Science and Technology Publishing (SCI & TECH)
ISSN: 2632-1017
Vol. 3 Issue 1, January - 2019

Reproductive Cycle As A Management Tool Of Two-Bar Seabream, *Acanthopagrus Bifasciatus* (Forsskål, 1775) From The Red Sea, Egypt

Sahar F. Mehanna[1], Usama M. Mahmoud[2], Fahmy I. El- Gammal[1] and Samia M. El-Mahdy[1]
[1]National Institute of Oceanography and Fisheries, Fisheries Division, Fish Population Dynamics Lab, Egypt
[2]Assiut University, Faculty of Science, Zoology Department, Egypt
Corresponding author: Sahar F. Mehanna
sahar_mehanna@yahoo.com

***Abstract*—The present study on reproductive cycle of Acanthopagrus bifasciatus revealed that the spawning season started from December to April for males and from December to March for females. The overall sex ratio was 1.5: 1 males to females. The gonado-somatic index of females and males reaching its peak in January (4.37 and 2.9, respectively) then decreased gradually. Fecundity analysis revealed linear relationships for absolute fecundity with length and weight. The absolute fecundity (F) of Acanthopagrus bifasciatus was varied from 737674 to 1741666 eggs/ female/ spawn.**

***Keywords*—Reproduction, sex ratio, fecundity, Acanthopagrus bifasciatus, Red Sea.**

I. Introduction

Seabreams (Family Sparidae) are common coastal fish species inhabiting tropical and temperate waters throughout the world. Up to date, 158 species of 38 genera have been ascribed to this family (Froese and Pauly, 2017). Its members are carnivorous, marine, brackish, reef-associated and inhabit shallow coastal waters (Sommer *et al.*, 1996 and Riede, 2004). The two-bar seabream *Acanthopagrus bifasciatus* is member of this family which represents the most important fish families in the Red sea. It is distributed in the Western Indian Ocean from the Red Sea and Arabian Gulf to Natal in South Africa. It is found in association with reefs in shallow coastal waters (2-20 m depth) and estuaries and bays (Sommer *et al.*, 1996).

To understand fish population dynamics, reproductive information,

such as the maturation of oocytes, the size and age at first maturity, gonado-somatic index (GSI), sex ratio, fecundity and recruitment, is indispensable. Understanding the reproductive biology of a species is the central aspect of providing sound scientific advice for fisheries management. Reproductive biology plays an important role in determining productivity and therefore a population's resiliency to exploitation by fisheries or to perturbation caused by other human activities (Morgan, 2008).

The objective of this study is to provide information on spawning seasonality, size at maturity, sex ratio and annual fecundity of *Acanthopagrus bifasciatus* in the Egyptian Red Sea as necessary information for sound management of this species.

II Material and Methods

A. Sampling

A total of 442 males (17 – 56 cm in total length) and 287 females (18 – 57 cm in total length) of *Acanthopagrus bifasciatus* were collected randomly from the Red Sea, Egypt (Fig. 1) during the period from January to December 2015. The total length (TL) was measured to the nearest centimeter and the body weight (W) was recorded to the nearest gram. Sex of each specimen was determined macroscopically after dissection of specimens.

B. Sex ratio

The sex of each specimen will identify by examination of the gonads. The proportion of the two sexes relative to one another will be used to calculate the sex ratio.

C. Spawning season

Spawning period was established from the analysis of two variables: percentage frequency of the maturity stages and the monthly variation in the gonado-somatic index.

D. Gonad maturation

The maturity stages were assigned macroscopically according to Orange (1961) as follows:

- Stage I (immature): gonads thread-like, sexes can't be visually determined.
- Stage II (mature): gonads enlarged, sexes can be easily determined, but ova not visible to naked eye.
- Stage III (ripe): gonads enlarged occupying about 10% of body cavity, ova visible to naked eye.
- Stage IV (running): gonads greatly enlarged, ova easily dislodged from follicles or loose in lumen of ovary.
- Stage V (spent): gonads small containing mature ova as remnants in various stages of resorption.
-

