International Journal of Fisheries and Aquatic Studies 2023; 11(1): 150-154

E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 76.37
(GIF) Impact Factor: 0.549
IJFAS 2023; 11(1): 150-154

www.fisheriesjournal.com
Received: 02-01-2023
Accepted: 05-02-2023

Abdalla N Elawad
Fisheries Research Center, Khartoum, Sudan

Zuheir N Mahmoud
Department of Zoology, Faculty of Science, University of Khartoum, Sudan

Sayed M Ali
Department of Marine Science, Omar Al-Mukhtar University, Libya

Corresponding Author:
Abdalla N Elawad
Fisheries Research Center, Khartoum, Sudan

Aspects of fecundity of some fishes from the Sudanese coast off Suakin

Abdalla N Elawad, Zuheir N Mahmoud and Sayed M Ali

DOI: https://doi.org/10.22271/fish.2023.v11.i1b.2780

Abstract
The mean total length and age at first maturity were established for *Nemipterus japonicus*, *Leiognathus virgatus*, *Gerres oyena*, *Saurida undosquamis*, *Mulloidichthys flavolineatus* and *Terapon theraps* from the Sudanese coast off Suakin. Five maturity stages were identified for each species. Females dominated in 53.3% of the cases, but not significantly ($p > 0.05$) in 40% of the cases, and the sex ratio was equal in two cases (6.7%). The lowest recorded fecundity was 150,500 eggs in *M. flavolineatus* and the highest was 1,950,342 eggs in *G. oyena*. April-June was the breeding season for *N. japonicus*, *L. virgatus* and *G. oyena* while May-July was the breeding season for *S. undosquamis*, *M. flavolineatus* and *T. theraps*. In all six species, the logarithmic relationships between fecundity and total length were very highly significant (p 0.001).

Keywords: Fecundity, *Nemipterus japonicus*, *Leiognathus virgatus*, *Gerres oyena*, *Saurida undosquamis*, *Mulloidichthys flavolineatus*, *Terapon theraps*

Introduction

The study of fecundity is of paramount importance for sustainable exploitation and management of fish resources (DeMartini and Sikkel, 2006; Morgan, 2008; Ganias *et al.*, 2014) [11, 23, 13] as it directly impacts the stock. The attainment of sexual maturity in fish is influenced by differences within and between species, age, size, physiological conditions, and habitat. Banbieri (1989) [8] established five stages of gonadal maturation. He stated that fractional and prolonged spawning periods are characteristic of tropical and subtropical fishes. Reproductive activity is influenced by internal physiological rhythms. That is why some species spawn once, twice, thrice, or almost continuously throughout the year (Bardach and Passino, 1967) [9]. According to Burns and Flores (1981) [10] and Rajasilta *et al.* (1988) [26], external seasonal rhythms such as temperature, photoperiod, salinity, and topography result in significant differences in brood size. The authors added that these cues determine the selection of the spawning site and regulate the beginning and duration of spawning. In nature, the sex ratio of fish species is expected to be 1:1. Any deviation from unity, on the other hand, can be explained by changes in food supply (Merryll, 1964) [22], differences in natural mortality between sexes (Ahmed and El Moghraby, 1984) [4], or dominance of one sex over the other (Shamsan and Ansari, 2010) [32].

Fecundity in fishes is of survival value. The fish species that have parental care of their eggs have low fecundity, such as *Oreochromis niloticus,* compared with fish species that produce a large number of eggs in open water, like *Chanos chanos*. According to Scott (1962) [30], the quantity of food assimilated and stored in the form of fats affects fecundity. The higher the investment of energy in reproduction, the higher the number and survival of the offspring. In fish, survival is maintained at the cost of growth rates (Rincon and Lobon, 1988) [28].

This work aimed to establish the fecundity and reproduction season of *N. japonicus*, *L. virgatus*, *G. oyena*, *S. undosquamis*, *M. flavolineatus, and T. theraps* off the Suakin coast.

