Community-based Shrimp Stock Enhancement for Coastal Socio-ecological Restoration in the Philippines

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Abstract

The reality of declining quality of coastal areas has been evident for many developing countries, especially in Southeast Asia. In the Philippines, rural coastal zones and estuaries are now being characterized by declining wild fisheries resources and degrading environment. This paper presents, as an example, the typical rural coastal towns of New Washington and Batan in Aklan province, Philippines and showcases how the concept of shrimp stock enhancement can provide incentives to restore the environment and provide sustainable fishing livelihood in the area.

The New Washington-Batan Estuary in northeast Panay Island, Philippines was a productive fishing ground that has been in a state of degenerating brackishwater fisheries and estuarine environment. Average daily catch composed of various species decreased from 24 kg in 1970s to 0.7 kg at present. Shrimp fisheries, the most important livelihood, declined in quality and quantity. The highly-priced and once very abundant tiger shrimp *Penaeus monodon* was replaced with smaller-sized and lower-priced species like the *Metapenaeus ensis*. These can be attributed to the conversion of 76% of mangroves to culture ponds in the past 50 years and more than 400% increase in fishing gears since the 1990s. The need to reduce fishing structures and rehabilitate mangroves is evident. However, these drastic changes directly affect fishers' livelihood. This paper explores the prospects of *P. monodon* stock enhancement as "positive reinforcement" for the estuary's rehabilitation. Number of gears per fisher may have to be reduced but shrimp catches will be relatively high-priced. Simulations with additional tiger shrimp caught due to stock enhancement show that fishers can increase income by more than 4 times from their current PhP 34 $gear^{-1}$ day^{-1}. Campaigns on the importance of mangrove especially as shrimp habitat can encourage local communities to reforest the estuary especially in abandoned ponds. With effective management, law enforcement, and sustained support from different sectors, shrimp stock enhancement can be a positive strategy in estuarine rehabilitation and livelihood sustainability in the New Washington-Batan Estuary.

Keywords: stock enhancement, *Penaeus monodon*, rehabilitation, estuary, mangroves, livelihoods

Introduction

Fish stock enhancement programs have been done since the late 1800s and continues until now for many countries. However, crustacean stock enhancement initiatives, especially for shrimps, are limited. Only seven programs were reported in literature involving varied purposes. In the USA, Kuwait, Sri Lanka, and Taiwan, the primarily aim is to increase available shrimps in the wild for commercial capture fisheries (Bell *et al.*, 2005). On the other hand, the loss of natural coastal habitats and nurseries caused by industrialization in Japan since the 1960s has affected supply of natural shrimp seeds, hence the need for artificial stocking of shrimp juveniles (Hamasaki and Kitada, 2006). In China, excess shrimp seeds originally produced for aquaculture were instead used for release in the wild (Wang *et al.*, 2006). Shrimp stock enhancement projects in Australia were done to verify new scientific protocols and release technology (Loneragan *et al.*, 2006). However, in developing countries like the Philippines where poverty is prevalent especially in rural coastal communities, improving the lives of artisanal fishers through better harvest is the major consideration.

In the Philippines, being an archipelago of 7,107 islands, coastal zones are considered to be the most important areas for residence and livelihood, especially for more than half of the country's 100 million people living in the rural areas. This paper focuses on the New Washington-Batan Estuary as an example, located in the province of Aklan, northern Panay Island, central Philippines (Figure 1).

Methods

Field surveys were conducted to update data and monitor the actual daily catch for the modified fish corral or stake net, locally known as *tigbakol*, the most dominant stationary fishing gear in the area (Figure 2). Twenty *tigbakol* were monitored twice monthly from January to December 2013 to establish a trend in annual harvest, catch composition and catch-per-unit-effort or CPUE. Parallel socioeconomic survey which includes questions related to the present stock enhancement project were also conducted among 200 respondents. Review of secondary data and literature were also done site-specifically, especially on the environmental and fisheries status of New Washington and Batan.

Shrimp fishery in the estuary is considered as the most important livelihood in the area (Ingles *et al.*, 1992). So, more focus was given on shrimps as a commodity, particularly the tiger shrimp *Penaeus monodon* or *sugpo* which commands the highest market value. Stock enhancement impact simulations were also based on *P. monodon*, using the following assumptions: (1) 500,000 shrimps released, (2) 330 fixed fishing gears to potentially capture the shrimps around the area, (3) conservative recapture rate of 2% after 2 months of release, and (4) even lower recapture rate of 0.5% after 3 months of release.

