



**GENERAL FISHERIES COMMISSION FOR  
THE MEDITERRANEAN  
COMMISSION GÉNÉRALE DES PÊCHES  
POUR LA MÉDITERRANÉE**



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**GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN**

**SCIENTIFIC ADVISORY COMMITTEE (SAC)**

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**LIST OF ABSTRACTS\***

**\*As received by the GFCM Secretariat**

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## The importance of demographic approach to conservation and management of Mediterranean red coral (*Corallium rubrum*)

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Demographic population models are fundamental to foster survival of endangered and overexploited species matching harvesting to population growth rates. Such models are widely applied by conservation biologists to check population viability and to project population trends over time.

Mediterranean red coral (*Corallium rubrum*) is object of harvesting since ancient times and in the last years the need for conservation and management plans for this species has emerged. Two different kind of populations can be distinguished: 1) Coastal shallower populations (up to 70 meters depth), characterized by colonies with small size, few braches, high density and limited economic value. 2) Deep populations (below 70 m depth) characterized by big, sparse colonies with high economic value.

Harvesting pressure on the coastal populations has been going on for thousands of years and probably determined the actual demographic structure of such populations. In the last years mortality events linked to global warming affected some coastal populations adding another mortality cause and bringing some of that populations to the risk of local extinction. To conservation purposes, demographic studies are necessary to plan an effective management of the resource. Therefore we set out a dynamic model of a red coral population living in coastal waters. This population is characterized by small/young, crowded colonies and high recruitment rate. On the basis of the size–age structure determined for this population, a static life-history table has been set out. Demographic data of the life table were included in a non-linear, discrete, age-structured dynamic model, based on a Leslie-Lewis transition matrix. We applied such model to simulate the trends of the studied population under different scenarios as the effect of mortality events and the increases of survival and life-span. As some populations of red coral actually show the dominance of sparse, big/old colonies and low recruitment rate, while others are characterized by crowded, small/young colonies and high recruitment rate, we simulated the shift from the former to the latter structure increasing survival and life-span. Our results suggest that a dramatic mortality increase of bigger–older colonies (due, in the case of red coral to overfishing) could have determined the population structure we found. The application of such demographic models, showing the possible coupling negative effect of mortality events and harvesting, suggest an urgent need of intervention. As recently proposed in the course of workshops on red coral management, the banning of the harvesting activity on coastal populations could be an effective intervention. About deep population a rational management could be possible only if planned on the basis of demographic studies. The lack of demographic data on such populations does not allow the application of the models. In absence of demographic studies on the deep population and a consequent rational management plan, the risk is that they could suffer a shift similar to the one modeled for the coastal populations and consequently undergo to local or economical extinction.

Cannas R.\*, Follesa M.C.\*, Ortu A. \*, Pedoni C. \*, Pesci P. \*, Porcu C. \*, Sacco F. \*, Cau A \*.  
Connectivity among red coral deep populations measured through genetic means.

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Size and interconnectivity of genetic breeding units are important parameters to design management plans and identify conservation strategies. In fact, small and/or isolated populations are vulnerable to inbreeding depression, which might reduce their evolutionary potential that is their resistance and resilience following disturbance, such as harvesting or environmental perturbations. In species with sessile adult stage, as for the red coral, dispersal is almost impossible to track directly because it relies on larval and/or gamete transport in the water column. A indirect way to measure connectivity is through genetics.

Up today, detailed genetic studies have been performed almost exclusively on shallow-water *C. rubrum* populations (15-50 m of depth). However, at present the populations deeper than 80m are those which are heavily commercially exploited. At present the Department of animal biology and ecology of the University of Cagliari is performing the assessment of the genetic structure of populations from Sardinian commercially exploited banks (from -80 m to -120 m of depth) in order to gather information useful both for scientific and management purposes. The main finding of this research (still ongoing) will be illustrated. In summary, colonies from the Northern, Central Western, and South Western Sardinian coasts prove to be highly genetically differentiated. A strong genetic heterogeneity is measurable between samples over different spatial scales from hundreds to less than 1 km. In all samples, the inbreeding coefficient  $F_{IS}$  is significantly  $> 0$ , indicating that breeding among close relatives seems to occur. Preliminary comparisons between deep and shallow-water populations from the same area seems to indicate the existence of a strong genetic differentiation among populations over depth. Morphometric data for each of the genotyped populations are analysed to investigate on possible links among populations structure (size, and hence age) and the main genetic indices.

Cannas R.\*, Follesa M.C.\*, Ortu A. \*, Pedoni C. \*, Pesci P. \*, Porcu C. \*, Sacco F. \*, Cau A \*.  
Red coral yield data: can we (need to) improve them?

