Stock enhancement as a major element of reservoir fisheries management

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ABSTRACT

For poor local communities throughout the riparian countries, reservoir fisheries are an important source of food and family income. The Management of River and Reservoir Fisheries (MRRF) and Aquaculture of Indigenous Mekong Fish Species (AIMS) components of the Mekong River Commission (MRC) Fisheries Programme play an important role in augmenting these natural resources by restocking them with species of fish indigenous to the Mekong. The stocking supports government policy to regenerate those species that have been lost and to increase the catch in this important ecosystem.

This paper reports the findings of a study carried out in northern Cambodia in November 2002 on the effects on local food supply and family income of stocking the Thmorda reservoir. Stocking is widely accepted by fishers as one of the most practical ways of strengthening community fisheries management and improving the livelihoods of local people. With the support of the Department of Fisheries (DoF), MRRF and AIMS, local inhabitants of the Thmorda reservoir formed community fishery (CF), drew up a reservoir-wide management plan that included restocking as a priority activity. The community then participated in restocking the reservoir with 21,500 fingerlings of native species (*Barbonymus gonionotus, Barbonymus altus, Pangasianodon hypophthalmu*s and *Trichogaster pectoralis*) produced at Bati and Chrang Chamres, and monitoring the results of their activities.

During the seven months following restocking, the reintroduced fish grew five to six times faster than fish in pond-based aquaculture systems. Up to 30-40% of reintroduced *B. gonionotus* and *B. altus* were recaptured within seven months and had reached a total weight of about 1,180 kg, with an estimated value of about US$1,700.

Whilst these results are encouraging, the ecological effects of stocking on the reservoir and the socio-economic effects on people living in the area need to be investigated further .

KEY WORDS: Reservoir, stock enhancement, livelihood, CF participation

INTRODUCTION

Literature on Cambodia's inland fisheries makes frequent reference to the abundance of fish in the Tonle Sap and Mekong river systems, and to the expertise of the fishers who exploit these resources. Fish, together with rice, forms the stable diet of most Cambodians. Inland fisheries provide three quarters of the animal protein consumed by the population. In addition, fishing is a major source of income providing full or part-time employment for around two million people. Fishing is the principle livelihood for many rural families, who comprise almost 90% of the country's poor. Inland fisheries produce between 290,000 - 430,000 tonnes of fish each year; and the value of the landing is in the order US$150 to US$200 million (DoF 2002). The contribution of freshwater capture fisheries to national food security, and to the larger Cambodian economy, is probably higher than in any other country in Southeast Asia.

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Cambodia has a vast fresh water system that extends over nearly two million hectares. This system contains over 600 reservoirs, in addition to rivers lakes, flooded forest, grassland, rice fields, and swamps. Reservoir fisheries in this system are an important source of food and income for poor local communities.

Whilst these reservoirs may adversely affect existing fish habitats and stocks, they can also provide new environments well suited for fish aquaculture and fisheries. The government of Cambodia acknowledges the importance of reservoir fisheries and emphasises the need for appropriate management to promote and develop their existing use and to ensure the fisheries sustainability into the future.

The ecological issues relating to the reservoir fisheries draw increasing attention. These issues include, the consequences of over-fishing and the impacts of destructive practices such as, electro-fishing and fishing with homemade bombs, dynamite, and fine-mesh nets. Although Cambodian law prohibits these practices, they are still commonplace and cause great damage to fish populations and other aquatic fauna.

However, effective fisheries management, with the involvement of local communities, has been able to reduce the incidence of two of these illegal practices (bombs and dynamite) countrywide. This kind of cooperation, together with active stock enhancement, may pave the way for rehabilitation and preservation of the country's aquatic resources.

This paper documents the results of restocking the Thmorda reservoir, in northern Cambodia, with species of fish that were under threat of becoming extinct locally. The exercise, which required the cooperation of the local community and local fisheries authorities, shows that effective management can enhance food supplies and family incomes.

