EXHAUSTIVE EXERCISE DOES NOT AFFECT THE PREFFERED TEMPERATURE FOR RECOVERY IN JUVENILE RAINBOW TROUT (*ONCHORHYNCHUS MYKISS*)

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EXTENDED ABSTRACT ONLY – DO NOT CITE

The temperature selected by fish during recovery from exhaustive exercise has not been studied and the behavioral selection of post-exercise temperatures could have direct significant benefits or consequences for survival. There are a number of metabolic/physiological advantages to selecting a reduced environmental temperature, including increases in water oxygen solubility (2.1% per ^{o}C) and blood-oxygen affinity, a decrease in metabolic rate and biochemical reaction rates (Q_{10} ~ 2), and a reduction in the cost of ventilation (Schurmann and Steffensen, 1992). Despite these energetic advantages of selecting a cooler

temperature for recovery, other factors may have significant influence over the actual temperature selected. For example, selection of a colder post-exhaustion temperature would reduce swimming ability (Hammer, 1995) and, by also slowing the rate of restoration of metabolite levels, may prolong the period of recovery and increase predation risk. It is unclear whether the rate of metabolite recovery or overall post-exercise energetic cost has the strongest influence over T_{sel}. Thus, we tested the hypothesis that juvenile rainbow trout (*Oncorhynchus mykiss*) would select a temperature colder than their acclimation temperature (16^{o}C) to minimize post-exercise metabolic demands.

Methods

Trout were given an initial 3-hour discovery in a thermal gradient (range 6ºC to 25ºC) to select a temperature, and to obtain baseline levels of activity, before being assigned to experimental (chased) and control (non-chased) groups. Thereafter, the chased fish were exhaustively exercised for 1.5 min in an oval arena (60 x 120 cm), and the activity and selected temperature of both groups was monitored for 2 hours. Also, fish were terminally sampled for analyses of plasma and skeletal white muscle chemistry at 3 time points after exhaustive exercise: time 0 (immediately after being chased); 60-min after being released into the thermal gradient; and 120-min after being released into the thermal gradient.

Results

For the final 10 min of the discovery period in the thermal gradient a baseline (pre-chase) T_{sel} and activity were determined. During this time T_{sel} was identical for the control and chased groups (14.1±0.3ºC and 14.2±0.4ºC, respectively) (Fig. 1). Activity levels were also similar between the control and chased fish groups, averaging 59.9±7.0 and 66.7±9.5 cm min^{-1}, respectively, for the pre-chase values (Fig. 2).

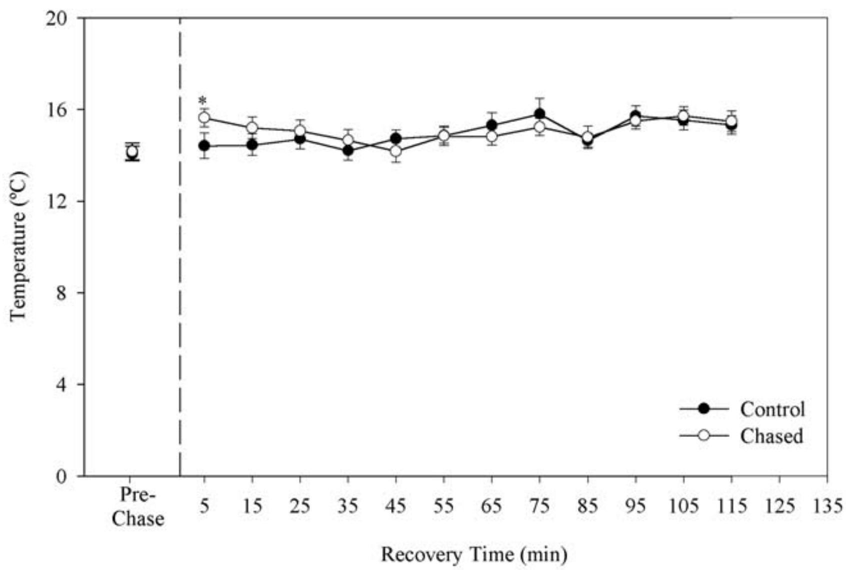

Fig. 1. Selected temperature (T_{sel}) for control and chased juvenile trout prior to being chased and during 120 minutes of recovery. The presented values represent the mean temperature for the 10-min interval bracketing the value indicated on the x-axis. For the control group N=33 for the pre-chase value, N=23 at 5 to 55 min, and N=12 at 65 to 115 min. For the chased group N=31 for the prechase value, N=23 at 5 to 55 min and N=12 at 65 to 115 min. * denotes a statistical significant difference ($P<0.05$, using a two-way ANOVA) between control and chased fish.

