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POPULATION DYNAMIC PARAMETERS IN *PLANILIZA KLUNZINGERI* (DAY 1888) FROM BALOCHISTAN COAST OF PAKISTAN

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ABSTRACT

The grey mullet fish, *Planiliza klunzingeri* (Day, 1888) is a commercially important and mostly benthic in food habits, usually swim near the surface. A total of 400 specimens were collected from June 2020 to May 2021 from four commercial landing sites Gwadar, Pasni, Kalmat and Ormara of Balochistan coast. This is the first study to estimate the population dynamic parameters in *Planiliza klunzingeri* from four commercial landing sites of Balochistan. Length-weight relationship were isometric growth and significant variation were observed in these sites. R^2=0.76 was observed in *Planiliza klunzingeri* from Pasni site, R^2 = 0.54 from Ormara site while minimum length frequency observed 10cm and maximum was 20cm. Mortality rate ,length frequency, growth performance index were also observed. Highest condition factor was observed 1.15 from Kalmat site. The lowest condition factor was calculated 0.09 from Ormara site.

Keywords: *Planiliza klunzingeri*, length-weight relationship, population dynamics, Balochistan

INTRODUCTION

The Mugilidae family is significant to global commercial aquaculture and fisheries. One of the prized fish with significant captures is Planiliza klunzingeri (Al-Hassani 2021 and Day, 1888), formerly known as Liza klunzingeri (Carpenter *et al*., 1997), is a widely distributed fish in the coastal waters of tropical and subtropical areas including estuaries. The mullets are reported globally and known to occur arctic shore waters (Hashemi *et al*., 2013). These fishes are reported from Red Sea to Bombay in Indian Ocean (Fisher and Bianchi, 1984) and also from the coasts of China and Japan (Hashemi *et al*., 2013). This species is very euryhaline and thrives in a variety of salinities (McDowall, 1988; Pombo *et al*., 2005; Abd *et al*., 2020). The grey mullets showed variations (Hashemi *et al*., 2013) and growth rate affects age at sexual maturity and survival.

According to GAFRD (2017), mullets are the most important species in the Red Sea fisheries, accounting for around 0.31% of the annual Red Sea production despite constantly spawning at sea. Despite the significance of mullets as a fishing resource, no management guidelines have been devised to safeguard this important asset (Abd *et al*., 2020). Mugilidae are widely blown out and represent a crucial species for fish farm aquaculture. Mortality either from fishing activity (fishing mortality) or natural mortality is a major cause of decline in any fish population (Pauly, 1983; Edmond *et al*., 2017). Since they are essential to describing the dynamics of the fish population, mortality rates in fisheries management cannot be ignored (Marshall, 1993; Amponsah *et al*., 2021.

Fish length-weight relationships are crucial tools in fisheries science for estimating the average weight of different fish species in an assemblage of a certain length (Ali *et al.,* 2021). Fish population growth rates are closely correlated with recruitment and mortality rates. Although annual recruitment is frequently the most unpredictable element influencing fish population dynamics, it can offer important insight into why fish populations may differ in size and structure (Gulland, 1982; Amponsah, *et al*., 2021). The length-weight relationship (LWR) is fundamental to the biological research of fishes and the evaluation of their stocks since

it facilitates the estimation of fish growth, gonad development, and feeding rate (Pauly-Munro, 1984; Le Cren, 1951). Pauly (1983) provides a description of techniques for estimating the length-weight connection in fish (Baset *et al*., 2020). Because many societies rely on marine fish supplies, effective management of fisheries is required to safeguard these resources. For the management and sustainable exploitation of fish stocks, knowledge of these fish's dynamic, age, growth, and reproductive biology is crucial (Zan *et al*., 2022). The aim of the present study was to evaluate the population structure of *Planiliza klunzingeri* in the coastal waters of Balochistan. The findings of this study can be used to the effective management of this important fish resource in future.

