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LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF THE BARTAIL FLATHEAD (*Platycephalus indicus*) IN BARDAWIL LAGOON, NORTH SINAI, EGYPT

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ABSTRACT

The present work was carried out to study the length-weight relationships and condition factor of the commercial Bartail Flathead (*Platycephalus indicus*), in Bardawil lagoon, North Sinai, Egypt. Monthly, random samples of Bartail Flathead (*Platycephalus indicus*) were collected from the mixed catch of the main landing site at the Bardawil lagoon. 947 specimens of *Platycephalus indicus* varied from 17.9 to 52.1 cm with weights ranging between 27.6 and 1003.7 g. were collected from August to December during two fishing seasons 2019-2020. The length-weight relationship of *Platycephalus indicus* representing were Male: $W= 0.0019\ L^{3.3502}$ (R^2 = 0.9677); Female: $W = 0.0018\ L^{3.3635}$ (R^2 = 0.9822) and Combined sexes: $W = 0.002\ L^{3.3402}$ (R^2 = 0.9815). The relationship equation showed a positive allometric (b > 3); the value of (b) equals 3.3502, 3.3635 cm and 3.3402 cm for males, females and combined sexes respectively. The condition factor for *Platycephalus indicus* during the study period was about 0.65 in males, 0.76 in females and 0.76 in combined sexes.

INTRODUCTION

Bardawil lagoon is one of the most important lagoons in Egypt as a source of good quality fish and a habitat for wildlife (**Touliabah *et al.*, 2002**). The lagoon is considered the main ecological and economic natural resource of North Sinai region (**GAFRD, 2001**). It has been designated as an Important Bird Area (IBA) by Bird Life International (**Noor El Deen *et al.*, 2016**).

Bartail Flathead (*Platycephalus indicus*) belongs to Family: Platycephalidae. It includes about 17 genera (**Imamura, 1996; Imamura, 2007**). The Bartail Flathead, this economic fish has been listed in the Mediterranean Sea coasts as a migratory species through Suez Canal (**Rodríguez and Suárez, 2001**). It is found at Alataka Harbor, Suez Governorate, Egypt and it is an invasive fish inhabiting the Egyptian coasts and becomes a preferable food for millions of costal peoples (**Arafa and Mahmoud, 2019**).

Length-weight relationship (LWR) and condition factor are important to study the biology of a fish. It is one of the important morphometric characters that can be used for taxonomy and ultimately in fish stock assessment. This relationship might change over seasons or even days (**De Giosa *et al.*, 2014**). It is argued that b may change during different time periods illustrating the fullness of stomach, general condition of appetite and gonads stages (**Zaher *et al.*,**

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2015). Length-weight relationships also are important for comparative growth studies (**Moutopoulos and Stergiou, 2002; Froese, 1998**).

Using condition factor (CF) in monitoring growth is also an important way to examine ecological and physiological processes, including death in winter (**Ibarz *et al.*, 2010; Dirican *et al.*, 2012**). In addition, the CF is an index of good nutrition (**Sutton *et al.*, 2000**).

This work aims to identify biological data for *Platycephalus indicus* to assess the status of species in Bardawil lagoon to provide the information required and provide fisheries managers with current and reliable biological information about the catch of *Platycephalus indicus*, which may be useful for improving fisheries in Bardawil lagoon.

MATERIALS AND METHODS

Study Area

Bardawil lagoon (Fig. 1) is a large, very saline lagoon nearby the protected area of Zaranik in Egypt on the north coast of the Sinai Peninsula. It is about 30 kilometer (19 mi) long, and 14 kilometer (8.7 mi) wide. It is shallow, reaching a depth of about 3 meters, and is separated from the Mediterranean Sea by a narrow sandbar and often the waters of the sea find their way there, making it saline. (**Zahran and Willis, 2008**), it is an important source for economical fish and salt production (**Abd Elrazek *et al.*, 2006**) The fishing is seasonal, starts from the beginning of May to the end of December (**El-Ganainy *et al.*, 2002**).

Sampling

Over five months from August to December during two fishing seasons 2019/ 2020, random samples of Bartail Flathead (*Platycephalus indicus*) were collected from the mixed catch of main the landing site (El-Nasr(A1), Eghzeuan (A2) and El-Tulul(A3)) at Bardawil lagoon. 947 specimens of *Platycephalus indicus* were collected. The total length of *P. indicus* from the tip of the snout to the end of the caudal fin was measured to nearest centimeter, total weight to the nearest 0.1 gram.

