

OBSERVATIONS ON THE MARINE MALACOFAUNA OF THE LAMU ARCHIPELAGO, KENYA

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Abstract The marine malacofauna of the Lamu Archipelago in Northern Kenya was studied in 2001. In this paper, known data from Spry (1964, 1968), Sawyer (1999, 2000), Wronski (2007) and Rosenberg et al. (2004) are supplemented by the results of the author's fieldwork. A total of 55 gastropod and bivalve species was recorded; of which 23 are reported from Zanzibar but not listed in the East Africa section of the OBIS Indo-Pacific Molluscan Database. Five species (*Pseudominolia climacota* (Melvill, 1897); *Terebra nassoides* Hinds, 1844; *Pupa cf solidula* (Linne, 1758); *Ostrea* (*Nanostrea*) *deformis* Lamarck, 1819; *Divaricella irplex* (E.A. Smith, 1885)) were neither reported from Zanzibar nor listed by Rosenberg et al. (2004), and are therefore considered new for East Africa. The study represents the first comprehensive species list of marine gastropods and bivalves found in the tidal flats and beaches of the Lamu Archipelago.

Key words Marine fauna, Gastropoda, Bivalvia, Kenya

INTRODUCTION AND METHODS

Previous comprehensive records of marine molluscs from the East African coast were provided by Spry (1964, 1968), Sawyer (1999, 2000) and Wronski (2007). These authors focused on the marine molluscs of Zanzibar Island, Dar es Salaam and adjacent reefs and islands in the Zanzibar Channel (Pwani Province). In this study, observations were related to the check lists provided by the above mentioned authors and to the *OBIS Indo-Pacific Molluscan Database* of Rosenberg, *et al.*, (2004). The current investigation was carried out between 14th February and 21th February 2001 in order to study the marine malacofauna of the Lamu Archipelago in Kenya. The following localities (not included in the Kiunga National Marine Reserve) were investigated: i) tidal flats between Lamu and the mainland, ii) Mangrove forest of Manda Island and iii) Lamu beach, exposed to the Indian Ocean. Lamu beach and the tidal flats were sampled during five days, while the mangroves around Manda Island were searched for only two days.

An inventory was made of all available data on marine molluscs collected by daily beach-combing and searching on tidal flats. At Lamu beach and on the tidal flats, shell grit was collected, in which many dead molluscs and juvenile specimens of larger species were found. Further material was collected by searching mangrove roots and solid rock surfaces. Collecting methods did not include snorkelling, SCUBA-diving or dredging. Therefore the search-range was limited from the supra-lit-

toral zone down to just beneath the lowest low water mark. This also implies that nudibranch gastropods and chitons were excluded from the survey. However, results were influenced by tide level, wind force and direction.

Shell determinations followed mainly geographic monographs such as Richmond & Rabesandratana, 1997; Cernohorsky (1971, 1972, 1978); Kensley (1973); Oliver (1992); Bosch *et al.* (1995); Drivas & Jay (1988); Lamprell & Healy (1998); Lamprell & Whitehead (2001) and Wilson (1993, 1994), but where available, family or genus monographs were used to improve the accuracy of the identifications (i.e. Bratcher & Cernohorsky, 1987; Henning & Hemmen, 1993; Kilburn, 1981; Coover & Coover, 1995; Rombouts, 1991; Oliver & Chesney, 1994; Cernohorsky, 1984). Systematic and nomenclature of gastropods and bivalves were used following predominantly Rosenberg *et al.* (2004) and Vaught (1989). Most material (only shells) was preserved for definite identification and is now stored in the Zoological Museum Hamburg, Germany and in the private collections of the author.

DESCRIPTION OF LOCALITIES

The Lamu Archipelago is a small group of islands situated on Kenya's northern coastline, near the Somali border. The archipelago is composed of four major islands, being Lamu, Manda, Pate and Kiwayu. This group of islands extends between latitudes 2°15' and 2°30' South and longitudes 40°45' and 40°55' East (Lamu World Heritage Site and

