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Assessment of three nemipterid stocks based on trawl surveys in the Gulf of Suez, Red Sea

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ABSTRACT

The population structure of three Nemipterid species (*Nemipterus japonicus*, *Nemipterus bipunctatus* and *Nemipterus zysron*) from the Gulf of Suez was investigated. A total of 3663 specimens (2597 *N. japonicus*, 576 *N. bipunctatus* and 490 *N. zysron*) were collected during the fishing season 2014/2015 in the Gulf of Suez. The maximum life span estimated from otolith reading was 5 years for *N. japonicus* and *N. bipunctatus* while, it was 4 years for *N. zysron*. The parameters of von Bertalanffy growth equation were L_∞ = 31.66 cm, K = 0.24 year^{-1} and t_o = −1.2 year for *N. japonicus*; L_∞ = 29.55 cm, K = 0.26 year^{-1} and t_o = −1.2 year for *N. bipunctatus* and were L_∞ = 24.69 cm, K = 0.38 year^{-1} and t_o = −0.84 year for *N. zysron*. The estimated exploitation rate for the three species exceeded the optimum exploitation rate, indicating an overexploitation of the nemipterid species in the Gulf of Suez. The yield per recruit analysis revealed that the fishing pressure of the trawling fleet in the Gulf of Suez, has overridden the critical level. Findings suggest that decrease in the fishing effort of trawl fishery and increase the length of the mesh size is required for the protection of the nemipteridae resources in the Gulf.

Introduction

The thread fin breams *Nemipterus japonicus, Nemipterus bipunctatus and Nemipterus zysron* are demersal species have an economic importance in the trawl fishery of Suez Gulf (Breikaa, 1992, 1996). The threadfin breams (Nemipteridae) are more common in the tropical and subtropical Indo-West Pacific Area, on the other hand these species are absent in the eastern Pacific and Atlantic oceans (Russell, 1990). In the last few years, threadfin bream has become one of the demersal finfish resources exploited along the Egyptian Mediterranean coast as a lessepsian migrant species (El Haweet, 2013). Further, no studies have examined all species of family Nemipteridae in the Red Sea and Gulf of Suez. Three nemipterid species are caught by trawlers up to a depth of 100 m (Saber, 2014). The catch rate of threadfin bream has been increased within the last decade and became as one of the main target species that constituted about 7% of the total trawl catch in the Suez Gulf (Saber, 2017).

Biology of *N. japonicus* has been discussed by various authors in different regions (Bakhsh, 1996) in Saudi Arabia; (Rajkumar et al., 2003; Manojkumar, 2004; Kerdgari et al., 2009) in India; (Breikaa, 1992, 1996; El-Ganainy and Mehanna 2003; Amine 2012) in the Gulf of Suez, Egypt and El Haweet (2013) in the Egyptian Mediterranean coast. Rao and Rohit (2010) recorded the threadfin bream, *Nemipterus zysron* (Bleeker, 1857) from Andhra Pradesh Coast. Sululu et al., (2017) studied the food and feeding habits of *N. bipunctatus* from the coastal waters around Dar es Salam, Tanzania. The present study is the first to estimate the population parameters of *N. bipunctatus* in the Gulf of Suez.

Due to the importance of the basic biological traits such as age estimates, growth parameter, mortality estimates and population dynamics in proper management, this study was implemented to evaluate these parameters for Nemipterid spp. Also to help manage the fishery for sustainability of this species in the Gulf of Suez.

Materials and methods

Size-frequency data for three nemipterid species were collected from four experimental trawling surveys conducted in the Gulf of Suez during the fishing season 2014–2015 in addition to data collected from commercial catches of the Attaka fishing harbour. Fish samples (Fig. 1) were immediately transported to the laboratory in

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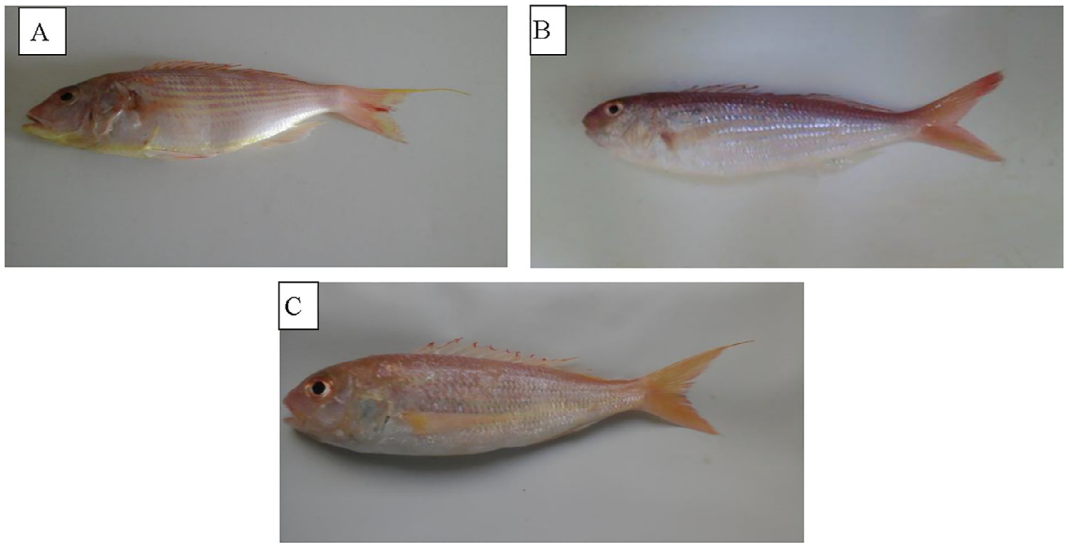

