

*New Fisheries Cooperation Promotion Project*

***Education and Dissemination Aimed at  
Introducing Coastal Fisheries Resources Management  
and Stock Enhancement***

***- Example of Artificial Fish Reef Experimental Projects in the Republic of Senegal  
& St. Vincent and the Grenadines -***





## 1. Introduction

Throughout history, mankind has skilfully utilized the reproductive capacity of nature and has prospered utilising fisheries products which are precious gifts of nature provided by the world's oceans, lakes and rivers and which do not require much labour for rearing as in the case of agriculture or livestock farming.

There has been active development and improvement of fishing technologies up to the present to increase the production volume to deal with the rapid growth of the world's population and diversifying diet while the production volume of aquaculture has speedily increased. Despite these efforts, the world's fisheries resources have been fully exploited for most species of fish and shellfish. Even if aquaculture continues to grow in the coming years, it will be difficult to meet mankind's demand on fisheries products for years to come.

The global implementation of several measures is urgently required to restore the present stock situation so that mankind can continue to enjoy fisheries products. These include ① strengthening of the management to preserve fisheries resources, ② development and improvement of the conditions of fishing grounds (including impacts from the land), ③ promotion of sea farming, ④ development of spawning grounds as well as rearing grounds for juveniles, ⑤ improvement and conservation of seaweed beds and tideland and ⑥ reduction of the quantity of fish eaten by whales and other marine mammals due to their unnecessarily excessive protection. However, small-scale coastal fishermen are unlikely to accept the prohibition of fishing to restore deteriorated coastal resources because such acceptance would deny them their livelihood. A more realistic approach is to aim at ensuring sustained utilization through efforts to increase coastal fisheries resources while maintaining the current level of the catch as much as possible.

Over the last 30 years, many projects have been implemented throughout Japan to actively increase coastal fisheries resources and have achieved certain positive results. This educational pamphlet has been prepared to allow not only small-scale coastal fishermen but also people throughout the world to utilize fisheries resources as precious gifts of nature in a sustainable manner by disseminating the knowledge and experience accumulated by Japan to the entire world, including developing countries, in the belief that this is the responsibility of Japan as a major fishing nation which has led fisheries in the world.

Japan has been implementing activities designed to educate people, particularly in developing countries, on the necessity for and importance of the preservation/conservation and increase of coastal resources together with the management of fisheries resources in general while conducting demonstration experiments under various projects in these countries which have no choice but to seek an increase of the catch because of their socioeconomic conditions.

## 2. Trends of Fisheries in the World

FAO (Food and Agriculture Organization of the United Nations) statistics put the total production volume of world fisheries in 2001 at 130 million tons, including the catch and cultured production, underlining the high level of production in recent years. Fish and shellfish accounted for more than 15% of the global supply of animal protein. China remains the largest producing country, accounting for more than 30% of the global production. Aquaculture, which has recently recorded rapid growth and is as high as 26 million

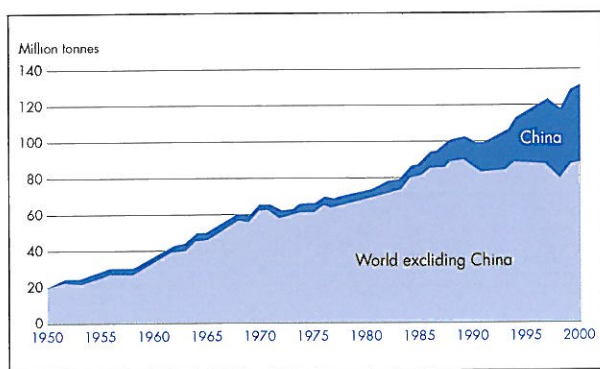


Fig. 1-1 World Fisheries Production

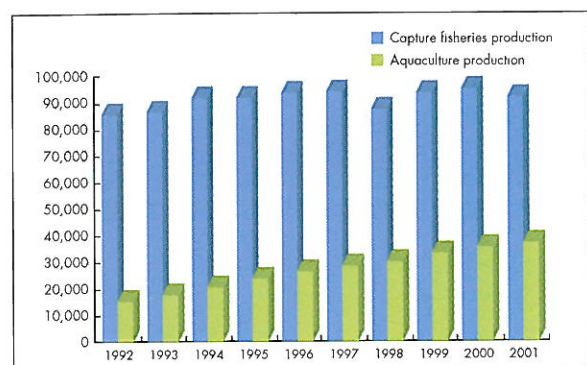
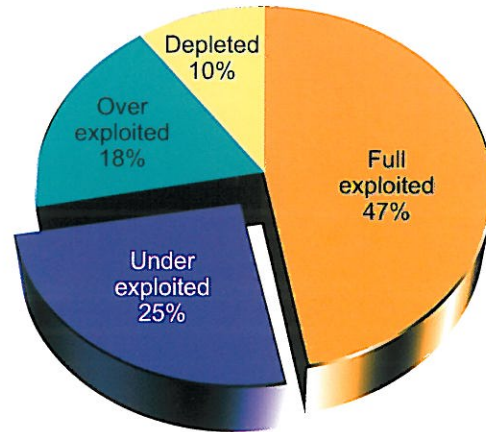


Fig. 1-2 Change in World Capture Fisheries Production and Aquaculture Production



tons, accounts for a major part of this. Experts in the field, however, are suspicious of this statistical data which has been self-declared by China. Excluding the production volume of China, the total production volume appears to have levelled off at the some 80 million ton level. In particular, a major production increase of ocean fisheries is believed to be difficult to achieve (Figs. 1 and 2). In fact, the FAO evaluated in 2002 that 28% of the world's important fisheries resources have been either depleted or over-exploited with another 47% being fully exploited. It is also said that if the current level of the world's fisheries resources is to be maintained, it will be necessary to reduce current fishing effort by more than 30% (Fig. 2).



The State of World Fisheries and Aquaculture 2002

Fig. 2 Stock Evaluation (FAO)

The number of people working in the fisheries industry throughout the world, i.e. those in fisheries and aquaculture, has been relatively steady since 1995 and was estimated to be 35 million in 2000, of which 65%, 15% and 20% were engaged in ocean fisheries, inland water fisheries and aquaculture respectively.

The international trade volume of fisheries products has grown at an annual rate of 4% in the past 10 years, reaching a record-breaking US\$ 55.2 billion in 2000. The net export value of developing countries also grew from US\$ 10 billion in 1999 to US\$ 18 billion in 2000, recording an inflation-adjusted real growth rate of 45%.

### 3. Fisheries Resources Management in Japan

#### 3-1. Resources Management-Orientated Fisheries

Ceilings for the TAC (total allowable catch) and TAE (total allowable effort) have been implemented in Japan under a plan to restore coastal resources in addition to the conventional regulations on fish size, fishing gear, fishing grounds, fishing seasons and fishing effort. Moreover, the number of the tuna fishing fleet has been reduced by 20% in accordance with the FAO action plan.

#### 3-2. Promotion of Fisheries Based on Stock Enhancement

Since 1976, Japan has shifted its basic fishing policy from "production-orientated fisheries" to "fisheries based on stock enhancement" and has implemented a number of projects described below to enhance coastal resources (Fig. 3).

