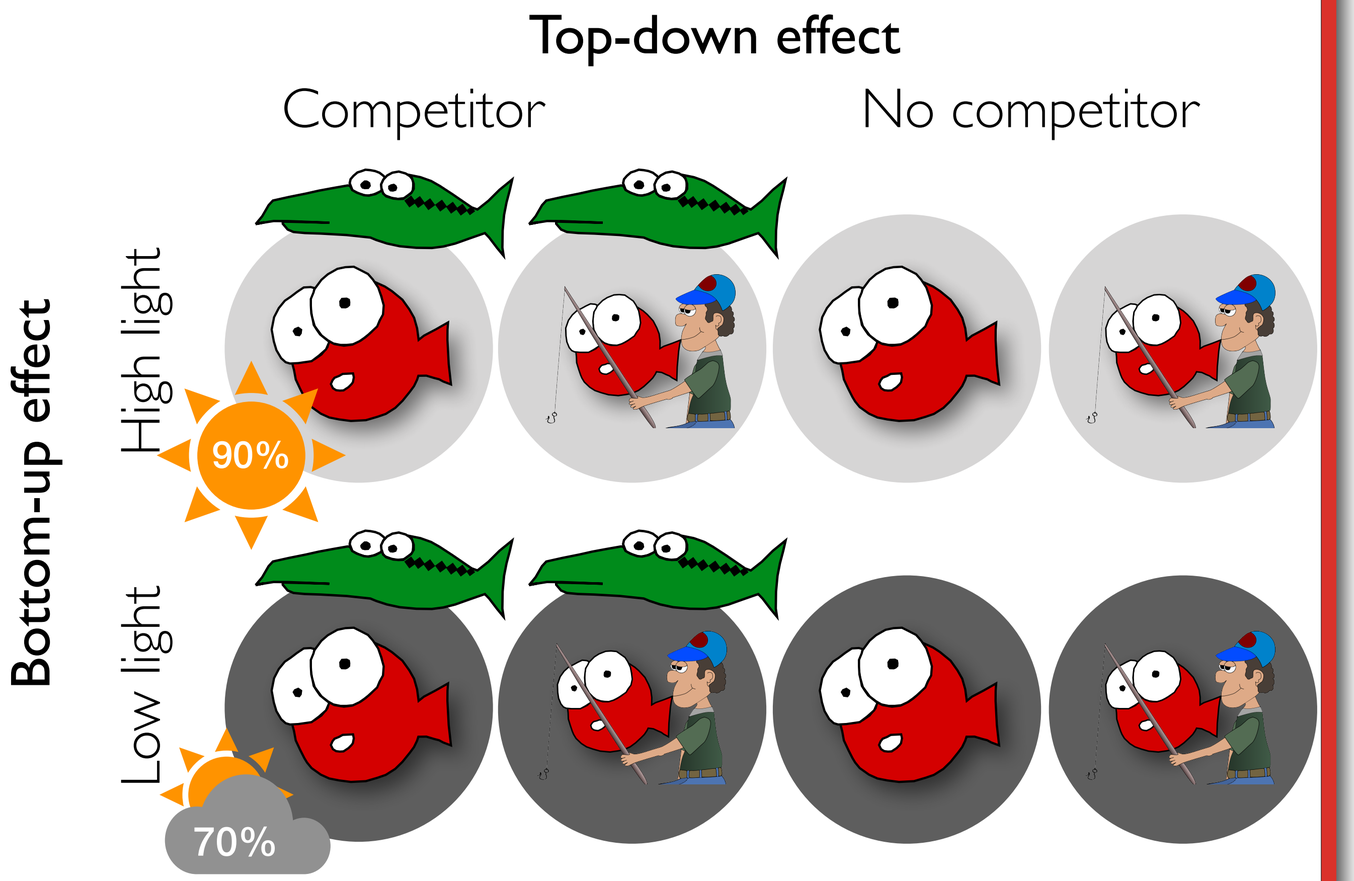
Methods

- 500 L
- 24 mesocosms
- 2 males & 2 females
- 6 weeks
- 3 treatments:

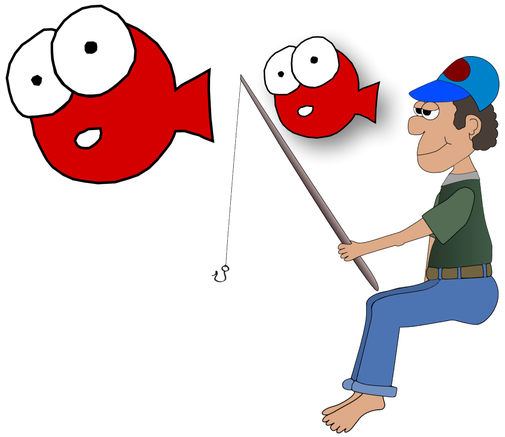
Outdoor mesocosms experiment

Methods

- 500 L
- 24 mesocosms
- 2 males & 2 females
- 6 weeks
- 3 treatments:
  - Size-selection (slow vs. fast life history)
  - Competitor (presence vs. absence)
    Light intensity (high vs. low)



