Symposium for Applied Biological Sciences
-
Gembloux Agro-bio Tech
-
January 31st 2020

Water

Temperature

Brown trout

Continuous monitoring

Rivers

Climate change

Environment

Warming

Riparian vegetation

Shadow

River management

Infrared thermal images

Keep it cool...

INVESTIGATING STREAM WATER TEMPERATURE IN SOUTHERN BELGIUM: ENVIRONMENTAL DRIVERS AND POTENTIAL IMPACT ON A THERMAL SENSITIVE SPECIES (SALMO TRUTTA)

LIÈGE université Gembloux Agro-Bio Tech

Introduction

Context

- Stream water temperature (WT) is a key ecological factor :
  - WT is influenced by : climate change, atmospheric conditions, topography, stream bed characteristics…
  - WT influence : oxygen solubility, organic matter, decomposition rates, aquatic species (metabolism, survival, growth)…
- Due to its importance, it is essential to record continuous WT
- In Wallonia, +/- 140 stations record WT continuously (10 min.)
  - How can this network improve our knowledge?
  - Is the aquatic ecosystem in danger ?

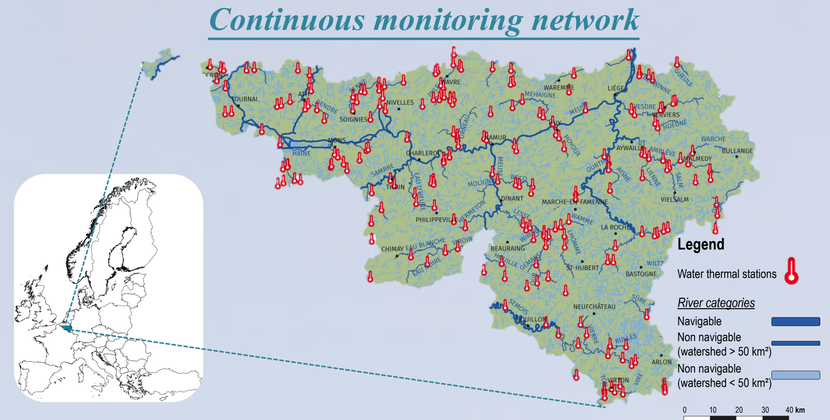
Objectives

- Study WT evolution between 2012 and 2018 with a continuous monitoring network
- Understand the potentially damaging effect of WT on the aquatic ecosystem with the example of the brown trout (***Salmo trutta fario L.***)
- Study the influence of environmental parameters on WT

Study area

- Wallonia (Southern Belgium): +/- 16.000 km²
- 140 stations (1obs./10min), 2012-2018

Continuous monitoring network



Common name : Brown trout
Scientific name : Salmo trutta fario L.


©P. Dunbar

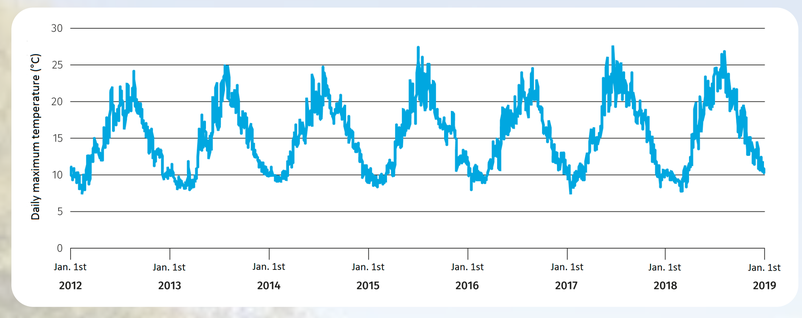
Specificity : Thermal sensitive and umbrella fish species

Thermal requirements : 4°C > <19°C > < 25°C >
Thermal preferendum
Lethal temperature

