

Reproduction of the rubber lip grunt *Plectorhinchus mediterraneus* (Guichenot, 1850) (Pisces : Haemulidae) on the northern coast of Mauritania

Reproduction du diagramme gris *Plectorhinchus mediterraneus* (Guichenot, 1850) (Pisces : Haemulidae) dans la côte nord de la Mauritanie

Cheikhna GANDEGA¹, Mohammed RAMDANI^{*2} & Roger FLOWER³

1. Institut Mauritanien des Recherches Océanographiques et des Pêches, Nouadhibou, Mauritanie.

2. Université Mohammed V de Rabat, Institut Scientifique, Zoologie et Ecologie Animale, Morocco *(ramdanimed@gmail.com).

3. University College of London, Department of Geography, UK.

Abstract. The reproduction of the rubber lip grunt (*Plectorhinchus mediterraneus*) was studied from January to December 2014 on the northern of the Mauritanian coast. Examination of the gonads showed that the species is gonochoric and the sex ratio not statistically significant using the χ^2 test. Analysis of the gonad index and the maturity stage percentages indicate that the spawning period occurs June to August. The hepato-somatic ratio analysis confirms that the species uses its energy reserves in the liver to ensure maturation of the gonads. The size of individuals at first maturity (L50) was estimated at 29.20 cm for males and 29.26 cm for females. The results are relevant for management of the Rubber Lip grunt fishery.

Keywords: *Plectorhinchus mediterraneus*, reproduction, gonochoric, Mauritania, northern coast.

Résumé. La reproduction du diagramme (*Plectorhinchus mediterraneus*) a été étudiée de Janvier à Décembre 2014 dans la partie nord de la Mauritanie. L'examen des gonades a montré que l'espèce est gonochorique et le sexe ratio n'est pas statistiquement significatif avec le test χ^2 . L'analyse du rapport gonado-somatique et les pourcentages des stades de maturité ont montré que la ponte se situe durant la période estivale de juin à août. Le rapport hépato-somatique montre que ce poisson utilise ses réserves énergétiques contenues dans le foie pour assurer la maturation des gonades. La taille de la première maturité sexuelle (L50) a été estimée à 29,20 cm pour les mâles et à 29,26 cm pour les femelles.

Mots-clés : *Plectorhinchus mediterraneus*, reproduction, gonochorique, côtes nord, Mauritanie.

INTRODUCTION

Demersal fishery resources (fish, cephalopods and crustaceans) of Mauritania have been exploited actively and sustainably during the last two decades. An artisanal, and national and European fishing fleets are actively operating in the northern coast of Mauritania; they produce a total catch of fisheries resources estimated at ~150,000 tons per year. Faced with this fishery effort, the abundance of demersal fisheries resources has significantly declined (Gascuel *et al.* 2007). Thus, evaluation of the actual stock will help clarify the status of this fishery that includes the Rubber lip grunt, croaker, thiof, and sea bream.

Plectorhinchus mediterraneus (Guichenot, 1850) is a common bottom fish along Eastern Atlantic coasts; it is known from Spain and Portugal to Henties Bay in Namibia (Fisher *et al.* 1981). It also occurs in the western Mediterranean Sea and the Canary Islands (45 °N - 22 °S, 25 °W - 20 °E) (Druzhinin & Filatova 1979, Hattour *et al.* 2011);

The maximum length is around 80 cm, common length about 60 cm and the maximum published weight is 7.9 kg. This fish habitats superficial and deep coastal water masses (10-180 m depth) and is mainly observed on sandy and muddy bottoms (Gandega *et al.* 2009; Da Silva 2011).

P. mediterraneus is amongst the target species of demersal fish for artisanal and industrial fishing in Mauritania. The catches are made using trammel nets, gill

nets, purse seines and bottom trawls. This fish is landed throughout the year. The caught quantities vary between 3,000 and 9,000 tons per year for artisanal fishing and 100-1,500 tons / year for industrial fishing (Tab. 1), (Gascuel *et al.* 2007). This fish is increasingly appreciated at local markets, with a preference for specimens weighing more than 500 grams. Previous studies on the growth and reproduction of demersal fishes of northwest African and Mediterranean coasts are few: Fanqueville (1982), Chakroun-Marzouk & Ktari (2006), Layachi *et al.* (2007), Fehri Bedoui & Gharbi (2008), Hebbar *et al.* (2012), Merlo *et al.* (2012).

