The Rufford Foundation
Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Sinan MAVRUK
Project title	Strongholds for Groupers in Iskenderun Bay: Defining Conservation Hotspots for Sustainability
RSG reference	20449-1
Reporting period	August 2016 - 2017
Amount of grant	£5000
Your email address	smavruk@cu.edu.tr
Date of this report	22.08.2017

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Biodiversity of Groupers				We detected which grouper species inhabit in the study area and the relative intensity of them by way of interviews with fishermen and local people.
Distribution of Groupers				Based on the fishermen knowledge, we revealed that the grouper populations were more abundant around the northern coasts of Iskenderun Bay. We also validated this result with visual censuses.
Habitat preferences of groupers				Based on the fishermen knowledge, we revealed that the *Epinephelus aeneus* and *Epinephelus caninus* prefers sandy and muddy habitats whereas the others inhabit around reefs. We also validated these results with visual censuses.
The status of undersized groupers in fishery and fish market				Juveniles of nearly all species of groupers, including two banned species *E. aeneus* and *E. marginatus* were reported as to be subjected to fishery activities and also present in the fish market.
Spawning and nursery sites of Groupers				In ichthyoplankton surveys, we detected that *Mycteroperca rubra* spawns in spring period. The larval stages were abundant in the northern part of Iskenderun Bay. However, we could not yet validate the identifications with genetic analyses. Additionally, we need further studies to detect the spawning areas of other grouper species.
Create public awareness about the importance of groupers and to reduce demand on small sized fishes				We organised meetings with the representatives of each fishery cooperative around the bay, fishery managers and controllers. Prepared and distributed a total of 2000 flyers and posters. We created a website in local language regarding to increase public awareness. To reduce demanding the small size groupers, we also left posters and flyers to the fish markets and restaurants.

Impact and Value Added with this project				We made an oral presentation in an international symposium. Our results about the fishermen knowledge has passed the editorial investigation and now it is under review in an international journal indexed in SSCI (Marine Policy). We are planning to produce other publications about spawning and nursery areas after we enrich present data with several further efforts.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

Just before the interviews of project was started, the catch of white and dusky groupers was completely banned by Turkish fishery management authority. As a result of this, major objections were risen among the fishermen. Therefore, we lived significant problems to achieving a connection with fishermen. We tackled this by communicating with them. Thus, we organised many meetings with fishermen as an important stakeholder in the fisheries port to know us better and also invited them to our university. We tried to explain the importance groupers for ecosystem. Then we discussed about the effective ways of management such as temporary or permanent marine protective areas. We believe that we managed to gain the trust of fishermen and convince them to volunteer for our project. Now we have a huge network among grouper fishermen of the area who is willing to contribute conservation and fishery management of these species. We believe that this made provide us a great potential to acquire further data on the conservation and management of local populations if we can maintain our dialogue continuity with fishermen.

Another difficulty was the genetic validation of grouper larvae due to small size of larvae that are used as tissue sample for genetic analysis. We tried different genetic analysis method to tackle this problem and found proper method for it. The process has taken longer time than we expected. Spending consumables mostly for finding proper method was also limited the number of samples. Therefore, we concentrated on one species, we could only detect the spawning and nursery areas of *Mycteroperca rubra* since this species spawn in a different period than others. Additionally, the number of Epinephelin larvae was not satisfying in summer sampling. Therefore, we need further investigations to detect the positions of spawning aggregation for the other grouper species.

3. Briefly describe the three most important outcomes of your project.

In order to understand the status of grouper populations in Iskenderun Bay, we performed interviews with local community as well as recreational and professional fishermen. Regarding to this a total of 113 interviews were conducted across 10 fishery ports as well as sport fishing and free diving groups. All interviews were started with an introductory explanation about the importance of groupers on the coastal ecosystems. Then we explained our project and purposes which was to detect

critical habitats for conservation of groupers. Eventually, we showed a catalogue of all known and non-native grouper species, then directed questions about their habitats, presence and abundance.

We mostly took positive responses from participants. Based on these interviews, the major source of fishery pressure on groupers were artisanal fishermen, especially longliners. Specific details and characteristics of their fishing activity require further investigation and may provide significant benefits in the conservation of groupers.

