Akademisk Avhandling för Filosofie Doktorsexamen
Thesis for the Degree of Doctor of Philosophy

The Effects of Temperature on Gut Blood Flow and Gut Motility in Fish

för filosofie doktorsexamen i zoofysiologi som enligt naturvetenskapliga fakultetens beslut kommer att försvaras offentligt fredagen den 30 mars 2012, kl. 10.00 i Lyktan Konferenscentrum Wallenberg, Medicinaregatan 20A, Göteborg

av

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DISSERTATION ABSTRACT

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In order for a fish to grow and thrive, the gut must function efficiently. This is achieved through a range of processes, including controlled patterns of gut motility and modifications in gut blood flow. How these processes are affected by long and short-term changes in ambient temperature was the main focus of this thesis.

After acclimation to a higher temperature, the interdigestive motility of rainbow trout was higher. This indicates an increased demand for movements involved in the housekeeping functions of the gut. Temperature acclimation did not affect the postprandial response, in neither gut blood flow nor gut motility. These results indicate that thermal compensation processes work to neutralize acute thermal effects, so that these two functions are maintained at a certain rate. Also, *in vitro* preparations of isolated intestine showed signs of thermal compensation processes, as the acute temperature effects on the response to the cholinergic agonist carbachol were abolished after a temperature acclimation period.

Fish species studied responded very differently to an acute change in temperature. A relatively linear correlation with temperature was seen in, both gut blood flow and gut motility, in two species of sculpins (shorthorn and Arctic sculpin). The gut blood flow, in both green and white sturgeon, was unaffected by moderate fluctuations in water temperature during the interdigestive state. White sturgeon were also studied after feeding and a correlation between gut blood flow and temperature was observed, in a similar fashion as for the unfed sculpins.

Thermoregulatory behaviours observed in white sturgeon, show that moving between different temperatures, after a meal, will have a great influence on the volume of blood distributed to the gut. An increase in gut blood flow is probably an important factor explaining why it can be beneficial to migrate into warmer waters after feeding. However, if combining the presented data with data from previous studies, it shows that perfusion of the gut can also be a limiting factor when the environmental temperature changes. This is probably the reason why some fish species forage in warm waters and then move into colder areas when digesting the meal.

A leading hypothesis suggests that the temperature limitations for a fish are mainly set by a reduction in metabolic scope. However, experimental data has shown that temperature can have significant effects on both appetite and growth before metabolic scope is reduced. The findings in this thesis suggest that oxygen-limited thermal tolerance in the gut of fish could also be a significant variable in determining the temperature range that fish can tolerate.

Keywords: Fish, thermoregulatory behaviours, electrical activity, biotelemetry