Methods: Fish traits



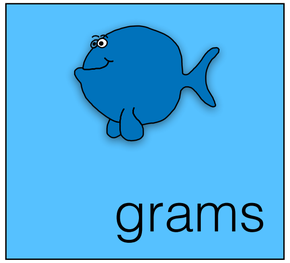
Life history

Behaviour

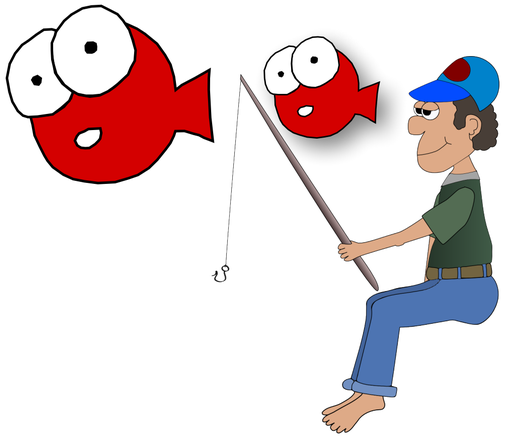
Stoichiometry

Methods: Fish traits

Life history



Adult growth rate



Behaviour

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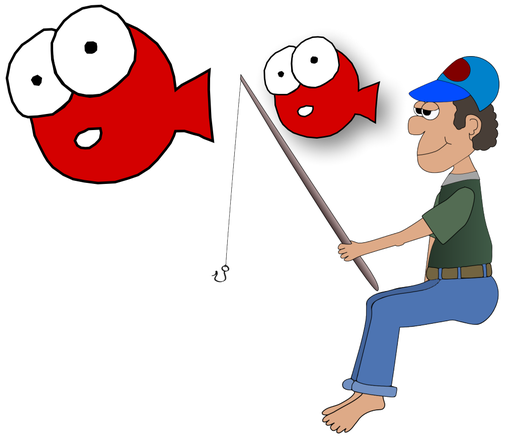
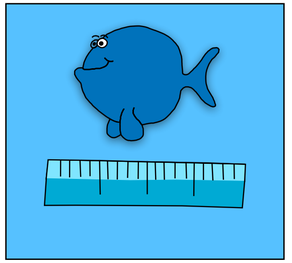
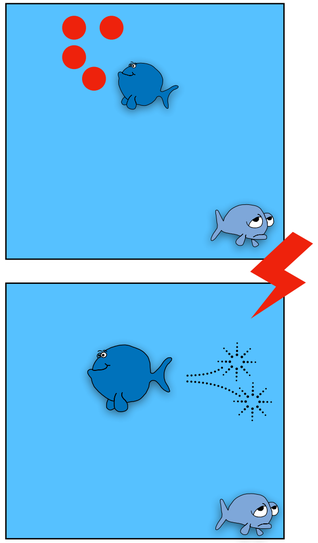


Life history



Adult growth rate

Behaviour

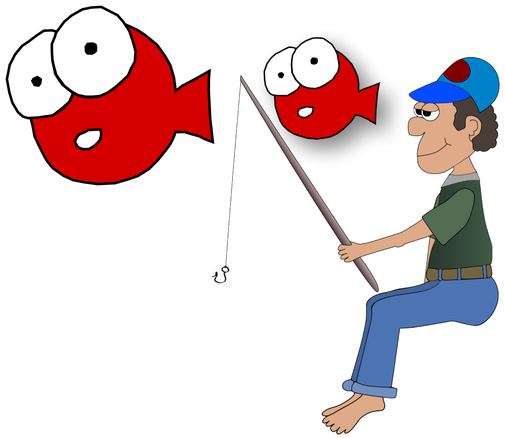


Feeding

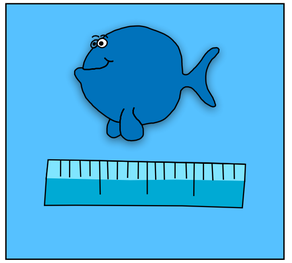
Boldness

Stoichiometry

Methods: Fish traits



Life history



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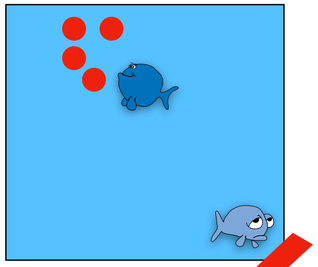
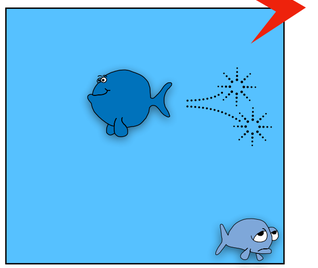
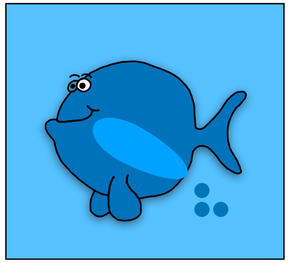


