Marine mollusc (Mollusca: Gastropoda and Bivalvia) diversity of the Saya de Malha and Nazareth Banks, Mascarene Plateau

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Abstract

Marine molluscs are among the largest assemblages of the animal kingdom and inhabit the marine environment from the intertidal zone to the deep sea. This study reports the diversity of marine molluscs (Gastropoda and Bivalvia) collected from sediments at 19 stations (SS) at the Saya de Malha and Nazareth Banks during the EAF-Nansen expedition in May 2018. Sampling was carried out using the five hydraulic Van Veen grabs mounted on a Video-Assisted Multi-Sampler (VAMS). The mollusc shells were morphologically identified using established procedures and published guides. Shannon-Wiener diversity (*H'*) and Pielou's evenness (*J*) indices were used to assess the diversity of the molluscs at each station. A total of 56 genera of marine gastropods belonging to 34 families, and 40 genera of bivalves from 16 families were recorded. The SS8 station at the Saya de Malha Bank had the highest diversity at a depth of 79 m for Gastropoda and Bivalvia, while SS1 harbored the highest overall molluscan diversity. At the Nazareth Bank, highest gastropod diversity was recorded at SS44, while SS43 had the highest bivalve and overall molluscan diversity. This study provides new information on the molluscan diversity at the Saya de Malha and Nazareth Banks.

Keywords: Gastropoda, Bivalvia, diversity, Saya de Malha Bank, Nazareth Bank, VAMS

Introduction

The Saya de Malha and Nazareth Banks are submerged banks on the Mascarene Plateau, Western Indian Ocean (WIO), hosting a diversity of marine organisms, including molluscs. The molluscan diversity around the easily accessible islands of the Plateau are better documented as compared to the remote banks. One such study to document marine molluscs was carried out around Rodrigues Island by Oliver *et al.* (2004) where 17 new species of cryptic bivalves were reported, and Schwabe (2004) provided descriptions for seven species of Polyplacophora with a new description of the bivalve *Cryptoconchus oliveri*, while the survey by Sheppard (1984) confirmed 384 mollusc species representing 282 gastropods and 99 bivalves in the Chagos Archipelago. Lorenz and Chiapponi (2012) reported two new gastropods from the Cargados Carajos Shoal - *Bistolida nanostraca* and *Ficus dandrimonti*, while Monsecour (2016) reported one new species of giant clam, *Tridacna lorenzi.*

Michel (1985) carried out preliminary works on marine molluscs in Mauritius reporting some species based on morphological features. More recently, Kaullysing *et al.* (2017a) reported the presence of a higher number of mollusc species (16) at a sheltered intertidal zone (east

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coast) in Mauritius as compared to an exposed zone (7) with relatively stronger wave action (south coast), highlighting the suitability of calmer zones for mollusc settlement. Coral-eating gastropods *Drupella* spp. have been found in high densities on corals (Kaullysing *et al*., 2016; 2017b; 2020). Furthermore, the presence of species of marine molluscs such as the ectoparasitic gastropods *Coralliophila erosa* and *C. radula* on coral hosts, and the giant clams *Tridacna maxima* and *T. squamosa* have been recorded in the coastal waters of Mauritius, with the identification having been confirmed using morphological and as well as molecular tools (Kaullysing *et al*., 2019; Ramah *et al*., 2017; 2019).

Despite the efforts to document the marine molluscan diversity from the Mascarene Plateau by Mackie *et al*. (2003) in the Seychelles, Bourmaud *et al.* (2005) and Drivas and Jay (2001) in Reunion Island, Oliver *et al.* (2004) in Rodrigues, and Kaullysing *et al.* (2019) and Michel (1985) in Mauritius, many of the molluscan taxa remain understudied or unreported (Fedosov and Puillandre, 2005), especially in remote and less frequented areas such as the Saya de Malha and Nazareth Banks (Federov *et al*., 1980; Sirenko and Scarlato, 1991; Sirenko, 1993; Nesis, 1993; Vortsepneva, 2008; Fauvelot *et al.*, 2020), leading to a potential drastic underestimation of the extant molluscan assemblage in this part of the world. The present study therefore aimed at providing additional information on the diversity of molluscs found within the waters of the Saya de Malha and Nazareth Banks, Mascarene Plateau.