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In different times three proposals have been submitted to CITES (Cop6-1987, Cop14-2007, Cop15-2010) for listing the red coral *Corallium rubrum* in Appendix II, calling for its management through a strict regulation of the trade. These proposals, all rejected, heavily depended on catch statistics to support inclusion under decline criterion. Recently, the FAO ad hoc expert advisory panel for the assessment of proposals to amend CITES Appendices reaffirmed that catch statistics in red coral do not necessarily mirror the status of the species since they can be influenced by many complex factors (e.g. economics such as price of coral, management practices such as size limits and area closures, etc.). Anyway, the availability of accurate catch data (along with independent fishery data) is not only a requirement limited to the CITES context, but all management/conservation programs need this information to design sound and effective plans. At the moment, the only compilation of yield statistics for red coral by country is the FAO global capture production database, in which data for red coral are presently available from 1974 to 2008. The GFCM capture production database includes the same data (updated to 2006 for the moment) but also by GFCM statistical divisions, when this more detailed information is available. A provisional analysis of these main sources and the cross-checking with published data permitted to highlight some problematic issues that can strongly compromise their utility (credibility). Some examples will be presented related to incompleteness (e.g. areas where coral harvesting is actively performed but data are sparse), incongruence both with other official sources (data provided by ministerial bureau strikingly different from the FAO figures) and the national legislations (e.g. data on coral catches for areas for which the harvesting is legally interdicted since a decade). Many of these discrepancies can be explained by the fact that the majority of the data included in the FAO database are not provided by national official correspondent, as for the other capture fishery data, but by a major wholesale company. In fact, it is highly plausible that data are confused also because yields figures are known to be regularly provided to FAO both by some (too few) production countries (data on harvesting) and by red coral wholesalers (that could provide along with fishing data also commercial data on sales probably mixing up annual actual data with data from stockpiles from previous years).

From this preliminary analysis, three main indications emerge. There is an urgent need :

1. to have complete and correct data, and with respect to this a more prompt collaboration from countries in recording and providing national data to FAO is highly desirable;
2. to identify discrepancies between different sources and possibly revise and improve backward data included in the FAO and GFCM databases;
3. to have complete and trustable data on the effective annual yield that must be clearly distinct from the data on sales.

Chessa Lorenzo A<sup>o</sup>, Michele Scardi\*

## The state of red coral (*Corallium rubrum*) populations in the N.W. Sardinian fishing grounds

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Some aspects concerning distribution and ecology of the red coral (*Corallium rubrum*) in N.W. Sardinian coast and in particular on fishing grounds are discussed. In particular the distribution of the shallow as well as deep population are considered. The main population parameters are exposed with a particular emphasis for those colonies of a commercial value for which a calculation of the structural complexity has been made.

The fishing techniques are also discussed in consideration with recent technological advances that could allow a safe fishing with an high level of environmental protection and good management.

Costantini Federica\*, Fauvelot Cecile, Pintus Eleonora, Abbiati Marco  
Population genetics, connectivity and management issues of precious red coral  
in the Mediterranean Sea

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Understanding spatial scales of genetic structuring is essential for the conservation and sustainable management of Mediterranean red coral populations. In this study we review the main results collected in the last decade on population genetics of the species. Several molecular markers (e.g. allozymes, microsatellites, ITS, COI) have been used to investigate patterns of genetic structuring at geographical scales ranging from meters to thousands of kilometers, as well as vertical gradients from 15 to 800 meter depth. Phylogeographic patterns showed the occurrence of chaotic genetic structuring at Mediterranean scale in *C. rubrum* shallow water populations (15-50 meter depth). Genetic structuring has been found between shallow and deeper water populations (50-150 meter depth). At spatial scales of meters and tens of meters a surprisingly strong genetic divergence among neighboring populations has been found. These data suggest that habitat features together with biological processes favor the structuring of red coral in local “Evolutionarily Significant Units”. Level of larval exchange and gene flow among red coral ESU is very limited, therefore, they should be considered equivalent to the “Management Unit”, which require individual harvesting and conservation plan.