Feeding



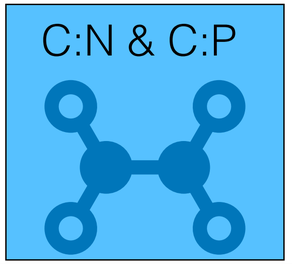
Boldness



Excretion rate NH4

Stoichiometry

Related to fluxes of nutrients within ecosystem

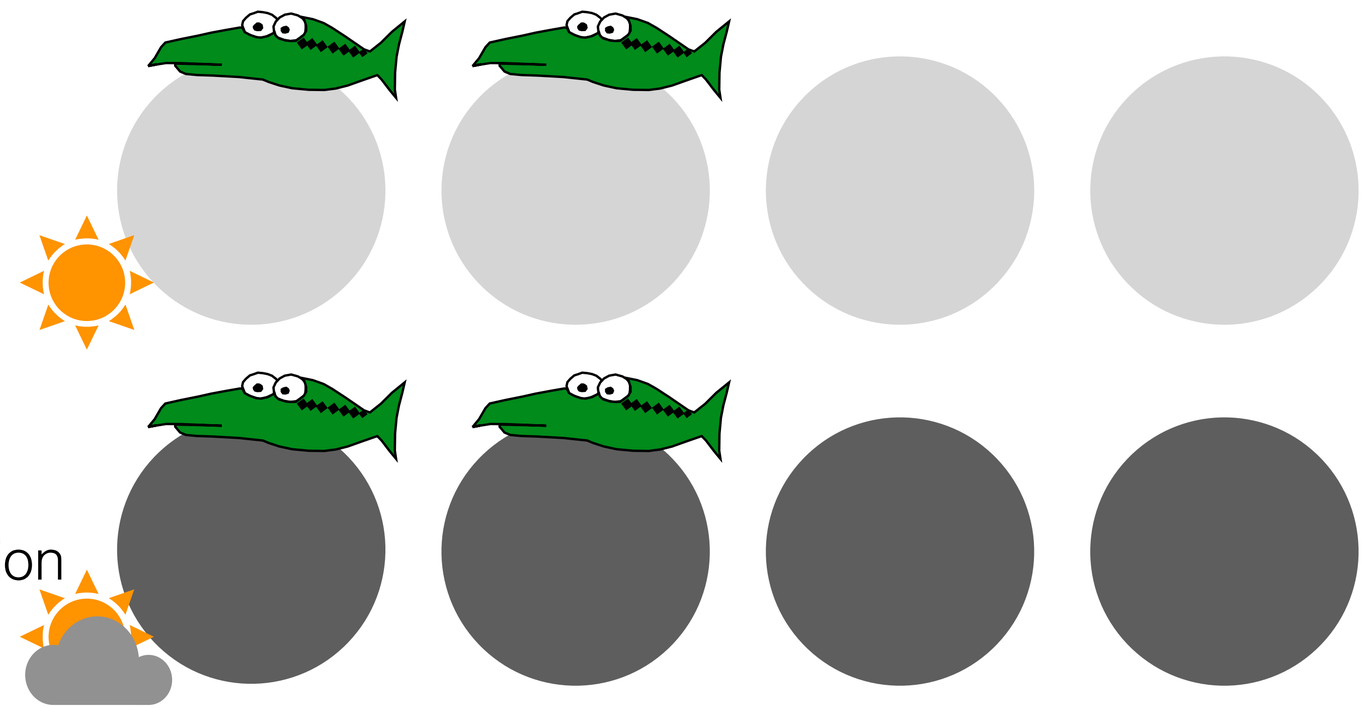


Proportion Nitrogen and Phosphorous relative to Carbon

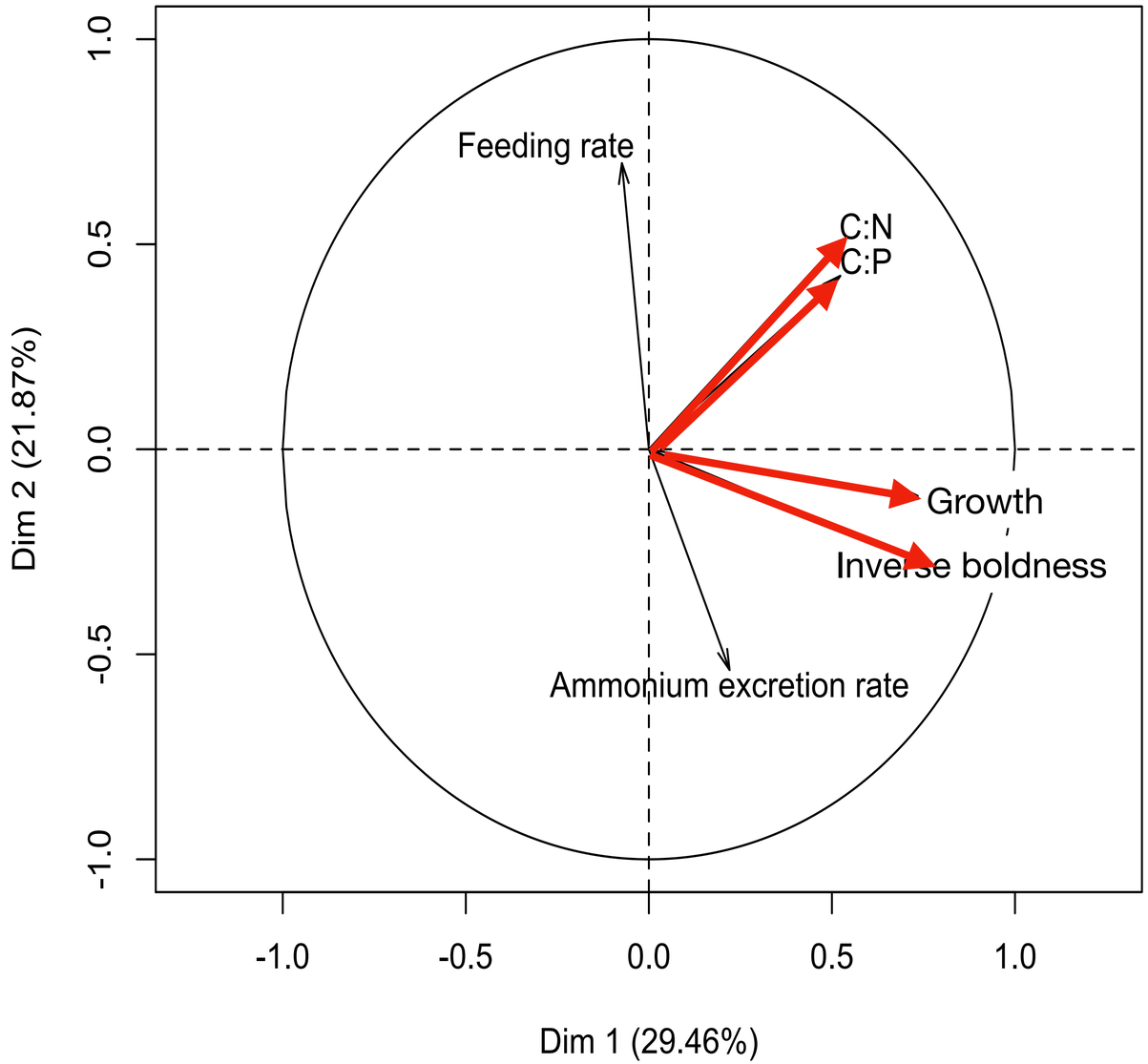
Methods: **Ecosystem traits**

Community abundance
- Zooplankton
- Zoobenthos: 6 taxa

Ecosystem processes:
- Respiration & GPP
- Nutrients in water: P & N
- Sediment stoichiometry
- Pelagic & Benthic algae concentration



