



## **NEW ECO-JOBS from Marine Post Larval Collection**



# MOANA

initiative



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## Foreword

### By the Secretary of the UNESCO Man and the Biosphere (MAB) Programme

#### **“Eco-jobs: good for biodiversity, people and business”**

As part of our contributions to the United Nations Decade of Education for Sustainable Development (2005-2014), the UNESCO Man and the Biosphere (MAB) Programme supports capacity building dedicated to environmentally friendly and economically viable income generating opportunities, or in short, eco-jobs. Based on our experiences, such as those gleaned from the Eco-Job Training Centres in the São Paulo City Green Belt Biosphere Reserve in Brazil, we are confident that eco-jobs are good for people, biodiversity and businesses.

This is why I am particularly pleased about our partnership with the MOANA Initiative and the work of Sven-Michel Lourié and Gilles Lecaillon to support eco-jobs based on the sustainable use of coral reef resources. Focusing on their experiences in the Philippines, we trust that this manual on “New Eco-Jobs from Marine Post-Larval Fish Collection” will be of high value to all those interested in building quality economies with and for local people through the conservation and sustainable use of coastal and marine biodiversity.

#### **N. Ishwaran**

Director  
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UNESCO



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## Introduction

### **Overview**

This guide introduces and describes a new and sustainable marine fisheries activity – the collection and rearing of post-larval fish – which provides a supplementary income for fishing communities. This activity complies with the requirements of the Man and the Biosphere (MAB) directive.

The objectives of this manual are to:

1. Introduce the appropriate technology for collecting post-larval fish.
2. Describe the various stages in the collection of post-larval fish and some of the tools that can be used for this collection.
3. Introduce an incentive-based system for restocking and returning post-larval and juvenile fish into marine protected areas and managed areas to boost stocks, and
4. Present the results of some of the experiments and research being carried out in the Philippines.

The Moana Initiative is a non-profit organisation which focuses on sustainable capacity building for fish farmers, fishers and their families. Moana's team is based in France, and has worked extensively around the world in recent years.

The Moana Initiative seeks to establish sustainable post-larval collection systems and build capacity for their management around the world, with the aims of:

1. Providing local food-fish for aquaculture
2. Providing sustainable alternatives to the traditional and unsustainable marine aquarium trade
3. Restocking fish stocks in depleted and damaged marine ecosystems
4. Encouraging innovative fisheries rehabilitation strategies that are tied into more traditional coastal management strategies, such as Marine Protected Areas (MPAs).

The status of fisheries in the Philippines :

Fisheries are culturally, economically, socially and ecologically important for the Philippines.

They contribute significantly to income, employment, foreign exchange earnings and nutrition, and thus to the overall stability of the Philippines (Green et al. 2003).

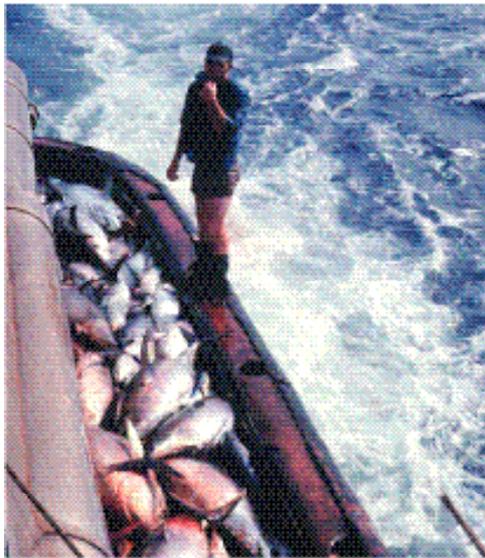
The Philippines has a long history of destructive fishing activities, over-exploitation and pollution. Near-shore habitats have suffered considerably from these problems, resulting in heavy damage to reefs, over-fishing and eventual destruction of coral reefs.

Over the past 25 years, the stocks of both food and aquarium fish have been severely depleted, and show severe signs of over-fishing. This is especially serious amongst pelagic\* species such as tuna, and in coastal fisheries where reef fish have been collected using cyanide and dynamite fishing.

This stock depletion has led to an ecological imbalance with devastating consequences for the wider ecosystem, as up to 75% of Philippines coral reefs are now degraded (Russ and Alcala, 2004).



**Illegal fishing gear, Philippines**  
*Photo : Stuart Green*



**Tuna fishing in the Pacific Ocean**  
*Photo: Bernard Preik, NOAA Fisheries collection, fish0637*



**Illegal cyanide fishing**

## Current Solutions

### *Aquaculture will not replace fishing*

Most countries' fishery resources are already over-fished, yet the demand for animal protein continues to grow rapidly, especially in developing countries. One of the most frequently suggested alternative sources of animal protein is a massive expansion of "standard aquaculture"\*- the so-called "Blue Revolution" that assumes the growth of aquaculture in the 21st Century will match the Green revolution of the last.

The Blue Revolution, however, appears unlikely to satisfy the world's protein needs. Aquaculturists have only managed to breed\* some 70 of the several thousand food fish available in the wild, and therefore aquaculture will be unable to replace the demand for wild fish or reduce pressure on fish stocks worldwide.

The number of species that aquaculture can provide for the marine aquarium trade is even less; tank rearing is possible for only 40 of the thousand-plus species that are actively traded in the ornamental fish industry.

The reasons for this lack of culturing capacity are many, but for most species it is the inability of aquaculture to control the whole biological cycle of marine fish that is the biggest stumbling block. Understanding and controlling these cycles requires years of scientific studies and significant financial investment for each individual species.

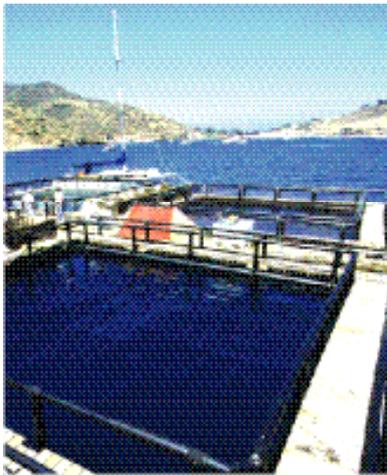
In the Philippines, the national fish, the milk fish (*Chanos chanos*) is commonly aquacultured, due to the availability of wild fry and more recently the ability to breed them in captivity. There are very few hatcheries for groupers and shrimps (*Peneus* sp). Most other food fish grown out in cages are captured as juveniles in mangrove areas, particularly rabbit fish and groupers. However, the majority of these juveniles have significant levels of parasites and disease, whilst collection in the wild damages the mangroves and sea grass beds from which they are collected.

