Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 28 (2): 757- 767 (2024)
www.ejabf.journals.ekb.eg

Comparative Biological Study on the Shrimp Scad *Alepes djedaba* Between Its Native and Non-Native Habitats, Egypt

Ahmed N. Mohamed[1], Sahar F. Mehanna[1*], Mohamed F. Osman[2], Sara Mohammad[3]

[1]National Institute of Oceanography and Fisheries, Fisheries Division, Egypt
[2]Faculty of Agriculture, Ain Shams University, Egypt
[3]Faculty of Graduate Studies and Environmental Research, Ain Shams University, Egypt

***Corresponding Author: sahar_mehanna@yahoo.com**

ARTICLE INFO

Article History:
Received: March 2, 2024
Accepted: April 9, 2024
Online: April 20, 2024

Keywords:
Red Sea,
Mediterranean Sea,
Alepes djedaba,
Lessepsian migrant,
Length frequency,
Age,
Growth

ABSTRACT

The length frequency distribution, age, growth and length-weight relationship parameters of shrimp scad *Alepes djedaba* population in its native habital (Red Sea, Gulf of Suez fishing area) were compared with those in its non-native habitat (Mediterranean Sea, Alexandria fishing area) during the period from January 2022 to December 2022. The estimated length-weight relationship for combined sexes (♂♀) indicated an isometric growth in both native and non-native habitat, with no difference between both areas. The longevity of this species was estimated to be 6 years in the Gulf of Suez and 5 years in Alexandria. The highest growth rate in length was recorded in the first year of life (40% in the Gulf of Suez and 46% in Alexandria). Growth in length for both sexes was described by the von Bertalanffy equation as: $L_t = 40.01\ (1-e^{-0.43\ (t+0.097)})$ in the Gulf of Suez; $L_t = 34.05\ (1-e^{-0.48(t+0.175)})$ in Alexandria. The results suggested that the *A. jedaba* populations in the Gulf of Suez and Alexandria may differ, indicating the need for detailed analysis to confirm if this species, after inhabiting the Mediterranean Sea, has undergone any changes from its original population or not.

INTRODUCTION

The Mediterranean Sea is an enclosed sea, hence it is heavily affected by several behaviors, such as intense fishing activities, pollution, invasion of alien species, industrial and tourism activities, as well as climate changes. The bio-invasion of the Mediterranean involves nearly all the major marine taxonomic groups. Fish invade the Mediterranean via three pathways: the Strait of Gibraltar, the Suez Canal, and direct human activities such as shipping, aquaculture, and fish trade, among others **(Mehanna, 2015, 2018; Mehanna & Hassanein, 2020)**. However, the most significant change in the Levantine marine environment took place after the opening of the Suez Canal. The lessepsian migrant species should be studied in detail to show the impact of these species on the fishery and ecology of the new habitat and vice versa.

Family Carangidae is a highly diverse group consisting of fish, such as jacks, scads, trevallies, pompanos, amberjacks and queen fish. The family is made up of four subfamilies represented by 32 genera and 140 species **(Nelson, 2006)**. The shrimp scad (*Alepes djedaba*), the member of family Carangidae, is one of the migratory species through the Suez Canal inhabiting the east coast of the Mediterranean Sea around Israel, Lebanon and Egypt **(Golani, 1993; Taskavak & Bilecenoglu, 2001)**. It is distributed throughout the IndoPacific region from South Africa in the west, along the coasts of East Africa, India, Asia, Indonesia, Northern Australia, Japan **(Iwatsuki & Kimura, 1996)** and extending as far east as Hawaii **(Carpenter & Volker, 2001)**. Additionally, it is one of the species involved in the lessepsian migration through the Suez Canal.

Information on biology of *Alepes djedaba* is scarce, with only a few reports available. Number of studies has been conducted on different aspects of shrimp scad from different parts of the world, including the Philippines **(Schoeder, 1982)**, India **(Sivakami, 1990; Raje, 1993; Sajana & Bijoy, 2017; Bandkar *et al.* 2019)**, France **(Kulbicki *et al.* 1993)**, Turkey **(Taskavak & Bilecenoglu, 2001)**, Egypt **(Akel, 2005; Attia, 2018; Quayed *et al.*, 2022)**, Taiwan **(Chu *et al.*, 2011)**, Pakistan **(Shuaib & Ayub, 2011; Abdul Majeed *et al.*, 2022)**, Saudi Arabia **(Abdel Barrr *et al.*, 2014)**, Indonesia **(Siwat *et al.*, 2016; Vonklauss *et al.*, 2016; Jaliadi *et al.*, 2017)** and Iran **(Parsa & Khoshdarehgi, 2017)**. No previous study has aatempted to answer the question if the migrant species biology and dynamics could be impacted by the ecological characters of the new habitat or not. Thus, this work aimed to compare some biological aspects, such as age and growth, length frequency distribution and length weight relationship of the shrimp scad as a migrant species between its native habitat (Red Sea, Gulf of Suez) and its new one (Mediterranean Sea coast).

