SAC GFCM
Sub-Committee on Stock Assessment

	DAY	MONTH	YEAR			
Date*	19	10	2010	**Code***		rum710Geo

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Species Scientific name*

1 *Corallium rubrum*
Source: -

2
Source: -

3
Source: -

Geographical area* ESP

Geographical Sub-Area (GSA)* 7

Combination of GSAs
1
2
3

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)

Code: rum710Geo

Date*	19	10	2010	Authors*	Georgios Tsounis, Sergio Rossi, Josep-Maria Gili

Species Scientific name*	Corallium rubrum	Species common name*	Red Coral

Data Source

GSA*	7	Period of time*	2002 - 2005

Description of the analysis

Type of data*	Population size structure	Data source*	Tsounis et al. 2007
Method of assessment*	Fishery independend Survey. Photography with ruler for calibration of coral size	Software used*	

Sheets filled out

B	P1	P2a	P2b	G	A1	A2	A3	Y	Other	D	Z	C
1	1	1	1	---	---	---	---	---	---	---	---	---

Comments, bibliography, etc.

Bruckner, A. & Roberts, G. (eds) 2009. Proceedings of the First International Workshop on Corallium Science, Management and Trade. NOAA Technical Memorandum. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. Washington.

Bussoletti E, Cottingham D, Bruckner A, Roberts G, and Sandulli R (eds) 2010. Proceedings of the International Workshop on Red Coral Science, Management, and Trade: Lessons from the Mediterranean

Comments, bibliography, etc.

Tsounis G, Rossi S, Gili JM, Arntz WE (2007) Red coral fishery at the Costa Brava (NW Mediterranean): Case study of an overharvested precious coral. Ecosystems, 10: 975-986

Tsounis G, Rossi S, Grigg RW, Santangelo G, Bramanti L, Gili JM. (2010) The Exploitation and Conservation of Precious Corals. Oceanography and Marine Biology Annual Review. Vol 48: 161-212

García-Rodríguez, M. & Massó, C. 1986a. Estudio biométrico de poblaciones de coral rojo (Corallium rubrum L.) del litoral de Gerona (NE de España). Boletin Instituto Español de Oceanografia 3, 61-64.

García-Rodríguez, M. & Massò. C. 1986b. Modelo de exploitación por buceo del coral rojo (Corallium rubrum L.) del Mediterráneo. Boletin Instituto Español de Oceanografia 3, 75-82.

García-Rodríguez, M. & Massò, C. 1986c. Algunas bases para la determinación de la edad del coral rojo (Corallium rubrum L.). Boletin Instituto Español de Oceanografia 3, 61-64.

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Biology

Somatic magnitude measured (LH, LC, etc)*			Base Diameter; Colony Hei	Units*	mm

Sex	Fem	Mal	Both	Unsexed		
Maximum size				40 (D) / 450 (H)	Reproduction season	Summer (July-
Size at first maturity				1.4 (D) / 24 (H)	Reproduction areas	distribution area
Recruitment size					Nursery areas	distribution area

Parameters used (state units and information sources)

		Units	Sex			
			female	male	both	unsexed
Growth model	L∞					
	K					
	t0					
	Data source	Garcia-Rodriguez and Masso 1986				
Length weight relationship	a				W = 0.086 D x 10^1.98	
	b					

M						

sex ratio (mal/fem)	01:01

Comments

Size data given above are total coral colony height (H), and base diameter (D). However, formula describing correlation of size to biomass and age usually refer it to base diameter, as the correlation is better.

For this stock, the following publications provide age-weight relationships:

García-Rodríguez, M. & Massó, C. 1986a. Estudio biométrico de poblaciones de coral rojo (Corallium rubrum L.) del litoral de Gerona (NE de España). Boletin Instituto Español de Oceanografia 3, 61-64.

