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A contribution to the knowledge of the butterfly fauna of Maputo Special Reserve, Mozambique from African Natural History Research Trust expeditions (Papilionoidea)

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Abstract: This article provides a checklist for the butterfly species of the Maputo Special Reserve (MSR) in the south of Mozambique, recorded during three expeditions organised by the African Natural History Research Trust (ANHRT), in collaboration with the Museu de História Natural, Maputo, between 2016 and 2018. A total of 163 species in 86 genera are recorded from the reserve with two new country records for Mozambique: *Deloneura millari millari* Trimen, 1906 and *Iolaus lulua* (Riley, 1944), both Maputaland-Pondoland-Albany hotspot endemics. A brief note is also included for a short reconnaissance expedition in 2018 to the north of Mozambique which yielded two further new records, *Acraea nohara halali* Marshall, 1896 and *Gretna carmen capra* Evans, 1937. The possible factors governing butterfly distribution in the MSR, including seasonality, choice of study site and habitat are discussed in further detail. Photographs of habitus, genitalia and habitat are provided to corroborate findings and suggestions for future work included.

Resumo: Este artigo fornece uma lista de espécies de borboletas da Reserva Especial de Maputo, no sul de Moçambique, registadas durante três expedições organizadas pelo African Natural History Research Trust, em colaboração com o Museu de História Natural, Maputo, entre 2016 e 2018. Um total de 163 espécies, em 86 géneros foram registadas na reserva com dois novos registos nacionais para Moçambique: *Deloneura millari millari* Trimen, 1906 e *Iolaus lulua* (Riley, 1944), ambas são endémicas do hotspots de Maputaland-Pondoland-Albany. Esta incluida tambem uma breve nota de uma curta expedição de reconhecimento em 2018, ao norte de Moçambique que rendeu mais dois novos registros, *Acraea nohara halali* Marshall, 1896 e *Gretna carmen capra* Evans, 1937. Os possíveis fatores que padronizam a distribuição de borboletas na MSR, incluindo sazonalidade, escolha do local de estudo e habitat são discutidos em mais detalhes. Fotografias de habitus, genitália e habitat são fornecidas para corroborar as descobertas e sugestões para trabalhos futuros incluídos.

Key words: Afrotropics, butterflies, Rhopalocera, new records, Kwa-Zulu Natal, Maputaland-Pondoland-Albany hotspot, faunistics, checklist, ANHRT

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INTRODUCTION

Maputo Special Reserve (MSR) is a particularly biodiverse area of coastal scrub and forest located on Mozambique's southern coastline, bordering South Africa's Kwa-Zulu Natal Province (KZN). It was first established in 1932 as a hunting reserve, and in 1960 was named the Maputo Elephant Reserve and converted to a conservation area to protect Mozambique's shrinking elephant population. In 1969, to reflect its wider conservation value, it was renamed Maputo Special Reserve, and later included in the Libombo Transfrontier Conservation Area, linking it with several South African reserves including Tembe Elephant Park (Soto *et al.*, 2001; Smith *et al.*, 2008).

The reserve is located in the Maputaland Centre of Endemism, part of the Maputaland-Pondoland-Albany hotspot (MPA), which comprises much of the eastern coast of South Africa and southern Mozambique (Smith *et al.*, 2008; Perera *et al.*, 2013). Originally based on White's (1983) Tongaland-Pondoland regional mosaic, the MPA hotspot consists of a mosaic of scrub forest and thickets in a matrix of grassland and wooded grassland, with smaller patches of forest and hygrophilous grassland, which contain about 3000 plant species, many of which are endemic (White, 1983). The Maputaland centre of endemism spans the coastline between Maputo and St. Lucia in KZN, extending inland to Eswatini (formerly Swaziland). The region contains at least 203 endemic or near endemic plant species (van Wyk, 1996), most of them occurring in 'licuáti' or 'sand forest' habitats which are restricted to ancient coastal dunes in northern KZN and southern Mozambique, and thus is one of the most important plant communities in the Maputaland region (Matthews *et al.*, 2001; Izidine, 2003).

With such a high concentration of endemic plant species, the insect diversity of the region is expected to be great, with numerous endemic species. However, historically, the Lepidoptera fauna of Mozambique has been understudied

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in comparison to that of some other African countries (Congdon & Bayliss, 2013; László *et al.*, 2021), but there are a number of historical collections which have provided an important foundation for further entomological study in the area. Particularly important to the area now comprising the Maputaland Centre of Endemism is the work of British botanist and lepidopterist Rose Monteiro, who collected in the region of Delagoa Bay between 1876 and 1891 (Monteiro, 1891). Many of her specimens are now housed in the Natural History Museum, London (NHML), and Delagoa Bay (now Maputo Bay) is an important historic collecting locality as a result.

Augusto Cabral, former director of the Natural History Museum in Maputo (NHMM), published a checklist of the butterflies of Mozambique in his book, *Borboletas de Moçambique* (2000), containing 261 species. This list was revised by Congdon *et al.* (2010) providing an up-to-date and comprehensive checklist of the butterflies of Mozambique recording 523 butterfly species for the country, with a further nine species subsequently added to the total by Congdon and Bayliss (2013).

More recently there have been a number of research papers to come out of MSR as a result of expeditions organised by the African Natural History Research Trust (ANHRT) in collaboration with the Museu De História Natural de Maputo. These include both checklists and new species descriptions for Lepidoptera belonging to the following families and subfamilies: Cossidae (Yakovlev *et al.*, 2020), Erebidae: Arctiinae: (Volynkin & László, 2018; 2019), Limacodidae (Taberer & László, 2022), Nolidae: Nolinae (László & Vetina, 2019), Notodontidae (László *et al.*, 2021), Saturniidae and Eupterotidae (Takano & László, 2022), Sphingidae (Bakowski *et al.*, 2020) and for the Mantodea (Miles, *in prep*.).

Insects are excellent indicator species due to their short generation times and specificity to certain plant taxa, which makes them very sensitive to environmental conditions. Among insects, butterflies are frequently used as indicators because of their size and conspicuity which not only make them easy to sample, but result in them being relatively well known taxonomically in comparison to other insect groups (Ribeiro *et al.*, 2010; Grøtan *et al.*, 2012; Castro & Espinoza, 2015). However, insects in tropical communities are far from well known: an estimated 90% of the world's 20,000 or so butterfly species occur in tropical areas, yet there are far more publications on the temperate faunas of Western Europe and North America than on those of the Afro- and Neotropics (Bonebrake *et al.*, 2010; Tolman & Lewington, 2008).

The ecology of tropical insect communities is very poorly understood, with extremely variable patterns being observed across countries, habitats and microhabitats. The complexity of responses by diverse taxa in different locations means that environmental changes may have far-reaching effects on tropical communities (Cheka *et al.*, 2019). With the ever-increasing threat of habitat destruction in tropical countries, a modern understanding of insect diversity and ecology is crucial to predicting their impacts on communities, and to preserve the world's biodiversity, much of which is still unknown to science (Hill *et al.*, 2003; Samways, 2007; Devries & Walla, 2001; Maicher *et al.*, 2018b).

This paper aims to provide a complete list of the butterflies of MSR, encountered over the course of three ANHRT research expeditions between 2016 and 2018. This will enhance the comprehensive checklist of butterflies of Mozambique by Congdon *et al.* (2010) while providing further information on habitat, new country records and range extensions for species in the area. The current paper also provides a note on a short reconnaissance mission to the north of Mozambique in 2018.

METHODS AND MATERIALS

Sampling efforts were largely directed by de Boer's (2000) vegetation map of MSR, and by the reserve rangers whose expertise enabled the team to locate areas of high botanical diversity. A list of the habitat types in which sampling was carried out is given below, along with the codes used to designate them in de Boer's map (Table 1). The habitats will be referred to by these codes herein: ST = sand thicket, SF = sand forest, HG = hygrophilous grassland, F = Futi Riverine vegetation, DG = dune grassland, DF = dune forest, WLx = woodland mosaic, CWL = closed woodland, GWL = grassy woodland, MA = mangrove. In addition to these habitats, numerous mosaics and ecotones were designated by researchers in the field. Mosaics (indicated by 'x' between habitats e.g., SFxWL) were defined as locations where two habitats could not easily be separated whereas ecotones (indicated by '-' between habitats e.g., ST-SF) were defined as locations where two habitats showed a clear demarcation; in this study the ecotone region was treated as a habitat in its own right (Figs 1 A–D).