Doneddu Roberto, M. Campolmi, R. Caddeo, M.C. Soro  
Red coral sustainable management: key success factors and challenges for  
further improvement of regional regulation

Regione Autonoma della Sardegna Assessorato dell'Agricoltura e Riforma Agro-pastorale – Servizio Pesca

The Sardinian Regional Administration has enacted one of the first legislation on red coral harvesting in the Mediterranean Sea. In order to ensure sustainable exploitation since 1979 a regional law has introduced several management measures, including: annual fishing permits, restrictions on harvesting methods and, since 1989, banning of non-selective and destructive dredges (such as the “barra italiana” and the St. Andrew’s cross), limited harvesting period and areas, daily quotas, minimum basal diameter, minimum depth, harvesting data collection. Furthermore, since the 1980’s the Regional Administration has been funding scientific studies in order to collect biological data and obtain periodical assessment of the status of the resource along Sardinian coastal waters. On the basis of the scientific evidences the regulation has been gradually implemented and seems to be effective for the conservation of the resource as confirmed by recent scientific study (Cannas et al., 2010). An overview of the red coral regulation and management actions in Sardinia in the last 30 years is provided, including the recent restocking programme. The analysis of the annual yield data related to the harvesting effort is also illustrated. Starting from a SWOT analysis an overview of key success factors and challenges for further improvement of regional regulation is provided.

Elalloussi Khalid

## Fisheries of the red coral *Corallium rubrum* (Linnaeus, 1758) in Morocco

Chef des Service de l'aquaculture et des activités littorales (Marine Fisheries Department)

This presentation contains data on several domains relating to the fishing of coral in Morocco, At the beginning we present briefly the most important historic information which are scattered in the department of marine fisheries and which indicates to us the level of exploitation of coral; The historic analysis shows an annual variation of captures by fishing boat during the last 30 years, expressing a progressive decrease of the captures which end by the closure of the fishing area. The units fishing was of foreign vessels and the transfer of the fishing activity toward the area of Asilah in 1990 toward has allowed the application of new rules (marocanisation of the boat), which led the reduction in the number boat of 23 to 10 units. Red coral is distributed in several areas of marine water in Morocco, but the official fisheries data show that existed in three areas from 40 to more than 120 m. The harvesting methods was scuba diving .Generally, the production of the red coral carried out each year shows the same tendency of evolution. The production reaches a maximum in the first year the opening of the zone of fishing and starts to fall progressively. During the last ten years the landing data shows a decline from maximum of 21,999 kg in 2002 to 1,595 kg in 2006. 70 Per cent of coral fished, between 1980 and 2009, is exported in Italy and 11 % in Switzerland. The rotation harvest schemes: currently, only two areas (Asilah and Al hoceima) are concerned the rotation will allow the reconstitution of the banks of coral affected. The area will be closed to fishing as the yield of fishing decrease. The harvesting period in each zone can vary depending on the density of coral populations. The regulation of red coral fishing has introduced several restrictions in order to improve sustainable exploitation (number of coral licences, Annual harvest amounts of each boat and closing area of fishing...), conservation of coral resources, and protection of marine ecosystems. The national Institute of halieutic Search (INRH) has to make prospecting before the opening of the fishing of coral, the last operation of prospecting is realized between July 2008 and June 2009 this operation gives detailed mapping and a regular monitoring scheme along with measures for the fishing and the protection of the red coral in the area Larache Cap spatel. The result of this operation of prospecting allowed the opening the area between Cap Sparte and Larche in these conditions:

- The depth of exploitation is situated between isobaths 40 to 80 metres;
- The period of opening of this fishery is one year with scientific follow-up and proceeds to a regular biological sampling;
- Authorization 10 licences and 3 divers by ship;
- Fixation TAC 600 kg by ship (6 tons by year for ten ships).



Follesa M.C.\*, Cannas R.\*, Ortu A. \*, Pedoni C.\*, Pesci P.\*, Porcu C. \*, Sacco F.\*, Cau A \*.  
The status of red coral (*Corallium rubrum*) resource in the Northern and  
Western coasts of Sardinia.

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In the last 30 years Sardinian Administration have established some management actions to improve sustainable exploitation, conservation and protection of red coral in its waters. Taking into account that these regulations could have affected the state of the red coral banks, a picture of the spatial distribution of the deep red coral resource in the Northern and Western coasts of Sardinian are illustrated. Data of the last 4 years (2007-2010) on size structure, density, spatial distribution pattern were collected both by ROV video transects and colony sampling by professional divers. Three zones with different demography and density were identified. Some specific issues on the growth and reproductive biology of the deeper colonies in these zones are also presented. It will be also emphasized the utility of these data in the management of the resource.

Follesa M.C.\*, Cannas R.\*, Doneddu R.\*\*\*, Pedoni C.\*, Campolmi M\*\*, Pesci P.\*, Porcu C.\*,  
Sacco F.\*, Cau A\*.

