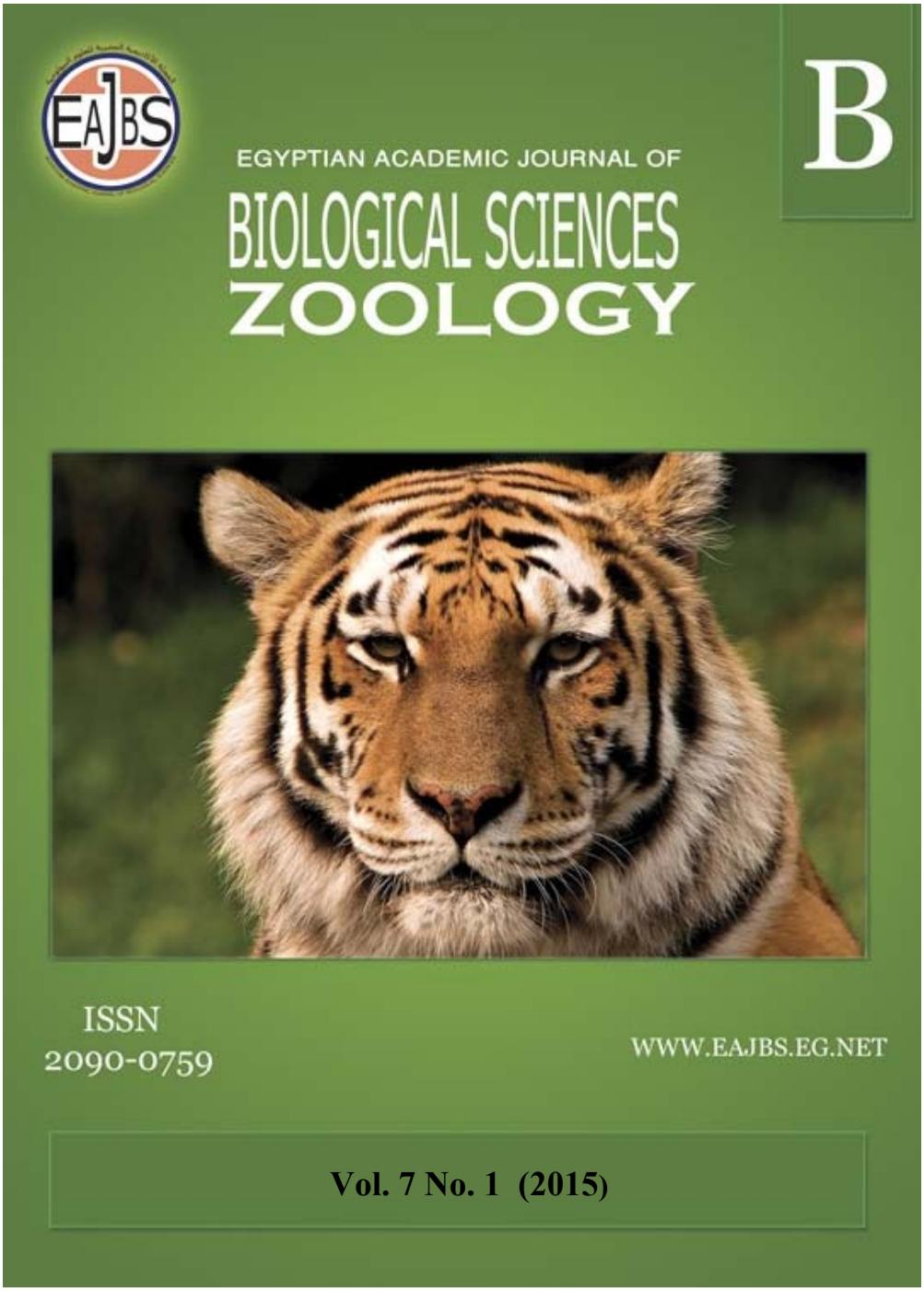


Egyptian Academic Journal of Biological Sciences is the official English language journal of the Egyptian Society of Biological Sciences, Department of Entomology ,Faculty of Sciences Ain Shams University .

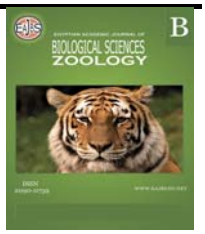
The Journal publishes original research papers and reviews from any zoological discipline or from directly allied fields in ecology, behavioral biology, physiology, biochemistry, development, genetics, systematics, morphology, evolution, and general zoology

www.eajbs.eg.net

Citation: *Egypt. Acad. J. Biolog. Sci. (B. Zoology) Vol. 7(1)pp53-65 (2015)*

Egypt. Acad. J. Biolog. Sci., 7(1): 53- 65 (2015)

Egypt. Acad. J. Biolog. Sci.
B. Zoology
ISSN: 2090 – 0759
www.eajbs.eg.net



Biometric relationships of the invasive crayfish *Procambarus clarkii* to the Egyptian freshwater drainage canals

El-Sayed, A. A. M.; Al-Damhougy, Kh. A.; Zaakouk, S. A. and Amer, M. A.
Faculty of Science, Al-AzharUniversity, Cairo, Egypt.