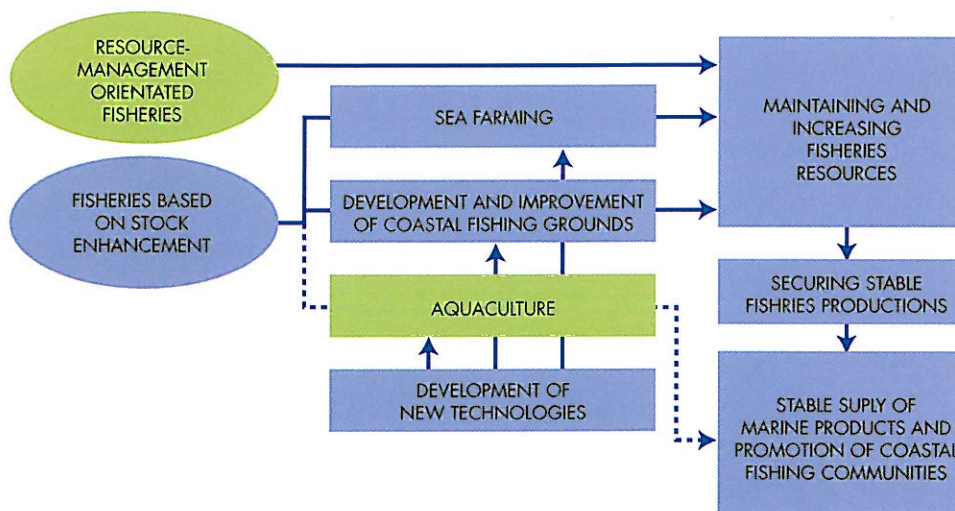


Fig. 3 Japan's Basic Policy is to Shift from "Production-Orientated Fisheries" to "Fisheries Based on Stock Enhancement"



## (1) Development and Improvement of Coastal Fishing Grounds

Efforts to develop and improve coastal fishing grounds to create suitable habitats for marine living organisms include the installation of artificial fish reefs designed to rear and protect juveniles and to promote spawning, the creation of seaweed beds and tideland and the removal of accumulated sludge and predators (Fig. 4).

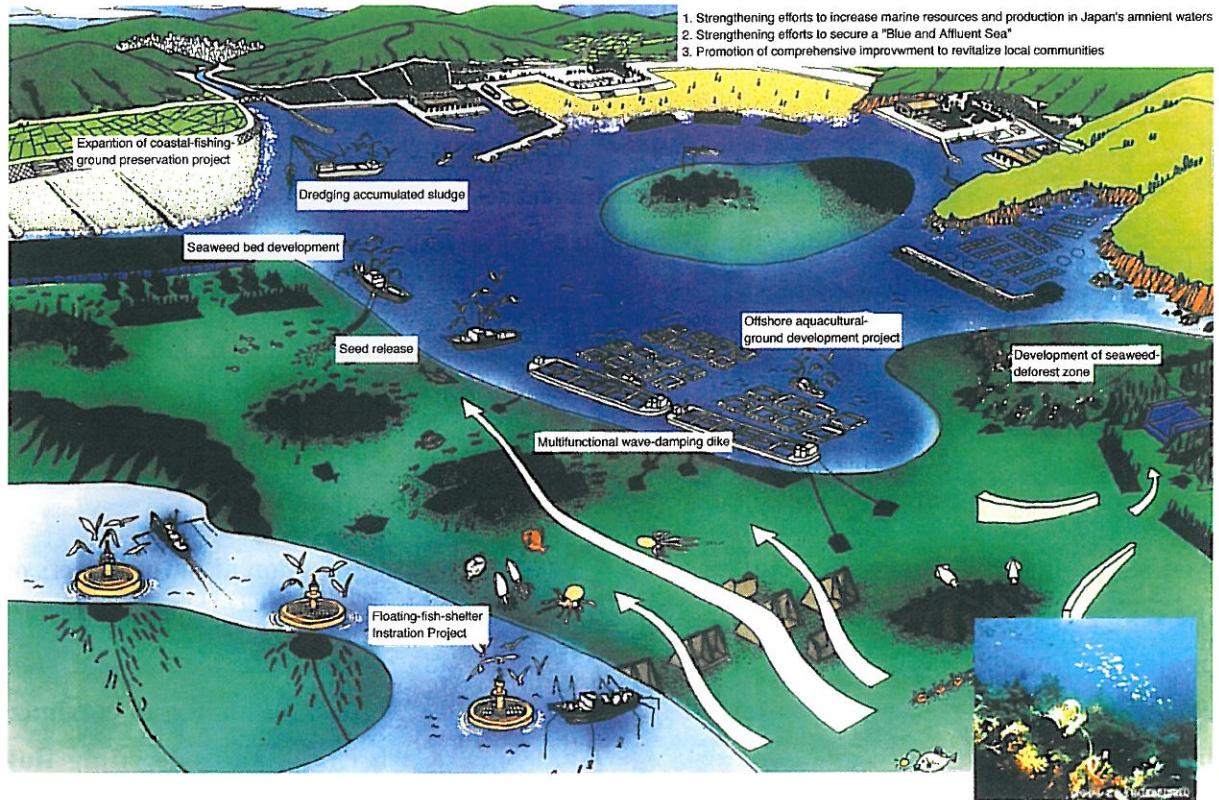


Fig. 4 Development and Improvement of Coastal Fishing Ground

## (2) Promotion of Sustainable Marine Aquaculture

Efforts to promote sustainable marine aquaculture include the creation of a calm aquaculture environment through the introduction of wave dumping dikes and floating wave-damping dikes, the computerised control of an appropriate feeding volume to avoid self-contamination and the development of an offshore aquaculture system capable of resisting strong currents (Figs. 5-1 and 5-2).

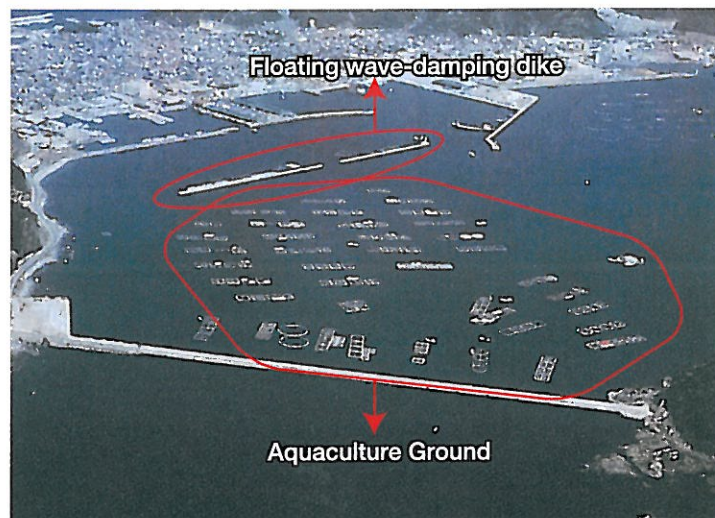


Fig. 5-1 Aquacultural Ground-Development Project



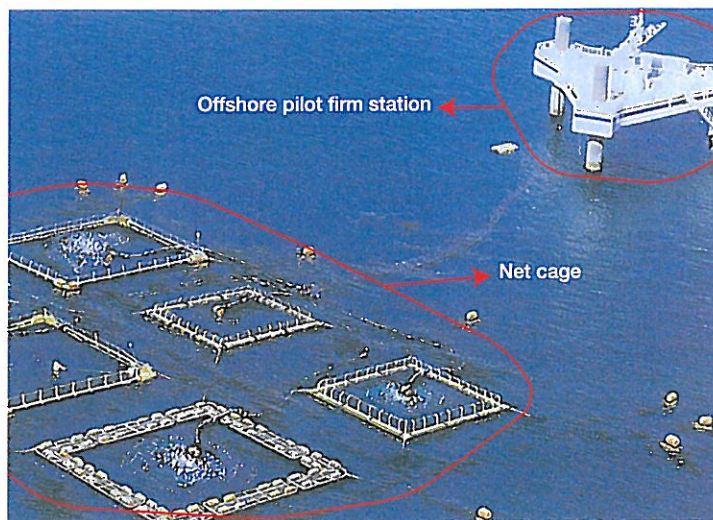


Fig. 5-2 Pilot Firm Off-Shore Culture

**(3) Promotion of Sea Farming and Marine Ranching Project**

This project involves the production of a large quantity of healthy seeds under complete human control and their release at such places as protected reefs, where suitable habitats for marine living organisms have been developed, at an appropriate time, taking the impacts on the ecosystem into careful consideration. It aims to enhance the resources size of the target fish while improving the survival rate of the released juveniles (Figs. 6-1 and 6-2).

