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POPULATION BIOLOGY OF SPARID FISHES IN QATARI WATERS. 1 - REPRODUCTIVE CYCLE AND FECUNDITY OF LONGSPINE SEABREAM, *ARGYROPS SPINIFER* (Forskal)

By

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بيولوجية المجموع لأسماك عائلة «سباريدي» في المياه القطرية
١ - دورة الحياة والخصوبة في اسماك الكوفر

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لقد تمت دراسة دورة التزاوج ، نضوج المناسل والخصوبة في أسماك الكوفر في المياه القطرية في الفترة من نوفمبر ١٩٩١م وحتى مايو ١٩٩٣م . وقد أثبتت الدراسة أن نمو المناسل يحدث بين ديسمبر ومارس حيث يصبح وزن المناسل بالنسبة لوزن الجسم أعلى ما يمكن . ويتم التزاوج وإلقاء البيض في فترة قصيرة تمتد من منتصف شهر أبريل وحتى آخره . بعد ذلك لا يحدث أي تغيير في حالة المناسل وحتى شهر أكتوبر حيث يبدأ تكوينها من جديد . وقد أوضحت الدراسة أيضاً أن التزاوج يتم عندما تكون درجة حرارة الماء وفترة سطوع الشمس عند أقل قيمة لهما . كما ثبت من الدراسة أن جميع الأسماك الأقل من ١٦ سم في الطول كانت غير ناضجة بينما جميع الأسماك الأكبر من ٢٦ سم كانت ناضجة جنسياً وأن جميع الأسماك تكون ناضجة جنسياً عند السنة الرابعة من عمرها .

وقد أمكن تمثيل العلاقة بين طول الأسماك والخصوبة بمعادلة خط منحنى هي :

لوغاريتم الخصوبة = ٢,١٤٨٨ + ١,٩٩ لوغاريتم الطول .

أما العلاقة بين الوزن والخصوبة فقد كانت علاقة خط مستقيم هي وقد مثلتها المعادلة الآتية :

الخصوبة = ٣٤,١٨ + ٠,١٩٥ × الوزن .

Key Words: Arabian Gulf, *Argyrops spinifer*, fecundity, kover, maturation, reproduction, seabream, sparidae, Qatar.

ABSTRACT

The reproductive cycle, gonads maturation, gonado-somatic indices (GSI) and fecundity of longspine seabream *Argyrops spinifer* from the Arabian Gulf waters off Qatar were investigated. Bi-weekly samples representing all age groups were collected from November, 1991 through May, 1993. Gonad maturation occurred in December-March. Spawning was restricted to about 15 days from mid to late April. No changes in gonad conditions were noted from May to October. Maximum spawning activity occurred at minimum photoperiod and water temperature. No fish smaller than 16 cm in length, and all fish greater than 26 cm, were sexually mature, and 100% of the fish mature at age 4. The relationship between absolute fecundity (1000' s of ova) and fish length was best represented by the following non-linear equation: log F = 2.1488 + 1.99 log L (r = 0.899), while a linear equation; F = 34.18 + 0.195 W, (r = 0.984) was found between fecundity and fish weight.

INTRODUCTION

Sparid fishes are a major component of fish landings and have extremely high market value in the Arabian Gulf fisheries (Samuel and Mathews, 1987; El-Sayed, 1992). The increased demand, concomitant with shortage in the catch of these fishes in the Gulf region has resulted in a sharp increase in their market prices (EI-Sayed, 1992). Despite the importance of sparid fishes in the Gulf waters little has been published on their biology, feeding, reproduction and fisheries.

A series of studies on the population biology of sparid fishes in Qatari waters is currently being conducted in Marine Sciences Department, Faculty of Science, University of Qatar, in cooperation with the Department of Fisheries, Ministry of

Municipal Affairs and Agriculture, State of Qatar. The present study describes the reproductive biology of longspine seabream *Argyrops spinifer*, (which is locally known as kover) in Qatari waters. It throws light on: 1) sexual maturity, 2) spawning season, 3) sex ratio, and 4) fecundity. This information contributes significantly to the overall understanding of reproduction patterns 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.

MATERIAL AND METHODS

The study was conducted on 463 fish (combined sexes) obtained from the trawl catch of the trawler "Falcon" which belongs to the Qatar National Fishing Company (QNFC) between November, 1991 and May, 1993. Random samples representing a wide range of sizes (14-75 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, kover were grouped into 2 cm length intervals (Ttable 1).

GONAD MATURATION

Maturity stages were determined according to Orange (1961). 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.

