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Con la colaboración de:



Rafik Nouaili, Carlos Montero-Castaño
& José Luis Sánchez-Lizaso

**Environmental sustainability analysis of
the clam (*Ruditapes decussatus*, Linnaeus
1758) fishery in Zaboussa production area
(southeastern Tunisia) using the MSC
fisheries standard**

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Environmental sustainability analysis of the clam (*Ruditapes decussatus*, Linnaeus 1758) fishery in Zabooussa production area (southeastern Tunisia) using the MSC fisheries standard

RAFIK NOUAILI^{1,2}, CARLOS MONTERO-CASTAÑO^{1,3},
JOSÉ LUIS SÁNCHEZ-LIZASO¹

¹ Department of Marine Sciences and Applied Biology, University of Alicante, POB, 99, E-03080 Alicante, Spain.

² General Directorate for Fisheries and Aquaculture, 30 Rue Alain Savary 1002 Tunis Tunisie.

³ Marine Stewardship Council, Paseo de La Habana, 26, 7º puerta 4, 28036, Madrid, Spain.

Abstract

The Tunisian grooved carpet clam *Ruditapes decussatus* (Linnaeus 1758) fishery is of interest to the authorities due to its social importance and its economic contribution given the

export nature of its product. Efforts have been made to ensure proper management and development of this fishery. A sustainable exploitation of the natural resource is of crucial relevance to guarantee the socio-economic role of the fishery. Therefore, sustainability should be integrated within those management measures and development actions. To analyse the sustainability level of the fishery concerning the main obstacles and actions needed to achieve it, the most recognized tool worldwide is the MSC certification program throughout its fisheries standard. The present study assesses the Zaboussa production area clam fishery using the 31 performance indicators of the 3 principles of the MSC standard for sustainable fisheries. The results of the assessment show that this fishery could be potentially considered sustainable and, therefore, certifiable though implementing an action plan to satisfy four conditions to improve research, surveillance and monitoring measures.

Keywords: clam fishery, *Ruditapes decussatus*, MSC certification, management, sustainability, Tunisia, Mediterranean Sea.

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Résumé

La pêcherie tunisienne de la palourde croisée d'Europe Tunisienne *Ruditapes decussatus* (Linnaeus 1758) présente un intérêt certain en raison de son poids social et économique et sa contribution dans la dynamique des exportations des produits de la pêche. Des efforts ont été déployés pour assurer la gestion et la promotion de cette filière. Une exploitation durable de la ressource naturelle est donc d'une importance cruciale pour garantir le rôle socio-économique de la pêche. Ainsi, la durabilité devrait impérativement être intégrée au niveau des mesures de gestion et des actions de développement. Pour analyser le niveau de durabilité d'une pêcherie en mettant en exergue les principales contraintes et les actions nécessaires pour y remédier, l'outil le plus reconnu au monde est le programme de certification MSC dont les standards sont souvent utilisés pour plusieurs pêcheries.

La présente étude a évalué la pêche à pied de la palourde dans la zone de production de Zaboussa en utilisant 31 indicateurs de performance des 3 principes de la norme MSC. Les résultats de l'évaluation montrent que cette pêcherie pourrait être considérée potentiellement bien gérée et, par conséquent, éligible à cette certification à condition d'établir un plan d'action pour remplir quatre conditions ayant pour

principaux thèmes la recherche et investigations de l'espèce cible et le contrôle et surveillance de l'activité de pêche.

Mots-clés : pêche de la palourde, *Ruditapes decussatus*, certification MSC, gestion, durabilité, la Tunisie, la mer Méditerranée.

1. Introduction

The world's marine fisheries resources are under enormous pressure. The global fishing effort is estimated to exceed the optimum by a factor of three to four (Pauly and *al.*, 2002). FAO reported that Mediterranean and Black Sea had 33 percent of assessed stocks fully exploited, 50 percent overexploited, and the remaining 17 percent non-fully exploited in 2009 (Sofia, 2014). The reasons for this crisis can be found, not just in illegal practices but also in fisheries management failures such as an inappropriate fleet modernization, inadequate efficiency increase in fishing gear and methods or the increase of water pollution (Nouaili, 2013).