MATERIALS AND METHODS

Study area

The Egyptian marine fisheries have an area of more than 11 million acres, comprising the Red Sea and the Mediterranean, and despite the large area they occupy, their fish production is still low compared to their area. The fisheries grounds in the Red Sea is 4.4 million acres, and its beaches extend a thousand kilometers long, including the areas of the Gulf of Suez in Suez Governorate, El-Tur, Dahab and Newibaa in South Sinai Governorate, and Hurghada, Safaga, El—Quseir, Berenis, Shalatein and Abo Ramad in the Red Sea Governorate **(Mehanna *et al.*, 2023)**.

The Gulf of Suez (Fig. 1), the northern part of the Red Sea, is considered to be one of the major sources of fish production in the Egyptian sector of the Red Sea and in Egypt. Its importance as a fish resource can be attributed to the shallowness and sandy bottom which make it suitable for trawling. Moreover, it is characterized by the presence of a great diversity of highly economic fish and invertebrate species **(Mehanna & El-Gammal, 2007; Mehanna, 1997, 2021)**.

The Egyptian coast of the Mediterranean Sea is about 1100km, extending from El-Arish in the East to El-Sallum in the West (Fig. 1). This distance is divided as 600km between El-Sallum and Alexandria with 10- 100m in depth, 300km from Alexandria to Port Said and 200km from Port Said to El-Arish. A maximum of 70 meters long is recorded in front of the Delta. According to GAFRD, the Mediterranean Sea‘s Egyptian coast is divided into four main fishing grounds namely, the western fishing ground which covers Alexandria and El-Mex, Abu-Qir, Rasheed or Rosetta, El-Maadiya and Mersa Matrouh landing sites. Additionally, the eastern fishing ground has two important landing sites: Port Said and El-Arish, then Demietta and the Nile Delta fishing grounds **(GAFRD, 2021)**.

Fig. 1. A map of the Red and Mediterranean Sea coasts with the chosen studied fishing grounds

Collection and investigation of fish samples

Samples were monthly collected from the Gulf of Suez and Alexandria landing sites during the period from January 2022 to December 2022. Samples were taken to the laboratory, accurately investigated for removing any other carrangid species in the samples and after classification. The *A. djedaba* samples were classified into length groups, and a subsample was taken from each length group. Finally, the following measurements were taken for each specimen; the total length "TL" (cm) and total weight "W" (g). The sex and maturity stage for each fish specimen were determined. Fish scales and otoliths were taken and preserved for use in age determination.

Length – weight relationship (LWR)

Length- weight relationship was calculated using the equation $W= a L^b$ **(Beckman, 1948)**, where W is the total body weight of the fish; L is the total length; a is the intercept of the regression curve, and b is the regression coefficient. a and b values were estimated by the least square method.

Age determination

The age was determined directly by the examination and counting of annual growth rings on otoliths of fish specimens. The total radius of the otolith "S" and the distance between the focus of the otolith and the successive annuli were measured. The relationship between otolith radius (S) and total fish length (TL) was determined according to the formula $TL = a + b (S)$. The back-calculated lengths at the end of each year of life were estimated by following **Lee (1920)** equation as follows:

$L_n = (L - a) S_n / S + a$, where L_n is the calculated length at the end of n^{th} year; L is the length at capture; S_n is the otolith radius to n^{th} annulus; S is the total otolith radius, and a is the intercept of the regression line with the Y-axis.

Growth parameters and growth performance index

Shrimp scad *A. djedaba* growth was described by the model of **von Bertalanffy (1938)** as $L_t = L\infty (1 - e^{-k(t-to)})$, where L_t= predicted length at time (t); L∞= asymptotic length or maximum attainable length; e= Base of the natural log t; t = Time; t_o = Age at zero length, and K= Growth coefficient.

Von Bertalanffy growth parameters L∞ and K were estimated by applying **Chapman (1961)** method. t_o was estimated from the following rearranged formula of the von Bertalanffy equation: $- \ln [1 - (L_t/L_\infty)] = - k*t_o + k*t$.

