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Population Characteristics of the Senatorial Scallop *Mimachlamys sanguinea* (Linnaeus, 1758) (Bivalvia: Pectinidae) inhabiting the Suez Canal Expansion Channel, Egypt

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ABSTRACT
This is the first attempt to study the population characteristics and growth of the Lesspsian migrant scallop *Mimachlamys sanguinea* (Family: Pectinidae) from the expansion channel of the Suez Canal. The growth of *M. sanguinea* was considered by revealing the increasing growth rate of one body parameter to the other. The relationships between shell length and different body weight parameters indicated a negative allometric growth, except shell weight. Monthly variations in three condition indices were investigated during the study period. The highest values were during winter and early spring months, reaching the maximum in March 2022 for CI_1, CI_2 and CI_3 (48.27, 73.84 and 7.57, respectively). The population characteristics of *M. sanguinea* were studied depending on the length frequency analysis. The von Bertalanffy growth parameters; asymptotic length ($L\infty$) and growth coefficient (K) were 91.93 mm and 0.71, respectively. The theoretical maximum age (T_{max}) was 4.22. The growth performance index (φ') was valued as 3.778. Total mortality (Z), fishing mortality (F), and natural mortality (M) were calculated. The estimated exploitation rate was 0.425, indicating that it is not exploited. This study would aid in better fisheries management and would be helpful for the sustainable exploitation of the senatorial scallop in the Suez Canal expansion channel.

INTRODUCTION

Egyptian shellfish production is principally based on mussels and clams that are commercially marketed and cultured as a needed source of protein in Egypt **(Ghobashy *et al.*, 2017; Kandeel, 2018)**. Interest in the family Pectinidae, commonly known as scallops, has recently increased **(Manthey-Karl *et al.*, 2015)**. They represent considerable part of the universal sea food market and support commercial fisheries and aquaculture all around the world **(Telahigue *et al.*, 2010)**. Among them, the senatorial scallop *Mimachlamys sanguinea* (Linnaeus, 1758) is considered.

The scallop *M. sanguinea* is an Indo-Pacific species that has been described from the Red Sea by **Sharabati (1984)**. It is a lessepsian migrant that was recorded for the first time from the Suez Canal by **Dijkstra and Knudsen (1998)** and from the eastern Mediterranean coast by **Shefer *et al*. (2012)**. *M. sanguinea* was observed among the catch of the fishermen working in the new expansion channel of the Suez Canal. It has now become an economically important seafood in the markets of the Suez Canal area, being present in considerable amounts. The new expansion canal is an artificial channel that is considered as a separate shipping lane corresponding to the existing one.

Studies on length-length and length-weight relationships are of great importance in fishery biology researches. Measuring shell dimensions permits comparisons of the rates of increase of one body parameter to the other parameters by calculating allometric relationships **(Naidu & Shumway, 1991)**. These relationships are essential for managing resources and understanding changes in environmental conditions **(Palmer, 1990)**. The estimation of growth rates is also needed for revealing population dynamics which, in turn, is essential to support the exploitation and management **(Peharda *et al.*, 2007)**. Geographic latitude has a profound effect on the growth rate and age of bivalves (**Chauvaud *et al,* 2012; Moura *et al.*, 2013)**. Certain techniques used for the evaluation of age and growth of bivalve populations may be more suitable for one species than other **(Daniel & James, 2013)**. The loss of individuals in a population can be valued in terms of mortality rate. For commercial and edible species, overfishing is a source of mortality **(Gosling, 2003)**.

No previous studies have been conducted on the senatorial scallop population dynamics or allometric growth in the Suez Canal. Given the increasing commercial importance of *M. sanguinea* as a candidate species in the Suez Canal area for food, research studies have focused on its population parameters of extensive requirement for future sustainable management of this source in Egypt. The present study provided the first data on the population characteristics, depending on size frequency analysis of *M. sanguinea* from the Suez Canal expansion channel (SCEC) to define the population parameters and exploitation rate, which help in the fishery management of this species.

MATERIALS AND METHODS

The study area is the Suez Canal expansion channel (SCEC) located in Ismailia. It lies between 30.441385°N and 32.355423°E (Fig. 1). The new expansion channel is a great project in Egypt that was started on the 5^{th} of August 2014 and finished in 2015. It is an artificial extension of the main Suez Canal corresponding to the existing one that permits a separated shipping line in the opposite direction. It extends for 72km long and 24m deep including 35 km of dry digging in addition to 37km of expansion and deep digging (Suez Canal Authority, 2022).

The Suez Canal water is approximately turbid due to the passage of tankers and ships and the continuous dredging of the main channel **(Madkour *et al*., 2006)**. The bottom substrate of the main navigational channel of the Suez Canal is composed of coarse and fine sand and muddy-sand with rocks and gravels. Water temperature ranges between 15.9°C in winter and 30°C in summer. Water salinity varies from 35.4 ‰ to 43.2‰ **(Kandeel, 2008)**. The bottom of the expansion channel also consists of sand with few scattered rocks (personal observations and communication).

