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A Chain of Butterflies—Butterfly Endemism in Africa's Eastern Mountains

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Abstract: Moreau's Tanganyika-Nyasa Montane Chain is a series of mountain ranges running from south-eastern Kenya, south and west through Tanzania, and thence southwards through Malawi and extreme north-western Zambia to Mulanje Mountain in southern Malawi. These mountain ranges are the links in Moreau's Tanganyika-Nyasa Montane Chain (the Chain). This is examined in terms of a series of butterfly Centres of Endemism. Butterflies endemic to the Chain are listed and distributions within it are examined. Neighbouring butterfly Centres of Endemism are used as counterfactuals to test the validity of the Chain, and butterflies endemic to these centres are also listed. The southernmost mountains of the Chain are found to belong to the South East Africa Montane Archipelago ecoregion, while the more northerly part of the Chain, from the Taita Hills in Kenya to the Nyika Plateau west of Lake Malawi, is found to be divide naturally into two overlapping Centres of Endemism, separated by altitude: the Eastern Arc Mountains of southern Kenya and Tanzania, and the 'Tanzania – Malawi Highlands'; the former is already known but the latter we now identify as a new butterfly Centre of Endemism. Connecting the links in the Chain is shared butterfly endemism between the individual mountain blocks, enabling the identification and delineation of Centres of Endemism. The important endemic butterfly fauna of the adjoining Zanzibar – Inhambane Coastal Forest Mosaic, the Eastern Africa Coastal Zone, is separated from that of the montane highlands inland, and is discussed. This study shows that few otherwise locally endemic species have distributions which transgress from neighbouring Centres of Endemism into the Chain or vice versa. Conservation issues are considered.

Key words: Biodiversity, Centres of Endemism, ecological zones, ecoregions. Moreau's Tanganyika-Nyasa Montane Chain.

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INTRODUCTION

In his study of bird faunas, Moreau (1966) identified as a biogeographical entity the chain of tropical East African mountains running 1500 km from the Taita Hills in Kenya, south and west though Tanzania from the Usambara Mountains (including the whole of the Eastern Arc Mountains) to the Southern Highlands, and thence southward through Malawi from the Misuku Hills in the north to Mulanje Mountain in the south. He called this the Tanganyika–Nyasa Montane Chain. Moreau was aware of other mountains to the east of Mulanje in Mozambique but had not examined them. We suggest that an examination of the butterfly distribution data justifies the division of Moreau's Chain into three parts, the mountains of southern Malawi being part of the South East Africa Montane Archipelago (SEAMA) ecoregion, while the more northerly part divides into two Centres of Endemism. The Eastern Arc Mountains of Kenya and Tanzania (the Eastern Arc), and the higher elevations of the mountains of the Chain, notably those of southern Tanzania and northern Malawi – the Tanzania-Malawi Highlands.

Moreau identified the Chain as rich in montane forest birds. Lovett (1985) separated the mountains of eastern Tanzania and south-eastern Kenya from the rest of the chain as the 'Eastern Arc Mountains', on the grounds of their rich medium altitude east facing forests and high levels of endemism. For example, *Allanblackia stuhlmannii*, potentially valuable for its seed oil, is an Eastern Arc (and Tanzanian) endemic tree which reaches its south-western limit in the Kigogo Forest in the Udzungwa Mountains. The Eastern Arc Mountains of Kenya and Tanzania are now recognised as one of the world's richest ecoregions of biodiversity (Lovett 1985, Lovett & Wasser 1993, Olson & Dinerstien 1998, Myers *et al.*, 2000, Platts *et al.*, 2011).

We divide the east facing forests at intermediate elevations on the Eastern Arc Mountains from the higher, colder and usually somewhat drier Afromontane forest and grassland on the mountain tops. Although widely distributed throughout eastern and southern Africa, within the northern part of Moreau's Chain, this latter vegetation type is found mainly on the Udzungwa Mountains, the Southern Highlands of Tanzania, and the mountains of northern Malawi and north-eastern Zambia. For this Centre of Endemism, we propose the name 'Tanzania-Malawi

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Highlands'. There are small amounts of Afromontane forest and grassland on the tops of most of the Eastern Arc Mountains, and some species confined to it are also present on these mountains. In effect, we find that butterflies of the higher elevations within the Eastern Arc Mountains are not confined to these mountains. They are present where their Afromontane habitat is most extensive, and they appear to have no difficulty in crossing the so-called Makambako Gap between the Udzungwa Mountains and the Southern Highlands of Tanzania.

Centres of Endemism

This paper tests the validity of Moreau's Tanganyika-Nyasa Montane Chain in terms of its butterfly fauna. In order to do this, we compare the butterfly fauna of distinct mountain ranges and identify several butterfly Centres of Endemism. We therefore examine the distributions of the many species of butterfly (Lepidoptera: Rhopalocera) endemic to Moreau's Chain, including the Eastern Arc Mountains, and also the species in neighbouring Centres of Endemism to investigate the degrees of separation and endemism. Fortunately, in recent years several publications have considered butterfly biogeography in parts of tropical East Africa. These include *The montane butterflies of the eastern Afrotropics* (de Jong & Congdon 1993); *Butterflies of the Albertine Rift* (Davenport, 2002); the study of endemism in the Eastern Arc Mountains of Kenya and Tanzania with adjoining coastal areas for the Critical Ecosystems Partnership Fund (Collins *et al.*, 2006); *Butterflies of Mozambique* (Congdon *et al.*, 2010); and the *South East Africa Montane Archipelago* (Bayliss *et al.*, 2024). These works enable a comparison of the butterfly Centres of Endemism for eastern Africa.

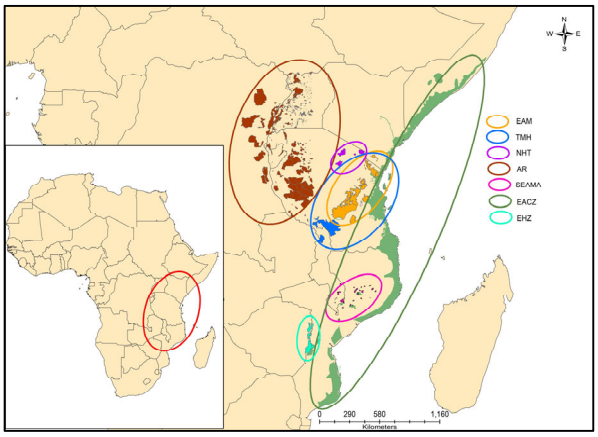

Figure 1 – The location of relevant mountains ranges and ecoregions in east and south-east Africa. Map by Julian Bayliss.

