CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Thirty-first meeting of the Animals Committee
Geneva (Switzerland), 13-17 July 2020

Species specific matters

PRECIOUS CORALS (ORDER ANTIPATHARIA AND FAMILY CORALLIIDAE)

1. This document has been prepared by the Secretariat.

2. At its 18th meeting (CoP18, Geneva, 2019), the Conference of the Parties renewed Decisions 17.192 and 17.193 on *Precious corals (Order Antipatharia and family Coralliidae)* as follows*:*

17.192 (Rev. CoP18) Directed to the Animals Committee

The Animals Committee is requested to:

a) analyse the outcomes of the precious coral survey and the FAO study and prepare recommendations, as appropriate, on actions needed to enhance the conservation and sustainable harvest and use of all precious corals in international trade; and

b) report these recommendations to the Standing Committee at its 73rd meeting.

17.193 (Rev. CoP18) Directed to the Standing Committee

The Standing Committee is requested to consider the information and recommendations of the Animals Committee, made in accordance with Decision 17.192 (Rev. CoP18), and make its own recommendations, as appropriate, for communication to the Parties or for consideration at the 19th meeting of the Conference of the Parties.

3. As reported in document AC30 Doc. 19, the Secretariat notes that the precious coral survey was originally linked to Decision 17.190, which requested the Secretariat to issue a Notification to the Parties to invite precious coral range States and relevant regional fisheries management organizations to complete a survey on their precious coral resources. The Secretariat previously reported on its implementation of Decision 17.190 to the Animals Committee in document AC29 Doc. 22, which contained the responses to the survey in its Annex. The study *Global Report on the Biology, Fishery and Trade of Precious Corals* conducted by the Food and Agriculture Organization of the United Nations (FAO) pursuant to Decision 17.191 considered the responses to the survey.

4. A draft of the study by FAO was made available shortly before the 30th meeting of the Animals Committee (AC30, Geneva, July 2018), and the Committee adopted, on that basis, a set of preliminary recommendations contained in document AC30 Com.4 (Rev.1) (Rev. by Sec.).

5. The final study by FAO could only be made available at CoP18 through information document CoP18 Inf. 68, which did not give the Animals Committee an opportunity to fulfil its mandate under Decision 17.192. Following discussions on this matter, it was decided to renew and extend the mandates given to the Animals and Standing Committees in Decisions 17.192 and 17.193, respectively.

6. The study was only available in English at CoP18, so to assist the Animals Committee in its review, the sections “Summary” and “Suggestions for improving management conservation and trade” have been translated into French and Spanish. These sections are presented in the Annex to this document.

7. In its workplan for 2019-2022, the Animals Committee identified a lead or co-leads for each of the instructions directed to it in Resolution and Decisions (see document AC31. Doc. 7.2). The alternate representative for Europe (Mr. R. Novitsky) is leading on the implementation of Decision 17.192 (Rev. CoP18).

8. The Secretariat proposes that the Animals Committee establish an intersessional working group on precious corals in support of the implementation of Decision 17.192 (Rev. CoP18). Draft terms of reference for such a working group are presented in paragraph 9.

Recommendations

9. The Animals Committee is invited to establish an intersessional working group on precious corals (Order Antipatharia and family Coralliidae) to:

    a) review the study by FAO, focusing on the following aspects:

        i) verifying if the preliminary recommendations of the Animals Committee, adopted at AC30, are still valid, and updating them as appropriate;

        ii) making regional or national-level recommendations to enhance the conservation and sustainable harvest and use of all precious corals in international trade, where appropriate; and

        iii) considering the possibility of additional CITES listings of precious corals in the family Coralliidae; and

    b) report on the outcomes of its work at the 32nd meeting of the Animals Committee.

Global Report on the Biology, Fishery and Trade of Precious Corals

SUMMARY

Precious corals in the study

This study covers precious corals of the order Antipatharia, otherwise known as black corals, and the family Coralliidae, otherwise known as red, pink and white corals.

The order Antipatharia includes about 265 currently accepted species (in 44 genera and seven families), commonly known as black corals. At least 13 species in 11 genera are used in jewellery; however, except for those produced in Hawaii, the names of most species are unknown.

The family Coralliidae comprises 43 valid species. Apart from *Corallium rubrum*, another nine species are known to be harvested. This includes three species from the Hawaiian Archipelago that have not been collected commercially since 2001, although they have been fished in the past. In addition, several undescribed species are still reported to exist within the Coralliidae. In particular, recent molecular data confirm the possible occurrence of cryptic species and species-complexes even among recognized cosmopolitan species. For instance, according to a recent genetic study the boundaries between three commercial species (*Pleurocorallium carusrubrum,*[1] *Pleurocorallium elatius* and *Pleurocorallium konojoi*) were deemed to be ambiguous, and these species were placed together and indicated as the '*P. elatius* species-complex'.

Distribution of precious corals

Black corals have a wide geographic distribution that ranges from tropical to polar regions. However, most of the currently described species are found in tropical and subtropical waters. Black corals are found across a wide depth gradient (from 2 to 8 900 m of depth). Despite this wide bathymetric range, over 75 percent of described antipatharian species are restricted to depths below 50 m.

Species in the family Coralliidae inhabit tropical, subtropical and temperate oceans. Hotspots of coralliid species are located in the west and central Pacific, including the surrounding seas of New Caledonia, Taiwan Province of China, Japan and the Hawaiian Archipelago. Species diversity appears lower in the Atlantic, Indian and eastern Pacific oceans. Nevertheless, historically only two areas had large populations and are commercially exploited: the Mediterranean Sea and the adjacent Atlantic, together with the northern Pacific Ocean.

In the Mediterranean the only species is *C. rubrum*, dwelling at depths ranging from 5 to over 1 000 m. However, it is more common in the 30–200 m depth range. *C. rubrum* inhabits subtidal rocky substrates and is one of the most important components of Mediterranean "coralligenous" animal-dominated assemblages. Within the Pacific context, commercially valuable species of the family Coralliidae are distributed within two depth zones: 50–400 m and 1 000–1 500 m in the waters around the Hawaiian Archipelago and Emperor Seamounts, Japan, the Philippines and Taiwan Province of China.

Biology of precious corals: reproduction, growth, mortality and connectivity

With the exception of a few studies on shallow-water species (< 50 m), very little information is available on reproduction of antipatharians. In general, individual polyps are strictly gonochoric, and colonies are either female or male, with the exception of one species (*Stichopathes saccula*) which has mixed colonies with both male and female polyps. Fertilization and larval development most likely occur externally in the water column. Very little is known about the larval biology and reproductive seasonality of antipatharians. To date, larvae have only been observed for members of a single shallow-water species from New Zealand (*Antipathella fiordensis*) in laboratory cultures.

Only few studies have examined the reproductive seasonality of black corals, and all of these have been conducted in shallow waters (< 70 m). All of these studies report the seasonal appearance and disappearance

[1] *Recently discovered P. carusrubrum has been reported to be circulating on the market as pink coral (Jeng, 2015). Therefore P. elatius commercialized in Taiwan Province of China may contain P. carusrubrum (see following sections and Annex 2).*

of gametes, which has been correlated to seasonal temperature fluctuations in some cases, with peak maturities occurring when temperatures are warmest. It is currently not known whether the reproductive cycle of deepwater black corals is seasonal and this aspect should be examined by future studies.