Material and Methods

Random fish samples of *N. japonicus*, *L. virgatus*, *G. oyena*, *S. undosquamis*, *M. flavolineatus, and T. theraps* were taken monthly from the shrimp trawling by-catch of off the Suakin coast

(19° 6' 14" N. / 37° 19' 45" E), Sudan. For each specimen, the total length in mm, body weight, and ovary weight (W1) to the nearest 0.1 gm were recoded. The gonadal condition of each specimen was classified according to Kesteven (1960) [19] as immature, maturing, mature, ripe and spent. An ovary subsample of a known weight (W_2) was fixed in Bouin's fluid to facilitate egg counting (N) under a binocular microscope. The total egg count was determined by using the following equation:

Total bomber of eggs = $[W_1 x N] \div W_2$.

The spawning season was determined by the monthly variation in the gonadal index. The seasonal changes in ovarian development were followed by calculating the gonadosomatic index for each fish species in each monthly sample. Chi square (χ^2) and logarithmic regression analysis were applied whenever appropriate.

Results

Maturity stages

The five maturity stages recognized during the present study are summarized in Table 1.

Table 1: A five-point scale of gonadal maturity stages and states.

Stage	State	Description of the gonad morphology
I	Immature.	Gonads were small, slender, and hard. Intestinal mesenteries were prominent within the abdominal cavity.
II	Maturing.	The gonads were enlarging, but did not occupy a prominent part of the abdominal cavity. The eggs may be visible to the naked eye or with a magnifying glass.
III	Mature.	The ovaries and testicles were large and occupied much of the abdominal cavity; however, the gonadal material was not ejected by compression of the gonads.
IV	Ripe.	The gonads were well-developed, swollen, and occupied most of the abdominal cavity. The eggs were large and mature. The gentle squeezing of the gonads released some eggs and milt.
V	Spent.	Essentially, a spawning/post-spawning stage. The gonads were partially flaccid, but may not have been completely empty.

Sex ratio

The ratio of males to females of the six fish species deviates considerably from unity (Table 2). A comparison between the sex ratio within any maturity stage of any of the six species is given in Table 2. The overall sex ratio in each species showed that females dominated in the study area, with a sex ratio ranging from 2.76:1.0 to 4.74:1.0, and the ^{2} values were statistically significantly different (p 0.001 at DF=1), Table 2. Statistical analysis showed that the females dominated in 53.3% of the studied fishes (p 0.001) and were not significantly dominant ($p > 0.05$) in 40% of the cases. The sex ratio equaled unity (1:1) in two cases (6.7%), Table 2.

Table 2: Maturity stages and sex ratio of the examined species.

Species	Sex	Maturity stages 1	2	3	4	5	F:M ratio, χ^2
Nemiptreus japonicas	M	2.6	3.5	8.1	0.0	6.3	4.13:1.0 p<0.001
	F	28.2	10.4	16.3	17.3	12.6	
	χ^2	21.28 p<0.001	3.43 NS	2.64 NS	17.3 p<0.001	2.1 NS	
Leiognathus virgatus	M	4.5	15.0	0.0	2.1	2.0	4.74:1.0 p<0.001
	F	26.7	35.0	27.1	17.1	5.9	
	χ^2	15.79 p<0.001	8.0 p<0.001	27.1 p<0.001	11.72 p<0.001	1.93 NS	
Gerres oyena	M	3.9	2.7	10.9	7.4	6.1	2.76:1.0 p<0.001
	F	23.3	13.4	21.9	14.8	12.2	
	χ^2	14.26 p<0.001	7.11 p<0.01	3.69 NS	2.46 NS	2.03 NS	
Saurida undosquamis	M	0.0	0.0	11.4	10.9	1.7	3.12:1.0 p<0.001
	F	32.0	25.6	5.7	10.9	1.7	
	χ^2	32.0 p<0.001	25.6 p<0.001	1.9 p<0.01	0.0 NS	0.0 NS	
Mulloidichthys flavolineatus	M	8.9	5.0	7.2	6.2	0.0	3.22:1.0 p<0.001
	F	17.8	10.0	21.7	12.5	25.8	
	χ^2	2.96 NS	1.66 NS	7.26 p<0.01	2.12 NS	25.8 p<0.01	
Terapon theraps	M	9.4	7.1	0.0	3.8	6.2	3.86:1.0 p<0.001
	F	37.6	21.4	19.6	11.3	12.5	
	χ^2	16.92 p<0.001	7.16 p<0.01	19.6 p<0.001	3.72 NS	2.12 NS	

NS= insignificance difference (p>0.05).

