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Population Dynamics Study of Ribbonfish, *Lepturacanthus savala* from the North-Eastern Tip of Bay of Bengal

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Population Dynamics Study of Ribbonfish, *Lepturacanthus savala* from the North-Eastern Tip of Bay of Bengal

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Abstract- Land-based survey data were collected from two major fish landing centers of south-east Bangladesh. A total of 1,770 *Lepturacanthus savala* in dividuals were collected for length-frequency and length-weight analysis. The asymptotic length ($L\infty$), growth coefficient (k), theoretical age with length at zero (t_0) and growth performance index ($Ø'$) were estimated to be 111 cm, 0.34 year^{-1}, -0.34 year and 3.622 respectively. Based on the growth parameters total mortality (Z), natural mortality (M) and fishing mortality (F) was found 1.09 year^{-1}, 0.611 year^{-1}, and 0.479 year^{-1} respectively. The exploitation rate (E) using the length converted catch curve was found as 0.43 year^{-1} which denotes that the studied population is not in over-exploited condition. Recruitment pattern revealed the peak in July. Length-weight relationship of *L. savala* was established as $W = 0.0381\ TL^{2.1194}$ where $R^2 = 0.8697$.

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I. Introduction

Lepturacanthussavala (Cuvier, 1829), commonly known as Ribbon fish or locally as '*Churimach*' is one of the most abundant species in the marine waters of Bay of Bengal Bangladesh part. It is unique for the shape that resembles like a snake, but highly compressed and has a ribbon-like body with silvery in color. The species is benthopelagic and amphidromous (Riede, 2004) and found in tropical waters (Nakamura and Parin, 1993) along the coastal waters of Indo-west Pacific and Indian Ocean (Bianchi, 1985; Nakamura and Parin, 1993). The species is highly carnivorous and predominantly piscivorous feeding both during day and night. The favored food items of *L. savala* includes a variety of small fishes (mostly of the anchovy type, e.g., *Anchoviella)*, prawns and shrimps (e.g., *Acetes*) (James, 1967; Abdussamad, 2006; Mustafa and Begum, 1994).The fish is popular in dry form to the people of Bangladesh and also exported to the countries like UK, Singapore, Middle-East and SriLanka (Mustafa *et al*., 2000).

Very few works have been done for the population dynamics study of *L. savala* in Bay of Bengal Bangladesh part. However, some of the discrete attempts have been taken by Ashraful (1998), Mustafa *et al*. (2000) and Khan *et al*. (2003) to study the growth, mortality and length-weight relationship of the species. Therefore, the objective of this research is to study the growth and mortality parameters along with recruitment pattern and length-weight relationship of *L. savala* using the length frequency data.

II. Materials and Methods

a) Study area and duration

The study was conducted in two major fish landing centers of the south-eastern part of Bangladesh (north-eastern tip of Bay of Bengal). The red circle in the map shows the '*Fishery ghat*' landing center ($22^0$19'38.33"N and $91^0$50'50.15"E) in Chittagong district and the yellow circle designates the 'BFDC *Fishery ghat*' landing center ($21^0$27'04.05"N and $91^0$58'16.62"E) in Cox's Bazar district (Fig. 1). Data were collected throughout the 24 months tenure from January/16 to December/17 to get an ideal picture of the landing trend and to avoid the bias of length-frequency distribution.

