

Review Article

Overview of the Marine Ornamental Cleaner Shrimp, *Lysmata amboinensis* (De Man, 1888)

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Abstract

The marine ornamental trade, worth \$300 million, relies heavily on wild collection from tropical reef ecosystems. Few endangered species, including ornamental shrimps, may be at risk during the coming days due to continued exploitation. In this context, captive breeding helps to meet market demands and reduces pressure on coral reef ecosystems. Among the ornamental shrimp, *Lysmata amboinensis*, also known as “cleaner shrimp,” is a highly traded crustacean in the marine aquarium industry because of its bright colouration and compatibility with tankmates. The high-value white-striped cleaner shrimp *L. amboinensis* has a protandric simultaneous hermaphrodite nature and requires hatchery technology. Moreover, optimum water quality, reproductive biology, broodstock diet, and the selection of suitable live feeds are crucial parameters for the commercial production of this shrimp. This review aims to provide an updated overview of the existing knowledge and research trends in marine ornamental shrimp, particularly *L. amboinensis*, with a focus on biology, feeding management, economics, and future perspectives.

Keywords: Biology of cleaner shrimp; Challenges; Future perspectives; *Lysmata amboinensis*; Water quality

Introduction

The marine ornamental trade, which began in the 1930s, has grown into a multimillion Euro industry globally [1]. The marine ornamental organism trade is growing; however, it continues to rely heavily

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on wild collection from tropical coral reef ecosystems. The marine ornamental fish trading industry is constantly developing, highlighted by its expanding statistics, which amount to approximately US\$ 300 million [2,3]. Reef fishes and corals are heavily exploited in the marine aquarium trade, with invertebrates such as sea anemones and sponges becoming popular among hobbyists. Decapod crustaceans play a crucial role in the industry, providing ecosystem services. Marine ornamental shrimp, such as *Stenopus spp.* and *Lysmata spp.*, are popular and extensively traded [4]. Presently, many endangered species, including ornamental shrimp, are at risk due to over-exploitation, which can reduce biodiversity and cause ecological imbalances. Captive breeding helps to meet market demands and reduces pressure on coral reefs. The high-value white-striped cleaner shrimp *L. amboinensis*, due to its protandric simultaneous hermaphrodite (PSH) nature, requires hatchery technology, and brood stock development/management to satisfy oogenesis and spermatogenesis [1] is highly needed. *L. amboinensis*, also known as “cleaner shrimp,” is a highly traded invertebrate in the marine aquarium industry due to its bright colouration and endurance. However, there are insufficient scientific data on this species, which is crucial for commercial production and broodstock development. Biological information, such as information on brooder development and biology, is essential for understanding the early life of *L. amboinensis* [1,5]. Recently, an increasing number of publications on this commercially important shrimp, *L. amboinensis*, including collection from the wild, maintenance, feeding and spawning of behaviour, have been published. However, knowledge related to the culture of ornamental shrimp has also substantially advanced [6]. This present review aims to provide an updated overview of the existing knowledge and research trends in the broodstock management of the marine ornamental shrimp *L. amboinensis*, with a particular focus on biology, feeding management, economics and the future, which are arguably the most important aspects in aquaculture. The objectives of this review are to highlight the current achievements and challenges and to elucidate new research directions for the conservation of this marine ornamental shrimp, *L. amboinensis*.

Biology

L. amboinensis is one of the major traded organisms in the marine aquarium industry. This species can be identified by the following characteristic features: a light brown body with a white band dorsally, red bands laterally and longitudinally, two white patches on the tail, and a white antenna with a crimson base, reaching a maximum length of 6 cm [7] [Figure 1]. It is classified as a member of Decapoda, the Lysmatidae family, and the *Lysmata* genus. It is a popular ornamental crustacean found in the waters of Indonesia and Sri Lanka [7]. Cleansing shrimp have been discovered off the coast of Tuticorin in the Gulf of Mannar region of India. This shrimp was identified as *L. amboinensis*. The researchers collected this shrimp from the Gulf of Mannar, a biodiverse marine ecosystem, from February to July 2015. The shrimp were collected from giant moray eels using small hooks and fishing nets, packed in air-filled polyethylene bags and transferred to the Centre for Climate Change Studies [4]. It is an omnivore and scavenger that feeds on external parasites of fishes. It cleans fish,

including moray eels and groupers, by feeding on their external parasites, mucous and dead or injured tissue. The shrimp molts once every 3-8 weeks and spawns regularly every 2-3 weeks [8]. *L. amboinensis* is a protandrous simultaneous hermaphrodite in which individuals start as males with an ovo-testis that produces only sperm. They later become females with a functional ovo-testis, producing both eggs and sperm but not self-fertilizing or storing sperm. The female phase involves one male contributing sperm and the other acting as a female [9].

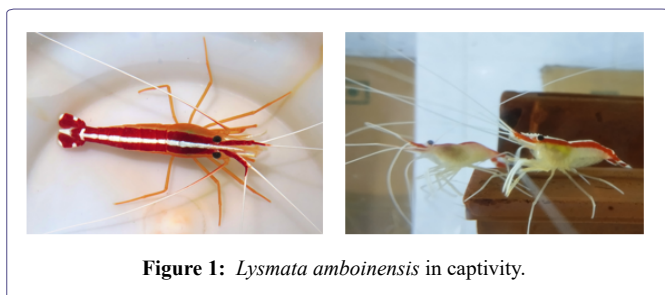


Figure 1: *Lysmata amboinensis* in captivity.

