

## Climate Trout

The project ClimateTrout investigates the interaction of thermal regimes, bryozoan colonies, brown trout and the emergence of proliferative kidney disease (PKD) in four Austrian rivers in relation to climate change. Here, we present results from one case study river, the river Wulka, which was originally selected as a reference river, as the Wulka was known to host a vital brown trout population despite a warm thermal regime [8]. We hypothesized that the river is free from PKD.

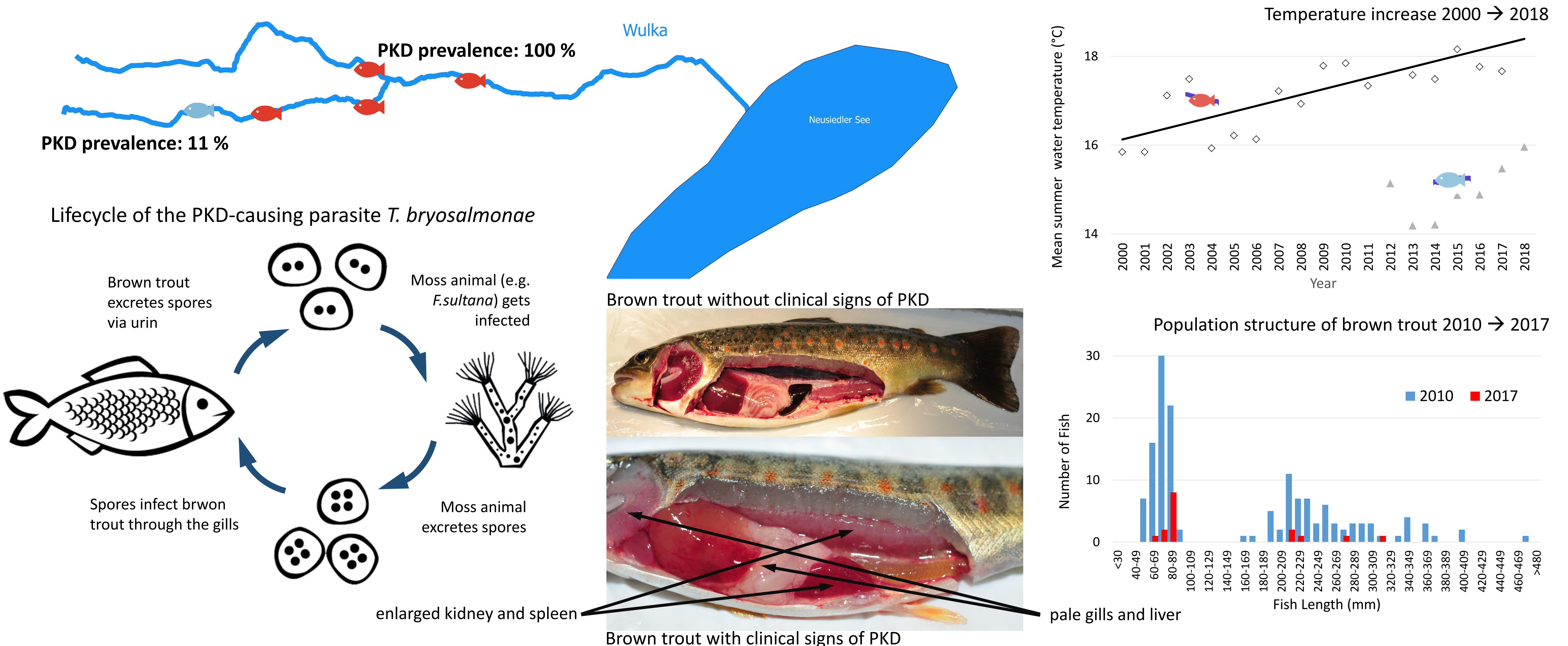
Secondly, we show insights into the Austrian wide water temperature analyses. Based on a literature review, we identified critical thresholds for PKD outbreak and thermal stress of brown trout. Subsequently, we developed a risk assessment scheme to identify river reaches that are at thermal risk for brown trout.



