VOL.65 NO.02 JULY-DECEMBER 2023 • PRINT ISSN 0025-3146 • ONLINE ISSN 2321-7898

JMBAI

JOURNAL OF THE MARINE BIOLOGICAL ASSOCIATION OF INDIA

ESTD.1958
MBAI
Marine Biological Association of India
सी एम एफ आर आइ
CMFRI

Available online at: www.mbai.org.in doi:10.6024/jmbai.2023.65.2.2372-14

Preliminary observation on the stock of *Jinga* shrimp, *Metapenaeus affinis* (H. Milne Edwards, 1837) along the Ratnagiri coast of Maharashtra, India

S. J. Dongre[1], S. Y. Metar[2*], V. H. Nirmale[1], N. D. Chogale[2], S. D. Naik[1] and S. S. Gangan[3]
[1]College of Fisheries, Ratnagiri- 415 629, Maharashtra, India.
[2]Marine Biological Research Station, Zadgaon, Ratnagiri-415 612, Maharashtra, India.
[3]Taraporewala Marine Biological Research Station, Mumbai-400 051, Maharashtra, India.

*Correspondence email: santoshmetar@gmail.com

Received: 27 June 2022 Revised: 10 Nov 2022
Accepted: 21 Nov 2022 Published: 13 Nov 2023

Short Communication

Abstract

Growth and mortality parameters of Jinga shrimp, *Metapenaeus affinis* were estimated based on length frequency data collected from March 2018 to February 2019 from the Arabian Sea coast of Ratnagiri, Maharashtra, India. The asymptotic length (L_∞) and growth coefficient (K) were estimated to be 180 mm and 1.8 per year, respectively by ELEFAN and t_0 0.0055 year by the von Bertalanffy plot. This species attains a size of 65, 106, 133, 150 and 161 mm at the end of three, six, nine, twelve and fifteen months, respectively. Mortality parameters Z, M and F were estimated as 7.2, 3.02 and 4.18 respectively. The length at first capture for *M. affinis* was 119 mm. The present exploitation ratio and exploitation rate was 0.58. Therefore, the present study suggests reducing the fishing pressure on *M. affinis* along the Arabian Sea coast of Ratnagiri, Maharashtra, India, for the sustainability of the resource.

Keywords: *Metapenaeus affinis, growth, mortality, exploitation, length frequency, shrimp trawl*

Introduction

Metapenaeus affinis (H. Milne Edwards, 1837) popularly known as Jinga shrimp is a marine crustacean in the family penaeidae of class malacostraca under order decapoda. Penaeid shrimps are widely distributed in tropical and sub-tropical areas around the world. They are particularly abundant in southeast Asia, India, the Gulf of Mexico, Australia and the Persian Gulf (Fischer and Bianchi, 1984*).* The genus *Metapenaeus* is characterised by the pubescent body having a rostrum toothed dorsally. The blunt orbital spine, antennal and hepatic spines are prominent in the carapace. Also, the merus contains a proximal notch followed by a distal conspicuous knob or spiniform process *i.e.* exopod lacking on the fifth pereopod (Fischer and Bianchi, 1984*). M. affinis* is one of the dominant and highly valued penaeid shrimps along the coastal waters of Maharashtra. In Indian waters, it is caught up to depths of about 20 -70 m. Trawlers are the main gear used to capture *M. affinis* along with artisanal gears. They are marketed fresh, frozen, dried or peeled and cooked. It is distributed throughout the west and east coasts of India and Andaman waters, with major landings from Maharashtra and Kerala. The fishery is chiefly bimodal and dominated by large-size groups early in the season and smaller-size groups later (Ramamurthy *et al.*, 1975; Deshmukh *et al.*, 2001).

Landings of penaeid shrimps showed phenomenal fluctuations in the last decade as the landings in 2008 were 43,695 tonnes and gradually dropped to 37,642 tonnes in 2019, as a result, its contribution declined from 13.1 to 10.8% in the total marine landings of Maharashtra (CMFRI, 2008, 2020).

The present study was undertaken to estimate the growth and mortality parameters required for assessing the status of *M. affinis* stock in the Arabian Sea, western coast of India and to provide the information needed for management purposes.