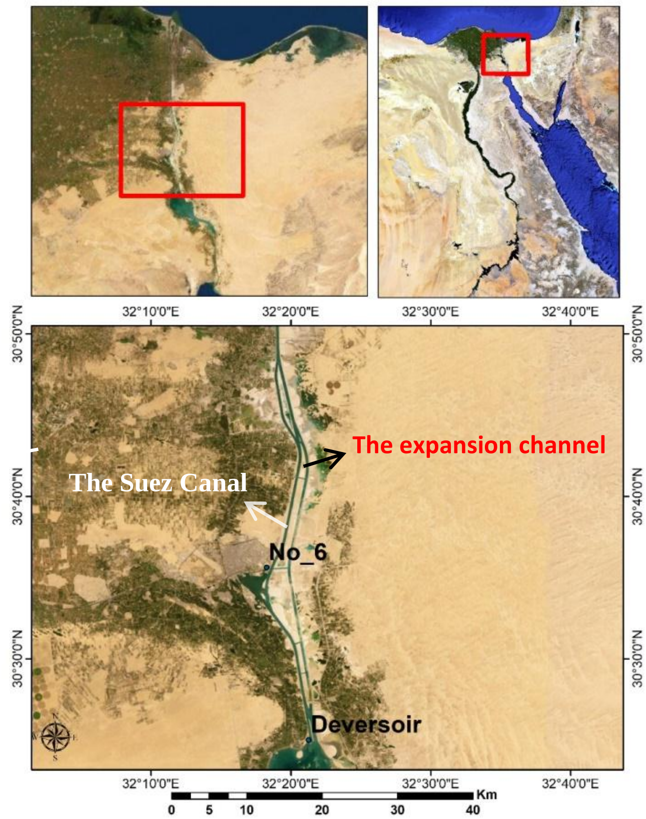

Fig. 1. Map of the Suez Canal showing the sampling site; the Suez Canal expansion channel

1. Collection and processing of samples

Samples of *M. sanguinea* were collected for twelve months starting from December 2021 to November 2022 from fishermen who dive with a snorkel mask at a depth of nearly six to nine meters and gather the scallops by hand. Samples were put in plastic bags filled with seawater then carried to the laboratory for biometric analysis. Each living specimen was cleaned from the extraneous bio-fouling organisms and external parasites by scraping it from the ventral and dorsal shell, and then the different measurements were recorded.

2. Biometric measurements

The maximum scallop shell length from the umbo to the ventral edge (SL), shell width (SW) and shell height (SH) were measured using a Vernier caliper according to the method of **Gallois (1976)** (± 0.1 mm precision) (Fig. 2.1). Total weight (TWt) was recorded to the nearest 0.01g. Then, the scallops were dissected and