Pauly and Munro (1984) formula was applied to estimate the growth performance index as follows: $Ø' = Log_{10} K + 2 Log_{10} L_{\infty}$, where: $Ø'$ = Phi-prime, i.e. a length-based index of growth performance.

RESULTS AND DISCUSSION

Length frequency distribution

Total of 1160 and 795 length frequency data were collected from the Gulf of Suez and Alexandria, respectively. Length frequency data were assembled in two cm length classes interval ranging from 10 to 37.5cm in Gulf of Suez and from 11 to 31.3cm in the other site. The highest number of frequencies was observed from 10-25cm length class in the Gulf of Suez and from 11 to 22cm in Alexandria (Fig. 2). The maximum length in the present study (37.5cm in the Gulf of Suez and 31.3cm in Alexandria) was higher than that reported in Egypt in the studies of **El Aiatt (2018)**, who recorded 25.3cm in the Mediterranean Sea, Egypt, and **Quayed *et al.* (2022)**, who recorded 26.9 cm (TL) in North Sinai. On the other hand, **Bandkar *et al.* (2022)** observed a maximum length at 28.4cm in India. But the present observed maximum length is close to the findings of **Abdul Majeed *et al.* (2022)**, who recorded 38.5cm maximum length in Pakistan.

This study recorded the highest maximum length for shrimp scad in Egypt both in its native and non-native habitat. Moreover, the present results revealed that the maximum observed length for shrimp scad is significantly different between its native and non-native habitat.

Length – weight relationship (LWR)

Estimated length- weight relationship (Fig. 3) was applied for 1160 and 795 specimens of *A. djedaba* (combined sexes) from the Gulf of Suez and Alexandria, respectively. *A. djedaba* specimens varied in total lengths (TL) from 10 to 37.5cm and in total weights (W) from 14 to 565g in the Gulf of Suez. Whereas, in Alexandria, the total length varied from 11 to 31.3cm, and the total weight varied from 15 to 414g. The obtained LWR for *A. djedaba* was:

$W = 0.009 L^{3.0896}$ ($R^2 = 0.991$) in Gulf of Suez

$W = 0.0092 L^{3.0679}$ ($R^2 = 0.984$) in Alexandria

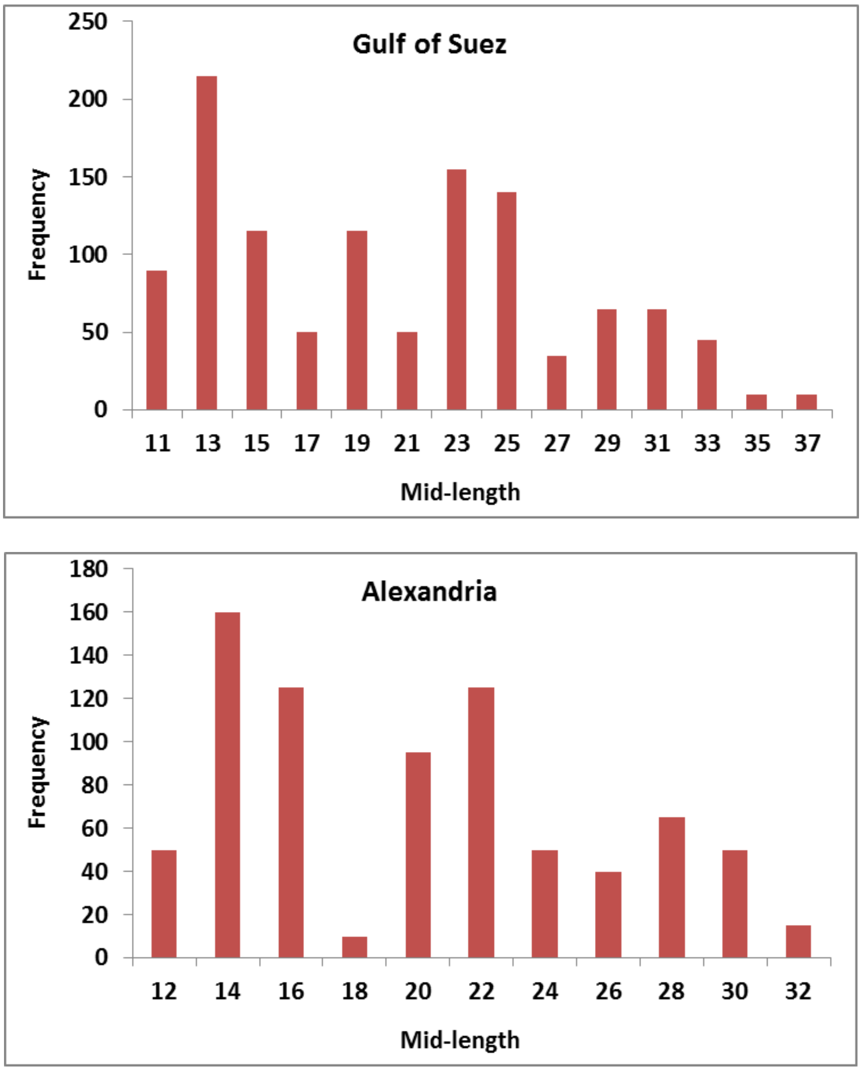

Fig. 2. Length frequency distribution of *Alepes djedaba* from its native and non-native habitats

The estimated b values indicated an isometric growth in pooled individuals and no significant difference was detected between the two areas. All R^2 values were > 0.90, indicating a strong effect of size or influence of the length on the weight in all groups. *A. djedaba* showed a difference in the slope value compared to the earlier results. **Shuaib and Ayub (2011)** reported a negative allometry in males and an isometry in females of *A. djedaba* from Karachi. **Sajana and Bijoy (2017)** reported that *A. djedaba* from Cochin coast exhibits an isometric growth based on the estimated b values. Moreover, negative allometry has been reported by **Osman and Al Abdulhadi (2011)** from the Arabian Gulf, **Taskavak and Biterceoglu (2001)** from the coast of Turkey, and **Siwat *et al.* (2016)** from Semerang waters. Isometric growth was reported in **Bandkar *et al.* (2022)** from India and **Quayed *et al.* (2022)** in Egypt (North Sinai). The b value in the present study is found to be in the expected range of 2.5 to 3.5 **(Froese, 2006)**. Variations in length-weight relationship can be ascribed to several factors such as sex, gonad maturity, fullness of stomach, sample size, size range covered and habitat **(Froese, 2006; Mehanna & Farouk, 2021)**.

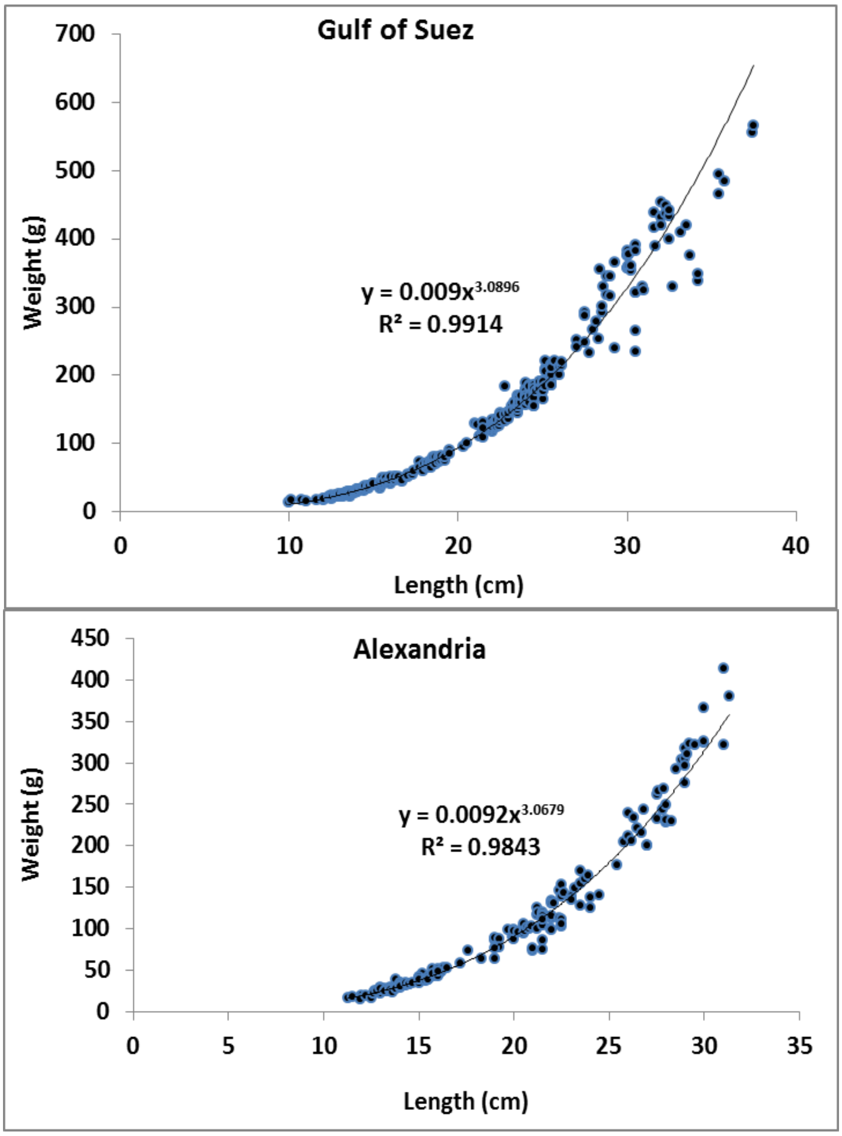

Fig. 3. Length– weight relationship of *Alepes djedaba* from its native and non-native habitats