Material and methods

Length frequency

The sampling was done from commercial demersal shrimp trawl catches during the daytime at weekly intervals from March 2018 to February 2019. A total of 3772 individuals ranging in the size group of 85 to 174 mm total length (TL) from the Mirkarwada landing centre, Ratnagiri (16.98º N, 73.30º E) were measured for length frequency analysis (Fig. 1). TL was measured from the anterior tip of the rostrum to the extremity of the telson for each specimen using a fish measuring board for estimation of length-frequency distribution. Strict care was taken to only measure the specimens with intact rostrum and telson. No sex segregation was done while measuring the lengths of individuals. All TL measurements were taken up to the nearest millimetre. The length frequency data were grouped into 5 mm class intervals. The day's catch was divided by sample weight and the resultant factor was multiplied by the actual numbers measured and distributed in each group. This way the samples were raised to obtain per-day catch. The length frequencies of all four days of observation in a month were pooled and multiplied by the monthly raising factor to obtain the monthly catch (Sekharan, 1962). This pooled data was used for the estimation of growth, mortality and exploitation levels.

Growth parameters

The asymptotic length ($L\infty$) and growth coefficients (K) were estimated by FiSAT (FAO-ICLARM Stock Assessment Tools) computer software package developed by Gayanilo *et al.* (1996). The estimation of age at length zero *t0* and length at age data was done using the von Bertalanffy growth equation (Von Bertalanffy, 1938).

$$-\ln(1- Lt/ L\infty) = -K^* t0 + K^*t\ t = t0- (1/K) * \ln(1Lt/L\infty)$$

Mortality parameters and exploitation status

The total instantaneous mortality rate (Z) was calculated using FiSAT software following the length-converted catch curve (Pauly, 1983 and 1984).

The natural mortality coefficient was estimated by Pauly's method as per Pauly (1980) and given as:-

$$\ln(M) = -0.0152 - 0.279 \ln(L\infty) + 0.6543 \ln(K) + 0.463 \ln(T)$$

Fishing mortality (F) was determined using the relationship, F= Z-M., where Z is the total mortality coefficient, and M is the natural mortality coefficient. The exploitation ratio (E), defined as the fraction of year class recruits *i.e.,* being caught during all the years of its existence (Ricker, 1975) was estimated as:

$$E = F/Z$$

The exploitation rate (U) is defined as a fraction of shrimps present at the beginning of a year *i.e.*, being caught during the year (Gulland, 1971). Thus 'U' was estimated by the following formula,

$$U = (F/Z) * (1- e^{-Z}).$$

Length at first capture

The length at first capture (L_c) of *M. affinis* by trawl net was estimated and the selection curve was plotted using FiSAT software.

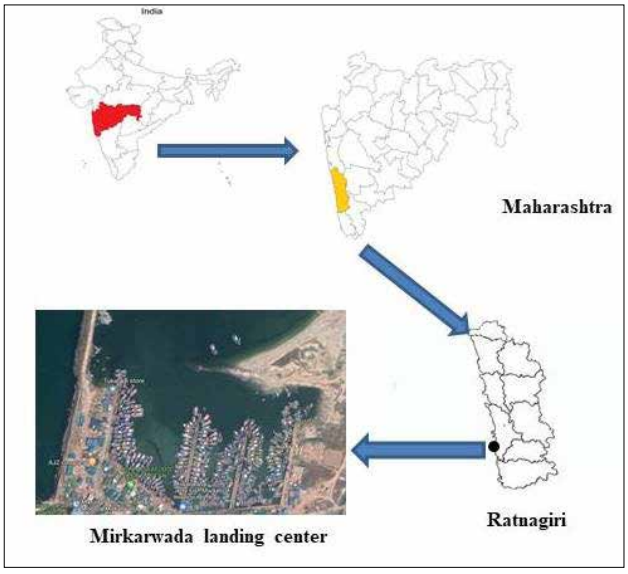

Fig. 1. Study area showing sampling location of Mirkarwada, Ratnagiri

Results and discussion

Growth parameters

A total of 3772 individuals in the length range 85-174 mm was studied for length frequency analysis for a period of ten months from March 2018 to February 2019 (Fig. 2). The growth parameters, $L\infty$ and K were estimated at 180 mm and 1.8 per year respectively for *M. affinis* by ELEFAN-I employing FiSAT software (Fig. 3). The t_0 estimated by VBGF plot was found to be–0.0055 year and t_{max} was estimated as 1.89 yr. Leena and Deshmukh (2009) studied the age and growth of *M. affinis* along the