## Evolution of the main Sardinian red coral regulations from 1980 to 2010.

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Red Coral (*Corallium rubrum*, 1758) in Sardinia is a historical important commercial resource with banks mainly distributed in the Northern and Western coasts of the island. Since 1979, harvesting has been regulated by the Regional Law n. 59 - 5 July 1979 “Coral Fishing Regulation” that introduced several restrictions to enable the sustainable exploitation of coral resources. In 1989, the Regional Law n. 23 of 30th May 1989 partly modified the Regional Law 5th July 1979 n. 59 and introduced new restrictions to ensure a more strict and effective protection of the coral resource and the marine ecosystem. For instance, the non selective gears (St. Andrew cross and ingegno) were banned and only manual harvesting with the hatchet is permitted and a limit size of harvesting is imposed. In this paper the progressive evolution with time of the main regional red coral management regulations (number of issued permission, time of harvesting, size limit, daily catch limit, closed harvesting areas) is discussed.

Garibaldi Luca

## The harvest data on red coral (*Corallium rubrum*) available in the FAO global capture database

FAO - Fisheries and Aquaculture Statistics and Information Service

The FAO global capture production database includes harvest data for red coral (*Corallium rubrum*) for more than 30 years. Differently from the other catch statistics included in the database, which are usually submitted by national official sources, data on red coral are consistently provided since mid-1980s by a major red coral import-export and production of jewellery wholesaler. Shortcomings and advantages of these data are briefly discussed.

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A ROV for red coral (*Corallium rubrum*) fishing

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The underwater modern technologies allow the prospection of benthic resources at high depth. These technologies could also be useful for fishing purposes. Red coral fishing in Sardinia is allowed at depths over 80 m only to professional fisherman equipped with autonomouns breathing apparatus. In this work a R.O.V explicitly designed for fishing coral with very low impact for the biotopes, compared to the professional divers activities is presented. The R.O.V. is equipped with 4 single-phase asynchronous engines that allow any kind of movement. It has 4 camera for a complete vision of the fishing grounds and for details. An mechanical harm allow more that 270° of excursion along the vertical plane. It allows the detach of the red coral ramification with high precision movements. These is obtained thanks to 2 idrojet pump that allow micro lateral movements of the harm. The R.O.V. weights 250 Kg and can operate up to 300 m by only a single pilot who can drive the R.O.V. with the aid of a simple console equipped on the surface unit of the system. The small size of the entire system, allows the operation by small and inexpensive boats. The modular construction allows repairs directly on the R.O.V. by the operator himself, on the field, with the of unqualified people. To reach the best performances, respecting the environment, the constructor of the R.O.V. supplies, together the system, a technical and operative training for the pilots.

Pani Marco

## The need for binding management measures at regional level in the fishery of Red Coral (*Corallium rubrum*) in the Mediterranean.

IWMC-World Conservation Trust- <http://www.iwmc.org>

The paper summarizes the actions taken by GFCM in the 80's and the 90's for the management of the species in the Mediterranean and the more recent attempts to include the species and the entire family Corallidae into CITES. These attempts to use trade controls under CITES as a supposed conservation tool, failed because the criteria for inclusion were not met, for implementation and enforcement issues and especially because the Parties felt that proper management under the relevant RFMO was far more important for the conservation of these species than trade controls. The GFCM was specifically mentioned during various interventions at the CITES Conference in Doha (March 2010) as the most appropriate body to start new management actions on the Mediterranean species of precious corals. The author suggests that the conservation of the Red Coral in the Mediterranean and the livelihoods of thousands of people that depends fully on this species, are now in the hands of fishery managers and the devising and implementation of common management measures in the region and related management plans are now imperative. Several management measures are proposed and a call is made on GFCM to start a process to adopt these measures, among others, in a timely manner, for the benefit of the species and the livelihoods of people depending on it.

Pesci P.\*, Cannas R.\*, Follesa M.C.\*, Olita A.\*\*\*, Pedoni C.\*, Pendugiu A.A.\*, Porcu C. \*, Sacco F.\*, Sorgente R.\*\*, Cau A \*

### Coral morphology and current flows. A preliminary overview.

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Preliminary analyses by the working group of the Department of Animal Biology and Ecology of University of Cagliari underlined a different morphology of the coral colonies in the different Sardinian coasts. In particular, in the Northern Coast taller and more branched colonies have been found than North-Western coast colonies of the same age. Southern colonies showed could be linked to the diverse hydrodynamic features in the areas. A hydrodynamic model 3D of Sardinian Seas has been used to highlight if some hydrodynamic variables can be related to the growth pattern of the colonies in the different coasts. This model allowed to simulate a 2-years circulation in the areas. Average intensity and direction of currents between 80 and 120 m depths (the depth of the analysed red coral samples) have been found and the circulation in the area has been simulated. The possible correlation between currents (intensity, direction and variability) and growth pattern of red coral colonies in the North, North-Western and South-Western coast of Sardinia have been evaluated. The three studied areas showed different hydrodynamic features and an inverse relation between velocity of current and height of colonies has been found. Obtained results, even if they are preliminary, confirm that red coral colonies have growth patterns different in the three areas in relation to the different velocity of currents. This differentiation confirms the proposal of a local management of red coral.