RECENT ANNUAL SEED RELEASE FIGURES

Main fry	Release (millions)
Red seas bream	23
Flatfish	26
Prawn	218
Greasyback shrimp	23
Blue crab	36
Abalone	28
Scallop	2,755
Short-necked clam	86
Sea urchin	65

Fig. 6-1 Average Annual Seed Release Figures (1997~2001)



Fig. 6-2 Mechanism of Sea Farming (Photographs: Courtesy of the Fisheries Research Agency)



## 4. Cooperation Project Implemented on West African Coast

### 4-1. Outline and Purpose of the Project

Against the background described so far, the Overseas Fisheries Consultants Association (OFCA) conducted an experimental project for three years from April, 2001 to March, 2004 in the Republic of Senegal. Entrusted by the Fisheries Agency, Government of Japan, this project aimed at improving local awareness of the need for the proper management, preservation and enhancement of fisheries resources.

After a series of preliminary surveys and the training of personnel in Japan, artificial fish reefs were installed under this project to attract marine living resources and to make rearing grounds for juvenile, followed by a monitoring survey to measure the outcomes and effects.

In addition, an international workshop sponsored by OFCA, Fisheries Department of Senegal and assisted by the FAO, CSRP (Commission Sous-Regionale des Pêches), Japanese Ministry of Foreign Affairs and JICA (Japan International Cooperation Agency) was held, to which those involved in fisheries sector is not only Senegal but also other West African countries were invited, to introduce the purpose, contents and outcomes of the experiment in Senegal, to explain the effects and necessity of the project and to facilitate the exchange of opinions.

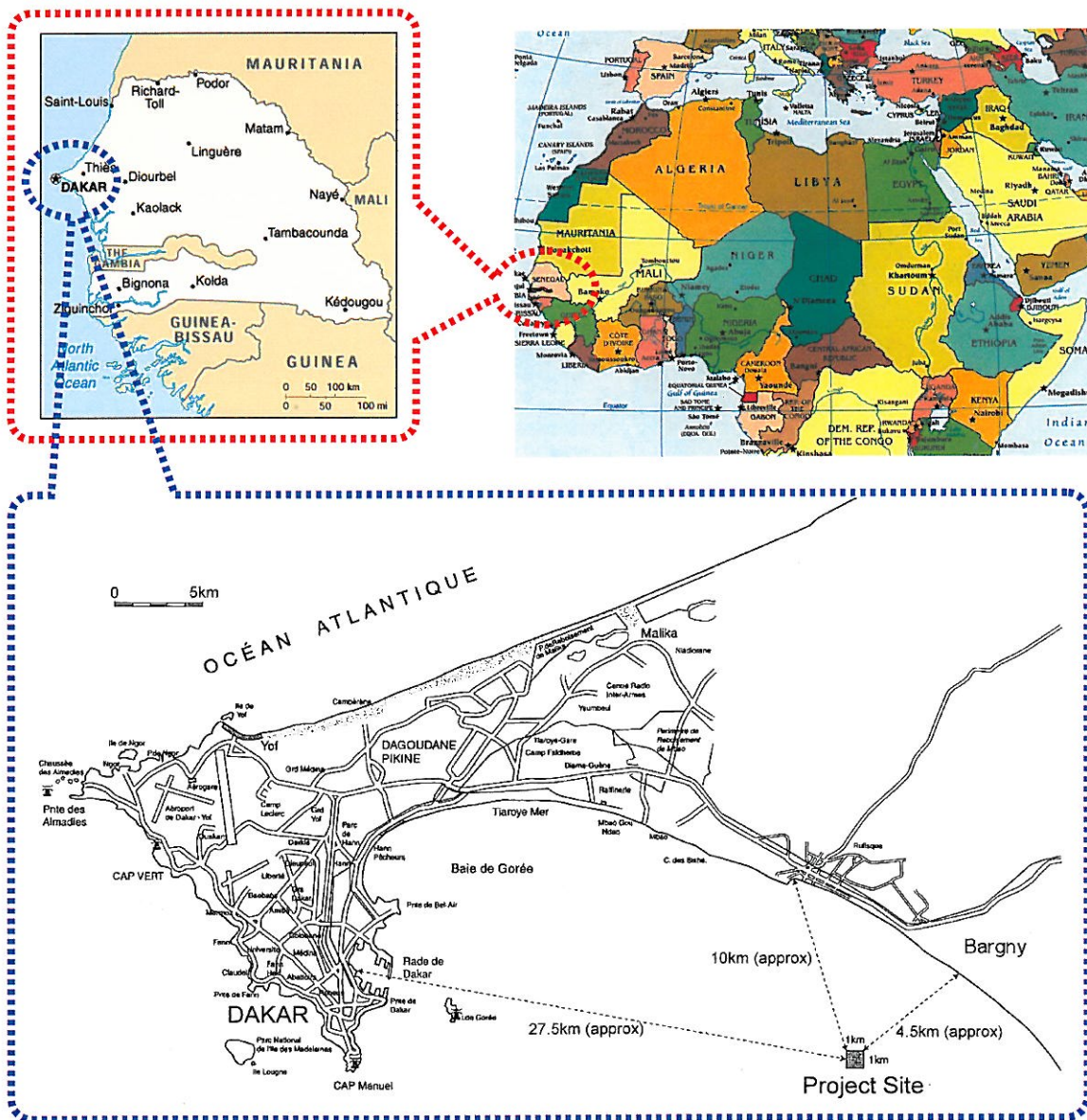


Fig. 7 Installation Site of Artificial Fish Reefs



This international workshop was followed by a local workshop in the Republic of The Gambia and the Islamic Republic of Mauritania to which fisheries-related government officials and small-scale fishermen were invited on suitable measures to manage, preserve and enhance fisheries resources in the respective countries to promote understanding of these issues among those who directly depend on fisheries resources for their livelihood.

#### **4-2. Present Situation of Fisheries in Senegal**

The Republic of Senegal is situated at the westernmost point of the African continent and has good fishing grounds endowed with favourable currents and upwellings in the coastal zone along the country's some 700 km coastline. Fisheries production has been above 400,000 tons a year since 1997, the largest among West African countries, and more than 70% of this total is produced by some 8,000 small scale fishing boats. Exports of fisheries products account for more than one-quarter of the total export value of Senegal and the export value of fisheries products is ranked first in terms of export items. The fish consumption per capita is approximately 27 kg a year and fish is a precious source of animal protein intake for the people. The decline of coastal demersal fish production in recent years due to increased fishing effort has become a serious problem for small-scale fisheries.