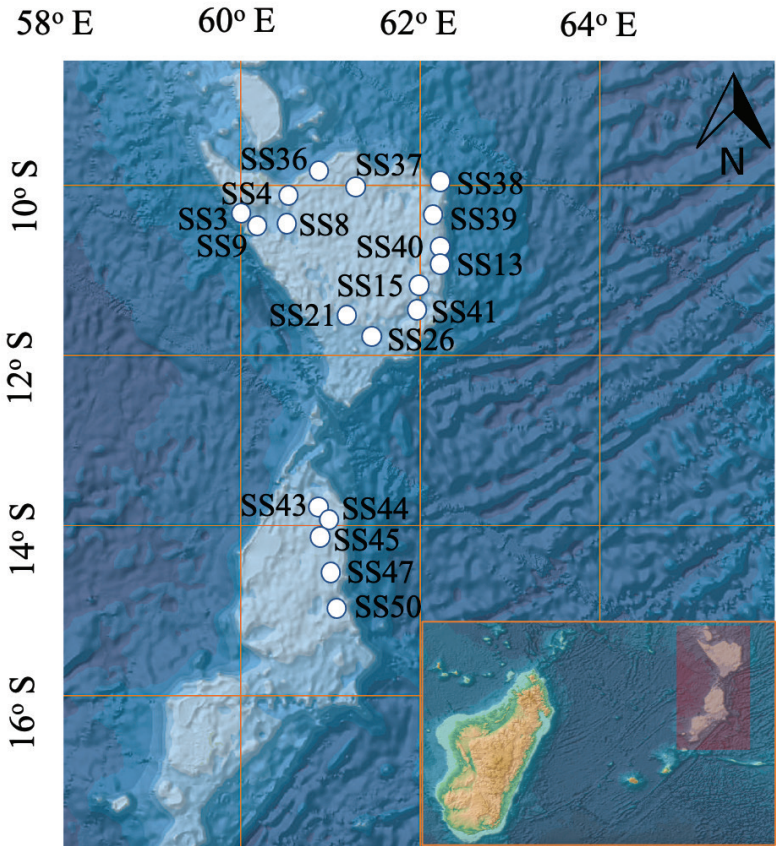

Figure 1. Map of the Saya de Malha and Nazareth Banks indicating the 19 sampling stations (SS). The map was prepared using the GEBCO Bathymetry Grid layer data 2020.

Materials and methods

Survey sites

This study focused on the Saya de Malha and Nazareth Banks on the Mascarene Plateau. The survey took place in May 2018 during the EAF-Nansen Indian Ocean Expedition on board the F/V Dr. F. Nansen. Nineteen stations were surveyed, namely, SS3, SS4, SS8, SS9, SS13, SS15, SS21, SS26, SS36, SS37, SS38, SS39, SS40 and SS41 on Saya de Malha Bank, and SS43, SS44 SS45, SS47 and SS50 on Nazareth Bank, inclusive of shallow, deep and slope areas (Fig. 1).

Sampling

Sampling of bottom sediments was conducted using the five hydraulic Van Veen grabs mounted on the Video-Assisted Multi-Sampler (VAMS) at the 19 stations - 14 stations at the Saya de Malha Bank and 5 stations at the Nazareth Bank. Once the grabs were brought on the deck, the surface water was drained, and the sediment was passed through a sieve of 5 mm mesh size to collect the mollusc shells. They were then cleaned and washed with freshwater and stored for further identification.

Morphological identification

Identification of the collected shells to the family and genus levels was carried out based on their morphological features using published identification manuals and guides, namely Michel (1985), Oliver (1992), Jarrett (2000), Abbott and Dance (2000), Drivas and Jay (2001), Dandrimont (2008), Richmond (2011), Wilson (2016), and Harasewych and Moretzsohn (2017). Species-level identification was difficult to achieve due to some of the shells being eroded and degraded.

Diversity Index

Shannon-Wiener diversity index (*H'*) (Shannon and Wiener, 1949) and Pielou's evenness index (*J*) (Pielou, 1966) were used to assess molluscan diversity at each station at the banks.

Results and discussion

Fifty-six genera of gastropods belonging to 34 families, and 40 genera of bivalves belonging to 16 families were recorded from the 19 stations on the Saya de Malha and Nazareth Banks. At the Saya de Malha Bank, 51 genera of gastropods from 30 families, and 38 genera of bivalves from 15 families were recorded, while at the Nazareth Bank, 12 genera of gastropods from 12 families, and 13 genera of bivalves from 7 families were found (Table 1). While this study recorded fewer families of gastropods as compared to the compilation by Vortsepneva (2008), it has reported a higher number of bivalve families (16) comprising of 40 genera, as compared to four families (5 genera) from Vortsepneva (2008) and adds 13 new gastropod families to the existing list for Saya de Malha Bank. New data on molluscs is also presented for the first time from the Nazareth Bank as no published literature is available on molluscs from this specific bank.