Data analysis

Length-weight relationship was determined by **Le Cren (1951)** using the following equation:

$$W = a\,L^{b}$$

W= is the total weight in gram, L= is the total length in centimeter and a &b are constants whose values were estimated by the least square method.

The composite coefficient of condition was calculated monthly during the study period. The coefficient of condition factor was calculated by two methods, namely (**Hile, 1936**):

$$Kc = (W \times 100) / L^{3}$$

Kc = composite coefficient of condition, W = weight in g., L = length in cm.

$$Kn = W / W^{*}$$

Kn= relative coefficient of condition; W= observed weight in g.; W*= calculated weight in g.

Statistical analysis for the length-weight relationship and condition factor (k) of the specimens were tested among stations by Microsoft Excel.

RESULTS AND DISCUSSION

Length-Weight Relationship

In the present study the total length of combined sexes of the investigated specimens of Bartail Flathead, *Platycephalus indicus* varied from 17.9 to 52.1 cm with weights ranging between 27.6 and 1003.7 g. It was used to estimate the length-weight

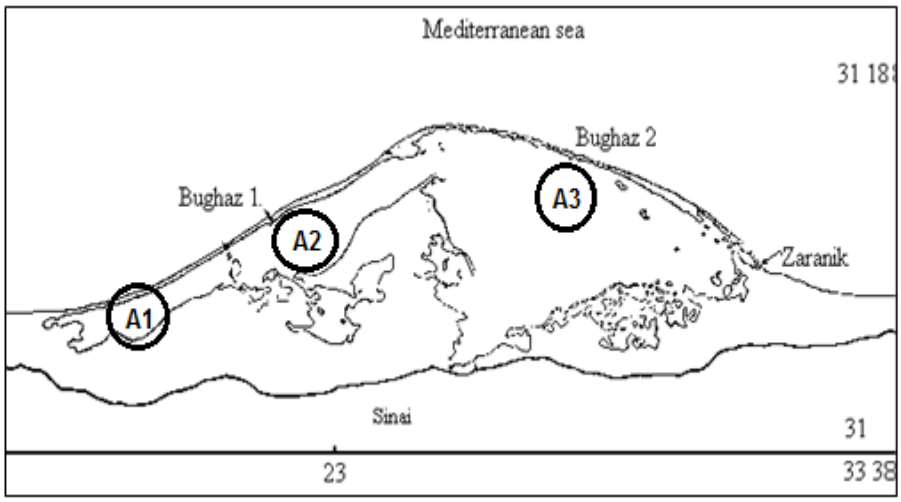

Fig. 1. The map of Bardawil lagoon

relationship of *P. indicus* representing male, female and combined (both sexes) are presented in Figs. 2, 3 and Fig. 4, respectively. The equations thus derived in respect of length-weight relationship are as follows:

Male: $W = 0.0019\ L^{3.3502}$ ($R^2 = 0.9677$).

Female: $W = 0.0018\ L^{3.3635}$ ($R^2 = 0.9822$).

Combined sexes: $W = 0.002\ L^{3.3402}$ ($R^2 = 0.9815$).

Length- weight Relationship is used to determine growth in fish (**Ighwela *et al.*, 2011**). The length-weight relationships can be used for forecasting both the potential yield and determining the most favorable size of capture to obtain optimum yield; these management parameters are directly related to the weight of the fish (**Suresh *et al.*, 2006; Shakman *et al.*, 2008**). Length and weight relationship in conjunction with age data can give information on the stock composite, age at maturity, life span, mortality, growth and production. The relative robustness or degree of well-being of a fish expressed as the coefficient of condition (condition factor) is an important tool for the study of fish biology, mainly when the species lies at the base of the higher food web (**Diaz *et al.*, 2000; Lizama *et al.*, 2002**).

Observed and calculated weight (g.) as well as fish frequency of *Platycephalus indicus* for male, female and combined sex according to mean of fish length (cm) are shown in Table 1.

