

Integrating fishermen's perception : A key success for the projected Marine Protected Area "Jabal Moussa"

Mohamed Rida Derdabi^{1*}, Mustapha Aksissou¹, and Patrick Triplet²

1. LESCIB, URL- CNRST N°18, University of Abdelmalek Essaâdi /Faculty of sciences/ Ecology, systematics and biodiversity preservation team
2. Director of the National reserve of "Some Bay, France; Patrick.triplet1@orange.fr

* Corresponding author: medridaderdabi@gmail.com

ARTICLE INFO

Article History:

Received: Oct. 25, 2021

Accepted: Dec. 29, 2021

Online: Jan. 19, 2022

Keywords:

Marine protected area,
Jabal Moussa,
Fishermen's perception,
Co-management

ABSTRACT

Marine protected areas (MPAs) have been created all over the world to preserve biodiversity and manage human activities such as fishing and tourism. Even though they are a result of human decision-making processes aiming to change human behavior, many MPAs have neglected the human dimension and therefore failed to accomplish their goals. Thus, taking into account local community perceptions would undoubtedly contribute to MPAs success and durability. This paper has been focused on assessing fishermen's perception of the projected marine protected area "Jabal Moussa" situated in northern Morocco and overlooking the strait of Gibraltar. The survey was conducted with 99 fishermen in the three fishing sites of this area. Results showed reluctance towards the idea of implementing a MPA. The majority of fishermen illustrated that the implementation of this MPA would lead to a decrease in catches and an increase in costs and charges if some fishing grounds were closed. Compensatory measurements would be an alternative to this loss. Fishermen affirmed that the projected MPA should be managed conjointly with local cooperatives and associations according to a co-management approach to reach its goals. This approach could avoid conflicts likely to occur during the creation and post-creation of the future MPA. For the success of the projected MPA, authorities/fishermen meetings should be organized to discuss the fears, benefits, incentives, expectations, mode of governance, zonation, etc... In this context, it is possible to move towards better management of the MPA, balancing the conservation of the marine ecosystem and the well-being of fishermen.

INTRODUCTION

Fish stocks are going to be overexploited all over the world. In response to this overexploitation, marine protected areas have been created, acting as tools to conserve biological diversity and sustainably manage fisheries (Botsford & Hastings, 2006; Worm *et al.*, 2006; Claudet *et al.*, 2008; Guidetti & Claudet, 2010; Bobiles *et al.*, 2015). In 2010, the number of MPAs in the world was 5800 (Toropova *et al.*, 2010); in

2012, it was 10280 (Spalding *et al.*, 2013). Whereas in 2015, Lubchenco and Grorud-Colvert (2015) reported a rise in MPAs reaching 12,000 (12 million km² of protected ocean).

In Morocco, specifically in 2004, the first MPA was created in the Alhoceima National Park (IbnTattou *et al.*, 2014). The year of 2013 witnessed the creation of 3 MPAs purposed for fishing (Alboran, Mogador and Massa) (www.mpm.gov.ma, 2019). However, social aspects such as human perception, which have been defined by scientists as processes “wherein people select, organize, interpret, retrieve, and respond to the information from the world around them” (Cen-López & Aguilar-Perera, 2020), was neglected in the approach of creating a MPA compared to the biological aspect. This neglectation took place despite the direct linkage between the MPAs and the environment in which they are implemented (Kelleher *et al.*, 1995a). Recently, studies have started to notice the growing interest of scientists and decision-makers in integrating the society perception into new management strategies (Gelcich & O’Keeffe, 2016). Hence, the relationship between stakeholder’s and decision-makers must be strengthened; knowledge about fishermen perception must be generated. Their needs, vision and goals must be integrated in the decision making process, thus, conflict between conservation of biodiversity and human activities (Lopes *et al.*, 2015; D’Anna *et al.*, 2016; Pieraccini & Cardwell, 2016) can be avoided through communication among different stakeholders (Markantonatou *et al.*, 2016). This communication combined with the involvement of fishermen at the first steps of implementation of the MPA is the best way to avoid conflicts likely to occur during the application of the regulations specific to the MPA. It would constitute the key of MPA success (Jentoft, 2000; Christie *et al.*, 2003; Jentoft, 2004; Chuenpagdee & Jentoft, 2007; Jentoft, 2007; Mikalsen *et al.*, 2007; Kooiman *et al.*, 2008; Guidetti & Claudet, 2010; Jones, 2014; Havard *et al.*, 2015; Read *et al.*, 2015; Rodriguez Rodriguez *et al.*, 2016; Schuhbauer & Sumaila, 2016). Otherwise, the lack or absence of communication with the local fishing community could lead to a feeling of marginalization and generate a resistance to the establishment of an MPA (Mikalsen *et al.*, 2007; Havard *et al.*, 2015; Pieraccini & Cardwell, 2016). That could lead without a doubt to failure in its creation or in its functioning.

