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Meristic and Morphometric Characteristics of five-lined snapper, *Lutjanus quinquelineatus* (Bloch, 1790) from the Red Sea, Egypt

Faiza M. Soliman[1], Sahar F. Mehanna[2], Hamdy A. Soliman [3] and Taha S. Baker[4]

(1, 3) Department of Zoology, faculty of Science Sohag University, Egypt.(**2**) National Institute of Oceanography and Fisheries, Egypt. **(4)** Department of Biology, Faculty of Science, Aden University, Yemen

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ABSTRACT

In the present study, 120 fish specimens (64 male and 56 female) of the five-lined snapper, *Lutjanus quinquelineatus* of variable sizes were used for demonstration the morphometric and meristic characteristics of this species in the Egyptian Red Sea, Hurghada fishing area. The total length varied from 15.3 to 28.7 cm in males and from 16.0 to 31.7 cm in females while their weights ranged between 44 and 378 g in males and between 48 and 512 g in females. This fish species showed constant meristic characters. Statistical interpretation of morphometric data indicated that there is direct relationship between total body length with head length (HL), snout length (SnL), eye diameter (ED) and length of caudal peduncle (CPL). The meristic characters like dorsal fin rays, anal fin rays, lateral line scales, gill rakers on lower arm and scales in transversal line were counted. The results revealed that there is no sexual dimorphism in *L. quinquelineatus* from Hurghada fishing area.

INTRODUCTION

In fish, identification may be determined based on two factors which are morphometric and meristic characters. Mostly the morphometric means of determining the growth rate of the fish is carried out by measuring some parts of the physiological structures of the fishes, while meristic is determined by performing some numerical counts on the fish in order to determine the species and class of the fish. Also, morphometric studies are essential to determine the growth form and growth rate of a species, which is very much important for proper exploitation and management of the population of a species.

Characters used to identify fish stocks can be purely genetic, purely environmental or those that may reflect both genetic and environmental variation (Swain *et al.*, 2005). Morphometrics and meristics are the two types of morphological characters that have been most frequently used to delineate stocks of a variety of exploited fish species (Murta, 2000; Silva, 2003; Turan, 2004).

Morphometric and meristic characters of fishes were found to be of taxonomic importance in sex, race and species identification by many investigators (Costa *et al*., 2003; Smith and Paulin, 2003; Basmidi, 2004; Lawson, 2010; Simon *et al*., 2010; Elamin *et al*., 2011; Mazlan *et al*., 2012; Deepti *et al*., 2013; Sajina *et al*., 2013; Fakunmoju *et al*., 2014; Jawad, 2015; Masood *et al*., 2015; Zubia *et al*., 2015; Mahmoud *et al.*, 2016 & 2017).

In the present investigation, the morphometric and meristic characters were used to elucidate sexual dimorphism of *Lutjanus quinquelineatus* (Bloch, 1790) from Hurghada fishing ground, Red Sea, Egypt.

- **Morphometric:** characters refer to measureable structures such as fin length, head length, eye diameter, or ratios between such measurements.
- **Meristic:** characters include almost any countable structure, including fin rays, scales, gill rakers, and so on.

MATERIALS AND METHODS

Morphometrics: In the present investigation, 64 males (15.3 – 28.7 cm in TL) and 56 females (16.0 – 31.7 cm TL) of *L. quinquelineatus*, were randomly collected from the southern Red Sea, Hurghada, fishing port, Egypt during the period from January to December 2016. Sex was determined by macroscopic examination of the gonads, and this subset was used to test the hypothesis of no sexual dimorphism in morphometric and meristic characters of *L. quinquelineatus.*

For each fish, 18 morphometric measurements were made on the left side up to the nearest millimeter using a divider and a measuring board. The following is a list of these measurements, which are diagrammatically represented in Figure 1; its corresponding number indicated in such a list labels each measurement on this figure. Those morphometric measurements included:

1- Total length (**TL**)
2- Standard length (**SL**)
3- Body depth (**BD**)
4- Caudal peduncle depth (**CPD**)
5- Head length (**HL**)
6- Predorsal fin length (**PRDFL**)
7- Head depth (**HD**)
8- Preventral fin length (**PRDFL**)
9- Distance between ventral and dorsal fins origin (**VDOL**)
10- Distance between anal and dorsal fin ends (**ADFEL**)
11- Dorsal fin base length (**DFBL**)
12- Distance between the ventral fin origin and the end of anal fin (**VOAEFL**)
13- Distance between the first spine of the dorsal fin and the end of anal fin (**SPDAEFL**)
14- Distance between dorsal fin end and ventral fin origin (**DEVOFL**)
15-Distance between the ventral fin and the end fin origin (**VEADFL**)
16-Distance between dorsal fin end and dorsal caudal fin origin (**DEDCF**)
17-Distance between anal fin end and ventral caudal fin origin (**AEVCFL**)
18- Eye diameter (**ED)**

Meristics: Certain meristic counts of 64 males and 56 females of *L. quinquelineatus* were considered. The following meristic counts were recorded:

1-Number of the dorsal fin spines (**DFS**)
2-Number of the dorsal fin soft rays (**DFSR**)
3- Number of the pectoral fin rays (**PFSR**)
4-Number of the ventral fin rays (**VFR**)
5-Number of the ventral fin spines (**VFS**)
6-Number of the anal fin rays (**AFR**)
7-Number of the anal spines (**AFS**)
8-Number of the caudal fin rays (**CFR**)

9-Total number of gill rakers (**TGR**)

Statistical analysis: The basic statistics of certain morphometric indices (relative to SL, TL or HL) and meristic characters were estimated. The allometric coefficients of the raw morphometric characters and their relationships with fish size (TL) using power function equation and linear regression model respectively.

The length-length relationships (TL in relation with different body lengths were determined by the method of least squares to fit a simple linear regression equation as:

$$Y = a + bX$$

Where Y = various body lengths, X = total length, a = Proportionality constant and b = regression coefficient.

The mean values of meristic characters of the species considered are testified by t-test.

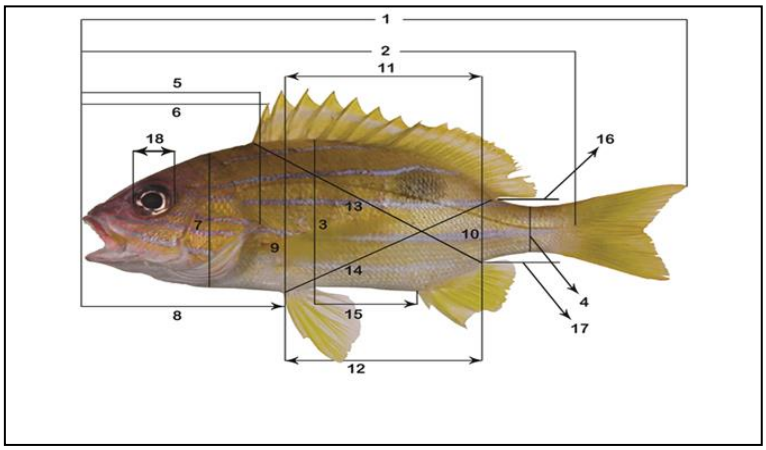

Fig.1: Morphometric measurements taken for *Lutjanus quinquelineatus* from Hurghada, Red Sea, Egypt.

RESULTS AND DISCUSSION

Morphometric and meristic features were used since they are still dependable tools to characterize fish species especially on the field and they are sensitive to any environmental changes (Fryer and Iles, 1972). Also, morphometric and meristic characteristics have provided useful results for identifying marine fish stocks and describing their spatial distributions (Ihssen *et al.*, 1981) and here, the morphological and meristic characters of *L. quinquelineatus* from Egyptian Red Sea were studied.

Morphometrics

The relationship between the morphometric characters and fish size (TL) of *L. quinquelineatus* were best described by the linear regression equations (Table 1). The basic statistics of the morphometric indices (relative to TL or SL or HL) of *L. quinquelineatus* considered show sexual dimorphism (Tables 2&3). HL/SL, SLL/SL, SDVOFL/SL, EDSAFL/SL, EDSAFL/HL, PRDFL/SL, SDEAFL/HL, PFL/HL, SpDASFL/HL, BD/HL, CLL/HL, SLL/HL and ADFEL/HL are indices to be size-free and so valid as a discriminating tool between males and females of *L. quinquelineatus.* The other indices exhibited variable mode of growth with fish size within species, so could not be considered in sexual dimorphism.

