Fishery Stock Enhancement in Malaysia

Kamarruddin Ibrahim and Zaidnuddin Ilias

Turtle and Marine Ecosystem Centre
Rantau Abang, 23000 Dungun, Terengganu Malaysia

Introduction

Stock enhancement is a management tool which alleviates problems that endanger natural resources. Endangered aquatic resources are broad issues that involve not only individual species but also the habitat and environment where they live and interact. Although measures are being undertaken to help specific cases, the universal problem of threatened aquatic species cannot be solved until humans protect their natural environments (Kurpis 2002). Species may become endangered due to overexploitation, habitat alteration and destruction, and overpopulation by alien species and other factors. Natural changes normally occur at a slow rate giving most organisms ample time to evolve and adapt to changes. However, drastic changes due to natural disasters, e.g., earthquakes or tsunamis, may halt adaptation and cause most individuals to die, or even lead to species extinction.

Species extinction is a global issue that requires all nations to practice sustainable management. This paper aims to examine the status of endangered fisheries species in Malaysia, and highlight some resource management initiatives including the restocking and stock enhancement program in the country. Its scope covers only aquaculture-based species, which is in line with the Program on Stock Enhancement for Species of International Concern being implemented by the Southeast Asian Fisheries Development Center/Aquaculture Department in the Philippines.

Table 1. List of endangered freshwater fish.

Scientific name	English name	Local name
Scleropages formosus	Golden arowana	Kelisa
Tor tambroides	Malaysian Mahsheer	Kelah
Probarbus jullieni	Jullien's golden-price barb	Temoleh

Endangered species

Freshwater vertebrates

At present, three indigenous species of freshwater fishes are protected by law in some States in Malaysia (Table 1). Thus far, no invertebrates have been listed for protection.

Brackishwater and marine invertebrates and vertebrates

To date, Malaysia protects 26 species of vertebrates including one fish, five reptiles and 20 marine mammals. In addition, four species of marine mollusks (invertebrates), all of which belong to the genus *Tridacna*, are included in the protection list. Several other species that are heavily exploited but have yet to be listed under the Malaysian marine protected species include sea cucumbers (in particular, *Stichopus* spp.) and seahorses (*Hippocampus* spp.) (Table 2). These species deserve urgent protection.

Volume of yearly catch for the last 10 years

Freshwater vertebrates

Although the two species of freshwater fish (*Tor tambroides* and *Probarbus jullieni*)

Table 2. List of endangered brackishwater and marine invertebrates and vertebrates.

Group	Scientific name	English name	Local name
Mollusks	*Tridacna gigas*	Giant giant clam	Kima gergasi
	Tridacna maxima	Large giant clam	Kima besar
	Tridacna crocea	Crocus giant clam	Kima
	Tridacna squamosa	Scaly/Fluted clam	Kima sisik
Fish	*Hippocampus* spp.	Sea horses	Kuda laut
Invertebrates	*Stichopus* spp.	Sea cucumbers	Gamat

are protected in a number of states, these fishes are still exploited for local consumption. The golden arowanas (*Scleropages formosus),* sought after as exotic fishes are found in both domestic and international markets. They are legally caught from rivers but their export is prohibited except the second filial generation (F_2) juveniles produced from artificial breeding. Unfortunately, annual catch statistics of all three species are not available. However, the estimated landings of all freshwater fishes, both from public water bodies and inland fisheries are presented in Table 3.

Brackishwater and marine invertebrates and vertebrates

The collection of giant clams for consumption is prohibited in islands that have been declared as marine parks. However, scattered illegal collection persists in some areas particularly in the Borneo part of Malaysia. Catch data is hardly available. The seahorses (*Hippocampus* spp.) and sea cucumbers (*Stichopus* spp.) have been sought-after species for medicines for decades. Seahorses are mainly exported, whereas *Stichopus* spp. are locally used. Compared to other fishery products, the volume of catches for these two groups of fishes is rather small and limited to a few selected areas hence, the data is hardly documented.

Fisheries Biology

Habitat, life cycle and feeding habits

Freshwater species

The sought-after ornamental species of arowanas are native to most undisturbed rivers in Malaysia. *S. formosus* is found to

Table 3. Estimated landings (mt) of freshwater fishes from both public water bodies/inland fisheries in Malaysia (excluding Sarawak State), 1994-2003.

