DEVELOPMENT OF CORAL REEF PROPAGATION TECHNOLOGY BY SEXUAL REPRODUCTION, IN JAPAN

by

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ABSTRACT

The coral reef is an area of primary production that cultivate ecosystems with high biodiversity, and it is also an important area as fishery resources. However, many of the coral reefs around the world tend to decline because of rising seawater temperature caused by global warming (Carpenter et al. (2008)). Meanwhile, the upsizing of ships has become a global trend along with the increase in demand for logistics, so dredging of routes and construction of harbors and fish ports are increasingly important. As a result, coral reef area came to be directly changed and coral growth came to be indirectly influenced by the coastal area development. For these reasons, in Japan, as a measure to avoid, reduce or compensate for the influence on ecosystems in the development of coral reef, we have been developing coral reef propagation technology by sexual reproduction. In this technology, it is possible to produce genetically diverse corals which can propagate themselves and supply coral larvae. So, it is considered to be effective for restoration of a wide range of coral reefs. It is composed of three technologies, which are coral production, coral cultivation on nurseries, and coral transplantation. In addition, coral production by sexual reproduction is divided into two methods; one is producing corals in water tanks on land, and the other is producing corals by collecting, rearing, and seeding natural coral larvae in situ. Here we introduce the efforts of coral propagation technology and report on the result.

Keyword: coral reef propagation technology by sexual reproduction, coral production on land, collecting coral larvae in situ, coral cultivation on nurseries, coral transplantation

1. THE CORAL PROPAGATION TECHNOLOGY BY SEXUAL REPRODUCTION

The coral propagation technology is composed of three steps, which are coral production, coral cultivation on nurseries and coral transplantation. In addition, coral production by sexual reproduction is divided into two methods; one is producing juvenile corals in water tanks on land, and the other is producing juvenile corals in situ by collecting, rearing, and seeding natural coral larvae. It is important to use an appropriate method according to the conditions of the sea.

Collecting adult corals in the sea and making them spawning in water tanks on land	Outplanting juvenile corals and growing them on nurseries (until they become about 5cm)	Transplanting grown corals on nurseries to places where is suitable for coral growth
Collecting, rearing, and seeding natural coral larvae in situ (using “Larval Cradle")		

Figure 1: The flowchart of the coral propagation technology by sexual reproduction

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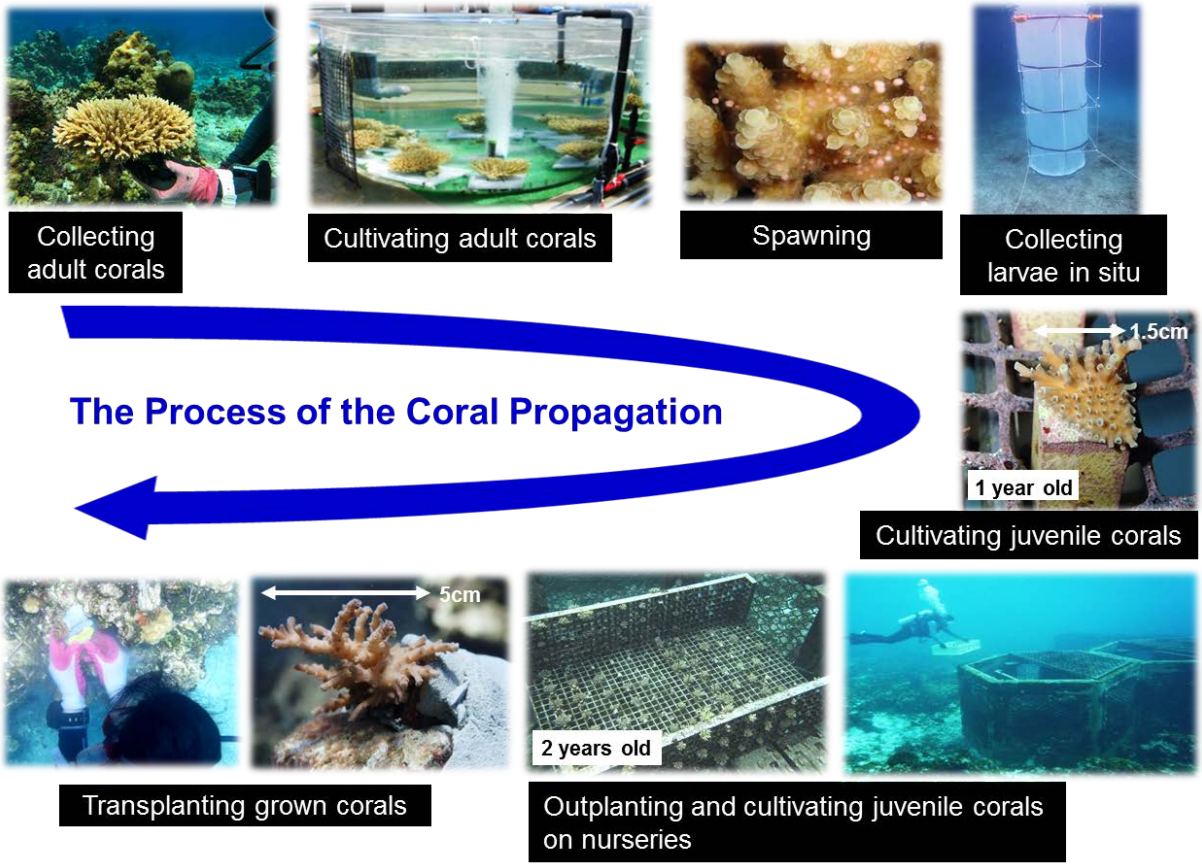