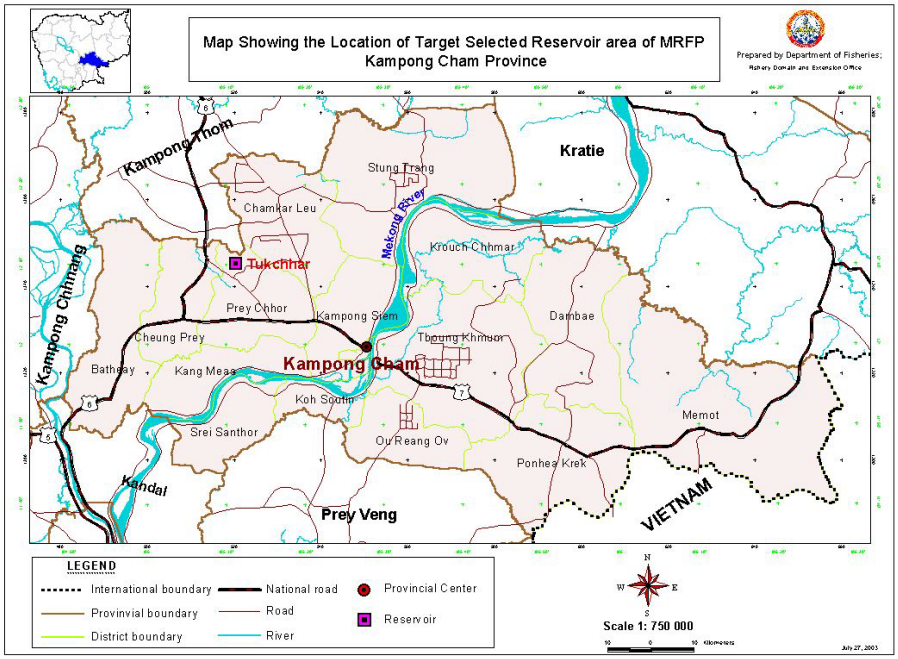

Figure 1. Location Map

THMORDA RESERVOIR

Characteristics and ecology

The Thmorda reservoir in Kampong Cham province of northern Cambodia is located 17 km from the provincial capital and 135 km north of Phnom Penh. Originally built during the Pol Pot era (1976 to 1977), the reservoir was refurbished in 1996 with the aid of a US$1,543,000 Royal Government Loan from the Asian Development Bank (ADB).

The designated area of the reservoir covers 200 ha, the surface area of water is approximately 70 ha and it has a maximum depth of four metres. With storage capacity of nearly 2.5 million m^3, the reservoir can provide enough water to irrigate 2,000 ha of rice fields. During the rainy season, the excess outflow from the reservoir flows into the Tonle Sap river via a canal. In the dry season, even though isolated from this outlet, the reservoir can still supply enough water for irrigation purposes.

Fishing activities

The four villages nearest to the reservoir house 749 families. While rice cultivation provides the main livelihood for the villagers, fishing accounts for about 30% of their income. About 15 families, who do not own a paddy field or garden, depend solely on fishing the reservoir for their living.

The Thmorda reservoir is rich in natural aquatic fauna including many species of fish and snails. Estimated fish production in 2001 and 2002 was between 13,000-15,000 kg. Most local fishers use small-scale fishing gear including cast nets, gillnets, seine, hooks, long lines, and spear guns and some collect snails by hand. Using this gear, fishers can expect to catch between 8-10 kg of fish per day during the rainy season and 2-3 kg per day during the dry season. The most common species in their catch are: *Hampala dispar, Pristolepis fasciata, Oxyeleotris marmorata, Channa striata, Clarias batrachus, Clarias macrocephalus, Notopterus notopterus, Henicorhynchus caudimaculatus, Anabas testudineus, Pseudabassis notatus, Mystus nemurus, Monopterus albus, Tilapia nilotica, Macrognathus siamensis,* and *Macrognathus maculates.*

The catch of some species has declined sharply over the past five years because of over-fishing and illegal fishing. These species include *Barbonymus gonionotus, Cyclocheilicthys repasson, Cyclocheilicthys armatus*, *Osteochilus hasseltii* and *Wallago attu.*

Despite the efforts of the community and local authorities to stop it, illegal fishing, usually electro fishing or fishing with very fine mesh nets, continues to be a problem.

