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Socio-ecological status of marine ornamental reef fishery in Trincomalee, Sri Lanka - An application of strategic SWOT analysis

M.S.V.H. PRIYASHADI[1], K.H.M. Ashoka DEEPANANDA[1]*, Asanka JAYASINGHE[2]

[1]*Department of Fisheries and Aquaculture, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara 81000, Sri Lanka. ORCID K.H.M. Ashoka Deepananda https://orcid.org/0000-0002-2866-1906, ORCID M.S.V.H. Priyashadi https://orcid.org/0000-0003-0918-1189*

[2]*Department of Limnology and Water Technology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara 81000, Sri Lanka. ORCID Asanka Jayasinghe https://orcid.org/0000-0002-7528-7718*

ABSTRACT. The present study elucidates the socio-ecological status of the marine ornamental reef fish (MORF) fishery in Trincomalee, Sri Lanka, through strategic SWOT analysis. Data were collected through interviews with full-time fishers (n = 49) fishing at Pulmodai, Sampur, and Kuchchaweli reef sites, focus group discussions (n = 3), and participant observations during 2019–2020. Data gathered *in-situ* were further investigated in detail, analyzed, and grouped into attributes of SWOT analysis. Results revealed higher fishing income (90–900 USD) by 91.84% of respondents as the major strength of the fishery, followed by low production costs (24–240 USD), a low labor force, and others. Seasonality of the fishery, multiple ownership of reefs, and the limited number of fishing hours (4-6 hrs.) were the main weaknesses identified in the system. High global demand, the fish-to-order concept, and the intervention of local buyers were the major opportunities for the fishery. Long market chains, bopyrid isopod infection on Pacific cleaner shrimp, and poor monitoring systems were the major threats to the industry. The MORF fishery in Trincomalee, Sri Lanka, results in higher living standards for fisher communities and empowers them. The present study has policy implications for the MORF fishery and the long-term sustainability of the industry.

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INTRODUCTION

Coral reef ecosystems underpin various ecosystem services that support the social well-being of coastal communities (Eddy et al., 2021; Woodhead et al., 2019). A total of 39% of the global human population that lives within 100 km of the coast is supported by coral reef environs through tourism-related activities, fisheries opportunities, food, and drugs. A wide range of natural and anthropogenic stressors, i.e., pollution, destructive fishing methods, overfishing, recreational activities, and climate change, detrimentally influence the ecological stability of the ecosystem (Eddy et al., 2021). At present, 19% of coral reefs around the globe have been destroyed, and scientists have estimated that 15% of coral reefs are threatened to be lost within the next 10–15 years (Biondo, 2018). Coral reefs and reef-associated fish, a popular commodity in the aquarium trade, provide significant revenue for exporting countries worldwide, particularly developing countries in Southeast Asia (Leal et al., 2015). The Marine Ornamental Reef Fish (MORF) fishery is a well-established multibillion-dollar industry that mostly relies on extractive fishing, which can eventually deplete renewable resources (Wood, 2001; Biondo and Burki, 2020). Indonesia, Hawaii, Sri Lanka, the Philippines, the Maldives, and Vietnam are the major exporters, while the aquaria of the USA, Europe, and Japan are intensive consumers of MORF (Biondo, 2018).

The Sri Lankan coastline is rich in coral reefs, mangroves, sea grass beds, and other valuable resources (Macusi et al., 2011). Nearshore fringing reefs and off-shore bar reefs are unevenly distributed along the Southern, Northwestern, Northern, Eastern, and Southeastern coasts (Rajasuriya et al., 2005). The MORF fishery has been established off the coastline of Sri Lanka, while the eastern provinces that border the Ampara, Batticaloa, and Trincomalee districts are significant contributors to the industry (NARA, 2008). Fishing season for the reef fisheries on the Eastern Coast extends over eight months from March to October (non-monsoonal) each year (Priyashadi et al., 2022a). The MORF is collected through self-contained underwater breathing apparatus (SCUBA) diving or snorkeling during the non-monsoonal period. Due to the paramount importance of the industry to the Gross Domestic Product (GDP) of the country, issues of the MORF fishery are essential to be identified to obtain maximum benefits, ensuring the sustainability of the industry while protecting sensitive coral reef environments (Manejar and Guiehem, 2018). However, comprehensive studies to elucidate the present status of the MORF fishery in Trincomalee, which is a hotspot for the MORF fishery in Sri Lanka (Priyashadi et al., 2022a), are rather scanty. In pursuance of this knowledge gap, the present comprehensive study was conducted to assess the socio-ecological status of the MORF fishery in Trincomalee, eastern Sri Lanka, through the lenses of strategic SWOT analysis, which is a simple, strategic, and flexible tool to identify strengths, weaknesses (through internal drivers), opportunities, and threats (through external drivers) of a system (Helms and Nixon, 2010).

