Contribution of a bioenergetics model to investigate on growth and survival of European seabass in the Northeast Atlantic

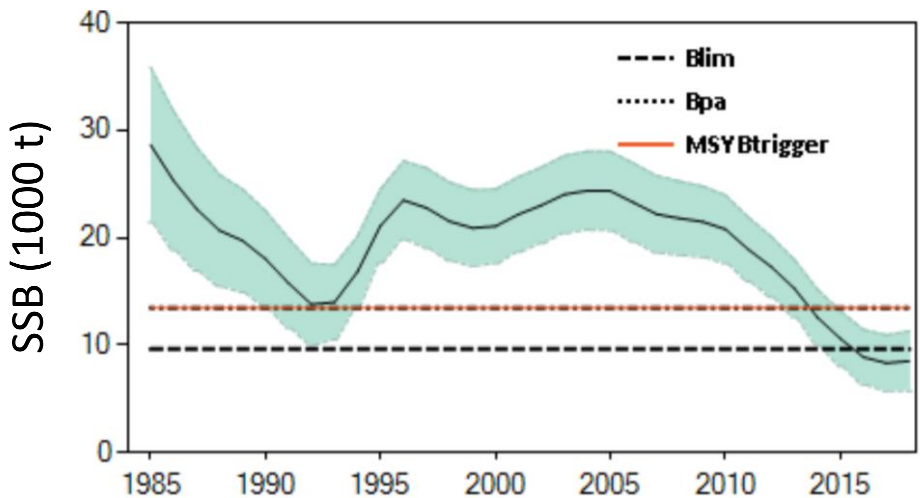
Chloé Dambrine, Martin Huret, Mathieu Woillez,
Laure Pecquerie, Romain Lopez, Hélène de Pontual

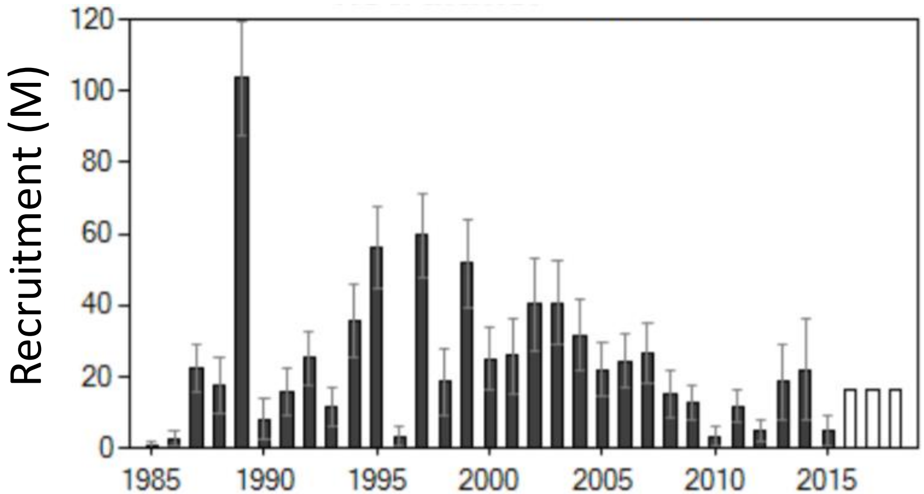
April 2019, Brest, France

Outline

- Introduction
- Model development
- Starvation ability of early life stages
- Impact of temperature and food on growth of early life stages
- Conclusion

Why working on *European seabass* ?





ICES, 2018

Worrying state of the ICES « Northern stock » (since 2013)

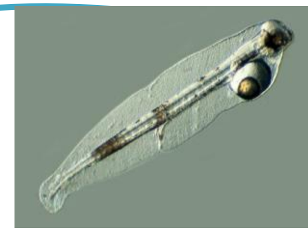
➔ European Commission set management measures (since 2015)

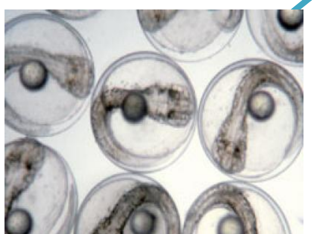
European seabass lifecycle

OFFSHORE

Drift

COAST





NURSERY

SPAWNING AREA

FEEDING AREA

Migration

Needs

BARFRAY

Still a lot of unknown concerning its lifecycle in the wild.

Studies have been carried out to better understand:

- the spatio-temporal structure of the population
- the recruitment process

➔ Would help to define management measures for a sustainable exploitation

Needs

Still a lot of unknown concerning its lifecycle in the wild.

Studies have been carried out to better understand:

- the spatio-temporal structure of the population
- the **recruitment process (e.g. connectivity between spawning areas and nurseries)**