García-Rodríguez, M. & Massò. C. 1986b. Modelo de exploitación por buceo del coral rojo (Corallium

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Data source*	Fisheries Department of Catalunia (Spain)	Year (s)*	2002-2007
Data aggregation (by year, average figures between years, etc.)*	year		

Fleet and catches (please state units)

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	ESP	7	M	98	35	rum
Operational Unit 2						
Operational Unit 3						
Operational Unit 4						
Operational Unit 5						

Operational Units*	Fleet (n° of boats)*	Kilos or Tons	Catch (species assessed)	Other species caught	Discards (species assessed)	Discards (other species caught)	Effort units
ESP 7 M 98 35 - rum	12		1465				. of licens
Total			1465				

Legal minimum size	7mm base diameter

Comments

Code: rum710Geo

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Data source*	Fisheries Department of Catalunia Spain	OpUnit 1*	ESP 7 M 98 35 - rum

Time series

Year*	1996	1997	1998	1999	2000	2001
Catch	1600	800	1600	1200	1500	1465
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Year	2002	2003	2004	2005	2006	2007
Catch	1434	1581	1339	1015	1230	1465
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Selectivity   Remarks

L25	
L50	
L75	
Selection factor	

Structure by size or age

No data on the size of landed coral is being routinely recorded for Corallium rubrum in any fishery. It should one of the priorities for future management. It is difficult though, as coral is easy to hide, and harvesters evade controls, given the high price of the corals.

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Assessment form

Sheet P2b
Fishery by Operational Unit

Code: rum710Geo

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Data source*	Tsounis et al. 2010		OpUnit 1*	ESP 7 M 98 35 - rum

Regulations in force and degree of observance of regulations

The fishery operates only during the summer months.

Managment is based on a license system, with an annual quota of 400 kg per licence. harvesting consists of manual collection by SCUBA divers.

The minimum size of 7mm has been arbitraly chosen some decades ago, as the industry was not interested in making jewelry from smaller size. Later studies found red coral to reproduce at a smaller size (an unusual trait in octocorals), so the size has not been modified.

Unofficial interviews confirm that legal fishermen do not fully comply with the rules.

Furthermore, poachers outnumber the licensed fishermen, and are impossible to control.C. rubrum is not on the CITES list, in order to favour local management efforts over international trade control, thus poachers can easily send their corals overseas via Switzerland. At the Costa Brava the low patrolling frequency makes illegal harvest easy.

Accompanying species

Corallium rubrum fishing is very species selective. There should be hardly any bycatch or damage to other species

Code: rum710Geo

| Analysis #* | |

| Data source* | Tsounis et al. 2007 | Gear* | SCUBA |

Model characteristic

| Type of model* | Beverton-Holt | Fitting criterion | |
| Software | | Bibliographical source | |

Data

Year	1996	1997	1998	1999	2000	2001	2002
Catch	1600	800	1600	1200	1500	1465	1434
Effort	10	9	7	8	9.5	11	11
CPUE							

Year	2003	2004	2005	2006	2007		
Catch	1581	1339	1015	1230	1465		
Effort	12	11	11	10	10		
CPUE							

Adjustment

| RMS | |

Results

Carryng capacity		a	
Growth rate		b	
Catchability			
MSY			
FMSY		TACMSY	

Other assessment methods

This assessment relies most of all on a thorough survey of the population structure in 0-60m depth. Using parameters from various studies, including growth and mortality values from populations in France, a Beverton & Holt model could be calculated. Abundance of corals in the study area and total stock size and therefore yield recomendations are not very reliable, due to the extreme patchy distribution of red coral. However, the age at MSY is an important result. Another issue is the extremely geographical variation of growth rates, dependend on environmental conditions in different locations.

Depending on what parameters are trusted and chosen, MSY occours at an age between 33-98 years. The most probable combination of parameters (low growth, and low mortality) results in a MSY of colonies that are of 21mm base diameter. The weakness of the model are presice estimates of mortality and growth rates over the entire (unknown) life span of this species. However, even after discarding the extreme values, and even accounting for a margin for error,it appears that the currently harvesting limit of 7mm thick corals is not adequate.