Table 1 – Habitat codes and types

Code	Habitat type
ST	Sand thicket
SF	Sand forest
HG	Hygrophilous grassland
F	Futi Riverine vegetation
DG	Dune grassland
DF	Dune forest
WLx	Woodland mosaic
CWL	Closed woodland
GWL	Grassy woodland
MA	Mangrove
DF-DG	Dune forest – Dune grassland ecotone
SF-ST	Sand forest – Sand thicket ecotone
HG-SF	Hygrophilous grassland – Sand forest ecotone
SFxWL	Sand forest x Woodland mosaic

The research teams travelled to the MSR three times between November 2016 and February 2018, spending a total of 64 days sampling through a variety of seasons. The first expedition ran from 21st November until 12th December 2016 (22 days); the second from 24th May until 13th June 2017 (22 days); and the third from 7th until 27th February 2018 (20 days). A fourth expedition was undertaken between 2nd and 19th August 2018 to various locations north of Maputo (Chimanimani Mts., Gorongosa

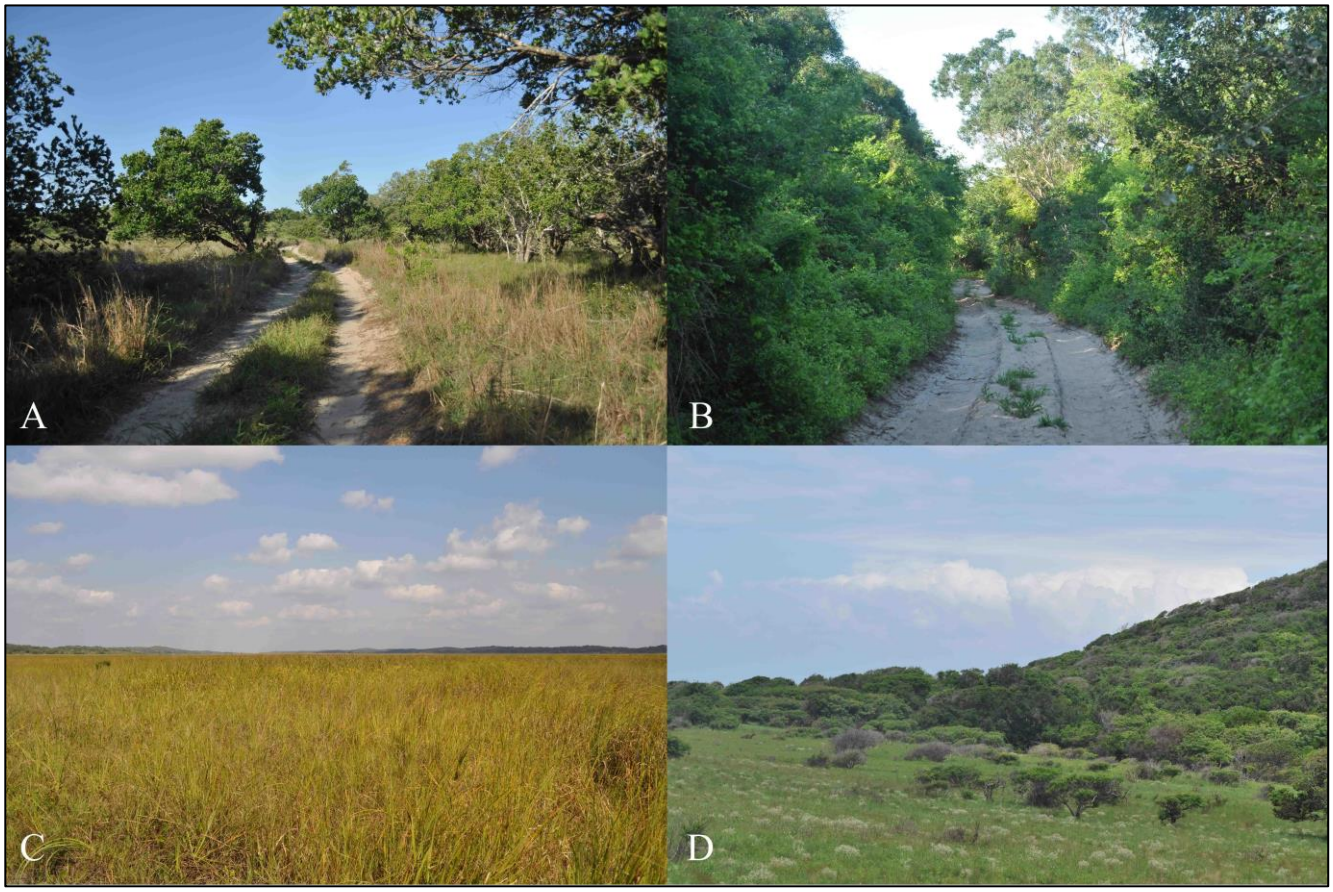

Figure 1 – Some of the major habitat types encountered in the MSR: sand thicket (A), sand forest (B), hygrophilous grassland (C), dune grassland-dune forest ecotone (D)

NP, Mt. Mabu, Mt. Namuli). The dates and collectors for these expeditions are given below:

1. 21.xi–12.xii.2016, leg. Aristophanous, M., Cristóvão, J., László, G., Miles, W.
2. 24.v–13.vi.2017, leg. Aristophanous, M., László, G., Miles, W., Vetina, A.
3. 7–27.ii.2018, leg. László, G., Mulvaney, J., Mulvaney, L. (née Smith).
4. 2–19.viii.2018, leg. László, G., Miles, W., Vetina, A.

A total of eight sampling sites were visited during the three expeditions to MSR, some of them several times and others only once (Fig. 8, p. 63):

1) West Gate: the main ranger station near the reserve's west gate, close to the Maputo-Ponta do Ouro highway, and the team's main base on all three expeditions. About 60% of the total collecting days were spent in this area. Main habitat types encountered: ST, SF, F and ecotones thereof. Geographical coordinates 26°30′14.2″S, 32°42′59.6″E, 22 m asl.
2) Hygrophilous grassland: a large expanse of hygrophilous grassland approximately 3 km north-east of West Gate. Main habitats encountered: HG, SF and ecotones thereof. Geographical coordinates: 26°29′8.3″S, 32°45′8.9″E, 2 m asl.
3) Ponta Milibangalala: a ranger outpost on the Indian Ocean coast, approximately 20 km east of West Gate. About 20% of the total collecting days were spent in this area. Main habitat types encountered: DG, DF. Geographical coordinates: 26°26′58.6″S, 32°55′'29.8″E, 15 m asl.
4) Mangrove camp: an area of mangrove swamp, woodland mosaic and open woodland close to the Maputo River, approximately 20 km north of West Gate. Main habitat types encountered: MA, CWL, GWL and ecotones/mosaics thereof. Geographical coordinates: 26°19′35.9″S, 32°42′35.7″E, 9 m asl. Only visited on expedition 1.
5) Forest clearing: an area of hygrophilous grassland penetrating into a large patch of sand forest, close to Maputo Bay, approximately 3 km north-east of Mangrove camp. Main habitat types encountered: HG, SF. Geographical coordinates: 26°17′24″S, 32°45′45″E, 11 m asl. Only visited on expedition 2.
6) Near swamp forest: a small area of sand thicket, sand forest and hygrophilous grassland surrounding one of the only patches of swamp forest in the reserve, approximately 3 km south-west of Ponta Milibangalala. Main habitat types encountered: ST, SF, HG. Geographical coordinates: 26°27′59″S, 32°54′16″E, 15 m asl. Only visited on expedition 2.
7) Futi Corridor: an area of woodland x sand forest mosaic in the south of the reserve, approximately 5 km south of West Gate. Main habitat types encountered: WL, SF. Geographical coordinates: 26°32′10.1″S, 32°43′09.7″E, 17m asl. Only visited on expedition 3.
8) Road to Salamanga: a small village on the road between forest clearing and Salamanga, a town outside the reserve; about 10 km north-west of West Gate. Main habitat type encountered: ST. Geographical

coordinates: 26°25′30.3″S, 32°41′29.1″E, 22 m asl. Only visited on expedition 2, for less than 1 hour.

Butterflies were collected utilising two main methods: hand collecting with a Watkins and Doncaster butterfly net; and bait trapping using a Bugdorm pop-up butterfly bait trap, baited with either fermenting bananas or rotting shrimp. In a few cases, butterflies were attracted to light trapping systems intended for capturing moths – these cases are mentioned in the results section.

Specimens were preserved in glassine Lepidoptera envelopes, desiccated using silica gel and pinned and spread in the ANHRT laboratories. Specimens were identified using Williams (2020), Mecenero et al. (2013) and Quickelberge (2012). Classification follows Williams (2020). Photos of selected specimens were taken using a Nikon D500 DSLR camera with a Neewer 750II TTL Flash Speedlite attachment, and modified in Adobe Photoshop.

Results are laid out as follows: the collecting locality, expedition number (1-3) and the two letter habitat code are followed by the number of specimens in parentheses. Different habitat types at the same locality are separated by commas without repeating the locality e.g.: West Gate 1: ST (3), SF (1). Different localities, and different expeditions visiting the same locality, are separated by a semi-colon, without repeating the locality if it was visited multiple times e.g. West Gate 1: SF (3); 3: SF (1). The total number of specimens of each species are given at the end of the entry in square brackets.

RESULTS

Family: **Papilionidae**
Subfamily: **Papilioninae**

Graphium angolanus angolanus (Goeze, 1779)
West Gate 1: ST (3), SF (1), SF-ST (1); 3: ST (1), SF (3); Futi Corridor 3: SFxWL (1) [10]
Remarks: two specimens recorded at light.

Graphium antheus (Cramer, [1779])
West Gate 1: SF (3); 3: SF (1); Mangrove camp 1: WLx (1) [5]
Remarks: specimens restricted to forests and woodlands.

Graphium colonna (Ward, 1873)
West Gate 3: SF (1) [1]

Graphium leonidas leonidas (Fabricius, 1793)
West Gate 3: SF (1) [1]

Graphium morania (Angas, 1849)
West Gate 1: ST (1), SF (1), SF-ST (1); 3: ST (1), SF (1) [5]

Graphium porthaon porthaon (Hewitson, [1865])
West Gate 1: ST (1), SF (2) [3]
Remarks: one specimen was attracted to a millipede pitfall trap.

Papilio constantinus constantinus Ward, 1871
West Gate 1: ST (3), SF (4); 3: SF (1); Hygrophilous grassland 3: HG (1); Ponta Milibangalala 1: DF (1); 2: DF (1); 3: DF (1); Forest clearing 2: SF (2); Futi Corridor 3: SFxWL (2) [16]

Papilio dardanus cenea Stoll, [1790]
West Gate 1: SF (3); 3: SF (2); Ponta Milibangalala 1: DF (1); 3: DF (1); Forest clearing 2: SF (15) [22]
Remarks: more numerous in the early dry season, in contrast with other Papilionidae. Only found in forest habitats.

Papilio demodocus demodocus Esper, [1798]
West Gate 1: ST (3), SF-ST (1), SF (7); 2: SF (3), SF-ST (1); 3: SF (4); Mangrove camp 1: CWL (1) [20]
Remarks: one specimen was attracted to a millipede pitfall trap.

