

FISHERIES RESOURCE MANAGEMENT PROJEC



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A GUIDE TO  
SPECIES SELECTION  
and PRINCIPLES of  
MARINE STOCK ENHANCEMENT  
in the PHILIPPINES

by

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## Fisheries Resource Management Project

The **Fisheries Resource Management Project** or FRMP is a six-year initiative of the Philippine Government to address the twin problems of coastal resources depletion and poverty of municipal fisherfolk. FRMP started in 1999 and covered 18 bays and gulfs in the country. Its mandate includes the establishment of fishery management systems on resource enhancement, law enforcement, legislation and regulation, and information systems; promotion of microenterprises including mariculture; and capability-building of Project partners.

A strategy to regenerate coastal resources especially those that are threatened with severe exploitation is marine stock enhancement. Under FRMP, BFAR and technical personnel from the Local Government Units were trained on this important activity and guided to prepare regional stock enhancement programs. Majority of FRMP regions are now in various stages of implementation.

This booklet, written in simple, easy-to-read format, contains important technical considerations needed to successfully undertake marine stock enhancement, including information on the screening of candidate species, stocking, management and monitoring. Through this booklet, the Project hopes to provide CRM practitioners with a practical alternative in managing coastal resources, particularly commercially important marine species that are under threat.

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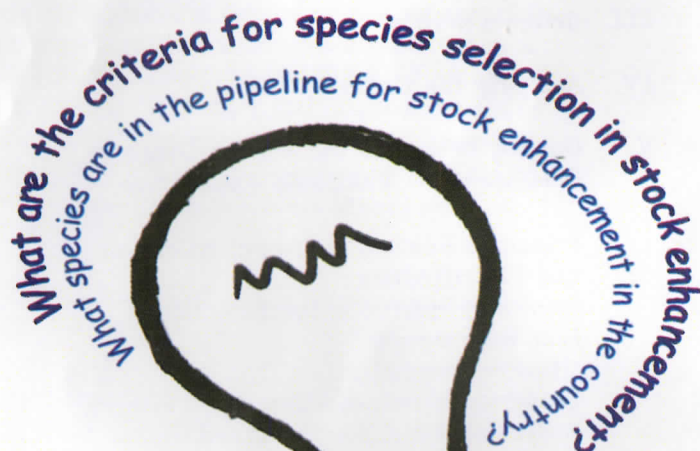
# I. Introduction

## What is stock enhancement?

Stock enhancement is a fisheries management tool to increase and sustain the biomass of a certain population especially in cases where the population is depleted. Some workers use the

## What you should know before starting

a stock enhancement project!



Knowledge on the criteria and guiding principles would be critical in carrying out a successful stock enhancement project.

term **restocking** as a tool to restore the population. Here, we refer to **stock enhancement** as a tool for recovery, increase, and sustainability of fishery stocks.

The establishment of marine protected areas and sanctuaries is among the strategies used for coral reef resources to regenerate naturally. On the other hand, many coastal resource managers and workers use resource enhancement or restocking of marine species as a proactive effort in propagating resident species in their natural environment.

## What can stock enhancement achieve?

The concept of stock enhancement has become popular among coastal resource managers and workers who have begun to restock their coastal habitats with selected species.

They observed that stock enhancement can:

- hasten the recovery of a depleted resource by increasing the number of parents or juveniles of a certain species in the area;
- increase and sustain the production of the fishery resources; and
- provide potential livelihood for the coastal communities as the species abound.

Species enhancement and restocking could be most effective when done in a protected area. However, implementing stock enhancement requires complex preparations and considerations.

Candidate species have to be studied and prioritized in order to determine which among them is most suitable for stock enhancement in a particular site.



## II. Proposed Criteria for Selecting a Species for Stock Enhancement

### Biodiversity

**Conservation Status** refers to the status or condition of the species or population in its environment.

This status expresses the viability or fitness of the species or population to thrive sustainably in the fishery.