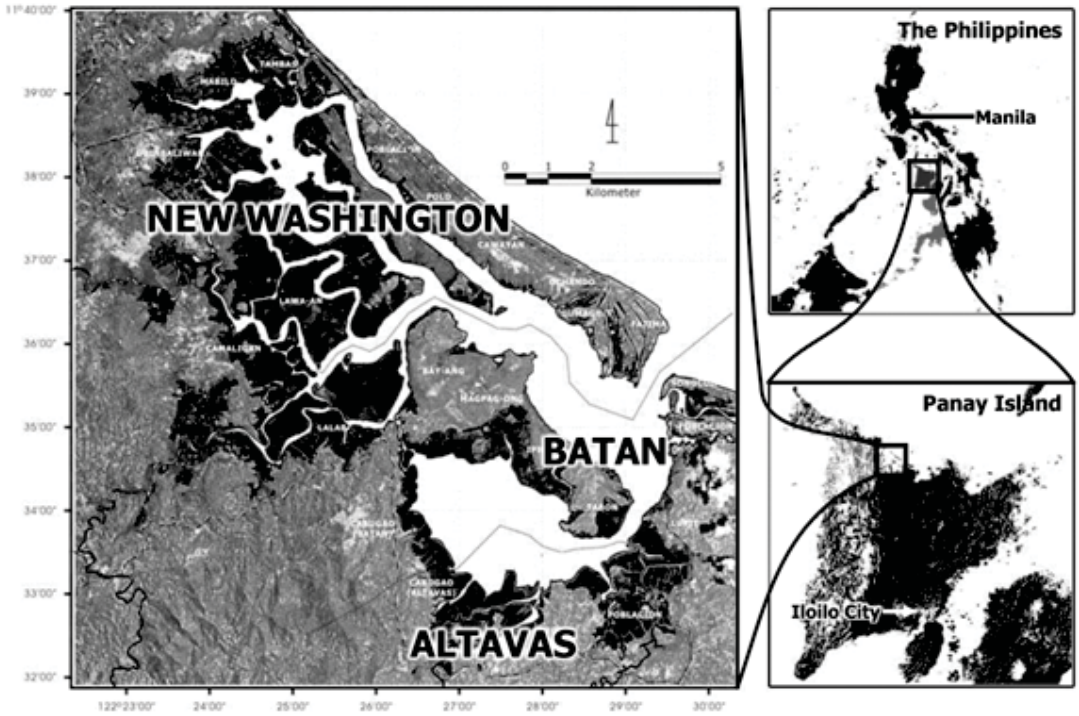

Figure 1. The study site showing the location of New Washington that composes most of the semi-enclosed estuary; Batan in the middle, and Altavas sharing a small portion in the south.