MATERIALS AND METHODS

Study sites

Trincomalee, located in the eastern province of Sri Lanka, is a hotspot for MORF fisheries (Priyashadi et al., 2022a). MORF collectors, engaged in fishing at in-shore and off-shore patchy reefs, suppliers, and exporters are the three main actors in the horizontal market chain of the MORF trade in Trincomalee, Sri Lanka, while other stakeholders are engaged in the vertical or accessory chains (Priyashadi et al., 2022a). Three fisher communities fishing at Pulmodai (8°57′07″N, 80°59′31″E), Sampur (8°29′08″N, 81°17′11″E), and Kuchchaweli (8°49′19″N, 81°11′00″E) reefs that accounted for approximately

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90% of the MORF catch in Trincomalee (Priyashadi, 2023) were comprehensively evaluated in the study.

Data collection strategy

SWOT analysis was conducted through participant observation, focus group discussions, and interviews conducted by administering survey questionnaires. The survey questions were based on the present and past socio-ecological status of the MORF industry in Trincomalee. Each survey question was open-ended, which facilitated exploring unidentified facts in detail. Data on the status unique to the fishery, including fishing operations, post-harvest losses, market price of fish, fisher income, expenditures, and health issues, were distilled through interviews with active full-time fishers (n=49) through semi-structured interviews and participant observations over two years of study starting in 2019. The veracity of the details of identified elements was validated through informal discussions made with traditional fishermen (n=6), input suppliers of the value chain (n=4), three focus group discussions each of which involved 23 participants, key informant interviews with the district fisheries officers (DFOs) of the Department of Fisheries and Aquatic Resources (n=3), and subject officers of the Sri Lanka Navy (n=2). Selected elements of the threats to the system were investigated in detail. Three samples of the species (one from each site) that were identified as a threat to the MORF industry were collected for further investigation. The number of individuals with such abnormal species or threats was counted at each landing site throughout the study period. The market prices of the identified species were gathered from the logbooks of local fish buyers. All the interviews with fishermen and focus group discussions were carried out in the native language of the interviewees with the assistance of a language translator from time to time. The saturation level of information collected was confirmed through repeated information as heard by the researchers (Deepananda et al., 2016).

Data analysis

The identified elements were assigned to the components of strategic SWOT analysis: strengths, weaknesses, opportunities, and threats. The percentage of responses for each element was calculated, and the identified elements were listed based on the percentage response. Photographs were used to identify the disease of a species that was considered a threat to the MORF fishery in Trincomalee, Sri Lanka. Post-harvest mortalities were computed as a percentage of the total abundance (TA) of relevant families. The presence of parasites on the species was confirmed concerning published literature and morphological features. The composition of infected species was computed as a percentage of the total catch of the species. Data were analyzed using MS Excel 2016 and IBM SPSS statistical software (Version 25), whichever was applicable and aptly presented.

RESULTS AND DISCUSSION

The socio-ecological status of the MORF fishery in Trincomalee, which contributes to 70% of the total MORF fishery sector in Sri Lanka (Priyashadi, 2023), was empirically assessed to elucidate the present status of the sector through the lenses of SWOT analysis. A strategic SWOT analysis facilitates scientists and policymakers in taking robust policy implications for a fishery based on the responses of internal and external stakeholders (Benzaghta et al., 202: Orr, 2011). The goals of the SWOT analysis are to increase strengths, avoid weaknesses, and develop opportunities to mitigate threats to the fishery. The present findings are significant as they provide a complete insight into the status of the MORF fishery industry in Trincomalee, Sri Lanka. Considering the economic benefit to the country, it is necessary to manage the MORF fishery, which has existed for over nine decades, for the well-being of the fisher communities. Elements

of the SWOT analysis of the MORF fishery in Trincomalee, eastern Sri Lanka, are summarized in Table 1. Strengths and weaknesses were the attributes of the MORF fisher community (internal), while opportunities and threats were the attributes of other stakeholders in the MORF fishery value chain, including government officials (external). Therefore, the present analysis elucidates the internal and external elements of each attribute that affect the industry, all of which are aptly presented hereinafter under the title of each attribute.