Age and growth

Investigation of *A. djedaba* otoliths revealed that this fish population in the Gulf of Suez and Alexandria has a maximum life span of 6 and 5 years, respectively.

Growth values in length and weight at the end of each year of life are represented in Fig. (4). The mean back-calculated total lengths corresponding to various age groups for *A. djedaba* at Gulf of Suez were 14.67, 22.88, 30.24, 33.42, 35.79 and 36.93cm for 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, 5^{th} and 6^{th} year of life. While in Alexandria, the mean back-calculated total lengths corresponding to various age groups for *A. djedaba* were 14.44, 21.51, 27.12, 29.61 and 31.05cm for 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th} year of life. Additionally, the annual increment in length was at its maximum at the end of the first year of life (40% in the Gulf of Suez and 47% in Alexandria).

It is clear that the age and growth were significantly different between the native and non-native fishing areas, where the age and growth were higher in the Gulf of Suez than in Alexandria.

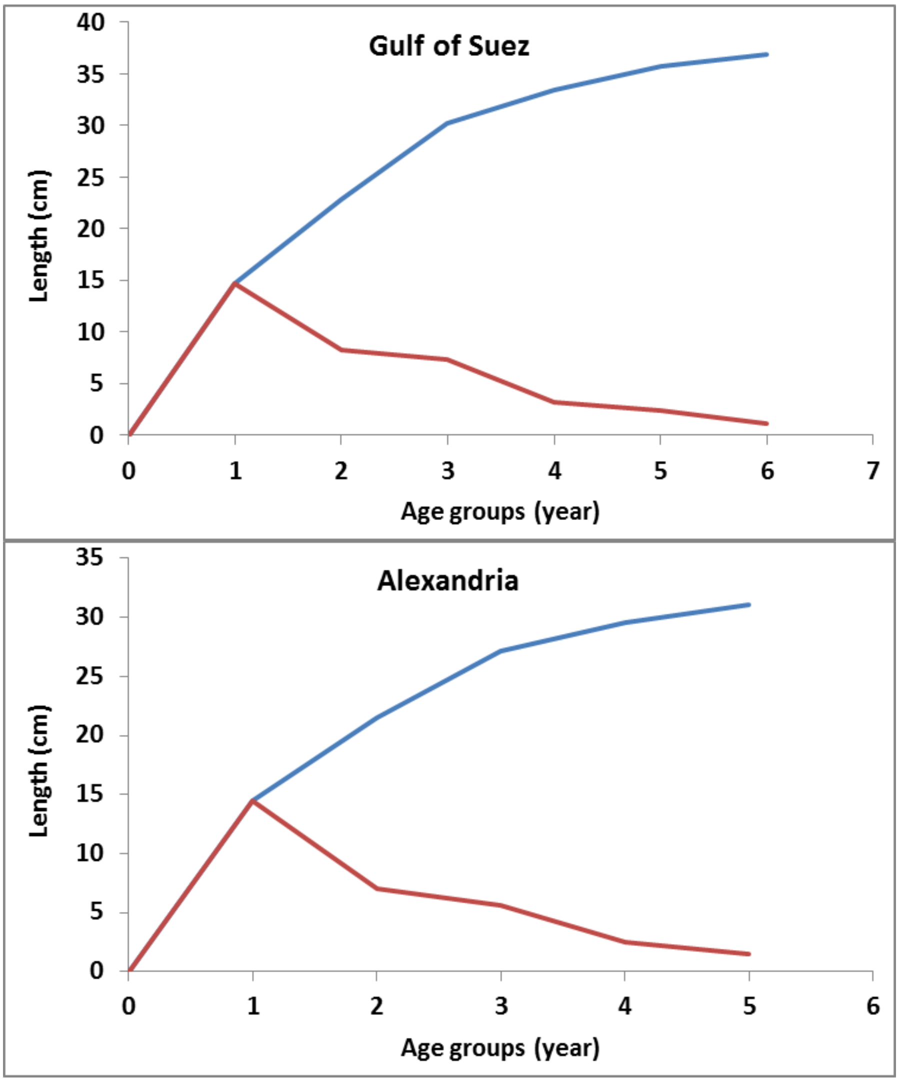

Fig. 4. Growth in length and the annual growth increment of *Alepes djedaba* from native and non-native habitats

