Understanding the vulnerability of Peruvian anchovy larvae to environmental variables

Claudia Ofelio[1]

Anna Schukat[2], Dominik Auch[1], Stefanie Kurbjuweit[1], Marta Moyano[1], Fanny Rioual[3], Michael Sswat[4], Arturo Aguirre Velarde[3] and Myron A. Peck[1, 5]

claudia.ofelio@uni-hamburg.de

(1) Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

(2) Universität Bremen

CUSCO

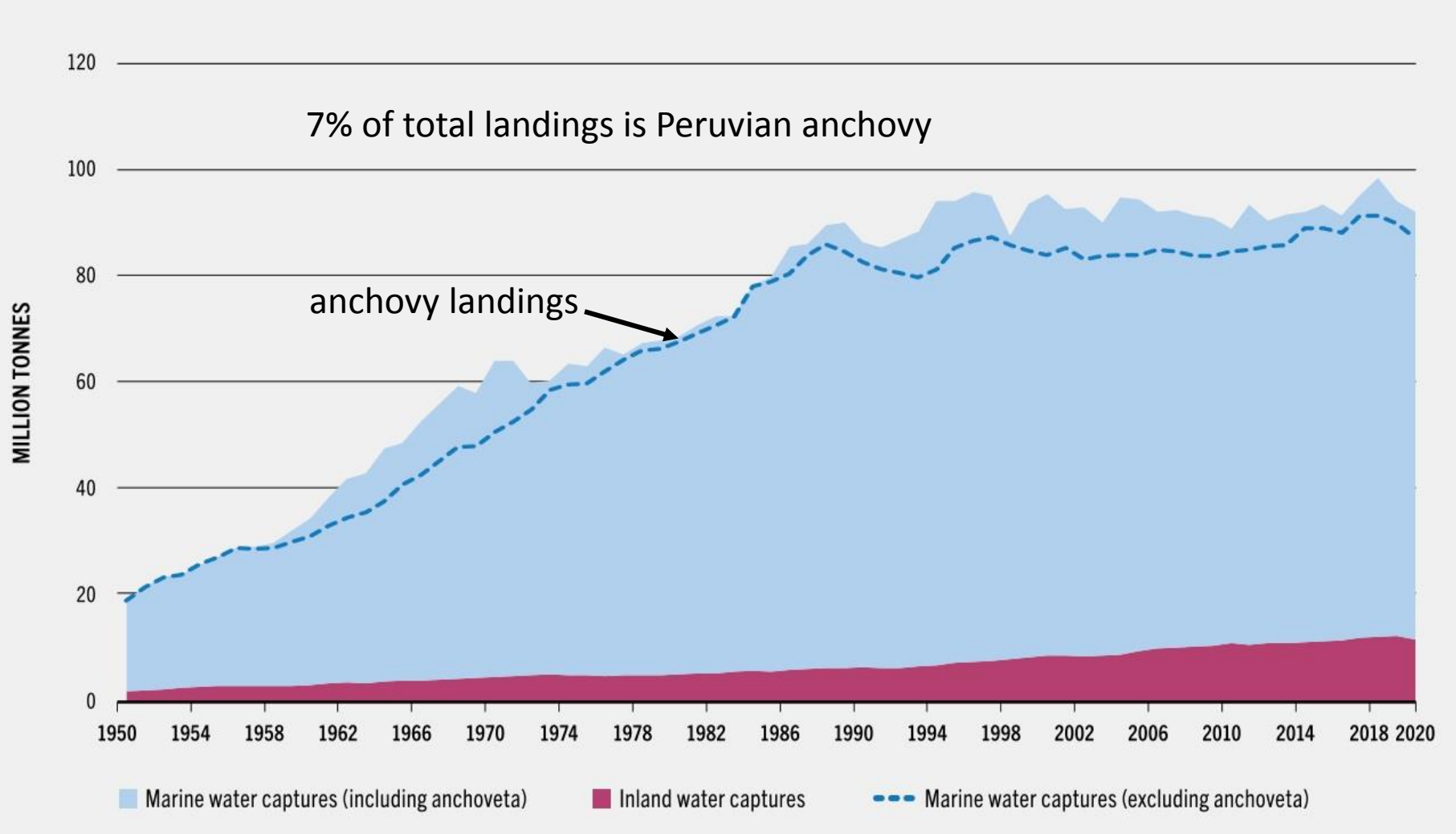
(3)

