Asian Fisheries Science 5(1992):219-229.
Asian Fisheries Society, Manila, Philippines
https://doi.org/10.33997/j.afs.1992.5.2.007

Reproduction of Longnose Emperor *Lethrinus elongatus* in the Red Sea

ELHAM WASSEF* and FAIZA BAWAZEER

Zoology Department
Girls College, Al Madaris St.
Bughdadia, Jeddah
Saudi Arabia

Abstract

Breeding of longnose emperor *Lethrinus elongatus* was studied on the basis of a year's sampling data from the commercial fishery of Jeddah (Red Sea). Six maturity stages were assigned to gonad development, based on visual inspection and ova diameter measurements. The spawning season extends about four months, from May to August, when water temperatures are around 30°C. Large variations in ova diameter within the ripe ovaries suggested multiple spawning. Length at 50% maturity (L_{50}) attained during the third year of life was 22.9 and 23.5 cm for males and females, respectively. The predominance of females at earlier ages and males in older age groups suggests sex reversal during the fifth year of life.

Introduction

Fish of the family Lethrinidae (emperors) are widespread in the Indo-Pacific region from the southern tip of Africa to the coast of Japan, including Australian waters (Aldonov and Druzhinin 1978). Despite the fact that these fishes have commercial significance in a number of countries, their biology has been little studied. In the Red Sea area, most studies on these fishes were devoted to taxonomy and distribution (Al Kholy 1965; Wray 1979; Randall 1983; Fischer and Bianchi 1984). In Saudi Arabia, they constituted about 29% of local Red Sea landings in 1986 (Chakraborty et al. 1987).

---

*Present address: National Institute of Oceanography and Fisheries, Alexandria, Egypt, to whom correspondence should be addressed.

The present work investigated some aspects of reproduction of longnose emperor *Lethrinus elongatus* Cuv. and Val., 1830 in the Red Sea. Some data on stock assessment and growth rate in the region are available (Kedidi and Bouhleil 1985; Wassef and Bawazeer 1990). The most significant contributions on reproduction of other lethrinids are those of Toor (1968) on *L. lentjan* in Indian waters, Loubens (1980) on some lethrinids in New Caledonia and Bertrand (1986) on *L. mahsena* in Saya de Malha (Indian Ocean).

Materials and Methods

L. elongatus were collected from the commercial catch shortly after being captured and landed at the 'Al Bangala' center. Most of the fish examined came from the hook-and-line fishery. Monthly samples were obtained from December 1988 to November 1989. A total of 518 specimens ranging from 17 to 51 cm and weighing between 70 and 1,325 g were used. Fish were available all year round. However, fish smaller than 20 cm were rare.

In the laboratory, total length (cm) and weight (g) were recorded and sex and stage of gonad maturity were assigned after dissection using a 6-stage scale (described in Results section) based on visual inspection and ova diameter measurements. In younger fish with smaller gonads, complementary examination under a binocular microscope was done adopting the method of Loubens (1980). Scale samples were taken from the pectoral fin area to determine age. Gonads were carefully removed, accurately weighed (mg) and gutted fish weight (g) was recorded. For fecundity estimates, 18 ripe ovaries were preserved in 5% neutral formalin solution. Egg counts, for combined samples from the anterior, middle and posterior sections of the ovary, were made gravimetrically according to the method mentioned by Bertrand (1986).

Gonad Index (G.I.) was calculated as percentage of fresh gonad weight to gutted fish weight (Hickling 1970).

Three statistical models (linear, semilogarithmic and power regressions) were fitted to the data of fecundity and length or weight or age. The model which gave the least discrepancies between observed and calculated fecundity values was considered the best fit (Snedecor and Cochran 1980).

Results

Maturity Stages

The gross morphology of testes and ovaries of *L. elongatus* has not been described before. The paired testes are strap-like structures and each testis is supported dorsolaterally by the mesorchium. As maturity advances they appear as two prominent strips. The paired ovaries are elongated bodies which are usually symmetrical (instances of asymmetry, i.e., the right lobe slightly longer than the left lobe, are occasionally seen).

