Drivers of dynamics of small pelagic fish resources

Victoria, Canada – 8 March 2017

How food size and quantity could impact small pelagic fish : an experimental study

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UNIVERSITÉ DE MONTPELLIER

Ecole Doctorale GAIA Biodiversité Agriculture Alimentation Environnement Terre Eau

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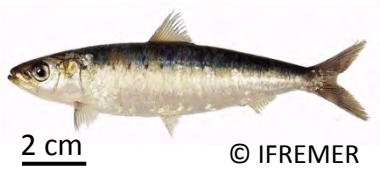
marbec marine biodiversity exploitation & conservation

Sardine



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Anchovy

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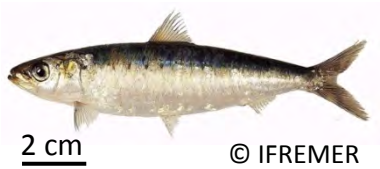
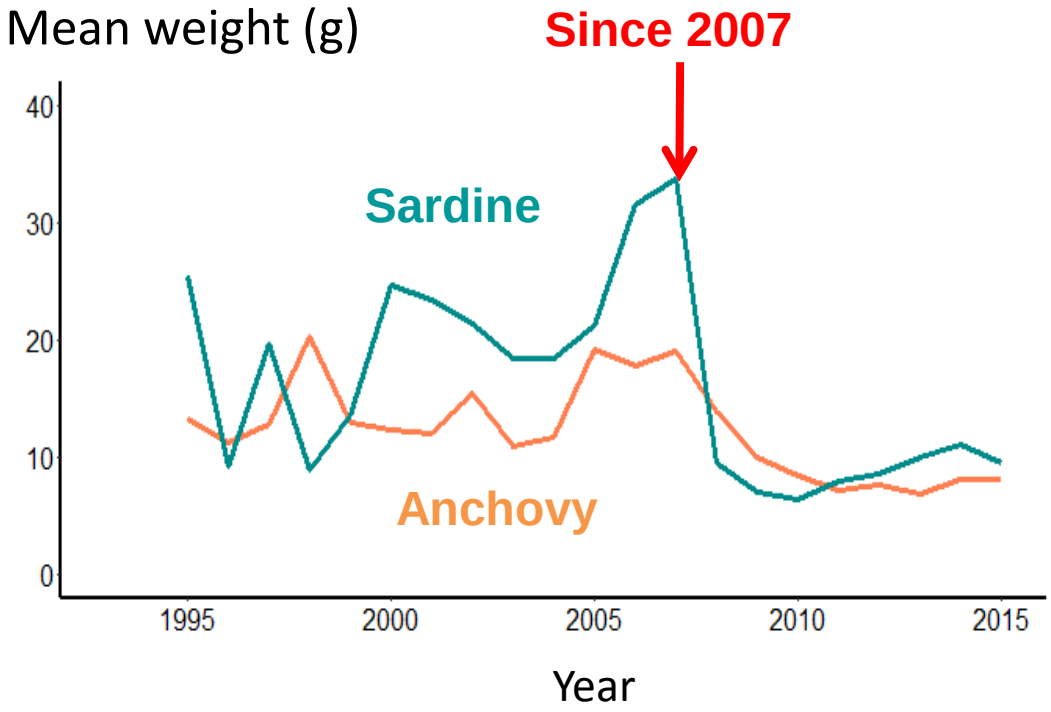
Sardine



Anchovy

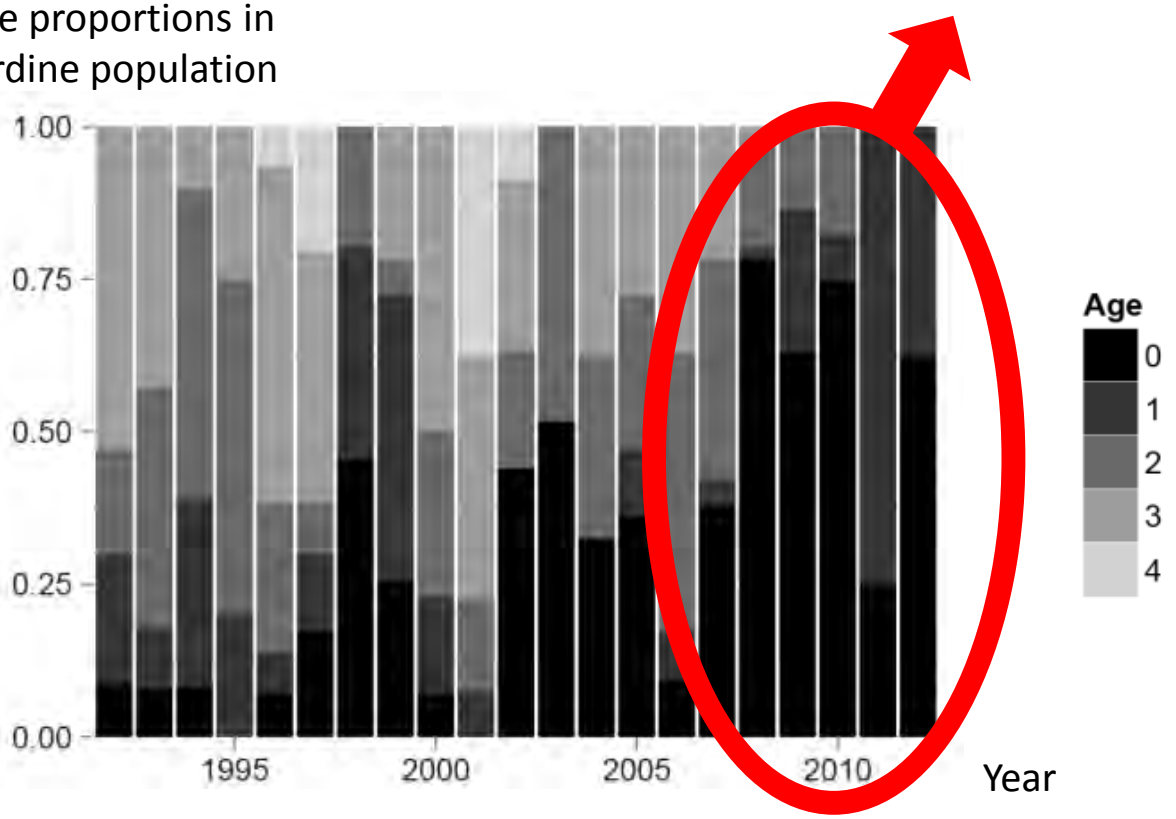


Brosset (2015)