Various methodologies have been used to estimate the growth rates and longevities of several species of black coral occurring over a wide depth range. These studies indicate that growth rates vary greatly across different species and environments, with the fastest growth observed in shallow water species, and slowest growth in deepwater species. The fastest growing antipatharians are shallow-water, tropical wire corals, with vertical growth rates ranging between 3 and 7 cm/year for *Stichopathes* spp. from Puerto Rico, up to 159 cm/year for *Stichopathes* cf. *maldivensis* from Indonesia. At the other end of the spectrum, the slowest growing antipatharians belong to the genus *Leiopathes*, with radial growth rates ranging from 0.005 to 0.022 mm/year.

For red corals, *C. rubrum* is the most studied; it is a gonochoric species that undergoes internal fertilization and broods larvae internally (planulator). Gonadal development follows an annual cycle with a synchronized release in summer. Larvae remain in the water column for a period ranging from a few hours to days, before settling from the plankton near parent colonies. The actual age of first reproduction has been estimated to be 6 years for males and 10 years for females. Very little is known about the basic life history of most species of Pacific Coralliidae species, however those that have been studied appear to be gonochoric broadcast spawners, unlike the brooding *C. rubrum*. Data concerning the age at which corals attain sexual maturity and the relationship between the size of a colony and its level of maturity are currently lacking for most species in the family. Estimates for the age at maturity for the three investigated Pacific species range from 10 to 80 years.

Longevity studies are also not well represented in the literature, although *C. rubrum* is a slow-growing (0.21–0.35 mm/year in basal diameter in shallow populations), long-life species. Even slower growth rates are recorded in deeper populations. Known growth rates for Pacific Coralliidae are similar. The natural mortality of *C. rubrum* occurs due to competition over space with the sessile biota. Phenomena of mass mortality events have been observed in shallow-water populations since the late 1990s, linked to elevated temperature anomalies; in some cases these have also been associated with fungal and protozoan diseases.

A few genetic studies on black corals indicate significant genetic variation between sites, suggesting that larval dispersal is restricted even at distances of 10–15 km. The dispersal of black coral larvae is highly philopatric and most larvae appear to settle very close to parent colonies. However, even within the same species there appear to be mixed strategies, with most larvae settling close to their parents, and few larvae dispersing over long geographic distances.

In the case of *C. rubrum,* several studies have confirmed the occurrence of genetic differentiation at spatial scales of tens of metres and across depth. The strong genetic differentiation between nearby samples implies that the recovery of overexploited populations should mainly be the result of self-recruitment, and this has implications for the need for the localised management of red corals. Genetic population studies performed on two Pacific species to date (*Hemicorallium laauense* and *Pleurocorallium secundum*) confirm that recruitment was from local sources with only occasional long-distance dispersal events.

Precious coral fisheries

Because of their beauty, durability and high economic value, precious corals have been exploited since ancient times. The harvesting of black coral is known to occur/have occurred in several areas: in the Indo-Pacific (especially the Philippines), the Caribbean (notably Cayman Islands and the Dominican Republic), Latin America, the Red Sea, and very sporadically in the Mediterranean Sea. In addition to targeted commercial harvesting, black corals are also inadvertently caught in bottom trawls. Southeast Asia and the South Pacific islands continue to be an important source of black coral for international markets – however, very limited information is available on the fishery or the amount harvested. The only black coral fishery in the United States of America, fished by a limited number of divers that collect black corals in shallow waters of the Hawaiian Islands, has been profitable and continuous since its inception in 1958. Three black coral species have been harvested commercially in the Hawaiian Islands (*Antipathes grandis, Antipathes griggi,* and to a lesser extent *Myriopathes* cf. *ulex*). In Mexico, black coral is an important resource for jewellery and handicrafts, providing economic support for authorized fishermen, craftsmen and merchants. Black coral harvests are reported to occur without any control or any management in other regions and countries (e.g. Madagascar), where illegal trade is expanding.

The fishery for Coralliidae, harvests about ten species of red, pink and white coral. Currently, the harvest of *H. laauense* or probably *H. regale,* and *P. secundum* from Hawaii has been on hiatus since 2001, while the collection of corals around the Emperor seamounts (*P. secundum* and *C.* sp. nov.) was suspended at an earlier date. The remaining six species are harvested in the Mediterranean and Atlantic Ocean (*C. rubrum*), and in

remaining areas of the Pacific Ocean (*P. konojoi, P. elatius, P. carusrubrum,* [2] *Hemicorallium sulcatum,* and *Corallium japonicum*).

Countries primarily involved in harvesting Coralliidae are in the Pacific region: Japan, Taiwan Province of China, and the United States of America. The methods of harvesting currently used are coral nets (Japan and Taiwan Province of China) and remotely operated vehicles (ROVs) or submersibles (Japan and the United States of America). Experiments carried out to investigate the impact of these dragging nets on the sea floor underlined their negative impact on coral populations and their habitats. The fishery in the Mediterranean involves vessels from five Mediterranean countries, where it is regulated by national law (Croatia, France, Italy, Spain and Tunisia) while it is temporally closed in the Mediterranean waters of three countries (Algeria, Greece and Morocco). Today in the Mediterranean region, SCUBA (Self-Contained Underwater Breathing Apparatus) divers use manual picks as the only legal method for harvesting red coral, with dredging banned throughout the Mediterranean Sea since the mid-1980s. As robotic equipment has become more technically advanced and accessible this method offers very targeted harvesting; however, due to sound reservations as to its sustainability, the use of this extraction method is not permitted for harvesting Mediterranean red coral in the General Fisheries Commission for the Mediterranean (GFCM) competence area, unless for scientific purposes within permitted scientific projects.

Use and trade

The skeleton, or fragments of the skeleton of larger black coral species has been used for jewellery and religious articles from at least the time of the ancient Greeks. Black corals have long been used for a variety of purposes ranging from jewellery to their presumed ability to fend off evil and health-related ailments. With regard to the order Antipatharia, according to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) trade statistics black coral is frequently traded as *Antipatharia* spp. This is because in most cases the identification of genus or species is possible only if an entire colony is available, and even when this is the case, taxonomic understanding at the species level is difficult and requires microscopic examination. Therefore, processed black coral products often cannot be identified beyond the order. CITES guidance (2017) suggests that trade in raw black coral should be reported at the species level.