Modern fisheries management is moving towards a precautionary approach to ensure sustainable utilization of our marine resources (ICES, 1997). Several mechanisms have been introduced by governments at the national, regional and international levels to face sustainability (Nouaili, 2013). Notably

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in the case of Tunisia there should not only be an emphasis on decreasing the fishing effort but also on the coordination with the European Common Fisheries Policy. Additionally, the globalized nature of the seafood market worldwide implies that commercial issues are key features to integrate in the decision making process of the fisheries management. Thus, commercial tools such as eco-labels and certification programs might play a relevant role to drive improvements within fisheries. Fisheries certification is an emerging market-based instrument existing alongside traditional regulatory and economic policies (Pérez-Ramirez, 2012).

Since the 1990s several eco-labelling schemes for fisheries have developed in response to public society concerns regarding the sustainability of fish stocks, the impacts of fisheries on other species and the effects of the fishing activity on marine habitats (Kirby et al., 2014).

The Marine Stewardship Council (MSC) is the most-known fisheries certification organization (Froese et al., 2012). MSC Principles and Criteria are further designed to recognize and emphasize that management efforts are most likely to be successful in accomplishing the goals of conservation and sustainable use of marine resources when there is full co-operation among the full range of fisheries stakeholders, including

those who are dependent on fishing for their food and livelihood (MSC, 2002).

There are currently 216 certified fisheries in the World and 111 in assessment and 10.5% of wild caught global seafood landings are MSC certified or in assessment (MSC a, 2015). Among these 327 fisheries, there are some clams' fisheries included which mobilizes a large community of small-scale fishers throughout the world. The first fishery in this category to become MSC certified was the Burry Inlet estuary hand-raking fishery on the western part of the United Kingdom, which is certified since 2001 (MSC b, 2015).

The clam fishery in Tunisia has an important socio-economic impact. On one hand, it implies an important contribution in terms of employment and, on the other hand, the export of clams constitutes a considerable engine for economic growth in the region (Nouaili, 2007). Several projects have been developed, with the support of the Tunisian Government, addressed to support the clam fishery sector through the establishment of a regulatory and institutional basis or the improvement of supervision and monitoring activities. Although the achievements of those projects and the fact that the clam sector seems overall to be well organized, a lot of measures and actions could be considered in order to improve the en-

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vironmental and socioeconomic performance of the fishery, especially in the field of resource management and promotion of the product.

A potential certification of the Tunisian clam fishery against the requirements of the MSC certification program might not only lead to an improved market-access and hence a potential increase in prices, but also to serve as a monitoring tool to assure the sustainable exploitation of clams which could be expanded to other neighbouring countries in the southern Mediterranean region. This article is focused on the presentation and description of activities related to fishing, processing and marketing clams (*Ruditapes decussatus*) in Tunisia and the sustainability analysis against the MSC fisheries standard of this fishery in the Zaboussa production area.

2. Presentation and description of the clam sector in Tunisia

Ruditapes decussatus (Linnaeus, 1758) is the only species of bivalve molluscs which is harvested in the wild on the Tunisian coast (Zamouri-Langar, 2010). Its fishing activity started at the turn of the 1950's at a time when foreign demand for clams was growing. The Tunisian coastal zone is known for their natural populations of clam in some particular areas. This

irregular distribution of resources, concentrated in the south of Tunisia and nearly absent in the central area, explains the presence of a large population of by foot fishermen, especially in the regions of Sfax, Gabes and Medenine (Nouaili, 2013).

At the beginning of the fishery, Tunisian clams were not subject to any prior treatment and were exported in bulk to European countries. The depuration procedure was responsibility of importers meaning that there was a shortfall for Tunisian operators (Belkahia, 1997). Due to the trade liberalization, new standards and requirements have been established for imports of seafood products in several countries including the European market. The European Union (EU) has enacted numerous directives laying down the sanitary and hygienic conditions for the production and the access to the market of seafood products and live bivalve molluscs in particular (Nouaili, 2007).

