 ISSN: 2581-3749 (online)

Transportation of Live Marine Ornamental Fish

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Abstract

The growing popularity of marine aquarium has made the marine ornamental fish very popular in all parts of the world and its trade in the international market is a multimillion dollar industry. The successful transportation of marine ornamental fish is the major issue in the trade. The critical factors in the transportation *viz*., design of the container, water quality, fish density, flow rate, period of haul and handling of fish is discussed in the present review. The technology of keeping the highly priced ornamental fishes alive onboard and bringing to the markets will help partially meeting the demand of the industry and improve socio-economic condition of the fishermen.

Keywords: Ornamental fish, fish by-catch, flow rate, container design

Introduction

The marine ornamental fish show tremendous amount of variation in color pattern and attractiveness. In the context of increasing popularity of keeping ornamental fish in home aquaria, the demand for them has been increasing and substantial trade for these fish developed in several parts of the world. The world ornamental fish trade is about 4.5 billion US$ and India's export earnings through ornamental fish is about 0.5 million US$. (Sivaramakrishnan *et al*. 2012). Major chunk of these fishes is exported globally from the country through the wild catches. An estimate carried out by MPEDA shows that there are one million fish hobbyists in India. About 90% of Indian exports are from Kolkata followed by 8% from Mumbai and 2% from Chennai. (Ghosh *et al.* 2003).

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Received Date: 30.11.2017; Accepted Date: 19.4.2018

Many aquatic organisms including species with potential ornamental value are being discarded as by-catch all over the world. These discards have received a great deal of scientific attention and their minimization being a goal of marine fisheries management. FAO database estimate annual average discards as 7.3 million tonnes (mt); contribution of Indian Ocean accounts for about 9% (Pillai *et al*. 2009). The annual landing of the by-catch in the country is estimated to be around 1.3 mt (Chandrapal 2005). According to Kurup *et al.* (2003) the quantity of discards of bottom trawlers in Kerala during 2000-01 and 2001-02 were 2.62 and 2.25 lakh tonnes respectively. Biju Kumar and Deepthi (2006) reported on the fish diversity and mean trophic index of fish fauna associated with trawl by-catch of Kerala coast. Sajeevan and Somavanshi (2013) collected 66 species of marine ornamental fish from the trawl fishery of west coast of India. The high demand for these resources increased the pressure on fragile coral reef ecosystems which support most of the marine ornamental species. On the other hand, many valuable resources are being discarded along with by-catch from different parts of the world. The technology of keeping the highly priced ornamental fish and brood fish alive onboard and bringing to the markets will help partially meeting the demand of the industry. The survival of fish mostly depends on the design of the container, water quality, fish density, flow rate, period of haul and handling of fish.

The basic principles of the container design include an even distribution of oxygen, minimum stagnant regions and adequate removal of fish waste. Most containers have been designed for profitability and maximum carrying capacity with less attention to container related effects on fish. Container design directly and indirectly affects the metabolic rates and health of fishes (Kindschi *et al*. 1991; Barnes *et al.* 1996; Cooke *et al.* 2002). Ideally, a fish holding system for mixed species or size groups might include areas with characteristics that meet species or life stage requirements. However, there is little documentation of short-term holding effects on fishes, especially from wild habitats. Tanks may also

be constructed from glass, wood, concrete, stainless steel, galvanized iron, and sheet metal. Fiberglass is a superior building material because it can be shaped into any configuration and is strong, easy to repair, simple to clean, corrosion-free, non-toxic to fish, and chemically unreactive with water. An additional criterion for a building material is that it can be made smooth, so that the interior of the tank will not damage fins or flesh upon contact (Piper *et al.* 1982).

Water quality is a crucial factor in transportation of live fish and can be affected by the condition and/or deterioration of the holding systems. Fishes may incur additional energetic costs associated with stress responses from physical and chemical fluctuations in aquatic systems (Barton and Iwama 1991). The optimal water quality is essential for holding fish in an environment that will neither activate their stress responses nor alter their normal energy budget. Short-term exposure to poor water quality can result in permanent damage or mortality if physical or chemical variables are allowed to reach lethal levels and/or synergize in a deleterious manner (Carmichael *et al*. 1984; Pavlidis *et al*. 2003). Maintenance of water quality parameters like dissolved oxygen (DO), PH, temperature, salinity, carbon dioxide, alkalinity, ammonia, nitrate and nitrite at optimal level is essential in successful transportation of live marine fish.

The number (or weight) of fish that can be successfully transported depends on water quality, the duration of the transport, water temperature, fish size and the species (Piper et al.1982). Holding fish at high densities is known to adversely affect many biological functions including metabolism (Vijayan and Leatherland. 1990; Barton 2002, Ruane and Komen 2003).

Flow rates within a holding structure should be sufficient to promote optimum water quality and the removal of fish wastes, without causing fish to become stressed and physically overwhelmed by the fast flows (Burrows and Chenoweth 1970). Water flow rate is the volume of water turnover in a given amount of time (i.e. litres min^{-1}). Excessive flow rates should be avoided, because it may fatigue fishes.

The period of haul and handling of fish is often overlooked. Maule *et al.* (1988) reported that the most stressful event in their salmonid study was loading the fish into the tanks and not the actual transport. Robertson *et al.* (1988) also suggested that capturing and handling prior to transport proved most traumatic to red drum *Sciaenops ocellatus* (Linnaeus). Johnson and Metcalf (1982) also found that capturing and handling was a major cause of mortality in the transport of drum *Aplodinotus grunniens*. However, handling fish in nets is almost inevitable during transport procedures. When nets are necessary, it is advisable to use nets that are less abrasive. Nets made from polypropylene or polyethylene should be avoided; these nets tend to be stiff and can cause scale loss (Yeager *et al*. 1990).

Maharashtra with a long coastline of 720 km is endowed with rich marine fishery resources. The average annual marine fish landings during 2001-10 were of 3.6 lakh t valued at about ₹ 2,322 crores contributed 0.5% to the GDP of the state (CMFRI, 2011). The total fishermen population is 3,86,259 residing in 456 villages in the state. There are 17,362 vessels in the fishery of which 13,016 are mechanized, 1563 motorized and 2,793 non-motorized vessels (Anon. 2010).

Marine Ornamental fish industries have enormous potential in Maharashtra**.** Many species with potential ornamental value are being discarded through by-catch. These fish, not having food, are simply thrown in the sea but in ornamental industry they have enormous scope, In ecological perspective, there is biodiversity loss due to discarding of these species and pollution to the ecosystem. The technology of keeping the highly priced ornamental fish and brood fish alive onboard and

Fig. 1 Some important marine ornamental fish which need specialized containers for live transport: (a) Lion fish, (b) Butterfly fish, (c) Sergeant major, (d) Monoangel fish

bringing it to the suitable markets will help partially meeting the demand of fishery industry and improve socio- economic condition of fishermen in the state.

In order to develop cost effective method in transportation of live marine ornamental fish, Marine Biological Research Station, Ratnagiri has taken up research on design and development of live marine fish carrier. Accordingly studies are being carried out on design and efficacy aspects of live marine ornamental fish holding system suitable for mechanized and non-mechanised boats. This will promote live fish trade of potential ornamental fish and brood fish caught in the by-catch of different gears along the Maharashtra coast and help in future seed production programme of the ornamental fish. This technology will benefit the fishermen of the state to earn additional income from their existing occupation.

Acknowledgement

Authors are grateful to the Vice Chancellor's Out-of-Box Scheme of DBSKKV, Dapoli for funding the present research live fish carriers.

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