### Marine Protected Areas (MPAs)

Marine Protected Areas (MPAs) have been used to create areas where marine life can safely live and breed. Unfortunately, most of these areas are not properly managed (White et al. 2005), and even where they are properly managed, natural recovery can take anything from 9 to as much as 18 years in some cases (Russ and Alcala, 2004).

### A viable alternative

Fortunately, a possible solution for reducing the impact of aquaculture and boosting fish biomass and species diversity in MPAs is now available.



Tuna cage



Small scale aquaculture of grouper fish



MPA guard house



## A Solution For Today: Access To A New Resource

### *The planktonic\* stage of marine fish*

Recent studies have shown that most coral reef fish breed in reef areas (e.g. in the reef lagoon) and release their eggs into the open ocean to be carried by currents (Victor, 1986). The pelagic planktonic stage of the larvae then occurs in the open sea. Between 20 and 100 days later (Victor and Wellington, 2000) the larvae move to the surface, and in most cases actively swim back to nearby reefs utilizing the upper ocean currents.

This last part of the planktonic stage of reef fish is called 'colonization' and the larvae at this stage are termed post-larval. Depending on the year, month and moon cycle, millions of these post-larval fish return to their permanent habitat (Doherty and Williams, 1988; Dufour et al, 1996).

Unfortunately, more than 99% of these larvae will disappear within one week of returning to the reef area, mainly due to predation (Doherty et al, 2004; Planes et Lecaillon, 2001; Planes et al, 2002), physiological changes (the consequences of metamorphosis to become a juvenile) and coastal pollution.

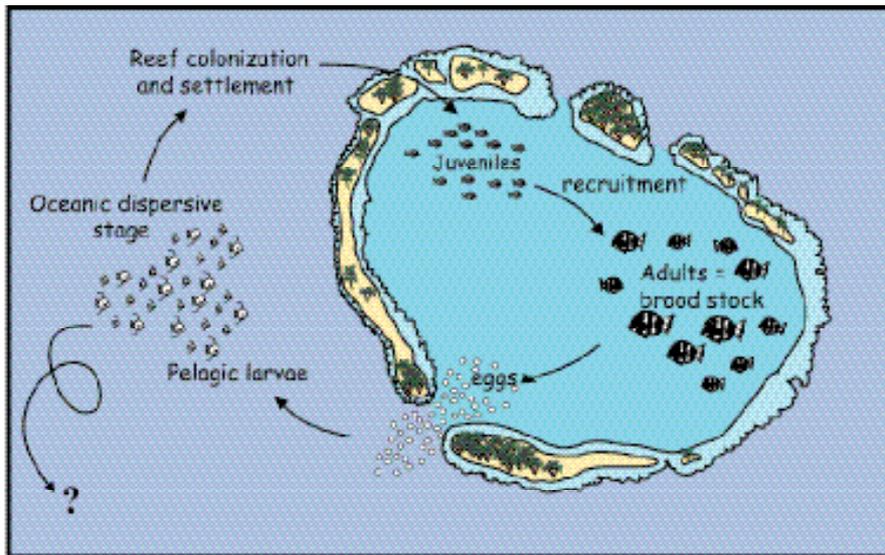
Access to a historically untapped resource

By collecting a small percentage of these post-larval fish prior to this high mortality phase, the impact of collection on future fish stocks will be negligible (Bell et al, 1999).

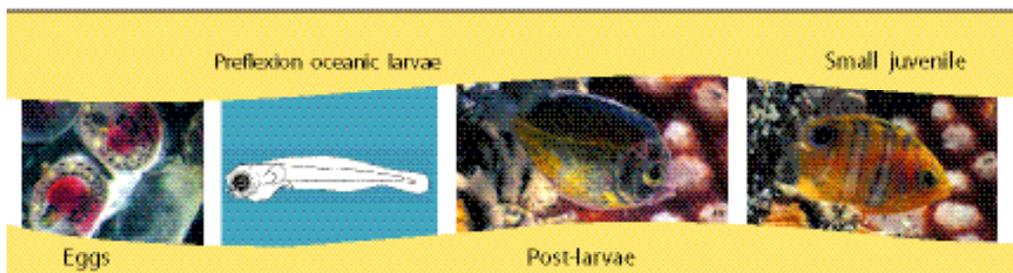
Worldwide, various larval collection techniques have been tested, including plankton nets, crest nets, and channel nets. However these techniques often have the drawback of wounding the animals during capture, as well as sometimes capturing unnecessarily large quantities of post-larval fish. Such techniques are more focused on fish collection for research activities, and are not well adapted for use in post-larval collection for fish production (Lecaillon, 2004).

Ecocean Inc. has designed a system which only catches minimal amounts of post-larval fish, and does not harm or damage the captured fish or any other organisms in the collection area. This is the system used in the Moana Initiative's capacity building project (see p.14).





Biological cycle



## Advantages Of This Innovative Technique

Breeding marine fish is highly expensive, labour intensive and technically difficult. However we propose a solution whereby Mother Nature does all the hard work, and where the abundant hatcheries of the sea can provide large quantities of post-larval fish with relative ease.

The Moana Initiative's technology transfer technical assistance focuses upon:

- 1 Catching live, healthy and uninjured post-larval fish
- 2 Identifying and segregating species which could harm or consume one another
- 3 Growing the fish for sale or for restocking.