Results: **Fish traits**



Traits covariate —> Pace-of-life syndrome

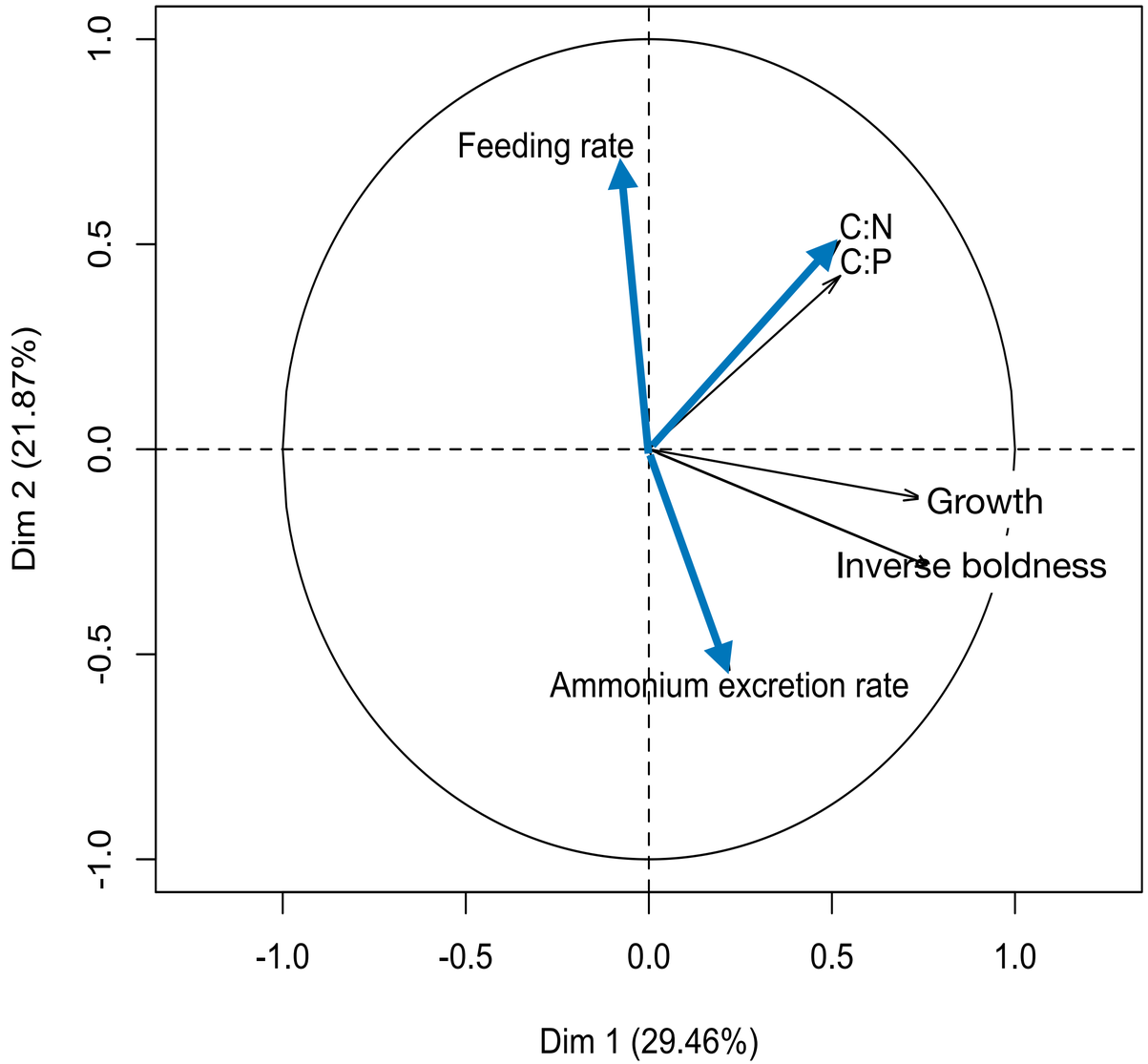
1st axis:

- \+ Growth rate
- \- Boldness
- \+ Carbon: +C:N & C:P

2nd axis:

- \+ Feeding rate
- \+ C:N
- \- Excretion of NH4

Results: **Fish traits**



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Results: **Fish traits**

Small-selected line —> Fast pace of life

- **+** Carbon: +C:N & C:P
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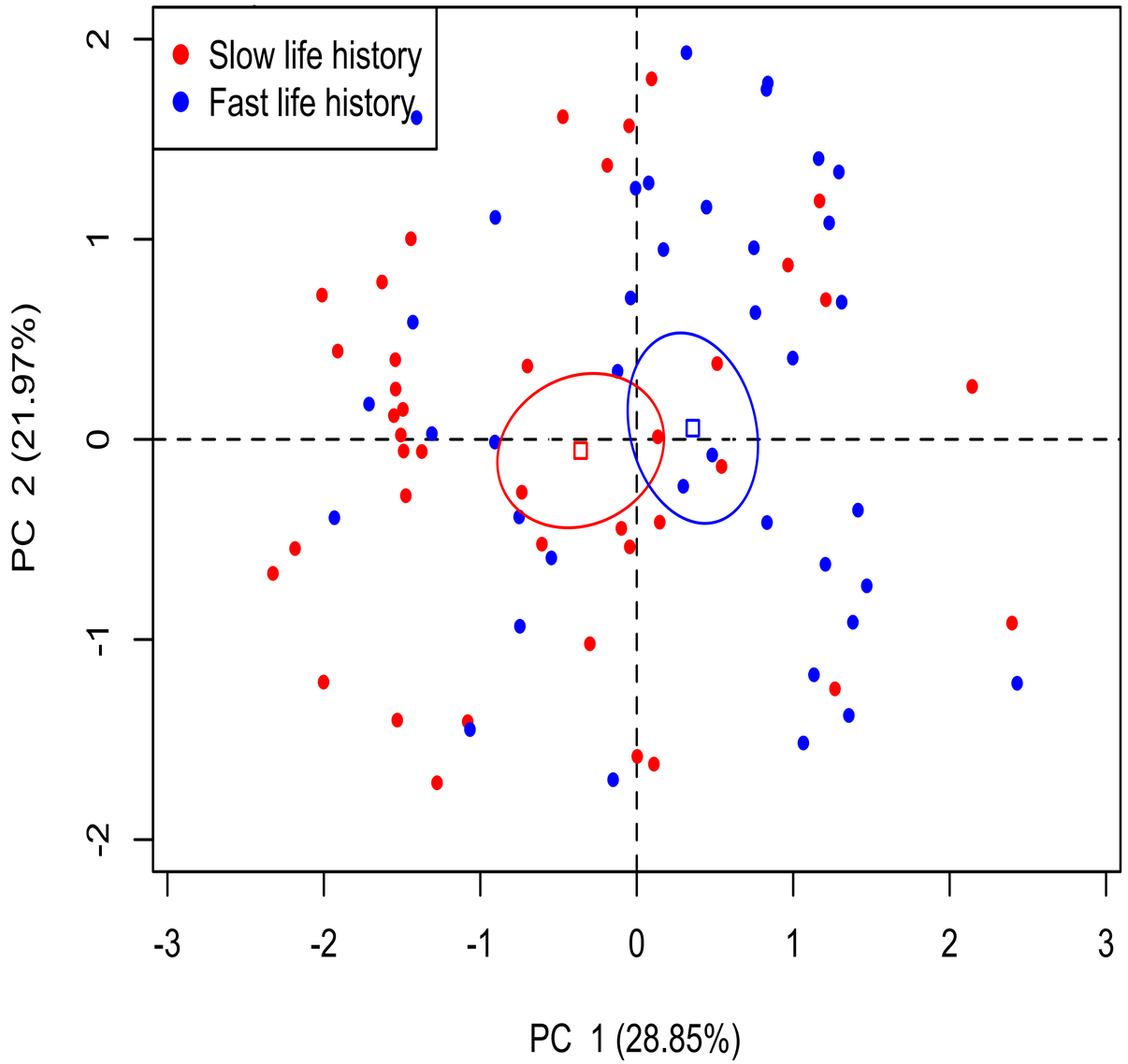
- **-** Boldness