In Jabal Moussa, artisanal fishing activities constitute the main source of income for the majority of the population. Limiting access to fishing without proposing compensatory measures would surely lead to a repudiation of the MPA. This is why it is necessary to assess the perception of the fishing community on the implementation of the projected MPA. Understanding fishermen’s fears, attitudes and expectations will allow decision-makers to take them into account, thus ensuring the success and the sustainability of the projected MPA. Our broad goal through the collection of data via field surveys was to bridge the division between decision makers and fishermen and provide authorities with a synthesis of fishermen’s opinions to reach a balance between biological diversity conservation and community well-being.

MATERIALS AND METHODS

1. Study area

Morocco has created four marine protected areas and is planning, through its national strategy of MPAs network, to create other ones. The marine part of the site of biological and ecological interest "Jabal Moussa" is one of the areas proposed to become a marine protected area in collaboration with the CAR/ASP (PNUE/PAM-CAR/ASP, 2016). It is located in northern Morocco, overlooking the strait of Gibraltar and is also part of the intercontinental biosphere reserve of the Mediterranean, in the framework of the international program Man and Biosphere of the UNESCO (T.M.S.A, 2010). Three fishing sites are located in the study area: Dalia, Oued Marsa, Belyounech (Fig.1).

The study area is known for its important biological diversity in terms of species and habitats, particularly with the presence of *Corallium rubrum*, a species protected by several international conventions, and also with the presence of algae, ascidians and anthozoa considered to be bio-indicators of water quality. Two *Zoostera marina* meadows of great ecological interest are also found. The important ecological diversity of the site justifies the interest of decision-makers to transform the marine part of the site of biological and ecological interest "Jabal Moussa" into a marine protected area (PNUE/PAM-CAR/ASP, 2016).

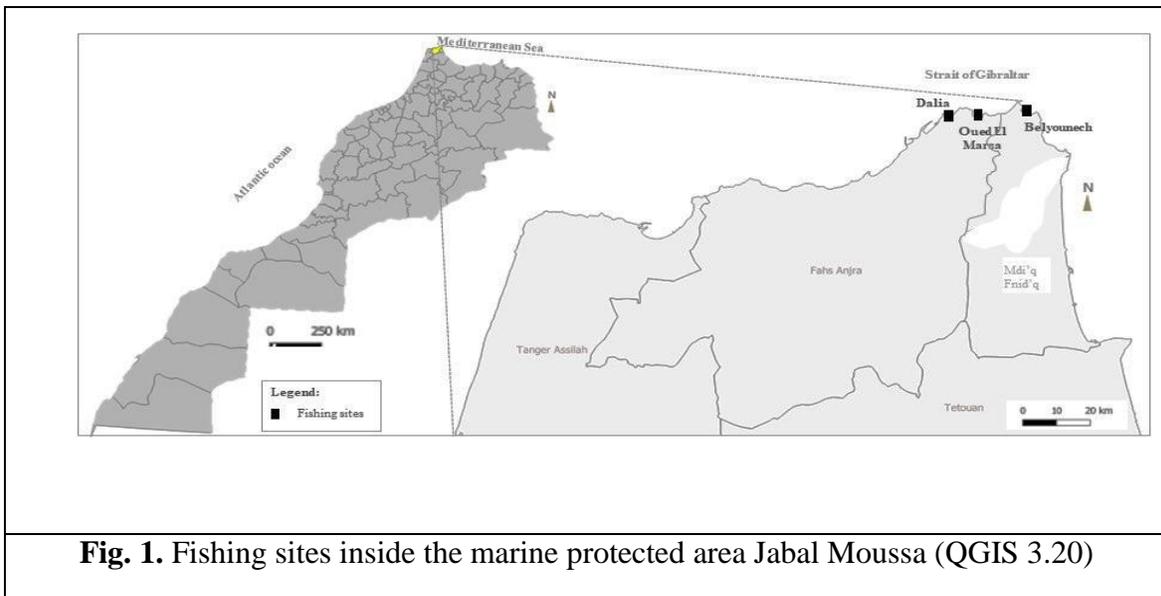


Fig. 1. Fishing sites inside the marine protected area Jabal Moussa (QGIS 3.20)

2. Methods

A survey was conducted in February and March 2019 based on face to face interviews. The ninety-nine active boats of the area were concerned by the study. The interview was often conducted with the responsibility of the manboat, but in case of his absence or a rejecting response to collaborate, another crew member was interviewed so

that only one person per boat was taken into consideration. The interview lasted about 20 minutes and was generally held once the fishermen come back from a fishing session.

