Journal Homepage: - www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI: 10.21474/IJAR01/1185
DOI URL: http://dx.doi.org/10.21474/IJAR01/1185
ISSN NO. 2320-5407

RESEARCH ARTICLE

MORPHOMETRIC AND MERISTIC CHARACTERS OF *MULLUS SERMULETUS* (LINNEAUS, 1758) AND *MULLUS BARBATUS* (LINNEAUS, 1758) FROM MEDITERRANEAN SEA, ALEXANDRIA, EGYPT.

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Manuscript Info

Manuscript History

Received: 19 June 2016
Final Accepted: 16 July 2016
Published: August 2016

Key words:-
Morhpometric, Meristic, *Mullus sermuletus*, *Mullus barbatus*, Alexandria, Egypt..

Abstract

In the present investigation, Intra-and inter-specific variations in morphometric indices of *Mullus sermuletus* and *Mullus barbatus*, from Mediterranean Sea at Alexandria, Egypt, were revealed. The type of allometry of morphometric measurements showed that for both species studied, females showed isometric measurements more than males and *M. sermuletus* showed isometric measurements more than *M. barbatus* for combined sexes. Meristic characters are significantly different between the two species studied. No sexual dimorphism was found in the meristic characters of the two species under study.

Introduction:-

Morphometric characters of fishes were found to be of taxonomic importance in sex, race and species identification by many investigators (Nelson, 1984; whitehead *et al.*, 1986; Golani, 1994; Mekkawy, 1987&1994; Mahmoud, 1988, 1991& 1993; Harabawy, 1993& 2002; Khalil *et al*., 1983& 1984; Oliveira and Almada, 1995; Osman, 2000; Costa *et al*., 2003; Obady, 2003; Smith and Paulin, 2003; Basmidi, 2004; Turan, 2004; Randall and Heemstra, 2009; Randall and King, 2009; 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; Uiblein and Heemstra, 2010 &2011; Abbaspour *et al*., 2013; Safi *et al.*, 2014; Jawad, 2015; Masood *et al*., 2015; Zubia *et al*., 2015 and Mahmoud *et al*., 2016 a, b).

The meristic characters were also found to be valid in sex, race and species identification (Mahmoud and Mekkawy, 1991; Mahmoud, 1991, 1993&2002; Mekkawy, 1991& 1997; Costa *et al.*, 2003; Obady, 2003; Basmidi, 2004; Turan, 2004; Randall and Heemstra, 2009; Randall and King, 2009; Lawson, 2010; Simon *et al*., 2010; Elamin *et al*., 2011; Mekkawy and Mohammad, 2011; Uiblein and Heemstra, 2010 & 2011; Safi *et al*., 2014; Jawad, 2015; Masood *et al*., 2015; Zubia *et al.*, 2015 and Mahmoud *et al.*, 2016 a, b) .

In the present work, the morphometric and meristic characters were used to reveal intra- and inter-specific variations of stripped red mullet (*Mullus surmuletus*, Linnaeus, 1758) and red mullet (*Mullus barbatus*, Linnaeus, 1758) from Mediterranean sea at Alexanderia, Egypt.

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Matreials and Methods:-

In the present study, 105 males (78-165 mm in Standard Length "SL") and 123 females (82-187 mm in SL) of *Mullus sermuletus* and 100 males (85-138 mm in SL) and 107 females (90- 153 mm in SL) of *Mullus barbatus* were randomly collected from Mediterranean sea at Alexanderia, Egypt during the period from January 2015 to December 2015.

Morphometrics:-

For each fish, 22 morphometric measurements were made on the left side up to nearest millimeter using divider and measuring board. The following is a list of these measurements which are represented in figure (1); each measurement is labeled on this figure by its corresponding number indicated in such a list. Those morphometric measurements included:

1. Total length (TL).
2. Forked length (FL).
3. Standard length (SL).
4. Pre-1st Dorsal length (PrD1L).
5. Pre-Pectoral length (PrPL).
6. Pre-Ventral length (PrVL).
7. Pre-Anal length (PrAL).
8. Head length (HL).
9. Pre-Orbital length (PrOL).
10. Eye diameter (ED).
11. Post-Orbital length (PtOL).
12. Inter-Orbital width (IOW).
13. Body depth at anus (BD).
14. Caudal peduncle depth (CPD).
15. Distance between 1st dorsal fin and ventral fin origins (D1VOFL).
16. Distance between 2nd dorsal and anal fin ends (D2AEFL).
17. Distance between 1st dorsal fin origin and the end of anal fin (D1OAEFL).
18. Distance between 2nd dorsal fin end and ventral fin origin (D2EVOFL).
19. Distance between 2nd dorsal fin end and ventral caudal fin origin (D2EvCFL).
20. Distance between 2nd dorsal fin end and dorsal caudal fin origin (D2EdCFL).
21. Distance between anal fin end and ventral caudal fin origin (AEvCFL).
22. Distance between anal fin end and dorsal caudal fin origin (AEdCFL).