➔ Would help to define management measures for a sustainable exploitation

Modelling seabass lifecycle

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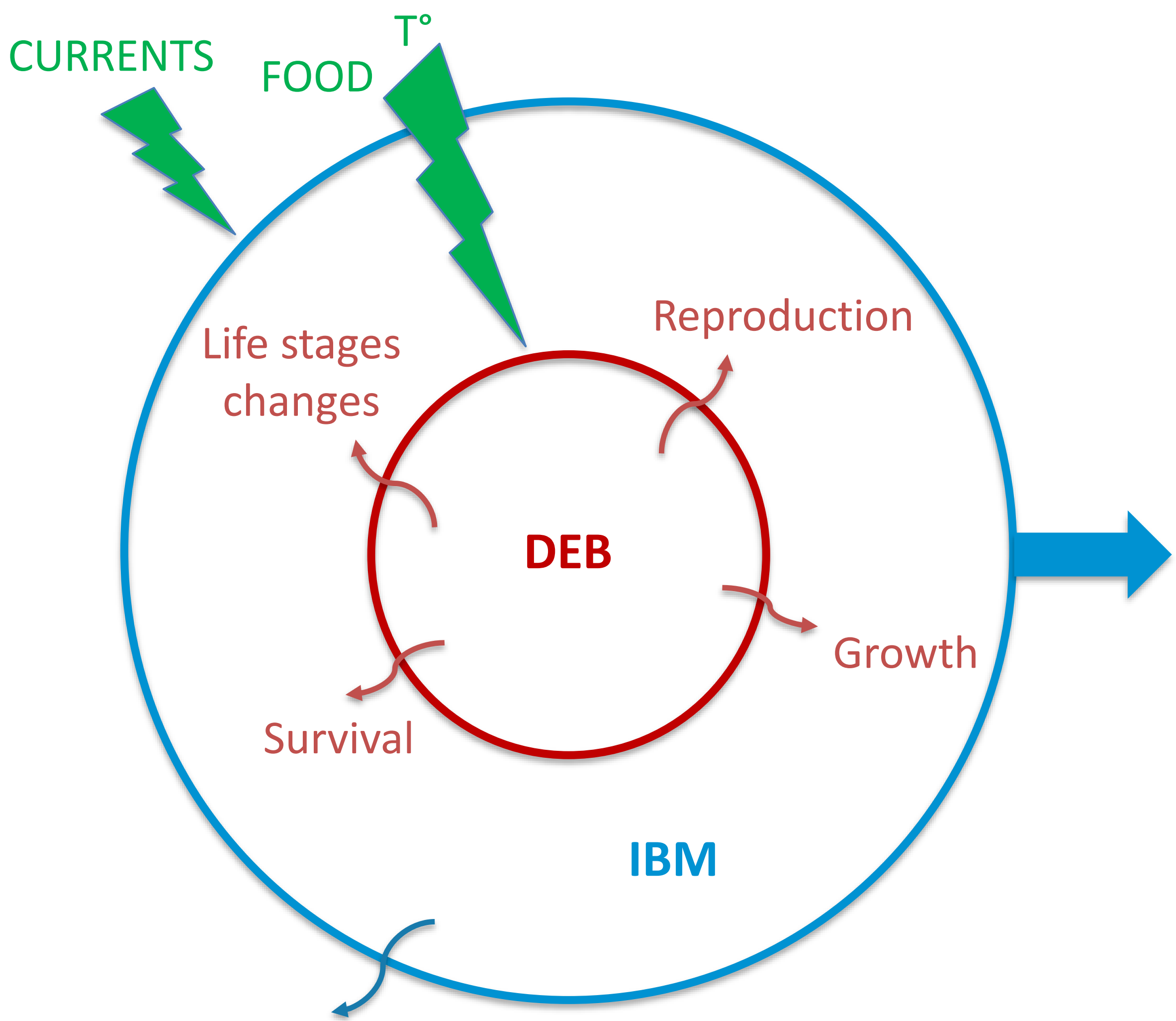

- Life traits and their key drivers
- Population resilience
- Management & conservation strategies

Movements (e.g. connectivity)

ELSEVIER

Journal of Sea Research

Volume 94, November 2014, Pages 37-46

Metabolic acceleration in Mediterranean Perciformes

Konstadia Lika [a], Sebastiaan A.L.M. Kooijman [b], Nikos Papandroulakis [c]

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https://doi.org/10.1016/j.seares.2013.12.012

ELSEVIER

Journal of Sea Research

Volume 143, January 2019, Pages 262-271

A DEB model for European sea bass (*Dicentrarchus labrax*): Parameterisation and application in aquaculture

Orestis Stavrakidis-Zachou [a, b], Nikos Papandroulakis [a], Konstadia Lika [b]

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https://doi.org/10.1016/j.seares.2018.05.008

