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POPULATION BIOLOGY OF SPARID FISHES IN QATARI WATERS 3. REPRODUCTIVE CYCLE AND FECUNDITY OF BLACK-BANDED SEABREAM, *MYLIO BIFASCIATUS* (FORSSKAL)

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بيولوجيا التجمعات لأسماك عائلة سباريدي في المياه القطرية ٣ - دورة الحيـاة والخصوبـة في أسماك الفسـكر

عبد الفتـاح محمـد السـيد و كمـال عبد البـاري مصطفى

لقد أجريت هذه الدراسة لالقاء الضوء على دورة الحياة والنضوج الجنسي والخصوبة والتناسل في أسماك الفسكر في المياه القطرية ، وقد تم في هذا الصدد جمع عينات نصف شهرية تمثل جميع الأطوال والمجموعات العمرية وذلك في الفترة من يناير وحتى ديسمبر ١٩٩٣م .

وقد أوضحت الدراسة أن نمو المناسل يتم بين شهري ديسمبر ومارس ، بينما يستمر وضع البيض حوالي أسبوعين بدءاً من منتصف شهر أبريل وحتى آخره . كما وجدت علاقة عكسية بين نمو المناسل وكل من درجة حرارة الماء وطول نهار اليوم . أما متوسط نسبة الذكور للإناث فقد بلغ ٢ : ١ . وقد وجد أن هذه الأسماك تصل لمرحلة النضوج الجنسي عندما تبلغ أطوالها ١٧ سم للذكور و ١٩ سم للإناث . وقد كانت العلاقة بين الخصوبة المطلقة وكل من طول ووزن الأسماك علاقة خط منحني تم تمثيلها بالمعادلتين الآتيتين :

لوغاريتم الخصوبة = - ٢,٨٢٨ + ٣,٥٩٨٩ × لوغاريتم الطول .

لوغاريتم الخصوبة = - ٠,٧٠٧ + ١,١٨٢٤ × لوغاريتم الوزن .

Key Words: Arabian Gulf, *Mylio bifasciatus*, Fecundity, Maturation, Reproduction, Seabream, Sparidae, Qatar.

ABSTRACT

The reproductive cycle, gonads maturation, gonado-somatic indices (GSI) and fecundity of black-banded seabream *Mylio bifasciatus* from the Arabian Gulf waters off Qatar were investigated. Bi-weekly samples representing all age groups were collected from January through December, 1993. Gonad maturation occurred in December-March. Spawning was restricted to about 2 weeks from mid to late April (2nd and 3rd quarters of the lunar month). No changes in gonads conditions were noted from May to November. Maximum spawning activity occurred at minimum photoperiod and water temperature. The mean sex ratio was 2 males: 1 female. Males outnumbered females at smaller length groups. No males less than 17 cm, and no females less than 19 cm, while all fish greater than 29 cm, were sexually mature, and 100% of the fish mature at age 5. The relationships between absolute fecundity (1000's of ova) and fish lengths and weights were best represented by the following non-linear equations:

$\log F = -2.828 + 3.5989 \log L$ ($r = 0.924$), and $\log F = -0.707 + 1.1824 \log W$ ($r = 0.94$), respectively.

INTRODUCTION

Sparid fishes are a major component of fish landings and have extremely high market value in the Arabian Gulf fisheries [1, 2]. The increased demand, concomitant with shortage in the landing of these fishes in the Gulf region has resulted in a sharp increase in their market prices [2]. Despite the importance of sparid fishes in the Gulf waters, little has been

published on their biology, feeding, reproduction and fisheries.

The present study describes the reproductive biology of black-banded sea bream, *Mylio bifasciatus*, (which is locally known as faskar) in the Arabian Gulf waters off the state of Qatar. It throws light on: 1) sexual maturity, 2) spawning season, 3) sex ratio, 4) fecundity, and 5) the effects of environmental conditions on the reproductive patterns of the fish. This information contributes significantly to the overall understanding of reproduction biology of sparid fishes in the Gulf, and is particularly essential for the current trials of intensive culture of these fishes in some of the Gulf countries.

MATERIALS AND METHODS

The study was conducted on 466 fish (combined sexes) obtained from the Qatar National Fishing Company (QNFC). Random samples representing a wide range of sizes (16-44 cm, total length) were collected bi-weekly. For each fish, total length (cm), total weight (g), gutted weight (g), gonad weight (g), sex, and maturity stages were recorded. Ovaries of mature and ripe females were preserved in 10% formalin solution for fecundity determination. To determine the sex distribution in relation to fish size, Faskar were grouped into 2 cm length intervals (table 1).

