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## Temporal variations in the diversity of true crabs (Crustacea: Brachyura) in the St Lucia Estuary, South Africa

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### ABSTRACT

The St Lucia Estuary is part of the iSimangaliso Wetland Park, which is a UNESCO World Heritage Site. It is characterised by instability and experiences ongoing anthropomorphic change, both of which have a significant impact on the biodiversity of the estuary and surrounding area. Brachyurans (true crabs) play an integral role in the functioning and maintenance of this ecosystem. They are a food source for organisms at higher trophic levels, maintain nutrient balance, regulate trophic flow and aerate dense mud through the construction of burrows. However, since the early survey of Millard and Broekhuysen (1970), no study has focussed on this taxon, the identification of which is confounded by the existence of cryptic and pseudocryptic species. This study provides a census of the brachyuran species inhabiting the St Lucia estuarine lake, highlighting the changes in diversity that have occurred in this region between 1948 and 2012. A total of thirty species were found in the area during this period, five of which have not been recorded in previous literature. The extent to which regional endemic species, such as *Paratyloidiplax blephariskios*, have been affected by the dynamics of the system is discussed. The distribution and abundance of three key species, namely *P. blephariskios*, *Neosarmatium africanum* and *Hymenosoma projectum*, are outlined; and possible reasons for observed changes are discussed. Future scenarios regarding the state of the estuary mouth and the stability of physico-chemical variables are also considered. Lastly, an annotated checklist illustrated by photographs is included to aid in identification of species for research and management purposes.

**KEY WORDS:** Crustacea, Brachyura, South Africa, iSimangaliso Wetland Park, St Lucia estuarine system, true crabs, diversity, estuarine variability, illustrated checklist.

### INTRODUCTION

The St Lucia Estuary is a crucial component of the iSimangaliso Wetland Park, which is a UNESCO World Heritage Site. It is the largest estuarine lake system in Africa and covers approximately 80% of the total estuarine area of KwaZulu-Natal, South Africa (Begg 1978). The estuary is characterised by prolonged mouth closure and experiences large-scale periodic fluctuations in physico-chemical characteristics due to stochastic flood and drought events (Begg 1978; Owen & Forbes 1997; Pillay & Perissinotto 2008). The shallow nature of the lake, combined with its large surface area, results in high evaporative loss. The system experiences additional stress from increased human numbers, forestry and agricultural developments in the catchment area around the lake (MacKay *et al.* 2010; Cyrus *et al.* 2011). These activities include manipulation of the St Lucia Estuary mouth, freshwater abstractions from surrounding rivers (Fig. 1a) and the increase in sugar cane farming and number of tree plantations in adjacent areas (Whitfield & Taylor 2009), all of which lead to an intensification of drought conditions. As a result, the St Lucia Estuary experiences regional hypersalinity at times, especially in the northern part of the lake where salinities occasionally exceed 200 ppt (Whitfield & Taylor 2009; Cyrus *et al.* 2011). In drought conditions, however, the Back Channel (Fig. 1b) may provide a connection to the Mfolozi River and the ocean, thereby supply-

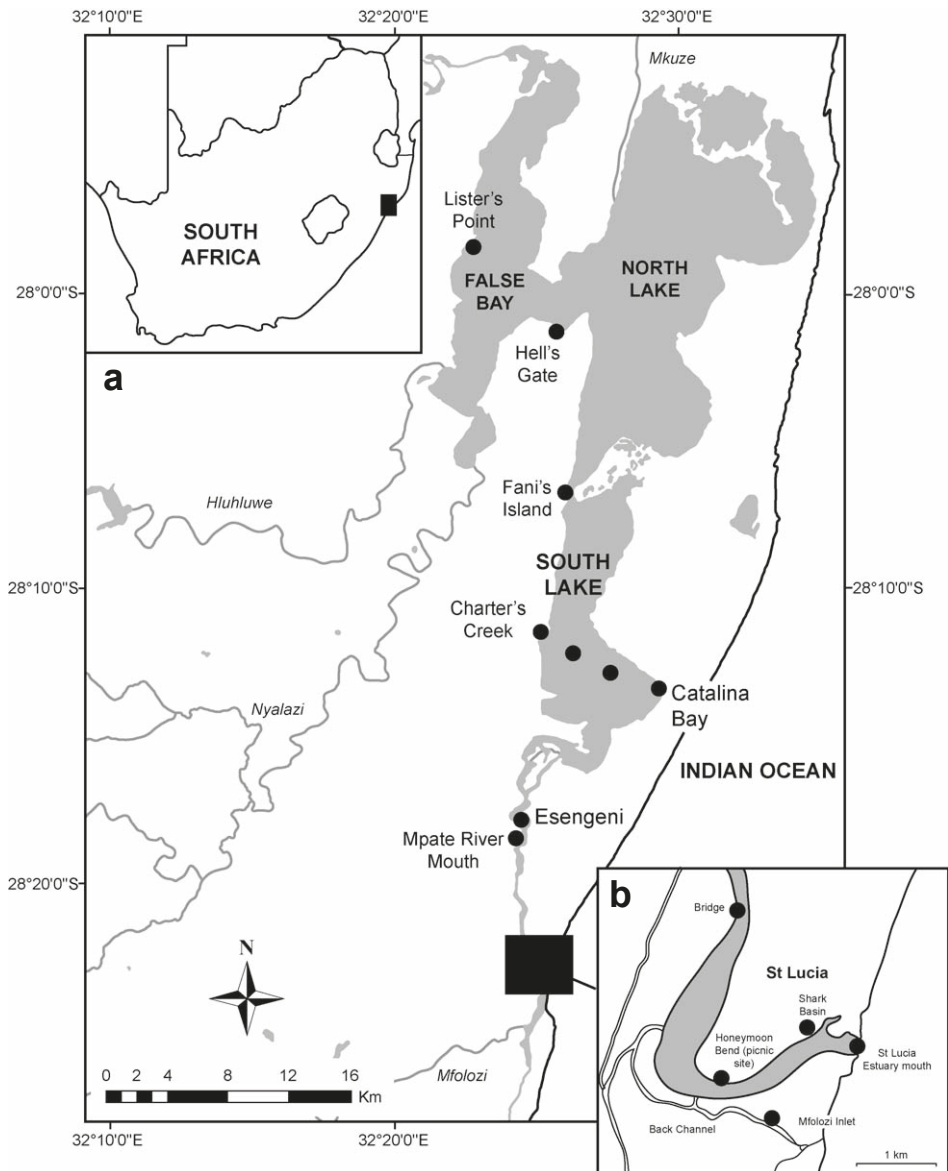


Fig. 1. Maps of the St Lucia Estuary: (a) expansion of the estuary and mouth region (adapted from Carrasco *et al.* 2010); (b) highlighting sampling sites and sources of freshwater inflow via tributary rivers.

ing water to the system, allowing limited biological migrations into St Lucia from the sea, and decreasing the overall salinity of the Narrows and estuary mouth (Whitfield & Taylor 2009). Most of the recent research on the system has been carried out during drought events (Cyrus *et al.* 2011).

The instability and ongoing degradation of the estuarine lake both have a significant impact on associated biodiversity (Schlacher & Wooldridge 1996; MacKay *et al.* 2010).

Hypersaline conditions lead to movement of stenohaline species out of the area and extinction of less mobile organisms, resulting in changes in community structure and species richness (Schlacher & Wooldridge 1996; Owen & Forbes 1997). The decrease in salinity caused by freshwater run-off from the Mfolozi promotes biodiversity (Whitfield & Taylor 2009). Persistent mouth closure (since June 2002) has resulted in limited juvenile recruitment from the ocean and no tidal exchange, which has led to desiccation of the extensive mangrove swamps that occur in the regions of the mouth and Narrows (Adams *et al.* unpubl. data).

Brachyurans (true crabs) play an integral role in the functioning and maintenance of the mangrove ecosystem (Day 1981). Herbivorous and detritivorous species are important components of mangroves as they feed on leaf-litter and decaying organic matter present on the forest floor (Dahdouh-Guebas *et al.* 1997). They facilitate the decomposition process by breaking down organic matter and exposing it to microbes, thus playing an important role in nutrient cycling and energy flow in these ecosystems (Steinke *et al.* 1993; Cumberlidge *et al.* 2009). In addition, burrowing species are important for aeration and oxygenation of the dense mangrove mud. The creation of burrows further allows for movement of nutrients and water through the soil, which in turn is beneficial for the growth and development of mangrove seedlings (Steinke *et al.* 1993). Brachyurans also modify sediment topography and associated microfloral structure (Skov *et al.* 2002).

The biological survey conducted by Millard and Broekhuysen (1970) in the St Lucia Estuary revealed the presence of twenty-six brachyuran species, all located mainly within the Narrows and estuary basin. However, the same areas are currently dominated by only a few brachyuran species, such as *Paratylodiplax blephariskios* (Stebbing, 1924), *Hymenosoma projectum* Dawson & Griffiths, 2012 together with the mangrove crabs *Neosarmatium africanum* Ragionieri, Fratini & Schubart, 2012 and *Chiromantes eulimene* (De Man in Weber, 1897) (Owen & Forbes 1997; MacKay *et al.* 2010). Moreover, the mangroves along the Narrows have been separated from the ocean for virtually the past 10 years (Whitfield & Taylor 2009). Thus, the unstable salinity levels in many parts of the lake are believed to impact on brachyuran diversity negatively (Owen & Forbes 1997). Land use, mostly in the form of agriculture and forestry, is also a major contributor to the decreased diversity within the system, as it leads to deterioration in water quality, reduction in freshwater inflow, and urbanisation of the natural habitat (Darwall *et al.* 2009). Brachyurans endemic to the north-east region of KwaZulu-Natal are especially vulnerable to environmental degradation, given their restricted distribution range.