The relationship equation showed a positive allometric ($b > 3$); the value of (b) equals 3.3502, 3.3635 cm and 3.3402 cm for males, females and combined sexes respectively. These results agree with (**Hashemi *et al.*, 2012**) who found that, the value of (b) equals 3.1 for *P. indicus* in Northwest of Persian Gulf, Iran. **Mohammadikia *et al.*, (2013**) recorded the value of (b) equals 3.1 in coastal waters of Bandar Abbas, Iran, **Adeleh *et al.*, (2015**) found the value of (b) equals 3.26 in Bahrekan, Persian Gulf, **Samir and El Sayed, (2016**) found that, the value of (b) equals 3.34 in Port Said, Egypt, **Akita and Tachihara, (2019**) the value of (b) equals 3.29 in the waters around Okinawa jima Island and also **Hajializadeh *et al.*, (2019**) find out that, the value of (b) equals 3.16 in northern coastline of Gulf, Oman.

On other hand, the (b) value in this study was higher than that recorded by **Naik *et al.* (1990)** where they found that, the values of (b) for the same species equals 2.99 for male, 2.91 for female in Indian waters. And also, higher that recorded by **King (2007)** in Queensland, Australia where the values of (b) was 3.

Table 1. Observed and calculated weight for fish frequency of male, female and combined sex according to mean lengths of *P. indicus* collected from Bardawil lagoon during fishing seasons, 2019-2020

Length group (cm)	Male				Female				Combined sex			
	Freq.	Mean length	Obs. Wt.	Cal. Wt.	Freq.	Mean length	Obs. Wt.	Cal. Wt.	Freq.	Mean length	Obs. Wt.	Cal. Wt.
17-17.9	0	0	0	0	1	17.9	27.6	29.5	1	17.9	27.6	30.6
18-18.9	6	18.6	32.4	33.7	1	18.5	31.6	32.9	7	18.5	32.3	34.4
19-19.9	5	19.3	38.7	38.8	4	19.4	38.8	38.6	9	19.4	38.8	39.8
20-20.9	9	20.4	45.5	46.7	11	20.4	43.1	45.5	20	20.4	44.2	47.4
21-21.9	9	21.3	51.7	53.5	17	21.5	53.5	54.6	26	21.4	52.9	55.8
22-22.9	15	22.4	62.8	63.6	15	22.4	60.2	62.8	30	22.4	61.5	64.9
23-23.9	8	23.5	80.1	74.9	16	23.4	73.8	72.7	25	23.4	75.4	75.3
24-24.9	17	24.4	89.0	85.0	17	24.2	80.3	81.4	35	24.3	84.7	85.4
25-25.9	25	25.6	107.2	98.6	15	25.5	94.2	96.4	40	25.5	102.3	100.0
26-26.9	40	26.5	114.8	111.0	10	26.5	112.3	110.0	52	26.5	113.9	112.9
27-27.9	36	27.4	127.6	125.2	22	27.5	128.9	124.8	60	27.4	127.5	127.6
28-28.9	19	28.4	142.7	140.1	27	28.4	144.2	138.7	48	28.4	144.1	142.8
29-29.9	15	29.4	165.3	157.3	24	29.5	158.1	157.3	45	29.4	159.4	161.1
30-30.9	25	30.5	181.0	177.6	33	30.4	171.7	174.9	71	30.4	173.9	180.0
31-31.9	15	31.3	192.7	195.6	34	31.4	194.8	196.0	57	31.4	193.2	200.0
32-32.9	11	32.3	218.7	217.0	46	32.4	223.9	217.6	63	32.4	219.9	222.0
33-33.9	14	33.4	235.0	241.7	30	33.5	249.4	243.5	45	33.5	244.6	248.0
34-34.9	14	34.4	265.1	267.4	22	34.4	267.4	265.4	37	34.4	266.2	271.3
35-35.9	11	35.5	298.9	295.4	31	35.5	295.2	294.6	42	35.5	296.1	300.9
36-36.9	3	36.6	331.1	327.6	25	36.5	322.8	322.9	28	36.5	323.7	330.2
37-37.9	1	37.5	384.7	356.5	27	37.5	360.5	354.8	28	37.5	361.3	362.3
38-38.9	2	38.3	353.6	382.6	24	38.4	393.7	385.1	26	38.4	390.6	392.7
39-39.9	0	0	0	0	23	39.4	429.4	419.6	23	39.4	429.4	428.0
40-40.9	0	0	0	0	17	40.5	487.0	457.8	17	40.5	487.0	466.6
41-41.9	0	0	0	0	24	41.4	506.9	493.9	24	41.4	504.0	503.1
42-42.9	0	0	0	0	20	42.4	512.8	535.3	20	42.4	508.8	545.0
43-43.9	0	0	0	0	13	43.4	560.2	578.4	13	43.4	560.2	588.6
44-44.9	0	0	0	0	5	44.5	634.7	629.3	5	44.5	634.7	640.1
45-45.9	0	0	0	0	11	45.4	681.0	672.8	11	45.4	671.9	684.0
46-46.9	0	0	0	0	15	46.4	700.3	727.9	15	46.4	686.9	739.6
47-47.9	0	0	0	0	10	47.6	767.0	788.8	10	47.6	767.0	801.0
48-48.9	0	0	0	0	5	48.5	781.2	840.7	5	48.5	781.2	853.4
49-49.9	0	0	0	0	4	49.3	839.4	886.5	4	49.3	839.4	899.5
50-50.9	0	0	0	0	3	50.4	900.4	960.2	3	50.4	900.4	973.8
51-51.9	0	0	0	0	1	51.5	999.9	1030.2	1	51.5	999.9	1044.3
52-52.9	0	0	0	0	1	52.1	1003.9	1071.2	1	52.1	1003.9	1085.5
SUM	**300**				**604**				**947**			