#### **4-3. Outline of the Experimental Project**

Project implementing bodies:

OFCA and Department of marine fisheries, Ministry of Economy and Maritime, Government of Senegal (DPM)

Project implementation period:

April, 2001 ~ March, 2004 (three years)

Artificial fish reefs construction and installation cost:

approx. ¥60 million

Installed site:

20 m deep muddy sand sea area 4.5 km offshore of Bargny in the Republic of Senegal (Figs. 7 and 8)

Target fish:

coastal demersal fish and small pelagic fish

Main stakeholders:

fisheries-related officials of the Government of Senegal and fishermen engaged in small-scale coastal fisheries in the Bargny area

Types and size of artificial fish reefs:

- Concrete blocks (Figs. 9 and 11)

Size : approx. 16 hollow m<sup>3</sup>/unit

Weight : approx. 8 tons/unit

Quantity : six

- Natural stones (Fig. 10)

Size : approx. 200 m<sup>3</sup>, creating a natural stone mound (13 m in diameter and 3 m in height) using large natural stones weighing 0.5 ~ 1 ton each



*Fig. 8 Installation of Concrete Blocks*





Fig. 9 Concrete Block (3 m x 3 m x 3 m)

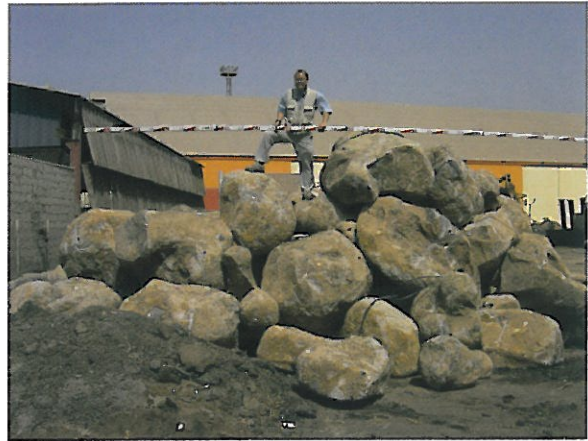


Fig. 10 Large Natural Stones (500 kg ~ 1,000 kg each)

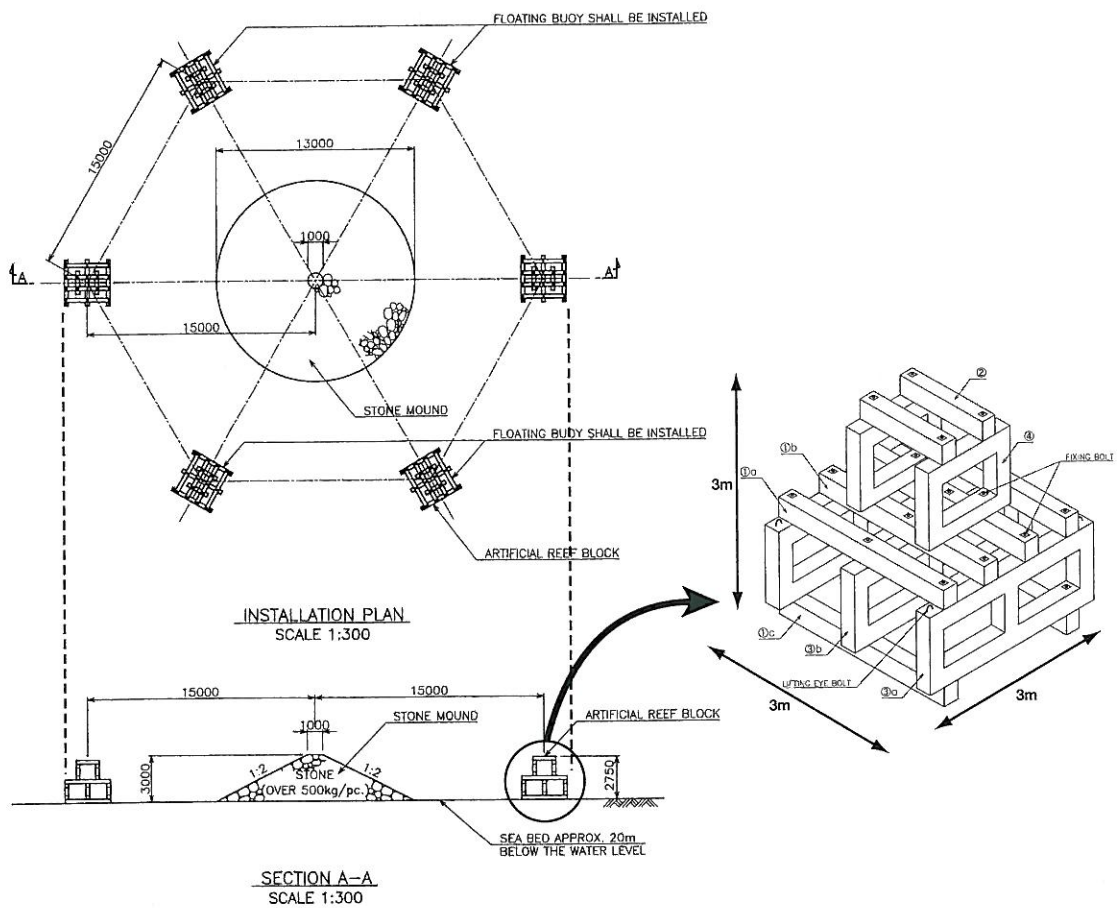


Fig. 11 Deployment of Artificial Fish Reefs



#### 4-4. Project Contents

	2001		2002		2003		2004	
	Apr.-June	July-Dec.	Jan.-June	July-Dec.	Jan.-June	July-Dec.	Jan.-Mar.	
Committee Meeting in Japan	two times		three times	once	once			
Preliminary Explanation and Consultation on Implementation	↔							
Field Survey		↔						
Training in Japan			↔					
Educational Activities in Neighbouring Fishing Villages			→					
Establishment of Management Committee			→					
Construction and Installation of Artificial Fish Reefs			↔					
Monitoring				→				
Closed Period for Fishing					→			Until Dec., 2004
International Workshops						●	4th - 11th Dec.	



Fig. 12 Speech by the Minister of Fisheries at the Ceremony to Celebrate the Completion of Artificial Fish Reefs



Fig. 13 Educational Activities for Fishermen Using Underwater Images, etc.



Fig. 14 Scene of Underwater Monitoring

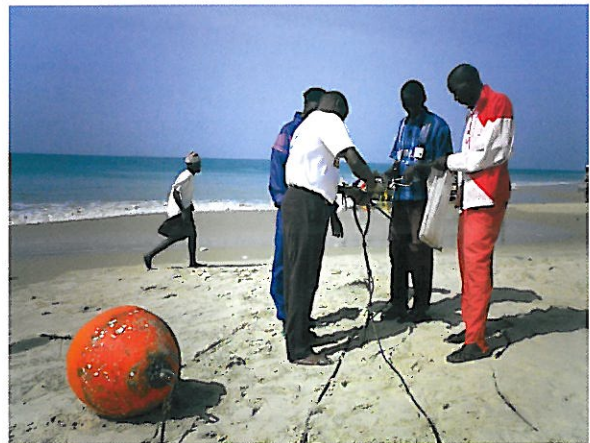


Fig. 15 Scene of Preparatory Work to Install a Marker Buoy



#### 4-5. Gathering Situation of Marine Living Species Around Artificial Fish Reefs

- Within one year of their installation, some 50 species of marine living species were observed to gather around the artificial fish reefs made of concrete blocks and natural stones (Fig. 16).
- An underwater survey and filming confirmed the attached seaweed and shellfish, crustaceans and fish schools.
- The gathering of grouper (*Epinephelus aeneus*), the catch of which has declined due to extensive fishing reflecting the extremely high commercial value of grouper, was frequently observed (Fig. 17). In addition, the underwater images confirmed the presence of a school of adult grouper of 60 ~ 80 cm in length around the artificial fish reefs during the spawning season.