Species of red, pink and white corals, Coralliidae are traded as whole, dried colonies, unworked branches and branch fragments, as well as beads and manufactured jewellery. A few species within the family Coralliidae are/were most likely encountered in international trade: four non-CITES species (*C. rubrum, H. regale (H. laauense*)*, Corallium* sp. nov. and *H. sulcatum*) and four CITES-listed Appendix III species (*P. elatius, P. secundum, P. konojoi,* and *C. japonicum*). Records of products in trade for the four CITES species is available since their listing in Appendix III of CITES (2008), while data on trades of the three non-CITES species is more difficult to obtain. In the CITES trade database, most of the records in recent years (2008–2016) refer to *P. elatius*, then in decreasing order to *P. secundum*, *P. konojoi*, and *C. japonicum*. It is worth highlighting that a new species, recently discovered by Tu *et al.* (2012) has been reported to be circulating on the market as pink coral. Therefore *P. elatius* commercialized in Taiwan Province of China may contain *P. carusrubrum*. In the Mediterranean and Atlantic, C. *rubrum* has been a precious commodity since prehistoric times. Nowadays, the skeletons of precious corals still provide the raw materials used in jewellery, sculptures, figurines, amulets, clothing, ornamentation, and for a variety of art objects. In general, raw and whole dried specimens of Coralliidae can be identified to the species level using an electron microscope. Where worked specimens are concerned, it may only be possible to identify them to the family Coralliidae level.

Apart from the data on the CITES database, other sources of trade data for Coralliidae harvested species are not available in the public domain. In Japan, for instance, data on trade at the species level are not available. The Japanese trade statistics aggregate all coral species together, and it is difficult to distinguish processed and manufactured items because they are reported under the same code with semi-precious corals, bone, tortoise-shell, horn, antlers, mother-of-pearl and other animal carving materials. On a spatial basis, similar difficulties exist. Official and comprehensive data on the trade of *C. rubrum* are not available for any Mediterranean country.

In general, for most precious corals, data on trade are not species-specific (worked products often cannot be identified beyond the order or the family), and sales can amalgamate reef-building and precious corals in the amounts reported. Unlike fresh fish, precious corals can be preserved after they are landed, which means sellers can hold on to corals when market prices are low; this means there are often differences in the timing of when corals are landed and when they are traded, and the amounts held by traders or in trade can include both live and fossilized or dead corals, thus complicating the identification of precious corals coming from living resources in trade further.

[2] *See Footnote 1.*

Population status of precious corals

Population densities are highly variable among antipatharian corals, but at least some black coral species can reach particularly high densities, to the point of becoming ecologically dominant. Such aggregations are considered as marine forests that are composed of animals rather than plants, enhancing the complexity of benthic habitats.

Black coral communities, both in shallow and deep waters, are under increasing threat from a range of direct and indirect anthropogenic impacts. In particular, black corals are considered vulnerable because they display life-history characteristics often associated with a susceptibility to local extirpation (e.g. longevity and slow growth) but also because of the threats to their survival associated with fishing, pollution (including nutrient pollution), climate change and ocean acidification. The few studies that exist for the most important commercial black coral species, which investigate shifts in the status of black corals impacted by fisheries, reveal a shift to a younger age frequency in fished populations. In a recent assessment of the conservation status of Mediterranean anthozoa, five species of Antipatharia were included in the Mediterranean International Union for Conservation of Nature (IUCN) Red List as Data Deficient, Near Threatened or even Endangered. On the contrary, black corals have still not been classified as endangered on the Red Lists of Taiwan Province of China, the Republic of Korea, the Philippines, India and Sri Lanka.

Similarly, the harvesting of red corals is just one of the pressures in a range of anthropogenic disturbances that threaten *C. rubrum* populations, including water temperature anomalies, pollution, tourism, recreational diving, incidental take and habitat degradation. The population structure of *C. rubrum* differs significantly between shallow and deepwater locations. Possibly owing to intense harvesting, shallow-water populations (< 50 m) are now also dominated by small colonies at a high density. In deepwater locations, the percentage of large colonies is greater and the densities lower, but it varies between studies and locations.

Reliable data on the fishing of precious corals is incomplete, and it is difficult to identify historical and current coral capture production, as in most areas the data collected by national authorities were not systematically recorded, while in some areas they were not disclosed. In some cases such as the Mediterranean, a systematic collection of capture production data has begun only recently, after the implementation of new management systems. Historical FAO statistics of precious coral capture production has related shortcomings. In addition, mixed live and dead coral weights are often recorded in landings, thus complicating the identification of the total impact of harvesting on living resources.

The incomplete datasets on the fishing of *C. rubrum* are a case in point. The shortcomings of the historical data available in the FAO database have been recognized by GFCM (Annex 1). This is exacerbated by the understanding that recovery from past depletion can require extended protection periods. For instance, after 20–30 years of protection within French and Spanish marine protected areas (MPAs), red coral colony sizes had not returned to values close to those of pristine populations, suggesting that the full recovery of precious coral beds requires decades of effective protection. This knowledge has further encouraged efforts to collect more systematic recordings of official data from national sources. Trend analysis of recent GFCM data per country (both yield/year and yield/dive) indicate that total landings of red coral have been decreasing in some countries, while remaining stable in all others. However, information on the species is generally not sufficient to provide an overall assessment on the status of red coral populations. An improvement of the quality of data is expected as a result of the entry into force of Recommendation GFCM/41/2017/5, with the establishment of a Regional Management Plan for red coral.

Less information is available on Coralliidae from the Pacific area. In Japan the size differences between non-harvested and harvested populations suggest that harvested populations reach harvestable size after 10–20 years. No data on abundance, density or size structure are available for Coralliidae in the waters of Taiwan Province of China.

Considering local depletions of red corals observed, and an estimated decline in shallow populations, *C. rubrum* has been listed as ‘Endangered’ by IUCN specialists in the recent assessment of Mediterranean anthozoa. However, doubts have been raised concerning the data used for this assessment, especially the reference to the decline in yields in recent years, because precise figures are not available on this aspect and the FAO data (which they possibly relied on) have recognized shortcomings. For Pacific Coralliidae, the Japanese Ministry of the Environment included red, pink and white corals on their Red List of Threatened Species under the classification “Near Threatened” in 2017. While the risk of extinction of these species is not considered significant at present, this classification was made on the basis of increased pressure on fisheries as a result of dwindling fishing resources, greater numbers of permitted fishing vessels, and poaching by foreign boats.

Management of precious corals

Information on the management of black coral species worldwide is not well documented or easily accessed, with the most detailed management found in the Hawaiian Islands, United States of America. This fishery occurs in waters that fall within the jurisdiction of both the State of Hawaii, as well as American federal waters. The fishery is therefore managed through both state and federal regulations, which are set by the Hawaii Department of Land and Natural Resources, and National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) in consultation with the Western Pacific Regional Fishery Management Council (WPFMC). Fishing regulations include both minimum colony size limits, as well as biannual quotas. Additionally, even though the fishery targets at least three species, it has historically been managed as a single stock, in large part owing to difficulties in differentiating the targeted species *in situ*. Information listing the progression of implementation of management controls for black coral fisheries are also available from Madagascar.

Coralliidae fishing is regulated in several Mediterranean countries, in the United States of America, Japan and Taiwan Province of China. Japan and Taiwan Province of China have management measures in place, and regulations have been getting stronger in recent years. The 2009 "Regulations Governing Fishing Vessels that Also Engage in Coral Harvesting" established in Taiwan Province of China have tightened controls and restricted the number of vessels fishing, fishing zones, catch quotas and designated landing ports, and have implemented the requirements of the use of vessel monitoring systems (VMS). These regulations require fishers to keep a logbook of fishing operations and to have an observer on board the boat, as well as to centralize auction markets. Fishing in Japan has also been curtailed recently.

