Fishery Resource Enhancement: An Overview of the Current Situation and Issues in the Southeast Asian Region

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Abstract

The total global production from capture fisheries has plateaued since the mid 90s. This stagnation in production or reduced productivity of the world's coastal and marine wild fisheries is caused by overfishing and degradation of habitats through coastal development and destructive fishing methods. Reports have shown that if the current fishing trends continue, all of the commercial fisheries will have collapsed by 2050. To boost production, scientists, fisheries managers, government agencies, and NGOs have been looking at ways of enhancing fish stocks. Replenishing depleted stocks may be done by regulating fishing effort, restoring degraded nursery and spawning habitats or through resource enhancement. Resource enhancement using individuals reared in aquaculture facilities or seed stocks abundant in the wild is becoming a popular method of supplementing depleted stocks. It is one of the many strategies that could help address the decreasing fisheries production in the wild. A brief history of resource enhancement, the aquatic species released in the different countries in the region, the reasons for releasing stocks, and the issues involved, are discussed briefly in this paper. Among the main reasons for resource enhancement are to increase production or enhance stocks and increase food supply and/or family income. Other reasons include protection of endemic and maintenance of endangered species, rehabilitation of degraded natural habitats and for recreation fisheries, among others. Age or size of seeds, seed quality, genetics, governance, economics, biodiversity conservation, politics, and the introduction of exotics are among the resource enhancement issues identified in the region.

Keywords: Resource enhancement, Southeast Asia, species released, status, issues

Introduction

Southeast Asia has a total coastline of 105,070 km, almost 30% of the total coastline of all the countries in the world. The coastal zones of Southeast Asian countries are endowed with some of the world's richest ecosystems, in terms of both biodiversity and productivity. About one-third of the world's coral reefs and a quarter of the world's mangroves are found in this region. Consequently, the center of marine biodiversity is also located in the region, specifically in the Philippines (Carpenter and Springer, 2005). It is not surprising, therefore, that fisheries constitute the largest and the most important renewable resources in the area.

Fish remains the most important source of protein for Southeast Asians with10.2-54.8% of their protein needs sourced from fish. The per capita fish consumption ranges from 14 to 35 kg. Such dependence on fish as the main protein source for 593 million population with an average annual growth rate of 1.33 (based on 2010 data; Jones, 2013) creates high demand for fishery products, locally and regionally. Overgrowing concern on overexploitation of fish stocks emanate from high harvest of fish in the wild keeping the global trend for marine capture fisheries on a steady state since mid 90s. Global trends in the state of marine fish stocks showed that since 1974, the number of overexploited stocks grew from 10 to 30% in 2009 and the opposite trend was observed with the non-fully exploited fish stocks (FAO, 2010).

Resource enhancement using individuals reared in aquaculture facilities is becoming a popular method of supplementing depleted stocks (Bert *et al*., 2003). However, according to Bell and Nash (2004), the capability to produce and release juveniles from aquaculture facilities is not enough reason to conduct resource enhancement. Success in resource enhancement depends on knowing enough about the ecology of the species, its nursery habitat, and the survival of cultured juveniles in the wild (Bell *et al*., 2005). This means gathering information about the population of the species concerned and its habitat prior to any attempts on resource enhancement. It has been stressed by Gulland and Carroz (1968) that the essential basis of any management is proper biological understanding of the status of stocks concerned and emphasized that proper management requires good scientific knowledge based on adequate data.

Blaxter (2000) further added appropriate size-at-release, season of release and area for release as keys to stock enhancement success. To ensure success, 10 components of a responsible approach to developing, evaluating and managing marine stock enhancement programs have been prescribed by Blankenship and Leber (1995). An evaluation of the different strategies applied by Southeast Asian countries in managing resources to address the declining fish stocks in the wild were examined from available published materials.

Activities/Results

Table 1 shows some of the reasons why resource enhancement is being done in Southeast Asia. Early stock enhancement activities focused on increasing the supply of fish in inland water bodies known to be fishing grounds for the communities. With the exception of countries that practiced fish release ceremonies as part of their traditional religious practices, resource enhancement in the form of fish stocking activities was done as early as 1912 during the Dutch occupation in Indonesia (Maskur, 2010). The main purpose of stocking in those early times was to increase the population and diversification of fish species in the wild. Other countries such as Thailand, Philippines, Myanmar, and Malaysia conducted fish stocking activities in much later years in 1950, 1961, 1967, and 1970, respectively. Fish stocking was considered as a major input in increasing and sustaining fish yields in these Indo-Pacific areas (Sreenivasan, 1989). Fish species commonly used for stocking were catfish, tilapia and various species of carps. Species used in stocking include both exotic and indigenous species (**Table 2**). No biological assessments were conducted prior and after fish release. Its impact on the diversity of the fish species in the environment where the stocks were release was not assessed and success was merely based on increase in the volume of fish harvested after stocking activities.