The broader WIO region is known to host approximately 2,500 species of molluscs out of which 75 families are from the Gastropoda class, 667 species from 49 families of the Bivalvia, and 39 species from 6 families of the Polyplacophora (Vortsepneva, 2008). The findings of this study complement the only record available from Saya de Malha Bank from the previous Russian expedition reporting a total of 142 species of molluscs, out of which 102 species were from 36 families of gastropods, 32 species from 10 families of cephalopods and 8 species from 3 families of bivalves (compiled in Vortsepneva, 2008).

At the Saya de Malha Bank, SS8 harboured the highest diversity of gastropods (*H'* = 2.56) and bivalves (*H'* = 2.40). In terms of total molluscan population at this bank, the highest diversity was also recorded at SS3 (*H'* = 3.14) (Fig. 2). At the Nazareth Bank, the highest diversity of gastropods was recorded at SS44 (*H'* = 1.61), while the highest bivalve and total molluscan diversity were recorded at SS43, with *H'* values of 1.79 and 2.30, respectively (Fig. 2). Pielou's evenness (*J*) values were comparable at all the stations for gastropods, bivalves and overall molluscan population, ranging from 0.93 to 1.00, implying an equally distributed molluscan assemblage at all the studied stations at the Saya de Malha and Nazareth Banks. In this study, the highest number of genera was recorded from the Strombidae and Cypraeidae families (four genera in both) for gastropods, and in the Cardiidae and Veneridae families (nine genera in both) for bivalves.

As compared to the only available list of molluscs from the Saya de Malha Bank (compiled by Vortsepneva, 2008), the high diversity may be explained by the difference in the collection depth and methodology. Sirenko and Scarlato (1991; 1993) carried out their collection at depths of 12-15 m, 70 m and 200 m only by using trawls. This study used the Van Veen grabs that were able to collect a deeper profile of the bottom sediment. However, the sediment collected by the grabs were composed of only dead molluscs shells, ranging from 0.5 cm to 2.0 cm, while no live molluscs were recorded.

Conclusion

This expedition to the Saya de Malha and Nazareth Banks presents new records of gastropod and bivalve families in addition to the compilation made by Vortsepneva (2008). Records from previous expeditions and the records from this expedition indicate the possibility of a substantial infauna residing in these areas. However, mollusc species diversity of the Saya de Malha and Nazareth Banks may be underestimated, and further collections are required to provide a clearer picture of the situation in these areas.

Table 1. List of molluscan families and genera recorded during the May 2018 EAF-Nansen Indian Ocean Expedition at the Saya de Malha and Nazareth Banks. √ = genus present, (n) = number of species recorded under the genus.