MATERIALS AND METHODS

Data sampling and analysis

Fresh sample of *Planiliza klunzingeri* were collected from four commercial landing sites Gwadar, Pasni, Kalmat and Ormara from Balochistan coast (Fig.1). A total of 400 specimens were collected from June 2020 to May 2021. Total length was taken in centimeter and total weight was recoded in gram through digital weight scale. The data were distributed in a class interval of 1 cm and inserted into FISAT II program for further analysis.

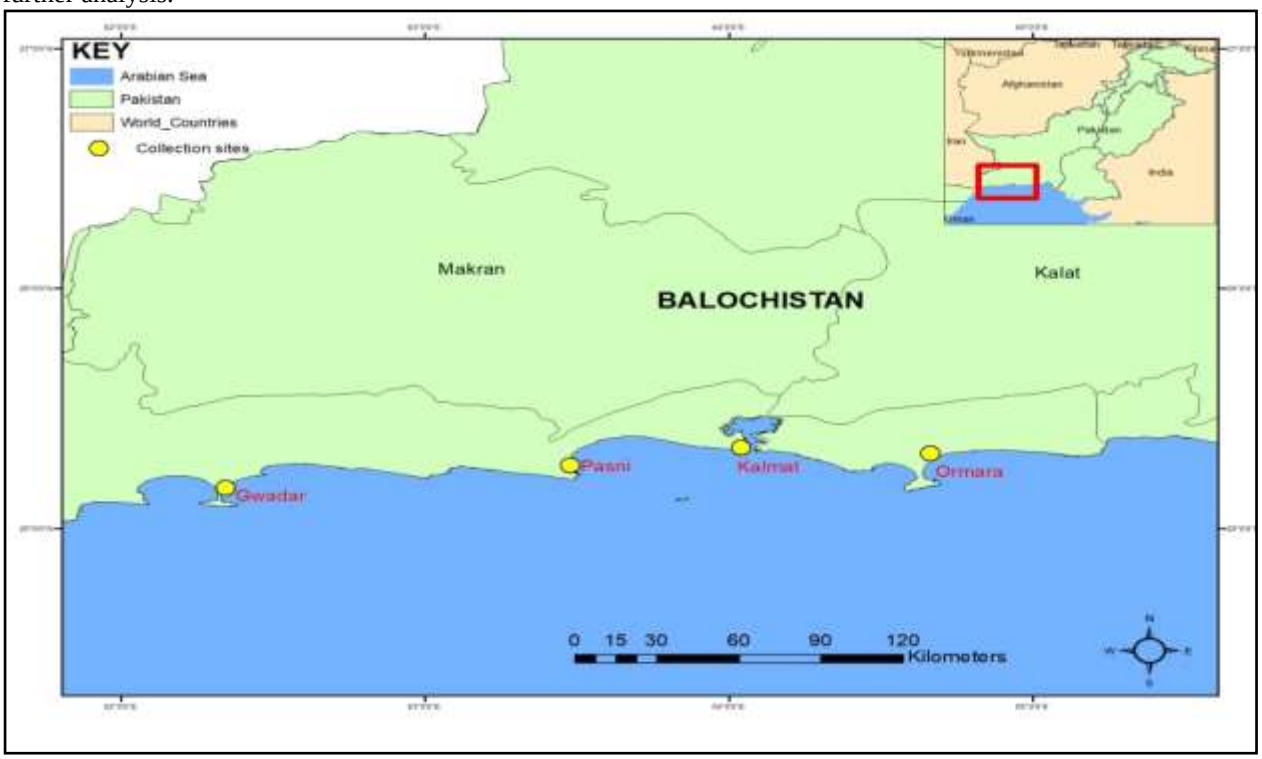


Fig. 1. The study map showing sample collection sites of Balochistan coast.