The CARE system (Collection by Artificial Reef –Ecofriendly, see p. 14) has the following features:

- Abrasions inflicted during the collecting process usually lead to increased mortality during rearing. The CARE material causes no surface abrasions and therefore no damage occurs to the post-larval\* fish.
- The trap prevents entry of seaweed or algae inside the cod-end (the bottom section where the post-larval fish collect), easing the sorting stage and reducing stress to the post-larvals captured in the cod-end.
- The collection devices are ergonomic for the user, easy to set up at sea, and highly durable.
- If the equipment should become damaged, it is easy to repair using locally available materials, thus reducing reliance on imported equipment and minimizing costs.
- The CARE trap can be universally applied in different weather conditions (tide, current, turbidity etc) and is a highly efficient tool for collection.
- The rearing (or grow-out) facilities are easy to establish using intermediate technologies, reducing the need for technologically advanced and expensive laboratories and hatcheries.
- The CARE trap can be easily adapted to target particular species and avoid others.

Using the CARE technology, and with limited technical assistance, reared post-larval fish can be produced in large quantities. This opens up many opportunities for the creation of supplemental employment and other economic and conservation benefits, such as:

- ✦ Supply of juveniles for food fish aquaculture,
- ✦ Supply of marine aquarium fish through tank-raising of fish that cannot normally be reared in captivity,
- ✦ Restocking damaged areas for maintaining biodiversity and/or for fisheries enhancement, and
- ✦ Future biomonitoring (see Future Prospects, p. 32)



CARE installation



Overnight collector

## Methodology

The CARE trap is basically a fishing device which is illuminated at night with a waterproof lamp emitting specific light wavelengths, as the majority of post-larval fish return to the reef at night and not during the day. The CARE device is not simply a trap; it is an illuminated artificial floating device which mimics a coral reef setting.

Post-larval fish are attracted by the light and cover offered by the floating device, and upon arrival at the CARE trap they spontaneously dive into it, using its shelter to hide from predators. It works similarly to more widely used Fish Attraction Devices (FADs).

Various studies have shown that the majority of oceanic ichthyoplankton\* is phototropic\*. This characteristic, common to many marine animals, is also specific to reef fish larvae. More surprising is the fact that this characteristic disappears once the young fish has settled in its habitat (Leis 1991). Therefore the CARE trap in effect avoids the collection of juveniles or (sub-) adult reef fish, and ensures that only post-larval fish that have not yet returned to the reef are collected.

Harvesting the post-larval fish from the cod-end of the CARE is very easy, and fishers then bring the post-larval fish to land-based facilities for sorting.

Once sorted, post-larval fish are then segregated into separate aquariums to avoid predation. However fish species with similar characteristics (feeding, growth etc) are often reared together.

The use of the CARE trap is as unpredictable as all other forms of fishing; sometimes only one post-larval fish can be collected in a night, but at other times many thousands of post-larvals will enter the trap. On average, around 50 fish per trap are collected, although the number is unfortunately less in over-fished areas. Once collected, the fish may grow from an average of 8mm (around 0.1 grams) to an average of 25 to 50 mm length (a few grams) in less than three months.

These juveniles are saleable for marine aquarium trade or as pre-growth fingerlings for either future food fish grow-out, depending on species. They are also ideal for reef rehabilitation through restocking.

The steps in these processes are detailed in the subsequent pages.





Post-larval fish attracted and trapped



Morning collecting and sorting



## The Collecting And Sorting Process

### *Collection of fish at night:*

Each fisher may use several CARE devices. Depending on the weather conditions and the security of the traps, fishers may use either of the following approaches:

- deploy the CARE devices from a boat and remain all night (usually fishing alongside the trap) while larvae enter the passive devices, or
- moor the CARE devices and then return the next morning for harvesting.

The traps are laid well beyond the reef, so that they do not disturb reef ecosystems.

Early morning collection:

Since the post-larval fish are already settled inside the trap after a night's fishing, fishers simply pour them into foam boxes containing sea water, with oxygen supplied from small air pumps.

Sorting:

Sorting can be done without the need of a magnifying glass, as distinct shapes can already be seen with most common species. Post-larval size ranges from 6 mm for a Napoleon wrasse\* up to 50 mm for larger families such as surgeonfish, squirrelfish and filefish.

A visual quick identification guide is provided to help sorters identify species, enabling them to sort the larvae quickly, thereby minimizing stress (see p. 31), as this is a critical stage in the process.

It is important to avoid touching the smallest larvae with the net, to avoid abrasion injuries. Instead, a small cup is used to put the post-larval fish into small dedicated aquariums, combining fish species with similar habits and keeping predators separate to avoid predation.

Depending on the purpose of the collection, some species (bycatch) not targeted for collection should be returned to the sea.



## Grow Out

### *Initial feeding and weaning*

Initially the sorted post-larval fish are fed with artemia (brine shrimp) which are hatched daily. The live food is rapidly replaced by fish food granules, the sizes of which are fitted to the needs of the different species and size of their mouth openings.

Weaning is simple and can be done quickly for most species. The time taken varies from one day for species like damselfish, to a few months for scorpionfish. The post-larval fish can be fed up to four times per day.

Even corallivorous\* (coralline eating) butterflyfish will eat standard granules if handled properly. Because these normally fussy eaters are collected prior to feeding naturally on coral polyps, they quickly adapt physiologically to the dry pellets and have no problems maintaining this diet in the future.

### *Grow-out for the marine aquarium trade*

Grow-out to a small but saleable size takes an average of 3 months.

Juveniles caught as post-larvae also become accustomed to human handling, and become acclimated to elevated levels of fish by-products in their tanks. In this way they become adapted to the tank environment, and as they acclimatize they become much less prone to stress. Therefore they are much easier to transport and to keep in captivity if sold to the ornamental trade.

Such hardiness and stress resistance is important, as it is believed that 90% of wild-caught fish die before arrival at the hobbyist's (i.e. end-user's) aquarium (Rubec and Soundarajan, 1991).

In other words, tank-raised\* fish from post-larval collection offer many benefits both for conservation and for the marine aquarium trade. They reduce the number of wild-caught fish, which in turn reduces the pressure from marine ornamental collectors on coral reef habitats. Additionally, their acclimatization, freedom from disease and general hardiness increases their lifespan in marine aquaria, increasing demand for such eco-friendly fish yet reducing pressure to restock aquaria after fish mortality.