Papilio nireus lyaeus Doubleday, 1845
West Gate 1: ST (4), SF (10); 2: SF (3); 3: SF (4); Mangrove camp 1: WLx (5), CWL (5); Futi Corridor 3: SFxWL (1) [32]
Remarks: the most numerous papilionid found in MSR.

Family: **Hesperiidae**
Subfamily: **Coeliadinae**

Coeliades lorenzo Evans, 1947
Ponta Milibangalala 2: DF (1); West Gate 2: SF (2) [3]
Remarks: only found in forest habitats.

Coeliades pisistratus (Fabricius, 1793)
Ponta Milibangalala 2: DF (1) [1]

Subfamily: **Pyrginae**

Gomalia elma elma (Trimen, 1862)
West Gate 1: SF (1); 2: SF (2) [3]

Ernsta confusa confusa (Higgins, 1925)
West Gate 2: SF-ST (1); Hygrophilous grassland 2: HG-SF (1); 3: HG (1); Futi Corridor 3: SFxWL (1) [4]

Ernsta dromus (Plötz, 1884)
West Gate 1: ST (1); 2: ST (3), SF (3); Futi Corridor 3: SFxWL (1) [8]

Spialia ferax (Wallengren, 1863)
West Gate 1: ST (1), SF (1); Hygrophilous grassland 2: HG-SF (1) [3]

Spialia spio (Linnaeus, 1764)
West Gate 2: ST (2); Hygrophilous grassland 2: HG-SF (1) [3]

Subfamily: **Tagiadinae**

Sarangesa motozi (Wallengren, 1857)
West Gate 1: ST (1), SF (1); Futi Corridor 2: SF (2) [4]

Sarangesa phidyle (Walker, 1870)
Futi Corridor 2: SF (1) [1]

Sarangesa ruona Evans, 1937
Futi Corridor 2: SF (1) [1]

Eagris nottoana nottoana (Wallengren, 1857)
Ponta Milibangalala 3: DF (1) [1]

Netrobalane canopus (Trimen, 1864)
West Gate 2: SF (1), SF-ST (1) [2]

Tagiades flesus (Fabricius, 1781)

West Gate 2: SF (6), SF-ST (1); Hygrophilous grassland 2: HG-SF (1); Ponta Milibangalala 2: DG (1), DF (10); Futi Corridor 2: SF (3) [22]
Remarks: six specimens recorded at light.

Subfamily: **Hesperiinae**

Acleros mackenii mackenii (Trimen, 1868)
West Gate 2: SF (2) [2]

Fresna nyassae (Hewitson, 1878)
West Gate 2: SF (10), SF-ST (1) [11]

Dotta callicles (Hewitson, [1868])
West Gate 1: ST (4), SF (2); 3: ST (2); Ponta Milibangalala 3: DF (1); Mangrove camp 1: CWL (2); Futi Corridor 3: SFxWL (2) [13]

Platylesches moritili (Wallengren, 1857)
West Gate 1: ST (3); 2: SF (2); 3: SF (1); Mangrove camp 1: CWL (3); Futi Corridor 3: SFxWL (2) [11]

Platylesches neba (Hewitson, 1877)
West Gate 2: SF (1) [1]

Tsitana tsita (Trimen, 1870)
Pont Milibangalala 3: DG (1) [1]

Zophopetes dysmephila (Trimen, 1868)
West Gate 1: ST (1), SF (1); 3: ST (2); Futi Corridor 2: SF (1) [5]
Remarks: majority recorded at light.

Afrogegenes hottentota (Latreille, [1824])
Futi Corridor 2: SF (1) [1]

Afrogegenes letterstedti (Wallengren, 1857) (Figs 2, 3)
West Gate 2: SF (5), SF-ST (2); Near swamp forest 2: ST (6); Futi Corridor 2: SF (3) [16]
Remarks: the females of *A. hottentota* and *A. letterstedti* are incredibly difficult to separate based on external characters alone (Larsen, 2005; De Jong & Coutsis, 2017). A pair of *A. letterstedti* were caught *in copula* in MSR and upon dissection of the female (**Fig. 3**), it conformed to the Type A genitalia as figured in De Jong & Coutsis (2017: 53, figs. 53-58). Although not conclusive based on a single specimen, it is possible that the 14 females listed below are also referable to *A. letterstedti*, due to the rarity of *A. hottentota* in this study.

Afrogegenes sp. (♀♀)

West Gate 2: SF (7), SF-ST (1); Ponta Milibangalala 2: DF (1); Near swamp forest 2: ST (3); Futi Corridor 2: SF (1); 3: SFxWL (1) [14]
Remarks: These fourteen specimens were not dissected, and therefore cannot be identified to species (see remark on *A. letterstedti*, above). One specimen recorded at light.

Borbo detecta (Trimen, 1893)
West Gate 2: SF-ST (1); Ponta Milibangalala 2: DF (1), DG (1); Near swamp forest 2: ST (2); Futi Corridor 2: SF (1) [6]

Borbo fallax (Gaede, 1916)
Near Swamp Forest 2: ST (2); Futi Corridor 3: SFxWL (1) [3]

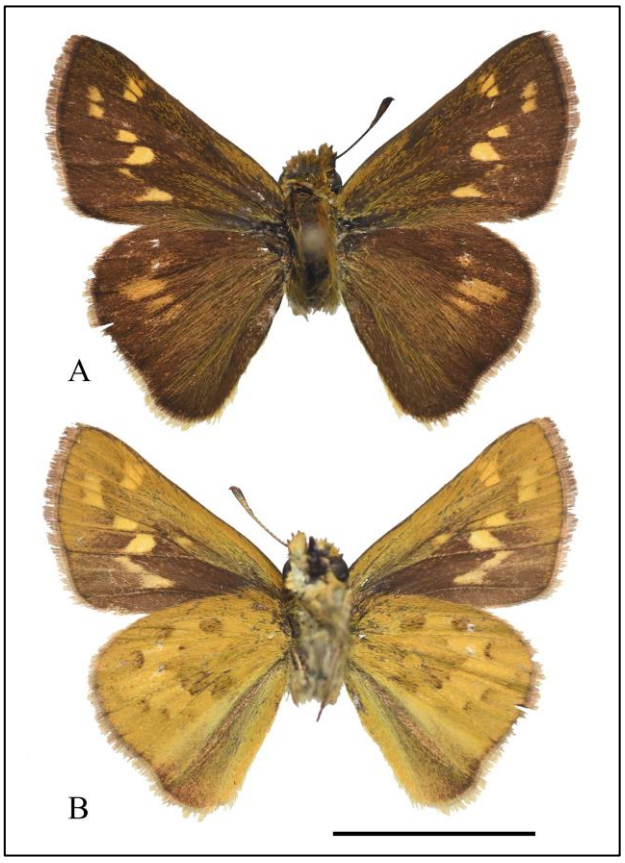

Figure 2 – *Afrogegenes letterstedti* ♀ habitus. Dorsal (A), ventral (B). Scale bar = 1cm.

Figure 3 – *Afrogegenes letterstedti* ♀ pre-vaginal plate, the diagnostic shallow indentation indicated by a black arrow (see De Jong & Coutsis, 2017 for a full explanation)

Borbo fatuellus fatuellus (Hopffer, 1855)
West Gate 2: ST (1), SF (6), SF-ST (2); Ponta Milibangalala 2: DF (4), DG (3); Futi Corridor 2: SF (6) [22]
Remarks: one specimen recorded at light.

Borbo lugens (Hopffer, 1855)
West Gate 2: SF (5), SF-ST (6); Near swamp forest 2: ST (1); Futi Corridor 2: SF (1) [13]

Gegenes pumilio gambica (Mabille, 1878)
West Gate 1: ST (3); 2: ST (1) [4]

Torbenlarsenia gemella (Mabille, 1884)
West Gate 1: SF (2); 2: ST (2), SF (16), SF-ST (12); Ponta Milibangalala 1: DG (1); 2: DG (4), DF (5); Near swamp forest 2: ST (3); Futi Corridor 2: SF (5); 3: SFxWL (1) [51]
Remarks: the most numerous hesperiid found in MSR, two specimens recorded at light.

Parnara monasi (Trimen, 1889)
West Gate 2: SF (2) [2]

Pelopidas mathias mathias (Fabricius, 1798)
West Gate 2: ST (3), SF (2), SF-ST (3); Ponta Milibangalala 2: DG (1); Near swamp forest 2: ST (1); Futi Corridor 2: SF (1) [11]

Pelopidas thrax (Hübner, [1821])
West Gate 2: SF (8); Ponta Milibangalala 2: DF (2), DG (2); Futi Corridor 2: SF (2) [14]
Remarks: one specimen recorded at light.