Figure 2: The process of the coral propagation technology by sexual reproduction

2. CORAL PRODUCTION BY SEXUAL REPRODUCTION

2.1 Mass Production of Corals by Sexual Reproduction on Land

Our development of coral propagation technology began with producing a large number of juvenile corals. by sexual reproduction. The target species was *Acropora tenuis*. We collected adult corals in the sea, which were used for the spawning in large water tanks on land located at Okinawa. In the period from 2006 to 2008, we succeeded in producing about 30,000 juvenile corals (Nakamura et al. (2011)).

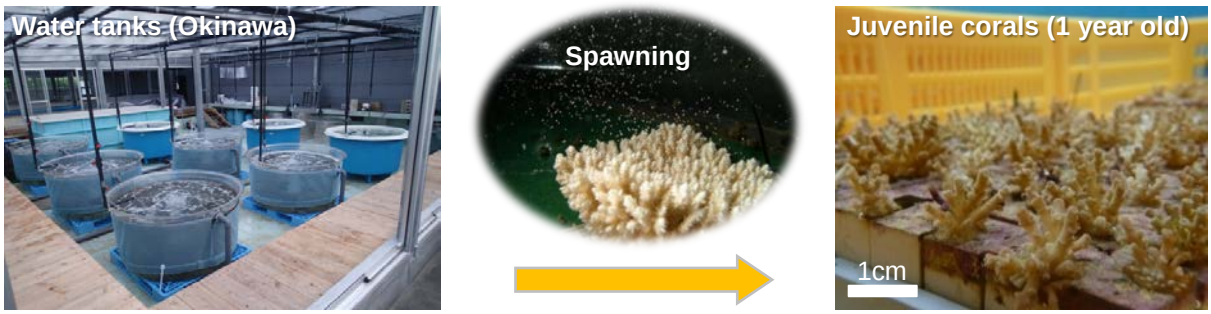

Figure 3: Coral production in water tanks

2.2 Collecting, Rearing, and Seeding Natural Coral Larvae in Situ

While producing a large number of juvenile corals in water tanks on land, we are currently undertaking the development of technology that can produce them in the sea. For that purpose, we developed an equipment that is capable of collecting, rearing, and seeding natural coral larvae in situ.

We call the equipment “Larval Cradle". The shape of it is cylindrical to reduce resistance to water flow. It is made of the nylon net, and appropriate mesh size of it, an important factor for enhancing survival rate of the enclosed larvae, is 30 μm. The maximum number of coral larvae which can be collected by larval cradle was 3 million at 4 days-old, which they can settle.

With “Larval Cradle", it is possible to produce corals in the area where is not able to make water tanks system, and to produce mass corals at a considerably lower cost compared with the method of producing corals in water tanks on land. We confirmed that the coral larvae settled on about 6,000 settlement devices.

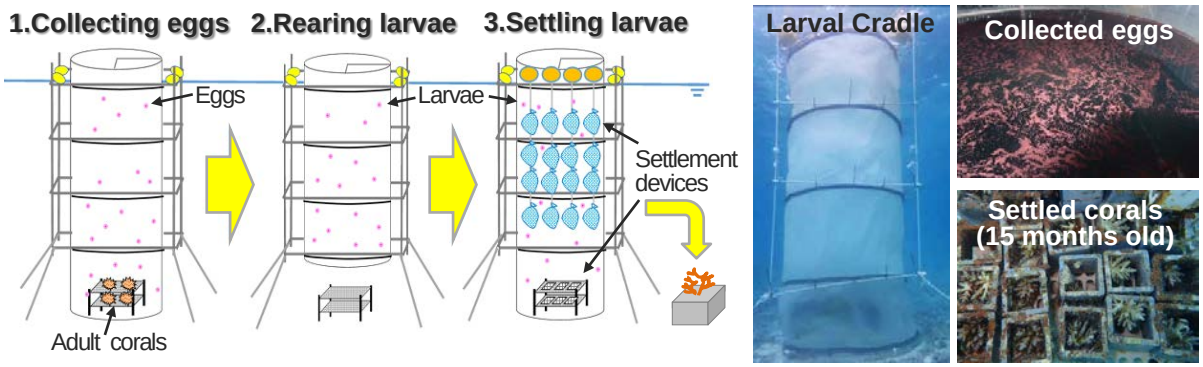

Figure 4: The image of producing corals by using Larval Cradle in the sea

3. OUTPLANTING AND GROWING MASS JUVENILE CORALS ON NURSERIES

We developed artificial structures (such as artificial concrete blocks) designed as nurseries for juvenile corals, and installed them to the unsuitable area for coral growing such as sandy bottom.

