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Rapid Communication

The brown shrimp *Penaeus aztecus* Ives, 1891 (Crustacea, Decapoda, Penaeidae) in the Nile Delta, Egypt: an exploitable resource for fishery and mariculture?

Sherif Sadek[1], Walid Abou El-Soud[2] and Bella S. Galil[3,*]

[1]*Aquaculture Consultant Office, 9 Road 256 Maadi, Cairo, Egypt*
[2]*Egyptian Mariculture Company, Dibah Triangle Zone, Manzala Lake, Port-Said, Egypt*
[3]*The Steinhardt Museum of Natural History, Tel Aviv University, Tel Aviv 69978, Israel*

**Corresponding author*
E-mail: galil@post.tau.ac.il

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Abstract

The penaeid shrimp *Penaeus aztecus* is recorded for the first time from Egypt. The West Atlantic species was first noted off Damietta, on the Mediterranean coast of Egypt, in 2012. This species has already been recorded in the Mediterranean Sea from the southeastern Levant to the Gulf of Lion, France. The impacts of the introduction of *P. aztecus* on the local biota, and in particular on the native and previously introduced penaeids, are as yet unknown. Shrimp farmers at the northern Nile Delta have been cultivating *P. aztecus* since 2016, depending on postlarvae and juveniles collected from the wild in the Damietta branch of the Nile estuary.

Key words: brown shrimp, first record, non-indigenous species, shrimp farming, wild fry

Introduction

Penaeus aztecus Ives, 1891 is native to the Western Atlantic, from Massachusetts, USA to Yucatan, Mexico (Cook and Lindner 1970). Penaeid shrimps are of great commercial value and *P. aztecus* is no exception (Williams 1955). Scientists at the National Marine Fisheries Service, Galveston, Texas, estimated the landing along the western Gulf of Mexico (July 2014–June 2015) at 53.2 million pounds (24.1 MT) (Nance 2014).

Penaeus aztecus was first recorded in the Mediterranean Sea in December 2009, when it was collected in Antalya, Turkey (Deval et al. 2010, as *Farfantepenaeus aztecus*), and shortly thereafter 1553 individuals were collected by trawls and trammel nets in the Bay of Iskenderun, Turkey (Gökoğlu and Özvarol 2013). Within an amazingly short period (2009–2015) the species has been recorded across the Mediterranean Sea – off France, Greece, Israel, Italy, Montenegro, and Turkey (for recent distribution maps see Galil et al. 2017; Scannella et al. 2017).

Transport in ballast waters was considered the most likely vector for its introduction in the Mediterranean Sea (Deval et al. 2010; Nikolopoulou et al. 2013; Kevrekidis 2014; Minos et al. 2015), with establishment in wide spread locations believed to result from distinct introduction events (Nikolopoulou et al. 2013). Yet, the contemporaneous or near contemporaneous records from distant locations (see also Minos et al. 2015) strain credulity. Bearing in mind that mark-recapture experiments in its native range revealed the limited movement of adult *P. aztecus* individuals (Klima 1963; McCoy 1968), it is likely that the newly arrived individuals would need a longer period to disperse progressively along the coastline from the Levant to the Ionian, Adriatic, Tyrrhenian and the Gulf of Lion. A more prudent proposition, in particular since many of the Mediterranean records have been collected in the vicinity

Figure 1. Fry of *Penaeus aztecus* Ives, 1891 collected in Damietta, Egypt, 30 May 2017.

of fish and shellfish farming, is that many of the Mediterranean populations issue from intentional introductions (Galil et al. 2017), followed by local natural spread.

In 2012 the senior author noted a previously unknown penaeid shrimp in the Damietta (western) branch of the Nile delta (31.4175ºN; 31.8144ºE). It has been recently identified as *P. aztecus*. We report the species' first record in Egyptian waters and discuss the possibility of its use as resource in artisanal fisheries and culture.

Material and methods

Egyptian shrimp farming is mainly concentrated in the Nile delta, owing to availability of water and non-agricultural lands. The Dibah Triangle Zone (DTZ), at the northern Nile Delta part of a wider brackish and marine ecosystem that includes Lake Manzalah and riparian areas of the Nile delta, is an important aquaculture production area (Sadek 2010, 2013). In 2014 the DTZ produced around 55 thousand tons of marine fish and shrimps in one thousand farms consisting of 18 070 ha of brackish and marine earthen ponds.

Egymarine (Egyptian Mariculture Company) introduced in 2016 specific pathogen free (SPF) *Penaeus vannamei* Boone, 1931 for trials at its DTZ fish farm. *Penaeus aztecus* entered those ponds possibly as larvae with water pumped from the Mediterranean Sea. In May 2017 postlarvae and juveniles of *P. aztecus* (370 to 700 animals/kg), collected by dip net in shallow waters in Damietta Nile estuary, were purchased from a wild fry trader and stocked in six earthen ponds (1 ha/each) for the purpose of growing out. Every ten days a random sample of 50 specimens have been collected, measured and weighed.