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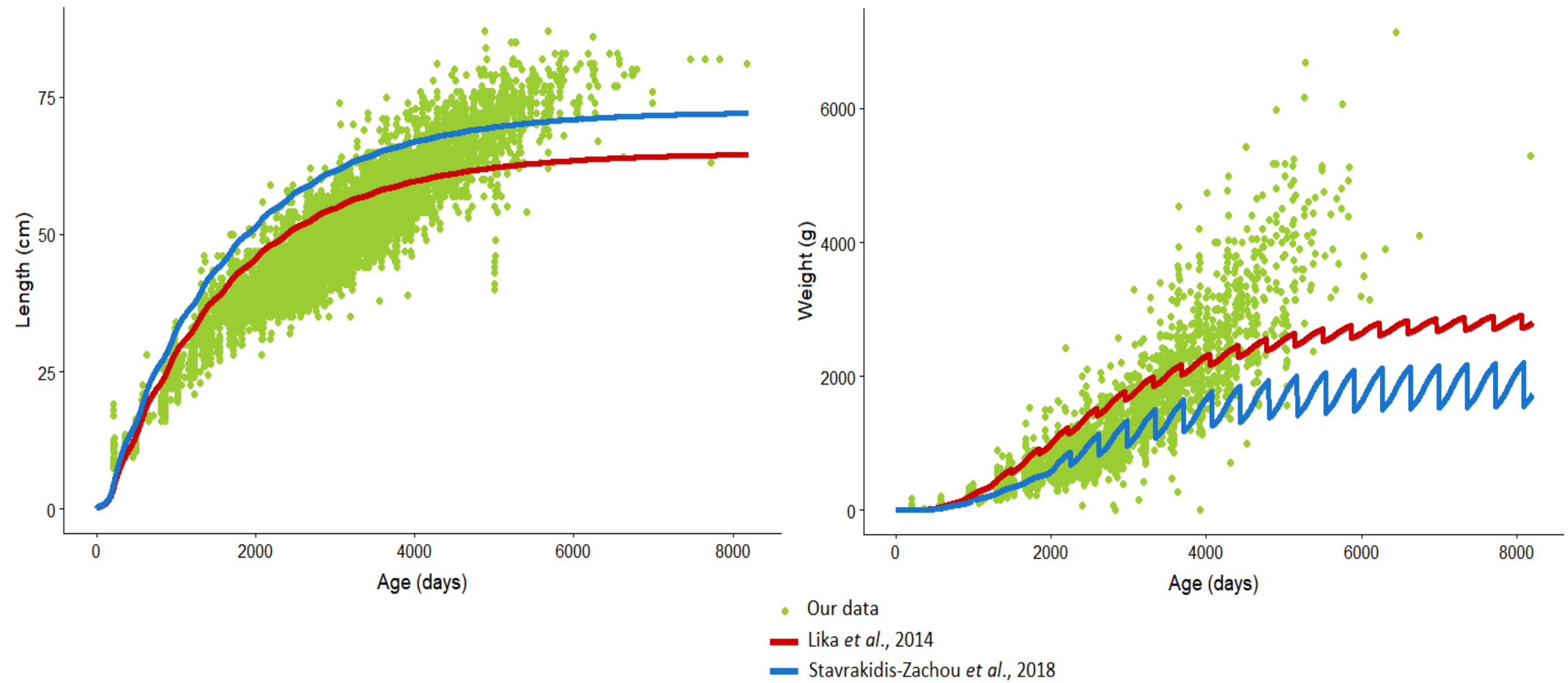
Journal of Sea Research
Volume 94, November 2014, Pages 37-46



aquaculture

Orestis Stavrakidis-Zachou [a, b], Nikos Papandroulakis [a], Konstadia Lika [b]

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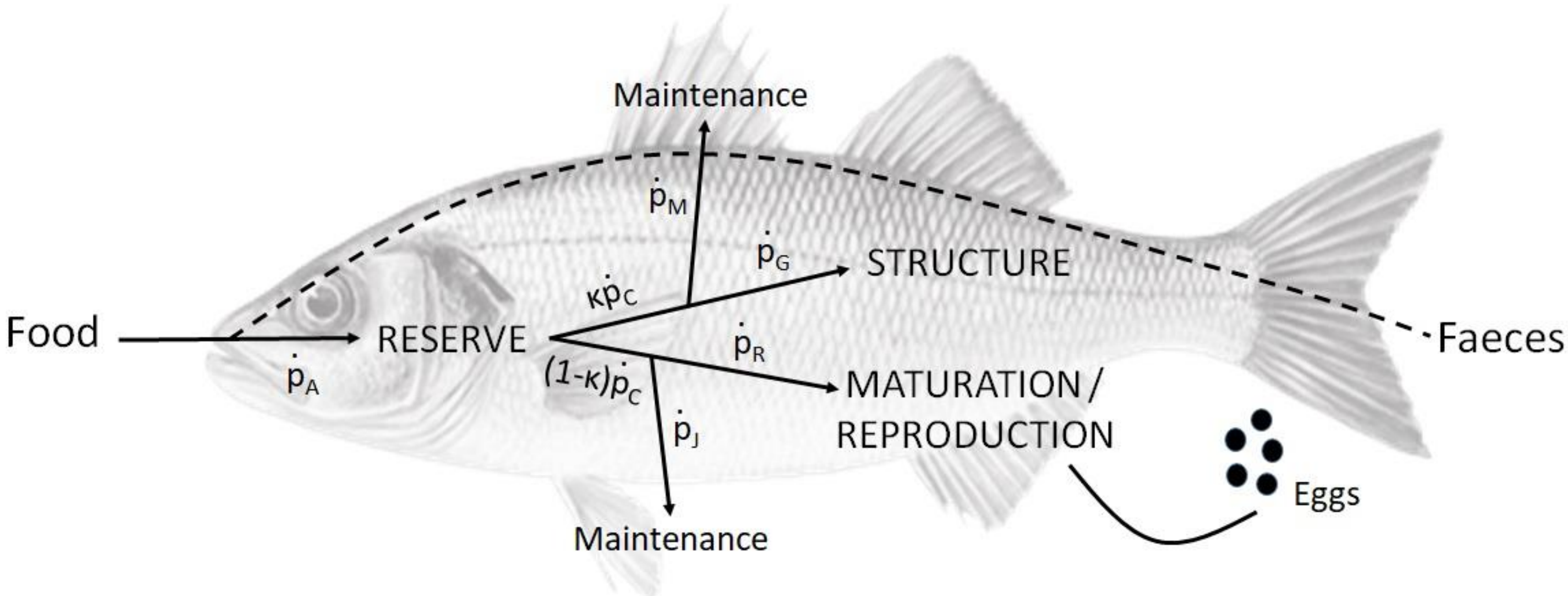
https://doi.org/10.1016/j.seares.2018.05.008

Model



- Egg – Non feeding larvae – Feeding larvae – Juveniles – Adults
- Acceleration of growth for larvae
- Reproduction between January and May
- At the end of the reproduction season, $E_R = 0$

Calibration

14 parameters: κ, $\{\dot{p}_{Am}\}, \dot{v}, [\dot{p}_M], [EG], E_H^h, E_H^b, E_H^j, E_H^p, \delta_{Mb}, \delta_{Mj}$, TA, TAL, f