Family: **Pieridae**
Subfamily: **Coliadinae**

Catopsilia florella (Fabricius, 1775)
West Gate 1: ST (3), SF (1); 2: ST (1), SF (6), SF-ST (5); 3: ST (2); Ponta Milibangalala 2: DF (1), DG (1) [20]

Terias brigitta brigitta (Stoll, [1780])
West Gate 1: ST (2); 2: ST (6), SF (4), SF-ST (3); Hygrophilous grassland 2: HG-SF (1); 3: HG (6); Ponta Milibangalala 1: DF-DG (2); 2: DF (1), DG (19); 3: DG (3); Mangrove camp 1: WLx (2); Futi Corridor 2: SF (1) [50]

Terias floricola floricola (Boisduval, 1833)
West Gate 1: SF (1); 2: SF (2), SF-ST (1) [4]

Terias hecabe solifera Butler, 1875
West Gate 1: ST (1); 2: SF (7); Ponta Milibangalala 2: DG (1) [9]

Subfamily: **Pierinae**

Leptosia alcesta inalcesta Bernardi, 1959
West Gate 1: ST (3), SF (6); 2: SF (15), SF-ST (1); 3: SF (7); Hygrophilous grassland 2: HG-SF (5); Ponta Milibangalala 1: DF (5); 2: DF (18), DG (1); 3: DF (4); Mangrove camp 1: CWL (3); Futi Corridor 3: SFxWL (4) [72]

Nepheronia argia variegata Henning, 1994
West Gate 2: SF (1); Hygrophilous grassland 2: HG-SF (1); Ponta Milibangalala 2: DF (1), DG (4); Futi Corridor 2: SF (11) [18]

Nepheronia buquetti buquetti (Boisduval, 1836)
Ponta Milibangalala 3: DF (1); Mangrove camp 1: WLx (2); Futi Corridor 2: SF (1) [4]

Nepheronia thalassina sinalata (Suffert, 1904)
West Gate 2: SF (5), SF-ST (2); Futi Corridor 2: SF (2) [9]

Belenois aurota (Fabricius, 1793)

West Gate 1: ST (2); Ponta Milibangalala 1: DF-DG (1); 2: DG (1); Mangrove camp 1: WLx (1); Futi Corridor 3: SFxWL (1) [6]

Belenois creona severina (Stoll, [1781])
West Gate 1: SF (2); 2: SF (3), SF-ST (3); Hygrophilous grassland 2: HG-SF (1); Ponta Milibangalala 1: DF-DG (2); 2: DF (16), DG (13); 3: DG (2), DF (6); Mangrove camp 1: WLx (1); Near swamp forest 2: ST (2); Futi Corridor 2: SF (3) [54]
Remarks: two specimens recorded at light.

Belenois gidica abyssinica (Lucas, 1852)
Mangrove camp 1: WLx (1), GWL (1); Futi Corridor 2: SF (1) [3]

Belenois thysa thysa (Hopffer, 1855)
West Gate 1: SF (2); 2: SF (11), SF-ST (1); Hygrophilous grassland 2: HG-SF (1); Ponta Milibangalala 1: DF-DG (1); 2: DF (4), DG (1); Near swamp forest 2: ST (2); Futi Corridor 2: SF (1) [24]

Dixeia charina charina (Boisduval, 1836)
Ponta Milibangalala 2: DG (1); Near swamp forest 2: ST (1); Futi Corridor 2: SF (2) [4]

Mylothris agathina agathina (Cramer, [1779])
West Gate 2: ST (1), SF (9), SF-ST (4); Hygrophilous grassland 2: HG-SF (1); Ponta Milibangalala 2: DF (2), DG (4) [21]

Appias epaphia contracta (Butler, 1888)
West Gate 1: SF (2); 2: SF (7), SF-ST (1); Ponta Milibangalala 2: DF (3), DG (1); Mangrove camp 1: CWL (1); Futi Corridor 2: SF (8) [23]

Pontia helice helice (Linnaeus, 1764)
Futi Corridor 3: SFxWL (1) [1]

Colotis antevippe gavisa (Wallengren, 1857)
West Gate 2: SF-ST (1); Ponta Milibangalala 1: DF-DG (6) [7]
Remarks: only recorded from ecotones.

Colotis auxo auxo (Lucas, 1852)
West Gate 1: ST (1), SF (1); 2: SF (14), SF-ST (5); Mangrove camp 1: WLx (4), GWL (1); Futi Corridor 2: SF (3) [29]

Colotis annae annae (Wallengren, 1857)
Mangrove camp 1: WLx (6), GWL (2) ; Futi Corridor 2: SF (2) [10]

Colotis euippe omphale (Godart, [1819])
West Gate 1: SF (4); 2: ST (1), SF (13), SF-ST (8); 3: SF (3); Hygrophilous grassland 2: HG-SF (4); 3: HG (3); Ponta Milibangalala 1: DF-DG (22), DG (1); 2: DF (2), DG (9); 3: DG (5), DF (5); Mangrove camp 1: WLx (1), CWL (1), GWL (1); Futi Corridor 2: SF (1) [84]
Remarks: the most numerous pierid found in MSR.
Colotis vesta argillaceus (Butler, 1877)
West Gate 2: SF (1); Mangrove camp 1: WLx (1) [2]

Eronia cleodora Hübner, [1823]
West Gate 1: SF (7); 2: SF (5), SF-ST (3); 3: SF (2); Hygrophilous grassland 2: HG-SF (1); Ponta Milibangalala 2: DG (2); 3: DG (1); Futi Corridor 2: SF (1) [22]

Family: **Lycaenidae**
Subfamily: **Miletinae**

Lachnocnema bibulus (Fabricius, 1793)
Forest clearing 2: SF (1) [1]

Lachnocnema laches (Fabricius, 1793)
West Gate 2: SF (5), SF-ST (5); 3: SF (1); Hygrophilous grassland 2: HG-SF (1); Ponta Milibangalala 2: DF (5); 3: DG (1), DF (2) [20]
Remarks: mostly restricted to forests and ecotones, only one recorded from grassland.

Subfamily: **Aphnaeinae**

Aloeides taikosoma (Wallengren, 1857)
West Gate 1: ST (11); 2: ST (3); 3: ST (5); Mangrove camp 1: GWL (3); Forest clearing 2: SF (2); Futi Corridor 3: SFxWL (3) [27]
Remarks: mostly restricted to grassland habitats.

Axiocerses tjoane tjoane (Wallengren, 1857)
West Gate 1: ST (34), SF-ST (1), SF (1); 2: ST (4), SF (5), SF-ST (5); 3: ST (16), SF (5); Ponta Milibangalala 2: DG (3); Mangrove camp 1: GWL (1); Futi Corridor 3: SFxWL (9) [84]
Remarks: three specimens recorded at light.

Cigaritis mozambica (Bertoloni, 1850)
West Gate 1: ST (1) [1]

Cigaritis natalensis (Westwood, [1851])
West Gate 1: ST (1); 2: SF (3) [4]

Subfamily: **Poritiinae**

Deloneura millari millari Trimen, 1906 (Fig. 4)
West Gate 2: SF-ST (2) [2]
Remarks: **new record for Mozambique**. **MPA endemic**. Only two specimens recorded, both from the same locality and habitat.

Baliochila aslanga (Trimen, 1873)
Forest clearing 2: SF (2) [2]

Teriomima zuluana van Son, 1949
West Gate 1: SF (1); Forest clearing 2: SF (3) [4]
Remarks: **MPA endemic**. The single Mozambican record to date was from Praia do Bilene (Mecenero *et al.*, 2020).

All specimens recorded in the forest, only in dry season. IUCN Red List category: **Vulnerable** (Mecenero *et al.*, 2020).

Pentila tropicalis tropicalis (Boisduval, 1847)
West Gate 1: SF (5); 2: SF (13), SF-ST (3); Ponta Milibangalala 2: DF (3); 3: DF (3); Mangrove camp 1: CWL (5); Forest clearing 2: SF (1) [33]
Remarks: restricted to forests and ecotones.

Subfamily: **Theclinae**

Deudorix antalus (Hopffer, 1855)
West Gate 2: ST (2), SF-ST (1); Ponta Milibangalala 1: DG (1); Mangrove camp 1: CWL (1) [5]

Deudorix dariaves Hewitson, 1877
West Gate 2: SF (4); Hygrophilous grassland 2: HG-SF (1) [5]

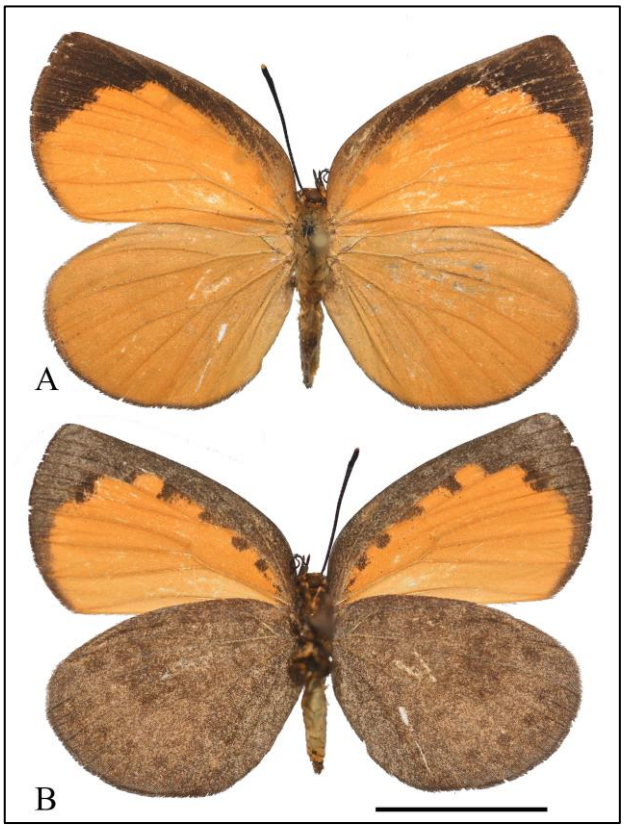

Figure 4 – *Deloneura millari* ♂ habitus. Dorsal (A), ventral (B). Scale bar = 1cm

Deudorix dinochares Grose-Smith, 1887
Forest clearing 2: SF (1) [1]

Deudorix dinomenes dinomenes Grose-Smith, 1887
Hygrophilous grassland 2: HG-SF (1) [1]

Deudorix diocles Hewitson, [1869]
Hygrophilous grassland 2: HG-SF (2); Forest clearing 2: SF (11) [13]
Remarks: restricted to sand forest and sand forest ecotones.

Hemiolaus caeculus caeculus (Hopffer, 1855)
Road to Salamanga 2: ST (7) [7]
Remarks: all specimens found at one location (within a half hour period in the afternoon).