Length weight relationship

Length-weight relationship was calculated with the help of formula $W=aL^b$ (Ricker, 1975) whereas w stands for total weight of species in gram (g) and L is used for the total length of fish in centimeters (cm) (a) is intercept and (b) is regression coefficient. $W=aL^b$

Mortality and exploitation rate

Total mortality (Z) was computed using linearized length- converted catch curve by inserting value of l∞ and k (Pauly, 1983).

The natural mortality rate (M) was calculated as:

Log M=- 0.0066 - 0.279 1og L∞ + 0.6543 log K + 0.4634 log T (Pauly, 1983).

Fishing mortality (F) was calculated as Z-M (Gulland, 1971).

Exploitation rate (E) was calculated as F/Z (Gulland, 1971).

Growth Parameters

Using the Electronic Length-Frequency Analysis (ELEFAN I) option in the FiSAT II Tool, growth parameters that adhere to the von Bertalanffy growth function (VBGF), such as growth rate (K), asymptotic length ($L\infty$), and growth performance index (Φ') were calculated (Gayanilo *et al*., 2005).

Theoretical age at zero (to) estimated as log10 (-t0) = -0.3922 – 0.275 log10L∞– 1.0381 log10K (Pauly, 1983).

The following method was used to estimate the species maximum lifespan (Tmax):

Tmax= 3 / K. (Ricker, 1975).

The growth performance index was calculated using the formula: $\Phi' = \log10\ K + 2\ \log10\ L\infty$.

Recruitment pattern

Recruitment pattern of *Planiliza klunzingeri* was calculated through FISAT with putting values of K, $L\infty$ and t0 (t0 =0) (Amin *et al*., 2014).

Yield per recruit

Knife- edge method was use to estimate the relative yield per recruit(Y/R).

Condition factor

The condition factor or coefficient of condition as multiplied the following formula.

CF= Final weight (g)/ Final length3 (cm) x 100

RESULTS

A total of 400 specimens were collected from June 2020 to May 2021 from four commercial important landing sites of Balochistan. The present study provides population dynamics, length-weight relationship and condition factor of *Planiliza Klunzingeri*. The maximum mean length (17.93 cm) was found from Ormara and the minimum mean length (17.53 cm) was observed from Pasni site. The relative condition factor K was calculated from four commercial landing sites and the highest (1.15) was obtained from Kalmat and lowest (0.09) was observed from Ormara fish landing site (Table 1). Highest condition factor was observed 1.15 from Kalmat site however lowest condition factor was calculated from 0.09 from Ormara site (Table 1).

Length-weight relationship of *Planiliza Klunzingeri* was calculated from four different commercial landing sites and all the results found isometric in length-weight relationship. In Pasni collection site the calculated value was R^2=762 and b value was 2.00 in same site. However in second collection site (Gwadar) the result was also isometric the estimated R^2=7629 and in third collection site (Kalmat) estimated value was R^2=5286 found isometric growth however in last collection (Ormara) estimated value was R^2=0.544 and the b value was 2.042 (Fig. 2).

Total mortality (z) was 2.32 year-1 and Natural mortality (M) was 1.59 year-1 while fishing mortality (F) was 0.73 year-1 however exploitation (E) was observed 0.31 (Table 3). Relative Recruitment Values were observed on the monthly basis and the highest percent recruitment was observed 11.77 from 8th month while the lowest was observed 0.00 from December (Table 4).

Table 1. Descriptive statics of length, weight, and width and condition factor of *Planiliza klunzingeri* from mentioned sites.

Sites name	Species	N	K Factor	Variables	Mean	SD	Minimum	Maximum
Gwadar	*Planiliza klunzingeri*	100	1.07	Length	17.90	2.22	10	21
				Weight	61.33	11.32	33.3	75
				Width	4.13	0.38	3	5
Pasni	*Planiliza klunzingeri*	100	1.12	Length	17.53	2.48	10	21
				Weight	60.84	11.01	36	76.5
				Width	4.12	0.433	3	5
Kalmat	*Planiliza klunzingeri*	100	1.15	Length	17.69	2.57	10	21
				Weight	63.88	11.90	35.6	88
				Width	4.09	0.47	3	5
Ormara	*Planiliza klunzingeri*	100	0.09	Length	17.93	2.21	10	21
				Weight	56.91	10.18	21	70
				Width	4.11	0.40	3	5

Table 2. Review and previous available literature on *Planiliza klunzingeri*.