E. Gonado-somatic index (GSI)

The average monthly gonado-somatic index (GSI) of both males and females was calculated according to Strum (1978) as follows:

$$GSI = \frac{\text{Gonad weight}}{\text{Body weight}} * 100$$

F. Length (L_m) and age (T_m) at first sexual maturity:

The length at first sexual maturity (L_m); the length at which 50% of *A. bifasciatus* reach their sexual maturity was estimated by using spread sheet empirical equation of Froese & Binohlan (2000) where:

Log L_m = 0.8979 Log L_∞ - 0.0782. The corresponding age at first sexual maturity (T_m) was computed by converting L_m to age using the von Bertalanffy growth equation as follows:

$$T_m = t_0 - (1/k * \ln [1- (L_m/L_\infty)])$$

G. Growth parameters

The von Bertalanffy growth parameters obtained by Mehanna *et al.* (2018) were used in this study.

H. Absolute fecundity

To determine the absolute fecundity of the fish, Ovaries of 32 females (stage III and IV) were collected in January 2015 to March 2015 and December 2015. Each pair of ovary was carefully dried with filter paper and weighed to the nearest 0.01 g. One ovary was randomly selected from each pair and used for fecundity determination. A subsample of about 0.1 to o.2 g from the selected ovary was weighed to the nearest 0.001 g and placed in a Petri dish containing few drops of tap water. Clumps of adhering eggs were broken up and eggs carefully separated using dissecting needles. Eggs were counted using modified colony counter. Total number of eggs (N) in both ovaries was calculated using the following formula:

$$N= N_s (W_t / W_s)$$

Where W_t = Ovary weight, W_s = weight of subsample and N_s = number of ova counted in the subsample. The linear regression of fecundity- length and weight relationship was calculated as: $F = a + b\,TL$ and $F = a + b\,W$.

Where F = Fecundity, TL= Total length of fish (cm), W= weight of fish (g), a= regression constant and b= regression coefficient.

Figure 1: Egyptian Red Sea map showing the study area

III. Results and Discussion

The present study has established key reproductive dynamical characteristics of one of the commercial species of family Sparidae in the Egyptian Red Sea.

A. Spawning season

Knowing the time of spawning is essential to protect both of the ripe females and the new recruits and to predict the recruitment variability. To determine the reproduction period of *A. bifasciatus*, monthly variations in both of maturity stages and gonado-somatic index values were used.

Gonad maturation

Monthly pattern of gonadal activity showed occurrence of five maturity stages for females and males; from stage I up to stage V (Fig. 2). For males, maturity stages I to III were dominated in all months, while maturity stage IV was appeared during January to April and December. Stage V was available in March to September. In respect to females, maturity stage II was dominated the catch from April to November and absent during spawning season. Maturity stage III was absent in February, March and September, while maturity stage IV was occurred from January to March and December. Maturity stage V was appeared from March to September.

Gonado-somatic index (GSI)

The gonado-somatic index is another method for studying the spawning season by following the monthly changes in the gonad weight in relation to the total fish weight. Gonado-somatic index is one of the important parameter of fish biology, which gives the detail idea regarding fish reproduction and reproductive status of the species and help in ascertaining breeding period of fish (Gupta & Srivastava, 2001 and Shankar & Kulkarni, 2005).

Gonado-Somatic Index (GSI) was calculated for males and females of *A. bifasciatus* (Fig. 3). The gonado-somatic index of females reaching its peak in

January (4.37) then decreased gradually from February to November then increased again in December (2.9). In respect to males, the gonad-somatic index reaching its peak in January (1.65) then afterward start to decrease. Gonads of males started to develop in July (0.13) until December (0.27). The results revealed that spawning season is extended from winter through spring.

Gonad maturation and spawning season of sparid fishes are correlated to environmental conditions especially water temperature (Coetzee, 1986 and Garratt, 1986). In the present study, gonads development and maturation of *A. bifasciatus* occurred at lowest water temperature (from winter to spring) and this agree with El-Sayed and Abdel-Bary (1994) and Grandcourt *et al.* (2004). The short spawning season of *A. bifasciatus* in the present study is in agreement with the reports on other sparids living in warm waters (Buxton, 1990 and El-Sayed and Abdel-Bary, 1994; Grandcourt *et al.,* 2004). They confirmed that the spawning period of *A. bifasciatus* is during the winter months and there is no any spawning activities in the summer.

