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Research article

The establishment of the Oriental River Prawn, *Macrobrachium nipponense* (de Haan, 1849) in Anzali Lagoon, Iran

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Abstract

A population of the Oriental River Prawn *Macrobrachium nipponens*e is recorded from Anzali Lagoon, along the shores of the southern Caspian Sea in Iran, with the first recorded specimens encountered in 1998. Based on available evidence it is postulated that the species is already widespread in countries to the east and south of the Caspian Sea, but as yet unrecorded in several countries.

Key words: *Macrobrachium nipponense*, Caspian Sea, Iran, introduction

Introduction

The native range of the Oriental River Prawn, *Macrobrachium nipponense* (de Haan, 1849) comprises of China, Japan, Korea, Vietnam, Myanmar and Taiwan (Yu and Miyake 1972, Cai and Ng 2002); whilst it has been introduced in Singapore, the Philippines (Chong et al. 1987, Cai and Shokita 2006), Uzbekistan (Mirabdullaev and Niyazov 2005), and most recently southern Iraq (Salman et al. 2006). In addition, the species is cultivated in the cooling reservoirs of several thermal power stations in Russia, Belarus and Moldova (Alekhnovich and Kulesh 2001), with these authors also noting the occurrence of established wild populations in water bodies of the Syr-Darya drainage basin, the Arnasi system of brackish lakes and the Kapchagai Reservoir in Kazakhstan (Alekhnovich and Kulesh 2001). The present note records a well-established population in Anzali Lagoon (Iran), along the southern shores of the Caspian Sea. Although the existence of this population has been known since 1998, so far this species has not been reported upon, a situation which is here rectified.

Throughout its native range, the Oriental River Prawn supports a considerably fishery, especially in Vietnam, Japan and China (Holthuis 1980). In addition, the species is extensively cultivated in China, with total production in 1998 being 15,000 metric tonnes (Kutty 2005). Despite its small size (total length around 8 cm), the species has high aquaculture potential, as it can withstand low winter temperatures and can be bred exclusively in freshwater (Kwon and Uno 1969). As a result of this, cultivation trials may well have been carried out in numerous aquaculture locations the world over, but records on this are virtually non-existent in the scientific literature. The only records of which the authors are aware are production level culture in thermal power stations in Russia, Belarus and Moldova (Alekhnovich and Kulesh 2001 and papers therein).

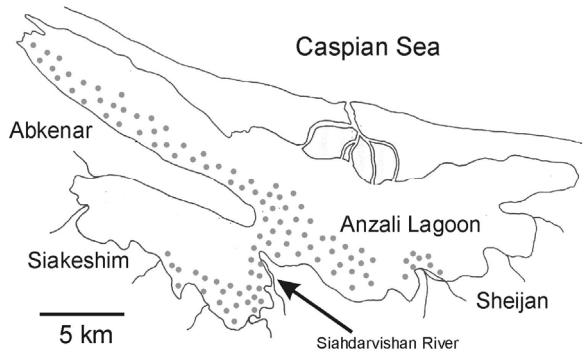

Figure 1. Anzali Lagoon (Iran), with the current distribution of *Macrobrachium nipponense* indicated (stippled)

Results

In June 1998 the second author (AG) encountered the species in Anzali Lagoon (Iran), along the southern shores of the Caspian Sea (37°28'N, 49°28'E) (Figure 1). More than 50 specimens were collected, all of a relatively small size (18-30 mm), from the Siahdarvishan River (close to the lagoon) (Figure 1) and later along the Pasikhan River. These juvenile specimens were sent to Prof. L.B. Holthuis (Leiden) for identification, with further adult specimens collected some months later from the same area. The adult specimens (RMNH 48019-48021) indeed confirmed the population was *M. nipponense*. Further specimens were sent to the first author (SDG) in July 2006, now in the collections of the Oxford University Museum of Natural History (OUMNH.ZC.2006-16-001) (Figure 2). A comparison with literature descriptions (Kubo 1940, Yu and Miyake 1972, Suzuki and Kusamura 1997, Cai and Dai 1999, Cai and Ng 2002) as well as a direct comparison with specimens from Japan (Kagoshima Peninsula, southern Kyushu, leg Suzuki and Matsuo, July 1997; OUMNH.ZC.2002-06-002) and China (Miyun Reservoir, North of Bejing, leg. Janssens de Bisthoven, August 2000; OUMNH.ZC.2004-22-001) leaves no doubt as to their identity. The rostral shape and dentition (2-3+7-10/2-3) (Figure 2) of the species, combined with the presence of one pair of denticles in the proximal one-third of the chelae and the telson not reaching beyond the postero-lateral spines all being diagnostic. Adult males in the examined material also have the fingers of the second pereiopod covered with dense hairs, whilst the carapace is finely tuberculated, a further characteristic of the species.