Table 1. Elements of the SWOT analysis of MORF fishery in Trincomalee, eastern Sri Lanka (Percentage responses computed for each element are in the parentheses).

Internal origin (within the fishing community)	**Strengths** • Higher fisher income (91.84%) • Low production cost (91.84%) • Low labor cost in fishing operations (77.56%) • Lack of competition in marketing (40.82%) • Minimum conflict among fishers (36.73%) • Minimum effort in monitoring compliance (36.73%) • Availability of skilled fishers and/or suppliers for fish handling (12.24%) • Traditional ecological knowledge (4.08%)	**Weaknesses** • Seasonality of the fishery (95.92%) • Multiple ownership for fishing reef (79.59%) • Limited number of fishing hours (73.47%) • Decompression sickness (DCS) (71.43%) • Use of illegal fishing methods (55.10%) • Fishing methods embedded with low technology (55.10%) • Susceptibility of collected fish to post-harvest mortalities (24.49%) • Collecting immature fish (16.33%) • Engaging illiterate/ low literacy level fishers in fishing (4.05%)
External origin (from other stakeholders)	**Opportunities** • High global demand for fish (97.96%) • Fish-to-order concept (87.76%) • Intervention of local fish buyers in problem-solving and legitimate the fishers (67.35%) • Issuance of operation license by DFAR (67.35%) • Proximity to Pigeon Island National Park (55.10%) • Size-based market price determination (44.90%) • Conservation rules (36.73% • Fishing territory lies within a confined area (36.73%) • Migratory fishing during off-season (20.41%)	**Threats** • Long market chain (89.80%) • Bopyrid isopod infection (81.63%) • Poor monitoring system (53.06%) • Insufficiently trained government officers (53.06%) • Absence of financial aid (36.73%) • Lack of training and awareness programs (12.24%)

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Strengths

The MORF fishery industry in Trincomalee, Sri Lanka, solely based on wild reef and reef-associated fish and invertebrate stocks, was supported by the strengths integral to the system. The higher fisher income (90–900 USD per month) gained through the significantly higher market price that ranges from approximately 0.03–36 USD per individual fish attracted new fishers to the industry and avoided the income-based vulnerability of fishers engaged in MORF fishery in Trincomalee, Sri Lanka (Priyashadi et al., 2022a and 2022b). The use of small hand-held fishing gear by the majority of the MORF fishers, i.e., moxy net (91.83% of fishers), barrier net (79.59% of fishers), and hand net (100% of fishers), and the use of long-lasting diving equipment and fishing vessels, either Outboard Fiber Reinforced Plastic (OFRP) boats (93.88% of fishers) or traditional outrigger canoes (6.11% of fishers), helped fishers incur a low production cost (24–240 USD per month), which affirms the socio-economic stability of the MORF fishers in Trincomalee (Priyashadi et al., 2022a). Moreover, limited fishing hours per day reduced additional costs for food and other subsistence to be borne by the MORF fishers. In contrast, fishers engaged in multiday fisheries targeting food fish incur high fishing operational costs since they carry out fishing activities, spending 15–30 days per trip on offshore fishing grounds (Amarasinghe, 2003). All these factors collectively accounted for comparatively higher income for the MORF fishers compared to other small-scale fishers in Sri Lanka, which facilitates the higher economic index in the MORF fisher community of Trincomalee, Sri Lanka (Priyashadi et al., 2022a). Although some of the small-scale coastal fisheries in Sri Lanka are labor-intensive (Deepananda et al., 2016), the number of fishermen engaged in one fishing turn was confined to two or three fishers, including one supporter or boatman in the MORF fishery in Trincomalee, Sri Lanka. This enables boat owners and shareholders to engage in MORF fishing to maximize their profit per unit effort. The market chain of the MORF fishery in Trincomalee is fixed (Priyashadi et al., 2022b), because the fish trade is solely based on the live species in contrast to the other small-scale fisheries in Sri Lanka (Hasini et al., 2020). Moreover, market competition amongst the MORF fishers was comparatively low due to the fixed market chain of the fishery (Elsler et al., 2019; Priyashadi et al., 2022b). In addition, the fish-to-order concept employed in the export-oriented MORF fishery in Trincomalee supported the lower market competition.

