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PKD – Climate Impacts
Impacts of Global Warming on rivers temperature and development of Proliferative Kidney Disease (PKD) on native brown trout Salmo trutta population in Switzerland

Aurélie Rubin[1,3], Jean-François Rubin[1,2], Thomas Wahli[3], Nicole Strepparava[3], Philippe Heller[4]
[1]Maison de la Rivière, Chemin du Boiron 2, 1131 Tolochenaz, [2]Hepia, Rue de la Prairie 4, 1202 Genève, [3]Centre for Fish and Wildlife Health, Institute of Animal pathology, University of Bern, Längassstrasse 122, 3001 Bern, [4]Hydrique, Chemin du Rionzi 54, 1052 Le Mont-sur-Lausanne

Key words
Proliferative kidney disease, Salmo trutta, Tetracapsuloides bryosalmonae, bryozoa, temperature, water quality, population dynamic, fish mortality, temporal variability, climate warming

Aim of the study
The project aimed (1) to observe the temporal evolution of the disease along the year in native brown trout populations, (2) to identify what are the environmental triggers parameters and to determine precisely from which water temperature the disease becomes lethal to fish in the environment, (3) to determine the part of fish mortality in a native population related to PKD, respectively to the down- or upstream migration of juveniles, (4) to identify which fish-farms are still PKD free, influencing therefore stocking and (5) to establish a predic-tive model linking air and water temperature in order to estimate, according to the different climate scenarios, the development of the disease.

Material and methods
For PKD investigations, 25 young-of-the-year brown trout Salmo trutta were sampled in each station by electrofishing. After capture, fish were euthanized. In the laboratory, kidneys were removed and embedded in paraffin. Organs were cut using histological routine methods and stained with hematoxylin and eosin (H&E). One slide per fish was examined for the presence of Tetracapsuloides bryosalmonae. In a sub-sample, fish were also analysed by means of PCR and immunohistochemistry.
During 2013, field work was focused on two streams in the Canton of Vaud (Switzerland). Electrofishing were performed once a month between June and November in order to identify the best suitable period for PKD sampling (peak of infection prevalence in fish). In both rivers, an upstream site without infection and a downstream site with PKD-positive fish were chosen. In parallel, water temperature chronicles were measured.
Based on the results of 2013, 45 stations spread over the Canton of Vaud were analysed in September 2014 to know where PKD was present. For each station, water temperature, water quality through benthic fauna index and other biotic and abiotic factors were measured.
In July 2014, trout captured in the Boiron de Morges, Dullive, Hongrin and Torneresse streams were also marked with PIT-Tags (Passive Integrated Transponder Tags). Campaigns of tracking mobile were then conducted to observe fish dispersal. By electrofishing, the percentage of capture/recapture could be obtained.
14 farms of the Canton of Vaud were selected for PKD investigations. Each of these farms produce trout for stocking. 25 0+ trout were sampled by electrofishing in each of these farms between June and October 2013. Fish were analysed by means of histology in the laboratory.
Finally, by combining all these elements, a climate model was built for the Boiron de Morges, in collaboration with the agency Hydrique, specialized in the simulation of water flow.

Results and significance

The results of the 2013 sampling campaign showed that the highest prevalence of PKD was detected in August and September. Comparison of water temperatures with PKD prevalence revealed that highest prevalence values were reached after 1627 degree days or 34 days with a daily mean temperature of ≥15°C.

During 2014 sampling, positive fish were found in 19 stations of 6 streams, while in 26 stations distributed over 17 rivers no infected fish were detected. Overall, PKD prevalence ranged from 0 to 100%.

Analysis of environmental parameters showed that the number of day with a daily mean temperature of ≥15°C was positively correlated with the presence of PKD. On the other hand, the biological water quality resulting on a benthic fauna index seemed to have no influence on the infection.

Marking, electrofishing, tracking mobile and capture/recapture data showed the potential impact of the disease in a native brown trout population. In PKD-positive stations, survival of young-of-the-year during the first winter was reduced by 40% compared to sites free of infection.

14 fish farms were analysed for the presence of PKD. Only one farm was infected with a prevalence of 32% and had been closed based on these results.

A climate model of the Boiron de Morges was constructed. After calibration, different climate scenarios were applied, highlighting the trout populations potentially at risk in the future. Therefore, solutions can then be proposed in order to fight against the spread of the disease, such as plantation of trees along the river. The very upstream part of this stream is problematic, and actions will be conducted to improve the situation.

Publications, posters and presentations

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Project *1.14.04*

Project duration *February 2014 – February 2017*