Results

The specimens collected from Egymarine shrimp ponds were identified as *Penaeus aztecus* following Pérez-Farfante (1988, p. 12, figure 17): the adrostral sulcus long, almost reaching posterior margin of carapace, median sulcus long, deep along entire length; rostrum with 3 ventral teeth; cheliped coxae unarmed; telson with deep median sulcus, lateral movable spines; ventral costa of petasma tapering distally, arched, bearing elongate patch of closely set small teeth were noted. Subsequently it was learned that *P. aztecus* had been noted by local fishermen since 2012. The fishermen reported collecting 700–800, 400–600 and 150–200 individuals/kg respectively during February–March, March–April and May 2017 (Figure 1).

Discussion

Non-indigenous shrimps, chiefly *Penaeus pulchricaudatus* Stebbing, 1914 (misidentified as *P. japonicus* Spence Bate, 1888) and its relatives – *P. semisulcatus* De Haan, 1844 [in De Haan, 1833–1850], *Metapenaeus monoceros* (Fabricius, 1798), *M. stebbingi* Nobili, 1904 – are highly prized and are considered a

boon to the Levantine fisheries (Gruvel 1936; Kumlu et al. 1999; Can et al. 2004; Duruer et al. 2008). They compose most of the shrimp catch off the Mediterranean coast of Egypt and in the Nile delta lagoons (Bishara 1976; Dowidar and Ramadan 1976), as well as supplying culture stock and broodstock to the Delta shrimp farming industry. Yet, that boon to fisheries came at a cost. A native cogener, *P. kerathurus* (Forskål, 1775), commonly caught along the Levant shelf in the past, has since nearly disappeared, and its habitat overrun by the penaeids introduced from the Red Sea (d'Udekem d'Acoz 1999). The impacts of the introduction of *P. aztecus* on the native and previously introduced penaeids is yet unknown.

Egyptian aquaculture has expanded rapidly in the past two decades and is considered among the top ten worldwide in terms of overall production, with total market value of 2.2 billion US$ in 2015 (Wally 2016). Marine species constitute 14.5% (165,000 MT in 2014) of the total Egyptian aquaculture, of which only 7,235 MT are penaeid shrimps (GAFRD 2016). The bulk of marine aquaculture production is located in Damietta and Port-Said Governorates, on the Mediterranean coast at the northeast corner of the Nile delta (Wally 2016). The decline in the 1990s in the coastal Mediterranean shrimp fisheries prompted the government to encourage development of shrimp farming. Demand for broodstock and postlarval juveniles of *P. semisulcatus* and *P. pulchricaudatus* was unmet by the production of domestic hatcheries, leaving producers to scramble for legally and illegally caught wild postlarvae (Sadek et al. 2002). The grow-out phase of these species to market-size individuals lasts six to eight months, thus limiting production to a single crop per year. To overcome these limitations farm operators illegally introduced *Penaeus indicus* H. Milne Edwards, 1837 from the United Arab Emirates in 2011 (Megahed 2014). However, since September 2014 massive mortalities of *P. indicus* have been reported in Damietta shrimp farms, where they were found to be heavily infected with Gram-negative bacteria (mainly *Vibrio harveyi* (Johnson and Shunk, 1936) Baumann and Baumann, 1981 and *V. alginolyticus* (Miyamoto, Nakamura and Takizawa, 1961) Sakazaki, 1968) and *White spot syndrome virus* (Elgendy et al. 2015, Sherif Sadek, pers. com.) and annual production plummeted from 7,235 MT in 2014 to 12 MT in 2015 (GAFRD 2016, 2017). In 2015–2016 *SPF P. vannamei* was introduced for commercial trial run at fish farms near Ismailia and Port-Said (Sherif Sadek pers. com.).

The presence in the past few years of plentiful wild fry of *P. aztecus* at Damietta was welcomed as a fortuitous introduction. The commercial cultivation of the species in the Nile Delta is currently based on postlarvae collected from the wild. Indeed, *P. aztecus* seems uniquely suitable for culture in the Nile Delta. The postlarvae migrate to shallow, low-salinity waters and enter estuaries in spring, with juveniles arriving in February and continuing throughout the summer months, much as in the southern U.S.A. (Williams 1955; Copeland and Truitt 1966). Under laboratory conditions *P. aztecus* postlarvae survived at higher rates when held at temperatures above 24 °C (Cook and Murphy 1969), but experience physiological stress at temperatures above 32 °C (Larson et al. 1989). Growth rates and conversion efficiency are highest at low salinity (25 to 50% seawater) (Venkataramaiah et al. 1972), with optimal growth occurring at temperatures between 22.5–30 °C, at salinity of 15 ppt (Zein-Eldin and Griffith 1966) – well within the temperatures and salinities in the region. Deyab and El-Katony (2015) report temperatures of 24, 30, 28 and 25 °C and salinities of 25, 30, 15, 24 g/L respectively in May, July, September and November 2012, near Damietta estuary branch.

Until postlarvae can be obtained from hatcheries in required amount and appropriate timing, access to wild culture stock is vital for the initial phases of development of *P. aztecus* farming in Egypt. Wild broodstock are required also to produce animals with a closed lifecycle, replenishment of viable spawning stock and maintenance of genetic diversity. Appropriate management practices, including ecologically sustainable collection methods for broodstock and culture stock, will help sustain growth of the shrimp farming industry in Egypt and reduce conflict with other stakeholders.

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