The institutional structure governing the MORF fishery in Trincomalee complied with the principle organizational characteristics of the community-based fisheries management (CBFM) system proposed for coastal fisheries systems by Ruddle (1998). In analyzing the characteristics of the CBFM system, the absence of well-defined primary fishing rights and the availability of plenty of fishing reefs minimized conflicts among the MORF fishers in Trincomalee, albeit well-established institutions that ensured fishing rights averted conflicts among fishers in some other small-scale fisheries governing systems in the coastal fisheries of Sri Lanka (Deepananda et al., 2016; Gammanpila et al., 2019; Deepananda and Amarasinghe, 2021). The authority (leadership) of the governing systems was vested in local fish buying centers (Priyashadi, 2023), and this institutional arrangement helped minimize the cost incurred by fishers for monitoring compliance. The existing fisheries governance through the traditional CBFM system minimized the operational cost of the MORF fishery in Trincomalee, Sri Lanka.

Small-scale fisheries around the globe are based on Local Ecological Knowledge (LEK) (Deepananda et al., 2015 and 2016). The MORF fishery industry was solely based on live commodities collected from shallow to

deeper areas, and the LEK of MORF fishers was identified as vitally important in fish handling and storing in proper storage conditions. Skilled fishers engaged in the MORF fishery in Trincomalee minimized the post-harvest mortalities of fish, increasing the fisher income. The present study revealed that fishermen become experts by engaging in fishing with other skilled fishermen. However, the contribution of traditional fishers in sharing the LEK with new fishers was rarely observed, and only 1.34% of the MORF fishers in Trincomalee acquired LEK through traditional fishers (Priyashadi et al., 2022a), although the LEK of some other small-scale coastal fisheries systems is transferred mainly through traditional fishers (Deepananda et al., 2016; Deepananda and Amarasinghe, 2021). It was found out that newcomers were also being trained by the more skilled traditional fishers regarding fishing in risky reefs, predicting the availability of fish stocks based on weather conditions, effective fishing methods, threatened fish species, varieties of a species, and precautionary measures to be taken to avoid decompression sickness (DCS), which is a common disease among SCUBA divers caused by super-saturation of inert gas in the bloodstream of fishers (Howle et al., 2017; Nakayama et al., 2003). Contrary to the present findings, Bender et al. (2013) have found that traditional MORF fishers in eastern Brazil collect threatened species, emphasizing their minor awareness of threatened species and species conservation.

Weaknesses

Weaknesses in the system reveal failures in the institutional structure (Orr, 2011). The eastern coast of Sri Lanka is subjected to the north-western monsoon (*Maariya*) from September to February each year. The seasonality of the MORF fishery in Trincomalee was the major weakness identified through the study. During the monsoon period, MORF fishers in Trincomalee refrained from fishing and were compelled to use seasonality-based migration as a livelihood strategy. Consequently, most of the MORF fishers in Trincomalee (59. 18% of fishers) migrated to the northern, western, and north-western provinces of Sri Lanka for MORF fishing, while others switched to food fishing (24.49% of fishers) or refrained from MORF fishing (16.33% of fishers). Ownership of fishing reefs or fishing territory vested to either single or multiple fishers increased fishing pressure on reef fish, ultimately affecting fisher income and the long-term sustainability of the fishery. The high demand for fish species in the export market increased fishing pressure on wild stocks, affecting the ecological balance of the sensitive coral reef ecosystem (Eddy et al., 2021). The current study identified that fishing duration per fishing turn relied on light intensity, which was a major limiting factor in the MORF fishery of eastern Sri Lanka. Visibility-based fishing duration in the MORF fishery was limited to 4-6 hours, and there was a significant weakness observed in the system that affected fisher income (Amarasinghe, 2003). Although a fishing trip for the MORF fishermen in Trincomalee was restricted to a day, it is extended by several days to a week in some regions of Indonesia and the Philippines (Schmidt and Kunzmann, 2005). It exposes various fish species to direct sunlight, leading to oxygen deficiencies (Schmidt and Kunzmann, 2005) and accelerating post-harvest mortalities among collected MORF. DCS was a major health issue found amongst SCUBA divers engaged in the MORF fishery in Trincomalee, Sri Lanka. The study proposed that DCS effects the vulnerability of fishers or livelihood diversification of fishers (Priyashadi et al., 2022a) and confirmed that 21.11% of fishers were affected by the DCS at least once during their MORF fishing life, resulting in minimum impacts on the fishery that help sustain the MORF fishery industry in Trincomalee, Sri Lanka.