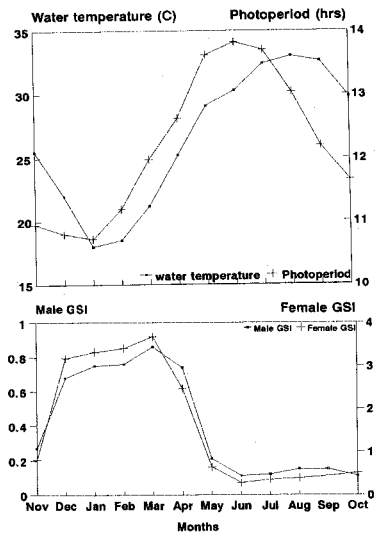

Fig. 1: Gonado-somatic indices of *A. spinifer* in Qatari waters in relation to water temperature and photoperiod.

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

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

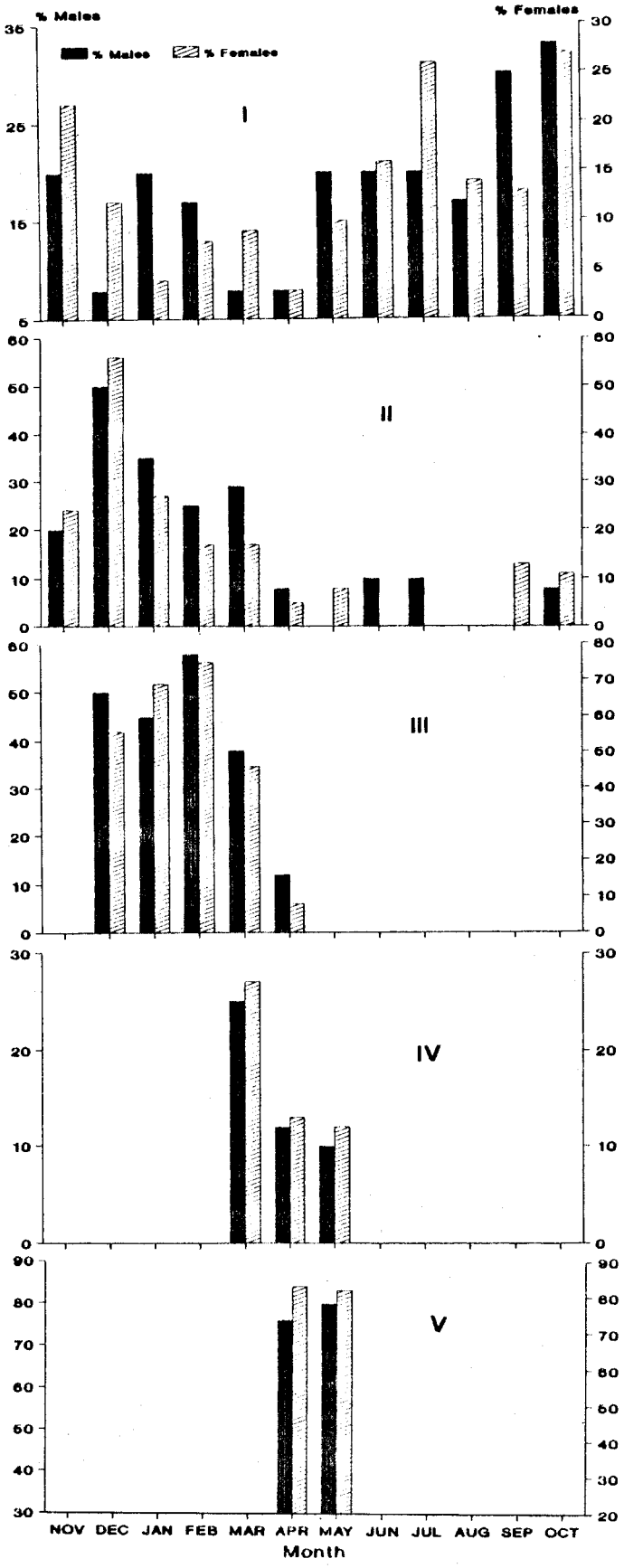

Fig. 2: Distribution of maturity stages of *A. spinifer*.

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 studied.

The monthly frequency distribution of each maturity stage was determined. In order to predict the age at first sexual maturity, female fish were grouped into 2 cm length intervals, and their maturity (%) was calculated.

ABSOLUTE FECUNDITY

To determine the absolute fecundity of the fish, ovaries of 31 ripe females (21 to 64 cm, total length) were collected in February and March, 1992. 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 (Lassiter, 1962):

$$N = Ns\frac{Wt}{Ws}$$

where: Wt = ovary weight, Ws = weight of the subsample, and Ns = number of ova counted in the subsample. The regression of fecundity on both length and weight was calculated.

RESULTS

SEXUAL MATURITY

The gonads conditions of *A. spinifer* progressed from stage V (spent) which extended from early May through November without a significant change. A sudden increase in GSI values of both sexes were recorded in December (Fig. 1). Gonads development continued in January and February. In late March and early April gonads were fully ripe. The distribution of different maturity stages is given in Fig. 2.