ARTICLE INFO

Article History
Received: 2/5/2015
Accepted: 25/6/2015

Key words:
Crayfish
Standard length
Body weight
Relative growth
Condition factor

ABSTRACT

The specimens of the freshwater crayfish, *Procambarus clarkii* were collected from the River Nile tributaries at Al-Kanater Al-Khairiya, Qalyoubia governorate during the period from April 2010 to October 2011. The individuals of this species are small lobster-like freshwater crustacean. They have hard- rigid outer exoskeleton, and dark- red, or deep brownish color carapace, characterized by prominent whitish granules during the intermolt stages. The mature individuals of this species are varied from 6 to 10.5 cm in standard length, and from 6.5 to 11.5 cm in total length, and ranged between 10.38 and 56.34 gm in total body weight. The biometric study indicated that the relationship between body weight and standard length for the whole population (males and females) of this species is curvilinear, with positive regression coefficient "b" (slope) equals to 2.998, indicates to an isometric growth and correlation coefficient "r" 0.994, denotes to stability of this species at the prevailing environmental factors. For sex separate, the value of "b" showed also positive isometric regression coefficients, up to 3.359 and 3.118 for males and females respectively, indicating to slightly heavier males than females, without significance difference between sexes (T-test = 1.36, $P > 0.05$). These results also showed that, the values of regression coefficients "b" for the whole population during different seasons indicated heavier males and females during spring (3.719) and winter (3.879) than those in summer (3.091) and autumn (3.331). The values of relative condition factor "Kn" or the "wellbeing" for this species were varied from 0.89 to 1.11, with an average of 1.01, showing an ideal growth for the whole population with relatively high values in small and medium size-classes less than 9.0 cm in standard length. The relative growth rate of male's right chelae was varied from 2.63 to 6.3 cm, showing highly positive regression with an increase in standard length, sharply declined to vary between 1.93 and 3.93 cm in females, denotes to relatively weak correlation in females.

INTRODUCTION

The red swap crayfish, *Procambarus clarkii* (Girard, 1852) had been introduced into the Egyptian freshwater systems, the River Nile and its drainage canals, during the early 1980's via a private fish farm (Ibrahim *et al*., 1995; Ibrahim and Khalil, 2009).

This species belongs to family Cambaridae and is a very common native species lives in many freshwater bodies of the south-central U.S.A., particularly Louisiana (Huner, 1995). However, it extended to other countries including Europe, Australia and China (Huner *et al*., 1993), and represents at the present times the most common wide spread species from over 400 species of freshwater crayfishes belonging to the families Astacidae, Cambaridae and Parastacidae around the world (Huner & Lindqvist, 1995).

Several attempts had been carried out to remove the occurrence of this species form its new habitats in several countries due to its harmful effects on natural biodiversity, but all were failed. Therefore, many attempts were made during the last few years to maximize their use as source of protein, as live bait, as animal diet, or even as experimental animals in the class room in order to eliminate a considerable number of their population (Lodge *et al.,* 2000; Ibrahim and Khalil, 2009).

The crayfish considers a good animal for culturing, because it exhibits fast growth rates at temperature between 23-31°C, requires relatively simple spawning technique, tolerates a wide range of water qualities, including dissolved oxygen, and elevated ammonia and nitrite levels (Ibrahim and Khalil, 2009). About 20-25 % of the total body weight of the crayfish is edible meat, even other wastes including carapace, viscera and cephalothorax have high protein sources, and can be used as fish meal (Agouz ansd Tonsy, 2003), or as food for egg producing and meat producing poultry (Raafat, 2006).

In USA, *Procambarus clarkii* accounts at least 80 % of all wild and cultured crayfish harvest around the world (Huner, 1995), and over 60,000 tons are produced annually in the USA and China (Huner, *et al*., 1993). But in Egypt, in spite of this invasive species became one of the faunal components, only about 4.6 tons are the annual yield (Emam and Khalil, 1995) and represent a new natural protein resource with high nutritive value, and can be consumed by the Egyptian peoples as cheap food, with high protein (Mona *et al*., 1999; Raafat, 2006; Ibrahim and Khalil, 2009), instead of the other high expensive marine shrimps and lobsters. Fishar (2006) presented a case study on *Procambarus clarkii* in the River Nile and pointed out to the negative and positive impacts for this species in the Egyptian waters. He proposed two scenarios for dealing with this species either consume locally or export to the other countries.

Therefore, this study aims to throw light on the biometric relationships of this species indicting to the possibility of exploitation as mass stock resource for aquatic protein in Egypt.

MATERIAL AND METHODS

A total of 166 specimens of *Procambarus clarkii* were collected from River Nile tributaries at Al-Kanater Al- Khairiya, Qalyoubia Governorate during the period from April 20110 to October 2011. The collected individuals were transported to the laboratory in the Faculty of Science Al-Azhar University, Naser City, Cairo. All individuals were sexed and weighed to the nearest 0.1 gm using an electric balance with accuracy of 0.01 g after blotting excess water with absorbent tissues. The total body length, standard length (length without telson and uropods), right chela length

and abdomen width (maximum breadth of abdominal segments) were measured with a Caliper Vernier with accuracy of 0.01 mm.