Meristics:-

The following meristic counts were recorded:

1. Number of the pectoral fin rays (PFR).
2. Number of gill rakers on the epibranchial portion of the first left gill arch (ascending) (UGR).
3. Number of gill rakers on ceratohypobranchial portion of the first left gill arch (descending) (LGR).
4. Total number of gill rakers on the first left gill arch (TGR).

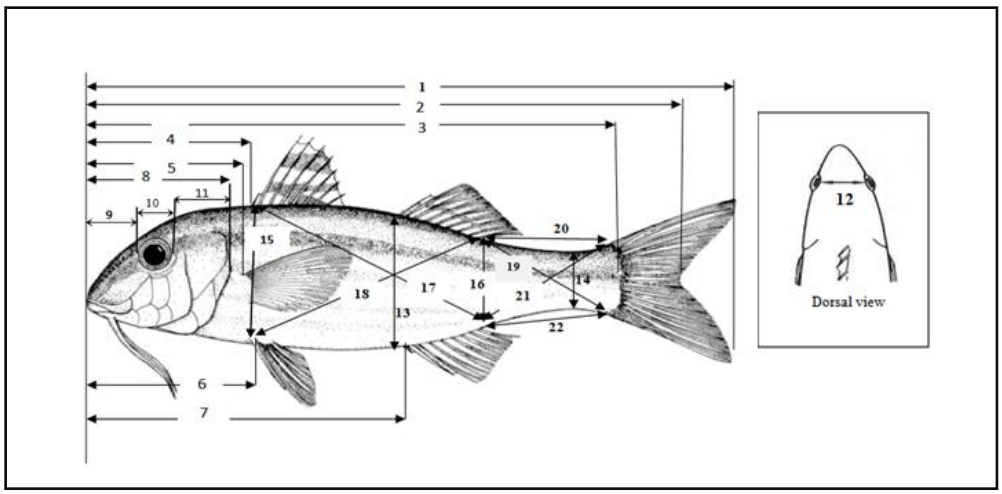

Fig. 1:- Schematic illustration of measurements taken on the body of the two Mullidae species from Mediterranean Sea at Alexandria, Egypt.

Statistical analysis:-

The basic statistics (mean, standard error and range) of certain morphometric indices (relative to standard length, SL or head length, HL) and meristic characters were estimated. The allometric coefficients of the raw morphometric characters and their relationships with fish size (SL) were estimated using power function equation and the linear regression model respectively. The simple power function or allometry equation of Huxely (1932):

$$Y=a\ X^{b}$$

was used, where Y and X are dependent and independent variables respectively and a and b (the allometric coefficient) are constants. The parameters a and b of this equation were estimated by fitting a linear equation to the logarithmic values of Y and X according to the least square method. This leads to an equation of the form:

$$\text{Log } Y = \text{Log } a + b \text{ Log } X$$

Moreover, the type of allometry was determined by estimating of confidence limits of the allometric coefficients, isometry (I), negative allometry (-) or positive allometry (+). The type of allometry was evaluated by testifying the significance of the allometric coefficients (b) (b=1, b>1, and b<1 for isometric growth, positive allometric growth and negative allometric growth respectively) that serves as a criterion for the intensity of differential increase in the morphological measurements relative to a certain reference length. The type of allometry was found to be helpful for studying intra-and inter-specific variation of *Mullus sermuletus* and *Mullus barbatus*. The mean values of meristic characters within and between species considered were testified by t-test.

Statistical analyses for morphometric and meristic data were performed using the SPSS version 18 software package and Excel (Microsoft office, 2007).

Results:-

Morphometrics:-

The relationship between the morphometric measurements and fish size (SL) of *Mullus sermuletus* and *Mullus barbatus* were best described by the linear regression equations (Tables 1&2).

The basic statistics of the morphometric indices (relative to SL or HL) of *M. sermuletus* considered show sexual dimorphism (Table 3&4). IOW/SL, BD/SL, D1VOFL/SL, D2AEFL/SL, D2EdCFl/SL, PrD1L/HL, PrPL/HL and PrOL/HL are indices to be size-free and so valid as discriminating tool between males and females of *M. sermuletus*.

The basic statistics of the morphometric indices (relative to SL or HL) of *M. barbatus* considered show sexual dimorphism (Table 5&6). PrAL/SL, PrOL/SL, ED/SL, BD/SL, CPD/SL, D2AEFL/SL, AEdCFL/SL, CPD/HL, D2AEFL/HL and D1OAEFL/HL are indices to be size free and so valid as discriminating tool between males and females of *M. barbatus.*

The basic statistics of the morphometric indices (relative to SL or HL) of *M. sermuletus* and *M. barbatus* considered show inter-specific variations (Tables 7&8). All morphometric indices are significantly different except for PtOL/SL, D1OAEFL/SL, D2EVOFL/SL, D2EvCFL/SL, D2EdCFL/SL and IOW/HL.