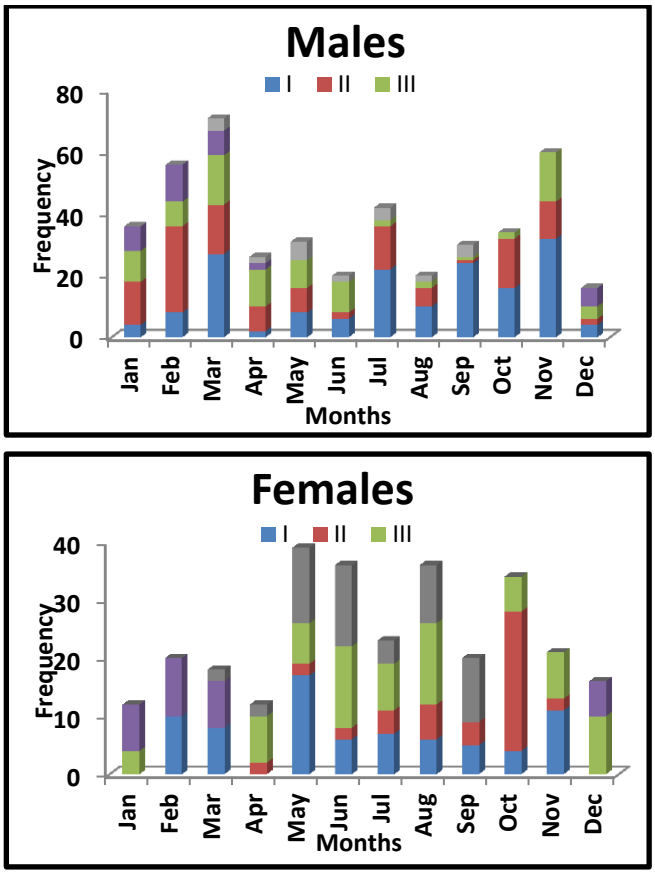

Fig. 2: Monthly distribution of maturity stages for *Acanthopagrus bifasciatus* from Red Sea, Egypt.

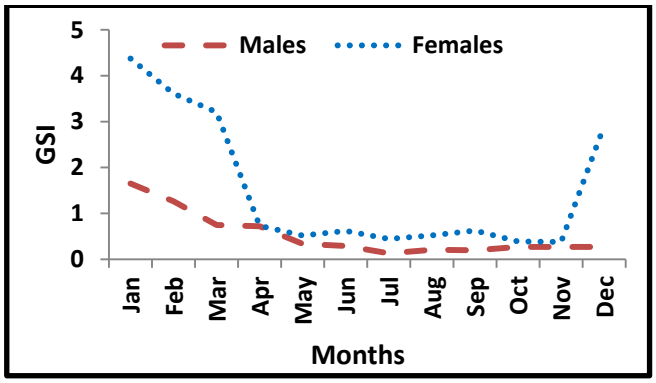

Figure 3: Monthly variation in gonado-somatic index (GSI) of *Acanthopagrus bifasciatus* from Red Sea, Egypt.

B. Sex ratio

Sex ratio constitutes basic information indispensable for the assessment of the potential of fish reproduction and stock size estimation in fish population (Vicentini & Araujo, 2003 and Adebiye, 2013). The calculated overall sex ratio was M: F = 1.5: 1. The highest percentage of females was found in May and the highest percentage of males was found in March (Fig. 4). The overnumber of males than females agrees with El-Sayed and Abdel-Bary (1994) who recorded overall sex ratio 2:1 for *A. bifasciatus.*

