Marine ornamental Fishes in the Red Sea: Statusand trade

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Abstract

The Ornamental fish trade is rapidly expanding and there is a growing recreational demand for aquarium fishes in international markets. This paper aims to initially assess the status of the marine ornamental fishes and their trade in the Yemeni Red Sea. For this purpose, a field survey was conducted in May-June (2006) in 42 sites in this coast, and information regarding the trade was collected. These sites were located in 40 islands where coral reefs are the most dominant habitats. There were statistically differences in the number of ornamental fishes between and within the sites. Many species of such fishes were targeted for trade in unsustainable manners. This could affect the marine ecosystem in Yemen if such trade continues without unsustainable management.

Keywords: Ornamental fishes, trade, Yemeni Red Sea, islands, coral reefs.

Introduction

Coral reefs are habitats for many ornamental fishes. These reefs are considered to be amongst the most biologically rich and productive ecosystems on Earth and isknown as the 'rainforest of the seas'[e.g.1,6,8]. Theyare enriched with communities of flora and fauna. Fishes are a dominant community of these fauna, in terms of both their biomass and their diversity.Many brightly-colored fishes with attractive shapes, including angelfishes and butterfly fishes, living in coral reefs are targeted as ornamentalanimals for aquarium purposes. Many worldwide areas of coral reefs have been degraded [8,16,27,35,36]. This degradation could affect the abundance of fishes, including ornamental species [9,27,34].These speciesplay an important role in maintaining the ecological balance of the coral reef ecosystem.

Marine ornamental fishesalso play an important role in the world trade for fish aquarium.Global trade in these fishes started in the 1930s in Sri Lanka, but has been rapidly expanded involving at least 45 exporting countries around the world[6]. More than 90% of these ornamental fishes are wild-caught worldwide [17]with high values. About 27 milliontropical marine ornamental fishes are traded every year[34]. About 80% of theses fishes come from Indonesia, the Philippine, the United States of America (USA) and Seri Lanka. The annual value of the world trade in ornamental fishesisestimated at US$ 2.2 billion and 98%of which comesfrom tropical species. According to Food and Agriculture Organization (FAO), the value of international trade in exports of ornamentals has increased at an average growth rate of approximately 14%per year since 1985. Developing countries, including Yemen, account for about two-thirds of the total export earnings[15].

There are global concerns about stock sustainability of the marine ornamental targeted in trade[5,9,10,11,12,16,21,32,34] due to their collected quantities and methods used for catching them alive for aquarium markets. Globally, the high collected quantities of these fishes might affect this sustainability, but such an effect is difficult toquantify andmanage dueto the lack of data on trade in these animals [12]. The data are usually confidential in many countries. However, unsustainable practices, such as cyanide fishing and overexploitation of target species, are used for catchinglive marine ornamental fishes inmany countries worldwide[9,10,11,12,16,20,31]. These practices have impacts on sustainability stock of these fishes. In fact, some of marine ornamental fishes have been declined in some areas of the

world [31]. This stock could be at risk if their trade continues without sustainable management. There is a need for local and global actions to sustain the stock of the ornamentalfishes in the world[12].

In Yemen, the trade in manymarine ornamental fishes, including groups ofbutterflyfishes and angelfishes,started in1995. These two species groups are within the most ten targeted fish groups for the international trade in these animals[21]. The Yemeni Ministry of Fish Wealth (MFW) is the responsible authority to issue license for collecting and exportingmarine ornamental fishfor aquarium markets. These fishes had been collected alive from Yemeni seawaters, mainly from the Red Sea coast, and then exported abroad. However, the systemprocess applied for this exporting and the trade in the ornamental fishesis not clear.