- **Context :**

Oldest sardines disappeared

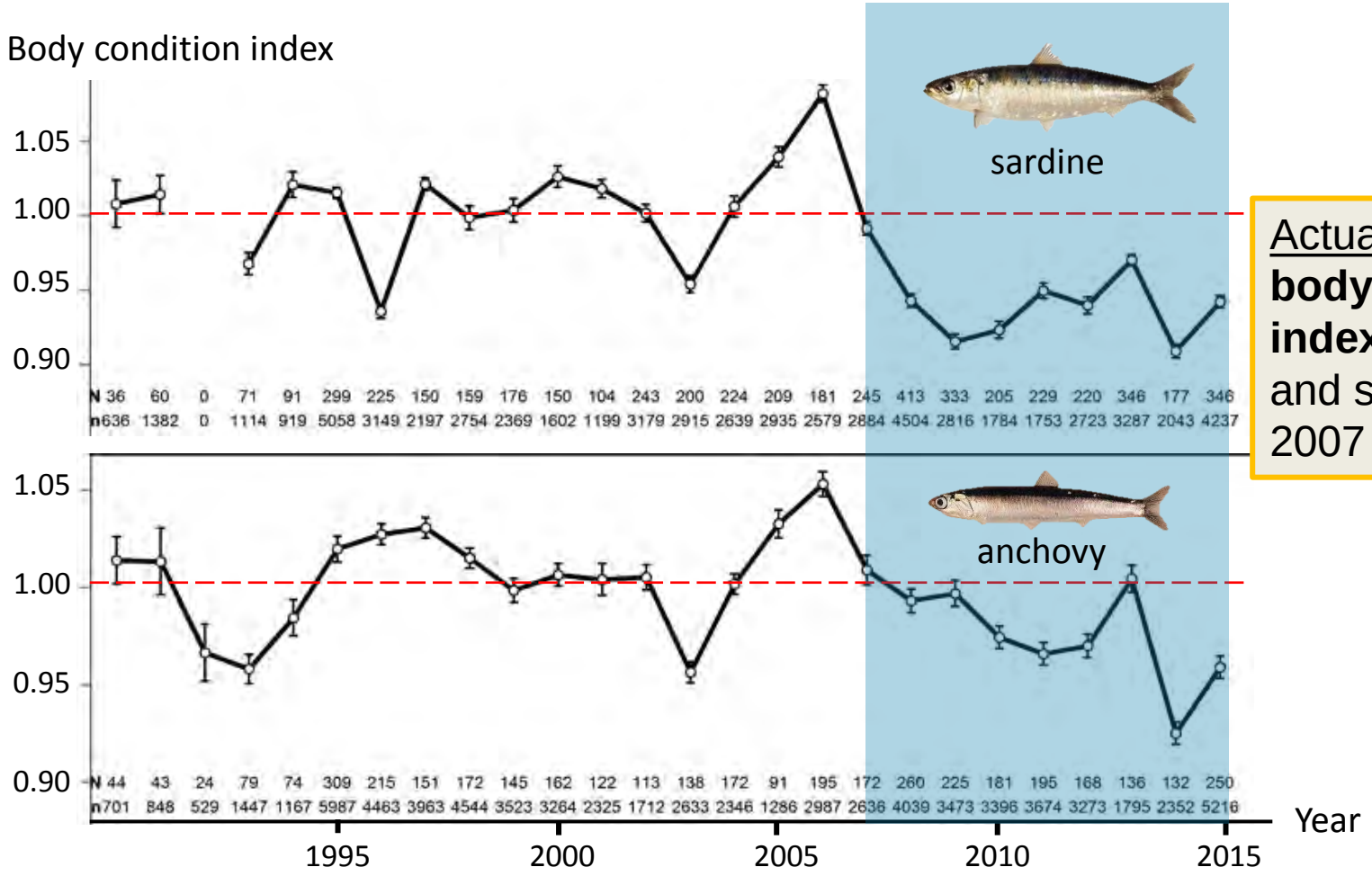
Age proportions in sardine population



Van Beveren et al. (2014)

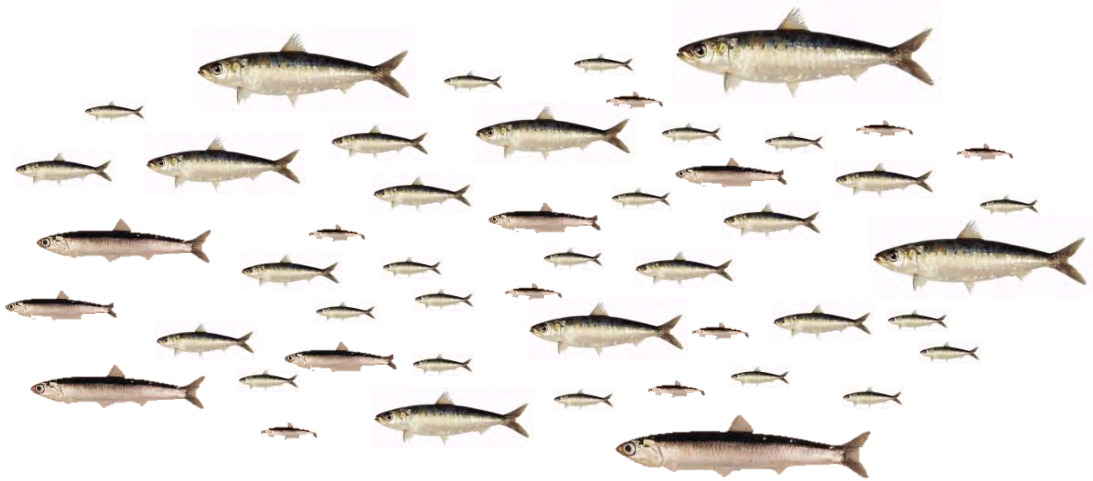
Body condition index = Amount of nutritive reserves

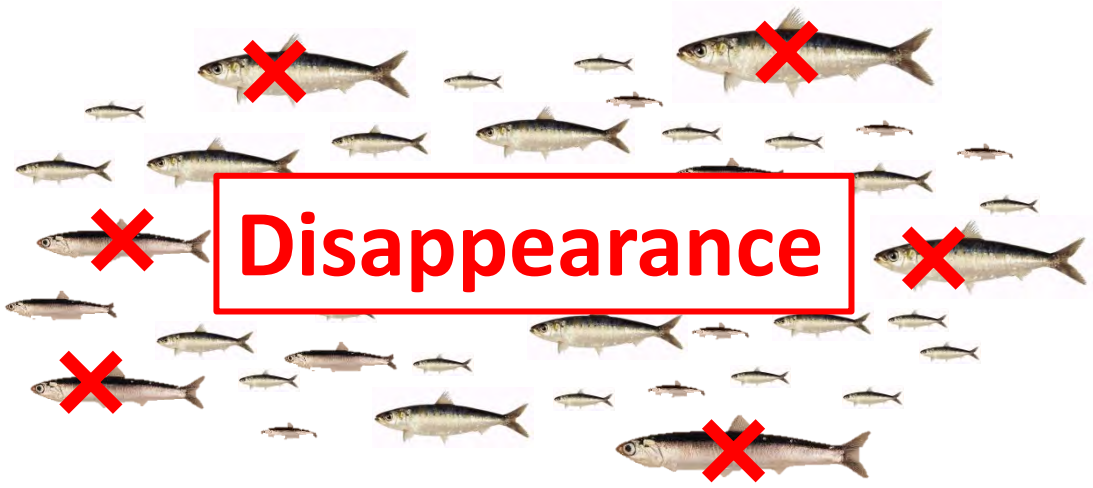
→ **Reflects available energy**



Actual issue: **low body condition index** of anchovies and sardines since 2007

P. Brosset (2016)



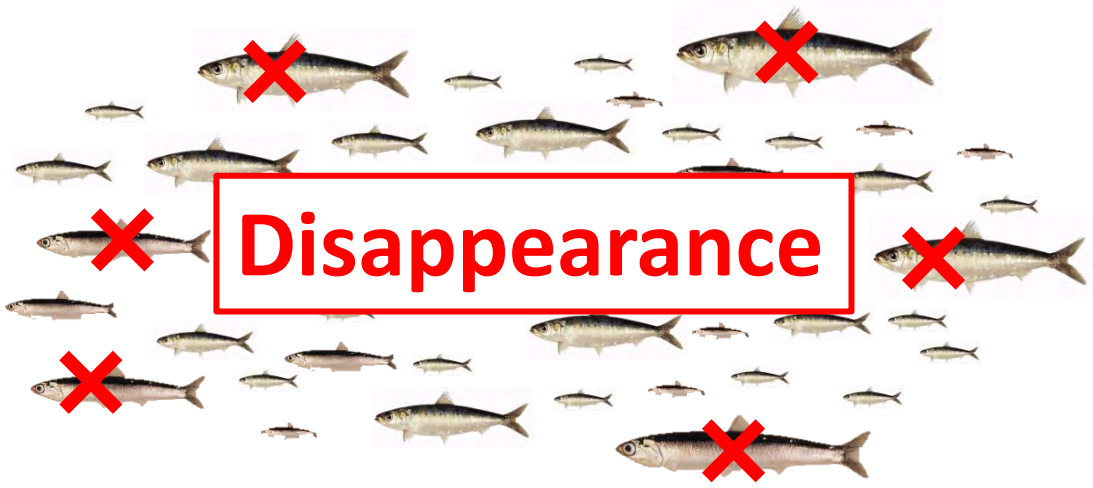

Disappearance

Van Beveren (2015)

emigration ?