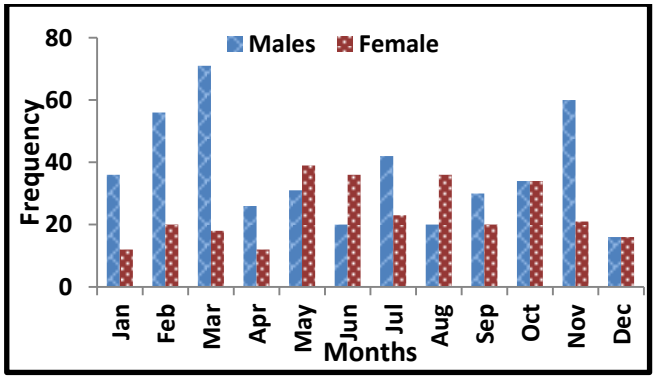

Figure 4: Monthly variation in males and females of *Acanthopagrus bifasciatus* from Red Sea, Egypt.

C. Length (L_m) and age (T_m) at first sexual maturity

The length at first sexual maturity is important for determining the optimum length at first capture and consequently the optimum mesh size. The length at first sexual maturity (L_m) was 35.8 cm for combined sexes of *A. bifasciatus*. The corresponding age at first sexual maturity (T_m) was 3.65 year. Grandcourt *et al.* (2004) gave mean size at first sexual maturity at 26.4 cm Fork length for females and 21.9 cm Fork length for males in UAE

The smallest length recorded in the catch was 17 cm for males and 18 cm for females and all fish of lengths ≤ 30 cm were immature. It is evident that a considerable proportion (28%) of *A. bifasciatus* catch didn't reach the maturation and up to 42% of *A. bifasciatus* catch didn't reach the length at first sexual maturity. This means that the exploited *A. bifasciatus* must be protected till in order to share at least once in

the spawning activity. Therefore, mesh sizes used should be increased to catch fish of about at least 30 cm length.

D. Absolute Fecundity

Fecundity estimation is useful in the estimation of population and its productivity. The knowledge of fish fecundity has much relevance in fish population studies and in successful management and exploitation of the fishery (Alam and Das, 1996).

The absolute fecundity (F) of *A. bifasciatus* was varied from 737674 to 1741666 eggs/ female/ spawn, showing considerable variations among individuals. The relationship between fecundity and both total length (TL) and total weight (W) were best fitted by the following linear equations (Fig. 5):

$F = 67803^{*} TL - 2E+6 R^2 = 0.92$

$F = 245791 + 473.23^{*} WR^2 = 0.82$

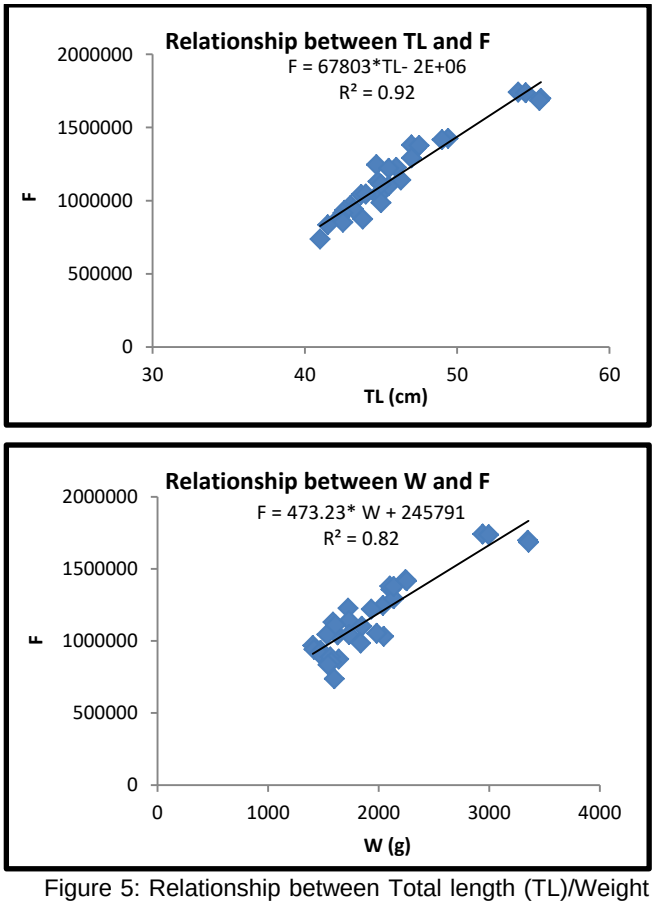

Figure 5: Relationship between Total length (TL)/Weight (W) and Absolute fecundity (F) of *Acanthopagrus bifasciatus* from Red Sea, Egypt.