Maturity and Spawning cycles

Records of monthly examination of fish to determine their stages of gonadal development and gonadosomatic index are given in Fig. 1. For *N. japonicus*, *L. virgatus*, and *G. oyena*, maturation of gonads, spawning, and fat building start from February to April, and from April to June, and from June to September, respectively. On the other hand, in *S. undosquamis*, *M. flavolineatus* and *T. theraps* maturation was from February to May; spawning was from May to July, and fat building from July to September.

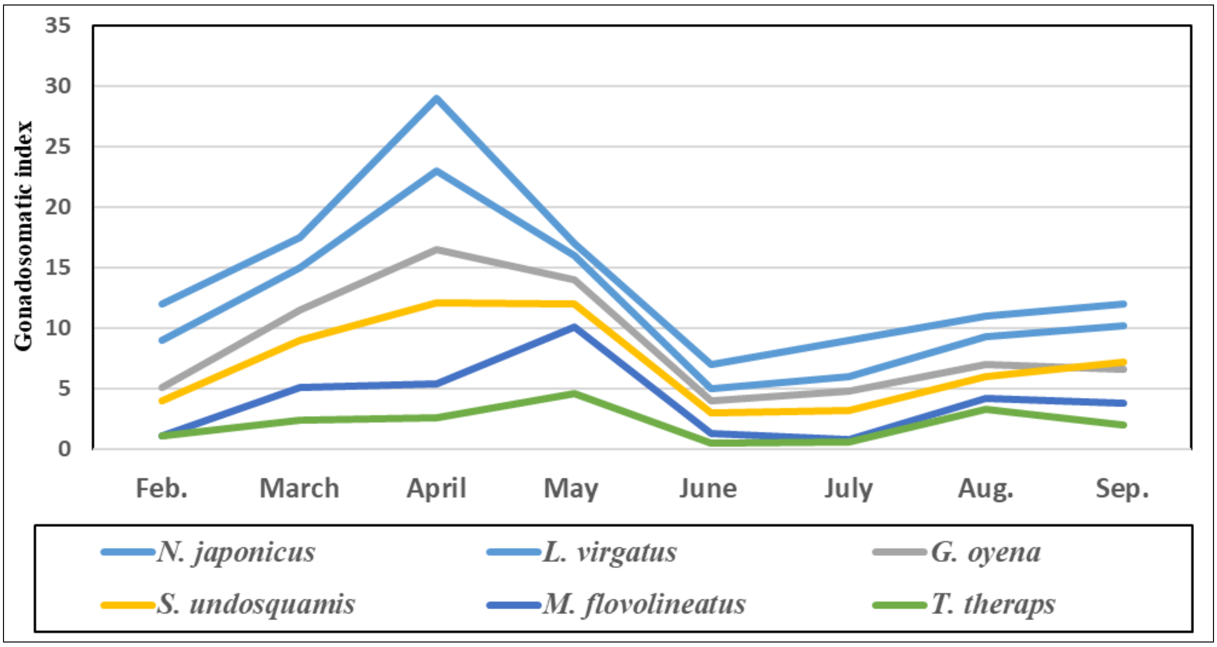

Fig 1: Monthly changes in fish gonads from Suakin coast.

Sexual maturity in *N. japonicus*, *L. virgatus*and *G. oyena* begins in April. For *S. undosquamis*, *M. flavolineatus* and *T. theraps* it began in May. The spawning of the six species clearly overlapped during May and June. All six species spawn once per year. The sexual maturity of the species varies with total length. All species matured at one year of age (Fig. 1 and Table 3), except *L. virgatus* which matured at 1+ year of age.