The patterns of variations in the morphometric measurements of *M. sermuletus* and *M. barbatus* were considered in terms of their mode of growth (i.e, their type of allometry). For both *M. sermuletus* and *M. barbatus*, females show isometric characters more than males while the morphometric measurements of combined sexes of *M. sermuletus* show isometric growth more than *M. barbatus* (Tables 9 &10)

Meristics:-

The pectoral fin rays and upper, lower and total gill raker counts of males and females and combined sexes of *M. sermuletus* and *M. barbatus* are represented in tables (11&12). These counts were helpful in studying inter-specific variations between species considered. No sexual dimorphism was revealed in the meristic characters of the aforementioned species.

Table 1:- The relationship between some morphometric measurements and standard length of ***Mullus sermuletus*** from Alexandria, Egypt for future prediction of missing measurements

The equation	R	The equation	R
FL= -1.37 + 1.13 SL	0.99*	BD= -1.13 + 0.26 SL	0.94*
PrD1L= 4.47 + 0.30 SL	0.97*	CPD= -1.20 + 0.12 SL	0.96*
PrPL= 4.98 + 0.26 SL	0.97*	D1VOFL= -1.54 + 0.27 SL	0.96*
PrVL= 2.61 + 0.30 SL	0.97*	D2AEFL= -0.69 + 0.17 SL	0.95*
PrAL= 1.23 + 0.65 SL	0.99*	D1OAEFL= -5.64 + 0.52 SL	0.99*
HL= 5.35 + 0.24 SL	0.97*	D2EVOFL= -2.73 + 0.52 SL	0.99*
PrOL= 1.88 + 0.08 SL	0.86*	D2EvCFL= -1.62 + 0.27 SL	0.97*
ED= 2.48 + 0.06 SL	0.88*	D2EdCFL= -0.81 + 0.24 SL	0.95*
PtOL= 1.00 + 0.11SL	0.90*	AEvCFL= -0.92 + 0.24 SL	0.97*
IOW= 0.64 + 0.07 SL	0.93*	AEdCFL= -1.10 + 0.28 SL	0.97*

*correlation is significant at the 0.01 level.

Table 2:- The relationship between some morphometric measurements and standard length of ***Mullus barbatus*** from Mediterranean Sea Alexandria, Egypt for future prediction of missing measurements

The equation	R	The equation	R
FL= -0.25 + 1.13 SL	0.99*	BD= -2.29 + 0.26 SL	0.93*
PrD1L= 2.26 + 0.30 SL	0.95*	CPD= -1.00 + 0.11 SL	0.95*
PrPL= 2.70 + 0.26 SL	0.97*	D1VOFL= -3.75 + 0.29 SL	0.95*
PrVL= 2.72 + 0.28 SL	0.97*	D2AEFL= -1.50 + 0.17 SL	0.93*
PrAL= 0.26 + 0.64 SL	0.99*	D1OAEFL= -4.30 + 0.51 SL	0.98*
HL= 1.58 + 0.26 SL	0.96*	D2EVOFL= -3.46 + 0.53 SL	0.99*
PrOL= -0.48 + 0.09 SL	0.85*	D2EvCFL= 1.89 + 0.24 SL	0.95*
ED= 2.48 + 0.05 SL	0.81*	D2EdCFL= 3.55 + 0.20 SL	0.93*
PtOL= -0.39 + 0.12 SL	0.89*	AEvCFL= 1.92 + 0.22 SL	0.95*
IOW= 0.40 + 0.06 SL	0.90*	AEdCFL= -0.47 + 0.28 SL	0.97*

*correlation is significant at the 0.01 level.

Table 3:- The basic statistics (Mean ± standard error and range) of morphometric indices (relative to SL) of males and females of ***Mullus sermuletus*** collected from Mediterranean Sea at Alexandria, Egypt.

Morphometric index	Males		Females	
	Mean±SE	Range	Mean±SE	Range
PrD1L	33.81±0.14**	29.60-37.36	33.96±0.12**	30.6-36.7
PrPL	29.84±0.14**	26.15-34.07	30.06±0.12**	26.8-33.3
PrVL	31.58±0.12**	28.5-35.6	31.87±0.12**	27.5-34.3
PrAL	65.24±0.14**	62.1-69.2	65.75±0.14	58.6-69.0
HL	28.48±0.12**	25.5-32.2	28.53±0.11**	25.8-31.4
PrOL	9.20±0.08**	7.8-11.6	9.45±0.07**	7.3-11.2
ED	7.64±0.06**	6.1-9.0	7.30±0.05**	5.8-8.8
PtOL	11.64±0.09**	9.8-14.1	11.78±0.08	9.0-14.3
IOW	7.23±0.04	6.3-8.3	7.08±0.04	6.2-8.2
BD	25.08±0.14	21.9-29.6	25.32±0.15	21.1-28.7
CPD	10.65±0.05*	9.2-11.9	10.97±0.05*	9.42-12.2
D1VOFL	26.00±0.13	22.8-29.2	26.46±0.12	23.0-31.9
D2AEFL	15.94±0.09	13.2-17.78	16.14±0.09	13.3-18.1
D1OAEFL	46.90±0.14**	43.1-50.4	47.35±0.13**	43.1-50.9
D2EVOFL	50.03±0.11*	47.8-53.9	50.22±0.13**	45.1-54.9
D2EvCFL	25.60±0.09*	23.0-28.2	25.62±0.11	20.4-29.6
D2EdCFL	22.89±0.11	19.3-25.7	22.85±0.11	19.3-28.1
AEvCFL	23.48±0.098*	20.6-26.2	23.52±0.10	20.6-26.7
AEdCFL	27.59±0.12	24.8-31.0	27.56±0.11*	25.0-33.3
Range of correlation coefficient	(-0.68 - 0.61)		(-0.61 - 0.44)	
N	105		123	