(4) GEOMAR

(5) NIOZ

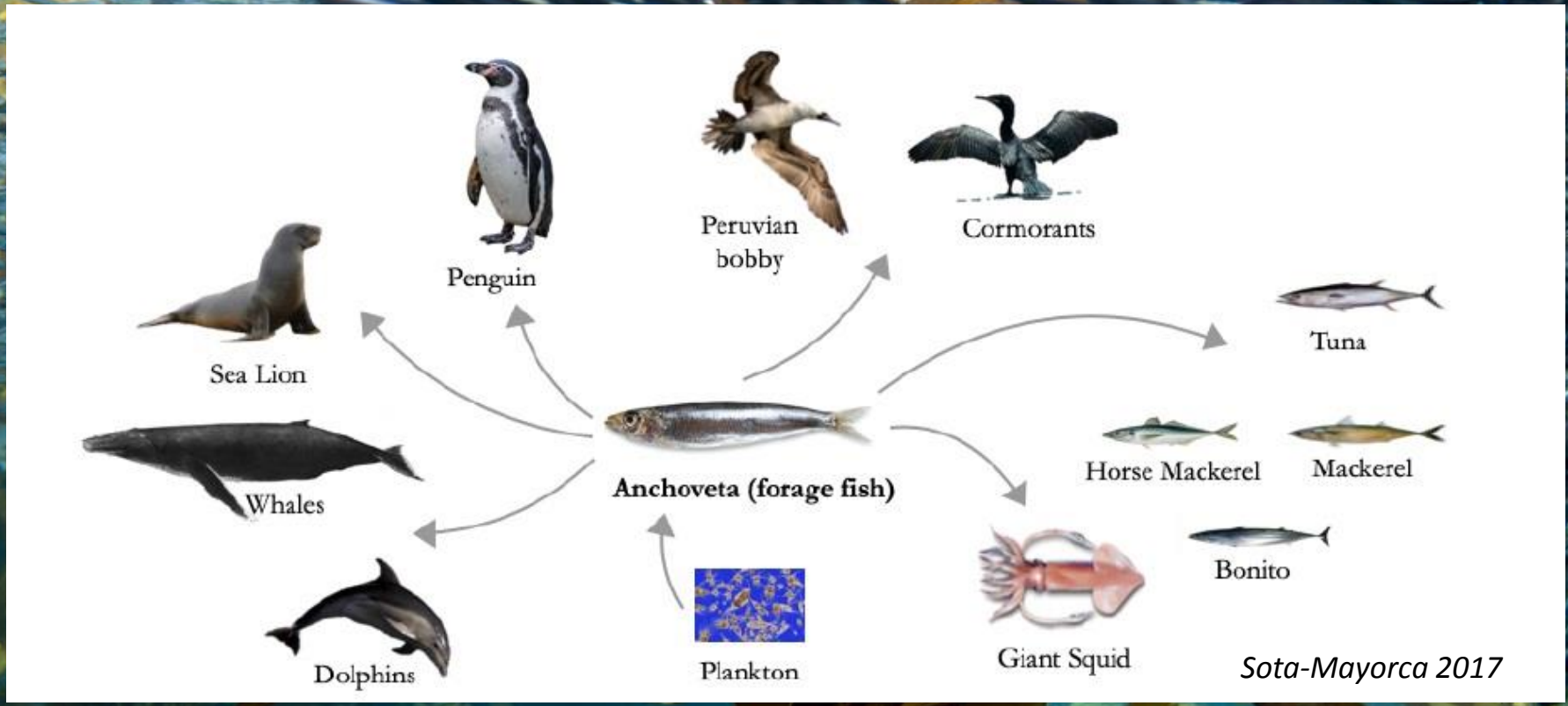
Peruvian anchovy *Engraulis ringens*

Largest single-species fishery worldwide



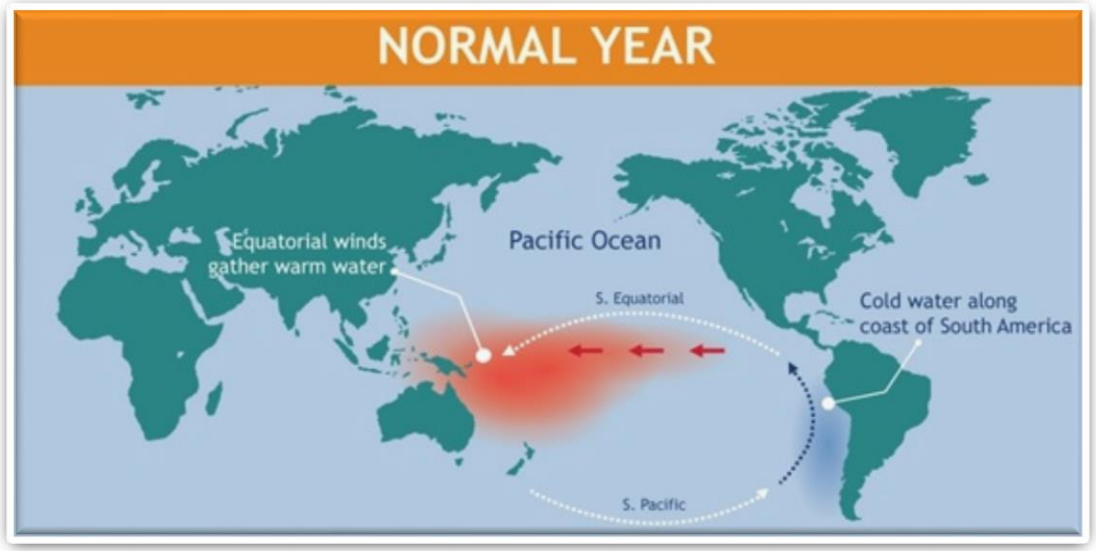
FAO 2022

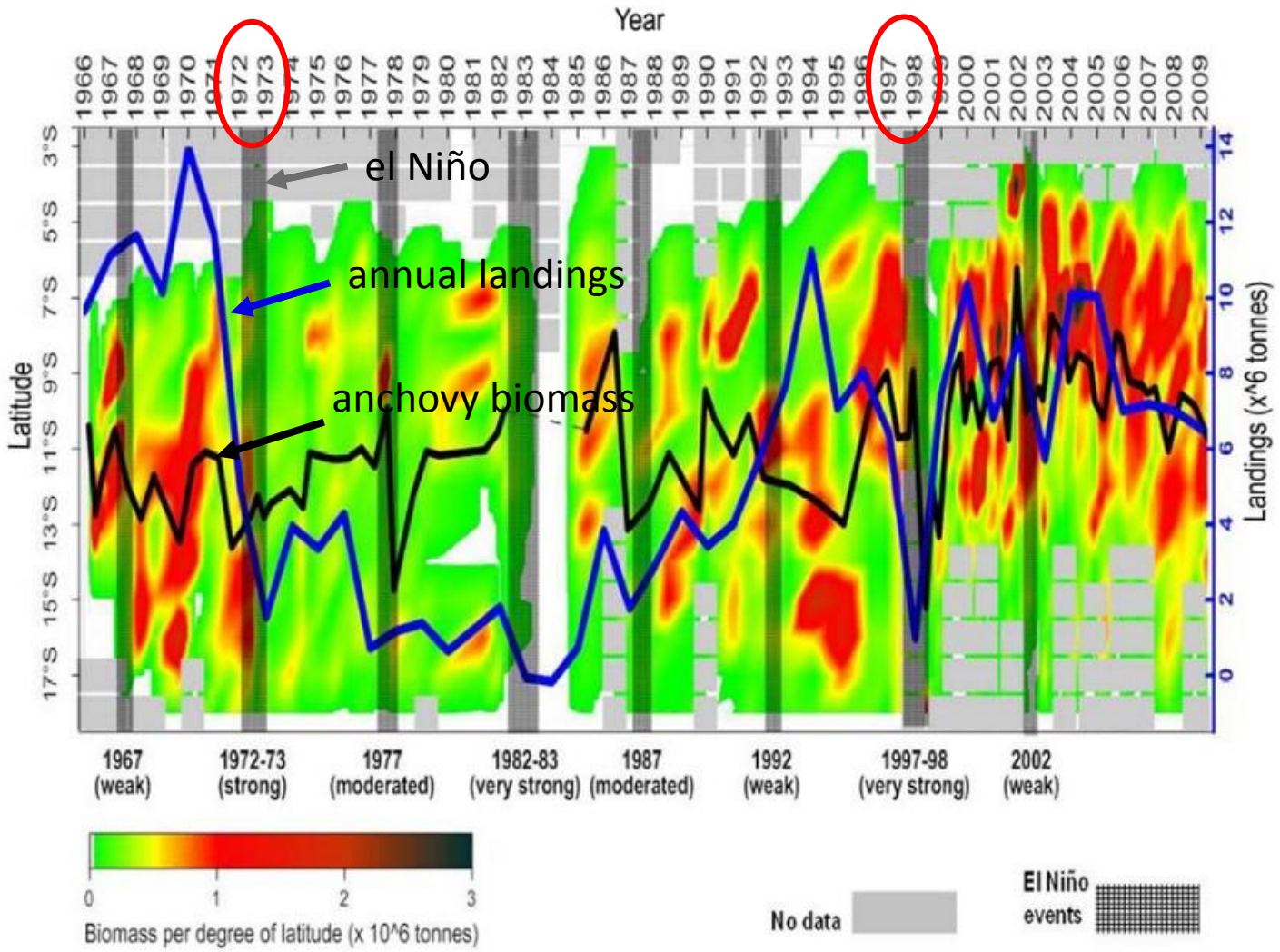
Key species for trophic networks



Sota-Mayorca 2017

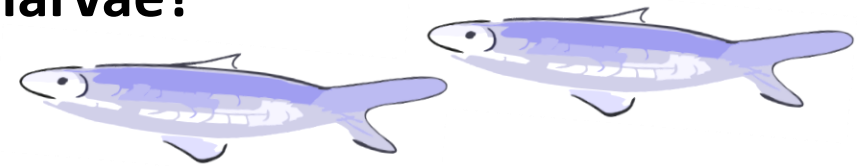
Ocean-climate variability influences anchovy productivity along HCS



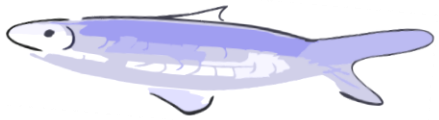


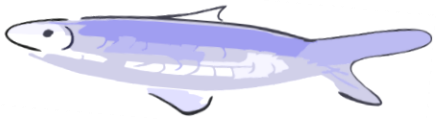
Gutiérrez et al. 2012

How bottom-up processes influences growth and development of Peruvian anchovy larvae?

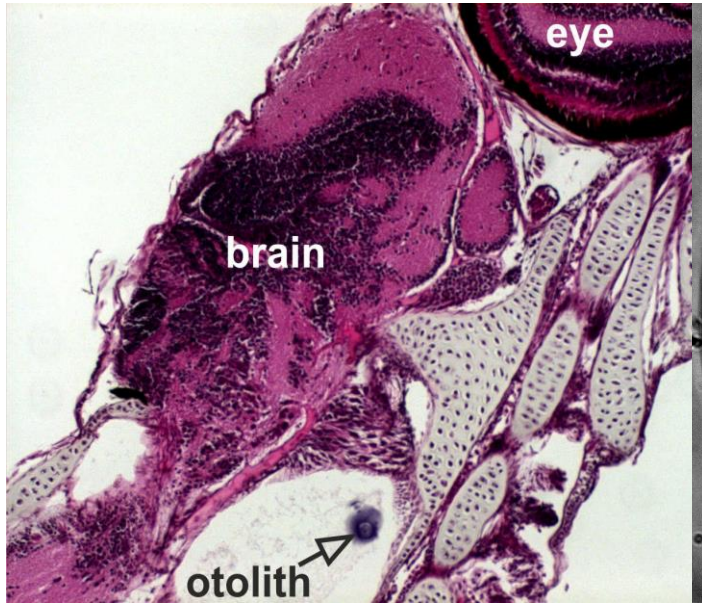


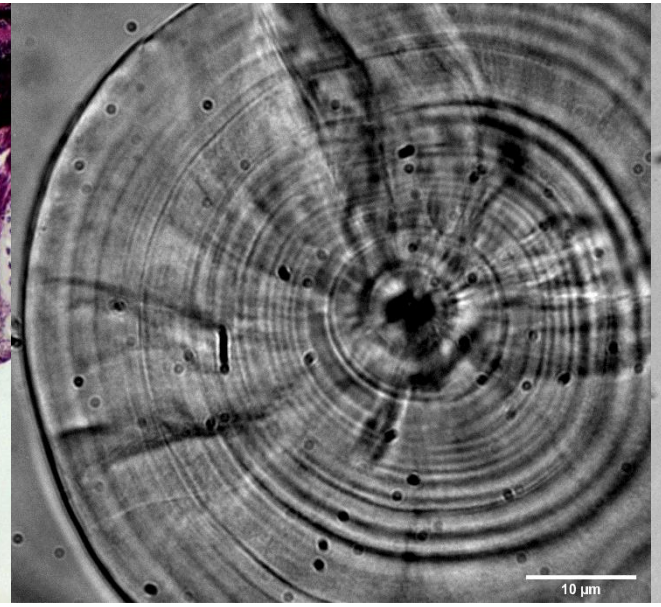
- Influence of temperature and food concentration on **larval growth and otolith microstructure**
- Comparison between **laboratory-reared** larvae and larvae collected in the **field**