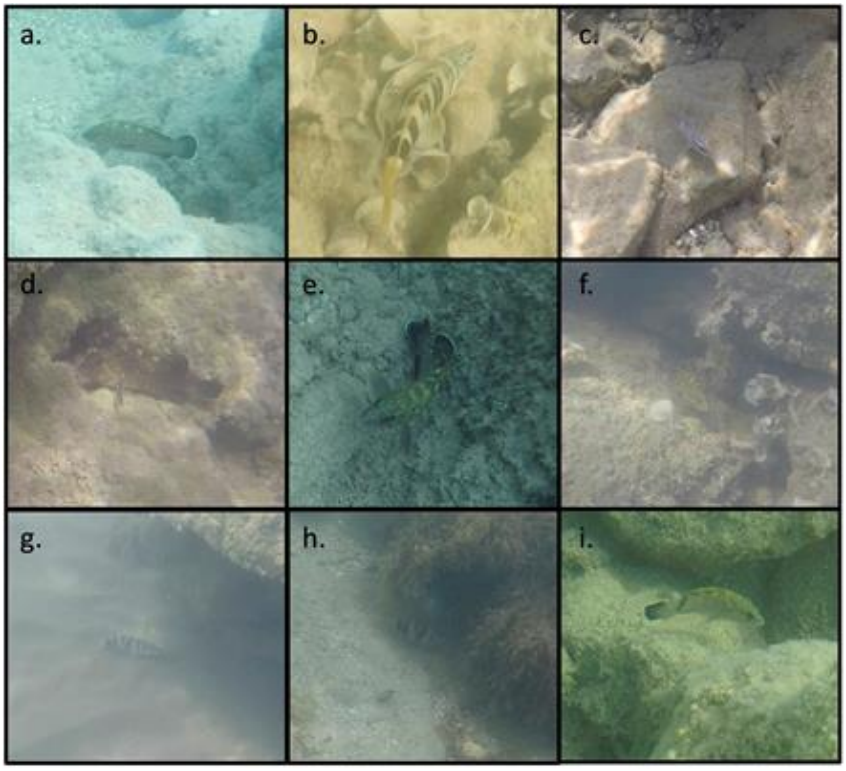

Figure 1. Groupers photographed during visual censuses (a. Epinephelus marginatus, Golovasi; b: Serranus scriba, Yumurtalik; c. Epinephelus costae, Yumurtalik; d. Epinephelus marginatus, Yumurtalik; e. Epinephelus marginatus, Golovasi; f. Epinephelus marginatus, Yumurtalik; g. Serranus scriba, Golovasi; h. Serranus scriba, Yumurtalik; i. Epinephelus marginatus, Golovasi)

A. Status of Grouper Populations around Iskenderun Bay

a. Nine grouper species were recognized around Iskenderun Bay

Fishermen recognized all seven native groupers (*Epinephelus marginatus*, *E. aeneus*, *E. costae*, *E. caninus*, *Hyporthodus haifensis*, *Mycteroperca rubra* and *Polyprion americanus*) as well two non-native groupers (*Epinephelus fasciatus* and *Epinephelus coioides*) previously unknown from the study area. Whereas 13 grouper species were reported in Mediterranean six of them were non-indigenous. Therefore, invasive species appears one of the source of pressure on grouper populations around Iskenderun Bay. Citizen science and social media streams may provide an early warning system about invasive species since fishermen can provide reliable information faster than scientific surveyors. Therefore, our findings may suggest that two non-native groupers may have been established successful populations in the study area. On the other hand, the findings about these alien groupers require further validation since none of the respondents can provide an evidence such as a photograph or a video.

To validate the information acquired from fishermen, we performed 12 diving across the study area. During diving, we observed individuals of *E. marginatus*, *E. costae* and *M. rubra* as well as *Serranus scriba* and *Serranus cabrilla* (Figure 1).

b. White Grouper and Dusky Grouper were Abundant and Frequent

We used best daily catch (BDC) of last year (2016) and frequency of occurrence (FO%) values as proxies of abundance of groupers. The FO% values of species were significantly different each other. Near threatened (NT) *E. aeneus* and Endangered (En) *E. marginatus* were more frequently reported than others (Figure 2). Data Deficient (DD) *Polyprion americanus* was the rarest one. In accordance with frequency, BDC was also the highest in NT *E. aeneus*, followed by *E. caninus*, *P. americanus*, *E. marginatus* and *H. haifensis* (Figure 2).