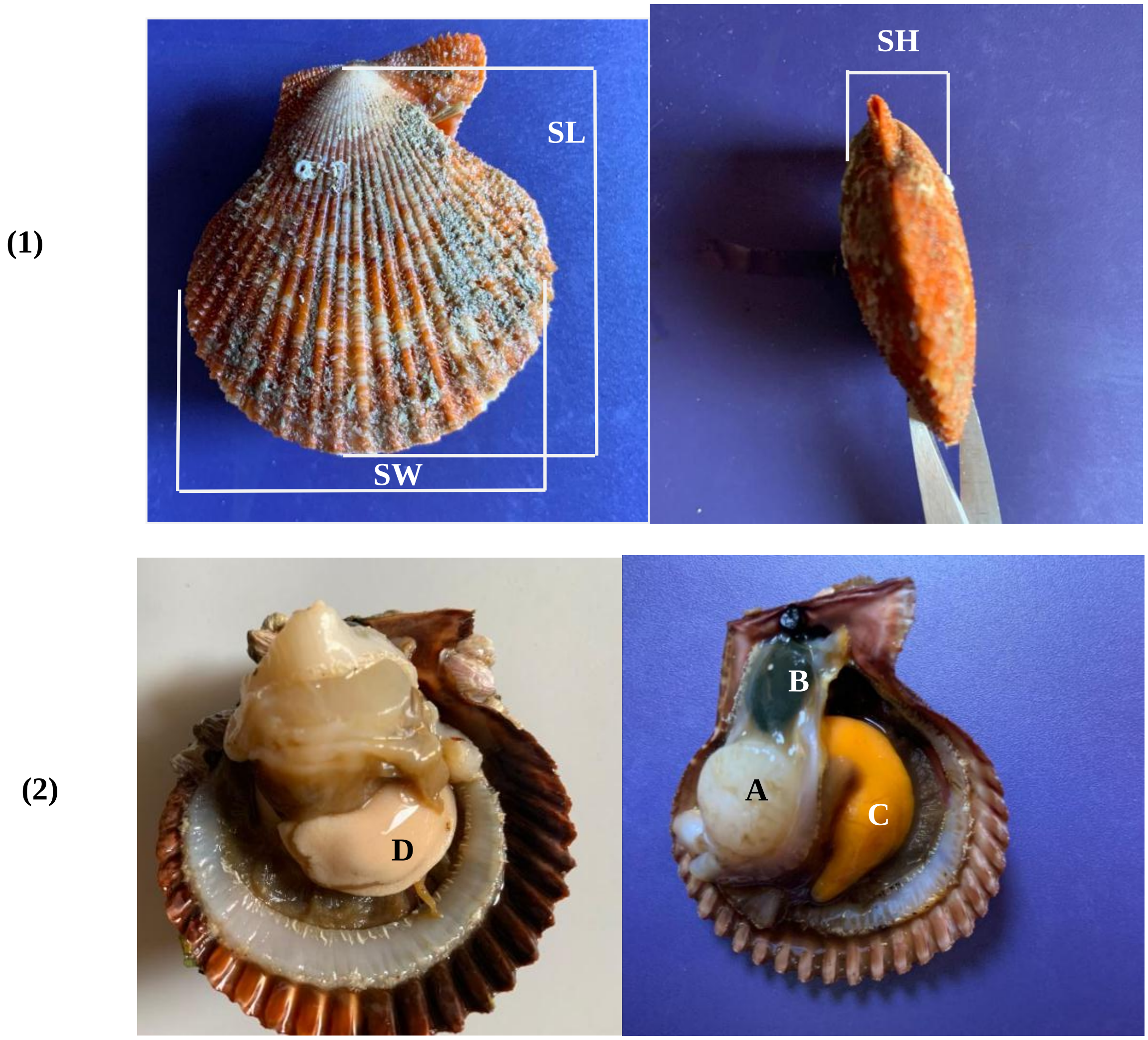

Fig.2. (1) Measurements of the scallop *Mimachlamys sanguinea*; shell length (SL), shell width (SW) and shell height (SH). **(2)** Anatomy of *M. sanguinea* showing adductor muscle (A), digestive gland (B), female gonad (C) and male gonad (D).

sexually differentiated; testes were creamy white in males; the ovaries were orange or red in females (Fig. 2. 2), and the gonad was weighed (GWt). The soft part was removed from the shell using a spatula, and it was weighed (FWt). The shell weight (SWt) and the adductor muscle weight (AWt) were recorded to the nearest 0.01g using a single pan digital balance.

3. Morphometric relationships

1. The relations between shell length (SL), shell width (SW) and shell height (SH) were described by the linear regression equation of Y = a + X b; where, "Y" is the dependent variable; "X" is the independent variable of the length (mm); "a" is the intercept of the regression line, and "*b"* is the slope regression coefficient that gives the rate at which the variable Y alter with the variable X. When "*b*" = 1, the growth is considered as isometric.

2. Length - weight relationship was defined by the following equation: $W = a\ L^b$ **(Ricker, 1975)**; where, "W" is the body weight (TWt); "L" is the shell length (SL) in mm; "a" is the intercept, and "*b*" is the relative growth rate. Weight and length values were converted to logs to determine the linear equation: $\log W = \log a + b \log L$.

The linear equations were calculated for the total weight (TWt), flesh weight (FWt), shell weight (SWt) and gonad weight (GWt) versus shell length (SL). Student's *t*-test was applied to determine if the slope value "*b*" obtained from the linear regression was significantly different from the hypothetical isometric value ($b = 3$) at a confidence level of $P \leq 0.05$. Statistical analysis were carried out by using Microsoft Excel 2010.

4. Condition indices

Three approaches were monthly applied to determine the condition indices of the studied clam. The first condition index (CI_1) as used by **Naidu (1987)** was calculated as the percentage of flesh weight to total weight (FWt/TWt) ×100. The second one (CI_2) was the percentage of flesh weight to shell weight (FWt/SWt) ×100. Whereas, the third condition index (CI_3) was determined by the percentage of flesh weight to shell length^3 in cm ($FWt/\ L^3$) ×100 according to that used by **Kandeel (2008)**. Condition indices were expressed as mean ± standard deviation (SD). Pearson correlation coefficient (Pearson's *r*) was assessed to measure the linear correlation between the condition indices at the significance level of $P < 0.05$.

5. Population structure

A total of 483 specimens were used for the length frequency analysis by using the software package, FiSAT II (FAO-ICLARM Stock Assessment Tools) prepared by **Gayanilo *et al*. (2005)**. The recorded shell lengths (in mm) were grouped to six size classes at 10mm interval, and the frequency of each group was calculated.

6. Estimation of von Bertalanffy growth parameters

The growth parameters of the Von Bertalanffy's formula **VBGF (1938)**, ($L\infty$) which is the average asymptotic length to which the individual grows and has no concrete biological significance but only theoretical constant and (K) which is the growth coefficient and has a precise biological significance, were determined by using the appropriate routines and subroutines of the FAO-ICLARM Stock Assessment Tools

(FiSAT) program of **Gayanilo *et al.* (2005)**. A prime estimate of the asymptotic length ($L\infty$) and the growth coefficient (K) were obtained by applying the method of **Wetherall (1986)**. The resultant growth estimates were then used as seed values in ELEFAN I program **(Pauly & David, 1981)** for the estimation of the best combination of (L_∞ and K).

The growth performance index (Φ) was calculated by the equation of **Pauly and David (1981)**: $\Phi = \log_{10} K + 2 \log_{10} L\infty$.

The theoretical maximum age (T_{max}) was calculated by using the following equation performed by **Michaelson and Neves (1995)**:

$$T_{max} = (\ln L\infty + K\, t_o) / K$$

7. **Estimation of mortality rate**

Total mortality (Z) was attained according to **Pauly (1990)**, using length converted catch curve method. FiSAT II estimates Z at confidence intervals equal 95% based on the goodness-of-fit of the regression. The natural mortality was calculated by using the empirical equation of **Then *et al.* (2014)** based on the estimated maximum age (T_{max}) and the growth coefficient (K):

$$M = 4.899\, T_{max}^{-0.916}$$

Fishing mortality (F) was directly estimated by subtracting M from Z.