Since 1995, Tunisia has been implementing several actions to adapt the production, processing, transportation and marketing activities to the European market requirements. These efforts have resulted in the accreditation and registration of Tunisia in the list of countries allowed to export to the EU in 1998 (Ibn Ichbil, 2010). Since then, the clam industry has established a new organizational structure which has contribut-

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ed to i) the creation of 17 production areas of bivalve molluscs, each with its own sanitary and hygienic code (table 1) ii) the implementation of a sanitary and hygienic monitoring network and iii) achieving the approval for Depuration and Dispatch Centres (DDC) for clams in accordance with national legislation and sanitary and hygienic requirements (Belkahia, 1997 et Nouaïli, 2007).

Table 1. Delimitations of clam production areas in Tunisia (MARHP, 2004)

Production areas	Classification	Sanitary number	Geographic data
Lake of Tunis (North)	B	T1	Lake chikli North shore of the lake
Chennal of Tunis	C	T2	Rades port TGM line-South Lake
Menzel Jemil	C	B1	300 m from dike, ONP discharge, Wadi Nechrine
Faroua	C	B2	1km bridge, railway tracks Tinja South point of jazira kébira
North of Sfax	C	S1	Draa Ben Zied Haggouna
Gargour	B	S2	Pier Tabia Sidi Freah
Guétifa	C	S3	Ras Bourmada Ras Barkallah

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Production areas	Classification	Sanitary number	Geographic data
W.North Maltine	B	S4	Wadi kébir Ras Younga Nord
W.South Maltine	B	S5	Ras Younga Sud Ras Ferchatt
Skhira	B	S6	Chaara Nadhour Bou-Saïd
North Gabes	B	G1	Wadi Om Ghram Tarf El Ma
South Gabes 1	B	G2	Wadi Ashan Wadi Om El Abayer
South Gabes 2	B	G3	Wadi Om El Abayer Sabkha Mezessar
North Mednine	B	M1	Sabkha Mezessar Cable teleg.(Tarf Jorf)
Bougrara lagoon	C	M2	N (Câb teleg).O (Litt Meden) E (Litt Djerba).S (Borj Kastill)
North Djerba	B	M3	Câble Teleg.(Côté Djerba) Houmet Souk
Lamsa	B	M4	Lamsa et Jdaria

Fishers on foot are important players in the clam sector. They are mostly women working in extreme weather conditions and earning lower incomes than the minimum wage. Outside the local community, this contribution by the women has no visibility and remains unacknowledged. Clam sector development

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and harvesting groups have been working since 2004 both to organize fishing activities and primary marketing (Nouaili, 2013). These groups act as a link between fishers and exporters (Nouaili, 2007)

The General Directorate of Fisheries and Aquaculture is the competent authority for the sector at national level. It is responsible for upgrading the industry and maintaining national and international requirements. It determines the fishing seasons, issuing of fishing licenses and controlling the activity from collection to product development. The General Directorate of Veterinary Services on the other hand is responsible for technical control (sanitary and hygiene) of seafood products. It has the authority to control the import, export and monitor the sanitary and hygienic characteristics of seafood products at each step of the production chain (Nouaili, 2013). A network monitors microbiological and animal health parameters as well as toxic phytoplankton, biotoxins and chemical contaminants. Laboratories participating in this network belong to the Institute of Veterinary Research of Tunisia and the National Institute of Science and Technology of the Sea (Nouaili, 2007). Moreover, the depuration of clams is provided by nearly twenty DDCs.

Before the development of the clam sector and the establishment of the harvesting groups, the clams' primary marketing was controlled and administrated by wholesalers who bought clams from fishers and sold them to DDCs, hotels and restaurants. Nowadays, the creation of these harvesting groups, one for each production area, constitutes a step towards a greater accountability of the different participants of the production phases (Belkahia, 1997). Groups are the relay point between fishers and buyers. It is thus mandatory to procure clams exclusively from representatives of these groups that provide product from a safe area. This is the first step to ensure traceability.