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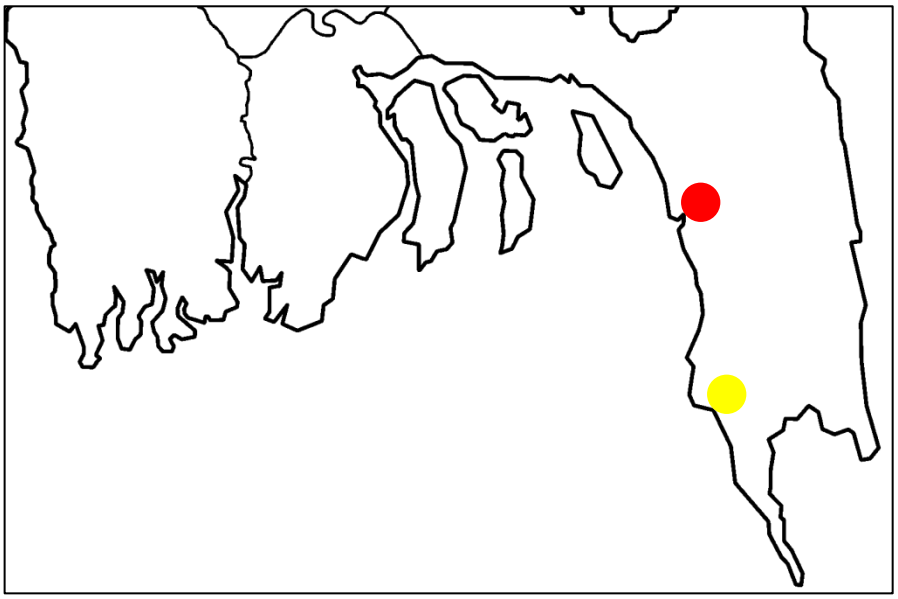

Fig. 1: Red and yellow circles are showing the data collection sites of the present study

b) Data collection

Landing-based data were collected for eight days/month in both the stations throughout the study period. Here selection was like that in every full moon period two days and in every new moon period two days data will be collected. In between full moon and new moon two days, and between new moon and full moon another two days data will be obtained (Fig. 2). This sampling technique was done to avoid sampling error and biases. Moreover, everyday catch composition, length-frequency and length-weight data were collected randomly from two mechanized boats.

