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Malaysian Prawns, *Macrobrachium rosenbergii,* Trinidad's Invasive Alien; Biological Indicator or Aquaculture Species?

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ABSTRACT

An update of the distribution of *Macrobrachium rosenbergii* indicates a distribution within ten rivers, in comparison to two rivers as previously documented. These rivers have higher dissolved oxygen concentrations in comparison to those where they have not been collected. With this in mind it is proposed that this species could possibly be regarded as a biological indicator species in Trinidad. They have been found in low densities and it is presumed not to be an ecological threat to native species of aquatic fauna particularly other *Macrobrachium* species.

Key words: Malaysian prawns, *Macrobrachium, rosenbergii,* alien invasive, biological indicator, aquaculture.

INTRODUCTION

Internationally, Malaysian prawns, *Macrobrachium rosenbergii,* are regarded as an aquaculture species (Sandifer 1977) and are native to rivers of South East Asia (Raman 1967). They were originally introduced into Trinidad in 1985 at the Orange Grove Fish Farm and Institute of Marine Affairs (IMA) with hopes of establishing an aquaculture industry (Fisheries Division, Ministry of Agriculture, Land and Marine Affairs 1990). A prawn hatchery was subsequently established at the Orange Grove Fish Farm. It is presumed that individuals escaped from this facility, which is located within the Caroni Basin drainage system, and have now begun to slowly colonize various river systems of suitable water quality. This species relies on brackish water (5‰ to 10‰) to complete its life cycle (Bowles *et al.* 2000), and is very sensitive to changes in water quality (Rostant 2005). Their preferred dissolved oxygen concentration is 6 to 6.5 mg l^{-1} (Johnson 1978) when stocked at 12 individuals m^{-2} for culture purposes. Studies of the distribution of decapod crustaceans by Rostant (2005) indicated this species as occurring locally in the wild.

At present the two aforementioned production and hatchery facilities where the prawns were first introduced are no longer in operation; however, controlled and limited breeding occurs at the IMA in addition to two other private establishments. There are currently no new prawn farms in existence. The species has also infiltrated the local ornamental pet trade and has been sighted in pet shops by two of the authors in north, south and central Trinidad. The ecological impact of this species is unknown thus far. Due to its non-native origins and the subsequent natural spread into local rivers, it can be categorized as an invasive alien species (Devick 1991; Williams *et al.* 2001; Woodley *et al.* 2002).

METHODOLOGY

Baseline sampling of various west coast draining rivers were conducted between the years of 2005 and 2009 targeting aquatic macroinvertebrates and fish. This was facilitated using cast-netting (mesh size, 0.5 cm, 2.0, diameter), seining (mesh size 0.5 cm, 1.25m x 5.0 m) and setting of baited fish pots (mesh size, 0.5 cm, 60.0cm x 30.0cm x 30.0cm, 20.cm funnel opening diameter, 10.0 cm funnel base). At all sites the three methods of sampling were utilized and sampling effort standardized and the data acquired from this was pooled for analysis which consisted of counting and identifying all *Macrobrachium* species captured. Physico-chemical water quality parameters such as salinity, temperature, dissolved oxygen (DO) (using multiprobe YSI 85 meter) and pH (using YSI pH 100 meter) were monitored *in situ* to determine water quality. This was correlated to number of individuals caught using a linear regression and correlation analysis. An updated distribution map was prepared using ESRI ARC MAP 9.2.

RESULTS

No statistically significant correlations were noted when pH, salinity or temperature was compared to number of *Macrobrachium* individuals captured. Significant correlation was noted, however, when DO was compared