WPFMC's Precious Corals Fisheries Management Plan (FMP) has regulated the harvest of *P. secundum* since 1983 within the 3–200 miles exclusive economic zone (EEZ) of the United States of America. The FMP imposes permit requirements valid for specific locations, harvest quotas for precious coral beds (only live corals are included in the quota), a minimum size for pink coral, gear restrictions, area restrictions and fishing seasons. The harvesting of precious corals using non-selective gear is banned. The plan also recognizes differing categories of coral beds: established beds, conditional beds, exploratory areas and refugia.[3] Yield estimates (maximum sustainable yield, MSY) were estimated for *P. secundum* for a single bank for which biological data were available. Data on Coralliidae coral beds show stability of fished stocks.

Management of *C. rubrum* fisheries includes a variety of national measures within territorial waters (See Annex 1). Limits on licenses, temporal closures, minimum legal size for landings, allowed depth and areas are commonly imposed. With regards to monitoring, control and surveillance (MCS), apart from the logbook, other MCS measures are not fully in place in many countries. Regional management cooperation is a reality for the Mediterranean stocks of precious corals. In 2017 red coral became part of the GFCM 'midterm strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries,' and the adoption in 2017 of Recommendation GFCM/41/2017/5 (on the establishment of a regional adaptive management plan for the exploitation of red coral in the Mediterranean Sea), which formally entered into force on 1 April 2018.

Protection of precious corals

All international trade in black coral species are regulated on a global scale by CITES, an intergovernmental treaty that controls the international trade of animals and plants under its Appendices. Since 1981, all species of black coral belonging to the order Antipatharia have been listed in CITES Appendix II, which contains species that are vulnerable to becoming overexploited but that are not necessarily yet at risk of extinction. Additionally, in the Mediterranean Sea five antipatharian species are protected by international conventions – in Annex II of the SPA/BD Protocol (Protocol concerning the Specially Protected Areas and Biological Diversity in the Mediterranean) of the Barcelona Convention (list of endangered or threatened species), and Appendix III of the Bern Convention (list of the protected fauna species). Protection is also granted by national laws in several countries. In India and Indonesia measures for the protection and conservation of antipatharians have recently been introduced, while countrywide laws operate in Madagascar.

The Mediterranean red coral, *C. rubrum* is included in several international legal instruments aimed at the conservation and protection of species and their habitats: Annex III of the SPA/BD Protocol of the Barcelona Convention – i.e. the list of species whose exploitation is regulated; Appendix III of the Bern Convention (list of protected fauna species); Annex V of the European Union Habitats Directive (List of the "Animal and plant species

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[3] *Established beds are ones for which appraisals of MSY are reasonably precise. Conditional beds are ones for which estimates of MSY have been calculated by comparing the size of the beds to that of Makapuu Bed and then multiplying the ratio by the yield from the Makapuu Bed. Refugia beds are areas set aside for baseline studies and possible reproductive reserves. Exploratory areas are the unexplored portions of the EEZ.*

of Community interest whose taking in the wild and exploitation may be subject to management measures"). Protection for *C. rubrum* is also granted by national laws in several countries in the Mediterranean region, establishing spatial controls (MPAs) for the protection of the species in some areas or even totally forbidding harvesting. In the Pacific region, China has classified precious corals as a Class 1 Protected Species under the Wildlife Protection Law, so fishing is prohibited, while in the Philippines, according to Section 91 of The Philippine Fisheries Code of 1998 (Republic Act No. 8550), the collection, possession, sale and exportation of precious corals are all prohibited, except for research purposes.

Recommendations for the management and conservation of the fishery and trade of precious corals

The information collated on precious corals in this study highlighted a number of opportunities for enhancing management and conservation of these vulnerable natural resources. Below are five summaries for topics for further consideration to improve the status of these natural renewable resources.

1) An improved understanding of taxonomy and life history is needed

Considering the lack of knowledge on many (most of) precious coral species of commercial importance, priority should be given to enabling their correct identification through systematic studies, and biological investigations conducted on the life history of commercially exploited species, in order to gather useful information for the proper identification and management of harvested species. In the Mediterranean context, the need to carry out scientific research studies on red coral has been raised on several occasions, with a particular focus on the need for data on the biomass, recruitment, and mortality rate of commonly fished species – necessary to construct a population dynamics models to estimate projected resource allocations. Today data are limited by a paucity of landings information, while the growth rate and recovery studies have mainly been conducted on a few 'shallow' water populations. A Mediterranean research programme on red coral which is part of the GFCM regional management plan for red coral (Recommendation GFCM/41/2017/5) has been launched with a programme of work currently being formulated by scientific institutions that are part of the GFCM Scientific Advisory Committee on Fisheries (SAC).[4] The programme prioritizes the collection of useful data for the provision of advice to support management. The combination of fishery-dependent (e.g. analysis of catch) and fishery-independent sources of information (e.g. surveys on a multi-annual basis) will ensure a regular monitoring of the resource.

Information on scientific research studies on precious coral resources in the Pacific are not well represented in literature. In particular, the data on the Asian species – including biomass, recruitment, and mortality rate – necessary to construct a population dynamics model to estimate future resources and landings is almost non-existent, with only growth rates defined. Therefore, such studies should be prioritized in the future.

2) Fishery-dependent data are urgently needed, and fishing methods must be improved

Apart from some countries, data on fishing effort and the amounts of precious corals harvested are either generally inaccurate, amalgamated across a range of species or life-form groupings, or lacking entirely. The priority should be data collection on fisheries worldwide, with detailed information per species/area. GFCM started to collect such data in 2013, moving from a dataset of sporadic submissions of information that included trade data (raw corals and commodities together) to data on coral capture. In some cases, compulsory data, such as the overall quantities of red coral caught per year, or the percentage of undersized colonies has not yet been made available to GFCM. In some Asian countries data are collected, but are also not disclosed or available for general assessment. When such data are not made public, they should be made available to government experts for formal stock assessments. In addition, further studies are required on the use of damaging fishing methods, such as coral nets, that are known to indiscriminately impact precious coral habitats. More selective and less impactful fishing gears and practices need to be identified and promoted as alternatives to dragging gears.

3) Improvement of science-based management planning needed in many harvesting countries

Apart from a few sporadic cases, comprehensive management plans (including stock assessments) do not exist for the management and conservation of precious coral species. The priority should be given to the development, implementation and enforcement of national management plans for precious coral species in countries where these are exploited, with a greater focus on research and controls of commercially exploited species. The full implementation of the GFCM measures by member states including the newly established

[4] *Details are available in Appendix 10 of the Report of the twentieth session of the GFCM Scientific Advisory Committee on Fisheries, Tangiers, Morocco, 26–29 June 2018.*

management plan (Recommendation GFCM/41/2017/5) is expected to be sufficient to counteract or prevent overfishing, with a view to ensuring long-term yields while maintaining the size of *C. rubrum* populations at biologically sustainable levels. Alongside this, actions to eliminate illegal, unreported and unregulated (IUU) fishing of red coral should also be foreseen. In the Mediterranean, countries actively harvesting red coral should consider the full range of fishery management, including spatial management, to introduce fishing regimes on the basis of the scientific advice available since the end of 2018.

