DOES THE LIGHT COLOR MODULATE STRESS DURING OUT-OF SEASON REPRODUCTION OF EURASIAN PERCH FEMALES – FIRST STEP TO UNDERSTANDING

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Introduction

Since the 1990s, the Eurasian perch (*Perca fluviatilis* L.) has been considered one of the key species for diversifying aquaculture in Europe. Despite the fact that commercial production of this species began over 30 years ago and is already established in some countries, research on its biology, larviculture, and reproduction technology in controlled conditions is still being optimized and developed. One aspect that still requires in-depth research is determining the optimal lighting conditions, especially during out-of-season reproduction in Eurasian perch. This is especially important when **considering the modulation of light as a tool to reduce stress** during this critical period. In the present study, selected genes related to stress and immune response were investigated in response to different light colors (white - W, blue - B, and red- R) used during the controlled out-of-season reproduction of this species.

Materials and methods

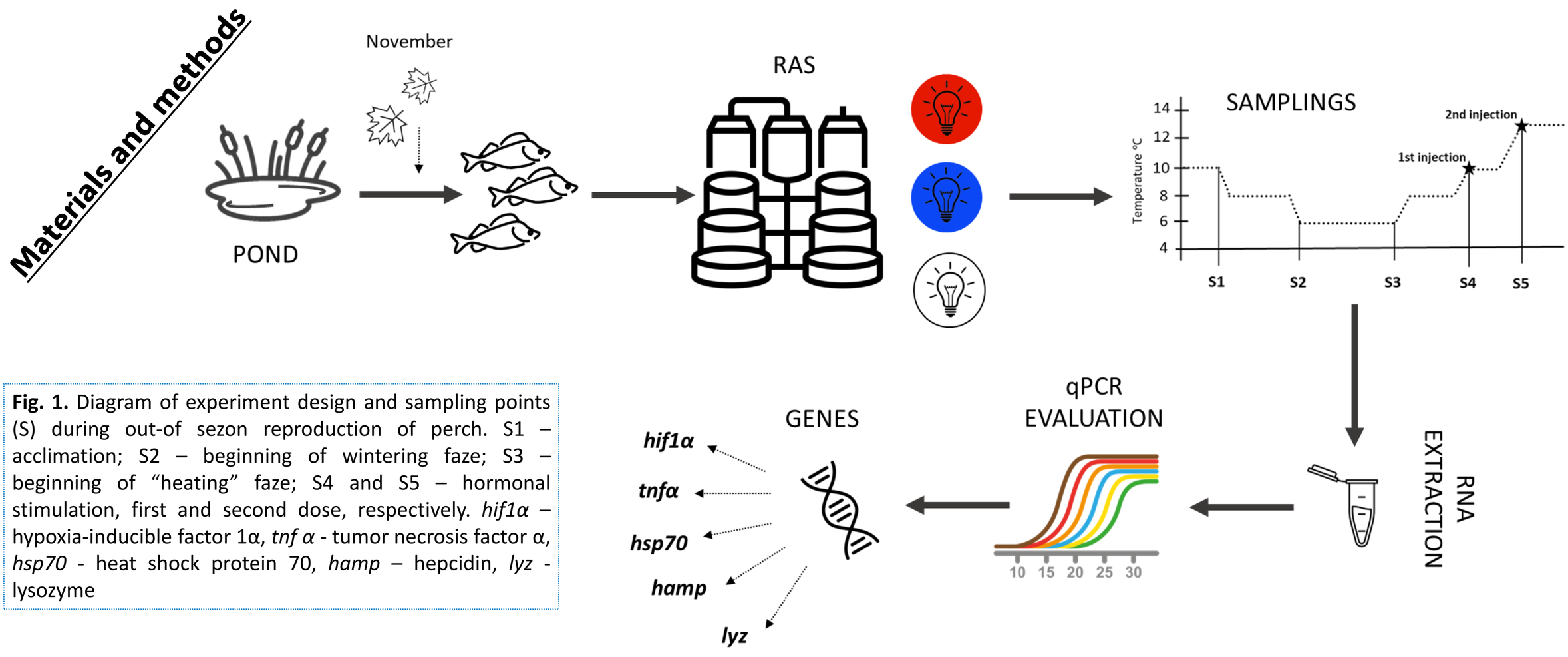

Fig. 1. Diagram of experiment design and sampling points (S) during out-of sezon reproduction of perch. S1 – acclimation; S2 – beginning of wintering faze; S3 – beginning of "heating" faze; S4 and S5 – hormonal stimulation, first and second dose, respectively. *hif1α* – hypoxia-inducible factor 1α, *tnf α* - tumor necrosis factor α, *hsp70* - heat shock protein 70, *hamp* – hepcidin, *lyz* - lysozyme

The obtained data were compared using a two-way ANOVA, and differences were further analyzed through Tukey's *post-hoc* test ($p<0.05$). All statistical analyses were performed using Statistica software developed by StatSoft.