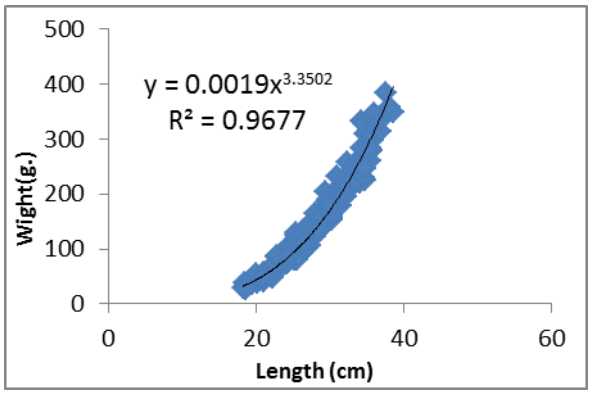

Fig. 2. Length-weight relationship (♂) of *P. indicus*

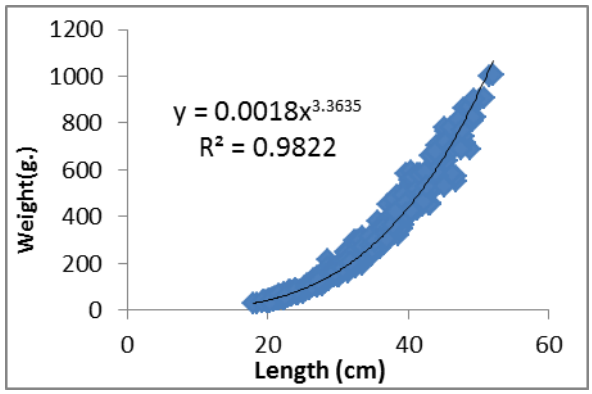

Fig. 3. Length-weight relationship (♀) of *P. indicus*

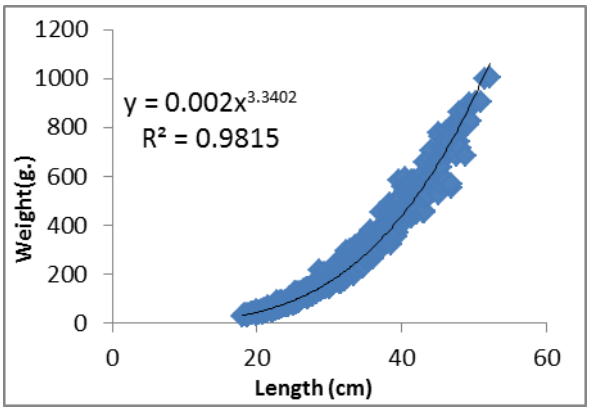

Fig. 4. Length-weight relationship (♀♂) of *P. indicus* collected from Bardawil lagoon during two fishing seasons, 2019-2020

The (b) values in fish is species specific and varies with sex, age, seasons, physiological conditions, growth increment and nutritional status of fish, health, habitat, nutrition, environmental conditions (such as temperature and salinity), area, degree of stomach fullness, differences in the length range of the caught specimen, maturity stage and techniques of sampling fishing gear (**Tesch, 1968; Le Cren, 1951; Bangenal and Tesch, 1978**).