Fig. 16 School of Small Pelagic Fish Gathering Around an Artificial Fish Reef



Fig. 17 Grouper Attracted to an Artificial Fish Reef

These results indicate that the installation of artificial fish reefs under the experimental project has created a new ecosystem in the water around these reefs, including rearing grounds for attached organisms in the bottom of flat, muddy sand coastal area where seaweed beds and rock reefs do not naturally exist, rearing grounds for juveniles and spawning grounds for demersal fish. It is, therefore, hoped that these useful resources will proliferate in the coming years.

#### 4-6. Voices of Officials of the Fisheries Department and Fishermen

**Fisheries Department:** The continued educational activities for fishermen have improved the awareness of fishermen of the need for fisheries resources management and the fishermen's organization has been strengthened, including the establishment of a management committee. Moreover, having observed the outcomes of the project, local fishermen have voluntarily installed natural stones in the water to create artificial fish reefs by themselves (Fig. 18).

**Fisherman:** After the installation of the artificial fish reefs, grouper of which the catch has drastically declined in recent years are observed in abundance surrounding in the nearby water.

**NGO:** As artificial fish reefs not only enhance resources but also protect fishing grounds from invasion by illegal trawlers, they are very beneficial for coastal fishermen engaged in small-scale fisheries.

**Fisherman:** The underwater image showing a school of large grouper around the artificial fish reefs has made me recognise the positive effect of artificial fish reefs. It is now hoped that the scale of artificial fish reefs will be expanded to proceed with efforts to preserve and manage fisheries resources under the leadership of local fishermen.

**Fisherman:** The creation of fishing grounds and the enhancement of fisheries resources using artificial fish reefs are necessary today when the decline of fisheries resources has become a critical issue. As these



Fig. 18 Voluntary Sinking of Natural Stones by Local Fishermen (10-40kg)



efforts are also necessary to ensure the future of children, it is hoped that the scale of the project will be expanded in the coming years.

*Fisheries Department:* This experimental site is to be afforded the status of a spawning ground as well as a fish rearing area to protect juveniles and, therefore, the closed season for fishing under the relevant ordinance will be extended. The introduction of fishing rights at artificial fish reefs or a similar administrative measure will be examined in the future.

#### **4-7. International Workshop**

On 4th and 5th December, 2003, an international workshop was held in Dakar, the capital of Senegal, to improve the level of awareness regarding the management, preservation and enhancement of fisheries resources through the introduction of the project and its monitoring results. More than 100 people from Senegal and other countries participated the workshop to actively exchange opinions on the issues and the level of awareness of the issues among the people concerned was improved together with the establishment of a common understanding (Fig. 19).



*Fig. 19 International Workshop*

#### **4-8. Local Workshops**

A local workshop aimed at local fishermen and government officials was held on 8th December, 2003 (The Gambia) and 11th December, 2003 (Mauritania). This workshop also successfully improved the level of awareness regarding the management, preservation and enhancement of fisheries resources among the participants (Fig. 20).



*Fig. 20 Local Workshop*

#### **4-9. Future Development and Prospects of the Project**

In Senegal where the experiment has been completed, it is planned to legally establish fishing rights fisheries for the artificial fish reefs fishing grounds utilising the demonstrated effect of attracting fish and to further organize fishermen through the management of fisheries resources. An experimental project of artificial fish reefs targeting lobsters is currently in progress in St. Vincent and the Grenadines, a country selected for the further experimentation of artificial fish reefs after Senegal, for the purpose of preserving, managing and enhancing fisheries resources and also to strengthen the organization of fishermen in the Caribbean Sea.

Other cooperation projects which are currently at the planning stage feature the development of full-scale fishing grounds using artificial fish reefs to enhance fisheries resources in response to a request made by a recipient country, the development of spawning grounds as well as rearing grounds for juveniles through the preservation and improvement of seaweed beds and tideland and the preservation and improvement of the ocean environment, taking impacts from the land into consideration.

It is sincerely hoped that this pamphlet which is designed to introduce the positive outcomes of a demonstration experiment entrusted by the Fisheries Agency, Government of Japan and also to educate on and to disseminate such outcomes will help governments throughout the world, particularly those of developing countries, and people working in the fisheries sector to recognize that existing fisheries resources are not only their own assets but also precious assets of everyone on the planet. It is further hoped that they will actively participate in fisheries management with a sense of self-responsibility based on the awareness that they have an obligation to ensure that sustainable fisheries resources are inherited by the next generation.<sup>5</sup> Cooperation Project Implemented in Caribbean Countries



## 5. Cooperation Project Implemented in Caribbean Countries

### 5-1 Purpose of the Project

Following the experimental project in Senegal, an experimental project of the same purpose was conducted in St. Vincent and the Grenadines (hereinafter referred to as "St. Vincent"), a country of islands in the Caribbean. The lack of available land for cultivation in Caribbean countries limits the scope for increase in agricultural production. The scarcity of useful mineral resources makes it necessary for these countries to rely on tourism and fisheries for economic development. Thus, their national development plans call for sustainable fisheries development and there are strong public expectations for the promotion of fisheries.

Recognising the importance of promoting fisheries, many Caribbean countries are sharing Japan's ideas for international management and sustainable use of fisheries resources, and hence, Japan has been continually providing cooperation for the fisheries sector of Caribbean countries.

Up to the present, many cooperation projects in island countries have focused on the improvement of fisheries complexes and fisheries development. However, an alert has been raised over the decrease of coastal fisheries resources. Therefore, the emphasis is being placed on sustainable fisheries development by increasing fisheries resources. For these reasons, the implementation of the experimental project has been decided in order to facilitate understanding of the present situation of fisheries.

### 5-2 Present Situation of St. Vincent and the Grenadines



Fig. 21-1 Map of Caribbean Countries



Fig. 21-2 Map of St. Vincent

St. Vincent is situated in the southern part of the Lesser Antilles in the Eastern Caribbean and consists of St. Vincent, the main island, and some 33 large and small islands of the Grenadines. Among these, the principal islands are Bequia, Mustique, Canouan, Mayreau and Union. (Fig. 21-1, Fig. 21-2). The total land area is 389 km<sup>2</sup>, of which mainland St. Vincent accounts for 344 km<sup>2</sup>.

In terms of the climate, St. Vincent belongs to the tropical trade wind zone and a northeast trade wind prevails throughout the year. There is little temperature fluctuation throughout the year and the mean annual temperature is 24°C. The annual rainfall is 1,524 mm in the coastal area and 3,810 mm in the inland mountain area. Heavy rain falls from June to December. While hurricanes have usually passed to the north of St. Vincent, the country is hit by a hurricane every two or three years.

St. Vincent has a total coastline of 84 km. Its EEZ covers an area of 27,503 km<sup>2</sup> (10,623 square miles), of which 7,800 km<sup>2</sup> consists of the continental shelf. St. Vincent supports an artisanal fishery with some 3,000 people engaged in the fishing industry. Most of these are coastal fishers using small (15 - 20 foot long) fishing boats with an outboard engine of 25 - 100 HP. A much smaller number of fishers engage in long-line tuna fishing. Small coastal fishing boats commonly carry 2 - 3 crew members and return to their base every day (Fig. 22). The main industries in the small islands of the Grenadines are tourism and fisheries. In some islands, more than 80% of the adult male population are involved in fisheries, illustrating the importance of fisheries in providing employment



opportunities.