Figure 2. Preserved male specimen (top) of *Macrobrachium nipponense* (de Haan, 1849) from Anzali Lagoon (Iran) and close up of rostrum (bottom) (Photographed by SDG)

Since 1998, the species has become both well established in Anzali Lagoon (Figure 1), with the highest density observed along the Siahdarvishan River. However, *M. nipponense* can now be encountered in virtually all channels and stream within the lagoon, except the open water central parts, as well as numerous irrigation channels in the area surrounding the lagoon. Population densities generally decline towards the mouth of the lagoon and the species does not occur in the oligohaline parts at the entrance of the lagoon, nor along the seashore of the Caspian Sea proper.

A survey of 176 specimens (108 males, 167 females) from the Siahdarvishan River area revealed that males are slightly longer than females, with a mean total length (± Standard Deviation) of 49.84 mm (12.62) and 46.44 mm (12.20), respectively. This is considerably smaller than the total length quoted by Holthuis (1980), as 86 mm for males and 75 mm for females. One logical explanation for this is the lower water temperatures in Anzali Lagoon (10 year average 19.1°C, range 4.2-33.0), considerably lower than

the tropical-subtropical temperatures in the species' native range.

Despite its abundance in Anzali Lagoon, there is no commercial fishery for the species at present, although it is extensively used as bait for line fishing of commercially important fish species such as *Esox lucius* Linnaeus, *Perca fluviatilus* Linnaeus, *Cyprinus carpio* Linnaeus and *Siluris glanis* Linnaeus.

Discussion

No details are available on the apparent method of introduction in the Philippines nor Kazakhstan, but it can be assumed these populations are either derived from escaped aquaculture/ornamental stock or perhaps deliberately introduced. In relation to the wild population in Kazakstan, its should be noted that Mirabdullaev and Niyazov (2005) indicate that *M. nipponense* has spread from Uzbekistan to neighboring countries through aquaculture related activities. Chong et al. (1987) suggested that *M. nipponense* may have been introduced, accidentally or otherwise, with ornamental goldfishes and carps from either China or Japan into Singapore, initially into rural fish ponds, from which the species has spread. Now it is common in numerous well-weeded streams and reservoirs, particularly in less acidic waters (Ng 1990). Khurshut and Mirabdullaev (2005) state about twenty species of fish, one species of shrimp, eight mollusks and a range of fish parasites and pathogens were accidentally introduced into Uzbekistan in the 1960's, resulting from experimental aquaculture work on *Ctenopharyngodon idella* (Valenciennes) and *Hypophthalmichthys molitrix* (Valenciennes), with imports originating from the Yangzte and Amur rivers in China. Mirabdullaev and Niyazov (2005) further state that one of the most successful of these alien species is *M. nipponense*, first noted in the Tashkent region in NE Uzbekistan. Since the 1980's the species has spread along all the major water bodies on the plains of Uzbekistan and neighboring countries, through natural range expansion and further aquaculture transportations (Mirabdullaev and Niyazov 2005). At present *M. nipponense* occurs in fresh and brackish water systems (rivers, canals, ponds, lakes) in all Uzbekistan provinces, and forms an important component of the diet of native fish species. Salman et al. (2006) suggest that the southern Iraqi populations may have been derived from aquaculture ponds in Iran and dispersed throughout Iraq. Although we do not dispute this potential vector, Salman et al. (2006) base the presence in Iran on the basis of the species being mentioned in Wong and McAndrew (1994) and Abbasi (2005). Wong and McAndrew (1994) in their experimental study of larval tolerance obtained animals from Hong Kong, and make no mention of any records outside of its native range. Although Abbasi (2005) mentions a species of shrimp from the Anzali Lagoon (location of the herein reported specimens), he only records it as *Macrobrachium* spp. Unquestionably this record is conspecific with the individuals herein reported as *Macrobrachium nipponense*, as no other species of *Macrobrachium* have been recorded from wild populations in the Anzali Lagoon or neighbouring areas (AG pers. obs.). The present record is thus the first confirmed record of *M. nipponense* for Iran, although as noted above the population has been known privately since 1998.

