

# Management Issues for the Sustainable Use of Lagoon Fish Resources

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## Introduction

Coastal lagoons form an integral part of marine fisheries and provide important spawning and nursery grounds for many fish species. The economic contributions of lagoon fisheries have not been given adequate consideration by fisheries authorities. Ghana's 550-km coastline includes over 90 lagoons. These lagoons and their wetlands provide valuable products and services, which include supporting the fisheries, absorbing floodwaters and protecting biodiversity. They also serve as roosting, nesting and feeding sites for many species of birds.

Through the support of the World Bank and the Global Environmental Facility, Ghana has designated five coastal wetland areas as Ramsar sites due to their importance as fishing areas and as roosting, nesting and feeding sites for waterbirds. These are the Muni- Pomadze Lagoon, the Densu Delta, and the Sakumo, Songhor and Keta Lagoons.

The Ghana Coastal Wetlands Management Project (GCWMP) was initiated under the auspices of the Ghana Wildlife Department to undertake studies for the sustained management of the resources in these Ramsar sites. The management of lagoon fisheries depends also on understanding the socioeconomic nature of the fisheries, biological knowledge about the resources and capture characteristics of the fishery.

Research, as part of the fisheries component of GCWMP, was carried out between June and December 1998 to look at the fishery resources of these five sites and their exploitation (especially that of *Sarotherodon melanotheron*), and to evaluate traditional management practices and options. For further details of these sites, see Pauly (1975), Mensah (1979), Ntiamoa-Baidu (1991) and Ntiamoa-Baidu and Hollies (1998).

Some of the fishing gears in use are cast nets, dragnets, hook and line, acadja, and various traps. Fishing pressure is high in all five lagoons. *S. melanotheron* normally constitutes over 60% of the catch (Eyeson 1983; Blay and Ameyaw 1993; Koranteng 1995) and forms over 90% of all fish caught from the lagoons in Ghana (Denyoh 1982). Altogether, 20 fin- fish species belonging to 17 genera and 10 families were encountered in the five lagoons. The most important invertebrates encountered were the blue crab *Callinectes amnicola*, the lagoon crab *Cardiosoma armatum*, the shrimp *Penaeus notialis*, and the gastropod *Tympano-tonus fuscatus*. The fisheries in these lagoons are threatened by irresponsible fishing and environmental degradation. This is manifested in the high exploitation rates of *S. melanotheron* and small sizes encountered. Direct and indirect management schemes have been suggested.

In the past, management of these lagoons was linked to traditional beliefs in the form of taboos and other cultural practices. With increasing urbanization, the migration of fishers and the effects of western practices, these traditional rules and regulations are being lost or forgotten (Ntiamao-Baidu 1991).

### Summary of Results

Some of the freshwater species encountered were *Oreochromis niloticus*, *Tilapia zillii*, *Hemichromis fasciatus* and *H. bimaculatus*. The common marine species found were the mojarra (*Gerres melanopterus*), half beak (*Hyporhamphus picarti*) and the needle fish (*Strongylura senegalensis*). Juveniles of the flat sardine *Sardinella mardrensis*, mullets *Mugil curema* and *Liza falcipinnis* as well as *Caranx hippos* were also encountered. The endemic fishes in all the lagoons were mostly cichlids.

*S. melanotheron* is the dominant fish in all five lagoons comprising 66% in Muni, 80% in the Densu Delta, 95.9% in Sakumo, 59% in Songhor and 33% in Keta. *I. guineensis*, *I. zillii* and *H. fasciatus* were also found in the catches. In Keta Lagoon, *Pellonula leonensis* was most abundant (Shenker et al. 1998).

Fishery yields from lagoons are not uniform due to fluctuations in salinity, conductivity, dissolved oxygen, pH and depth. Fishing effort changes from one season to another

Table 1. Catch per unit effort (CPUE) effort, estimated total catch by cast nets and average daily catch of *S. melanotheron* in five Ghanaian lagoons from June to December 1998.

Lagoon	CPUE (gperson-hour <sup>-1</sup> )	Effort (person-hours-day <sup>-1</sup> )	Catch per day (kg)	No. of fishing days	Estimated total catch per month (kg)
Densu Delta	978.8	208*	203.6	30*	61140
Keta	321.5	-	-	-	-
Muni-Pomadze	106.0	105.3*	11.2	25*	280
Sakumo	551.6	235.5*	129.9	28*	3637
Songhor	65.3	-	-	-	-

\*. indicates data from baseline studies (Koranteng 1995).

due to changes in water level and other environmental conditions. Annual fishery production estimates for *S. melanotheron* using baseline data (Koranteng 1995) were 270 t from the Densu Delta, 75 t from the Muni-Pomadze Lagoon and 114 t from the Sakumo Lagoon. The gear most commonly used in the lagoons is the cast net, although drag nets are commonly used in the Songhor and Keta Lagoons. Other fishing gears used in the lagoons are bottles, hook and line, acadja and traps. Although acadjas act as fish aggregating devices and provide shelter for fish thereby enhancing fish breeding in the Densu Delta and Keta Lagoon, the use of mangroves and twigs, which are cut from neighboring vegetation, makes this method of fishing environmentally unfriendly. Table 1 gives the catch per unit effort, average daily catch and estimated total catch of *S. melanotheron* by cast nets in these five lagoons from June to December 1998. Table 2 shows some parameters for growth and exploitation level of *S. melanotheron* in the five lagoons.

The natural mortality of *S. melanotheron* was between 1.55 and 2.21 per year. Keta Lagoon had the highest natural mortality, followed by the Densu Delta and Sakumo Lagoon. This high value can be attributed to predation by birds. The instantaneous total mortality rates (ranging between 2.96 and 5.43 per year) of the fish were also high in all the

Table 2. Growth parameters and exploitation of *S. melanotheron* in the five Ghanaian lagoons.