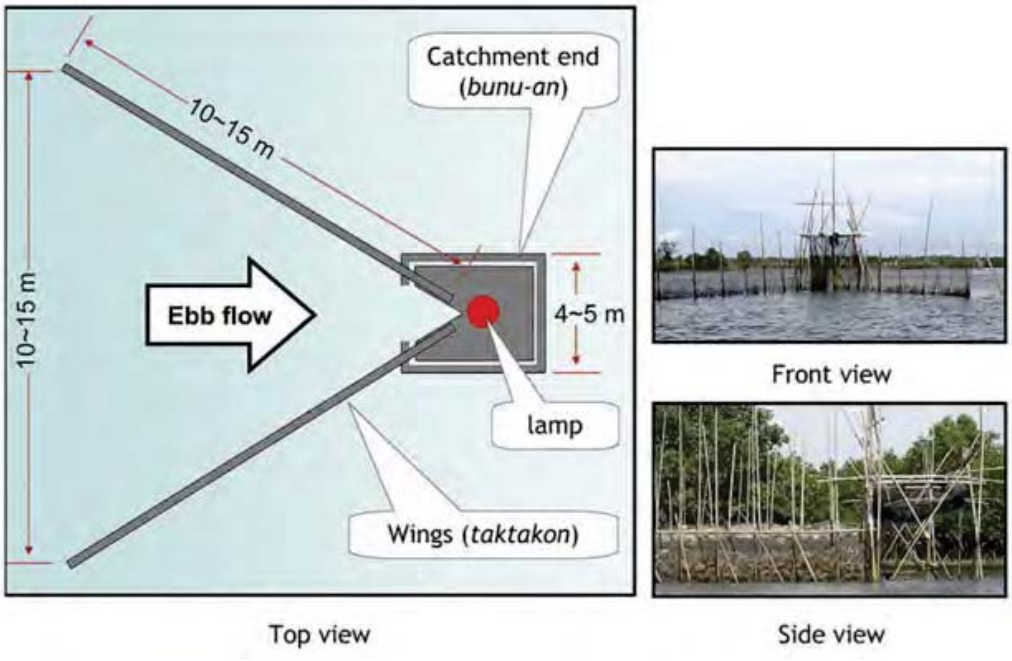

Figure 2. Photos and schematic diagram of the fixed gear *tigbakol* or fish corral.

Results

Changes in the New Washington-Batan Estuary

The New Washington-Batan Estuary was once considered as a very productive fishing ground with lush mangrove forests and abundant aquatic resources but now suffer from degrading environment and brackishwater fisheries (Altamirano, 2007). Mangrove forests were reduced by 76% in less than half a century, from 4,923 in 1950s to only 406 ha of thin fringing mangroves in 2008, which is viewed to have been caused by rapid development of culture ponds from 513 ha 1988 to 3,747 ha by 2008 (Altamirano *et al.*, 2010). Nevertheless, some evidences of conversion of the remaining mangroves or reclaiming riverbanks to build more ponds can still be found.

Decline in estuarine fisheries were similarly striking. Representative CPUE (gear^{-1} d^{-1}) in terms of total daily catch of various species per *tigbakol* was about 24 kg in 1970s, decreasing by about half every decade until 1.65 kg in 2006 (Altamirano and Kurokura, 2010). The most recent survey in 2013 showed an average daily catch per gear of *tigbakol* to be 0.7 kg only. Shrimp fisheries declined in quality and quantity where the highly-priced and once abundant tiger shrimp *P. monodon* was replaced in composition with smaller-sized and lower-priced shrimp species, like *Metapenaeus ensis*. In a 1978 data, *P. monodon* composed some 60% of daily shrimp catch from the estuary (Ingles *et al.*, 1992). However, catch survey in 2006 showed that tiger shrimps only composed <10% of the catch, while more than 80% are of the cheaper *M. ensis*. Most of these catch (about 70%) belongs to the smaller size classes of juveniles of less than 20 mm carapace length (Figure 3). On the average, with this size composition of shrimps, a fisher can only earn PhP 34 per day from sale of catch from one *tigbakol*. Local fishers who recalled catching about 6 kg of tiger shrimps per day in the 70s, were disappointed to catch literally nothing of the species at present. From January to December 2013, the monitoring of 20 *tigbakol* gears twice in a month (a combined total of 480 hauls) only caught a total of 19 pcs of *P. monodon*. This is equivalent to only one tiger shrimp caught for every 25 hauls of the gear.

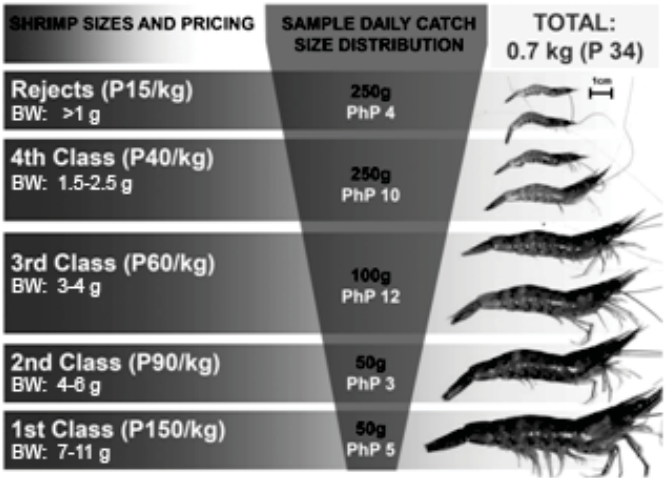

Figure 3. Average daily shrimp catch composition (mainly of *M. ensis*) from *tigbakol* (Altamirano, 2007).

In every decade since 1940s, human population in the area has been increasing by 15-25%, but slowed to only 10% in 2000. Desperate to increase income to feed an average family of 8, fishers intensified fishing effort by multiplying their fishing gears, reaching 400% more stationary gears than in 1990 (Altamirano and Kurokura, 2010). In 2006, surveys showed that fixed gears (fish corral, filter nets, lift nets) in the area already reached more than 2,300 structures. This does not include active gears like gill nets, push nets, traps and others. Surely, the estuary and rivers in New Washington is overcrowded of fishing gears where local navigation is even hampered in some areas because of bamboo structures spanning the whole width of rivers (personal observation).

