

Physiological and behavioural responses of the European abalone *Haliotis tuberculata* to thermal stress



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**STATION MARINE
CONCARNEAU**



European abalone *Haliotis tuberculata*



- 🐚 In France (Normandy and Brittany):
 - Commercial fisheries (40-45 tons/year)
 - Growing aquaculture (5-7 tons/year)

🌡️ Global warming

⚠️ *Rise in temperature ⇒ threat for abalone aquaculture and fisheries*



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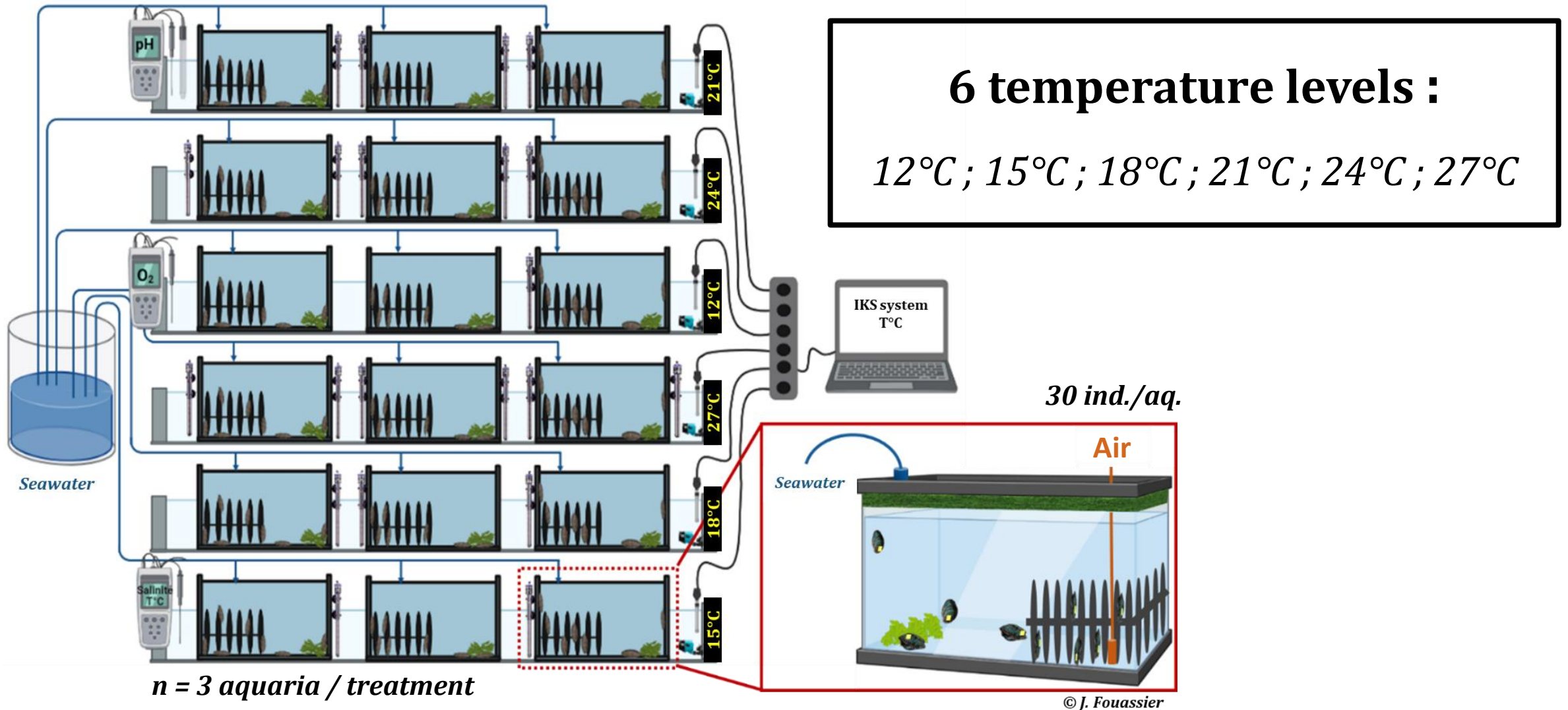
⚠️ *Rise in temperature ⇒ threat for abalone aquaculture and fisheries*



OBJECTIVES :

- *To determine thermal tolerance limits and optima of the European abalone*
- *To better understand thermal stress on abalone physiology and behaviour*

① Experimental set-up



② Experimental design

Habituation
period

(15 days)