Information on conservation status can be drawn from:

- Republic Acts (RAs), *B550, Wild Life Act.*
- Fisheries Administrative Orders (FAOs),
- International Union for Conservation of Nature (IUCN),
- Convention on International Trade in Endangered Species (CITES), etc.

**Ecological importance** refers to the importance of the species as a member of the ecosystem, taking into account the interactions in the food web and the transfer of energy and matter between herbivores (primary consumers) and carnivores (secondary consumers).



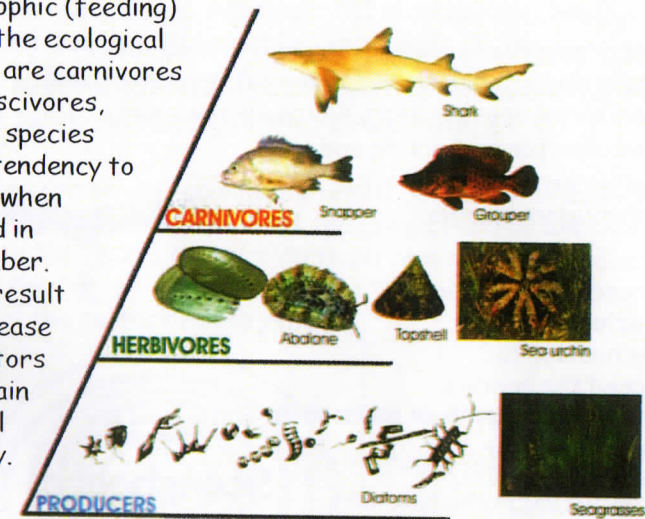
**Species Scoreboard for Conservation Status**

Endangered	- 4
Rare	- 3
Threatened	- 2
Vulnerable	- 1

**Species Scoreboard for Tendency to Dominate**

High	- 2
Low	- 1

Since sea animals at the higher trophic (feeding) levels of the ecological food web are carnivores and/or piscivores, these key species have the tendency to dominate when restocked in great number. This will result in an increase of predators in a certain ecological community.



**Grazers or animals (e.g. shells) preying on algae and are being preyed upon by bigger and tougher animals are more ecologically safe for restocking.**

"The **HIGHER** the **THREAT** to the species, the **HIGHER** is its **PRIORITY** for selection."

"The **HIGHER** the **TROPHIC LEVEL** of the animal species in the **FOOD WEB**, the **LOWER** is its **PRIORITY** for selection."



## Technology

For pragmatic reasons, criteria on availability of technologies on breeding, grow-out, transport, and monitoring are necessary to ensure the source of juveniles for restocking and to better evaluate the stock enhancement project.

**Breeding Technology:** the technology to breed the species in captivity must be existing or available.

**Grow-out Technology:** the technology for grow-out in captivity (e.g. in pens, cages, or tanks) for the species must be existing or available.

**Ease in transport:** refers to the conditions and requirements for transporting the species from the hatcheries to release sites. Variables could be the use of oxygen and water



**Breeding Technology :**

Available — 1  
Not Available — 0

**Grow-out Technology:**

Available - 1  
Not Available - 0

**Ease in transport:**

No need for water and oxygen - 2  
Needs water - 1  
Needs oxygen and water - 0  
Information not available - 0

**Ease in monitoring:**

Not moving, usually attached to a substrate (sessile) - 2  
Slow moving - 1  
Fast moving - 0

during transport and the length of time that the species would survive in transit. Thus, availability of transport technology for mature and juveniles must be considered.

**Ease in monitoring** refers to the relative time and effort to be spent during monitoring of the released species.

Monitoring criterion is equally important because this is where the data for impact evaluation of the project will be derived. Restocked individuals that are difficult to monitor will make it hard for the implementers to measure the success and effects of the restocking project.