The Rubber lip grunt remains poorly researched in Mauritania and the most relevant study was by Da Silva (2011) on the growth and reproduction in the coastal waters of Namibia. Investigation of its reproductive period is necessary to complete the work of Gandega *et al.* (2009) and contribute to the rational management of the national demersal fisheries in Mauritania. The objective of this study is to contribute to fishery management by conducting a biological assessment of the Rubber lip grunt. This demersal fish species is of particular importance for the artisanal and industrial fisheries on the continental shelf off the northern coast of Mauritania. This study focuses on the biological aspects of the life cycle relating to the period of reproduction, the sex ratio and size at first maturity for *P. mediterraneus* in the northern coast of Mauritania.

Table 1. Catches (in tons) of Rubber lip grunt and total demersal fish caught in Mauritania (Gascuel *et al.* 2007)

Years	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Rubber lip grunt	4008	5307	5567	2475	2535	5125	3225	8024	9562	3094	3821	3762
Total fishery	45624	60376	37553	99145	46389	83694	70862	92605	89868	70901	82220	76561

MATERIAL AND METHODS

The sampling of Rubber lip grunt was performed in the northern coast of Mauritania between 50-200 m depth (Fig. 1). Sampling was combined with sea campaigns for monthly monitoring of the *Octopus vulgaris* (scheduled at the start of each month) stock, using the research vessel Al Awam.

The reproduction is studied from January to December 2014. All individuals were caught by demersal trawl (Irish type) and transported to the laboratory for processing and analysis. The catch consisted of 483 individuals (ages and sexes mixed). For each sample, the weight was determined before and after evisceration, and the total length (Lt) and the fork length (Lf) were measured. Gonads and liver were weighed to the nearest 0.01 g and the degree of sexual maturity calculated.

Changes in gender proportions as percentages for males and females are: Males% = Number of males x 100 / Number (male + female); Females% = Number of females x 100 / Number (male + female). The results were tested by the test χ^2 .

Sexual maturity is determined according to the macroscopic appearance of the gonads using the Mann and Buxton (1998) scale.

Five stages were distinguished: stage 1= immature, stage 2 = pre mature, stage 3 = mature, Stage 4 = spawning and stage 5 = post mature 6 and 7;

The sexual cycle is determined using the change in the gonad index:

$$GSR = \text{Gonado-Somatic Ratio} = \frac{\text{gonad weight (g)}}{100/\text{weight of gutted fish (g)}}$$

Graphical representation of the GSR reflects the different stages of maturation of the gonads. The spawning period was determined from the gonad index by calculating the proportion of fish at this stage of maturity (Layachi *et al.* 2007; Hebbar *et al.* 2012).

Monitoring changes in the hepato-somatic ratio (HSR) and the condition factor (K) was conducted in parallel with GSR measurements. With $RHS = \frac{\text{liver mass (g)}}{\text{weight of gutted fish (g)}} \times 100$

$$K = \frac{\text{Mass of gutted fish (g)}}{\text{Lf (cm)}} \times 100$$

The size at first maturity is considered as the length at which 50% of individuals are mature (L50). It was estimated by calculating the proportions (P) of mature individuals in each size class (range: 1cm).

The proportions of each sex are calculated for males and females and adjusted by a Log function (Saila *et al.* 1988); the curves were fitted by a nonlinear regression method using the PRISM software (Graph Pad Prism 6 software).