Considering that the last thorough survey of brachyuran diversity in St Lucia was conducted by Millard and Broekhuysen in 1970, the primary aim of this study was to investigate current brachyuran diversity within the estuarine system, with particular emphasis on the Narrows, estuary basin and estuary mouth. The extent to which the brachyuran community has been altered was determined by comparing the distribution and abundance of three key species and examining records of past and present surveys. An additional aim of this study was to provide an illustrated, annotated checklist of all brachyuran species recorded historically in the area, in order to update the current database of brachyurans known from the system and to provide an identification guide for future research and management purposes.

## MATERIAL AND METHODS

*Sampling sites*

The study was conducted at the St Lucia estuarine lake, located between 27°52'S to 28°24'S and 32°21'E to 32°34'E. The estuary consists of three lakes, viz. False Bay, South Lake and North Lake, all connected to the mouth via a 20 km channel called the Narrows. Sampling was undertaken in both the wet season (17–19 March 2012) and the dry season (10–13 July 2012) at various representative sites around the lake including Charter's Creek, Lister's Point, the St Lucia mouth, the boardwalk mangroves near the mouth, the Bridge, Hell's Gate, Makakatana, Fani's Island, Honeymoon Bend (picnic site), Shark Basin (near the dredge outlet pipe) and the Back Channel (Fig. 1).

*Physico-chemical parameters*

Salinity (ppt), temperature (°C) and turbidity (NTU) were recorded through the use of a YSI® 6600 data-logger. Further data on salinity, temperature and turbidity were obtained from past records at the Iziko South African Museum (Cape Town) and from published literature.

*Published literature and museum records*

All literature relevant to the abundance and diversity of brachyurans in St Lucia was perused and necessary data extracted. Preserved specimens were examined at the Iziko South African Museum, which houses the largest collection of brachyurans in the country, along with records of historical surveys undertaken at St Lucia and dating back to 1948. No brachyuran collections or records pertaining to St Lucia were found at the Durban Natural Science Museum or the KwaZulu-Natal Museum (Pietermaritzburg).

*Collection methods*

During the current survey of 2012, various methods were employed for the collection of specimens, the most useful being active search and capture. A shovel was used to dig up burrows, while a Zabalocki-type Ekman grab and modified D-net were used in softer sediments and vegetation patches. Baited pitfall traps were set at the bridge and monitored over 2 days. In the case of D-net tows, quantitative samples were taken and quadrats were counted for selected species to determine their abundance.

*Measuring distribution and abundance for selected species and sites*

Distribution and abundance data were collected for certain species so as to compare past and present conditions. Included were *P. blephariskios*, a species endemic to the region, *H. projectum*, a species once distributed throughout the lake, and *N. africanum*, currently the dominant species in the system. Abundance was represented using the density code system of Owen & Forbes (1997) for *H. projectum* and *P. blephariskios*, where a density (ind.m<sup>-2</sup>) of 1–10 is very rare (V), 11–100 is rare (R), 101–1000 is common (C), 1001–10000 is abundant (A) and > 10001 is super-abundant (S). Estimates of *N. africanum* abundance were obtained using a crab : burrow ratio of 0.81 (Skov *et al.* 2002).

*Compilation of a photographic database*

Dorsal and ventral images of a representative specimen of each species were obtained using a Canon Powershot G11 digital camera. Either female or male specimens were

used for this purpose on the basis of availability, but when species exhibited a marked sexual dimorphism (e.g. *Uca* spp.), only males were used. Photographs were taken using only fresh specimens with full colours, immersed in a shallow layer of distilled water in a white tray. Photographs were edited using Corel Photo-Paint X3 for Windows, Picasa 5, Paint and Microsoft Office Picture Manager.

## RESULTS

In total, thirty brachyuran species were recorded at St Lucia from 1948 to 2012. In 1948/49, twenty species were found in the system (Millard & Broekhuysen 1970). These are listed in Table 1 and include four of the five sesarmid species, two fiddlers and the freshwater crab *Potamonautes sidneyi* (Rathbun, 1904). Six additional species were collected in 1964/65 (Millard & Broekhuysen 1970) (Table 1). In 2012, seventeen species were found in and immediately around the St Lucia estuarine system (this study), including the mangroves near the Mfolozi inlet. Four of these crabs were previously unrecorded from the system, viz. *Ocypode madagascariensis* Crosnier, 1965, *Ocypode ryderi* Kingsley, 1880, *Neosarmatium smithi* (H. Milne Edwards, 1853) and *Potamonautes* cf. *lividus*, which may represent a new species.

As regards sesarmids, the following inhabitants of mangrove forests were recorded from 1948 to 2012: *N. africanum*, *Parasesarma catenatum* (Ortmann, 1897) and *C. eulimene*. *Perisesarma guttatum* (A. Milne-Edwards, 1869) has been known from the system since 1964 and *Neosarmatium inerme* (De Man, 1887), which was present in 1948, has not since been seen in the system. *Varuna litterata* (Fabricius, 1798) was found near Charter's Creek and on the mudbanks of the Mfolozi in 1948, but currently has been located alive only at the mouth. Dead specimens were also collected after a flood event at False Bay in March 2012, along the shore just south of Lister's Point.

Of the total of thirty species recorded in the system, nine are known only from single records. Aside from *N. inerme*, *Acanthonyx quadridentatus* (Krauss, 1843) and *Acanthonyx scutellatus* MacLeay, 1838 were both recorded only in 1948, in the channel connecting the Mfolozi to St Lucia. *Ptychognathus onyx* Alcock, 1900 was found in the mud, also at the mouth, in 1949. *Macrophthalmus (Mareotis) depressus* Rüppell, 1830 and *Uca (Gelasimus) vocans* (Linnaeus, 1758) were both collected at the Mfolozi inlet, while *Uca (Tubuca) urvillei* (H. Milne Edwards, 1852) was found at Shark Basin in 1964. *Uca (Paraleptuca) chlorophthalmus* (H. Milne Edwards, 1852) was recorded at the Mpate River mouth in 1949. *Metopograpsus thukuhar* (Owen, 1839) was collected in the South Lake at Catalina Bay and at Shark Basin in 1948. To complete the illustrated checklist, specimens of *Ashtoret lunaris* (Forskål, 1775), *P. sidneyi*, *Cardisoma carnifex* (Herbst, 1796), *M. thukuhar*, *Portunus pelagicus* (Linnaeus, 1758), *U. (P.) chlorophthalmus* and *U. (T.) urvillei*, none of which currently occur in the system, were obtained from a variety of locations along the KwaZulu-Natal coast.

The range of *Hymenosoma projectum* (Fig. 2) appears to have contracted since the survey conducted in 1948 (Day *et al.* 1954; Millard & Broekhuysen 1970), when the species occurred throughout the system. In 2012, it was found only at Fani's Island, Charter's Creek and Catalina Bay, all stations within the South Lake. The distribution of *H. projectum* probably fluctuates with the state of the lake and this current, more restricted distribution is possibly due to the drought conditions that have prevailed in the region until recently. *P. blephariskios* was recorded throughout the Narrows and at the estuary

TABLE 1  
Brachyuran species (with previously used names and describing author) collected from St Lucia since 1948. \* – As recorded by Millard & Broekhuysen (1970).

Accepted name	Author	Previous name*	Years collected in St Lucia				
			1948/49	1964/65	2007	2011	2012
<i>Acanthonyx quadridentatus</i>	(Krauss, 1843)	<i>Dehaanius quadridentatus</i>	x				
<i>Acanthonyx scutellatus</i>	McLeay, 1838	<i>Dehaanius scutellatus</i>	x				
<i>Ashtoret lunaris</i>	(Forskål, 1775)	<i>Matuta lunaris</i>	x				x
<i>Cardisoma carnifex</i>	(Herbst, 1796)	<i>Sesarma eulimene</i>		x			x
<i>Chiromantes eulimene</i>	de Man in Weber, 1897		x				x
<i>Cyclograpsus punctatus</i>	H. Milne Edwards, 1837		x				
<i>Dotilla fenestrata</i>	Hilgendorf, 1869		x				x
<i>Hymenosoma projectum</i>	Dawson & Griffiths, 2012	<i>Hymenosoma orbiculare</i>	x		x		x
<i>Macrophthalmus depressus</i>	Rüppell, 1830			x			
<i>Metopograpsus thukuhar</i>	(Owen, 1839)		x				
<i>Neorhynchoplax bovis</i>	(Barnard, 1946)	<i>Rhynchoplax bovis</i>	x		x		x
<i>Neosarmatium inerme</i>	(De Man, 1887)	<i>Sarmatium inerme</i>	x				
<i>Neosarmatium africanum</i>	Ragionieri, Fratini & Schubart, 2012	<i>Sesarma meinerti</i>	x			x	x
<i>Neosarmatium smithi</i>	(H. Milne Edwards, 1853)	<i>Sesarma smithii</i>					x
<i>Ocypode ceratophthalmus</i>	(Pallas, 1772)		x			x	x

TABLE 1 (continued)  
Brachyuran species (with previously used names and describing author) collected from St Lucia since 1948. \* – As recorded by Millard & Broekhuysen (1970).