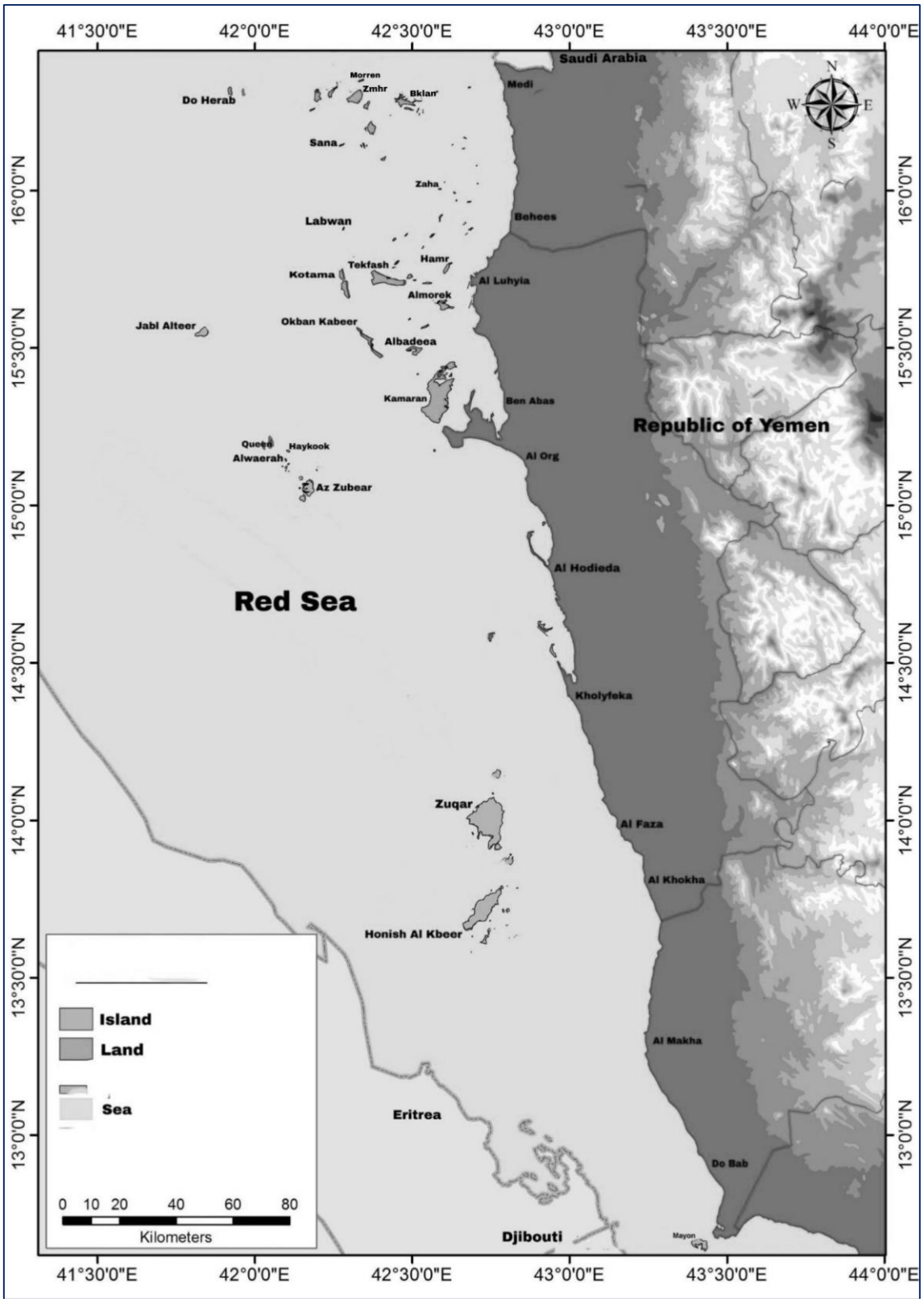
This aimof this paperis to assessthe status of marine ornamental fishes in the Yemeni Red Sea coastwith three main objectives. The first objective is to comparethe abundance of these fishes between and within their locations in this coast,The secondobjective is to provide an overview on the trade of these fishes in the Yemeni Red Sea coast , arethe last is to highlight the implication of this study.

Study area

The study area was the Yemeni Red Sea coast. This coast extends for more than 760 km from the border with Saudi Arabia to the strait of Bab Al Mandab [19]. There are 120 Islands in the Yemeni Red Sea coast. Some of these islands are inshore, such as Kmaran, and others are of fshore such as Do Herab Island and Uqban al Kabeer Island. There are 229 species of coral fishes, including ornamental fishes, recorded in in the Yemeni Red Sea coast, including these islands [7]. The abundance of coral reefs and fishes living in these habitats varies from each other in this coast[2,3,4,7,14,18,24].

Material and methods

A field survey wasconducted in the study area to initially assess the marine ornamental fishes in 42 sites located in40islands (Figure 1; Table 1) during the period May-June 2006. Underwaterrapid visual observations, using SCUBA diving, were used for this assessment. The observations in these surveysweredocumented with photos using underwater camera (Nikon IV) at each site for records and identification of some species. Ecological parameters, water depth, salinity and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Temperature were recorded at each site. Geographical coordinates were also recorded with a hand – held Global Positioning System (GPS: Garmin-e-trex) for each site. Official visits carried out to the Hodeida office of MFW and companies involved in trading marine ornamental fish in Hodeida city to gather data about this trade.