Specie	Region	b value	R^2	Reference
Planiliza klunzingeri	Iran (Persian gulf)	2.5	0.96	Taheri, 2021
Planiliza klunzingeri	Hormouzgan(Persian gulf)	2. 82	0.87	Hakimelahi, *et al.,* 2010
Planiliza klunzingeri	Kuzestan	2. 8	-------	Hashemi *et al.,* 2013
Planiliza klunzingeri	Oman	2.966	0.98	Hajializadeh *et al.,* 2019
Planiliza klunzingeri	Egypt (Gulf of Suez)	2.55	0. 85	Saber *et al.,* 2020
Planiliza klunzingeri	Pakistan	2.08	0.63	Present study

Table 3. Descriptive parameters of *Planiliza klunzingeri.*

Parameters	Calculated Value
Total mortality (Z)	2.32 year-1
Natural Mortality (M)	1.59 year-1
Fishing Mortality (F)	0.73 year-1
Exploitation rate (E)	0.31
L25 (cm)	16.52
Length at first capture L50 (cm)	17.28
L75 (cm)	18.07
Asymptotic length (L∞ cm)	22.05
Growth co-efficient (K yr -1)	0.700
Growth performance index (φ')	2.532
Maximum age (tmax years)	4.28 year
Yield / Recruit (Y/R)	0.014
Lc/L∞	0.78
M/K	2.27
Y/R (Relative yield per recruit)	0.009
B/R (Relative biomass per recruit)	0.642
Age at zero length (to)	-0.250 year
E10	1.000
E50	0.452
Emax	1.000

Growth parameters

Growth performance index was estimated 2.532 which is based on the estimated growth parameters (Fig. 3). Table 2 presented the comparison of LWR parameters collected throughout current study with the earlier available records. Length frequency of *P. klunzingeri* was estimated through FISAT software however minimum length frequency observed 10cm and maximum was 20cm in overall length data of four commercial landing sites (Figure 3). B/R Relative biomass per recruit was observed 0.642 (Figure 4). Over-all mortality "Z" coefficients the length was converted catch curves and exposed annual estimate for total age of 2.32 and the natural mortality (F) value was 0.73 while the (E) Was 0.45 (Fig. 4).

Recruitment pattern

The recruitment of *P. klunzingeri* began from June 2020 right up to May 2021 forming 90% of fish recruited that year, with the highest recruitment peak recorded in November, 17.5% and also observed Exploration ratio (e) (Fig. 5).

Mortality Rates (Z, M, F) and Exploitation Ratio (E)

Growth parameters for *Planiliza Klunzingeri* were calculated with using ELEFAN method in the FiSATII computer software package. Whereas asymptotic length was observed L∞ 22.05 cm and Growth co-efficient K yr -1 0.700 estimated (Fig. 6).

Table 4. Relative recruitment of *Planiliza klunzingeri* from coast of Balochistan.