All the collected specimens were sexually mature. They varied from 6.5 to 10.5 cm in standard length, and from 9.1 to 48.25 g in total body weight. These specimens were divided temporary into groups and kept for two weeks in water tanks, containing fresh water (50 L), aerated with air pumps at room ambient temperature, with the oxygen concentration up to 7-8 mg/L, and pH varied from 7.8 to 8.0, and fed with commercial pellets, frozen fish meat and squids.

A total of 166 specimens (92 males, 74 females) from the crayfish *Procambarus clarkii* were used for calculation of the length-weight relationship according to the following equation:

$$Y = a \pm bX$$ (Hile, 1936, Bagenal and Tesch, 1978).

Where Y= body weight in grams, X = carapace length in cm, a = constant and equal to the intercept of the straight line with Y axis; b = the coefficient of allometry. The method of least squares was used and the coefficients (a) and (b) were calculated by plotting log Y against log X according to the formula of Hile (1936) and Bagenal & Tesch, 1978) as following:

$$\text{Log } Y = \text{Log } a \pm b \log X$$

It is worth to mention that, sex and seasonal variations were taken in account.

The well-being or the relative condition factor "kn"' was calculated for the collected crayfish individuals according the following formula:

$$Kn = W/W`$$ (Hile, 1936, Bagenal and Tesch, 1978)

Where W = observed weight, and W`= calculated weight from the length-weight relationship**.**

The size frequency distribution in standard length for monthly sampled *Procambarus clarkii* was estimated. The individuals of this species were measured and allocated to 1mm size classes. The frequency of each size class was determined and plotted histographically according to Hill (1975), Schembri (1982); and Hartnoll and Bryant (1990).

RESULTS

A-General morphology:

The fresh water crayfish, *Procambarus clarkii* (Girard, 1852, Cambaridae) is a small lobster-like freshwater crustaceans (Fig. 1), has hard outer skeleton or carapace, which protects the body and makes it rigid. The carapace in mature adults has dark-red, to deep brownish color, with prominent whitish granules during intermoult stage. The abdomen has also the same color but lacks granules. Juveniles have grayish, faint brownish and faint green color, sometimes with wavy dark lines, but without spots. The rostrum relatively protruded, triangular, has spike- like protrusion over the head with two lateral spines or notches near its tip. The first three pairs of walking legs are chelate, while the last two pairs are subchelate. The first chelipeds are elongate; pincers are narrower and longer in males than females. Palms of cheliped have a row of tubercles along the mesial margin. There are hooks on the ischia of male at the 3rd and 4ththoracic appendages (walking legs).

B- Length-weight relationship:

Whole population:

A total of 166 specimens (92 males, 74 females) of *Procambarus clarkii* were used for study the relationship between stander length (St. L) and total body wet weight (W). These specimens were varied from 6 to 10.5 cm in standard length, and

from 6.5 to 11.5 cm in total length. Their wet weight ranged between 10.38 and 56.34 gm. All specimens which have regenerated limbs or missed chelae or walking legs were been excluded. The results of relationship between body total wet weight and standard length of this species are given in Table (1) and Fig. (2) and represented according to the following formula:

Log Y= Log a +b log X (Bagenal and Tesch, 1978).

Consequently, the values of this relation are represented by the following equation:

Log Y= -1.307 + 2.998 Log X

Where Y= Total body weight, X= Standard length, b= Regression coefficient, and a= an intercept from Y axis.

Table 1: The length–weight relationship and relative condition factor for *Procambarus clarkii*.

Items Size class (cm)	Mean Weight (gm)		Relative condition factor "Kn"
	Observed	Calculated	
6.0	10.38	10.0	1.04
6.5	12.53	12.59	1.00
7.0	17.59	15.85	**1.11**
7.5	20.68	19.95	1.04
8.0	26.11	25.12	1.04
8.5	34.03	31.62,,	**1.08**
9.0	36.63	35.48	1.03
9.5	39.17	41.67	0.94
10.0	46.60	50.11	0.93
10.5	56.34	63.10	**0.89**
Average	30.006	30.55	**1.01±0.07**

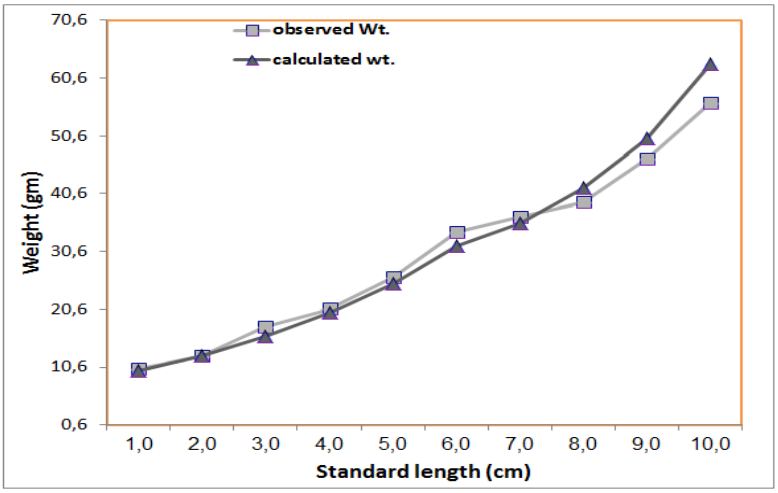


Fig. 2: The length–weight (observed and calculated) relationship for *Procambarus clarkii* (whole population).