The one-way analysis of variance (ANOVA) was used to test the significance of differences in the species number for each ornamental fish family between and within the survey sites. The StatisticalPackage for the SocialSciences (SPSS) 25 was applied for this test.

Results and Discussions

In this study, a total of 23 ornamental fishes belonging tofour families were recordedin 21sites out of the total sites (n=42) surveyed in this study (Table 1). Pomacentridae was the most dominant fish family, whereas Pomacanthidae was the less common familyliving in these 21 sites (Figure 2). Nearly50% of these fishes (n=11) of the four familieswere recorded in one site only (Morreen Island). In contrast, less than20% of fish species (n < 5) belonging to different families were observed in most sites (n=12)(Figure2), including Al bedha Island and Kamaran Island. In general, there were statistically significant in the species number for each fish family between and within the survey sites.

The ornamental fishes were surveyed at areas dominating with coral reefs, but the health conditions of these habitats differed across the study sites. A previous studies in the Red Sea region showed that there was a correlation between the health of coral reefs and the numbers of some marine ornamental fishes living at these habitats[33,37]. In facts, the coral reefs were in good health in the sites located in the vicinity of military areas. The number of the marine ornamental fishes was high in these sites. In contrast, the number of these animals was low in the other study sites where coral reefs are in poor health. This might result of the unsustainable methods used for collecting these fishes, including species sheltering in branching coral colonies, for the aquarium markets in these sites. Collateral damage could be involved to collect these species [25].There was noprogram or system applied to assess the health conditions of the coral reefs where ornamental fishes are caught for trade in the Yemeni Red Sea.

In Yemen,The trade in the ornamental fishes lacks management system for conserving them and their habitats (coral reefs) where these animals live. There is no management plan for conservation of these fishes or propersystemsapplied for controlling their collection in this country. The ornamental fishes were collected alive from many coral reef areas and there was no surveillance system to control their methods used in these places. These fishes include rare and endemic ornamental species that lack special management as well. These species are easily overexploited [23,25].Many international researchers [e.g.9,10,11,12,21,32,34]are concerned about the unsustainable management of the trade in live marine ornamental fishes for aquarium markets. These researchers highlighted the importance of effective controlling systems for catching these fishes. There is a need for conservation plan and legislation for the collection of marine ornamental fishes, including rare and endemic species, in Yemen.

Table 1 Distributions of targeted fishes recorded in the field survey (May-June, 2006)

Family / Sites	Duwema Island	Ashio as Sagheer	Al Munaes as Sager	Al Munaes al Kaber	Barnoor	Atdhra	Bakkan Island	Tokala Island	Al Moassa	Abu Ohr Sager	Abu OhrKaber	Al bedha Island	Gareeb	Abu Hashish	Gemme	At Towaa	Do herab Island	Rafae	Brre Island	Morreen Island	Robo	Addeng Island	Al Mfhoo	Al Foshi	Ardhen	Saranda	Zmbar	Sana	Arwean	Sakhr	Abu Shagara	Ghorab	kamaran Island 1	kamaran Island 2	Al Budhea Island	Kadaman	Hadhaban	Okbankabeer	Al Gabool Wreck	Al Alam Island 1	Center Pick Island	Al Alam Island 2
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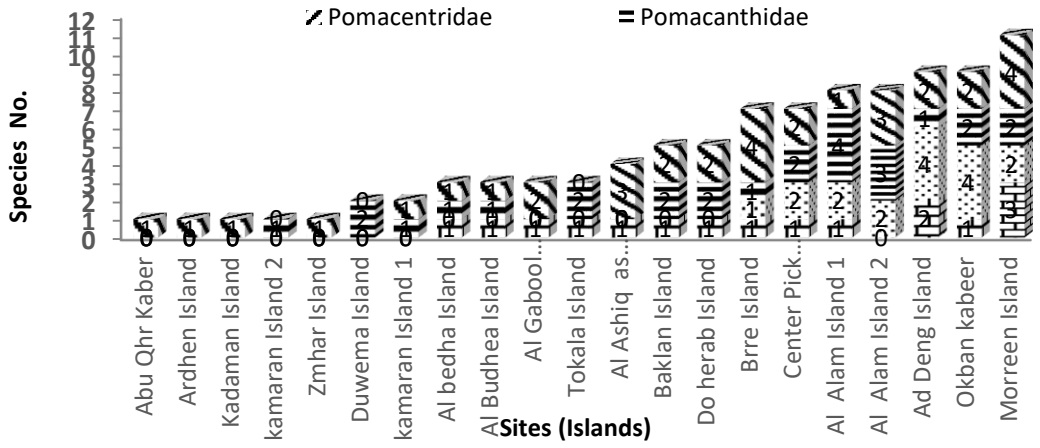

Figure 2. Spatial distribution of the ornamental family fishes in each study site.