Increased T°C
period

+1°C.day⁻¹



Exposure
period

(22 days)



Sampling
Biological
measurements



③ Biological measurements

PHYSIOLOGY

 **Growth**
(shell length)



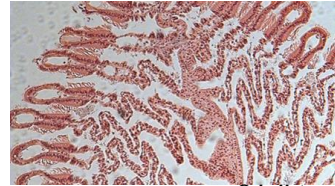
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 **Reproduction**
(gonad index)



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 **Histopathology**
(gill lesions)




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 **Metabolism**
(respiration and excretion)

 **Oxidative stress**

 **Internal acid/base balance**

BEHAVIOUR

 **Feeding**
(feeding rate)



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Ulva sp.

  **Diurnal rhythm**

    **Righting and Sheltering**

③ Biological measurements

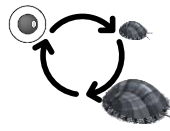
PHYSIOLOGY



Growth
(shell length)



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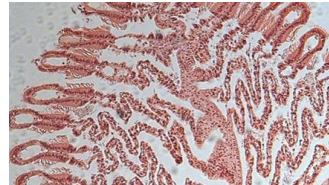
Reproduction
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Histopathology
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Metabolism
(respiration and excretion)



Oxidative stress



Internal acid/base balance

BEHAVIOUR



Feeding
(feeding rate)



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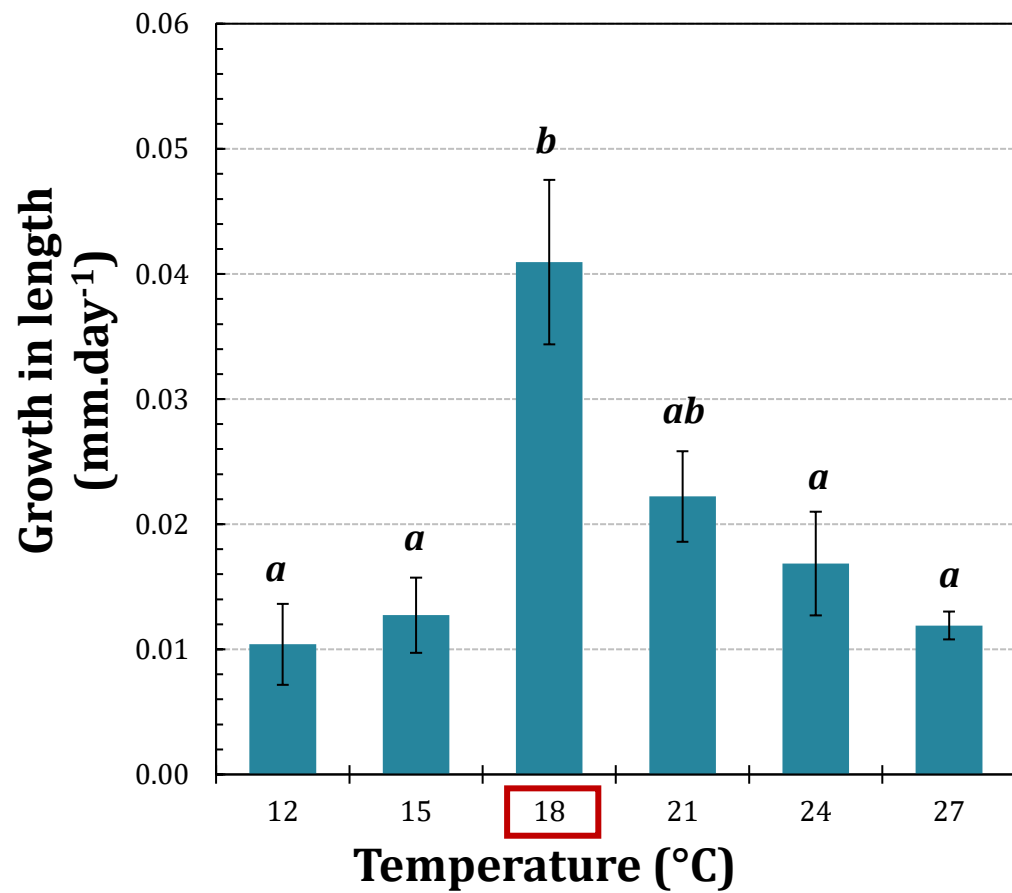
Diurnal rhythm