Hypolycaena buxtoni buxtoni Hewitson, 1874
West Gate 2: SF-ST (1); Hygrophilous grassland 2: HG-SF (1) [2]
Remarks: restricted to sand forest-grassland ecotones.

Hypolycaena lochmophila Tite, 1967
West Gate 2: SF (7), SF-ST (1); 3: ST (1), SF (2); Hygrophilous grassland 2: HG-SF (1); Ponta Milibangalala 2: DF (1) [13]
Remarks: IUCN Red List category: **Vulnerable** (Mecenero *et al.*, 2020).

Hypolycaena philippus philippus (Fabricius, 1793)
West Gate 1: SF (2); 2: ST (1), SF (25), SF-ST (12); 3: ST (2), SF (2); Ponta Milibangalala 2: DF (7), DG (3); 3: DG (4); Forest clearing 2: SF (4); Futi Corridor 3: SFxWL (1) [63]

Leptomyrina hirundo (Wallengren, 1857)
West Gate 2: SF (5); Hygrophilous grassland 2: HG-SF (64) [69]
Remarks: nearly all specimens were collected in a small area at the edge of hygrophilous grassland, within a two hour period – presumably a hatching event as this species is known to be widely distributed but extremely localised.

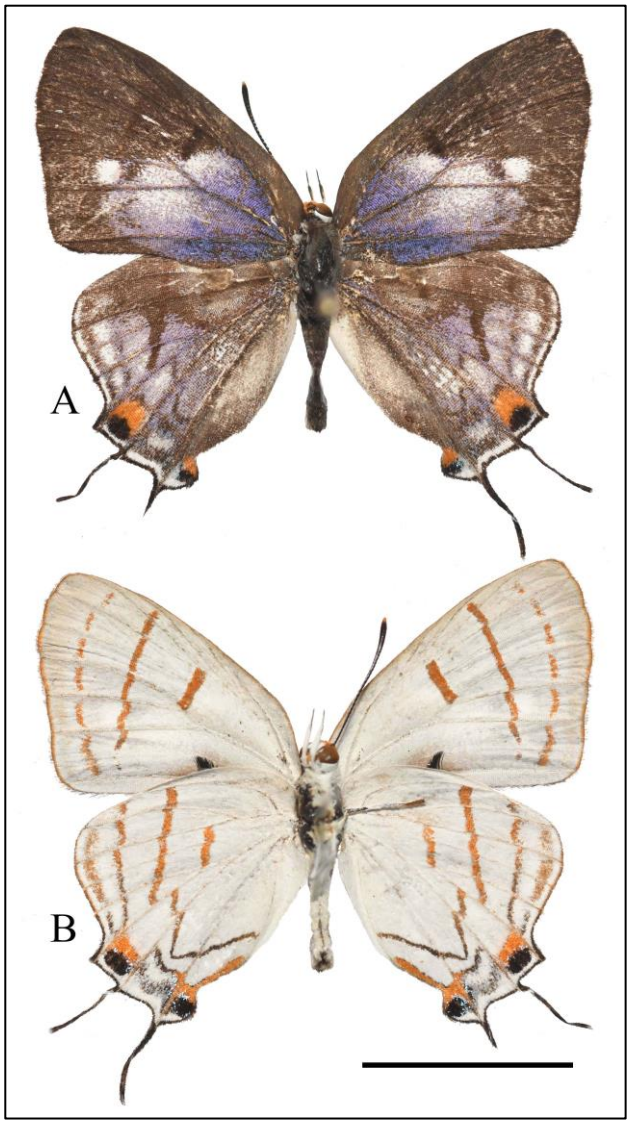

Figure 5 – *Iolaus lulua* ♂ habitus. Dorsal (A), ventral (B). Scale bar = 1cm

Iolaus lulua (Riley, 1944) (Fig. 5)
West Gate 1: SF (1) [1]
Remarks: **new record for Mozambique**. **MPA endemic**.
IUCN Red List category: **Vulnerable** (Mecenero *et al.*, 2020).

Iolaus silarus silarus Druce, 1885
West Gate 1: SF-ST (1); 2: ST (2), SF (1) [4]
Remarks: two specimens recorded at light.

Stugeta bowkeri tearei Dickson, [1980]
Ponta Milibangalala 1: DF-DG (1) [1]
Remarks: one specimen recorded at light.

Subfamily: **Polyommatinae**

Anthene amarah amarah (Guérin-Méneville, 1849)
West Gate 3: ST (2), SF (1); Mangrove camp 1: WLx (1); Futi Corridor 3: SFxWL (8) [12]

Anthene larydas (Cramer, [1780])
West Gate 1: ST (4), SF (3); 2: SF (6), SF-ST (1); Hygrophilous grassland 2: HG-SF (2); Mangrove camp 1: WLx (1), CWL (1); Futi Corridor 3: SFxWL (1) [19]

Anthene lemnos lemnos (Hewitson, [1878])
West Gate 2: SF-ST (1) [1]

Actizera lucida (Trimen, 1883)
West Gate 3: ST (3); Hygrophilous grassland 3: HG (1); Ponta Milibangalala 3: DG (1); Forest clearing 2: SF (2) [7]

Azanus jesous (Guérin-Méneville, 1849)
Futi Corridor 2: SFxWL (2) [2]

Azanus mirza (Plötz, 1880)
West Gate 1: SF (1) [1]

Azanus moriqua (Wallengren, 1857)
West Gate 1: ST (9), SF (3), SF-ST (1); 3: ST (1), SF (3); Ponta Milibangalala 1: DG (1), DF (2); 3: DF (1); Mangrove camp 1: WLx (3); Futi Corridor 3: SFxWL (23) [47]

Cacyreus lingeus (Stoll, [1782])
West Gate 2: SF (1); Forest clearing 2: SF (2) [3]
Remarks: restricted to forest habitats.

Cupidopsis jobates jobates (Hopffer, 1855)
Ponta Milibangalala 3: DG (8); Futi Corridor 3: SFxWL (1) [9]

Eicochrysops hippocrates (Fabricius, 1793)
West Gate 2: ST (2), SF (16), SF-ST (3); Forest clearing 2: SF (11) [32]

Eicochrysops messapus mahallakoaena (Wallengren, 1857)
West Gate 1: ST (2); 2: ST (12), SF (2), SF-ST (12); 3: ST (5), ST (4); Hygrophilous grassland 3: HG (1); Ponta Milibangalala 3: DG (27); Mangrove camp 1: WLx (1), GWL (2); Near swamp forest 2: ST (14); Futi Corridor 3: SFxWL (5) [87]
Remarks: the most numerous lycaenid found in MSR, almost exclusively found in grasslands and ecotones.

Euchrysops barkeri (Trimen, 1893)
West Gate 2: ST (1), SF (7), SF-ST (1); Ponta Milibangalala 2: DG (16); 3: DG (7); Mangrove camp 1: WLx (1); Forest clearing 2: SF (8); Near swamp forest 2: ST (1) [42]

Euchrysops malathana (Boisduval, 1833)
West Gate 3: ST (1); Hygrophilous grassland 2: HG-SF (1); Ponta Milibangalala 2: DG (1); 3: DG (3) [6]
Remarks: restricted to grasslands and ecotones.

Euchrysops osiris (Hopffer, 1855)
West Gate 2: SF (4), SF-ST (2); 3: ST (1); Ponta Milibangalala 2: DG (3); 3: DG (15); Near swamp forest 2: ST (3); Futi Corridor 3: SFxWL (2) [30]

Lampides boeticus (Linnaeus, 1767)
Ponta Milibangalala 1: DG (5); 2: DG (1); 3: DG (2), DF

(1) [9]
Remarks: only encountered at Ponta Milibangalala, unusual for a normally very common species.

Lepidochrysops plebeia plebeia (Butler, 1898)
Mangrove camp 1: WLx (1) [1]

Leptotes pirithous pirithous (Linnaeus, 1767)
West Gate 1: ST (4), SF-ST (1); 2: SF (9); 3: ST (2); Ponta Milibangalala 1: DF (1), DG (3); Futi Corridor 3: SFxWL (5) [25]
Remarks: the majority of the male specimens were dissected, the genitalia all conforming to *Leptotes pirithous* as figured in Larsen (2005: 253).

Oraidium barberae (Trimen, 1868)
West Gate 2: SF (1); Hygrophilous grassland 2: HG-SF (1); 3: HG (1) [3]

Pseudonacaduba sichela sichela (Wallengren, 1857)
West Gate 1: SF-ST (4) [4]

Tuxentius melaena melaena (Trimen, 1887)
West Gate 2: SF (5), SF-ST (1); Ponta Milibangalala 3: DF (1); Forest clearing 2: SF (2) [9]

Zizeeria knysna knysna (Trimen, 1862)
West Gate 1: ST (4); 2: ST (2), SF (1); Ponta Milibangalala 2: DG (7); Mangrove camp 1: WLx (1), GWL (1); Futi Corridor 3: SFxWL (1) [17]
Remarks: one specimen recorded at light.

Zizula hylax (Fabricius, 1775)
West Gate 1: ST (1); 2: ST (1), SF (5), SF-ST (1); 3: SF (1); Ponta Milibangalala 1: DG (1); Mangrove camp 1: GWL (2) [12]

Freyeria trochylus (Freyer, [1844])
West Gate 1: ST (6); 2: ST (8), SF (3), SF-ST (3); 3: ST (9); Ponta Milibangalala 2: DG (5); 3: DG (6); Forest clearing 2: SF (1); Near swamp forest 2: ST (2); Futi Corridor 3: SFxWL (3) [46]
Remarks: three specimens recorded at light.