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0. 05 level.

Table 4:- The basic statistics (Mean ± standard error and range) of morphometric indices (relative to HL) of males and females of ***Mullus sermuletus*** collected from Mediterranean sea at Alexandria, Egypt.

Morphometric index	Males		Females	
	Mean±SE	Range	Mean±SE	Range
SL	351.83±1.51**	310.3-391.9	351.17±1.37**	318.8-387.5
PrD1L	118.84±0.45	107.1-129.7	119.13±0.40	105.0-130.0
PrPL	104.83±0.33	90.5-113.3	105.42±0.30	95.4-117.78
PrVL	111.00±0.39**	102.9-122.2	111.81±0.42	94.1-125.0
PrAL	229.42±0.81**	210.3-251.4	230.80±0.83**	207.3-257.5
PrOL	32.28±0.21	27.8-37.5	33.10±0.20	27.5-40.5
ED	26.84±0.18	21.4-30.8	25.60±0.16**	20.8-29.7
PtOL	40.88±0.26	34.21-47.62	41.31±0.24**	33.3-47.9
IOW	25.44±0.16*	21.6-31.4	24.86±0.16	20.6-30.0
BD	88.24±0.64**	75.9-108.1	88.91±0.63**	72.7-107.5
CPD	37.45±0.24**	32.0-43.2	38.53±0.22**	33.3-45.0
D1VOFL	91.45±0.57**	78.1-105.4	92.90±0.54**	76.5-110.3
D2AEFL	56.07±0.39**	48.28-64.86	56.68±0.38**	44.1-66.7
D1OAEFL	165.09±1.01**	137.9-190.5	166.37±0.93**	137.5-192.7
D2EVOFL	176.03±0.89**	148.3-202.4	176.40±0.89**	153.1-205.0
D2EvCFL	90.09±0.56**	74.2-102.7	90.01±0.56**	66.7-105.0
D2EdCFL	80.55±0.55**	65.5-92.7	80.27±0.53**	68.4-102.4
AEvCFL	82.61±0.53**	69.0-97.1	82.61±0.50**	66.7-100.0
AEdCFL	97.08±0.60**	82.8-118.9	96.79±0.57**	84.0-118.2
Range of correlation coefficient	(-0.09 - 0.63)		(-0.32 - 0.46)	
N	105		123	

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0. 05 level.

Table 5:- The basic statistics (Mean ± standard error and range) of morphometric indices (relative to SL) of males and females of ***Mullus barbatus*** collected from Alexandria, Egypt.

Morphometric index	Males		Females	
	Mean±SE	Range	Mean±SE	Range
PrD1L	32.31±0.14**	28.4-35.0	32.33±0.13*	26.5-35.6
PrPL	28.55±0.09	26.0-30.0	28.6±10.09**	26.1-31.8
PrVL	30.47±0.09**	27.8-33.3	30.41±0.10**	28.0-33.1
PrAL	64.24±0.13	61.5-67.8	64.68±0.12	61.2-68.4
Hl	26.96±0.10	23.5-28.9	26.92±0.09**	25.0-29.6
PrOL	7.92±0.07	5.8-9.5	8.25±0.06	6.8-9.5
ED	7.50±0.06**	6.1-9.0	7.09±0.05**	5.7-8.4
PtOL	11.53±0.08	9.0-13.4	11.57±0.08	9.2-13.0
IOW	6.65±0.04	5.7-7.8	6.74±0.04*	5.9-7.8
BD	23.75±0.12	21.6-26.9	24.63±0.14	20.8-29.0
CPD	9.83±0.04	8.9-11.3	10.13±0.05	8.9-11.3
D1VOFL	24.95±0.12*	22.0-28.5	25.90±0.13	22.1-29.3
D2AEFL	15.54±0.08	13.3-17.8	16.02±0.09	13.3-18.0
D1OAEFL	46.28±0.13**	43.5-49.6	47.33±0.12*	44.3-50.3
D2EVOFL	49.60±0.11	46.6-52.4	50.34±0.12*	46.7-53.8
D2EvCFL	25.43±0.11*	23.4-27.6	25.75±0.11**	22.8-28.2
D2EdCFL	23.08±0.10*	20.4-25.5	23.00±0.12**	19.5-27.0
AEvCFL	23.95±0.09**	21.9-26.5	24.04±0.10*	21.1-26.5
AEdCFL	27.86±0.09	25.5-30.5	28.06±0.09	26.1-31.3
Range of correlation coefficient	(-0.29 - 0.31)		(-0.50 - 0.24)	
N	100		107	

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0. 05 level.