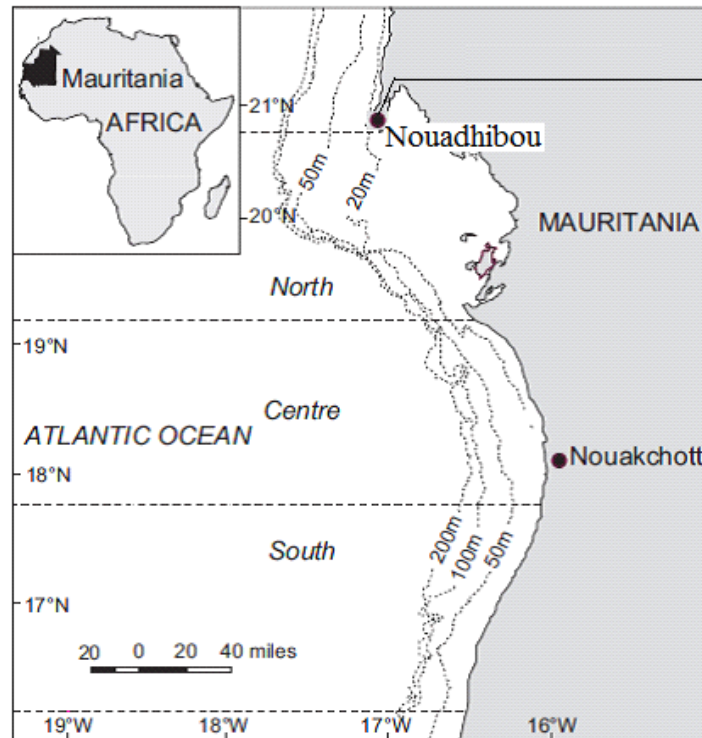


Figure 1. Geographical location of the Rubber lip grunt sampling area in the northern coast of Mauritania, near Nouadhibou.

RESULTS

Reproduction studies of *Plectorhinchus mediterraneus* were conducted on the 483 individuals caught; sizes (fork length) are between 23.8 and 44.4 cm. The numbers of both sexes are charted in Fig. 2 and Fig. 3. The average size fluctuates around 30 cm, while the maximum does not exceed 45 cm and the minimum is 23 cm for males and females. Note that some poorly preserved individuals in the catch did not allow distinction between male or female and could not be observed macroscopically.

We calculated the percentages of females and males for each size range after grouping all the harvested samples. The total was divided into 201 males and 224 females representing 47.4% and 52.6% respectively (Tab. 2). For the rest of the samples, 58 specimens, sex could not be determined macroscopically. The gender ratio, determined according to the monthly data, was statistically tested. Analysis of the monthly variation of the sexes shows a dominance of females (Fig. 2). This dominance remains insignificant (calculated $\chi^2 = 17.61$; significantly less than theoretical $\chi^2 = 19.68$ threshold $\alpha = 5\%$).