With our present knowledge, the data support the following seven zones as important Centres of (butterfly) Endemism. (Fig. 1)

1. The Northern Highlands of Tanzania (NHT)
2. The Eastern Arc Mountains of Kenya and Tanzania (EAM) (Lovett 1985)
3. The highlands in Moreau's Tanganyika-Nyasa Montane Chain as far south as the Nyika Plateau, the Tanzania – Malawi Highlands (TMH) (Moreau 1966)
4. The Eastern Africa Coastal Zone (ECZ), the Zanzibar – Inhambane Coastal Forest Mosaic (White 1983)
5. The South East Africa Montane Archipelago of northern Mozambique and southern Malawi (SEAMA) (Bayliss *et al.*, 2024)
6. The Eastern Highlands of Zimbabwe (EHZ) (Larsen 2005)
7. The Albertine Rift (AR) (Davenport 2002)

In terms of butterflies, recent studies demonstrate that the mountains of southern Malawi form part of SEAMA (Bayliss *et al.*, 2024). South of this is the biogeographical barrier of the Zambezi valley, beyond which are the Eastern Highlands of Zimbabwe. Over to the west, beyond the dry central plateau of Tanzania, and forming the western boundary of the area under study, is the Albertine Rift. This zone, as defined by Davenport (2002), includes mountains surrounding Lakes Kivu and Tanganyika.

Biogeographical Descriptions of the Centres of Endemism

1. The Northern Highlands of Tanzania

These sweep round the northern end of the Masai Steppe in a wide arc nearly 400 km long, and include Kilimanjaro (5895 m) Meru (4566 m), Kitumbaine (2858 m), the active volcano Ol Doinyo Lengai (2878 m when last surveyed), the Ngorongoro Crater Highlands (3648 m), the Mbulu Highlands (2417 m) and Hanang (3417 m). They are mainly volcanic in origin, in contrast to the block faulted Eastern Arc. The higher levels are forested, and the isolated mountains are surrounded by hot dry lowland.

2. The Eastern Arc Mountains of Kenya and Tanzania

The Eastern Arc Mountains together with the Tanzania – Malawi Highlands form the greater part of Moreau's Tanganyika-Nyasa Montane Chain (Fig. 2). We therefore describe both in greater detail than the neighbouring Centres of Endemism.

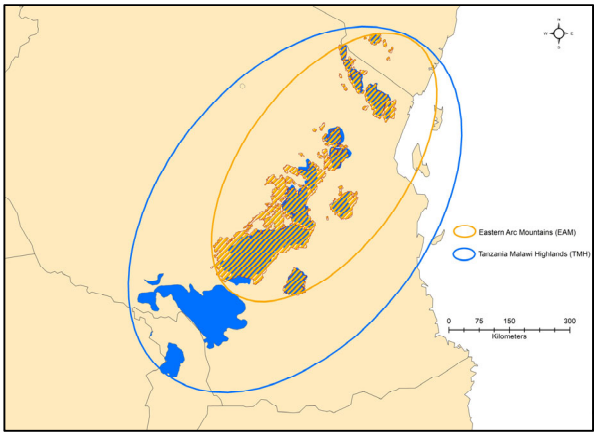

Figure 2 – The two overlapping butterfly Centres of Endemism forming part of the northern chain of mountains. Map by Julian Bayliss.

Lovett's (1985) Eastern Arc Mountains of Kenya and Tanzania run for 800 km from the Taita Hills in south-east Kenya to the south-western end of the Udzungwa Mountains of southern Tanzania. This is the most northerly part of Moreau's Chain. These mountains are separated from each other by lower, dry country and from the forests of the Albertine Rift by the wide, arid central plateau of

Tanzania. The forested eastern faces of these mountains have been bathed since the Miocene in moist air from the Indian Ocean (mainly the south-east trade winds). Alternating wet and dry periods (pluvials and interpluvials) have led to colonisation followed by isolation and hence speciation on the separate mountain masses. It is the intermediate altitude forest flora with its associated endemic fauna which define the Arc (Lovett 1992).

Davenport (in Scharff *et al.*, 2015) argues for the inclusion of the Southern Highlands of Tanzania in the Eastern Arc, mainly based on the number of vertebrates found on both sides of the Makambako Gap, and the number of endemic species found in the Southern Highlands, to which he rightly draws attention. However, we believe this misunderstands the nature of the Eastern Arc, which is defined by its flora, not its fauna. It is characterised by east facing forests of low to medium elevation on ancient crystalline mountains. These forests are absent from the Southern Highlands. Further, the soils of the Eastern Arc Mountains are leached, the result of millions of years of rainfall. The soils of the Southern Highlands are volcanic (and therefore mineral-rich), the result of ash falls from Mt Rungwe, and are therefore unsuitable for the vegetation of the Eastern Arc. The same applies to Mt Kilimanjaro, which with its east facing forests might otherwise be part of the Eastern Arc.

Figure 3 – View over the South Pare Mountains in 2005, Tanzania. Photo by Colin Congdon.

Figure 4 – View of the Usambara Mountains in 2010, Tanzania. Photo by Julian Bayliss.

There are small amounts of Eastern Arc forest on the Taita Hills in south-eastern Kenya, and the North and South Pare Mountains (Fig. 3) including outlying forested peaks in the Mkomazi Game Reserve such as Ibaya Peak and Maji Kunenua (van Noort & Stone 2000). However, the rich, east facing forests of intermediate altitude really only begin with the Usambara Mountains (Fig. 4).

Patches of Eastern Arc forest exist on the North Nguru or Nguu Mountains (1500 m), but the next large area is the Nguru Mountains, 120 km south-west of the Usambaras. Here, as with the Usambaras, the forests reach down to the coastal plain.

South and slightly east of the Ngurus are the Uluguru Mountains, 70 km across the Mkata Plains. They rise to 2650 m, and at one time were forested to the bottom. Now the lower and intermediate altitude slopes are nearly all under cultivation, but a small area of low elevation forest at Kimboza has been preserved (Fig. 5).

Figure 5 – View over the Uluguru Mountains in 2004, Tanzania. Photo by Colin Congdon.

West of the Ulugurus, and perhaps in their rain shadow, are the Rubeho Mountains (with the Ukagurus). The highest of these is Lugunga Mountain at 2357 m. Like the Pares, they are only forested on the tops and therefore have very little Eastern Arc forest.

Separated from the Rubehos by the gorge of the Great Ruaha River lies the Udzungwa range. (Fig. 6) This great mountain mass rises from the coastal plain and runs 250 km south and west to the Makambako Gap, achieving an altitude of 2576 m (Luhombero Mountain). The eastern flank is forested to the coastal plain at 300 m, providing an unbroken sequence of forest vegetation over the whole altitudinal range of 2200 m. The Arc forests end in Lulanda, in the south-west of the Udzungwas; although there is Eastern Arc forest on Mahenge Mountain, rising out of the Kilombero Valley south of the Udzungwas.

The east facing intermediate elevation forests which define the Eastern Arc Mountains are lacking elsewhere. In Kenya, those in the west (e.g. Kakamega) belong to the Lake Victoria regional mosaic as do the forests of north-western Tanzania. Intermediate elevation forests in western Tanzania are Guineo-Congolean (Kigoma and Mpanda), those in south-western Tanzania (Tukuyu) and Malawi (Chintechi) being Zambezian in origin, and receive

their rain from Lake Malawi. Throughout the region, including the Eastern Arc, forests above about 1800 m are of Undifferentiated Afromontane vegetation (White 1983).