The questionnaire (Table 1) was divided into four parts: The first part was concerned with the socio-demographic data of fishermen and their fishing activities. The second part dealt with the perception of the general state of the environment and resources. The third part focused on fishermen's perception with respect to the implementation of the projected marine protected area. The fourth part was related to possible compensatory measurements. It contained 22 questions, with 5 open-ended questions providing no restriction in answering and 17 close-ended questions with a set of fixed alternatives.

A map was used to help fishermen for the identification of the MPA limits. To avoid non-compliance and minimize false statements, researchers used to question fishermen about the perception of their colleagues instead of asking them directly.

RESULTS

1. Socio-demographic data

Age and experience are very important parameters to define fishing activity. Fishermen were 43.6 ± 11.4 years old and their average experience was 23.2 ± 13.4 years. Fishermen educational level is low, mainly dominated by Quoranic studies (Fig.2). Boats are made of wood and are totally equipped with out-board motors. Their average length is 5.60 m; the average power of engines is 17.15 HP, and the gross tonnage is 1.49 t (Table 2). The most used gear in the region is the blackspot seabream longline, targeting the blackspot seabream (*Pagellus bogaraveo*), the most valuable species in the region and species classified in the IUCN red list near threatened species. Static gears are rarely used and trawling is not used in the region.

2. Perception of the general state of the environment and resources

More than half of the fishermen mentioned a degradation in the the general state of fishery resources (Fig.3). They claimed that this deterioration affects the majority of species sold in the region, particularly the blackspot seabream. The results do not include the state of small pelagic species as the quantities landed in the region are limited. The causes explaining this degradation of the resource are diverse; however, overexploitation and ghost fishing are the most cited ones. According to fishermen, gaps in the fishing sector regulations and sometimes a lack of regulations contributes to this overexploitation.

Table 1 . Questionnaire applied to the fishing community

Socio-demographic data and fishing activities	1- Age	18-25, 26-35, 36-45, 46- 55, > 56
	2- Fishing experience	< 5, 6-15, 16-25, 26- 35, > 36
	3- Educational level	No school level, Quoranic school, Primary school, Junior high school, Senior high school, University
	4-Boat construction material	Wood, iron, polyester
	5-Boat characteristics (Length, engine power, gross tonnage)	Free answer
	6- Engine type	Out-board motor, In-board motor
	7- Used gears	Free answer
Perception on the general state of the environment and resource	9- What do you think of the general state of the fishery resources?	Degraded, in good condition, not known
	10- In the case of degradation, it concerns which species?	Free answer
	11- What do you think about the reason for this degradation?	Over exploitation, Ghost nets, Use of illegal gears, pollution, Tanger Med port-complex
Perception on the projected MPA	12- Have you ever heard of MPAs?	Yes, No
	13- If so, what is the role of MPAs?	Protect species, Protect ecosystems, Scientific research, Eco-touristic activities
	14- Do you know how MPAs are managed?	Free answer
	15- Do you agree with establishing an MPA in the area?	Agree, Disagree, No answer
	16- Do you agree with the limits proposed to the projected MPA?	Agree, Disagree, No answer
	17- Do you agree with the full-protected zone?	Agree, Disagree, No answer
	18- What is the role you could play in the conservation of the resource?	Free answer
	19- Do you think that your participation is primordial for MPA success?	Yes, No, No answer
	20- If so, how do you want to be represented	Personally, Through cooperatives and associations, No answer
Perception on compensatory measures	21- Do you agree with compensatory measures?	Agree, Disagree, No answer
	22- If you agree, what kind of measures do you prefer?	Monetary compensation, Eco-tourism activities, Purchase more sophisticated means of production, Aquaculture

Table 2 . Boats characteristics

Variable	Boats	Min	Max	Mean	Standard
Gross tonnage (t)	99	0.91	1.79	1.49	0.17
Length (m)		4.30	6.65	5.6	0.34
Power engine (HP)		8.00	25.00	17.15	3.34