v-test = 2.26, *P* = 0.023

Results: **Fish traits**

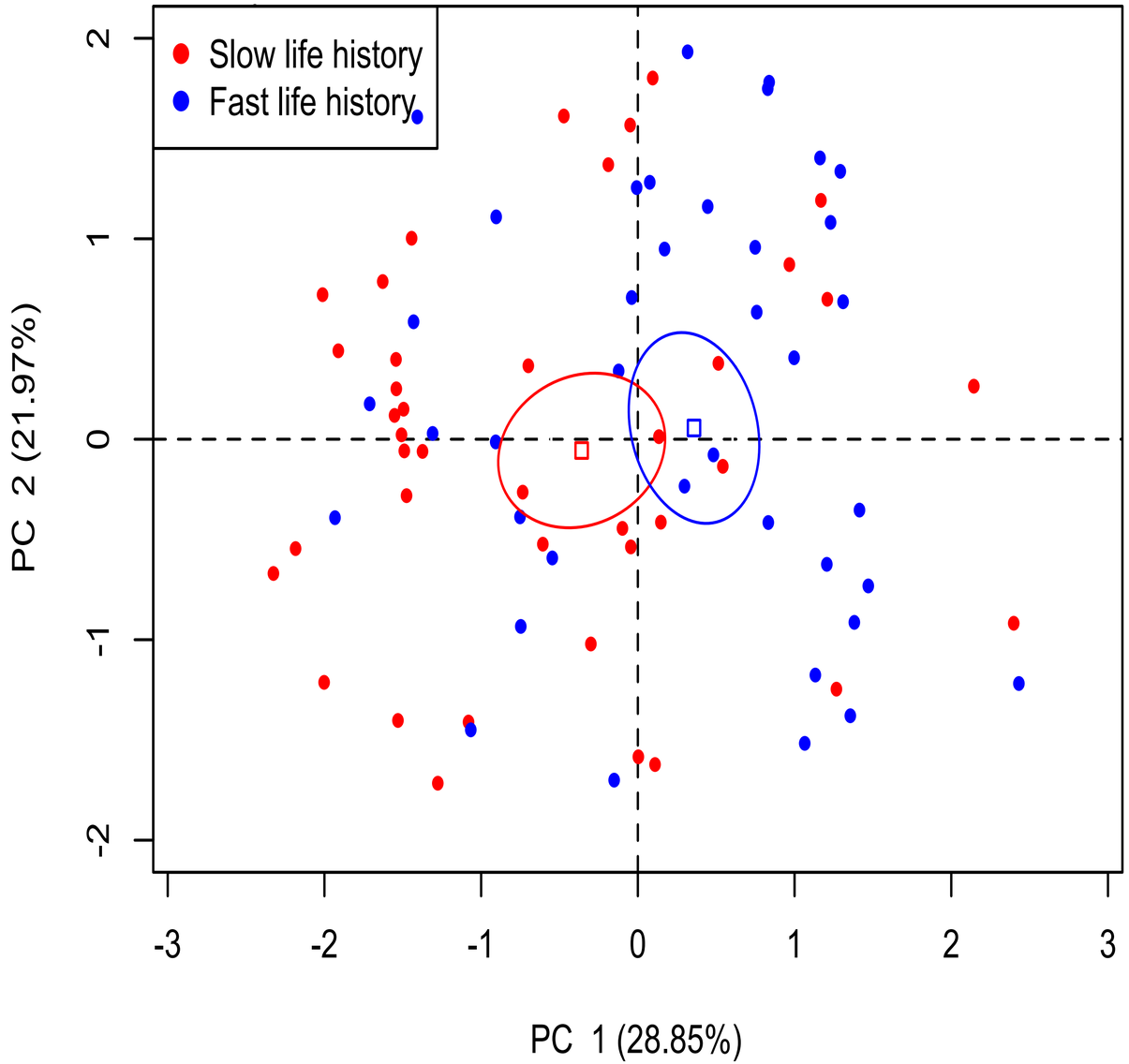
Small-selected line —> Fast pace of life

- **+** Carbon: +C:N & C:P
- **+** Growth rate
- **-** Boldness

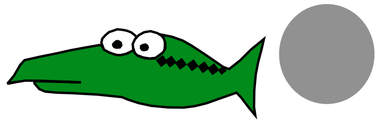
Small-selected had earlier maturation:

Weight increase linked +C (fat tissue)
—> and investment in reproduction

v-test = 2.26, *P* = 0.023

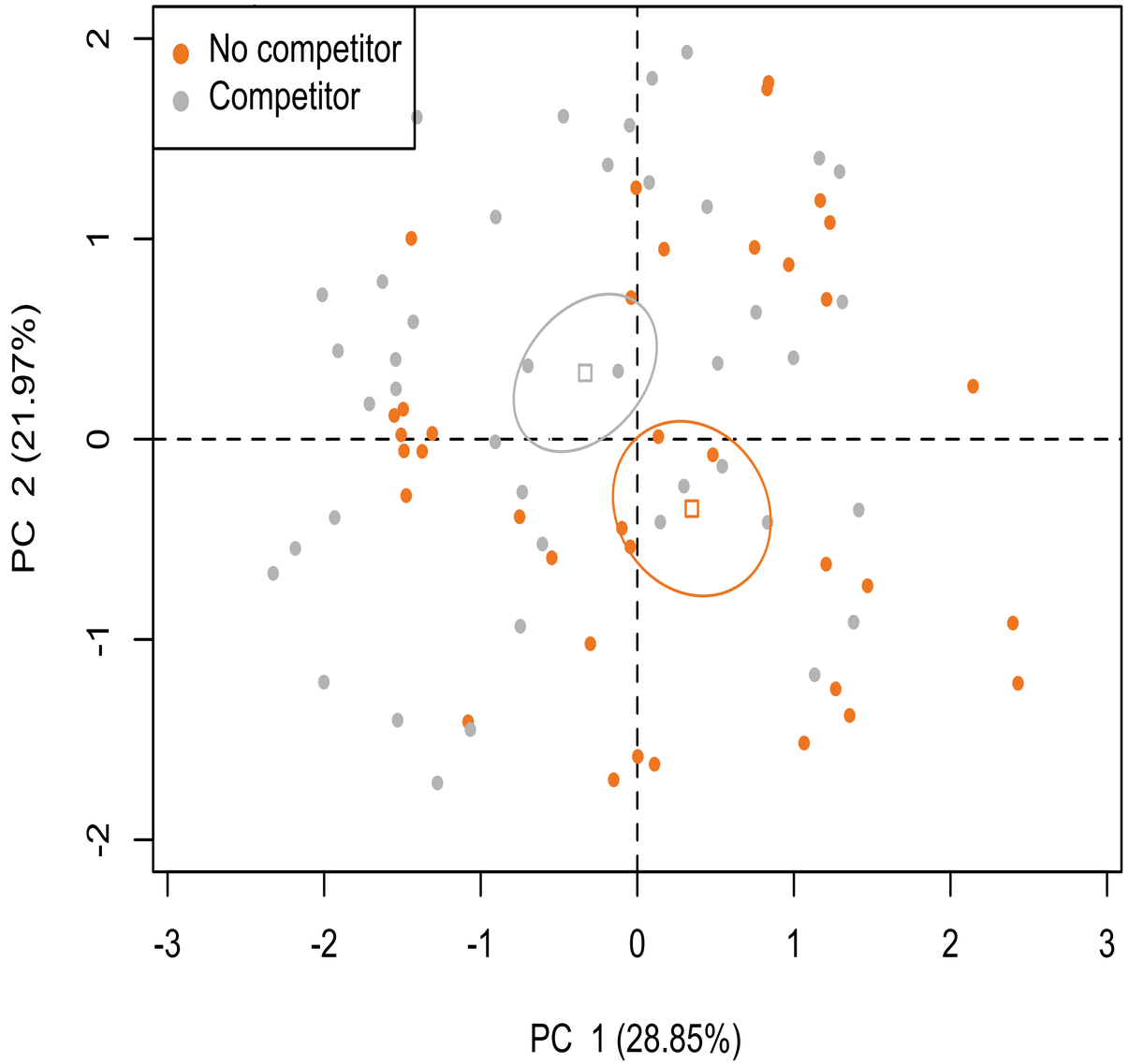


Results: **Fish traits**



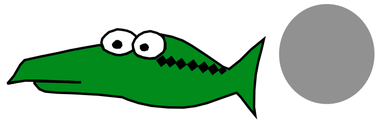
Competitor presence —> Slow pace of life