Figure 6 – View of the Kihansi Gorge in 2007 in the Udzungwa Mountains, Tanzania. Photo by Colin Congdon.

3. The Tanzania – Malawi Highlands - extending southwards from and including the Eastern Arc Mountains

A mountain is classified as belonging to the Eastern Arc if it has low to intermediate elevation forest on its eastern flank. It is those forests which are so different from anywhere else. But the Eastern Arc Mountains also have montane grassland and higher elevation forests, classified as Undifferentiated Afromontane forests. This habitat type is present to some extent on all mountains in Moreau's Montane Chain, but most extensively on the Udzungwa Mountains, the Southern Highlands of Tanzania and the Nyika Plateau of northern Malawi and north-east Zambia. The higher elevations are usually drier, and some of the grasslands, as on the Southern Highlands and the Nyika Plateau, are ancient and botanically very rich. It is these higher elevation areas, from the Taita Hills to the Nyika Plateau, that we distinguish as the Tanzania – Malawi Highlands.

Figure 7 – View over the Bundali Hills in 2003 in the Southern Highlands, Tanzania. Photo by Colin Congdon.

The Southern Highlands of Tanzania surround the northern end of Lake Malawi and rise to 2961 m (Mts. Mtorwi and Rungwe) with the Mbeya Range (2834 m) to the north. (Fig. 7). They are linked by the Misuku and Mafinga Hills (2164 m) to the much larger Nyika Plateau (2606 m) west of the Lake. (Fig. 8). The Nyika in turn is far distant from Zomba and Mulanje in the south, now included in the South East Africa Montane Archipelago. Moreau included these southern mountains in his Chain, and for birds there is ample justification for this step. He remarked (p. 212) that of 34 species of (mainly montane) evergreen forest birds reported from Cholo (Thyolo) Mountain in southern Malawi, 29 (85%), were also found on the Usambaras, 800 miles (1300 km) to the north; a convincing case for the validity of the Chain in terms of its bird fauna.

Figure 8 – Ivan Bampton† looking over Manyenjere Forest on the Nyika Plateau in Zambia in 1996. Photo by Colin Congdon.

4. The Eastern Africa Coastal Zone

This is the Zanzibar-Inhambane Regional Forest Mosaic vegetation zone (White 1983). In Kenya and Tanzania, it has been well studied (Kielland 1990, Larsen 1991). Little is known of the butterflies of northern coastal Mozambique, although Bampton and Congdon made a small collection south of the Ruvuma River in 2009, but coastal Mozambique south of the Zambezi is well documented (Pringle *et al.*, 1994, Williams 2024). The butterflies of coastal South Africa, although well studied, fall outside the scope of this paper. The Coastal Zone is bordered to the north by the dry Somali-Masai zone, and inland by higher ground, not least by the Arc. The southern extremity is defined by the start of the winter rainfall zone.

Some of the butterflies of the Coastal Zone are also found at lower elevations in the forested foothills of the Eastern Arc Mountains, but in practice the separation between the Arc and the Coastal Zone is in most cases readily distinguishable. For the purposes of this study, species occurring in coastal forests away from the foothills of the Eastern Arc Mountains are taken to be coastal, even if they also occur in the lower levels of the Arc, while only those that have not been found to stray away from the Arc forests are defined as Eastern Arc butterflies. This definition obviates the difficulties encountered when using elevation to separate montane from coastal species (e.g. Platts *et al.*, 2011). A very few locally endemic species are equally at home in the coastal plain and in mountainous regions inland. These transgressor species are listed separately. Kielland (1990) divided the coastal zone in Tanzania into a northern part, as far south as Dar es Salaam, and a southern part down to the Ruvuma River. Although the

more northerly areas are generally richer in species, we find no clear line of separation between them.

5. The South East Africa Montane Archipelago (SEAMA). The mountains of northern Mozambique and southern Malawi

The SEAMA ecoregion is defined as a range of ancient granitic inselbergs in southern Malawi and northern Mozambique, climatically isolated by topography and trade winds, hosting humid evergreen forest, montane grassland and shrublands notable for their high levels of endemism across multiple taxa (Bayliss *et al.*, 2024). It consists of at least 30 granitic inselbergs found in southern Malawi, such as Mts. Zomba (2087 m) and Mulanje (3002 m); and in northern Mozambique including Mts. Chiperoni (2054 m), Inago (1870 m), Mabu (1710 m), Nallumi (1400 m) and Namuli (2419 m). SEAMA hosts the largest (Mt Mabu) and smallest (Mt Lico) mid-elevation rainforests in southern Africa, as well as biologically unique montane grasslands. Most mountains within the SEAMA were formed ca. 600–126 million years ago (Mya) as a result of igneous, rock-forming batholiths intruding into older, softer metamorphic rocks that subsequently weathered away (Bayliss *et al.*, 2024).

6. The Eastern Highlands of Zimbabwe

The Eastern Highlands of Zimbabwe extend approximately 250 km from Nyanga in the north (with Mt Nyangani, 2592 m) to the Chimanimani (2440 m) and lower Mt Selinda (1234 m) in the south. This range includes forests in the Vumba, Chitoria Hills and Chirinda. The highlands are bordered to the west by the Odzi and Savi Rivers, and to the east by the Mozambique coastal plain. The Zambezi Valley forms a northern biogeographic barrier, while the Savi River cuts across the southern end.

The terrain is rugged, with a mix of montane grasslands, Afromontane and lowland evergreen forests distributed across most of the range. These habitats support a distinct assemblage of flora and fauna, contributing to the region's status as a Centre of Endemism.

7. The Albertine Rift

According to Davenport (2002) there is no clear-cut definition of the Albertine Rift. He states (p.4):

> "The endemic butterflies of the Albertine Rift are those found only within the geographical boundaries north of Lake Albert between Arua and Pakwach (West Nile, Uganda) and extending southward including the Lendu Plateau, the lower reaches of the Kibali and Ituri rivers (Orientale, DRC), the forests of western Uganda and Kigezi (Uganda), north and south Kivu (DRC), western Rwanda and Burundi, Itombwe to Marungu in western Katanga (DRC), western Tanzania (Kigoma and Mpanda regions) and a small part of north east Zambia. The Ufipa Plateau, Mbizi and other highland areas of Rukwa region (Tanzania) are also included."

The northern part of this Centre of Endemism is particularly rich in endemic species. The difficulty, as illustrated by Davenport (2002), is that there are no clearly defined boundaries, leading to varying estimates of the number of endemics. For instance, Plumtre *et al.*, (2016), using a different definition of the Albertine Rift, state that it contains 16% of Afrotropical butterflies, which would make the total for the area of about 710 species. This seems an unrealistically low figure for such a rich and varied area. For instance, Bayliss *et al.*, (2024) estimate that there are 500 endemic butterfly species in an undefined Albertine Rift.

MATERIALS AND METHODS

Butterfly distribution data are according to Gifford 1965, D'Abrera 1980, Kielland 1990, Larsen 1991, Congdon & Collins 1998, and Congdon *et al.*, 2010, together with the authors' unpublished records. Nomenclature and arrangement follow Williams' Digital Encyclopaedia (Williams 2024).