### *Grow out for food fish*

Food fish are usually fast-growing larvae, and can reach market size after six months. Prior to this they may also be sold to local aquaculture facilities.

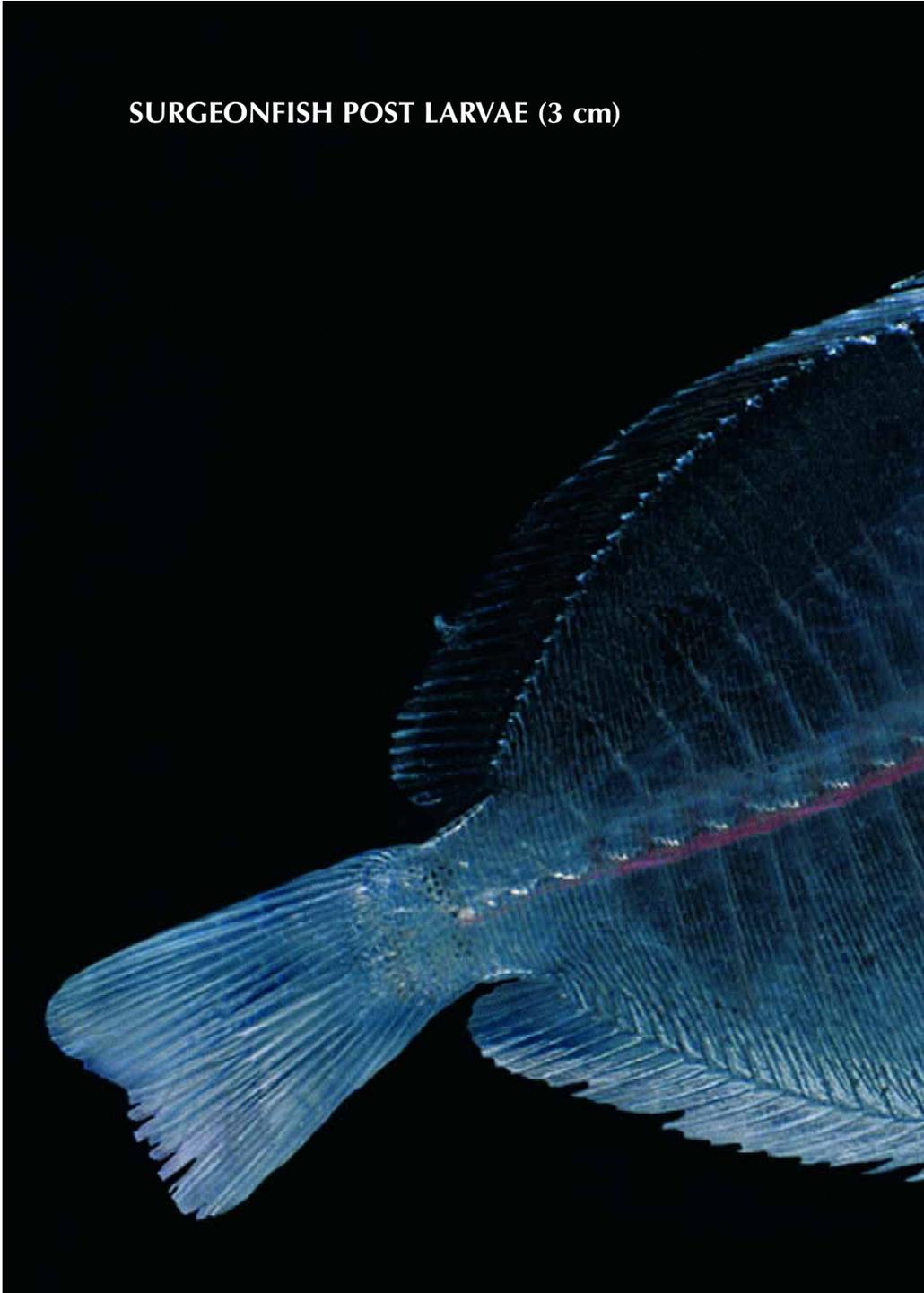
### *Grow out for restocking*

Before restocking, fish are fed with their normal prey to recover hunting abilities and prey/predator habits. Fish farmers should also stimulate juveniles to acquire predator avoidance habits by adding some predators to tanks (Yamashita et al, 1994).

Ongoing testing can then be carried out while raising the fishes in cages. This should be done close to local MPAs in order to reduce inland growing and shipment costs, and to ensure security and minimize transport costs during restocking.