Sites		**Saya de Malha Bank**														**Nazareth Bank**				
Stations (SS)		**3**	**4**	**8**	**9**	**13**	**15**	**21**	**26**	**36**	**37**	**38**	**39**	**40**	**41**	**43**	**44**	**45**	**47**	**50**
Depth (m)		**79**	**32**	**60**	**57**	**30**	**56**	**160**	**251**	**36**	**32**	**23**	**30**	**70**	**381**	**43**	**37**	**32**	**58**	**53**
Family	**Genus**																			
Class: Gastropoda																				
Ancillariidae	*Ancilla*							√ (1)												
	Amalda													√ (1)						
Bullidae	*Bulla*									√ (1)										
Bursidae	*Bursa*						√ (1)													
	Marsupina	√ (1)																		
Calliostomatidae	*Calliostoma*	√ (1)		√ (1)			√ (1)													
Cassidae	*Casmaria*									√ (1)										
Cerithiidae	*Cerithium*			√ (1)													√ (1)			
Columbellidae	*Columbella*																√ (1)			
Conidae	*Conus*	√ (1)				√ (1)		√ (2)	√ (1)	√ (1)									√ (1)	√ (2)
Costellariidae	*Vexillum*	√ (1)	√ (1)	√ (3)	√ (1)															
	Gyrineum		√ (1)	√ (1)																
Cymatiidae	*Monoplex*					√ (2)														
	Cymatium													√ (1)						
	Staphylaea		√ (1)																	
Cypraeidae	*Cypraea*		√ (1)				√ (1)	√ (1)	√ (1)	√ (1)				√ (1)		√ (1)				√ (1)
	Ipsa									√ (1)										
	Naria									√ (1)										
Drilliidae	*Fusiturricula*								√ (1)											
Epitoniidae	*Epitonium*								√ (1)											
	Janthina								√ (1)						√ (1)					
	Peristernia	√ (1)	√ (1)												√ (1)					
Fasciolariidae	*Fusinus*	√ (1)										√ (1)	√ (1)							
	Latirus		√ (1)							√ (1)										
Fissurellidae	*Fissurella*										√ (1)									
Haminoeidae	*Aliculastrum*								√ (1)											
Littorinidae	*Littorina*		√ (1)			√ (1)		√ (1)									√ (1)	√ (1)		
Marginellidae	*Volvarina*	√ (1)																		
	Marginella	√ (1)		√ (1)																
	Mitra	√ (1)								√ (1)			√ (1)							
Mitridae	*Neocancilla*			√ (1)			√ (1)								√ (1)					
	Cancilla														√ (1)					
Muricidae	*Murex*							√ (1)				√ (1)								
	Siratus							√ (1)									√ (1)			
	Nassarius			√ (2)				√ (1)												√ (1)
Nassariidae	*Bullia*							√ (1)												
	Phos							√ (1)												
Naticidae	*Neverita*	√ (1)		√ (1)				√ (1)			√ (1)			√ (1)						
	Polinices							√ (1)	√ (1)											
Olividae	*Oliva*						√ (1)		√ (1)											
Patellidae	*Patella*				√ (1)	√ (1)														
Phasianellidae	*Phasianella*															√ (1)		√ (1)		
Siliquariidae	*Tenagodus*																√ (1)			
Strombidae	*Strombus*	√ (1)		√ (1)			√ (1)			√ (1)									√ (1)	
	Lambis	√ (1)																		
	Dolomena			√ (1)																
	Persististrombus									√ (1)										
Tegullidae	*Tectus*															√ (1)				
Terebridae	*Terebra*	√ (2)		√ (1)			√ (1)		√ (1)											
Triviidae	*Trivia*			√ (1)				√ (1)												

Sites		**Saya de Malha Bank**														**Nazareth Bank**				
Stations (SS)		**3**	**4**	**8**	**9**	**13**	**15**	**21**	**26**	**36**	**37**	**38**	**39**	**40**	**41**	**43**	**44**	**45**	**47**	**50**
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Family	**Genus**																			
Class: Gastropoda																				
Trochidae	*Stomatolina*				√ (1)															
Turbinidae	*Turbo*			√ (1)																
	Bolma					√ (1)														
Turridae	*Gemmula*			√ (1)					√ (1)				√ (1)		√ (1)					
	Turris							√ (1)												
Tonnidae	*Tonna*															√ (1)				
Total number of species recorded		14	7	17	3	6	7	14	10	10	2	2	3	4	5	**4**	**5**	**2**	**2**	**4**
Class: Bivalvia																				
Arcidae	*Arca*	√ (2)		√ (2)	√ (1)		√ (2)	√ (1)				√ (1)								
	Anadara			√ (1)				√ (1)												
	Barbatia							√ (1)												
	Lunulicardia		√ (1)																	
	Fulvia		√ (1)						√ (1)				√ (1)		√ (1)					
	Nemocardium			√ (1)		√ (1)			√ (1)											√ (1)
	Ctenocardia	√ (1)			√ (1)		√ (1)	√ (1)												√ (1)
	Fragum						√ (1)	√ (1)		√ (1)										
	Trachycardium									√ (1)		√ (1)		√ (1)						√ (1)
	Lyrocardium						√ (1)									√ (1)				
	Tridacna									√ (1)							√ (1)			
Carditidae	*Cardita*				√ (1)			√ (1)												
Chamidae	*Chama*	√ (1)																		
Donacidae	*Donax*			√ (1)			√ (2)													
Glossidae	*Meiocardia*							√ (1)												
Glycymerididae	*Glycymeris*	√ (1)		√ (1)	√ (2)		√ (2)											√ (1)		√ (2)
Limidae	*Lima*					√ (1)						√ (1)						√ (1)		√ (1)
	Limaria												√ (1)							
Lucinidae	*Ctena*	√ (1)																		
	Anodontia		√ (1)																	√ (1)
	Miltha			√ (1)																
	Divaricella				√ (1)															
Mactridae	*Mactra*	√ (1)																		
Mytilidae	*Perna*								√ (1)											
Pectinidae	*Aequipecten*	√ (1)		√ (2)	√ (2)		√ (2)	√ (1)												
	Chlamys	√ (1)	√ (1)	√ (4)	√ (2)	√ (1)			√ (1)	√ (2)	√ (1)					√ (1)				
	Pecten		√ (1)	√ (3)			√ (2)			√ (2)					√ (1)	√ (1)	√ (1)			
Pinnidae	*Pinna*					√ (1)														
Semelidae	*Semele*	√ (2)																		
Spondylidae	*Spondylus*															√ (1)				
Tellinidae	*Tellina*						√ (2)					√ (1)								
	Pitar	√ (1)			√ (1)			√ (1)												
	Dosinia	√ (1)		√ (2)			√ (2)	√ (1)	√ (1)	√ (1)	√ (1)			√ (2)		√ (1)				
	Antigona			√ (5)	√ (2)															
	Marcia			√ (2)																
Veneridae	*Circomphalus*			√ (1)	√ (1)	√ (1)														
	Paphia				√ (1)		√ (1)													
	Chionella					√ (1)														
	Globivenus															√ (1)				
	Humilaria						√ (1)													
Total number of species recorded		**13**	**5**	**26**	**15**	**6**	**19**	**10**	**5**	**8**	**2**	**4**	**2**	**3**	**2**	**6**	**2**	**2**	**0**	**7**

