Aspects of the Biology of *Pomadasys stridens,* Forskål, 1775 from the West Coast of the United Arab Emirates

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ABSTRACT. Age, growth and reproduction of *Pomadasys stridens* Forskål, 1775 (Pomadasyidae), native to United Arab Emirates reefs, were investigated. The length frequency distribution ranged from 15.0 to 16.0 cm throughout the year. The growth marks on otolith were used to estimate the age. The maximum standard length (SL) of this species was 21.0 cm (338.6g female). The pre - spawning and spawning months (November to March) exhibited the highest and post - spawning (April to July) the lowest values for coefficient of condition K. The average value of K over the standard length range of 12 to 20 cm decreased in proportion to the increase in fish length. The minimum length of fully mature fish was 11.0 cm, with females maturing earlier. Development of gonads occurred in November and December. From April through October all the fish were found to be in the spent stage. The female to male sex ratio was 2.5:1.

Siganidae, Lethrinidae and Pomadasyidae are among the most common families of fish in the Arabian Gulf and form a major contribution to the trap fishery of UAE (Al-Ghais 1993). Only one species, *Pomadasys argenteus* Forskål (Family Pomadasyidae), of these families has been studies for its biology (Abu-Hakima 1984). Because of the importance of the family Pomadasyidae for local consumption it was decided to study the one endemic to UAE. Therefore, *Pomadasys stridens*

(Pomadasyidae) was selected for detailed studies. The species appears in the commercial landings at Ras Al-Khaimah fish market throughout the year. It is an edible fish and is usually eaten in its breeding season. It is often regarded by the fishermen as a nuisance species. Biological data on this species are completely lacking in the UAE. However, taxonomic description of this fish is given by various authors (Botros 1971, White and Barwani 1971, Kuronuma and Abe 1972, Al-Baharna 1986, Randall 1986). Market sampling was used as a source to study the reproduction, age, growth and basic biometry of this species.

Since age determination is essential for calculation of growth rate, one of the primary aims of this work was to select structures for determining age in this species.

It is essential to identify the size at first sexual maturity and the spawning period of the species concerned. For this, gonad development scales had to be developed. These were based on gross morphology (Munro 1976, Nzioka 1979), and modified for the species concerned here. The scales were cross - checked by microscopic examination of gonads. Histological examination, although more precise, is not applicable in field examinations of large numbers of fish and was not used routinely.

Materials and Methods

This study was carried out in Ras Al-Khaimah's maritime, Which lies between 25 and 26° N and 55 and 60° E. The maritime of Ras Al-Khaimah (Northern region of UAE) stretches for about 70 km from Umm Al-Quwain to Shaam on the Arabian Gulf (Fig. 1).

The fish samples were purchased from Ras Al-Khaimah fish market or directly from the fishing boats at the time of landing. All specimens, therefore, came from the immediate area of Ras Al-Khaimah, which stretches for about 70 km from Musandam peninsula (near Strait of Hormuz, Fig. 1) to the Emirate of Umm Al-Quwain. The collections were made from March 1988 to March 1990. Regular visits were made to the landing site in Ras Al- Khaimah at fortnightly intervals in the suspected breeding season (December - February) or monthly during the rest of the year. About fifty individuals of *P. stridens* were collected from the commercial catches whenever possible. Occasionally, the sample size was smaller because of limited availability. Care was taken to obtain fresh samples. During the above period a total of 1,478 *P. stridens* were collected. Samples were placed in ice boxes and transferred to the laboratory for further study.

The standard length *i.e.* SL (from the tip of the snout to the end of hypural plate of the caudal fin) of each fish was measured to the nearest mm, and the total body
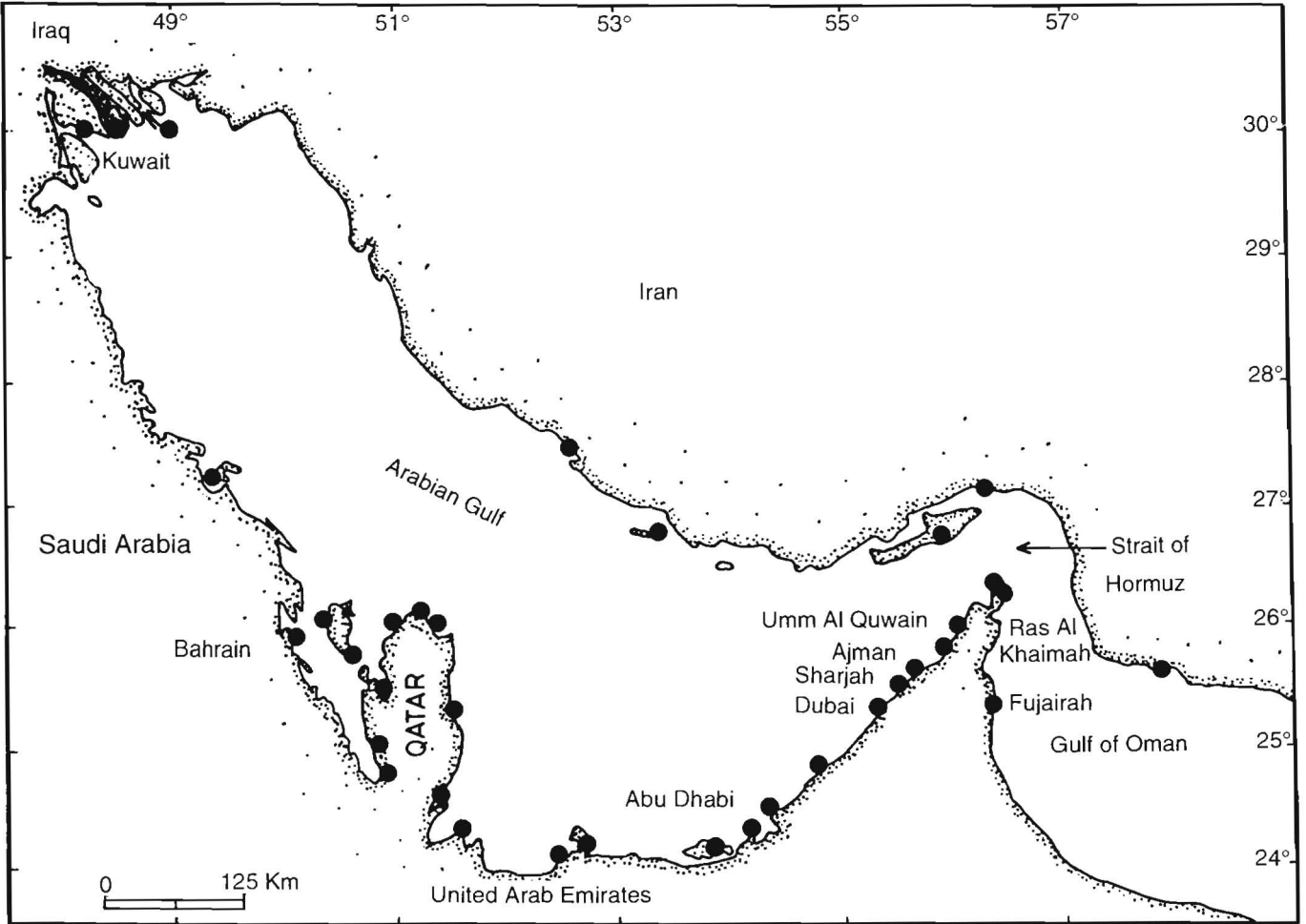
Fig. 1. The west and east coasts of the United Arab Emirates on the Arabian Gulf.