- **-** Carbon: +C:N & C:P
- **-** Growth rate
- + Boldness



v-test = -2.39, *P* = 0.016

Results: **Fish traits**



Competitor presence —> Slow pace of life

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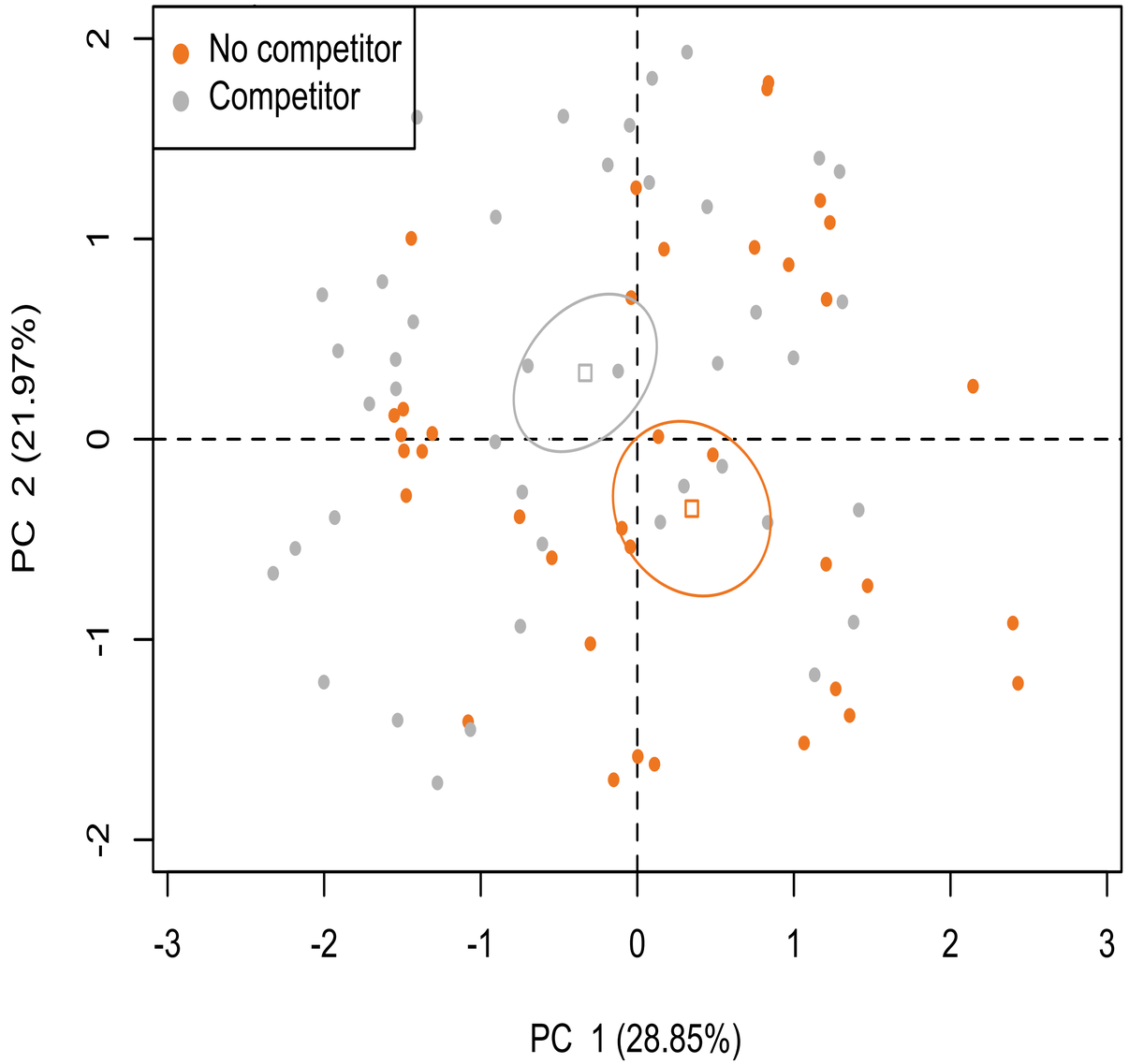
- **-** Growth rate
- **+** Boldness

Slow growth due to lower access to resources



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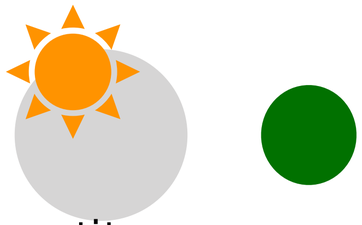

Competitor presence —> Slow pace of life

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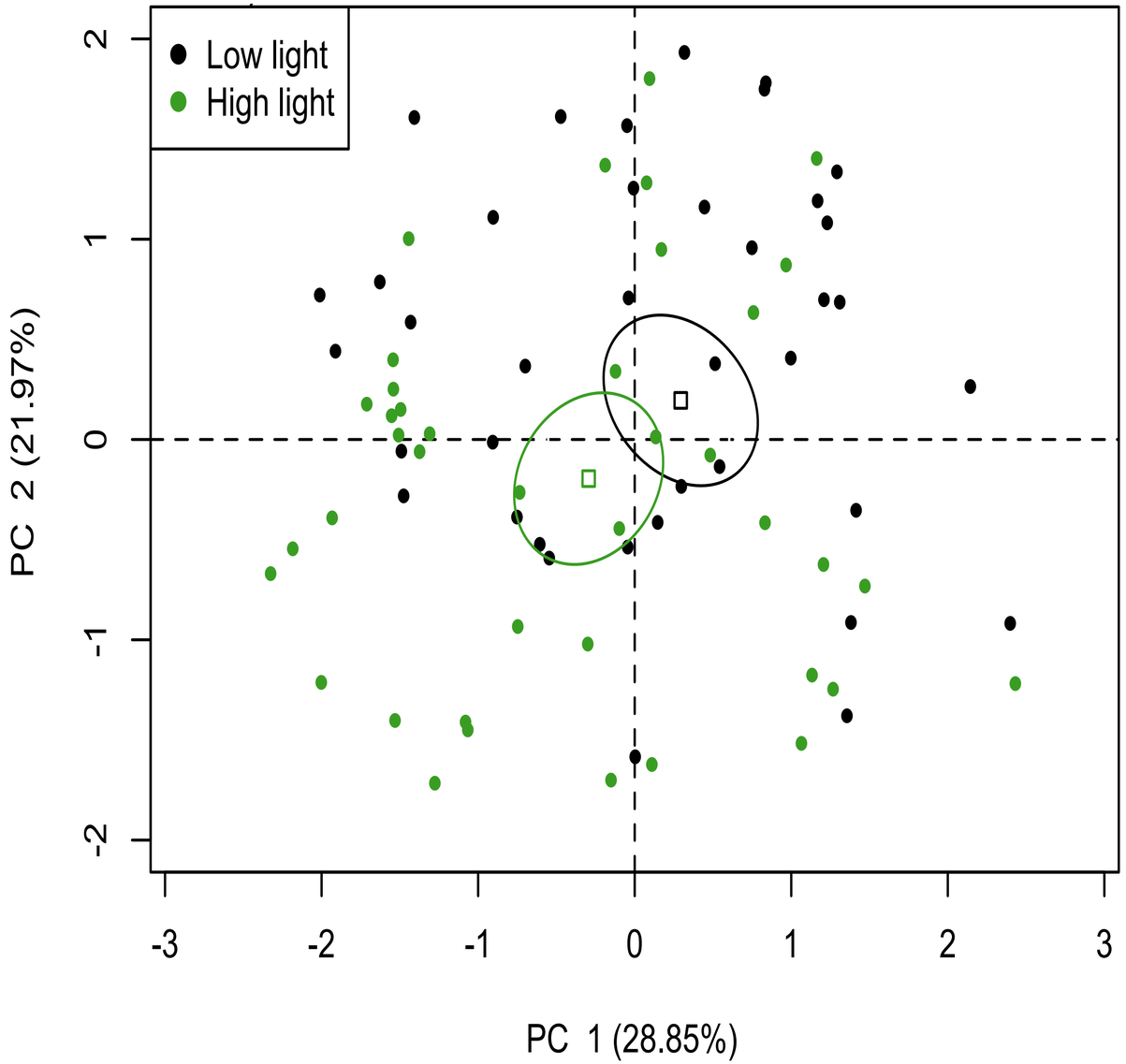
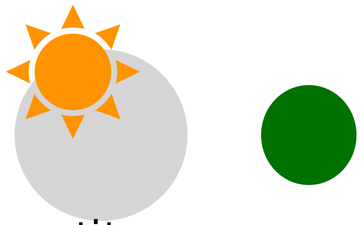
- **-** Growth rate
- **+** Boldness