Conservation Office, 2006). The Lamu Archipelago has the largest area of mangroves in Kenya, covering some 28,400 ha. On a straight line basis, the coastline of Lamu district extends 138 km Southwest from the Somali border, but its irregularity and the numerous islands give it a total coastline length of 650 km. Except for the south and south-eastern coast of Lamu, Manda, Pate and a short stretches of continental coastline directly exposed to the Indian Ocean, all of Lamu's tidal plains are covered with mangrove forests of varying widths (Yap & Landoy, 1986). Two communities of mangroves occur along the Kenyan coast entailing eight species belonging to six families (Kairo, 1995; Aboudha & Kairo, 2001). The structure of the mangrove forests follows the typical succession, being a narrow belt of *Sonneratia* (sometimes absent) along the seaward margins, a *Rhizophora*-belt of varying width and finally an *Avicennia*-belt at the highest reach of the tide (Van Speybroeck *et al.*, 1993; Ott, 1996). In most places a clear space is found directly behind or in the midst of the *Avicennia*-zone. Detailed botanical descriptions of the species composition have been provided by Kokwaro (1985) and Gallin *et al.* (1989).

The waters around the islands have a salinity level of 35–36 ppm and the average water temperature varies between 25° and 29°C. Given that the Lamu Archipelago is located in the Doodori River delta, large amounts of river sediments prevent the growth of coral reefs in that area. Within the mangroves and the channels the water has a rich, green colour indicating high productivity with transparency of no more than 2 m in most places. Evidence of this high productivity is the profuse growth of oysters on the prop roots and branches of the *Rhizophora* and *Sonneratia* trees (Yap & Landoy, 1986). The tidal flats of the Lamu Archipelago can be characterised by their relatively low elevation, with most areas less than 2.0 m above datum. Clear areas, without mangrove forest, lie at least 2.75 m above datum, but most rise 3.0 to 3.5 m above datum (Yap & Landoy, 1986). All areas visited were invariably sandy, occasionally with an extensive amount of root material pervading the substrate, giving it a very peat-like characteristic.

RESULTS AND DISCUSSION

In total, 55 species of marine molluscs (28 gastropods and 27 bivalves out of 29 families) were recorded during this study. Out of this, 23 species are also

reported from Zanzibar or the adjacent mainland area of Tanzania (Spry 1964, 1968; Sawyer 1999, 2000; Wronski, 2007) but are not listed in the East Africa section of the OBIS Indo-Pacific Molluscan Database (Rosenberg *et al.*, 2004; highlighted by “x” in Table 1). Five species are neither reported from Zanzibar nor listed in Rosenberg *et al.* (2004) and are therefore newly recorded for East Africa (highlighted by “xx” in Table 1). Spry (1964, 1968) cites in his survey of Dar es Salaam area 504 gastropod species (Spry, 1968), and 246 bivalves (Spry, 1964) coming to a total of 750 mollusc species. Some of his records are synonyms of current taxa (see Table 1). Sawyer's species list includes 197 gastropod (Sawyer, 1999) and 78 bivalve species (Sawyer, 2000), including 167 taxa exhibited in the Natural History Museum Stone Town, Zanzibar. Wronski (2007) reports 139 gastropod species and 44 bivalve species from Zanzibar Island and the adjacent mainland coast of Pwani Province in Tanzania. Additionally, the results of this study (Table 1) are compared with species listed in the Kenya section of the OBIS Indo-Pacific Molluscan Database (Rosenberg *et al.*, 2004).

A few records denote a considerable species range extension, namely for *Tellinides adenensis* and *Tellinides ovalis* which are currently known from the Red Sea, the Gulf of Aden and Oman (Rosenberg *et al.*, 2004; Bosch *et al.*, 1995), *Divaricella irplex* from the Red Sea, India and Australia (Oliver, 1992; Rosenberg *et al.*, 2004) and *Ostrea deformis* which is only known from the Red Sea (Oliver, 1992). *Semele cordiformis*, also reputed as *S. sinensis*, is known from India and from the Red Sea (Rosenberg *et al.*, 2004; Oliver, 1992), and *Chlamys (Chlamys) tincta* is reported from South Africa and the Persian Gulf (Bosch *et al.*, 1995; Rosenberg *et al.*, 2004; Rombouts, 1991). The trochoid vetigastropod *Pseudominolia climacota* is only reported from the Gulf of Oman (Bosch *et al.*, 1995; Rosenberg *et al.*, 2004) while *Bullia mauritiana* is known from Madagascar and from the Persian Gulf (Bosch *et al.*, 1995; Rosenberg *et al.*, 2004).