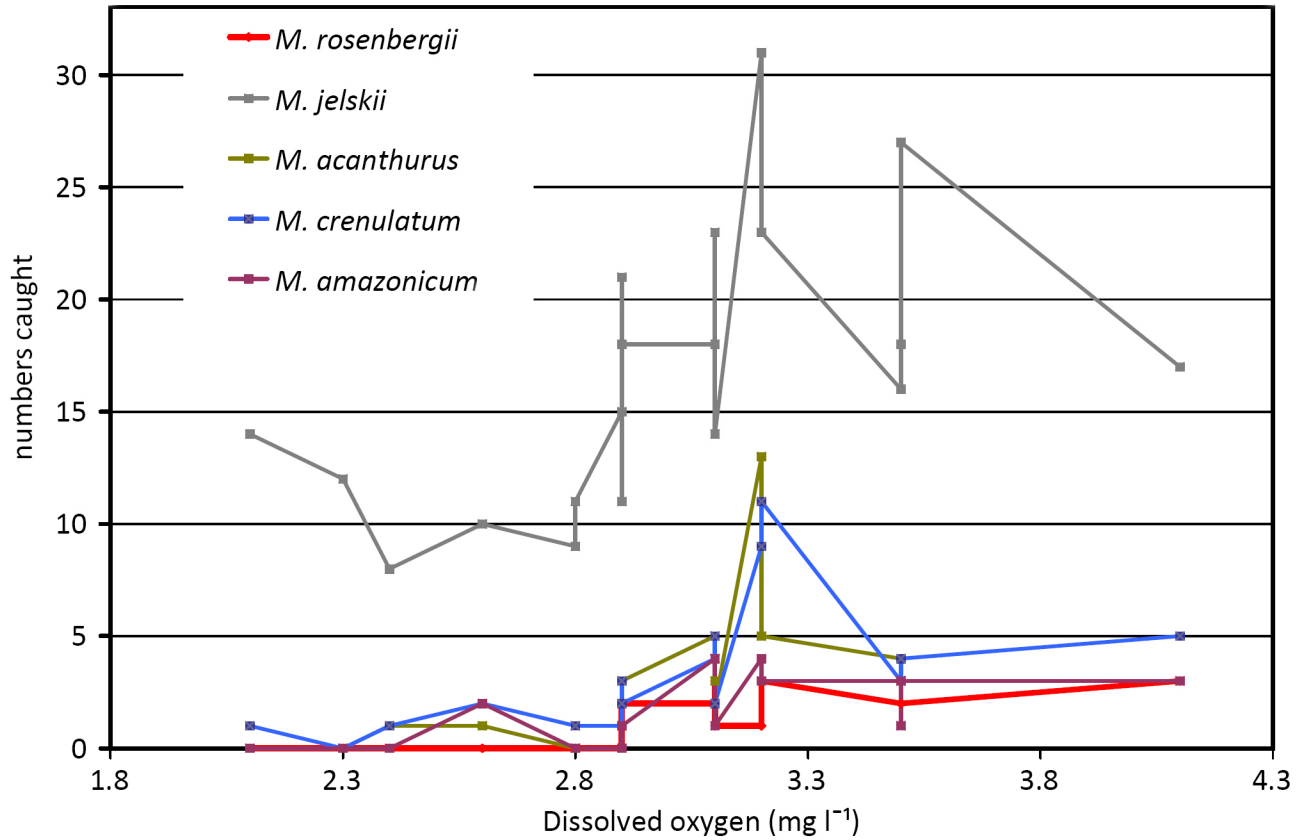

Fig. 1. Comparison of *Macrobrachium* species found during surveys of the west flowing rivers of Trinidad against dissolved oxygen concentrations (DO).

to the number of other *Macrobrachium* individuals, as seen in Fig.1 (see Appendix 1 for sites and year of collection). At the current survey sites, *M. acanthurus, M. jelskii* (found in the highest numbers), *M. crenulatum* and *M. amazonicum* were also found.

Table 1 shows that *M. rosenbergii* is most correlated to DO concentrations and *M. jelskii* is least correlated as indicated by the respective R^2 values and as displayed in Fig.1. Fig. 2 displays the current distribution of *Macrobrachium* species along the west coast of Trinidad, their proximity to the existing breeding facilities, and the historical distribution of this genus. *M. rosenbergii* was previously found only within the South Oropouche and Guapo Drainages (Rostant 2005). It has since been recorded at eight additional sites.

DISCUSSION

The new distribution of *M. rosenbergii* would imply colonizing and infiltrating of rivers if the water quality, particularly DO, is suitable for its survival.

The sensitivity of this species to waterways with low DO would indicate that there is potential for this species to serve as an aquatic biological indicator for Trinidad's rivers. At all sites and times when *M. rosenbergii* was absent, the DO was below 2 mg l^{-1}. Mohammed (2010) noted the low DO and poor water quality of several west coast rivers, particularly the Couva and Guaracara Rivers where *M. rosenbergii* has not yet been found.

The low numbers recorded would imply that *M. rosenbergii* is currently not an ecological threat to other native species of decapods particularly other *Macrobrachium* species. At all sites, with the exception of Guapo, Silver Stream and Caroni Rivers, smaller individuals (<4.0 cm) were found (personal observations). This would imply that they are juveniles transitioning from brackish water to freshwater. Both Rostant (2005) and this current survey reported populations in the Guapo River, which would imply that the prawns are breeding successfully. Guapo River also yielded the widest size range of specimens (carapace lengths of 3.8 to 10.9 cm).

Table 1. Correlation values for *Macrobrachium* species.