**SURGEONFISH POST LARVAE (3 cm)**



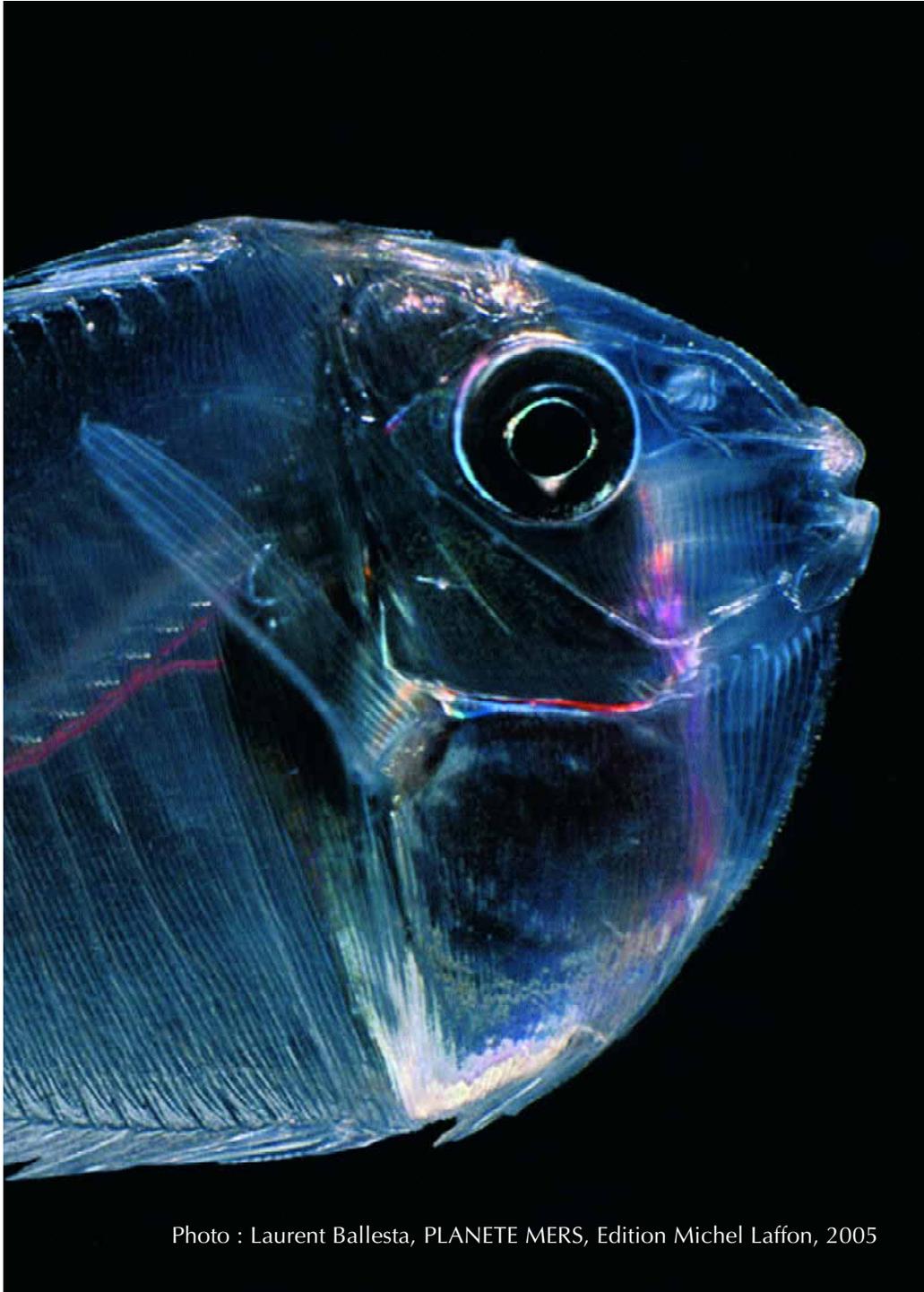


Photo : Laurent Ballesta, PLANETE MERS, Edition Michel Laffon, 2005

## Distribution To Fish Markets

### *Distribution to the marine aquarium trade*

The global marine aquarium market is worth around \$US 500 million annually, and is the second most lucrative hobby activity in the USA. The Philippines and Indonesia are major suppliers of marine ornamental fish worldwide.

No certification system yet exists for raised tank fish, so a trademark, Ecocean™, has been created. This quality label aims to provide transparency and offer traceability to the customer, as well as provide fairer prices to local collectors using a Welfare Trade\* approach. The Ecocean™ trademark may only be used when suppliers are promoting conservation of coral reefs.

Since it is not possible to “bar code\*” tank-raised fish, a Quality Charter is signed by all partners in the process, from the collector to the marine aquarium trade distributor (see [www.ecocean.fr](http://www.ecocean.fr)).

### *Distribution of food fish*

Growing experiments are still in progress, but once grown in tanks juveniles can either be sold to standard aquaculture\* producers for grow-out. The resulting food fish can be sold to local markets, or more expensive varieties such as grouper can be sold to Asian live food fish markets.



## Restocking To Boost Reef Conservation

Although new jobs can be created through aquaculture production for ornamental or food-fish markets, a percentage of the stocks collected should always be returned in the form of restocking.

Restocking of different coral reef fish species from post-larval collection is an entirely new concept. The very first tests on post-larval fish collection started in Moorea (French Polynesia) in 2004, and continued the following year in the Philippines.

Once grown and prepared, juveniles are brought to the restocking location. Monitoring is then done by marine scientists from local NGOs / academic institutions, as divers release the fish, study their behaviour, and count survival rates.

The impact of restocking can be measured against the baseline data already collected prior to restocking. These data include habitat as well as the condition and abundance of fish and invertebrates. Tagging has been tested, but suffers from several disadvantages (cost, time, stress to fishes during the tagging procedure, etc.). Results are determined through a long-term process of counting fish populations before restocking and at regular intervals after restocking of the site, and comparing the results with a local control area with similar habitat and fishery characteristics (to ensure like-for-like comparison).

The successful restocking of juveniles may also lead to synergistic effects on the recruitment of other larval fishes from outside the MPA (due to noise and pheromone attraction). Genetic diversity is often lower in disturbed and degraded areas, with a possible risk of extinction. Post-larvals collected by the CARE trap have higher genetic diversity than the resident adult fish population, as they have not yet undergone major mortality events. Therefore restocking with the resulting juveniles will increase genetic diversity and ensure population continuity (Frankham et al. 2002).

Ideally, restocking should focus on species that are either lacking within the restocking area or whose characteristics fit the needs of the MPA. For example, if coral reef cover is low and algae are abundant, algal grazers can be introduced to clear the algae, which in turn should enhance new coral recruitment within the MPA.

The restocking activities can also help promote the local MPAs and open up the area to tourism. Educational tours and volunteering-based tours (with visitors taking part in collection, restocking or monitoring) are well suited to this kind of destination. Fisher families may earn additional income by providing transport, accommodation and food, and guiding visitors through the MPA and the restocking facility. The potential for such activities has yet to be fully explored.





Damselfishes before restocking



Rabbitfishes before restocking

## Restocking Operations

### Case study 1: Municipality of Tubigon, Bohol

Under a sub-contract from the Marine Aquarium Market Transformation Initiative (MAMTI\*), funded by the International Finance Corporation under the Global Environment Facility, Ecocean began working with the three partners managing the project: Reef Check, the Marine Aquarium Council (MAC) and the Conservation and Community Investment Forum (CCIF). The objective of the sub-contract was to collect post-larval fish for restocking, track their survival after restocking of the reef, and compare the results with areas without restocking.