As might be expected from a flat sandy coastline with lagoons and tidal flats in the lee of several islands, gastropods are poorly represented in the material collected in the Lamu Archipelago. By contrast, the few gastropods species inhabiting this type of environment usually occur in relatively large numbers (Ott, 1996). Interestingly, the only gastropods found along the sandy beaches exposed to the Indian ocean were both olives (*Oliva bulbosa* and *Sparella sarda*), corresponding to their habitat requirements (Kilburn, 1981). Another *Sparella* spe-

cies found at Nungwi, Zanzibar (Wronski, 2007), *Ancilla (Sparella) farsiana* (Kilburn, 1981), has been misidentified and was therefore changed to *Ancilla (Sparella) tronsoni* (Sowerby, 1859). However, in comparison to gastropods, the proportion of bivalve molluscs found in the study area is proportionally high. On Zanzibar, where several habitats merge (e.g. coral reefs, rocky cliffs, sand beaches; Wronski, 2007), numbers of gastropod species are distinctively higher than in the tidal flats and mangroves investigated in the Lamu Archipelago.

Since lagoons and tidal flats of the Lamu Archipelago did not prove to be a suitable habitat for nudibranch molluscs, these taxa were excluded from the survey. Nevertheless, the comparatively rich mollusc fauna of East Africa justifies a more detailed study on the distribution and ecology of molluscs in this region and their intersections with Red Sea and Arabian faunas as well as with the malacofauna of South Africa.

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Table 1 Marine mollusc taxa collected in the Lamu Archipelago (Kenya). For comparison, the occurrence of these taxa (and were applicable their synonyms) on Zanzibar Island and mainland Tanzania (Spry, 1964, 1968; Sawyer, 1999, 2000; Wronski, 2007) and their listing in Rosenberg *et al.* (2004; OBIS Indo-Pacific Molluscan Database, East Africa) are provided. Bold crosses indicate taxa collected during this study but not reported by Spry (1964, 1968), Sawyer (1999, 2000) or Wronski (2007), double crosses indicate taxa neither listed for Zanzibar nor by Rosenberg *et al.* (2004; OBIS Indo-Pacific Molluscan Database, East Africa). Additionally, results are compared with species listed in the Kenya section of the OBIS Indo-Pacific Molluscan Database (Rosenberg *et al.*, 2004).

GASTROPODA	SYNONYM (in Spry)	OBIS EA	OBIS Kenya	Zanzibar	Tidal Flats, Mangroves	Lamu Beach
Fissurellidae						
<i>Diodora ruppellii</i> (Sowerby, 1834)	<i>rupelli</i>	x		x	x	
Trochidae						
<i>Pseudominolia climacota</i> Melvill, 1897					xx	
Neritidae						
<i>Nerita (Ritena) plicata</i> Linné, 1758		x	x	x	x	
<i>Nerita (Ritena) undata</i> Linné, 1758		x	x	x	x	
Cerithidae						
<i>Rhinoclavis (Proclava) kochi</i> (Philippi, 1848)		x		x	x	
Potamididae						
<i>Terebralia palustris</i> (Linne, 1767)		x		x	x	
Strombidae						
<i>Strombus (Gibberulus) gibberulus</i> Linné, 1758				x	x	
Hipponicidae						
<i>Antisabia cf. foliacea</i> (Quoy & Gaimard, 1835)		x			x	
Naticidae						
<i>Polinices (Polinices) mammilla</i> (Linné, 1758)				x	x	
<i>Eunaticina papilla</i> (Gmelin, 1791)				x	x	
<i>Natica gualtieriana</i> Recluz, 1844				x	x	
Tonnidae						
<i>Tonna cepa</i> (Röding, 1798)	<i>canaliculata</i>	x		x	x	
Ranellidae						
<i>Cymatium (Monoplex) pileare</i> (Linné, 1758)	<i>Lampusia pileare</i>			x	x	
Muricidae						
<i>Purpura panama</i> (Röding, 1798)				x	x	
Nassariidae						
<i>Nassarius (Nassarius) arcularia</i> (Linné, 1758)				x	x	
<i>Bullia mauritiana</i> Gray, 1839		x			x	
Olividae						
<i>Oliva bulbosa</i> (Röding, 1798)		x		x		x
<i>Ancilla (Sparella) sarda</i> (Reeve, 1864)		x	x			x