Table 3: Mean age (years) and total length (cm) at first maturation, spawning season, and fecundity of the six species.

Species	First maturity			Spawning season	Fecundity (No. of eggs)
	Age	Female length	Male length		
Nemiptreus japonicas	1	10.5	12.0	April/June	(2-9) x10^5
Leiognathus virgatus	1+	9.5	8.8	April/June	(2.1-8.8) x10^5
Gerres oyena	1	11.3	10.3	April/June	(6.5-16.6) x10^5
Saurida undosquamis	1	12.5	14.5	May/July	(1.9-5) x10^5
Mulloidichthys flavolineatus	1	10.7	10.8	May/July	(3.2-7) x10^5
Terapon theraps	1	10.5	10.5	May/July	(9-18) x10^5

The regressions between log total length and log mean number of eggs had very high R^2 and were very highly significant ($p < 0.001$) in all the studied fish species (Table 4).

Table 4: Regression analysis between log total length and log mean number of eggs.

Species	Regression equation	r	P
Nemiptreus japonicas	Y=2.81 + 2.67X	0.928	p<0.001
Leiognathus virgatus	Y= 5.56X – 0.17	0.839	p<0.001
Gerres oyena	Y= 2.10 + 3.43X	0.848	p<0.001
Saurida undosquamis	Y= 4.12 + 1.57X	0.920	p<0.001
Mulloidichthys flavolineatus	Y= 2.57 + 2.85X	0.837	p<0.001
Terapon theraps	Y=0.01 + 5.79X	0.999	p<0.001

Discussion

The present study showed that in N. japonicus, maturation of gonads, spawning, and fat building start from February to April, from April to June, and from June to September, respectively. The sex ratio (F: M) was 4.13: 1.0, which was highly significant (p 0.001). The logarithmic regression analysis between TL and the mean number of eggs of N. japonicus was very highly significant and correlated (p 0.001). Nettely *et al*. (2016) [25] studied the reproductive biology of N. japonicus from the coastal waters of Bintulu, Malaysia, and recorded a sex ratio of 1.48:1.0 (M: F). The TL was significantly higher for males in September and March, while in May the number of females was significantly higher (2 = 6.53; p 0.05). The gonadosomatic index values of N. japonicus ranged from 0.07 to 0.19 for males and 0.34 to 4.99 for females. Nettely *et al.* (2016) [25] revealed seven maturity stages and a fecundity of 19,221 to 85,923 in N. japonicus. The present study showed that first maturity was attained at age 1 year, corresponding to females 10.5 cm long (TL) and males 12 cm TL. The fecundity range was 2-9x105 eggs. The disagreement between the present study and Nettely *et al.* (2016) [25] results might be attributed to differences in locations.

The present study revealed a sex ratio of 4.74:1.0 (p 0.001) in favor of female Leiognathus virgatus. In L. virgatus, maturation of gonads, spawning, and fat building starts from February to April, and from April to June, and from June to September, respectively. This species was found to attain the first maturity at age 1+ with females 9.5cm TL and males 8.8cm TL; and had a fecundity range of (2.1–8.8) x105 eggs. The logarithmic regression between TL and the mean number of eggs of L. virgatus was highly significant (p 0.001).

