

FISH LIBERATION

3R METHODS IN FISH PHYSIOLOGY

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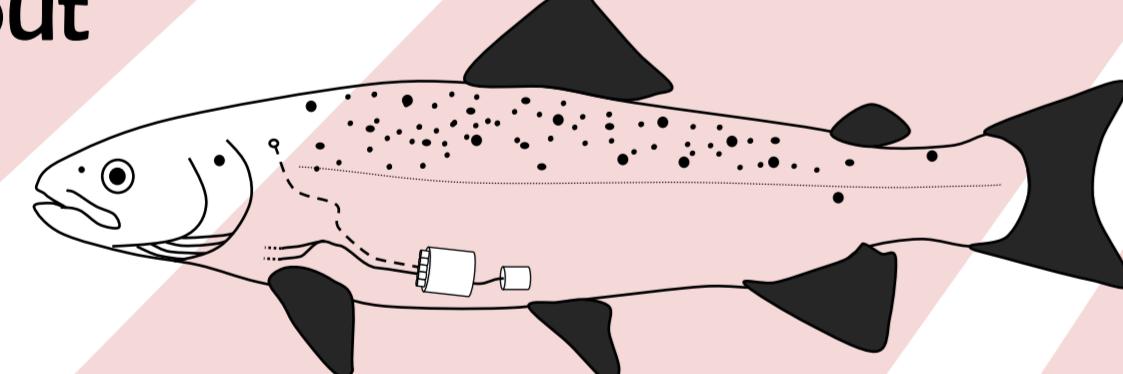
BACKGROUND

- When working experimentally with animals, stress may compromise the welfare of the animal and therefore override the investigated effects.
- In accordance with the 3R principles, we work to develop new cardiorespiratory recording techniques that will *refine* our methods and thereby *reduce* the number of animals used.
- Here, we present methods that allow for long-term recordings of physiological variables in unrestrained fish and discuss how they can improve fish physiological research.