Community fisheries management

Residents of the local four villages formed a community fishery (CF) and, with technical support from the Department of Fisheries (DoF) and financial assistance from the Management of River and River Fisheries component (MRRF), drew up a reservoir-wide management plan. The main aims of the plan

Figure 2. Fishing with cast net

Figure 3. Illegal practices, electro-fishing (left) and fine mesh nets (right)

Figure 4. Local people help re-stock the Thmorda reservoir

are to encourage sustainable management of the fisheries and to develop the resources of reservoir in a way that ensures security of food supplies and helps alleviate poverty. The villagers elected a committee that, together with the local authority and technical support from DoF, devised a plan to regulate internal fisheries. The chief of committee and the local authorities endorsed the regulations and distributed them to people living in and around the reservoir. Since the introduction of these regulations, illegal fishing has declined and fish stocks are recovering.

An example of stock enhancement as a major component of reservoir fisheries management

Why stock?

Re-stocking indigenous fish species also has high priority in the community fisheries' reservoir-wide management plan, the members saw as it another means to increase the catch and improve the livelihood of local people. They also see it as a very effective way of regenerating fish stocks depleted by over fishing and legal fishing. The Prime Minister of the Royal Government of Cambodia officially signed a sub-decree on 25th August 2002, and with immediate effect, declaring July 1st of every year National Fish Day.

METHODS

In support of this proclamation, the Thmorda reservoir was targeted as a site for restocking. The community fishery selected fish species that were in danger of becoming locally extinct to restock the reservoir (Table 1). These species, which include *B. gonionotus*, *Barbonymus altus, Pangasianodon hypophthalmus,* and *Trichigaster pectoralis,* are known to thrive in the type of habitats provided by the reservoir.

Table 1. *Number and weight of fish species restocked in the Thmorda reservoir*

Species	N° of seeds stocked	Average weight (g)
B. gonionotus	10,000	2.60
B. altus	10,000	1.60
P. hypophthalmus	1,000	1.30
T. pectoralis	500	2.50
Total	**21,500**	

Brood stock were collected from the Tonle Sap River and bred at the Chrang Chamres station. Fish seed from the station was transferred and stocked in the reservoir on 6th November 2002. A stocking ceremony, organised by the community fishery, and attended by local authorities, department and provincial fisheries officers, presented an opportunity to advise local people how to manage stocked fish and urge them to stop using prohibited fishing gear.

Monitoring and data collection

Regular monitoring began immediately after stocking and continues today. Forty local fishers, provided with special record sheets to ensure accuracy, give monthly accounts of the type of fishing equipment

they use and the number, species, weight, and market price of fish they catch. Every month a district facilitator collates these data. The data provide a record of the recapture of restocked fish.

At the same time, informal discussions with the community fishery and fishermen provide feed back on the progress of the fish stocking programme and promote information sharing. These discussions take in the yearly catch assessment in order to evaluate the catch since the formation of the community fishery and the restocking of the reservoir.

RESULTS

Restocking took place in November 2002. By May 2003, seven months after stocking, the average weight of recaptured specimens of *B. gonionotus* and *B. altus*, were 0.8 kg and 0.4 kg respectively. Figure 5 (opposite) gives the average daily growth rate of the re-introduced fish. Low stocking density and the high productivity of the reservoir probably contributed to growth rates significantly higher than those of the same fish reared in other culturing regimes. As an example, on average *B. gonionotus* gained 3.77 g per day, some five or six times that of the same species reared in a the pond-based culture system. The same is true for the growth rates of *B. altus*, *T. pectoralis* and *P. hypophthalmus,* even though only a small number of the last two species were recaptured.

The numbers of re-introduced fish recaptured reached a peak in December 2002 before decreasing sharply from January to May 2003 (Figure 6-opposite). By May, the proportions of recaptured re-introduced fish were *B. gonionotus* (30%)*, B. altus* (22%)*, T. pectoralis* (15%) and *P. hypophthalmus* (1%).

In contrast, the weight of recaptured re-introduced fish reached a peak in January 2003, remained at a high level through to March, and declined gradually in April and May (Table 2). *B, gonionotus* (72%) and *B. altus* (26%) account for the bulk of the 972.7 kg catch.