The spawning season of *Leiognathus splendens* was from March till August or September, with a peak in April and August in Rameswaram (Jayabalan, 1986) [16]. The present study identified five maturity stages in *L. virgatus*. According to Maung *et al*. (2019) [21], in the Myeik coastal waters of Myanmar, *L. splendens* spawns throughout the year, with a peak during April-May and September-December. The length at first maturity was 9 cm TL in males and 8.4 cm in females. The sex ratio (1.1 females to 1 male) shows the dominance of females. Fecundity varied from 6120 to 58412 eggs. Fecundity was significantly related to gonad weight (r = 0.90), total length (r = 0.80), and fish weight (r = 0.70). In *L. splendens*, five stages in females and three stages in males based on the external appearance of ovaries and color and size of testes were recorded by Abraham *et al*. (2011) [2], six stages by Rao *et al*. (2015) [27], and seven stages in several Leiognathidae fishes by James and Badrudeen (1986) [15]. These variations may be due to differences in species, gonad development, and spawning periodicity. In the present study, the sex ratio of G. oyena was 2.76:1.0 in favor of females (p 0.001). The maturation of gonads occurred from February to April; the spawning from April to June, and the fat building from June to September. The first maturity was at age 1 year, corresponding to females and males of 11.3 and 10.3 cm TL, and a fecundity range of 6.5 to 16.6 x105 eggs. The logarithmic regression between TL and the mean number of eggs of G. oyena was highly significant (p 0.001). EL-Agamy (1986) [12] found that the fecundity of G. oyena from Qatari waters increased at a rate proportional to the power of 5.47, 1.79, 1.78, and 1.08 of the total length, the body weight, the age, and the ovary weight, respectively. According to Lamtane *et al*. (2007) [20], the size at first maturity in G. oyena was 13.9 and 12.8 cm TL for females and males, respectively. They found the sex ratio to be 1:1. G. oyena spawns throughout the year with two peaks: one in March and the other between October and December, which coincides with the northeast monsoon. The average fecundity in G. oyena was 148,138 per fish. Kanak and Tachihara (2008) [18] found that in G. oyena, ovary development occurred from March to September, and testes during March and August, with a peak in April and May in both sexes. The minimum SL at sexual maturity was 8.97 cm for females and 8.14 cm for males.

Saurida undosquamis exhibited a sex ratio of 3.12:1.0 in favor of females (p 0.001). The first maturity was at age 1 year, with females of 12.5 cm TL and males of 14.5 cm TL and a fecundity range of (1.9-5) x10^5 eggs. The logarithmic regression between TL and the mean number of eggs of *S. undosquamis* was highly significant (p 0.001). Maturation was from February to May, spawning from May to July, and fat building from July to September. This is in disagreement with Ismen (2003) [14], who found that *S. undosquamis* spawned twice (May-July and September-November) and attained first sexual maturity at 16 and 16.5 cm for males and females consecutively. Ismen reported fecundity-length relationships of log F = 0.422+ 3.293logL (r = 0.76) and log F = 0.132+ 3.490logL (r = 0.86), respectively. The present work agreed with Bakhsh (1994) [7] in that the females of *Saurida tumbil* outnumbered males, but not with his statement that females attained a larger size than males. According to Bakhsh, the smallest size at first maturity was 11 cm for males and 13 cm for females. The spawning of both sexes continued throughout the year, with a peak during winter.

The present study recorded the first mature at age 1 year, with females and males of 10.7 and 10.8 cm TL, and a fecundity range of (3.2-7) x105 eggs. The logarithmic regression between TL and the mean number of eggs of M. flavolineatus was very highly significant and correlated (p 0.001). Anand and Pillai (2002) [6] reported a fecundity range of 4,638–12,945 eggs at 9.1 and 11.0 cm for females and males of the same species. The present study showed that the sex ratio is significantly (p 0.001) biased in favor of females. This agrees with the 1: 0.791 (F: M) reported by Anand and Pillai (2002) [6]. In M. flavolineatus, maturation was from February to May, spawning from May to July, and fat building from July to September. Anand and Pillai (2002) [6] reported two spawning periods, one from January to April and the second from October to November. The spawning season of M. flavolineatus was from June to August and coincides with increasing water temperatures (Abu El-Regal, 2018) [3]. Roberts (1989) [29] found that gonochoristic behavior applies to *Polyprion oxygenios* and *Polyprion americanus*. He stated that behavioral differences between the sexes may significantly influence the sex ratio.

In *T. theraps,* maturation was from February to May, spawning from May to July, and fat building from July to September. The first maturity was at the age of 1 year, with females at 10.5 cm TL and males at 10.5 cm TL, and a fecundity range of (9-18) x10^5 eggs. The logarithmic regression analysis between TL and the mean number of eggs of *T. theraps*was very highly significant and correlated (p 0.001). According to Nandikeswari *et al*. (2014) [24], the fecundity of Terapon jarbua from the Bay of Bengal ranged from 13,475 to 115,920 eggs in fish of 17.3 to 2.78 cm TL.