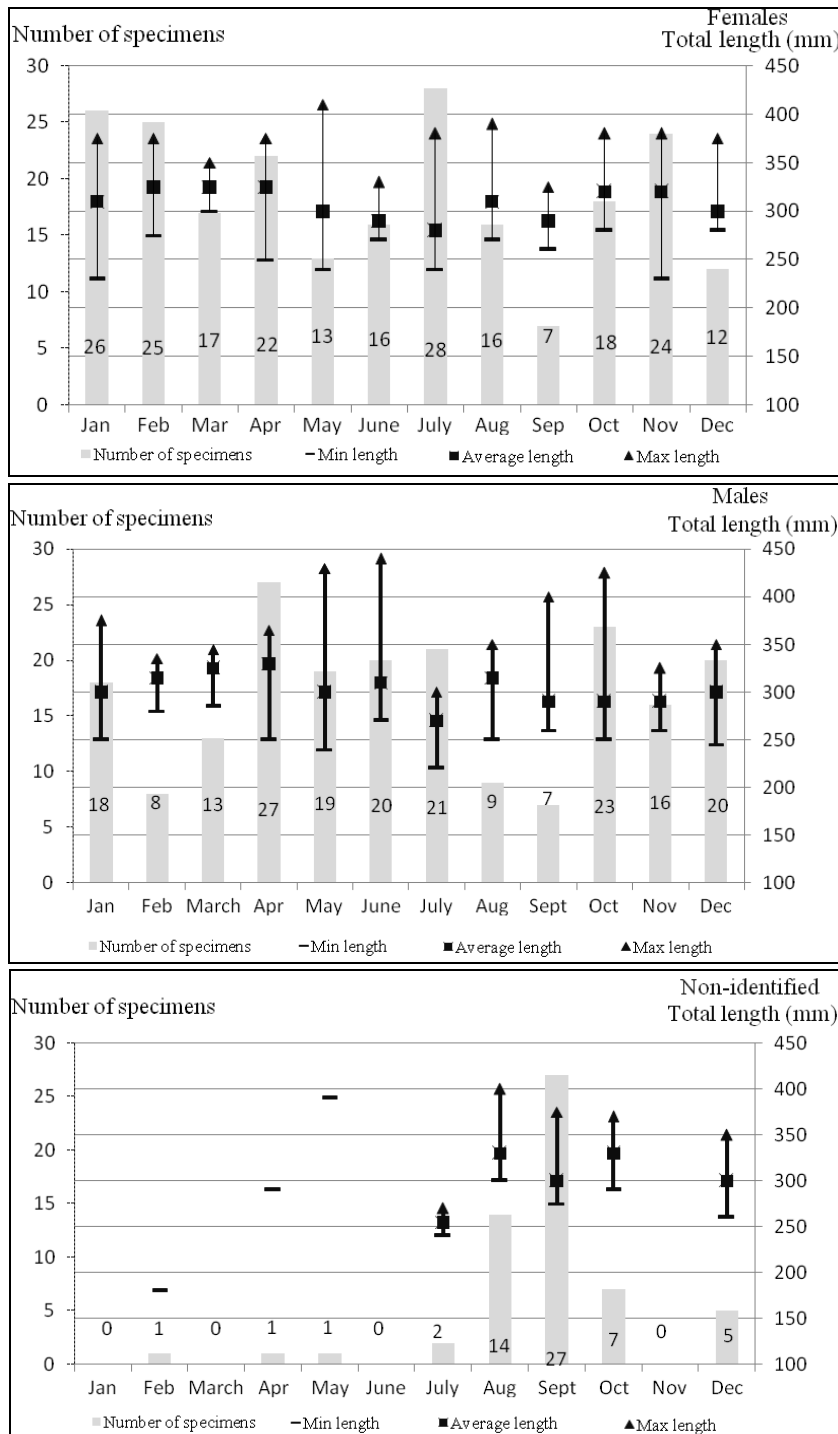


Figure 2. *Plectorhinchus mediterraneus*, monthly number caught and size (length to fork) of both male (upper) and females (middle) and the number of non-identified sex specimens (lower). Each data point indicates numbers of specimens.

Reproduction period

The monthly and seasonal variation of the GSR during an annual cycle used a total sample of 425 individuals (224 females and 201 males) whose sex could be determined macroscopically. The GSR variation in females follows the same shape as those of the males and the period of maturation is reflected by an increase in this ratio. In females, it extends from February to May (cold season). However the egg spawning period, started in June and ended in August (the warm season), the

period of sexual rest lasted from September to November (cold-warm transition) while that of the pre-maturation ran from November to the January each year (Fig. 4).

In males, the GSR change follow at the same pace as found in females. However, gonadal maturation begins in earlier (January) than in females (Fig. 4). The monthly RHS changes in *P. mediterraneus* shows that RHS peaked during the spawning period. The monthly change in the K condition factor is not clearly significant during the breeding period (Tab. 2-3).

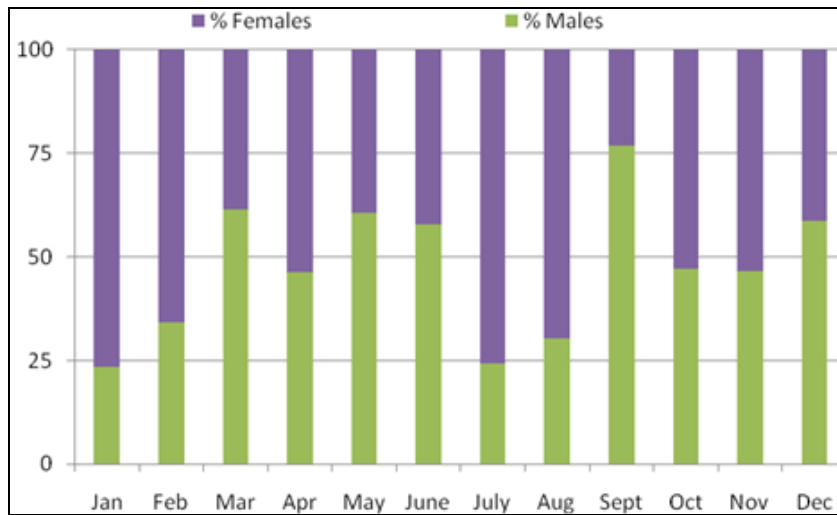


Figure 3. Monthly ratio variation of both sexes of *Plectorhinchus mediterraneus*.