Fig. 1. Photo of *Nemipterus japonicus (A)*, *Nemipterus bipunctatus (B)* and *Nemipterus zysron* (C).

the Department of Fisheries Biology. A total of 3663 specimens (2597 *N. japonicus*, 576 *N. bipunctatus* and 490 *N. zysron*) were measured to the nearest mm (Total Length TL) and weighed to the nearest g, and then sagittal otoliths and gonads were dissected. Sagittal otoliths were rinsed, dried and stored in labeled paper envelopes.

Based on preliminary examination of both otoliths and scales, otoliths of the three species were used for age determination where it revealed clear ring marks. Sagitta otoliths were removed from the fish, rinsed in distilled water to remove any tissue, and then dried with a paper towel. Otoliths were stored dry in envelope. Otoliths of 873 (441 *N. japonicus*, 258 *N. bipunctatus* and 174 *N. zysron*) specimens were checked. The sagittal otoliths were read whole, against a black background and immersed in glycerol, The number of ring marks (outer edge of opaque zone) on sagitta otolith was counted by two readers using a stereo micro-scope.

Otoliths of *Nemipterus sp.* is a three dimensional oval-shaped structure its outline is irregular, especially in the posterior and the lower sides, the anterior part is pointed while the posterior one is broad rounded. The lower side is smoothly curved having a convex appearance giving the otolith a pronounced convex appearance. It is composed of a number of concentric and alternating narrow opaque and wide hyaline zones Fig. 2.

The length-at-age relationship for three nemipterid species was described using the von Bertalanffy growth curve including the three-parameter of von Bertalanffy growth function (VBGF). The FiSAT software was used with the monthly length-frequency distributions for determination growth parameters (L_{∞}, K and to). curves were fitted to length-at-age data by nonlinear regression (Pauly et al., 1992).

$$L_t = L_{\infty}\left[1 - e_o^{-k(t-t)}\right]$$

where L_t is the total length at age t, L_{∞} is the asymptotic length; K is the growth coefficient and t_o is the hypothetical age at zero length. von Bertalanffy growth parameters (L_{∞} and K) were estimated by Gayanilo et al. (2005).

The total mortality coefficient (Z) was calculated by applying the linearized catch curve method of Pauly (1983a). The natural mortality coefficient (M) was estimated according to Pauly (1983b). While the fishing mortality coefficient (F) was estimated as: F = Z–M. The exploitation rate "E" was calculated according to the equation of Gulland (1971) where:

$$E = F/Z.$$

According to the methods of (Pauly, 1984a,b) which depend on the backwards extrapolation of the length converted catch curve, the length at first capture (L_c) was estimated. The relative yield per recruit (Y/R)' was calculated according to Beverton and Holt (1966).

Results

Growth and mortality

Age was determined by otolith reading. The maximum age was found 5 years old for *N. japonicas* and *N. bipunctatus* while the maximum age observed in *N. zysron* was 4 year old. The mean estimated lengths at age for the three investigated species (Table 1) showed that the mean incremental growth rate was greatest in the first year of life, and then the growth rate decreased gradually with the increase in age. The age distribution of *N. japonicus* and *N. zysron* fishes indicated that the most abundant age groups is age groups 1 (31.19% and 31% respectively) while, for *N. bipunctatus* age group 2 (35%) was the dominant group (Fig. 3).

The growth curves of the three studied species based on the mean lengths at age for all aged specimens are given in (Figs. 4–6). The calculated VBGF parameters are given in Table 2.

The estimated mortality parameters of total (Z), natural (M) and fishing (F) mortality coefficients are given in Table 2. It can be seen that *N. zysron* suffers from higher natural mortality. Fishing mortality rates exceeded the natural mortality rates for the three investigated species, accounting for 65%; 61% and 53% of the total mortality of *N. japonicus*; *N. bipunctatus* and *N. zysron* respectively.

Per-recruit analyses and fishery assessment

Yield per recruit (YPR) curves on E showed that the yield of nemipterid species from the Gulf of Suez could be maximized by increasing the length at first capture (L_c) from 10 to 14 cm for *N. japonicus* and from 11 to 15 cm for both *N. bipunctatus* and *N. zysron* (Figs. 7–9).

Yield-per-recruit curves showed that the current exploitation rates is higher than the levels of $E_{0.5}$ and $E_{0.1}$ of the three investi-