National clam production in Tunisia has experienced rather irregular changes over time. Indeed, this production shows strong annual variations explained by the temporary closures of production areas due to sanitary conditions or market trends. The evolution of the production during the last decade has witnessed a relative stabilization around an average of 600 tonnes per year (Nouaili, 2007). This increase is primarily due to the improvement and stabilization of the sanitary conditions of the production areas, the better control of these sanitary conditions in the management areas and consolidation of operators in the sector (Ibn Ichbil, 2010 and Nouai-

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li, 2007). The European Union, and more in particular Italy, remains the main destination for clam exports where more than 75% of the entire Tunisian clam production is consumed (Nouaili, 2007).

3. MSC certification scenario of the Tunisian clam fishery

3.1. Methodology for scoring fisheries against the MSC Principles and Criteria for Sustainable Fishing

The MSC was established in 1997 with the primary goals of ensuring the sustainability of fish stocks globally, minimizing environmental impacts, and promoting effective management of fisheries (Martin *et al.*, 2012). The organization sets sustainable fisheries standard based on three principles: (1) status of the target stock, (2) ecological and environmental impact of the fishery, and (3) management systems within which the fishery operates. Under each of these principles are 31 'performance indicators' that address specific aspects. Fisheries must achieve a minimum score of 60 (out of a possible 100) for each performance indicator and an average score of 80 or above for each principle. For any performance indicator scoring below 80 but above 60, the certifier must assign a condition that will raise the score to 80 over a specified pe-

riod of time to a maximum of five years (MSC, 2002). This scoring system is applied to measure the sustainability level of a particular fishing activity defined by a “Unit of Certification (UoC)”. UoC is defined as “target stock(s) combined with the fishing method/gear and practice (including vessel type/s) pursuing that stock, and any fleets, or groups of vessels, or individual fishing operators that are covered by an MSC fishery certificate (MSC c, 2015).”

In order to justify the scoring of each performance indicator, we carried out an analysis of all the relevant documents such as the statistics data, the research works but also the scientific publications. Moreover, surveys and semi-structured interviews have been elaborated with the different stakeholders. This database allowed evaluating the performance of the fishery in relation to the evaluation tree. The results presented come from a pre-assessment analysis and therefore this is just a previous exercise of a real MSC full assessment needed in order to become MSC certified.

3.2. Unit of Certification analysed and proposed

The Unit of Certification (UoC) analysed in this study and proposed for a potential MSC certification is the grooved carpet

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clam (*R. decussatus*) hand-raking fishery harvested on foot in the production area of Zaboussa.

The eligible fishers whose fishing activity is analysed in this UoC and therefore the beneficiaries of its potential certification are the Inter-Professional Group of Fishing products and all members and participants from the group of the exploitation of the clam in Zaboussa area. This Unit of Certification is defined as shown in Table 2.

Table 2. Details of unit of certification clam production area of Zaboussa

Target species	<i>Ruditapes decussata</i> – Grooved carpet shell
Stock	Gulf of Gabes (Region of Sfax - production area : S5)
Fishing area	It extends along the tidal zone (15 km) from the south Oued Maltine to the port of Zaboussa so that's from Ras Younga South to Ras Ferichatt including Kneiss island.
Fishing method	Harvest on foot: small hand rake practiced mostly by women
Authority fishery management	The Ministry of Agriculture: District Fisheries and Aquaculture - Commissioner Regional for Development Agriculture of Sfax and the Directorate-General for Fisheries and Aquaculture.

3.3. Overview of the clam fishery carried out by the “Unit of Certification”

The production area of Zaboussa is located near to El Hchichina town in the delegation of Ghraiba, about 70 km south of the Sfax city, and it is part of the Gulf of Gabes. This zone is characterized by Kneiss archipelago which consists of four islands, the most important being the island of Bessila covering approximately 480 ha. The zone holds the sanitary code “**S5**” corresponding to the coastal area between the Oued Maltine and port Zaboussa (Fig. 1). It is remarkable gravitational tides in the Gulf of Gabes, to 1.4m in height between high and low tide.