Fish families

Acanthuridae (Surgeonfishes)

The species number of Acanthuridae (surgeonfishes) wassignificantly different between (F =60.106, $p<0.001$) and within ($p<0.001$) the sites. Surgeonfishes are the most targeted species of marine ornamental fishes in Yemen for the aquarium tradebecause of their different shapes and bright colors. Only five surgeonfish species were recorded in less than 35% (n=13) of the total survey sites (n=42) (Table 1). Nine sites, including Baklan Island and Do herab Island, were observed with only one surgeonfish species. *Zebrasomaxanthurum*was recorded in two sites only in a number less than fours, though this species is often observed in schools [3,20]. *Nasolituratus*(Figure 3)was observed only in one site (Al Alam Island) in this survey, but in a few numbers. A previous study [25] recorded only one individual of this species found in a site located in the Yemeni Red Sea coast in 2002. Another previous study [13] did not record *N. lituratus* in the north part of this coast in 2004.

Chaetodonetidae(Butterflyfishes)

There were significant differences in the number of Chaetodonetidae(Butterflyfishes) species between (F = 295.958 , $p<0.001$) and within ($p<0.001$) the study sites. Only six species of this family were recorded in less than 20% (n=7) of the total study sites (n=42) and not all of them were observed in a site (Table 1). Fourbutterflyfish species were found in two sites (Ad deng Island and OkbanKabeer Island), whereas only one species was found in a site (Brre Island). The species of *Chaetodonmesoleucos*(Figure 3)was found in one site only, whereas *Heniochusintermedius* was observed in five sites. The species of *Chaetodonfasciatus, Chaetodonmesoleucos* and *Chaetodonaustriacus* were observed as individuals or in pairs in the sites. In contrast, *Chaetodonlarvattus, Chaetodonsemilarvatus* and*Heniochuslintermedius*were observed in a few numbers.

The abundance and distribution of the butterflyfish species in this study were different from other previous studies. Nine species of butterflyfisheswere recorded in the Yemeni Red Sea in 1999 by a previous study[7], whereas only six species of these fishes where observed in this survey.In addition,the distribution of most of butterfly fishes was reported in the north part of the Red Sea in the vicinity of Midi and Al Luhyia area, including Rafa Island, in 2004 by another study [13], whereas these fishes were not recorded near in this Island, in this study. However, not all sitelocations of this survey were similar to those conducted by the previous studies. Nonetheless, the lack of butterfly fishes in Rafa Island and in most study sites suggested that their abundance was in decline.

The abundance of some butterflyfish species could be useful for indicating the health of coral reefs [33,37]. In this survey, butterflyfishes were not observed in more than 75% (n=36) of the total study sites (n=42) where many coral reefs were in poor health.

Pomacanthusmaculosus

Pomacanthus imperator

Pomacanthusasfur

Pygoplitesdiacanthus

Nasolituratus

Chaetodonmesoleucos

Amphiprionbicinctus

Abudefdufsexfaciatus

Pomacanthidae(Angelfishes)

The species number of Pomacanthidae(angelfishes) was significantly differed between (F = 27.291, p<0.001) and within (p<0.001) the study sites. Four species belonging to this family were recorded in less than 40% (n= 15) of the total study sites (n=42) (Table 1). Only one site (Al Alam Island) was observed

with these all four species, whereas six sites were recorded with only one species of angelfishes. The Arabian Angelfish (*Pomacanthusasfur*) (Figure 3) was observed in five sites and the Yellowbar Angelfish (*Pomacanthusmaculosus*)(Figure 3)was observed in one site (Al Budhea Island) within these six sites. The Arabian Angelfish was observed in all 15 sites, except this Island, followed bythe Yellowbar Angelfish.

In general, the sizes of the angelfishes found in this survey were large, but in a few number. For example, *P.maculosus was* observed with large sizes with no less than 25cm long. Surprisingly, small sizes of angelfishes were not observed in this survey except for one site (Center Pick Island). Ornamental fish collectors probably targeted juveniles of these species. The Arabian Angelfishwas observed in a few numbers in the survey sites. In contrast, it was previously able to record about 150 of this species within a short period [25]. The Arabian Angelfishwere documented to be distributed in the Red Sea and in the seawaters of Kenya, Oman, Somalia and Tanzania only [27].