Results

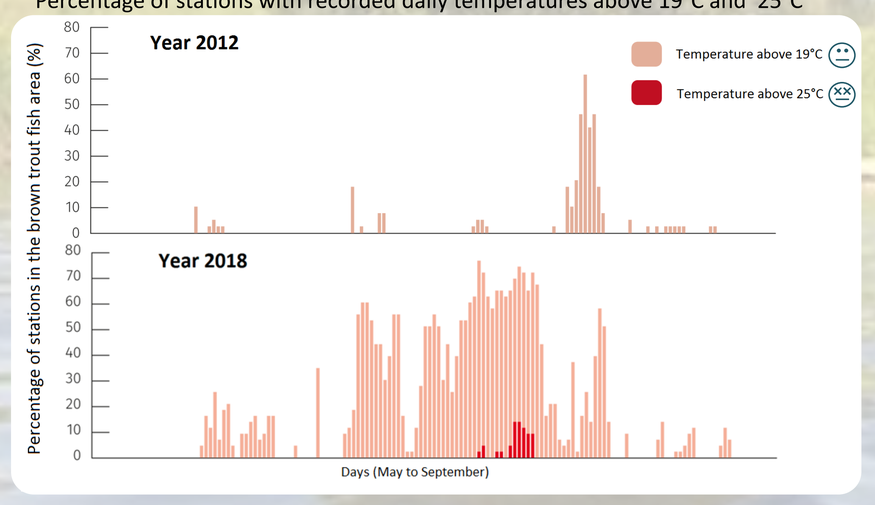
Evolution of WT between 2012-2018

- Typical yearly sinusoidal WT evolution
- Coldest/warmest winter : 2013/2016
- Daily amplitude > 5°C (summer) ; ≈ 2,5°C (winter)

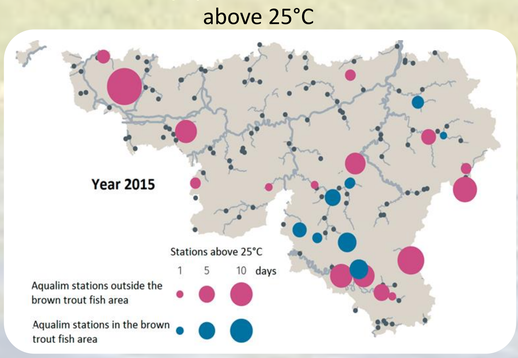


Spatiol-temporal queries for the brown trout (Salmo trutta fario)

Percentage of stations with recorded daily temperatures above 19°C and 25°C



Number of days per station with recorded WT above 25°C



Influence of environmental parameters on WT

- GAM models were adjusted on our daily WT to extract "extreme" days (i.e. days with above normal WT) → 96 dates between 2012 and 2018
- Environmental variables were calculated for 94 watersheds
- Environmental time dependent variables* were also calculated for all the "extreme" days selected
- Statistical analyses : Linear Mixed-Effects Regression between WT and environmental variables

Slope
Elevation
Sinuosity
Landcover
Watershed area
Air temperature*
Water level*
Water flow*
Shade*

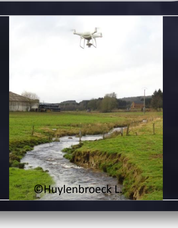
→ **SHADE**

Discussion

- Importance of continuous monitoring to :
  - Characterize the variability of the thermal regime
  - Identify extreme thermal episodes occurring very locally and that might be limited in time
  - Model WT changes in future climate scenarios
- WT exceeded the brown trout thermal preferendum (19°C) all years during the study period and even reached the lethal temperature (25°C) in 2015, 2017 and 2018
- Thermal excesses have been recorded :
  - Spatially : in different stations (mostly in the west of Wallonia)
  - Temporally : in summer period (mainly between May to September)
- The identification in time and space of the thermal excesses of the brown trout allow to :
  - Identify and localize priority areas that require the intervention of a manager ("thermal risk areas")
  - Highlight the critical periods to adapt river management practices to mitigate thermal warming
- The study provides a better understanding of the relationship between WT and the environment. Out of 9 groups of variables, **shade**, water level and water flow have the stronger impact on WT
- Based on the results, we can provide solutions to determine how river managers can put measures in place to mitigate river thermal overheating
- Thanks to the radiation retained by its foliage and through the shade it provides, riparian vegetation must be managed to limit extreme thermal events that are expected to be more frequent

Perspectives

- Use infrared thermal images acquired from drones to have spatially continuous mapping of stream water temperature (longitudinal profile)
- Develop decision making tools for river managers to mitigate summer warmings (e.g.: riparian forest restoration)


©Huylenbroeck L.

(i)Georges B. *et al.,* 2019. Can water level stations be used for thermal assessment in aquatic ecosystem?. *River Research and Applications*.
(ii)Georges B. *et al.,* 2019. Suivi de la température des cours d'eau wallons: potentiels et contraintes du réseau Aqualim. Forêt. Nature, (153), 42-53.
(iii) ©Figures : Forêt.Nature, foretnature.be(ii)

Blandine Georges[1], Hervé Piégay[2], Philippe Lejeune[1], Yves Brostaux[1], Adrien Michez[1]
Contact : **blandine.georges@uliege.be**

(1)Faculty of Gembloux Agro-bio Tech (ULiège) (TERRA research and teaching center), Passage des Déportés 2, 5030 Gembloux, Belgium
(2)University of Lyon, UMR 5600 CNRS EVS, Site ENS de Lyon, 15 Parvis René Descartes, F- 69342 Lyon, France