Relative Recruitment Values	
Relative Times	Percent Recruitment
Month 1	3.43
Month 2	3.45
Month 3	5.15
Month 4	6.38
Month 5	10.76
Month 6	16.84
Month 7	15.91
Month 8	11.77
Month 9	8.76
Month 10	8.11
Month 11	9.44
Month 12	0.00

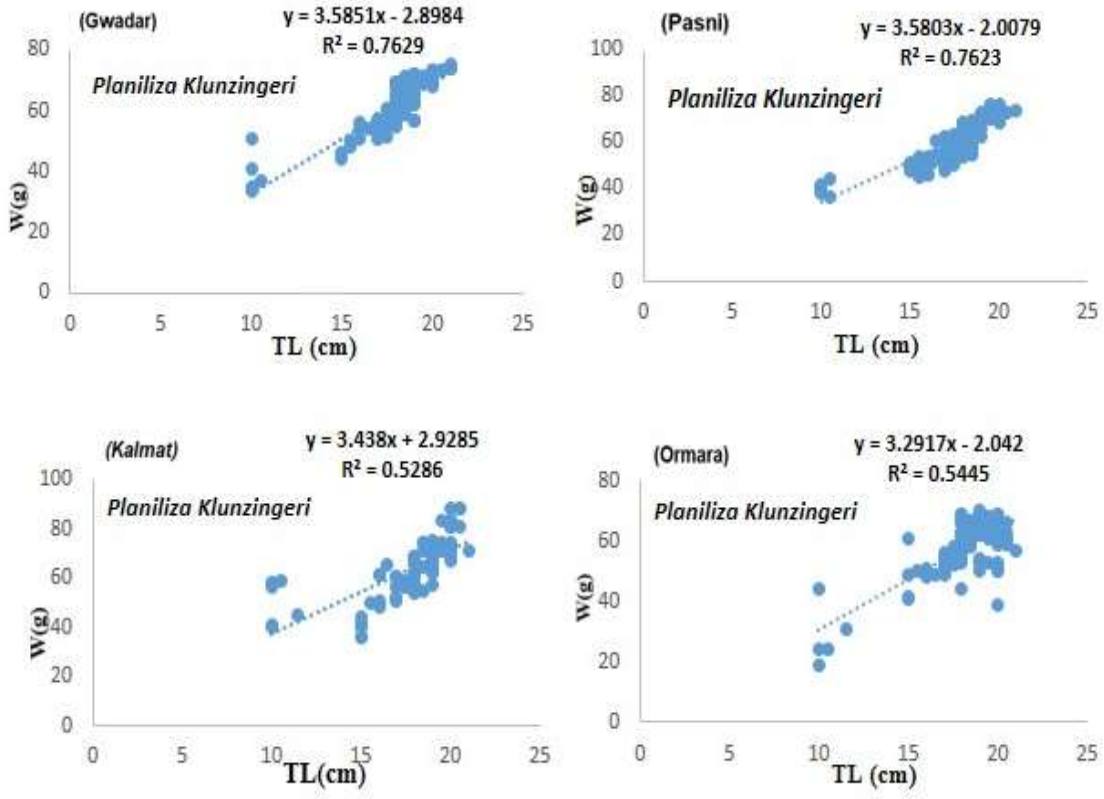
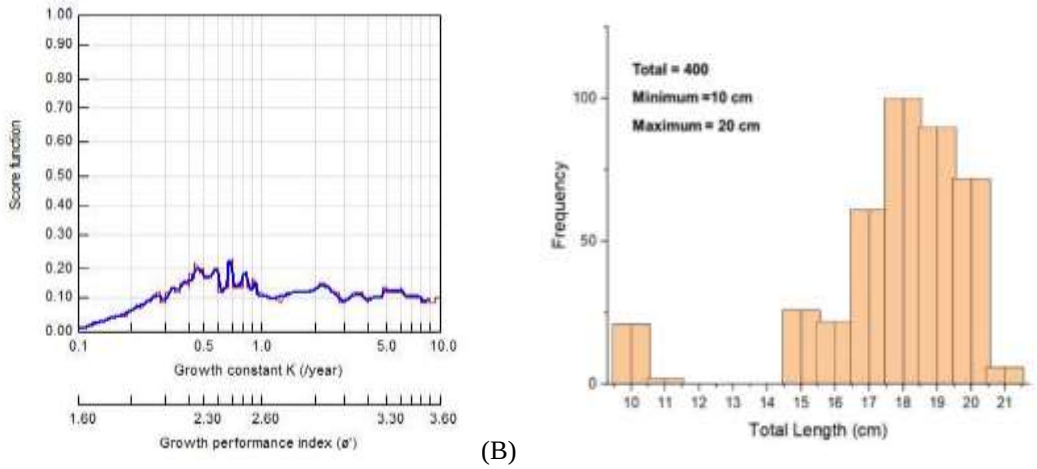
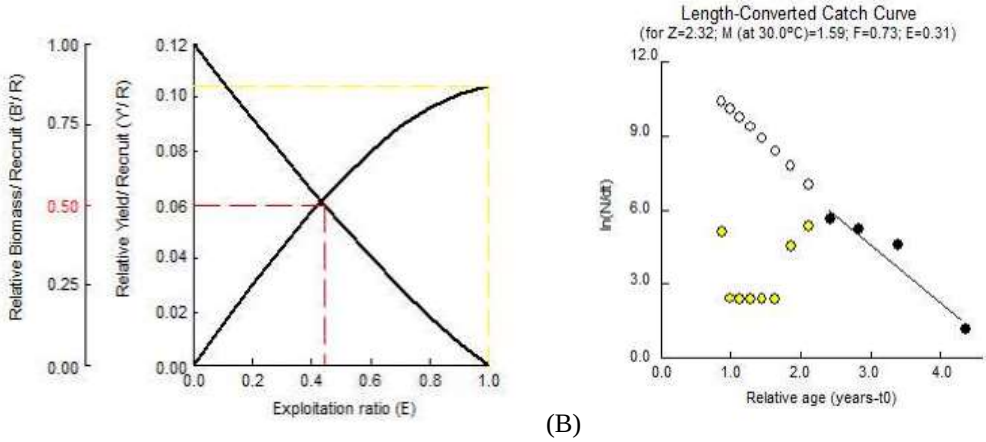