On the other hand, the estimated growth parameters (L∞ & K) using **Chapman (1961)** method for combined data of *A. djedaba* in the Gulf of Suez and in Alexandria, as well as the value of t_0 estimated from von Bertalanffy plot (Fig. 5) were embedded in von Bertalanffy's growth model, and the obtained equations were as follows:

In the Gulf of Suez

For growth in length: $L_t = 40.01\ (1\text{-}e^{-0.43(t+0.097)})$

For growth in weight: $W_t = 802.24\ (1\text{-}e^{-0.42\ (t+1.07)})^{3.0896}$

In Alexandria

For growth in length: $L_t = 34.05\ (1\text{-}e^{-0.48(t+0.175)})$

For growth in weight: $W_t = 461.50\ (1\text{-}e^{-0.48(t+0.175)})^{3.0679}$

In the present study, the von-Bertalanffy growth parameters of *Alepes djedaba* were the highest in the Egyptian waters. **Akel (2005)** determined L∞ = 33.2cm and K= 0.24yr^{-1}. **El-Aiatt (2018)** gave growth parameters as L∞ = 26.94cm and K=

$0.29yr^{-1}$. **Quayed *et al.* (2022)** estimated L∞ = 29.26cm, K= $0.189yr^{-1}$, t_0 = -1.99yr. On the other hand, the growth parameters were estimated in different localities rather than Egypt. **AbdelBarr *et al.* (2014)** in the Arabian Gulf estimated L∞ = 41.7cm, K= $0.36yr^{-1}$, and t_0= -0.76yr.

The estimated growth parameters of the present study were easily compared to those of previous studies of the same species in different regions by using the growth performance index (Ø'). This index is used to measure the overall growth performance. The present study reported that Ø' of *A. djedaba* in the Gulf of Suez was 2.84 and in Alexandria it was 2.74. The Ø' values of the present study are the highest compared to all previous studies, confirming the suitability of native habitat more than its non-native habitat**.**

CONCLUSION

Shrimp scad, *Alepes djedaba* has an economic importance in the Egyptian Red Sea fisheries. Beside its importance in its native areas, the shrimp scad is an invasive species, spreading throughout the Mediterranean coasts of Egypt and countless Mediterranean countries, and also became an important source for food in its new habitats. This study compared some biological and dynamical aspects of the shrimp scad populations between the Gulf of Suez, the northern Red Sea as its native habitat, as well as Alexandria and the Mediterranean Sea as its new habitat. The present results revealed that the population of shrimp scad in the Gulf of Suez, the Red Sea differs from the population in the Mediterranean Sea, with respect to the maximum recorded length, age and growth rate. This may be traced back to the difference in the ecological parameters, especially temperature and salinity, as well as food availability. This differentiation needs detailed phenotypic analysis to show any variations in the population. The results presented here would be an important baseline for the fishery scientists when they study a migrant species.

REFERENCES

AbdelBarr, M.; Osman, A. M. and Al-Abdullauh, H. A. (2014). Fisheries studies and stock evaluation of shrimp scad, *Alepes djedaba* (Teleostei: Carangidae) caught from Arabian Gulf, J. Coastal Life Med., 2(3): 203-208.

Abdul Majeed; Liang, Z.; Zhu, L.; Liu, C.; Kalhoro, M. A. and Saeed, F. (2022). Stock Analysis of Shrimp Scad (*Alepes djedaba*) Fishery from Northern Arabian Sea, Balochistan Coast, Pakistan. Pakistan J. Zool., 54(5): 2203-2212.

Akel, E. H. (2005). Growth, mortality and yield per recruit of shrimp scad *A. djedaba* from Abo quir Bay eastern Alexandria, Egypt. Eypt. J. Aqu. Biol. and Fish, 9 (4): 145-160.

Quayed, W.; Hassanan, G. D.; Ahmed, M. S. and El-Aiatt, A. O. (2022). Some biological aspects of shrimp scad, *Alepes djedaba* (Forsskal, 1775) landing at north coast Sinai, Mediterranean Sea, Egypt. Sinai Journal of Applied Sciences 11 (3): 463-476.

