

Potentials and prospects of marine aquaculture

A window view from Lakshadweep Island

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Lakshadweep comprises the only coral atolls in the country and 36 islands are scattered in the Arabian Sea. The major source of income for the local community is fishing and coconut-based activities, and there is no potential scope for additional/alternate income from other sources. It is very much needed to explore and provide a source of income generation to the local community at Lakshadweep with fisheries-related activities, which they can able to adopt easily. In this context, the ICAR-National Bureau of Fish Genetic Resources (NBFGR) took an initiative at Agatti Island of Lakshadweep on ornamental organisms breeding and rearing. The simplified technology is being disseminated through community aquaculture for native women inhabitants as an additional/alternate livelihood option. This is a unique venture, where societal development and conservation are taken up hand-in-hand through the use of indigenous organisms. The present study demonstrates the successful adaptation and utilization of the technology of marine shrimp-based ornamental farming through capacity-building initiatives that involve community participation and a well-structured adaptation process.

Keywords: Community aquaculture, Conservation, Livelihood, Marine ornamental organisms

THE Lakshadweep islands lying off the west coast of India, comprised of coral atolls, reefs, and submerged banks, which surround 36 low-lying coralline islands. It is considered the smallest Union Territory of India with a population of less than a lakh. The rich aquatic biodiversity of Lakshadweep is a common heritage of the local community. The main livelihood activity is live bait-based pole and line fishing of tuna. The exploitation of live baits, following unsustainable fishing practices from the coral reefs, resulted in the decline of the targeted fish population, besides negatively affecting the coral ecosystem's health. The recent reports and interactions with the local islanders revealed that the live bait population is drastically reduced, subsequently reducing tuna catch. So, conserving the indigenous resources, and generating alternate/additional livelihood options for the local islanders is the need of the hour at

Lakshadweep. Hence, diversified livelihood opportunities through community participation are the way forward and the solution will be bio-based interventions and capacity building of the islanders.

Aquaculture for conservation and livelihood

In the context of the marine aquarium industry, the majority of organisms are exploited from the wild, often involving the adoption of unsustainable fishing practices. This will increase the pressure on the wild stock, leading to the collapse of the natural habitats. The captive propagation of marine ornamental organisms can bring long-term sustainability to the resources, as the natural population is not disturbed. The captive-bred organisms also give confidence to the aquarium trade through a consistent supply of quality animals. In this context, the ICAR-NBFGR introduced the concept of 'Marine Ornamental

Aquaculture with Community Participation' at Lakshadweep for local livelihood and marine biodiversity conservation.

A germplasm resource centre was established by the ICAR-NBFGR at Agatti Island, Lakshadweep to carry out exploratory surveys and conduct research on marine ornamentals. Initially, this program was funded by the Department of Bio-Technology (DBT, Govt. of India), and moving forward with the financial support of the Tribal Sub Plan program (TSP) of the ICAR-NBFGR and the Centre for Marine Living Resources and Ecology (MoES, Govt. of India).

Ornamental shrimps are highly demanded organisms in the aquarium industry, and rearing and marketing them is a way to enhance the income of the local population at Lakshadweep. So exploratory surveys were conducted in different islands namely Agatti, Bangaram, Kavaratti, Thinnakara, Kalpeni, Parali I, Parali II, and Minicoy to



Aerial view of the Agatti island, where ICAR- NBFGR germplasm resource centre is established



Inner view of the ICAR-NBFGR germplasm resource centre at Agatti, Lakshadweep

document the marine biodiversity. The explorations revealed the hidden biodiversity with the discovery of three new species / new to Science, *Periclimenella agatti*, *Urocaridella arabianensis* and *Actinimenes koyas*. Besides, *Thor hainanensis*, *Lysmata hochi*, *Palaemonella tenuipes*, *Palaemonella rotumana* and *Urocaridella antonbruunii* were documented, which are new distributional records to Indian waters. In addition, shrimps such as *Gnathophyllum americanum*, *Saron neglectus*, *S. marmoratus*, *Ancylocaris brevicarpalis*, *Stenopus hispidus*, *Alpheus* sp., and *Cuapetes* sp. were collected. Currently, efforts are underway to standardize captive breeding and seed production

techniques of these collected specimens.