The main fishing methods in St. Vincent are bottom fishing for sea bream and grouper, purse seine, targeting small pelagic fish such as horse mackerel and trawling, targeting larger pelagic fish such as skipjack, tuna, Spanish mackerel and common dolphin. Fishing for lobsters and conch using basket nets and through scuba diving is conducted mostly from the islands of the Grenadines. The catch is either consumed locally by tourists or exported to regional and international countries.



Fig. 22 Fishers in Action

### 5-3 Outline of the Experimental Project

#### Purpose (Target Species)

Lobsters were selected as the main target species of the experimental project because lobsters are an economically important species among fishery products caught in St. Vincent. According to the fisheries statistics for 2001, lobsters accounted for 27.6% of the export volume (or 30% of the export value) even though they only accounted for 2.6% of the gross catch in terms of weight (or 7% in terms of value).

Year	2003												2004												2005											
	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12						
Consultation Mission																																				
Preliminary Survey																																				
Training in Japan																																				
Resource Mgmt. & Dive Training																																				
Tender																																				
Construction																																				
Inaguration																																				
Installation																																				
Supervision and Monitoring																																				
Public Education and Awareness																																				
International Workshop																																				

Fig. 23 Project Implementation Schedule (Flow of the Experimental Project)



Fig. 24 Fishers Meeting

The experimental project was conducted from FY 2003 to FY 2005. The actual experiment was conducted by consultations with the local authority on project implementation, a preliminary study, the training of C/P personnel in Japan and the designing/ manufacturing/ installation of artificial reefs. Meanwhile, the Fisheries Division of St. Vincent conducted the monitoring of artificial reefs and educational activities with fishers



## Sea Area for the Installation of Artificial Reefs (Fig. 25)

Through consultations with government officials and fishers of St. Vincent and based on the findings of diving and catch surveys, two places were selected as the project sites. These were located in the off-shore area of the island Isle a Quatre (Site 1) near Bequia and an inshore area of Mustique Island (Site 2). Site 1 is located in an inlet of Isle a Quatre where the water depth ranges from 10 to 15 m. The seabed consists of rocks and soft coral and a fishing test using traps resulted in lobster catches. The area is part of a legitimate fishing zone. Site 2 is located on the sandy beach face and the water depth ranges from 15 m to 20 m. The seabed consists of sand and a fishing test using traps failed to catch any lobsters. The surrounding area is a diving spot and the site is part of a designated area that prohibits fishing.

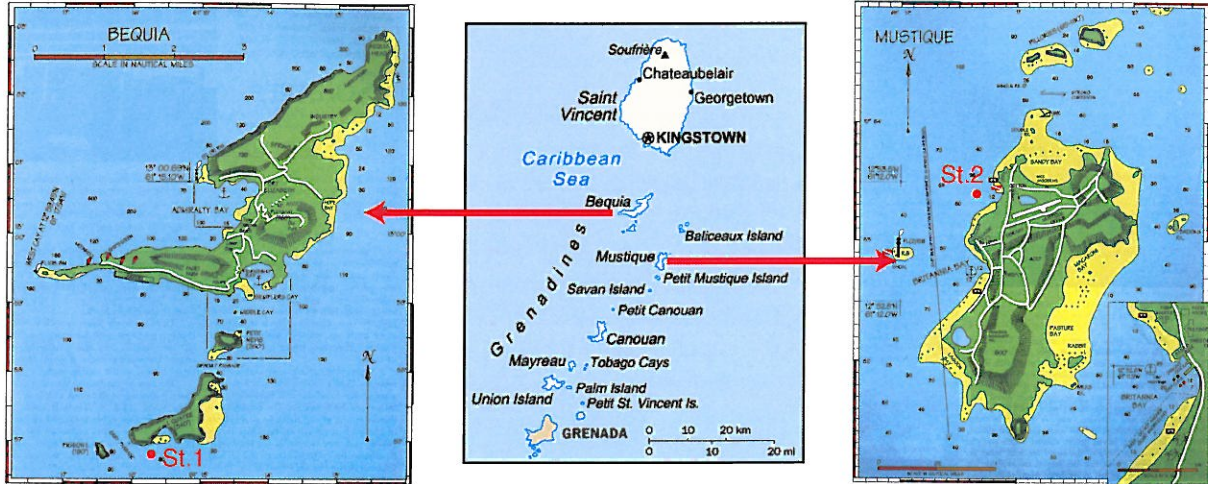
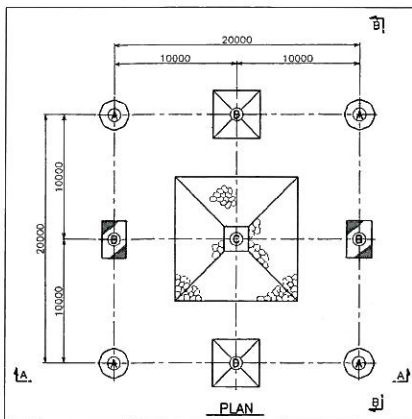


Fig. 25 Target Sea Area for Installation of Artificial Reefs

## Artificial Reefs

Four types of artificial reefs were installed. These were locally manufactured concrete lobster reefs, 104m<sup>3</sup> areas of natural stones 500 kg - 1,000 kg, truss reefs manufactured by Yamaha Motor Co., Ltd. and newkarus units (gabion baskets) manufactured by Hexafour Co., Ltd.



← Fig. 27 Deployment of Artificial Reefs

## Installation Method

For the installation of the artificial reefs, a marker buoy was set to indicate the location to deploy artificial reefs. To start with, natural stones were placed using a backhoe to create a stone mound which was 10 m in diameter and 2 m in height. Using a crane (Fig 26-1 and Fig. 26-2, the artificial reefs were then hoisted one by one and placed around the stone mound. Four lobster reefs, two truss reefs and two newkarus units (gabions) were installed at each site (Fig. 27).



Fig. 26-1(up), Fig. 26-2(down) Installation Method





**Fig. 28 Newkarus Units**  
 Newkarus units are cube-type mesh baskets made of steel wires coated with vaporised aluminium. For the experiment, these units were filled with small natural stones and local dumped conch shells. The small gaps created by the small natural stones and conch shells can be used as shelters for young lobsters and small fish. The utilization of conch shells was decided partly because of the expectation for the attachment of organisms which can be eaten by fish and partly in an attempt to recycle waste materials.



**Fig. 29 Truss Reefs**  
 To make the truss reefs, parts (concrete posts, discs and gabions, etc.) manufactured in Japan were transported to St. Vincent by container ship and were assembled locally under the guidance of a Japanese engineer. The shape of complete reef is a pyramidal shape with a large surface area. The existence of large areas which are not directly exposed to the water current as well as hiding areas creates a habitat for organisms which are eaten by fish. As such, this type of reef promises a high fish gathering effect and shelter effect for long residence by fish and the favourable growth of young fish. For the purpose of attracting lobsters, the bottoms of these truss reefs were combined with a gabion basket which was filled with small natural stones.