Changes in food supply (Merryll, 1964) [22] or differences in natural mortality between the sexes (Ahmed and El Moghraby, 1984; Abdelha *et al*., 2020) [4, 1] can cause the sex ratio to deviate from unity. In all six species, the study recognized five gonadal developmental stages, which agrees with Jones (1969) [17] and Alam (2000) [5]. The present study showed that these fish species spawn at an age of 1 to 1+. This agreed with Jones (1969) [17], who stated that fish with a short life span mature at an early age. In *N. japonicus*, *L. virgatus*, and *G. oyenaspawning,* it was from April to June. This is likely due to differences in habitat and in May in *S. undosquamis*, *M. flavolineatus, and T. theraps*. This coincides with the early precipitation. The Baraka River flows intermittently from July to October, adding a substantial amount of influx into the Red Sea south of Suakin. Muddy flats are suitable spawning grounds for fish species off Suakin.

The present study showed that fecundity correlates highly and significantly (p 0.001) with the total length of the studied fish. Several researchers have reported that intragroup variation in fecundity (Ahmed and El Moghraby, 1984) [4], food availability (Simpson, 1951; Jones, 1969) [31, 17], temperature (Simpson, 1951) [31], or photoperiod (Rajasilta *et al*., 1988) [26] could explain fecundity variation.

References

1. Abdelha EM, Fedekar FM, El Ganainy AA, Abu El-Regal MA, *et al*. Reproductive biology of *Siganus rivulatus* (Forsskal, 1775) in the Red Sea, Suez Canal and the Mediterranean Sea, Egypt. Egyptian Journal of