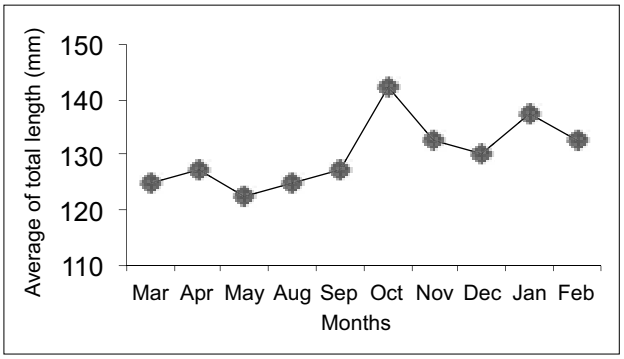

Fig. 2. Length frequency distribution of *M. affinis* during the study period

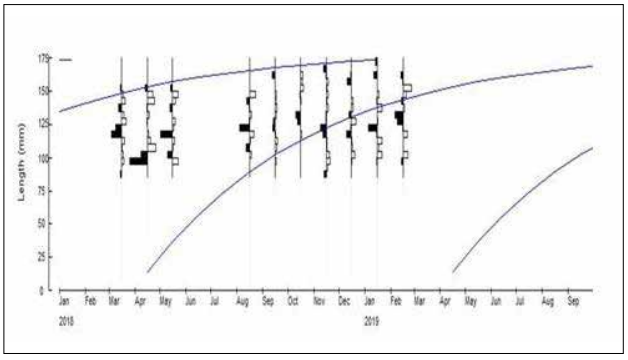

Fig. 3. Modal progression analysis of length frequencies observed by using ELEFAN

Mumbai coast. They estimated the growth parameters for males and females by employing modal progression and a computer-based FiSAT software package. The parameters were estimated as L_∞ = 162 mm, K = 2.25 for males and L_∞ = 204 mm, K = 1.91 for females. Ramamurthy *et al.,* 1975 estimated L_∞, K and t_0 along the Mangalore coast as 174 mm, 0.07, 1.7 yr and 188 mm, 0.06, 0.17yr respectively for males and females of the species. These values were more or less similar to those estimated for the same species in different areas (Table 1).

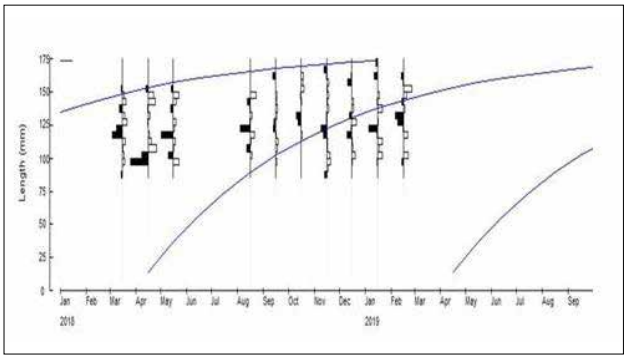

Fig. 4. Growth curve (Length at age for *M. affinis*)

Length at age

The present study indicates that *M. affinis* attains a length of 65, 106, 133, 150 and 161 mm length at the end of the 3rd, 6th, 9th, 12th and 15th month, respectively (Fig. 4). The maximum size recorded during the study period was 174 mm, at an estimated age of 1.88 years. Chakraborty *et al.* (2014) stated that the lengths for 6, 12 and 24-month-old females were 98, 122 and 130 mm respectively, whereas the corresponding lengths of males were 69, 92 and 102 mm for *M. dobsoni.* The results of the present study are comparable with the findings of Leena and Deshmukh, 2009, for *M. affinis* which was reported as 145 mm and 174 mm at the end of one year and their life spans as 1.16 and 1.4 years respectively for males and females.