GASTROPODA	SYNONYM (in Spry)	OBIS EA	OBIS Kenya	Zanzibar	Tidal Flats, Mangroves	Lamu Beach
Marginellidae						
<i>Volvarina cf obscura</i> (Reeve, 1865)		x		x	x	
Mitridae						
<i>Vexillum (Pusia) unifasciale</i> (Lamarck, 1811)				x	x	
<i>Vexillum (Costelaria) exasperatum</i> (Gmelin, 1791)		x		x	x	
Terebridae						
<i>Terebra nassoides</i> Hinds, 1844					xx	
<i>Duplicaria duplicata</i> (Linné, 1758)		x		x	x	
Architectonicidae						
<i>Architectonica perspectiva</i> (Linné, 1758)		x		x	x	
Actaeonidae						
<i>Pupa (Pupa) cf solidula</i> (Linné, 1758)					xx	
Pyramidellidae						
<i>Pyramidella maculosa</i> Lamarck, 1816				x	x	
<i>Pyramidella (Pyramedella) acus</i> (Gmelin, 1791)				(x)	x	
<i>Pyramidella (Pyramedella) dolabrata</i> (Linné, 1798) var. <i>terebellum</i> (Müller, 1774)				x	x	
BIVALVIA						
Arcidae						
<i>Sheldonella cf lateralis</i> (Reeve, 1844)		x			x	
Ostreidae						
<i>Ostrea (Nanostrea) deformis</i> Lamarck, 1819					xx	
<i>Saccostrea cucullata</i> (Born, 1778)				x	x	
Pectinidae						
<i>Chlamys (Chlamys) tinctoria</i> (Reeve, 1853)		x			x	
<i>Chlamys (Mimachlamys) senatoria</i> (Gmelin, 1791)	<i>senatorius</i>	x		x	x	
Lucinidae						
<i>Anodontia (Anodontia) edentula</i> (Linné, 1758)	<i>Cryptodon eutornus</i> ?			x	x	
<i>Divaricella irplex</i> (E.A. Smith, 1885)					xx	

	SYNONYM (in Spry)	OBIS EA	OBIS Kenya	Zanzibar	Tidal Flats, Mangroves	Lamu Beach
BIVALVIA						
<i>Loripes clausus</i> (Philippi, 1848)		x		x	x	
<i>Cardiolucina semperiana</i> (Issel, 1869)		x			x	
Mactridae						
<i>Mactra (Mactra) lilacea</i> Lamarck, 1818				x	x	
<i>Mactra aequisulcata</i> Sowerby, 1894		x		x		x
Solenidae						
<i>Solen (Solen) roseomaculatus</i> Pilsbry, 1901	<i>S. aspersus</i> ?	x		x	x	
<i>Solen (Solen) ceylonensis</i> Leach, 1814				x	x	
Tellinidae						
<i>Tellina valtonis</i> Hanley, 1844		x		x	x	
<i>Pharaonella perna</i> (Spengler, 1798)		x		x	x	
<i>Tellinides ovalis</i> (Sowerby, 1825)		x			x	
<i>Tellinides adenensis</i> (Smith, 1891)		x			x	
<i>Tellina (Serratina) capsoides</i> Lamarck, 1818	<i>diaphana, resecta</i>	x		x	x	
<i>Psammotreta (Tellinimactra) edentula</i> (Spengler, 1797)	<i>Macoma edentula</i> ?	x		x		x
Semelidae						
<i>Semele cordiformis</i> (Holten, 1802)	<i>cardiformis,</i> <i>proficus</i>			x	x	
Veneridae						
<i>Antigona (Antigona) lamellaris</i> Schuhmacher, 1817		x			x	
<i>Tivela cf. ponderosa</i> (Philippi, 1844)		x			x	
<i>Marcia paupercula</i> (Chemnitz, 1795)	<i>Anomalocardia</i> <i>paupercula</i>	x	x	x	x	
<i>Bassina foliacea</i> (Philippi, 1846)		x	x	x	x	
<i>Sunetta (Cyclosunetta) contempta</i> (E.A. Smith, 1891)				x	x	
<i>Clementia (Clementia) papyracea</i> (Gray, 1825)		x		x	x	
Pholadidae						
<i>Barnea (Anchomasa) manilensis</i> Philippi, 1847				x	x	