Reasons for choosing this area include particularly that (i) it has benefited from activities of the FAO project “Strengthening the role of women in the shellfish clam industry in Tunisia” and (ii) it contributes significantly to national production with usually more than 40 percent of total production.

Currently, nearly 400 persons were involved in this activity in the study area, the majority of them from Maaouma, Khaoula and Hechichina communities. This area is served by two landing sites. This population is young, mostly women, with an average age of 30 years. The activity is learnt on the job across generations (Nouaili, 2007).

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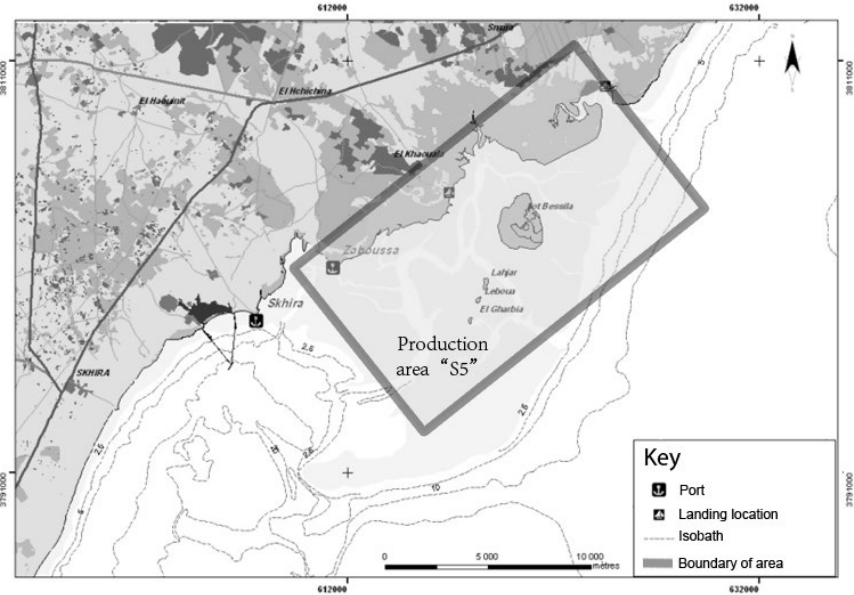


Figure 1. Delimitations of Zaboussa clam production area “S5”.

These fisherwomen are poor and marginalized and tend to have low educational qualifications and are registered in the clam development and harvesting group of EZDIHAR, an entity created in 2004 whose wholesalers are exclusively men. Many of the local fisherwomen believe that this entity has not improved their income or working conditions (Nouaili, 2013).

As soon as the tide is low, collectors make their way to the production areas. They are scattered along the foreshore

equipped with a sickle and container. The duration of the fishery is dependent on the duration and characteristics of the tide (Belkahia, 1997).

The shellfish picker's activity is subject to a special permit issued by the competent authority: "Commission for regional agricultural development". Under the regulations, fishing clams is prohibited during the period from 15th May to 30th September each year. Administrative supervision aims at ensuring compliance with fisheries regulations including minimum catch size (diameter of 3.5 cm) and the origin of product (Mekni, 2011).

Indeed, the primary marketing of clam always takes place at the landing sites that have been officially designated by regional authorities and where sorting and weighing takes place under the supervision of representatives of the harvesting groups. The transaction of sales brings together "Fishery Guardians", representatives of Depuration and Dispatch Centers (DDC) and representatives of harvesting groups. Besides, a transport document, the first link of traceability, is issued exclusively by Fishery Guardians to the representatives of Depuration and Dispatch Centers (DDC) (Nouaili, 2007).

DDC also must comply with the requirements of the identification marking and labelling by which traceability is established

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from primary production to the stage of the local market or export.