Gonads were distinguishable to six maturity stages as follows:

Stage I: Resting stage. Gonads are dormant or immature. Testes are thin, thread-like, semi-transparent structures which occupy less than one-third of the body cavity. Ovaries are two small slender, flesh-colored structures, also extending to less than one-third of the body cavity. Oogonia vary in diameter from 11 to 18 μm.

Stage II: Developing stage. Gonads are at the beginning of maturation. Testes are opaque white, strap-like but slightly bigger, firmer and occupy almost one-third of the body cavity. Ovaries are short and plump, increased in size and paler red to cream in color. Minute networks of blood vessels appear on the ovary. Two groups of oocytes measuring 37-44 and 60-125 μm are discernible.

Stage III: Mature stage. Gonads are at the middle of the maturation process. Testes are dark white, enlarged and occupy almost half the body cavity. The blood supply has started to appear in the middle, dorsal and ventral parts of the testis. Ovaries are creamy-yellow, extending up to half of the body cavity and their walls are thinner, with an immense blood supply. Oocytes are not visible to the naked eye but two major groups are noticeable, measuring 108-166 and 208-274 μm in diameter.

Stage IV: Pre-spawning stage. Gonads are at the end of maturation. Testes have increased in size to occupy most of the body cavity. They are strip-like, thin-walled and whitish. Ovaries are much more distended and occupy almost the entire body cavity. The yellow-orange mature ova are clearly seen by the naked eye through the thin ovary wall. Ova diameter ranges from 257 to 282 μm. Fish are close to spawning and are considered 'ripe' until gonads have lost approximately 50% of their maximum weight.

Stage V: Running stage. Gonads are shedding their sexual products during the spawning season. Testes or ovaries are similar to those of the previous stage, but ova or sperm can be easily extruded by gently pressing the abdomen. The blood supply has disappeared due to the completion of vitellogensis. Only a few running individuals were obtained during the period of investigation.

Stage VI: Spent stage. Gonads are partly filled with ripe oocytes or spermatocytes. Testes are shrunken, walls are thicker and wrinkled. Ovaries are flaccid, elongated and narrow. The general color is rather dark. Residual ova or sperm can be squeezed out from a cut ovary or testis.

Monthly Variations in Different Maturity Stages

The relative frequency of each maturity stage throughout the year is given in Table 1 for male and female *L. elongatus*. Maturity stages I and II were represented all the year. Development of gonads was initiated in March when about 50% of females studied were mature (stage III). In April, ripe individuals (prespawners) started to appear in the catch and contributed about 17% of fish examined. Ripe fish were found in the following months until July, whereas running fish appeared in May and constituted about 7 and 10% for males and females, respectively. These percentages increased to about 25% for males and 69% for females in June, then decreased thereafter. Partially spent fish appeared in the catch from June and their percentage increased progressively in the following months to reach about 55% for males and 43% for females in August.

The average duration for spawning can be identified as the time when at least 50% of the adult population has reached maturity stage IV or higher up to the time when 50% of the adult population becomes spent (stage VI). On this basis, *L. elongatus* has a prolonged spawning season in Jeddah waters of the Red Sea of almost four months, May-August.

These findings are further supported by results of G.I. monthly variations (Fig. 1). Maximum G.I. was recorded for males in May (3.62) and for females in June (4.46). During this period, water temperature was around 30°C (Fig. 1).

Table 1. Monthly distribution of different maturity stages for *Lethrinus elongatus*.