The spawning season of longspine bream was fairly short, extending for about 2 weeks, depending on water temperature and photoperiod. In 1992 spawning occurred between 10 through 30 April. More frequent samples were examined in April, 1993. On April 13, only 9% of ripe females were spent. Spawning activity increased progressively to reach 73% by April 22. By April 30, all fish were spawned. Ovaries collected in May were flaccid and contained residual ova, resorbed by early June.

Gonad maturation was significantly correlated to water temperature and photoperiod. Maximum GSI occurred during December-March at lower water temperatures (15-22 °C) and photoperiod (10.5-12 hrs). Spent and resting gonads were recorded during higher water temperatures and photoperiod (May-November) (Fig. 1).

SEX RATIO

The sex ratio of kover was not 1:1 as hypothesized, but females were predominant (Table 1). The overall male: female ratio was 1:1.93. It was noted that females were outnumbering males at small size classes. As the fish reach their full sexual maturity (at about 24-26 cm), sex ratio becomes closer to 1:1. However, females were predominant at larger sizes (>40 cm).

AGE AT FIRST MATURATION

No fish less than 16 cm, and all individuals greater than 26 cm, were sexually mature (Fig. 3). The linear regression equation of % maturity (Y) on length (X) was:

$$Y=-153.48+10.214X, r=0.998.$$

Table 1.
Sex ratio (male: female) of *A. spinifer* in relation to fish length.

Length (cm)	Number			Sex Ratio
	Total	Males	Females	
14-16	6	1	5	1:5.00
16-18	13	3	10	1:3.33
18-20	29	8	21	1:2.63
20-22	63	18	45	1:2.50
22-24	68	31	37	1:1.19
24-26	65	30	35	1:1.16
26.28	47	19	28	1:1.47
28-30	47	20	27	1:1.35
30-32	30	17	13	1:0.79
32-34	23	8	15	1:1.88
34-36	17	8	9	1:1.13
36-38	9	4	5	1:1.25
38-40	7	3	4	1:1.33
>40	31	10	21	1:2.00
Average				1:1.93

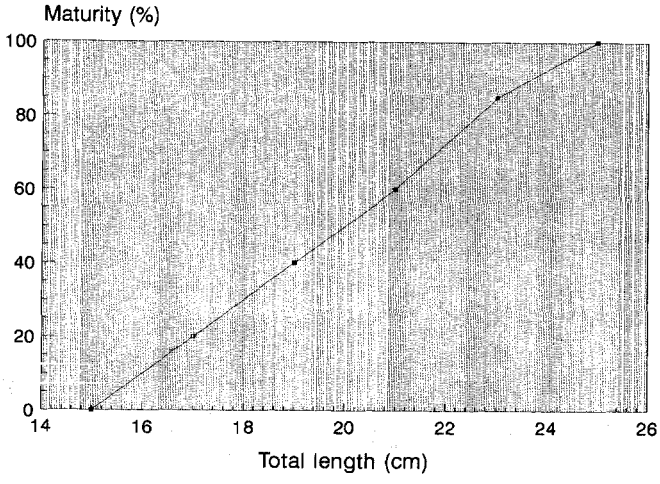

Fig. 3: Maturity (%) of *A. spinifer* in relation to total fish length.

In a previous work (unpublished), we found that the lengths of *A. spinifer* at ages 1, 2, 3 and 4 were 14, 20, 25 and 28 cm, respectively. By inserting these length values to the equation, age at first sexual maturity was determined. The results suggested that no fish at age 1, 41% at age 2, 85% at age 3, and 100% at age 4 were sexually mature.

ABSOLUTE FECUNDITY

The absolute fecundity ranged from 47,000 to 706,000 eggs/female, showing considerable variations among individuals. In one sample, however, fecundity was 1,240,000. This sample was excluded from the analysis due to high variance. The regression analyses indicated that both total length (L) and total weight (W) could be used to predict fecundity in longspine seabream. The relationship between fecundity and length was non-linear (Fig. 4), and best represented by the following equation:

$$\text{Log } F = 2.1488 + 1.99 \text{ Log } L, r = 0.899.$$

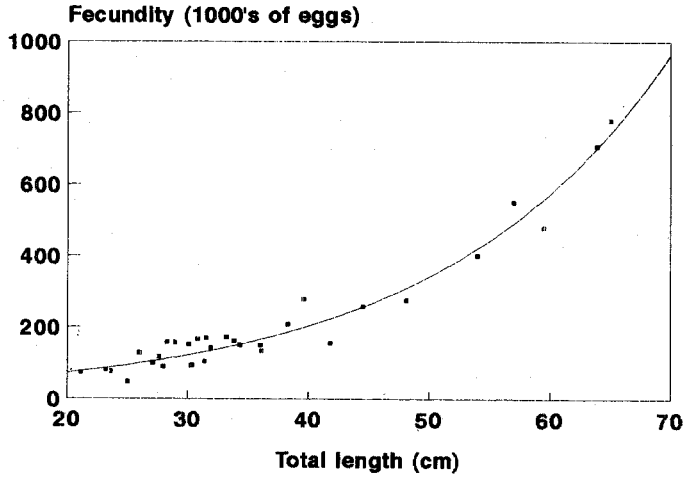

Fig. 4: Length / fecundity relationship of *A. spinifer* in Qatari waters.