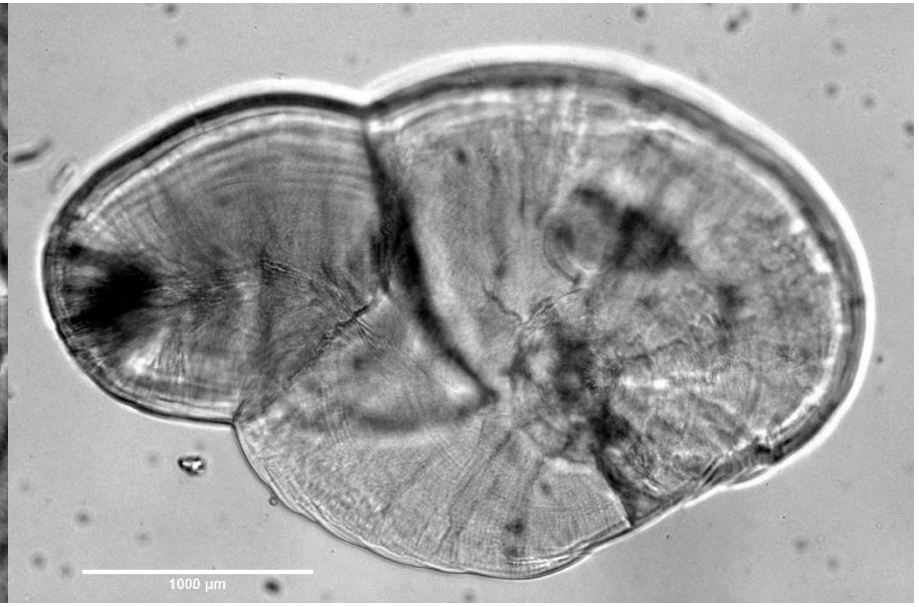




Otoliths as a proxy of larval growth







Calcium carbonate structure inner ear of fish

Increments deposited daily
- age calculation

Growth history
- Temperature
- food availability
- reproductive season
- spatial distribution

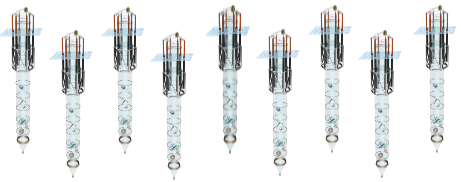
CUSCO - **C**oastal **U**pwelling **S**ystem in a **C**hanging **O**cean

January 2019 — Research Cruise

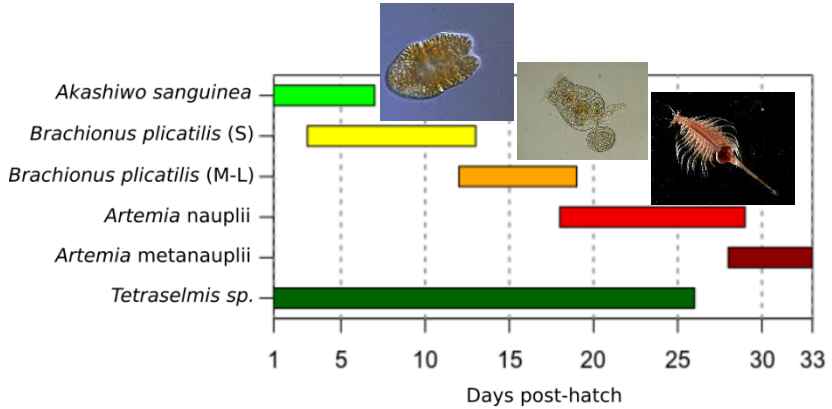
January - March 2020 — Laboratory rearing

March - April 2020 — Offshore Mesocosms

9 mesocosms:
High Light + upwelling:
0%, 15%, 30%, 45%, 60%
Low Light + upwelling:
0%, 15%, 30%, 45%