Month	Sex	No. fish	Percentage of fish in each maturity stage I	II	III	IV	V	VI
December 1988	M	11	54.6	45.5				
	F	30	66.7	33.3				
January 1989	M	17	23.5	76.5				
	F	27	40.7	59.3				
February	M	15	63.7	36.4				
	F	21	23.8	76.2				
March	M	25	40.0	60.0	-			
	F	24	25.0	25.0	50.0			
April	M	36	7.7	46.2	46.2	-		
	F	30	6.7	43.3	33.3	16.7		
May	M	27	3.7	55.6	33.3	-	7.4	
	F	39	-	51.4	17.6	20.6	10.3	
June	M	16	6.3	25.0	6.3	6.3	25.0	31.3
	F	13	7.7	7.7	-	-	69.3	15.3
July	M	15	-	46.7	20.0	-	6.7	26.7
	F	13	7.7	7.7	7.7	7.7	69.2	-
August	M	11	0.1	36.4	-	-	-	54.6
	F	21	38.1	19.1	-	-	-	42.9
September	M	35	14.3	71.4	-	-	-	14.3
	F	27	18.5	40.7	-	-	-	40.7
October	M	10	30.0	50.0	20.0	-	-	-
	F	12	25.0	33.3	41.7	-	-	-
November	M	9	11.1	88.9	-	-	-	-
	F	34	8.8	91.2	-	-	-	-

Size and Age at First Sexual Maturity

The length-frequency distribution of mature and immature *L. elongatus* is shown in Fig. 2. The data were restricted to months of greatest gonadal activity (April-July). Fifty per cent of males and females reached maturity at a length of 22.9 cm (122 g) and 23.5 cm (146 g), respectively. Fish longer than 24.5 cm for males and 26.5 cm for females were all mature (Fig. 2).

Referring these lengths to corresponding ages as determined earlier (Wassef and Bawazeer 1990), fish became mature during their third year of life.

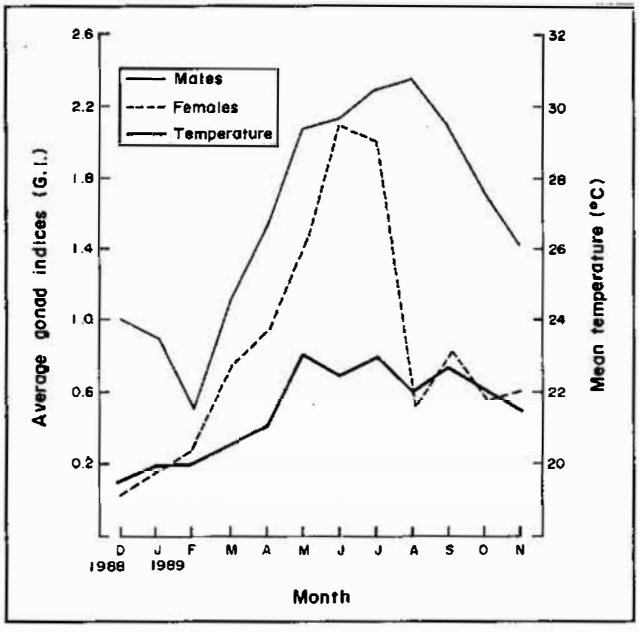

Fig. 1. Monthly changes in average gonad indices of *Lethrinus elongatus* (from Wassef and Bawazeer 1990).

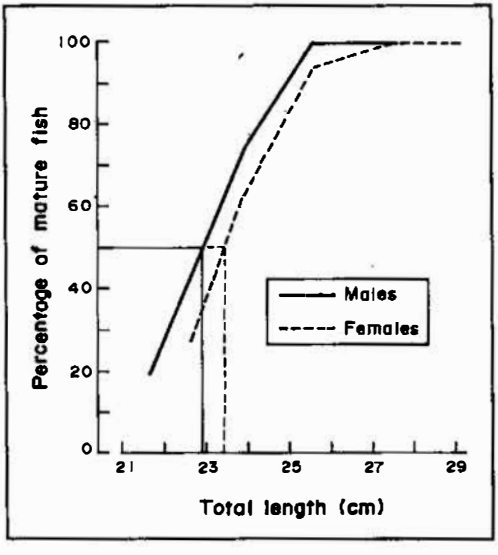

Fig. 2. Changes in the percentage of mature fish with size of *Lethrinus elongatus*, showing length at 50% maturity.