Table 1. Reasons for conducting resource enhancement in Southeast Asian countries

Reasons for Resource Enhancement	Bru	Cam	Ind	Lao	Mal	Mya	Phi	Sin	Tha	Vie
Population/production	✔		✔	✔	✔	✔	✔		✔	✔
Food supply/income		✔				✔			✔	
Endemic species			✔							
Endangered species			✔			✔	✔			
Degraded natural habitats		✔	✔		✔	✔		✔	✔	✔
Spawning and feeding grounds		✔	✔			✔			✔	✔
Fish sanctuaries		✔	✔			✔	✔		✔	
Biological control		✔					✔			
Promote aquaculture		✔								
Recreational fisheries					✔					

Inland fishery resources for enhancement were given wider attention compared with marine fishery resources (**Table 2**) as manifested by the number of reports, as well as proceedings available on this subject. Pioneer works on mollusks and perhaps on stock enhancement in the Pacific and Southeast Asia was on the conservation of the endangered tridacnid clams (Yamaguchi, 1995). Earlier than that, marine conservation works were focused on rehabilitating degraded reefs and establishment of marine protected areas. Starting in the late 1970s, artificial reefs were employed and the effective of use of fish aggregating devices were tested all over Southeast Asia.

Successful development of breeding techniques on *Macrobrachium rosenbergii* in the late 1980s made it the only freshwater crustacean species used for resource enhancement in different areas of Southeast Asia. Prawn larvae were usually provided by the fishery agencies of the governments. Release of prawn larvae in reservoirs and river systems were considered successful despite the lack of data on the increments on their harvest as a result of the stocking activities. More marine species were considered for conservation and natural resource enhancement lately when depleted fish stocks in the world's oceans became more evident.

Table 2. Freshwater and marine species released in Southeast Asia for resource enhancement

Species Released for Resource Enhancement	Bru	Cam	Ind	Lao	Mal	Mya	Phi	Sin	Tha	Vie
FRESHWATER										
Barbs										
Barbonymus gonionotus		☐	☐	☐	☐		☐		☐	
Puntius orphoides					☐	☐				
Carps										
Aristichthys nobilis									☐	
Catla catla						☐				
Cirrhinus cirrhosus				☐		☐				
Cirrhinus molitorella					☐				☐	
Ctenopharyngodon idella					☐	☐			☐	
Cyprinus carpio			☐		☐	☐	☐		☐	
Cyprinus mrigala									☐	
Hypophthalmichthys nobilis				☐	☐					☐
Hypophthalmichthys molitrix					☐	☐			☐	☐
Catfish										
Clarias batrachus			☐							
Pangasianodon gigas									☐	
Cyprinid – *Barbonymus altus*		☐								
Goby - *Oxyeleotris marmoratus*					☐					
Gourami										
Helostoma temminckii					☐					
Osphronemus gouramy					☐					
Trichogaster pectoralis		☐	☐		☐					
Rohu – *Labeo rohita*				☐		☐				
Iridescent shark – *Pangasianodon hypophthalmus*		☐				☐				
Tilapias										
Oreochromis mossambicus			☐		☐	☐	☐			
Oreochromis niloticus			☐	☐	☐	☐	☐		☐	
Giant freshwater prawn – *Macrobrachium rosenbergii*	☐								☐	
MARINE										
Fish										
Lates calcarifer								☐		
Sea horses							☐			
Crustaceans										
Charybdis			☐							
Portunus		☐	☐							
*Scylla*spp.			☐				☐			
Penaeus merguiensis								☐		
Penaeus monodon							☐			
Mollusks										
Chicoreus ramosus									☐	
Haliotis asinina							☐			
Trochus niloticus			☐				☐			☐
Placuna placenta							☐			
Tridacnids							☐		☐	
Echinoderms										
Holothuria scabra							☐			
Sea urchins							☐			

Lessons Learnt

Major enhancement activities were mostly linked or associated with government initiatives and were purposely done to increase production in a particular area with the aim of increased harvest for fishers. Success or failure was based only on the volume of the stocked species during harvest. Enhancement activities in marine environment were access is open to all users were mostly limited to habitat enhancement and regulation of catch. Resource enhancement activities involving the release of fish in such environments were best done in sanctuaries or marine protected areas where access or entry is controlled.

Poaching is a major problem if stocking activities were done outside these areas. Most reported release activities were done on small-scale or experimental scale. The knowledge on propagating seeds of highly exploited marine organisms for stocking purposes remained a wide gap to fill in. A common limitation in government funded resource enhancement project is the limited budget. Long term monitoring or assessment of the impacts of these activities is mostly overlooked. Political matters sometimes interfere in the proper implementation of the project that may be brought by limited understanding and appreciation of policy makers on resource enhancement and conservation of aquatic resources.

Recommendations and Way Forward

A resource enhancement protocol developed for a particular area, in a particular ecosystem and for a particular purpose is ideal. Decisions to take up resource enhancement as a programme could be better implemented if supported by accurate and reliable fishery statistics data on species composition, density and production in a particular aquatic system over a reasonable period of time. Release strategies for various species used for resource enhancement should be determined to establish stocking protocols in order to ensure higher probability of success of the released stocks. The issue on the preference for non- native species over native species for resource enhancement on a heavily utilized fishery area with the purpose of increasing economic benefits from fishing should be carefully evaluated.