Table 6: The basic statistics (Mean ± standard error and range) of morphometric indices (relative to HL) of males and females of ***Mullus barbatus*** collected from Alexandria, Egypt.

Morphometric index	Males		Females	
	Mean±SE	Range	Mean±SE	Range
SL	371.50±1.44**	346.2-426.1	371.89±1.21	97.2-130.0
PrD1L	119.92±0.43**	102.9-129.6	120.18±0.52	97.2-130.0
PrPL	105.97±0.29**	100.0-117.4	106.34±0.30**	100.0-116.7
PrVL	113.15±0.39**	106.7-124.0	113.03±0.40*	105.7-122.6
PrAL	238.54±0.80**	225.0-273.9	240.47±0.75	223.1-259.3
PrOL	29.35±0.22**	23.1-34.3	30.64±0.19	25.0-37.0
ED	27.86±0.24**	23.1-36.0	26.35±0.17**	21.2-32.1
PtOL	42.77±0.25	35.7-46.7	42.98±0.25**	35.5-48.5
IOW	24.72±0.22**	21.2-30.8	25.04±0.17*	21.9-30.0
BD	88.25±0.56*	75.0-104.2	91.59±0.63	76.7-107.7
CPD	36.52±0.24	32.14-45.8	37.68±0.22	30.8-42.31
D1VOFL	92.65±0.47	83.3-108.7	96.29±0.52*	83.3-108.1
D2AEFL	57.72±0.34	50.0-66.7	59.59±0.39	50.0-67.7
D1OAEFL	171.96±0.90	155.2-200.0	176.03±0.78	153.9-194.9
D2EVOFL	184.30±0.87*	167.9-217.4	187.22±0.76*	168.0-206.7
D2EvCFL	94.51±0.61**	82.1-117.4	95.78±0.55*	80.8-107.7
D2EdCFL	85.76±0.56**	73.3-108.7	85.57±0.56**	73.5-103.3
AEvCFL	89.00±0.53**	76.9-113.04	89.42±0.52	77.8-100.0
AEdCFL	103.52±0.54**	90.0-126.1	104.38±0.51	88.5-117.7
Range of correlation coefficient	(-0.42 - 0.33)		(-0.37 - 0.27)	
N	100		107	

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0. 05 level.

Table 7:- The basic statistics (Mean ± standard error and range) of morphometric indices (relative to SL) of combined sexes of ***Mullus sermuletus*** and ***Mullus barbatus*** collected from Mediterranean Sea at Alexandria, Egypt.

Morphometric indices	*M. sermuletus*		*M. barbatus*		T-value
	Mean±SE	Range	Mean±SE	Range	
PrD1L	33.89±0.09	29.6-37.4	32.32±0.09	26.5-35.6	13.63**
PrPL	29.96±0.09	26.2-34.1	28.58±0.06	26.0-31.8	13.58**
PrVL	31.74±0.09	27.5-35.6	30.44±0.07	27.8-33.3	12.28**
PrAL	65.52±0.10	58.6-69.2	64.46±0.09	61.2-68.4	7.19**
HL	28.50±0.08	24.0-32.2	26.94±0.07	23.4-29.6	15.69**
PrOL	9.33±0.05	7.3-11.6	8.09±0.05	5.8-9.5	17.36**
ED	7.45±0.04	5.8-8.9	7.29±0.04	5.7-9.0	4.50**
PtOL	11.70±0.06	8.2-14.3	11.55±0.06	9.0-13.4	1.80
IOW	7.16±0.03	6.2-9.3	6.70±0.03	5.7-7.8	11.23**
BD	25.21±0.11	21.1-29.6	24.21±0.10	20.6-29.0	6.93**
CPD	10.82±0.04	9.2-12.17	9.99±0.04	8.9-11.3	15.05**
D1VOFL	26.25±0.09	22.7-31.85	25.44±0.09	22.0-29.3	6.37**
D2AEFL	16.05±0.06	13.2-18.1	15.80±0.06	13.3-18.0	2.76**
D1OAEFL	47.14±0.10	43.1-51.0	46.82±0.10	43.5-50.3	1.78
D2EVOFL	50.13±0.09	45.1-54.9	49.99±0.09	46.6-53.8	0.60
D2EvCFL	25.61±0.07	20.4-29.6	25.59±0.08	22.8-28.2	0.01
D2EdCFL	22.87±0.08	19.3-28.1	23.04±0.08	19.5-27.0	-1.35
AEvCFL	23.50±0.07	20.6-26.7	24.00±0.07	21.1-26.5	-5.08**
AEdCFL	27.58±0.08	24.8-33.3	27.97±0.07	25.5-31.3	-4.15**
Range of correlation oefficient	(-0.61 - 0.52)		(-0.46 - 0.38)		
N	228		207		

* *Significant difference at 0.01 level.
* Significant difference at 0.05 level.