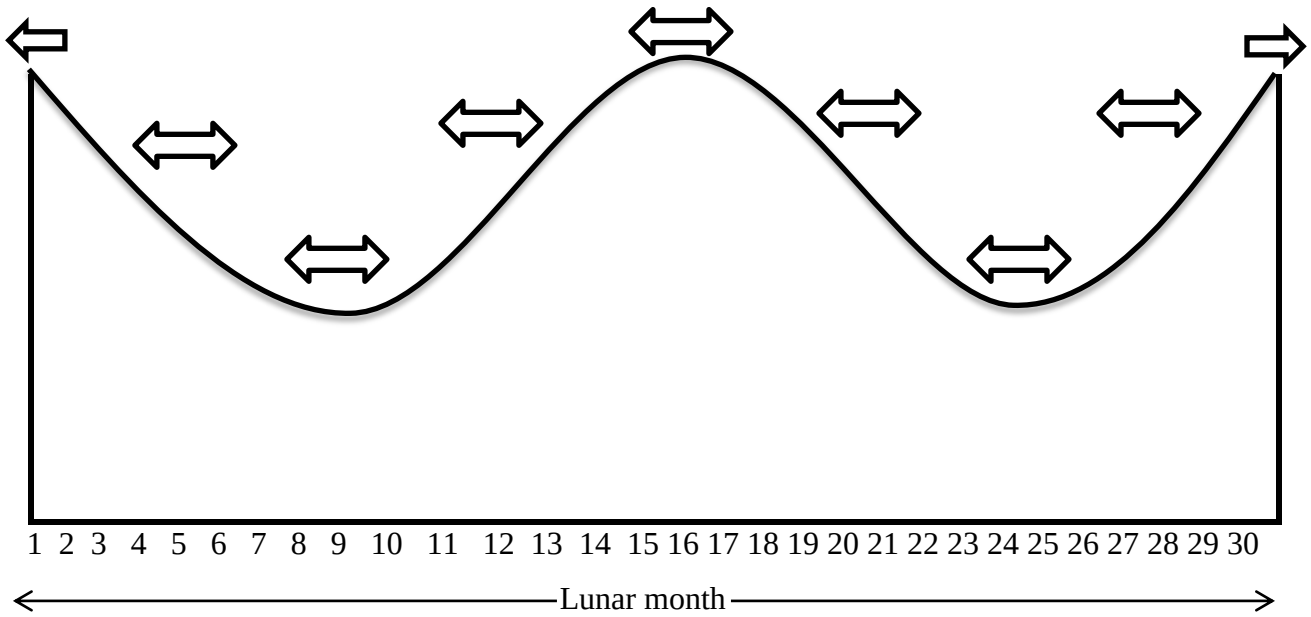

Fig. 2: Arrows are showing the land-based data collection duration in an ideal lunar month where waves are denoting the tidal action due to the full and new moon

III. Data Analysis

Length-frequency data of *L. savala* were analyzed by FISAT II (FAO-ICLARM stock assessment tool, Gayanilo *et al*., 2003) for the estimation of growth and mortality parameters. However, the length-weight relationship was established on Microsoft Excel version 10.

a) Growth

Von Bertalanffy's growth function (VGBF) was used to estimate the length with age:

$$Lt = L\infty(1 - \exp(-k(t-t_0)))$$

Where Lt is the length at age t, $L\infty$ is the asymptotic length, K is the growth coefficient, and t_0 is

the theoretical age at zero length (Haddon, 2011) which can be calculated using the empirical equation of Pauly (1983):

$$\log_{10}(-t_0) = -0.3922 - 0.275 \log_{10} L\infty - 1.0381 \log_{10} k$$

Growth performance index (Ø') was calculated according to the formula of Pauly and Munro (1984):

$$Ø' = \log_{10} K + 2 \log_{10} L\infty$$

b) Mortality

The annual total mortality rates (*Z*) were estimated by the length-converted catch curve analysis method of Pauly (1983):

$$\ln(Ni / \Delta ti) = a + bti$$

Where *Ni* is the number of fish in length class i, Δt_i is the time needed for the fish to grow through length class i, *ti* is the age (or the relative age, computed with $t_0 = 0$) corresponding to the mid-length of class i, and where *b* is an estimate of *Z*. Natural mortality was estimated by Pauly's empirical formula:

$$\log_{10}(M) = 0.006 - 0.279 \log_{10}(L\infty) + 0.654 \log_{10}(k) + 0.6434 \log_{10}(T)$$

Where $L\infty$ is in cm and *K* is in per year. *T* is the annual average sea surface temperature. Fishing mortality (*F*) is estimated by subtracting (*M*) from (*Z*), the exploitation ratio E is calculated from *F*/*Z*.

c) Length-weight relationship

For the estimation of length-weight relationship the power function was used:

$$W = aL^b$$

Where *W* is the weight of fish in gram, *L* is the length offish in centimeter, *a* is constant condition factor, and *b* is the slope.

IV. Results

a) Growth

Two years (2016 and 2017) land-based data were pooled month-wise, and 1,770 fish samples were clustered in 17 groups (7-125 cm) with seven units of class intervals (Fig. 3). Modal groups 42-48, 49-55 and 56-62 were found every month throughout the study period.