GONAD MATURATION

The following maturity stages were determined according to Orange [3]. Stage I (immature): gonads thread-like, sexes can not 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 (spawned) (spent): ovary small containing mature ova as remnants in various stages of resorption.

The spawning season was determined by calculating the average monthly gonado-somatic index (GSI) of both males and females, as follows:

$$GSI = 100 \frac{\text{gonads weight (g)}}{\text{gutted weight (g)}}$$

The average monthly water temperature and photoperiod were obtained from Meteorology Department, Ministry of Communication and Transport, State of Qatar, throughout the study. The relationship between gonad maturation and both water temperature and photoperiod was investigated.

The monthly frequency distribution of each maturity stage was determined during the reproductive season (December-May). The length and age at first sexual maturity were calculated by grouping the fish into 2 cm length intervals, and calculating the maturity (%) at each length group. A regression between % maturity and fish length was performed, and the length at first maturity calculated.

ABSOLUTE FECUNDITY

To determine the absolute fecundity of the fish, ovaries of 21 ripe females (stage III and IV) were collected in February and March. Each pair of ovaries was carefully dried with a 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 0.2 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 two dissecting needles. Eggs were counted using a modified colony counter (Gallenkamp Colony Counter CNW-325). It was noted that ripe ovaries contain primary oocytes and immature ova which develop in subsequent years, and mature ova which will be shed in the coming spawning season. Therefore, primary oocytes and ova less than 0.3 mm in diameter were not counted. Total number of eggs (N) in both ovaries was calculated using the following formula [4]:

$$N = N_s \frac{W_t}{W_s}$$

where: W_t = ovary weight, W_s = weight of the subsample, and N_s = number of ova counted in the subsample. The linear regression of fecundity on both length and weight was calculated.

RESULTS

SEXUAL MATURITY

Gonadal conditions of *M. bifasciatus* progressed from stage V (spent) which extended from early May through November without a significant change. A sudden increase in GSI's of both sexes were recorded in December, as water temperature started to sharply decline (Fig. 1). Gonads development continued in January and February. By late March and early April, gonads were fully ripe. The distribution of different maturity stages during the reproductive season is given in Fig 2.

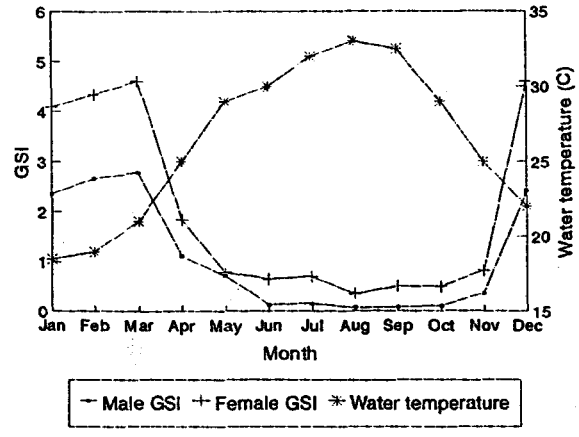

Fig. 1: Gonadosomatic indices of *M. bifasciatus* in relation to water temperature.

It is evident from the above results that gonads maturation was significantly correlated to water temperature and photoperiod. Maximum GSI occurred during December-March, at lower water temperature (15-22 ^{o}C) and photoperiod (10.5-12 hrs), while spent and resting gonads were recorded during higher water temperature and photoperiod (May-November) (Fig. 1).