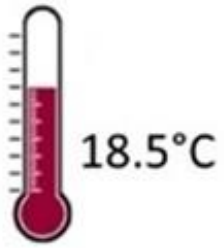


Set up laboratory rearing



High Food

100 dinoflagellates per ml
20 rotifers per ml
2 nauplii per ml

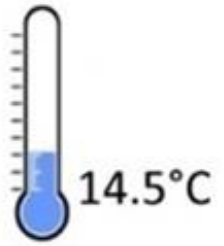


Low Food

20 dinoflagellates per ml
10 rotifers per ml
2 nauplii per ml

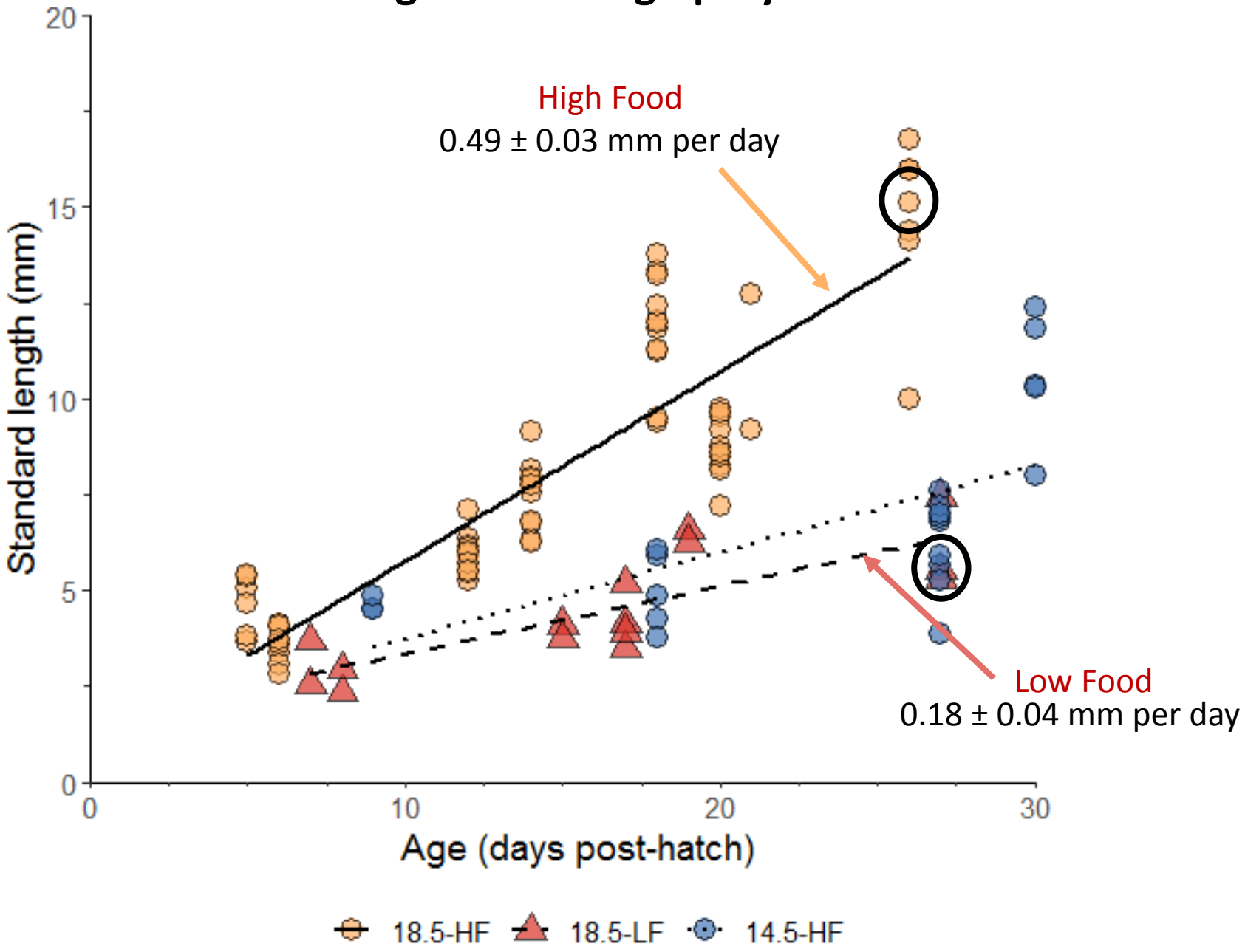
High Food

100 dinoflagellates per ml
20 rotifers per ml
2 nauplii per ml



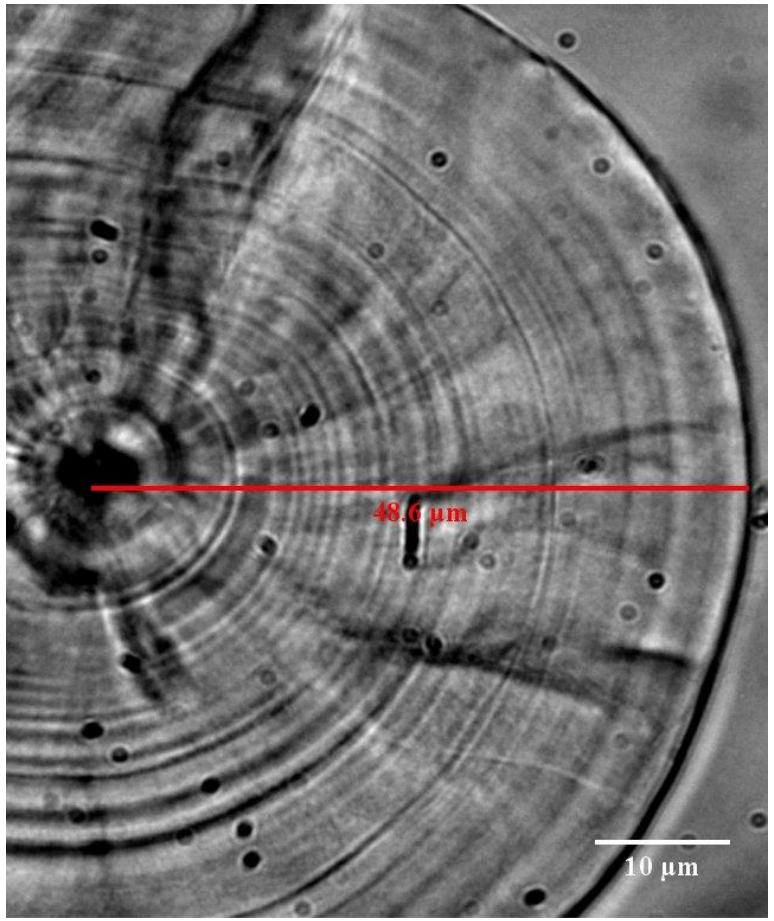
Rioual, **Ofelio** et al., 2021 *JFB*

Faster growth at high prey densities

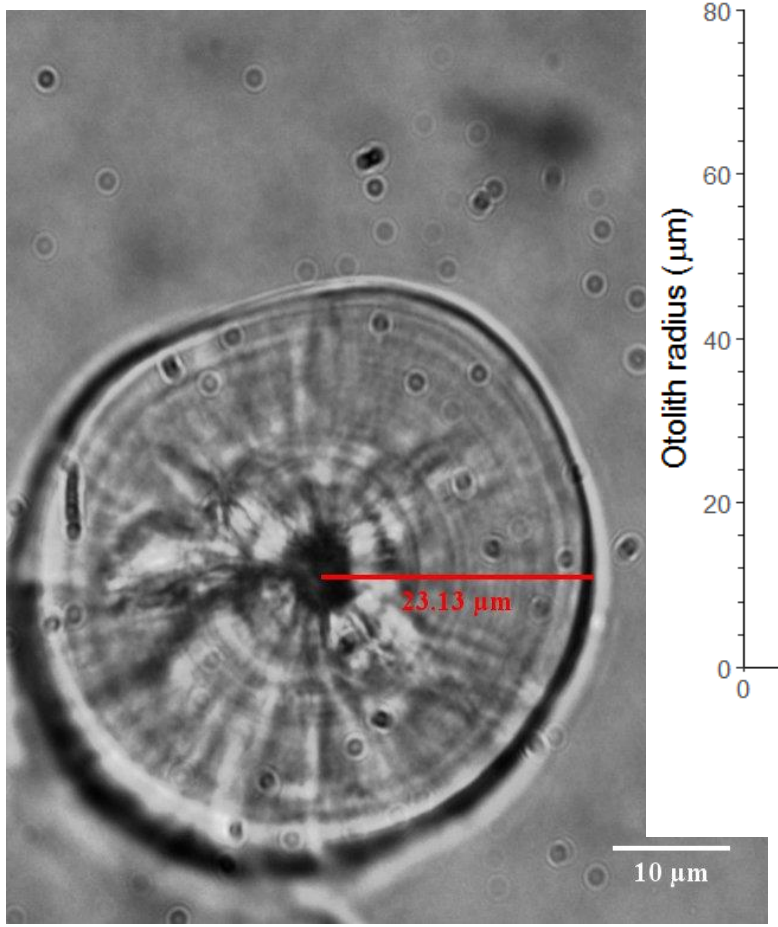


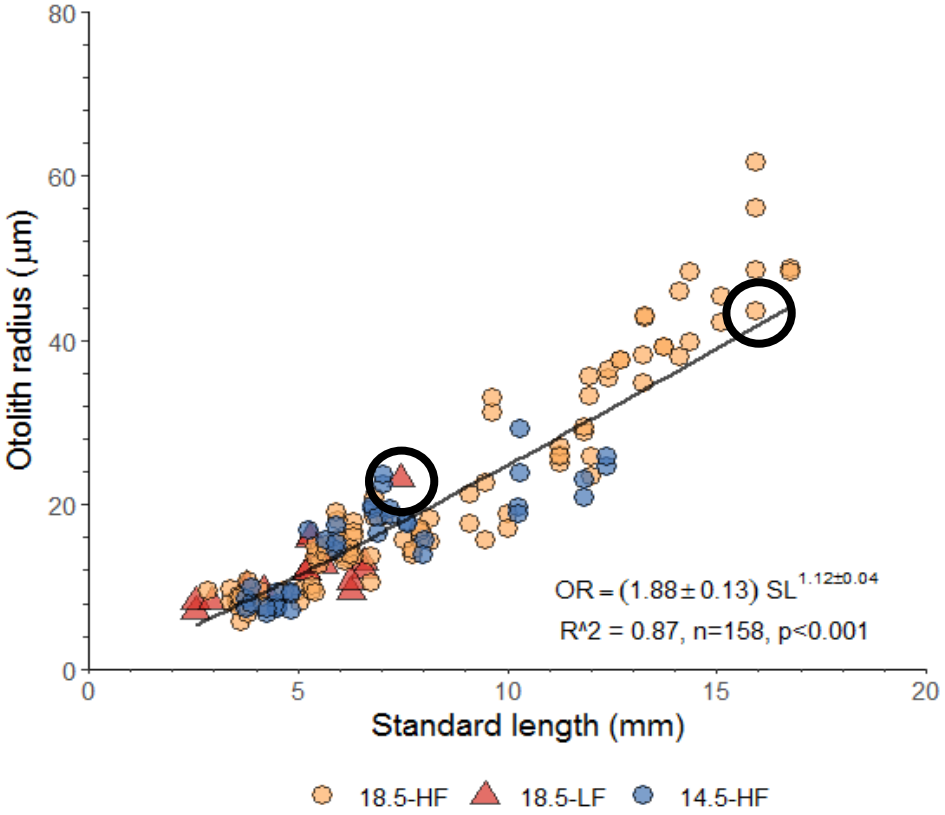
Otolith radio and fish length are smaller under low food conditions

18.5°C – High Food
Radio: 48.6 µm
Standard Length: 16.75 mm
Age: 26 days post hatch
Number of Increments: 23



18.5°C – Low Food
Radio: 23.1 µm
Standard Length: 7.45 mm
Age: 27 days post hatch
Number of Increments: 16

