

Technical development of seed production and transplantation of corals by the Fisheries Agency, Japan

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Abstract

Coral reef is not only the richest example of biodiversity in the sea, but it's also one of the most economically important ecologies and an irreplaceable asset of mankind. However, coral reefs have been seriously degraded by various factors such as climate change. This problem is serious for the fishery in coral reef. Therefore, the development of restoration techniques to increase coral colonies is indeed necessary. Past attempts to restore coral communities have mainly used transplanted coral fragments. Trials on transplantation of fragmented coral have been conducted in many countries as means of restoring the depleted coral colonies. However, this method would not only wound the coral colonies but also affects the ecosystem of the coral reefs where large quantities of fragments are taken for restoration purposes. On the other hand, juvenile corals can be produced by sexual reproduction in the laboratory. As a large number of eggs and sperm released from the broodstock are used in this technique, mass-culture of coral juveniles is possible. Also genetic diversity of the sexual method is higher than that of the asexual one. The Fisheries Agency of Japan started a project of coral propagation, in 2006. This project has the objective of developing practical sexual reproduction techniques for rehabilitation of coral reefs. Okinotorishima was chosen as the target site of coral propagation. The island is the southernmost Japanese territory where is located about 1,740km far from Tokyo. The goals of the project are to develop a series of methodology as follows,

- 1) Production of juvenile corals from eggs in land tanks.
- 2) Long-term maintenance for juvenile corals and long distance transportation.
- 3) Transplanting cultured juvenile corals back to the native, remote coral reef.

We produced approximately 63,000 colonies of 1 year old juvenile corals, which were attached on 564 artificial substrates (ceramic tiles), with the eggs spawned in June 2007. They were transplanted to the native Okinotorishima in May 2008, and have been monitored so far.

Keywords: Coral reefs, Restoration, Fishery, Okinotorishima island

Coral Habitat Expansion Project

Okinotorishima Island is the southernmost island of Japanese territory, located 1,740 kilometers (1,060 miles) south-southwest of Tokyo. The island is an isolated table reef, east-west 4 kilometers and north-south 1.7 kilometers. Around the island, corals certainly play an important role in ecological system. However, coral reefs are decreasing due to environmental deterioration. Therefore, Fisheries Agency of Japan started the Coral Habitat Expansion Project around the island in 2006. This project develops methods to maintain and increase coral ecosystems around the island.

We have researched the growing condition and natural environment of corals around the island. We brought up juvenile corals from eggs, and eventually transplanted 63,000 juvenile corals to the island.

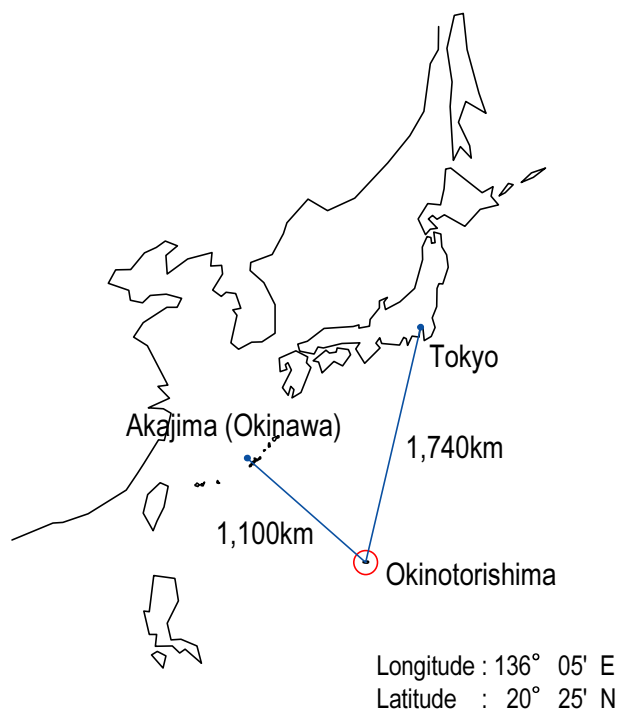


Fig.1 Okinotorishima Island

The project flow is shown in Fig.2. The main techniques are as follows.

- 1) Production of juvenile corals from eggs in land tanks.
- 2) Long-term maintenance for juvenile corals and long distance transportation.
- 3) Transplanting cultured juvenile corals back to the native, remote coral reef.