Covariance Matrix Adaptation Evolution Strategies (see e.g. Gatti *et al.*, 2017)

$$Fcost = \sum_{i}^{stages} \sum_{j}^{variables} \frac{1}{n_{obs\ i,j}} \sum_{k}^{n_{obs\ i,j}} \left(\frac{x_{i,j,k} - y_{i,j,k}}{\sigma_{obs\ i,j}}\right)^2 + \sum_{l}^{thresholds} \left(\frac{x_l - z_l}{\sigma}\right)^2$$

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4 maturity thresholds

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4 maturity thresholds

Stage « threshold »	Size (cm)
Hatching	0.3 (Regner & Dulcic, 1993)
Mouth openning	0.6 (Kennedy & Fitzmaurice, 1972)
Metamorphosis	2 (Barnabé, 1990)
Maturity	42 (Drogou *et al.*, 2017)

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Datasets

AQUACULTURE

Length and weight data from 7 to 1600 days at 15°C

T = 15°C
f = 1 (ad libitum)

WILD

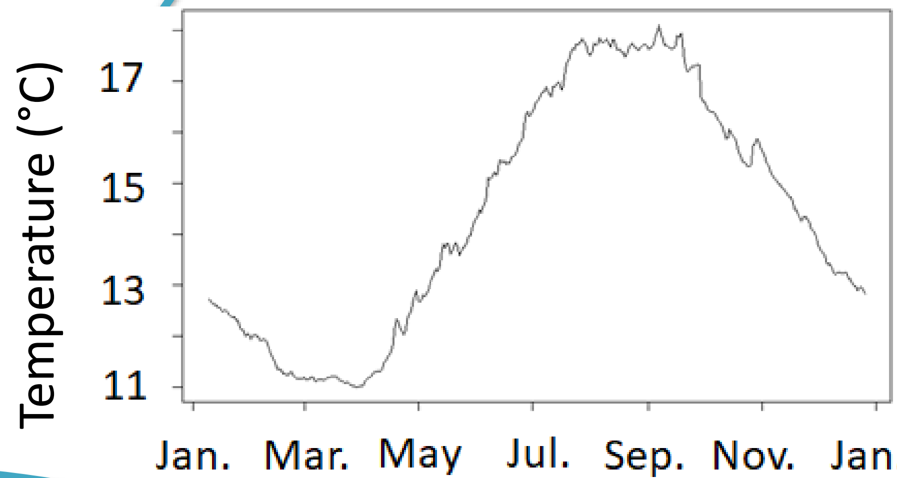
Length and weight data from 6 months to 22 years from surveys and fish markets

T = mean per days from tagged seabass
f = ? (calibrated)

AQUACULTURE

Length and weight data from 7 to 250 days at 20°C

T = 20°C
f = 1 (ad libitum)



$$Fcost = \sum_{i}^{stages} \sum_{j}^{variables} \frac{1}{n_{obs\ i,j}} \sum_{k}^{n_{obs\ i,j}} \left(\frac{x_{i,j,k} - y_{i,j,k}}{\sigma_{obs\ i,j}} \right)^2 + \sum_{l}^{thresholds} \left(\frac{x_l - z_l}{\sigma} \right)^2$$

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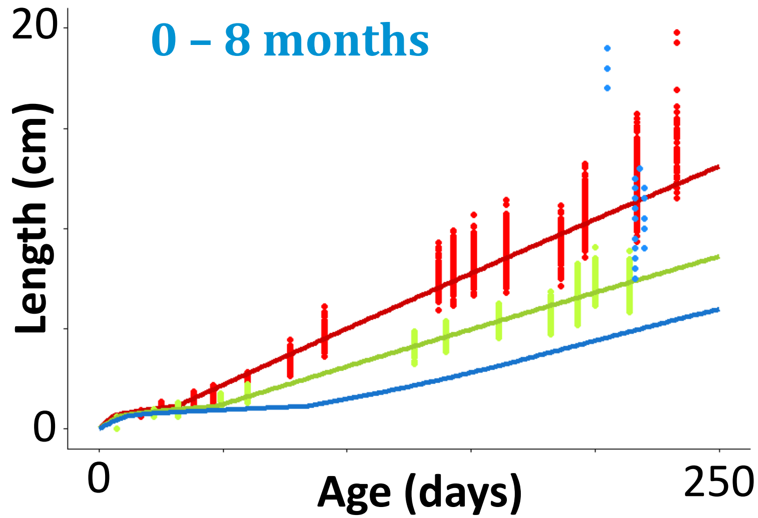
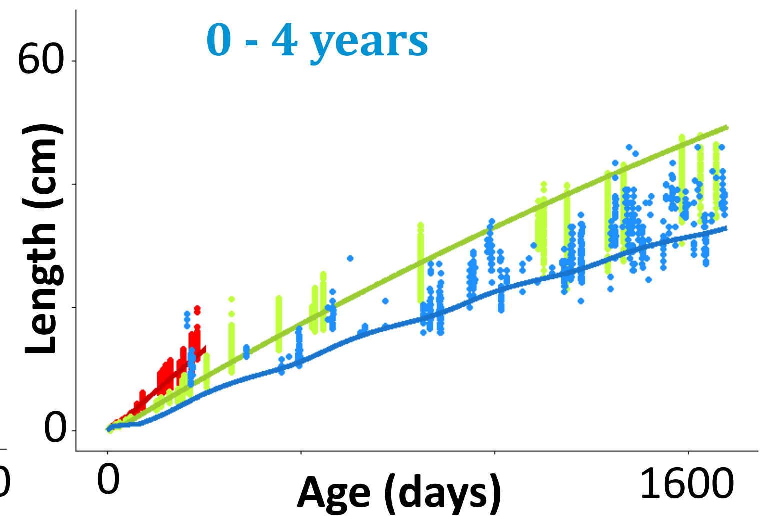
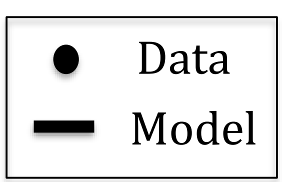
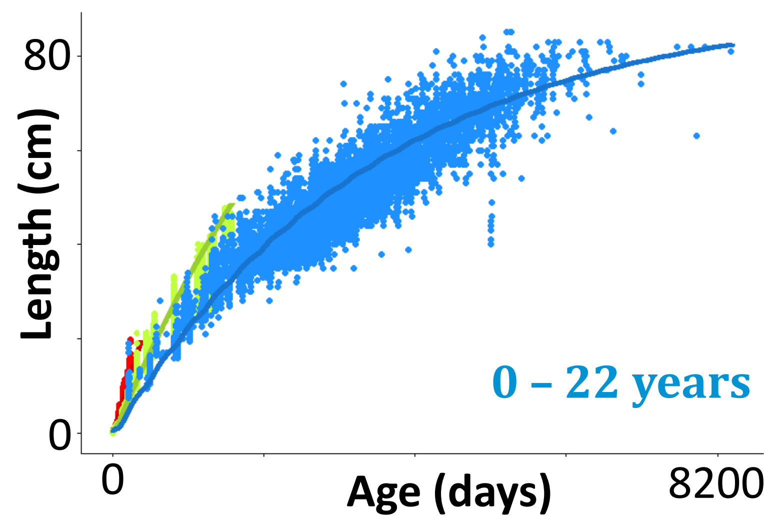
Fitting the length