*The bottom line is whether the one who conducts monitoring would be able to see or readily observe the released species while monitoring.*

*Ease in monitoring is a critical criterion, because this will provide the basis for the assessment of the impact of restocking.*



## Socio-Economics

**Economics** refers to the value/price of the commodity, raw or finished product. The market for export must also be considered under this criterion.

**Thus, high-value and desirable species are good candidates for stock enhancement!**

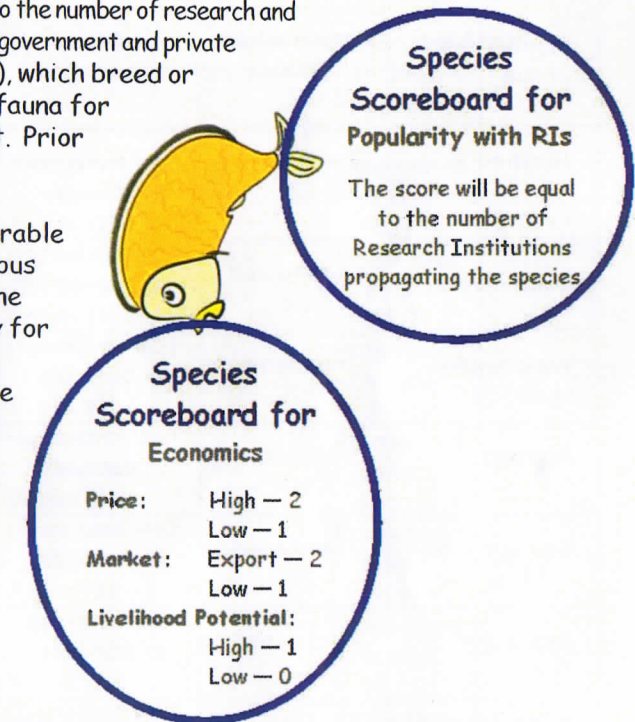
**Livelihood potential:** The livelihood criterion is related to economics, that is, if the product has an ensured market locally or abroad. It considers whether the species could be of direct benefit to the community through livelihood when its population recovers through time and becomes abundant again.

**In this context, if the species will provide direct economic benefits to the community, then it would be a good choice for stock enhancement.**



## Research Institutions (RIs) Engaged in Stock Enhancement Work

This criterion refers to the number of research and academic institutions, government and private (including hatcheries), which breed or propagate marine fauna for stock enhancement. Prior to breeding, these institutions have conducted considerable researches on various species to determine their sustainability for responsible stock enhancement. These researches would most likely supply the information for the other criteria earlier mentioned i.e. biodiversity, technology, and socio-economics.



**Thus, species that have been studied extensively by RIs would be good candidates for stock enhancement.**



### III. Criteria Matrix

Species	Biodiversity		Technology	
	Conservation Status	Ecological Importance	Breeding Technology	Grow-out Technology
Topshell	Threatened (2)	Low tendency to dominate (1)	Available (1)	Available (1)
Giant clams	Endangered (4)	Low tendency to dominate (1)	Available (1)	Available (1)
Windowpane shell	Threatened (2)	Low tendency to dominate (1)	Available (1); no mass reproduction	Available (1)
Abalone	Vulnerable (1)	Low tendency to dominate (1)	Available (1)	Available (1)
Sea cucumber	Threatened (2)	Low tendency to dominate (1)	Available (1)	Available (1)
Sea urchin	Threatened (2)	Low tendency to dominate (1)	Available (1)	Available (1)
Angel wing shell	Threatened (2)	Low tendency to dominate (1)	Available (1)	Not available (0)
Seahorse	Threatened (2)	Low tendency to dominate (1)	Available (1)	Available (1)
Trumpet shell	Endangered (4)	Low tendency to dominate (1)	Not available (0)	Not available (0)
Helmet shell	Rare (3)	Low tendency to dominate (1)	Not available (0)	Not available (0)
Green snail shell	Threatened (2)	Low tendency to dominate (1)	Not available (0)	Not available (0)