Habitat, Collection and Maturity

The ornamental crustaceans commonly found in coral reefs in shallow and near-shore regions are typically caves and crevices of corals in the Indo-Pacific and Red Sea regions. Tziouveli et. al., (2009) reported that by maintaining stable surroundings, ideal water quality parameters, and a nutritionally balanced diet, *L. amboinensis* plants reach sexual maturity at approximately 5-6 months of age. It matures with an average total length of 34.0 mm. Male and female shrimp have different abdomen plates, with adult females having a wider plate and males having a smaller plate. To secure their eggs during spawning, hiding places must be provided in captivity. Moreover, the less aggressive behaviour and simultaneous hermaphroditic nature of *L. amboinensis* necessitate cross-fertilization, which is necessary due to the lack of sperm storage in *L. amboinensis*. It has been reported that *L. amboinensis* produces 100 to 2,000 eggs during each spawn, which hatch 10-15 days later [9-11].

Sexual Dimorphisms

L. amboinensis is a protandric simultaneous hermaphrodite that reproduces in both sexes earlier as adults and in the early stages as males [12]. There are some differences in sexual dimorphism between male and female shrimp (Table 1).

Parameters	Male	Female	References
Colouration	Males appear to have a less prominent, and brighter yellow body colour.	The yellow body is most prominent among the vibrant colors.	[13]
Size	The main body length is approximately 2.5 inches, with their antennae measuring 3-4 inches in length.	The species appears to be large, with antennae reaching 4-5 inches long and their main body reaching 3 inches.	[14]
Maturity age	They reach sexual maturity approximately 5-6 months of age. <i>L. amboinensis</i> matures with a total length of 34.0 mm		[15]

Table 1: Sexual dimorphisms of *Lysmata amboinensis*.

Food and Feeding of *L. amboinensis*

Every living organism requires food for survival, impaired growth, tissue repair and maintenance, physiological function regulation and health maintenance [13]. Nutritionally balanced feed is crucial for maximizing production and profitability. Inappropriate feed can lead to disease outbreaks, poor growth, and high mortality rates. High-quality feed and appropriate feeding practices can improve feed conversion efficiency, lower production costs, and reduce environmental degradation [14]. An effective feeding program should consider the basic principles of aquatic animal nutrition and feeding, including understanding the nutrient requirements of cultured species, their feeding habits, and the ability of animals to digest and utilize essential nutrients. Food and food management are major parts of the culture of any kind of aquatic animal. Basically, we have to provide live feed, plant-based microalgae and microorganisms, and commercial feed. The feeding must be based on the animal's feeding habits and preferences. In captive conditions, this Pacific cleaning shrimp is omnivorous and a scavenger, consuming live feed such as *Artemia*, an enriched rotifer, *B. rotundiformis* [1,11-16] and microalgae such as *T. pseudonana* as well as damaged fish tissue and detritus. It even cleans inside of fish mouths and gill cavities without being eaten [8,14,17].

Water Quality Parameters

Maintaining optimum water quality, such as temperature, dissolved oxygen, pH, ammonia, nitrite, nitrate, alkalinity, hardness and salinity, has played a vital role in successful cultivation [3,11-20]. Maintaining the optimum water quality (Table 2) ensures that the shrimp are stress free and well-sufficient because it directly affects their development, reproduction, and total productivity.

Parameters	Optimum range of water quality levels
pH	8 - 8.5
Temperature	28 - 32° C
Dissolved oxygen	04 - 06 mg L ⁻¹
Salinity	30 - 32 ppt
Ammonia	0 ± 0.5 mg L ⁻¹
Nitrite	0 ± 0.25 mg L ⁻¹
Nitrate	05 ± 02 mg L ⁻¹

Table 2 : Optimum range of water quality [19-21].

Challenges

Initiating and standardizing the production of broodstock, domestication, and larval rearing of *L. amboinensis* is essential for commercial production. It can be challenging to completely comprehend this species' larval cycle, which makes it difficult to increase it in captivity. Overcoming the long larval period and low larval survival rate is another difficulty [9,21].

Future perspective

L. amboinensis thrived because it is a highly valued marine ornamental decapod. Broodstock care is simpler for decapods than for marine fish, and broodstock care may be performed on a large scale by using countries. Additionally, improving the economic status of the fisherman community in coastal and island regions is a potential alternative livelihood [9].

Economic importance

Currently, there is a healthy market demand for this expensive decorative shrimp, which is being supplied by wild collections. Divers deploy smaller scoop nets and collect the species, which are then transported in oxygen-filled bags made with polyethylene. According to Santhosh et al. [21], between 1998 and 2003, 2,88,484 products were imported, and 1,07,462 products were exported worldwide. The main importers of marine ornamental invertebrates are the UK (15%) and the USA (80%), whereas the main exporters are Taiwan (22%) and the USA (35%).

Conclusion

Marine ornamental aquaculture is still in its infancy, and most of the fish traded are from wild collections. The high-value white-striped cleaner shrimp is a highly traded invertebrate species in the marine aquarium industry due to its bright colouration and endurance. Therefore, increasing broodstock management and commercial production are recommended for this species. In addition to engaging, it also provides the benefit of feeding on external parasites of other fishes, so it is highly suitable for community aquaria. It is quite challenging to comprehend the larval life cycle of *L. amboinensis* completely, which makes domestic production difficult. Captive breeding will help to meet market demands and reduce strains on coral reefs. However, further biological studies on the species would help in captive production.

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