This relation is curvilinear and positively correlated, with positive regression coefficient "b" beings 2.998, and "a" = -1.307 and correlation coefficient "r" 0.994. The regression coefficient value indicates to an isometric growth, which means that, the ratios of an increase in weight is correlated with that of an increase in length, and denotes to stability of this species as well as to prevailing environmental factors.

Sex separate:

The computed relationships between standard length and body weight for both separate sexes are also represented by the following equations:

Log Y= -1.685 + 3.359 Log X For males, with ("r" 0.985)
Log Y= -1.394 + 3.118 Log X For females with ("r " 0.982)

These relations showed heavier males than females, with positive correlations, and isometric regression coefficients "b", beings slightly higher in males (3.359) than in females (3.118). The negative intercept "a" was equal to -1.685 and -1.394 for each sex, respectively. No significance difference was detected between the regression coefficients of both sex values (T-test = 1.36, P > 0.05).

Seasons:

The length-weight relationship is also treated for the whole population (males and females) during different seasons. It was highly significant and represented by the following equations:

Log W= - 2.003 + 3.719 Log X (spring, r = 0.990)
Log W= - 1.374 + 3.091 Log X (summer, r=0.990)
Log W= - 1.597 + 3.331 Log X (autumn, r= 0.986)
Log W= - 2.085 + 3.879 Log X (winter, r = 0.973)

The regression coefficients (slopes) for these relations indicated heavier individuals from both males and females during spring and winter than those in summer and autumn. The values of "b" were 3.719 in spring, declined to the minimum (3.091) in summer, but increased again to 3.331 in autumn, and reached the maximum (3.879) during the following winter.

On the other hand, there were sharply fluctuations in the values of regression coefficients "b" for males during different seasons. These values were also positively allometric, and took nearly the same pattern for whole population. These values reached (4.090) also in spring, but declined to 3.365 in summer, and increased again to the maximum (4.175) in autumn, but declined to the minimum value (3.285) in winter.

In females, the values of "b" were also allometric, being generally lower comparable with those of males, and have positive high allometric values in spring (3.564), declined sharply to 2.652 in summer, and recorded the minimum value (2.217) in autumn, but increased again to 3.077 in winter.

C-Relative condition factor "Kn":

The results of relative condition factor "Kn" for *Procambarus clarkii* were calculated from the ratios of mean calculated weight on observed weight and given in Table (1). These values are varied from 0.89 to 1.11 with an average of 1.01 for whole population (males & females) showing ideal growth for the whole population with relatively high values in small and medium size-classes less than 9.0 cm standard length.

On contrast, the values relative condition factor in larger individuals decreased to 0.94 for 9.0 size class and reached the minimum value (0.89) for the larger (10.5 cm) size class.

The values of relative condition factor were varied during seasons. For whole population, the values of relative condition factor were relatively higher than one all seasons, but equal to 100.0 ± 0.05 in autumn (Table 2). For sex separate, no significant differences were noticed, where most values were around "1.0", but a slight increase was observed for females during spring, and reached to the maximum value (1.05 ± 0.16) in winter.

Table 2: Seasonal fluctuations in relative condition factor (mean ±SD) for whole population and sex of *Procambrus clarkii.*

Sex \ Seasons		Spring	Summer	Autumn	Winter
Males	Average	0.999± 0.07	1.005±0.11	1.004±0.10	1.00±0.03
	Range	0.924-1.11	0.842-1.16	0.90-1.15	0.97-1.06
Females	Average	1.04±0.09	1.001±0.03	1.001±0.05	**1.05±0.16**
	Range	0.871-1.12	0.97-1.04	0.962-1.09	0.81-1.30
Males & females	Average	1.003±0.08	1.004±0.08	1.00±0.05	1.01±0.15
	Range	0.88-1.11	0.905-1.13	0.96-1.05	0.78-1.14

D- Relative growth rates:

1-Right chela length:

The present results showed that, relative growth rate of chelae for males and females of *Procambrus clarkii* is gradually increasing with length. The relationships between standard length (St.L) and right chelae length (RChL) of the two sexes, are used as tools for determine relative growth rates for this species.

For males, the right chela length varied from 2.63 to 6.3 cm, while in females, the length of right chela is relatively smaller, and varied from 1.93 to 3.93 cm.

The results of relationship between standard length and right chela length for males and females are given in Figs. (3 & 4). These relations have positive correlation between the two variables, with high statistical significant correlation coefficient "r", and represented by the following equations:

Ch. L = - 0.9851 + 0.6568 St. L (For males r =0.976)

Ch. L = - 0.8181 + 0.5097 St.L (For females, r =0.948)

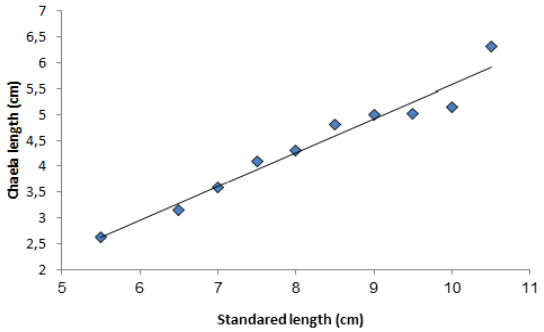


Fig. 3: Male standard length (St. L) - right chelae length (RChL) relationship of the crayfish *Procambarus clarkii.*