Pacific Coralliidae corals are distributed across different countries and international waters (the United States of America, Japan, Taiwan Province of China and southern China). International cooperation is essential for the conservation and management of precious coral resources, which extends management beyond the boundaries of each nation's territorial waters or EEZ. In order to properly manage precious coral resources, and to eliminate IUU fishing, the establishment of a regional fishery management organization (RFMO) composed of representatives from the different countries is highly recommended. Similar to what has been done in the Mediterranean region, the development, implementation and enforcement of a Pacific management plan for Coralliidae is one option to consider.

4) Improvement of trade statistics is required

Trade data for black corals are available since their inclusion in Appendix II of CITES. However, in many cases the records refer to the genus or even the order, because of the above-mentioned difficulties in the identification of specimens (both raw colonies and finished products). Regardless of whether a species is listed on CITES, data on trade should be obtained and strictly monitored by all the harvesting countries within the framework that is connected to fishery management plans. Traceability mechanisms should be envisaged: from the time the coral is landed and sold as raw material to the manufactures until it reaches the retailer. These mechanisms would allow certification that the precious coral was collected in compliance with regional or national regulations (which would be effective in helping to curtail IUU fishing).

In the Pacific, given the difficulty of distinguishing among different types of corals in imports/exports (precious corals, semi-precious corals, stony corals or even shells) a convenient method of data collection needs to be devised in order to desegregate products from different species, and allow the compilation of trade statistics that can be compared against fishery activity and stock status.

5) Consideration of the likely effectiveness of the conservation of precious corals if they are placed under the provisions of multilateral environmental agreements (MEAs) and national control processes

At present CITES includes black corals (Antipatharia) in CITES Appendix II, without distinguishing between species, given their ecological importance and the range of threats they face.~~).~~

Furthermore, CITES already includes *P. elatius, P. secundum, P. konojoi,* and *C. japonicum* specifically for China in Appendix III. With regard to *C. rubrum*, strict protection was in place in Germany for a limited time (January 1987–June 1997) through the listing of the species in Annex 1 of Germany's Federal Ordinance on Species Conservation.

As early as 1987 at CITES Sixth Conference of Parties (CoP6, Ottawa 1987), a proposal for listing *C. rubrum* in the CITES Appendices was first presented and was rejected by CITES Parties. In 2007 (CITES CoP14), species in the genus Corallium were proposed for inclusion in CITES Appendices (Appendix II) and in 2010 (CITES CoP15) the proposal was extended to all the species of the family Coralliidae. In both these cases the proposals were made under CITES Criteria Annex 2aB (CITES Conf. 9.24 (Rev. CoP17)) that states:

> It is known, or can be inferred or projected, that regulation of trade in the species is required to ensure that the harvest of specimens from the wild is not reducing the wild population to a level at which its survival might be threatened by continued harvesting or other influences.

On both of these later occasions the proposals were assessed by the FAO Expert Advisory Panel[5] with an outcome that differed from that of the CITES Secretariat. In both cases CITES Parties rejected the listing proposals when they came to be voted on at the CITES CoP. The advice from the FAO Expert Advisory Panel concluded that the available evidence did not support the proposal to include all species in the family Coralliidae (*Corallium* spp. and *Paracorallium* spp.) in CITES Appendix II. The FAO Expert Panel considered the available data to be not very reliable, but useful to observe the extreme "boom-and-bust" cycles characteristic of this fishery: for example, where new beds were discovered these yielded large returns when

[5] http://www.fao.org/fishery/cites-fisheries/ExpertAdvisoryPanel/en

first fished, but quickly depleted. The Expert Panel noted declines in catches of precious corals, maximum size of colonies, mean height and proportion of older colonies per stock, and recognized clear over-exploitation of shallow-water beds which had led to a shift in harvesting to deeper water coral beds. The Expert Panel also considered the difficulty in identifying products in trade, the substantial administrative burden of issuing CITES trade documents and recording the large number of individual pieces of precious coral in trade, as key issues affecting the potential effective implementation of CITES regulations. This advice was supported by experience in Germany, which had significant (irresolvable) identification problems at the species level for the enforcement of their Annex 1 Federal Ordinance on Species Conservation.

Today in addition to black corals being listed on CITES Appendix II, four species of Coralliidae (*P. elatius, P. secundum, P. konojoi,* and *C. japonicum*) are listed under Appendix III by China (as of July 2008[6]). Recent reports have suggested that demand for *Corallium* corals has increased in mainland China in recent years, leading to higher prices for unworked corals. However, available trade data does not reflect this. According to CITES trade data, mainland China has reported fewer imports of *Corallium* corals. According to exporting countries, the total amount of unworked coral exports to mainland China did not show any increase between 2008 and 2016. In assessments of trade, the mixing of products (across species, differentiating *Corallium* corals from non-*Corallium* corals) is further acknowledged to have hampered understanding and compliance of trade controls. Finally, consideration of how counterproductive a CITES listing could be is needed, as it may be perceived as evidence of rarity and may therefore stimulate the desire to purchase – thus boosting demand and increasing fishing pressure on resources, potentially jeopardizing the good fishery management efforts which are in progress.

With regard to the possibility of amending the listing status of precious corals in CITES Appendices, this report offers readers access to data collated across regional studies and summaries of the current situation for their general consideration, both for species listed in the CITES Appendices and not. This information goes some way to inform the reader on whether the conservation of precious corals has been affected by their CITES listing and the likely outstanding local and international management needs to ensure the long-term sustainability of precious coral resources.

In general, the use of multiple tools for the management of precious coral resources must continue to be the reality, and the report stresses that any effective management intervention requires the relevant authorities to collaborate on any management framework adopted.

[6] *https://www.cites.org/eng/disc/how.php*

6. SUGGESTIONS FOR IMPROVING MANAGEMENT, CONSERVATION AND TRADE

6.1 BIOLOGY

6.1.1 Black corals

6.1.1.1 New studies on the biology and taxonomy of commercially valuable species, particularly in harvested areas

Considering the lack of knowledge on many (most) antipatharian species of commercial importance, priority should be given to taxonomic studies and biological investigations (i.e. mortality, both natural and fishery-related, growth rate, reproduction, recruitment, biomass, density, population structure, connectivity, genetics) to gather useful information for the proper identification of harvested species, with a special focus on understanding their biological features in relation to management.

6.1.2 White, pink and red corals

6.1.2.1 New studies on the biological features of **C. rubrum** *per harvested areas*

In the Mediterranean context, the need to carry out scientific research studies on red coral has emerged on several occasions (GFCM 2010, 2011, 2013, 2014a, 2014b, 2017b); only small areas of red coral populations (mainly in Italy, France and Spain) have been the subject of some studies in the last three decades. The data – such as biomass, recruitment and mortality rate – necessary to construct a population dynamics model to estimate future resources and landings is almost non-existent and growth rate was studied mainly in a few 'shallow' populations.