*** But smaller effect



v-test = -2.06, *P* = 0.038

Results: **Fish traits**



Competitor presence —> Slow pace of life

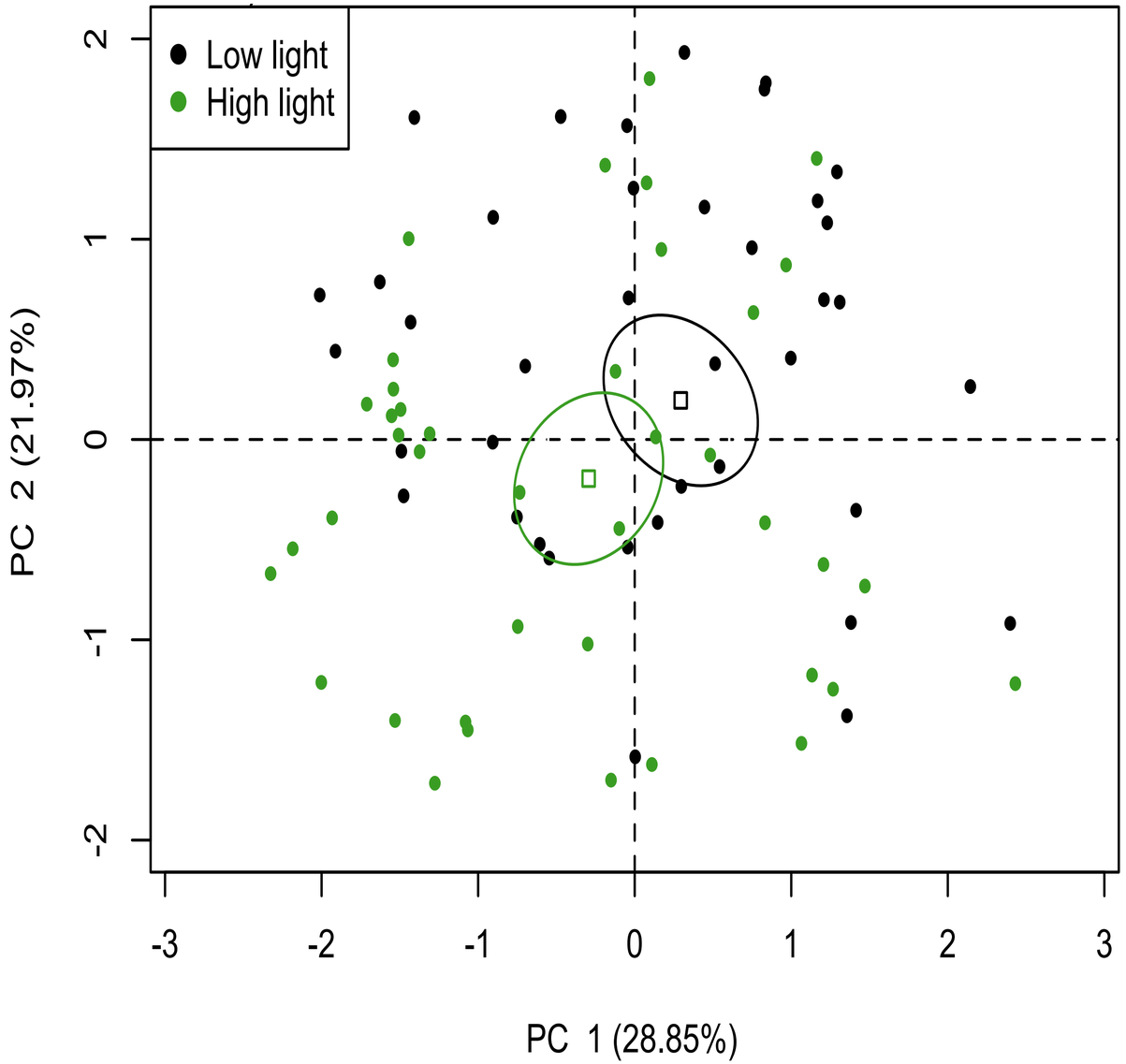
- - Carbon: +C:N & C:P
- - Growth rate
- + Boldness

*** But smaller effect

Slow growth due to lower access to resources

High light —> more algae, but low quality —> less plankton

v-test = -2.06, *P* = 0.038



Results: **Community abundances**

2nd axis:

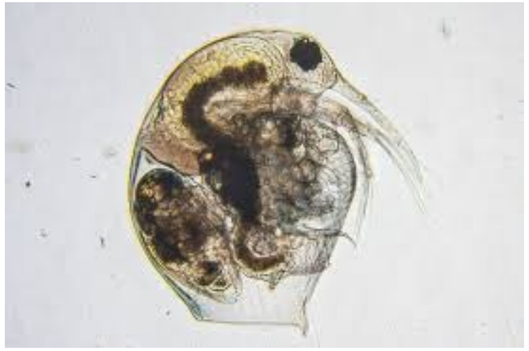
- **+** Feeding rate
- **+** C:N
- **-** Excretion of NH4

→

Lower abundance:

- Bosminidae
- Cyclopidae
- Planorbidae

Probably by feeding on them



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2nd axis:

- **+** Feeding rate
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- **-** Excretion of NH4

Lower abundance:

- Bosminidae
- Cyclopidae
- Planorbidae

Results: Ecosystem processes

No fish trait effect on any process

Take-home message

1) Selection for small size not only changes life history

- but behaviour and stoichiometric traits

2) Growth, behavioural and stoichiometric traits covary

-Size-selection for small size <—> fast pace of life

3) Individual traits variation in feeding, C:N and excretion led to changes in 3 invertebrate species abundance

Thank you for listening



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