Artüz, M. L. and Kubanç, N. (2014). First record of shrimp scad *Alepes djedaba* (Carangidae) from the Sea of Marmara, Turkey. Cybium, 38(4): 319-320.

Bandkar, D. S.; Nirmale, V. H.; Metar, S. Y. and Pawar, R. A. (2019). Estimation of population parameters of shrimp scad, *Alepes djedaba* (Forsskål, 1775) along the Ratnagiri coast of Maharashtra, India. J. Indian Fish. Ass., 46(1): 67-73.

Bandkar, D. S.; Nirmale, V. H.; Gurjar, U. R.; Metar, S. Y.; Pawar, R. A. and Chogale, N. D. (2022). Reproductive biology and feeding dynamics of the shrimp scad *Alepes djedaba* (Forsskal, 1775) from Ratnagiri, central west coast of India J. Indian J. Fish., 69(1): 37- 44.

Beckman, W. C. (1948). The length – weight relationship, factor for conversions between standards and total length and coefficient of condition for seven Michigan fishes. Trans. Amer. Fish. Soc., 75: 273-256.

Bertalanffy, von, L. (1938). A quantitative theory of organic growth (Inquiries on growth Laws. 2). Human Biology, 10: 181- 213.

Carpenter, K. E. and Volker, H. N. (2001). FAO species identification guide for fishery purposes.The living marine resources of the Western Central Pacific. Volume 5. Bony fishes part 3

Chapman, D. G. (1961). Statistical problems in dynamics of exploited fisheries populations. Proc. 4th Berkeley Symp. Math. Stat. Prob. Cont. Biol. Prob. Med., 4: 153-168.

Chu, W. S.; Wang, J. P.; Hou, Y. Y.; Ueng, Y. T. and Chu, P. H. (2011). Length-weight relationships for fishes off the southwestern coast of Taiwan. Afr. J. Biotechnol., 10 (19): 3945-3950.

El-Aiatt, A. O. (2018). Growth, mortality and yield per recruit of the shrimp scad (*Alepes djedaba*) from Mediterranean Sea coast of sinai Egypt. Abbassa Int. J. Aquacul., 11 (1): 86-108.

Froese, R. (2006). Cube law, condition factor and weight-length relationships: History, meta analysis and recommendations. J. Appl. Ichthyol., 22(4): 241-253. https://doi.org/10.1111/j.1439-0426.2006.00805.x

GAFRD (2021). Annual statistical report of the General Authority for Fish Resources Development, Egypt.

Golani, D. (1993). The sand shore of the red sea-launching pad for lessepsian (Suez Canal) migrant fish colonizers of the eastern Mediterranean sea. J. Biogeoger, 20: 579-85.

Iwatsuki, Y. and Kimura, S. (1996). First record of the carangid fish, *Alepes djedaba* (Forsskal) from Japanese waters. Ichthyol. Res., 43 (2): 182-185.

Kulbicki, M. G.; Mou, P. and Wantiez, T. (1993). Length weight relationship of fishes from Lagoon of New Caledonia. Naga ICLARM Quart., 16: 26-29.

Lee, R. M. (1920). A review of the methods of the age and growth determination in fishes by means of scales. Fish, Invest. Ser., London, 2 4 (2): 1-32.

Mehanna, S. F. (1997). A biological and dynamical study on fish population of *Lethrinus mahsena* in Gulf of Suez, Egypt. Ph.D. Thesis. Faculty of science. Zagazig University. Benha Branch. Egypt.

Mehanna, S. F. (2015). The positive impacts of the Lessepsian migration in Egypt. MedCoast Annual Conference, Bulgaria, 5-7, October, 2015.

Mehanna, S. F. (2018). Population dynamics of two Lessepsian migrant goatfish species; *Upeneus pori* and *Upeneus moluccensis* from the southeastern Mediterranean, Port Said region, Egypt. First Euro-Mediterranean Conference for Environmental Integration, 22-25 November, 2017, Sousse, Tunisia (Springer).

Mehanna, S. F. (2021). The Lessepsian immigrant fish species, is it a national disaster or a national wealth. Tropentag 2021 “Towards shifting paradigms in agriculture for a healthy and sustainable future” September 15 - 17, 2021, Hohenheim Univ., Germany.

Mehanna, S. F. (2021). Egyptian Marine Fisheries and its sustainability, pp. 111-140. In: Sustainable Fish Production and Processing (Ed. Galanakis, Ch. M.). Academic Press, Elsevier, 325 p.

Mehanna, S. F. and El-Gammal, F. I. (2007). Gulf of Suez fisheries: current status, assessment and management. JKAU: Mar. Sci., 18: 3-18.