weight was measured to the nearest g.

The only external sexual difference is that the males showed a yellowish colour on the pelvic fin during the breeding season. Fish were dissected to determine the sex and the stage of maturity. Maturity stages were determined from gonad size, shape, texture and colour using criteria similar to those described by Munro *et al.* (1973), Chan and Chua (1980) and Hara *et al.* (1986). Ovaries and testes were weighed to the nearest 1mg. To determine fecundity a series of replicate sub - samples from one ovary of a number of ripe females were taken and weighed to the nearest 1mg. The sample for counting eggs was placed in a petri dish and viewed under a dissecting microscope. The fecundity was determined in accordance with the standard methods (Sturm 1978), using the formula:

$$F = n \ G/g$$

Where: F = fecundity; n = number of eggs in the sample; G = weight of gonads in gram; g = weight of sample.

A quantitative assessment of the reproductive state was made using the gonado - somatic index (GSI) determined by the following formula.

$$GSI = \frac{\text{gonad weight (g)}}{\text{body weight (g)}} \ X \ 100$$

The Condition factor of the fish was estimated using fulton's condition factor (K):

$$K = \frac{Tw}{(SL)^3}$$

Where: Tw = total weight (g); SL = standard length (cm).

The length-weight relationship for *P. stridens* was analysed by the method described by Al-Ghais 1993 using the following equation.

$$\log W = \log a + b \log L$$

Otoliths were used for age determination. Scales and vertebrae were found not to be reliable for age determination of this species, due to the absence of clear annuli on these structures. The day on which the peak of the spawning season was observed, was considered its "birthday". For example, for all fish aged five months

after the spawning peak, the age of each individual will be 5 months (in 0⁺ group), 1 year 5 months (in 1⁺ group), 2 year 5 months (in 2⁺ group), *etc*.

The (FSAS) computer programmes (Saila *et al.* 1988) were applied to fit the growth curve by Marguardt's alogrithm for nonlinear least squares parameter estimation using the Von Bertalanffy Growth Formula (VBGF):

$$L_t = L \infty [l_{-e} - k (t - t_0)].$$

Where: L_t = length at age t; $L \infty$ = maximum theoretical length; k = growth coefficient; t_0 = age at length 0.

When employing this formula to analyse the data, the value of t_0 was forced through zero, because of the absence of the small fish from the commercial samples. The mean standard length was used for each age class.

Results

Age and Growth

Size Distribution

The length frequency distribution of *P. stridens* (Fig. 2) shows that only the length groups 15.0 and 16.0 cm were common in the trap catches. It is assumed that the small fish escape through the standard mesh size. Large fish were uncommon in the commercial catch, possibly due to their absence from the area sampled. Therefore, the length frequencies of the catches were remarkably similar throughout the year.

Age Composition

Otoliths of *P. stridens* are easy to handle and interpret. They are reasonably large compared with the size of the fish (nearly 6% of the fish standard length) and can be easily removed from the cranium. The growth marks can be seen without grinding or sectioning of the otoliths (Fig. 3). The mean length according to age of *P. stridens* is summarized in Table 1. The "birthday" of this species was set to be the first of Ferbruary.

Overall, age 1⁺ and 2⁺ dominated the trap catches. Clear growth rings could be seen on the otoliths of older fish (2⁺ or 3⁺ groups). False rings were present in some fish which caused some problems in age determination.