Table 8:- The basic statistics (Mean ± standard error and range) of morphometric indices (relative to HL) of combined sexes of ***Mullus sermuletus*** and ***Mullus barbatus*** collected from Mediterranean Sea at Alexandria, Egypt.

Morphometric indices	*M. sermuletus*		*M. barbatus*		T-value
	Mean±SE	Range	Mean±SE	Range	
PrD1L	351.48±1.01	310.3-391.9	371.70±0.93	338.5-426.1	-15.54**
PrPL	119.07±0.31	105.0-136.4	120.06±0.34	97.2-130.0	-2.28*
PrVL	105.15±0.22	90.5-117.8	106.16±0.21	100.0-117.4	-3.76**
PrAL	111.50±0.31	94.1-136.4	113.09±0.28	105.7-124.0	-4.90**
HL	230.31±0.62	207.3-277.3	239.53±0.55	223.1-273.9	-13.10**
PrOL	32.74±0.15	27.5-40.5	30.01±0.15	23.1-37.0	13.32**
ED	26.18±0.13	20.8-30.8	27.08±0.15	21.2-36.0	-3.81**
PtOL	41.08±0.18	33.3-47.9	42.88±0.18	35.5-48.5	-7.78**
IOW	25.17±0.12	20.6-35.0	24.89±0.14	21.2-30.8	1.51
BD	88.60±0.45	72.7-108.1	89.98±0.43	75.0-107.7	-2.56*
CPD	38.03±0.17	32.0-45.0	37.12±0.17	30.8-45.8	2.97**
D1VOFL	92.29±0.40	76.5-111.4	94.53±0.37	83.3-108.7	-5.14**
D2AEFL	56.44±0.28	44.1-70.5	58.69±0.27	50.0-67.7	-6.81**
D1OAEFL	165.9±0.70	137.5-200.0	174.06±0.61	153.9-200.0	-10.86**
D2EVOFL	176.34±0.65	148.3-211.4	185.81±0.58	167.9-217.4	-12.72**
D2EvCFL	90.10±0.40	66.7-109.1	95.16±0.41	80.8-117.39	-8.93**
D2EdCFL	80.45±0.39	65.5-102.4	85.66±0.40	73.3-108.7	-9.13**
AEvCFL	82.61±0.36	66.7-100.0	89.22±0.37	76.9-113.04	-12.54**
AEdCFL	96.93±0.41	82.8-118.9	103.96±0.37	88.5-126.1	-13.72**
Range of correlation coefficient	(-0.29 - 0.53)		(-0.44 - 0.29)		
N	228		207		

* *Significant difference at 0.01 level.
* Significant difference at 0.05 level.

Table 9: The allometric coefficients and their standard error (b±SE) of morphometric measurements of males, females and combined sexes of ***Mullus sermuletus*** collected from Alexandria, Egypt.

Morphometric measurements	Males		Females		Combined sexes	
	b±SE	a	b±SE	a	b±SE	A
PrD1L	0.86±0.02 -	0.68	0.89±0.02 -	0.59	0.89±0.01 -	0.58
PrPL	0.82±0.02 -	0.72	0.83±0.02 -	0.69	0.84±0.02 -	0.65
PrVL	0.88±0.02 -	0.55	0.91±0.02 -	0.50	0.91±0.02 -	0.48
PrAL	0.95±0.01 I	0.85	0.97±0.01 I	0.78	0.97±0.01 I	0.76
HL	0.80±0.02 -	0.76	0.82±0.02 -	0.68	0.82±0.01 -	0.68
PrOL	0.76±0.05 -	0.29	0.83±0.04 -	0.22	0.84±0.03 -	0.20
ED	0.79±0.04 -	0.21	0.76±0.03 -	0.24	0.75±0.03 -	0.25
PtOL	0.86±0.05 -	0.23	0.91±0.04 -	0.19	0.89±0.03 -	0.20
IOW	0.94±0.04 -	0.10	0.94±0.03 I	0.09	0.93±0.02 I	0.10
BD	1.07±0.04+	0.18	1.00±0.04 I	0.25	1.04±0.02 I	0.21
CPD	1.09±0.03+	0.07	1.05±0.03 I	0.09	1.09±0.02+	0.07
D1VOFL	1.05±0.03 I	0.20	1.02±0.03 I	0.24	1.04±0.02 I	0.21
D2AEFL	1.03±0.04 I	0.13	0.99±0.03 I	0.17	1.02±0.02 I	0.15
D1OAEFL	1.13±0.02+	0.25	1.07±0.02+	0.33	1.10±0.01+	0.30
D2EVOFL	1.05±0.02 I	0.40	1.03±0.02 I	0.45	1.03±0.01 I	0.43
D2EvCFL	1.05±0.02 I	0.20	1.04±0.05 I	0.21	1.04±0.02 I	0.21
D2EdCFL	1.03±0.03 I	0.20	1.01±0.03 I	0.21	1.02±0.02 I	0.21
AEvCFL	1.06±0.03+	0.18	1.03±0.03 I	0.21	1.04±0.02 I	0.20
AEdCFL	1.01±0.03 I	0.26	1.04±0.02 I	0.22	1.02±0.02 I	0.25
Number	105		123		228	