Aquatic Biology & Fisheries. 2020;24(6):117-134.
2. Abraham KJ, Murty VSR, Joshi KK. Reproductive biology of *Leiognathus splendens* (Cuvier) from Kochi, south-west coast of India. Indian Journal of Fisheries. 2015;58(3):23-31.
3. Abu El-Regal M. Reproductive biology of the yellow-striped goatfish *Mulloidichthys flavolineatus* (Lacepède, 1801) (Perciformes: Mullidae) in the Red Sea, Egypt. Egyptian Journal of Aquatic Biology and Fisheries. 2018;22(4):233-247.
4. Ahmed AA, El Moghraby AI. Breeding of *Barbus bynni* (Pisces, Cyprinidae) in Jebel Aulia Reservoir, Sudan. Hydrobiologia. 1984;110:319-325.
5. Alam MK. Biological characters of commercial fishes in Saudi Arabia, Saudi Arabia, 2000, 15-47.
6. Anand PEV, Pillai NGK. Reproductive biology of some common coral reef fishes of the Indian EEZ. J. Mar. Biol. Ass. India. 2002;44(1-2):122-135.
7. Bakhsh AA. Reproductive Biology of Lizard Fish, *Saurida tumbil* (Forskal) in the Jizan Region of the Red Sea. J. KAU: Mar. Sci., Special Issue: Symp. on Red Sea Mar. Environ., Jeddah, 1994;7:169-178.
8. Banbieri G. Spawning type and fecundity of three sympatric species of tropical fishes in Brazil. J. Fish Bio. 1989;35(2):167-322.
9. Bardach J, Paasino DM. Ichthyology of fishes. 2nd ed. NY, 1967, 504.
10. Burn JR, Flores JA. Reproductive biology of *Cutaro ojos, Anableps dowi* (Pisces: Anablepidae) from El Salvador and its seasonal variation. Copeia. 1981;(1):25-32.
11. DeMartini EE, Sikkel PC. Reproduction. In: The Ecology of Marine Fishes: California and Adjacent Waters. Eds. LG Allen, DJ Pondella and MH Horn. University of California Press, California, USA., 2006, 483-523.
12. EL-Agamy AE. The fecundity of *Gerres oyena* Forskal 1775, (Fam. Gerreidae) in the Qatari waters of the Arabian Gulf. Qatar Univ. Sci. Bull. 1986;6:371-388.
13. Ganias K, Somarakis S, Nunes C. Reproductive Potential. In: Biology and Ecology of Sardines and Anchovies, K Ganias, (Ed.). CRC Press, Boca Raton, Florida. 2014, 79-121.
14. Işmen A. Maturity and Fecundity of Lizardfish (*Saurida undosquamis* Richardson, 1848) in İskenderun Bay (Eastern Mediterranean). Turk. J. Zool. 2003;27(3):231-238.
15. James PR, Badrudeen M. Studies on the maturation and spawning of the fishes of the family Leiognathidae from the seas around India. Indian Journal of Fisheries. 1986;33(1):1-26.
16. Jayabalan N. Reproductive biology of silver belly *Leiognathus splendens* (Cuvier) at Porto Novo. Indian Journal of Fisheries. 1986;33(2):171-179.
17. Jones R. Theory of fish population dynamics as the biological ground for rational exploitation and management of fishery resources. Scotland, 1969, 270.
18. Kanak K, Tachihara K. Reproductive biology of common silver biddy *Gerres oyena* in Okinawa Island of southern Japan. Fisheries Science. 2008;74:265-275.
19. Kesteven GL. Manual of field in fisheries biology. FAO Man. Fish Sci. 1960;1:152.
20. Lamtane HA, Pratap HB, Ndaro SMG. Reproductive Biology of *Gerres oyena* (Pisces: Gerreidae) Along the Bagamoyo Coast, Tanzania. Western Indian Ocean J. Mar. Sci. 2007;6(1):29-35.
21. Maung KMC, Thu MP, Tun NN. Reproductive Biology of Splendid Ponyfish *Leiognathus splendens* (Cuvier, 1829) in Myeik Coastal Waters, Myanmar. Journal of Marine Science. 2019;1(2):7-13.
22. Merryll MB. Age and growth maturity and sex maturity of the American smelt *Osmerus Mordax* (Mitchell) of western Lake Superior. Trans. Am. Fish. Soc. 1964;93(4):382-395.
23. Morgan MJ. Integrating reproductive biology into scientific advice for fisheries management. J. of Northwest Atlantic Fisheries Science. 2008;41:37-51.
24. Nandikeswari R, Sambasivam M, Anandan V. Estimation of Fecundity and Gonadosomatic Index of *Terapon jarbua* from Pondicherry Coast, India. Journal of Biological, Biomolecular, Agricultural, Food and Biotechnological Engineering. 2014;8(1):61-65.
25. Nettely T, Rajaee AH, Denil NA, Idris MH, *et al*. Reproductive biology of *Nemipterus japonicus* (Bloch, 1791) from the coastal waters of Bintulu (South China Sea), Sarawak, Malaysia. J. Environ. Biol. 2016;37(4):715-724.
26. Rajasilta M, Eklund J, Kaaria J, Ranta K. Photoperiod effects on gonadal in captivity-born gilthead bream, *Sparus aurata* (L.): early findings. J. Fish Biology. 1988;32(5):793-794.
27. Rao PY, Veni DNK, Sirisha IR. Biology of orange fin pony fish, *Photopectoralis bindus* (Valenciennes, 1835), off Visakhapatnam, East coast of India. International Journal of Environmental Sciences. 2015;5(6):1159-1171.
28. Rincun PA, Lobon J. Reproductive and growth strategies of the red roach *Rutilus arcasli* (Sterndachhner, 1866). J. Fish Biology. 1988;34(5):687-697.
29. Roberts CD. Reproductive mode in the percomorph fish genus *Polprion* (Oken). J. Fish Biology. 1989;34(1):1-9.
30. Scott RD. Effect of food quantity on fecundity of rainbow trout, *Salmo gairdneri*. J. Fish Res.Bd. Canada. 1962;19(4):715-731.
31. Simpson AC. The fecundity of plaice. Fish Invest., 1951;2(17):5.
32. Shamsan EF, Ansari ZA. Studies on the reproductive biology of Indian Sand Whiting *Sillago sihama* (Forsskal). Indian Journal of Marine Sciences. 2010;39:280-284.