Anecdotal reports showed that a number of fisheries and resource management programs have already been implemented in the estuary. However, most of these programs were grants and aids that usually only had short term effects and no observable long-term sustainability. The "top-down" nature of these programs mostly fails to reach down into the base of problems, which are the local communities. When funds have been exhausted and activities slow down, people still tend to return to what they were used to do. Driven by poverty and desperation to survive, some fishers engage in illegal fishing practices like the use of small meshed nets, and theft of other people's fishing gears and catch.

Main concerns in the estuary

Interview surveys revealed that fishers and communities were well aware of the threats they are facing in the estuary. They outlined many problems that were generalized into (1) small income caused by poor catch and overcrowded fishing gears; (2) degraded environment with hardly any mangroves, shallow water with heavy siltation; and (3) poor law enforcement. Table 1 further summarizes the main problems in the New Washington-Batan estuary, as well as the direct solutions to these problems. It is with these ideas that shrimp stock enhancement is viewed to play a crucial role.

Table 1. Main problems in the New Washington-Batan Estuary and their direct solutions.

Problems in the estuary	Direct solutions
1) poverty situation among local fishers is worsening due to low quality and quantity of catch, especially of shrimps	1) increase fishers' income
2) intense overfishing in the area is evident with overcrowded fishing gears, and the use of illegal fishing methods	2) reduce number of fishing gears used
3) natural environment is extremely degraded where 76% of mangroves were lost, mostly to aquaculture ponds	3) rehabilitate mangroves

Can shrimp stock enhancement increase income?

Fishers catch about 700 g of shrimps for one gear (*tigbakol*) daily, equivalent to PhP 34 (Philippine Peso), that were sold at prices respective of size class (Figure 3). Assuming that one fisher has 5 gears, the combined daily total catch for shrimps will be 3.5 kg or about PhP 170. This is still below the PhP 235 law-mandated minimum daily wage in this region on 2008 (National Wages and Productivity Commission of the Philippines, 2008). Interestingly, during heavy rains, some dikes of ponds collapse, releasing cultured shrimps out to the rivers. Consequently, fishers noted unusual catch of tiger shrimps at these times, thereby boosting their profits temporarily. This unintentional release of pond stocks

exemplifies the prospects of a programmed shrimp stock enhancement as a viable technique, especially for increasing income of fishers.

Assuming that a successful release of 500,000 tiger shrimps was accomplished in the estuary, possible hypothetical scenarios on impacts on catch are presented in Table 2. With effective fishery rules and enforcement, Scenario 1 shows that two months after release and with a conservative recovery rate of only 4%, each of the 330 *tigbakol* can possibly catch about 60 pcs (900 g total) of *P. monodon* (2-3 cm carapace length, CL; 5-15 g body weight, BW), which can eventually provide PhP 135 in one day. While in Scenario 2, when shrimps are allowed to grow until 3 months after release and even with a much lower hypothetical recovery rate of 1%, each gear can potentially catch some 15 pcs (475 g total) but of larger shrimps (3-4 cm CL, 15-35 g BW). This in turn can also earn the same amount (PhP 135). Whether within scenario 1 or 2, a single gear can sell PhP 135 of tiger shrimps, on top of the PhP 34 pesos of other shrimp species, plus earnings from fish and crabs. This is a huge 400% increase in shrimp sales per fishing gear. The recovery estimates of 4% after 2 months and 1% after 3 months are very conservative, which means that potential higher recovery rates can further increase income of fishers. In comparison, common recovery rates for shrimp stock enhancement activities is around 20%; the lowest recovery rates for shrimp releases was about 5% in Japan (Bell *et al.*, 2005; Hamasaki and Kitada, 2006).

Can shrimp stock enhancement reduce number of fishing gears?

The hypothetical figures in Table 2 show that a single *tigbakol* can potentially provide a conservative estimate sale of PhP 135 daily for tiger shrimps. This means that with only two *tigbakol*, a fisher can expect PhP 270 sales daily which is a little more than the PhP 235 daily minimum wage in 2008. Earnings from other species caught by *tigbakol* along with shrimps like fish and crabs will add to the PhP 270 obtained from *P. monodon* catch. Basically, this means that the number of gears can be reduced to allow only 2 gears per household. Assuming that on the average, one fisher currently owns 5 gears of *tigbakol*, a reduction to only two can mean a huge 60% decrease in fixed gears distribution in the area, if implemented well, but with improved shrimp catch quality and prices received.