The International Union for Conservation of Nature (IUCN) has shown that the Emperor Angelfish (*Pomacanthus imperator*) [29] (Figure 3) and Royal Angelfish (*Pygoplitesdiacanthus)* [30] are distributed in many areas of the world, including Red Sea and Gulf of Aden, but they are uncommon in the Yemeni Red Sea. This survey did not record these two species, except for one site (Al Alam Island). Similarly, previous studies, conducted in 2002 [25] and 2004 [13], did not record these twospecies in the sites surveyed in the Yemeni Red Sea, expect for *P. imperator* that was found by in 2002 [25] in a site that was not within the current survey sites. The other species (*P. diacanthus)* wasonly were observed in a company facility holding this speciesfor export in 2002,in Yemen[25]. The distributionof the Emperor and Royal Angelfishes is highly likely to be restricted to a few locations in the Yemeni Red Sea coast. Their abundance was also very low and their numbers could be largely reduced if there is nocontrolling systemfor their collection. They are easily overexploited [25]. TheEmperor and Royal Angelfishes (Figure 3) could be considered as rare species in the Yemeni Red Sea coast, so there is a need for special management to conserve these two species in Yemen.

Pomacentridae (Damselfishes)

The species number of Pomacentridae (Damselfishes)was significantly different between ($F = 22.978$**,** $p < 0.001$**)** and within($p < 0.001$) the study sites. Eight species belonging to thisfamily were recorded in less than 45%(n=18) of the total study sites (n=42) (Table 1). Within these 18 sites, only three sites were observed with the maximum number of damselfishes (four species). Nearly fifty percent of the 18 sites were observed with only one species (*Abudefdufsexfasciatus*) (Figure 3). This species was found in all 18 sites.

Damselfishes had the highest number of individuals and common species in the most surveyed sites of this study, but some of these species were not widely found in previous studies. For example,*A. sexfasciatus* was not recorded in a previous study conducted in the YemeniRed Sea coast in 2002 [25]. In contrast, this species was widely distributed in this survey and in another previous study conducted in the north part of this coast in 2004[13]. These two previous studies did not record the Red Sea/Two-banded Clownfish (*Amphiprionbicinctus)* in the Yemeni Red Sea, whereas,incontrast, this species was observed in two sites (Okbankabeer and Center Pick Island) in this survey.

Conserving *A.bicinctus*(Figure 3)should be highly considered in Yemen forthreemain reasons. The first reason, this species could be considered as a rare species in Yemen because their abundance was very low even if it was found in specific deep seawaters close to military areaswhere its collection is not allowed,the second reason is, the worldwidedistributionof *A. bicinctus*is restricted to the Red Sea, Gulf of Aden and British Indian Ocean Territory (Chagos Archipelago) only [22],and the third reason is that this species has poorsurvivorship in captivity [25].

Fish trade

The data regardingthe tradein the marine ornamental fishes, including operating companies and their quantities, were not available for public or reported in a governmental document in Yemen. The Yemeni

Fish Statistics Books (YFSB) has not shown any records aboutthe ornamental marine fishes targeted for trade or their annualquantities collected for exports.as well as the list of thecompanies involved in this trade. Some data were available from the MFW,Hodeida Office ,where information can be found about the trade in the marine ornamental fishes in the Yemeni Red Sea coast. However, these data were not adequate or useful to show more information about this trade, including the scientific name of each target species and its quantity collected from different places.

Generally, the MFWissued an official license toacommercial company to catch 10,000 marine ornamental fishesfor aquarium markets per year in the Yemeni seawaters (MFW-Hodeida Office), but the exported annualquantities of their fish families were different from each other (Table 2). There werethree private companies involvedin the trade of the marine ornamental fishes in the Yemeni red sea coast. They collected these fishes alive from this coast to be then kept in a captive facility before exporting them abroad for aquarium markets. The annual quantity of all marine ornamental fishes exported by each company did not exceed 10, 000 individuals in 2004 or in 2005. The annual quantities of butterflyfishes and surgeonfishes were much more than the other family fishes in 2004 or in 2005. The average quantity of all marine ornamental fishes exported abroad for ten years (1995-2005) was about 100,000 fishes per company (MFW- Hodeida Office). These fishes were exported to East Asia, Saudi Arabia, Jordan and theUSA.