Table 1: The relationship between some morphometric parameters and standard length of *L. quinquelineatus* collected from the Hurghada, Red Sea of Egypt.

Equation	R*	Equation	R*
SL= 3.11+ 0.803***TL**	0.95	**DFB** = 4.182+0.498***TL**	0.84
BD = 7.47 + 035***TL**	0.81	**VOAER**= 9.04+0.464***TL**	0.77
CPD=1.86 + 0.103* **TL**	0.54	**SPDA**= 0.989+0.546***TL**	0.88
HL = 2.806+ 0.322 ***TL**	0.88	**DEVO**=1.034+0.405***TL**	0.78
PRD= 4.22 + 0.3067* **TL**	0.80	**VEA**= 1.50+0.098***TL**	0.42
HD = 5.421+ 0.175* **TL**	0.33	**DED** = 1.222+0.032***TL**	0.66
PRVL = 2.875 +0.324* **TL**	0.82	**AEV** = 0.936+0.1778***TL**	0.57
VDOL = 4.27+0.320***TL**	0.80	**ED** = 0.474+0.079***TL**	0.51
ADFE= 4.160+0.111***TL**	0.48		

*Correlation is significant at the 0.01 level.

The patterns of variations in the morphometric characteristics of the Lutjanid species were considered in terms of their mode of growth; i.e. their type of allometry. Except for ED, SDFL, SDFH and SAFH for males; ED, SDFL, SDFH and SAFH for females of *L. quinquelineatus* (Tables 2 and 3).

Morphometric indices of fishes were found to be of taxonomic importance in sex, race and species identification by many authors (e.g. Khan *et al*., 2002; Basmidi, 2004; Myers *et al*., 2004; Turan, 2004; Cadrin, 2005; Cheng *et al*., 2005; Ali and McNoon, 2010; Lawson, 2010; Simon *et al*., 2010; Elamin *et al*., 2011; Mekkawy and Mohammad, 2011; Mazlan *et al*., 2012; Deepti *et al*., 2013; Sajina *et al*., 2013; Jawad, 2015; Masood *et al*., 2015; Zubia *et al*., 2015 ; Sley *et al.*, 2016; Mahmoud *et al.*, 2016 & 2017). In the present investigation, it was possible to reveal sexual dimorphism in *L. quinquelineatus*, by comparing means of the selected morphometric indices. For both males and females, the range and mean of most of these ratios were not significant (t-test; p>0.05).

Table 2: The basic statistics (mean ± Total length error and range) of morphometric indices (relative to TL) of males, females and combined sexes of *L .quinquelineatus* from Hurghada, Red Sea.

Morphometric index	F		M		Combined sexes	
	Mean± Std. E	Range	Mean± Std. E.	Range	Mean± Std. E.	Range
SL/TL	79.02±0.28*	69.23-83.54	78.94±0.26	73.30-85.71	78.97±0.19	69.23-85.71
BD	31.50±0.26*	23.08-36.17	31.94±0.26	26.14-37.50	31.73±0.19	23.08-37.50
CPD	9.58±0.15*	6.54-12.09	9.41±0.15	6.54-11.96	9.49±0.10	6.54-12.09
HL	30.94±0.19*	25.00-33.33	30.95±0.17	28.17-35.00	30.94±0.13	25.00-35.00
PRDFL	32.71±0.23*	25.00-35.71	32.49±0.22	28.57-35.71	32.59±0.16	25.00-35.71
HD	19.97±0.40	15.63-32.97	20.14±0.39	13.07-29.84	20.06±0.28	13.07-32.97
PRVFL	31.00±0.28*	21.98-34.16	31.31±0.18	28.57-35.00	31.16±0.16	21.98-35.00
VDOL	29.95±0.25*	22.31-34.15	30.16±0.24	25.71-35.21	30.06±0.17	22.31-35.21
ADFEL	12.79±0.19*	7.69-15.56	13.20±0.18	10.53-17.14	13.01±0.13	7.69-17.14
DFBL	47.72±0.38	37.69-51.72	48.11±0.30	41.21-53.85	47.92±0.24	37.69-53.85
VOAEFL	41.96±0.42	34.23-47.10	42.67±0.37	36.32-48.00	42.34±0.28	34.23-48.00
SPDAEFL	51.77±0.31	38.46-56.03	51.93±0.24	46.81-57.85	51.85±0.19	38.46-57.85
DEVOFL	48.52±0.40	37.69-54.55	49.56±0.42	42.74-56.00	49.08±0.29	37.69-56.00
VEADFL	10.50±0.17*	7.69-13.53	10.57±0.18	6.61-14.29	10.53±0.13	6.61-14.29
DEDCFL	10.69±0.18*	7.69-14.29	10.69±0.13	8.44-13.16	10.69±0.11	7.69-14.29
AEVCFL	12.47±0.17*	7.89-14.56	12.89±0.13	10.05-15.71	12.70±0.11	7.89-15.71
ED	6.97±0.11*	4.98-9.18	6.79±0.11	5.03-9.00	6.88±0.08	4.98-9.18
Range of Correlation Coefficient	**(-0.097)-(0.375)**					
N	**56**		**64**		**120**	