The absolute fecundity of the present study (737674-1741666 eggs/ female) for *A. bifasciatus* is much higher than absolute fecundity which observed by El-Sayed and Abdel-Bary (1994) (180000 – 894 eggs/ female). This conflict may be attributed to the fact that their samples covered a limited length interval compared to those collected in the present study.

In conclusion, the study of reproductive dynamics revealed two important facts which should be considered through fisheries management of *A. bifasciatus* in the Red Sea, Egypt. Firstly, the spawning period for the species extends from December to April which occurs during the active fishing season. Secondly, a considerable percentage of the catch comprises fish don't reach their first sexual maturity and don't contribute in spawning. Accordingly, it is recommended to reconsider timing of fishing and closed season to protect *A. bifasciatus* during it spawning season. In addition, a detailed study concerned gear selectivity should be done to find the proper mesh size which guarantees the contribution of a considerable part of the stock of *A. bifasciatus* during the spawning season.

References

F.A. Adebiye, The sex ratio, gonadosomatic index, stages of gonadal development and fecundity of Sompatgrunt. *Pomadasys jubelini* (Cuvier, 1830), Pakistan J. Zool. 2013, 45(1):41-46.

S.D. Ahirrao, Status of gonads in relation to total length (TL) and gonadosomatic index (GSI) in freshwater spinyeel (pisces) *Mastacembelus armatus* (Lacepede) from Marathwada region Maharashtra. J. Aqua. Biol. 2002, 17(2): 55-57.

M.D. Alam and N.G. Das, Fecundity and condition index of *Crassostrea maadrasensis* (Cupped oyster) in the intertidal water of the Moheshkhali Chammel of the Bay of Bengal. J. Inland Fish Soci. Ind. 1996, 28:105-109.

F. Al-Kiyumi, S.F. Mehanna and B. Al-Siyabi, Reproductive dynamics as a management tool for the spotted grunter *Pomadasys commersonnii* (Lacepède, 1801) from the Arabian Sea off Oman. International Congress on "Estuaries & Coastal Protected Areas, "ECPA 2014, 04 - 06 November 2014, Izmir – Turkey.

C.D. Buxton, Protogynous hermaphroditism in *Chrysoblephus laticeps* (Cuvier) (Teleostei: Sparidae). S. Afr. J. Zool. 1989, 24:212-216.

C.D. Buxton, The reproductive biology of *Chrysoblephus laticeps* and *Chrysoblephus cristiceps* (Teleostei: Sparidae). J. Zool. London, 1990, 220: 497-511.

P.S. Coetzee, Diet composition and breeding cycle of blacktail, *Diplodus sargus capensis* (Pisces: Sparidae) caught off St. Croix Island, Algoa Bay, South Africa. S. Afr. J. Zool. 1986, 21:237-243.

M.A. El-Kasheif, K.A.S. Shalloof and M.M.N. Authman, Studies on some reproductive characters of *Tilapia* species in Damietta branch of the River Nile, Egypt. J. Fish. Aquat. Sci. 2013, 8: 323-339.

A.M. El-Sayed and K. Abdel-Bary, Population biology of sparid fishes in Qatari waters. 3. Reproductive cycle and fecundity of black-banded bream, *Mylio bifasciatus* (Forsskal). Qatar Univ. Sci. J. 1994, 14(1): 212-216.

A.A. Ezzat, S.H. Abdel-Aziz and S.S. Breeka, Protogynous sex reversal in Bogue, *Boops boops* (Linnaeus, 1758) (Teleostei: Sparidae). Alex. J. Vet. Sci. 1990, (6-7): 39-49.