Accepted name	Author	Previous name*	Years collected in St Lucia				
			1948/49	1964/65	2007	2011	2012
<i>Ocypode madagascariensis</i>	Crosnier, 1965						x
<i>Ocypode ryderi</i>	Kingsley, 1880					x	x
<i>Parasesarma catenatum</i>	(Ortmann, 1897)	<i>Sesarma catenata</i>	x				x
<i>Paratyldiplax blephariskios</i>	(Stebbing, 1924)	<i>Tyldiplax blephariskios</i>	x	x	x		x
<i>Perisesarma guttatum</i>	(A. Milne-Edwards, 1869)	<i>Sesarma guttata</i>		x			x
<i>Portunus pelagicus</i>	(Linnaeus, 1758)	<i>Lupa pelagica</i>		x	x		
<i>Potamonautes sidneyi</i>	(Rathbun, 1904)		x				
<i>Potamonautes cf. sidneyi</i>	-						x
<i>Ptychognathus onyx</i>	Alcock, 1900		x				
<i>Scylla serrata</i>	(Forskål, 1775)		x				x
<i>Uca annulipes</i>	(H. Milne Edwards, 1837)		x				x
<i>Uca chlorophthalmus</i>	(H. Milne Edwards, 1837)						
<i>Uca urvillei</i>	(H. Milne Edwards, 1852)		x				
<i>Uca vocans</i>	(Linnaeus, 1758)	<i>Uca marionis</i>		x			
<i>Varuna litterata</i>	(Fabricius, 1798)		x			x	x

TABLE 2  
Density codes indicating the maximum density of brachyuran species at each sampling period in St Lucia Estuary. A = abundant (1001–10000 m<sup>-2</sup>), C = common (101–1000 m<sup>-2</sup>), R = rare (11–100 m<sup>-2</sup>) and V = very rare (1–10 m<sup>-2</sup>). Figures in brackets denote average abundance over the entire estuary (m<sup>-2</sup>), except for *P. blephariskios*, found at the Back Channel in 2012.

Date (and reference)	<i>Paratyloidioplax blephariskios</i>		<i>Hymenosoma cf. orbiculare</i>		<i>Neosarmatium africanum</i>	
	Abundance	Location	Abundance	Location	Abundance	Location
<b>1983</b> (Owen & Forbes 1997)	A	Narrows	-	-	-	-
<b>1984</b> (Owen & Forbes 1997)	C	Narrows	R	Narrows	-	-
<b>1987</b> (Owen & Forbes 1997)	A	Narrows	V	Narrows	-	-
<b>1988</b> (Owen & Forbes 1997)	C	Narrows	V	Narrows	-	-
<b>1989</b> (Owen & Forbes 1997)	A	Narrows	R	Narrows	-	-
<b>1990</b> (Owen & Forbes 1997)	C	Narrows	-	-	-	-
<b>1993</b> (Owen & Forbes 1997)	C	Narrows	-	-	V (3.7 ± 0.7 SD)	Mouth and Narrows
<b>1994</b> (Owen & Forbes 1997)	C	Narrows	-	-	-	-
<b>2005</b> (Pillay & Perissinotto 2008)	R (20.4)	Mouth, Narrows and South Lake	-	-	-	-
<b>2012</b>	R (88.8)	Back Channel	V (5.0)	Fani's Island	V (5.7 ± 1.1 SD)	Mouth and Narrows

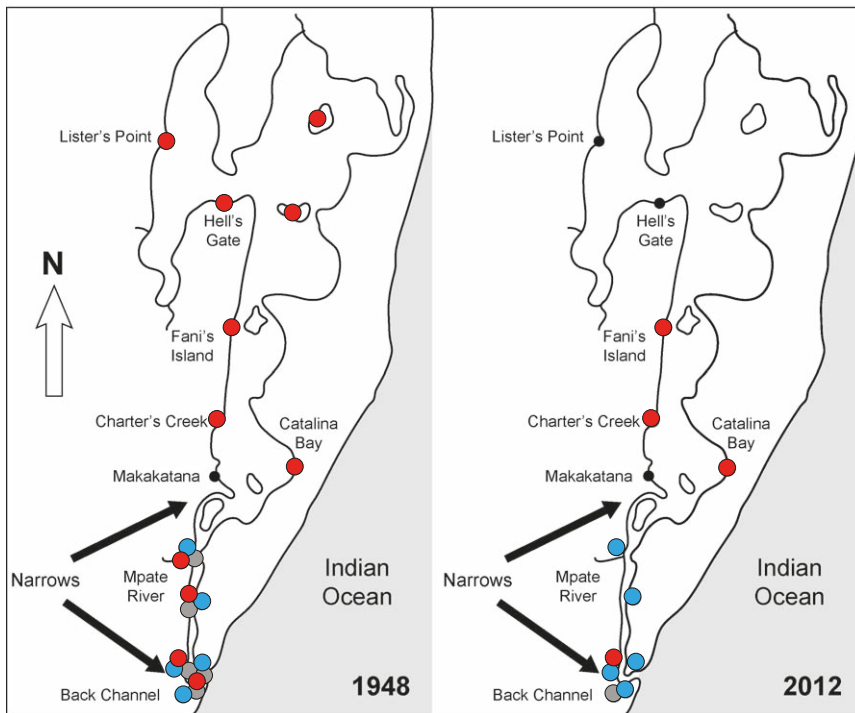


Fig. 2. Distribution of *Hymenosoma projectum* (red), *Paratyldiplax blephariskios* (grey) and *Neosarmatium africanum* (blue) in 1948 and 2012.

mouth in 1948 (Day *et al.* 1954) (Fig. 2). However, during the 2012 survey, the species was not encountered in the system. It was only found along the banks of the Mfolozi and the Back Channel which leads into St Lucia. The mangrove crab, *N. africanum*, is the only species which has maintained its original distribution (Fig. 2). It still occurs where it was previously found in 1948, from the estuary mouth up to the Mplate River mouth in the Narrows (Millard & Broekhuysen 1970; Owen & Forbes 1997).

In terms of abundance (Table 2), *P. blephariskios* was regarded as common to abundant in the Narrows during 1994 (Owen & Forbes 1997). In 2005, it was recorded as rare in this region (Pillay & Perissinotto 2008) and in 2012, its status was rare in the Mfolozi Back Channel. *H. projectum* has been designated as either rare or very rare in the Narrows and South Lake and its abundance appears to fluctuate erratically. *N. africanum* has always been very rare at all locations (Pillay & Perissinotto 2008).

#### DISCUSSION

Only 13 of the originally recorded brachyuran species appear to be in the St Lucia system at present, with 5 additional species having being found. As most of these species occur naturally in mangroves or on the beach berm, they are the least affected by the extreme salinity fluctuations of the system, which at times experiences a reverse salinity gradient. The exceptions were all at the mouth or the Mfolozi inlet. *P. blephariskios* individuals were seen burrowing in the muddy banks of the Mfolozi near the inlet;

*Scylla serrata* (Forskål, 1775) was found dead at the mouth and alive on the banks of the Mfolozi; and *V. litterata* occurred regularly at the mouth.

Therefore, the distribution range of brachyurans around the estuarine lake has changed compared to earlier surveys (Millard & Broekhuysen 1970). In the late 1940s, *H. projectum* specimens were netted as far north as the North Lake, while *V. litterata* was found at False Bay (Fig. 1). In the 1960s, *P. pelagicus* occurred as far north as Catalina Bay. In 2012, Fani's Island was the northernmost point of collection of live specimens previously recorded in the system and only *H. projectum* was found here in high abundance, while only dead *V. litterata* were collected at False Bay. However, *P. sidneyi* was present in a freshwater stream flowing into the lake just north of Lister's Point and *P. cf. lividus* was netted from ephemeral pans between Dukandlovu and Lister's Point. This species is yet to be conclusively identified and appears to occupy only ephemeral pans, as it has not yet been found in any other habitat. These pans represent a harsh but unique habitat niche for specialised species, as they are often waterless for long periods during the dry season. It has been suggested by Millard and Broekhuysen (1970) that salinity levels affect crab distribution. They reported an "excessively high" salinity of 89 ppt at False Bay. In recent years, salinity has been much higher in this region, even exceeding 200 ppt at times during 2010–2011 (Carrasco & Perissinotto 2012).

Brachyurans play a prominent role in maintaining mangrove forests, as they facilitate a process known as tidal flushing. The construction of burrows allows for oxygenation of the dense mangrove mud (Vopel & Hancock 2005). Tidal fluctuations or, in the case of St Lucia, wind-driven fluctuations in water levels transport nutrients through the mud and burrows, allowing for the removal of ammonium and other forms of nitrogen by the outgoing flow. Even in systems where tidal movement is negligible or completely absent, the feeding and burrowing behaviour of the inhabitant brachyurans is vital to preservation of the mangrove system. In a study conducted by Smith *et al.* (1991) in Queensland, Australia, mangrove crabs were removed over a 12-month period to determine whether or not burrowing activity influenced nutrient concentrations, soil sulphide concentration, forest productivity and growth. It was determined that burrowing affects soil aeration, which in turn affects reproduction and growth of mangrove forests. Furthermore, feeding and selectivity of feeding allows for recycling of nutrients and shaping of the mangrove community structure, respectively (Lee 1998).

The genus *Uca* and the family Sesamididae are the two most important taxa in South African mangroves in terms of abundance (Skov *et al.* 2002). *Uca* maintains an important flow of nutrients by feeding on microphytobenthos, making this source of production available to higher trophic levels (Nagelkerken *et al.* 2008). By feeding largely on benthic micro-organisms, they alter both the sediment topography and composition of the mangrove forest floor (Skov *et al.* 2002). However, as this genus has an obligate marine phase for its larvae, it is unable to colonise when there is no sea-estuary connection (Papadopoulos *et al.* 2002). The current loss of *Uca* from the St Lucia mangroves is detrimental. There is a similar problem in respect of the swimming crab *S. serrata*. The only two specimens of this species collected from the system during 2012 were both dead. Hill (1975) reported a similar phenomenon: large numbers of dead and dying *S. serrata* were found following heavy rainfall in Eastern Cape estuaries. This indicates that the species is drastically affected by a sudden change in physico-chemical parameters, despite its euryhaline nature (Forbes & Hay 1988). The negative impact on the St Lucia

*S. serrata* population could be exacerbated by the need for females to move out to sea with their fertilised eggs in order to release their larvae (Hill 1975). The closure of the mouth means that females have difficulty reaching the sea and larvae have limited access to the estuary once they are released.