Van Beveren (2015)

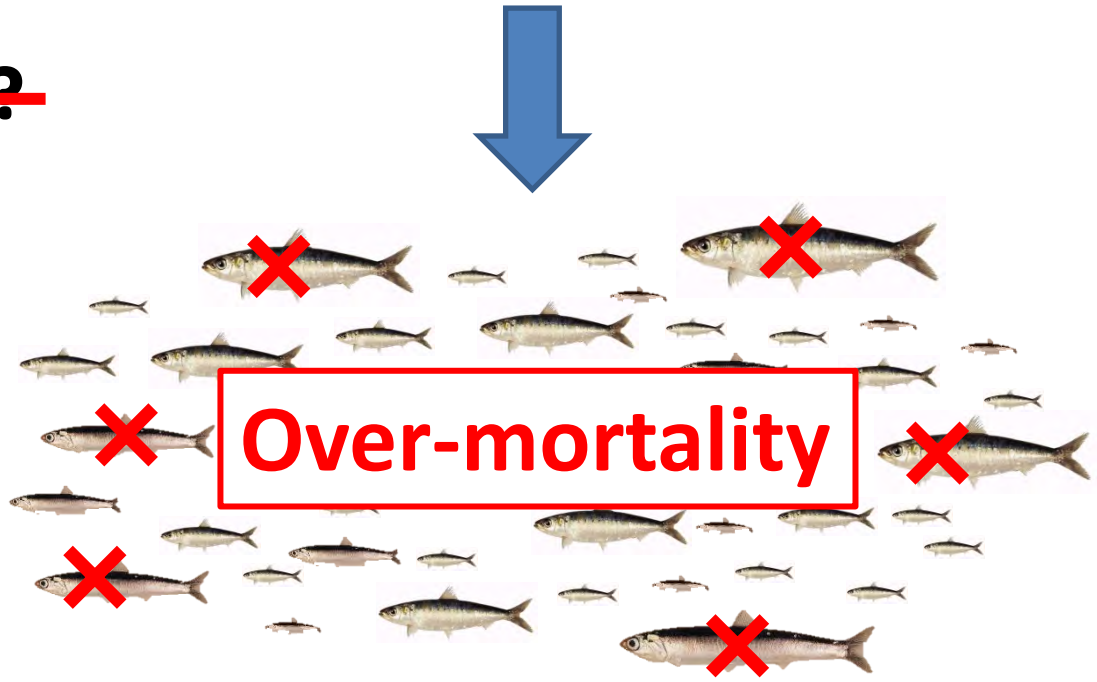
~~emigration ?~~



~~emigration ?~~

top-down control ?

~~emigration ?~~



top-down control ?

~~emigration ?~~

Fisheries
Van Beveren et al., 2016

Top-predators
Van Beveren et al., in press
Queiros et al., in prep

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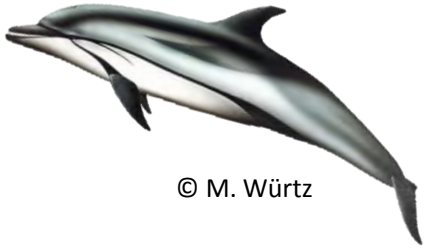

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top-down control ?

~~emigration ?~~

~~Fisheries~~
Van Beveren et al., 2016

~~Top-predators~~
Van Beveren et al., in press
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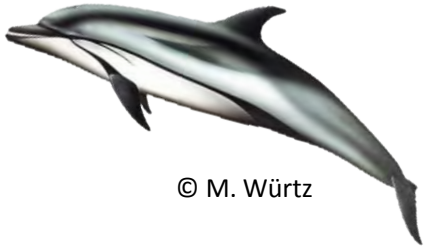
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~~top down control ?~~

~~emigration ?~~

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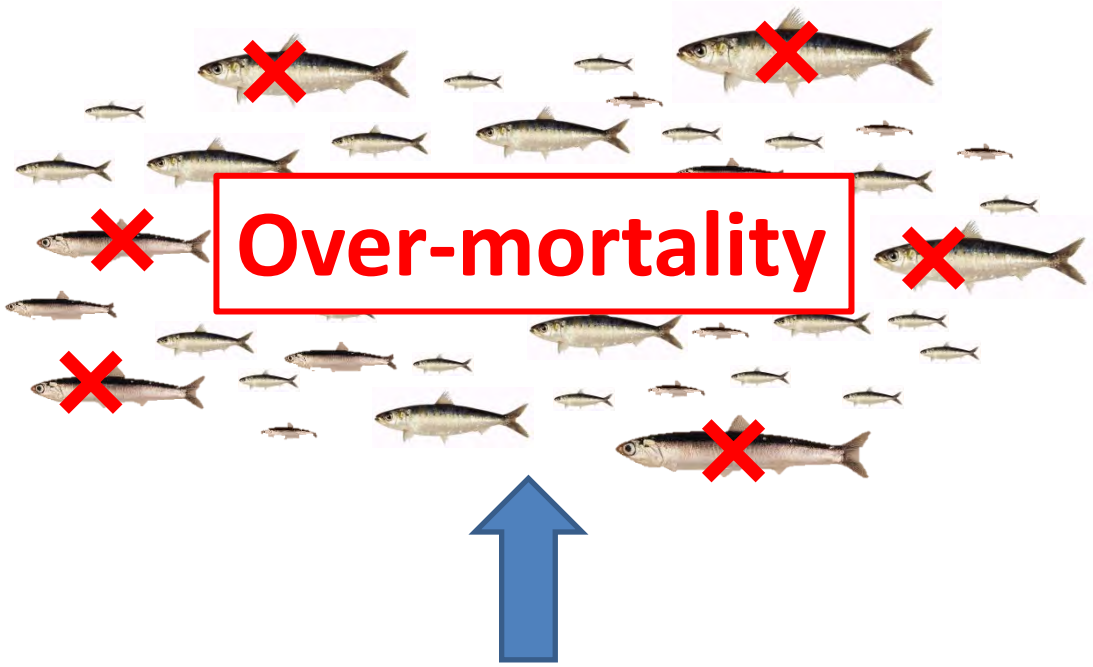


bottom-up control

Brosset (2016)

My PhD:

bottom-up control

EXPERIMENTAL APPROACH
(1st step) + Modelisation (2nd step)

effects of food on …

My PhD:

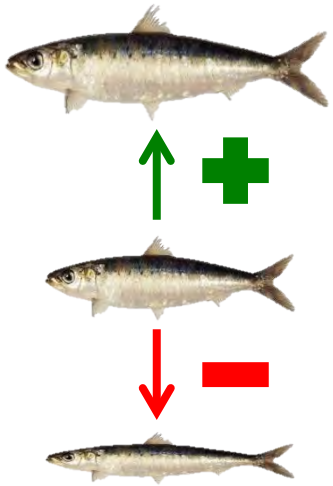
bottom-up control

EXPERIMENTAL APPROACH
(1st step) + Modelisation (2nd step)

effects of food on …

… body condition

… growth



My PhD:

bottom-up control

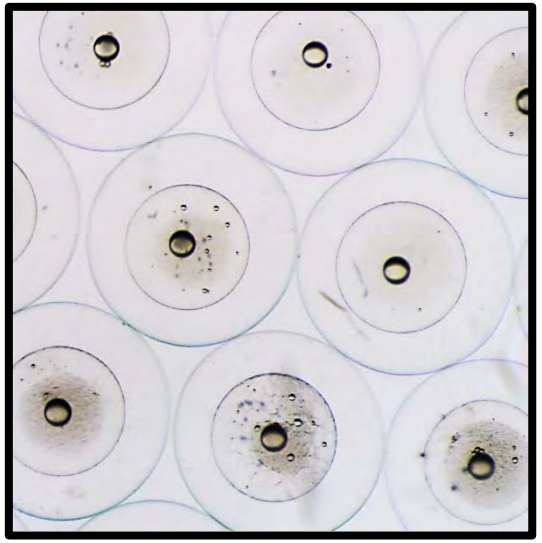
EXPERIMENTAL APPROACH
(1st step) + Modelisation (2nd step)

effects of food on …

… body condition

… growth

… reproduction



My PhD:

bottom-up control

EXPERIMENTAL APPROACH
(1st step) + Modelisation (2nd step)

effects of food on …

… body condition

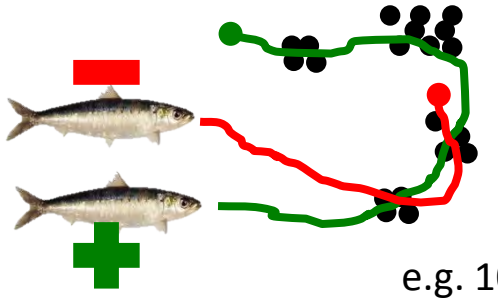
… growth

… reproduction

… locomotion

escape

foraging



e.g. 10 h

My PhD:

bottom-up control

EXPERIMENTAL APPROACH
(1st step) + Modelisation (2nd step)

effects of food on …

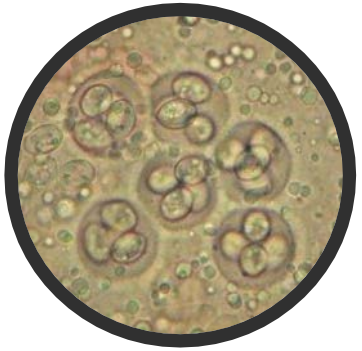
… body condition

… growth

… reproduction

… locomotion

… immunity



My PhD:

bottom-up control

EXPERIMENTAL APPROACH
(1st step) + Modelisation (2nd step)

effects of food on …

… body condition
… growth
… reproduction
… locomotion
… immunity

Experimental approach → Effects of food size and quantity

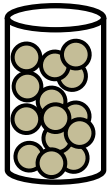
- **2 sizes** → **1.2 mm | 0.1 mm**
- **2 quantities** → **Low | High** (= 2 x low quantity)

Experimental approach → Effects of food size and quantity

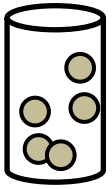
- **2 sizes** → **1.2 mm | 0.1 mm**
- **2 quantities** → **Low | High** (= 2 x low quantity)

4 treatments

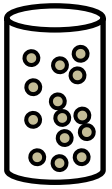
Large x **High**



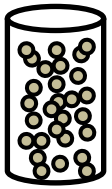
Large x Low



Small x Low



Small x **High**



Experimental approach

Effects of food size and quantity

- Characteristics:
  - **wild sardines** caught in October 2016

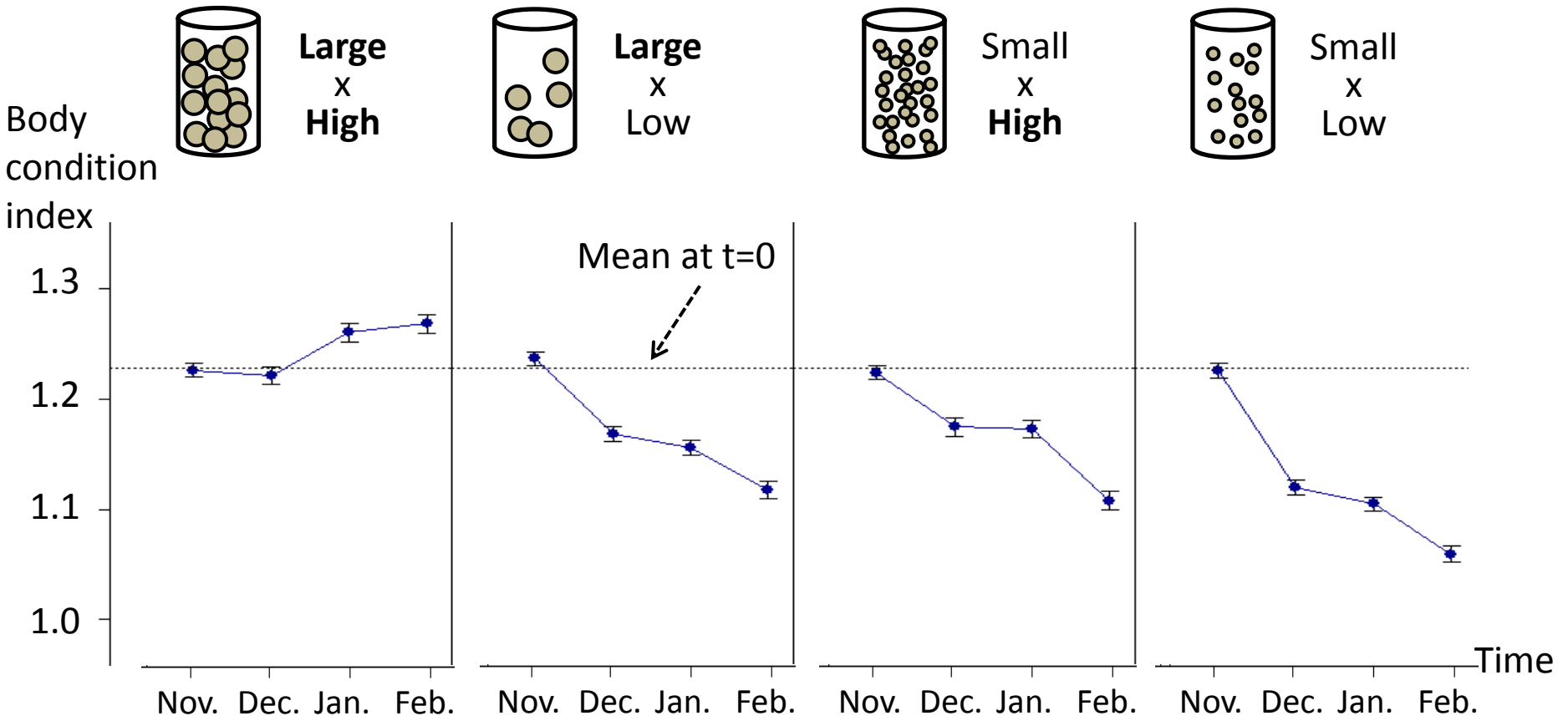
Experimental approach

Effects of food size and quantity

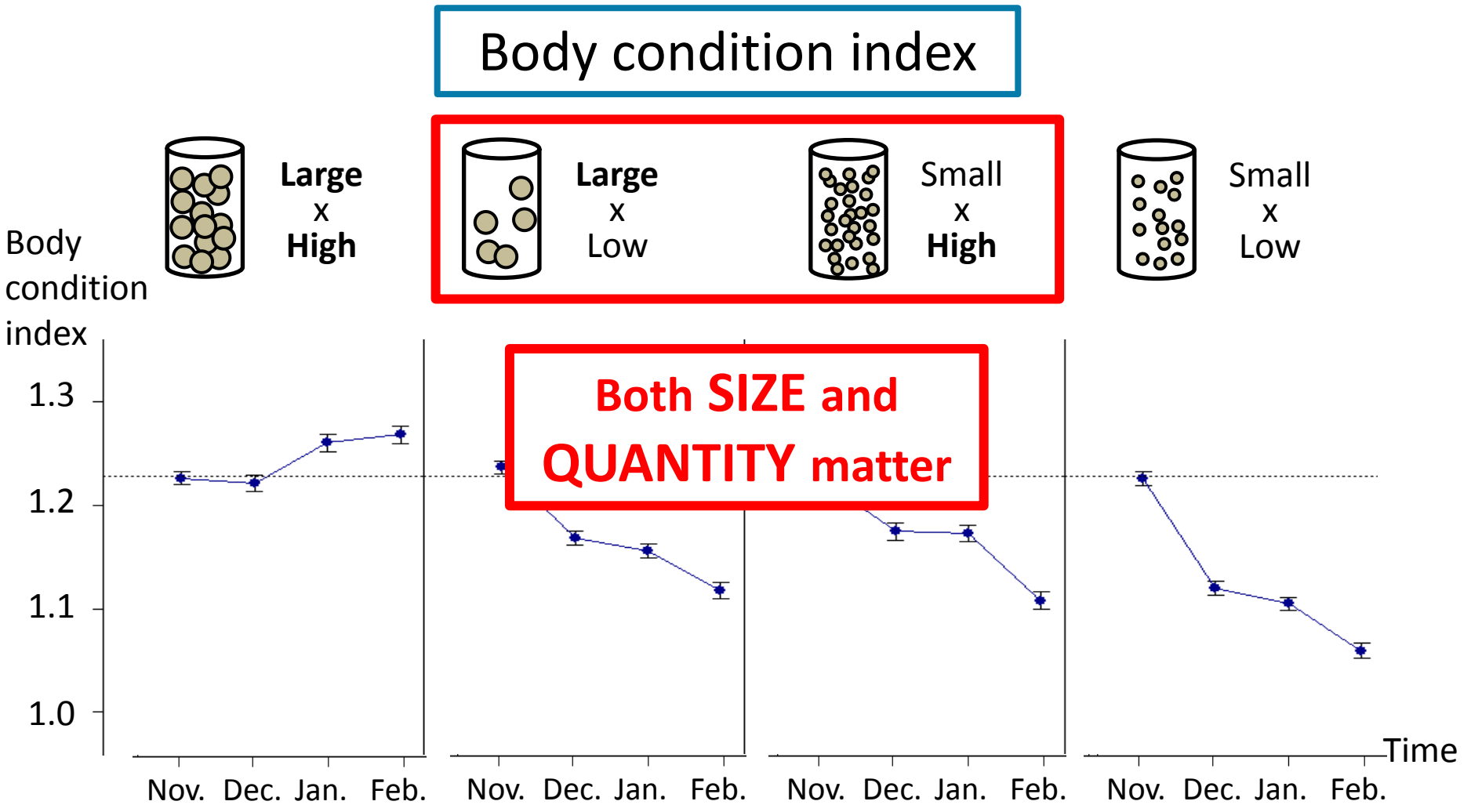
- Characteristics:
  - **wild sardines** caught in October 2016
  - **8 ponds** (0.3m^3 each)
  - 2 replicas (= 4 treatments)
  - **~ 55 sardines tagged** per pond