Table 1 – Total number of endemic butterflies for each Centre of Endemism.

Centre of Endemism	Number of endemics	Notes
Northern Highlands	9	butterflies confined to the (mainly volcanic) mountains of northern Tanzania
Eastern Africa Coastal Zone	35	butterflies confined to the Zanzibar – Inhambane Coastal Forest Moasaic
Eastern Arc Mountains	45	endemic butterflies found only in the east facing medium-altitude forests of the Eastern Arc Mountains
Tanzania-Malawi Highlands	58	endemic butterflies found only in the Afromontane forests and grasslands, which includes 43 from the Eastern Arc Mountains found above the east facing medium-altitude forests
		Total Tanganyika-Nyasa Montane Chain = 103
South East Africa Montane Archipelago	31	endemic butterflies found mainly in the Afromontane forests and grasslands
Eastern Highlands of Zimbabwe	15	
Albertine Rift	113	This is certainly an underestimate, as already mentioned.

Butterflies endemic to each Centre of Endemism are listed in the Appendix. Totals are summarised in Table 1. The area under study includes most of the Zanzibar-Inhambane Vegetation Zone (White 1983), and the mountains which rise to the west of it. These extend from the south-east of Kenya through to eastern Zimbabwe, and the Albertine Rift. Coastal butterflies which transgress up into the nearby highlands are listed separately. We examine the butterfly fauna of Moreau's Tanganyika-Nyasa Montane Chain, identifying the butterflies endemic to it, and placing them

into several Centres of Endemism. We then consider the biogeography of the butterfly Centres of Endemism in eastern Africa as a whole. We follow a more descriptive approach in identifying Centres of Endemism and base these on our species checklists.

RESULTS

Zonal Endemism

Distribution of Endemic species on the Montane Chain (Excluding SEAMA)

The Taita Hills and Pare Mountains do not appear to be particularly species rich, perhaps due to a paucity of east facing medium elevation forest.

The Rubeho Mountains are only separated from the Udzungwas by the Ruaha Gorge, so it is not surprising that of the 21 Chain endemics on the Rubehos, all but the four single site endemics are found in the Udzungwas. Thus, for biogeographical purposes we include them with the Udzungwas.

The Udzungwas are pivotal. They have as many species in common with the Southern Highlands and northern Malawi as with the Eastern Arc Mountains. These are different faunas. This is shown quite clearly in Table 2. The Southern Highlands have no Eastern Arc endemic butterfly species, as they lack the east facing intermediate altitude forest which characterises the Eastern Arc Mountains. The forests above 1800 m are Undifferentiated Afromontane, while those on the western slopes are Zambezian in origin.

Table 2 – **Distribution of endemic species.**

	Tanzania-Malawi Highlands	Eastern Arc	Chain total
Taita Hills	-	2	2
Pare Mts	3	1	4
Usambara Mts	11	20	31
Nguru Mts	10	19	29
Uluguru Mts	17	13	30
Udzungwa Range	26	18	44
Rubeho Mts	18	3	21
Southern Highlands	28	-	28
Nyika	26	-	26

The northern Malawi highlands have very few Chain endemic species in common with SEAMA to the south, so the SEAMA mountains do not connect to the Tanzania-Malawi Highlands. This disjunction may be due to the wide geographical separation of these areas. This is approximately 500 km, and although there are intermediate highlands in the Viphya and Dedza areas, they are either lower and dryer or small in extent.

The links in the Chain are the individual mountain blocks within the two Centres of Endemism. The connections between the links are the endemic species they share with each other (shared endemism). For the many endemic species which are present on one link only, i.e. one mountain only, see Appendix.

Table 3 – **Distributions of shared endemic species, within the Chain, from Southern Kenya to Northern Malawi.** [The number of species which are Chain endemics, but occur on more than one mountain, so their distributions are shared between mountains in the Chain].

	Northward shared endemic species	North and south shared endemic species	Southward only shared endemic species
Taita Hills			1
Pare			3
Usambara	1	2	16
Nguru	5	10	6
Uluguru	3	10	8
Udzungwa	10	15	11
S. Highlands	6	14	4
Nyika	20		

Note: totals do not include endemic species which are only known from a single mountain, as these are not shared between mountains.

DISCUSSION

Effects of Extensions

All of the neighbouring butterfly Centres of Endemism have appreciably more endemic species than near endemics which also occur on the Eastern Arc and Tanzania-Malawi Highlands. This shows clearly that the neighbouring Centres of Endemism have distinct faunas (Table 1). Note: a near endemic is a species which would become endemic if the area were to be extended, as distinct from a shared endemic, which is a species which occurs on more than one mountain in the same Centre of Endemism.

Davenport (2002) points out that the number of endemic butterflies in the Albertine Rift is greatly increased if the study area is extended to include for instance the neighbouring Lake Victoria Regional Mosaic. In the case of Moreau's Montane Chain, extensions add relatively few species.

For example, seven species are Northern Highlands' endemics. Two species occur on the Northern Highlands and on the Chain, but nowhere else. These are the near endemics. Since they occur on both, they cannot be endemic to either, but if the Chain were extended to include the Northern Highlands, these two species would become endemic to the enlarged area, resulting in an addition of nine species to the Chain (Table 4).

Moreau also included the mountains of southern Malawi in his Tanganyika-Nyasa Montane Chain. While he was correct to include them from an avian perspective, the butterfly fauna now suggests that they belong in a zone consisting of mountains east of the Rift Valley and north of the Zambezi River, the South East Africa Montane Archipelago (Bayliss *et al.*, 2024). If the revised Chain were to be extended to include these mountains, just three species would become endemic to the enlarged area, in addition to the 31 SEAMA endemics.

Table 4 – **The effect of enlarging the Chain to include neighbouring Centres of Endemism.**

Zone	Endemics	Shared Endemics	Total added to the Chain
Northern Highlands	7	2	9
Albertine Rift	113	1	114
South East Africa Montane Archipelago	31	3	34
Eastern Highlands	15	1	16
Eastern Africa Coastal Zone	33	2	35

The status of Mts. Mecula, Jao/Yao (Congdon & Bayliss 2012) and the Njesi Plateau in northern Mozambique is uncertain. The presence of *Neocoenyra fulleborni* Thurau, 1903 on Jao is a link to the TM Highlands. This species also occurs in the Matengo Hills just across the border in Tanzania. There are species of *Baliochila* on Mecula and Jao, and these might provide a link to the Eastern Arc Mountains, while the presence of *Leptomyrina congdoni* Bayliss *et al.*, 2019 on Mecula links this mountain to the South East Africa Montane Archipelago. Extending Moreau's Chain still further south would include the Eastern Highlands of Zimbabwe, south of the Zambezi River. In terms of butterfly biogeography these belong to the Cape Sub-Region (Larsen 2005), but inclusion of this area in the Chain would increase the total of shared endemics by one species (*Issoria smaragdifera* (Butler, 1895)). This large and isolated area of forest and moorland also holds a further 15 locally endemic species, so adding it would increase the Chain total by 16.