Pesci P.\*, Cannas R.\*, Follesa M.C.\*, Ortu A. \*, Pedoni C.\*, Porcu C. \*, Sacco F.\*, Cau A \*  
Red coral fishing trends in Sardinia from 1978 up to now: analyses of published data.

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According to the FAO data, since the last 20 years Sardinia turned out to be one of the main producers of red coral in Mediterranean Sea. The annual yield jumped from 35% in 1983 to more than 95% of the total Italian yield in 1991. Since 2000 the Sardinian production reached about the 99% of the overall Italian yield of *Corallium rubrum* (FAO, 2007).

Data by Liverino (1998) and FAO on red coral amounts harvested from 1978 to now in Sardinia are here presented to underline the evolution of its landings by the light of the Sardinian regulations. The amount harvested with towed gears (St. Andrew Cross and Ingegno) substantially decreased since 1978 but the quantity obtained by diving has not strongly reduced. The last one in fact has been subjected to rules more and more restrictive. Results show that red coral landings in Sardinia are stable over time, differently from what observed in other Mediterranean areas.

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## A demographic approach to management and conservation of the precious Mediterranean red coral.

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The precious Mediterranean red coral, whose exploitation lasts since two thousand years at least, is one of the most valuable marine resources. In recent years overharvesting occurred in several countries and the majority of shallow populations have been depleted. Demography could supply tools for a rational and sustainable exploitation of this resource; however there is the need of sound data on colony growth rate, population structure and reproduction which can allow modelling population trends over time. Demographic data collection and stock assessment are particularly needed for deep-dwelling populations which, having the highest economic value, are nowadays the main object of commercial exploitation. The Italian research team on red coral recently started a study on deep-dwelling populations of the North and Central Tyrrhenian Sea in which the species have been harvested until recent times. The scientific cruise has been carried out (with the support of the Italian Environment Ministry) by the research vessel *Astrea*. MULTIBEAM bathymetry, ROV video transects and colony sampling by professional divers have been carried out between 65 and 120 meters depth. Data on size (and age) structure, abundance, spatial distribution pattern, reproduction and genetic structure of four populations in Campania and Tuscany have been collected and are actually under analysis.



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New insight into *Corallium rubrum* fishery management:  
An application oriented synthesis of recent data

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Recent studies on the population status of *Corallium rubrum* brought international concern over the sustainability of coral fisheries. The available data state with confidence that shallow water stocks in air diving range have been overexploited, so that expert consultations recommend a Mediterranean-wide protection of shallow water populations, and a shift of the fishery to deeper stocks under a new management paradigm. The main revisions of current management measures include most importantly a larger minimum size limit, as the existing one is based on outdated practical considerations, rather than being based on recent scientific studies. A sufficiently large part of the population needs to be protected through permanent protected areas (MPA's), as corals play a significant role in the ecosystem. Weekly catch limits, as well as number of licenses must be carefully set for the deep stocks, in order to avoid overharvesting from which the stocks likely take decades or centuries to recover. The key to set adequate harvesting guidelines are stock surveys prior to exposing an area to harvesting, and ongoing monitoring. A major challenge that requires considerable attention and efforts, is improving and strengthen enforcement, as poaching and exceeded quotas are in large part responsible for the observed overexploitation. Finally, it is recomendable that a cross-national and legally binding management umbrella is established.

Zoubai A., Taleb S.

## The exploitation of red coral in Morocco

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The exploitation of the red coral in Morocco is endowed with a great economic importance beside fisheries resources. Coral resource is an old, rare, precious, much in demand and not easily renewable. At the national level, the exploitation of red coral started at the 70's. This exploitation activity caused in a localised way a rarefaction of red coral colonies, particularly at zones at low depths. The red coral by its commercial interest that it presents led to the extension of the activity of fishing towards the great depths. Taking into account the fragility of this resource and with the aim of preserving and ensuring the durability of this species, targeted research was undertaken. On the basis of scientific results obtained by l'Institut National de Recherche Halieutique (INRH), the Department of marine fisheries worked out in concertation with professionnels a regulation by promulgating decrees of fishings aiming at regulating the exploitation of the red coral and controlling the fishing effort.