Effects of food size and quantity on

Body condition index

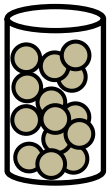


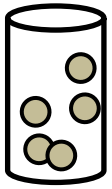
Effects of food size and quantity on

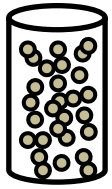


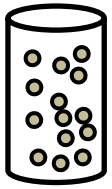
Effects of food size and quantity on

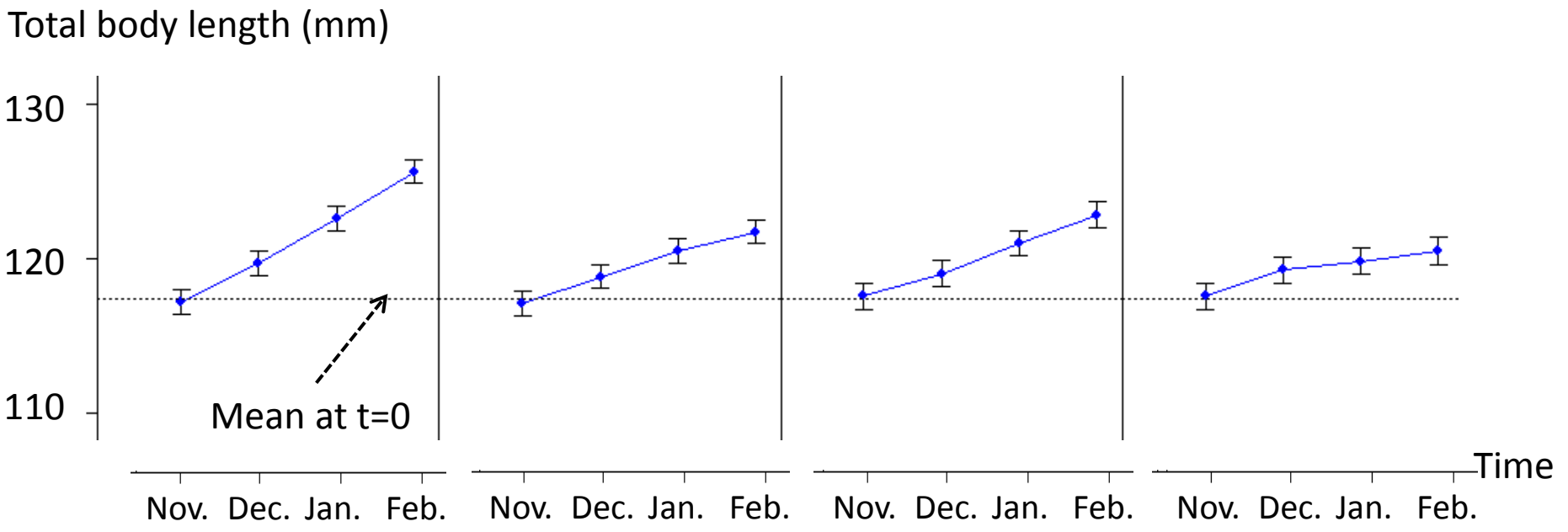
Total body length


Large x High


Large x Low

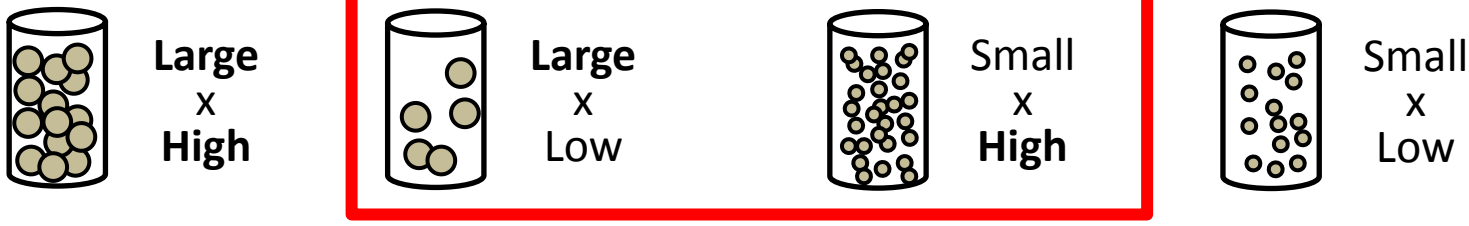

Small x **High**


Small x Low



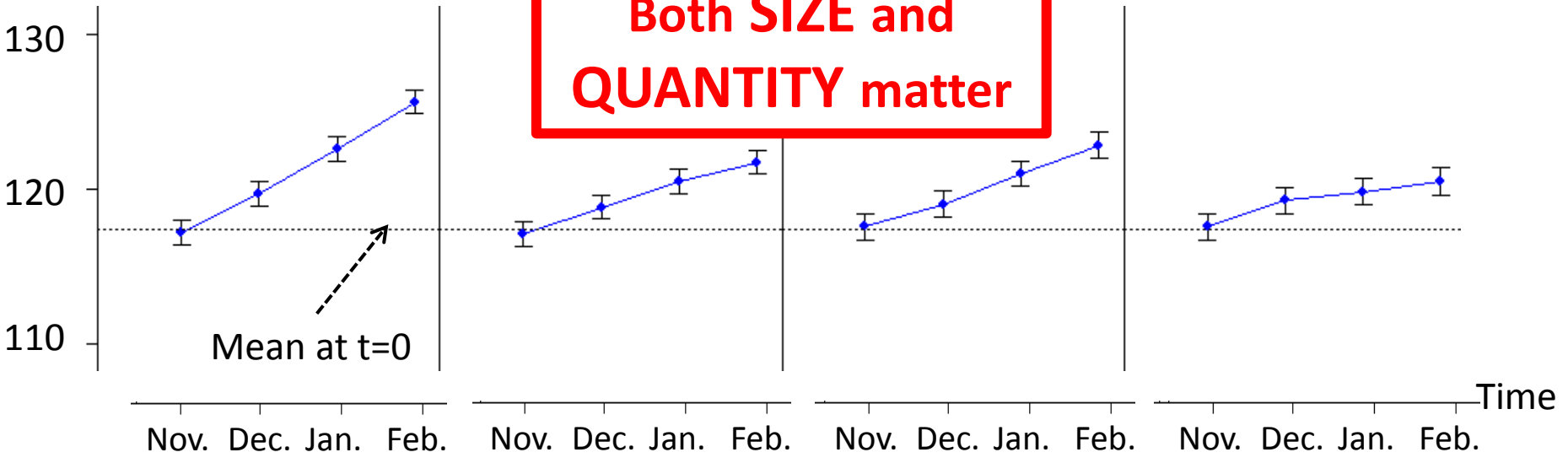
Effects of food size and quantity on

Total body length



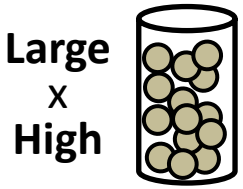
Total body length (mm)

