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# GLOBAL WARMING: IMPLICATIONS ON FRESH WATER FISH. A REVIEW.

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## ABSTRACT.

*Global warming and climate change are growing environmental concerns which are much in the scientific, governmental and public eye are present. The potential impact on freshwater fish is immense because most fish have no physiological ability to regulate their body temperature.*

*Keywords: Global warming, climate change, freshwater fish.*

## INTRODUCTION.

The issue of global warming has assumed a worldwide dimension cutting across developed and developing nations, necessitated by the impacts generated as a result of either natural variation or anthropogenic emission of "greenhouse gases". Scientist are increasingly been called upon to predict the outcomes of global temperature changes on fish populations.

Temperature is known to affect the behavior, feeding, growth and reproduction of fish. In general it has a pronounced effect on chemical and biological process. Rates of chemical and biological reactions double for every 10°C increase in temperature. Fishes are known to have poor tolerance to sudden changes in temperature (Boyd, 1979).

Global warming is as a result of natural or human – induced increase in the average global temperature of the earths, surface (Daniel & Edward, 1998). This is brought about by the action of Green House Gasses (GHG) notably carbon dioxide, methane and nitrous oxide which are transparent to short wave solar radiation during the day, but opaque to terrestrial radiation at night thereby increasing global temperature. According to the GIEC (International group of experts on global warming) (2007), global temperature should increase by 1.4° – 5.8°C between now and the year 2100. As small as this temperature may appear, its consequences would certainly be devastating. Environmental hazards would be pushed to the extreme such that certain species of plants and animals both terrestrial and aquatic would become extinct especially within the tropical parts of the world which holds the most agrarian population.

Freshwater fish living in relatively small bodies of water also frequently experience marked diurnal and seasonal changes in temperature, often in excess of 20°C. Although some species become torpid at low temperature others can remain active over a wide range of temperatures, indicating phenotype plasticity (Lemons & Crawshaw, 1985). This paper reviews the effects of elevated temperature on spawning and post ovulatory viability of fish eggs..

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## POSSIBLE EFFECTS OF GLOBAL WARMING ON FRESHWATER FISHES.

Meteorological monitoring has indicated an increase in atmospheric CO<sub>2</sub> levels and a rise in global air temperatures. Global climatic change models have predicted that the average global air temperature may increase by up to 0.5°C per decade (Haughton, Jenkins & Ephraums, 1990). In freshwater ecosystems fish are already exposed to fluctuation in water temperature on an annual, seasonal and daily basis; these fluctuations can be quite large; however, the general trend is upward. Schindler *et al.* (1990) report that the mean annual air and water temperature of the experimental lakes Area of northwestern Ontario has increased by 2°C and length of the Ice – free season has increased by 3 weeks over the last 30 years. The effects of global warming on fresh water fish may vary according to latitude: it is possible that climate change may result in a general year round shift average water temperature or it may accentuate the seasonal differences already present. However, most of the models that seek to describe the possible effects of climatic change on freshwater fish have focused on lacustrine environments (e.g. Hill & Magnuson, 1990; Magnuson, Maisnea & Hill, 1990; McLain, Magnuson & Hill 1994; see also Magnuson & Destasio –) and there is a scarcity of data for riverine fish (Power, 1990; Yensen, 1991).

## SPAWNING.

Most fish are external fertilizers and the release of gametes to the environment via the behavior act of spawning must occur before fertilization can take place. It is not clear what effect temperature change is likely to have on spawning behavior and endocrine state. (Reviewed in Pankhurst, 1995), and any environmental factor that interferes with normal endocrine function may also disrupt behavioral process.

## POST OVULATORY EGG VIABILITY

Following ovulation, gamete viability is dependent on the residence time of the eggs in the oviduct or body cavity before spawning. All fish display a window of post – ovulatory egg viability within which spawning must occur if optimum fertility is to be achieved. This window can range from as long as days to weeks in rainbow trout (Billard & Breton 1977; Springgate *et al.*, 1984) and Pacific herring, *Clupea harengus* (Hay, 1986) to as little as a few hours in New Zealand snapper (Scot, Zeldis & Pankhurst, 1993), goldfish (Formacin, Hori & Lam, 1993) and sabalo, *Prochilodus Platensis* (Fortuning, Ros & Amutio, 1988). The rate at which post ovulatory viability declines is temperature dependent. The fall in egg viability is thought to be associated with falling intracellular levels of ATP (Bonlekbache *et al.*, 1989). At later stages of 'over ripening' there is photolytic breakdown of yolk proteins and loss of small organic molecules or fragments through the egg membranes (Craik & Harrey, 1984). Both processes are likely to be accelerated at high temperature. Collectively, these data indicate that even when Oocytes develop and are ovulated normally, exposure of ovulated fish to abnormally high temperature may change the phasing of optimum egg viability relative to the time of spawning.

## TEMPERATURE AND STRESS.

In appropriate temperature regimes or rapid changes in temperature are stressful to fish and may also

augment the response to other stressors (reviewed in Barton & Iwana, 1991; Pickering, 1992). The primary effects of stress are to activate the sympathetic chromaffin tissue, and hypothalamic – pituitary interregal pathways, resulting in the release to the blood stream of catecholamine's and corticosteroid hormones, respectively. These hormones collectively enhance metabolic process that provides a short – term benefit to the animal in terms of responding to the stressor. If, however, the stress is maintained, and then detrimental effects often begin to occur as a result of the stress response (Barton & Iwana, 1991). One of these is inhibition of reproductive function, with stress resulting in depression of plasma levels of reproductive hormones, cessation of ovulation, and ovarian atresia (Reviewed by Pankhurst, Van Der Kraak & Peter, 1995). The mechanism whereby stress exerts its effects on reproductive process are not well understood, but if exposure to elevated temperatures results in sustained activation of the physiological stress response, then one of the probable outcomes will be the inhibition of reproductive functions.

## CONCLUSION

Temperature affects virtually all aspects of reproduction cycles in fish including spawning process and the viability of post ovulatory window of eggs. This includes alterations in the secret hormones associated with all components of the hypothalamic – pituitary-gonad which controls spawning process

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