**Fig. 30 Natural Stones**  
 Each natural stone weighs 500 kg - 1,000 kg and was collected from St. Vincent Island.



**Fig. 31 Lobster Reefs**  
 A lobster reef has layers of concrete discs with a slit for lobsters to hide between the discs. All of the discs except the top disc have a centre hole to allow the lobsters to move from one floor to another. The slit size corresponds to the size of adult lobsters which inhabit that area.



**Fig. 32 Manufacturing of Lobster Reef**



## 5-4 Monitoring Method

Monitoring involved recording of the size and number of each fish (nine species with a commercial value) and lobsters gathered around each reef. Nine species of fish were chosen, some of commercial value and some indicative of a natural healthy reef. Scenes of fish gathering in and around the artificial reefs were recorded by video camera. To determine the effects of the artificial reefs, an area of natural reef, of which the conditions are similar to those of the project sites, was selected as a control site (Fig. 33). The size and number of lobsters and the nine different fish species were recorded for comparison with the corresponding data for the project sites.

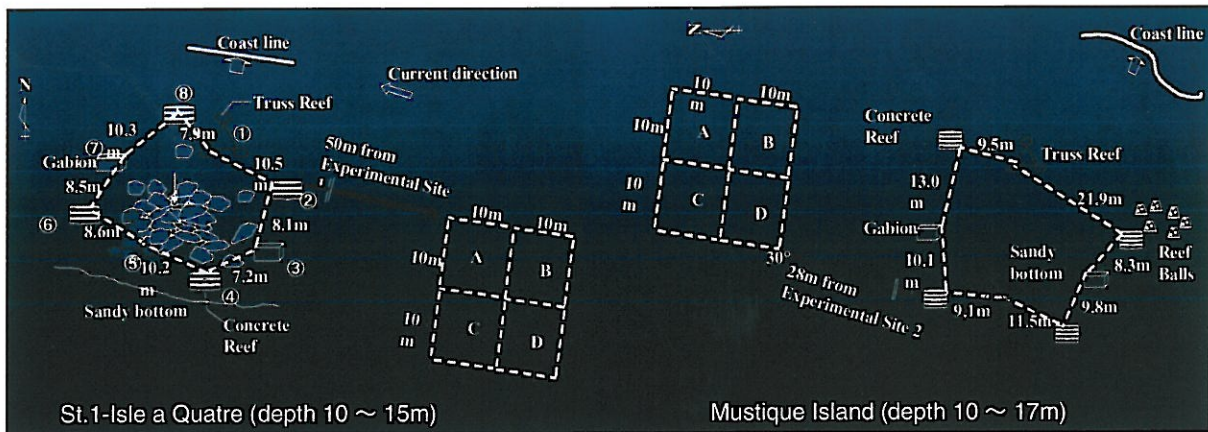


Fig. 33 Introduction of Control Site

Local Name	Scientific Name
Cony	<i>Cephalopholis fulvus</i>
Red Hind	<i>Epinephelus guttatus</i>
Rock Hind	<i>Epinephelus adscensionis</i>
Yellowtail snapper	<i>Ocyurus chrysurus</i>
Schoolmaster	<i>Lutjanus apodus</i>
Foureye butterflyfish	<i>Chaetodon capistratus</i>
Banded butterflyfish	<i>Chaetodon striatus</i>
Blue parrotfish	<i>Scarus coeruleus</i>
Princess parrotfish	<i>Scarus taeniopterus</i>
Yellow Goatfish	<i>Mulloidichthys martinicus</i>
Spotted Goatfish	<i>Pseudupeneus maculatus</i>

Local Name	Scientific Name
Caribbean Spiny Lobster (CS)	<i>Panulirus argus</i>
Spotted lobster (SP)	<i>Panulirus guttatus</i>

Fig. 34 Target Species for Monitoring



### Training of C/P Personnel (Fig. 35)

Having learned useful lessons from the experimental project in Senegal, emphasis was put on guidance for diving techniques so that the C/P personnel could smoothly conduct monitoring activities. A highly skilled engineer was dispatched from Japan as a Japanese Expert, and guidance on diving was carried out three times. The Japanese expert also attended the principal monitoring survey.

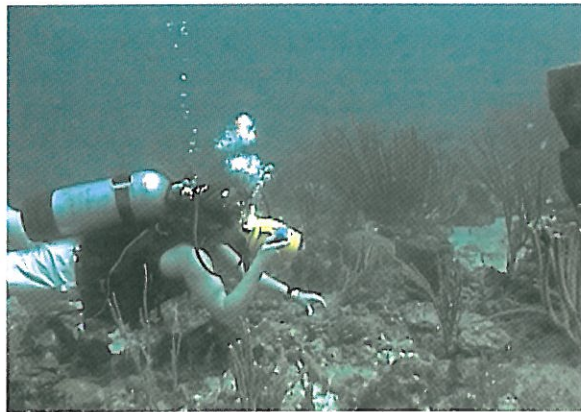


Fig. 35 Guidance on Diving Techniques

### 5-5 Results

At Site 1, lobsters began to gather immediately after the installation of reefs. The number was approximately six times larger than that of the control site. In the case of fish, the number at site 1 was approximately double than that of the control site (Fig. 36, Fig. 37 and Fig. 38).

Although hardly any inhabitation of fish was observed at the sandy Site 2 previous to the artificial reef deployment, the gathering of many pelagic fish was observed after the installation of the artificial reefs (Fig. 39). Only one lobster was observed, however the number is expected to increase with the time. The observation on a fairly large number of fry immediately after hatching suggests that eggs were laid and hatched at this site, possibly indicative of the fact that artificial reefs contribute to providing the habitat for hatched young fish to grow.

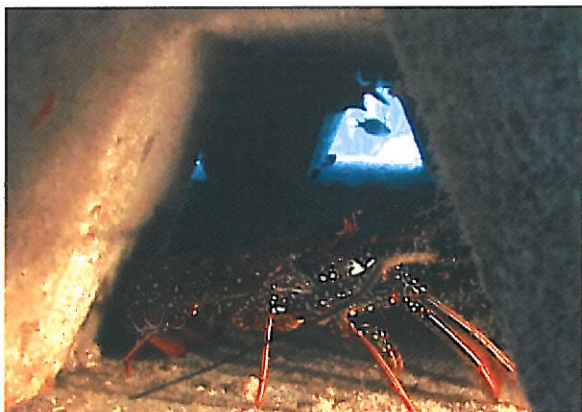


Fig. 36 Gathering of Lobsters (Manufacturing of Lobster Reef)



Fig. 37 Gathering of Lobsters (Natural Stones)