A von Bertalanffy growth curve was used to analyse all data (both sexes including immature fish, males and females) by the FSAS computer programme
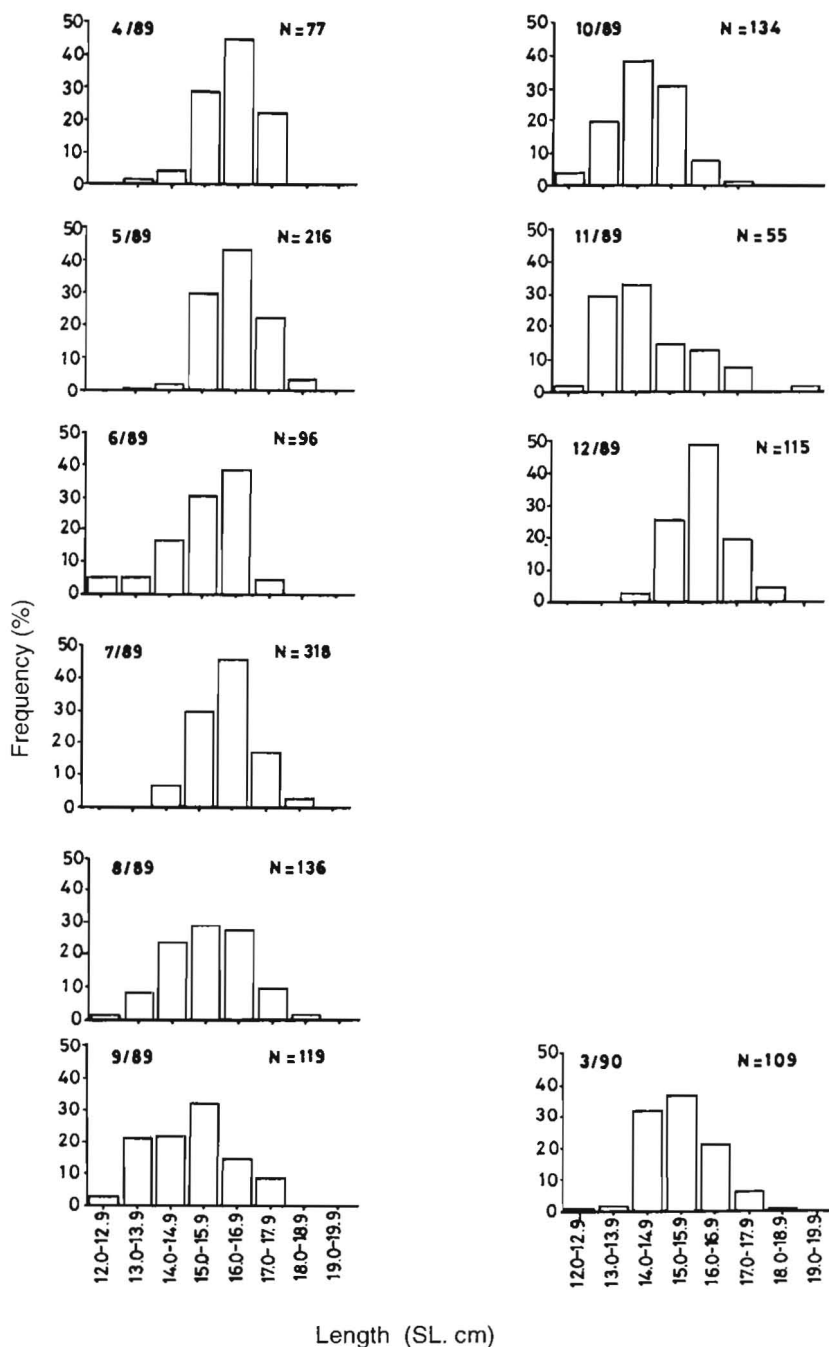
Fig. 2. The size distribution of *P. stridens* caught by traps at Ras Al - Khaimah from April, 1989 to March, 1990.
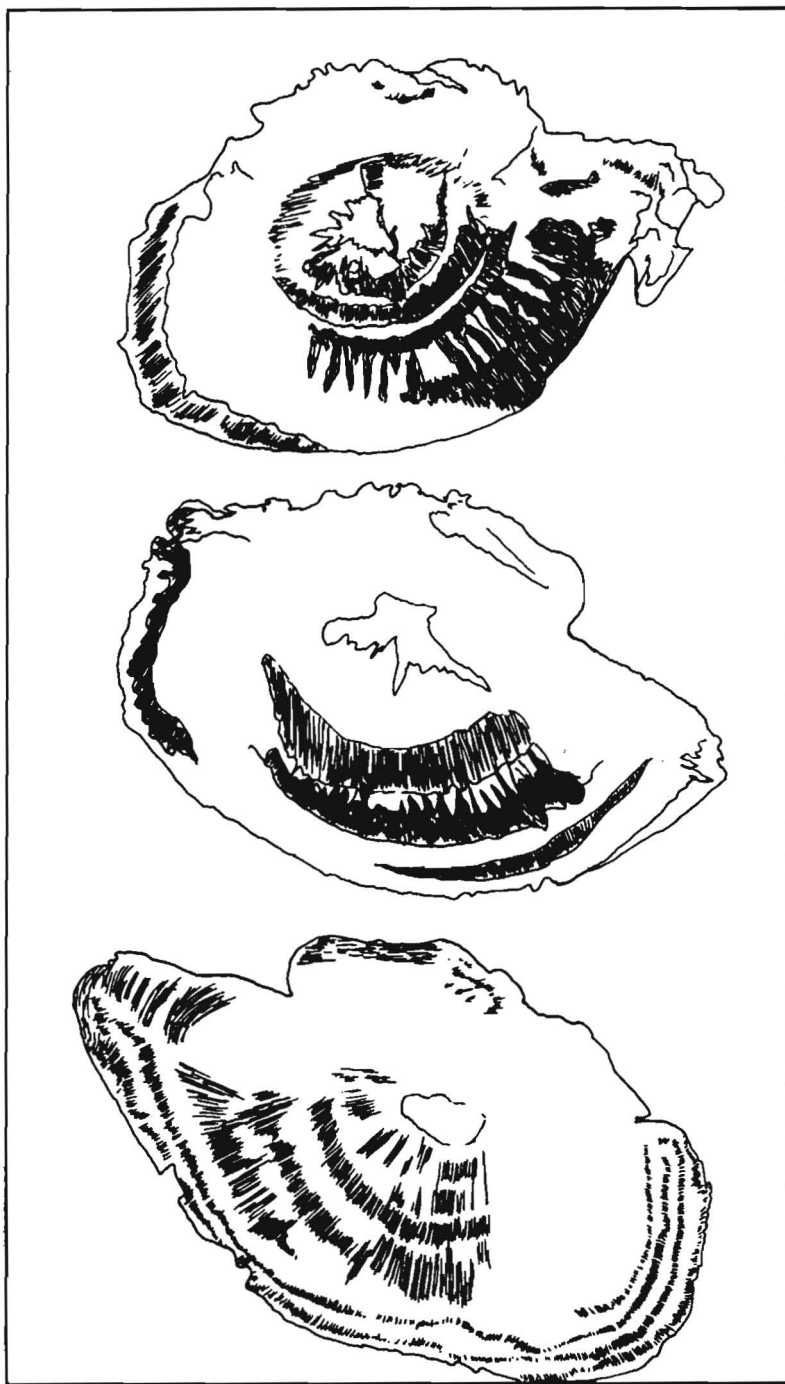
Fig. 3. The formation of annual marks on the otoliths of *P. stridens.*

Table 1. The mean standard length at various age of both males and females *P. stridens*