The urgency of launching a Mediterranean scientific project was widely recognized (GFCM, 2017b), aiming to fill several knowledge gaps on understanding the different traits of red coral life history, essential knowledge in support of any red coral management measure. Priority is given to the collection of useful data for the provision of advice in support of management, especially as regards adopted GFCM recommendations on red coral. The combination of fishery-dependent (e.g. analysis of catch) and fishery-independent sources of information (e.g. surveys on a multi-annual basis) will ensure a regular monitoring of the resource. Guidelines to facilitate the harmonization and standardization of data collection protocols are desirable outputs of the programme.

The implementation of a Mediterranean research programme on red coral, with the characteristics outlined above, is specifically mentioned in Recommendation GFCM/41/2017/5 on the establishment of a regional adaptive management plan for the exploitation of red coral in the Mediterranean Sea (see Paragraph 28). The GFCM Secretariat, with the support of the SAC, is called upon to provide terms of reference including costs, services and other requirements to support, through a call for tender, the implementation of a research programme on red coral in the Mediterranean Sea, which should be launched in 2018 or 2019.

The data collected through the Scientific Programme will allow an assessment of the adequacy of the management measures in place, and/or whether there is a need to modify them according to the best available scientific information.

6.1.2.2 New studies on the biological features of Pacific Coralliidae per species and harvested areas

Scientific research studies on precious coral resources in the Pacific are scant. In particular, the data on the Asian species – such as biomass, recruitment, and mortality rate – necessary to construct a population dynamics model to estimate future resources and landings is almost non-existent; only growth rate has been defined (Annex 2).

Particular attention should be devoted to ascertain the possible causes of the very high percentages of dead coral colonies collected in the waters of Taiwan Province of China and Japan, in particular to investigate and quantify the impacts of dragging gears on the coral populations and associated species.

6.2 FISHERY

6.2.1 Black corals

6.2.1.1 Data collection on black corals fisheries worldwide, per species/areas

Apart from in the United States of America (Hawaii), data on fishing effort and amounts of black corals harvested are lacking. Priority should be given to data collection on black coral fisheries worldwide, with detailed information per species/area.

6.2.2 White, pink and red corals

6.2.2.1 C. rubrum

6.2.2.1.1 Improvement of fishery-related data

Reliable data concerning *Corallium rubrum* harvesting are essential in order to understand the level of exploitation of the resource.

Considering that it has been recognized that the FAO global capture database for Mediterranean red coral present some shortcomings (see previous paragraphs and Annex 1 for details), the data available in the FAO database is understood as an estimate of the industrial annual production for that given year, and not the actual annual harvest of the resource.

In order to get beyond such limitations and to ensure the sustainable exploitation of red coral in the Mediterranean Sea, the GFCM started to put in place a series of measures in 2012, including the establishment of its own data collection protocol to obtain data on the annual landings of red coral from the national administrations of its member countries. The GFCM data collection (Annex 1) for red coral is coherent with the binding decisions adopted in recent years and it ensures that the minimum data required to assess the status of the fishery is collected. Nonetheless, the analysis of the data received from 2013 to 2016 highlighted that often the data related to catches: the size structure and the biology of the species are in general not sufficient to provide an overall assessment on the status of red coral populations. In some cases, important compulsory data, such as the overall quantities of red coral caught per year or the percentage of undersized colonies, has not yet been made available to GFCM.

It is essential for successful management that GFCM member states comply with the aforesaid decisions and submit precise production figures, including the percentage of undersized colonies. Future GFCM actions should address the issue of ensuring the proper reporting of obligatory data (Annex 1).

The management plan should be periodically revised by SAC, to assess its efficacy. Eventual changes should be made in accordance with up-to-date information received by CPCs, and the results of scientific studies.

6.2.2.2 Pacific Coralliidae

6.2.2.2.1 Improvement of fishery-related data

Data concerning precious coral production is essential in order to determine the condition of resources; however, statistics are not always disclosed by countries (Annex 2). Even if data are not made public, action must be taken to verify (validate) landings in order to make them useful in formal stock assessments.

6.2.2.2.2 Fishing techniques

Studies are required on the coral nets used in Japan and Taiwan Province of China, and their impact on precious corals and the environment. Coral nets, which consist of several flat nets attached to a stone weight or horizontal bar, are thought to disturb the sea floor especially when many fishing boats repeatedly drag nets over a limited area (Annex 2). Research on the way coral nets impact the sea floor is therefore necessary.

Detailed experimental trials should be undertaken to estimate the actual fishing effort of dredging gears and their eventual damage to the environment, as compared to robotic harvesting or any eventual new fishing technique.

More selective and less impactful fishing gears and practices are required. However, detailed studies and experimental tests must be compulsory before the authorization of any new harvesting technique. The full

sustainability for the resource and the environment should be scientifically proven well in advance of any massive use.

6.3 MANAGEMENT

6.3.1 Black corals

6.3.1.1 Development, implementation, and enforcement of national management plans in harvesting countries per species

Apart from the United States of America (Hawaii), comprehensive black coral management plans (including stock assessment) do not exist in any other country. Where harvesting of these species is taking place, priority should be given to the development, implementation and enforcement of national management plans, as well as to supporting scientific studies that can help monitor and refine the effectiveness of such management plans. The plans should include the following: principles, goals and broad objectives; operational objectives, reference points and decision rules; recovery strategy; management measures; MCS system; implementation and enforcement mechanisms; reviewing the system and timeframe; stakeholder role and involvement; and conservation and ecosystem-related issues.

6.3.2 White, pink and red corals

6.3.2.1 C. rubrum

6.3.2.1.1 Implementation of GFCM Management Plan

The full implementation of the GFCM measures by member states, including the newly established management plan (Recommendation GFCM/41/2017/5 on the establishment of a regional adaptive management plan for the exploitation of red coral in the Mediterranean Sea) is expected to be sufficient to counteract or prevent overfishing, with a view to ensuring long-term yields while maintaining the size of red coral populations within biologically sustainable levels. In addition to the measures already implemented, according to the new 2017 management plan, CPCs shall: establish an individual system of daily and/or annual catch limitation; will maintain the fishing effort at the levels authorized and applied in recent years for the exploitation of red coral; and will temporarily close the area concerned to any red coral fishing activity when undersized specimens of red coral (i.e. colonies whose basal diameter is lower than 7 mm) exceeds 25 percent of the total catch harvested from a given red coral bank for a given year.

6.3.2.1.2 Enforcement of existing management measures

Only the actual level of implementation of the GFCM management plan at the national level will determine the success or failure of such a series of regional measures. In parallel, actions to eliminate IUU fishing of red coral should be also foreseen.