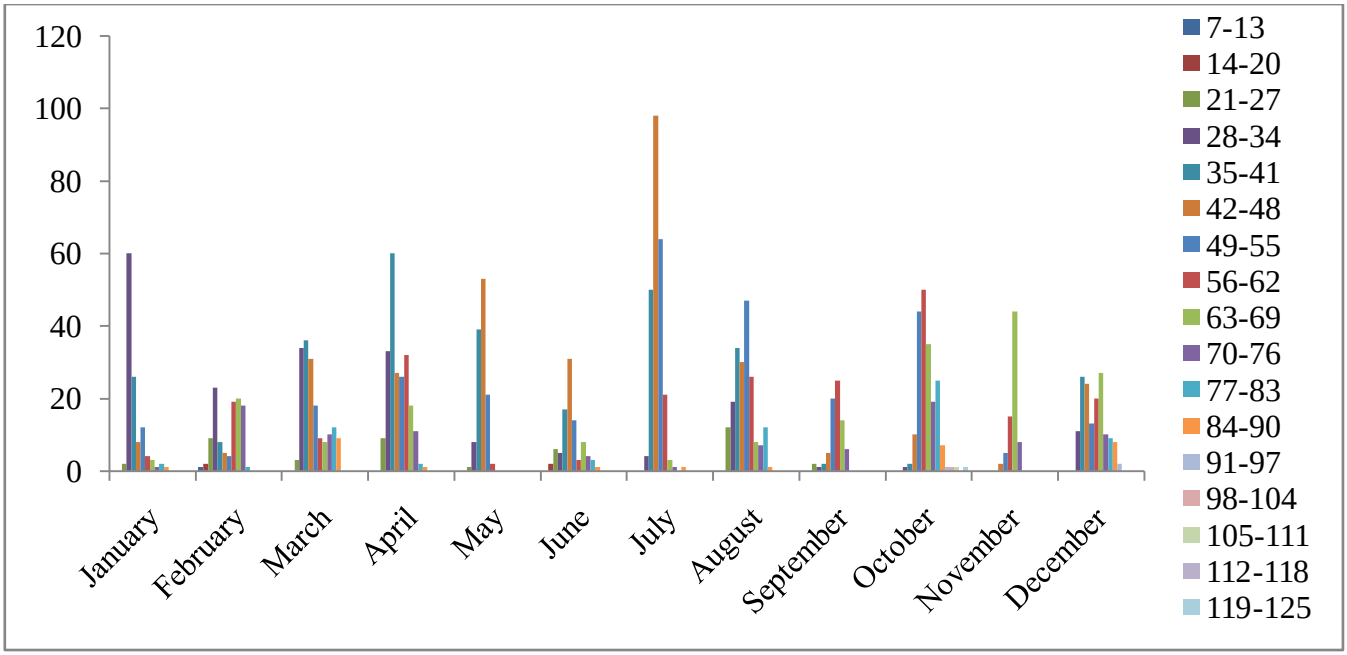

Fig. 3: Pooled month-wise length frequency distribution of *L. savala*

The calculated Von Bertalanffy's growth function (VGBF) parameters of *L. savala* using ELEFAN method in FISAT were $L\infty = 111$ cm, $k = 0.34$ year^{-1} (Fig. 4), $t_0 = -0.34$ year and Ø' = 3.622, while the estimated values of goodness of fit of model estimation Rn = 0.19.