** Correlation is significant at the 0.01 level (2-tailed). N = Number of fish specimens.

* Correlation is significant at the 0.05 level (2-tailed).

Table 3: The basic statistics (mean ±Total length error and range) of morphometric indices (relative to HL) of males, females and combined sexes of *L .quinquelineatus* from Hurghada, Red Sea.

Morphometric index	F		M		Combined sexes	
	Mean± Std. E.	Range	Mean± Std. E.	Range	Mean± Std. E.	Range
SL/HL	255.80±1.32	235.29-290.70	255.54±1.67	214.29-288.46	255.67±1.08	214.29-290.70
BD	101.88±0.76	90.91-121.21	103.37±1.00	85.71-125.00	102.67±0.64	85.71-125.00
CPD	31.00±0.47	25.00-40.00	30.44±0.49	22.22-40.32	30.70±0.34	22.22-40.32
PRDFL	105.83±0.72	93.75-120.00	105.14±0.87	85.71-125.00	105.46±0.57	85.71-125.00
HD	64.61±1.29	50.00-109.09	65.12±1.27	44.44-100.00	64.88±0.90	44.44-109.09
PRVFL	100.31±0.92	72.73-116.28	101.25±0.62	92.31-116.67	100.81±0.54	72.73-116.67
VDOL	96.87±0.72	83.33-112.90	97.63±0.93	83.33-116.67	97.28±0.60	83.33-116.67
ADFEL	41.40±0.63	30.77-53.03	42.73±0.63	33.33-58.33	42.10±0.45	30.77-58.33
DFBL	154.41±1.24	135.71-171.43	155.77±1.36	125.00-178.57	155.13±0.92	125.00-178.57
VOAEFL	135.81±1.39	107.14-153.85	138.08±1.37	116.67-160.00	137.03±0.98	107.14-160.00
SPDAEL	167.56±1.12	150.00-186.05	168.13±1.28	149.35-186.67	167.86±0.86	149.35-186.67
DEVOFL	157.08±1.43	128.57-184.62	160.44±1.62	139.71-186.67	158.87±1.10	128.57-186.67
VEADFL	34.00±0.59	25.00-46.00	34.22±0.62	21.43-48.08	34.12±0.43	21.43-48.08
DEDCFL	34.59±0.55	27.50-43.75	34.61±0.46	28.57-42.86	34.60±0.35	27.50-43.75
AEVCFL	40.35±0.56	25.00-48.39	41.74±0.49	33.33-52.63	41.09±0.37	25.00-52.63
ED	22.55±0.36	16.13-30.00	21.96±0.33	16.00-26.67	22.23±0.24	16.00-30.00
Range of Correlation Coefficient	**(0.01)-(0.607)**					
N	**56**		**64**		**120**	

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

N = Number of fish specimens.