Fig.2. Length-weight relationship of *Planiliza klunzingeri* from Balochistaan coastal water.



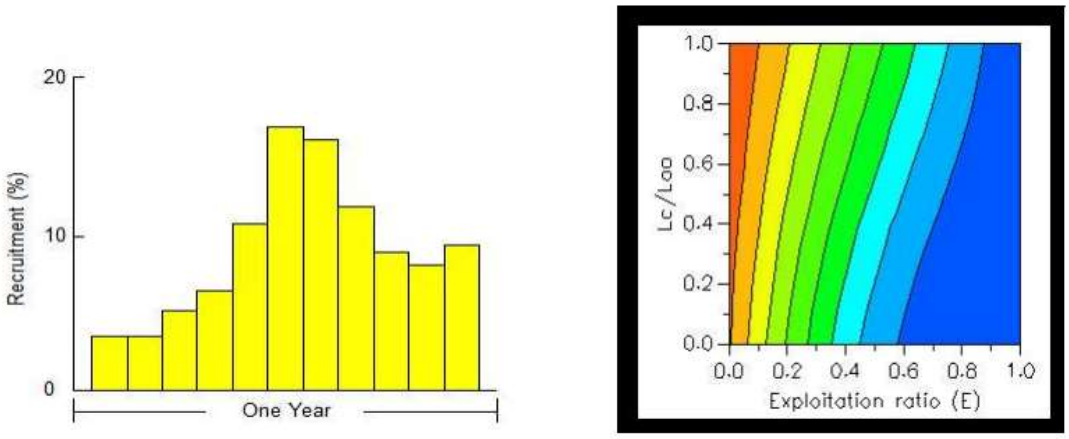
(A) (B)

Fig. 3. (A) ELEFAN I K-scan routine FiSAT II output for *Planiliza klunzingeri* (B) length frequency of *Planiliza klunzingeri* from Balochistaan coastal water.