Condition Factor

Table 2 and Figs. 5, 6 and 7 were used for describing the variation of condition factor with age. Monthly average values of Kn and Kc for the period from August to December 2019-2020 as calculated from the observed total weight and represented of *P. indicus* in Table (3) and figures (8, 9 and 10) from these tables and figures it is obvious that both composite (Kc) and relative (Kn) condition factor follows the same trends of fluctuations in both males and females.

Kn measures the deviation of an organism from the average weight in a given sample in order to assess suitability of a specific water environment for growth of fish (**Yilmaz *et al.*, 2012; Mensah, 2015**). An overall fitness for fish species is assumed when Kn values are equal or close to 1.

Table 2. Average Kc and Kn (♂, ♀ and ♀♂) of *P. indicus* collected from Bardawil lagoon during two fishing seasons, 2019-2020

Length Group	Males		Females		Combined sexes	
	Kc	Kn	Kc	Kn	Kc	Kn
17-17.9	0.00	0	0.48	0.94	0.48	0.90
18-18.9	0.51	0.96	0.50	0.96	0.51	0.94
19-19.9	0.54	1.00	0.53	1.00	0.53	0.97
20-20.9	0.53	0.97	0.51	0.95	0.52	0.93
21-21.9	0.54	0.97	0.54	0.98	0.54	0.95
22-22.9	0.56	0.99	0.53	0.96	0.55	0.95
23-23.9	0.61	1.07	0.57	1.01	0.59	1.00
24-24.9	0.61	1.05	0.57	0.99	0.59	0.99
25-25.9	0.64	1.09	0.57	0.98	0.62	1.02
26-26.9	0.62	1.03	0.60	1.02	0.62	1.01
27-27.9	0.62	1.02	0.62	1.03	0.62	1.00
28-28.9	0.62	1.02	0.63	1.04	0.63	1.01
29-29.9	0.65	1.05	0.62	1.01	0.63	0.99
30-30.9	0.64	1.02	0.61	0.98	0.62	0.97
31-31.9	0.63	0.99	0.63	0.99	0.62	0.97
32-32.9	0.65	1.01	0.66	1.03	0.65	0.99
33-33.9	0.63	0.97	0.66	1.02	0.65	0.99
34-34.9	0.65	0.99	0.66	1.01	0.65	0.98
35-35.9	0.67	1.01	0.66	1.00	0.66	0.98
36-36.9	0.68	1.01	0.67	1.00	0.67	0.98
37-37.9	0.73	1.08	0.68	1.02	0.68	1.00
38-38.9	0.63	0.92	0.69	1.02	0.69	0.99
39-39.9	0	0	0.70	1.02	0.70	1.00
40-40.9	0	0	0.74	1.06	0.74	1.04
41-41.9	0	0	0.72	1.03	0.71	1.00
42-42.9	0	0	0.67	0.96	0.67	0.93
43-43.9	0	0	0.69	0.97	0.69	0.95
44-44.9	0	0	0.72	1.01	0.72	0.99
45-45.9	0	0	0.73	1.01	0.72	0.98
46-46.9	0	0	0.70	0.96	0.69	0.93
47-47.9	0	0	0.71	0.97	0.71	0.96
48-48.9	0	0	0.69	0.93	0.69	0.92
49-49.9	0	0	0.70	0.95	0.70	0.93
50-50.9	0	0	0.70	0.94	0.70	0.92
51-51.9	0	0	0.73	0.97	0.73	0.96
52-52.9	0	0	0.71	0.94	0.71	0.92
Average	0.62	1.01	0.64	0.99	0.64	0.97

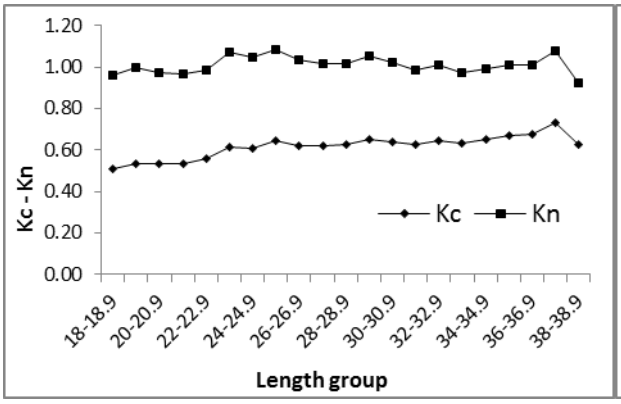

Fig. 5. Average Kc and Kn (♂) of *P. indicus* collected from Bardawil lagoon during two fishing seasons, 2019-2020