Mortality parameters

The estimated values for total mortality (Z), natural mortality (M) and fishing mortality (F) coefficients were 7.2, 3.02 and 4.18 y^{-1} (Fig. 5),

Table 1. Growth parameters of *M. affinis* from different localities

Locality	$L_{\infty\ (mm)}$	K (/year)	t_0	Authors
Kerala, India	M=151.5	1.5	-	Chakraborty *et al.* (2014)
	F=188.8	1.47	-	
Mumbai coast, India	M=162	2.25	-	Leena and Deshmukh (2009)
	F=204	1.91	-	
Khoozestan, Iran	M=135.4	1.8	-0.1075	Ansari *et al.* (2014)
	F=156.7	2.1	0.088	
Kotabatru waters, Indonesia	M=103	2.01	-0.00018	Tirtadanu *et al.* (2017)
	F=130	2.51	-0.000046	
Gujarat, India	M=185.5	1.9	-0.001	Dash *et al.* (2018)
	F=204.75	1.7	-0.001	
Ratnagiri coast, India	180	1.8	-.0055	Present study

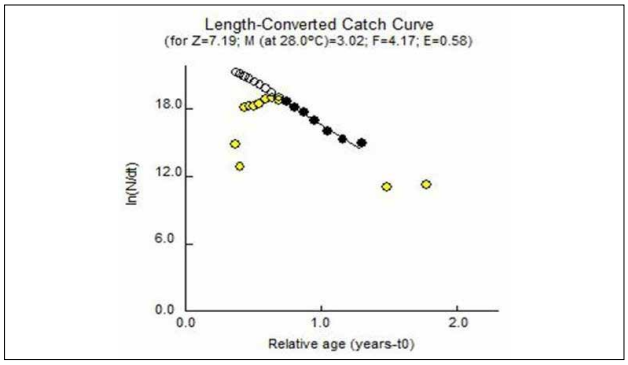

Fig. 5. Total mortality coefficient by length converted catch curve

respectively in the present study whereas on the Mumbai coast, total mortality (Z) was estimated as 13.06 and 7.18 yr^{-1} for males and females respectively by length converted catch curve method (Pauly, 1984). Natural mortality (M) was estimated as 3.62 and 3.05 yr^{-1} for males and females, and fishing mortality (F) as 4.13 yr^{-1} respectively (Leena, 2003). Gerami *et al.* (2012) studied the mortality parameters of *M. affinis* in the Hormozgan Province, Iran. Z, M and F were estimated (4.04, 1.95908 and 2.08 yr^{-1}) for males and (4.93, 1.74954 and 3.18 yr^{-1}) for females, respectively.

Chakraborty *et al.* (2014) studied the mortality parameters of *M. dobsoni* from the Kerala coast. M, F, and Z, were estimated as 2.17, 5.57, 7.74 and 2.00, 5.83, 7.83, yr^{-1} for males and females, respectively. Dash *et al.* (2018) studied the mortality parameters of *M. affinis* in Gujarat waters. Z, M, and F estimated were 8.37, 2.926 and 5.45 yr^{-1} for males and 6.76,2.61 and 4.15 yr^{-1} for females respectively. The increase in F value is observed in the present study than the previous years and locations. Most of the penaeid fisheries around the world have high fishing mortalities due to high demand and thus show high Z values. F value is affected by fishing effort and the catchability coefficient that is used in specific regions (Sparre and Venema, 1998). So, F may be different between fishing areas or at different times in the same fishing area. However, the values of natural mortality may change to the varying levels of water temperature, predation, salinity and any other natural cause (Allen and Hightower, 2010), as observed in the present investigation.

Exploitation ratio and rate

The exploitation ratio (E) was estimated at 0.58 for *M. affinis.* and the exploitation rate (U) was estimated as 0.58. Thus it can be said that the stock along the Ratnagiri coast, is overfished. To sustain the yield of *M. affinis* the exploitation level needs to be reduced from the current level of 0.58 to below 0.5. Leena (2003) estimated the exploitation ratio of *M. affinis* along the Mumbai coast of India. The E of the two sexes was estimated as 0.72 and 0.58 for males and females respectively. Ravangave (2014) studied the exploitation ratio of *P. stylifera* along the Ratnagiri coast. The exploitation rate (U) was calculated as 0.76 and the exploitation ratio (E) was 0.76 for *P. stylifera.* Dash *et al.* (2018) studied the exploitation rate of *M. affinis* in Gujarat waters. The current exploitation rate (E_{cur}) was 0.65 and 0.61 for males and females respectively. Thus similar results have been found in the present study compared to earlier findings. Short-lived species such as Jinga shrimps with high fecundity can produce large numbers of pre-recruits when environmental conditions are suitable (King, 1995). Therefore, it is not important to establish E=0.5 during the fishing season. However, it is important to limit fishing in a fishing season and/or breeding area and reduce efforts to get a sustainable catch.