Age	Length (cm)					
	Males	**(n)**	**Females**	**(n)**	**Both**	**(n)**
0^+			13.8	(26)	13.8	(26)
1^+	14.3	(45)	14.8	(77)	14.5	(122)
2^+	15.7	(154)	15.9	(111)	15.8	(265)
3^+	16.4	(48)	16.8	(53)	16.6	(101)
4^+	16.4	(4)	17.8	(8)	17.1	(17)

(Saila *et al.* 1988), to obtain the following results:

Both sexes $L_t = 16.5 \ [1_{-e} -1.067_t]$

Male $L_t = 16.7 \ [1_{-e} -0.774_t]$

Female $L_t = 16.9 \ [1_{-e} -1.002_t]$

The maximum length recorded for this species was found to be 21.0 cm for a female of 338.6 g in weight. The L_∞ value of the VBGF did not fit the growth curve of this species which may be due to the absence of younger fish from the commercial catches. In addition, the fish may have been captured before reaching their maximum length at older age. This is evident from the fact that older fish were not common in the trap catches (Fig. 4).

Length - Weight Relationship

The results of length - weight relationship for *P. stridens* are based on three seasons each year namely the period the period of gonad developement (November to February), post - spawning (March to June or July) and prior to developement of the gonads (Fig. 5). There were no marked sex differences in the length - weight relationship during gonads developement and spawning seasons. However, the females were heavier than males in relation to length during post - spawning period of this species.

Coefficient of condition "K"

The pre - spawning and spawning months gave the highest values of condition, with the lowest values after the spawning season. Variation in "K" could be mainly explained by the different location of the fishing grounds (Fig. 6A).

The condition coefficient of *P. stridens* was calculated for each 1 cm standard length interval over a range of 12.0 to 20.0 cm (Fig. 6B). The average value of K decreased in proportion to the increase of fish length.

Reproduction

Sexual Maturity

The gonad stages of *P. stridens* before the spawning season were easy to distinguish (Table 2). The smallest fishes showing maturational progress were found to be of 11.0 cm in both sexes. All fish of 12.0 cm showed the spent condition indicating successful spawning. However, females probably mature at a smaller size because one femal of 11.1 cm was found in the spent condition (Fig. 7). No immature fish were found to be larger than 16.0 cm and > 90% of fish measuring 14.0 cm or more were sexually mature.

Reproductive Cycle

The monthly variations of maturity stages are given in Fig. 8. Developement of gonads occurred in November and December, with ovaries maturing faster than testes. By January the distribution of the gonad stages in males was similar to that in the females. Reproductively active *P. stridens* (Table 2) were found from December to March. Spawning probably occurred between late January and March. From April to October all the fishes examined were found to be in the spent stage. In October, the gonads start developing and the fish slowly disappear from the catches until the end of December when they reappear in the catches.

In addition, the GSI of *P. stridens* (female) was found to increase from November, reaching the peak value in February, and then decline in March (Fig. 9). This further supports that the breeding season of this fish occurs between late December and March of each year. The large increase in GSI in 1989 (November) was one month earlier than in 1988 (December) suggesting an earlier onset of reproduction. This may be due to different fishing ground and marine environment and may not be related to biology of the fish.

Sex Ratio

The sex ratio of 1,469 *P. stridens* was 2.5:1 (female to male). Females were especially predominant prior to the spawning season. Males were then predominant throughout the breeding season. After this the sex ratio in the trap catches favoured females.

Discussion

From observations pertaining to relationship between the size distribution and age of *P. stridens*, it is concluded that otoliths growth marks can be used as the best indicator for determination of age in this species. Care should be taken in interpreting the data on size distribution on the basis of commercial catches because there is probably a lot of trap selectivity for this species due to fixed mesh size of a particular trap. There is insufficient data in the literature for comparison of growth rates of this species. The age and growth data in this study show that the females become sexually mature in their first year of life while the males do so a year later.

The von Bertalanffy growth equations of *P. stridens* did not show much difference between the growth coefficient of the two sexes. The reason could be that data for length were not available for the younger and the older classes of fish. The fish of younger group are absent from the catches as they escape from the traps, and the absence of older class may be due to heavy (almost complete) selective fishing of individuals up to this size. Generally, the von Bertalanffy estimates of $L \infty$ are way below the recorded values and therefore, can not be used for ananlysis of the data for this species.

The coefficient of condition seems to be affected mainly by the maturity of the gonads and the different locations of the fishing ground used by the local fishermen.