Parameter	Densu delta	Muni	Sakumo	Songhor	Keta
L <sub>∞</sub> (cm)	11.5	12.5	12.5	12.4	17.5
L <sub>max</sub> (cm)	11.5	9.5	12.5	11.5	14.5
L <sub>m</sub> (cm)	3.2	5.8	5.2	4.2	2.2
L <sub>c</sub> (cm)	4	3.8	4.7	4	4
L <sub>c</sub> /L <sub>max</sub>	0.27	0.61	0.42	0.37	0.15
M (year <sup>-1</sup> )	1.92	1.55	1.64	1.21	2.21
F(year <sup>-1</sup> )	3.5	1.93	2.51	1.75	2.81
Z(year <sup>-1</sup> ) = F/Z <sup>0</sup>	5.43	3.48	4.15	2.96	5.02
	0.65	0.55	0.61	0.59	0.56
	1.99	1.93	1.97	1.77	2.53

lagoons. From length at first capture and length at first maturity, it is clear that fish are being caught at very small sizes and that some are mature at these sizes. The estimated growth performance indices ( $\dot{O}$ ) ranged from 1.77 to 2.53, implying fast growth and an "r selected" mode of life, adapted to unstable ecological conditions and high mortalities. The exploitation levels (0.55-0.65) suggest overexploitation, capitalizing upon the rather fast early growth and continuous spawning habit of this species.

These fisheries are also affected by habitat degradation, pollution by domestic waste and poverty of the fishers. Overfishing causes changes in the size structure of the fishes as well as species composition of the catches. Most of the mangroves around the lagoons have been cut down for fuelwood and to make way for salt pans. Thus the breeding and feeding sites of the fish are being destroyed. Fishers also tend to use smaller mesh nets as a means to increase their catch.

The effectiveness of traditional conservation in fisheries management at the local level has been recognized by many scientists. Ntiamo-Baidu (1991), in comparing the size composition of *S. melanotheron* and *T. fuscatus* in Djange and Sakumo Lagoons, clearly showed that traditional beliefs and associated taboos can be effective tools for conservation if they are adhered to.

The principal traditional management practices employed in the five lagoons studied are:

- *Closed fishing days, seasons and areas.* Sakumo is closed for fishing for about four months of the year and fishing is not allowed before noon on Fridays; in Muni Lagoon, fishing is not permitted on Wednesdays; in some areas around Keta Lagoon, fishing is banned on Sundays and before certain festival times; there are no restrictions in the Densu Delta.
- *Restriction of certain gears.* The use of drag-nets is not permitted in the Muni and Sakumo Lagoons.
- *Regulation of entry.* In the Lufenya wing of Songhor Lagoon, only the fetish priest and people living near the lagoon are allowed to enter; in Muni Lagoon, only the indigenous people are allowed to fish.
- *Taboos.* It is prohibited to use a canoe on the Muni and Sakumo Lagoons. Women are not allowed to cross the Muni and Songhor Lagoons during their menstrual period.
- *Mesh size regulation.* The use of mesh sizes below 25 mm is not permitted in the Muni and Sakumo Lagoons.

It can be concluded that to protect the juveniles and spawning stocks of *S. melanotheron*, the following should be implemented:

1. existing mesh size regulations should be enforced;
2. District Assemblies should be assisted by the Fisheries Department and traditional authorities to determine the total allowable catch (TAC) for each lagoon in their area, and the appropriate fishing gears and effort to achieve the TAC;
3. traditional authorities or District Assemblies should ensure legally backed enforcement of a system of appropriate controls and fines;
4. efforts should be made to restore mangrove cover; and
5. fishers and their children should be educated to appreciate the importance of resource management.

Diverting fishers into other jobs such as masonry and carpentry can lessen the problem of poverty.

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## Discussion

- Dr. Van der Bank:* What do you mean by dominant species?
- Ms. Entsua-Mensah:* The most important in terms of weight and number.
- Mr. Kwafu:* Can't traditional methods be complemented with stocking programs?
- Ms. Entsua-Mensah:* Yes, but whatever is done should be in consultation and in agreement with the local fishers.
- Dr. Kouassi:* During your presentation, you talked about some conservation methods. Have there been any such measures in the Aby lagoon?
- Ms. Entsua-Mensah:* None.
- Dr. Brummett:* Stocking programs are not that successful. Examples can be cited from several places. You may end up increasing the fishing pressure. Co-management programs are needed along with the stocking program to manage the fishing pressure.
- Dr. Teugels:* Are there any data on the lagoons about 20 years ago? Are fishes disappearing?
- Ms. Entsua-Mensah:* Yes, there are data on some lagoons. There have been indications that fishes are disappearing.
- Dr. Laleye:* Some aspects of taboos are good. Do you need to take some measures in the enforcement of these good taboos?
- Ms. Entsua-Mensah:* Yes, that is being taken into consideration in the new Coastal Management Programs.
- Ms. Akrofi:* The Directorate of Fisheries is in close contact with the fisherfolk concerning the adoption of co-management strategies. By-laws are to be passed very soon to address some of these issues.
- Dr. Pullin:* It is good that the Ramsar Convention has expanded its criteria for the designation of Ramsar sites to include criteria based on important fish and fish habitats. Also, it is good that these five lagoons are all Ramsar sites. My question is, do the people who live there know they are Ramsar sites and what do they think about it? Has the designation done anything for the conservation of fish?
- Ms. Entsua-Mensah:* Yes, the people know that, and all the sites have assigned Wildlife Officers who are trained on a lot of issues including fisheries. They benefit a lot from these training programs. There are also District Management Committees in place, so there is more awareness now.