In terms of abundance, the brachyurans belonging to the family Sesarmidae are dominant in St Lucia, currently occurring at all mangrove sites around the estuarine lake. Sesarmids feed predominantly on leaf litter in the mangroves (Dahdouh-Guebas *et al.* 1997) and have been found to remove up to 67% of all leaf litter produced in a day (Ólafsson *et al.* 2002). *N. africanum* is the largest and most common mangrove sesarmid (Skov *et al.* 2002) in South Africa. Individuals are mainly herbivorous, with mangrove leaf litter forming approximately 75% of the diet of this species (Steinke *et al.* 1993). Individuals compete for fallen leaves and drag them back to their burrows where they are left to senesce for the removal of unpalatable tannins. They are then consumed. In this way, mangrove production is retained within the ecosystem, while detritus is broken down, leading to a faster rate of decomposition and facilitating the biogeochemical cycle within the mangrove ecosystem (Steinke *et al.* 1993; Dahdouh-Guebas *et al.* 1997). Additionally, the floor remains relatively free from leaf litter and this is especially important in areas lacking tidal influence. *N. africanum* usually inhabits the landward side of mangrove forests and can survive in fairly dry areas (Dahdouh-Guebas *et al.* 1997), largely due to its semi-terrestrial, air-breathing habits (Lee 1998). This could be the main reason for their success and dominance around the St Lucia Estuary and lake system (Fig. 2).

In all surveys, the mouth and the Mfolozi inlet have appeared to exhibit the highest diversity in terms of brachyuran species. A Mfolozi-St Lucia link can be considered a particularly valuable feature of the system. Because of its fairly stable physico-chemical properties, the Mfolozi could serve as a refuge when hypersalinity prevails in the St Lucia estuarine lake. This possibility is evident when the diversity of the Mfolozi mangroves is compared to those fringing St Lucia. In 2012, the mangroves around St Lucia were mostly inhabited by only one brachyuran species, with the exception of the boardwalk mangroves and the Bridge, which had two and three inhabitant species, respectively. On the other hand, six species were found at the Mfolozi mangroves, including *Uca annulipes* (H. Milne Edwards, 1837). The Mfolozi is also currently the only habitat of *P. blephariskios* in the entire system (Fig. 2). A species endemic to the southeast coast of Africa (Owen 2003), it occurs abundantly in muddy substrata where it plays an important role as a deposit- and filter-feeder (De Villiers *et al.* 1999). Until recently, the Mhlathuze and St Lucia estuaries both supported the largest populations of *P. blephariskios* and in 1997, its average density in St Lucia was calculated at 1500 ind.m<sup>-2</sup> (Owen & Forbes 1997). Owen and Forbes (2002) stated that the species is euryhaline and able to survive in the St Lucia Narrows at a maximum salinity of 55 ppt. This salinity tolerance was, however, affected by food availability and temperature and a marked decline in abundance was observed at a salinity of 38 ppt, whereas torpor was induced at 50 ppt. Moreover, the primary method of dispersal for the species is tidal and the lack of tidal fluctuation in the Narrows and the estuary in general means that *P. blephariskios* has a limited means of dispersal (Owen & Forbes 2002). As the system experiences highly fluctuating salinity levels, it is unlikely that *P. blephariskios* would be able to survive the current conditions. Owen *et al.* (2010) have suggested that during periods of crisis,

TABLE 3

Distribution of brachyuran species sampled from 1948 to 2012, where: BM – boardwalk mangroves, BP – black pipe, BR – bridge, CB – Catalina Bay, CC – Charter’s Creek, EM – estuary mouth, FB – False Bay, FI – Fani’s Island, HB – Honeymoon Bend, MI – Mfolozi inlet, MR – Mpate River mouth, MT – Makakatana, NA – Narrows and NL – North Lake.

Identification	EM	BM	BP	MI	HB	BR	MR	NA	MT	CB	CC	FI	FB	NL
<i>Acanthonyx quadridentatus</i>				1948										
<i>Acanthonyx scutellatus</i>				1948										
<i>Ashtoret lunaris</i>	1948 2012													
<i>Cardisoma carnifex</i>				1965		2012								
<i>Chiromantes eulimene</i>	2012	1949 2012	2012	2012	2012	2012	1949	1949			1949			
<i>Cyclograpsus punctatus</i>		1948						1948						
<i>Dotilla fenestrata</i>	1948 2012													
<i>Hymenosoma projectum</i>	1948									2012	1948 2012	1948 2012	1948	1948
<i>Macrophthalmus depressus</i>				1965			2012	2012						
<i>Metopograpsus thukuhar</i>			1948							1948	1948			
<i>Neorhynchoplax bovis</i>	1949					2012						1948		1948
<i>Neosarmatium inerme</i>			1948											
<i>Neosarmatium meinerti</i>	1948 2012	2012		2012		2012	2012	1948			1948			

TABLE 3 (continued)  
Distribution of brachyuran species sampled from 1948 to 2012, where: BM – boardwalk mangroves, BP – black pipe, BR – bridge, CB – Catalina Bay, CC – Charter’s Creek, EM – estuary mouth, FB – False Bay, FI – Fani’s Island, HB – Honeymoon Bend, MI – Mfolozi inlet, MR – Mpate River mouth, MT – Makakatana, NA – Narrows and NL – North Lake.

Identification	EM	BM	BP	MI	HB	BR	MR	NA	MT	CB	CC	FI	FB	NL
<i>Ocypode ceratophthalmus</i>	1948 2012													
<i>Ocypode madagascariensis</i>	2012													
<i>Ocypode ryderi</i>	2012													
<i>Parasesarma catenatum</i>		1949		1949 2012										
<i>Paratyldiplax blephariskios</i>	1948			2012		1964								
<i>Perisesarma guttatum</i>	2012					1964 2012								
<i>Portunus pelagicus</i>						1964	1964	1964		1964				
<i>Potamonautes cf. Ividus</i>													2012	
<i>Potamonautes sidneyi</i>										1948				
<i>Ptychognathus onyx</i>	1949													
<i>Scylla serrata</i>	2012			2012							1948			
<i>Uca annulipes</i>				2012			1949							
<i>Uca chlorophthalmus</i>							1949							
<i>Uca urvillei</i>	2013	1948												
<i>Uca vocans</i>				1965										
<i>Varuna litterata</i>	2012			1949							1948		1948 2012	

the Mfolozi-Msunduzi system may provide a refuge to organisms that normally occur in the St Lucia estuarine lake. Indeed, *P. blephariskios* is found at the Back Channel and, should favourable conditions be restored, dispersal and recolonisation from this “refuge population” could occur via a newly restored Mfolozi- St Lucia link (Owen *et al.* 2010). This is an important consideration and supports the recently implemented reconnection of the St Lucia Estuary to the Mfolozi.

The North Lake and False Bay are the least diverse areas, inhabited by the lowest number of species found in the various regions. In 1948, there were two species present at each of these two locations (Day *et al.* 1954; Millard & Broekhuysen 1970) (Table 3), while in 2012, only *V. litterata*, was found (dead) in False Bay and had probably been washed downstream from a nearby river. The reverse salinity gradient that persists in the system best explains the lack of brachyurans in the northern reaches of the estuarine lake, as even the most euryhaline species would be unable to tolerate the salinity levels currently prevailing in these areas (Carrasco & Perissinotto 2012). *H. projectum* was once recorded as *Hymenosoma orbiculare* Desmarest, 1823 until recent genetic studies proposed splitting of the South African *H. orbiculare* population into five distinct species (Edkins *et al.* 2007; Teske *et al.* 2009). These have subsequently been described by Dawson and Griffiths (2012). The species once occurred throughout False Bay and the North Lake (Fig. 2). It is endemic to the east coast of southern Africa, and is known from as far south as Port St Johns (Branch *et al.* 2010; Teske *et al.* 2009).

Lawrie and Stretch (2011) proposed three possible scenarios for the future state of the St Lucia estuarine system. In scenario 1, the St Lucia Estuary is separated from the Mfolozi and an open mouth is artificially maintained. Scenario 2 provides for separation from the Mfolozi with no mouth manipulation (closed), while in scenario 3, the St Lucia Estuary and the Mfolozi have a combined inlet with no further manipulation. In the recent past, Scenario 2 has prevailed, although the mouth has now been linked to the Mfolozi (Scenario 3). Scenario 2 is largely associated with high salinity levels and low water levels for prolonged periods, leading to the predominant closure of the mouth. Salinity would be expected to fluctuate between extremely high and extremely low levels. This would negatively affect the diversity and distribution of brachyurans, as large salinity fluctuations and lack of ocean influence in the estuarine lake and surrounding mangroves create conditions that are unfavourable for them. This is problematic when an affected species depends largely on the St Lucia Estuary and is endemic to the region, as is the case with *P. blephariskios*. Additionally, scenario 2 would prevent recruitment of new species and juveniles from the ocean, leading to a temporary loss of species such as *S. serrata* and those belonging to the genus *Uca*. However, species capable of surviving these conditions, such as *N. africanum* and *C. eulimene*, would dominate in the system and possibly spread due to lack of competition. When the mouth does open briefly, as it did in March 2007, diversity would probably increase, although unsustainably so because of reversion to the closed mouth state soon afterwards. MacKay *et al.* (2010) reported an increase in the diversity of brachyurans following the overtopping/breaching event of March 2007, which could possibly indicate that larval recruitment had taken place. However, whereas four species were recorded after the storm, only one was found six months later.

