Popular science summary of the PhD thesis

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Science summary

Many European lakes are turbid and algae-dominated due to excessive nutrient inputs from agriculture, cities and industry. This eutrophication makes these lakes both less diverse, as habitats degrade, and less usable, as algal blooms, oxygen depletion and poor water quality reduce their value for drinking water, fisheries and recreation. One restoration tool is biomanipulation: removing fish such as roach, which feed on zooplankton — the small animals that graze the algae suspended in the water. With fewer roach, zooplankton become more abundant and can graze the algae down, helping to keep the water clear. But removing thousands of fish is costly and must be repeated regularly, so gains in efficiency matter.

This thesis elaborates whether a better understanding of fish behaviour could make removal more effective. In a small hypertrophic Danish lake, roach and pike, the lake's natural predator of roach, were implanted with acoustic transmitters and tracked continuously for several years. Some pike additionally carried loggers recording their heart rate, providing a rare window into the physiology of a wild predator.

Roach distribution was strongly influenced by the environment. They formed dense pelagic aggregations on autumn mornings and dispersed at night, with grouping (i.e. the close proximity of roach to each other) shaped by time of day, water clarity, temperature, oxygen conditions and population density. Timing fishing hauls to these predictable aggregations can increase catch efficiency. Notably, as the population declined through repeated removals, the remaining roach aggregated more tightly rather than dispersing, so removal remained effective for repeated biomanipulation efforts.

Pike showed a different pattern: heart rates peaked in warm, stratified, oxygen-poor water, precisely the conditions eutrophication creates. Scheduling removals outside these physiologically stressful periods would reduce additional stress on pike, helping to preserve the predation pressure they naturally exert on roach and thereby supporting restoration.

This study shows that fish behaviour and physiology are crucial for lake restoration efficiency and offer a practical way to protect these biodiversity hotspots and their ecosystem services.