### Hierarchical list of marine species for DA-BFAR-FRMP stock enhancement projects (with their corresponding total points based on the given criteria)

Technology		Socioeconomic		Research	
Ease in Transport	Ease in Monitoring	Economics	Livelihood Potential	RIs Engaged in Seed Production	Total points
No need for H2O & O2 (2)	Slow moving (1)	High price (2); Export (2)	High (1)	Propagated in three RIs (3)	16
No need for H2O & O2 (2)	Sessile (2)	High price (2); Local market (1)	High (1)	Propagated in one RI (1)	16
No need for H2O & O2 (2)	Sessile (2)	High price (2); Export (2)	High (1)	Propagated in one RI (1)	15
No need for H2O & O2 (2)	Slow moving (1)	High price (2); Export (2)	High (1)	Propagated in two RIs (2)	14
Needs water (1)	Slow moving (1)	High price (2); Export (2)	High (1)	Propagated in one RI (1)	13
Needs water (1)	Slow moving (1)	Low price (1); Export (2)	High (1)	Propagated in one RI (1)	12
No need for H2O & O2 (2)	Slow moving (1)	High price (2); Local market (1)	High (1)	Propagated in one RI (1)	12
Needs H2O & O2 (0)	Fast moving (0)	High price (2); Export (2)	High (1)	Propagated in one RI (1)	11
Info. not available (0)	Slow moving (1)	High price (2); Export (2)	High (1)	none	11
Info. not available (0)	Slow moving (1)	High price (2); Export (2)	High (1)	none	10
Info. not available (0)	Slow moving (1)	High price (2); Export (2)	High (1)	none	9

The above criteria were used to select and prioritize stock enhancement species in the Philippines by DA-BFAR-FRMP.



## IV. Applying the Criteria

According to the criteria used, topshell and giant clams are the most suitable restocking species, followed by the windowpane shell. Abalone, sea cucumber, and sea urchin ranked 3<sup>rd</sup> to 5<sup>th</sup>.

However, windowpane shell is not a suitable species for restocking in coral reef areas or in fish sanctuaries as they naturally occur in soft muddy substrates. Thus, for stock enhancement in coral reefs, abalone is a more suitable species. Nevertheless, stocking of windowpane shell is recommended in protected areas with soft muddy substrates.

Seahorse ranked 6<sup>th</sup>. Although the seahorse is difficult to monitor, it may be used by some regions which can develop their own monitoring system.

Although a priority list of suitable species for restocking is presented, the final selection would be up to the local implementer after considering the actual needs and situation in their respective sites. Priority of restocking species listed in the previous pages is presented from a general perspective at the national level. Thus, if local conditions are to be considered, the ranking of species in the priority list may change.

# 1



Topshell



Giant clam

# 3



Abalone

# 5



Sea urchin

# 2



Windowpane shell  
(recommended only  
for stocking in  
soft bottoms)

# 4



Sea cucumber

# 6



Seahorse could be stocked in seagrass and sargassum beds, though difficulty in monitoring may be experienced.

Species	Total points	Rank
Topshell	16	1
Giant clams	16	1
Windowpane shell	15	2
Abalone	14	3
Sea cucumber	13	4
Sea urchin	12	5
Angel wing shell (diwal)	12	5
Sea horse	11	6
Trumpet shell	11	6
Helmet shell	10	7
Green snail shell	9	8

Judging from the above results, the recommended species suitable for restocking in the country are: 1: topshell, giant clam; 2: abalone; 3: sea cucumber; and 4: sea urchin.

The practical selection of appropriate species for restocking in a locality could be done based on the above criteria and the general principles for restocking.



## V. Guiding Principles for Marine Stock Enhancement: Philippine Application

### Principles Related to Species Selection and Prioritization

#### A. Define species selection criteria and rank for prioritization

Define criteria that will be used to identify candidate species.