Of the endemic species of the Eastern Africa Coastal Zone, only two are also present at medium to higher altitudes inland: *Iolaus (Philiolaus) maritimus* Stempffer & Bennett, 1958 and *Iolaus (Epamera) mermis* (Druce, 1896).

It therefore appears that extensions to the core areas of the Eastern Arc Mountains and Tanzania – Malawi Highlands, while they may be rich in endemic species of their own, do not have many endemics in common with them. This contrasts with the core areas themselves, where individual mountain blocks, the links in the chain, have large numbers of shared endemic butterfly species in common (see Appendix).

Biogeographical Considerations: Origins of the Butterfly Fauna

The relatively large number of endemic species in the Eastern Africa Coastal Zone may result from long isolation, given the apparent uniformity of the terrain and climate. They do not appear to be direct vicariants of western butterflies, nor are they obviously descended from nearby montane stock. Possibly the answer lies in their great antiquity. As an indication of this, three genera, *Euthecta*, *Eresinopsides* and *Congdonia* are endemic to the Eastern Africa Coastal Zone.

The high numbers of endemic species in the Eastern Arc Mountains should be no surprise, given the age and isolation of the environment, and the biological richness of the forests. The importance attached to conservation measures in these forests is fully justified.

The large number of Tanzania-Malawi Highland (Afromontane) endemics may be accounted for by much the same factors as apply to the Eastern Arc Mountains. The mountains of these Highlands are at least as old as the Rift Valley, some 20 million years. Endemism in the forests is to some extent augmented by some speciation in the highland grasslands e.g. *Lepidochrysops nyika* Tite, 1961. The genus *Uranothauma* Butler 1895 may well have arisen at high levels in these mountains. Kielland (1990) pointed out that of the 20 species of *Uranothauma* known at that time, 18 occur in Tanzania; seven of these are Tanzania-Malawi Highlands endemics.

Aspects of Conservation

The information presented above makes it easier to prioritise the various mountains and Centres of Endemism in terms of the conservation needs of the butterflies. From a conservation point of view, every endemic species is important. As every link (mountain block) in Moreau's Chain has at least one species endemic to it alone, all should be protected. But in terms of priorities, the greatest numbers in need of protection are in the Usambara, Nguru, Uluguru and Udzungwa Mountains, and the highlands of Malawi.

In the Eastern Arc Mountains, some international attention is focused on the Usambaras, and forest reserve boundaries are generally respected. Outside of the reserves the tea estates provide protection for some smaller forest patches. Population pressures in the Ulugurus are high, but again forest reserve boundaries are generally respected, at least in terms of encroachment for cultivation. The situation in the Ngurus on the other hand is bordering on tragic. Cultivation encroachment on the forests at intermediate elevations is apparently uncontrolled and is proceeding rapidly. In 1999, we found the previously unknown male of *Ornipholidotos nguru* Kielland, 1987 in an area of closed-canopy evergreen rain forest. The following year the area was a maize field. As this study has shown, the Ngurus are one of the four core areas of endemism in the Eastern Arc. If current trends continue, these forests will soon cease to exist. Montane forests on the Rubehos are also being cleared for cultivation.

In the Tanzania- Malawi Highlands, most of the Northern Malawi endemic species enjoy protection in the Nyika National Park. In Tanzania, the Udzungwa National Park provides similar protection, and recent investigations have shown that most of the Udzungwa endemic species occur within the park boundaries. It is hoped that this examination of the status and distributions of endemic butterflies will be of help to land use planners and conservationists in identifying areas most in need of protection to safeguard biodiversity.

CONCLUSIONS

Analysis of the distributions of butterflies endemic to Moreau's Tanganyika-Nyasa Montane Chain shows that they belong to three largely distinct faunas. The butterflies

of the southern part of the chain are found to belong to SEAMA. In the northern part of the Chain, butterflies inhabiting the east facing medium altitude forests of the Eastern Arc Mountains, are separate from those of the higher elevation Undifferentiated Afromontane forests and associated grasslands of the Tanzania-Malawi Highlands, which extend as far south as the Nyika Plateau.

From the Appendix, of the 42 Chain endemic species on the Udzungwas, 19 are Tanzania-Malawi Highland butterflies which also occur on the Southern Highlands. This suggests that the so-called Makambako Gap at the end of the Eastern Arc Mountains is no barrier to the spread of high altitude species. In fact a 'gap' suggests a space between, but in the case of the Eastern Arc forests, there is no 'beyond'. The Makambako Gap between the Udzungwas and the Southern Highlands has never seemed to constitute an effective ecological barrier, being nothing more than a saddle between the Udzungwas and the Southern Highlands, far less of a barrier than, say, the gap between the Usambaras and the Ngurus. This study demonstrates that as far as butterflies are concerned there is no barrier: the butterflies of the Undifferentiated Afromontane forests and associated grasslands, the Tanzania-Malawi Highland butterflies, cross it without difficulty. The reason there are no endemic Eastern Arc butterflies on the Southern Highlands and in northern Malawi is that these highlands lack the east facing medium altitude forests, which define the Eastern Arc Mountains. The butterflies which do cross the Makambako Gap are high altitude species found within the higher altitude Undifferentiated Afromontane forests and associated grasslands.

There is an interesting parallel here with recently discovered species of primates in southern Tanzania. The Sanje crested mangabey *Cercocebus sanjei* Mittermeir, 1986 occurs at low to medium elevations on the eastern flank of the Udzungwas (Butynski *et al.*, 2013). This makes it an Eastern Arc endemic. Another primate, the recently discovered 'Kipunji' *Rungwecebus kipunji* Davenport *et al.*, 2006 has been found at high elevations in the Udzungwas and on Mt Rungwe in the Southern Highlands (Butynski *et al.*, 2013) and is therefore a Tanzania-Malawi Highland species. The separation of the Coastal Zone from the Eastern Arc is perhaps more arbitrary. Nevertheless, there is a rich coastal fauna, and much of it is endemic.

In terms of the butterflies, the two overlapping Centres of Endemism (the Eastern Arc and the T–M Highlands) provide a continuum of distributions of endemic species from end to end (Table 3). The highlands to the north and south are shown to be separate.

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LITERATURE CITED

BAYLISS, J., BITTENCOURT-SILVA, G.B., BRANCH, W.R., BRUESSOW C., COLLINS, S.C., CONGDON, T.C.E., CONRADIE, W., CURRAN, M., DANIELS, S., DARBYSHIRE, I., FAROOQ, H., FISHPOOL L., GRANTHAM, G., MAGOMBO, Z., MATIMELE, H., MONADJEM A., MONTEIRO, J., OSBORNE, J., SAUNDERS, J., SMITH, P., SPOTTISWOODE C., TAYLOR P., TIMBERLAKE, J., TOLLEY, K.A., TOVELA, E., & PLATTS, P. J. 2024. The South East Africa Montane Archipelago (SEAMA) – a biogeographical appraisal of a threatened ecoregion. *Scientific Reports* **14**: 5971. https://doi.org/10.1038/s41598-024-54671-z

BUTYNSKI T.M., KINGDON, J. & KALINA, J. [eds.] 2013. *Mammals of Africa II*. Bloomsbury Press, London. 560 pp.