In scenario 1, medium to high water levels would persist, although hypersalinity would be experienced about 30% of the time. This would allow for a much higher diversity

and abundance of species, as well as faster recovery after hypersaline events, due to greater stability in salinity. Scenario 3 would have the least extreme conditions, with no anthropogenic intervention subsequent to the linking of the Mfolozi and St Lucia systems. The chances of hypersalinity occurring and desiccation taking place are the lowest in this scenario, while abundance and diversity would be highest (Lawrie & Stretch 2011). Bolt (1974) reported rapid re-colonisation of the system by benthic fauna following a period of high salinity. As there are refuge populations of some species around the Mfolozi River, this could be a future possibility and the presence of *U. (T.) urvillei* has already been noted near the mouth, in March 2013 (R.H. Taylor pers. obs.) (Table 3). The open mouth in scenarios 1 and 3 would allow for the recruitment of juveniles and possibly new species, although the threat of alien invasion would also increase. A good example of a non-indigenous species is the crab *Carcinus maenas* (Linnaeus, 1758) which, however, has yet to successfully invade the east coast of South Africa, having been found to prefer sheltered bays as opposed to the high-energy coastline of KwaZulu-Natal (Hampton & Griffiths 2007).

There is no well-defined arrangement for the identification of brachyurans within the system and this is partly due to the recent discoveries of pseudocryptic (identifiable through careful morphological analysis, but easily misidentified) and cryptic (morphologically similar but genetically different) species (Sarno *et al.* 2005), particularly amongst the sesarmids and within the genera *Uca* and *Hymenosoma* (Edkins *et al.* 2007; Teske *et al.* 2009, Ragionieri *et al.* 2012). The aim of the illustrated and annotated checklist in the Appendix is to provide interested parties with an updated and definitive means of identification. This will hopefully reduce identification error and facilitate both research and management.

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#### REFERENCES

*Note:* The number in square brackets at the end of some of the references refers to the in-text citation used in the annotated checklist (Appendix).

- BARNARD, K.H. 1950. Descriptive catalogue of South African decapod Crustacea. *Annals of the South African Museum* **38**: 1–837. [11]
- BEGG, G. 1978. *The estuaries of Natal*. Report no. 41. Pietermaritzburg: Natal Town and Regional Planning Commission.
- BOLT, R.E. 1974. The benthos of some southern African lakes. Part V: The recovery of the benthic fauna of St Lucia following a period of excessively high salinity. *Transactions of the Royal Society of South Africa* **41**: 295–323.
- BRANCH, G.M., GRIFFITHS, C.L., BRANCH, M.L. & BECKLEY, L.E. 2010. *Two oceans: a guide to the marine life of Southern Africa*. Cape Town: Struik. [1]
- CARRASCO N.K., PERISSINOTTO R. & PILLAY D. 2010. Zooplankton of the St. Lucia Estuary during the current drought cycle: a comparison between open- and closed-mouth conditions. *Marine Ecology Progress Series* **399**: 157–171.

- CARRASCO, N.K. & PERISSINOTTO, R. 2012. Development of a halotolerant community in the St Lucia Estuary (South Africa) during a hypersaline phase. *PLoS One* 7: e29927.
- CUMBERLIDGE, N., NG., P.K.L., YEO, D.C.J., MAGALHÃES, C., CAMPOS, M.R., ALVAREZ, F., NARUSE, T., DANIELS, S.R., ESSER, L.J., ATTIOPOE, F.Y.K., CLOTILDE-BA, F.-L., DARWALL, W., MCIVOR, A., BAILLIE, J.E.M., COLLEN, B. & RAM, M. 2009. Freshwater crabs and the biodiversity crisis: importance, threats, status, and conservation challenges. *Biological Conservation* 142: 1665–1673.
- CYRUS, D., JERLING, H., MACKEY, F. & VIVIER, L. 2011. Lake St Lucia, Africa's largest estuarine lake in crisis: combined effects of mouth closure, low levels and hypersalinity. *South African Journal of Science* 107 (3/4), Art. #291. DOI: 10.4102/sajs.v107i3/4.291
- DAHDOUH-GUEBAS, F., VERNEIRT, M., TACK, J.F. & KOEDAM, N. 1997. Food preferences of *Neosarmatium meinerti* de Man (Decapoda: Sesarinae) and its possible effect on regeneration of mangroves. *Hydrobiologia* 347: 83–89.
- DARWALL, W.R.T., SMITH, K.G., TWEDDLE, D. & SKELTON, P., eds. 2009. *The status and distribution of freshwater biodiversity in southern Africa*. Gland, Switzerland: International Union for Conservation of Nature and Grahamstown, South Africa: South African Institute for Aquatic Biodiversity. [12]
- DAVIE, P.J.F. 1994. Revision of *Neosarmatium* Serène and Soh (Crustacea: Brachyura: Sesarinae) with descriptions of two new species. *Memoirs of the Queensland Museum* 35: 35–74. [2]
- DAWSON, J. & GRIFFITHS, C.L. 2012. Revision of the crown crabs, genus *Hymenosoma* (Crustacea: Hymenosomatidae), of South Africa. *African Natural History* 8: 16–29.
- DAY, J.H. 1981. The estuarine fauna. In: Day, J.H., ed., *Estuarine ecology: with particular reference to Southern Africa*. Cape Town: Balkema. [13]
- DAY, J.H., MILLARD, N.A.H. & BROEKHUYSEN, G.J. 1954. The ecology of South African estuaries. Part IV: the St Lucia system. *Transactions of the Royal Society of South Africa* 34: 129–156.
- DE VILLIERS, C.J., HODGSON, A.N. & FORBES, A.T. 1999. Studies on estuarine macroinvertebrates: The macrobenthos In: Allanson B.R. & Baird, D. eds., *Estuaries of Southern Africa*. Cambridge University Press: Cambridge.
- EDKINS, M.T., TESKE, P.R., PAPADOPOULOS, I. & GRIFFITHS, C.L. 2007. Morphological and genetic analyses suggest that southern African crown crabs, *Hymenosoma orbiculare*, represent five distinct species. *Crustaceana* 80: 667–683. [3]
- FORBES, A.T. & HAY, D.G. 1988. Effects of a major cyclone on the abundance and larval recruitment of the portunid crab *Scylla serrata* (Forskål) in the St Lucia Estuary, Natal, South Africa. *South African Journal of Marine Science* 7: 219–225.
- GIDDINS, R.L., LUCAS, J.S., NEILSON, M.J. & RICHARDS, G.N. 1986. Feeding ecology of the mangrove crab *Neosarmatium smithi* (Crustacea: Decapoda: Sesamididae). *Marine Ecology Progress Series* 33: 147–155. [5]
- GOUWS, G., STEWART, B.A. & REAVELL, P.E. 2001. A New Species of Freshwater Crab (Decapoda, Potamonautidae) from the Swamp Forests of KwaZulu-Natal, South Africa: Biochemical and Morphological Evidence. *Crustaceana* 74 (2): 137–160.
- GUINOT, D. 1967. La faune carcinologique (Crustacea Brachyura) de l'océan Indien occidental et de la mer Rouge. Catalogue, remarques biogéographiques et bibliographie. In: Réunion de Spécialistes C.S.A. sur les Crustacés, Zanzibar, 1964. *Mémoires de l'Institut Fondamental d'Afrique Noire* 77: 235–352. [15]
- HAMPTON, S.L. & GRIFFITHS, C.L. 2007. Why *Carcinus maenas* cannot get a grip on South Africa's wave-exposed coastline. *African Journal of Marine Science* 29: 123–126.
- HILL, B.J. 1975. Abundance, breeding and growth of the crab *Scylla serrata* in two South African estuaries. *Marine Biology* 32: 119–126.
- KEMP, S. 1915. Fauna of the Chilka Lake: Crustacea, Decapoda. *Memoirs of the Indian Museum* 5: 199–325. [14]
- LAWRIE, R.A. & STRETCH, D.D. 2011. Occurrence and persistence of water level/salinity states and the ecological impacts for St Lucia estuarine lake, South Africa. *Estuarine, Coastal and Shelf Science* 95: 67–76.
- LEE, S.Y. 1998. Ecological role of grapsid crabs in mangrove ecosystems: a review. *Marine and Freshwater Research* 49: 335–343.
- LENZ, H. 1905. Ostafrikanische Dekapoden und Stomatopoden, gesammelt von Herrn Prof. Dr. A. Voeltzkow. In: Voeltzkow, A., ed., *Wissenschaftliche Ergebnisse der Reisen in Madagaskar und Ostafrika in den Jahren 1889–1895*. Vol. 3. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 27: 341–392. [6]
- MACKEY, F., CYRUS, D. & RUSSELL, K.-L. 2010. Macrobenthic invertebrate responses to prolonged drought in South Africa's largest estuarine lake complex. *Estuarine, Coastal and Shelf Science* 86: 553–567.