Fecundity

In this study, stage IV fish, with the potential to spawn shortly after the appropriate environmental stimuli, were used for fecundity estimates. Two terms are generally applied to study fecundity of fish: absolute fecundity, which is the total number of ripe ova (to be spawned in the current season) in the ovaries; and relative fecundity, which is the number of ova per unit length or weight of fish (Bagenal 1971).

Fecundity and Total Fish Length

Absolute fecundity of *L. elongatus* ranged from 10,400 for 23-cm fish to 621,100 for 49-cm fish, whereas relative fecundity varied between 4,800 and 12,676 for the same length groups. Data showed that both absolute and relative fecundities (F_a and F_r, respectively) increased with the increase of length (L) (Fig. 3). The following semilogarithmic equations were statistically the best to represent such relationships (fitting the model $Y=a \cdot e^{bX}$, where a and b are constants):

$\text{Log } F_a = 4.45798 + 0.0299 \text{ L } (r = 0.92217)$
$\text{Log } F_r = 3.35906 + 0.0175 \text{ L } (r = 0.83514)$

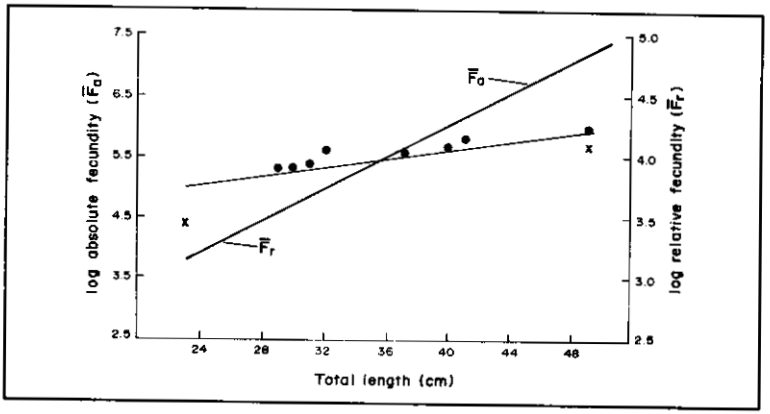

Fig. 3. Relation between absolute and relative fecundity and length for *Lethrinus elongatus*.

Fecundity and Weight

Similarly, absolute fecundity was shown to increase with fish weight (W) (within the limit 100-1,300 g). In contrast, relative fecundity showed a decreasing trend (Fig. 4). In this case, the power regression ($Y = a \cdot X^b$) was evidently the best way to describe the relationships:

$\text{Log } F_a = 3.67718 + 0.71247 \text{ Log W } (r = 0.9588)$
$\text{Log } F_r = 3.00958 - 0.0406 \text{ Log W } (r = 0.8063)$

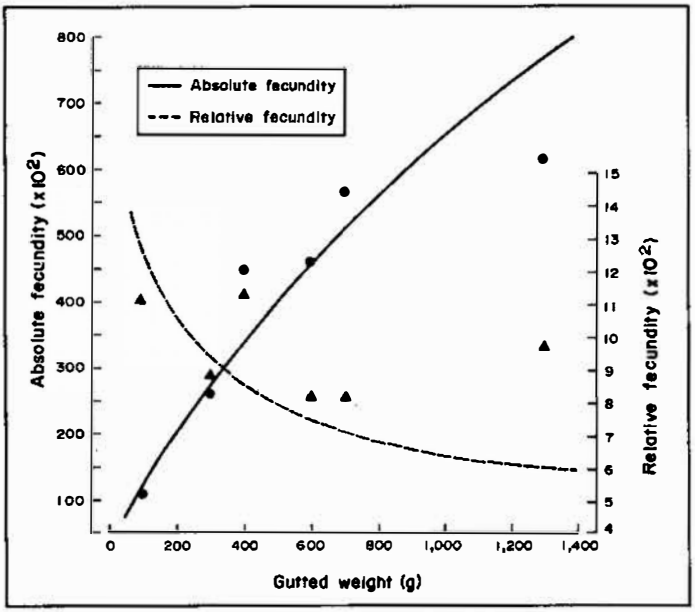

Fig. 4. Relation between absolute and relative fecundity and weight for *Lethrinus elongatus*.