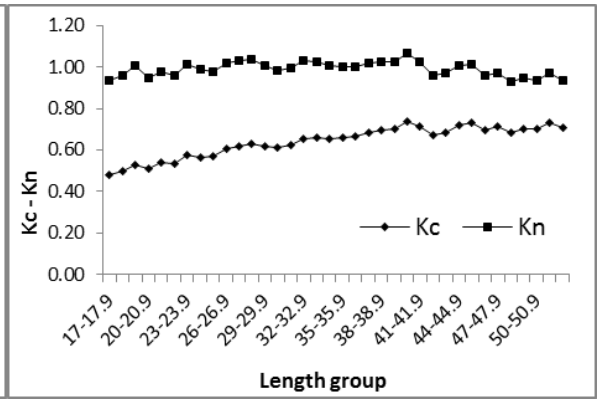

Fig. 6. Average Kc and Kn (♀) of *P. indicus* collected from Bardawil lagoon during two fishing seasons, 2019-2020

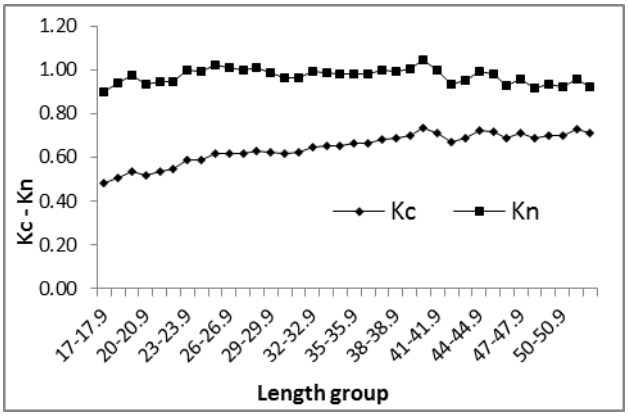

Fig. 7. Average Kc and Kn (♂♀) of *P. indicus* collected from Bardawil lagoon during two fishing seasons, 2019-2020

Table 3. Monthly variation of the condition factor of (♂, ♀ and ♀♂) of *P. indicus* collected from Bardawil lagoon during two fishing seasons, 2019-2020

Month	Males		Females		Combined sexes	
	Kc	Kn	Kc	Kn	Kc	Kn
Aug.	0.64	1.06	0.76	1.17	0.75	1.16
Sep.	0.58	1.01	0.73	1.15	0.72	1.13
Oct.	0.67	1.09	0.75	1.15	0.74	1.14
Nov.	0.70	1.13	0.80	1.22	0.80	1.21
Dec.	0.63	1.06	0.79	1.20	0.79	1.20
average	0.65	1.07	0.76	1.18	0.76	1.17

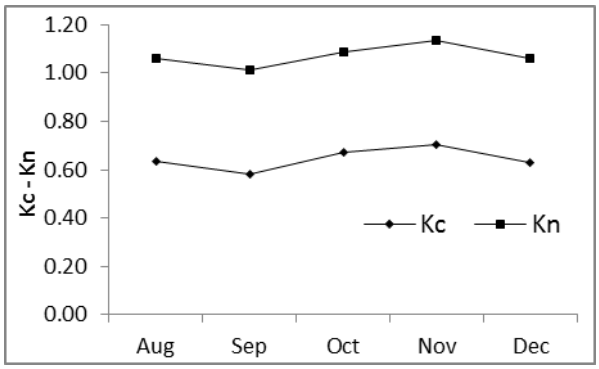

Fig. 8. Monthly variation of the condition factor (♂) of *P. indicus* collected from Bardawil lagoon during two fishing seasons, 2019-2020