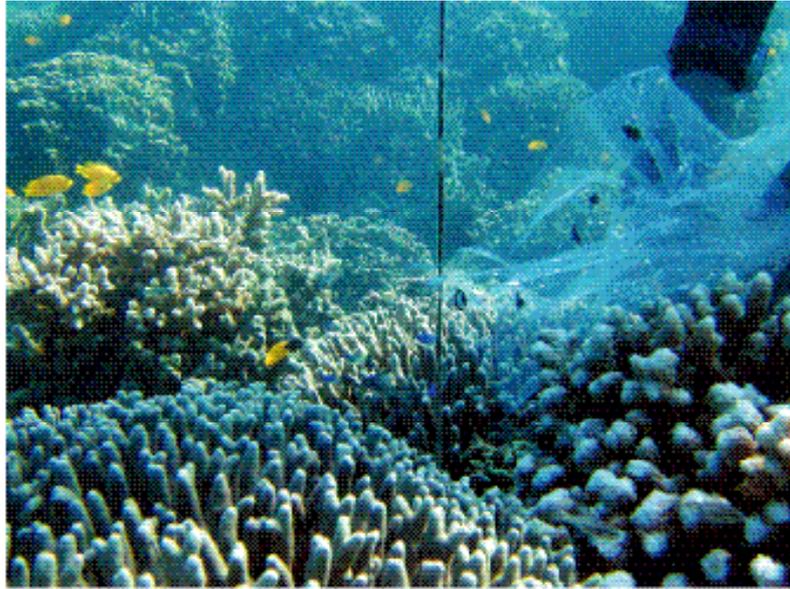
The Municipality of Tubigon was a natural choice, with the presence of the world's first MAC-certified marine ornamental fishery, a strong Local Government Unit with a long and successful experience of coastal management, the presence of an interested Non Government Organization - Feed the Children\* - and an environmentally conscious fisher population.

Post-larval fish were collected, grown for three months, and then returned to the Batasan Island MPA, a well-managed sanctuary which has unfortunately been slow to build up fish and invertebrate stocks.

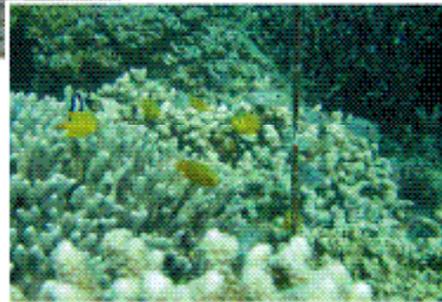
Restocking should help to build up fish biomass within the MPA and this should lead to spill-over of fish into the surrounding area, thereby increasing fishers' catch in the long run with good management.

Note: Case study 2, Establishing a Fish Farming School, is described on page 29.





Fish restocking



## A Potential Supplemental Income

Based on current collection data from Central Visayas province, 10 to 20 % of the larvae collected can be utilized for the ornamental market, around 30% for aquaculture and the remaining 50% can be used for restocking.

There are a variety of economic uses for post-larval fish. Some can go to the ornamental market (e.g. butterfly fish), as marine aquarium fish fetch a high unit price when there is a market for them. Some can be used for aquaculture (e.g. rabbit fish, groupers and snapper), but all can provide local income for local fishers, with the added benefit that post-larval collecting and rearing reduces fishing pressure on the already stressed fish stocks in the area.

While some fish can be returned for restocking (as a form of aquaculture mitigation), the operation can initially be financed through international grants, as in the Philippines (MAMTI program) and Fiji (CRISP program, [www.spc.int/crisp](http://www.spc.int/crisp)), with the objective of moving towards financial sustainability of the system over the medium term.

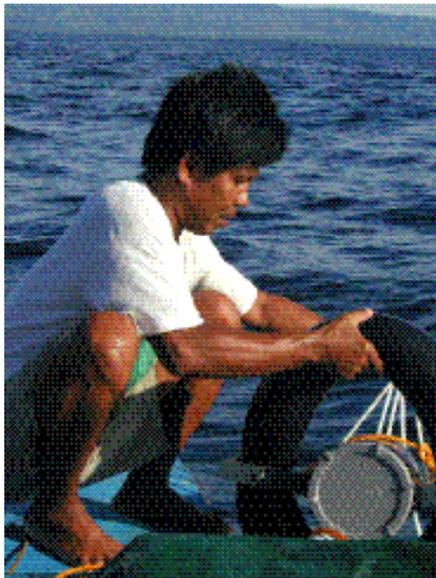
The following jobs are amongst those that can be created through a post-larval collection and rearing project such as this:

- ∑ Fishing using CARE devices for sale to the restocking organization.
- ∑ Work in the aquaculture facility, including cleaning and maintenance of equipment, and various fish rearing activities (feeding, medication etc). Jobs can range from unskilled labourers to highly skilled technicians.
- ∑ Handling, packing and shipping.
- ∑ Sales and marketing.

And also, security and MPA protection, management and administration, including accounting and quality assurance, Eco-tour guiding for visitors to the facility and the MPA and provision of visitor transport and facilities.

In the longer term, independent entrepreneurs could be encouraged to set up their own facilities, with the provision that the MPAs continue their protected status and a percentage of the fish are returned to local marine waters as mitigation for the collection.





Filipino fisherman using CARE technology



Capacity building in a Filipino village

## MAB and Eco-Job\* Training

What are eco-jobs?

Since 1996, the UNESCO Man and the Biosphere (MAB) Programme has supported the establishment and operation of Eco-Job Training Centres, such as the seven Centres established in the São Paulo City Green Belt Biosphere Reserve (Brazil). These Centres provide young people from economically disadvantaged families with training courses designed to give them competencies allowing them to enter the eco-job market.

The MAB programme is oriented towards sustainable development, focusing on conservation and the rational use of biodiversity. MAB supports scientific research and collection of information while taking into due consideration traditional knowledge, for example the rich knowledge contained in traditional fishing communities. A key instrument for the MAB Programme is the World Network of Biosphere Reserves, which acts as a laboratory of conservation and sustainable development action with and for local people.