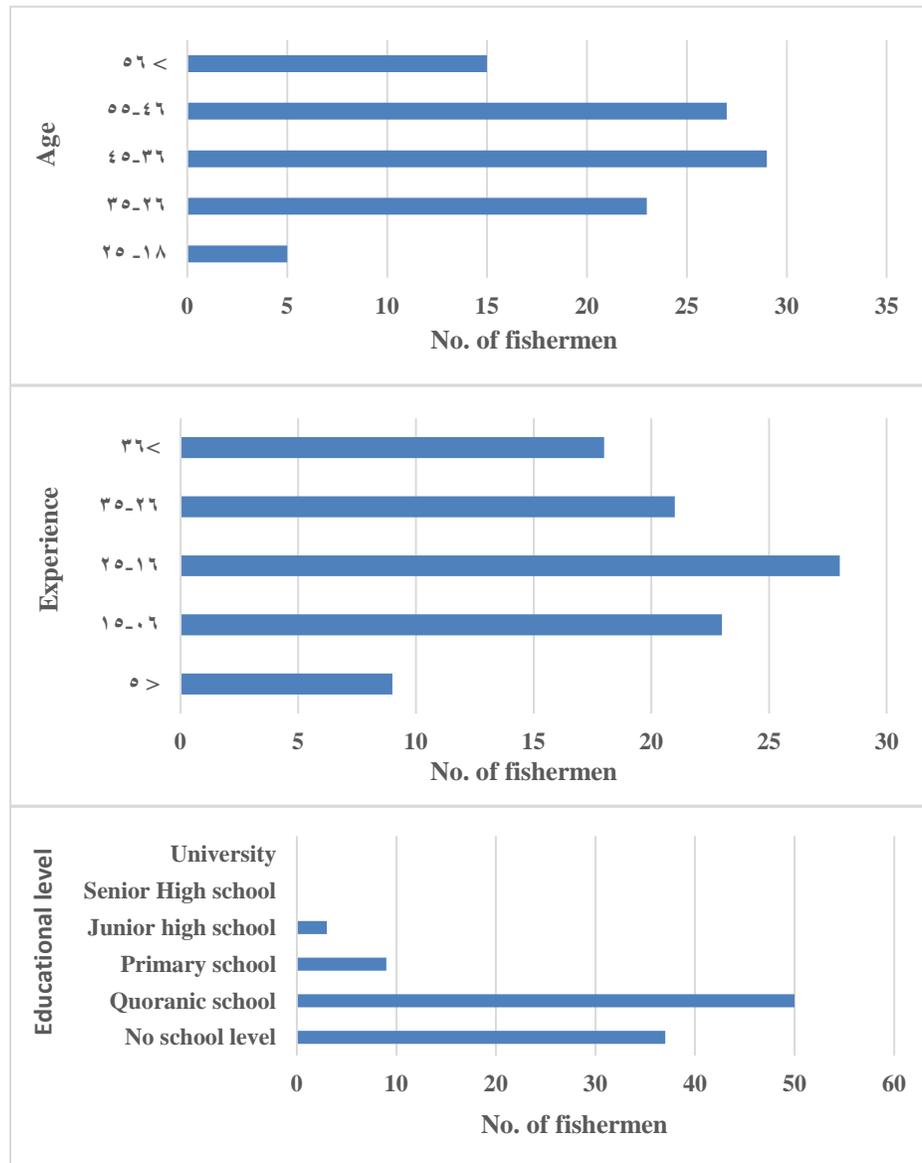


Fig. 2. Demographic data about fishermen in the study area

Fishermen consider that fishing gear and in particular nets that remain in the seabed contribute to pollute the environment, driving fish away from their natural habitats. The negative impact created by the implementation of the Tanger-Med port complex should not be overlooked too. This giant structure has reduced the number of fishing grounds and contributed to the pollution by the discharge of ships' oils in the sea. Pollution and the use of illegal gears were cited as minor causes of this degradation (Fig.4).