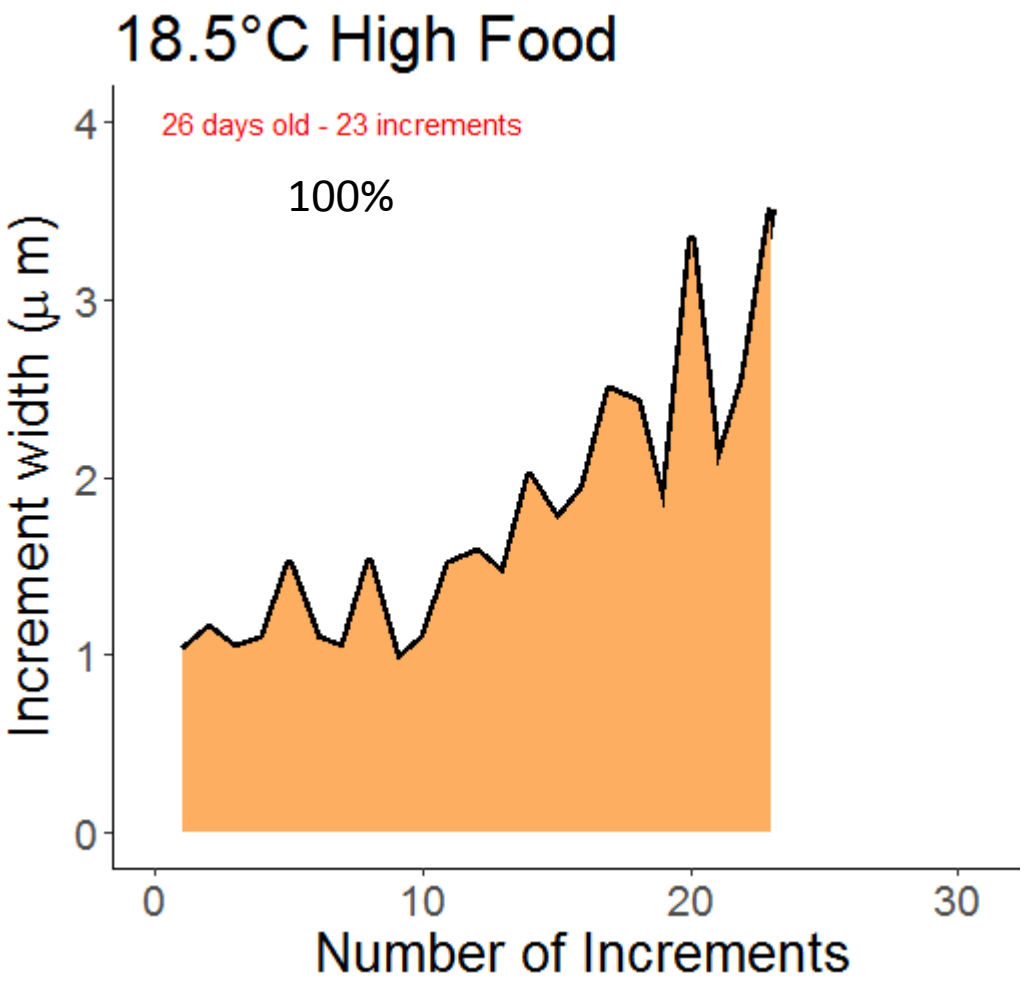


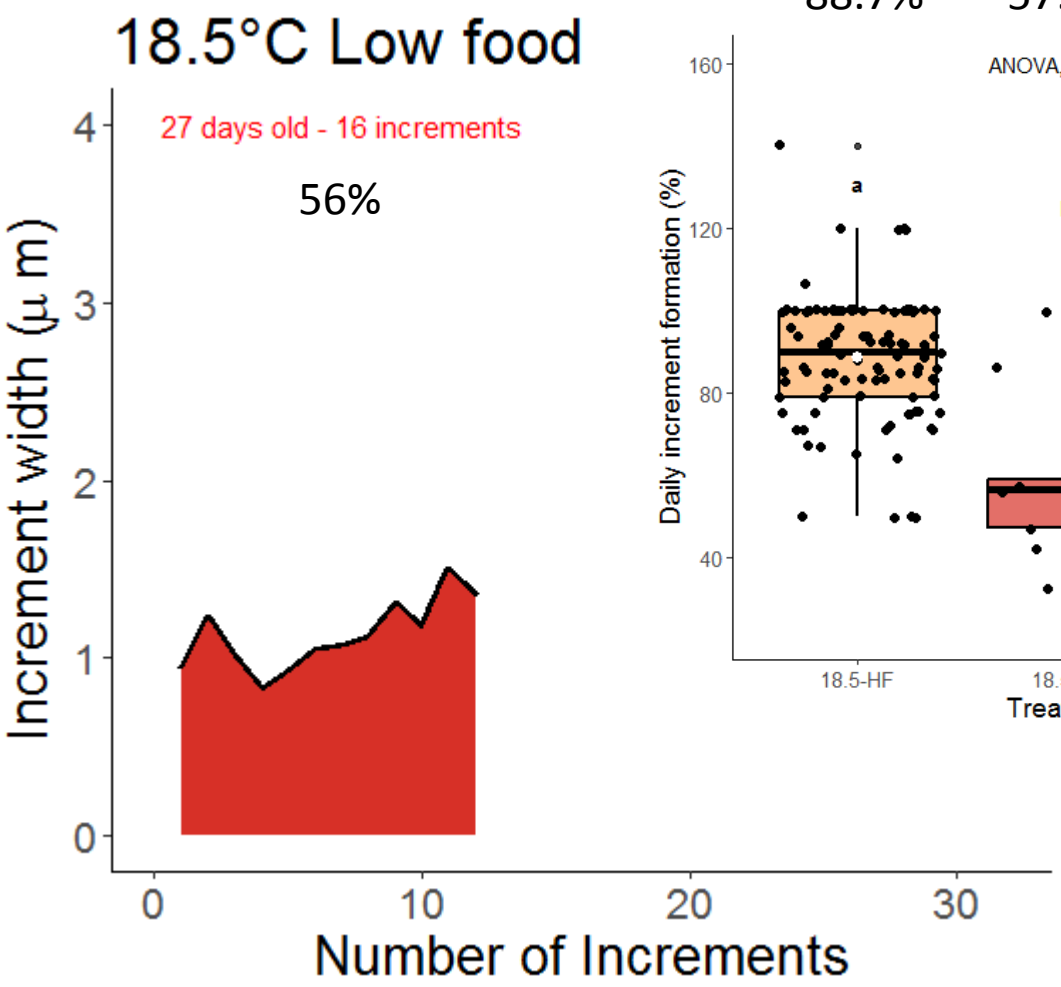


Ofelio et al. *Sci Rep* submitted

Age well depicted in otoliths from well feed larvae

Age: Number of increments +3





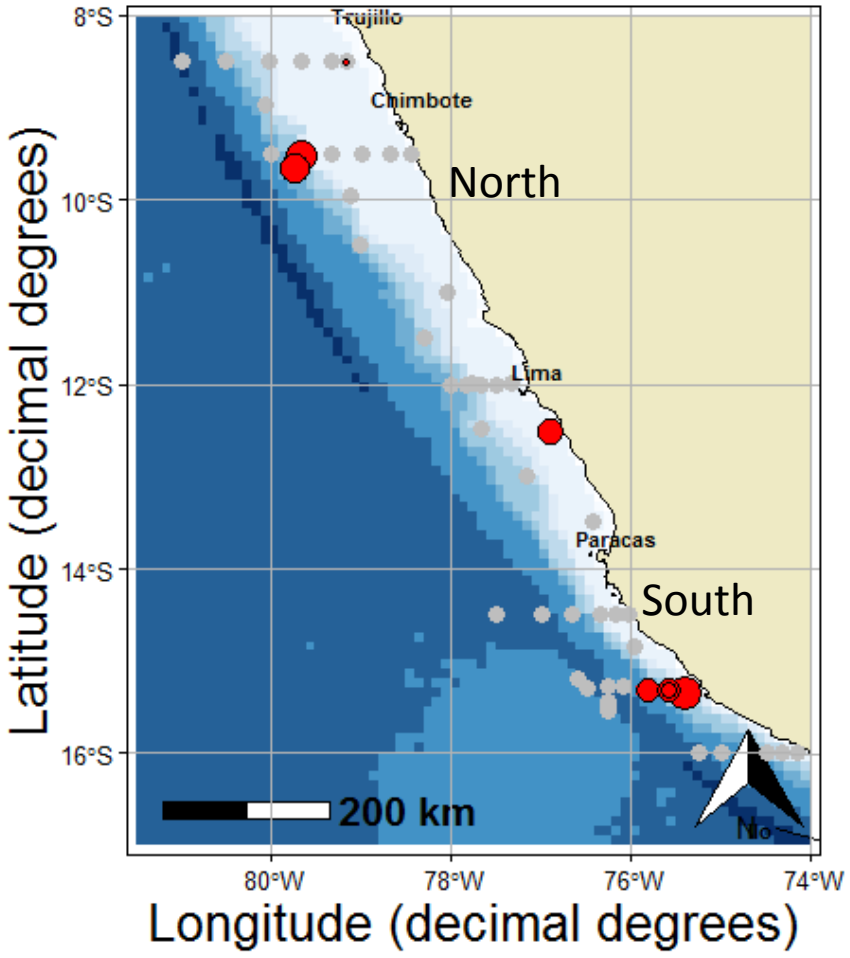
88.7% 57.3% 48.7%

Sampling stations - Research cruise

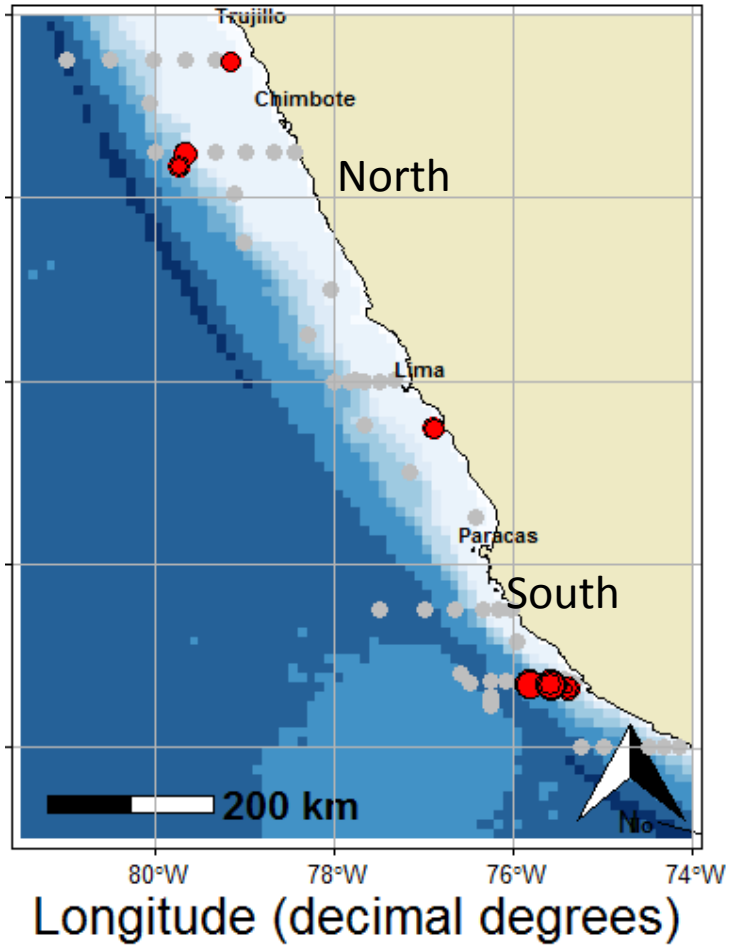
Temperature 13-24°C

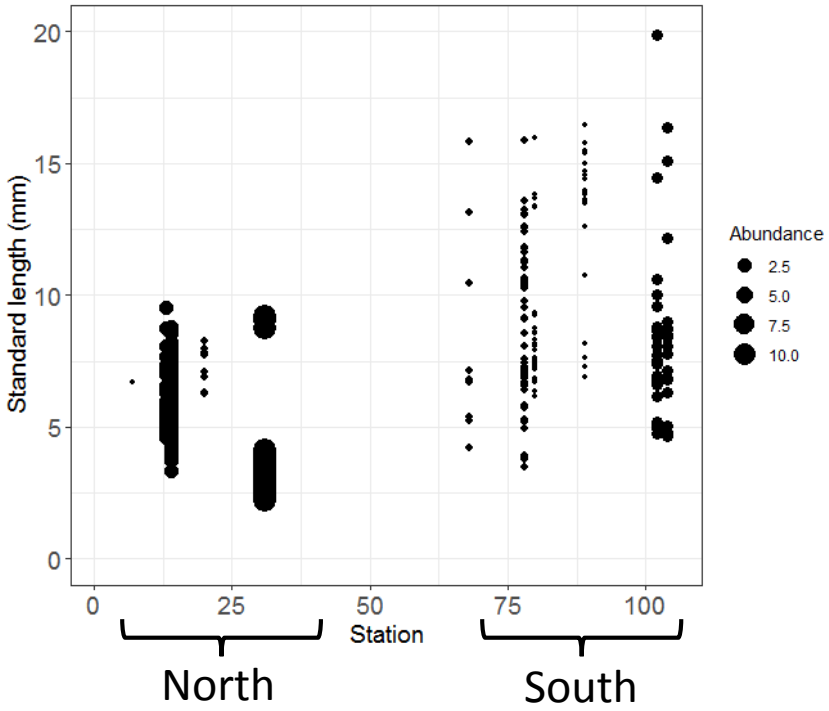
December 20th, 2019 –January 31st, 2020

Abundance m^3



Standard length mm



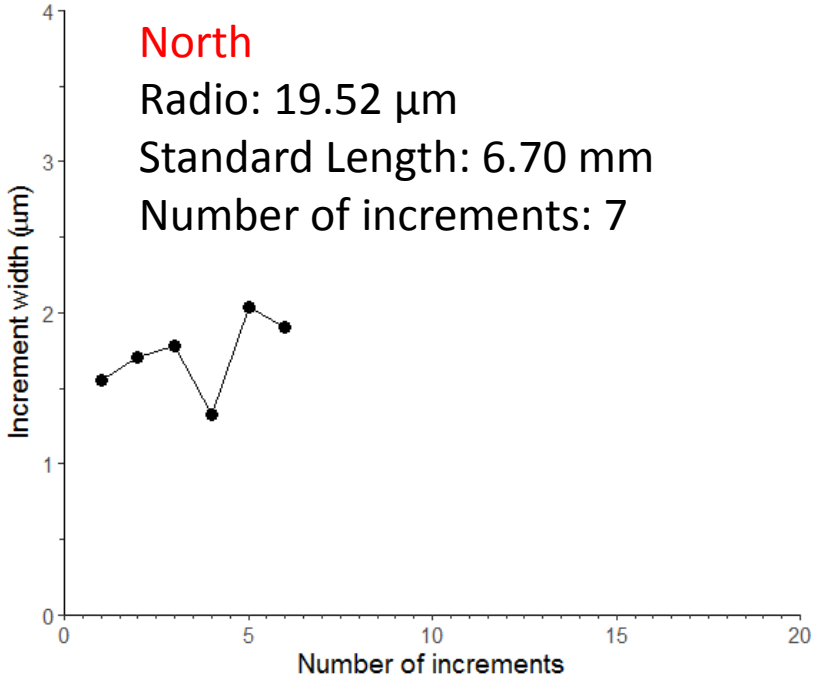


North

Radio: 19.52 µm

Standard Length: 6.70 mm

Number of increments: 7