8. **The Exploitation rate (E)**

According to **Gulland (1971)**, exploitation rate could be obtained from the equation, E = F / Z. if E value ≥ 0.5, an overexploitation is determined.

RESULTS

1. **Shell dimensions and allometric relationships**

In this study, 483 specimens were collected throughout a year from December 2021 till November 2022. The recorded mean shell length (SL), width (SW) and height (SH) were 63.35, 58.77 and 24.37 mm, respectively (Table 1). The relationship between shell length (SL) and shell width (SW) had a significant regression of determination R^2 = 0.81 ($P < 0.05$), with a negative allometric growth of b = 0.84. This means that the shell length increased with a rate more than that recorded for the shell width. On the other hand, both shell length and width showed positive allometric growth (b >1) to shell height, where shell height increased by rate less than shell length and shell width (Table 2).

Table 1. Range, mean, standard deviation (SD) and standard error (SE) of morphometric measurements of *Mimachlamys sanguinea* from the Suez Canal expansion channel

Variable	Minimum	Maximum	Mean	± Standard deviation	Standard error
Shell length (mm)	31.6	87.8	63.35	9.63	0.44
Shell width (mm)	29.5	88	58.77	10.34	0.47
Shell height (mm)	9	50.5	24.37	5.80	0.26
Total weight (g)	5.2	98.76	36.69	15.37	0.91
Flesh weight (g)	1.55	82.75	15.64	8.68	0.39
Shell weight (g)	3.65	80	24.81	11.98	0.71
Gonad weight (g)	0.03	6.3	1.37	0.93	0.06
Adductor muscle weight (g)	1.31	21.76	9.14	3.21	0.19

2. Morphometric relationship of *Mimachlamys sanguinea* from the Suez Canal expansion channel. Values between parentheses are the upper and lower 95 % confidence levels.

Morphometric relationship	R^2	a	*b*	Allometry
Shell length- Shell width	0.81	14.03 (11.65 - 16.94)	0.84 (0.79 - 0.88)	Negative
Shell length – Shell height	0.57	32.69 (27.36 - 33.016)	1.26* (1.26 - 1.47)	Positive
Shell width - Shell height	0.67	23.09 (17.50 - 22.58)	1.46* (1.49 - 1.69)	Positive

a = intercept, *b* = slope, R^2 = coefficient of determination. *Significant at P < 0.05.

Table (3) shows the relationships between the independent parameter shell length (SL) and the different dependable parameters; total weight (TWt), flesh weight (FWt) and adductor muscle weight (AWt). The slope "*b*" of the regression lines fluctuated from 1.93 to 2.84, indicating a negative allometric growth. Whereas, regression that describes the relationship between shell length (SL) and shell weight (SWt) had a coefficient of determination R^2 equals 0.72, showing low significant correlation at P< 0.001. Slop value "*b*" (= 2.90) was not significantly deviated from the value of three at $P < 0.05$, showing an isometric growth.

Monthly changes in the relationship between flesh weight (FWt) and shell length (SL) showed fluctuation in the coefficient of determination (R^2) that ranged from 0.01 in February 2022 to 0.89 in July 2022. Student *t*-test showed that flesh weight increased relatively slower than shell length in most all months of the year; where "*b*" value deviated significantly from isomerty indicating negative allometric growth. Isometric growth pattern was recorded only in July 2022 (Table 4).

2. Condition indices

The variation mode in CI_1 and CI_2 showed similar trend as shown in Fig. (3), with high significant correlation ($P < 0.0001$) (Pearson correlation $r = 0.95$).

In addition, an obvious monthly variation was detected in the three condition indices during the study period. The highest values were recorded during winter and early spring months, reaching the maximum in March 2022 for CI_1, CI_2 and CI_3 (48.27, 73.84 and 7.57, respectively). The decline in condition indices values was observed in July 2022 for CI_1 and CI_2 (29.13 and 42.31, respectively) and in December 2021 for CI3 (0.79).

Table 3. Morphometric relationships between shell length and different weights parameters of *Mimachlamys sanguinea* from the Suez Canal expansion channel

Measurements	R^2	Log a	*b*	Allometry
SL & TWt	0.79	-3.31	2.73	Negative
SL & FWt	0.77	-3.97	2.84	Negative
SL & AWt	0.78	-3.28	2.83	Negative
SL & SWt	0.72	-3.75	2.90	Isometric

a = intercept, *b* = slope, R^2 = coefficient of determination. *Significant at $P < 0.05$.

Table 4. Monthly regression equation's parameters of the relationship between the flesh weight (FWt, g) and the shell length (SL, mm) of *Mimachlamys sanguinea* from the Suez Canal expansion channel

Month	Log a	*b* ± SE	R^2	Allomerty	*t (b=3)*	Mean L (mm)
December 2021	-3.04	2.30 ± 0.29	0.79	-ve	*	70.9
January 2022	-3.71	2.75 ± 0.42	0.45	-ve	*	73.6
February	0.83	0.30 ± 0.85	0.01	-ve	*	74.7
March	-1.48	1.56 ± 0.41	0.28	-ve	*	72.6
April	-3.23	2.39 ± 0.16	0.78	-ve	*	61.3
May	-3.39	2.56 ± 0.20	0.93	-ve	*	61.5
June	1.43	0.31 ± 0.02	0.84	-ve	*	65.9
July	- 4.18	2.94 ± 0.23	0.89	Isometric	NS	68.2
August	-2.66	2.09 ± 0.09	0.80	-ve	*	57.2
September	-2.813	2.16 ± 0.54	0.74	-ve	*	57.3
October	-2.76	2.13 ± 0.022	0.61	-ve	*	60.3
November	-3.55	2.6 ±0.26	0.67	-ve	*	63

SE = Standard error, R^2 = Coefficient of determination, *b* = regression coefficient, NS = Non-significant, Lm (mm) = mean length. *Significant at $P< 0.05$.