Morphology is variable, thus number of branches is likely to be a more practical and universal descriptor for proper management. it may not be as perfectly correlated to age, but is more relevant ecologically in a colonial organism.
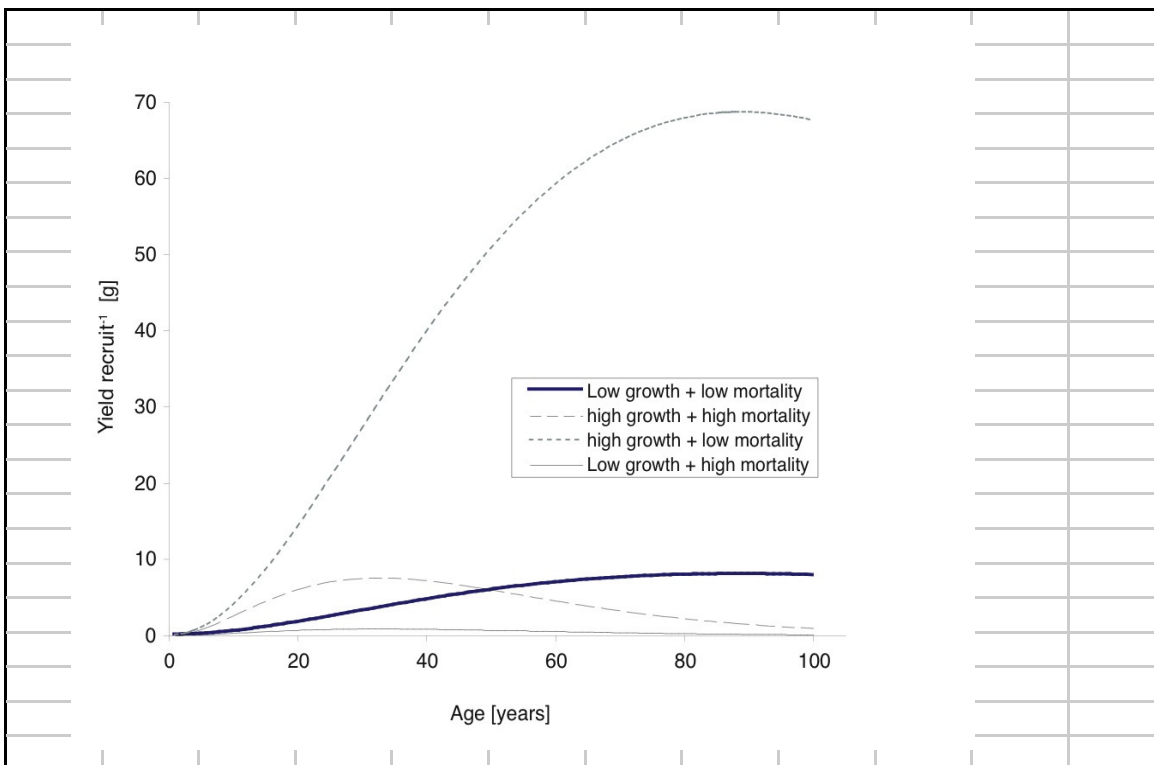
This sheet will be activated once the previous page will be successfully completed