Arthur *et al*. (2010) showed that stocking of non-native fish species in wetlands significantly increased total fish biomass and does not affect the biomass of the native species. If profitability or economic benefits is the factor used to measure success of an enhancement activity, an investment cost of resource enhancement and estimate of returns should be considered to evaluate completely the economic benefits derived from resource enhancement. In order to maintain environmental integrity and the genetic integrity of the population, a long term monitoring of the impact of enhancement activities should be included in most plans.

References

Arceo, H., B. Cazalet, P. Aliño, L. Mangialajo, P. Francour. 2013. Moving beyond a top-down fisheries management approach in the northwestern Mediterranean: Some lessons from the Philippines. Marine Policy 39: 29-42

Arthur, R., K. Lorenzen, P. Homekingkeo, K. Sidavong, B. Sengvilaikham, C.J. Garaway. 2010. Assessing impacts of introduced aquaculture species on native fish communities: Nile tilapia and major carps in Southeast Asian freshwaters. Aquaculture 299(1-4): 81-88

Bell, J., W. Nash. 2004. When should restocking and stock enhancement be used to manage sea cucumber fisheries? ***In***: Lovatelli A., Conand C., Purcell S., Uthicke S., Hamel J.F., Mercier A. (Eds.) Advances in Sea Cucumber Aquaculture and Management, FAO Fisheries Technical Paper No. 463. FAO of the United Nations, Rome (Italy); pp 173-179

Bell, J.D., P.C. Rothlisberg, J.L. Munro, N.R. Loneragan, W.J. Nash, R.D. Ward, N.L. Andrew. 2005. Restocking and Stock Enhancement of Marine Invertebrate Fisheries. ***In***: Southward A.J., Young C.M., Fuiman L.A. (Eds.) Advances in Marine Biology. Elsevier Academic Press, San Diego (U.S.A.); pp. 374

Bert, T.M., R.H.J. McMichael, R.P. Cody, A.B. Forstchen, W.G. Halstead, J. O'Hop, J.M. Ransier, M.D. Tringali, B.L. Winner, F.S. Kennedy, K.M. Leber, C.L. Neidig. 2003. Evaluating stock enhancement strategies: a multi-disciplinary approach. ***In***: Nakamura Y., McVey J.P., Leber K.M., Neidig C., Fox S., Churchill K. (Eds.) Thirtieth U.S.-Japan Meeting on Aquaculture: Ecology of Aquaculture Species and Enhancement of Stock. Mote Marine Laboratory, Sarasota, Florida (USA); pp. 105-126

Blankenship, H.L., K.M.Leber. 1995. A responsible approach to marine stock enhancement. American Fisheries Society Symposium 15: 167-175

Blaxter, J.H.S. 2000. The Enhancement of Marine Fish Stocks. ***In***: Southward A.J., Tyler P.A., Young C.M., Fuiman L.A. (Eds.) Advances in Marine Biology. Academic Press, London (United Kingdom); pp. 1-54

Carpenter, K., V. Springer. 2005. The center of the center of marine shore fish biodiversity: the Philippine Islands. Environmental Biology of Fishes 72(4): 467-480

De Silva, S. 2010. Enhancement and conservation of inland fishery resources in Asia. ***In***: Miao W., Silva S.D., Davy B. (Eds.). Inland Fisheries Enhancement and Conservation in Asia. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication 2010/22; pp. 189

Gulland, J.A., J.E.Carroz. 1968. Management of fishery resources. ***In***: Russell S.F.S., Yonge S.M. (Eds.) Advances in Marine Biology. Academic Press Inc., London (United Kingdom), pp. 1-71

Jones, G.W. 2013. The Population of Southeast Asia. Asian Research Institute Working Paper, No. 196

FAO, 2010. The state of world fisheries and aquaculture 2010

Said, M. 1994. Artificial reef as a tool in habitat enhancement in Malaysian waters. Fifth International Conference on Aquatic Habitat Enhancement, November 3-7, Long Beach, California.Bulletin of Marine Science 55(2-3): 1351

Sreenivasan, A. 1989. Fish stock enhancement in large Indo-Pacific inland water bodies using carps and tilapias. ***In***: Petr T. (Ed.). Workshop on the Use of Cyprinids in the Fisheries Management of Larger Water Bodies of Indo-Pacific. 4. Session of the Indo-Pacific Fishery Commission Working Party of Experts on Inland Fisheries, Kathmandu (Nepal), 8 Sep 1988

Yamaguchi, M. 1995. Aquaculture and stock enhancement of reef mollusks. Special publication. Phuket Marine Biological Center. Phuket 15:45-50 Proceedings of the Fifth Workshop of the Tropical Marine Mollusc Programme, Manado Ujung Pandang, Indonesia, 12-23 September 1994