Use criteria to rank species in order of suitability for restocking in a locality.

#### B. Consult stakeholders and experts

Conduct community and stakeholders consultations and public hearings to solicit their opinion and seek consensus on the conduct of stock enhancement projects. Involve local stakeholders in selecting possible species for stock enhancement.

Seek the assistance of experts in generating selection criteria and involve them in verification and confirmation of the final ranking of identified species.

Present and discuss the results of species identification and ranking with stakeholders and experts.

#### C. Consider the characteristics and quality of the stocking material.

*Check the species for the following desirable socio-economic and biologic factors:*

- high desirability and economic value
- fast growth

- high fecundity
- high post-release survival
- low tendency to become dominant or become a predator in the host environment
- ease of monitoring

*Check for the existence of technology for:*

- captive spawning and rearing in large quantities
- rearing in hatcheries in large quantities and at viable cost
- transport of adult and young individuals
- monitoring of released individuals

*Consider the long-term implications of stocking:*

- interactions with wild stocks in the host environment, including possibility of disease introduction
- Impact of planted species on native species
- Long-term fitness of released species

*Consider species occurrence in the area:*

- Species for release should preferably be native to or a resident of the host environment
- If not, species should have been known to previously inhabit the area, even in small quantities





#### D. Include Conservation Status as Basis

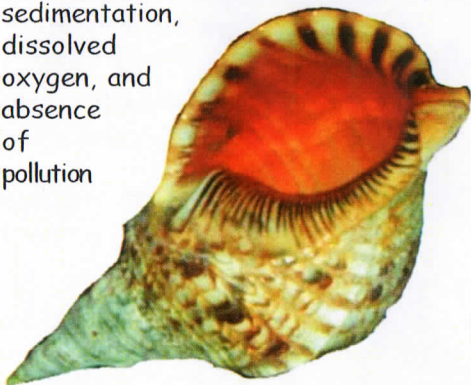
The status of the species or population in its environment should be considered. Information on conservation status could be drawn from Republic Acts, Fisheries Administrative Orders, IUCN, CITES, etc.

#### Principles Related to the Selection of Host Environment

##### A. Select the Right Habitat

Factors to consider in determining the suitability of the site for the survival, growth, dispersal, and reproduction of the intended species include:

1. absence of predators, available shelter, space, food, carrying capacity
2. abiotic factors vital to survival of the species: temperature and salinity ranges, sedimentation, dissolved oxygen, and absence of pollution



The species could be vulnerable, threatened, rare, or endangered.

The **HIGHER** the **THREAT** to the species, the **more reasons** its population should be enhanced.

The Philippine experience has shown that the marine protected area must be greater than or equal to 10 hectares (MPA  $\geq 10$  has) to maximize benefits.

Project evaluation reveals that stock enhancement projects are likely to succeed when done in a well-managed sanctuary, especially with effective law enforcement and financial administrative support.

3. human activities such as destructive methods of fishing, adjacent upland forest activities, and agricultural practices

The location of the release site must be accessible for the transport and transfer of stocks. The sanctuary area must be large enough to receive or accommodate a large number of individuals for reseeding.

##### B. Protect the habitat while enhancing the stock

Reseeding will have better results when done in a protected area. Thus, marine protected areas (MPAs) and sanctuaries with effective management bodies are recommended areas for restocking.



## Stocking Principles

### A. Involve stakeholders in stocking

Stakeholders should participate and contribute to the release of seed stock.

### B. Stocking can take different forms

1. Hatchery-bred stock can be used as seed stock.
2. Individuals can be gathered from adjacent areas and transferred to the "no-take" zone of the protected area. As much as possible, individuals from other bays or gulfs should not be used to prevent genetic problems from occurring.

### C. Plan the stocking activity well. Prior to release, obtain information on the following:

1. ideal size at release;
2. time and month of release;
3. exact release site; and
4. stocking density.