Fitting the weight

AQUACULTURE

Length and weight data from 7 to 250 days at 20°C

T = 20°C
f = 1 (ad libitum)

AQUACULTURE

Length and weight data from 7 to 1600 days at 15°C

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f = 1 (ad libitum)

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Length and weight data from 6 months to 22 years from surveys and fish markets

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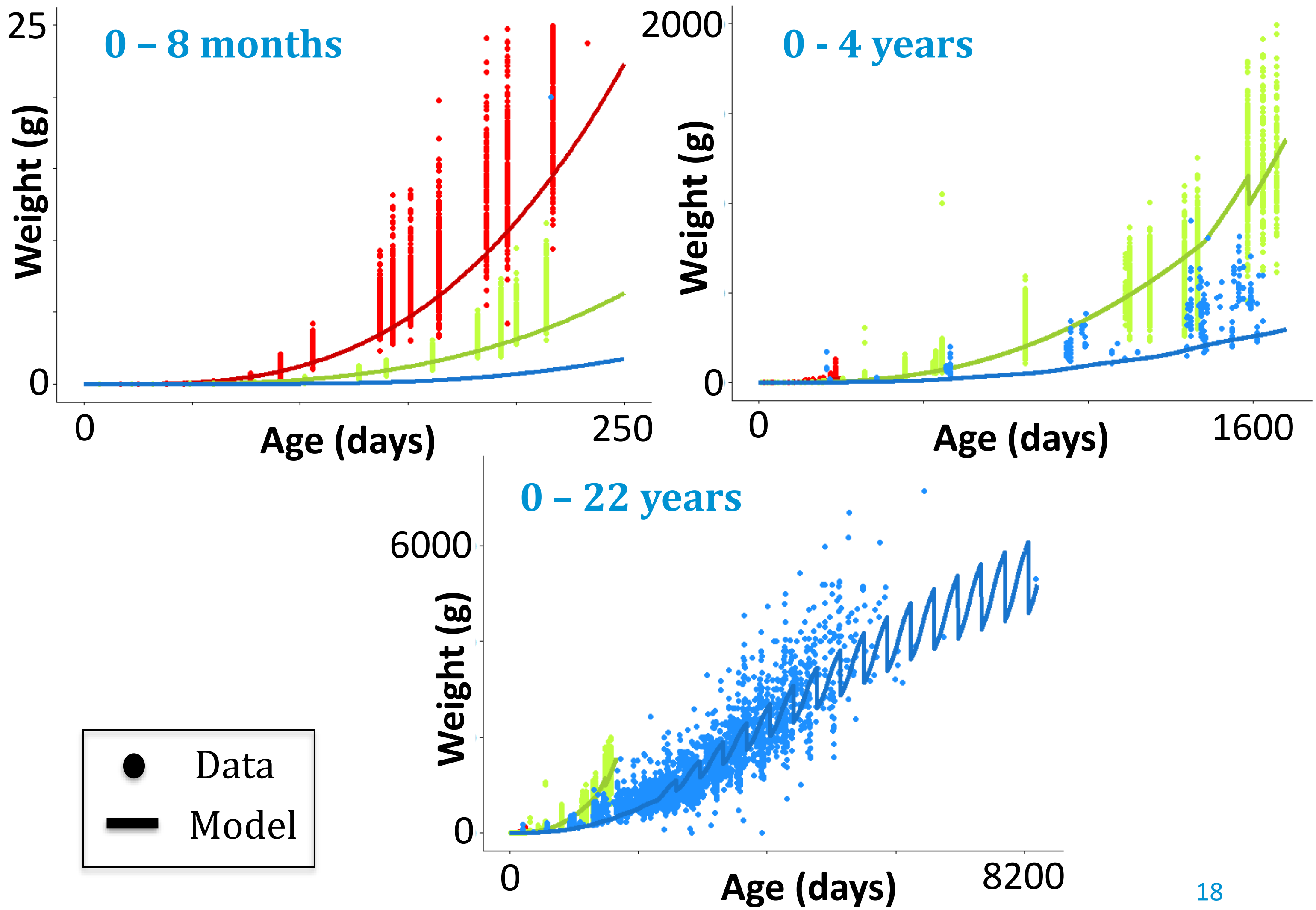
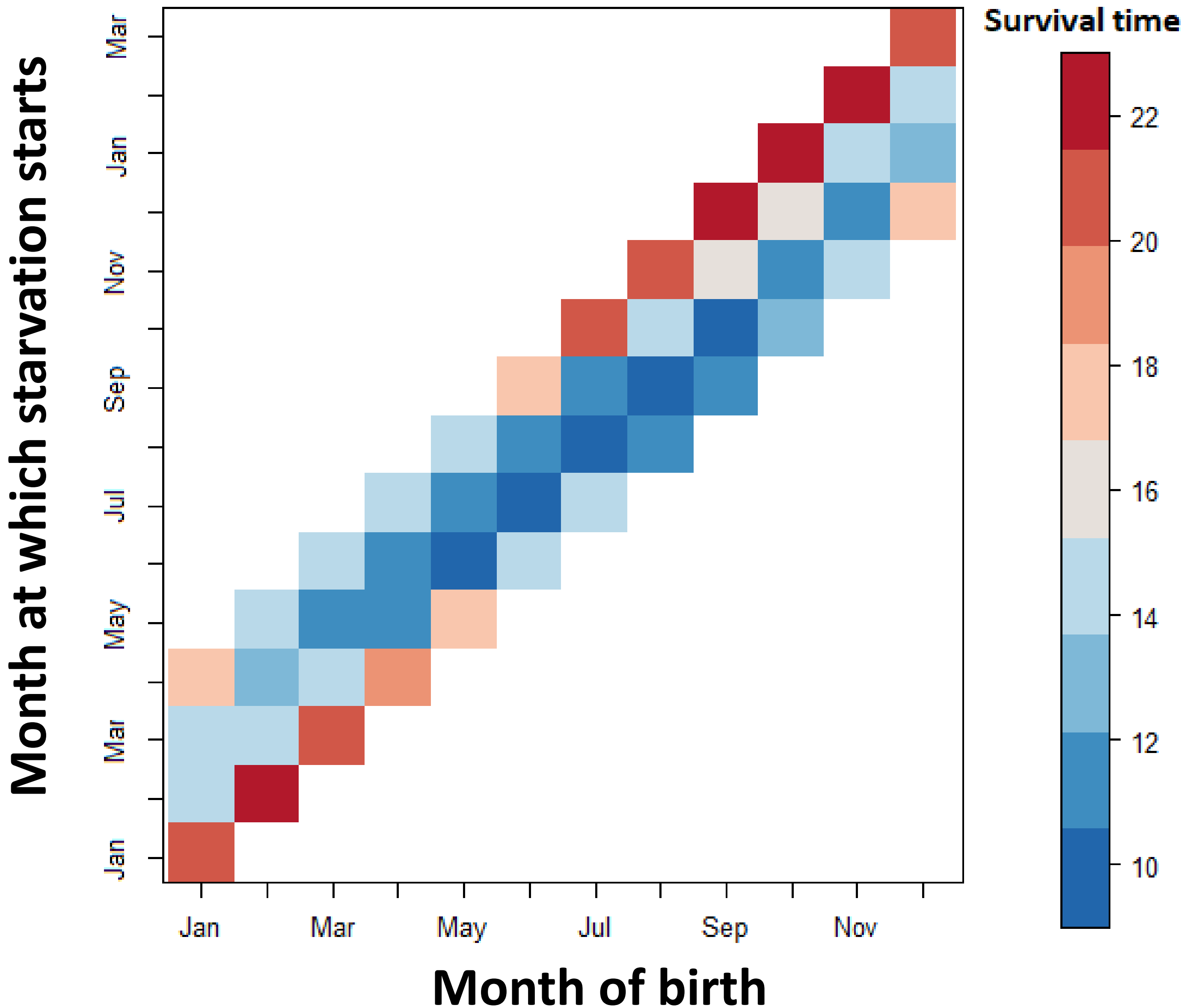