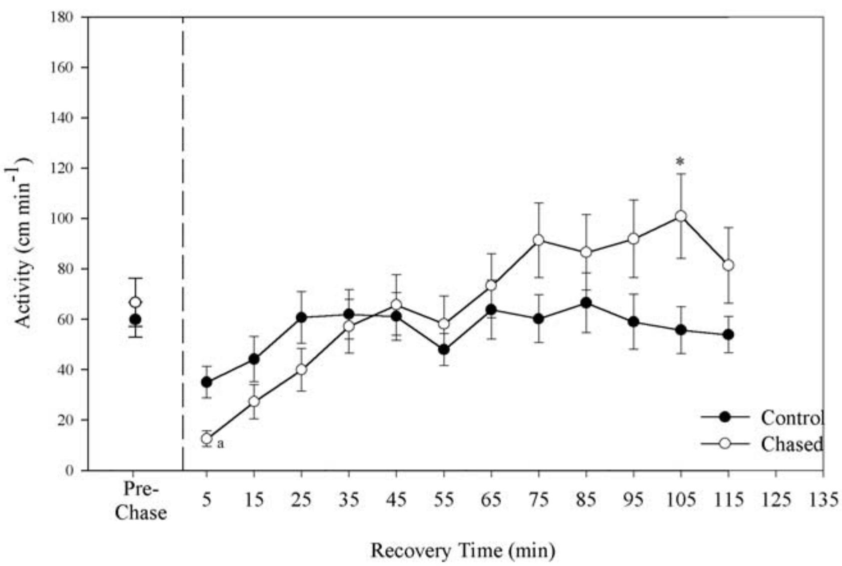

Fig. 2. Swimming activity for control and exhaustively exercised (chased) trout prior to being chased, and during 120 min. of recovery. * indicates a significant difference between control and chased fish ($P < 0.05$).

Immediately after being chased, trout had a metabolic profile that was consistent with exhaustion: levels of plasma and muscle lactate were 4.38 ± 0.25 mmol l^{-1} and 28.0 ± 2.0 mmol kg^{-1}, and levels of muscle glycogen, ATP and PCr were 3.89 ± 0.95, 4.23 ± 0.62 and 3.07 ± 0.73 mmol kg^{-1}. However, the temperature selected by the chased fish (14.2-15.7^{o}C) was identical to that for control fish (14.2-15.8^{o}C), with the exception of an initial 10 min post-recovery period. We attribute the initial difference in selected temperature to a significant decrease (by 81%; $P < 0.05$) in the activity level of chased fish as compared with pre-chase values.

Discussion and Conclusions

Present findings imply that rainbow trout did not select a warmer temperature post-exhaustion to enhance the recovery of tissue metabolite levels or a cooler temperature to minimize routine metabolic costs. Instead, it appears that rainbow trout preferred, on average, to remain at a temperature very close to their acclimation temperature. The finding that T_{sel} was unaltered by a brief period of exhaustive exercise contrasts with the response of fish to other types of stressors (toxicants, hypoxia, starvation), which generally cause a significant decrease in T_{sel} (Bryan, et al., 1984, Rausch, et al., 2000, Schurmann and Steffensen, 1992). T_{sel} probably represents a tradeoff between the beneficial reduction in routine energy demand and the potentially detrimental lengthening of metabolic recovery, that are both associated with anapyrexia. The observation that the chased fish were less active for the first 10 min of the recovery period compared to control fish is not surprising given the earlier results of Cooke *et al.* (2000) where it was found that locomotory activity of large mouth bass reached a minimum within 10 min of release and was then elevated above the control level for a period of 1-2 hours. In summary, the present findings suggest that juvenile rainbow trout do not select a colder temperature to decrease metabolic rate following exhaustive exercise, and that activity levels are acutely suppressed following brief intense exercise.

References

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