JWARP> Vol.2 No.2, February 2010

OPEN ACCESS

Temporal Study of Stress-Induced Effects Caused by Developmental Temperature Changes and Water Quality in an Isolated Northern Pike (Esox lucius L.) Population

PDF (Size:655KB) PP. 167-180 DOI: 10.4236/jwarp.2010.22019

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ABSTRACT

Development perturbations may affect the regular phenotype and are commonly measured through fluctuat-ing asymmetry (FA) levels. Short-term climatic variations, that modify the temperature, can influence chemical and physical water characteristics. Fishes have been used as model organisms for studying stress-induced changes in body symmetry, since they are ectothermic, good bioindicators, easy to find and having economic relevance. Northern pike being a holoarctic, big, edible, top predator is one of the most economically important freshwater fish for recreational and commercial fisheries and freshwater ecosystems management. The isolated population of Lake Trasimeno (Central Italy)—in good health conditions and that can be considered one of the genetically best conserved of Italy—, was chosen as model. FA, seven mi-crosatellite loci and early developmental stages were investigated in order to correlate the developmental stability of this population to its genetic variability and to environmental perturbations. The results obtained underlined a positive correlation (>>0.40) between FA indexes and temperature; the non-parametric Kruskall- Wallis test showed significant differences in FA levels for some FA indexes and parameters. Over-all results underlined that FA increased in individuals grown at a temperature above 8 °C as compared with those grown at 5 °C or at lower temperatures. Both positive and negative correlations between FA parameters and chemical and physical water characteristics were shown. The comparison of genetic and FA data under-lined a low correlation between microsatellite and FA pairwise distances, nevertheless a positive and signifi-cant correlation emerged for some FA measurements and microsatellite data. In particular, only Elu87 locus showed a statistical significant correlation versus total FA. Finally, as expected, results indicated that the in-cubation time was temperature-dependent; the ODT was in the range 8 – 10 °C and lower and higher tempera-tures caused drastic embryo mortality. These results showed robust correlations, both positive and negative, between some FA parameters and chemical and physical characters and were in agreement with the assump-tion that temperature variations as well as pH, conductibility and chloride variation, may increase molecular perturbations and, subsequently, the global developmental noise during development. These data suggest that FA could be considered a measure of animal welfare. The relative breeding easiness of this species may be a valid tool for the estimation of controlled environmental stress influences, not only of thermal origin, and a valid information basis for studies on wild populations. Furthermore, it has long been debated whether FA levels depend upon genetic variability, the particular molecular marker notwithstanding, and whether it is possible to use one or more molecular markers to better understand FA data. The Mantel tests performed in this study showed very interesting correlations between FA and the investigated microsatellites. For the lack of a linkage map for the investigated microsatellite loci, it is presently impossible to establish the relation-ships between the FA parameter and the microsatellite loci that the Mantel test defines as correlated.

KEYWORDS

Northern Pike, Esox Lucius, Fluctuating Asymmetry, Short-Term Climatic Variations

Cite this paper

L. Lucentini, L. Gigliarelli, A. Palomba, M. Puletti and F. Panara, "Temporal Study of Stress-Induced Effects Caused by Developmental Temperature Changes and Water Quality in an Isolated Northern Pike (Esox lucius L.) Population," *Journal of Water Resource and Protection*, Vol. 2 No. 2, 2010, pp. 167-180. doi: 10.4236/jwarp.2010.22019.

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