COLLINS, S.C., BAMPTON, I & CONGDON, T.C.E 2006. *An Overview of the butterfly faunas of the Eastern Arc Mountains and Coastal Forests: biodiversity, endemism, conservation*. Report for the Critical Ecosystems Partnership Fund. CEPF, Washington DC. 43 pp.

CONGDON, T.C.E. & BAYLISS, J.L. 2012. Butterflies of Mt Mecula and Mt Yao, Niassa Province, Northern Mozambique. *Metamorphosis* **23**: 26–34. https://doi.org/10.4314/met.v23i1.5

CONGDON, T.C.E., & COLLINS, S.C 1998. *Kielland's Butterflies of Tanzania supplement*. Nairobi and Tervuren, A.B.R.I. and Lambillionea. 143 pp.

CONGDON, C., COLLINS, S. & BAYLISS J. 2010. Butterflies of south east Africa's mountains (Mozambique and Malawi). *Metamorphosis* **21**(2): 45-107.

D'ABRERA, B. 1980. *Butterflies of the Afrotropical Region*. Hill House, London and Melbourne. 593 pp.

DAVENPORT, T.R.B. 2002. Endemic butterflies of the Albertine Rift – an annotated checklist. Wildlife Conservation Society, New York. 14 pp.

GIFFORD, D. 1965. *Butterflies of Malawi*. The Society of Malawi, Lilongwe. 151 pp.

JONG R. de & CONGDON, T.C.E. 1993. The Montane Butterflies of the Eastern Afrotropics. pp. 133-172. *In:* Lovett, J.C. & Wasser, S. [eds.]. *Biogeography and Ecology of the Rain Forests of Eastern Africa.* Cambridge University Press, Cambridge. https://doi.org/10.1017/CBO9780511895692.008

KIELLAND, J. 1990. *Butterflies of Tanzania*. Hill House, London and Melbourne. 363 pp.

LARSEN, T.B. 1991. *The Butterflies of Kenya and their natural history*. Oxford University Press, Oxford. 512 pp.

LARSEN, T.B. 2005. *Butterflies of West Africa, Volumes 1 & 2*. Apollo Books, Stenstrup. 865 pp. https://doi.org/10.1163/9789004531093

LOVETT, J. 1985. Moist forests of eastern Tanzania. *Swara* **8**: 8–9.

LOVETT, J.C. 1992. *Classification and affinities of the Eastern Arc moist forests of Tanzania*. School of Agriculture and Forest Sciences, Univ. of Wales, Bangor. 365 pp.

LOVETT, J.C. & WASSER, S.K. 1993. *Biogeography and Ecology of the Rain Forest of Eastern Africa.* Cambridge University Press, Cambridge. 341 pp. https://doi.org/10.1017/CBO9780511895692

MOREAU, R.E. 1966. *The bird faunas of Africa and its islands*. Academic Press, New York and London. 425 pp.

MYERS, N., MITTERMEIER, R.A., MITTERMEIER, C.G., DA FONESCA, G.A.B. & KENT, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* **403**: 853–858. https://doi.org/10.1038/35002501

OLSON, D.M. & DINERSTEIN, E. 1998. The Global 200: A representation approach to conserving the Earth's most biologically valuable ecoregions. *Conservation Biology* **12**: 502–515. https://doi.org/10.1046/j.1523-1739.1998.012003502.x

PLATTS, P.J., BURGESS, N.D., GEREAU, R.E., LOVETT, J.C., MARSHALL, A.R., McCLEAN, C.J., PELLIKKA, P.K.E., SWETNAM, R.D. & MARCHANT, R. 2011. Delimiting tropical mountain ecoregions for conservation. *Environmental Conservation* **38**: 312–324. https://doi.org/10.1017/S0376892911000191

PLUMTRE, A.J., AYEBARE, S., SEGAN, D., WATSON, J. & KUJIRAKINJA, D. 2016. Conservation Action Plan for the Albertine Rift. Wildlife Conservation Society, New York. 77 pp.

PRINGLE, E. L. L., HENNING, G. A. & BALL, J. B. [eds.]. 1994. *Pennington's Butterflies of Southern Africa, 2nd Edition*. Struik, Cape Town. 800 pp.

SCHARFF, N., ROVERO, F., JENSEN, F.P. & BRØGGER-JENSEN, S. [eds.]. 2015. *Udzungwa: Tales of Discovery in an East African Rainforest*. Natural History Museum of Denmark, Copenhagen. 177 pp.

VAN NOORT, S. & STONE, G. 2000. Species richness, Biogeography, Conservation and Pollination ecology of Butterflies (Lepidoptera: Hesperoidea & Papilionidea) in Mkomazi Game Reserve, Tanzania Metamorphosis **11**: 77–103.

WHITE, F. 1983. *The Vegetation of Africa*. UNESCO, Paris. 356 pp.

WILLIAMS, M.C. 2024. Checklist of the Afrotropical Butterflies. Lepidopterists Society of Africa. https://metamorphosis.org.za/?p=articles&s=atb

APPENDIX

Zonal and Subzonal Endemism

Butterflies endemic to each Centre of Endemism are listed. Totals are summarised. For each species, distribution within Moreau's Tanganyika – Nyasa Montane Chain and neighbouring zones is shown, together with known altitude range and preferred habitat. Where coastal butterflies occur in the foothills of Arc Mountains, this is shown. Coastal butterflies which transgress into the nearby highlands are listed separately. Species which are essentially high altitude Tanzania-Malawi Highland butterflies, but whose range extends onto the tops of the Arc Mountains are shown separately.

Key to Distributions:

1 Northern Highlands
2 Eastern Africa Coastal Zone
3 Taita Hills
4 Pare Mts
5 Usambaras
6 Nguru - including N. Nguru or Nguu
7 Uluguru
8 Udzungwa
9 Rubeho – including Ukaguru
10 Southern Highlands of Tanzania
11 Northern Malawi – Eastern Zambia (Vipya, Nyika to Misuku, Mafingas)
12 South East Africa Montane Archipelago
13 Eastern Highlands of Zimbabwe
14 Albertine Rift

Table A1 – Altitudinal range of distributions.

1	0 – 400 m
2	400 – 800 m
3	800 –1200 m
4	1200 –1600 m
5	1600 –2000 m
6	2000 m+
()	Occasionally – based on Kielland (1990)

Table A2 – Habitat types.

F	Forest
Fm	Forest margins
R	Riverine forest
W	Woodland
Oh	Open habitats
S	Swamp
?	Uncertain, based on Kielland (1990)

Table A3 – NORTHERN HIGHLANDS.