Both SIZE and QUANTITY matter

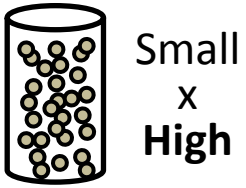


Effects of food size on

Reproduction



(2 replicas)

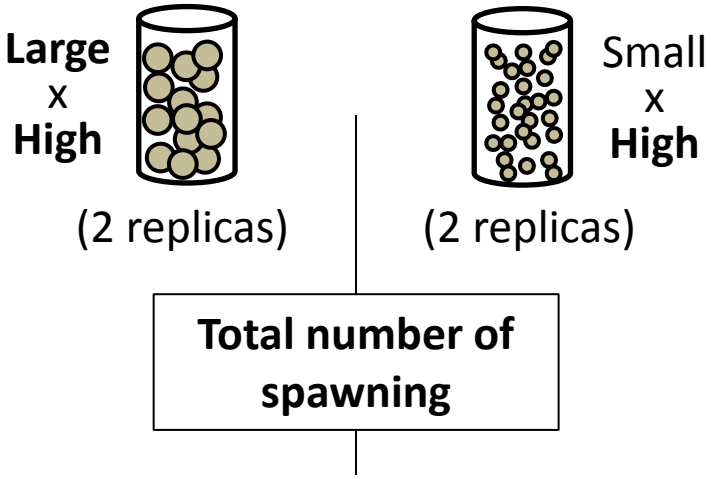


(2 replicas)

Large x High		Small x High
26	Total number of spawning	4
15.6 ± 2.6	Mean quantity of eggs ± SE (mL)	9.3 ± 1.8
9.8 ± 1.2	Mean quantity of floating eggs ± SE (mL)	4.8 ± 1.9

Effects of food size on

Reproduction

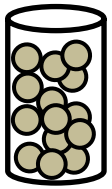


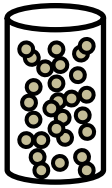
Large food ➔ Spawning more frequent

Effects of food size on

Reproduction

Large x High (2 replicas)





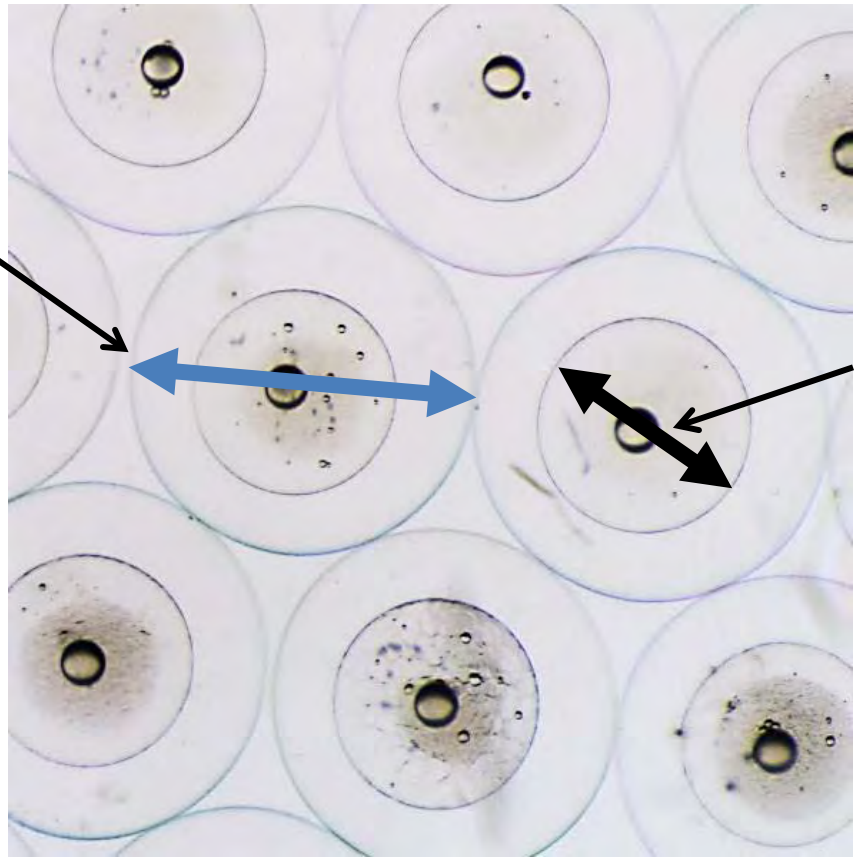
Small x **High** (2 replicas)

Large food ➔ Higher number of eggs

15.6 ± 2.6	**Mean quantity of eggs ± SE (mL)**	**9.3 ± 1.8**
9.8 ± 1.2	**Mean quantity of floating eggs ± SE (mL)**	**4.8 ± 1.9**

