THE PHYSIOLOGICAL AND GROWTH RESPONSES OF *Oreochromis esculentus* (Graham, 1929) POPULATIONS AT DIFFERENT TEMPERATURE REGIMES

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GENERAL ABSTRACT

Oreochromis esculentus, the once most important commercial fish species in Lakes Victoria and Kyoga, is currently confined in a few minor lakes. The rising atmospheric temperatures due to climate change may worsen the vulnerability of the surviving populations. Therefore, there is an urgent need for the species' conservation. However, scientific information needed to plan the species' conservation and stock improvement is limited. This study was carried out to document the metabolic, physiological, biochemical and growth responses of *O. esculentus* to different temperatures within and above the current normal range. A comprehensive temperature trial was conducted in a controlled laboratory set up where juvenile *O. esculentus* of three populations (Lake Kacheera, L. Nabisojjo, and farmed fish) were reared at 25, 28, 31, and 34 ^{o}C for 21 - 28 days. The experimental temperatures were based on the current lower mean temperature (25 ^{o}C) in its natural ecosystem and the maximum predicted global temperature increase (7 ^{o}C) by the end of the 21st Century. The critical thermal maximum (CT_{max}), and a range of metabolic rate traits (maximum metabolic rate-MMR, standard metabolic rate-SMR, aerobic scope-AS and lactate dehydrogenase LDH), heamatological profile (plasma cortisol, serum protein and glucose, and white blood and red blood cell counts and their indices), digestive enzymatic activity (proteases, amylase and lipase) and growth traits (condition factor, length-weight relationship, hepato-somatic index -HSI and specific growth rate -SGR) were assessed. Results showed that CT_{max}, metabolic traits and blood cell counts with their indices and digestive enzymatic activity, increased with

temperature. Whereas, plasma cortisol, serum glucose, and protein, and all growth traits decreased with temperature. The CT_{max}, the maximum metabolic rate, plasma cortisol, serum protein, red blood cell counts with their indices and amylase activity all varied significantly among acclimation temperatures. However, the aerobic scope (AS), lactate dehydrogenase (LDH), glucose, white blood cell count with their indices, and the activity of lipase and proteases did not show significant variation when tested at 95 % significance level. Fish growth was isometric, and significantly different among the populations. However, there were no significant differences in most of the tested parameters (apart from specific growth rate and standard metabolic rate) among the species' populations. This may signify limited genetic variation. The L. Nabisojjo population exhibited the best traits in most of the tested parameters which qualifies it as the best source of broodstock for aquaculture and thermal resilience research. However, there was noticeable variation in most traits even within populations. Overall, the findings suggest that *O. esculentus* can adapt to higher climate change induced temperatures when allowed time for acclimation. The physiological resilience of all the species' populations to high temperatures suggests that *O. esculentus* is a suitable candidate for earthen pond aquaculture where extreme seasonal and diel temperature changes are experienced regularly. However, the study recommends selective breeding using L. Nabisojjo population as the source of broodstock based on the population's observed superior adaptative qualities. Furthermore, investigations into other vital aspects such as species' immunity to disease, fecundity under thermal stress, the genetic variation among existing populations and finally scientific modelling of climate change impacts on *O. esculentus* should be carried out.

Key words: *Oreochromis esculentus,* biochemical, physiological, temperature regimes