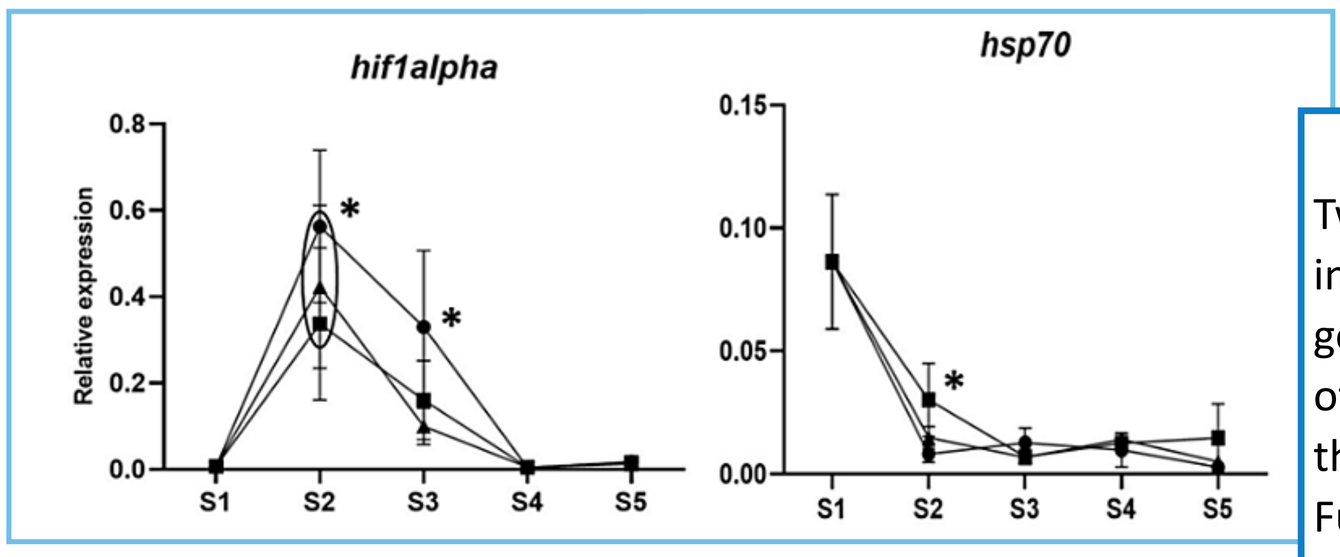

Fig. 2. Relative expression of chosen genes, during rearing Eurasian perch females in three different light colors. Data (mean ± SD) marked with asterisk were significantly different ($p < 0.05$). **W** – white ●, **R** – red ■, **B** – blue ▲, *hif1* α - hypoxia inducible factor 1 α, *hsp70* – heat shock protein 70, S – sampling point

Results

Two-way analysis of variance ($p < 0.05$) indicated significant interactions between light color and the expression of the genes encoding *tnfα*, *hsp70*, and *hif1α*, while there was a lack of significant interactions ($p > 0.05$) between light color and the expression of the genes encoding *hamp* and *lyz*. Furthermore, Tukey's *post-hoc* analysis revealed significant differences ($p < 0.05$) in the expression of *hif1α* at S2 for all tested light colors, as well as *hsp70*, but solely in the case of R light. Additionally, a higher expression of *hif1α* in S3 was observed, specifically in W light (Fig. 2).

Discussion and conclusion

One of the factors that significantly impact the induction of stress reactions in fish is the light color during rearing conditions. Therefore, **the aim of this study was to address the question**: Can different applied light colors during the out-of-season reproduction of pond-origin Eurasian perch, kept in RAS, somehow influence their stress levels? The used light colors did not yield significant differences in the maturation of females. However, the analysis of selected genes related to fish reactions to stress and their immune responses indicated that the light colors in which the spawners were kept significantly affected the expression of the ***hif1α*** and ***hsp70*** genes. It was revealed that these light colors stimulated stress reactions in fish at the beginning of the wintering phase, before reaching the final oocyte maturation. **Importantly**, just before spawning, the levels of all tested genes were comparable. The results obtained suggest that varying light colors indeed significantly influence stress reactions in fish during their adaptation to rearing conditions in RAS. However, these light colors do not directly impact the final reproductive outcome.

These preliminary observations need in-depth exploration of additional stress and immune-related parameters. Considering the distinct reactions of Eurasian perch females to different light colors and their welfare, it is advisable to **employ white light to minimize stress associated with fish adaptation to RAS conditions, whenever possible**.

Acknowledgment

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PRO PERCH