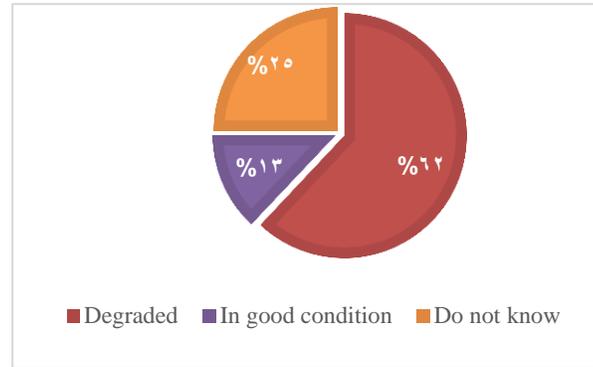


Fig. 3. General state of fishery resources

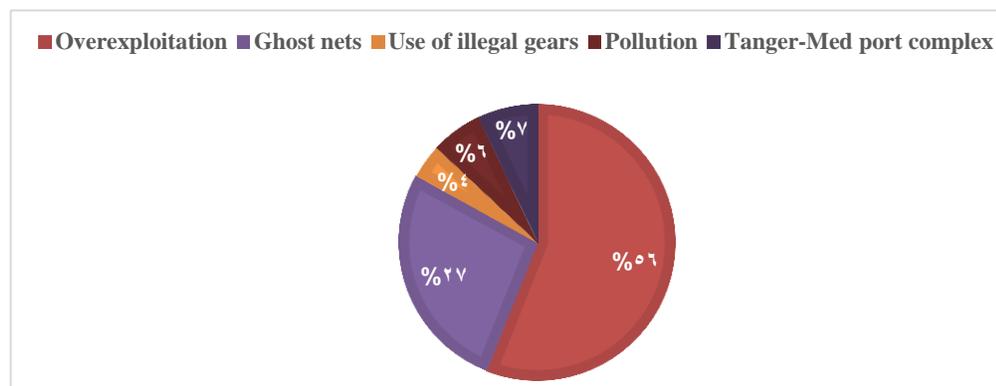


Fig. 4. Causes of fishery resources degradation

3. Perception about the projected MPA

Knowledge about the projected Jabal Moussa MPA is very poor among fishermen, barely 21% of them claim to have heard something about it. They have only a basic knowledge of the MPA, which is generally limited to its role of protecting the resource. They ignore everything related to the zoning system, the management methods, and the restrictions that may arise from it, etc..., generally, there was no opposition to the MPA and its limits. The only point that has aroused the discontent of fishermen is linked to the full protection zone which would shelter one of the most popular fishing areas (Fig.5). They affirm that this would undoubtedly have impacts on their activity. The fishermen have also expressed their fear about the closure of fishing areas within the future MPA, and consider that this would bring them to exploit more distant fishing areas, with a consequent increase in charges and expenses. Although a small number of surveyed fishermen have a rough idea of the MPA, questioned on the role they could play in the conservation of the resource, they are optimistic and are ready to share their knowledge, provide data if necessary, respect regulations, etc...as long as their profits are not at risk. However, they claim that the success and sustainability of the MPA over time is determined by their participation in the management process through their local

cooperatives and associations, this will empower them and make them respect the regulations of the MPA.

4. Perception of compensatory measures

Surveys and informal discussions show a feeling of concern about the idea of closing fishing grounds. However, once the concept of compensation was mentioned, there was a renewed motivation among a large part of the fishermen. 39% of fishermen prefer a direct monetary compensation, 15% wish to change their activities towards pesca-tourism and transport for summer visitors, 11% of fishermen seem to be able to exploit new fishing areas if the authorities help them in the purchase of oil and in the acquisition of more sophisticated means of production. Other alternative activities were mentioned such as aquaculture and seafood processing units. Nonetheless, 20% of fishermen categorically refuse any closure of fishing grounds (Fig. 6).

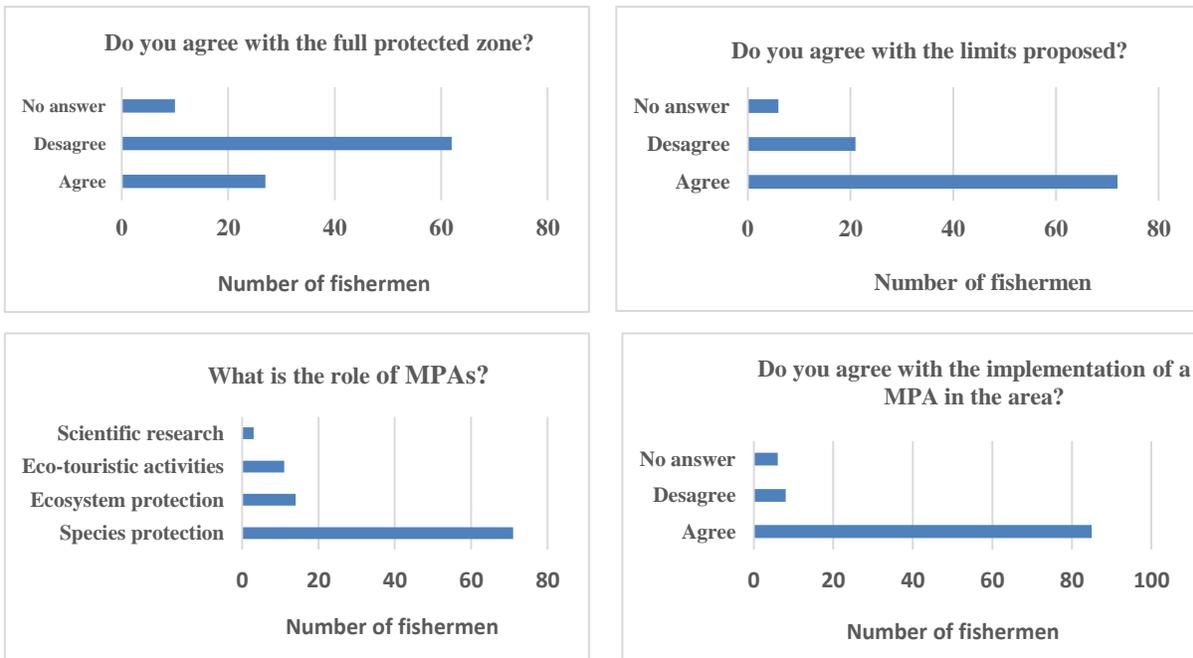


Fig. 5. Frequency of answers to the questions related to fishermen's perception on the projected MPA