(A) (B)

Fig. 4. (A) FiSAT II production for yield-per-recruit and average biomass per recruit (B) Length-converted catch curve output of *Planiliza klunzingeri* from Balochitsan coast



(A) (B)

Fig. 5. (A) Recruitment pattern output from FiSAT II (B) Expliration ratio for *Planiliza klunzingeri* from Balochistan coast during 2020 to 2021.

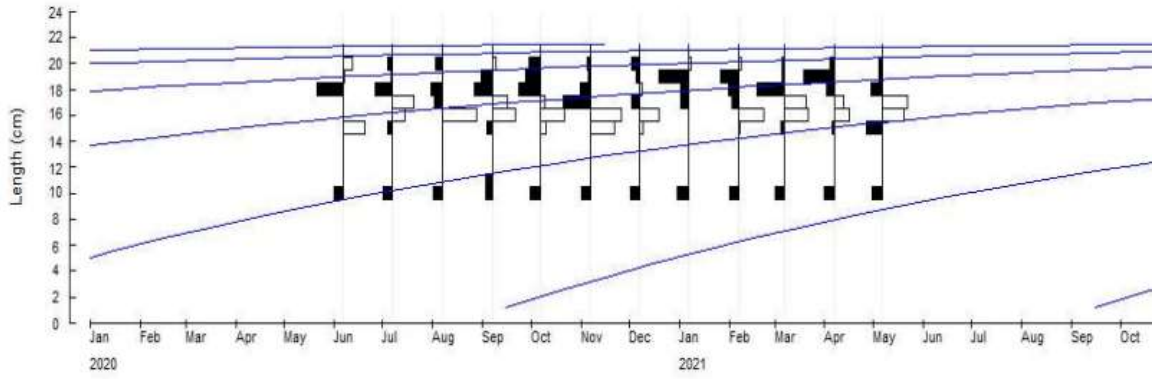


Fig. 6. Distribution of Length-frequency data and the growth curves observed using ELEFAN for *Planiliza klunzingeri* from Balochistan coast.

DISCUSSION

The length-weight relationship (LWR) is fundamental to the biological research of fishes and the evaluation of their stocks because it facilitates accurate estimations of population dynamics of fish, fish growth, gonad maturation, and feeding rates. Growth pattern of fish is ever such essential tool for the management of fish sustainable harvested population. In current study, we provided results on exploitation rate, mortality rate and length-weight relationship length frequency data used to analyze the above mentioned parameters of *P. klunzingeri*. The slope value "b" of this study is compared with the reports from Persian Gulf (Hakimelahi *et al*., 2010) and no significant difference was observed.

The length-weight relationships for *P. klunzingeri* was presented ever such significant positive correlation such as $R^2 = 0.7629$ Gwadar, $R^2 = 0.7623$ Pasni, $R^2 = 0.5286$ Kalmat, $R^2 = 0.5445$ for Ormara. The ultimate growth of *Planiliza Klunzingeri* in current study asymptotic length $L\infty$ 22.05 cm and which is similar to the same reported species from Shatt Al-Arab River, Iraq it was $L\infty$ 21.2 cm (Mohamed, 2022). However same study carried out in Tigris River, Turkey and $L\infty$ 19.6 which is little different may be due to environmental factors or sample size (Unlü *et al*., 2000). Condition factor *Planiliza Klunzingeri* is presented in table 1 whereas highest was found 1.5 from Kalmat site from coast of Balochistan and 1.3 is reported from report in the Gulf of Suez, Red Sea, Egypt as it is very similar to present study (Saber *et al*., 2020).

Conclusion

The results of current study provided beneficial information for the management of *Planiliza Klunzingeri* and this species is the main component in the sea food of Balochistan coast. It is implied that *Planiliza Klunzingeri* did not present any proof of overfishing. To increase production of this species and ensure its sustenance, it is recommended that adequate selectivity and gear usage be used in this location. Additionally, a routine monitoring program should be established to ascertain and record the population status of this significant food fish.

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