Nevertheless, it must be noted that red coral harvesting is currently active in only a few countries, while in most Mediterranean countries red coral is fully protected. Any unsustainable harvesting pressure or IUU fishing is expected to have mainly local effects, with the loss of red coral banks, occurring in red coral's shallower coastal habitat (i.e. between 50 and 140 metres); the GFCM has been actively working with its member countries for years to ensure that this will not eventually occur (Annex 1).

6.3.2.1.3 Species protection (spatial closures)

Several spatial and temporal closures have already been established at the national level (Annex 1). In addition to the existing closures, countries actively harvesting red coral must introduce additional closures for the protection of red coral, on the basis of the scientific advice available, by the end of 2018 (Recommendation GFCM/41/2017/5).

6.3.2.1.4 New management measures

The possibility to implement additional management measures was discussed during two recent GFCM Workshops (GFCM, 2014a, 2017b).

Among other possibilities, the implementation of programmes involving scientific observers on board, tracking devices, validation mechanisms for logbooks, has been recognized as highly effective but not always easily

feasible, mostly because of the economic costs connected to implementation (Annex 1, Table 13). However, countries should endeavour to make harvesting sustainable in the long term.

6.3.2.2 Pacific Coralliidae

6.3.2.2.1 RFMO and Pacific management plan

Coralliidae corals are distributed over sea areas across different countries and international waters (United States of America, Japan, Taiwan Province of China and southern China). International cooperation is essential for the conservation of marine life and management that extends beyond the boundaries of each nation's territorial waters or EEZ.

In order to properly manage precious coral resources and to eliminate IUU fishing the establishment of a regional fishery management organization (RFMO) composed of representatives from the different countries is highly recommended (Annex 2).

Similar to what has been done in the Mediterranean region, the development, implementation and enforcement of a Pacific management plan for Coralliidae is an option worth considering.

6.3.2.2.2 Species protection

Similarly to *C. rubrum*, the increase of MPAs for the recovery of stocks is recommended.

6.4 TRADE

6.4.1 Data on trade

6.4.1.1 Black corals

Trade data have been available since the inclusion of all species of black corals in Appendix II of CITES. However, in many cases the records refer to the genus or even the order because of difficulties in the identification of taxa (both raw colonies and finished products).

In any case, apart from CITES, data on trade should be obtained and strictly monitored by all the harvesting countries within the framework of fishery management plans.

6.4.1.2 White, pink and red corals

6.4.1.2.1 *C. rubrum: Data collection and eventual implementation of traceability mechanisms*

Traceability mechanisms for *C. rubrum* should be envisaged: from the time the coral is landed and sold as raw material, to its manufacture, until it reaches the retailer as a finished product. These mechanisms would allow certification that the red coral was collected in compliance with Mediterranean or national regulations and it would be also effective in eradicating red coral IUU fishing (Annex 1).

6.4.1.2.2 Pacific Coralliidae: Data collection and eventual implementation of traceability mechanisms per species

Given the difficulty to distinguish between different typologies of corals in imports/exports (precious corals, semi-precious corals, stony corals or even shells) a convenient method of data collection needs to be devised in order to compile accurate trade statistics (Annex 2).

The production area of the different species should be consistently disclosed at every stage, from the time the coral is landed and sold as raw material until it finally reaches the retailer as a finished product. This would not only enable traceability and certify that the coral was collected in compliance with the regulations of each production area, it would be effective in eliminating illegally fished coral; this would, in turn, help deter IUU fishing practices such as poaching (Annex 2).

The feasibility of using eco-labels to certify that the fishing methods and efforts have proven environmentally sustainable is a further option to explore (Annex 2).

6.4.2 Efficacy of CITES listing for conservation and management

In the following paragraphs two issues are briefly described: the effects of listing Antipatharia in Appendix-II of CITES, and whether or not a listing in Appendix II of CITES would improve the conservation of Coralliidae species.

6.4.2.1 Antipatharia listing

Black corals were added to Appendix II of CITES in 1981. What effects did the CITES listings have on fisheries? There is little evidence of an improvement in the conservation status of black corals and there is still a considerable lack of information on their harvesting and trade.

Black coral harvest in Hawaii is considered sustainable for about 60 years and represents an example where CITES listing and a fisheries management plan coexisted. Two years after the CITES Appendix II listing, in 1983, a Fishery Management Plan was developed by the WPFMC and the State of Hawaii and it has been enforced at the local level in cooperation with local industry (Grigg, 2010a, b). Some effects of adding CITES regulations have been: 1) increased costs for the procurement of raw and finished black coral products; 2) increased costs of selling finished black coral products internationally; and 3) a negative impact on domestic sales, since increased procurement costs are passed on to the consumer, thereby reducing demand (Grigg, 2010a; Tsounis et al. 2010). Grigg (2010a) highlights that the requirement for CITES provisions, has on occasion hindered the scientific investigation on black corals, and has been a costly administrative burden on the local industry in Hawaii, arguing that the long-term sustainability of the black coral fishery and the industry are the result of local fishery regulations and enforcement programmes in the State of Hawaii (Grigg, 2010a), even though documentation of international trade in black coral has been made more transparent.

In general, the CITES permitting process for black corals has created an administrative and costly burden for the trade of listed species and has done little to improve their conservation in Hawaii (Grigg, 2010a). It is important to point out that the black coral fishery in Hawaii is a unique case study, as the fishery is regulated by FMP. In other parts of the world where such FMP do not exist, CITES regulations may still be an important conservation measure protecting populations from overexploitation. The important point to remember is that CITES regulations should not be used as the only conservation measure: enforced and developed FMP may be much more effective at conserving populations. Additionally, it should be noted that while CITES regulations are applicable to all of the –250 black coral species currently described, only a small fraction of those are commercially harvested. Thus, other negative impacts of CITES regulations, such as increased difficulties for scientific studies on this group, should be addressed by providing researchers with easier ways to adhere to CITES regulations (e.g. simplifying existing procedures for scientific exchanges or researches). CITES has recognized this need and is working on it. Initially it canvassed Parties on where permitting requirements posed a significant barrier to their research. Responses that referred more generally to CITES permitting procedures highlighted the length of time to obtain a permit, the complexity and burdensome administrative processes and the fact that delays in issuing permits, permit costs, the registration of scientific organisations in accordance with Article VII paragraph 6, of the Convention and Resolution Conf. 11.15 (Rev. CoP12) meant processing of permits could lead to degradation of samples. Recognizing the need for putting in place simplified procedures to movements of legitimate scientific samples of Appendix II listed species is a current focus of CITES (CITES, 2018b)

6.4.2.2 Coralliidae listing

The inclusion by China (effective 1 July 2008) of four species of Coralliidae (*Corallium japonicum, Pleurocorallium elatius, P. konojoi, and P. secundum*) in Appendix III of CITES requires all international traders to obtain permits and certificates for import/export and placed a heavy administrative burden on the industry (Grigg, 2010b) while not reducing IUU or deterring poachers (Annex 2). CITES Appendix III has widely acknowledged problems with implementation (see draft resolution in CITES, 2018) and has observed that many Parties are not effectively implementing the provisions of the Convention with regard to Appendix III. There is also a danger that such a listing may have counterproductive responses from the market, since it could be considered as evidence of rarity, which may therefore stimulate the desire to purchase and sales of these corals, thus also increasing the request on fishers to supply the raw materials for the trade (Annex 2; Chang, 2013).