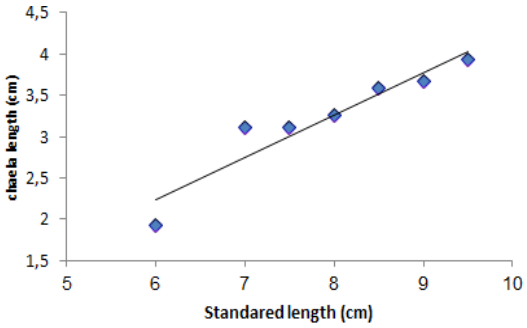


Fig. 4: Female standard length (St.L) - right chelae length (RChL) relationship of the crayfish *Procambarus clarkii*.

Standard length-abdomen breadth relationship:

The relationships between standard length and abdomen breadth for 28 specimens of *Procambarus clarkii* (13 males and 15 females) were calculated and represented in Figs. (5 & 6). In males, standard length varied from 6.4 to 9.1 cm, while abdomen breadth ranged between 1.45 and 1.95 cm; whereas, female's standard length ranged between 6.9 and 10.1 cm, and abdomen breadth varied from 1.43 to 2.3 cm. No significant difference was found between the slopes of this relationship for separated sexes (t-test= 1.74, df=12). Therefore, for sex combined, and separate sex these relations were considered, and represented by the following equation:

Log AB= - 0.529 + 0.873 Log St. CL (Males &females, r= 0.992)

Log AB= - 0.437 + 0.754 Log St. CL (For males, r = 0.970)

Log AB= - 0.620 + 0.984 Log St. CL (For females, r = 0.980)

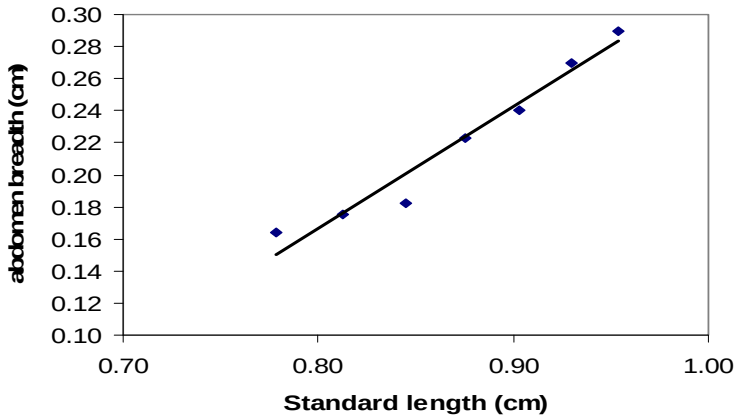


Fig. 5: Standard length and abdomen breadth for *Procambarus clarkii* males

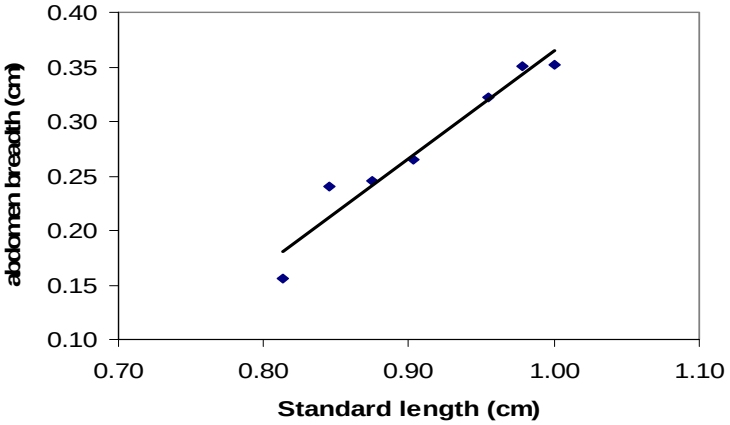


Fig. 6: Standard length and abdomen breadth for *Procambarus clarkii* females.

The relation of whole population is linear and shows an allometric negative regression coefficient (b= 0.873) being slightly below the ideal isometric value '1', with an intercept of Y-axis 'a'=- 0.529, and high correlation coefficient 'r'= 0.992. For male takes the same pattern of whole population with negative regression coefficient (b= 0.754) being, with an intercept of Y-axis 'a'=- 0.437, and high correlation coefficient 'r'= 0.970. But female show higher regression coefficient (b= 0.984) almost being the ideal isometric value '1', with an intercept of Y-axis 'a'=- 0.620, and high correlation coefficient 'r'= 0.980. These results also indicate

progressively very slight decrease in abdomen breadth with an increase in standard length, and for separate sex broader female abdomen than male.

E - Size-frequency distribution:

The size frequency distribution of *P. clarkii* is represented in Fig. (7). The size frequency distribution of this species composed of distinct peak from 7 – 9.5 cm in standard length which represented by high ratio of medium-sized individuals.