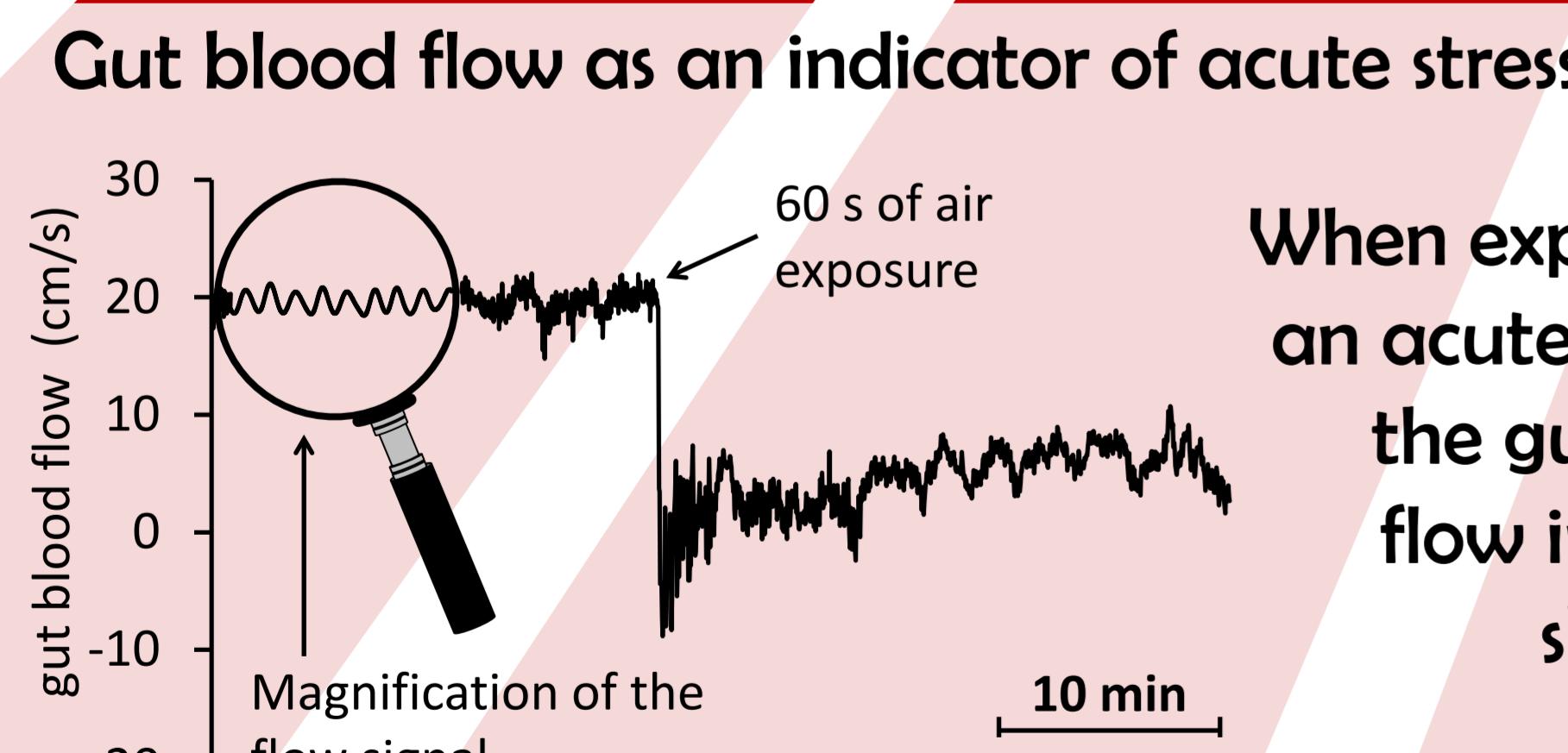
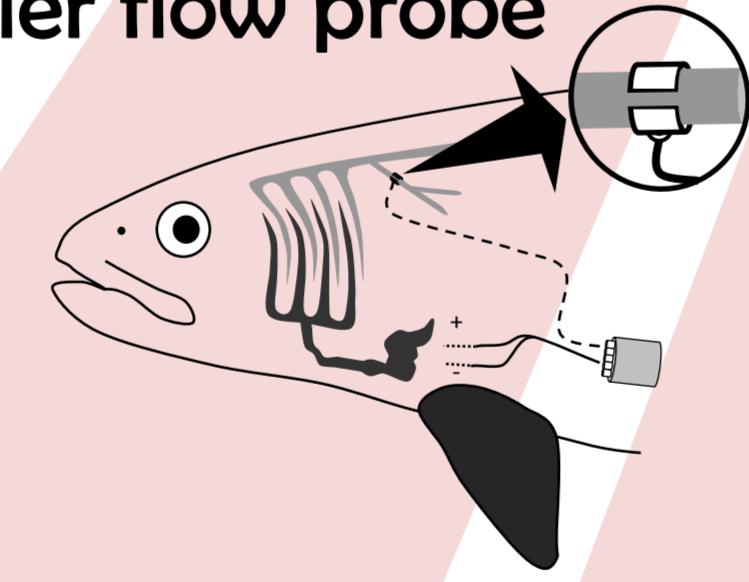
BIOTELEMETRY

- Together with Endogear transonic we have developed the 'EG3' implant that can measure ECG, blood pressure, blood flow, temperature and body movements in free-swimming fish.
- The EG3 can, in one or several fish, either transmit or store data continuously for 2-3 weeks in the lab, in a mesocosm or in a natural habitat.
- Implantation is an invasive procedure that must be performed by a trained person.

Position of the implant and battery in a rainbow trout



ECG electrodes and doppler flow probe



When exposed to an acute stressor the gut blood flow instantly shuts off.