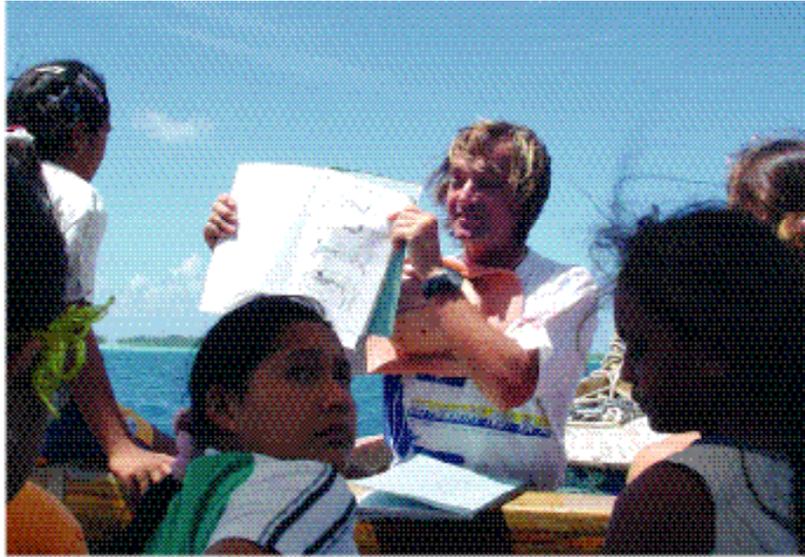
Eco-jobs and the Moana Initiative

The Moana Initiative offers a good working model of eco-job implementation, where technical assistance is provided to local stakeholders through multi-sectoral partnerships involving national and local government, local academic institutions, non-government organizations, the private sector, and of course the targeted communities themselves

In the context of MAB marine reserves (and other MPAs), the Moana Initiative can use its unique post-larval fish collection and rearing system to develop new fishing and aquaculture jobs with only minimal impact on fish stocks or reef ecosystems, whilst simultaneously boosting local fish stocks and providing an impetus for improved MPA management.

Building local capacity for implementing and operating aquaculture facilities is essential for successful and sustainable MPA conservation. Moana offers a technical assistance package for capability building of all the components required to establish a pilot production facility, in which all stakeholders are involved.





Training



Instructions for sorting



Instructions for weaning

## Designing A Post-Larval Collection Program

Prior to the establishment of any post-larval collection program, it is necessary to understand the political, social and economic situation of the local area. Prior to implementation, relevant legislation must be studied at several levels, within the framework of MAB Reserve criteria:

- International laws (e.g. CITES\* protected species),
- National laws on fishing and aquaculture activities (e.g. permits and licences), and
- Local authorisation for restocking and monitoring in local MPAs (if established).

During the consultation and research stage, local partners should be actively sought from the different local agencies and organizations, and buy-in from local government and other stakeholders is essential. A good example of the further implementation process is described in Case Study 2 below.

### Case study 2 – Establishing a Fish Farming School in Mindoro (Philippines)

The Moana Initiative is currently carrying out a feasibility study for a future project in the Puerto Galera MAB Marine Reserve, in partnership with a local child-care foundation, VIRLANIE\* . The project's goal is twofold.

1. To create a community-based fish farming school to train young adults living in the VIRLANIE shelter for street children, whilst also involving other local stakeholders.
2. To train local people from the wider community in new jobs, as well as to provide an education in the amazingly diverse underwater world of the Philippines.

People trained by the Moana Initiative will be from the NGO and the local population. After a few months the Fish Farming School is envisioned to become both the production unit and the training facility. A business plan is being drafted with the aim of leading the project towards financial independence. In the meantime, the NGO and the Local Government Unit (LGU) will continue to assist in covering the running costs until the business targets are achieved.



### Pre-sorting board

REAL SHAPE FOR SORTING STEPS			
REAL SHAPE	FAMILY COMMON NAME	RANGE SIZE IN MM	Apertures/teeth/Fishlet
	ACANTHOCYBIDAE TYPE I ACANTHOCYBIDAE	10 to 90 mm	1
	SOLOCHYTRIDAE TYPE I SOLOCHYTRIDAE	20 to 20 mm	1
	MELLETERAE MELLETERAE	40 to 80 mm	1
	ACANTHOCYBIDAE TYPE II ACANTHOCYBIDAE	20 to 40 mm	2
	SOLOCHYTRIDAE TYPE II SOLOCHYTRIDAE	20 to 40 mm	3
	MALLETIDAE MELLETERAE	20 mm	3

### Family board

**ACANTHOCYBIDAE = SURGONFISH, TANG, WAGON** Flesh: bland, 0+1+, value: 2222

- **Acanthura** → the value depend of the species, *A. aculeata*, *A. nigricans*, *A. albissima*, *A. gulosus* are the most interesting ones (IX eyes).



30 to 40 mm
- **Chromis** → depend of the species, but *C. armatus* and *C. strigatus* are the very important. Difference between *Acanthura* is different, but there are VII eyes instead of IX.



40 mm
- **Also = WAGON** → *N. latipinna* is the best one. Biggest larvae. VII eyes. More important than *Acanthura* genus.



25 to 30 mm
- **Schreiner** = **DAFO** → All species are very interesting. IX eyes like *Acanthura* but all dorsal fin, easy to identify. The most popular fish in the world is the yellow tang, *Schreinerus flavescens*.



15 to 20 mm

**Adult rear larvae**

**Stage: acanthoid**

Most of the acanthoid genera have big larvae, some very big like *Flax*. Larvae are often completely transparent or translucent, some with still pigments concentration (like *strobilatus*), some with black spot. Color are varying day after day.

**Feeding**

Not so difficult to rear with dry food. Fishes are not on the bottom. Hatched larvae, can eat the algae on the side of the tanks. Adult acanthoid or better use larvae and FOD for 4-5 months the best. This will include the development into the water around the head in some genera. They come usually to the surface to eat greenish. Donch rapidly the suitable diet.

**Behavior**

Can be grouped between each other, often one lower in the tank. This can be grouped by colors of the same genera, but they will group again. They can separate the weak ones, but a new one will appear. Don't let them killing the weakest. Multicolor need the beauty of fish (the best) best and fish only!