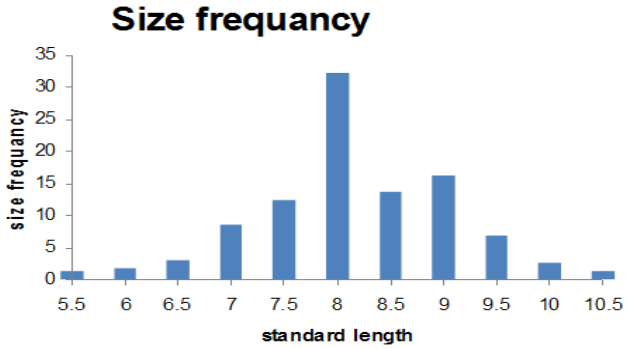


Fig. 7: The size frequency distribution of *P. clarkii*.

DISCUSSION

The mature individuals of freshwater crayfish, *Procambarus clarkii*, are small lobster-like freshwater crustacean. They have hard- rigid outer exoskeleton, and dark-red, or deep brownish color carapace, characterized by prominent whitish granules during intermolt of adult's mature individuals.

In crayfish, there is no easy way to determine the rate of growth or age, since the animal molts they do not retain any permanent features such as the growth rings on the scales of fish (Lowery, 1988). The most common criteria have been used to describe the size and rate of increments of crayfish included: increments in carapace length, annual instantaneous growth rate, moult increments, and percentage of premolt carapace length. Other authors have described the patterns of differential growth that occur at particular stages in the life cycle as detected by determining the ratio between the size of different parts of the body or heterogonic growth (Rhodes and Holdich, 1979; Thomas, 1983; Hogger, 1984).

Knowledge of the animal's weight always helps to known its production particularly in fisheries. The determination of the length-weight relationship by most of the biologists helps to find the weight by knowledge of length. (Abd El-Razek *et al.,*1989). This fact is well known in fishes (Bagenal and Tesch, 1978), shrimps (Thomas, 1977), lobsters (Hossien *et al.,* 1987; Abd El-Razek *et al.,* 1989), and crabs (Potter *et al.,* 1983; El-Sayed 1992, 1997; 2004b; Fouda, 2000). The formula applied is $W= aL^n$, where 'n' is a constant value ranging from 2.5 to 3.5 and usually nears to 3 for isometric relations and deviate from 3 for allometric ones (Bagenal and Tesch 1978).

The total body weight of crayfish was also greatly fluctuated all the year around. The fluctuations in weight is an indicator to increase the feeding rate, maturation of gonads, increase storage of materials within hepatopancreas or increase in relative growth such as chelae weight of males. Therefore, from the knowledge of length-weight relationship and their fluctuations, it can predict the well being of crab which is known as condition factors, including both of the relative condition factor 'Kn' and

Fulton's coefficient of condition or composite condition factor 'K' according to Hile (1936) and Bagenal and Tesch, 1978).

Thomas (1977) estimated the monthly relative condition factor 'Kn' for *Penaeus japonicus* and attributed the fluctuations to cyclic gonadal maturation. Similar changes were reported by Rao (1967) and Hossain *et al*., (1987) on *Nephrops norvegicus*. Moreover Turoboyski (1973) found that chelipeds of *Rithropanopeus harrisii* crab effect greatly on the condition factors of males, which was greatly significant than females of the same species.

In crayfish, carapace was used in most studies, as the parameter of choice for indicating size, since it is easy and accurately measurable. However, carapace length dose not always allow the complete picture of comparison between tow species to be fully appreciated (Lowery, 1988). Therefore, Abrahamsson (1971) used body length to compare between body weight and total body length of *Pacifastacus leniusculus* and *Astacus astacus* in the Rogle pond, in southern Sweden. This relation indicated a greater body weight of *Pacifastacus leniusculus* than *Astacus astacus*.

However, for commercial point of view, it would be necessary to compare data on meat yields of the two species to truly evaluate them. Carapace length was also used for studying the length weight relationship between some species in which the body length is approximately twice carapace length as mentioned by Shimizu and Goldman (1981) on *Pacifastacus leniusculus* form USA, and Hogger, (1984) on the same species and *Autropotamobius pallipes* from southern England, or between sexes of the same species as mentioned by (Lahti and Lindqvist, 1981) on *Astacus astacus*.

Biologists tried to estimate age of crustaceans indirectly through probability analysis of population size frequency distributions and moult increments. The discontinuous nature of size increase and lack of any way to determine age accurately makes estimation of growth rate difficult. The data used generally are of three types: length frequency, size increase during time at large from marking to recapture or a combination of separate estimates of moult increment and moult interval. Length frequencies can be used most effectively in short-lived species in which cohorts are identifiable (Cobb and Caddy, 1989). Variability in growth among individuals may be introduced by breeding season, multiple spawning, temporal or spatial variation food availability and so on (Leaffler, 1972; Turoboyski, 1973; Klein Breteler, 1975; Hill, 1979; Potter *et al*., 1983).

As a result from the passage of the different spawning groups through overall population composition from year to year, the size frequency distribution may be used for growth rate distribution. However, certain difficulties may appear in distinguishing between the older and young stages (Klein Breteler, 1975).