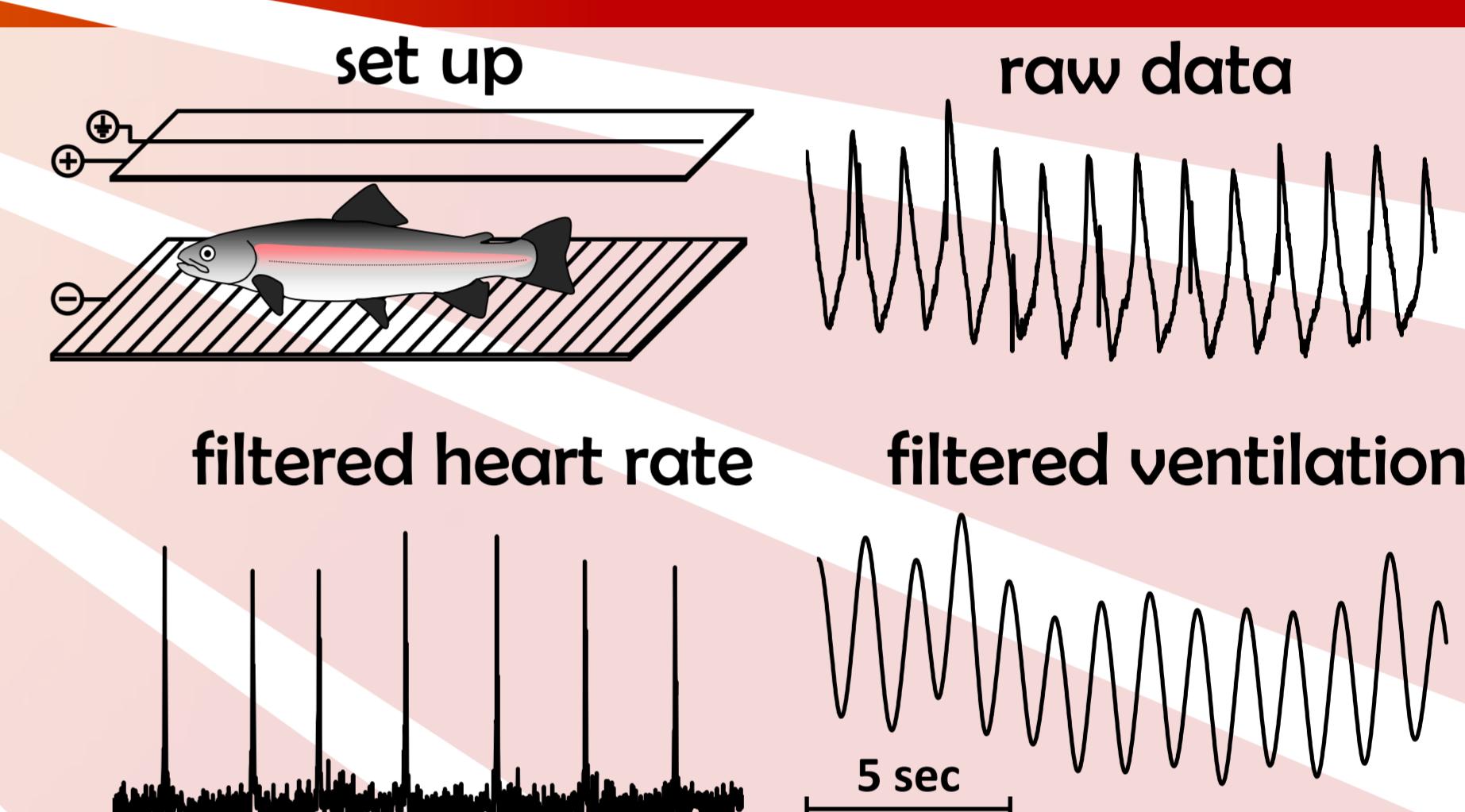


CONCLUSIONS

- We find that these three methods improve the quality of our data and allow new aspects of physiology to be explored as the fish are no longer connected to the recording equipment.
- Wireless techniques *refine* methods for collecting cardiorespiratory data as they increase the welfare of the fish by reducing or abolishing the confinement stress.
- With the improved quality of the data we are able to *reduce* the number of animals in our studies, all in accordance with the 3R principles.