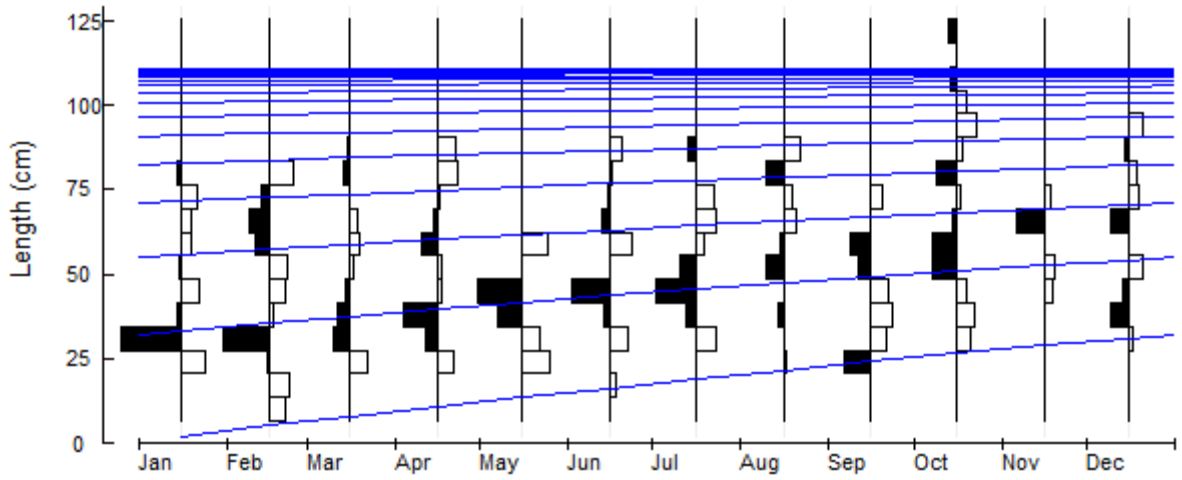

Fig. 4: Length-frequency distribution data and growth curves estimated using ELEFAN method for *L. savala*

b) Mortality and exploitation rate

The estimated rate of total mortality Z applying the length-converted catch curve analysis method for *L. savala* was $Z = 1.09$ year^{-1} (Fig. 5) and the natural mortality, $M = 0.611$ year^{-1} at an annual average sea surface temperature of 28°C in Bay of Bengal Bangladesh part during the study period while the rates of fishing mortality, $F = 0.479$ year^{-1}. Hence, exploitation ratio, $E = 0.43$ year^{-1}.

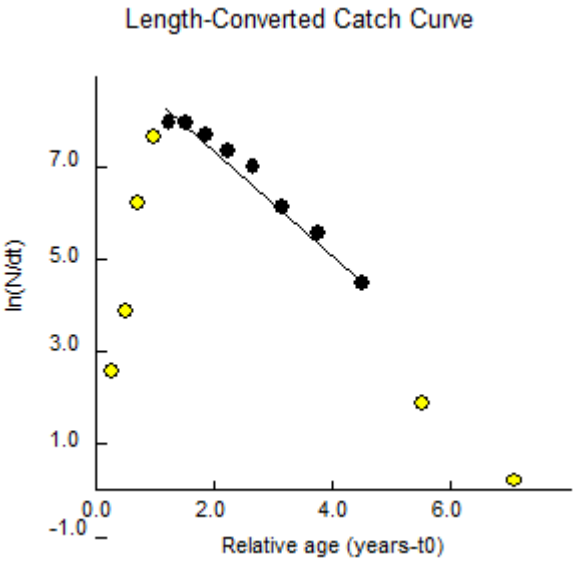

Fig. 5: Estimation of 'Z' by length converted catch curve method for *L. savala*

c) Recruitment

By pooling annual length-frequency, it was found that *L. savala* recruits almost throughout the year (Fig. 6). However, the main recruitment pulse was evident from June-September with the peak in July (20.21%).

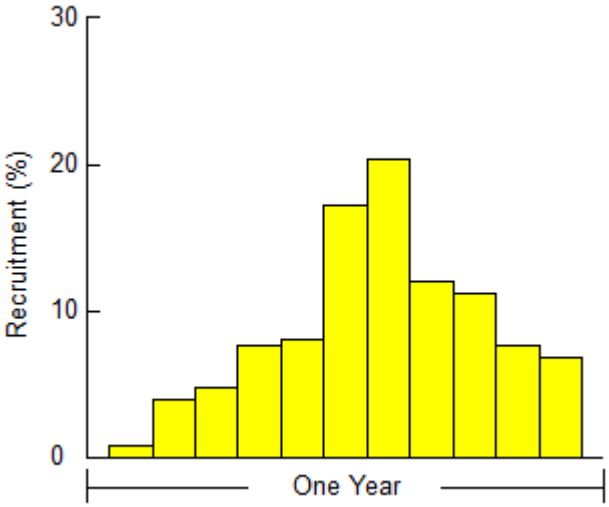

Fig. 6: Annual recruitment pattern of *L. savala* in the present study

d) Length-weight relationship

For length-weight relationship analysis, 1770 individuals were grouped according to length into 76 intervals, and their corresponding weights were averaged to get the standard weight of that length. The values of length-weight relationship for the *L. savala* were estimated as: a=0.0381, b= 2.1194 and R^2 = 0.870 (Fig. 7).