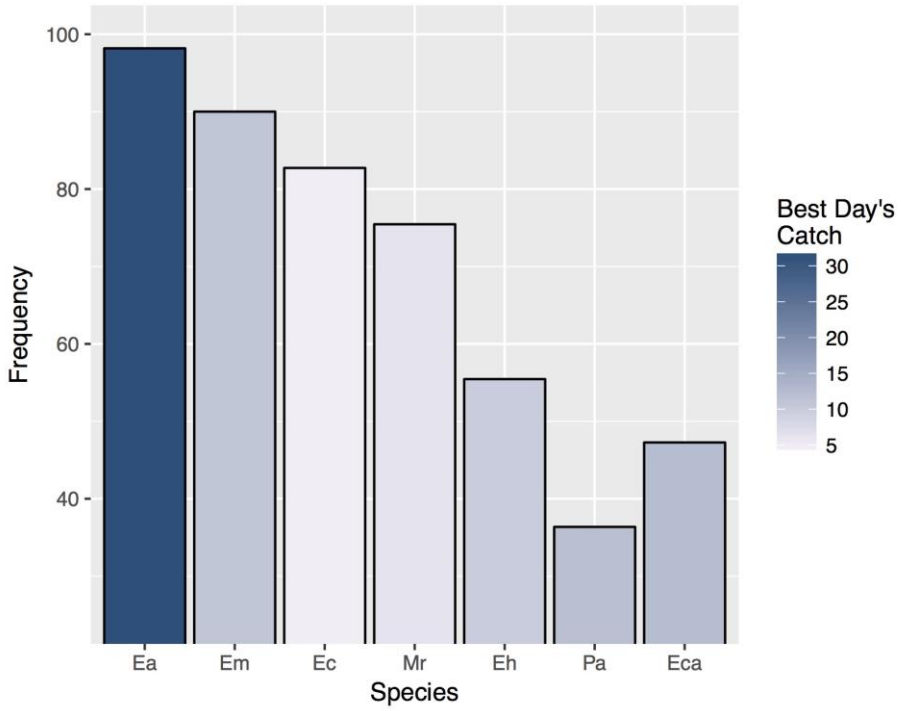

Figure 2. Frequency of occurrence and best daily catch of grouper species in Iskenderun Bay. (The colour of bars shows the best daily catch values of last year in kg; Ea: *Epinephelus aeneus*, Em: *Epinephelus marginatus*, Ec: *Epinephelus costae*, Mr: *Mycteroperca rubra*, Hh: *Hyporthodus haifensis*, Pa: *Polyprion americanus*, Eca: *Epinephelus caninus*)

c. Habitats of Groupers

Based on the reports of fishermen, *E. aeneus* prefers sandy and muddy bottoms up to 200m. They are abundant at 50-100m depth contour however juveniles inhabit shallower waters. In similar with *E. aeneus*, *E. caninus* also inhabit in sandy and muddy bottoms, but in deeper waters. *E. marginatus*, *E. costae* and *M. rubra* inhabit in shallow rocky habitats. *P. americanus* and *H. haifensis* were reported to be inhabiting in deep rocky habitats.

B. Distribution of Groupers in Iskenderun Bay

a. White Grouper was Abundant in Northern Part of Iskenderun Bay

Among groupers, the FO% values of *M. rubra* significantly increased towards inside Iskenderun Bay ($\chi2$ = 34.44; df = 9; p<0.001). The frequency of *H. haifensis* ($\chi2$ = 118.92; df = 9; p<0.001), *P. americanus* ($\chi2$ = 127.42; df = 9; p<0.001) and *E. caninus* ($\chi2$ = 107.86; df = 9; p<0.001) were reported lower in the same area. The both *H. haifensis* and *P. americanus* inhabits in deep rocky habitats. Additionally, *E. caninus* also inhabit in deeper areas. On the contrary, sandy and muddy bottoms with a gentle slope is the dominant bottom structure in Iskenderun Bay. Apparently, this is the reason why these species were rarely reported from this part. Regarding to abundance, BDC of *E. aeneus* was reported significantly higher (KW $\chi2$= 19.05; df=9; p<0.05) around the northern coasts of Iskenderun Bay (Figure 3).