Yearly assessment records show that the fish catch increased from 15,000 kg in 2002 to 18,720 kg in 2003, a 20% increase since the formation of the community fishery and re-stocking the reservoir. Re-introduced fish, which accounted for up to 26% of this increase and for about 5.4% of the total 2003 catch, generated an income of about US$1,470.

Table 2. *Total weight (Kg) of stocked fish species recaptured by month*

Species	**Month (Nov 2002 – May 2003)**							
	Nov	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Total**
B. gonionotus	65.0	150.0	155.0	95.0	120.0	70.0	50.0	705,0
B. altus	25.0	50.0	55.0	40.0	50.0	20.0	18.0	258,0
T. pectoralis		1.8	0.5	0.3			4.5	7.1
P. hypophthalmus		0.6		2.0				2.6
Total weight	**90.0**	**202.4**	**210.5**	**137.3**	**170.0**	**90.0**	**72.5**	**972.7**

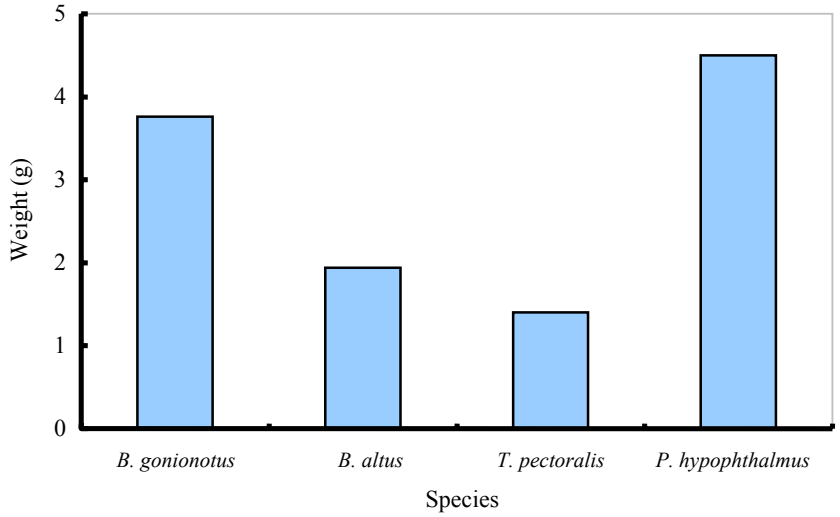

Figure 5. Average daily increase in weight of restocked fish

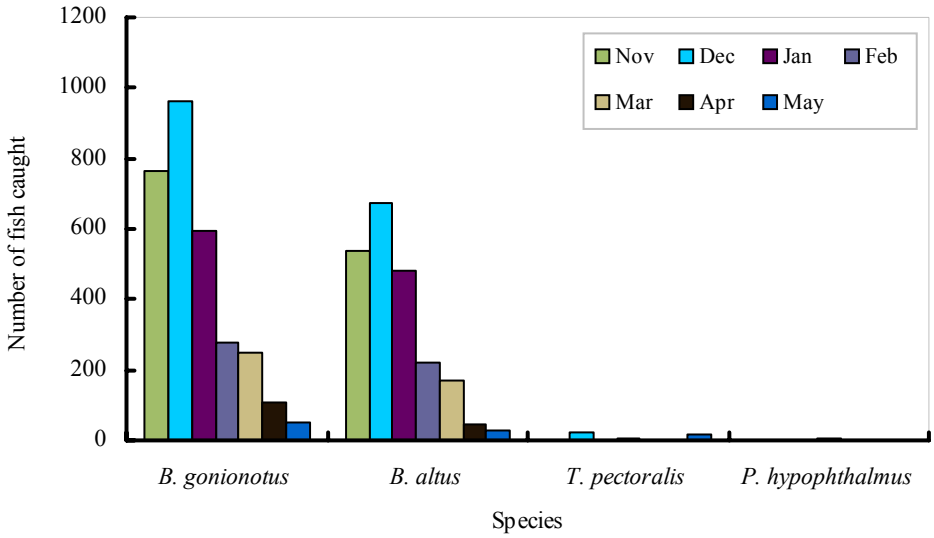

Figure 6. Number of restocked fish recaptured per month

Over 95% of the recaptured re-introduced fish were caught with either gillnets (80%) or cast nets (15%). In order to catch *B. gonionotus* the mesh size of gillnets size was increased monthly. The relationship between the weight of recaptured *B. gonionotus* and the effective mesh size of gillnets is given in Figure 7. Mesh size was increased from 4-5 cm to 9-10 cm in May 2003 when the average weight of this species reached about 800 g (from 2.6 g at stocking).