Even though institutional architecture showed a moderate level of compliance

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with the modified design principles proposed by Cox et al., (2010), the use of illegal and technologically low fishing methods such as moxy nets and barrier nets, which destroy reef ecosystems, was identified as a major weakness by 55.10% of stakeholders in the MORF fishery in Trincomalee, Sri Lanka. This indicates the institutions established to govern the MORF fishery in Trincomalee are not robust. The use of destructive fishing methods can be restricted by implementing robust institutions that address species conservation and illegal fishing methods, as is very well considered in some other small-scale coastal fisheries in Sri Lanka (Deepananda et al., 2016; Deepananda and Amarasinghe, 2021). Post-harvest mortalities in the families Apogonidae (0.91% of the family), Pomacentridae (1.24% of the family), and Rhynchocinetidae (1.33% of the family) accounted for significant economic losses, which was a minor weakness distilled from 24.49% of the respondents. Fishing of immature individuals, which was 8.21% of the total commercial fish catch of the MORF fishers, was an identified weakness and was noticeable at the beginning and end of the fishing season. The study identified that illiterate fishers (1.39% of total MORF fishers) in the fisher community, or those with low literacy levels, were identified as weaknesses that influence the sharing of LEK among community members, directly affecting the introduction of rules for the governing system in the long run (Ragavan et al., 2016).

Opportunities

The opportunities that exist in the system that are created through geographic conditions, weather, and institutional robustness are derived as external attributes (Orr, 2011), affirming the long-term sustainability of the MORF fishery. Marine aquarium keeping is a popular global trend (Biondo and Burki, 2020), which accounts for the high global demand for MORF and was a major opportunity identified for the fishery that helped improve the socio-economic well-being of the MORF fisher communities in Trincomalee, Sri Lanka (Priyashadi et al., 2022a). The fish-to-order concept that ensures an export market for the species collected by MORF fishers was identified as a significant opportunity for the fishery system, which reduces post-harvest losses in the sector. Active participation of local fish buyers in governing the fishery and legalizing the MORF fishers through mandatory registration at the Fisheries Inspectors (FI) of the area were significant opportunities observed in the MORF fishery in eastern Sri Lanka. All of these practices considerably minimize power inequality amongst MORF fishermen, which is in agreement with the findings of Quimby and Levine (2018). The present study revealed that the prime eligibility for engaging MORF fisheries was the fishery-specific operational license that was issued by the Department of Fisheries and Aquatic Resources (DFAR) in Sri Lanka. The eligibility license for fishing reduces conflicts among MORF fishers and competition among resource user groups engaged in fishing at the same fishing territory, i.e., sea cucumber collectors, reef food fishers, bait collectors, etc. The locality of fishing reefs near Pigeon Island National Park (PINP), considered a 'no-take-zone' and biodiversity hotspot (Perera and De Vos, 2007; Perera and Kotagama, 2016), was an opportunity for the MORF fishery. Marine national parks contribute to enhancing the fisheries at nearby reefs through species-specific boosting of fish (Kaunda-arara and Rose, 2004; Wiadnya et al., 2023); a similar argument has been made with the findings on intertidal macro-benthic communities on the southern coast of Sri Lanka (Deepananda and Macusi, 2012, 2013). The present study supports the argument that PINP contributes significantly to the MORF fishery in Trincomalee, Sri Lanka. Moreover, size-based market price determination was also identified as an opportunity that reduces conflicts among key actors in the MORF fishery market chain in Trincomalee, Sri Lanka (Priyashadi et al., 2022b).

The DFAR, Sri Lanka, has imposed several conservational rules, such as implementing limitations on the number of oxygen cylinders and the number of fishing hours per trip to mitigate illegal fishing methods and protect prohibited and restricted species, both of which help minimize the extinction risk of threatened species and maintain ecological balance in the reef environs. The fishing territory of the MORF fishermen in Trincomalee was confined to coral or rocky reefs, which could be accessed by a limited number of resource user groups. It supports institutional and ecosystem sustainability and helps sustain the industry in the long run due to the high demand for MORF in the export market (Rhyne and Tlusty, 2012). Even though the season-based migration for fishing was a weakness for some fishers, it stabilizes the financial status of the fishers during the off-fishing season for MORF fishing. However, the study confirms that monsoonal-driven fishing seasonality boosts fish stock in fishing reefs through recruitment during the off-season, which is supported by a high abundance of immature fish and a low individual abundance of mature species at the beginning of the fishing season (Priyashadi et al., 2022a).