Family: **Nymphalidae**
Subfamily: **Danainae**

Amauris albimaculata albimaculata Butler, 1875
West Gate 2: SF (2); Ponta Milibangalala 1: DF (1); 2: DF (1); Forest clearing 2: SF (6) [10]

Amauris niavius dominicanus Trimen, 1879
West Gate 2: SF (1), SF-ST (1); 3: ST (1), SF (1) [4]

Amauris ochlea ochlea (Boisduval, 1847)
West Gate 1: ST (1), SF (7); 2: SF (4), SF-ST (3); 3: SF (4); Ponta Milibangalala 1: DF (7), DG (1); 2: DF (1), DG (1); Mangrove camp 1: WLx (2); Forest clearing 2: SF (5); Futi Corridor 3: SFxWL (1) [37]
Remarks: one specimen was attracted to a millipede pitfall trap and another was recorded at light.

Danaus chrysippus orientis (Aurivillius, 1909)
West Gate 1: SF-ST (1); 2: SF (2); Ponta Milibangalala 1: DG (3), DF-DG (1); 3: DG (2); Mangrove camp 1: WLx (1); Forest clearing 2: SF (5); Near swamp forest 2: ST (1) [16]

Subfamily: **Limenitidinae**

Euphaedra neophron neophron (Hopffer, 1855)
West Gate 1: SF (12), ST (1); 2: SF (7); Ponta Milibangalala 1: DF (2); 2: DF (4); 3: DG (2); Forest clearing 2: SF (1) [29]

Euryphura achlys (Hopffer, 1855)
Ponta Milibangalala 2: DF (2) [2]
Remarks: one specimen recorded at light.

Hamanumida daedalus (Fabricius, 1775)
West Gate 1: ST (1); 2: ST (2), SF (2), SF-ST (6); 3: ST (1) [12]

Neptis jordani Neave, 1910
West Gate 2: SF (1) [1]

Neptis saclava marpessa Hopffer, 1855
West Gate 2: SF (2), SF-ST (3); Ponta Milibangalala 2: DF (1); Forest clearing 2: SF (1) [7]

Subfamily: **Heliconiinae**

Acraea acara acara Hewitson, [1865]
Ponta Milibangalala 1: DF (1), DF-DG (2); 3: DG (4); Mangrove camp 1: WLx (1) [8]

Acraea acrita acrita Hewitson, [1865]
West Gate 2: SF (1), SF-ST (1); Ponta Milibangalala 2: DF (1) [3]

Acraea natalica Boisduval, 1847
West Gate 2: SF (3), SF-ST (4); Ponta Milibangalala 1: DG (1); 2: DG (2); 3: DG (3), DF (1); Near swamp forest 2: ST (1); Futi Corridor 3: SFxWL (1) [16]

Acraea oncaea Hopffer, 1855
West Gate 1: ST (1); 2: ST (1), SF (1); Mangrove camp 1: WLx (1); Forest clearing 2: SF (1); Futi Corridor 3: SFxWL (1) [6]

Acraea petraea Boisduval, 1847
West Gate 2: SF (1), SF-ST (1); Mangrove camp 1: CWL (1) [3]

Acraea rabbaiae perlucida Henning & Henning, 1996
West Gate 2: SF (1); Forest clearing 2: SF (1) [2]

Phalanta phalantha aethiopica (Rothschild & Jordan, 1903)
West Gate 2: SF (2); Ponta Milibangalala 2: DF (3), DG (3); 3: DG (1); Forest clearing 2: SF (2) [11]

Telchinia encedon encedon (Linnaeus, 1758)
West Gate 1: ST (2); 2: SF (11), SF-ST (5); 3: SF (1); Hygrophilous grassland 2: HG-SF (1); Forest clearing 2: SF (3) [23]
Remarks: two specimens were attracted to a millipede pitfall trap.

Telchinia esebria (Hewitson, [1861])
West Gate 2: SF-ST (1) [1]

Telchinia serena (Fabricius, 1775)
West Gate 1: ST (4), SF (2); 2: ST (16), SF (21), SF-ST (19); 3: ST (1); Ponta Milibangalala 1: DF-DG (1), DF (1); 2: DF (1), DG (13); Mangrove camp 1: WLx (2), CWL (1);

Forest clearing 2: SF (16); Near swamp forest 2: ST (9); Futi Corridor 3: SFxWL (3) [110]
Remarks: one specimen was recorded at light and another was attracted to monkey dung. This species was the most numerous butterfly found in MSR.

Subfamily: **Biblidinae**

Byblia anvatara acheloia (Wallengren, 1857)
West Gate 2: ST (2), SF (4), SF-ST (8); 3: ST (4); Ponta Milibangalala 2: DF (2), DG (5); Futi Corridor 3: SFxWL (3) [28]
Remarks: one specimen recorded at light.

Byblia ilithyia (Drury, 1773)
West Gate 1: SF (1); 2: SF-ST (1); Ponta Milibangalala 2: DG (5); Mangrove camp 1: WLx (4), GWL (2); Forest clearing 2: SF (4) [17]

Eurytela dryope angulata Aurivillius, [1899]
West Gate 2: SF (5), SF-ST (3); 3: ST (2); Ponta Milibangalala 2: DF (5), DG (1); 3: DF (1); Mangrove Camp 1: CWL (1); Forest clearing 2: SF (3) [21]

Sevenia boisduvali boisduvali (Wallengren, 1857)
West Gate 2: ST (2), SF (16), SF-ST (42); Ponta Milibangalala 2: DF (3), DG (4); Forest clearing 2: SF (1) [68]
Remarks: three specimens recorded at light.

Sevenia natalensis (Boisduval, 1847)
West Gate 1: ST (1), SF (1); 2: ST (1), SF (7), SF-ST (14); 3: ST (6), SF (1); Hygrophilous grassland 2: HG-SF (1); Ponta Milibangalala 2: DG (1); Forest clearing 2: SF (4); Near swamp forest 2: ST (1); Futi Corridor 3: SFxWL (8) [46]
Remarks: one specimen recorded at light.

Sevenia rosa (Hewitson, 1877)
West Gate 2: SF-ST (1) [1]

Subfamily: **Nymphalinae**

Hypolimnas anthedon wahlbergi (Wallengren, 1857)
West Gate 2: SF (1) [1]

Hypolimnas misippus (Linnaeus, 1764)
West Gate 1: ST (1); 2: SF (2), SF-ST (1); Ponta Milibangalala 2: DF (2) [6]

Junonia hierta cebrene Trimen, 1870
West Gate 2: ST (1), SF-ST (1); Mangrove camp 1: Wx (3); Forest clearing 2: SF (1) [6]

Junonia natalica natalica (Felder & Felder, 1860)
West Gate 2: SF-ST (1) [1]

Junonia oenone oenone (Linnaeus, 1758)
West Gate 1: ST (4); 2: ST (2), SF (2), SF-ST (5); 3: ST (1); Ponta Milibangalala 3: DG (2); Forest clearing 2: SF (1); Futi Corridor 3: SFxWL (6) [23]
Remarks: one specimen was attracted to a millipede pitfall trap.

Junonia terea elgiva Hewitson, [1864]
West Gate 2: SF (5), SF-ST (1) [6]

Protogoniomorpha anacardia nebulosa (Trimen, 1881)
West Gate 2: SF (1); Ponta Milibangalala 2: DF (1) [2]

Vanessa cardui (Linnaeus, 1758)
Ponta Milibangalala 1: DG (1) [1]

Subfamily: **Charaxinae**

Charaxes brutus natalensis Staudinger, [1885]
West Gate 1: ST (4), SF-ST (1); 2: SF (9), SF-ST (36); 3: ST (1); Ponta Milibangalala 2: DG (2); 3: DG (1); Forest clearing 2: SF (3); Futi Corridor 3: SFxWL (4) [61]

Charaxes candiope (Godart, [1824])
West Gate 2: SF-ST (5); Ponta Milibangalala 2: DG (2); 3: DG (2); Forest clearing 2: SF (4) [13]

Charaxes castor flavifasciatus Butler, 1895
West Gate 1: ST (1); 2: SF-ST (14); 3: ST (1); Ponta Milibangalala 2: DG (1); Forest clearing 2: SF (6) [23]

Char*axes cithaeron cithaeron* Felder & Felder, 1859
West Gate 2: SF (1), SF-ST (2); Ponta Milibangalala 3: DG (2); Forest clearing 2: SF (11) [16]

Charaxes etesipe tavetensis Rothschild, 1894
West Gate 3: SF (1); Ponta Milibangalala 3: DG (1) [2]
Remarks: one specimen recorded at light.

Charaxes ethalion ethalion (Boisduval, 1847)
West Gate 2: SF (5), SF-ST (10); Ponta Milibangalala 2: DF (1), DG (1); Forest clearing 2: SF (2); Futi Corridor 3: SFxWL (1) [20]

Charaxes jahlusa argynnides Westwood, 1864
Ponta Milibangalala 1: DF-DG (1); 3: DG (9); Forest clearing 2: SF (13) [24]

Charaxes protoclea azota (Hewitson, 1877)
West Gate 2: SF (3), SF-ST (5); 3: ST (1) [9]

Charaxes saturnus saturnus Butler, 1866
Ponta Milibangalala 2: DG (1) [1]

Charaxes varanes varanes (Cramer, 1777)
West Gate 2: SF (8), SF-ST (8); Ponta Milibangalala 2: DF (1), DG (5); 3: DG (1); Forest clearing 2: SF (12) [35]

Charaxes wakefieldi (Ward, 1873)
Ponta Milibangalala 3: DG (1) [1]

Charaxes zoolina (Westwood, [1850])
West Gate 2: SF-ST (12); Ponta Milibangalala 1: DF-DG (2); 2: DF (1), DG (1); 3: DG (1); Forest clearing 2: SF (9) [26]

Subfamily: **Satyrinae**

Bicyclus anynana anynana (Butler, 1879)
West Gate 1: ST (1), SF (8); 2: SF (8), SF-ST (1); 3: SF (2); Ponta Milibangalala 1: DF (1); 2: DF (3), DG (3); Forest clearing 2: SF (11); Near swamp forest 2: ST (1); Futi Corridor 3: SFxWL (2) [41]

Bicyclus safitza safitza (Westwood, [1850])

West Gate 1: ST (3), SF (2); 2: SF (9), SF-ST (11); 3: ST(2); Ponta Milibangalala 3: DG (1); Forest clearing 2:

SF (1); Near swamp forest 2: ST (1); Futi Corridor 3: SFxWL (1) [31]
Remarks: one specimen was attracted to a millipede pitfall trap.