Righting and Sheltering

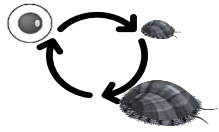


Growth in length

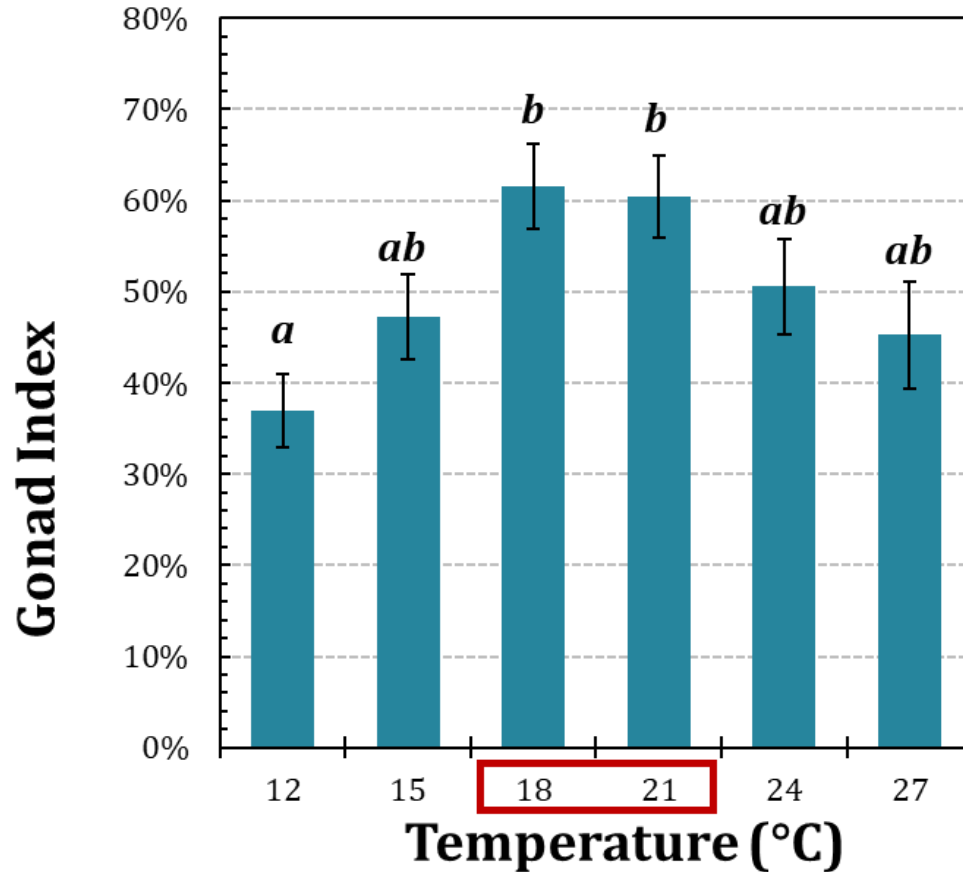


<i>H. midae</i>	20°C	<i>Britz et al. 1997</i>
<i>H. rufescens</i>	18°C	<i>Diaz et al., 2000</i>
<i>H. laevigata</i>	18°C	<i>Gilroy & Edwards, 1998</i>

