BOOK REVIEW

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Aquarium trade is a highly profitable industry in Europe and the USA with developing countries in Asia and the Caribbean acting as the main suppliers of ornamental species. The industry relies heavily on specimens collected from the wild. Therefore, collecting activities, especially those employing environmentally unfriendly techniques, are expected to translate into detrimental effects to communities. The laboratory culture of heavily traded ornamental species represents an activity capable of ameliorating the environmental costs related to the collection of ornamental shrimp from the wild. The recently published book by Dr. Ricardo Calado provides a review of the biology of ornamental shrimp and most useful information on the many aspects of their aquaculture.

In the first chapter, the author defines ornamental shrimp as those species featuring one or more of the following characteristics, dazzling color, delicate or bizarre shapes, unusual reproductive traits, feature partnerships with sea anemones or corals, clean fish, control aquarium pests, and do not represent a treat for other aquarium organisms (reef safe shrimp). Ornamental shrimp pertain to the Infraorders Stenopodidea and to six different families from the Infraorder Caridea. Interestingly, up to date, no species of Dendrobranchiata is treated as ornamental.

In Chapter 2, the author briefly introduces the different species of ornamental shrimp and provides information on their natural history. Most species are from the Indo-Pacific and the Caribbean. Remarkably, two shrimp genera, Stenopus and Lysmata, are among the top 10 most heavily collected marine ornamental invertebrates when corals are not taken into account. Also, cleaner shrimp from the genus Urocaridiella have become the newcomers to the industry.

In Chapter 3, additional details on the ecology and life history of ornamental shrimp are provided. Topics covered here include color, foraging, and the symbiotic lifestyle adopted by some species. The behavior of cleaner shrimp is detailed and several questions of ecological relevance about this remarkable habit are highlighted. The author nicely summarizes recent studies confirming that cleaner shrimp do clean fish clients and formal experiments demonstrating the benefits of this cleaning behavior for both the fish client and the shrimp. A useful summary table of 35 ornamental species together with their aquarium requirements, stocking limitations, associate behavior, and reef safety level is provided. After reading this chapter, it becomes clear that there is much to do to increase our understanding of the ecology of marine ornamental shrimp.

In Chapter 4, the author focuses on the reproductive biology and mating habits of ornamental shrimp. This section covers topics such as mating behavior, the role of body appendages during sexual interactions and brood production. Information on the reproductive biology of Stenopus hispidus is summarized. Most reproductive studies have been conducted in caridean shrimp. Nonetheless, observations have centered on shrimp from the genus Lysmata. Overall, the sexual and mating system of most ornamental shrimp is not known. Ornaments clearly provide us with an opportunity to reveal an outstanding diversity of reproductive modes among crustaceans.

In Chapter 5, the author focuses on larval development and metamorphosis. Larval morphology is described and the differences between Stenopodidea and Caridea are mentioned. The reader becomes aware of the large number of larval stages featured by ornamental shrimp, a condition that definitively complicates their industrial production as recognized by the author in a later chapter. Additional larval phenomena that cause difficulties with the mass laboratory culture of shrimp include intercalated staging, mark-time molting, and terminally additive staging. This chapter includes a table with information on the number of zoa larvae and diagnostic morphological features of the most commonly traded species. Interestingly, there is no mention of the actual number of species whose larval development is known either completely, or partially. The energetic aspects of larval biology are mentioned, and at the end of the chapter the little information available on metamorphosis and settlement cues is provided. I felt that this last section would have profited the most from the considerable body of literature accumulated during the last decades on metamorphosis and settlement cues of crabs and lobsters.