Brakefieldia perspicua perspicua (Trimen, 1873)
Ponta Milibangalala 2: DF (1); Near swamp forest 2: ST (3) [4]

Coenyra hebe (Trimen, 1862)
West Gate 1: ST (1); 2: SF (2), 3: ST (1) [4]

Melanitis leda (Linnaeus, 1758)
West Gate 1: ST (2), SF (1); 2: SF (3), SF-ST (16); Ponta Milibangalala 2: DG (8), DF (16); 3: DG (2); Forest clearing 2: SF (2) [50]

Physcaeneura panda (Boisduval, 1847)
West Gate 1: ST (28); 2: ST (1), SF-ST (3); 3: ST (5); Hygrophilous grassland 3: HG (3); Ponta Milibangalala 1: DG (1); 3: DG (2) [43]
Remarks: restricted to grasslands and ecotones. Two specimens were attracted to a millipede pitfall trap.

Ypthima granulosa Butler, 1883
West Gate 1: ST (5); 2: ST (8), SF (12), SF-ST (10); 3: ST (4); Hygrophilous grassland 2: HG-SF (2); Ponta Milibangalala 1: DG (4), DF-DG (2); 2: DG (7); Near swamp forest 2: ST (6); Futi Corridor 3: SFxWL (7) [67]
Remarks: genitalia dissections of all *granulosa*-like forms conformed to this taxon as figured in Kielland (1982: 119).

Ypthima impura paupera Ungemach, 1932
West Gate 1: ST (8); 2: ST (3); 3: ST (9); Hygrophilous grassland 3: HG (3); Ponta Milibangalala 3: DG (1); Forest clearing 2: SF (1); Futi Corridor 3: SFxWL (3) [28]
Remarks: restricted to grasslands and mosaic habitats. Two specimens were attracted to a millipede pitfall trap.

Reconnaissance trip to the North of Mozambique and new country records

A reconnaissance trip was undertaken to various locations in the north of Mozambique in August, 2018, including Chimanimani National Reserve (three days), Gorongosa National Park (three days), Lugela (one day) and Limbue (one day) in the Mt. Mabu area and Mt. Namuli (two days).

During this time 93 species were collected, two of which are new records for Mozambique:

Acraea nohara halali Marshall, 1896 (Fig. 6)
Mozambique, Manica Province, Chimanimani National Reserve, Moribane Forest Ndzou Camp (Moist Forest), 630 m, 19°44'01.4"S, 33°20'15.1"E, 3-5.viii.2018, General Coll., Laszlo, G., Miles, W., Vetina, A., Leg. (4 ♂♂, 2 ♀♀).

Gretna carmen capra Evans, 1937 (Fig. 7)
Mozambique, Zambezia Province, Lugela, around Hotel Mantega, 271 m, 16°25'50.4"S, 36°45'09.4"E, 9-10.viii.2018, General Coll, Laszlo, G., Miles, W., Vetina, A., Leg. (1♂).

DISCUSSION

A total of 2663 butterfly specimens, consisting of 163

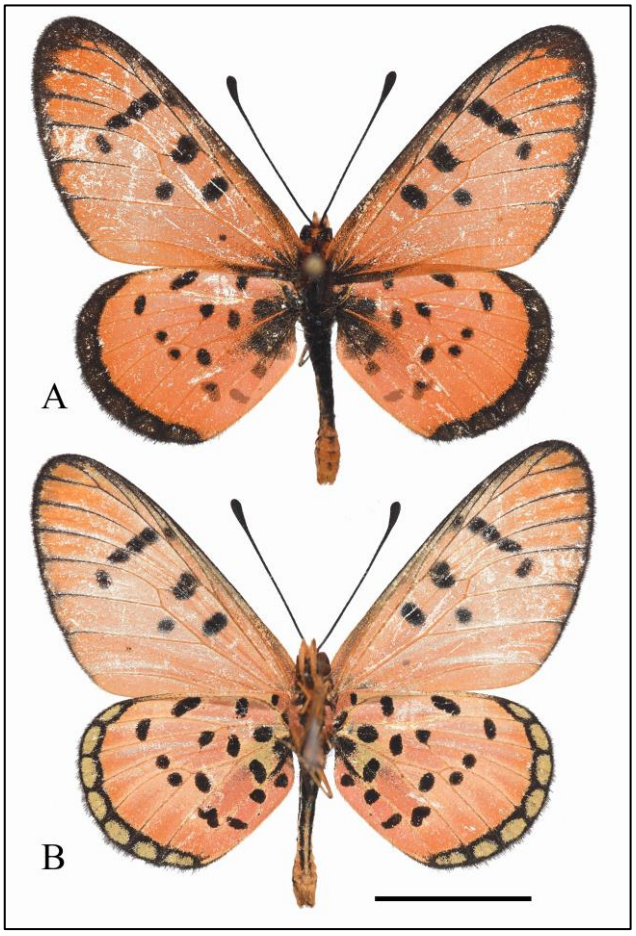

Figure 6 – *Acraea nohara halali* ♂ habitus. Dorsal (A), ventral (B). Scale bar = 1cm.

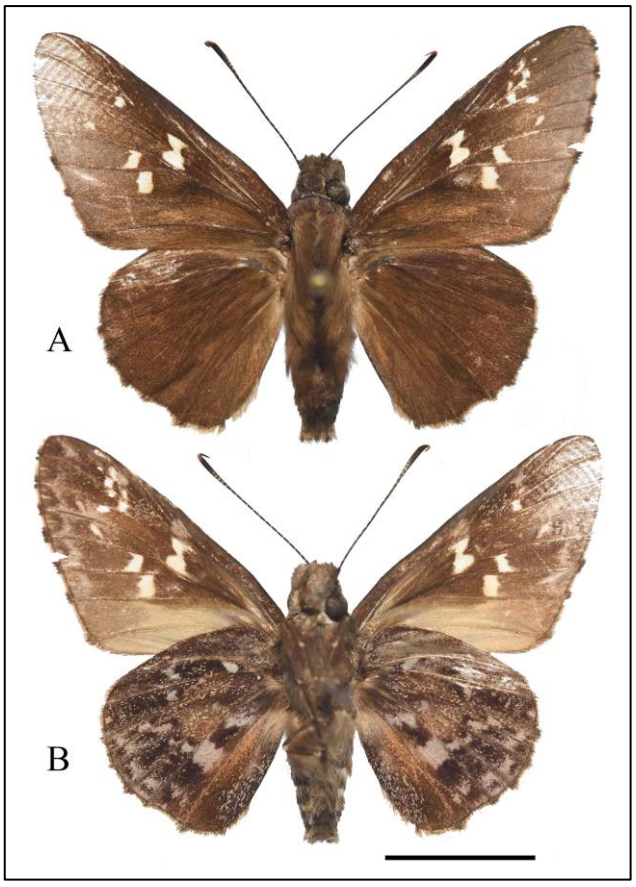

Figure 7 – *Gretna carmen capra* ♂ habitus. Dorsal (A), ventral (B). Scale bar = 1cm.

species in 86 genera, were collected in MSR during the three ANHRT expeditions, over a period of approximately 64 days. A total of 89 species were recorded from the study period between November-December 2016 (497 specimens); 139 species from May-June 2017 (1711 specimens); and 85 species from February 2018 (455 specimens). Papilionidae made up 6% of the overall species and 4% of the overall specimens; Lycaenidae 28% and 30%; Hesperiidae 20% and 10%; Pieridae 13% and 18%; and Nymphalidae 33% and 39% respectively. The notable differences in the numbers of species recorded between May-June 2017 and the other two study periods may be attributable to a number of factors including, but not limited to, seasonality, habitat and locations visited during the expedition, and will be explored in detail below. Four new records for Mozambique were found during the course of this study: *Deloneura millari millari* Trimen and *Iolaus lulua* (Riley) from MSR, *Acraea nohara halali* Marshall from Chimanimani National Reserve and *Gretna carmen capra* Evans from Lugela, near Mt. Mabu. The former two are elusive species restricted to coastal habitats in KZN, so their appearance in MSR is not surprising. *A. nohara halali* was previously known from the Chimanimani range in Zimbabwe, so its presence on the other side of the border could also be expected. The most southerly record of *G. carmen capra* was Shiwa N'gandu, in north-eastern Zambia, so this represents a significant south-easterly extension to its known range (Williams, 2020).

Seasonality

A far greater number of species were encountered during the period from May-June 2017 than in the other two study periods, suggesting that seasonality may be the most important factor governing butterfly distribution in MSR. Diversity and abundance were highest during the dry months of May and June and much lower in the wet month of February. Approximately 64% of specimens and 85% of all species were collected in the early dry season (May-June 2017), compared to the late dry season (November-December 2016) where 19% of specimens and 55% of all species were recorded. During the wet season (February 2018), only 17% of specimens and 52% of the total number of species were sampled. An explanation for this could be that peak rainfall occurs in January-February which corresponds with a peak in the abundance of larvae or ova, which then emerge about three months later between April-May, as detected by Valtonen *et al*. (2013). This would result in greater diversity being exhibited during the early dry season.