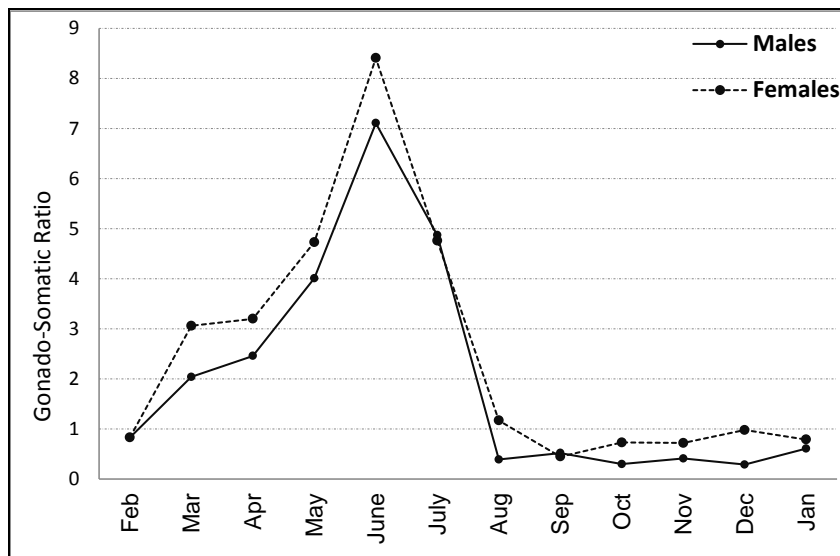


Figure 4. Change in the gonado-somatic ratio (GSR) in females and males of *P. mediterraneus*

Size at first sexual maturity

For each size range (class = 1cm) were calculated during the reproduction period, the percentage of female and / or male stages IV, V, VI, VII based on the total number of females and males where the values of these percentages calculated for all the months covering the laying period. The curve of mature individual frequencies allowed estimation of size at first maturity for each sex. The 50% level of mature individuals is 29.20 cm in males and in females 29.26 cm (Fig. 5-6).

DISCUSSION

Plectorhinchus mediterraneus is a gonochoric fish where males and females are easily distinguished. In immature individuals the gonads show a thin filament form and in mature individuals, the gonads are located in the posterior part of the abdomen according to stage of sexual maturity. The ovaries are of yellow-orange color, while the testes are whitish. The reproduction and the growth of this species were not studied before in the Atlantic area.

Females dominate in the samples and the length fluctuates between 23.8 and 44.4 cm for both sexes. The females dominance is not significant. χ^2 calculated is 17.61 significantly lower than the theoretical $\chi^2 = 19.68$ (Threshold $\alpha = 5\%$). The knowledge of the size of the first sexual maturity is important in the management of fishery resources (Dadedo *et al.* 2003).

However, males (Lt50 of 29.20 cm) reach sexual maturity at a size comparable to those of females (Lt50 of 29.26 cm). The knowledge of this parameter allows the establishment of a regulation on the size of first catch for the management of fishery resources.

The comparison of the GSR of males and females allows

observing that the evolution of these two relations remains identical throughout the year. The comparison of the RGS with the HSR shows the maximum values reached during the laying period (June, July). This species needs more investigations in other areas to compare results.

Higher temperature is considered the principle factor that affects reproduction in many fish species (Wootton, 1990). Reproduction of the Rubber lip grunt is clearly restricted in the hot season and the spawning period started in June and ended in August. The size at first sexual maturity is reached at a length of 29.20 cm (fork length) in males and 29.26 cm in females. Results are similar to those published by Da Silva (2011).

Table 2: Monthly changes in reproductive parameters in male specimens of *P. mediterraneus*; E: standard deviation; N: Monthly number; GSR: Gonado-Somatic Ratio; HSR: Hepato-Somatic Ratio; K = Mass of gutted fish

Month/males	GSR	E	N	HSR	E	N	K x 10 ⁻³	E x 10 ⁻³	N
February	0.83	0.41	8	0.53	0.23	8	1.5	0.1	8
March	2.04	1.22	13	0.95	0.20	13	1.6	0.1	13
April	2.46	1.15	27	0.88	0.19	27	1.7	0.1	27
May	4.01	2.07	19	0.96	1.02	19	1.9	0.8	19
June	7.11	2.15	20	1.25	0.30	20	1.7	0.1	20
July	4.87	1.78	22	1.46	0.23	22	1.7	0.1	22
August	0.39	0.33	9	0.70	0.52	9	1.3	0.7	9
September	0.52	0.18	7	0.77	0.28	7	1.6	0.1	7
October	0.30	0.27	23	0.73	0.30	23	1.7	0.5	23
November	0.41	0.32	16	0.99	0.34	16	1.6	0.1	16
December	0.29	0.13	21	0.78	0.26	21	1.6	0.1	21
January	0.61	0.49	17	1.06	0.33	17	1.6	0.1	17