Code: rum710Geo

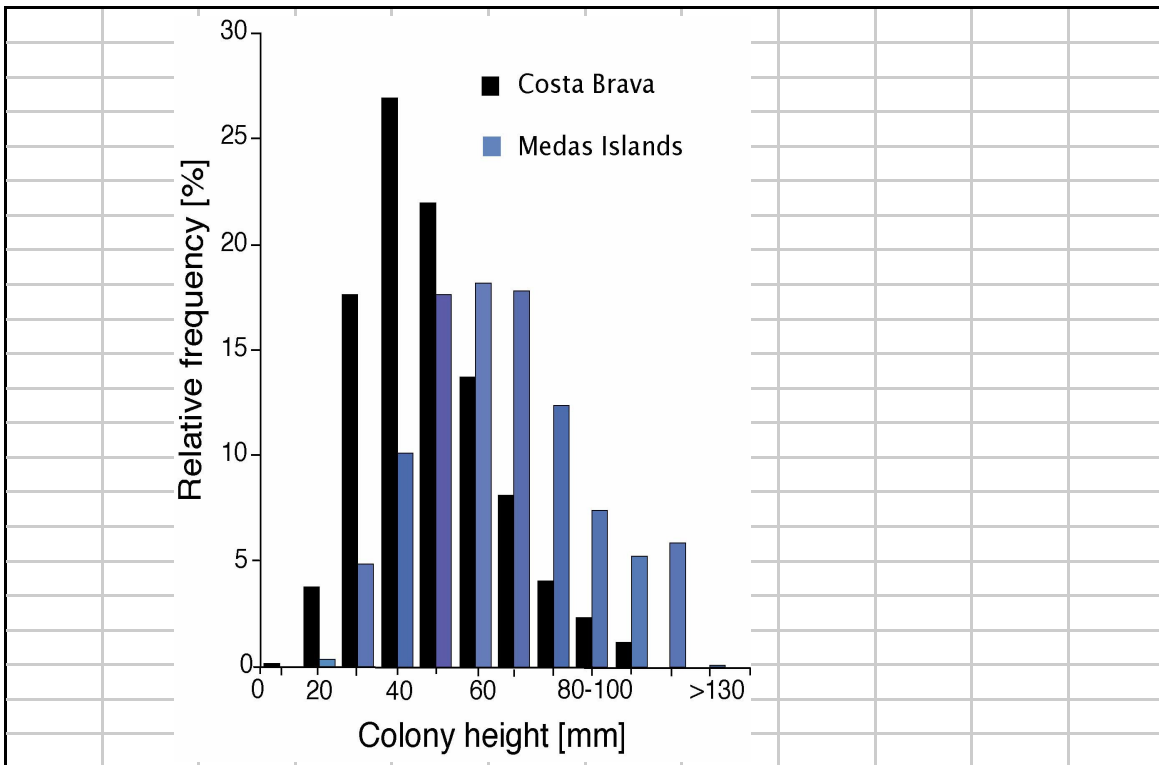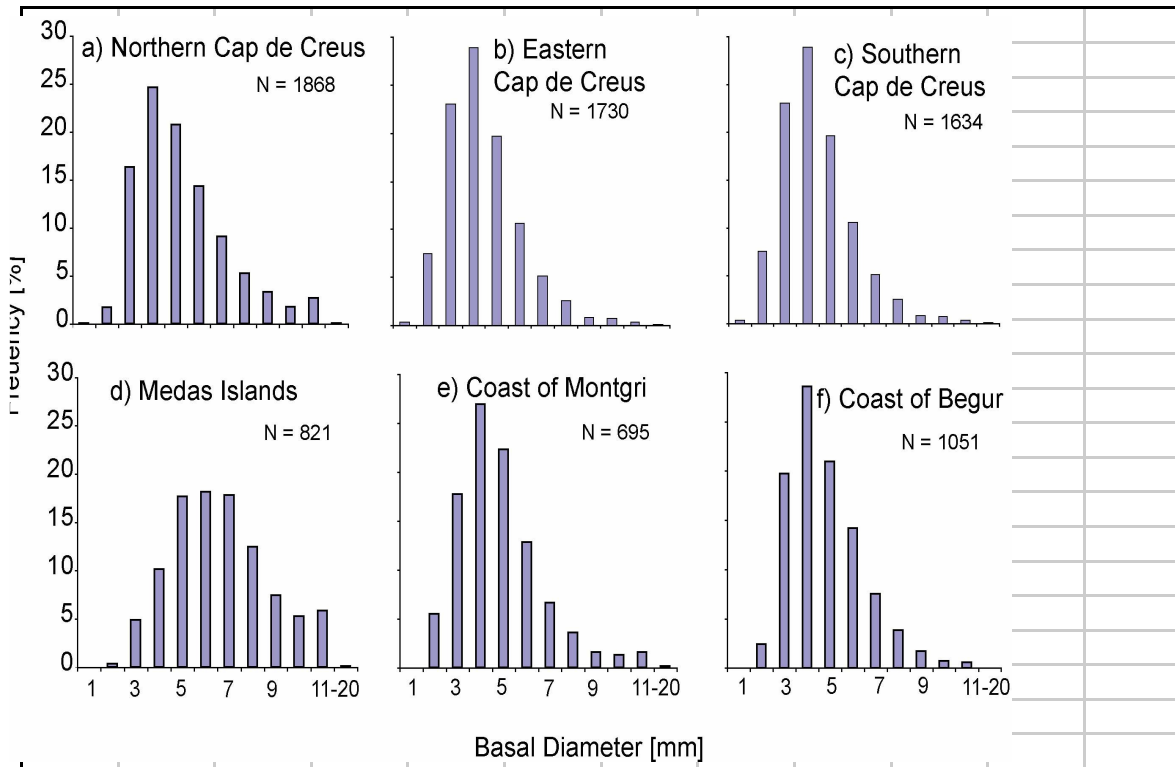Page 2 /