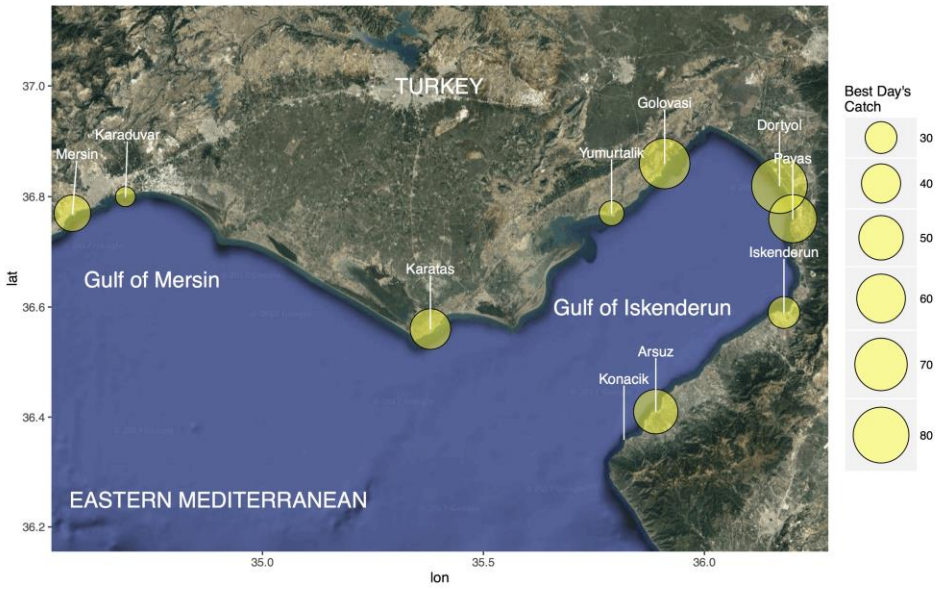

Figure 3. Spatial variations of Best Days' Catch of *Epinephelus aeneus* around Iskenderun Bay.

b. *M. rubra* spawn in the north-western Iskenderun Bay

In order to detect spawning and nursery areas of groupers, we performed ichthyoplankton samplings. We detected a total of 106 pre and 73 post larval groupers. Larval groupers were detected in April (30.75±27.26 (±sd) larvae/m^2), May (12.64±4.00 (±sd) larvae/m^2), June (17.57±10.21 (±sd) larvae/m^2) and September (13.43 larvae/m^2). *M. rubra* is the only grouper species known as spawning in spring and early summer. Therefore, the larvae sampled from April to June probably belong to this species. The larvae sampled in September, probably belong to one of the other grouper species. However, this information need to be validated with genetic analyses. This process is continuing.

We modelled the probability of presence of *M. rubra* larvae by using a binomial generalized additive model. The abundance of *M. rubra* larvae were also modelled

with environmental conditions. Mesozooplankton biomass were the only environmental condition found to be correlated with *M. rubra* larvae. Limited number of field surveys and samples prevented us to have detailed models. Therefore, the effect of environmental conditions requires further investigation in near future to validate current model and expand it.