Seed production technology is standardized for two ornamental shrimp species, *T. hainanensis*, and *A. brevicarpalis* for the first time in India /International (Table 1). Further, up-scaled the seed production of two indigenous clown fishes, *Amphiprion nigripes* (endemic to Lakshadweep) and *A. clarkii* and being supplied to the beneficiaries for further rearing and marketing.

Hands-on learning programs

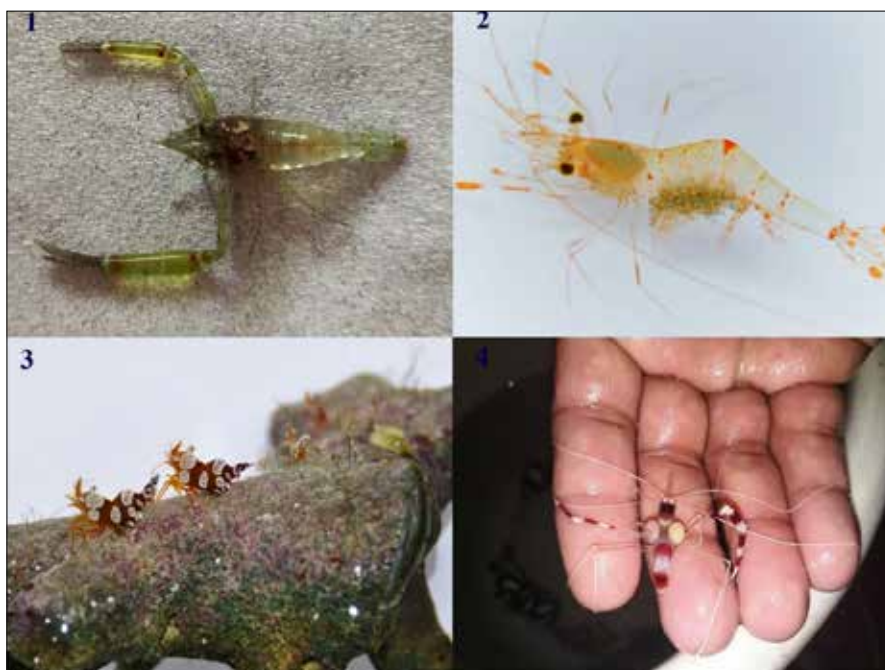
Mass awareness programs and a series of capacity-building programmes were conducted at Agatti and Kavaratti islands

(Table 2) to disseminate the marine ornamentals rearing technology. Following this, the local island administration has identified the interested islanders and recommended them to the NBFGR for providing training on the rearing of ornamental organisms. Under the TSP program of the institute, the selected islanders were trained in necessary aspects of marine ornamental shrimp rearing, which was held for a month duration (Table 3).

A total of 82 islanders (77 women and 5 men) were given hands-on learning about all aspects of ornamental fish and shrimp rearing in a backyard rearing setup and community aquaculture unit. This capacity building on captive propagation of commercially important marine ornamentals will lead to livelihood augmentation, besides the conservation of native resources.

Community-managed aquaculture units

As a part of technology adoption, captive-bred fish and shrimp seeds are being supplied to the beneficiaries for further rearing in backyard rearing setups and community aquaculture units. The rearing units were constructed using locally available raw materials with an eco-friendly approach. The institute is currently sponsoring and supporting four community aquaculture units, where the juvenile ornamental shrimps are successfully being raised to marketable size by 45 women beneficiaries, natives of Agatti island. Wild collected



1. *Periclimenella agatti*, 2. *Urocaridella arabianensis*, 3. *Thor hainanensis* and 4. *Stenopus hispidus*

Table 1. Biological and reproductive characteristics of ornamental shrimps, *Thor hainanensis* and *Ancyllocaris brevicarpalis*

Species name	Trade value in International market	Length range (cm)	Feeding habit	Fecundity	Incubation period (days)	Larval duration (days)	Larval survival (%)	Juvenile survival (%)
<i>Thor hainanensis</i>	14.99\$	3.5-4	Omnivore	150-200	10-11	39-45	80	85
<i>Ancyllocaris brevicarpalis</i>	19.99\$	2-2.5	Omnivore	800-1000	8-9	21-25	60	99