Young seabass facing starvation



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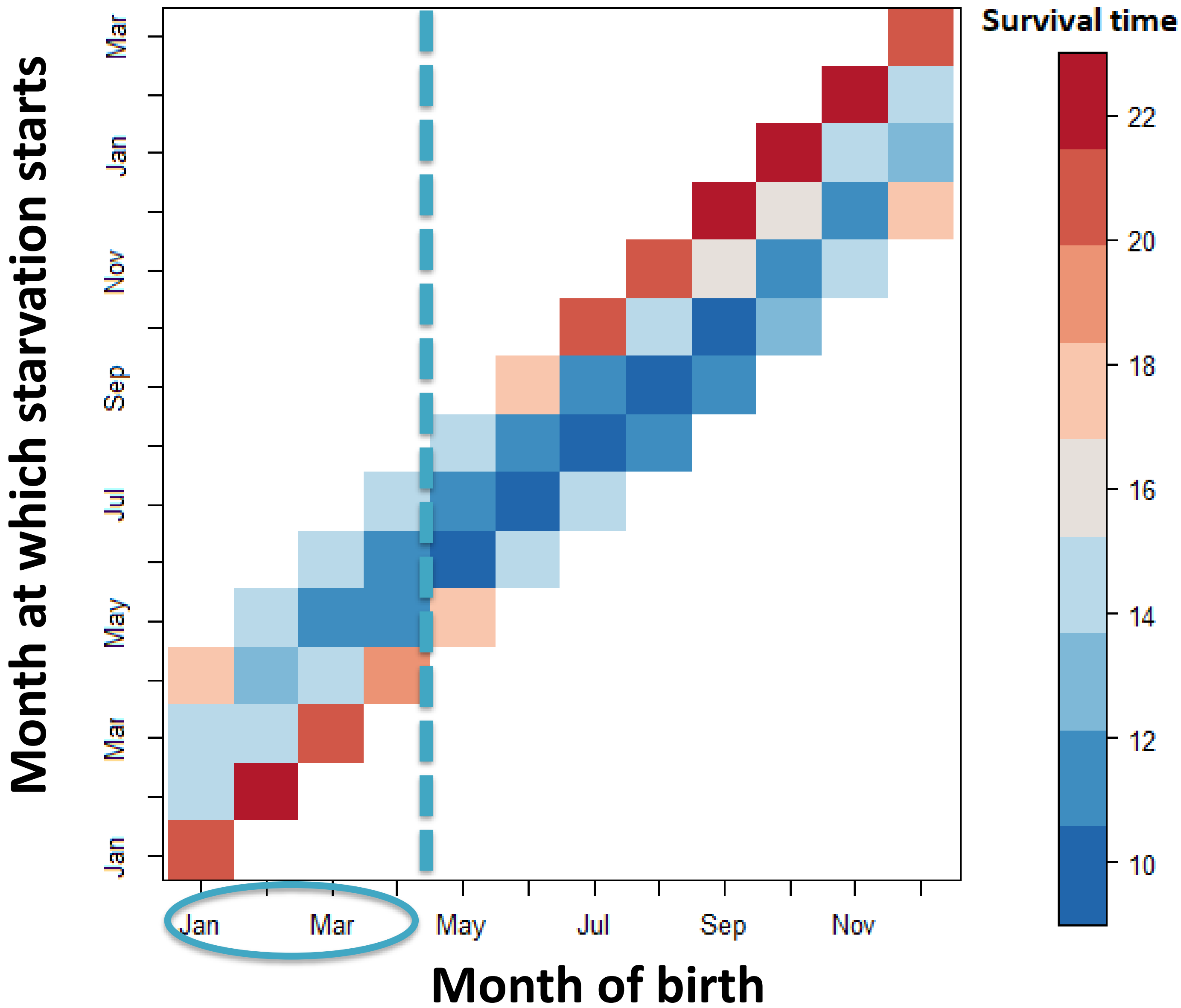