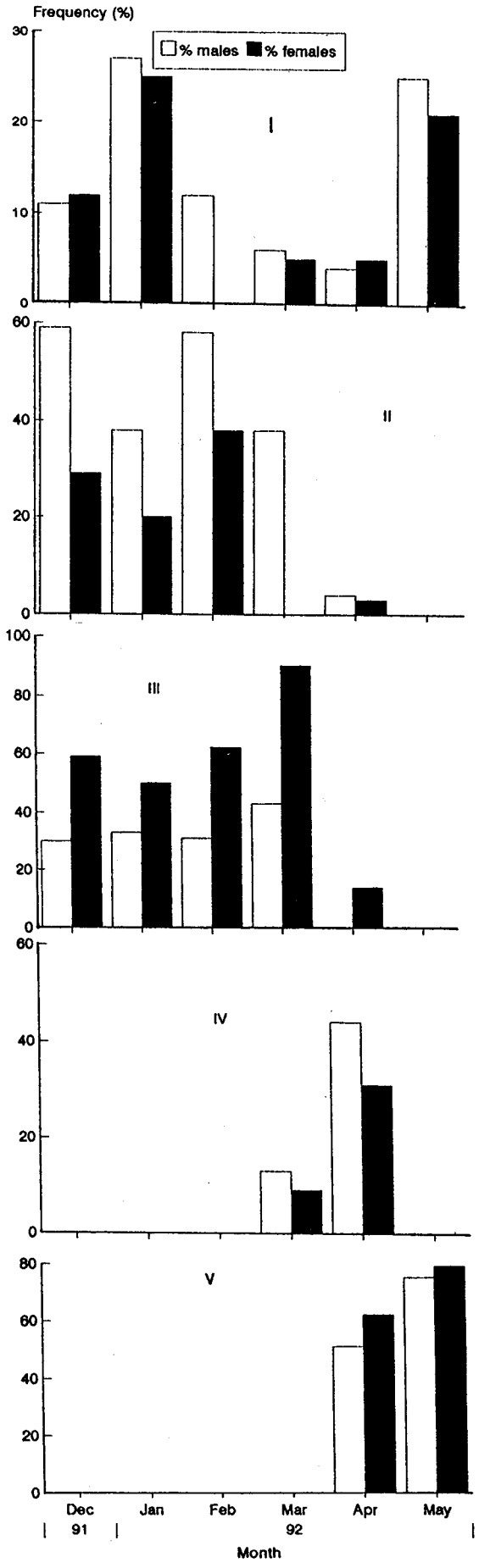

Fig. 2: The distribution (%) of *M. bifasciatus* at each maturity stage during reproduction season.

The spawning season of faskar was fairly short and extended for about 2 weeks (from about 10 through 25 April). Lunar cycle seems to affect the spawning activity of the fish. To investigate this assumption, more frequent samples were collected and examined in April (Table 2). Spent fish were first recorded on April 13 (2 days after the 1st lunar quarter). By April 25 (21st day of the lunar month), all fish were spawned. Ovaries collected in May were flaccid and contained residual ova, resorbed by early June.

SEX RATIO

The sex ratio of faskar was not 1:1. Males were predominant at all length groups. In addition, no females less than 20 cm TL were found throughout the study. (table 1). The overall male:female ratio was 2:1.

Table 1
Sex ratio (male:female) of *Mylio bifasciatus* in Qatari waters

Length (cm)	Number			Sex ratio
	Total	Males	Females	
16-18	8	8	00	8.00:1
18-20	8	8	00	8.00:1
20-22	32	23	9	2.56:1
22-24	33	22	11	2.00:1
24-26	80	50	30	1.67:1
26-28	101	65	36	1.81:1
28-30	65	46	19	2.42:1
30-32	54	36	18	2.00:1
32-34	34	20	14	1.43:1
34-36	22	12	10	1.20:1
36-38	14	10	4	2.50:1
38-40	11	8	3	2.66:1
40-42	4	2	2	1.00:1
Total	466	310	156	
Average				2.00:1

Table 2
Spawning times of *M. bifasciatus* during April, 1993

Day	Lunar Day	Percentage spawned	
		Males	Females
7/4	3	0	0
13/4	9	16	5
20/4	16	68	76
25/4	21	100	100

AGE AT FIRST MATURATION

The linear regression equations of % maturity (Y) on length (X) for males and females, respectively were:

$Y = -173.63 + 9.94X$ ($r = 0.93$) and $Y = -192.54 + 8.41X$ ($r = 0.97$).

It is evident from the equations that no males less than 17.46 cm and no females less than 19 cm, while all individuals greater than 29 cm, were sexually mature.

In a previous work, El-Sayed and Abdel-Bary [5] found that the lengths of faskar at ages 1, 2, 3, 4 and 5 were 16, 22, 24.6, 27.2 and 29.2 cm, respectively. By inserting these length values to the above equations, age at first sexual maturity was determined. The results suggested that no males at age 1, 45% at age 2, 71% at age 3, 97% at age 4, and 100% at age 5 were sexually mature. For females, % maturity was 0, 32, 58, 85, and 100% at age 1, 2, 3, 4, and 5, respectively.

ABSOLUTE FECUNDITY

The absolute fecundity (F) of faskar ranged from 180,000 to 894,000 eggs/female/spawn, showing considerable variations among individuals. The relationships between fecundity and both total length (L) and total weight (W) were best fit by the following non-linear equations (Figs. 3, 4):

$\text{Log } F = -2.828 + 3.599 \text{ Log } L$ ($r = 0.924$), and

$\text{Log } F = -0.707 + 1.182 \text{ Log } W$ ($r = 0.94$).