Table 3: Monthly changes in reproductive parameters in females of *P. mediterraneus*; E: standard deviation; N: Monthly number of individuals; GSR: Gonado-Somatic Ratio; HSR: Hepato-Somatic Ratio; K= Mass of gutted fish

Month/females	GSR	E	N	HSR	E	N	Kx10 ⁻³	E x 10 ⁻³	N
February	0.83	0.50	25	0.65	0.24	25	0.002	0.08	25
March	3.06	0.78	17	1.31	0.22	17	0.002	0.09	17
April	3.20	0.75	22	1.13	0.32	22	0.002	0.12	22
May	4.73	2.38	13	1.25	0.72	13	0.002	0.55	13
June	8.41	2.02	16	2.51	0.52	16	0.002	0.41	16
July	4.76	1.90	28	2.61	0.50	28	0.002	0.18	28
August	1.17	1.13	16	0.95	0.43	16	0.002	0.60	16
September	0.45	0.28	7	0.95	0.14	7	0.002	0.16	7
October	0.73	0.43	18	0.70	0.24	18	0.002	0.12	18
November	0.72	0.37	24	1.21	0.56	24	0.002	0.65	24
December	0.98	0.29	12	0.83	0.38	12	0.002	0.08	12
January	0.79	0.40	26	0.79	0.37	26	0.002	0.64	26

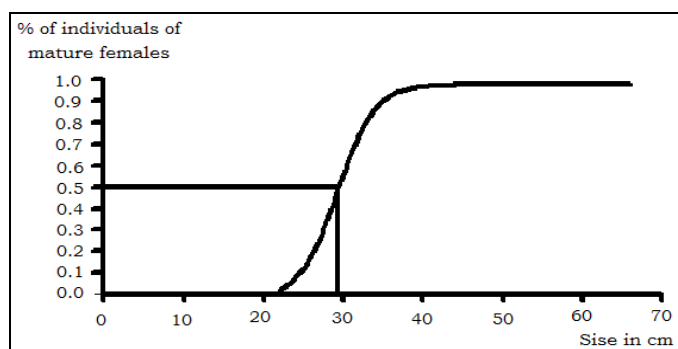


Figure 5. Size of the first sexual maturity for the females of *P. mediterraneus*

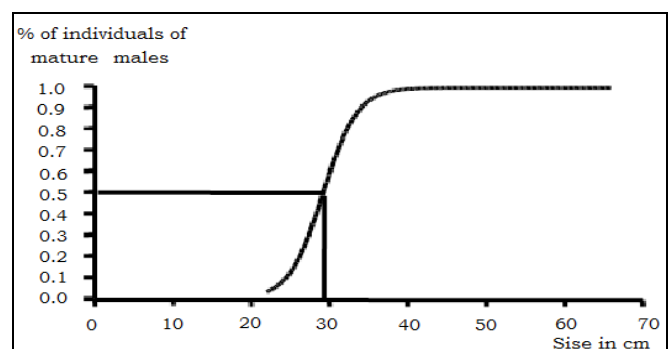


Figure 6. Size of the first sexual maturity for the males of *P. mediterraneus*

CONCLUSION

This study of reproduction in *Plectorhinchus mediterraneus* caught off the northern Mauritanian coast has shown that this fish is gonochoric with a clear distinction between the gonadal ratios of both sexes as macroscopically determined during the reproductive cycle. The sex ratio shows a strong, highly statistically significant relationship between males and females in all size classes. The water temperatures (between 18 and 22°C) in the masses of surface and coastal water in the catch area varied according to the intensity of upwelling during summer period in the region.

Considering these data, the timing of fisheries activity in northern parts of the Mauritanian coasts should take in consideration of the timing of reproduction and intensive fishing in July at least should be restricted and ideally between June and August. It is becoming imperative that management of all exploited fisheries is regulated in ways that ensures sustainability of the target fishery.

ACKNOWLEDGMENTS

We thank particularly the reviewers of our manuscript, their remarks and suggestions contributed to the improvement of this paper. We thank all the sampling team aboard the research vessel Al Awam, fellow researchers and laboratory technicians' ecology and biology of aquatic organisms that have contributed to this work.