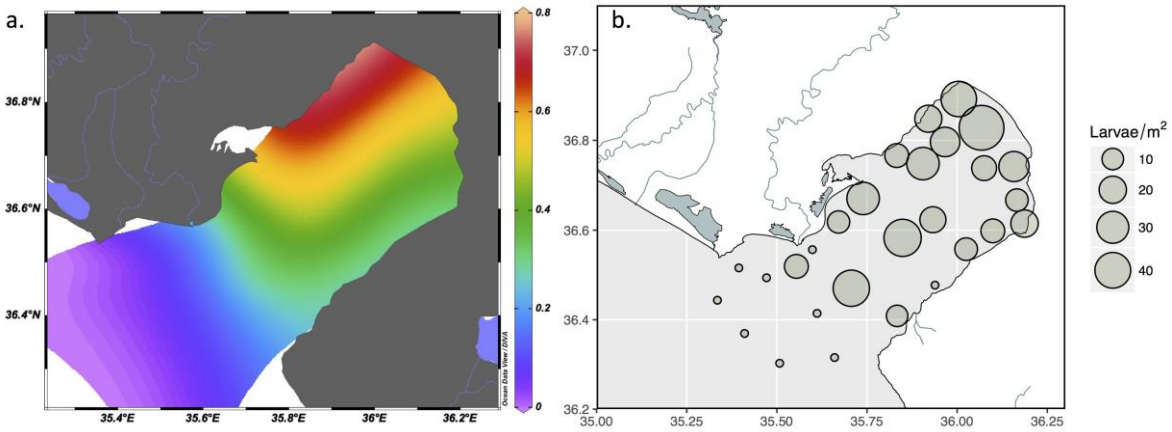

Figure 4. Predicted probability of presence (a) and observed average larval abundance (b) values for model validation.

C. Juvenile groupers were under strong fishery pressure

Nearly all reported minimum length of grouper catch was smaller than length at first maturity. Additionally, nearly half of the reported average length of NT *E. aeneus* and En *E. marginatus* were found to be smaller than fist maturity length (Figure 5). Even though *Epinephelus costae* and *Mycteroperca rubra* were larger than first maturity length, these values are apparently smaller than length at sex reversal. The fisheries of *E. aeneus* and *E. marginatus* has been prohibited in summer 2016. On the other hand, there is not any restriction on the catch of other groupers. This parameter is also very important on the conservation of hermaphroditic species. Therefore, the both species may also vulnerable to undersized fisheries. Therefore, minimum landing size restrictions are apparently required for these species.

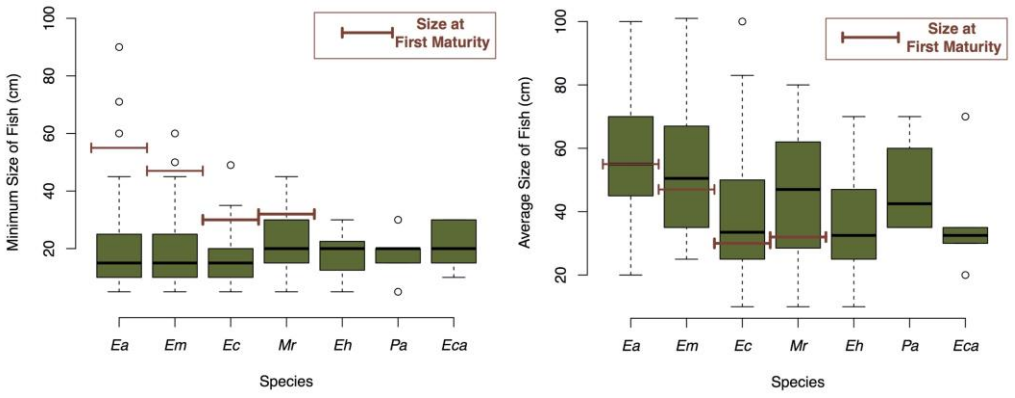

Figure 5. Reported minimum (left) and average (right) length of grouper catch by species in North-eastern Mediterranean (Please see the legend of Figure 2 for abbreviations).

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

Local communities of fisheries town surrounds İskenderun Bay, especially fishermen, contributed importantly to the project. Our interaction with them provide important knowledge for both sides. In the beginning of the project, Fishermen were participative against to us because of governmental prohibition for fishing of some species of groupers. However, they became sharing their knowledge with us by our close interaction. Additionally, they were open to learn more about the grouper species. Besides face to face interaction, flyers and posters about the project were positive responds behalf of conservation of the species. Knowledge sharing provided also fruitful discussions and suggestions on sustainable management plans for these vulnerable fish species in the region. During these meetings, we inform fishermen about the permanent and temporal marine protected areas (MPA) and explained that the MPA's can provide profits for the both side of management, fishermen and ecosystem.

Besides fishermen, other components of local community were considered to share our knowledge. Main problem in the region regarding to groupers is demanding on small sized individual as food. We put posters and handed out fliers to spread knowledge about their functions in the marine ecosystem and their critical sizes such as first maturity and sex reversal. Even though our effort on this issue, unfortunately we could not excite their attraction in fully. Constituting a public awareness is a challenging task and requires continuous effort. These issues should also be considered for the future efforts. Increase awareness for all local communities as consumers are also important step for the sustainability as well as fishermen's awareness.