In Tunisia, research on stock assessment of bivalve molluscs is ad hoc and sporadic (Nouaili, 2013). The results of a study to evaluate stocks of bivalve species in Tunisian coastal areas undertaken by the National Institute for Marine Science and Technology in the framework of the project «Stock Assessment of Ecosystem Benthic Resources» during 2002-2005 revealed a large potential for commercially valuable shellfish exploitation including the clam species *Ruditapes decussatus* whose concentrations can reach more than 400 specimens per m² (Zamouri-Langar et al., 2001).

Using data from eleven clam fishing seasons (2002-2013) in the production area S5, it was possible to apply a Schaefer's model which concluded that MSY is about 200 tonnes for a fishing effort of 65,000 fishermen*days of actual work (Fig. 2). The stock of clam in S5 area seems moderately exploited (Nouaili, 2013).

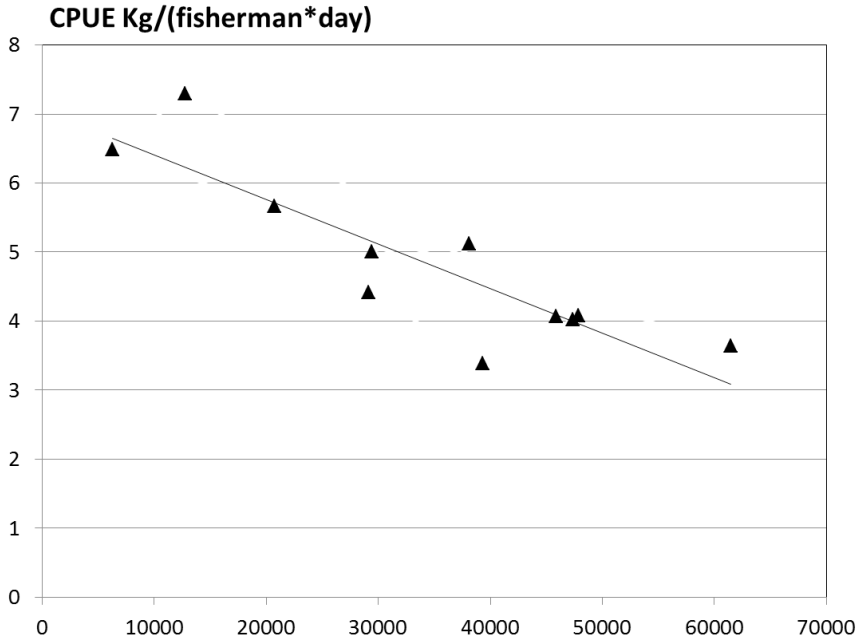


Figure 2: CPUE in Kg /(fisherman*day) in front of effort in fisherman*day for the Zaboussa clam fishery (2002-2013) to estimate parameter of the Schaefer model.

4. Analysis results

With regard to the Principles and Criteria of the MSC, for the case of Zaboussa clam fishery, the three Principles have achieved a scoring above 80 (green colour) and no performance indicator achieved less than 60, which is the minimum

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level required for certification (table 3). It is therefore determined that the Zaboussa clam fishery could be potentially considered sustainable, and therefore certifiable according to the Marine Stewardship Council Principles and Criteria for Sustainable Fisheries. The chosen basis is therefore eligible for certification provided that a plan is established to satisfy four conditions having as principal themes the research and investigation of the target species and the supervision and monitoring of the fishing activity.

The requirements for Principle 1 are fulfilled through the stock status indicator and the existence of a precautionary harvest strategy. Appropriate measures were taken in order to preserve the resource and to allow its sustained use such as (i) closure of fishery during the period from May 15th to September 30th of each year (ii) obligation to keep a fishery license renewable annually and issued by the competent authority, fixing of the size of the first capture to 35 mm and ban on the use of any fishing gear other than the sickle (Nouaili, 2013). Research is carried out to identify valuable information such as abundance, stock distribution and age structure. An integrated management plan for this region was prepared since 2008.