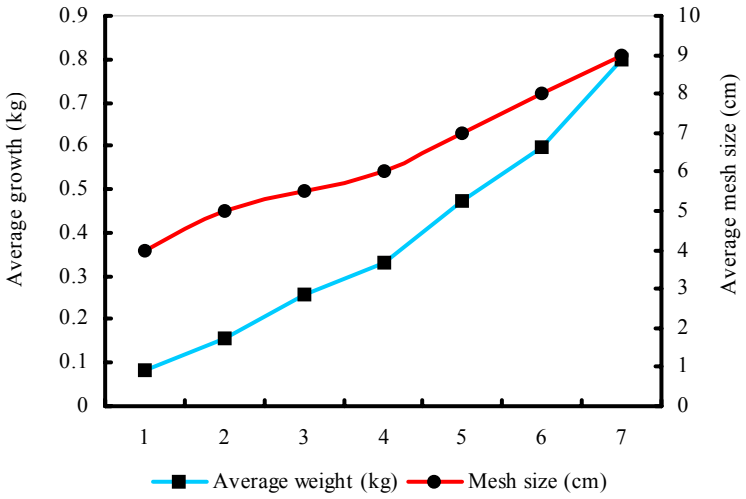

Figure 7. The relationship between weight of *B. gonionotus* and effective mesh size of gillnet mesh size

ATTITUDE OF THE FISHING COMMUNITY TO RESTOCKING

In general, the local villagers were pleased to take part in the restocking programme because the expected increase in their income and the security of their food supply would greatly improve the quality of their lives. The fishers sold about 60% of catch in their local market and kept the remainder for their own families.

Some fishers suggested the community fishery should bring in rules to regulate the mesh size of gillnets and introduce 'fishing seasons'. However, others complained that some fishers were unable to catch re-stocked fish because they could not afford to buy the appropriate fishing tackle.

CONCLUSIONS AND LESSONS LEARNED

Stocking is now widely accepted as one of the most practical and effective ways of improving the fish catch and preserving aquatic resources in reservoir fisheries.

Fish released into the Thmorda reservoir grew quickly and recapture rates were high, up to 30%. *B. gonionotus* and *B. altus* were particularly well suited to the reservoir environment and this factor should be borne in mind when fish species are selected for re-stocking.

Fishers were pleased to participate in restocking because they could see the potential benefits, i.e. more

food, increased income, and a better livelihood. Following the formation of the community fishery and restocking, the total catch increased by about 20% per year. Restocked fish accounted for about 26% of this increase. These realised a sales price of US$ 1,470.

The community fishery must now decide how it wants to control fish stocks and catches. It has two options:

1. The community fishery could regulate fishing activities by restricting mesh size and introducing fishing seasons. If these regulations are applied, the fish catch will increase and fish stocks will be recruited through natural reproduction, removing the need to stock the reservoir artificially. However, long-established fishing practices are difficult to change and these measures may meet some resistance.

2. The second option involves the community fishery nominating an individual to act as fish seed producer. This person could take on the responsibility of producing and stocking the reservoir with fingerlings. In this case, fishers who use the reservoir will pay the wages and costs of the nominated person.

We recommend prolonging the restocking of the Thmorda reservoir and extending the practice to other reservoirs in Cambodia. However, careful selection of the reintroduced species is essential, as they must be compatible with the ecology, productivity and physiology of the reservoir.

Future studies should include the social impact of restocking, constraints faced by fishers, and ecological change in reservoirs caused by this practice.

REFERENCE

DoF (2002). *Cambodian National Fishery Statistics for 2002*. DoF, Phnom Penh.