In Chapter 6, the author focuses on the maintenance of brood stocks in captivity. Rather than obtaining ovigerous females from the wild, breeding and the induction of reproduction of captive pairs is recommended. The author favors a “recirculated maturation system” that presents many logistic advantages compared to smaller brood stock systems. The advantages of this system include short time periods to perform routine tasks, maintenance of good water quality, reduced or no stressful handling of brood stock, automatic separation of larvae from brood stock, and continuous provision of food to parents without affecting larval survivorship. Brood stock nutrition is most relevant. Nonetheless, the most essential dietary requirements are not known for ornamental shrimp. The author suggests that
In Chapter 7, the author covers larval culture techniques. Culturing larvae is a challenging task, but helpful information is provided on culture systems and methods specific to ornamental shrimp that has been mostly developed in recent years by Dr. Calado and collaborators. For the large scale production of larvae, recirculating systems are preferred because they can be set up in inland areas and operate with natural or synthetic seawater. Issues on larval quality, rearing conditions (including water temperature, larval density and photoperiod, water quality, microbial aspects, and settlement cues), and nutrition are all discussed in detail.

In Chapter 8, the author focuses on grow-out techniques for juveniles. Importantly, although preferred for most ornamentals, communal rearing of juveniles might not be feasible in some highly aggressive species such as the boxer shrimp, *S. hispidus*; the Red Blood shrimp, *L. debelius*; and the Lady Scarlett shrimp, *L. amboinensis* and *L. grabhami*. The nutrient requirements for juveniles are barely known, but recent improvements in this topic have profited from the information generated by the culture of lobsters and crabs. The author regards the collection of post larval marine ornamental shrimps from the wild as an alternative for the production of this highly prized species. However, as this practice can potentially impact wild stocks, he cautiously argues first for the establishment of sustainable collecting practices. Issues on packing, shipping, and acclimatizing of ornamental shrimp are discussed at the end of this chapter.

In Chapter 9, the author mentions other decapods with potential in the ornamental industry while in Chapter 10 he discusses future improvements in marine ornamental shrimp culture. Brood stock management and maturation, nutritional requirements and the development of artificial diets are all considered of special concern and targets for future progress. In terms of larval culture, the author recognizes that the long larval period of several species coupled with their ability to delay metamorphosis is the major bottleneck impeding commercial-scale production. In terms of grow-out, the development of artificial diets, elimination of cannibalism, and impairment of precocious maturation of cultured specimens are the main problems to solve. Lastly, traceability and efforts taken to distinguish between cultured and wild collected specimens will help boost the industry.

In Chapter 11, the author covers conservation issues, mentioning that, up to date, there are no formal studies addressing the impact of collecting activities in wild populations of ornamental shrimp. Such a problem appears to be already a reality as exemplified by the small size of specimens being currently exported to wholesalers in Europe. Several ornamental shrimp provide cleaning services to many marine fish. Diminishing the natural abundance of these cleaner shrimp might have considerable detrimental effects at the community level. This is an important reason to conduct basic research on the natural history of ornamental shrimp. Another concern is the accidental release of exotic species from facilities cultivating marine ornamental shrimp. I completely agree with the author about his belief that the future of the industry depends on addressing the concerns of hobbyists with respect to the sustainable and rational use of these highly prized species.

In the final Chapter, the author summarizes the information given in previous chapters and marks that marine ornamental shrimp culture is a profitable reality but with room for improvement. It would have been nice to see and compare the amount of money spent by this and similar ornamental industries (corals, marine and freshwater fish) to really grasp the importance of the marine ornamental shrimp trade.

Overall, this book contains most useful information about the biology of marine ornamental shrimp. It also provides inspiration for new research on fascinating aspects of their natural history. Ornamental marine shrimp certainly represent great models to explore the adaptive value of many traits in the marine environment. This book is a primer on shrimp culturing techniques. Together with Raymond Bauer’s (2004) contribution to the biology of caridean shrimp, I really hope that this book will increase our appreciation, and will boost the interest of many students and established scientists, for these amazing marine invertebrates. This volume should be in the library of every aquaculturist and carcinologist interested in shrimp. The major problem I see with it is its considerable market price.

**REFERENCES**