Species	Landings (mt/yr)									
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
All freshwater fish species (Javanese carp, common carp, catfishes, black and red tilapias, etc.)	2,064	3,939	3,683	3,949	4,344	3,453	3,549	3,446	n/a	3,828

Table 4. Statistics of seed production of freshwater species and releases into public water bodies in Malaysia (excluding Sarawak State) for 1997-2003 (x 10^3 mt).

Species	Production (10^3 mt/year)						
	1997	1998	1999	2000	2001	2002	2003
All species (Javanese carp, Common carp, Giant freshwater prawns, River catfish and Red tilapias, etc.)	6,891	5,160	2,697	4.502	2,353	Not available	5,408

breed naturally in Krian River and Tasik Merah Lake in Taiping, Perak. The life cycle and other biological information of arowanas are well known and the breeding of this species is successful. On the other hand, Kelah (*Tor tambroides*) and Temoleh (*Probarbus jullieni*) are poorly studied (Ahmad-Ashar 1992).

Brackishwater and marine species

A number of ecological and biological studies on giant clams and sea cucumbers have been attempted by researchers from the Malaysian Department of Fisheries and local universities. Unlike giant clams and sea cucumbers, seahorses have received little attention from the scientific community.

Why endangered?

The Malaysian classification of endangered species follows the International Union for the Conservation of Nature categories and the Convention on International Trade in Endangered Species of Wild Fauna and Flora listings. However, there are species that need special attention as their populations have drastically declined. For example, the State of Perak has formulated laws to protect all three freshwater species listed in Table 1.

Status of seed production technology

Freshwater species

The technology for seed production of arowanas (*S. formosus*) is readily available in Malaysia. The production of F_2 and F_3 arowana juveniles by local aquaculturists was successful in the past ten years. However, seed production technology for Kelah and Temoleh species is still in its infancy. It is worth noting that there are established seed production technologies for Javanese carps, common carps, giant freshwater prawns, Red tilapia, River catfish and a few other freshwater fishes. Some 2,000–7,000 fry of these species are released annually into water bodies for conservation (Table 4).

Brackishwater and marine species

In Malaysia, seed production technology for brackishwater and marine vertebrate and invertebrate species, like the giant clams, sea cucumbers and seahorses, is still lacking. Therefore, data on seed production and releases for these species are not available.

Aquatic Resource Management

Fisheries laws and regulation

Enforcement at different levels

A number of laws and regulations are used to protect and manage aquatic fishery resources in Malaysia. A partial list of such legislation specifically addressing the issue of endangered resources follows:

- Fisheries Act 1985 (Act 317)
- Fisheries (Prohibition of Method of Fishing) Regulations 1980
- Fisheries (e.g., Prohibition of Import of Fish) Regulations 1990

Table 5. Existing sanctuaries and protected areas in Malaysia.

Sanctuary name	State in Malaysia	Species protected
Kelah (*Tor tambroides*) Sanctuary	Pahang (in National Park)	Freshwater fish/Kelah
Sungai Nenggiri Sanctuary	Kelantan (in National Park)	Freshwater fish/Kelah
Tasek Bukit Merah Sanctuary	Perak	Kelah, Arowana & other freshwater fish
Marine parks	Kedah, Pahang, Johor, Terengganu, Sabah and Sarawak	Coral reef ecosystems including giant clams, sea cucumbers, seahorses
Fisheries prohibited areas	Sarawak (P. Talang-Talang), Melaka (P. Besar), Negeri Sembilan (Tg. Tuan)	Mollusks, corals, fishes
No trawl zone (5 nm)	Entire country	All coastal species
State parks	All states	All terrestrial and aquatic organisms
National parks	Pahang, Terengganu Kelantan, Sarawak, Sabah	All terrestrial and aquatic organisms

- Fisheries (Prohibited Areas) (Rantau Abang) Regulations 1991
- Establishment of Marine Parks Malaysia Order 1994
- Fisheries (Prohibited Areas) Regulations 1994
- Fisheries (Control of Endangered Species of Fish) Regulations 1999
- State Fisheries (Riverine) Rules

Legislation and enforcement work at both Federal and State levels. In Peninsular Malaysia, the Department of Fisheries implements such laws for both levels. In Sarawak and Sabah, the enforcement is supplemented by some State laws and regulations.

Territorial use rights (TURFs)

Anything that is found on land and water areas up to three nautical miles (nm) is covered by State law whereas Federal law applies to aquatic areas beyond 3 nm. In addition, there are cases that involve both Federal and State levels, especially pertaining to fishery activities in 3 nm overlapping areas. Rights are given to some local communities to fish in protected areas using simple and traditional gears. For example, local island inhabitants are allowed to fish in the vicinity of Marine Parks, for their daily consumption using handlines.