Du Preez and Mclachlan (1984b) found that size frequency histogram did not reveal distinct size-classes for *Ovalipes punctatus*. Allover the year, some species show recruitment at certain modes and size frequency distribution may be peaked with two (bimodal) or three modes such as *Scylla serrata* (Hill, 1979), *Uca subcylindrica* (Thurman II, 1985), *Leucosia signata* and *Eucrate crenata* (El-Sayed, 1992). Others do not show any clear recruitment of juveniles nor any consistent progression of size modes due to difficulty in separating different spawning groups while spawning occurs allover the year (Du Preez and Mclachlan, 1984b) and the size frequency distribution of the population remained more or less static throughout the year. However, the pooled size frequencies is used for *Ebalia tuberosa,* three or four size modes for females and at least two modes for males are shown (Schemberi, 1982). A cumulative frequency analysis was used for determination of moulting cycle

and age of post larval stages for several crab species (Sasaki and Kawasaki, 1980; Schembri, 1982; Kanno, 1987; El-Sayed, 1992).

REFERENCES

Abrahamsson, S. (1972): Fecubdity and growth of some population of *Astacus astacus*. LINE in Seweden. Report of the Institute of freshwater resaerch Drotingholm, 52: 23-37.

Agouz, H. M. and Tonsy, H. D. (2003): Evaluation of whole crayfish meal *Procambarus clarkii* as partial or complete replacement of fish meal protein in polyculture commerical diets. Egypt. J. Nurtion and Feeds, 6: 315-330.

Bagenal, T. B. and Tesch, F. W. (1978): "Age and growth" in: Methods for Assessment of Fish Production in Freshwaters (W.E. Ricker, ed.), pp.101-136. Oxoford and Edinburgh, Blackwell.

Cobb, J. and Wang, D. (1989): Fisheries biology of Lobsters and Crayfish, The biology of Crustacea, Academic press, New York, Vol. 10 Economic Aspects, Fisheries and cultures, 166-207.

El-Sayed, A. A. M.; Saber, S. A.; El-Damhougy, K. A. and Fouda, M.M.A. (1998a): The reproductive biology of Grapsid Crab, *Metopograpsus messor* (Forskal, 1775) From Ain Sukhna, Gulf of Suez, Egypt. *J. Aquat. Biol. & Fish*. 2(4):359-377.

Emam, W.M. and Khalil, M.T. (1995): Population dynamics and stock assessment of the newly introduced crayfish, *P. clarkii* in the River Nile, Egypt. Proc. Zool. Soc. A.R. Egypt. 26: 131 – 143.

Fishar, M.R., (2006): Red swamp, crayfish (*Procambarus clarkii*) in River Nile Egypt. Biodiversity Monitoring and Assessment Project (Bio Map) Nature conversion sector.

Hartnol, R. G. and Bryant, A. D. (1990): Size frequency distributions in decapod Crustacea- The quick, the dead, and the cast-offs. *J. Crust. Biol*. 10 (1): 14-19.

Hile, R. (1936): Age and growth of Cisco *Leucichthys artedi* (L1: Sucur), in the lakes of the North-Eastern highlands, Wisconsin. Bull. U. Bur. Fisher, (X1Viii), 211-317.

Hill, B. J. (1975): Abundance, breeding and growth of the crab *Scylla serrata* in two South African Estuaries. *Mar. Biol*. 32:119-126.

Hogger, J. B. and Lowry, R. S. (1982): The encouragement of freshwater crayfish population by attain to the construction and maintenance of water ways, J., inst. Wat. Eng. Sci., 36: 214-220.

Huner, J.V. and Lindqvist, O. V. (1995): Special problems in freshwater crayfish egg production. In: Crustacean egg production, (eds. A. Wenner and A. Kuris), pp. 235-264.

Huner, J.V. Moody, M. and Thure, R. (1993): Cultivation of freshwater crayfish aquaculture in North America, Europe and Eustralia. Families Astacidae, Cambridae and Parastacidae. Haworth press, New York.

Ibrahim, A. M. and Khalil, M. T (2009): The red swamp crayfish ingypt. (Afast spreading freshwater invasive crustacean), Egypt, Centre of Researsh & Studies of Protectorates, Ain Shams Unv. (1) p: 153.

Ibrahim, A.M.; Khalil, M.T. and Mubarak, M.F. (1995): On the feeding behaviour of the Exotic crayfish, *P. clarkii* in Egypt and its prospects in the bicontrol of local vector snails. . J, Union Arab Biol., Cairo. 4 (A): 321-340.

Klein Breteler, W. C. M. (1975): Oxygen consumption and respiratory leaves of juvenile shore crabs, *Carcinus maenas*, in relation to weight and temperature. *Neth. J. Sea. Res*. 9: 243-254.

Lahti, E. and Lindqvist, O. V. (1983): On the reproductive cycle on the crayfish *Astacus astacus* L. in Finland, *Freshwater crayfish*, 5, 18-26

Lodge, D. M.; Taylor, C. A.; Holdich, D. M. and Skurdal, J. (2000): Non-endogenous crayfishes, Threaten North American freshwater biodiversity: Lessons fro Europe Fisheries, 25(8): 7-20.

Lowery, R.S. (1988): Growth, molting and reproduction. In: Holdich, D.M., Lowery, R.S. (Eds.), Freshwater Crayfish, Biology, Management and Exploitation. Croom Helm Press, London, pp. 83–113.