	Distribution	**Altitude**	**Habitat**
Papilio sjoestedti Aurivillius, 1908	1	5,6	F
Alaena ferrulineata Hawker-Smith, 1931	1	3-5	Oh
Mimacraea marginata Libert, 1999	1	-	W
Baliochila pseudofragilis Kielland, 1976	1	4	W, Fm
Uranothauma kilimensis Kielland, 1985	1	6	Oh
Lepidochrysops kilimanjarensis (Strand, 1909)	1	-	-
Cymothoe collinsi Rydon, 1981	1	5	F
Total number of endemics = 7			
Transgressors to the Chain:			
Papilio hornimani Distant, 1879	1,3,4,8	2-6	F
Neptis aurivillii Schultze, 1913	1,3,4,5,6,7,8,9,10,11	3-6	F

Table A4 – COASTAL ZONE.

	Distribution	**Altitude**	**Habitat**
Graphium kirbyi (Hewitson, 1872)	2,5,6,7	1,2	F
*Graphium philonoe** (Ward, 1873)	2,5,6,7	1,2	F,W
Gorgyra diva Evans, 1937	2,6,7	1-4	F,Fm,W
Mylothris talboti Berger, 1980	2,6,7,8	1-3(4)	F
Axiocerses collinsi Henning & Henning, 1996	2	1-3	W,Oh
Axiocerses styx Rebel, 1905	2,6,7	1,2	F
Deloneura abri Congdon & Collins, 1998	2	1	W
Pentila rogersi (Druce 1907)	2	1,2	F
Pentila rondo Kielland, 1990	2	3	F
Teriomima micra (Grose-Smith, 1898)	2	1-3	F
Teriomima parva Hawker-Smith 1933	2,5,6,7	1-3	F,R,W
Teriomima subpunctata (Kirby, 1887)	2,5,6,7,8	1-3	F
Teriomima sp. nov. (Zanzibar)	2	1	F
Baliochila amanica Stempffer & Bennett 1953	2,3,5,6,7,8	1-3	F
Baliochila collinsi Henning & Henning, 2004	2	3	F
Baliochila fusca Henning & Henning, 2004	2	3	Fm
Baliochila latimarginata Hawker-Smith, 1933	2,5,7,8	1,2	F
Baliochila lequeuxi Kielland, 1994	2	1	F
Baliochila minima Hawker-Smith, 1933	2	1,2	F
Baliochila stygia Talbot, 1937	2	1,2	F
Congdonia duplex Henning & Henning, 2004	2	3	Fm
Eresinopsides bamptoni Henning & Henning, 2004	2	3	F
Eresinopsides bichroma Strand, 1911	2,5,6,7	1-3	F
Monile kimboza (Kielland, 1990)	2,7	1,2	F,W
Acraea (Acraea) matuapa Grose-Smith, 1889	2	-	-
Acraea (Actinote) aubyni (Eltringham 1912)	2	1,2	F
Hypolimnas usambara (Ward, 1872)	2,5,6,7,8	1-3	F
Pseudathyma lucretioides Carpenter & Jackson, 1950	2,12	1,2	F
Neptis rogersi Eltringham, 1921	2	1	F
Eriboea pembanus Jordan, 1925	2	1	Fm
Eriboea contrarius van Someren, 1969	2,5,6,7,8	1,2	F,R,W
Charaxes lasti Grose-Smith, 1889	2,5,6,7	1,2	F
Bicyclus kiellandi Condamin, 1986	2,8	2-4	Oh
Coenyropsis carcassoni Kielland, 1976	2	1-3	W,Oh
Physcaeneura jacksoni Carcasson, 1961	2,4,6,8,9	1-4	Fm,W
Total number of endemics = 35			
Transgressors to the Chain:			
Iolaus (Philiolaus) maritimus Stempffer & Bennett, 1958	2,5,6,8,9,10	1-6	F, Fm
Iolaus (Epamera) mermis (Druce, 1896)	2,8	1-4	F

*It is very probable that *Graphium philonoe whallei* (Talbot, 1929) from western Ethiopia, Sudan, northern Uganda and north-western Kenya is a separate species. We treat it as such.

Table A5 – EASTERN ARC MOUNTAINS.

	Distribution	Altitude	Habitat
Apallaga kimboza (Evans, 1949)	7	1	F
Apallaga cordeironis (Kielland, 1992)	5	3	F
Apallaga sanjeensis (Kielland, 1990)	8	2	F
Apallaga uluguru (Kielland, 1990)	7	4,5	F
Ceratrichia bonga Evans, 1947	5,7	2,3	F
Astictopterus tura Evans, 1951	6,8	1-4	Fm
Chondrolepis uluguru Larsen & Congdon, 2012	7	4	F
Artitropa usambarae Congdon *et al.,* 1998	5,6,7	3	F
Mylothris pluviata Berger, 1980	6	3-6	F
Mylothris superbus Kielland, 1985	6,8	3,4	F
Aslauga tanga Libert and Collins, 1997	5,6	3,4	F
Lachnocnema unicolor Libert, 1996	6	4	F?
Axiocerses kiellandi Henning and Henning, 1996	6,8	3,4	F,Fm
Ornipholidotos nguru Kielland, 1987	6	4	F
Euthecta cordeiroi Henning & Henning, 2004	5	3	F
Baliochila abri Henning & Henning, 2004	8	3	F
Baliochila citrina Henning & Henning, 2004	7	4	Fm
Baliochila congdoni Kielland, 1990	6	4	F
Baliochila megadentata Henning & Henning, 2004	8	3	F
Baliochila mwanihanae Congdon *et al.,* 1998	8	3	F
Baliochila nguru Kielland, 1986	6	4	F
Baliochila pringlei Stempffer, 1967	5	3	F,Fm
Baliochila warrengashi Collins and Larsen, 1996	5	3	F,Fm
Mimacraea gelinia (Oberthur, 1893)	5,6,8	3,4	F
Deudorix (Virachola) vansomereni (Stempffer, 1951)	3,5	3-5	F
Pilodeudorix namukana Libert, 2004	6	3	F
Capys usambarae Congdon & Collins, 1998	5	3	Oh
Etesiolaus pinheyi Kielland 1986	5,7,8	1-3	F
Cymothoe amaniensis Rydon, 1980	5	3	F
Cymothoe aurivillii Staudinger, 1899	7,8,9	(3)4-6	F
Cymothoe teita van Someren, 1939	3	2-4	F
Pseudathyma uluguru Kielland, 1985	5,6	4-6	F
Acraea (*Acraea*) *punctimarginea* Pinhey, 1956	5,7	1	F
Acraea (*Acraea*) *bergeriana* Pierre, 1979	7,8	1-6	F
Acraea (*Acraea*) *rohlfsi* Suffert, 1904	5	3,4	F
Acraea (Actinote) vuilloti (Mabille, 1889)	5,6,7,8,9	3-6	F
Sevenia pseudotrimeni (Kielland, 1985)	4,7,8	3,4(5)	F
Hypolimnas antevorta (Distant, 1880)	5	3	F
Eriboea mccleeryi (van Someren, 1972)	7,8	2-6	F
Eriboea usambarae (van Someren & Jackson, 1952)	5,6	3-5(6)	F
Eriboea mtuiae (Collins *et al*., 2017)	8	2,3	F
Charaxes lucyae van Someren, 1975	5,6,8	3-5	F
Charaxes phenix Lequeux and Turlin, 1993	6,8	3	F
Bicyclus danckelmani (Rogenhofer, 1891)	5,6,8,9	3,4(5)	F
Neocoenyra jordani Rebel, 1906	6	3,4	F
Total number of endemics Eastern Arc Subtotal = 45			

Table A6 – EASTERN ARC MOUNTAINS. [Higher altitude species, which are essentially Tanzania-Malawi Highlands butterflies, but which occur on the tops of Eastern Arc Mountains].