- MILLARD, N.A.H. & BROEKHUYSEN, G.J. 1970. The ecology of South African estuaries Part X. St Lucia: a second report. *Zoologica Africana* **5**: 277–307. [7]
- NAGELKERKEN, I., BLABER, S.J.M., BOUILLON, S., GREEN, P., HAYWOOD, M., KIRTON, L.G., MEYNECKE, J-O., PAWLK, J., PENROSE, H.M., SASEKUMAR, A. & SOMERFIELD, P.J. 2008. The habitat function of mangroves for terrestrial and marine fauna: A review. *Aquatic Botany* **89**: 135–185.
- ÓLAFSSON, E., BUCHMAYER, S. & SKOV, M.W. 2002. The East African decapod crab *Neosarmatium meinerti* (de Man) sweeps mangrove floors clean of leaf litter. *Ambio* **31**: 569–573.
- OWEN, R.K. 2003. A short note on factors affecting the geographic distribution of the burrowing ocypodid crab, *Paratyloidiplax blephariskios*: temperature, habitat and competition. *African Journal of Aquatic Science* **28**: 57–60.
- OWEN, R.K., CYRUS, D.P., VIVIER, L. & JERLING, H.L. 2010. The potential for zoobenthic fauna dispersal into the St Lucia Estuary from the Mfolozi–Msunduzi estuarine system, KwaZulu-Natal, South Africa. *African Journal of Aquatic Science* **35**: 135–140.
- OWEN, R.K. & FORBES, A.T. 1997. Managing the St Lucia Estuary—messages from the mud. *Southern African Journal of Aquatic Sciences* **23**: 114–118.
- 2002. Salinity tolerance of the burrowing ocypodid crab, *Paratyloidiplax blephariskios*, in the St Lucia and Mhlathuze estuaries, KwaZulu-Natal, South Africa. *African Journal of Aquatic Science* **27**: 21–29.
- PAPADOPOULOS, I., WOOLDRIDGE, T.H. & NEWMAN, B.K. 2002. Larval life history strategies of sub-tropical southern African estuarine brachyuran crabs and implications for tidal inlet management. *Wetlands Ecology and Management* **10**: 249–256.
- PILLAY, D. & PERISSINOTTO, R. 2008. The benthic macrofauna of the St Lucia Estuary during the 2005 drought year. *Estuarine, Coastal and Shelf Science* **77**: 35–46.
- RAGIONIERI, L., FRATINI, S. & SCHUBART, C.D. 2012. Revision of the *Neosarmatium meinerti* species complex (Decapoda: Brachyura: Sesarmidae), with descriptions of three pseudocryptic Indo-West Pacific species. *The Raffles Bulletin of Zoology* **60**: 71–87.
- ROBERTSON, W.D. 1996. Abundance, population structure and size at maturity of *Scylla serrata* (Forskål) (Decapoda: Portunidae) in Eastern Cape estuaries, South Africa. *South African Journal of Zoology* **31**: 177–185. [8]
- SARNO, D., KOOISTRA, W.C.H.F., MEDLIN, L.K., PERCOPO, I. & ZINGONE, A. 2005. Diversity in the genus *Skeletonema* (Bacillariophyceae). II. An assessment of the taxonomy of *S. costatum*-like species, with the description of four new species. *Journal of Phycology* **41**: 151–176.
- SCHLACHER, T.A. & WOOLDRIDGE, T.H. 1996. Ecological responses to reductions in freshwater supply and quality in South Africa's estuaries: lessons for management and conservation. *Journal of Coastal Conservation* **2**: 115–130.
- SKOV, M.W., VANNINI, M., SHUNULA, J.P., HARTNOLL, R.G. & CANNICCI, S. 2002. Quantifying the density of mangrove crabs: Ocypodidae and Grapsidae. *Marine Biology* **141**: 725–732.
- SMITH, T.J., BOTO, K.G., FRUSHER, S.D. & GIDDINS, R.L. 1991. Keystone species and mangrove forest dynamics: the influence of burrowing by crabs on soil nutrient status and forest productivity. *Estuarine, Coastal and Shelf Science* **33**: 419–432.
- STEBBING, T.R.R. 1910. General catalogue of South African Crustacea. Part V of South African Crustacea, for the marine investigations in South Africa. *Annals of the South African Museum* **6**: 281–593. [9]
- STEINKE, T.D., RAJH, A. & HOLLAND, A.J. 1993. The feeding behaviour of the red mangrove crab *Sesarma meinerti* De Man, 1887 (Crustacea: Decapoda: Grapsidae) and its effect on the degradation of mangrove leaf litter. *South African Journal of Marine Science* **13**: 151–160.
- TESKE, P.R., MCLAY, C.L., SANDOVAL-CASTILLO, J., PAPADOPOULOS, I., NEWMAN, B.K., GRIFFITHS, C.L., MCQUAID, C.D., BARKER, N.P., BORGONIE, G. & BEHEREGARAY, L.B. 2009. Tri-locus sequence data reject a “Gondwanan origin hypothesis” for the African/South Pacific crab genus *Hymenosoma*. *Molecular Phylogenetics and Evolution* **53**: 23–33.
- VANNINI, M., CANNICCI, S., BERTI, R. & INNOCENTI, G. 2003. *Cardisoma carnifex* (Brachyura): where have all the babies gone? *Journal of Crustacean Biology* **23**: 55–59. [10]
- VOPEL, K., HANCOCK, N. 2005. More than just a crab hole. *Water and Atmosphere* **13**: 18–19.
- WHITFIELD, A.K. & TAYLOR, R.H. 2009. A review of the importance of freshwater inflow to the future conservation of Lake St Lucia. *Aquatic Conservation: Marine and Freshwater Ecosystems* **19**: 838–848.

## APPENDIX

An annotated and illustrated checklist of all brachyuran crustaceans identified from St Lucia Estuary during this study and that of Millard and Broekhuysen (1970). Abbreviations: CWW – Carapace width at widest point. Scale bars = 10 mm.

## FAMILY CAMPTANDRIIDAE

***Paratyrodoplax blephariskios* (Stebbing, 1924)**

Synonyms: *Cleistostoma blephariskios* Stebbing, 1924.

Common name: Eastern oval crab.

Size: 10 mm CWW.

Distinguishing features: Carapace almost oval in shape, with highly setose legs and eye stalks.

Distribution: Mngazana to Moçambique.<sup>[13]</sup>

St Lucia records:

1948 – Collected in sandy mud at the mouth and the bridge; abundant in the lower Narrows.<sup>[7]</sup>

2012 – Collected at the Mfolozi Back Channel.

Fig. 3. Mfolozi River, October 2012, N.A.F. Miranda, 10 mm.



3

## FAMILY DOTILLIDAE

***Dotilla fenestrata* Hilgendorf, 1869**

Synonyms: None.

Common name: Army crab.

Size: 10 mm CWW.<sup>[1]</sup>

Distinguishing features: Small and pea-shaped with a grooved carapace.<sup>[1]</sup>

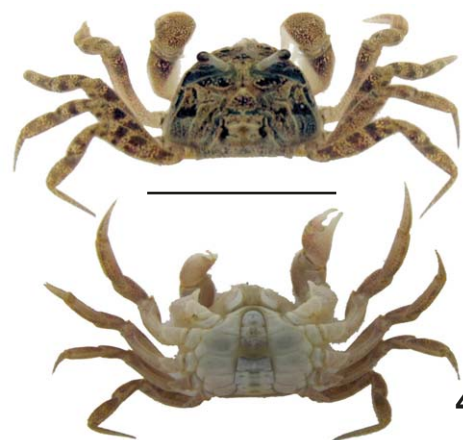
Distribution: Breede River to Moçambique.<sup>[1]</sup>

St Lucia records:

1965 – Recorded at the Mfolozi inlet.<sup>[7]</sup>

2012 – Recorded at the St Lucia Bridge and the Mfolozi Back Channel.

Fig. 4. Mlalazi Estuary, June 2012, N. Peer, 8 mm.



4

## FAMILY EPIALTIIDAE

***Acanthonyx quadridentatus* (Krauss, 1843)**

Synonyms: *Dehaanius quadridentatus* Krauss, 1843.

Common name: 4-toothed decorator crab.

Maximum size: 20 mm CWW.

Distinguishing features: Bears hooked hairs and three or four pairs of marginal teeth on the carapace; usually covered in algal fragments (decorations), as displayed here.<sup>[1]</sup>

Distribution: East London to Moçambique.<sup>[1]</sup>

St Lucia records:

1948 – Netted with seaweed fragments from the channel between St Lucia and Mfolozi.<sup>[7]</sup>

Fig. 5. Rocky Bay, October 2012, N. Peer, 11 mm.



5

***Acanthonyx scutellatus* MacLeay, 1838**

Synonyms: *Acanthonyx macleai* Krauss, 1843.

Common name: Shield decorator crab.

Maximum size: 20 mm CWW.

Distinguishing features: Bears hooked hairs on the carapace. Usually covered in algal fragments (decorations).<sup>[1]</sup>

Distribution: East London to Moçambique.<sup>[1]</sup>

St Lucia records:

1948 – Netted with seaweed fragments from the channel between St Lucia and Mfolozi.<sup>[7]</sup>

Fig. 6. Treasure Beach, October 2012, N.A.F. Miranda, 12 mm.



6

**FAMILY GECARCINIDAE*****Cardisoma carnifex* (Herbst, 1796)**

Synonyms: *Cancer carnifex* Herbst, 1796; *Cancer urvillei* H. Milne Edwards, 1853; *Cardisoma obesum* Dana, 1851; *Perigrapsus excelsus* Heller, 1862.

Common name: Mangrove butcher crab.

Maximum size: 10 mm CWW.<sup>[1, 10]</sup>

Distinguishing features: Body dark red to brown, rounded carapace and smooth.<sup>[1, 10]</sup>

Distribution: Durban Bay to Moçambique.<sup>[6, 10]</sup>

St Lucia records:

1965 – Recorded at the Mfolozi inlet.<sup>[7]</sup>

2012 – Recorded at the St Lucia Bridge and the Mfolozi Back Channel.

Fig. 7. Mlalazi Estuary mangroves, May 2012, N.A.F. Miranda, 95 mm.



7

**FAMILY GRAPSIDAE*****Metopograpsus thukuhar* (Owen, 1839)**

Synonyms: *Grapsus thukuhar* Owen, 1839; *Metopograpsus eydouxii* H. Milne Edwards, 1853; *Metopograpsus intermedius* H. Milne Edwards, 1853; *Pachygrapsus parallelus* Randall, 1840.

Common name: Estuarine rock crab.

Size: 35 mm CWW.<sup>[1]</sup>

Distinguishing features: External face of palm and dactylus often violet in colour, with carapace and legs mottled.<sup>[1]</sup>

Distribution: East London to Moçambique.<sup>[1, 4]</sup>

St Lucia records:

1948 – Juveniles were collected on the northern shore of the SAAF station at Shark Basin and on Catalina Bay.<sup>[7]</sup>

Fig. 8. Durban Bay Harbour, March 2012, N. Peer, 21 mm.



8

## FAMILY HYMENOSOMATIDAE

*Hymenosoma projectum* Dawson & Griffiths, 2012

Synonyms: None.

Common name: Eastern crown crab.