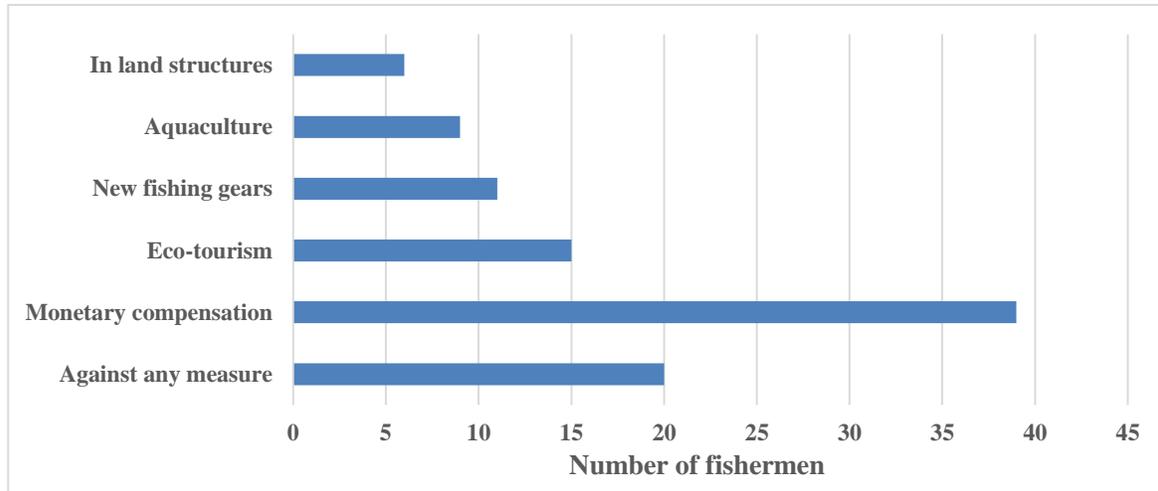


Fig. 6. Answers on compensatory measures

DISCUSSION

Analysis of the survey results shows that fishermen have a very advanced degree of awareness and have a good understanding in this projected MPA despite a recorded high illiteracy rate. Fishermen generally use small wooden and motorized boats and often use the blackspot seabream longline, which is a selective gear. This can explain the acceptance of the MPA zonation, where mostly artisanal fishing using non-destructive gears is allowed. In general, fishermen are more collaborative and favorable to conservation measures when they are not directly affected. Fishermen knowledge, based on centuries of interaction with ecosystem, can contribute also to MPA success by providing data and information not reachable by scientists. Thus, taking the opinions and recommendations of fishermen into consideration is essential for the success of this project. This can primarily be done through communication and dialogue and through the incorporation of the social science with the biological science into the process of design and implementation. A local population feeling marginalized and not involved in the management of the future MPA may constitute a force of opposition to the success of the project (Fiske, 1992). However, in order to successfully integrate local populations in the process of the MPA establishment, a thorough knowledge of all the social aspects related to it is essentially required. Thus, it is necessary to study the nature of the relationship between humans and their environment, their behavior vis-a-vis this environment and the precursors that encourage them to exploit in a sustainable way or not. Such studies must be done before MPA implementation.

Through communication, decision-makers must present the general objectives of the MPA to local populations in a clear and transparent way, from the earliest stages of

implementation. Since the relation is developed and confidence is established, the needs, expectations, conflicts and reasons for reluctance vis-a-vis the MPA will be identified and assessed. The fishermen must be well informed with the limits of the MPA, the regulations governing its development, its mode of governance, etc... The meetings held with fishermen have to dispel doubts and fears and present clearly the benefits that can be drawn from the creation of the MPA in short and medium terms. Once convinced, many conflicts could be mitigated to a considerable degree, opinions change, and fishermen would become messengers and advocates, and thus pass their enthusiasm on to family members, visitors, students, etc... In this respect, **Wells and White (1995)** postulated that once a fisherman fully understands the MPA regulations and is convinced, he passes this message on to other people.

The various compensatory measurements in case of resource access lost must also be discussed and developed with fishermen who already have a clear vision on the subject. Compensatory measures that generate short-term income such as the conversion to ecotourism activities would undoubtedly make possible the reduction of the pressure on the resource, increase the incomes of fishermen and ensure the long-term collaboration of local fishermen. Nonetheless, the definition and limits of a sustainable tourism within the future MPA has to be done to avoid negative impacts on the ecosystem (**Davis & Tisdell, 1995; Weaver, 2002**).

CONCLUSION

The concept of MPA is not widely used or understood in the fishing community, although they are the first concerned by such a project. To provide intensive education, share information and strengthen communication could build acceptance of MPA among fishermen on the one hand, and provide decision-makers, on the other hand, with valuable social and economic data to be integrated in decision-making process. For the governance system, the “top-down” management system has always shown a limited result, thus a co-management involving local fishermen and authorities would be the suitable mode to assure the success and durability of the future MPA. **Jentoft *et al.* (1998)** showed that effectiveness of MPA could be improved through increasing the involvement in management.