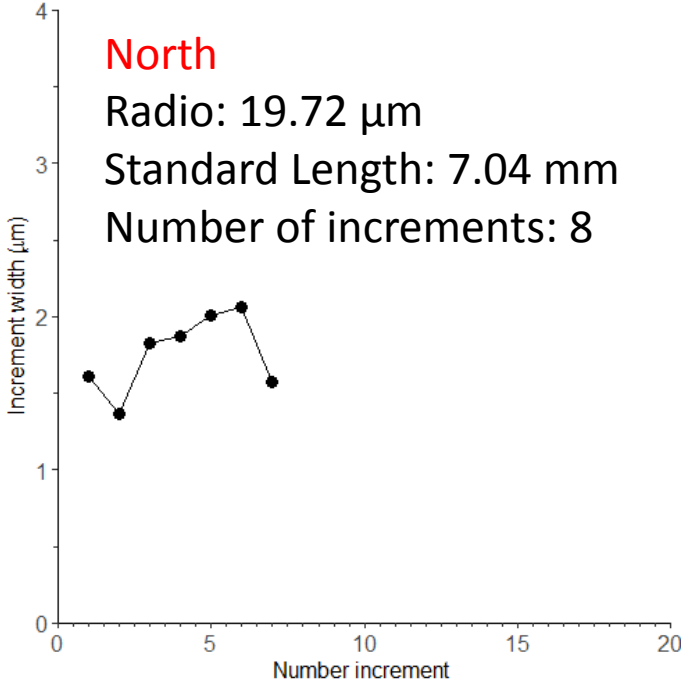


North

Radio: 19.72 µm

Standard Length: 7.04 mm

Number of increments: 8

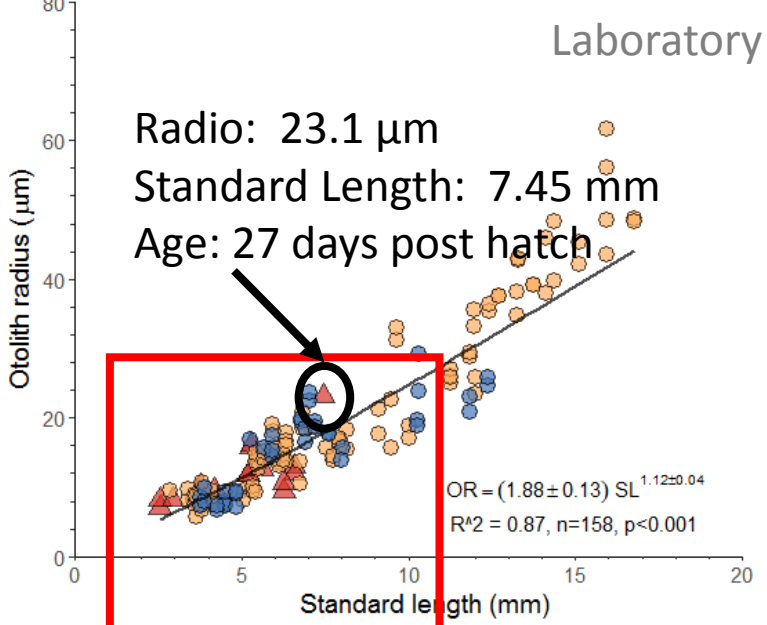


Laboratory

Radio: 23.1 µm

Standard Length: 7.45 mm

Age: 27 days post hatch

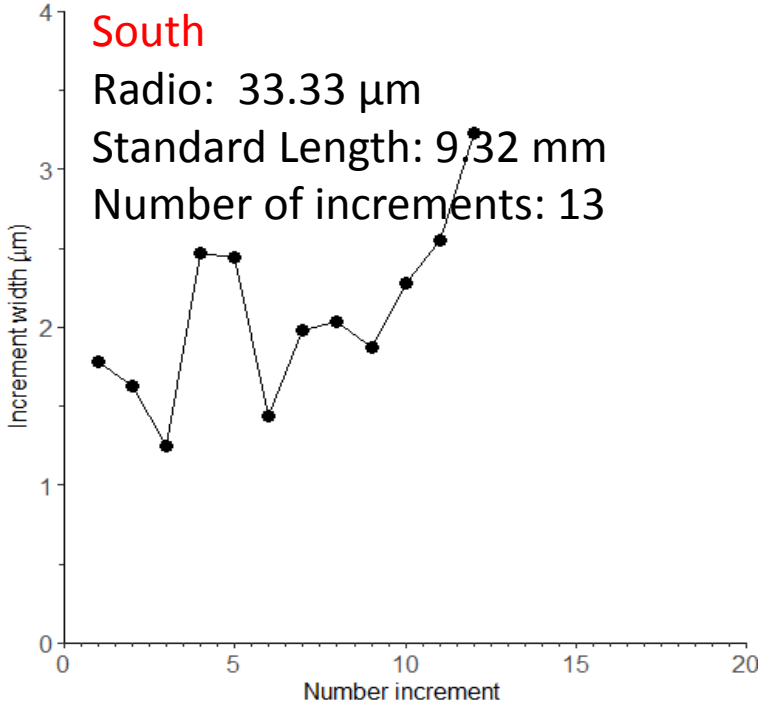


South

Radio: 33.33 µm

Standard Length: 9.32 mm

Number of increments: 13

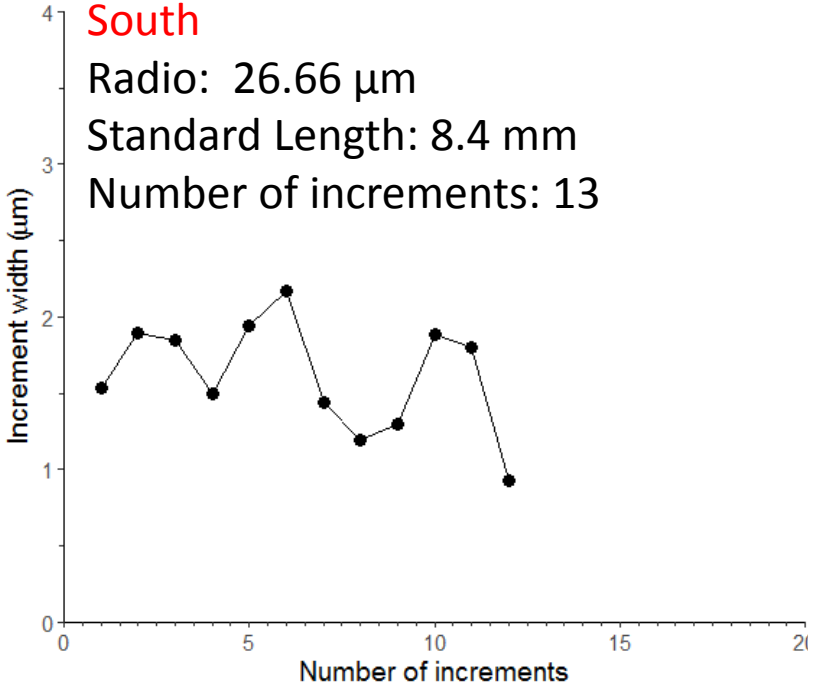


South

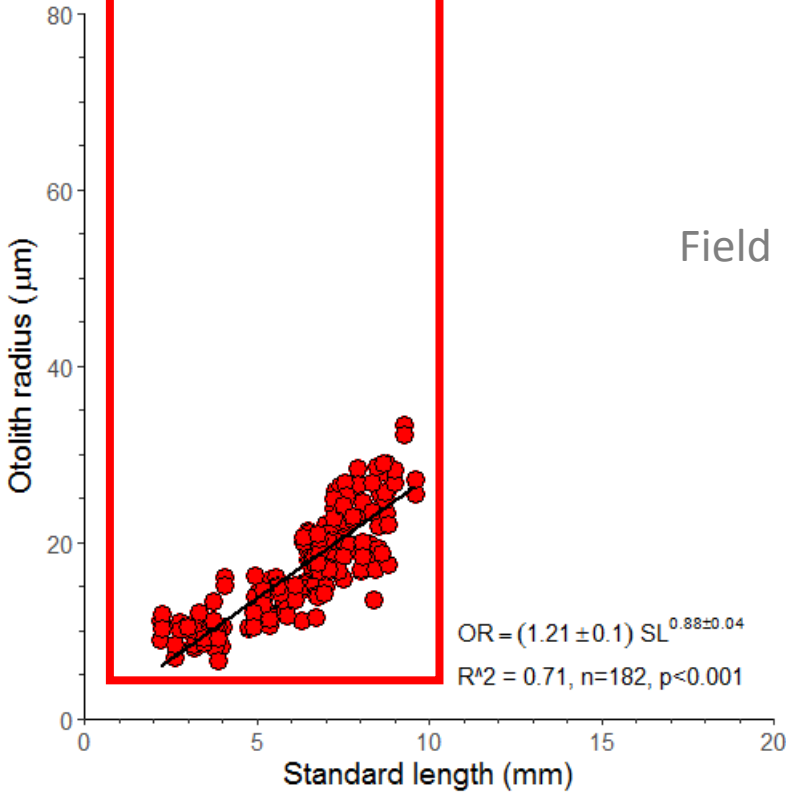
Radio: 26.66 µm

Standard Length: 8.4 mm

Number of increments: 13



Field

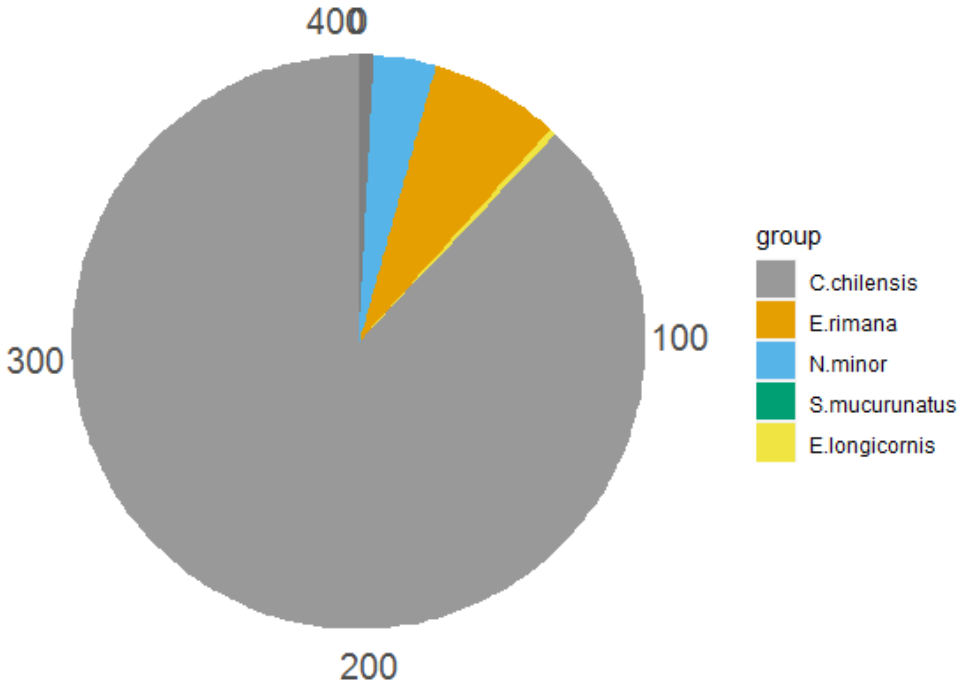


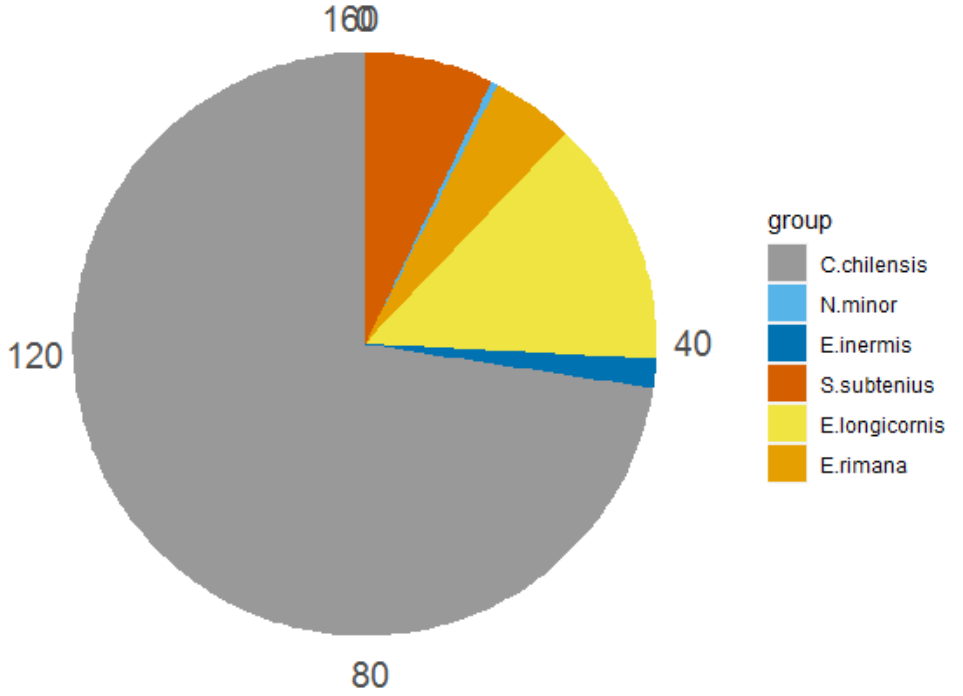