(-) = Negative allometric growth, (+) = Positive allometric growth, (I) = Isometric growth.
a = constant of allometric equation.

Table 10:- The allometric coefficients and their standard error (b±SE) of morphometric measurements of males, females and combined sexes of ***Mullus barbatus*** collected from Alexandria, Egypt.

Morphometric measurements	Males		Females		Combined sexes	
	b±SE	a	b±SE	a	b±SE	a
PrD1L	0.86±0.04 -	0.62	0.91±0.03 -	0.50	0.91±0.02 -	0.50
PrPL	0.94±0.03 -	0.38	0.86±0.02 -	0.55	0.90±0.02 -	0.46
PrVL	0.91±0.03 -	0.47	0.88±0.02 -	0.55	0.89±0.02 -	0.50
PrAL	0.98±0.02 I	0.69	0.96±0.01 I	0.10	0.98±0.01 I	0.72
HL	1.00±0.04 I	0.26	0.93±0.02 -	0.38	0.95±0.02 I	0.33
PrOL	1.10±0.10+	0.05	0.91±0.05 -	0.13	1.03±0.05 I	0.07
ED	0.72±0.07 -	0.27	0.75±0.04 -	0.23	0.70±0.04 -	0.30
PtOL	1.00±0.08 I	0.12	1.03±0.05 I	0.10	1.02±0.04 I	0.10
IOW	0.91±0.07 -	0.10	0.84±0.04 -	0.14	0.89±0.03 -	0.11
BD	0.98±0.05 I	0.26	1.03±0.04 I	0.21	1.07±0.03+	0.17
CPD	1.09±0.06+	0.06	1.04±0.03 I	0.08	1.09±0.03+	0.06
D1VOFL	1.11±0.05+	0.15	1.06±0.03+	0.19	1.11±0.03+	0.15
D2AEFL	0.98±0.06 I	0.17	1.04±0.04 I	0.13	1.06±0.03+	0.12
D1OAEFL	1.13±0.03+	0.25	1.05±0.02 I	0.37	1.10±0.02+	0.30
D2EVOFL	1.06±0.02+	0.37	1.04±0.02 I	0.42	1.06±0.01+	0.38
D2EvCFL	0.94±0.05 -	0.35	0.92±0.03 -	0.38	0.95±0.02 I	0.32
D2EdCFL	0.89±0.05 -	0.39	0.85±0.03 -	0.48	0.88±0.03 -	0.42
AEvCFL	0.92±0.04 -	0.35	0.94±0.03 -	0.32	0.95±0.02 I	0.31
AEdCFL	0.99±0.04 I	0.30	1.01±0.02 I	0.27	1.01±0.02 I	0.26
Number	100		107		207	

(-) = Negative allometric growth, (+) = Positive allometric growth, (I) = Isometric growth.
a = constant of allometric equation.

Table 11:- The pectoral fin rays counts of males and females and combined sexes of ***Mullus sermuletus*** and ***Mullus barbatus*** from Mediterranean Sea at Alexandria, Egypt

Species	Counts	N	15	16	17	18	Mean±SE	T-Value
M. sermuletus	**Male**	105	2	54	46	3	16.47±0.06	0.75
	Female	123	-	72	49	2	16.43±0.05	
	Comb.sex	228	2	109	113	4	16.52±0.04	**3.36***
M. barbatus	**Comb.sex**	207	-	136	70	1	16.35±0.03	
	Male	100	-	64	35	1	16.37±0.05	0.62
	female	107	-	72	35	-	16.33±0.05	

*Significant difference at 0.05 level.

Table 12:- The upper, lower and total gill raker counts of males, females and combined sexes of *Mullus sermuletus* and *Mullus barbatus* collected from Mediterranean Sea at Alexandria, Egypt.