Mona, M. H.; Geasa, N.M. Sh.; Sharshar, Kh. M. and Morsy, E. M. (1999): Chemical composition of freshwater crayfish (*Procambarus clarkii*) and its nutritive value. Egypt. J. Aquat. Biol. and Fish., 4(1) : 19 – 34.

Raafat, H. A. (2006): Biological and physiological studies on the freshwater crayfish, *Procambarus clarkii*, Ph. D. Thesis, Department of Zoology, Girls College for Arts, Science and Education, Ain Shams University, 267 pp.

Rao, K. R. (1965): Isolation and partial characterization of the molt-inhibiting hormone of the crustacean eyestalk. Experientia 21:593-594.

Rhodes, C. P. and Holdich, D. M. (1979): On size and sexual domorhism in *Ausropotamobius pallipes*, Aquaculture, 17, 345-358.

Schembri, P. J. (1982): The biology of a population of *Ebalia tuberosa* (Crustacea: Decapoda :Leucosidae) from the Clyde Sea area. J. *Mar. Biol. Ass. U.K*. 62: 101-115.

Shimizu, S. J. and Goldman, C. R. (1981): *Pacifastacus leniusculus* Production in the Sacramento River, Freshwater crayfish, 5, 210-228.

Thomas, W. J. (1983): Dimorphism in the British crayfish *Austrotamobius pallipes*, freshwater crayfish, 5, 12-17.

Thurman, C. L. (1985): Reproductive biology and population of fiddler crab *Uca subcylindrica* (stimpson). Biol. Bull., 169 215-229.

Fig. 1: General morphology of *Procambarus clarkii* (upper), dorsal and lower (ventral) view of mature female, 8.1cm in standard length

ARABIC SUMMARY

علاقة الأطوال والأوزان في استاكوزا الماء العذب، بروكامبارس كلاركي

عواد عبده محمد السيد - خالد عبد اللطيف الدمهوجي - سمير عطية زعقوق - محمد عبد الناصر عامر
قسم علم الحيوان كلية العلوم بنين- جامعة الأزهر بالقاهرة

تلقي هذه الدراسة الضوء على العلاقة بين طول ووزن الجسم وكذلك العلاقة بين طول الجسم وأطوال الرجل الكلابية ومعاملات الحالة والترددات الحجمية في استاكوزا الماء العذب " بروكامبارس كلاركي" المجمعة من الفروع والقنوات المائية بمنطقة القناطر الخيرية. وتوضح نتائج هذه الدراسة أن أفراد استاكوزا الماء العذب ذات أحجام صغيرة نسبيا، تتروح الأفراد الناضجة فيما بين ٦,٠- ١٠,٥ سم في الطول القياسي، ومن ٦,٥ إلى ١١,٥ سم في الطول الكلي شاملا الزائدة الذيلية والبوز، بينما يتروح وزن الجسم من ١٠,٣٨- ٥٦,٣٤ جم. وتتميز الأفراد الناضجة بهيكل خارجي صلب، ودرقة أكثر صلابة، ذو لون أحمر أو بني داكن، وتبدو الدرقة أدكن قيلا من اللون لعام للجسم، تتميز في الأفراد الناضجة بظهور حبيبات ذو قمم بيضاء باهتة، خاصة في المرحلة البينية للانسلاخ.

وتشير الدراسة أن العلاقة بين الطول والوزن لجميع الأفراد علاقة اعتماد شرطية، تأخذ شكل المنحنى الصاعد، ويصل معامل الاعتماد إلى ٢,٩٩٨ وهي قيمة مثالية توضح توازن العلاقة المطردة بين الزيادة في الطول والوزن، كما توجد علاقة ارتباط قوية بين المتغيرن حيث يصل معامل الارتباط إلى ٠,٩٩٤، مع عدم وجود اختلافات إحصائية جوهرية بين الشقين(T-test = 1,36, P < 0,05)، حيث تبدو الذكور أثقل في الوزن وأكبر في الطول نوعا ما عن الإناث، كما لوحظ ارتفاع قيمة معامل الاعتماد بين الطول والوزن في المواسم الختلفة ليسجل أعلى قيمة في الشتاء (3,879)، تنخفض تدريجيا في الربيع (3,719) والخريف(3,331) لتصل إلى أدنى مستوياتها في موسم الصيف (3,091)؛ أما قيمة معامل الحالة النسبي "Kn" فقد تراوحت ما بين ٠,٨٩- ١,٠١ أي حول الواحد الصحيح، مما يدل على انتظام النمو في جميع الأفراد، إلا أن قيمته سجلت ارتفاعا نسبيا في الأفراد صغيرة الحجم عنها في الأفراد الكبيرة، وتشير قيم هذه المعاملات على انتظام النمو ومقدرة أفراد هذا النوع على التأقلم مع الظروف البيئية السائدة.

كما أوضحت الدراسة أن هناك زيادة نسبية ملحوظة في طول الكُلاب الأيمن في الذكور عنها في الإناث تراوحت بين ٢,٦٣- ٦,٣٠سم في الذكور، إنخفضت إلى ما بين ١,٩٣- ٣,٩٣سم في الإناث بسبب وصول الأفراد إلى مرحلة النضج الجنسي والتي تتميز في الذكور بكبر نسبي في حجم الكُلاب الذي يستخدم في الكثير من الوظائف خاصة الغذاء والتزاوج.