Habitat protection and rehabilitation

Sanctuaries and protected areas

Establishing sanctuaries and protected areas is one of the best tools in managing aquatic resources. There are a number of sanctuaries and protected areas designated by the Federal and State governments (Table 5).

Artificial reefs and mangrove replanting

To mitigate factors causing resource over-exploitation and habitat loss and degradation, the government has long undertaken resource enhancement activities such as restocking and artificial reef programs.

a) Artificial reefs

Traditional artificial reefs of bamboo and coconut leaves started as early as the fishing industry in Malaysia. The Department of Fisheries first launched tire-made artificial reefs in 1975 in areas near Pulau Telor, Kedah (Zainuddin and Abdul-Razak 2000, Latun and Wong 1988, Omar et al 1991). Since then more than 40 sites of tire reefs have been installed around Peninsular Malaysia and Sarawak. This was followed by the use of other materials and designs such as sunken boats and concrete. Artificial reefs have proven to be effective and useful in Malaysia hence their development continues to be an important undertaking (Abdul-Razak and Ismail 1992, Wagiman et al 1994). Various materials and designs may be attempted in the future, taking into consideration successes reported by some authors (Baine and Heaps 1992, Collins et al 1992, Eggleston et al 1992, Jensen et al 1994(a), Jensen et al 1994(b), Snapier 1994).

b) Mangrove replanting

There are about 560,000 ha of mangrove forests in Malaysia. The Kerian and Kuala Sepetang mangrove reserves in Perak are good examples of properly managed mangroves where sustainable use and scheduled replanting are practiced. The recent tsunami incident that seriously hit neighbouring countries has prompted Malaysia to give special attention to mangrove replanting starting 2007 until 2010.

Stock enhancement/artificial restocking

Efforts to restock freshwater fishes and prawns were attempted as early as the 1980s. Approximately 30 species of these aquatic vertebrates have been included in the release programs. The most common species selected for restocking are given in Table 6.

The current problems regarding heavily depleted aquatic resources have prompted the government to look into this matter seriously. Stock enhancement will become another important tool that will dominate fisheries management in this country in the years to come.

National Restocking/Stock Enhancement Program

Species stocked

Freshwater species

Table 6 shows the species used for restocking in natural water bodies in Malaysia, of which the five most common species are the Javanese carp, Common carp, Giant freshwater prawn, Red tilapia and River catfish. The Red tilapia tops the list with a record of two million juveniles released in 2003. The Department of Fisheries plans to step up work on release programs for Kelah and Temoleh, after some success in artificial breeding (Ahmad-Ashar 1992).

Brackishwater and marine species

Restocking and enhancement for sea turtles and painted terrapin have been an on-going program for decades. No stock enhancement has been attempted for brackish-water and marine species because of the lack of breeding technology to date. Research is being carried out to develop and establish breeding technologies for sea cucumbers, to be followed by giant clams and seahorses.

Marking and tagging

Marking and tagging of fish have limited application in Malaysia. Passive Integrated Transponder (PIT) tags have been used in the country to mark mature females and F_2 arowana juveniles for export purposes.

Table 6. Culture-based fisheries and aquaranching in Malaysia.

Culture-based Fisheries	Aquaranching
Freshwater Fish in used mining pools – various species Freshwater lakes (man-made) – various species Freshwater fish in net-cages – various species Culture of red claw (*Cherax quadricarinatus)* in ponds	**Freshwater** Tilapia (*Oreochromis* spp.) Catfish (*Clarias* spp., *Pangasius* spp.) Freshwater prawn (*Macrobrachium rosenbergii)* Chinese major carps (bighead, grass and common) Indian carps (rohu, catla) Javanese carps Local cyprinids
Brackishwater Penaeid or marine prawn culture in trapping ponds Mussel culture (raft and pole methods Oyster culture (raft method) Marine finfish culture in net-cages Pen culture in lagoons	**Brackishwater** Cockles Mussels Grouper Oysters Mud crabs
Marine Cockles using on-bottom culture Mussel *(Perna viridis)* using raft and poles Oyster (*Crassostrea* spp.) using raft	**Marine** Cockle *(Anadara granosa)* Penaeid prawn *(Penaeus monodon)* Seabass *(Lates calcarifer)* Grouper *(Epinephelus* spp.) Snapper *(Lutjanus* spp.) Mussel *(Perna viridis)* Oyster *(Crassostrea* spp.) Seaweed *(Eucheuma, Gracilaria)*

Release strategies

Direct release of marine turtle and terrapin hatchlings has been practiced as this method simulates Mother Nature. For fishes, releases have been attempted to restore stocks in original habitats. Information on when, where and how best to release the juveniles should be determined through research.