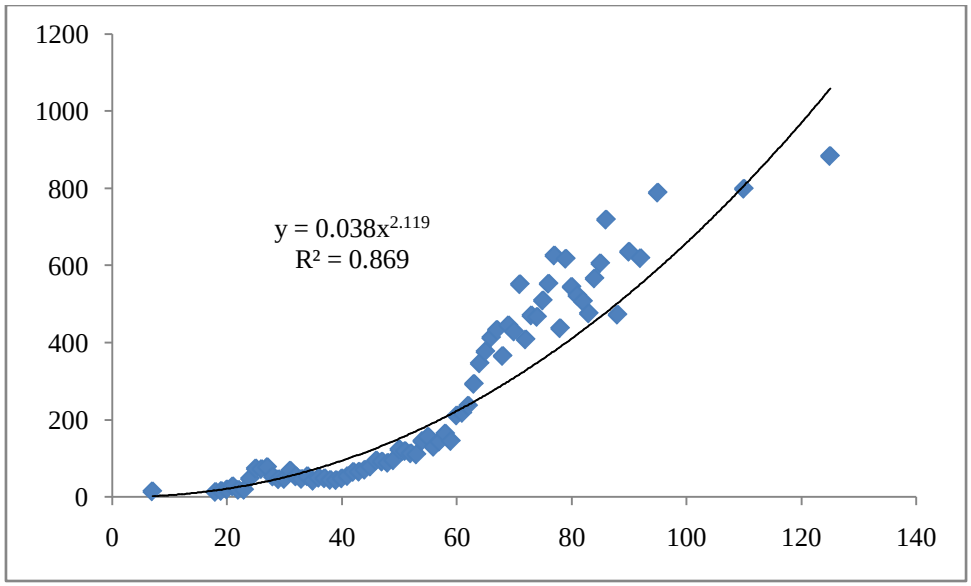

Fig. 7: Length-weight relationship of *L. savala* in the present study

V. Discussion

a) Growth

In the present study the length of *L. savala* varied from 7-125 cm and majority of individuals were observed within 28-69 cm range, where in the studies of Pakhmode *et al*. (2013) and Mustafa *et al*. (2000) size varied from 10-70 cm and 32-104 cm with maximum numbers within 20-60 cm and 56-70 cm respectively.

L∞ value of the present study was found close to the findings of Ashraful (1998), Khan *et al*. (2003) and Mustafa *et al*. (2000) whose sampling area was also the Bay of Bengal. However, the studies of Rizvi *et al*. (2010) and Pakhmode *et al*. (2013) revealed quite lower L∞ in Indian waters where Memon *et al*. (2016) found comparatively higher value in Pakistan (Table 1).

Growth coefficient (*k*) ranged from 0.13 to 0.87 year^{-1} and t_0 from -0.0003 to 0.0708 in different studies (Table 1). In this study, the *k* and t_0 value were found as 0.34 year^{-1} and -0.34year respectively.

Table 1: Comparison of growth parameters in studies of different authors

Author	Location	$L\infty$	k	t_0	Method
Ashraful (1998)	Bay of Bengal	108	0.75	-	-
Rizvi *et al*. (2010)	Mumbai Coast	68.8	0.87	-0.0003	Length-frequency
Pakhmode *et al*. (2013)	Ratnagiri Coast	68.25	0.55	-0.0396	Length-frequency
Khan *et al*. (2003)	Bay of Bengal	105.4	0.68	-	Length-frequency
Memon *et al*. (2016)	Pakistan	133.4	0.13	-0.877	Length-frequency
Mustafa *et al*. (2000)	Bay of Bengal	106.50	0.80	0.0708	Length-frequency
Present study	Bay of Bengal	111.0	0.34	-0.34	Length-frequency

b) Mortality and exploitation rate

Total mortality (*Z*), natural mortality (*M*) and fishing mortality (*F*) were found 1.09 year^{-1}, 0.611 year^{-1}, and 0.479 year^{-1} respectively for *L. savala* in the present study. Comparatively higher mortality rates were found in all the previous studies of different authors except Memon *et al*. (2016) in Pakistan waters. The obtained value of the exploitation rate (E = 0.43) indicated that the said population was not in over-exploited condition.