Table 2: Quantities of marine ornamental fishes exported by one company for 2004 and 2005 in Yemen.

Year	Butterflyfishes	Angelfishes	Surgeonfishes	Others	Total
2004	3158	1501	3201	1342	9202
2005	3345	1369	2171	1751	8438

Source: MFW-Hodeida Office.

The trade in the ornamental fishes in Yemen was processed without a proper management, including licenses, methods and places used for catching these animals. There were noregulations or a management plan for controlling the trade process of these fishes in this country. The MFW has issued official licenses for catching marine ornamental fishes alive without determining the methods and areas used for collecting them. A long metal rod is usually used to coax such fishes towards the net. This method could cause damage to corals. The collection process of the ornamental fishes was widely undertaken in many areas in the Yemeni Red Sea, including Kotama, Talaween Island, Tekfash Island, south of Al-Arj, As Salif, AzZubear and Zoqor Islands (MFW Hodeida office). Other areas include many sites in this study, such as Kamran Island and Kadaman Island, where some marine ornamental fish species were not observed. In addition, no assessment was undertaken to investigate the stock of the ornamental fishes in the Yemeni Red Sea coast. The MFW also determined the maximum annual quantity for collecting these fishes without studies. The number of rare, endemic or important marine ornamental fishes was not limited within this quantity. This could affect the sustainability stock of the marine ornamental fishes in Yemen. There is a need for management roles to arrange and determine the places or tools allowed to be used for collecting these animals [e.g.10] to mitigate or avoid the decline in the biodiversity of such fishes.

Marine ecosystems face multiple potential threats in some source countries trading in live marine ornamental fishes for fish aquarium markets [12,16,17,31,32]. These threats include incidences of reduced biodiversity from overexploitation of these species and destruction of coral reef habitats [16,31]. Yemen is one of the source countries trading in the ornamental fishes and exporting them abroad. Therefore, it is unsurprisingly for these fishes, including rare and endemic species, to be heavily targeted alive for international aquarium markets as long as there are no restrictions or effective management systems applied to control their collection in this country. Destructive fishing for collecting the ornamental fishes was previously reported in some sites of the Yemeni Red Sea [2,4,14]. The continuation of the trade in the marine ornamental fishes with absence of a species-specific quota system, caught and effective legislations, could pose the same potential threats to the stock sustainability and the

coral reef ecosystem in the Yemeni Red Sea. A certification program initiated by the Marine Aquarium Council (MAC) can be used as a framework for promoting this stock and this marine ecosystem [11].

Conclusion

This study implies that trade in the wild-caught marine ornamental fishes could cause reduction in the abundance of targeted species and effects to their habitats (coral reefs) in the Yemeni Red Sea coast. This trade has been processed without proper management systems in Yemen. The lack of a controlling system for collecting these species may contribute to the low abundance found in this study. Using of unsustainable practices is highly expected to be applied for collecting the ornamental fishes in the Yemeni Red Sea coast because of the lack of this system. This may affect the coral reef ecosystems in this coast. The current initial assessment and inadequate data cannot show how trade in the ornamental fishes could affect these ecosystems. However, targeting these fishes is likely to have significant impacts on coral reef ecosystems and stocks of these species if such trade continues without effective management. It is important to carry out comprehensive surveys and studies to understand these effects. More importantly, there is a need to develop a sustainable management plan for the trade in the marine ornamental fishes in Yemen.

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أسماك الزينة في البحر الاحمر، الوضعية و التجارة- اليمن

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**الهيئة الإقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن (برسجا)

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الملخص

تشهد تجارة أسماك الزينة البحرية نموًا متسارعًا، حيث يزداد الطلب على هذه النوعية من الأسماك في الأسواق العالمية. تم جمع المعلومات المتعلقة بهذه الورقة من خلال المشاركة في المسح الميداني الذي نفذ خلال الفترة من مايو إلى يونيو 2006م في البحر الأحمر اليمني. تهدف هذه الورقة البحثية إلى تقديم نتائج تقييم حالة أسماك الزينة ووضعيتها التجارية في البحر الأحمر اليمني.

وقد وجدت أن أنواع معينة من أسماك الزينة كانت مستهدفة للتجارة بطرق غير مستدامة. هذه التجارة يمكن أن تؤثر بشكل كبير على التنوع البيولوجي للأسماك إذا استمرت دون إدارة مناسبة.

الكلمات المفتاحية: أسماك الزينة، التجارة، البحر الاحمر اليمني، جزر بحرية، شعاب مرجانية.