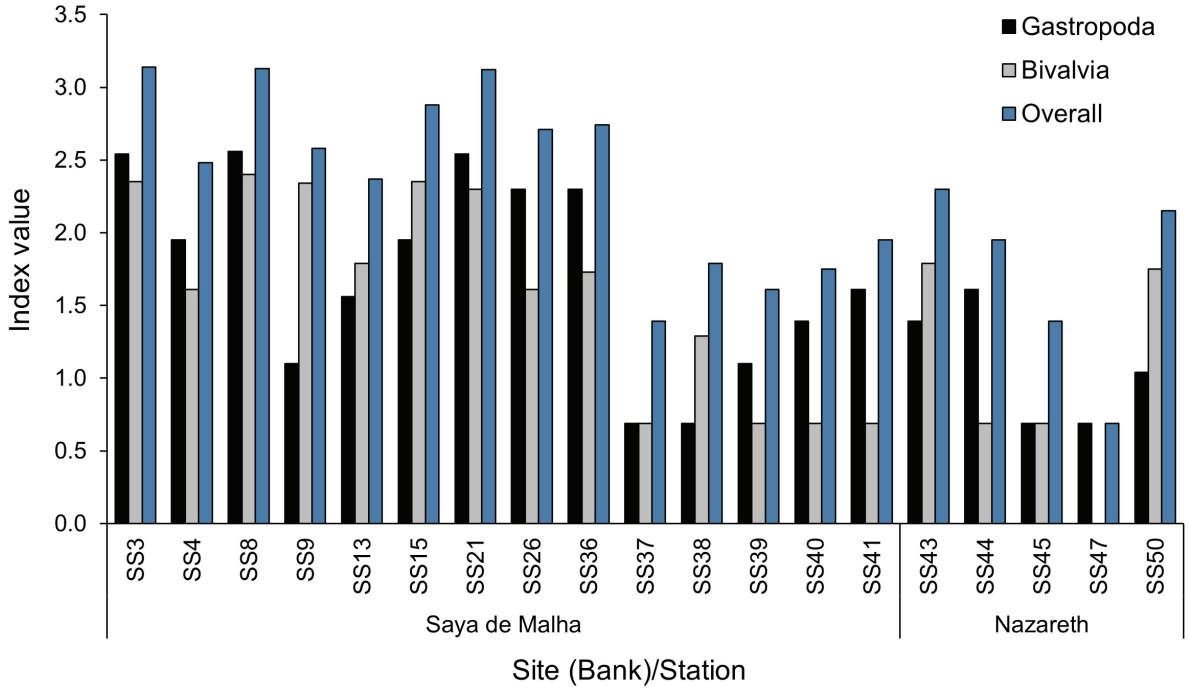

Figure 2. Shannon-Wiener diversity index (*H'*) indicating the molluscan diversity at the Saya de Malha and Nazareth Banks at each station (SS).

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