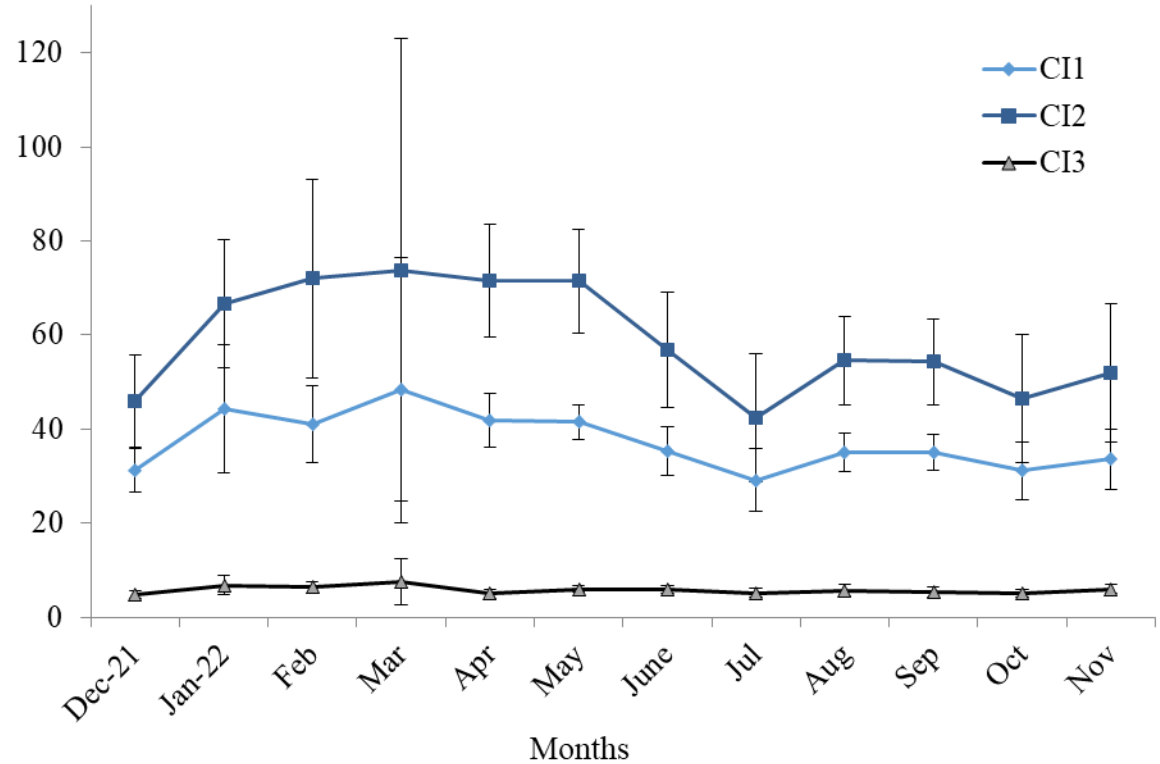

Fig. 3. Monthly variation of mean values of condition indices (CI) ± SD of *Mimachlamys sanguinea* from the Suez Canal expansion channel

3. Length frequency distribution

Size frequency distribution of males, females and combined sexes *M. sanguinea* showed that most of the individuals for combined sexes were between 60 & 69mm SL (35.4%) (Fig. 4). On the other hand, 0.62% of the population was smaller than 40mm, while about 4.14% was found between 80 & 89mm SL. Only female specimens attained the smallest shell length < 40 mm SL (0.94%) (Fig. 4).

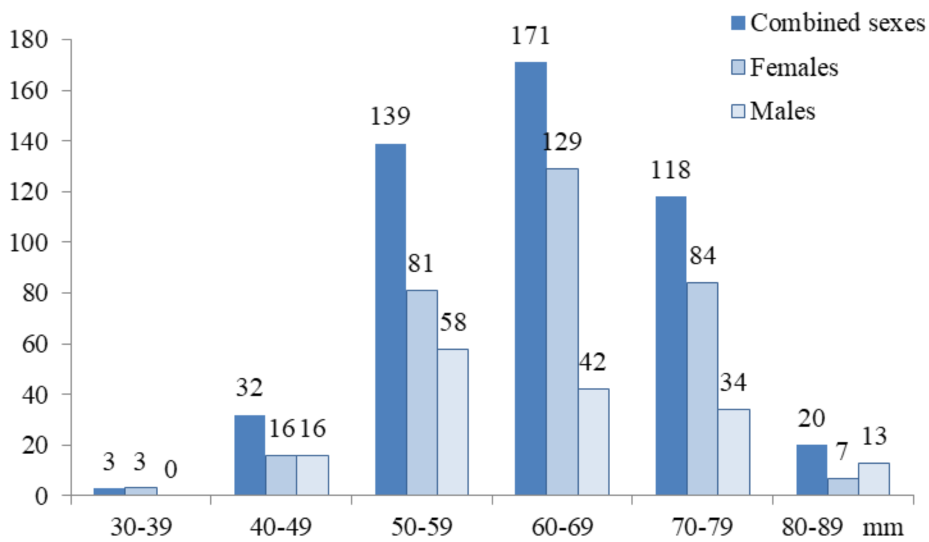

Fig 4. Size frequency distribution of *Mimachlamys sanguinea* from the Suez Canal expansion channel. Number of individuals was given for each category