Other assessment methods

This sheet will be activated once the previous page will be successfully completed

Code: rum710Geo

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Other assessment methods

a) Northern Cap de Creus N = 1868

b) Eastern Cap de Creus N = 1730

c) Southern Cap de Creus N = 1634

d) Medas Islands N = 821

e) Coast of Montgri N = 695

f) Coast of Begur N = 1051

Basal Diameter [mm]

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Indicators and reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B					
SSB					
F	0.3358				Natural mortality: 0.0242. Total mortality from population curve: 0.36
Y					
CPUE					

Stock Status* Use one (or both) of the following two systems for the stock assessment status description

	☐	? - (or blank) **Not known or uncertain**. Not much information is available to make a judgment;
	☐	U - **Underexploited, undeveloped or new fishery**. Believed to have a significant potential for expansion in total production;
	☐	M - **Moderately exploited**, exploited with a low level of fishing effort. Believed to have some limited potential for expansion in total production;
Uni dim ens ion al	☐	F - **Fully exploited**. The fishery is operating at or close to an optimal yield level, with no expected room for further expansion;
	☒	O - **Overexploited**. The fishery is being exploited at above a level which is believed to be sustainable in the long term, with no potential room for further expansion and a higher risk of stock depletion/collapse;
	☐	D - **Depleted**. Catches are well below historical levels, irrespective of the amount of fishing effort exerted;
	☐	R - **Recovering**. Catches are again increasing after having been depleted or a collapse from a previous;

◉ NONE

Exploitation rate		**Stock abundance**		
☐ No or low fishing		☐ Virgin or high abundance		☐ Depleted
☐ Moderate fishing mortality		☐ Intermediate abundance		☐ Uncertain / Not assessed
☐ High fishing mortality		☐ Low abundance		
☐ Uncertain / Not assessed				

◉ NONE **◉ NONE**

Sheet D (page 2)

Comments

This assessement focuses on the stocks from 0-60m depth, which are thorougly surveyed and where the fishery concentrates. Few dives to 70-130meters depth are made, because most of the divers use traditional air SCUBA devices.

The two recent workshops on Red Coral fishery and conservation in Naples (2009) and Sardinia (2010; see the respective reports) both recomended unisono a Mediterranean-wide ban of coral fishing in 0-80m or 0-50 meters respectively. There were no objections by industry and fishermen to these resolutions, because they know that economically valuable coral is left only beyond 60m. Divers in Morocco still harvest without size limitation and are not trained/equipped to dive deeper than 50m.

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Management advice and recommendations*

Management advise agred upon during recent red coral consultation meetings by NOAA, the Italian Government, and the GFCM:

Revision of minimum size limits for each fishery in different geographic regions using scientific models. Until then, a new size limits of at least 10mm base diameter is proposed (which may not be sufficient for all regions due to geographical variation).

Colony height and number of branches should be used as an additional descriptor.

Shallow water populations in practical air diving depth need to be fully protected from harvesting 0-50m or 0-80m.

Set appropriate quotas and number of licenses for deep stocks beyond 60m.

No use of new technology (remote harvesting) without prior impact assessment.

Improved monitoring of the fisheries, collecting size data of landed corals. Daily control of quotas.

Improved enforcement against poaching.

Establishing permanent no take areas as recruitment reservoirs

Annual revision of management measures in an adaptive management approach

Advice for scientific research*

Stock assessment prior to harvesting, and ongoing scientific monitoring, especially of deep populations beyond 60 meters: Population structure, abundance and stock size.

Studying the use of more advanced models.

Robust estimates for factors of use in advanced fishery models: Maximum age, mortality values, growth rates in function of environmental paramenters, coral morphology, alternative size descriptors. Size of landed corals.

Connectivity of populations

Identification of potential unfished virgin populations. If such populations exist, a fraction of them should be protected, for example, as UNESCO World Heritage Sites. These sites would serve as a base line reference for scientific research.