Fecundity and Age

For a given age group, fecundity varied widely. Average absolute fecundity was 228,924 for age group 2^+ and 612,399 for age group 8^+. The following linear equation best described the relationship between fecundity and age:

$$F_a = 101{,}489.3158 + 66{,}001.0175 \text{ Age } (r = 0.9916)$$

Sex Ratio

Table 2 shows the effect of age on the sex ratio. At younger ages (1-4 years), the percentage of females exceeded that of males, whereas the reverse was true for older age groups (5-7 years). The relationship between proportion of males (M%) and fish age or length (L) was linear;

$$M\% = 26.270 + 6.021 \text{ Age } (r = 0.887)$$
$$M\% = 32.067 + 2.389 \text{ L } (r = 0.823)$$

The overall sex ratio was found to be 1.3:1 (females to males) (Table 2). The predominance of females at younger ages and males at older ones suggests sex reversal from female to male (protogynous hermaphroditism) during the fifth year of *L. elongatus* life.

Table 2. Variation of sex ratio with age of *Lethrinus elongatus*. Ages older than 7 years were represented by small numbers of fish for both sexes.

Age (Year)	Males %	Males No.	Females %	Females No.	N.
1	41.2	7	58.8	10	17
2	38.0	38	62.0	62	100
3	36.9	38	63.1	65	103
4	44.8	26	55.2	32	58
5	55.6	20	44.4	16	36
6	61.1	11	38.9	7	18
7	77.8	7	22.2	2	9
Total number of fish		147		194	341
Means	43.1		56.9		

Discussion

While the six stages established for this species are a reliable guide for distinguishing the different maturity stages, the wide range of oocyte size groups within the mature ovary suggested "asynchronous ovaries" for *L. elongatus* according to the classification given by Wallace and Selman (1981). De Vlaming (1983) considers that most species with asynchronous oocyte development have protracted spawning seasons with multiple spawnings.

Unfortunately, other records on reproduction of *L. elongatus* are lacking in the literature. However, the information available for other lethrinids (Toor (1968) on *L. lentjan* in Mannar Bay, Indian waters; Salem (1976) on *L. mahsena* in Al-Ghardaqua, Red Sea; and Bertrand (1986) on *L. mahsena* in Saya de Malha, Indian Ocean) can be used for comparison.

In this study, running individuals were poorly represented in the catch. This was also observed by the authors mentioned above. They related this phenomenon to the breeding behavior of the

spawning stock, i.e., spawners move to areas (spawning grounds) away from the fishing grounds. The agreement between the start of gonadal development of the species and the elevation of water temperature (Fig. 1) may indicate the role of temperature as breeding stimulus. This conclusion is in line with those of Salem (1976), Loubens (1980) and Bertrand (1986).

Knowledge of the size at which fish reach sexual maturity in Jeddah waters is required for management purposes (Kedidi and Bouhleil 1985). Information on fecundity of other lethrinid species is relatively scarce. In the same area, *L. lentjan* was found to be more fecund than *L. elongatus* or *L. mahsena* of the same size (unpubl. data).

In a previous report on the species, monthly variations of average condition factor (K) revealed that peak condition coincided with the breeding period of the fish (April-July) (Wassef and Bawazeer 1990). This may result from the additional ripe gonad weights. Another relatively smaller peak in condition was noticed in October (postspawning). Measuring the filling indices (F.I.) of fish (F.I. = gut weight x 100 / gutted fish weight), the same authors showed that *L. elongatus* decreased their food intake during the spawning season, but they did not cease feeding. After spawning (September-October), the fish fed at a higher rate which likely produced the smaller peak in K noticed in October (Wassef and Bawazeer 1990).