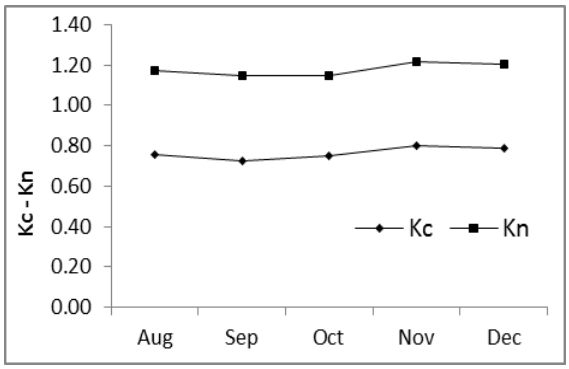

Fig. 9. Monthly variation of the condition factor (♀) of *P. indicus* collected from Bardawil lagoon during two fishing seasons, 2019-2020

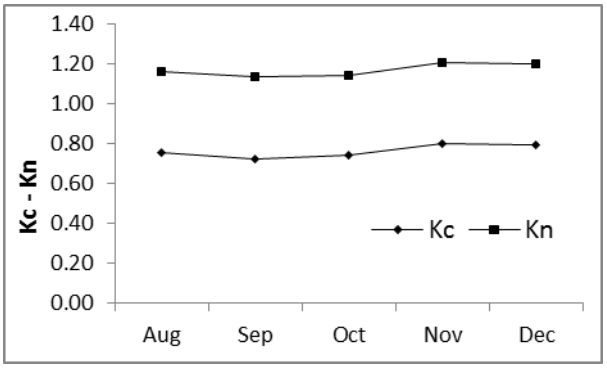

Fig. 10. Monthly variation of the condition factor (♀♂) of *P. indicus* collected from Bardawil lagoon during two fishing seasons, 2019-2020

In the present study, the condition factor for *P. indicus* during period study was about 0.65 in males, 0.76 in females and 0.76 in combined sexes. The highest K value was observed in November and December. Results indicated that condition factor k decrease with increase in length of the fish in both females and males. This result is similar to that obtained by **Hashemi *et al.*,** (**2012**) in Northwest of Persian Gulf, Iran (K- factor was 0.71 – 0.75 for males and females respectively). Also, these results disagree with **Al Mudhaffar,** (**2017**) who found that, the condition factor (Kc) was 1.72 for males and 1.92 for females for the same species in Iraqi Marine Waters.

The condition factor, according to the researchers, compares a fish's well-being and is based on the notion that heavier fish of a particular length are in better condition (**Bangenal and Tesch, 1978**). The condition factor has been utilized as a growth and feeding intensity indicator (**Fagade, 1979**). The reproductive cycle of fish is influenced by the condition factor (**Welcom, 1979**).

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الملخص العربي

العلاقة بين الطول والوزن ومعامل الحالة لسمكة الرقد، (*Platycephalus indicus*) بمنخفض البردويل، شمال سيناء، مصر

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تم إجراء هذا العمل لدراسة العلاقات بين الطول والوزن ومعامل الحالة لسمكة الرقد (*Platycephalus indicus*)، في بحيرة البردويل، شمال سيناء، مصر. تم جمع عينات شهرية بشكل عشوائي لسمك الرقد (*Platycephalus indicus*) من المصيد المختلط لمواقع الانزال الرئيسية في بحيرة البردويل. 947 عينة من *Platycephalus indicus* متفاوتة الأطوال من 17.9 إلى 52.1 سم وبأوزان تتراوح بين 27.6 و1003.7 جم. تم جمعها من أغسطس إلى ديسمبر خلال موسمي الصيد 2019-2020. تمثلت العلاقة بين الطول والوزن لاسماك الرقد*Platycephalus indicus* بالنسبة للذكور $W = 0.0019\ L^{3.3502}$ $(R^2 = 0.9677)$، الإناث $W = 0.0018\ L^{3.3635}$ $(R^2 = 0.9822)$ وللجنسين معا $W = 0.002\ L^{3.3402}$ $(R^2 = 0.9815)$. أظهرت معادلة العلاقة مقياس تماثل موجب ($b < 3$)؛ قيمة (ب) تساوي 3.3502 و 3.3635 سم و3.3402 سم للذكور والإناث والجنس مجتمعين على التوالي. كان معامل الحالة لأسماك الرقد *Platycephalus indicus* خلال فترة الدراسة حوالي 0.65 في الذكور، 0.76 في الإناث و0.76 في الجنسين معًا.

الكلمات الاسترشادية: علاقة الطول بالوزن، معامل الحالة، سمكة الرقد (*Platycephalus indicus*) ومنخفض البردويل.

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