Size: 15 mm CWW.<sup>[1]</sup>

Distinguishing features: Lighter in colour compared to other species of this genus and described as the least setose. Length ratio of first leg: second leg = 1.3 – 1.5:1, a smaller ratio compared to the other species.<sup>[3]</sup>

Distribution: Port St Johns to Moçambique.<sup>[3]</sup>

St Lucia records:

1948 – Found throughout the system.<sup>[7]</sup>

2012 – Collected at Fani's Island and Catalina Bay.

Fig. 9. Fani's Island, St Lucia, July 2012, N. Peer, 9 mm.



9

*Neorhynchoplax bovis* (Barnard, 1946)

Synonyms: *Rhynchoplax bovis* Barnard, 1946.

Common name: Furry crown crab.

Size: 5 mm CWW.<sup>[1]</sup>

Distinguishing features: Brown to dark green in colour. Fur-lined chelae are prominent in both sexes.<sup>[1]</sup>

Distribution: Restricted to tropical and subtropical estuaries along the KwaZulu-Natal coast, to Moçambique.<sup>[1]</sup>

St Lucia records:

1948 – Found throughout the system.<sup>[7]</sup>

2012 – Collected in the Narrows.

Fig. 10. Mpate Mouth, July 2012, R. Perissinotto, 5 mm.



10

## FAMILY MACROPHTHALMIDAE

*Macrophthalmus (Macrophthalmus) grandidieri* A. Milne-Edwards, 1867

Synonyms: *Macrophthalmus hilgendorfi* Tesch, 1915.

Common name: Long-eyed crab.

Size: 25 mm CWW.<sup>[1]</sup>

Distinguishing features: Carapace wider than long, with two pairs of antero-lateral teeth and two shallow grooves running from the midline to the sides of the carapace.<sup>[1]</sup>

Distribution: Durban Bay to Moçambique.<sup>[1, 2]</sup>

St Lucia records:

The species recorded in St Lucia by Millard & Broekhuysen (1970) was *M. depressus* (1965 – Mfolozi inlet), a species currently thought to occur only as far south as Moçambique<sup>[1]</sup>. Thus, *M. grandidieri* is reported here instead, as it is possible that misidentification had occurred.

Fig. 11. Durban Bay, May 2012, N. Peer, 19 mm.



11

**FAMILY MATUTIDAE*****Ashtoret lunaris* (Forskål, 1775)**

Synonyms: *Cancer lunaris* Forskål, 1775; *Matuta banksii* Leach, 1817; *Matuta lunaris* (Forskål, 1775).

Common name: Lunar box crab.

Size: 40 mm CWW. (excluding spines).<sup>[1]</sup>

Distinguishing features: Cream, round carapace with red dots and two lateral spines. Spiny chelae.<sup>[1]</sup>

Distribution: East London to Moçambique.<sup>[1]</sup>

St Lucia records:

1948 – Seine-netted at the mouth.<sup>[7]</sup>

2012 – Found dead on the beach berm in front of the closed St Lucia Mouth.

Fig. 12. Vetch's Beach, August 2012, N. Peer, 35 mm.

**12****FAMILY OCYPODIDAE*****Uca (Austruca) annulipes* (H. Milne Edwards, 1837)**

Synonyms: *Gelasimus annulipes* H. Milne Edwards, 1837.

Common name: Pink-clawed fiddler crab.

Size: 20 mm CWW.<sup>[1]</sup>

Distinguishing features: Broad frontal margin, mottled light-coloured carapace and long, light pink chela in males.<sup>[11]</sup>

Distribution: Port St Johns to Moçambique.<sup>[1]</sup>

St Lucia records:

1949 – Collected from the Mplate River mangroves.<sup>[7]</sup>

2012 – Collected at the Mfolozi Back Channel.

Fig. 13. Mlalazi Estuary, N.A.F Miranda, 13 mm.

**13*****Uca (Paraleptuca) chlorophthalmus* (H. Milne Edwards, 1837)**

Synonyms: *Gelasimus chlorophthalmus* H. Milne Edwards, 1837; *Uca amazonensis* Doflein, 1899.

Common name: Green-eyed fiddler crab.

Size: 20 mm CWW.<sup>[1]</sup>

Distinguishing features: Broad frontal margin. Bright green/blue and black mottled carapace with red legs and chelae.<sup>[11]</sup>

Distribution: Port St Johns to Moçambique.<sup>[1]</sup>

St Lucia records:

1948 – Collected in Mplate River mangroves.<sup>[7]</sup>

Fig. 14. Mlalazi Estuary, N.A.F Miranda, 18 mm.

**14**

***Uca (Tubuca) urvillei* (H. Milne Edwards, 1852)**

Synonyms: *Gelasimus urvillei* H. Milne Edwards, 1852.

Common name: Urville's fiddler crab.

Size: 25 mm CWW.<sup>[1]</sup>

Distinguishing features: Narrow frontal margin with black/brown mottled legs and carapace, red granulated chelae and cheliped.<sup>[11]</sup>

Distribution: Port St Johns to Moçambique.<sup>[1]</sup>

St Lucia records:

1949 – Found at Shark Basin.<sup>[7]</sup>

2013 – Observed in the Back Channel for the first time after a long absence from the system.

Fig. 15. Mlalazi Estuary, November 2012, R.H. Taylor, 30 mm.



15

***Uca (Gelasimus) vocans* (Linnaeus, 1758)**

Synonyms: *Cancer vocans* Linnaeus, 1758;

*Gelasimus cultrimanus* White, 1847; *Gelasimus*

*marionis* Desmarest, 1823; *Gelasimus nitidus*

Dana, 1851; *Ocypode cetharoedicus* Say, 1817;

*Uca marionis* (Desmarest, 1823); *Uca marionis*

*cultrimana* (Adams & White, 1848); *Uca marionis*

*excisa* Nobili, 1906; *Uca vocans excisa* (Nobili,

1906); *Uca (Thalassuca) vocans hesperiae* Crane,

1975.

Common name: Brown fiddler crab.

Size: 25 mm CWW.<sup>[1]</sup>

Distinguishing features: Narrow frontal margin with black/brown mottled legs and carapace, red granulated chelae and cheliped.<sup>[11]</sup>

Distribution: Port St Johns to Moçambique.<sup>[1]</sup>

St Lucia records:

1948 – Collected in Mpate River mangroves.<sup>[7]</sup>

Fig. 16. Mlalazi Estuary, August 2012, R. Perissinotto, 19 mm.



16

***Ocypode ceratophthalmus* (Pallas, 1772)**

Synonyms: *Cancer caninus* Herbst, 1782;

*Cancer ceratophthalmus* Pallas, 1772; *Ocypoda*

*macleaniana* Hess, 1865; *Ocypode brevicornis* var.

*longicornuta* Dana, 1852; *Ocypode urvillei* Guérin, 1829.

Common name: Horn-eyed ghost crab.

Size: 40 mm CWW.<sup>[1]</sup>

Distinguishing features: Has horned eyestalks and a green-coloured carapace. One chela usually noticeably larger than the other.<sup>[1]</sup>

Distribution: Knysna to Moçambique.<sup>[1]</sup>

St Lucia records:

1948 – Found on the beach near the Mfolozi inlet.<sup>[7]</sup>

2012 – Found on the berm at the St Lucia Estuary mouth.

Fig. 17. St Lucia Beach, November 2011, N. Peer, 32 mm.



17

***Ocypode madagascariensis* Crosnier, 1965**

Synonyms: *Ocypode madagascariensis* Crosnier, 1965.

Common name: Madagascan ghost crab.

Size: 35 mm CWW.<sup>[1]</sup>

Distinguishing features: Sandy in colour. Similar in appearance to *O. ryderi* but unlike this species, *O. madagascariensis* has orange/brown joints.<sup>[1]</sup>

Distribution: Durban to Moçambique.<sup>[1]</sup>

St Lucia records:

2012 – Found on the berm at the St Lucia Estuary mouth.

Fig. 18. St Lucia Beach, July 2012, R. Perissinotto, 28 mm.



18

***Ocypode ryderi* Kingsley, 1880**

Synonyms: None.

Common name: Pink ghost crab.

Size: 35 mm CWW.<sup>[1]</sup>

Distinguishing features: Dull pink in colour and similar in appearance to *O. madagascariensis*.

Unlike this species, *O. ryderi* has mauve joints.<sup>[1]</sup>

Distribution: Port Elizabeth to Moçambique.<sup>[1]</sup>

St Lucia records:

2012 – Found on the berm at the St Lucia Estuary mouth.

Fig. 19. St Lucia Beach, December 2011, N. Peer, 30 mm.



19

**FAMILY PORTUNIDAE*****Scylla serrata* (Forskål, 1775)**

Synonyms: *Achelous crassimanus* MacLeay, 1838;

*Cancer serrata* Forskål, 1775; *Lupa lobifrons* H.

Milne Edwards, 1834; *Scylla tranquebarica* var.

*oceanica* Dana, 1852.

Common names: Giant mud crab, Serrated swimming crab.

Size: 300 mm CWW.<sup>[1]</sup>

Distinguishing features: Carapace bears nine pairs of marginal teeth on an oval-shaped carapace.

Usually green/brown in colour with orange-tipped chelae and walking legs.<sup>[1]</sup>

Distribution: Indo-Pacific; in southern Africa, occurs between Knysna to Moçambique.<sup>[1]</sup>

St Lucia records:

1948 – Found at the St Lucia Estuary mouth and near islands. located in the Narrows.<sup>[7]</sup>

2011 – Observed at Charter's Creek.

2012 – Found dead at the St Lucia Mouth.

Fig. 20. Mfolozi River, March 2012, N. Peer, 121 mm.



20

***Portunus (Portunus) pelagicus* (Linnaeus, 1758)**

Synonyms: *Cancer pelagicus* Linnaeus, 1758; *Cancer cedonulli* Herbst, 1794; *Lupa pelagica* (Linnaeus, 1758); *Portunus denticulatus* Marion de Procé, 1822; *Portunus (Portunus) pelagicus* var. *sinensis* Shen, 1932.