Many mutual benefits can be targeted if the well-being of local fishermen and the conservation of the local biodiversity are equally considered.

REFERENCES

- Bobiles, R.U.; Soliman, V.S. and Nakamura, Y. (2015).** Partially protected marine area renders non-fishery benefits amidst high fishing pressure: A case study from eastern Philippines. *Regional Studies in Marine Science*.
- <https://doi.org/10.1016/j.rsma.2015.11.002>
- Botsford, L.W. and Hastings, A. (2006).** Conservation dynamics of marine metapopulations with dispersing larvae. Pp. 411-429 and Ch. 12 in: *Marine Metapopulations*, edited by P. Sale and J. Kritzer. <https://doi.org/10.1016/B978-0-12-088781-1.X5000-6>
- Cen-López, A. and Aguilar-Perera, A. (2020).** Perceptions of diver-fishermen and recreational divers on lionfish as a threat in the Parque Nacional Arrecife Alacranes, southern Gulf of Mexico. *Ocean & Coastal Management*, **193**: 105225.
- Claudet, J.; Osenberg, C. W.; Benedetti-Cecchi, L. ; Domenici, P.; García-Charton, J.-A.; Pérez-Ruzafa, Á.; Badalamenti, F.; Bayle-Sempere, J.; Brito, A.; Bulleri, F. et al. (2008).** Marine reserves: size and age do matter. *Ecology letters*, **11** (5): 481–489. doi: 10.1111/j.1461-0248.2008.01166.x
- Christie, P.; McCay, B.J.; Miller, M.L.; Lowe, C.; White, A.T.; Stoffle, R.; Fluharty, D.L.; McManus, L.T.; Chuenpagdee, R.; Pomeroy, C. and Suman, D.O. (2003).** Toward developing a complete understanding: A social science research agenda for marine protected areas. *Fisheries*, **28** (12): 22–25.
- Chuenpagdee, R. and Jentoft, S. (2007).** Step zero for fisheries co-management: what precedes implementation. *Marine Policy*, **31** (6): 657–668.
- <https://doi.org/10.1016/j.marpol.2007.03.013>
- D'Anna, G.; Fernández, T.V.; Pipitone, C.; Garofalo, G. and Badalamenti, F. (2016).** Governance analysis in the Egadi Islands Marine Protected Area: A Mediterranean case study. *Marine Policy*, **71**: 301-309. <https://doi.org/10.1016/j.marpol.2015.12.009>
- Davis, D. and Tisdell, C. (1995).** 'Recreational scuba-diving and carrying capacity in marine protected areas', *Ocean and Coastal Management*, **26**: 19–40.
- Fiske, S.J. (1992).** Sociocultural aspects of establishing marine protected areas. *Ocean and Coastal Management*, **18**: 25-46.
- Gelcich, S. and O'Keeffe, J. (2016).** Emerging frontiers in perceptions research for aquatic conservation. *Aquatic Conservation: Marine and Freshwater Ecosystems*, **26**(5): 986-994. DOI: 10.1002/aqc.2714
- Guidetti, P. and Claudet, J. (2010).** Co-management practices enhance fisheries in marine protected areas. *Conservation Biology*, **24** (1): 312–318. DOI:10.1111/j.1523-1739.2009.01358.x
- Havard, L.; Brigand, L. and Cariño, M. (2015).** Stakeholder participation in decision-making processes for marine and coastal protected areas: Case studies of the