Length at first capture

In the present study, the length at which 50% of the species became vulnerable to the gear was found to be 119 mm (Fig. 6). Any further reduction in cod end mesh size of trawlers will influence the gear selectivity and might lead to growth overfishing in the region. Leena (2003) studied the length at first capture for *M. affinis* along the Mumbai coast of India. She estimated LC_{50}% as 113.69 and 115.21 mm for males and

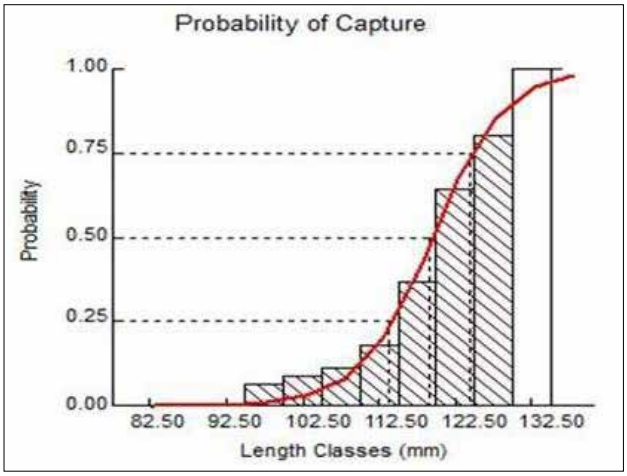

Fig. 6. Length at first capture of *M. affinis*

females, respectively. Dash *et al.* (2018) studied the length at first capture for *M. affinis* in Gujarat waters, India. He stated that 50% of the shrimp in the stock become vulnerable to gear (LC_{50} %) at the TL of 123.75 mm for male shrimps and 135.55 mm for female shrimps. The estimated LC_{50} % value confirms with the other regions.

Conclusion

The results of the present study reveal the stock *M. affinis* from the Arabian Sea off Maharashtra to be overexploited. To sustain the yield of *M. affinis* from the Ratnagiri coast, the exploitation

level needs to be reduced from the current level of 0.58 to 0.5. However, it may not be possible in multi-gear, multispecies tropical fishery. Thus some management measures are necessary to sustain the stocks of *M. affinis* along the Arabian Sea coast of Maharashtra.

Acknowledgements

The authors are grateful to the Associate Dean, College of Fisheries, Ratnagiri, for the encouragement and facilities provided.

References

Allen, M. S. and J. E. Hightower. 2010. Fish population dynamics: Mortality, growth, and recruit ment, In: W. A. Hubert and M. C. Quist (Eds.). Inland Fisheries Management in North America, 3rd Edition. American Fisheries Society, Washington. p. 43-79.

Ansari, H., M. Khodadadi and G. Eskandari. 2014. Growth and mortality Parameters of Jinga Shrimp (*Metapenaeus affinis* - H. Milne Edwards, 1837) in western coast of Khoozestan Province*, J. Mar. Biol.*, 23: 1-12.

Bertalanffy, L. von. 1938. A quantitative theory of organic growth (inquiries on growth laws. II.). *Human Biol.*, 10: 181-213.

Chakraborty, R. D., G. Nandakumar, G. Maheswarudu and K. Chellapan. 2014. Fishery, biology and population dynamics of *Metapenaeus dobsoni* (Miers 1878) from Kerala, south-west coast of India. *Indian J. Fish.*, 61 (4): 42-47.

Chakraborty, S. K., V. D. Deshmukh, M. Z. Khan, K. Vidyasagar and S. G. Raje. 1997. Estimates of growth, mortality, recruitment pattern and maximum sustainable yield of important fishery resources of Maharashtra coast, *Indian J. Mar. Sci.,* 26: 53-56.

CMFRI. 2008. Annual report, Central Marine Fisheries Research Institute, Kochi, 297 pp.