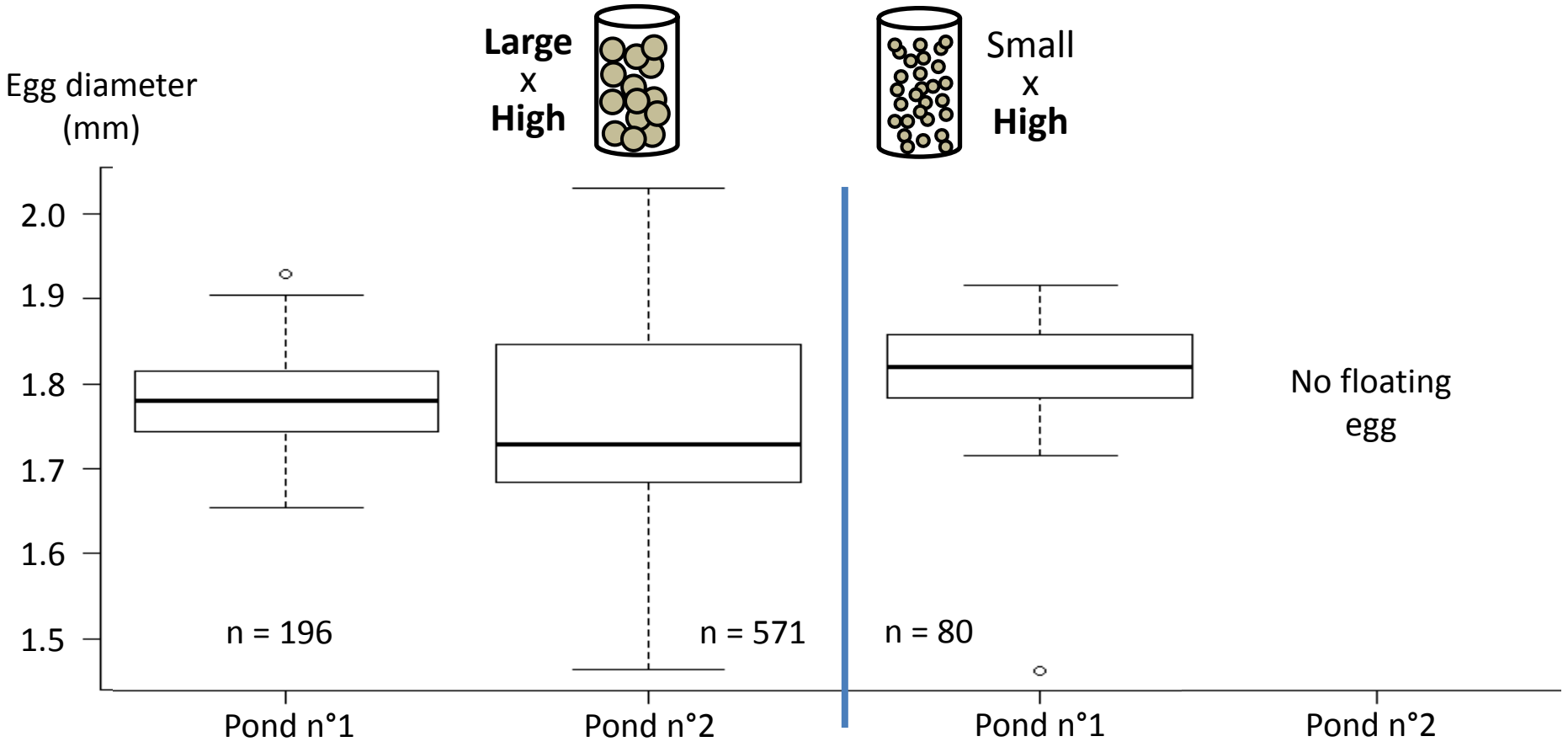
Effects of food size on

Reproduction



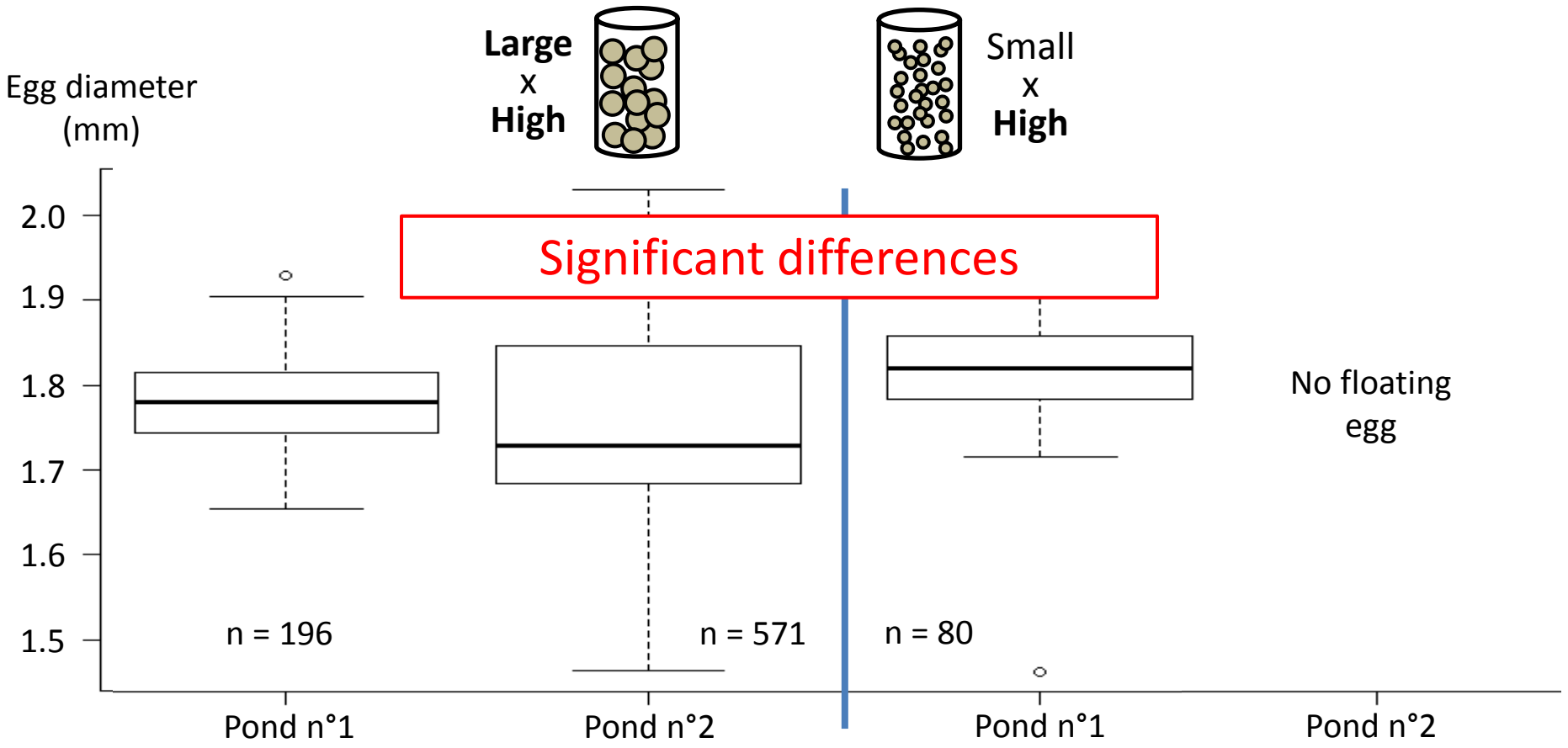
Effects of food size on

Reproduction : **egg diameter**



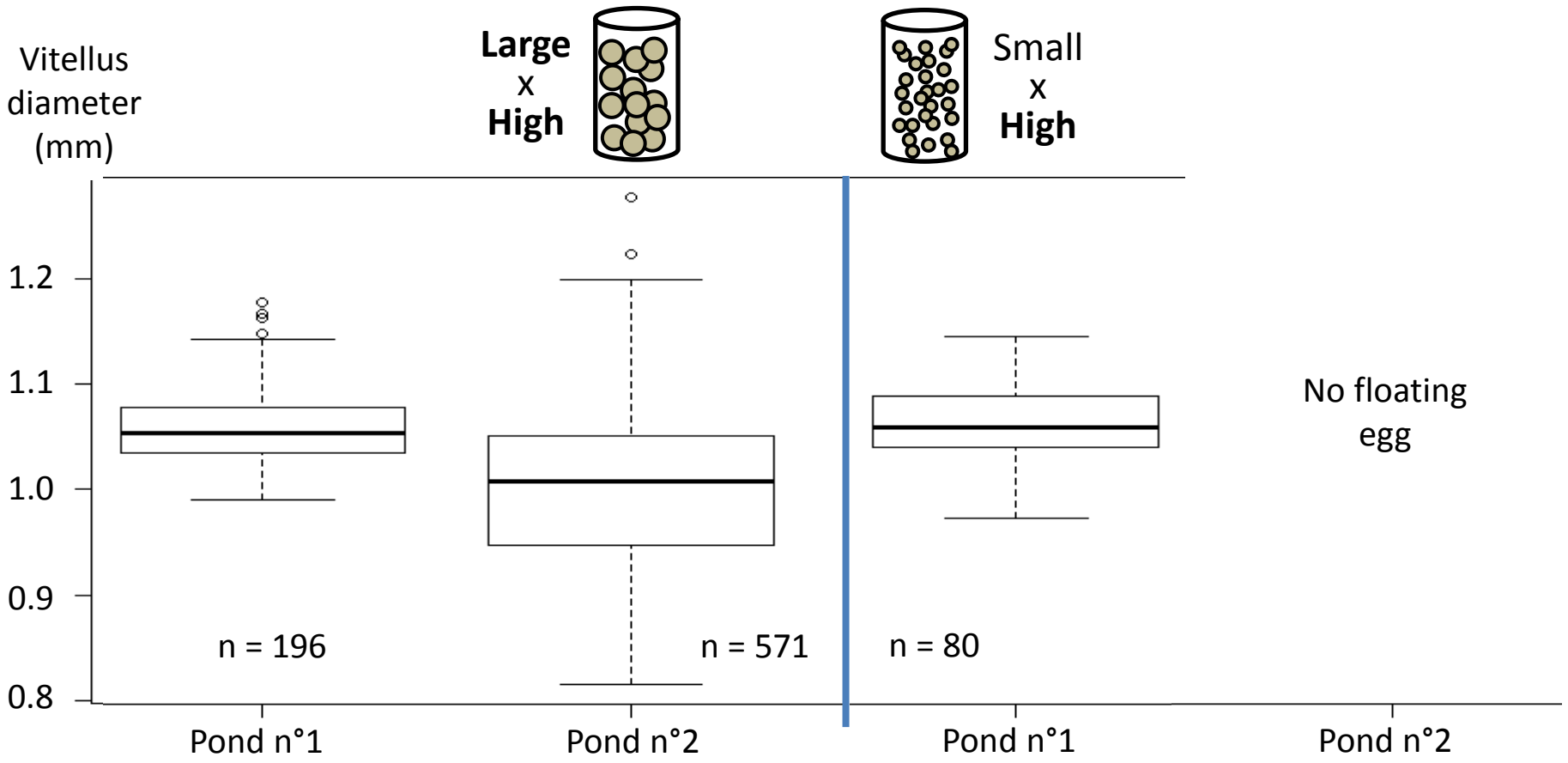
Effects of food size on

Reproduction : **egg diameter**



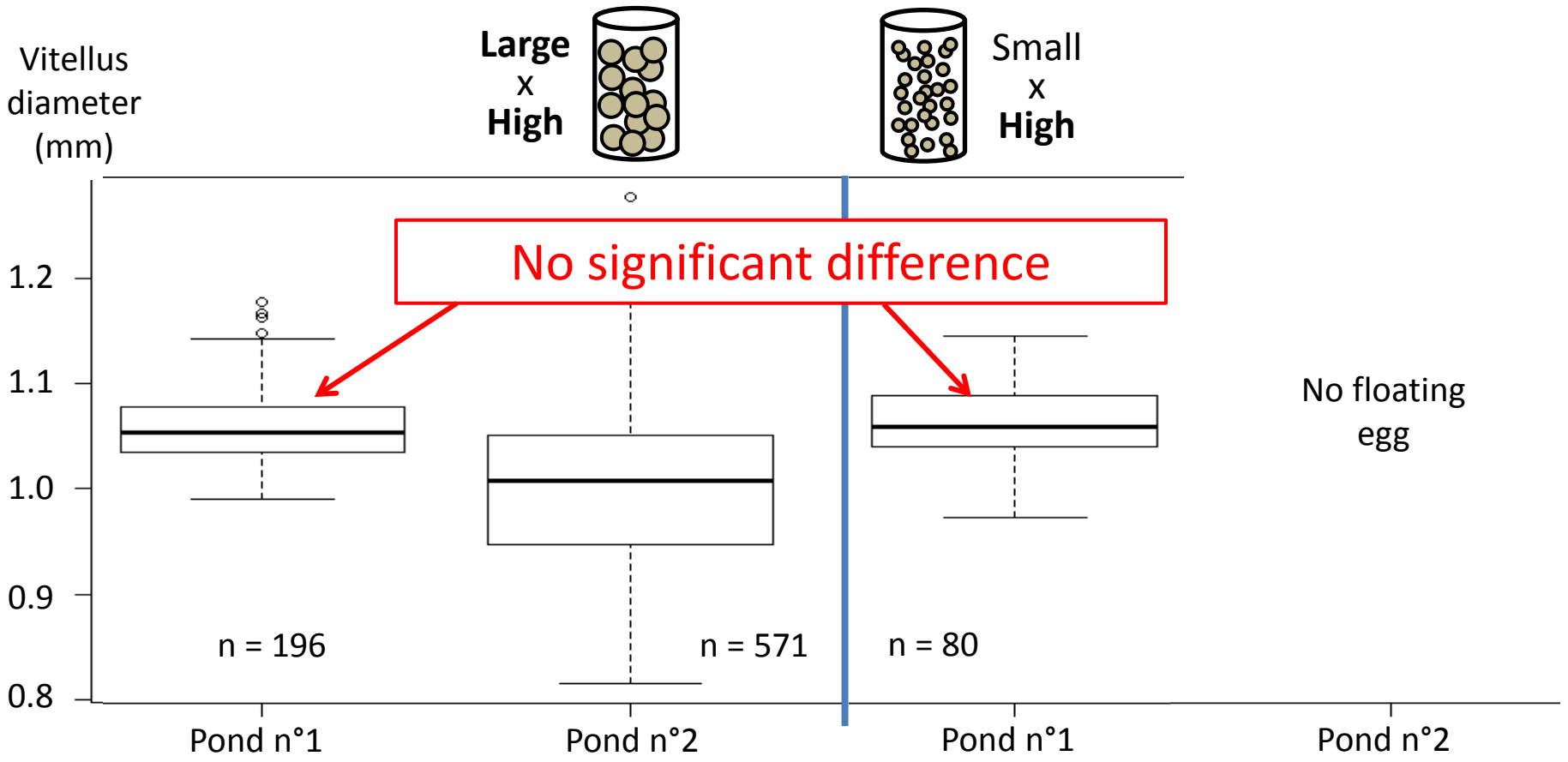
Effects of food size on

Reproduction : **vitellus diameter**



Effects of food size on

Reproduction : **vitellus diameter**



Take home message

Effects of food size and quantity on…

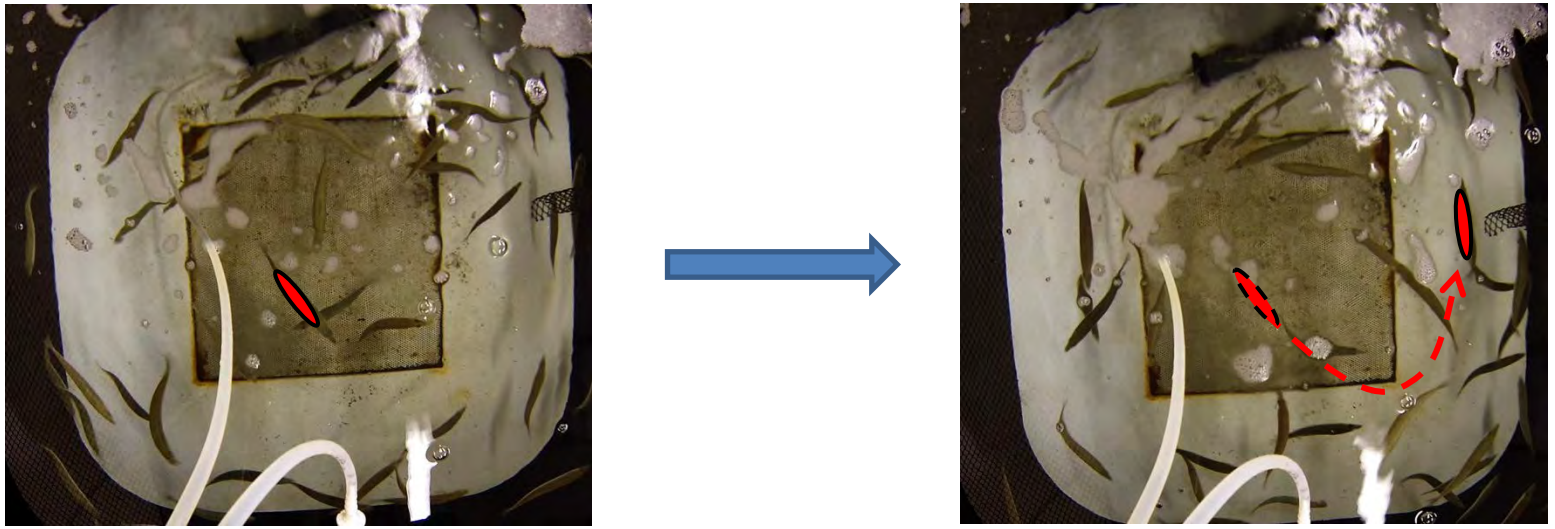
Body condition index	**Both SIZE and QUANTITY matter**
Total body length	**Both SIZE and QUANTITY matter**
Reproduction	**SIZE matters**

And after ?

- Pursuit of this experimentation till June

And after ?

- Pursuit of this experimentation till June
- Effects of food size and quantity on …
  - ➢ Locomotion ?



And after ?

- Pursuit of this experimentation till June
- Effects of food size and quantity on …
  - Locomotion ?
  - Immunity ?

And after ?

- Pursuit of this experimentation till June
- Effects of food size and quantity on …
  - ➢ Locomotion ?
  - ➢ Immunity ?
- New experimentation

  ⇒ Effects of food quality

And after ?

- Pursuit of this experimentation till June
- Effects of food size and quantity on …
  - ➢ Locomotion ?
  - ➢ Immunity ?
- New experimentation
  - ➡ Effects of food quality
- Modelisation approach


Thank you for your attention

References :

- Brosset, P. (2016) Condition corporelle et conséquences sur la plasticité des traits d'histoire de vie chez les petits pélagiques de Méditerranée - Thesis

- Van Beveren, E. (2015) Population changes in small pelagic fish of the Gulf of Lions: a bottom-up control? - Thesis

- Van Beveren, E., Bonhommeau, S., Fromentin, J.-M., Bigot, J.-L., Bourdeix, J.-H., Brosset, P., Roos, D. & Saraux, C. (2014) Rapid changes in growth, condition, size and age of small pelagic fish in the Mediterranean. Marine Biology, **161**, 1809–1822.

- Van Beveren, E., Fromentin, J. M., Rouyer, T., Bonhommeau, S., Brosset, P., & Saraux, C. (2016). The fisheries history of small pelagics in the Northern Mediterranean. *ICES Journal of Marine Science: Journal du Conseil*, fsw023.