REFERENCES

- Chakroun-Marzouk N. & Ktari M.H. 2006. Caractéristiques de la reproduction et de la croissance pondérale relative de *Pomadasyus incisus* (Haemulidae) du golfe de Tunis. *Cybium*, 30, 4, 333-342.
- Da Silva F. 2011. Avaliação biológica da população de *Plectorhinchus mediterraneus* (guichenot, 1850) (Pisces: Haemulidae) no sul de Angola (Namíbie). *Annual BCC Scientific Forum*, Oct. 2011, Swakopmund, Namíbia.
- Druzhinin A.D. & Filatova N.A. 1979. Some data on *Plectorhinchus pictus* of the family Pomadasyidae. *Journal of Ichthyology*, 19, 1, 154-155.
- Fanqueville C. 1982. *Biologie et dynamique de population des Daurades (Pagellusbellottii, steindacher 1882) le long des côtes sénégal-gambiennes*. Doctorat ès-Sciences, université Aix-Marseille II. 276 p.
- Fehri-Bedoui R. & Gharbi H. 2008. Sex-ratio, reproduction and feeding habits of *Pomadasyus incisus* (Haemulidae) in Gulf of Tunis. *Acta Adriatica*, 49, 1, 5-19.
- Fisher W., Bianchi G. & Scott W. B. 1981. *Fiches FAO d'identification des espèces pour les besoins de la pêche, Atlantique Centre – Est ; zones de pêche*, 34, 47.
- Gandega C., Dia M. & Ghorbel M. 2009. Régime alimentaire du diagramme gris *Plectorhinchus mediterraneus* (Guichenot, 1850), poisson Haemulidae, des côtes mauritaniennes. *Bulletin de l'Institut National des Sciences et Technologies de la Mer Salâmbo*, 36, 31-38.
- Gascuel D., Labrosse P., Meissa B. *et al.* 2007. Decline of demersal resources in North-West Africa: an analysis of Mauritanian trawl-survey data over the past 25 years. *African Journal of Marine Science*, 29, 3, 331-345.
- Guichenot A. 1850. Holotype de *Diagramma mediterraneus* guichenot, 1850 in exploration scientifique de l'Algérie pendant les années 1840, 1841 et 1842, poissons. *Histoire Naturelle Algérie*, 45, pl. 3.
- Hattour A. & Bradai M. N. 2011. First record of the Rubber-lip grunt *Plectorhinchus mediterraneus* (Guichenot 1850) (Osteichthyes: Haemulidae) in Tunisian waters (Central Mediterranean). *Bulletin de l'Institut National des Sciences et Technologies de la Mer Salâmbo*, 38, 159-163.
- Hebbar C., Kerfouf A. & Boutiba Z. 2012. Contribution à l'étude de la reproduction du rouget barbet de vase *Mullus barbatus barbatus* (Linné, 1758) de la baie d'Oran (Algérie). *Journal Sciences Halieutique & Aquatique*, 5, 144-151.
- Layachi M., Melhaoui M., Srour, A. & Ramdani M. 2007. Contribution à l'étude de la reproduction et de la croissance du Rouget-barbet de vase (*Mullus barbatus* L., 1758) de la zone littorale méditerranéenne de Nador (Maroc). *Bulletin de l'Institut Scientifique, Rabat, section Sciences de la Vie*, 29, 43-51.
- Mann B.Q. & C.D. Buxton. 1998. The reproductive biology of *Diplodus sargus capensis* and *D. cervinus hottentotus* (Sparidae) off the south-east cape coast, South Africa. *Cybium*, 22, 31-47.
- Merlo M.A., Pacchiarini T., Portela-Bens, *et al.* 2012. Genetic characterization of *Plectorhinchus mediterraneus* yields important clues about genome organization and evolution of multigene families. *Bio Med Central Genetics*, 13, 33.
- Saila S.B., Recksiek C.W. & Prager M.H. 1988 'Basic Fishery Science Programs. A compendium of microcomputer programs and manual of operation', *Dev. Aquac. Fish. Sci.*, 18, 1-230.
- Wootton, R. J. (1990). *Ecology of Teleost Fishes*, Chapman & Hall. Ed. London, 404 p.

Manuscrit reçu le 17/06/2016

Version révisée acceptée le 04/05/2017

Version finale reçue le 02/06/2017

Mise en ligne le 09/06/2017