4. Population structures

The observed maximum length of the scallop *M. sanguinea* collected from SCEC was 88.0mm, while the predicted extreme length was 91.03mm. The extreme predicted length ranged between 86.01 and 96.06 at 95% confidence interval (Fig. 5).

The Powel-Whetherall plot was used to get a prime estimate of $L\infty$ and Z/K. The results were $L\infty$ = 92.32 mm and Z/K = 2.35. The correlation coefficient for the regression line was r = 0.961 (Fig. 6). These growth estimates were used as seed values in ELEFAN I program **(Pauly & David, 1981)**, and the resultant best combination of $L\infty$ and K were 91.93 cm and 0.71, respectively (Fig 7). Length-frequency distribution of *M. sanguinea* from Suez Canal expansion channel with superimposed growth curves was estimated by ELEFAN 1 ($L\infty$ = 91.93 mm and K= 0.71).

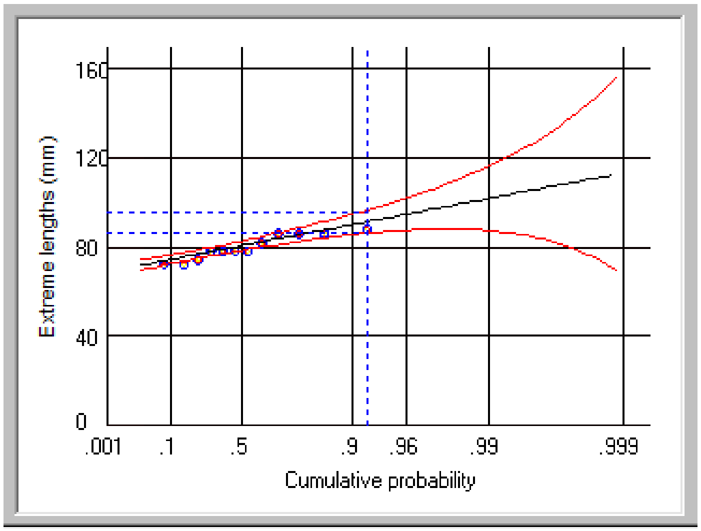

Fig 5. Observed maximum length (88.0 mm) and predicted extreme length (91.03 mm) of *M. sanguinea* collected from Suez Canal expansion channel

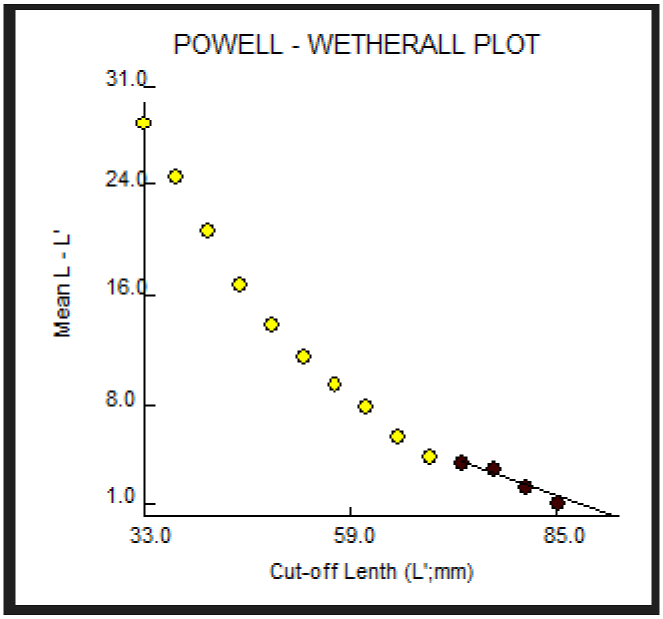

Fig 6. Powell-Wetherall plot of the estimated $L\infty$ (92.32 mm) and Z/K (2.35) of *Mimachlamys sanguinea* from the Suez Canal expansion channel

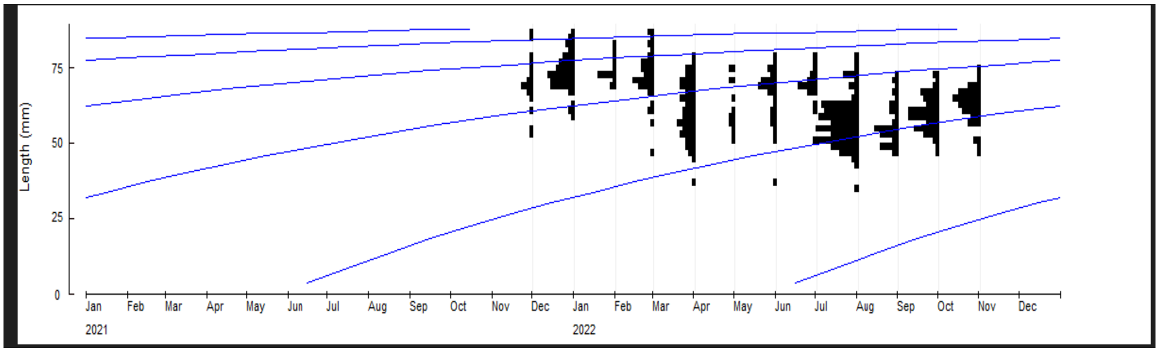

Fig 7. Length-frequency distribution of *M. sanguinea* from Suez Canal expansion channel with superimposed growth curves estimated by ELEFAN 1 (L∞ =91.93 mm and K= 0.71). The estimated growth performance index (Φ) of *M. sanguinea* was 3.778.