And we also developed lattice shaped foundation for efficient outplant of a large number of juvenile corals on the structure, and made it possible to efficiently outplant about 200 juvenile corals per person-day. After the outplant, we monitored and maintained them on a regular basis to keep them in good condition. Now, since the survival rate of coral one year after the outplant is as high as 80 %, we believe that our technology has been mostly established. The juvenile corals outplanted with a diameter of about 1 cm grow up to about 5 cm in one year.

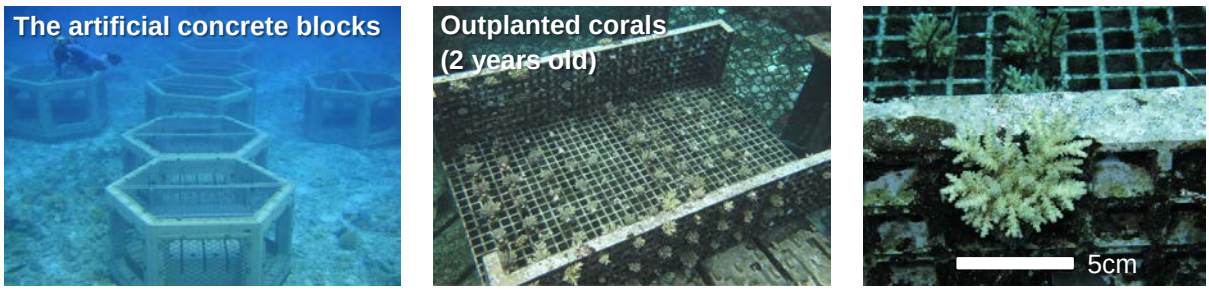

Figure 5: Corals outplanted on the artificial concrete block

4. TRANSPLANTING TO EXPAND CORAL HABITAT AREA

After choosing the suitable area for coral transplantation, we transplanted grown corals on nurseries to the area to expand coral habitat area. It is required that the transplantation area is suitable for coral growth. In addition, if transplanted corals spawn, it is preferable that coral larvae don’t flow out to the open sea. Therefore, we selected suitable area for coral transplantation by utilizing field survey and numerical simulation technology.

We are trying to develop of "the Larval Supply Base". If transplanted corals which has genetically diversity have grown and matured, they supply larvae to surrounding areas autonomously. We expect that such “larval supply base” will recover extensive coral reefs in near future.

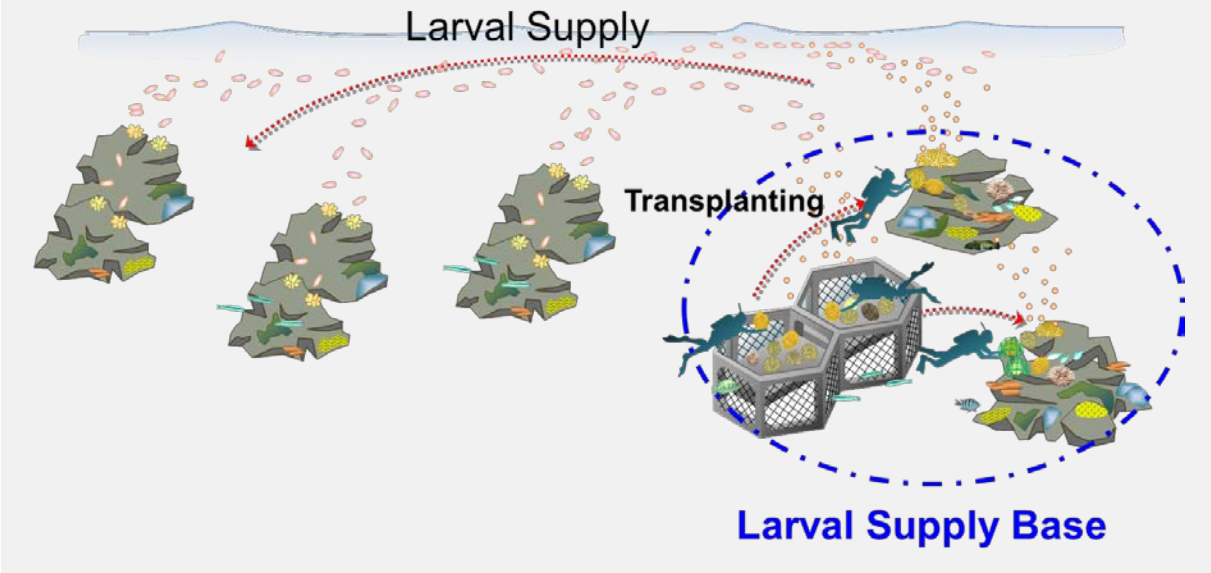

Figure 6: The schematic image of intensive coral reef restoration by larval supply base

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