Meristics

The meristic characters of *L. quinquelineatus* were 10 dorsal spines and 14 rays in the posterior dorsal fin (Table 4). The Anal spine had 3 pieces of spine while 8 rays were found in the posterior anal fin. The scale of the fish ranges between 36 and 60 with a mean range of 55.66 ± 6.67. The meristic characters like dorsal fin rays, anal fin rays, Lateral line scales, gill rakers on lower arm and scales in transversal line were counted. No sexual dimorphism was found in *L. quinquelineatus*. These characters are in the range given in Fishbase (2017) for *L. quinquelineatus* which were as follows: Dorsal spines (total): 10; Dorsal soft rays (total): 13-15; Anal spines: 3; Anal soft rays: 8. Preorbital width usually less than eye diameter and body depth 2.3-2.9 in SL (Allen and Erdmann, 2012). Also, in lutjanid species, the common adult length is usually 60 cm but may extend to 100 cm and have 10 dorsal spines, 14 soft dorsal rays, 3 anal spines and 8-9 anal soft rays, which is a determinant features that distinguished lutjanids from other similar fishes especially the so called popular lady fish (Allen, 1985).

In conclusion, observed morphometric and meristic differences in this investigation are probably influenced by both genes and environment. Thus, it would be valuable to conduct also some genetic studies in the future. The accumulated information from morphometrics, meristics and genetics, along with other life-history information could be evaluated for a better understanding of the population structure of *L. quinquelineatus.*

Table 4: Meristic counts of males and females of *Lutjanus quinquelineatus* from Hurghada, Red Sea, Egypt.

The Dorsal fin soft rays (DFSR)						
Counts	N	14	15	0	0	Mean±SD
Males	64	52	12	0	0	14.5±0.7
Females	56	47	9	0	0	14.5±0.7
Combined sexes	120	99	21	0	0	14.5±0.7
The pectoral fin rays (PFSR)						
Counts	N	13	14	15	16	Mean±SD
Males	64	5	42	15	2	14.5±1.3
Females	56	5	38	13	0	14±1
Combined sexes	120	10	80	28	2	14.5±1.3
The caudal fin rays (CFR)						
Counts	N	16	17	18	0	Mean±SD
Males	64	33	24	7	0	17±1
Females	56	30	22	4	0	17±1
Combined sexes	120	63	46	11	0	17±1
Total number of gill rakers (TGR)						
Counts	N	13	14	15	16	Mean±SD
Males	64	9	11	15	29	14.5±1.3
Females	56	6	8	14	28	14.5±1.3
Combined sexes	120	15	19	29	57	14.5±1.3

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ARABIC SUMMARY

الخصائص المورفومترية والميريستية لأحد الانواع الشائعة من عائلة البهار *Lutjanus quinquelineatus* (Bloch,1790) من البحر الأحمر ، مصر

فايزة محمد سليمان[١] ، سحر فهمى مهنا [٢] ، حمدي احمد سليمان [٣] ، طـــه صالــح باكــر [٤]

(١،٣) قسم علم الحيوان - كلية العلوم – جامعة سوهاج ، (٢) المعهد القومي لعلوم البحار و المصايد، مصر ، (٤) كلية العلوم- جامعة عدن – اليمن

في الدراسة الحالية ، تم استخدام ١٢٠ عينة (٦٤ ذكر و ٥٦ أنثى) من أحد انواع أسماك عائلة البهار ، *Lutjanus quinquelineatus* ذات الأحجام المتفاوتة لتوضيح الخصائص المورفولوجية والميريستية لهذا النوع في البحر الأحمر المصري ، منطقة الغردقة. وتراوح الطول الكلى بين ١٥,٣ و ٢٨,٧ سم في الذكور ومن ١٦,٠ إلى ٣١,٧ سم في الإناث بينما تراوحت أوزانها بين ٤٤ و ٣٧٨ جم في الذكور وبين ٤٨ و ٥١٢ جم في الإناث. أوضحت الدراسة ان الصفات ثابته داخل العائلة الواحدة لهذه الأنواع. كما أشار التفسير الإحصائي للبيانات المورفومترية إلى وجود علاقة مباشرة بين طول الجسم الكلي مع طول الرأس (HL) ، طول الخطم (SnL) ، قطر العين (ED) وطول الزعنفة الذيلية (CPL). تم حساب عدد أشعة الزعنفة الظهرية واشواكها ، أشعة زعنفة الشرج ، الزعنفة البطنية ، الفتحات الخيشومية والتى تستخدم فى التمييز بين الانواع واحيانا بين الاجناس وأوضحت النتائج أنه لا يوجد إختلاف فى المواصفات الميريستية بين الجنسين لنوع *L. quinquelineatus* من منطقة الغردقة.