Zooplankton abundance m^{-3}

Calanus chilensis

Depth: 0-50 m
Size: PL 1.9 mm
Total Lipids (%DM): 16.3±5.7
EPA (%TFA): 14.0±1.2
DHA (%TFA):33.1±0.6

North

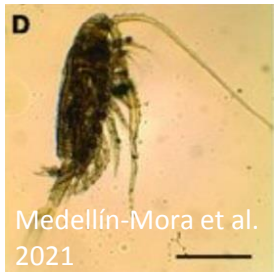




Massing et al. 2022

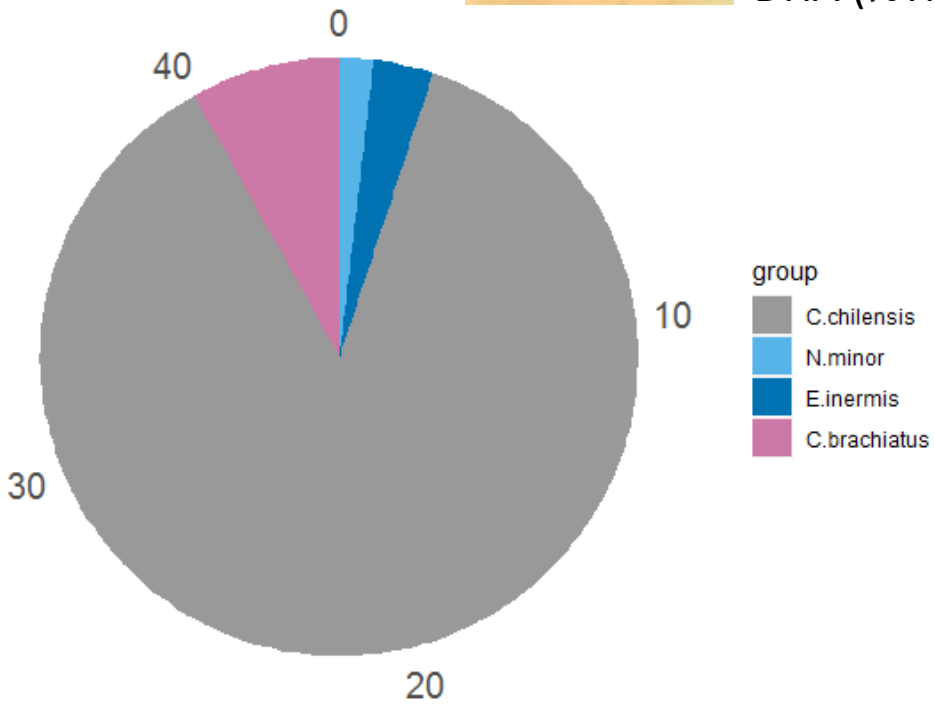
Zooplankton abundance m^{-3}

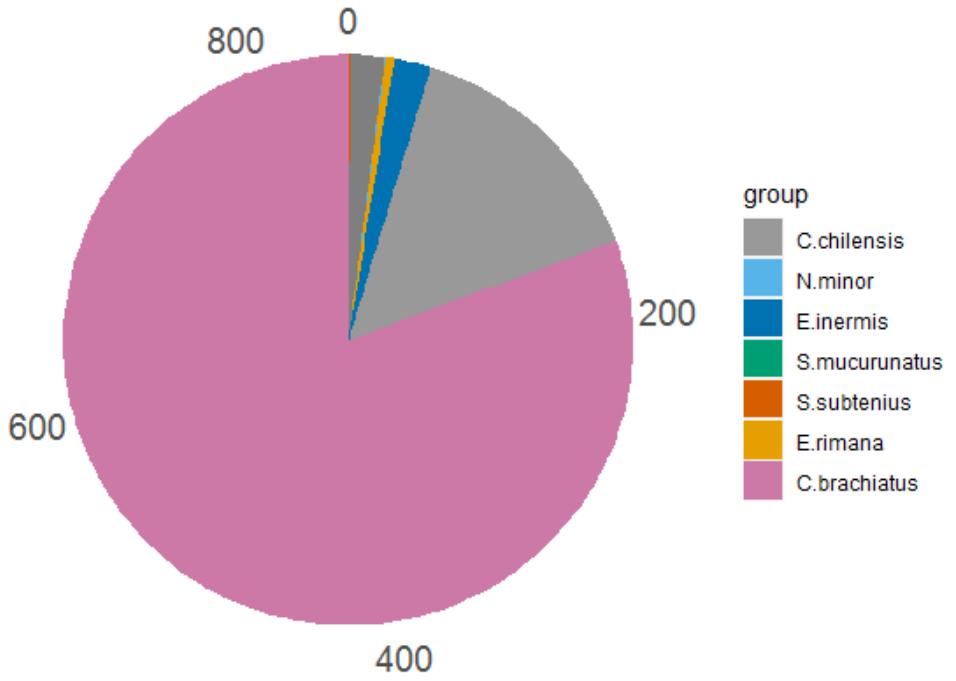
Centropages brachiatus



Depth: 0-50 m
Size: PL 1-1.5 mm
Total Lipids (%DM): 12.8±6.0
EPA (%TFA): 19.8±0.9
DHA (%TFA):38.5±1.6

South





Massing et al. 2022

Summary

- **Higher growth rates** in laboratory-reared larvae were promoted by **warmer temperature** and **high food**
- **Prey concentration** is the most important driving factor for **larval growth**
- Under **unfavourable** conditions the **otolith** formation can be **altered**
- Larvae from the **field** grow **slowly**, fish collected in the the wild could be older than estimated
- Differences in **zooplankton** community may explain differences in larval **growth and abundance**
- Results from **mesocosms** experiments in progress

Thank you for your attention!

Bundesministerium
für Bildung
und Forschung

Projektträger Jülich
Forschungszentrum Jülich

CUSCO

claudia.ofelio@uni-hamburg.de