To publicize our project, we organised a meeting in Cukurova University Faculty of Fisheries with the contribution of more than 50 persons from the Ministry of Food, Agriculture and Livestock, Coast Guard, Universities and fishery cooperatives. The presentation is freely available in our web site with the following link; http://orangerproject.wixsite.com/grouper/sunum

5. Are there any plans to continue this work?

However, we believe that we acquired significant information with this work, it is far from to fully achieve reliable management policies for all grouper species. The positions of spawning aggregations are still an open question for the groupers other than *M. rubra*. Therefore, ichthyoplankton samplings should continue, in order to collect new data on other groupers and monitor inter-annual variations as well as strengthened the information network for citizen science and implementing more effective conservation and management plans.

We established a wide network among fishermen and local community. This network should be expanded for a successful management of groupers. Additionally, this network can provide us more significant information for conservation.

6. How do you plan to share the results of your work with others?

We made an oral presentation in International Ecology-2017 Symposium which was held in June in Kayseri-Turkey. Our results about the fishermen knowledge has been submitted to a substantial international journal indexed in SSCI. Paper has already passed the editorial investigation and is under review. We submitted another oral presentation which will be held in October about the positions of spawning aggregation of *M. rubra*. Additionally, we are planning to produce other publications about spawning and nursery areas after we enrich present data with several further efforts.

We also have opened a new website on groupers and their conservation (http://orangerproject.wixsite.com/grouper). After our final report has accepted, we will translate our results to Turkish and publish them towards internet. Then we will share our results with stakeholders via social media. We have already shared progress of the project from the social media accounts of Cukurova University Fisheries Faculty which have more than 2000 followers in the area.

Finally, we are going to share our final report with the management authorities of Turkey.

7. Timescale: Over what period was The Rufford Foundation grant used? How does this compare to the anticipated or actual length of the project?

The grant was used as anticipated in the project proposal. Firstly, we meet fishermen in fishery ports and performed interviews. During these meetings, we hang posters and distribute flyers about groupers. Then we regularly performed visual censuses and took many visual materials as possible. Ichthyoplankton samplings were also performed seasonally with double oblique tows. One of the duplications immediately identified and used for abundance based analyses. The other was fixed in alcohol, sorted and grouper larvae were sent to the genetic analyses. As a last part of the project we shared our results with stakeholders, local communities by using posters, fliers and meetings. We are going to share our final report with the management authorities of Turkey.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Accommodation	1275	1000	275	Due to changes of exchange rates
Travels	250	500	-250	In project proposal, we anticipated working in six fishery ports. However,

				we realised that to establish a better connection and acquire better data, study domain should be increased to Mersin Bay and we worked in 10 fishery ports.
Ichthyoplankton Samplings	1000	1000	0	
Genetic Analysis	1700	1700	0	
GoPro Underwater Camera	500	400	100	
Printing Material	275	450	-175	Based on fishermen demands we published 1000 extra posters showing restrictions of grouper catch. These posters were for usage at sea conditions and published on thick, protection covered papers.
Total	5000	5050	-50	

9. Looking ahead, what do you feel are the important next steps?

With this study, we established a wide network among stakeholders. By this way, we found some aspects of biodiversity, abundance and distribution of grouper species in Iskenderun Bay. On the other hand, this network can be utilised for also further information. The biological, technical, sociological and economical characteristics of grouper fishery may also be a critical knowledge for the management of grouper fishery and applicability of restrictions. It is also be need to understand effectiveness such a strict management plan in the region.

In periodic spawner demersal fishes, settlement habitats are important constraints on the year class strength. Therefore, the distribution and habitats of juveniles is also an important question to understand the effect of coastal habitat losses on grouper populations. Iskenderun Bay is under threat of urbanisation and industrialisation and coastal habitats are prone to degradation. More data to produce information can provide the positions of potential MPAs in shoreline of Iskenderun Bay.

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

We used The Rufford Foundation logo and acknowledged the name in all published materials. A screen shot of our projects web site is shown in Figure 6. Posters hung on the fishery boats, fish markets and restaurants are shown in Figure 7 and flyers distributed to local community are in Figure 8.

RF received publicity in also our meeting with management authority. Figure 9 shows a photo of this meeting.