### D. Set up markers at the site

Release sites should be properly marked and bottom markers should be set during release.



## Implementation and Management Principles

### A. Use Adaptive Management

The continuing assessment of the project sites will enable the timely introduction of necessary improvements. Deal with changing conditions and issues in the re-planning process, which is repeated annually.

### B. Consider an Integrated Management Approach

The management approach should facilitate sharing of responsibilities for management functions among government agencies, the community, and the private sector.

The sanctuary to be reseeded must have an LGU-approved management plan, which includes a stock enhancement species management plan. The sanctuary must have an entity or body to manage the stock enhancement project.

The project must have scientific, technical, and funding support. Collaboration with BFAR, the LGU, academe, research institutions, or NGOs is recommended.



Workers prepare to set up markers at site of release for easy monitoring: (left photo) buoys and bottom markers.



### C. Prepare a Management Plan for the Species

Define goals and objectives clearly prior to implementation.

Define the genetic structure of wild stocks and manage them according to the objectives of the enhancement.

Prepare a management plan, which will include sections on:

1. Economic and policy objectives, estimated costs and benefits;
2. Advocacy and education for the public and policy makers on the need and benefits of responsible stock enhancement; and
3. Measuring stocking success (see below).

## Assesment and Monitoring and Evaluation Principles

### A. Conduct an Evaluation of Released Species

Assess if there is increased abundance of released species without displacing wild individuals.

Mark or tag the organisms before release for proper monitoring. Use tagging and marking systems appropriately.

### B. Measure Stocking Success

The following eight parameters are needed to measure the biophysical success and economic viability of stock enhancement programs:

1. **Existing population density** to be used as a benchmark for evaluating stock enhancement effectiveness —this will be determined through stock assessment prior to release by the concerned community Sanctuary Management Board, assisted by the BFAR regional staff, LGUs, and other sectors (academe, NGOs, etc.);

2. **Survival rate** of released individuals;
3. Changes in the **size of habitat area** of the organism;
4. **Unit value** of harvested species;
5. **Value of the additional landings of the species**, magnitude of the production increase resulting from enhancement;
6. **Increase in abundance and size** of the adult population; and
7. **Socio-economic gains and benefits**

### Stock Enhancement Tags Should be:

- able to mark juveniles and adults
- environment-friendly
- easy to detect while organisms are in the wild
- inexpensive and preferably available in the locality
- harmless to the tagged organism and its consumers
- socially and environmentally acceptable





## Legal and Policy Framework

### A. Restock only Endemic and Indigenous Species

The restocking of endemic and indigenous wildlife shall be allowed only for population enhancement or recovery purposes [*Wildlife Resources Conservation and Protection Act (RA 9147)*].

However, the community may include in their species management plan the harvest scheme and regulation outside the sanctuary when the density of species becomes high enough for sustainable use.

### B. Verify Clearance

Verify clearance from the Office of the Secretary of Agriculture in compliance with RA 9147. Consult proper agencies on local and national policies regarding restocking of species in the area.



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His recent published works include the "**Food Fishes of Palawan**," a colored field guide on the commercially important marine fishes in Palawan, and the "**Impact Study on the Binduyan Fish Sanctuary in Honda Bay**," a four-panel brochure featuring baseline data on the coral reef fishery resources within and outside protected areas, and fish catch efforts after the establishment of the Binduyan Fish Sanctuary in Honda Bay, Palawan.





Cover photos left to right: monitoring topshells, commercial sea cucumber, juvenile topshell in the wild, sea urchin in seagrass bed, sea urchin as livelihood, and giant clam in Honda Bay Fish Sanctuary.

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MARINE STOCK ENHANCEMENT  
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by

Benjamin J. Gonzales, Ph.D.

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Department of Agriculture  
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sagipin ang dagat  
sagipin ang bukas