Species	Upper gill rakers (UGR)									
	counts	N	5	6	7	8	-	-	**mean±SE**	**T-value**
Mullus sermuletus	**Males**	105	3	46	51	5	-	-	6.55±0.06	-1.06
	Females	123	-	50	69	4	-	-	6.63±0.05	
	Comb. sex	228	3	96	120	9	-	-	6.59±0.04	**4.34***
Mullus barbatus	**Comb. sex**	207	3	126	78	-	-	-	6.36±0.04	
	Males	100	-	59	41	-	-	-	6.41±0.05	1.18
	Females	107	3	67	37	-	-	-	6.32±0.05	
	Lower gill rakers(LGR)									
	counts	N	16	17	18	19	-	-	**mean±SE**	**T-value**
Mullus sermuletus	**Males**	105	3	46	52	4	-	-	17.54±0.06	-1.01
	Females	123	-	50	69	4	-	-	17.63±0.05	
	Comb. sex	228	3	96	121	8	-	-	17.59±0.04	**3.53***
Mullus barbatus	**Comb. sex**	207	2	123	80	2	-	-	17.40±0.04	
	Males	100	1	55	43	1	-	-	17.44±0.05	1.13
	Females	107	1	68	37	1	-	-	17.36±0.05	
	Total gill rakers(TGR)									
	counts	N	21	22	23	24	25	26	**mean±SE**	**T-value**
Mullus sermuletus	**Males**	105	1	3	40	8	47	6	24.10±0.11	-1.15
	Females	123	-	-	42	13	63	5	24.25±0.09	
	Comb. sex	228	1	3	82	21	110	11	24.18±0.07	**4.32***
Mullus barbatus	**Comb. sex**	207	-	5	113	18	69	2	23.76±0.07	
	Males	100	-	1	53	7	38	1	23.85±0.10	1.25
	Females	107	-	4	60	11	31	1	23.67±0.09	

*significant difference at 0.05 level.

Discussion:-

Morphometric indices of fishes were found to be of taxonomic importance in sex, race, and species identification by many investigators (e.g. Ezzat *et al*., 1979; Khalil *et al*., 1983, 1984; Mahmoud, 1988, 1991, 1993; Mahmoud and Mekkawy, 1991; Mekkawy 1987, 1991, 1994, 1997; Harabawy, 1993,2002; Turan, 2004; Lawson, 2010; Mekkawy and Mahmoud, 1992; Osman, 2000; Mekkawy and Mohammad, 2011; Safi *et al.*, 2014; Jawad, 2015 and Mahmoud *et al.*, 2016a,b). In the present study, it was possible to reveal intra-and inter-specific variations in *M.sermuletus* and *M.barbatus* by comparing means of morphometric indices.

The type of allometric coefficient was considered by Gould (1966) to be of taxonomic value. The type of allometry was used to study sexual dimorphism in some fish species comprising *Mugil cephalus* (Grant and Spain, 1975), *Mormyrus kanumme* (Mekkawy, 1987), *Clarias lazera* (Mahmoud, 1988), *Labeo horie* and *Labeo forskalii* (Mahmoud, 1991), *Oreochromis mossambicus* (Olivera and Almada, 1995), *Barbus bynni* (Mahmoud, 2002), *Carangoides Bajad* and *Caranx melampygus* (Mahmoud *et al*., 2016a) and *Acanthopagrus bifasciatus* (Mahmoud *et al*., 2016b). The type of alometry was used to study inter-specific variations of four species of genus *Epinephelus* (Mekkawy *et al.*, 2002) and three Epinephaline species (Mekkawy and Mohammad, 2011). Moreover, the type of

allometry was used to study intra-and inter-specific variations in some fish species comprising *Bagrus bayad* and *Bagrus docmac* (Mahmoud, 1993). In the present study, it was possible to reveal intra-and inter-specific variations of *M.sermuletus* and *M.barbatus* according to the type of allometry of the morphometric measurements considered.

Meristic characters were used in intra-and/or inter-specific variations of some fish species comprising *Osmerus mordaz* (Copeman, 1977), three *Synodontis* species (Mahmoud and Mekkawy, 1991), *Labeo horie* and *Labeo forskalii* (Mahmoud, 1991), *Alestis nurse* (Mekkawy, 1991), four Tilapiine species (Mekkawy, 1995), four species of genus *Epinephelus* (Mekkawy *et al*., 2002), three Epinephaline species (Mekkawy and Mohammad, 2011), *Trachurus mediterraneus* (Turan, 2004), *Carangoides Bajad* and *Caranx melampygus* (Mahmoud *et al*., 2016a) and *Acanthopagrus bifasciatus* (Mahmoud *et al*. 2016b). In the present investigation, the meristic characters of the two species studied showed significant differences in number of pectoral fin rays and upper, lower and total gill rakers counts between *M.sermuletus* and *M.barbatus*. No sexual dimorphism was revealed in the meristic characters of the two species studied.

Conclusion:-

In the present investigation, intra-and inter-specific variations of *M. sermuletus* and *M.barbatus* were possible in terms of morphometric indices and allometric coefficients. Discrimination between *M.sermuletus* and *M.barbatus* was revealed by using pectoral fin rays and upper, lower and total gill rakers counts. No sexual dimorphism was displayed in the meristic characters of the two species studied.

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