Technical handouts

## Tools For Capacity Building In Post-Larval Collection

The technical assistance and tools required for collecting and rearing post-larval fish will be provided to the Fish Farming School by the Moana Initiative

**The first tool is the CARE trap**, which has been used successfully to collect post-larval fish in the Philippines, French Overseas Territories (New Caledonia, French Polynesia, Comoros Islands), the USA (Florida and Hawaii coasts), as well as Vietnam and the Maldives. It is now relatively easy for people to be trained rapidly in its use, using a minimum of information materials and other collaterals.

**The second tool is a guide** (printed on a waterproof PVC board) for identifying key larval families collected, using life-sized representations of the shape and other visual characteristics of the larvae. The guide, which is site-specific, is an essential tool for the sorting process, to ensure that all post-larval fish are dispatched into the appropriate tanks for the following weaning stage.

**The third tool is a detailed guide** to identify genus or species. It also provides information for rearing (behaviour, feeding etc.) based on the needs of the individual species.

**The fourth tool is a series of technical handouts** which describe the construction and management of an aquaculture facility, with sea water and oxygen requirements and daily (or weekly) checklists. These handouts cover the following steps essential to managing a post-larval collection and rearing facility: collecting, sorting, feeding, sanitary aspects, and packing.



## Conclusion And Future Prospects

### *Conclusion*

Access to this new post-larval resource is easily achievable and the tools for capacity building are already available. This approach fits in perfectly with MAB's philosophy.

This approach is supported by programmes, such as UNESCO MAB, and will be further tested and applied in coastal and marine biosphere reserves around the world.

### *Future prospects*

This new approach to sustainable MPA conservation and exploitation, is already working in the Philippines, and its potential for application is truly global, as it offers great potential to all developing countries with reef shores.

However its application is not limited to tropical seas and developing countries; it is also suitable for use by advanced nations in temperate seas as an additional economic, conservation and restocking resource, especially where conventional conservation strategies have already failed. The heavily over-fished Mediterranean and North Sea fisheries are good examples of areas that could benefit from such an approach. As CARE traps can collect all kinds of post-larval fish, they will be of interest for all kinds of alternative aquaculture, and also for environmental fields such as:

- Biomonitoring\* for reef health studies or fishery prospecting (best siting of MPAs, key larval recruitment areas, etc.)
- Providing bio-indicators to assess environmental quality (presence of or lack of larvae)
- Global marine biological research (scientific studies) on key species and other fisheries research
- Identification of new or indeterminate species
- Marine biotechnology (cell culture for medical research) by collecting specific species required

Developing these new marine eco-jobs and the enhancing the capacity for restocking of fisheries will depend on a number of crucial factors. Community buy-in, political will, compatibility with existing policies and the willingness of people to adopt the new technology are essential preconditions for successful implementation. In addition, it is necessary to ensure full compliance, i.e. this technology is used for the purposes laid out in this booklet, and that a restocking component is always present. When managed properly, the tools outlined in this booklet can bring concrete and lasting benefits to the fishermen and other stakeholders of the coastal regions of the Philippines and beyond.

Finally, it is important to remember that it is not the fisheries themselves that need to be managed, so much as the fishermen and the other humans that interact with the marine ecosystem.



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## Glossary

- **Bar code** : is the small pattern of lines (bars) and spaces that is affixed to retail store items, identification cards etc. to allow digital reading and traceability of the product.
- **Biomonitoring** : a scientific technique for assessing marine environmental exposures based on sampling and analysis of marine animals.
- **Breed (to)** : To produce animals by inbreeding or hybridisation by broodstocks\*
- **Broodstock** : stock of genitors used for breeding in standard aquaculture; the group of males and females from which fish are bred for aquaculture.
- **CITES** : Convention on International Trade in Endangered Species. ([www.cites.org](http://www.cites.org)).
- **Corallivorous** : Species that feed primarily or exclusively on coral polyps.
- **Eco-job** : a job where natural and human resources are used in a sustainable way, ecologically and socially. This means benefiting from the resources without destroying them in the long term
- **Ecocean** : Ecocean Inc. is a French engineering company which developed the CARE traps; Ecocean™ is also a trademark for a quality label in the marine aquarium welfare trade.
- **Feed The Children** : Non-Government Organization with country headquarters in Bohol, Philippines.
- **Ichthyoplankton** : zooplankton (passive larvae in the water column) with only fish items (Greek: ichthys= fish); includes fish eggs, newly hatched eggs (fry), young fish.
- **MAMTI** : Marine Aquarium Market Transformation Initiative, a five year International Finance Corporation funded Global Environment Facility project partnership between MAC, Reef Check and CCIF in the Philippines and Indonesia.
- **Napoleon wrasse** : *Cheilinus undulatus*, one of the biggest reef fish in the world (up to 2m), but with one of the smallest larvae (6 mm)!
- **Pelagic species** : fish that live at or near the water's surface. Examples of large pelagic species include swordfish, tuna, and many species of sharks. Small pelagics include anchovies and sardines. (opp. benthic).
- **Phototropism** (adj. phototropic): Behaviour of an organism attracted by a light source.
- **Planktonic** : from plankton, organisms that float and drift in great numbers, which have limited swimming abilities, and which are carried largely passively by water currents (opp. nekton). They are mainly at or near the surface, and serve as food for fish and other organisms.
- **Post-larval** : fish larvae leaving pelagic plankton to colonize their shore habitat
- **Standard aquaculture** : The culture of organisms in water, from breeding to growing. Aquaculture means managing the whole biological cycle, from breeding in hatcheries with broodstocks, through reproduction and complex larval stages feeding, followed by weaning and growing stages.
- **Tank-raised** : animal grown in aquarium, raceway or circular tanks as opposed to collected from the wild.
- **VIRLANIE** : Non-profit organisation for childcare based in the Philippines ([www.virlanie.org](http://www.virlanie.org)).
- **Welfare trade** : trade oriented on a win-win approach for small producers in developing countries.



White Beach town in the Puerto Galera MAB Reserve.

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