Mehanna, S. F.; Ali, M. M. and Abdella, A. N. E. (2023). Evaluation of fishery status and some biological aspects of striped piggy, *Pomadasys stridens* from Gulf of Suez, Red Sea, Egypt. Egyptian Journal of Aquatic Biology & Fisheries, 27(6): 791 – 803.

Mehanna, S. F. and Hassanien, E. M. (2020). Lessepsian Migration with the First Record of the Red Sea Goatfish, *Parupeneus forsskali* (Fourmanoir & Guézé, 1976) in the Coastal Waters of Egyptian Mediterranean Sea. In: Advances in Agriculture and Fisheries Research Vol. 1. DOI: 10.9734/bpi/aafr/v1

Mehanna, S. F. and Farouk, A. (2021). Length weight relationship of 60 fish species from species from the eastern Mediterranean Sea, Egypt (GFCM-GSA 26) Front. Mar. Sci. doi: 10.3389/fmars.2021.625422

Nelson, J. S. (2006). Fishes of the world, 4th edn. John Wiley and Sons Inc., Hoboken, New Jersey, USA, 362 p.

Osman, A. M. and Abdulhadi, H. A. (2011). some aspects of reproductive biology of *Alepes djedaba* (Teleosti: Carangidae) in Arabia Gulf. Egypt. J. Aquatic Res., 37 (3): 267-274.

Parsa, M. and Khoshdarehgi, M. (2017). Length weight relationship of five fish species from Carangidae family in waters of the northern Persian Gulf, Iran. J. appl. Ichthyol., 33: 1055-1057. https://doi.org/10.1111/jai.13422

Pauly, D and Munro, J. L. (1984). Once more on the comparison of growth in fish and invertebrate. Int. Living Aqua. Res. Manag. Fishbyte, 2 (1): 21 pp.

Rajan, P. T. (2018). Biodiversity and Climate Change Adaptation in Tropical Islands, Academic Press. 805 p. ISBN: 978-0-12-813064-3. Chapter 11 - Marine Fishery Resources and Species Diversity of Tropical Waters. pp.323-354.

Raje, S. G. (1993). Some aspects of biology of *Alepes djedaba* (Forsskal) from Verval, Gujarat, Indian J. Fish., 40: 189-192.

Sajana, N. and Bijoy, N. S. (2017). Morphometry, length-weight relationship and relative condition factor of shrimp scad *Alepes djedaba* (Forsskal, 1775) off Cochin Coast, Kerala. J. Aqua. Biol. Fish., 5: 160-167.

Sajana, N.; Bijoy, N. S. and Radhakrishnan, C. K. (2019). Feeding behaviour and reproductive biology of the shrimp scad *Alepes djedaba* (Forsskal, 1775) off Cochin coast, Kerala, south India. Indian J. Fish., 66(3): 32-40.

Sajana, N. and Nandan, B. S. (2017). Morphometry, length-weight relationship and relative condition factor of shrimp scad *Alepes djedaba* (forsskal, 1775) off Cochin coast, kerala. J. Fisheries, 5: 160-167.

Schoeder, R. E. (1982). Length weight relationship of fishes from Honda Bay, Palawan Philippines. Fish. Res. J. Phillip., 7: 50-53.

Shuaib N. and Ayub Z. (2011). Length-weight relationship, fecundity, sex-ratio and gonadal maturation in shrimp scad, *Alepes djedaba* (Forsskal 1975), landing at Karachi Fish Harbour, Karachi, Pak. First Int. Fisheries Symposium, 10-16.

Sivakami, S. (1990). Observations on some aspects of biology of *Alepes djedaba* (Forsskal) from Cochin. J. Marine Biol. Ass. India, 32: 107- 118.

Siwat, V.; Ambariyanto, A. and Widowati, I. (2016). Biometrics of bigeye scad, *Selar crumenophthalmus* and shrimp scad, *Alepes djedaba* from Semarang waters, Indonesia. Aquac. Aquar. Conser. Legis, 9(4): 915-922.

Taskavak, E. and Bilecenoglu, M. (2001). Length–weight relationships for 18 Lessepsian (Red Sea) immigrant fish species from the eastern Mediterranean coasts of Turkey. J. Mar. Biol. Ass. U.K., 81: 895-896.

Vonklauss, S.; Ambariyanto, A. and Widowati, I. (2016). Biometrics of bigeye scad, *Selar crumenophthalmus* and shrimp scad, *Alepes djedaba* from Semarang waters, Indonesia. AACL Bioflux, 9: 915-922.