Optimum growth in length at 18°C



Reproduction



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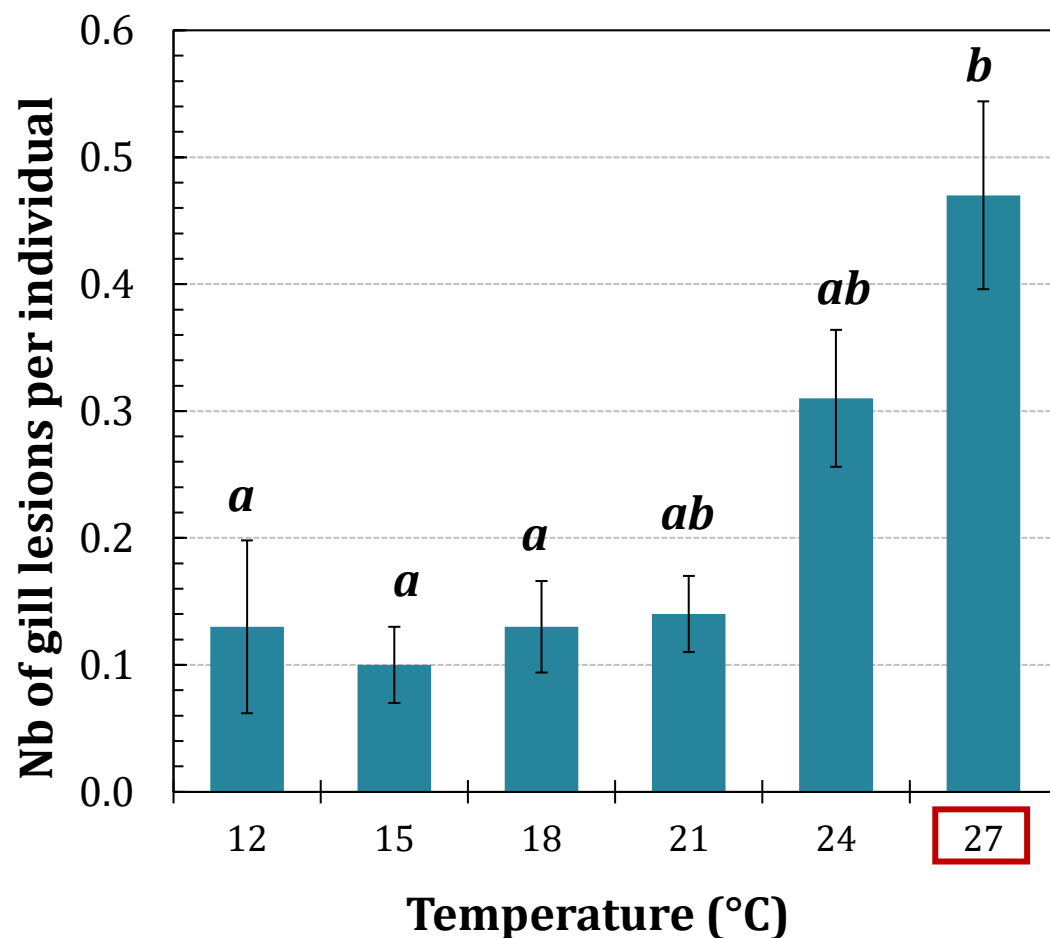
♀ gonad

*High temperatures stop reproduction
in red abalone *H. rufescens*
(Vilchis et al., 2005)*

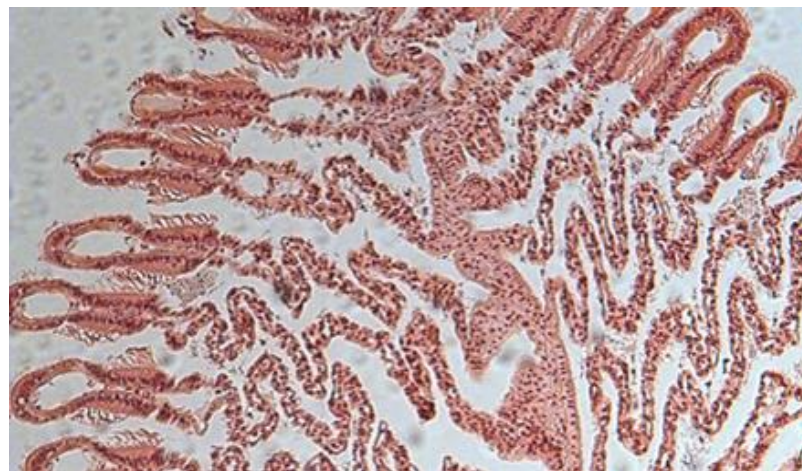
**Maximal gonadal development
at 18 and 21°C**



Histopathology



More gill lesions at 27°C



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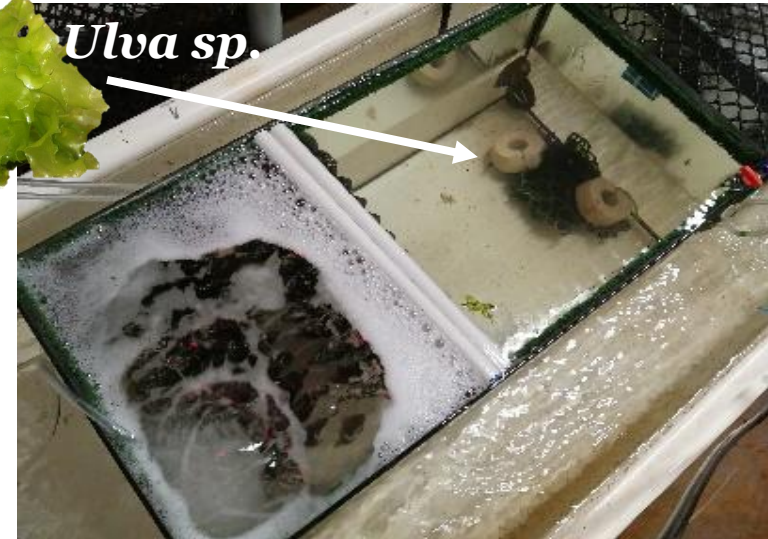
*Similar effect observed in
the hybrid *H. laevigata* x *rubra*
(Hooper et al., 2014)*