- southwestern gulf of California, Mexico. *Ocean & Coastal Management*, **116**: 116–131. <https://doi.org/10.1016/j.ocecoaman.2015.06.017>
- Ibn Tattou, M. ; Slimani, T. and Thévenet, M. (2014).** Inventaires Naturalistes de L'îlot de Cala Iris, Parc National d'Al Hoceima, Maroc. Initiative PIM. 18p
- Jentoft, S.; McCay, B.J. and Wilson, D.C. (1998).** Social theory and fisheries co-management. *Marine policy*, **22**(4-5): 423-436.
- Jentoft, S. (2000).** Legitimacy and disappointment in fisheries management. *Marine Policy* **24** (2): 141–148.
- Jentoft, S. (2004).** Institutions in fisheries: what they are, what they do, and how they change. *Marine Policy*, **28** (2): 137–149. [https://doi.org/10.1016/S0308-597X\(03\)00085-X](https://doi.org/10.1016/S0308-597X(03)00085-X)
- Jentoft, S. (2007).** Limits of governability: Institutional implications for fisheries and coastal governance. *Marine Policy*, **31** (4): 360–370. <https://doi.org/10.1016/j.marpol.2006.11.003>
- Jones, P. (2014).** Governing Marine Protected Areas: Resilience through Diversity. (eBook 1st ed.). Routledge. <https://doi.org/10.4324/9780203126295>
- Kelleher, G.; Bleakley, C. and Wells, S.M. (1995a).** A global representative system of marine protected areas. Technical report, Great Barrier Reef Marine Park Authority, The World Bank and IUCN.
- Kooiman, J.; Bavinck, M.; Chuenpagdee, R.; Mahon, R.; Pullin, R. et al. (2008).** Interactive governance and governability: an introduction. *Journal of Transdisciplinary environmental studies*, **7** (1): 1–11.
- Lopes, P.; Pacheco, S.; Clauzet, M.; Silvano, R. and Begossi, A. (2015).** Fisheries, tourism, and marine protected areas: Conflicting or synergistic interactions? *Ecosystem Services*, **16**: 333–340. <http://dx.doi.org/10.1016/j.ecoser.2014.12.003>
- Lubchenco, J. and Grorud-Colvert, K. (2015).** Making waves: The science and politics of ocean protection. *Science*, **350**(6259): 382-383.
- Markantonatou, V. ; Noguera-Méndez, P. ; Semitiel-García, M. ; Hogg, K. and Sano, M. (2016).** Social networks and information flow: Building the ground for collaborative marine conservation planning in Portofino marine protected area (MPA). *Ocean & Coastal Management*, **120**: 29–38. <https://doi.org/10.1016/j.ocecoaman.2015.11.023>
- Mikalsen, K.H.; Hernes, H.K. and Jentoft, S. (2007).** Leaning on user-groups: The role of civil society in fisheries governance. *Marine Policy*, **31** (2): 201–209. <https://doi.org/10.1016/j.marpol.2006.07.001>
- PNUE/PAM-CAR/ASP, (2016).** Maroc: Site de Jbel Moussa. Cartographie des habitats marins clés de Méditerranée et initiation de réseaux de surveillance. Par 534 Bazairi H., Sghaier Y.R., Benhoussa A., Boutahar L., El Kamcha R., Selfati M., Gerovasileiou V., Baeza J., Castañer V., Martin J., Valriberas E., 535 González R.,

Maestre M., Espinosa F.& Ouerghi A. Ed. CAR/ASP – Projet MedKey Habitats, Tunis. 92 p + Annexes.

Pieraccini, M. and Cardwell, E. (2016). Divergent perceptions of new marine protected areas: Comparing legal consciousness in Scilly and Barra, UK. *Ocean & Coastal Management*, **119**: 21–29. <https://doi.org/10.1016/j.ocecoaman.2015.09.016>

Read, A.D.; West, R.J. and Kelaher, B.P. (2015). Using compliance data to improve marine protected area management. *Marine Policy*, **60**: 119–127. <https://doi.org/10.1016/j.marpol.2015.06.008>

Rodríguez-Rodríguez, D.; Rodríguez, J. and Malak, D.A. (2016). Development and testing of a new framework for rapidly assessing legal and managerial protection afforded by marine protected areas: Mediterranean sea case study. *Journal of environmental management*, **167**: 29–37. <https://doi.org/10.1016/j.jenvman.2015.11.016>

Schuhbauer, A. and Sumaila, U. R. (2016). Economic viability and small-scale fisheries: A review. *Ecological Economics*, **124**: 69–75.

<https://doi.org/10.1016/j.ecolecon.2016.01.018>

Spalding, M.D.; Meliane, I.; Milam, A.; Fitzgerald, C. and Hale, L.Z. (2013). Protecting Marine Spaces: Global Targets and Changing Approaches. *Ocean Yearbook* **27** : 213–248.

Tangier Mediterranean Special Agency (T.M.S.A) (2010). Projet d'extension du complexe portuaire (Tanger Med II) Etude d'impact sur l'environnement, EIE Tanger-Med, Casablanca, Août 2010 ; 295p

Toropova, C.; Meliane, I.; Laffoley, D.; Matthews, E. and Spalding, M. (2010). Global Ocean Protection: Present Status and Future Possibilities. IUCN.

Weaver, D.B. (2002). 'The evolving concept of ecotourism and its potential impacts', *International Journal of Sustainable Development*, **5**(3): 251–264.

Wells, S. and White, A.T. (1995). Involving the Community. In *Marine Protected Areas* (pp. 61-84). Springer, Dordrecht.

Worm, B.; Barbier, E.B.; Beaumont, N.; Duffy, J.E.; Folke, C.; Halpern, B.S.; Jackson, J.B.; Lotze, H.K.; Micheli, F.; Palumbi, S.R. et al. (2006). Impacts of biodiversity loss on ocean ecosystem services. *Science*, **314** (5800): 787–790. <https://doi.org/10.1126/science.1132294>

www.mpm.gov.ma, (2019). www.mpm.gov.ma/wps/portal/PortailMPM