Threats

The fishing season of the MORF fishery in Trincomalee lasts eight months during the non-monsoonal period each year (March–October). The market prices of most of the MORF species at the fisherman level were approximately 10-fold lower than at the exporter level (Priyashadi et al., 2022b). Thus, the long market chain did not support the valuation of a reasonable price for the fish at the fishers' level (Priyashadi et al., 2022b) and was identified as a major threat to the MORF fishery in Trincomalee. Bopyrid isopod-infected Pacific cleaner shrimp (*Lysmata amboinensis*) individuals were reported in commercial catches of the MORF fishers at the latter part of the (end of the) fishing season (Figure 1). Pacific cleaner shrimp infected with Bopyrid isopods were named *Gedi hippolis* (Pacific cleaner shrimp with a tumor) and identified for the first time as a threat to the MORF fishery, reducing fisher income during the later part of the fishing season. Also, the occurrence of infected shrimp further suppresses the fishers because of the low abundance of Pacific cleaner shrimp in the commercial catches and the comparatively low CPUE at the later part of the season. Bopyrid isopods create reproductive castrations in shrimp by ceasing the maturation of gonads in parasitized females and feminizing infected males (Calado et al., 2006).

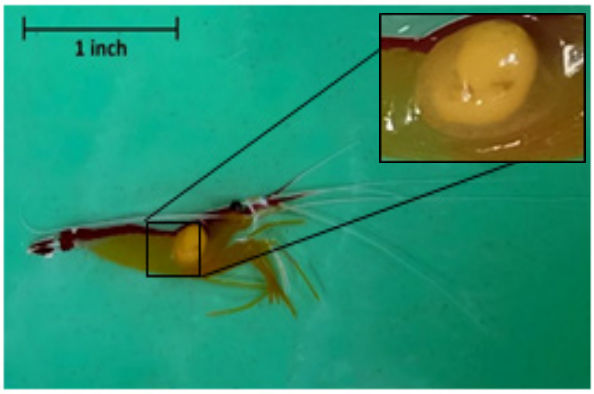

Figure 1. Infected Pacific cleaner shrimp (*Lysmata amboinensis*) (Inset: Bopyrid isopod attached to the abdomen).

The study confirmed that Pacific cleaner shrimp infected with Bopyrid isopods inhabited fishing reefs from the beginning of the fishing season, and infected individuals were not fished by the MORF fishers because of the availability of plenty of healthy individuals in the wild, which was sufficient to fulfill the demand. The peak individual abundance of healthy individuals was in May of 2019 and 2020, and the number of healthy individuals in the commercial catches started decreasing after May of each year (Figure 2). When the number of healthy individuals decreased towards the end of the fishing season from the peak in catches, an abundance of infected Pacific cleaner shrimp in the commercial catches of the MORF fishermen showed

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an increasing trend. A one-way ANOVA (analysis of variance) test indicated a significant difference in the infected Pacific cleaner shrimp catches between the three study sites (P<0.05). Even though the bopyrid isopods that infected Pacific cleaner shrimp were identified as a threat to the system through strategic SWOT analysis, participant observations confirmed local fish buyers and exporters buy infected individuals due to the scarcity of healthy individuals at the end of the fishing season for a comparatively lower market price (0.6 USD per individual) than healthy individuals (1.2 USD). This was a general practice because the spreading of bopyrid isopods is limited in aquariums as their life cycle requires an intermediate copepod host (Calado et al., 2006). Fishers confirmed that infected individual Pacific cleaner shrimp had collected throughout the fishing season, but fishers tended to remove the bulge using a metal blade, which is not accepted by local fish buyers and exporters since it exacerbates the mortality of the shrimp within 1-2 hours.