From September to March the temperature in the Gulf ranged from 33 to 22°C respectively, and the gonadal maturation increases with decrease in temperature. During the periods of lower water temperature prior to spawning the numbers of *P. stridens* in the trap catches decline. It is possible that this species avoid the fishing grounds at the start of the spawning season and aggregates elsewhere. This would also indicate that this species is a migrating spawner, as has been recorded for some other coastal marine fishes, for example *S. canaliculatus* and some *Lethrinus* in Palau (Johannes 1978, Al-Ghais 1993). Some species of the family Pomadasyidae have been found to migrate due to changes in day length (William *et al.* 1979) but this is unlikely in the Arabian Gulf where there is no significant difference in day length. Reproductively active males and females can be found from late November till March. At the end of the spawning season the fish appear to be in a very poor condition and the older ones probably die. The related species, *Pomadasys hasta* and *P. argenteus,* from the Indian Ocean and the Arabian Gulf respectively, had a peak GSI during the winter months (Deshmukh 1973, Abu Hakima 1984). The present study on *P. stridens* does not strengthen the contention that all species belonging to Pomadasyidae have a protracted spawning season (Abu Hakima 1984, Konchina 1977, Hussain and Abdullah 1977). The GSI. data collected for this species, over the two year study period, showed no indication of reproductive activity from May to November.
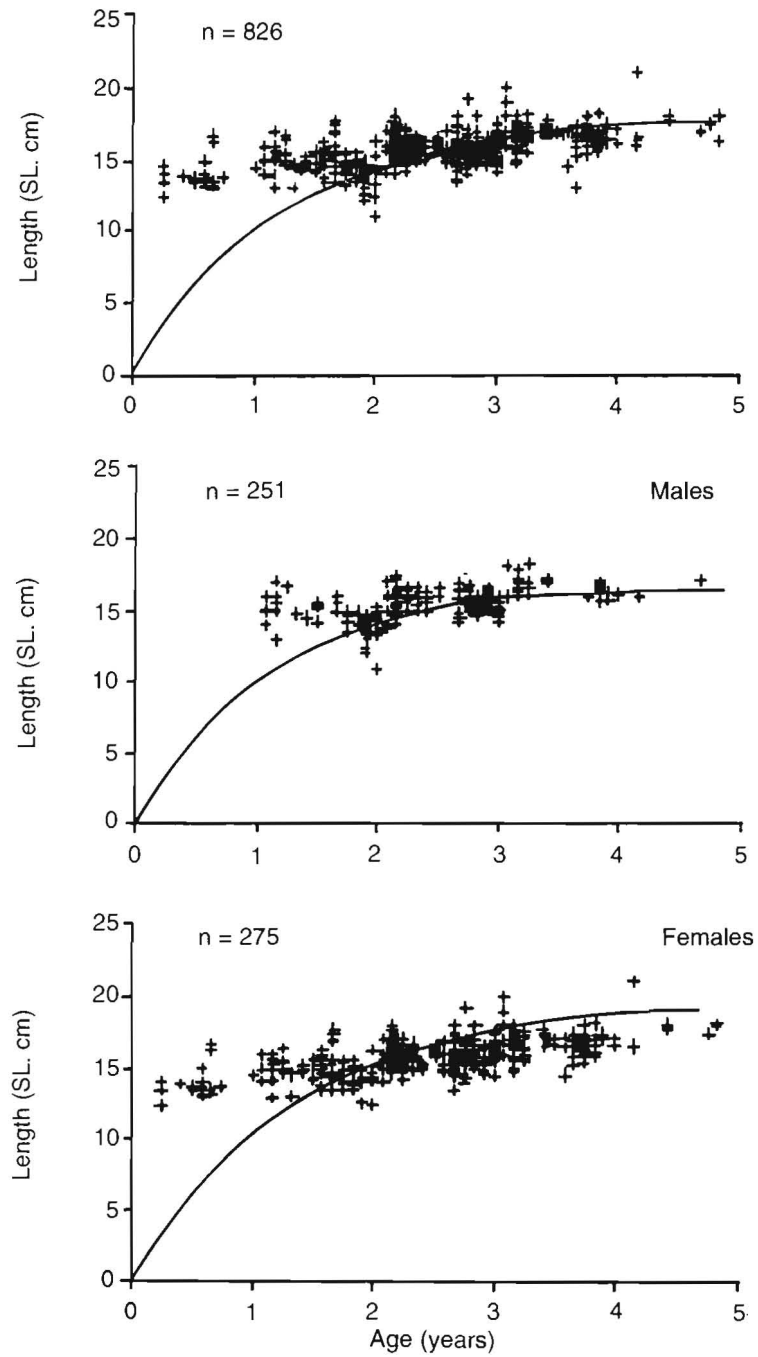
Fig. 4. The relationship between age of fish and body length for total fish, males and females *P. stridens* The line has been fitted by the Von Bertalanffy growth equation.
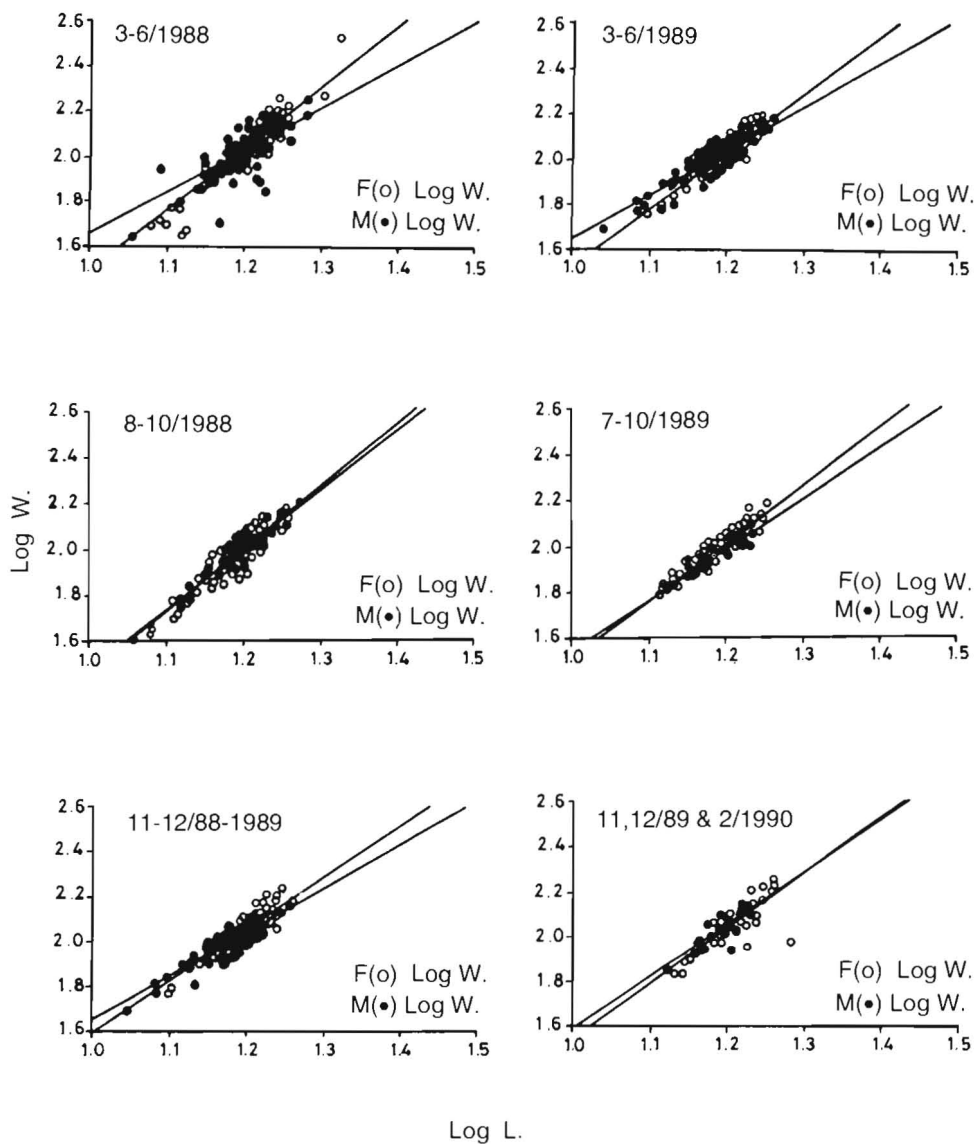
Fig. 5. Length - weight relationship of *P. stridens* during the three main seasons; at spawning (November to February, 1989 - 1990), after spawning (March to June, 1988 - 1989) and before spawning (August to October, 1988 and July to October, 1989).
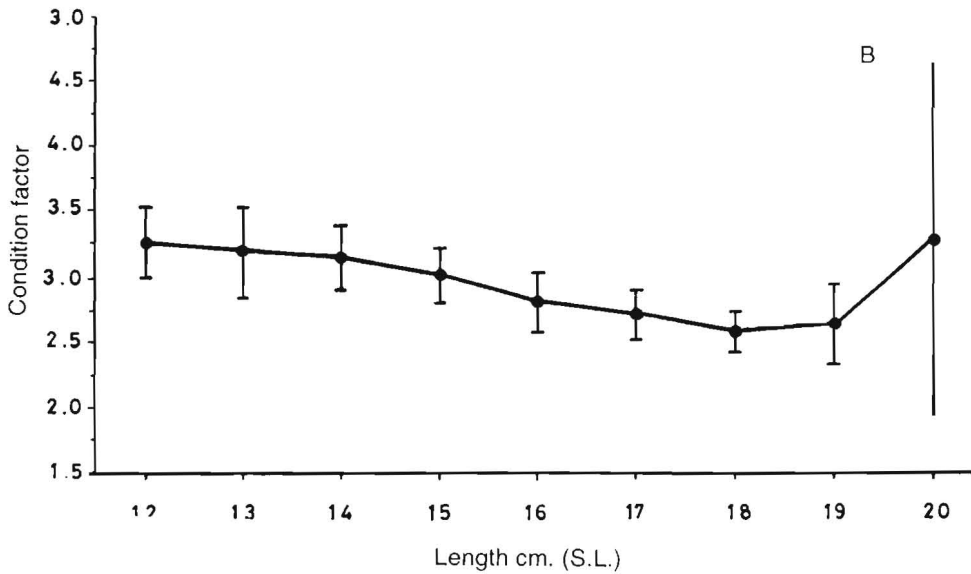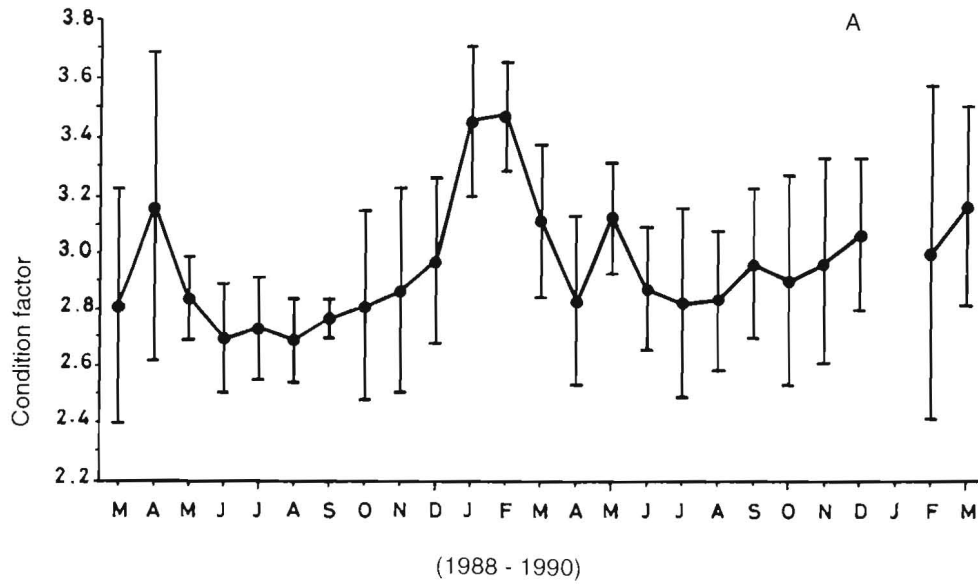
Fig. 6. A) Variation in condition factor with SD for *P. stridens* throughout the year.
B) Variation in condition factor with SD for *P. stridens* with body length.