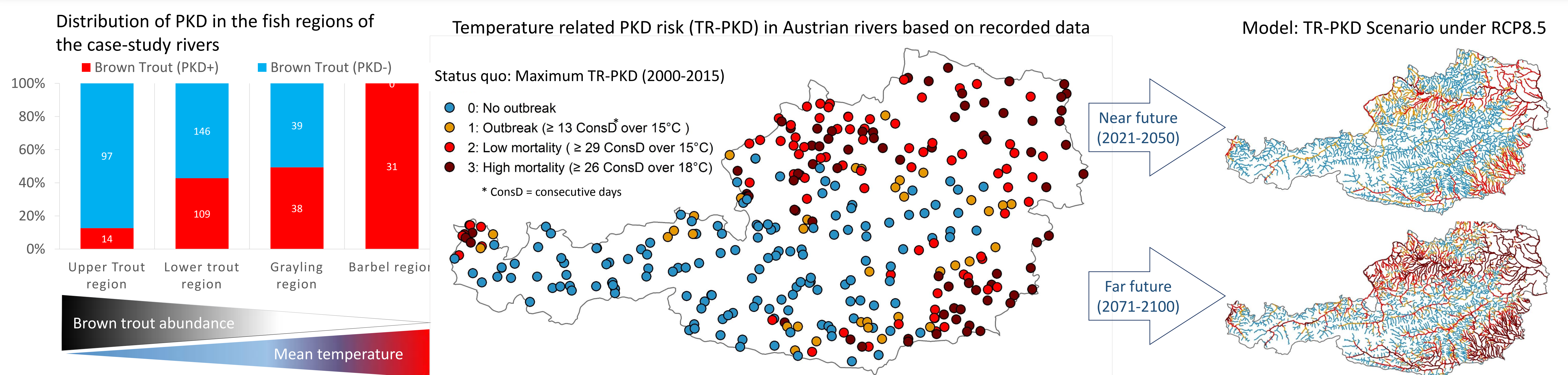
Proliferative kidney disease (PKD) is a widespread disease in Europe and North America [1] caused by the parasite *Tetracapsuloides bryosalmonae* (Myxozoa: Malacosporea) [2]. In Switzerland, PKD is considered to be a reason for the declining brown trout populations (*Salmo trutta*) [3].

The lifecycle of the parasites consists of moss animals as main hosts and a variety of salmonid fish as intermediate hosts [4, 5]. In fish, an infection leads to enlargement of kidney and spleen, anemic gills, skin darkening and distension of the abdomen [1]. The clinical signs of disease become more serious with higher water temperatures (>15°C)[6] Infected bryozoan colonies excrete more spores during warm water periods [7]. Therefore stream warming due to climate change might contribute to an aggravation of PKD symptoms in infected fish and in further consequence threaten wild brown trout populations.

## PKD related decline of a brown trout population in the case-study river Wulka



## Distribution of PKD in the case-study rivers and Austrian wide temperature risk assessment



## Highlights

- ✓ We found an overall PKD-prevalence of 92% in the brown trout population of the river Wulka
- ✓ In total, 22 out of 87 PKD-positive brown trout showed acute clinical signs of PKD
- ✓ Smaller, thus younger brown trout (< 16 cm) were significantly more severely affected than larger individuals
- ✓ The wild brown trout population is declining in the Wulka since 2010
- ✓ The mean water temperature of the Wulka increased by 3°C from 2000 to 2018
- ✓ A general trend of increased PKD-prevalence towards the lower distribution range of brown trout
- ✓ At 57% of the Austrian water temperature gauging stations the threshold for outbreak was at least once exceeded in the period from 2000-2015
- ✓ The water temperature model for far future (RCP8.5) predicts a possible outbreak for 63% of all selected river segments. (Status quo: 19%)

## Conclusion

Since the mean water temperature of the river Wulka rose by 3°C in the past years, it is plausible that the warm thermal regime of the Wulka might have increased the susceptibility regarding PKD infections. A critical temperature limit may have been passed, which might lead to the extinction of brown trout from the Wulka in the near future. This conclusion is undermined by the fact that healthy fish were only found in the uppermost reaches of the Wulka, where their occurrence is restricted to single locations. Supposedly, the numbers of remaining fish are too low for a recolonization of downstream sections. The Wulka can be seen as an early warning system for other pre-alpine Austrian rivers that still have cooler thermal regimes. The Austrian wide water temperature risk assessment shows that thresholds for PKD-related mortality are already being exceeded in some rivers. In the near future even more water stretches will have PKD permissive temperature regimes and in the far future brown trout will be endangered in all main rivers.

## References

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