Table 2. Hypothetical daily catch of *P. monodon* per *tigbakol* after a simulated stock enhancement release.

Shrimp Size (CL, BW)	Price (PhP·kg^{-1})	Scenario 1: 2 months after release (pieces) weight, price	Scenario 2: 3 months after release (pieces) weight, price
3-4cm, 15-35g	300		(15) 450g, PhP 135
2-3cm, 5-15g	150	(60) 900g, PhP 135	
1-2cm, 1-5g	60		
<1cm, <1g	20		
TOTAL:		900g, PhP **135**	450g, PhP **135**

Note: US$1 = PhP42.50 (2013 annual average)

Can shrimp stock enhancement promote mangrove rehabilitation?

It has been pointed out in the interviews and separate studies that majority of mangrove forests in the Batan Estuary have been cleared, mostly for aquaculture. The importance of mangroves as habitat especially for shrimps is already established (Sasekumar *et al.*, 1992; Chong *et al.*, 1996; Primavera, 1998). This suggests a very practical need for mangrove rehabilitation to allow natural revival of shrimp populations. Therefore, information, education and communication (EIC) campaigns on the importance of mangroves as shrimp habitat can encourage locals to reforest the estuary, most especially in abandoned ponds. This is a long term target which means that it is crucial that properly-guided mangrove rehabilitation be done soonest.

The role of the community in a stock enhancement program

The effect of stock enhancement on the people is clear. This has also been exemplified in the kuruma prawn *Penaeus japonicas* stock enhancement in Hamana Lake, Shizuoka, Japan (Fushimi, 1999). The bottom-up approach focusing mainly on local fishers themselves has enriched their awareness and encouraged active participation in the rearing and release phases of the program. In the case of New Washington-Batan Estuary, the fisherfolk community is the most direct beneficiary and stakeholder in stock enhancement. Hence, their awareness, participation and cooperation in the enhancement activities are critical determinants of success.

The socioeconomic survey in New Washington in 2012 revealed that 82% of the respondents preferred *P. monodon* over other local species for stock enhancement project. They considered *P. monodon* a high-valued species that could give them higher income compared with grouper, snapper, crabs and other shrimp species. They claimed that *P. monodon* used to be abundant in the past, but are now seldom caught in the estuary. Although 24% of them were not aware of the stock enhancement project in New Washington, still almost all of the respondents (97%) were willing to participate in the project. However, direct voluntary participation of fisherfolks in the rearing phase of the shrimp stocks was dampened by the limitations that characterize their organization.

There is also an apparent weak fisheries governance even when the national fisheries policy gave mandate to the local government to manage its own fishery resources. The local government have not acted to effectively manage and regulate fishing activities to accord with and support the stock enhancement activities. In particular, active fine-meshed gears that easily entrap released shrimps persist to operate in the estuary. On the other hand, majority of the fishers understand the problems better than the managers and officials but they lack the power to prevent unsustainable fishing operations. Therefore, it is better to implement a "bottom-up" approach in the area where local fishers are to be given main considerations. They should also be active "participants" in the planning and implementation of the stock enhancement activities, with strong supervision from technical authorities. The clear-cut incentive of increasing income through higher sales from *P. monodon* catch is a strong motivation for the fishers to join the stock enhancement activity.

Concluding Remarks

The usual environmental and fisheries problems are still evident in New Washington and Batan in spite of the various fishery ordinances and laws to guide sustainable fisheries. More so, there were several developmental projects implemented to prevent further degradation of the local fishery. Weak law enforcement and political will reported by fishers, together with the ineffective cooperation among leaders and local communities, further complicate the situation. The observations and results presented in this paper indicate that the New Washington-Batan Estuary urgently needs effective measures for rehabilitation. One alternative fisheries and environmental management option is through stock enhancement of the tiger shrimp *P. monodon*. Theoretically, by restoring wild populations of this highly-priced shrimp species, fishers can directly increase income. With this incentive, reduction of fishing gears is possible and mangrove rehabilitation can be promoted. The prospects of tiger shrimp stock enhancement in the area are high and the benefits are clear. However, it is important that support of sectors like the government, local universities, people's organizations, stakeholders, and local fishers must be solicited to create unbiased management plans.

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