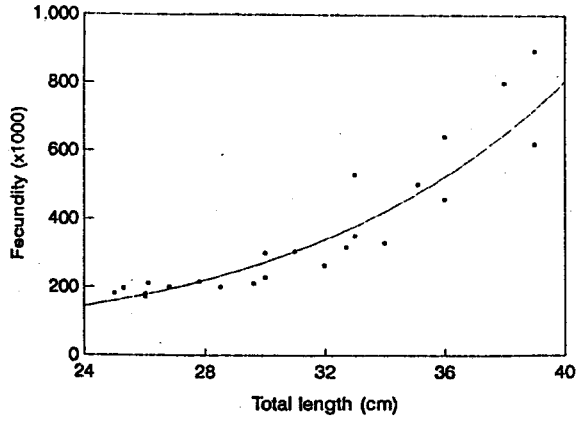

Fig. 3: Length/fecundity relationship of *Mylio bifasciatus* in Qatar waters.

DISCUSSION

Gonads maturation and spawning seasons of sparid fishes are correlated to environmental conditions especially water temperature [6-8] and photoperiod [9, 10]. Studies on *Pagrus pagrus* [11, 12], *Diplodus sargus* [13], *Boops boops* [14], *Argyrops spinifer* [5] and *M. bifasciatus* (present study) indicated that gonads development and maturation occurred at lowest water temperature. On the contrary, gonadal maturation of the breams *Chrysoblephus laticeps* and *C. cristicepes* occurred at peak water temperature and photoperiod [15].

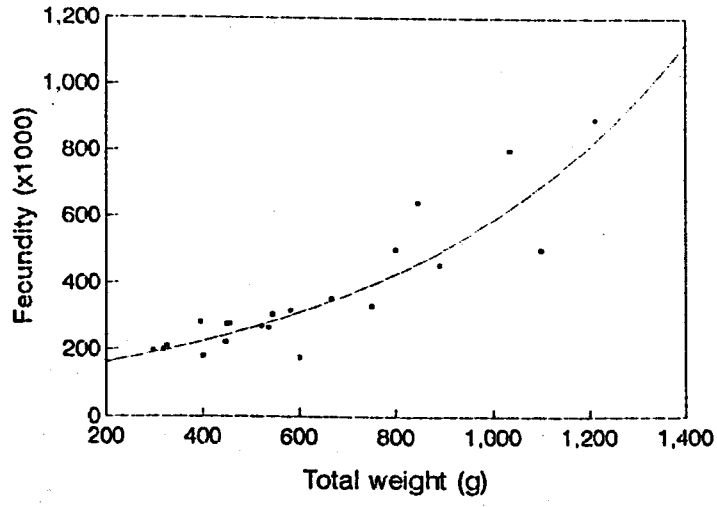

Fig. 4: Weight/fecundity relationship of *Mylio bifasciatus* in Qatari waters.

The short spawning season of faskar in the present study is in agreement with the reports on other sparids living in warm waters [15, 16]. However, longer spawning seasons of sparid populations in the warmer and sub-tropical waters have been reported [8, 17].

The lunar spawning rhythm of faskar in the present study has been reported in some other marine fishes. Spawning of rabbitfishes, *Siganus vermiculatus* [18] and *S. guttatus* [19] have been reported to occur around the first lunar quarter and full moon. The grouper, *Epinephelus guttatus* was reported to spawn 1-2 days after the full moon, in the Northern Caribbean [20].

Non-linear relationships between fecundity and length and weight have been reported on *P. pagrus* [12] and *B. boop* and *B. salpa* [14]. However, the fecundity of faskar observed in the present study was much higher than that of those fishes.

It is well known that both protogynous and protandrous hermaphroditism are common among sparid fishes [12, 21-26]. The predominance of males at smaller sizes in the present study suggests a protandrous hermaphroditism in this species. However, during the course of the study, no fish with both male and female sex organs were discovered. Further investigation is needed to detect the type of hermahproditism in this species.

In conclusion, gonadal maturation of black-banded sea bream in Qatari waters occurs from December through March (at minimum water temperature and photoperiod), while spawning takes place in mid-to late April. Spawning started around the first quarter of the lunar month, with a peak 3-4 days after the full moon. No fish less than 17.46 cm, (males) and 19 cm (females), and all fish greater than 29 cm were sexually mature. The males were predominant, especially at smaller sizes, with an overall male:female ratio of 2:1.

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