Grigorovich et al. (2003) identified 36 non-indigenous invertebrate species in the Caspian Sea and detailed their presumed entry vectors. The most important entry vector is shipping, accounting for 44.4% of all introductions, primarily after the opening of the Volga-Don canal in 1952. Accidental releases of non-target species with aquaculture accounted for 27.8% of all non-indigenous species. As the first recorded specimens in Anzali Lagoon were in 1998 it does appear reasonable to assume that the introduction took place in or before 1998. Beyond this, it is difficult to be more precise as to the exact entry vector, although three hypotheses can be put forward. The main aquaculture centre in the area (Shahid Ansari Rearing and Aquaculture Complex) is situated about 50 km south of Anzali Lagoon and has been involved in fish aquaculture for over 35 years. Brood-stock and fingerlings of several fish species (including *C. idella* (Valenciennes), *H. molitrix* (Valenciennes), *Aristichthys nobilis* (Richardson), and *C. carpio*) are periodically imported from China and Azerbaijan. It seems potentially possible that larval propagules of *M. nipponen*se were included with some of these shipments from China. Records show that in 1994 brood-stock of *H. molitrix* and *Mylopharengydon piceus* (Richardson) were imported from Guanzhou, Guangdong Province, China. As far as the authors are aware no further aquaculture importations from China were made between 1994 and 1998. A second potential entry vector is perhaps the experimental work on *Macrobrachium rosenbergii* (de Man) by the Fisheries Research Centre in Anzali. Adult brood-stock has been

periodically imported during the last ten years from Bangladesh, Thailand and probably from Indonesia. Within the suggested time frame for the introduction, records demonstrate that adult *M. rosenbergii* were imported in 1994 from Bangladesh and Thailand for research purposes. After some initial setbacks, outdoor warm water polyculture ponds were successfully stocked with juvenile *M. rosenbergii*. Although there is no evidence to suggest that wild populations of *M. nipponense* are present in Bangladesh, Thailand or Indonesia, it is not beyond the realms of possibility that cultured populations exist or existed in these countries and there may have been non-target species propagules in the shipments.

Thirdly, it appears possible that *M. nipponense* is already widespread in countries to the east and south of the Capsian Sea. Mirabdullaev and Niyazov (2005) do indicate that the species is widespread in Uzbekistan and neighboring countries, presumably including Kazakhstan (Alekhnovich and Kulesh 2001) and possibly Iraq (Salman et al. 2006). Although few rivers enter the Caspian Sea along its eastern seaboard, the Ural River and its tributaries flow into the Caspian Sea in Kazakhstan, offering a possible dispersal vector. Although the waters of the Caspian Sea hold about 10-13 grams per liter of salt, posing a potential barrier to dispersal of true freshwater species, larvae of *M. nipponense* can, through the course of several populations, tolerate and adapt to brackish water conditions (Ogasawara et al. 1979, Mashiko 1983, Wong and McAndrew 1994). Alternatively, as populations have been noted in ponds and lakes (presumably not connected with continuous waterways) in Uzbekistan (Mirabdullaev and Niyazov 2005), dispersal through Turkmenistan into north-eastern Iran appears possible, and indeed further south into Iraq (Salman et al. 2006). Although at present no published records exist of the species in Turkmenistan, of interest is that the collections of Naturalis (Leiden) contain specimens from a pool near Aq Qal'eh Town, Golestan province, Iran (37º00'N, 54º26'E), collected in December 2001 (leg. Alimohamadi, don S. Gorgin) in the north-eastern part of Iran.

On balance of the available evidence, we offer the hypothesis that *M. nipponense* is likely to be already widespread in countries to the east and south of the Caspian Sea, rather than the Anzali population being derived from an independent aquaculture related introduction. As the population in Anzali Lagoon was discovered in 1998, we further postulate this range expansion to have taken place in the 1980-1990's, supported by the date (1980's) mentioned in Mirabdullaev and Niyazov (2005). Whether all populations in Kazakhstan, Iran and Iraq are ultimately derived from the Uzbekistan importations from China in the 1960's remains open to debate, as independent aquaculture related introduction may have taken place. It is perhaps not all that surprising that the species has been under-recorded, given the turbulent political history of the region.

It is not known what impact *M. nipponense* is presently having on the native invertebrate populations, specifically other shrimps. Two other species of palaemonid shrimp occur in the Caspian Sea region: *Palaemon elegans* Rathke and *Palaemon adspersus* Rathke, both also non-indigenous species introduced in 1930-1934 (Grigorovich et al. 2003). Presently, *M. nipponense* does not compete with either, as both species of *Palaemon* only occur along the Caspian seashore and in the mouth of the lagoon near the harbour, where no individuals of *M. nipponense* have been found to date.

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