Table 2. The maturity stages of *P. stridens* used in this study

|		
Stage 0	Immature	No sign of maturity. Testis and ovary not visible.
Stage I	Mature	Gonads thread-like, testis less translucent than ovary. Eggs not visible in ovary.
Stage II	Developing	Gonads being to enlarge occupy more than 1/4 body cavity. Testis smaller than ovary.
Stage III	Mid-Developed	Testis opaque bright-white. Ovary elongated beneath swiming bladder, some vertical blood vessels visible on surface of ovary. Occupy over 1/2 body cavity.
Stage IV	Ripe	Sperm expelled from testis when cut. Ovary solid, tube-like in shape, eggs visible, not translucent. Gonads occupy over 3/4 body cavity.
Stage V	Running	Gonads large occupying major portion of body cavity. Milt and eggs expelled from genital aperture with slight pressure applied on two sides of genital area. Eggs translucent.
Stage VI	Spent	Testis shrunken, ovary flaccid. Dark-red colour at genital aperture of female at early spent and all over ovary at late spent.
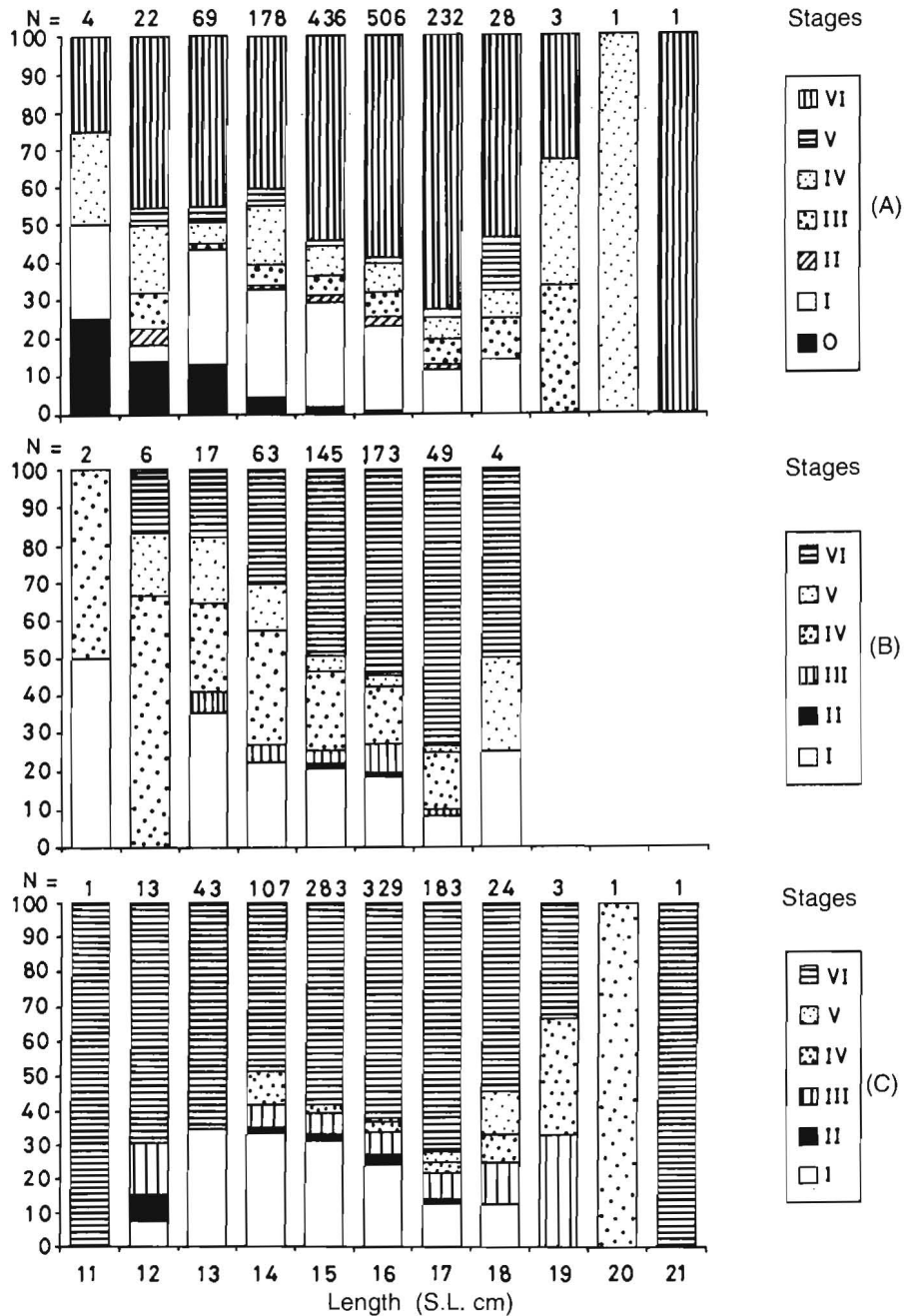
Fig. 7. Variation of gonad stages and the size of *P. stridens* Number above the bars represent sample size.
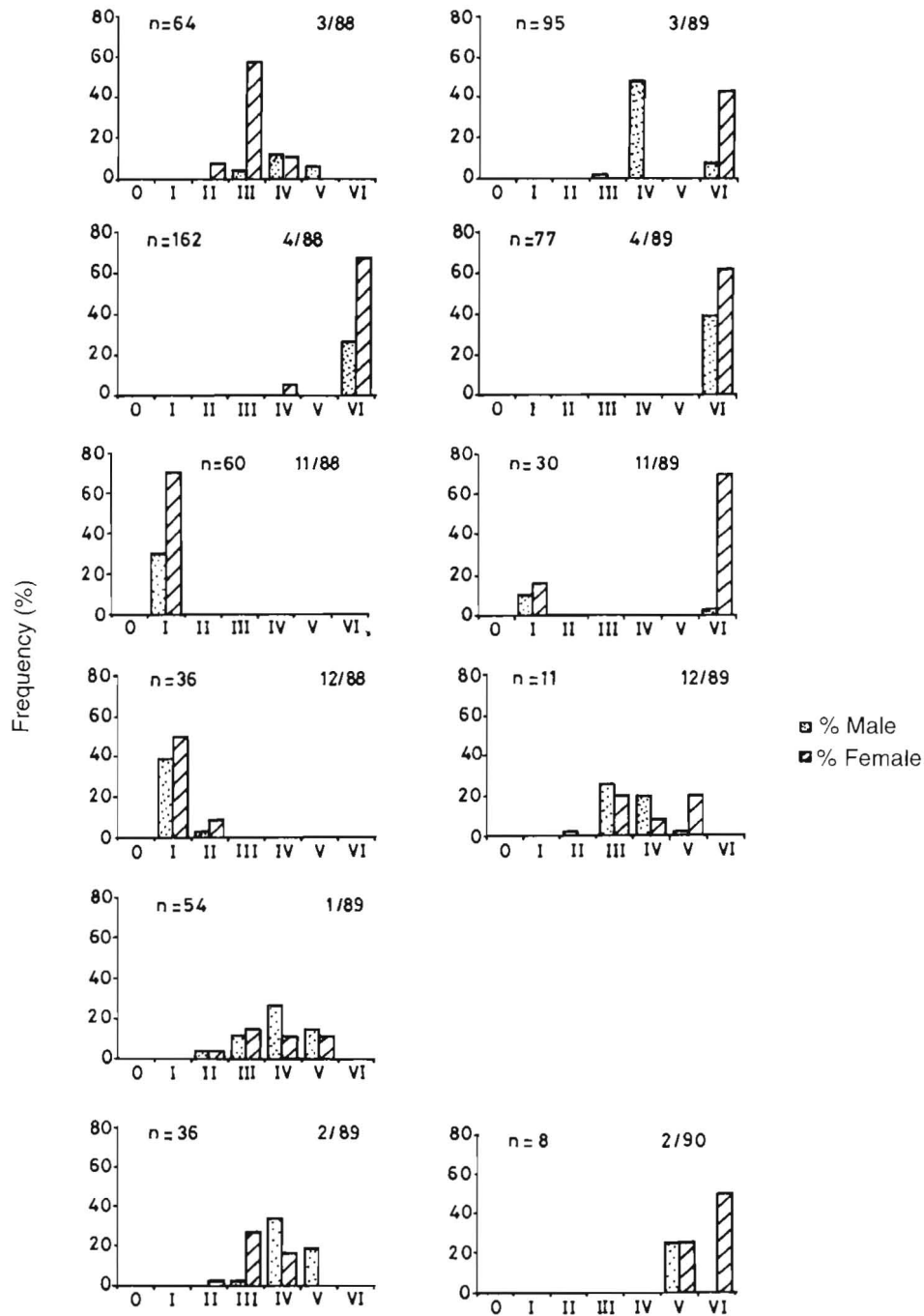
(A) all fish.   (B) males.   (C) females.