5. **Mortalities rate and exploitation rate (E)**

Length converted catch curve was used to evaluate total mortality (Z) = 2.28 (Fig. 8). The estimated natural mortality coefficient (M) was equal to 1.31, while the fishing mortality (F) was 0.97. (Table 5). The exploitation rate (E) of the population of the scallop *M. sanguinea* in SCEC was 0.425.

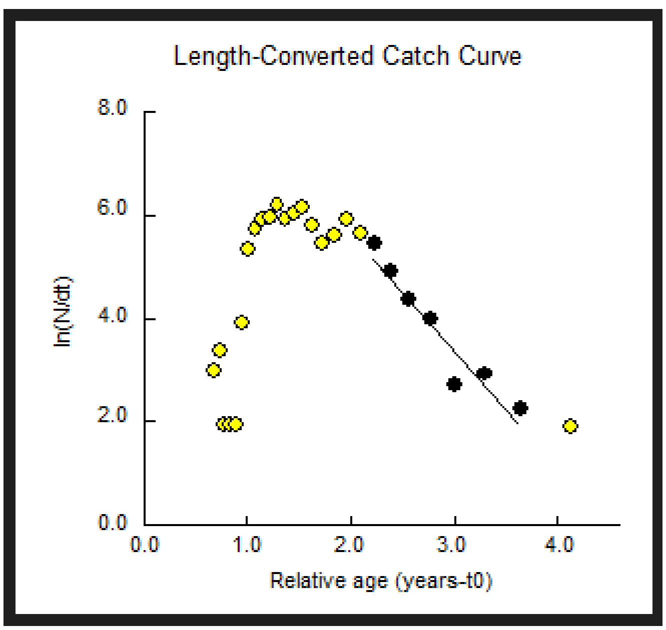

Fig. 8. Length converted catch curve of *Mimachlamys sanguinea* from the Suez Canal expansion channel

Table 5. Population parameters of the scallop shell *Mimachlamys sanguinea* collected from the Suez Canal expansion channel

Population Parameter	Value
Asymptotic length ($L\infty$) in mm	91.93
Growth coefficient K	0.71
Growth performance index ($\varphi^{/}$)	3.778
Theoretical maximum age (T_{max})	4.22
Natural mortality (M)	1.31
Fishing mortality (F)	0.97
Total mortality (Z)	2.28
Exploitation rate (E)	0.425

6. Recruitment pattern

The derived recruitment pattern (%) from FiSAT II for *M. sanguinea* showed two pulses throughout the year. The relative strength of minor pulse was 7.7% in March, while the major one was 16.33% in July (Fig.9).

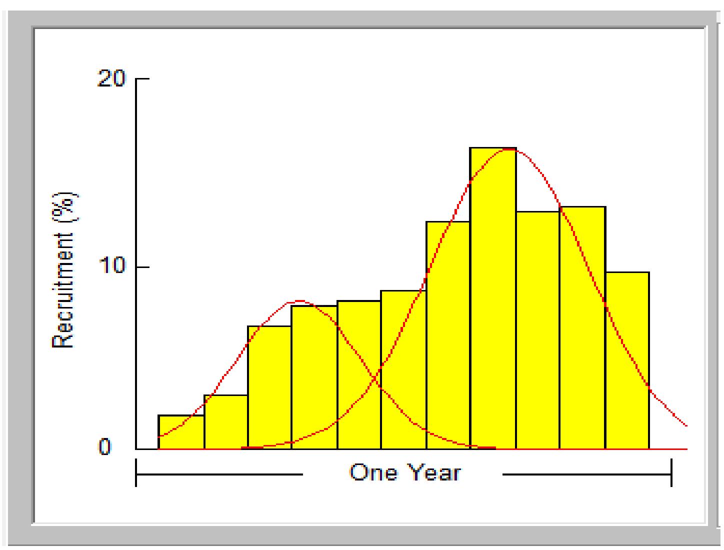

Fig. 9. Predicted recruitment pattern of *Mimachlamys sanguinea* population in Suez Canal expansion channel

DISCUSSION

Studying the population structure is the most actual method to know the biology, ecology and fishery management of bivalves. In the present work, new information with respect to the morphometrics, growth and population of the senatorial scallop *Mimachlamys sanguinea* in the Suez Canal Expansion Channel were suggested. Shell length and shell width (SL and SW) regression displayed the strongest relationship among others that is usual in traits expressed with the same unit **Moura *et al*. (2013)**. The highest R^2 is observed in the length-length relationship. The regression lines of SL & SW showed a negative allometric growth. On the other hand, the relationships of shell length and shell width with shell height (SL & SH and SW & SH) displayed a positive allometric growth. It means that, as the shell grows in length and width, there is a small change in the proportion of SH. Thus, the length and width grow faster than the height. Similar result was observed for the queen scallop *Chlamys opercularis* from the Clyde Sea **(Taylor & Venn, 1978)** and the senatorial scallop *Chlamys senatoria* from the Philippines **(Cabiles, 2021)**.