WIRELESS

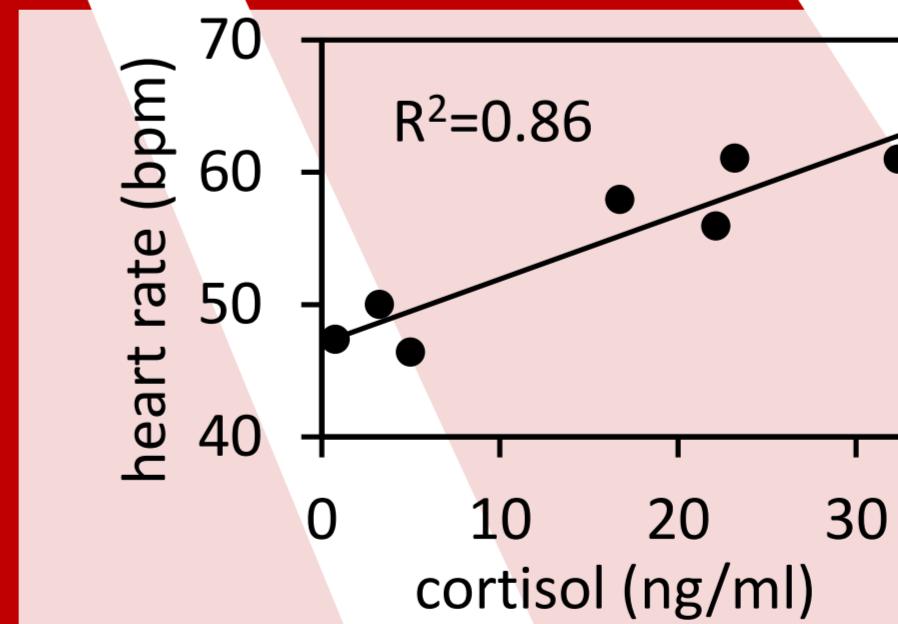
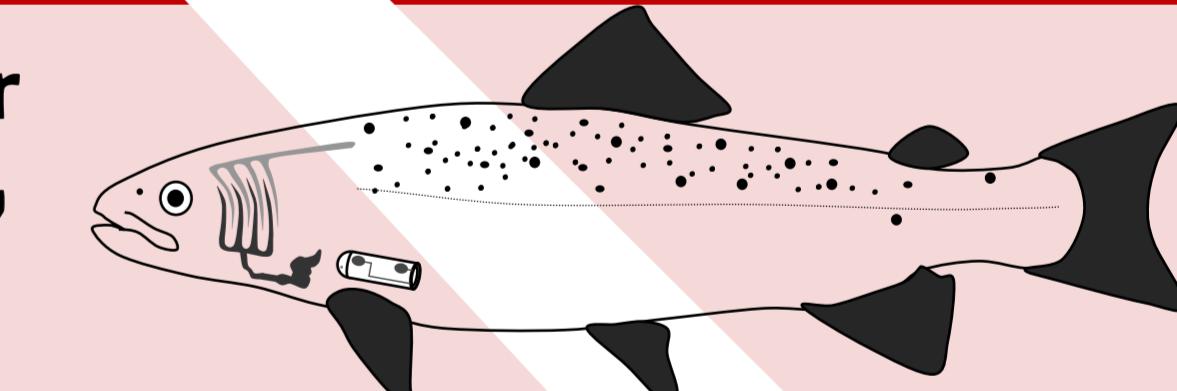
- We have improved a technique that uses external electrodes to record bio-potentials from the water.
- The system is restricted to fresh water and can only be used on individual fish in a tank.
- When applicable it can be used to obtain valuable data of heart rate and ventilation from un-instrumented animals.



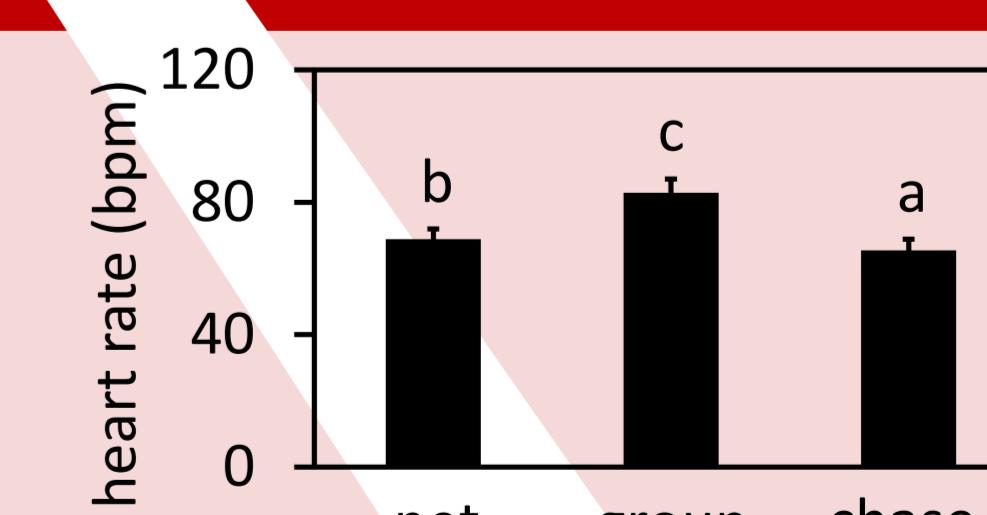
BIOLOGERS

- We have evaluated a commercial biologger (STAR ODDI's DRT milli-HRT) to measure heart rate and temperature in free-swimming fish.
- The system can, in one or several fish, store timed recordings for several months in the lab, in a mesocosm or in a natural habitat.

Position of the biologger in the abdominal cavity of a rainbow trout



Heart rate can be used as an indicator of stress as it correlates well with plasma levels of cortisol



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