Abstract for SCSA reporting

Authors	Georgios Tsounis, Sergio Rossi, Josep-Maria Gili	Year	2010

Species Scientific name Corallium rubrum

Source: -

Source: -

Source: -

Geographical Sub-Area 7

Fisheries (brief description of the fishery)*

The fishery in the studied stock for red coral allows only manual collection harvest by SCUBA divers (as is typical in all the Mediterranean). Most of the harvesters use traditional air SCUBA and work in depths less than 60m most of the time. The number of dives per year using mixed breathing gasses in 60-130m is very low (Tsouns et al. 2007). Poachers outnumber legal divers and seem to work exclusievly shallow, without respecting size limits.
Licensed harvesters are allowed to work during summer only, and to harvest a 400kg quota per year. The minimum size in Spain is 7mm of base diameter. There are usualy about 10-12 licenses active. Size of landed coral is not recorded, and stock surveys were done in 1986 and 2003.

Source of management advice*

(brief description of material -data- and methods used for the assessment)

Bruckner, A. & Roberts, G. (eds) 2009. Proceedings of the First International Workshop on Corallium Science, Management and Trade. NOAA Technical Memorandum. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. Washington.

Bussoletti E, Cottingham D, Bruckner A, Roberts G, and Sandulli R (eds) 2010. Proceedings of the

Bussoletti E, Cottingham D, Bruckner A, Roberts G, and Sandulli R (eds) 2010. Proceedings of the International Workshop on Red Coral Science, Management, and Trade: Lessons from the Mediterranean, September 23 - 26, 2009, Naples, Italy. NOAA Technical Memorandum CRCP-13. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. U.S. Department of Commerce.

FAO Fisheries Report GFCM: SAC13/2011/Inf. Report of the Transversal workshop on red coral Alghero (Sardinia), Italy, 16-17 September 2010. Food and Agricultural Organisation of the United Nations, Rome.

Tsounis G, Rossi S, Gili JM, Arntz WE (2007) Red coral fishery at the Costa Brava (NW Mediterranean): Case study of an overharvested precious coral. Ecosystems, 10: 975-986

Tsounis G, Rossi S, Grigg RW, Santangelo G, Bramanti L, Gili JM. (2010) The Exploitation and Conservation of Precious Corals. Oceanography and Marine Biology Annual Review. Vol 48: 161-212

Stock Status*

Exploitation rate

Stock abundance

Comments

The current fishing mortality (0.358) is extremely high for a longevous, low production species.

Management advice and recommendations*

Improved local enforcement against poaching through revising not only on-the-water vigilance, but also the legal system.

Legally binding transnational management umbrella, e.g. through the GFCM.

Revision of minimum size limits for each fishery in different geographic regions. Until then, a new size limits of 10 - 20 mm base diameter and 200 mm in height may serve as an initial estimate. Number of branches should be used as an additional descriptor.

Ban of shallow water coral harvesting in air diving range down to approximately 60 - 80 m depth.

Deep coral harvesting is organisation intensive, resulting in lower fishing effort. using remote robot technology however, will allow 24h access to the corals and rely entirely on adequate enforcement, which currently is demonstrable ineffective.

Set appropriate quotas and number of licenses for deep stocks, before these are harvested. Where necessary, licenses can be withdrawn by not transferring licenses of retiring divers.

Improved landings recording of the fisheries. Most importantly, the size of harvested corals needs to be documented and published (e.g. via the FAO).

Large Marine Protected Areas. Only a fraction of the deep habitat should be harvested, in order to ensure high biodiversity and overall productivity of the entire ecosystem.

Rotation harvesting should be abandoned in favor of sustainable harvesting of each stock.

Advice for scientific research*

Identification of potential unfished virgin populations, and, if such populations exist, a fraction of them should be protected for future research, for example, as UNESCO World Heritage Sites. Further models for red coral habitat protection (especially in international waters) may be the example of UN VMEs, which are designed by NAFO.

Stock assessment prior to harvesting, and ongoing scientific monitoring.

Mortality values , growth rates and population structure of deep populations beyond 60 meters.

Impact assessment of new technology (remote harvesting) prior to allowing their use.