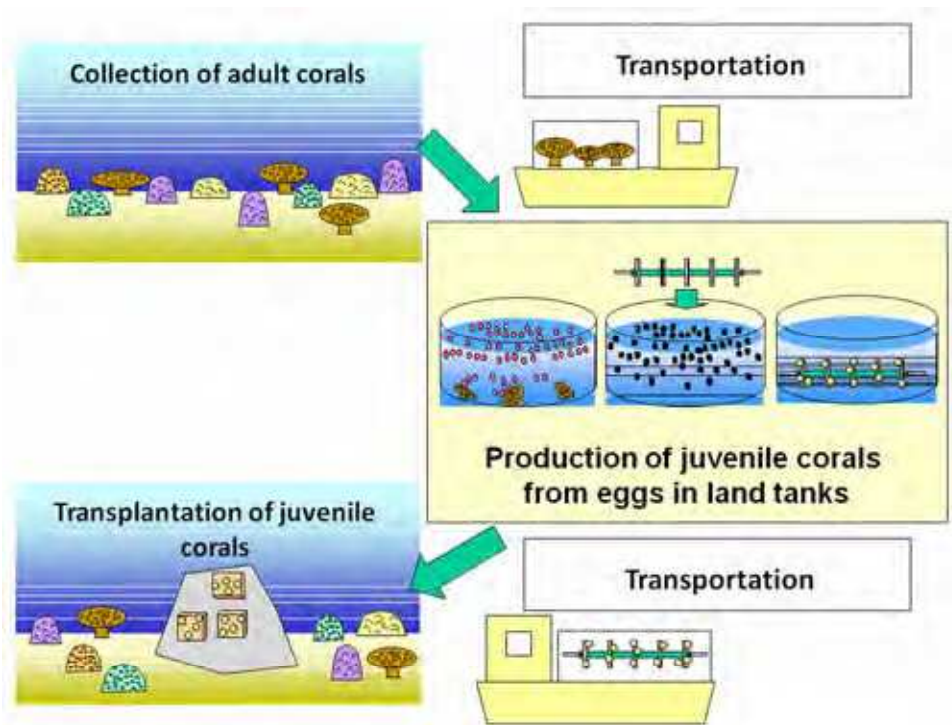


Fig.2 Outline of the project

We collected 45 colonies of 3 species of *Acropora* as mother corals and transported from Okinotorishima Island to Akajima Coral Hatchery in Okinawa (Fig. 3) in the period between May 2006 and May 2007.



Fig.3 Akajima Coral Hatchery in Okinawa

From June to August 2007, most of mother coral colonies spawned in the tanks. Seed production was carried out using those eggs spawned. In *Acropora tenuis*, which was one of the species collected as the mother coral, the best results of seed production was achieved as follows:

Approximately 111,000 larvae settled on the substrates. Those juveniles were reared in land tanks for about 10 months. Herbivorous snails and fish were stocked with the juvenile corals for the algae extermination. The survival rate of the juveniles was over 80 % in three months, and around 60% in ten months after spawning. We achieved this high survival rate of the juvenile corals, and believe that the technology of coral spawning and seed production in land tanks has been almost successfully developed.

We transported and transplanted the substrates with approximately 63,000 juveniles of *A. tenuis* to knolls (patch reefs) in the reef of Okinotorishima Island in May 2008 (Fig. 5). Some coral colonies were covered with basket for preventing from the fish feeding (Fig. 6).

We have monitored the transplanted corals to grasp survival and growth of the transplanted corals so far. In the most recent research in May 2010, the mean coverage of the juveniles protected with the baskets were 4 times higher than initial one. Meanwhile, the coverage of the juveniles without the baskets also have increased slightly since decreased in the early period of 8 months after transplantation.



Photo : THE SANKEI SHIMBUN

Fig.4 Juvenile corals in land tanks



Fig.5 Transplantation of substrates with juvenile coral colonies



Fig.6 Monitoring research of transplanted corals

Conclusion

From the site surveys at Okinotorishima Island, the present condition of coral distribution and coverage and environmental conditions surrounding those corals are almost understood. These information will be utilized to monitor the future change of the coral reefs as well as to evaluate the effectiveness of our transplantation activities. At present, we are still trying to improve the techniques of seed production and transplantation of coral juveniles. We expect that these techniques will work practically to increase coral coverage on Okinotorishima Island in the near future, and will be applied for recovery of coral reefs worldwide.



RESTORATION OF CORAL REEFS TECHNIQUES

1980~ Transplantation of fragments corals
1990~ Artificial substrate for coral transplantation
1996 Production of juvenile corals from eggs (AMSL)

http://img.kyushu-nippon.com

PERFORMANCE OF CORALS TRANSPLANTED

Ecology	No.	Number of the colonies/year	Survival rate (%)
Shallow Transplantation (Shoal Transplantation)	1	206	46
	2	250	?
	3	2,000	?
	4	520	?
Deep Transplantation (Deep Transplantation)	1	5,400(block)	?
	2	2,000~5,000	5 (1year)
(natural)	AMSL		89 (month)
	F.A	65,000	60 (1year)



OBJECTIVES OF THIS PROJECT

- 1) Production of juvenile corals from eggs in land tanks.
- 2) Long-term maintenance for Juvenile corals and long distance transportation.
- 3) Transplanting cultured juvenile corals back to the native, remote coral reef.

STUDY SITE

Akajima Coral Hatchery, Okinawa

Okinotorishima Island

Longitude 135° 00' E
Latitude 20° 20' N