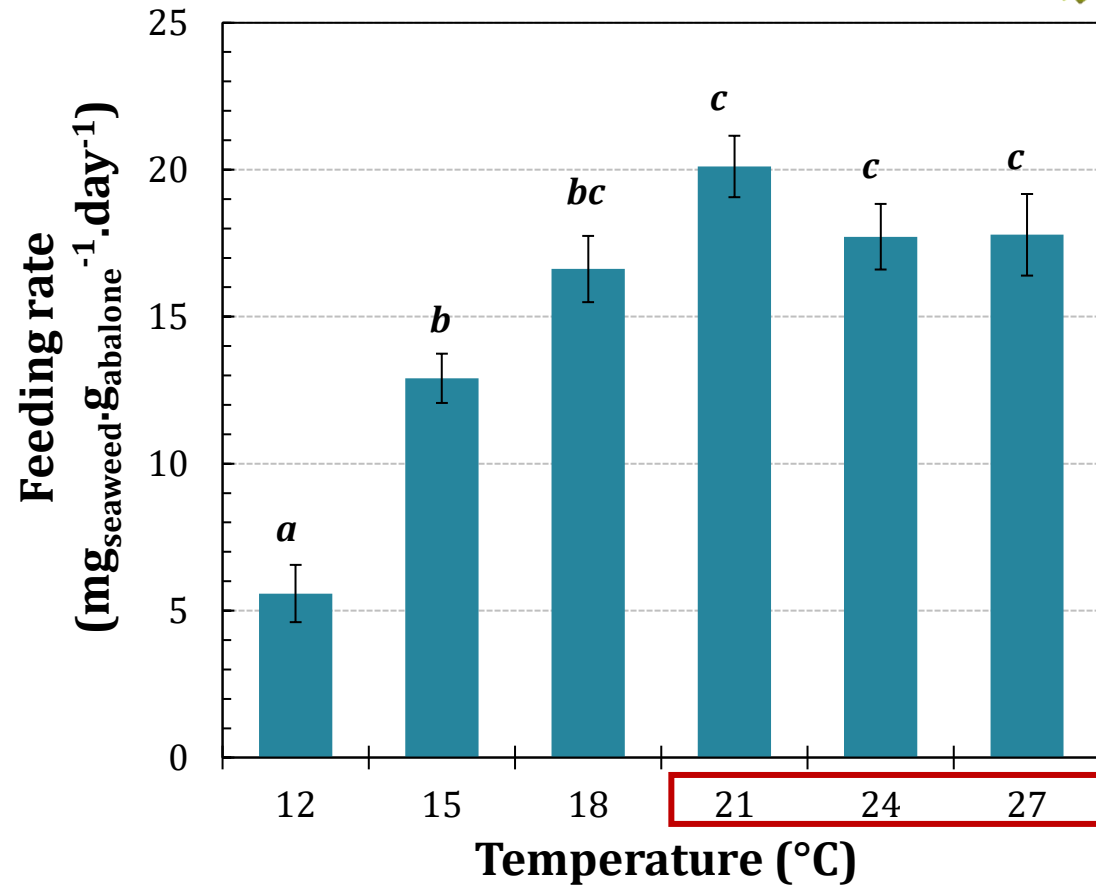
Feeding behaviour



Ulva sp.