In the case of nationally led legislative processes, in Germany *C. rubrum* was given a temporary, strict protection (January 1987–June 1997) through the listing of the species in Annex 1 of Germany's Federal Ordinance on Species Conservation. This resulted in a total prohibition of any commercial trade into Germany both from EU and non-EU Member States. In that period German customs was confronted with commercial imports of pre-manufactured and manufactured products made of other *Corallium* species with significant (irresolvable) identification problems at the species level for enforcement officials. This was particularly true of pre-

manufactured products, jewellery, or products made from coral powder (Jelden, 2010). The species is not listed anymore in the country.

In addition, proposals for listing Coralliidae species in CITES have presented on three occasions: in 1987 at CITES CoP 6 by Spain, limited to *C. rubrum*; in 2007 at CITES CoP14 by the United States of America, limited to the genus *Corallium*; and in 2010 at CITES CoP 15 by the European Union and its Member States, and United States of America, aimed at the family Coralliidae. Arguments in support of listing have stated that because of commercial fishery boom and bust cycles caused by inadequate fishery management, a CITES listing would provide a vital tool to strengthen conservation through trade monitoring, further control of resources (Tsounis et al., 2010; Chang 2013 and references therein) and in identifying scientific and research needs (Bruckner et al., 2009). In addition, Bruckner et al. (2009) argued the value of a CITES listing in raising awareness within the general public, industry, and other stakeholders that sustainability was a concern with this resource.

When there has been discussion on the value of listing precious corals, the FAO Expert Panel delivered a consensus decision that the species did not meet the CITES criteria and CITES Parties rejected all of the proposals. The FAO Expert Advisory Panel that reviewed the CITES Proposals for CoP14 in 2007 (FAO, 2007) noted that:

> ...despite being harvested since prehistoric times, the Mediterranean population of *C. rubrum* is still widespread. Small but mature colonies have high local densities. Nevertheless, mature colonies are now smaller than the minimum size for harvest and a problem is that large colonies have an important role in providing recruitment. These problems need to be addressed by the implementation and enforcement of suitable local management measures.

In 2010, for CITES CoP15, the FAO Expert Advisory Panel (FAO 2010) reiterated the view of the FAO (2007) assessment:

> The Panel does not recommend a CITES Appendix II listing for *Coralliidae* spp. Nevertheless, since international trade is a driver of their harvesting, if such a listing resulted in a tightening of their management, it could lead to an improvement in their status. However, this improved status would be bought at the cost of a considerable administrative overheads, and Government efforts would be better employed in enacting and enforcing appropriate local management regimes.
>
> The Panel cautions that if Coralliidae were included in Appendix II, aspects of the implementation would be problematic, particularly the identification at the species level of processed products and providing a suitable protocol for pre-convention specimens. The Panel noted that a very large number (many thousands) of small, individual specimens is in trade, meaning that a significant amount of paperwork would be required to track all items in trade.
>
> The Panel was convinced that the Coralliidae do require to be managed within EEZs and in areas beyond national jurisdiction in a fashion which takes account of their long life and their ecological role. The Panel considered that these long-lived species require appropriate and effective local management such as harvest restrictions and rotational closures and protected areas to facilitate their sustainable harvest.

In fact, the FAO views triggered renewed efforts from GFCM. In a few years, these have established comprehensive management measures for *C. rubrum*, and led to improved legislation for Pacific species (see Annexes 1 and 2).

The possible listing of all Coralliidae species in Appendix II of CITES could encounter similar problems as the black coral listing, in addition to new challenges:

1. Only a few species are commercially harvested in the world and species identification is very difficult, with even fake coral sometimes hard to differentiate from worked coral (Grigg 2010a; Tsounis *et al.* 2010). The identification of coral items relies on their colour. However, there are large colour variations within the same species. For the implementation of an export system based on CITES, a reliable method of species identification needs to be established (Annex 2).

2. Many Coralliidae specimens traded in the world today were harvested years ago and are drawn from stockpiles and are therefore exempt from CITES (Grigg, 2010a). This also the case for when jewellery under warranty is sent back to the manufacturer for repair and is held in customs due to missing permits (Tsounis *et al.* 2010).

3. The discovery and mining of large beds of fossilised coral that would be covered by CITES provisions but that would have no link to the conservation of the species (Tsounis *et al.* 2010).

4. Many species have distribution boundaries that extend beyond country boundaries, thus obscuring the location of collection (Grigg, 2010a). It should be noted that CITES has provisions for introduction from the high seas, however full implementation of these measures lags somewhat behind CITES adoption of these provisions.

5.

6. A further potential problem is that a listing in Appendix II of CITES may give the impression that species are under management control, thereby defusing efforts at the local level to enact legislation and enforcement programmes (Grigg, 2010a; Tsounis *et al.* 2010).

Additionally, from a socio-economic and cultural perspective opponents of the listing have argued that the CITES listing of precious corals may endanger the livelihood of local people, who depend on the precious coral handicraft industry, and damage to the traditional culture (Chang, 2013 and references therein).

Actually, at the international level, there is no doubt that precious coral resources need much stronger management practices and would greatly benefit from the creation of new spatial and fishery protections. However it is suggested that these actions (management and conservation) are best accomplished through action at the local level through cooperation of science and fishery governance measures, including surveillance, enforcement and prosecution (Grigg, 2010a).

On the other hand, advocates of trade controls argued that because corals grow slowly, poor fishery management methods will cause damage to corals that require decades to correct and for the corals to recover (Tsounis *et al*., 2010). They have indicated management failures in many communities or countries are caused by inadequate fishery management or an inability to reject short-term, high-profit economic incentives. They also advocate CITES listing as a vital tool for trade monitoring and control of resources (Tsounis *et al*., 2010; Chang 2013 and references therein).

The benefits of a CITES Appendix-II listing for Coralliidae were also recognized. In particular (Bruckner *et al*., 2009):

1. The listing would provide trade data that are not currently available; fill some gaps in knowledge in regard to the international volume of trade in Coralliidae. It would highlight areas where scientific and trade research should be conducted to better inform management and enforcement.

2. It would raise awareness within the general public, industry, and other stakeholders that sustainability is a concern with this resource. The aim of a listing is to prevent unsustainable use of the resource, which would ultimately benefit the long-term viability of the industry that depends on it.

However, it was also stressed that for any listing to be effective, CITES authorities must collaborate with relevant fishery management bodies, as it can be seen in the current case of CITES promoting complementary management between the biodiversity conservation and fishery sectors in the management and conservation of sharks and rays (CITES, 2016). Whilst CITES provides a mechanism to control international trade, it is fishery management that ultimately determines the sustainability of exploitation of this resource (Bruckner *et al*., 2009).

The important advances in fishery management that have occurred since 2010 in the Mediterranean, through GFCM, and in the Pacific though stricter domestic legislations, constitute important steps towards the sustainability of harvest – and the subsequent trade of these important marine resources.