Negative allometric growth was obvious in the relationships between shell length and different body weights (total weight, flesh weight and adductor muscle weight). On the other hand, shell length and shell weight displayed positive allometric growth. These results match with those of **Cankiriligil *et al.* (2017)** who studied the smooth scallop *Flexopecten glaber* from the Cardak lagoon in Turkey. This is particularly true since higher variations in length-weight have been reported in different species of scallop shells **(Brokordt *et al*., 2000; Beltrán-Lugo *et al*., 2006)**.

Condition indices validate changes in the physiological situations of organisms. In scallop shell, it depends on species, spawning season, feeding habit and environment conditions as in most bivalves **(Vural & Acarlı, 2021)**. Condition index show variations throughout the year depending on reproduction pattern **(Sarro & Stokesbuy, 2009)**. In the present work, CI_1 and CI_2 recorded the maximum values in late winter and spring (March) and the minimum ones in summer (July). By comparing the three condition indices used in this study, it was found that, CI_1 highly correlated with CI_2 (where R^2 equals 0.95 at $P< 0.0001$). These two indices were recommended by **Kandeel (2008)** because they are fast and easy to use. The condition index calculated by referring flesh weight to shell length at the exponential of b (CI_3) gives the impression to be more expressive for seasonal variations. It is the most appropriate tool to be applied. The reason for this divergence in condition indices may be due to the increase in gonad weight during the reproductive season of scallop **(Barnes, 1987)**. In spring, the gonad ration exceeds that of adductor muscle, with a weight of about half the scallop’s wet flesh weight **(Cankiriligil *et al*., 2017)**. Additionally, several studies have revealed that the total flesh weight increases due to the growth in gonad weight during the reproduction season **(Mattei & Pellizzato, 1999; Berik & Cankiriligil, 2013).**

In the present study, the asymptotic shell length ($L\infty$) of *M. sanguinea* was calculated with a value of 91.93mm. This value is much larger than that estimated by **Prato *et al.* (2020)** (ranging from 34.18 to 52.2 mm) for the black scallop *Mimachlamys varia* in the gulf of southern Italy. This result disagrees with the hypothesis of **Chauvaud *et al*. (2012)** who reported in their investigation that asymptotic size differs with latitudes. By studying the great scallop *Pecten maximus*, the evaluation of thermal stress was evaluated where scallops living at high latitudes in the northern part of the hemisphere have a greater maximum body length than those from the South **(Chauvaud *et al.*, 2012)**. The obtained K value in the present study was 0.71 that indicates a relatively high growth rate. This means that *M. sanguinea* has reached its maximum length so fast. **Cano *et al.* (2006)** found that, K equals 1.16 for *Nodipecten subnodosus* cultured in the Baja California Peninsula. The growth rate of *Mimachlamys varia* in southern Italy ranged from 0.14 to 0.35 **(Parato *et al.*, 2020)**. Furthermore, the growth rate studied by **Chauvaud *et al.* (2012)** among scallop populations along the Northeast Atlantic coast from Spain to Norway varied between 0.2 and 0.83. The differences in K values may be due to different latitudes, temperature and food availability.

Growth performance index ($\varphi^{/}$) was used to compare the growth of *M. sanguinea* with previous studies on pectinids where it records in Suez Canal expansion channel 3.80. *Nodipecten subnodosus* from Baja California Peninsula showed growth performance ($\varphi/$) in range of 3.93 – 4.12 **(Freites-Valbuena *et al*., 2011)**. Whereas, the growth ($\varphi^{/}$) of the Peruvian scallop *Argopecten purpuratus* showed values within 3.68 – 4.56 **(Mendo & Jurado, 1993)**. Similar growth parameter range (3.6 – 4.0) was attained for *Placopecten magellanicus* in the Great South Channel, USA **(Harris & Stokesbury, 2006)**.

The natural mortality (M) which is the mortality produced by all causes of death, except fishing, recorded 1.31.Whereas, fishing mortality (F) was 0.97. Both (M) and (F) is giving the total mortality (Z), which was valued to be 2.28. The exploitation rate was used to evaluate whether the stock is overexploited or not. This is based on the assumption that a stock is optimally exploited at $E = 0.5$ when (F) equals (M) **(Gulland, 1971)**. The estimated exploitation rate for *M. sanguinea* from the SCEC was 0.425, which indicates that it is not fully exploited. Recruitment of *M. sanguinea* was all over the year, exhibiting two pulses. This recruitment pattern is usual for tropical bivalve species that grow fast **(Kandeel *et al*., 2017)**.

CONCLUSION

Finally, the senatorial scallop *M. sanguinea* is a very successful species in the Suez Canal expansion channel due to its ability to accomplish well in the new habitat. This study focused on the scallop's growth and demographic structure of population dynamics that could be an essential starting point to evaluate its stock. Further studies are required on its spawning and reproduction. Moreover, genetic researches are also recommended to be investigated.

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