In terms of seasonality, there were a number of species only collected during one season and referred to here as seasonally unique. There was a total of 47 seasonally unique species collected in the early dry season which constituted 29% of the total number of species collected whilst the late dry season and wet season each had seven species encountered that were unique to that season (4.3%). However, many of these were found as singletons or in small numbers only and therefore seasonality cannot be directly attributed as a factor with certainty. In total, 31% of species were present during all the seasonal periods.

It is important to note that each expedition was carried out with at least a one-year gap in between and as a result the data is compared between seasons as well as between years. The differences recorded may therefore not be due to season alone but yearly differences in butterfly populations (Devries & Walla, 2001).

Habitat

Habitat seems to be the second most important factor overall for butterfly diversity. MSR is mostly composed of open grassland and tree savannahs, with denser patches of sand forest particularly along the Maputo River in the west of the reserve and in the wetter south. Separating the habitat types of de Boer (2000) was a difficult task but the researchers made a distinction between forested and thicket/grassland habitats. Others, such as woodland and woody grassland, ecotones, and mosaics were harder to identify and separate.

Of the 163 species collected in total, 28 (17.2%) were collected as singletons, 88 species (54%) were present in all habitats, leaving 47 species (28.8%) as unique to either grassland, forest or ecotones. For this study an ecotone record should be treated cautiously as it was often difficult to separate two habitats clearly, thus the record may belong to one of the habitats on either side and not to the ecotone itself. Nonetheless, five species (3.1%) were collected only in ecotones (*Spialia confusa*, *Pseudonacaduba sichela*, *Deloneura millari*, *Hypolycaena buxtoni*, *Colotis antevippe*). There were 11 species (6.7%) collected only in grasslands, while 31 species (19%) were collected only in forest. The higher proportion of forest specialists suggests that the forests in the reserve are species-rich and should be explored further.

Research site

Eight locations were visited during the three expeditions to MSR with, West Gate being by far the most intensively studied site with approximately 38 days out of a total of 63 spent there. This is very likely to be the reason for the observed richness of the butterfly community here: 133 species (82% of all species), 29 of them unique to West Gate. Ponta Milibangalala was sampled for a total of 13 days, in all seasons, and 87 species were found there (53%) with nine locally unique species. Hygrophilous grassland was sampled in all seasons, but for no more than five days in total: 30 species (18.4%) were found, only one of which was locally unique. Mangrove camp (37 species (22.7%)), forest clearing (71 species (43.6%)) and Futi corridor (39 species (23.9%)) were each visited only once on consecutive expeditions, for two to four days. This difference mirrors the general pattern of diversity found across the study, with comparatively more species collected in May-June than other times of the year. 'Near swamp forest' and 'road to Salamanga' were each sampled for less than a single day and thus far fewer species were recorded. *Hemiolaus caeculus* was unique to a single location along the road to Salamanga, possibly due to a hatching event and the presence of its larval foodplant, although no such observations were made at the time.

Most of the locally unique species were found in small numbers, perhaps indicating that these are elusive or rare species, at least during this study, with *Hemiolaus caeculus* and *Lampides boeticus* being the exceptions. Overall, there was little difference between locations and any variations

in species composition were more likely driven by habitat or seasonal differences.

Collecting method

In addition to general collecting (both hand sampling with nets, and trapping using banana and shrimp bait), which resulted in 2597 specimens, some butterflies were sampled as by-catch at light traps and in pitfall traps. A total of 54 specimens (belonging to 24 species) were recorded at light, the majority of them being Hesperiidae. *Zophopetes dysmephila*, a species commonly seen flying after sunset (Williams, 2020) and *Melanitis leda* which often remain active after midnight (Larsen, 2005) were both unsurprisingly attracted to light.

A further eleven specimens (belonging to eight species) were caught using a millipede pitfall trap. The traps were set with the intention to collect necrophagous onthophagine dung beetles which are attracted to the defensive secretions of the millipedes. These butterflies could have been searching for sugars or minerals they could not find elsewhere, or simply looking for water which is scarce in the reserve. *Telchinia serena* was also recorded on vervet monkey dung which was present around the researchers' camp in Ponta Milibangalala.

Limitations

Sampling was carried out in blocks of 20-22 days dispersed over three years, rather than collecting in consecutive seasons throughout one single year. This makes comparisons between seasons more difficult as there may be other influencing factors to consider. Additionally, sampling was undertaken in an opportunistic way aimed at maximising specimen capture and producing a comprehensive list of all species encountered. Researchers followed ecotones to obtain species occurring in both habitats, explored new areas frequently and sometimes briefly, and preferentially sampled rare or unusual species while ignoring common or easily identifiable ones, especially if they had already been collected (e.g. *Papilio demodocus*, *Catopsilia florella*, *Lampides boeticus*, *Melanitis leda*, etc). Therefore, species numbers should be treated with caution except in extreme cases, and cannot be used for statistical analysis.

Accurate abundance data would have been difficult to obtain in any case as different researchers were present during different expeditions and some locations could not be revisited; for example, 'mangrove camp' and 'forest clearing' were both completely inaccessible in the wet season. Certain habitats such as the forest proved challenging to physically catch the butterflies due to the amount of foliage and rough terrain so it is possible that some forest species were simply not sampled. Collecting was spread out across three years, so any comparisons between seasons are fallible.

CONCLUSIONS AND FUTURE WORK

This study provides up to date information on the butterfly fauna of MSR and further insight into the butterfly biodiversity of the region. A total of 163 species in 86 genera were recorded from MSR, with two of these species new to Mozambique. Despite this, numerous species that were historically described from Delagoa Bay, including *Spialia delagoae* (Trimen, 1898), were not recorded during this study suggesting future work is needed to provide a comprehensive and up to date list of the butterfly fauna of the reserve. Equally, with two new records found in just a few days of sampling in the north, it is clear that additional research is needed further afield as well, a prerequisite for understanding Mozambique's biodiversity and that of Africa as a whole.

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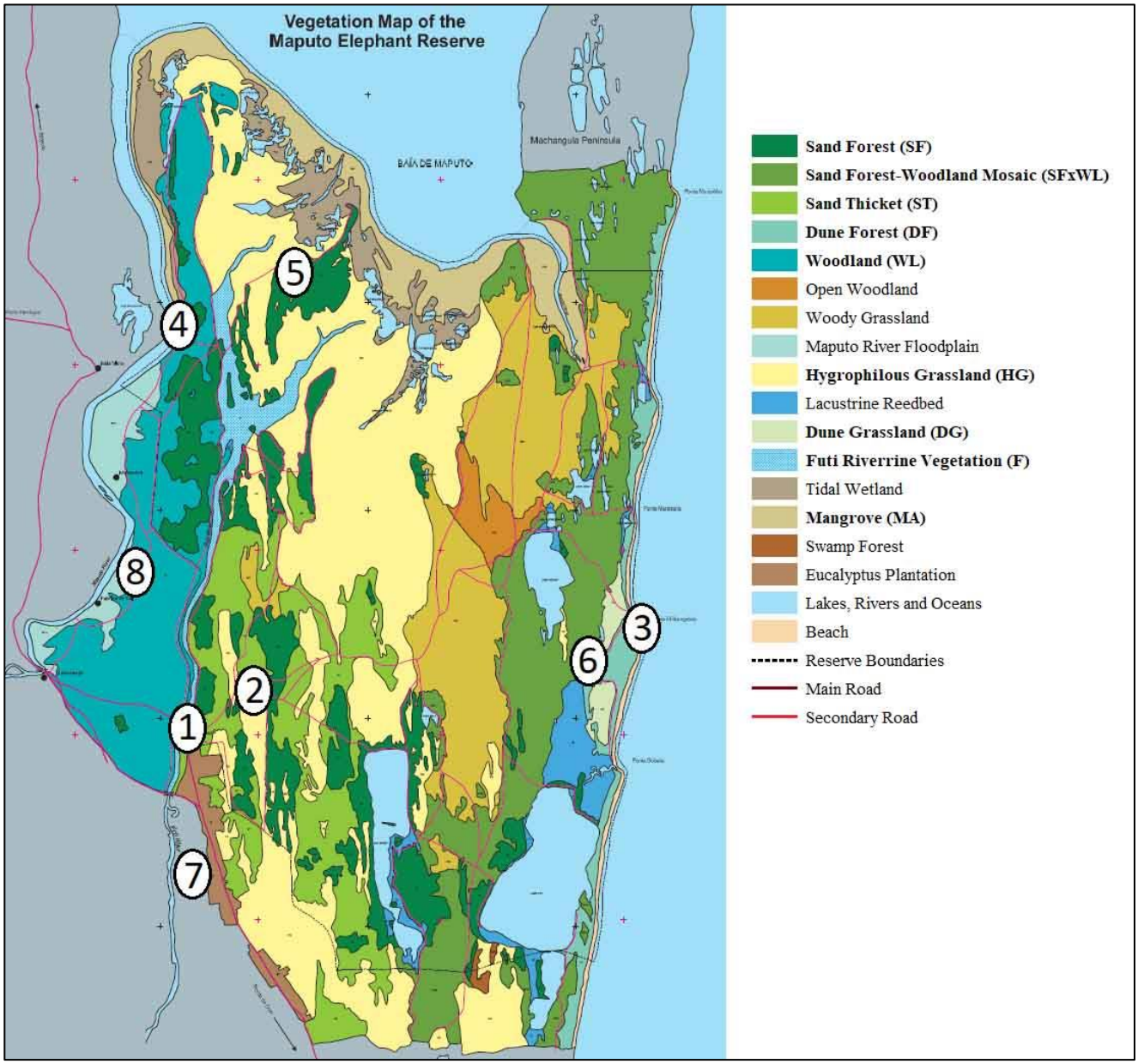

Figure 8 – Vegetation map of Maputo Special Reserve adapted from De Boer (2000). Collecting sites are numbered as they appear in the Materials & Methods. 'Woodland' *sensu* De Boer was separated by the researchers into 'Closed' and 'Grassy' woodland.