Additionally, we acknowledged the fund provided by RF in the abstract book of the International Ecology Symposium (Figure 10; http://www.ecology2017.com/files/abstractbook_official_rev2.pdf Page: 273) and used the logo in oral presentation (Figure 11). We have also stated the RF as source of funding the manuscript submitted to an international scientific journal indexed in social science citation index.

Figure 6. A screenshot of the home page of projects web site (http://orangerproject.wixsite.com/grouper).

Figure 7. Posters hanged on the fishery boats, fish restaurants and fish markets.

Figure 8. Flyers distributed to stakeholders.

Figure 9. Frames from the meeting with stakeholders.

ECOLOGY 2017
11-13 May, Kayseri TURKEY

Preliminary Results of Local Ecological Knowledge on the Grouper (Epinephelinae) Populations in Iskenderun Bay

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Introduction: Groupers are important components of coastal ecosystems as well as they have high economical values**.** Their populations are known to be decreasing throughout the world primarily due to over-exploitation. In spite of their ecological and economical importance, so far little is known about their populations in Eastern Mediterranean. Therefore, the purpose of this study is to present the preliminary results of Local Ecological Knowledge (LEK) on the grouper populations in Iskenderun Bay.

Material and Methods: In context of the study, we performed interviews with 96 fishermen in Iskenderun and Mersin Bays. The interviews were performed in Camlibel, Karaduvar, Karatas Yumurtalik, Dortyol, Payas, Iskenderun, Arsuz and Konacik fishery ports between 24 and 25th of January 2017. The participants were among the fishermen with at least five years of experience. We directed questions to understand the biodiversity, abundance, distribution and fisheries of grouper species.

Results and Discussion: According to preliminary results of LEK, four species of groupers have been caught in Iskenderun Bay, *Epinephelus marginatus*, *Epinephelus aeneus*, *Mycteroperca rubra* and *Epinephelus costae*. Also, the fishermen reported that *Epinephelus haifensis* and *Polyprion americanus* have been rarely caught in deep waters. Moreover, the critically endangered *Epinephelus marginatus*, near threatened *Epinephelus aeneus* and least concern *Mycteroperca rubra* are reported as frequent species. Results also indicated that trawlers, longliners and spear gun fishers responsible for the main fisheries removal.

Keywords: Serranidae, Northeastern Mediterranean, Epinephelus, Citizen Science,

Acknowledgement: This study was performed as a part of the project "Strongholds for Groupers in Iskenderun Bay: Defining Conservation Hotspots for Sustainability" granted by The Rufford Foundation.

Figure 10. Abstract of the oral presentation published online.

Figure 11. Frames from the presentation in International Symposium on Ecology-2017.

11. Please provide a full list of all the members of your team and briefly what was their role in the project.

Project leader, Sinan Mavruk, actively attended all work packages of project and made data analyses and visualisations with Fethi Bengil. Ismet Saygu and Sinan Mavruk also organised meetings with fishermen. Presentations mostly performed by Sinan Mavruk and Ismet Saygu. Interviews were performed by all project members. Ichthyoplankton samplings were collected by Sinan Mavruk and Vahit Alan, and Sinan Mavruk did the taxonomical analyses. Vahit Alan and Fethi Bengil organized and performed divings.

12. Any other comments?

Conservation Remarks

The both the results of frequency of occurrence and best days' catch indicate that Near Threatened (NT) *Epinephelus aeneus* and Endangered (EN) *Epinephelus marginatus* were the most frequent and abundant grouper species of north-eastern Mediterranean. These results seem promising regarding to the conservation of threatened species in Iskenderun Bay. Based on the catch amounts reported by fishermen, especially northern part of Iskenderun Bay may be a good candidate to protected area. On the other hand, this area is the most industrialised and populated part of the bay. Besides, according to development programmes, industrialisation is expected to increasingly remain. Therefore, conservation measures should be immediately taken at least to keep the present situation of grouper populations in this area.

There is a significant lack of knowledge on the length at first maturity and sex reversal of some grouper species such as *H. haifensis* and *E. caninus*. These are classed under Data Deficient (DD) category in the IUCN Red List, however their population may be under serious threat without the recognition of science and conservation society. Therefore, the necessary information should immediately be collected to understand the status of data deficient species.