Common name: Blue swimming crab.

Size: 120 mm CWW.<sup>[1]</sup>

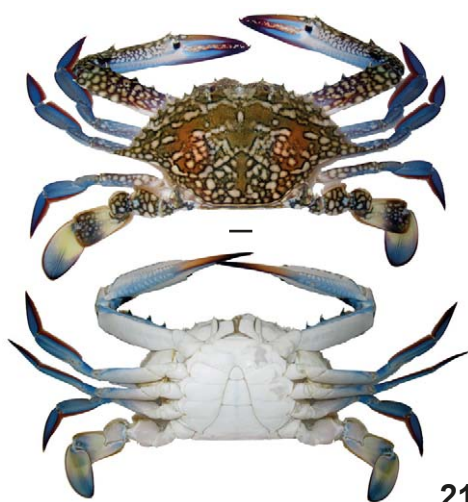
Distinguishing features: Carapace is mottled brown and pink with a toothed, fur-lined anterolateral margin. A lateral spine is present on each side of the carapace and chelae and walking legs are usually blue.<sup>[1]</sup>

Distribution: Durban to Moçambique.<sup>[1]</sup>

St Lucia records:

1964 – Seine-netted between Catalina Bay and Brodie's Shallows, below the Mpate River mouth and at the St Lucia Bridge.<sup>[7]</sup>

Fig. 21. Durban Bay Harbour, September 2012, Durban Seine-Netters, 90 mm.



21

**FAMILY POTAMONAUTIDAE*****Potamonautes cf. lividus* (Gouws, Stewart & Reavell, 2001)**

Synonyms: None.

Common name: St Lucia river crab.

Size: 15 mm CWW.

Distinguishing features: This could be an undescribed species (molecular and morphological study currently in progress). Very similar in appearance to *P. lividus* except for the larger size and colouration.

Distribution: Currently known only from ephemeral pans around False Bay, Lake St Lucia.

St Lucia records:

2012 – Netted from ephemeral pans adjacent to False Bay.

Fig. 22. Dukandlovu Pan, south of Lister's Point, July 2012, R. Perissinotto, 14 mm.



22

***Potamonautes sidneyi* (Rathbun, 1904)**

Synonyms: *Potamon sidneyi* Rathbun, 1904.

Common names: Natal river crab, Sidney's river crab.

Size: 50 mm CWW.<sup>[12]</sup>

Distinguishing features: Carapace strongly granulated, forming sharp angle between postfrontal crest and epibranchial region. Usually brown in colour.<sup>[12]</sup>

Distribution: Mozambique, South Africa (Eastern Cape Province, Free State, Gauteng, KwaZulu-Natal, Mpumalanga, Northern Cape Province, North-West Province) and Swaziland.<sup>[12]</sup>

St Lucia records:

1949 – Collected on the bank opposite the Catalina Jetty.<sup>[7]</sup>

2012 – Found at a freshwater stream north of Lister's Point.

Fig. 23. Cobham, Drakensberg, February 2012, R. Perissinotto, 48 mm.



23

**FAMILY SESARMIDAE*****Neosarmatium smithi* (H. Milne Edwards, 1853)**

Synonyms: *Sesarma smithi* H. Milne-Edwards, 1853; *Sesarma smithii* H. Milne-Edwards 1853.

Common name: Marsh crab.

Size: 50 mm CWW.<sup>[5]</sup>

Distinguishing features: Has uniformly bright red chelae and a black carapace. Very similar in appearance to *P. guttatum* but unlike *P. guttatum* this species bears at least two spines on the upper margin of its dactylus.<sup>[4]</sup>

Distribution: Mngazana to Moçambique.<sup>[2, 4]</sup>

St Lucia records:

2012 – Found amongst the mangroves around the St Lucia Mouth, the Narrows and the Mfolozi inlet.

Fig. 24. St Lucia Estuary mouth, February 2012, R. Perissinotto, 50 mm.

**24*****Neosarmatium africanum* Ragionieri, Fratini & Schubart, 2012**

Synonyms: Previously regarded as *Neosarmatium meinerti* (De Man, 1887).

Common name: Red mangrove crab.

Size: 50 mm CWW.<sup>[1]</sup>

Distinguishing features: Square-like carapace with red and yellow/orange granulated chelae. Chest strongly granulated and ridged upper margin of chelae.<sup>[1, 2]</sup>

Distribution: Port Elizabeth to Moçambique.<sup>[1]</sup>

St Lucia records:

1948 - Collected from Charter's Creek and mangroves around the Narrows and the St Lucia Mouth.<sup>[7]</sup>

2012 – Found amongst the mangroves at the mouth, the Narrows and the Mfolozi inlet.

Fig. 25. St Lucia Estuary mouth, March 2012, N.A.F Miranda, 48 mm.

**25*****Parasesarma catenatum* (Ortmann, 1897)**

Synonyms: *Sesarma catenata* Ortmann, 1897.

Common name: Furry marsh crab.

Size: 25 mm CWW.<sup>[1]</sup>

Distinguishing features: Chelae are orange/yellow in colour, similar to *S. eulimene*. *P. catenatum* is distinguished by the fur-lined chelae present in males and the oblique-shaped ridge on the upper margin of the dactylus.<sup>[1, 11]</sup>

Distribution: Cape Agulhas to Moçambique.<sup>[1]</sup>

St Lucia records:

1948 – Collected from mangroves in the lower Narrows and St Lucia Mouth region.<sup>[7]</sup>

2012 – Found at the Mfolozi inlet.

Fig. 26. Mfolozi River, March 2012, N. Peer, 13 mm.

**26**

***Chiromantes eulimene* (De Man in Weber, 1897)**

Synonyms: *Sesarma eulimene* De Man, 1895;

*Holometopus eulimene* (De Man, 1898).

Common name: Common marsh crab.

Size: 25 mm CWW.<sup>[1]</sup>

Distinguishing features: Chelae are similar in colour as those of *P. catenatum* but without the fur-lined chelae in males and with more rounded granulation of the dactyl's upper margin.<sup>[1, 11]</sup>

Distribution: Bashee to Moçambique.<sup>[11]</sup>

St Lucia records:

1949 – Found north of the Mfolozi inlet, on the islands near Charter's Creek, at the Mpate River mouth, near the pond at the mouth and at Honeymoon Bend Picnic Site.<sup>[7]</sup>

2012 – Found at the St Lucia Bridge, Honeymoon Bend, near the Mfolozi inlet and in Shark Basin.

Fig. 27. Honeymoon Bend, St Lucia, March 2012, N. Peer, 18 mm.



27

***Perisesarma guttatum* (A. Milne-Edwards, 1869)**

Synonyms: *Sesarma guttata* A. Milne-Edwards, 1869.

Common name: Red-clawed marsh crab.

Size: 50 mm CWW.<sup>[1]</sup>

Distinguishing features: Carapace is black and

chelae are uniformly red, similar to *N. smithi*.

Distinguished from *N. smithi* by the granulation on the upper margin of the chelae.<sup>[1, 4]</sup>

Distribution: Port St Johns to Moçambique.<sup>[11]</sup>

St Lucia records:

1964 – Found at the St Lucia Bridge.<sup>[7]</sup>

2012 – Collected at the St Lucia Mouth and Bridge.

Fig. 28. Mlalazi Estuary, May 2012, N. Peer, 26 mm.



28

**FAMILY VARUNIDAE*****Cyclograpsus punctatus* (H. Milne Edwards, 1837)**

Synonyms: *Cyclograpsus reynaudi* H. Milne Edwards, 1837; *Gnathochasmus barbatus* MacLeay, 1838.

Common name: Brown shore crab.

Size: 30 mm CWW.<sup>[1]</sup>

Distinguishing features: Smooth carapace, which is almost square in appearance. Usually dark brown to dark green in colour, with orange/brown legs.<sup>[1]</sup>

Distribution: Entire South African coastline.<sup>[11]</sup>

St Lucia records:

1948 – Collected from Shark Basin and islands located within the Narrows.<sup>[7]</sup>

Fig. 29. Mission Rocks, October 2012. N. Peer, 14 mm.



29

***Ptychognathus onyx* Alcock, 1900**

Synonyms: None.

Common name: Hairy swimming crab.

Size: 14 mm CWW.<sup>[14]</sup>

Distinguishing features: Similar in appearance to *Varuna litterata* but differs because of the presence of fur-lined outer palms of chelae and toothed margins of carapace.<sup>[14]</sup>

Distribution: In Africa, this species has only been recorded in St Lucia<sup>[7]</sup> and in Tanzania.<sup>[15]</sup>

St Lucia records:

1949 – Rarely found in mud banks of estuary. As the species is very similar to *V. litterata*, this record may represent an erroneous identification.<sup>[7]</sup>

Fig. 30. St Lucia, Estuary mouth, July 1949, K.H. Barnard, 10 mm. [Note – These photographs depict the 1949 specimen from the collection at the Iziko South African Museum. Photographs were highly manipulated due to the poor condition and colouration of the actual specimen.]



30

***Varuna litterata* (Fabricius, 1798)**

Synonyms: *Alpheus litteratus* Weber, 1795; *Cancer litterata* Fabricius, 1798; *Varuna tomentosa* Pfeffer, 1889.

Common name: River swimming crab.

Size: 70 mm.<sup>[12]</sup>

Distinguishing features: Carapace almost square in appearance. Dorso-ventrally flattened and mottled brown/green. Highly setose walking legs.<sup>[12]</sup>

Distribution: Indo-Pacific; in southern Africa, reaching as far south as Port St Johns.<sup>[11]</sup>

St Lucia records:

1948 – Recorded at a freshwater stream near Charter's Creek and at False Bay.<sup>[7]</sup>

2012 – Found at the mouth (alive) and at False Bay (dead).

Fig. 31. St. Lucia Estuary mouth, February 2012, R. Perissinotto, 45 mm.



31