In case of weight, however, the relationship was found to be linear (Fig. 5), and represented by the following equation:

$$F = 34.18 + 0.195W, r = 0.984.$$

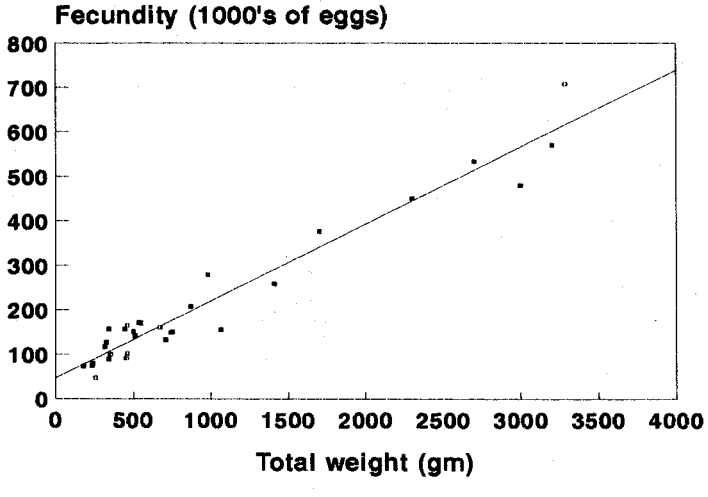

Fig. 5: Weigh / fecundity relationship of *A. spinifer* in Qatari waters.

DISCUSSION

The studies on the reproductive biology of porgy *Pagrus pagrus* (Walker, 1950; Ranzi, 1969; Manooch, 1976), *Diplodus sargus* (Micale et al., 1987), *Boops boops* (Hassan, 1990) indicated that gonad maturation of these sparids occurs in winter, while spawning takes place in spring. On the other hand, *Crysophrys auratus* (Abdel-Aziz, personal communication) and *Boops salpa* (Hassan, 1990) were found to spawn in winter in the Egyptian Mediterranean waters.

Gonad maturation and spawning seasons of sparid fishes are correlated to environmental conditions, especially water temperature and photoperiod (Coetzee, 1983, 1986; Garratt, 1986). An inverse relationship between spawning season and water temperature has been reported in *P. pagrus* (Walker, 1950; Manooch, 1976), *D. sargus* (Micale et al., 1987), *B. boops* (Hassan, 1990) and *A. spinifer* (present study). On the contrary, Buxton (1990) reported that gonadal maturation of the breams *Chrysoblephus laticeps* and *C. cristicepes* occurred at peak water temperature and photoperiod.

The short spawning season of *A. spinifer* in the present study is in agreement with the finding of Brownell (1979) and Buxton (1990) on other sparids living in warm water. However, longer spawning seasons of sparid populations in the warmer and sub-tropical water have been reported (Garratt, 1986). It would appear that most temperate sparids spawn in spring and summer, and have shorter and restricted breeding season than tropical sparids, as has been noted by Thresher (1984).

The non-linear relationship between fecundity and length has been reported on *P. pagrus* (Manooch, 1976) and *B. boops* and *B. salpa* (Hassan, 1990). However, the fecundity of *A. spinifer* 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 (D'Ancona, 1950, 1956; Manooch, 1976; Abdel-Aziz, 1988; Buxton, 1989; Ezzat et al., 1990-1991). The predominance of females at smaller sizes in the present study suggests a protogynous hermaphroditism in this species. However, during the course of the study only two fish (0.44%) with both male and female sex organs were discovered. Higher female: male ratios have been reported on other porgies; *P. pagrus* (Manooch, 1976; Alekseev, 1981) *P. orphus* and *P. ehrenbergi* (Alekseev, 1981) and *B. boops* (Hassan, 1990).

It is concluded that longspine seabream attain sexual maturity in Qatari waters from December through March (at minimum water temperature and photoperiod), while spawning takes place in mid- to late April. No fish less than 16 cm, and all fish greater than 26 cm were sexually mature. Zero, 41, 85 and 100% of the fish were mature at ages 1, 2, 3, and 4, respectively. The females were predominant, especially at smaller sizes, with an overall male:female ratio of 1:1.93.

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