Environments of the Black-chinned Tilapia, Sarotherodon Melanotheron, and Their Potential Effects on the Genetic Structure of Stocks in Ghana

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Ghana is one of the countries bordering the Atlantic Ocean on the coast of Africa. The country is located between latitudes 5" N and 11" N and longitudes 1" E and 3" W The coastline of Ghana, approximately 550 km long, is dotted with about 50 lagoons and estuaries that, together with rocky capes and a variety of sandy bays, constitute its coastal wetlands (Armah 1993). These lagoons, estuaries and associated floodplains provide habitats for a variety of wildlife including birds and fishes (Ntiamoa-Baidu 1991). With an estimated 40 000 ha surface area, the lagoons are important fish and fisheries resources for associated communities. The fish species composition of these lagoons varies slightly, but a constant and predominant species is the black-chinned tilapia, *Sarotherodon melanotheron* (Ruppel, 1852).

A recent survey of the proportion of S. *melanotheron* in local subsistence fishing showed that 60-80% of all fish caught in the lagoons were tilapias. Among the tilapias, S. *melanotheron* constituted between 85 and 98% of catch in various lagoons. Observations made in many West Mrican lagoons indicate a similar predominance of *S. melanotheron.* It is evident that this resource, if properly managed, might support a more important fishery, especially in Ghana.

S. melanotheron has also recently been recognized as having a potential for culture. Various studies have contributed information related to its culture performance (e.g., Egonifgh et al. 1996; Legendre and Trebaol 1996; Falk et al. 1998; Gourene and Teugels 1998). Some of these studies were on the genetic resources of *S. melanotheron* for the appropriate utilization of these resources. Thus, it is necessary to consider how the genetic structure of its populations might be influenced by their environment.

Ample evidence exists that pollutants in marine and estuarine environments can influence the genetic structure of organisms living in them. This study thus aimed at documenting the status of some of the major sources of *S. melanotheron* in Ghana, with respect to pollution. The sites studied included the Abbey, Ankobra, Whin, Pra, Aminsa, Nakwa, Mumford, Benya and Fosu Lagoons. The sources of pollution for these lagoons have been discussed by Armah (1993). **In** general, pollutants present in the lagoons could influence the genetic structure of organisms living there, including fish, in the following ways:

- *Genotype-dependent performance.* Exposure of organisms to pollutants requires adaptation to stressful conditions, which requires energy expenditure by the exposed organisms. Koehn and Bayne (1989) suggested that the energy cost and the success of organisms to "provide" the required energy was genotype- dependent.
- *Pollutants and mutations.* Pollutants are known to cause mutations by affecting nuclear DNA directly, leading to mutations at individual loci or to chromosomal aberrations (Dixon 1985). Metal concentrations above background levels have been shown to affect loci of various enzymes in *Mytilus* and other shellfishes. For example, copper and zinc have been implicated in phosphoglucose isomerase (PGI) and phospho- glucomutase loci (PGM) changes in *Mytilus* (Lavie and Alevo 1982; Dixon 1985).
- *Differentialfitness of genotypes.* Available evidence also indicates that populations living in contaminated environments often exhibit significant changes in genetic structure. This is due most probably to differential fit- ness of genotypes. However, the direction of change can be variable (Fevolden and Garner 1986), which has been attributed to a number of factors, including differences in the ability of species to respond to stress conditions; for example, homozygotes may yield selective advantage to others.
- *Protein structure.* The variability of responses to pollutants has also been related to differences in protein structure of allelic products at polymorphic loci, which reacts differently with pollutants. It is postulated that at a two-allele locus coding for a monomeric enzyme (e.g., PGM or MPI), enzyme activity reduction could be due to the effect of pollutants on one of the variants. However, heterozygotes at nonmonomeric loci may have higher activity because of the quaternary structure (characterized by the hetero- duplex chains) that none of the homozy- gotes possesses (Traut et al. 1989).

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Discussion

Dr. Brummett: Could you comment on the displacement of *Oreochromis niloticus* in Lake Ayame by S. *melanotheron?*

Dr: Abban: I can't be very sure, but there is literature showing that, among tilapias, wherever you put S. *melanotheron,* in the end they replace the whole group, but it is not known how long this takeover will last and I don't know why.

Dr. Van der Bank: I share your concern about the movement of fish from one place to another because we do not know much about our local stocks and their use in the future. We should also think about the changes in our environment. These changes happen so fast that the fishes cannot cope with them.

Dr. Abban: Sure, but we cannot stop the practice of moving fish from place to place as far as culture practices are concerned. A characteristic of a fish in one environment that makes it good for culture may not function in the same way in a new environment. Some kind of evaluation is needed.

D7: Pullin: On the general question that you asked about "pollution-challenged situations", my feeling is that a population that has survived those kinds of situation may itself be a valuable resource.

D7: Teugels: Did you say that S. *melanotheron* adults predate on juveniles of other species?

Dr. Abban: I said so, but not because it is particularly carnivorous. I have read that it can feed on the eggs of other tilapias.

D7: Brummett: Most tilapias eat the fry of other fish but the question is whether they are able to distinguish their own fry from those of other species.