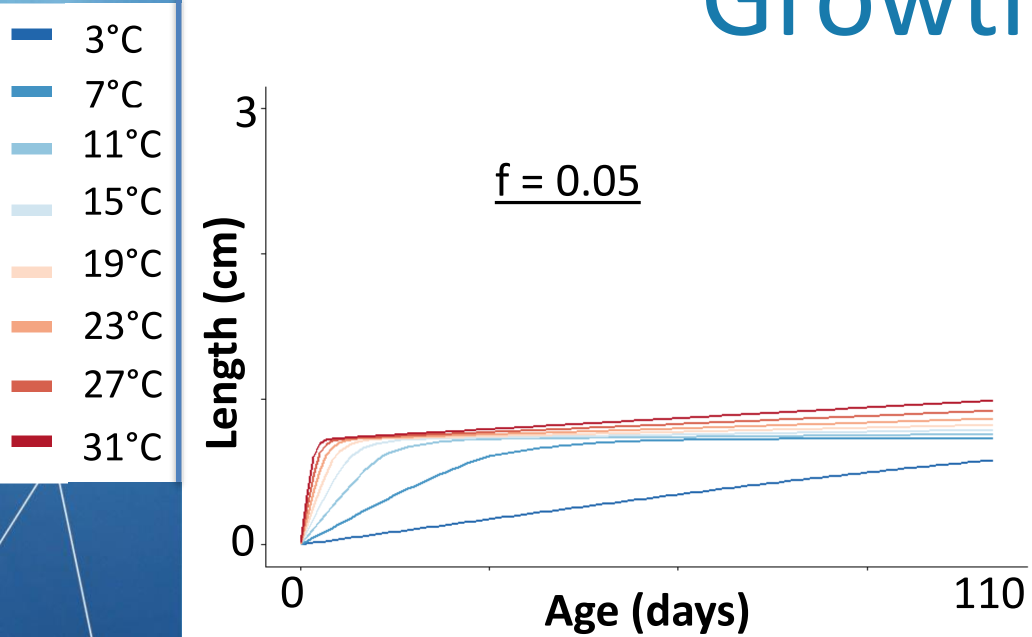
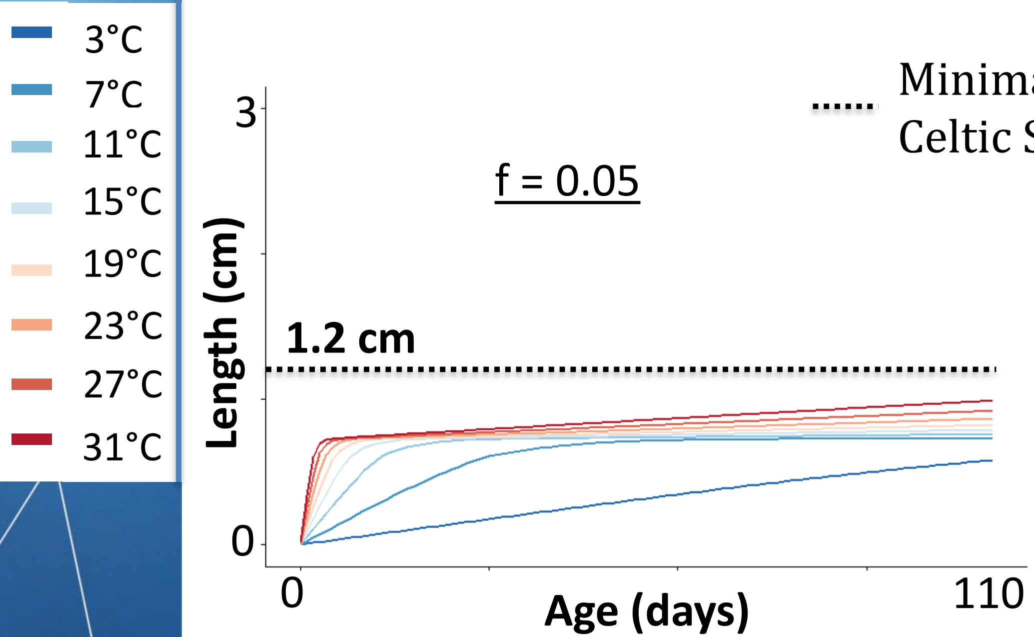
Young seabass facing starvation