Fig. 8. The monthly distribution of gonad stages for *P. stridens* during the spawning season. The data for April to October are excluded as there was no significant change in gonadal stage.
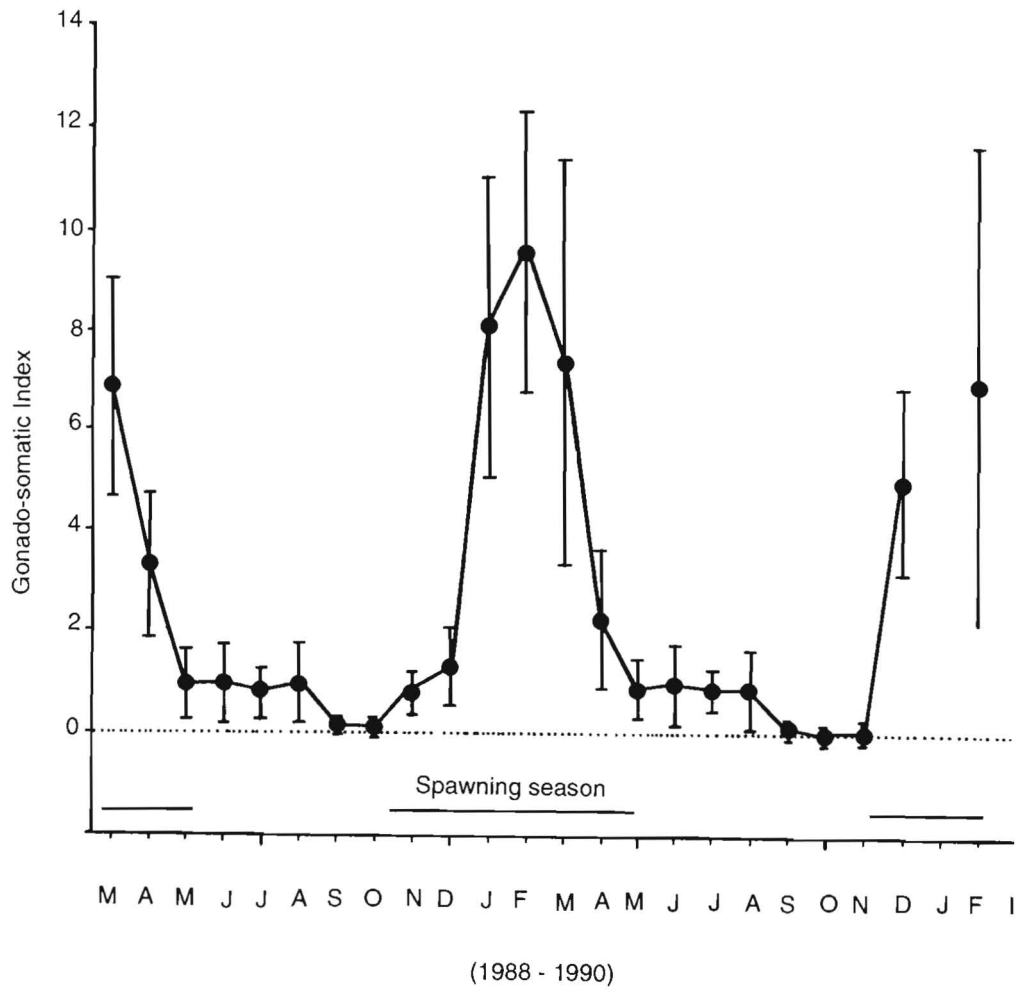
Fig. 9. Gonado - Somatic Index of *P. stridens* (females) from March, 1988 to March, 1990.

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بيولوجية أسماك *Pomadasys stridens* (Forskål 1775)

في مياه الساحل الغربي لدولة الامارات العربية المتحدة

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العين – ص .ب (١٧٧٧٧) – دولة الامارات العربية المتحدة

لقد تم دراسة العمر والنمو بالإضافة إلى دورة التكاثر في سمكة اليميامة *Pomadasys stridens* من عائلة Pomadasyidae وذلك في المياه الساحلية لجنوب الخليج العربي حيث وجد تكرر الطول للسمكة ما بين ١٥-١٦ سم خلال العام وهي تصل إلى طول ٢١ سم بوزن ٣٣٨, ٦ جرام (انثى) .

وقد تبين أن حلقات النمو أكثر وضوحاً بإستخدام عظمة الاتزان . وتكون المناسل في مرحلة التطور خلال شهر نوفمبر حتى فبراير استعداداً لموسم التكاثر الذي يمتد من نهاية شهر يناير حتى مارس من كل عام وبعد ذلك تكون المناسل في حالة سكون ، أي من مارس حتى الأشهر الأخيرة من الصيف في شهر يوليو . تكون السمكة في أحسن حال عند طول ١٢ سم ويتدنى الحال كلما كبرت السمكة في الطول . وقد وجد أن هذا النوع من الأسماك تصبح قادره على التكاثر عند طول ١١ سم ، وتسبق الأناث الذكور في مراحل النضوج الجنسي ، حيث تبين أن معدل نمو المبايض يكون أسرع من نمو الخصيات في شهر ديسمبر وتكون جميع الأسماك في حالة ما بعد انزال البيوض في الفترة من ابريل حتى اكتوبر . أما نسبة الاناث إلى الذكور فهي أعلى حيث وجدت ٢, ٥ :١ في ١٤٧٨ سمكة التي تم دراستها .