R. Froese and C. Binohlan, Emprical relationships to estimate asymptotic length, length at

first maturity and length at maximum yield per-recruit in fishes, with a simple method to evaluate length frequency data. J. Fish Biol. 2000, 56: 758-773.

R. Froese and D. Pauly (eds), Fishbase. World Wide Web electronic publication. 2017, www.fishbase.org, (10/2017).

P.A. Garratt, The offshore line fishery of Natal: II. Reproductive biology of the sparids *Chrysoblephus puniceus* and *Chermerius nufar*. Invest. Rep. Oceanogr. Res. Inst. Durban 1986, 63:1-21.

E.M. Grandcourt, T. Z. Al Abdessalaam, F. Francis and A.T. Al Shamsi, Biology and stock assessment of the sparids, *Acanthopagrus bifasciatus* and *Argyrops spinifer* (Forsskål, 1775), in the Southern Arabian Gulf. *Fisheries Research* 2004**,** 69**:** 7–20.

J.P. Gupta and S.P. rivastava, Maturity determination by gonadosomatic index during annual reproductive cycle in Passer domesticus. Environment and Ecology (Kalyani) 2001, 191: 216-218.

T. Manousaki, A. Tsakogiannis, J. Lagnel, E. Sarropoulou, J.Z. Xinag, N. Papandroulakis, C.C. Mylonas and C.S. Tsigenopoulos, The sex-specific transcriptome of the hermaphrodite sparid sharpsnout seabream (*Diplodus puntazzo*).BMC Genomices, 2014, 15: 655.

S. Mian, M.A. Hossain and A. Shah, Sex ratio, fecundity and gonado somatic index of spotted snakehead, *Channa punctatus* (Channidae) from a lentic ecosystem. International Journal of Fisheries and Aquatic Studies 2017, 5(1): 360-363.

W.L. Montgomery and R. Galzin, Seasonality in gonads, fat deposits and condition of tropical surgeonfishes (Teleostei: Acanthuridae). Marine Biology 1993, 115 (4): 529-536.

C.J. Orange, Spawning of yellowfin tuna and skipjack in the Eastern Tropical Pacific, as inferred from studies of gonad development. Inter-Am. Trop. Tuna Comm., Bull. 1961, 5(6): 459-526.

K. Riede, Global register of migratory species: From global to regional scales. Final Report of R&D-Projekt 80805081, Federal Agency for Nature Conservation, Bonn, Germany 2004, pp: 329.

D.R. Robertson, Differences in the seasonalities of spawning and recruitment of some small neotropical reef fishes. J. exp. mar. Biol. Ecol. 1990, 144: 49–62.

Y. Sadovy, Reproduction in reef fishery species. In: Reef fisheries (eds. N.V.C. Polunin and C.M. Roberts). Chapman & Hall, U.K. 1996, 15–59.

S.K. Saikia, S. Majumder, S. Nandi and S. K. Saha, Feeding ecology of the freshwater fish Rohu, *Labeo rohita* (Hamilton 1822): A case of intelligent feeding in the periphyton-based environment. Zoology and Ecology 2013, 23(4): 266-274.

D.S. Shankar and R.S. Kulkarni, Somatic condition of the fish, *Notopterus notopterus* (pallas) during phases of the reproductive cycle. J. Environ. Biol. 2005, 26(1): 49-53.

A. Siddiquee, Reproductive biology of great snakehead *Channa marulius* from the Sylhet basin, Dissertation, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh, Bangladesh 2012.

C. Sommer, W. Schneider and J.M. Poutiers, FAO Species Identification Field Guide for Fishery Purposes the Living Marine Resources of Somalia. FAO, Rome 1996, Pages: 376.

L.M.G. Strum, Aspects of the biology of *Scombemorus maculatus* (Mitchill) in Trinidad. J. Fish Biol.1978, 13: 155-172.

R. Vicentini and F.G. Araújo, Sex ratio and size structure of *Micropogonias furnieri* (Desmarest, 1823) (Perciformes, Sciaenidae) in Sepetiba Bay, Rio De Janeiro, BRAZIL. Braz. J. Biol. 2003, 63(4): 559-566.