Source: Sheena Jose *et al.* 2021, Manu Madhavan *et al.* 2022



Hon'ble Union Minister for State (Animal husbandry, Dairying and Fisheries), Dr L Murugan, launching the breeding program of ornamental shrimp at ICAR-NBFGR hatchery, Agatti, Lakshadweep

shrimps and F_1 generation were used for breeding programs in the germplasm centre and the F_2 generation is being supplied to the beneficiaries for further rearing in community aquaculture units. They will be rearing them for 2.5 to 3 months and it is directly

Table 2. Awareness programs conducted by the ICAR -NBFGR on biodiversity conservation at Lakshadweep islands

Awareness program	No of participants	Date	Funding support
Agatti	103	8 th March 2020	Department of Biotechnology (DBT)
Kavaratti	60	20 th October 2021	Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences (CMLRE)
Agatti	50	22 nd October 2021	Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences (CMLRE)

Table 3. Hands-on training programs conducted by the ICAR-NBFGR on marine ornamentals rearing at Agatti, Lakshadweep

Dates of training conducted	No. of trainees	No. of the beneficiaries adopted the technology
12 th September - 11 th October 2020	6	3
15 th October - 14 th November 2020	14	10
1 st December - 31 st December 2020	20	15
15 th January - 14 th February 2021	10	5
22 nd November -21 st December 2021	17	9
1 st January - 31 st January 2022	16	3

going to the trade. The project personnel of NBFGR residing at Lakshadweep regularly monitor the units and provide technical inputs to the beneficiaries. This innovative approach on community aquaculture of ornamental organisms will open new avenues, where native people access their heritage biodiversity to derive benefits while conserving these invaluable resources.

Livelihood generation

In Lakshadweep, the women are engaged in low-income generating activities such as the preparation of coconut oil and traditional snacks, tuna pickling, and cowrie collection. In this milieu, the trained women turned by the NBFGR into beneficiaries/entrepreneurs and adopted the technology of marine ornamental aquaculture in community aquaculture units and rearing the shrimp juveniles to marketable size. An MoU was signed between the ICAR-NBFGR, and M/S V G P Marine Kingdom, Chennai to trade the ornamental organisms to facilitate the marketing. The women beneficiaries attached to the community aquaculture units have earned an average income of ₹ 7,500 per individual within a short span.

Future prospects

The Community aquaculture units at Agatti are recognized as a successful model for the utilization



Hands-on training program on ornamental shrimp rearing



Distribution of ornamental shrimp seeds to the women beneficiaries by Mrs. Rekha, Scientist, ICAR-NBFGR

Lakshadweep waters and its captive breeding and seed production technology was standardized in the germplasm resource centre of the ICAR-NBFGR, Agatti, Lakshadweep. The wild-collected and F_1 generation are being maintained in the facility for seed production and the F_2 is going to the aquarists/hobbyists. Beneficiaries were given hands-on learning on ornamental rearing and exposed to capacity-building programs in this aspect. A total of 82 islanders were trained and currently, 45 women are involved in this venture in four community aquaculture units. An MoU was signed for marketing the marine ornamentals being produced by the beneficiaries. Each member attached to the community aquaculture units earns ₹7,500 within a short span as an additional income. This model enables the conservation of indigenous resources with the participation of the local community at Lakshadweep.

of native resources for income generation by the local people. This model can be adopted by policymakers to enhance islanders' income and expand this activity to other inhabited islands. This model of 'Conservation Aquaculture with Community Participation' will give long-term sustainability to the marine ornamental resources along with livelihood generation to the local community. These small-scale

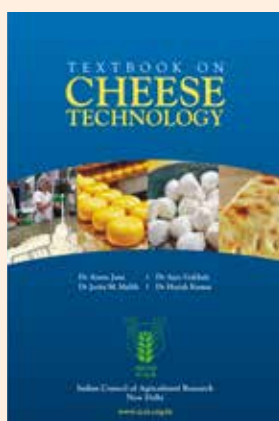
aquaculture units can be recognized as the nucleus /satellite centre that collects, propagates, and sells indigenous marine ornamentals and controls the Indian trade from Lakshadweep, which can be identified as the 'Marine Ornamental Hub' of the nation, in the future.

SUMMARY

The marine ornamentals (fish and shrimp) were collected from

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