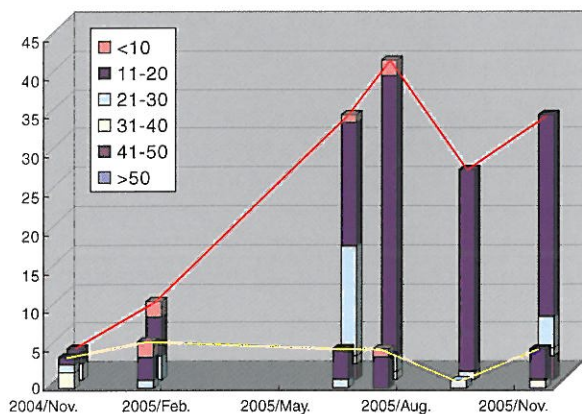


Fig. 38 Gathering Graph

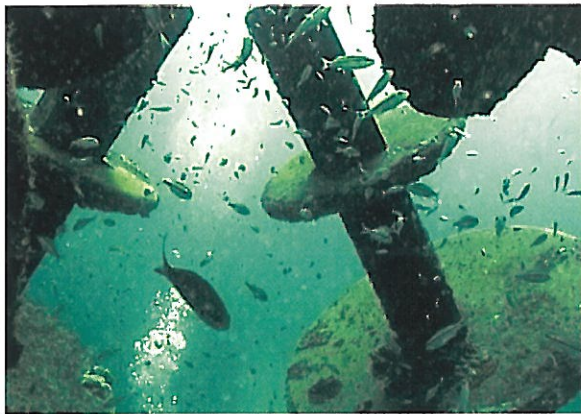


Fig. 39 Gathering of pelagic fish



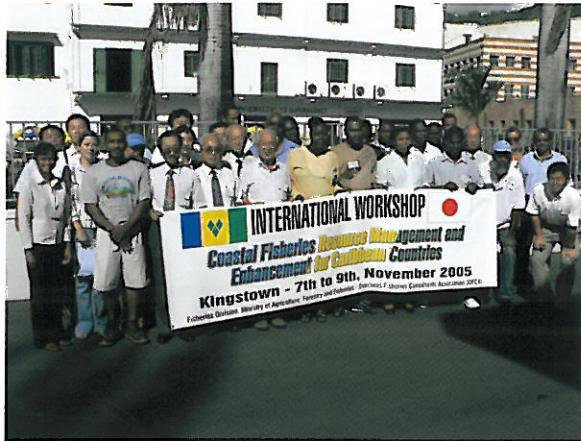


Fig. 40-1 International Workshop



Fig. 40-2 Panel Discussion

### 5-6 International Workshop

From 7<sup>th</sup> to 9<sup>th</sup> November, 2005, an International Workshop on fisheries resource management and enhancement for Caribbean Countries was jointly held by Japan and the Ministry of Agriculture, Forestry and Fisheries of St. Vincent at Kingstown, the capital of St. Vincent. The venue was the conference room of the Fisheries Division which was constructed under Japan's grant aid for fishery.

The participants of this workshop included not only fisheries officials and those engaged in the fishing industry in St. Vincent but also fisheries officials of neighbouring countries such as Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis and St. Lucia as well as officials of the OECS and the CRFM.

Japanese cooperation and assistance for the workshop were provided by the Japanese embassy in St. Vincent, the JICA project team for the "Project for the Promotion of Sustainable Marine Fisheries Resource Utilization" in progress in Trinidad and Tobago and staff of the Shizuoka Prefectural Fisheries Experimental station in Japan.

Several presentations were made at the workshop on the first day by the representatives from Japan, neighbouring countries, regional organizations and the JICA project team. Panel discussion was carried out in the morning of the second day and in the afternoon there was active exchange of opinions. On the third day, an excursion to one of the project sites was carried out and several people from neighbouring countries actually dived into the water to check and confirm the project outcomes.

This international workshop has significantly contributed to building awareness among all stakeholders on the importance and necessity for managing coastal fishery resources in the Caribbean. It has also promoted the need to set up fishers' organization to realise such management. It is strongly desired that the workshop provide the impetus for activities that ensure the sustainable use of fisheries resources through the better management and enhancement of coastal fishery resources in the future (Fig. 40-1 and 40-2).

#### \* Opinions Expressed in the Panel Discussion

- Two lobster species, i.e. Caribbean spiny lobster (*Panulirus argus*) and spotted lobster (*Panulirus guttatus*), were observed by the monitoring survey. Of these, spotted lobster is not a target species for fishing as hardly any individuals grow beyond body shell length (89 mm) which is the minimum catch size imposed by the government of St. Vincent. The existing resource management system results in the automatic and preferential protection of spotted lobster, possibly failing to materialise the effective utilisation of the fishery resource. Local fishers' proposed the need for introducing separate minimum body length regulations for spiny lobster and spotted lobster.
- Because of the absence of fishers' cooperatives in Caribbean countries like those in Japan, the introduction of a community-based management system is difficult. In the future, the organization of local fishers in a manner which is appropriate for Caribbean countries is expected to be established for the purpose of community-based fishery resource management.



- In regard to the question of co-management (i.e. joint management by the government and local fishers), the government side suggested the necessity to approach the issue of resource management from the viewpoint of fishers. It is hoped that resource management with fishers' initiative will be conducted without pressure by the government.
- The experimental project has introduced one of the meaningful methods to facilitate co-management. What will be important in the coming years is for the Fisheries Division of St. Vincent to take the lead in active efforts to establish a fishery resource management system led by fishers.
- Some migrating fish move beyond national borders, therefore an international resource management system is required to deal with such fish, indicating the necessity to supply/ exchange information and conduct joint research on migrating fish in the region.
- The implementation of the project envisaging a boost of fishery resources in the future should be highly evaluated as it was conducted in a region where no overseas cooperation for the management of fishery resources has existed in the past. Many participants from various countries expressed a desire to OFCA for continuous contribution to promote and develop fisheries in Caribbean countries.

### **5-7 Future Development and Prospects of the Project**

While monitoring was conducted for a period of some 18 months after the installation of the artificial reefs under the guidance of the OFCA, it is essential for the Fisheries Division of St. Vincent to continue its own monitoring activities in order to measure the effects of the installed artificial reefs and also to educate local fishers. The Fisheries Division has already secured the budget for monitoring activities up to 2009. Meanwhile, the C/P personnel trained under the project have expressed a desire to learn more advanced monitoring techniques (biological surveying including predators, and surveying migration of lobsters with the release of tagged lobsters). It is, therefore, hoped that high quality monitoring will be continued in the area.

At present, fishers in St. Vincent have begun to show interest in the importance of and necessity for fisheries resource management because of the results of the experimental project. Making the best use of this opportunity, the government should lead fishers to be involved in future monitoring activities with active publicity, and also to lead them to form fishers' organization under their own initiative.

Research on the ecology of not only pelagic fish but also demersal fish, which include lobsters, has been insufficient in the region, possibly because these fish move across national borders. As this possibly implies inefficient resource management by individual countries, it is strongly recommended that the feasibility of information exchange and joint research among various countries including universities and research institutes in the Caribbean, be urgently discussed and promoted.

To realize the original purpose of this project, fishers and fishery departments should take definite actions. Fisheries resource management cannot succeed if all fishers are able to access all fishing grounds freely and harvest all fish species without limits

Considering this basic principle, fisheries departments should introduce a registration system of fishers and fishing vessels in order to fully realise and record who are the users of the resources at the fishing grounds and who have rights to access specific fish species. This should be carried out taking full account of the needs of fishers and utilising their initiative. As a first step, fisheries departments should set regulations for limited entry systems that enable only limited fishers to utilize the fishing grounds and also to access specific fish species. Secondly the government should give guidance to fishers to formulate a plan for sustainable use of their fishing ground which can then be submitted to the government for approval. It is assumed that the fishers will naturally be developing their group as they formulate such a plan for submission. The government is expected to support fishers' formulating groups and fishers' resource management activities to achieve the goal of the proposed plan. At the implementation of the plan by fishers, it is recommended to involve the introduction of a mutual surveillance system among fishers to realize the importance of their own resources. If there is absence of their awareness on resources, it is clear that fishers will never start the activities for managing resources at their fishing grounds.

The limited entry system is the best way to bring the fishery management activities into fishing communities and to attain the final goal of the cooperation project.

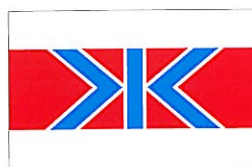




Published by the **Overseas Fisheries Consultants Association (OFCA)**

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