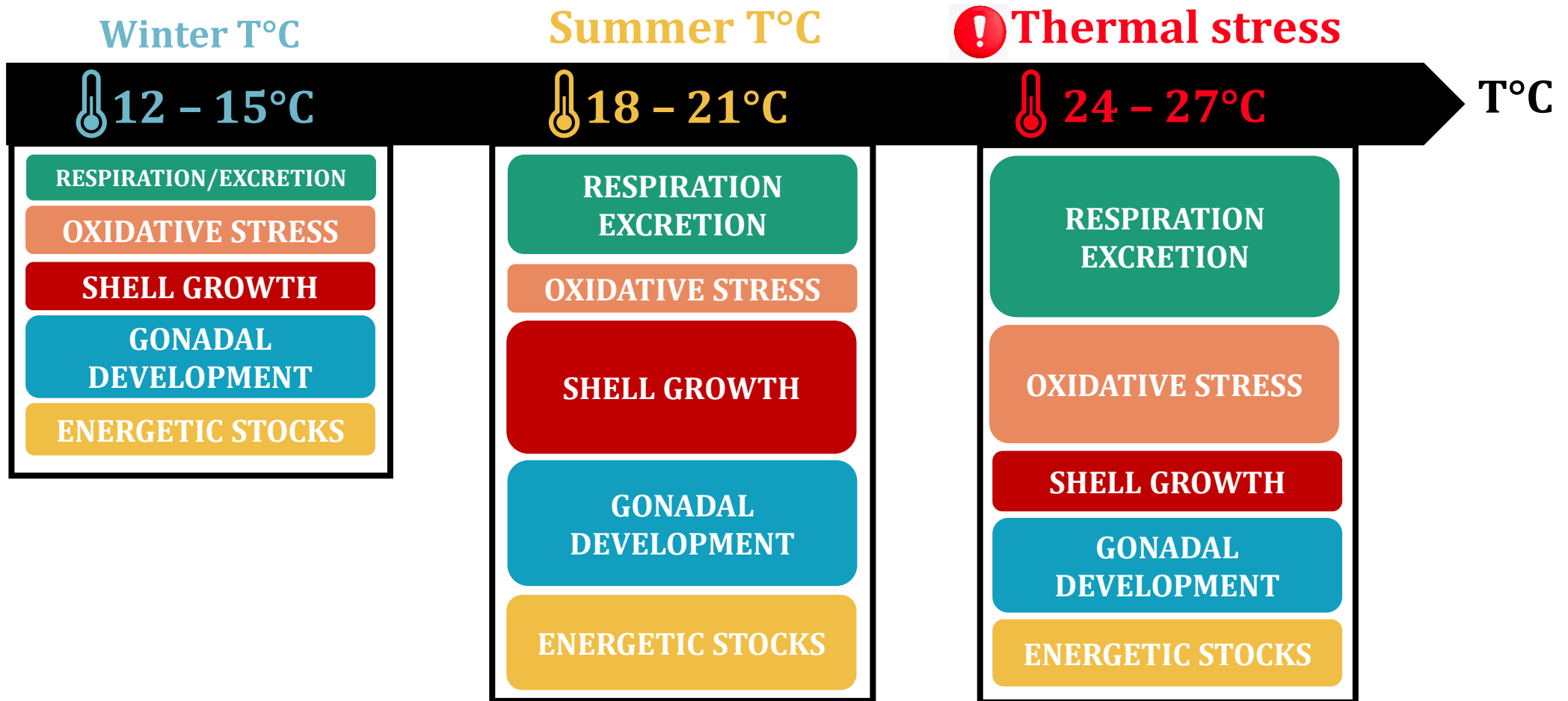
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*For H. midae, maximum at 20°C
(Britz et al., 1997)*

Higher seaweed consumption from 21 to 27°C

Summary of the effects of elevated T°C on European abalone biology :



Optimal thermal range for European abalone growth and development

Conclusion :

Impact of temperature on European abalone physiology and behaviour :

- ☑ *Optimal growth and reproduction between 18°C and 21°C*
- ☒ *Thermal stress harmful for biological functions from 24°C*



Conclusion :

Impact of temperature on European abalone physiology and behaviour :

- ✓ *Optimal growth and reproduction between 18°C and 21°C*
- ✗ *Thermal stress harmful for biological functions from 24°C*

Perspectives

- *To study the interaction $pH \times T^{\circ}C$ on abalone biology*
- *To evaluate the role of macroalgae in mitigating the effects of climate change*



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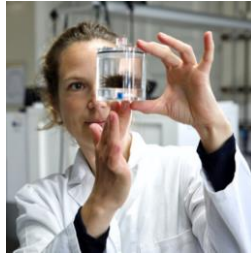
Thanks to...



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S. ROUSSEL



C. QUERE



L. HATEAU



STATION MARINE
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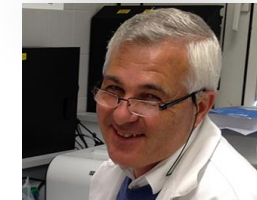
S. AUZOUX-BORDENAVE



A. BADOU



S. HUCHETTE
and his team



C. LAMBERT



C. DI POI



N. LE GOIC

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