Impact on catches

Appropriate studies have not been carried out to determine the impact of stock enhancement on the environment. Preliminary efforts to study the income and turtle related tourism and the impact of artificial reefs on the economy of traditional fishers are underway.

Monitoring

Monitoring the progress of stock enhancement activities is undertaken by the Department of Fisheries for selected freshwater species.

Government agencies, NGOs involved

Federal and State agencies involved in implementing restocking program collaborate

with local universities insofar as research activities are concerned. The involvement of non-governmental organizations is concentrated on the conservation of freshwater species at two localities, namely, the Sungai Nenggiri Sanctuary in Gua Musang, Kelantan and the Tasek Bukit Merah Sanctuary in Taiping, Perak.

Co-management by local communities

One good example of the community-based resource management for freshwater species is the so-called *tagal* (closed) system in Sabah. Local communities that live near the rivers are given traditional rights to manage and exploit resources from selected rivers. The selected rivers (total of 174, to date) are closed for one or two years. The communities look after the rivers and they are allowed to fish only on selected days in a year. Those who illegally fish and pollute the rivers can be fined.

References

Abdul-Razak L and Ismail I. 1992. An analysis of the efficacy of three artificial reef designs at Pulau Lembu, Kedah. Proceedings of Fisheries Seminar, Department of Fisheries Malaysia

Ahmad-Ashhar O. 1992. Induced spawning of Ikan Temoleh, *Probarbus jullieni* (Sauvage) using Human Chorionic Gonadotropin and Heteroplastic Crude Piscine Extract, pp. 243-244. In: Proceedings of the National IRPA Seminar, Kuala Lumpur, Malaysia, 9-11 Jan. 1992

Baine M and Heaps L. 1992. An introduction to artificial reef technology. Paper presented at the British Conference on Artificial Reefs and Restocking, Orkney Island, 12 September 1992

Collins KJ, Jensen AC and Lockwood APM. 1992. Stability of coal waste artificial reef. Chem. Ecol. 6: 79-93

Eggleston DB, Lipcius RN and Miller DL. 1992. Artificial shelters and survival of juvenile Caribbean spiny lobster *Panulirus argus*: Spatial, habitat, and lobster size effects. Fish. Bull. 90: 691-702

Jensen AC, Collins KJ, Free EK and Bannister RCA. 1994(a). Lobster (*Homarus gammarus*) movement on an artificial reef: potential use of artificial reefs for stock enhancement. Crustaceana 67 (2): 198-211

Jensen AC, Collins KJ, Lockwood APM, Mallinson JJ and Turnpenny AH. 1994(b). Colonisation and fishery potential of a coal waste artificial reef in the United Kingdom. Bull. Mar. Sci. 55 (2): 1242-1252.

Latun AR and Wong FH. 1988. Ecological monitoring of the concrete reef at Pulau Payar, Kedah – A preliminary report, pp. 208-215. In: Proceedings of the First Fisheries Seminar, Department of Fisheries Malaysia

Kurpis L. 2002. www.endangeredspecie.com/causes_of_endangerment.htm). Malaysian State Fisheries (Riverine) Rules

Omar RMNR, Kean CE, Wagiman S, Hassan AMN and Hussein M. 1991. The design and construction of artificial reefs using PVC pipes in Malaysia. 5th International Conference on Aquatic Habitat Enhancement, Long Beach, California, USA, 3-7 Nov. 1991

Snapier E. 1994. What are the characteristics of a good artificial reef for lobsters? Crustaceana 67(2): 173-185

Wagiman S, Omar RMNR, Che-Omar MH and Rosdi MN. 1994. *Tukun Tiruan Malaysia,* Jabatan Perikanan Malaysia: 132 p.

Zainuddin I and Abdul-Razak L. 2000. Fish standing stock observation at the artificial reefs of Pulau Payar, Kedah, pp. 89-97. In: Shariff M, Yusoff FM, Gopinath N, Ibrahim HM and Nik Mustapha RA (eds) Towards Sustainable Management of the Straits of Malacca. Malacca Straits Research and Development Centre (MASDEC), Universiti Putra Malaysia, Serdang Malaysia