The predominance of females at younger ages and males at older ones, suggesting sex reversal from female to male during the fifth year of life, has been confirmed by histological examination of *L. elongatus* gonads (unpubl. data). This sex reversal has been noted by other workers (Toor 1968; Salem 1976; Aldonov and Druzhinin 1978; Loubens 1980; Bertrand 1986). Evidence of protogynous hermaphroditism among eight lethrinids of Australian coral reef waters was also given by Young and Martin (1982).

Acknowledgement

The authors thank Prof. Altaf A. Ezzat, Faculty of Science, Alexandria University, Egypt, for help throughout this study.

References

Aldonov, V.K. and A.D. Druzhinin. 1978. Some data on the scavengers (Family: Lethrinidae) from the Gulf of Aden region. J. Ichthyol. 18(2):527-535. (Translated by Scripta Publications Company).

Al Kholy, A.A. 1965. Fishes and fisheries of the Red Sea. Aquatic Resources Authority, Egypt. 344 p. (In Arabic)

Bagenal, T.B. 1971. The interrelation of the size of fish eggs, the data of spawning and the reproduction cycle. J. Fish Biol. 3:207-219.

Bertrand, J., 1986. Données concernant la reproduction de *Lethrinus mahsena* (Forsskal, 1775) sur les bancs de Saya de Malha (Ocean Indian). Cybium 10(1):15-29.

Chakraborty, D., A. Al Yahya, A.R. Housan, A.M. Gazzaz, R. Mandorah, N.A. Sharif, M. Kalantaan and A. Sarraj. 1987. Marine fish production in the kingdom of Saudi Arabia during 1985-86. A preliminary report. Min. Agric. and Water, Fish. Res. Cent. Jeddah. 52 p.

De Vlaming, V. 1983. Oocyte developmental patterns and hormonal involvements among teleosts, p. 176-199. *In* J.C. Rankin, T.J. Pitcher and R.T. Duggan (eds.) Control processes in fish physiology. Croom Helm, London.

Fischer, W. and G. Bianchi, Editors. 1984. FAO species identification sheets for fishery purposes. Western Indian Ocean, Fishing Area 51. FAO, Rome.

Hickling, C.F. 1970. A contribution to the natural history of the English grey mullets (Pisces, Mugilidae). J. Mar. Biol. Assoc. U.K. 50(3):609-633.

Kedidi, S.M. and M. Bouhleil. 1985. Stock assessment of the longface emperor *Lethrinus miniatus* from the Djiboutian waters, Red Sea and Gulf of Aden. FAO/UNDP Proj. Dev. Fish. in Areas of the Red Sea and Gulf of Aden. RAB/83/023/12, 19 p.

Loubens, G. 1980. Biologie de quelques especés de poissons du lagon Néo-Caledonien. II. Sexualité et reproduction. Cah. L'Indo-Pac. 2:41-52.

Randall, J.E. 1983. Red Sea reef fishes. Immel Publ., London.

Salem, S.A. 1976. On the biology of two *Lethrinus* species from the Red Sea. Faculty of Science, Cairo University. 261 p. Ph.D. thesis.

Snedecor, G.W. and W.G. Cochran. 1980. Statistical methods. Iowa State University Press, Ames.

Toor, H.S. 1968. Biology and fishery of the pigface bream, *Lethrinus lentjan* Lacepede, from Indian waters. II. Maturation and spawning. Indian J. Fish 11(2):581-596.

Wallace, R.A. and K. Selman. 1981. Cellular and dynamics of oocyte growth in teleosts. Am. Zool. 21:325-343.

Wassef, E.A. and F. Bawazeer. 1990. The biology of *Lethrinus elongatus* Val., 1830 (Teleosts: Lethrinidae) in the Red Sea. Bull. Nat. Inst. Oceanogr. Fish. Alex. 16:103-124.

Wray, T., Editor. 1979. Commercial fishes of Saudi Arabia. Ministry of Agriculture and Water Resources, Kingdom of Saudi Arabia, and White Fish Authority, London.

Young, P.C. and R.B. Martin. 1982. Evidence for protogynous hermaphroditism in some lethrinid fishes. J. Fish Biol. 21:475-484.

Manuscript received 27 February 1991; accepted 13 March 1992.