Species	***M. rosenbergii***	***M. jelskii***	***M. acanthurus***	***M. crenulatum***	***M. amazonicum***
R^2	0.5744	0.1993	0.2577	0.2088	0.3811

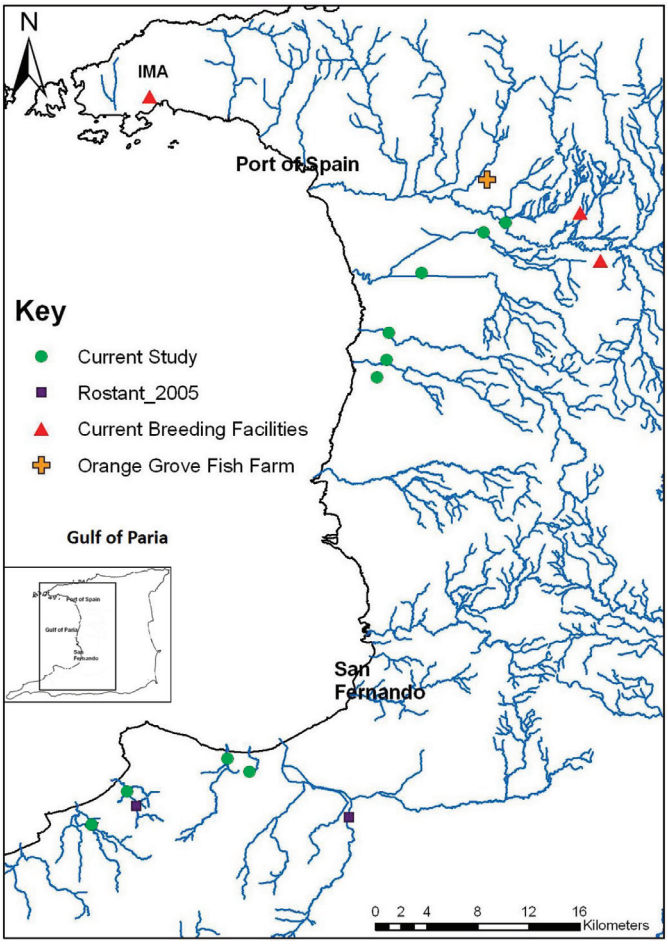

Fig. 2. West Trinidad showing the updated distribution of *M. rosenbergii*, the previous distribution and current captive breeding sites.

The common attribute that all occurrences have is relatively high DO. Heileman and Ramsaroop (1990) indicated that the salinity of the Gulf of Paria was sufficiently low to be characterized as estuarine. The low salinity (ranging between 5‰ and 20‰) and circular, clockwise-moving current (Kenny 1995) of the Gulf of Paria propelled by the Orinoco River discharge from the South American mainland, provide an efficient vehicle for the movement of larval *Macrobrachium*. Water quality would be a major contributing factor to the colonizing of the rivers, considering all west flowing rivers have similar assemblages of freshwater fishes (Kenny 1995) and hence similar predator pressures for juvenile prawns. Sampling events (Rostant 2005) across both islands have only produced specimens from the west flowing rivers of Trinidad.

M. rosenbergii can still be regarded as a freshwater alien species and care must be taken not to allow the spread of this species to Tobago's waterways. Rostant (2005) indicated an already high diversity and density of *Macrobrachium* species on that island. Should this species be introduced to the waterways there, it can potentially be a threat to the native species. This is based on easier access to estuarine conditions that would facilitate its reproductive cycle and waterways with high DO concentrations that favor its survival, thus allowing for high densities of this species which would ultimately put it into direct competition with other *Macrobrachium* species that exist there.

The Malaysian prawn, regardless of the threat of invading waterways, is still a potential aquaculture species due to tolerance of high stocking densities (Shanga and Fujimura 1977), and potential for fetching high prices. The hatchery operations for the breeding of this species must be managed effectively to prevent individuals from being added to the environment, and also to allow for the development of sustainable aquaculture practices.

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APPENDIX 1

Distribution of *Macrobrachium* species on the west flowing rivers of Trinidad.

Year	River Site	DO	*M. amazonicum*	*M. jelskii*	*M. acanthurus*	*M. crenulatum*	*M. rosenbergii*
2006	Couva	2.1	0	14	0	1	0
2005	Couva	2.3	0	12	0	0	0
2006	Guaracara	2.4	0	8	1	1	0
2006	Tarouba	2.6	2	10	1	2	0
2005	Cipero	2.8	0	9	0	1	0
2006	Guaracara	2.8	0	11	0	1	0
2006	Cipero	2.9	0	15	0	1	0
2007	Guayamare	2.9	1	21	3	2	1
2008	Couva	2.9	0	11	1	3	0
2009	Caroni	2.9	1	18	3	2	2
2006	Guapo	3.1	4	18	5	4	2
2008	Carapichaima	3.1	4	23	3	5	3
2009	Cunupia	3.1	1	14	2	2	1
2006	Silver Stream	3.2	4	31	13	9	1
2008	Caparo	3.2	3	23	5	11	3
2008	Chandernagore	3.5	3	16	4	3	2
2009	Vance	3.5	1	18	3	1	2
2009	South Oropouche	3.5	3	27	3	4	2
2009	Tarouba	4.1	3	17	3	5	3