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Table 3. Score at Performance Indicator level

Prin- ciple	Wt (L1)	Component	Wt (L2)	PI No.	Performance Indicator (PI)	Score		
One	1	Outcome	0.5	1.1.1	Stock status	100		
				1.1.2	Reference points	100		
				1.1.3	Stock rebuilding	Not considered		
		Management	0.5	1.2.1	Harvest strategy	60		
				1.2.2	Harvest control rules & tools	100		
				1.2.3	Information & monitoring	60		
				1.2.4	Assessment of stock status	100		
Two	1	Retained species	0.2	2.1.1	Outcome	100		
				2.1.2	Management	100		
				2.1.3	Information	100		
		Bycatch species	0.2	2.2.1	Outcome	100		
				2.2.2	Management	100		
				2.2.3	Information	100		
		ETP species	0.2	2.3.1	Outcome	100		
				2.3.2	Management	100		
				2.3.3	Information	100		
		Habitats	0.2	2.4.1	Outcome	100		
				2.4.2	Management	100		
				2.4.3	Information	100		
		Ecosystem	0.2	2.5.1	Outcome	100		
				2.5.2	Management	100		
				2.5.3	Information	100		
		Three	1	Governance and policy	0.5	3.1.1	Legal & customary framework	100
						3.1.2	Consultation, roles & responsibilities	100
						3.1.3	Long term objectives	100
3.1.4	Incentives for sustainable fishing					100		
Fishery specific management system	0.5			3.2.1	Fishery specific objectives	100		
				3.2.2	Decision making processes	100		
				3.2.3	Compliance & enforcement	60		
				3.2.4	Research plan	60		
				3.2.5	Management performance evaluation	100		

Key colour scoring	100	Above 80
	60	Between 60 and 80

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Regarding the requirements for Principle 2, they are met through the focused use of resource. Indeed, Tunisian fishing by foot exclusively target clams (*Ruditapes decussatus*) and consequently the fishery does not pose a risk of serious or irreversible harm to other retained species and does not hinder recovery of depleted retained species. Clam fishing by foot using a sickle is a highly selective fishing method and has no major side effects on the bycatch populations or on the endangered, threatened and protected (ETP) species. The study of Kneiss management plan explored all potential impacts on the ecosystem within that area and none were given to shellfish pickers' activity (APAL, 2008).

Lastly, regarding the Principle 3, the requirements are fulfilled through an efficient management system within an appropriate legal framework in accordance with MSC Principles 1 and 2. The follow-up of clams sector and all measures initiated were done by steering national and regional committees comprising all stakeholders and actors (including research, and administration) in order to ensure their views and a participatory management (Nouaili, 2013).

Four performance indicators (PI) were noted between 60 and 80 (yellow colour in table 3) and resulted in specific conditions. For these PI, conditions must be established to enable

the beneficiaries to improve the performance of the fishery. In the eventual case of proceeding with a certification, the beneficiaries shall develop an Action Plan to satisfy these four conditions.

The competent authority should build on the significant accomplishments and recommendations achieved from the research program to develop an appropriate strategy for the management and development of the resource. This strategy will therefore respond to the state of the stock and the elements of the harvest strategy. Furthermore, they ought to work together towards achieving management objectives reflected in the target and limit reference points (Nouaili, 2013).

5. Conclusion

The Zaboussa clam fishery can be a good candidate to be the first MSC certified fishery in northern Africa and Mediterranean sea due to the organization of the fishermen around a professional structure, the highly selective nature of the fishing technique, the interest in the ecological and environmental heritage, and the existence of a fairly complete organizational and institutional base to ensure a participatory approach in the planning and management of the sector. However, on the other hand, the marginal and precarious situation of the fish-

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ers' population and the relatively early stage of the Inter-Professional group can be seen as a real obstacle to the potential certification.

In conclusion, the MSC certification project of the coastal artisanal fishery of Tunisian clams is relatively ambitious considering the shellfish picker's precarious situation. Moreover, obtaining MSC certification would be a consecration of Tunisian efforts in management and development of fisheries. This will also call for greater coordination between all the stakeholders including research for the stock assessment component of clam's fishery, administration and extension for customized professional and technical support and finally fishermen group, principal player, for the provision and endorsement of the concept of MSC certification.

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