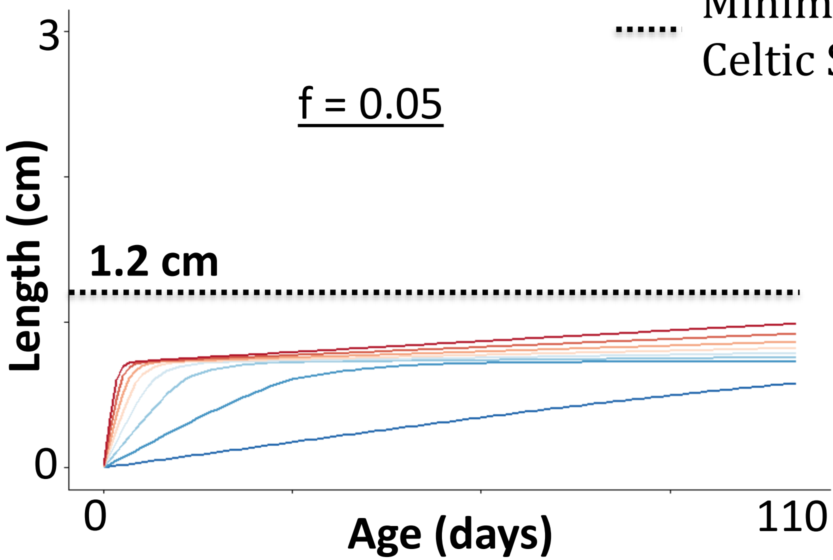
Growth with T & f





Minimal length observed in Bristol Channel and Celtic Sea nurseries (Jennings & Pawson, 1992)

- 3°C
- 7°C
- 11°C
- 15°C
- 19°C
- 23°C
- 27°C
- 31°C



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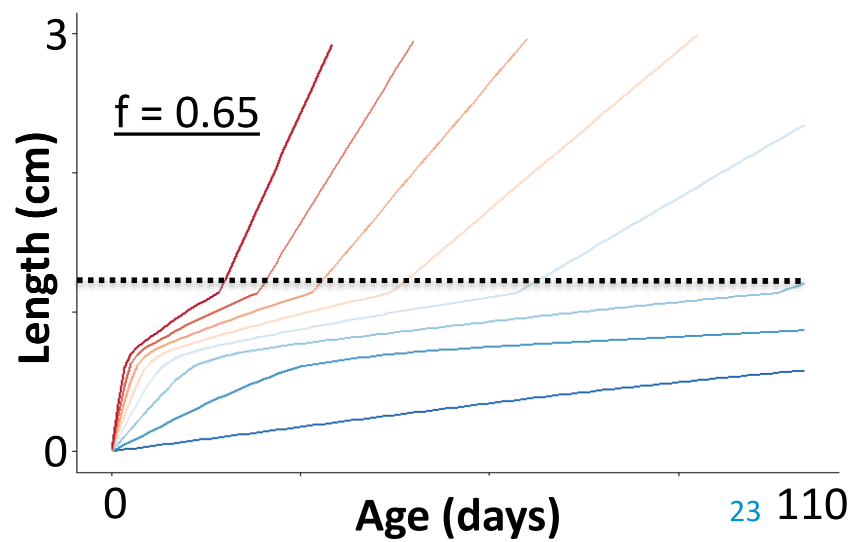


3°C
7°C
11°C
15°C
19°C
23°C
27°C
31°C
Minimal length observed in Bristol Channel and Celtic Sea nurseries (Jennings & Pawson, 1992)
f = 0.05
1.2 cm
Length (cm)
3
0
0
110
Age (days)
f = 0.25
Length (cm)
3
0
0
110
Age (days)
f = 0.65
Length (cm)
3
0
0
110
Age (days)

Take home messages

- First DEB model calibrated for **wild** Atlantic *European seabass*
- Young life stages **adapted** for a drift in winter but **need** food on nurseries
- **Rising temperatures** help to survive **low level of food**
- Useful tool to study the **connectivity between spawning areas and nurseries**

  (on going work)

Chloe.Dambrine@ifremer.fr

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Thanks for your attention!

Any questions?

Fundings:

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