CMFRI. 2020. Annual report, Central Marine Fisheries Research Institute, Kochi, 123 pp.

Dash, G., M. Koya, S. Sen, K. R. Sreesanth, V. K. Vase, R. K. Pradhan, K. Sukhdhane, D. Divu, V. Solanki and G. Maheswarudu. 2018. Fishery, population dynamics and stock status of Jinga shrimp, *Metapenaeus affinis* (Milne-Edwards, 1837) from Gujarat waters of India*, Indian J. Geo. Mar. Sci.*, 47 (11): 2267-2277 .

Deshmukh, V. D., D. S. Patkar and P. C. Karnik. 2001. Penaeid prawn fishery and its maximum sustainable yield at Versova, Mumbai. *Indian J. Fish.*, 48 (2): 165-175.

Fischer, W. and G. Bianchi. 1984. FAO species identification sheets for fishery purposes. Western Indian Ocean (Fishing Area 51). Prepared and printed with the support of the Danish International Development Agency (DANIDA). FAO, Rome. 1-6: pag. var.

Gayanilo, F. C., P. Sparre and D. Pauly. 1996. FAO-ICLARM Stock Assessment tools (FiSAT) users' guide, FAO computerised information series No. 8 (Fisheries) (FAO; Rome). 124 pp.

Gerami, M. H., R. Ghorbani, S. Y. Paighambari and M. Momeni. 2012. Population structure, growth and mortality rates of Jinga Shrimp, *Metapenaeus affinis* in fishing grounds of Hormozgan Province, Iran, Caspian *J. Appl. Sci. Res.,* 1 (8): 29-35.

Gulland, J. A. 1971. Fish Resources of the Ocean. West Byfleet, Surrey, Fishing News (Books) Ltd, for FAO: 255 pp.

King, M. 1995. Fisheries Biology, Assessment and Management. Oxford, UK, Fishing News Books. Blackwell Science Ltd. 342 pp.

Leena, K. 2003. *Reproductive dynamics of Metapenaeus affinis in Mumbai waters*, Ph. D. thesis, CIFE, 233 pp.

Leena, K. and V. D. Deshmukh. 2009. Age and growth of Jhinga prawn *Metapenaeus affinis* Milne Edwards (Decapoda, Penaeidae) in Mumbai waters. *Indian J. Fish.,* 56 (1): 1-5.

Pauly, D. 1980. On the interrelationships between natural mortality, growth parameters and mean environmental temperature in 175 fish stocks. *J. Cons. CIEM.,* 39 (3): 175-192.

Pauly, D. 1983. Some simple methods for the assessment of tropical fish stocks. *FAO Fish. Tech. Pap.*, 234: 1-52.

Pauly, D. 1984. Length converted catch curve, a powerful tool in fisheries research in the tropics (part-II). *ICLARM FishByte.* 2 (1): 17-19.

Ramamurthy, S., N. S. Kurup and G. G. Annigeri. 1975. Studies on the fishery of the penaeid prawn *Metapenaeus affinis* (Milne Edwards) along the Mangalore coast. *Indian J. Fish.,* 22 (1&2): 243-254.

Ravangave, R. 2014. Study on the biology of tiny shrimp *Parapeneopsis stylifera* (H. Milne Edwards, 1837) along the Ratnagiri coast of Maharashtra, M.F. Sc., Dissertation, Dr. B. S. K. K.V., Dapoli, India, 54 pp.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. *Bull. Fish. Res. Board. Can.*, 191: 1-382.

Sekharan, K. V. 1962. On the oil sardine fishery of the Calicut area during the years 1955-56 to 1958-59. *Indian J. Fish.*, 9 (2): 679-700.

Sparre, P. and S. C. Venema. 1998. Introduction to tropical fish stock assessment, Part 1. Manual. FAO Fisheries Technical Paper, No. 306.1, Rev. 2. Rome, FAO. 407 pp.

Tirtadanu, S., S. Suprapto and D. A. Suman. 2017. Biological aspects and population parameters of Jinga shrimp (*Metapenaeus affinis,* H. Milne Edwards, 1837) in Kotabaru waters, south of Kalimantan, e-J. *Bawal Widya Riset Perikanan Tangkap.*, 9 (1): 11-20.