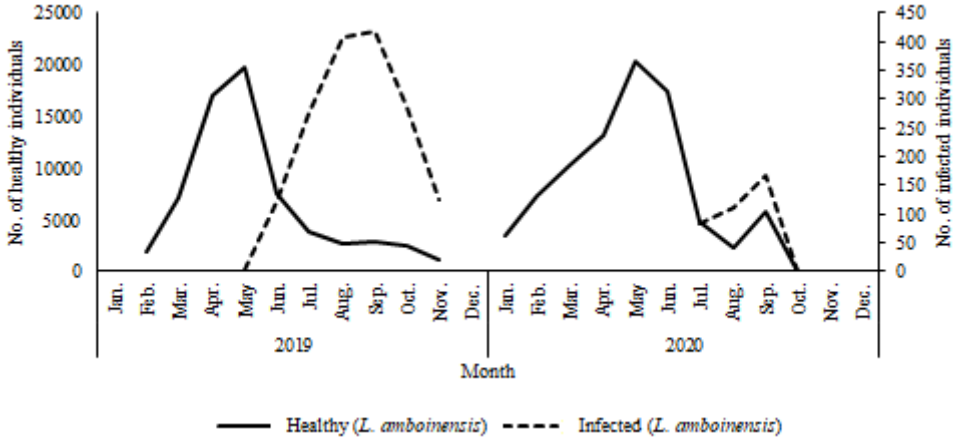

Figure 2. Variations in abundance of infected and healthy Pacific cleaner shrimp (*Lysmata amboinensis*) in Trincomalee during 2019-2020.

Monitoring and accountability in the prevailing institutional arrangements did not promise the long-term sustainability of the MORF fishery in Trincomalee, eastern Sri Lanka. The easy and cost-effective gear-based management approach was not successful in the MORF fishery in Trincomalee, Sri Lanka, even though it is a successful approach in Papua New Guinea (McClanahan and Cinner, 2008). The study identified that monitoring compliance with any violations of prevailing rules, such as illegal fishing methods (Moxy net and Barrier net), and collecting banned species (*Cephalopholis sonnerati*) for consumption should be further strengthened. In this regard, the institutional structure should be strengthened, and the MORF fisher communities should be empowered to comply with the institutions, monitoring, and accountability. The insufficient number of well-trained government officers essential in the prevailing governing system was a threat to the current system that allows conflicts between fishers and government officers of DFAR and Sri Lanka NAVY. The present study exposed that the MORF fishers were not supported by any financial aid from the government or non-government organizations, which was one of the best approaches to enhancing the adaptive capacity of the MORF fishers (Nenadović et al., 2016). However, livelihood diversification among MORF fishers in Trincomalee was very low, as reported in the other small-scale fisheries in Sri Lanka (Deepananda et al., 2016). Thus, a lack of financial aid was identified as a threat to the MORF fishery, which

exacerbates the fishing pressure. Due to a lack of awareness and training programs, which are promising tools for promoting species conservation (Miah et al., 2019), fishers employed technologically substandard fishing methods and performed destructive fishing activities to increase revenue gained through the industry. The present findings help recommend several approaches and interventions for sustainable MORF fishery in Trincomalee to robust the prevailing institutions of the MORF fishery governing system by introducing gear rules, establishing unbiased and transparent price determination mechanisms at each operational component of the value chain, and building capacity of the fishers through training programs to foster income through the proper post-harvest handling and storing of fish.

CONCLUSION

The present study confirms that the MORF fishery in Trincomalee is a promising livelihood strategy that improves the socio-economic well-being of the MORF fishers through strengths and opportunities embedded in the fishery system. The strengths and opportunities learned from the system help minimize conflict amongst the stakeholders of the industry while weaknesses and threats should be minimized and mitigated for the long-term sustainability fishery. Present findings elucidate that most of the weaknesses in the MORF fishery system could be averted by fortifying strengths identified from the system while strengths of the system can be improved through awareness and capacity building of the stakeholders. However, it was found that compensation for some weaknesses identified in the study may create another weakness for the entire system. The fishing seasonality facilitates the recruitment and adjacent MPA supported in boosting of fish stock and economic viability to support the longevity of the fishery over several decades and study highlights necessity to establish marine protected areas and manage properly the existing MPA network around Sri Lanka for sustainable MORF fisheries. The findings of the present study warrant the policy decisions for properly managing the fishery that is vital for sustainable industry. The policy decisions derived through the SWOT analysis help elucidate that fisher communities and other stakeholders must maintain robust institutions in governing the MORF fishery resources.

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