Table 2: Comparison of mortality parameters in studies of different authors

Author	Location	Z	M	F
Ashraful (1998)	Bay of Bengal	2.58	*1.54*	1.04
Rizvi *et al*. (2010)	Mumbai Coast	4.15	1.3	2.85
Khan *et al*. (2003)	Bay of Bengal	2.03	0.98	1.05
Memon *et al*. (2016)	Pakistan	0.49	0.304	0.185
Present study	Bay of Bengal	1.09	0.611	0.479

c) Recruitment

Recruitment pattern of *L. savala* species in the present study reveals that the major pulse takes place in July. A similar trend was also observed in the studies of Mustafa *et al*. (2000) for *L. savala* and Fofandi (2012) for *Trichiurus lepturus*.

d) Length-weight relationship

The observed values of *a, b* and R^2 for the *L. savala* were found as 0.0381, 2.1194 and 0.870 respectively. Comparison of some studies in different countries is illustrated in table 3 where *b* and R^2 values showed more or less similar distribution, but the significant variation is observed in case of *a* value.

Table 3: Comparison of length-weight parameters in studies of different authors

Author	Location	Sex	*a*	*b*	R^2
Rizvi *et al*. (2010)	Mumbai Coast	Both Sex	0.00000001	3.611	0.962
Myla *et al*. (2012)	Visakhapatnam	Male	0.00001	2.894	0.857
		Female	0.000014	2.517	0.825
Al-Sakaff, and Esseen (1999)	Yemen	Male	0.01300	2.776	0.97
		Female	0.01100	2.814	0.966
Pakhmode *et al*. (2013)	Ratnagiri Coast	Both Sex	0.0006049	3.2285	0.92
Memon *et al*. (2016)	Pakistan	Both Sex	0.0001	3.191	0.960
Present study	Bay of Bengal	Both Sex	0.0381	2.1194	0.870

VI. Conclusion

Like previous works of Bangladesh and adjacent countries, almost similar results have been identified in the present study. However, further extended work is needed to estimate the maximum sustainable yield (MSY) level of *L. savala* in the Bay of Bengal Bangladesh part and to take necessary management measures by that.

References Références Referencias

1. Abdussamad, E. M., Nair, P.N.R. and Achayya, P. 2006. The ribbonfish fishery and stock assessment of *Trichirus lepturus* (Linnaeus) off Kakinada, east coast of India. *J Mar Bio Asso India.* 48(1): 41-45.
2. Al-Sakaff, H. and Essan, M. 1999.Length-weight relationship of fishes from Yemen waters, 1999 (The Gulf of Aden and Red Sea).Naga ICLARM Q., 22: 41-42.
3. Ashraful, H. A. 1998. Population dynamics of five commercially important marines fishes in the northeastern part of Bay of Bengal. M.Sc. thesis, Institute of Marine Sciences, University of Chittagong, Chittagong, Bangladesh.
4. Bianchi, G. 1985. Field guide to the commercial marine and brackish-water species of Pakistan. FAO species identification sheets for fishery purpose. Prepared withthe support of Pak/77/033 and FAO (FIRM) Regular Programmed, Rome, FAO, pp. 200.
5. Fofandi, M. D. 2012. Population Dynamics and Fishery of Ribbonfish *(Trichiurus lepturus)* of Saurastra Coast.1: 189. doi:10.4172/scientific reports.189.
6. Gayanilo, F. C., Sparre, P., and Pauly, D. 2003.FAO ICLARM stock assessment tool (FISAT-II), User's guide FAO Computerized Information series (Fisheries), no. 8, Rome, FAO, pp. 266.
7. Haddon, M. 2011. Modeling and quantitative methods in fisheries. Chapman & Hall/CRC Press, London, pp. 449.
8. James, P. S. B. R. 1967. Comments on the four new species of ribbonfishes (family *Trichuridae*) recently reported from India. *J Mar BiolAsso India*. 9 (2): 327-338.
9. Khan, M. A. A., Sada, N. U. and Chowdhury, Z. A. 2003.Status of the demersal fishery resources of Bangladesh. In: Assessment, management and future directions of coastalfisheries in Asian countries(eds. G. Silvestre, L. Garces, I. Stobutzki, M. Ahmed, R. A. Valmonte-Santos, C. Luna, L. Lachica-Alino, P. Munro, V. Christensen and D. Pauly). World Fish Center Conf. Proc., 67, 63-82.
10. Memon, K. H., Liu, Q., Kalhoro, M. A., Chang, M. S., Baochao, L., Memon, A. M., Hyder, S. and Tabassum, S. 2016. Growth and Mortality Parameters of Hairtail *Lepturacanthus savala* from Pakistan Waters. *Pakistan J. Zool.*48 (3): 829-837.
11. Mustafa, M. G. and Begum, M. 1994. Some aspect of the biology of the *ribon* fish, *Lepturacanthus savala* in the Bay of Bengal. Proc. Ninth Nat. Zool. Conf. Bangladesh. pp. 23-30.
12. Mustafa, M. G., Zafar, M., Haque, M. A. and Amin, S. M. N. 2000. Population dynamics of the ribbon fish, *Lepturacanthus savala* (Cuvier 1829) from the north-eastern part of the Bay of Bengal. *Bangladesh Fish. Res.* 4(2):179-184.
13. Myla, S., Chakraborty, P. B. and Ganesh, P. R. C. 2012.Length-weight relationship of ribbon fishes *Trichiurus lepturus* (Linnaeus 1758) and *Lepturacanthus savala* (Cuvier 1829) from

Visakhapatnam coast. Department of Marine Living Resources, Andhra University, Visakhapatnam.
14. Nakamura, I. and Parin, N. V. 1993. FAO species catalog. Snake mackerel and cutlass fishes of the world (Families Gempylidae and Trichiuridae). An annotated and illustrated catalog of the snake mackerel, snoeks, escolars, gem fishes, sack fishes, domine, oil fish, cutlassfishes, scabbar fishes, hairtail and frostfishes know to date. *FAOFish Synop*, 125: 136.
15. Pakhmode, P. K., Mohite, S. A., Naik, S. W. and Mohite, A. S. 2013.Length frequency analysis and length-weight relationship of ribbonfish, *Lepturacanthussavala* (Cuvier, 1829) off Ratnagiri coast, Maharashtra. *International Journal of Fisheries and Aquatic Studies*. 1(2): 25-30.
16. Pauly, D and Munro, J. L. 1984.Once more, on the composition of growth in fish and invertebrates. *Fishbyte.,*2(1): 21.
17. Pauly, D. 1983.Some simple methods for assessment of tropical fish stocks.*FAO Fish. Tech. Pap.,* 234: 52.
18. Riede, K. 2004. Global registers of migratory species – from global to regional scales. Final Report of the R&D Project808 05 081. Federal Agency for Nature Conservation, Bonn, Germany, pp. 329.
19. Rizvi, A. F., Deshmukh, V. D. and Chakraborty, S. K. 2010. Stock assessment of *Lepturacanthus savala* (Cuvier 1829) along northwest sector of Mumbai coast in the Arabian Sea. *Ind. J. Fish.*, 57: 1-6.