	Distribution	Altitude	Habitat
Papilio fulleborni Karsch, 1900	4,5,6,7,8,9,10,11	3-6	F
Papilio pelodurus Butler, 1895	5,6,7,8,9,10,11,12	(1)2-5	F
Papilio thuraui Karsch, 1900[(2)]	8,10,11	4-6	Fm,Oh
Apallaga rubeho (Kielland, 1990)	9	5	Fm
Metisella congdoni de Jong and Kielland, 1983	8,10	(4)5	F
Metisella decipiens (Butler, 1896)	8,10,11	3-5	F,Oh
Metisella sp. aff. *medea* Evans, 1937	8,10	6?	Fm
Willema sp. aff. *willemi* (Wallengren, 1857)	9	5	W
Chondrolepis obscurior de Jong, 1986	7,8,10	5,6	F

Chondrolepis similis de Jong, 1986	8	4-6	F
Mylothris crawshayi Butler, 1896	7,8,9,10,11	4-6	F,Fm
Mylothris kiellandi Berger, 1985	5	5,6	F
Cigaritis collinsi (Kielland, 1980)	5	5,6	F
Pilodeudorix rodgersi Kielland, 1985	6,7,8,9	5,6	F
Iolaus (Epamera) congdoni (Kielland, 1985)	7,8,9,10,11	5,6	Fm
Iolaus (Philiolaus) uluguru Safian, 2022	7	6	F
Iolaus (Epamera) dubiosa Stempffer & Bennett, 1959	5,6,7,8,9,11	5,6	Fm
Uranothauma crawshayi Butler, 1895	8,10,11	5,6	F,R
Uranothauma cuneatum Tite, 1958	6,7,8,9,10,11	5,6	Fm
Uranothauma lukwangule Kielland, 1987	7	6	F
Uranothauma nguru Kielland, 1985	6	6	F
Uranothauma uganda Kielland, 1981	7	6	F
Uranothauma usambarae Kielland, 1980	5	5,6	F
Uranothauma williamsi Carcasson, 1961	5,6,7,8,9,10,11	4-6	F,Fm
Harpendyreus berger Stempffer, 1976	7	6	S
Tuxentius ertli (Aurivillius, 1907)	5,6,7,8,9,10,11,12	3-6	F
Lepidochrysops kennethi Kielland, 1986	8	5	W
Anthene montana Kielland, 1990	7	5,6	F
Anthene bamptoni Libert, 2010	5,6	5	F
Anthene uzungwae Kielland, 1990	8,10,11	5,6	Fm
Cymothoe magambae Rydon, 1980	4,5,6	5,6	F
Neptis incongrua Butler, 1896	7,8,9,10,11,12	4-6	F
Acraea (Acraea) scalivittata (Butler, 1896)	8,9,10,11	5,6	F
Eriboea chunguensis (White and Grant, 1986)	9	5,6	F
Eriboea congdoni (Collins, 1989)	8,10	5,6	F
Bicyclus pareensis Collins & Kielland, 2008	4	5	F
Bicyclus simulacris Kielland, 1990	7,8,9,10,11	(3)4-6	F
Bicyclus uzungwensis Kielland, 1990	8,9	5,6	Fm
Neocoenyra fuligo Kielland, 1990	9	6	Oh
Neocoenyra heckmanni Thurau, 1903	8,9,10	(4)5,6	Fm
Neocoenyra parallelopupillata Karsch, 1897	5	6	F
Number of endemics: subtotal shared with T-M Highlands = 41 **Total number of endemic species on the Eastern Arc = 86**			

(2)*Sensu* Kielland (1990)

Table A7 – TANZANIA - MALAWI HIGHLANDS.

	Distribution	**Altitude**	**Habitat**
Willema perexcellens (Butler, 1896)	10,11	5,6	Oh
Alaena sp. nr *reticulata* Butler, 1896	11	6	Fm
Axiocerses nyika Henning & Henning, 1996	11	5,6	F?
Iolaus (Epamera) helenae Henning & Henning, 1989	11	6	F
Iolaus (Philiolaus) stewarti (Heath, 1985)	10,11	5,6	W
Iolaus (Philiolaus) bundali Safian & Congdon, 2022	10	5,6	Oh
Iolaus (Philiolaus) njombe Safian, 2022	10	5	F
Harpendyreus hazelae Stempffer, 1973	11	4	S
Harpendyreus juno (Butler, 1895)	10,11	4-6	F,Oh,S
Lepidochrysops nyika Tite, 1961	11	5,6	Oh
Cymothoe cottrelli Rydon, 1980	10,11	5,6	F
Eriboea nyikensis van Someren, 1975	11	6	F
Charaxes dowsetti Henning, 1989	11	6	F,R
Neocoenyra mittoni Pinhey, 1956	10	6	Oh
Neocoenyra petersi Kielland, 1990	10	6	Oh
Subtotal of T-M Highlands endemics = 15 **Subtotal of shared endemics with E Arc = 43** **Total number of endemic species on the T-M Highlands = 58** **Total endemics for Tanganyika-Nyasa Montane Chain = 103**			

Table A8 – SOUTHEAST AFRICA MONTANE ARCHIPELAGO.

	Distribution	Altitude	Habitat
Mylothris similis Lathy, 1906	12	-	F
Afriodinia lico Bayliss, *et al*., 2022	12	3	F
Axiocerses bamptoni Henning & Henning, 1996	12	5	F
Alaena ochracea Gifford, 1965	12	5,6	W
Alaena lamborni Gifford, 1965	12	4	W
Cooksonia aliciae Talbot, 1935	12	-	W
Baliochila woodi Riley, 1943	12	?	F
Baliochila sp. nov. nr *woodi* (Mt. Mabu)	12	4	F
Baliochila nyasae Stempffer & Bennett, 1953	12	-	W
Baliochila sp. (Mt. Mangochi)	-	-	-
Mimacraea costleyi Druce, 1912	12	-	W
Iolaus (Epamera) malaikae Bayliss *et al.,* 2016	12	4,5	F
Iolaus (Epamera) handmani Gifford, 1965	12	3	W
Iolaus (Argiolaus) (Mt. Mabu)	12	4,5	F
Iolaus (Philiolaus) collinsi Safian *et al.,* 2022	12	4,5	F
Iolaus (Philiolaus) sp. aff. *stewarti* (Zomba Mt.)	12	-	-
Leptomyrina congdoni Bayliss *et al.*, 2019	12	4,5	Oh
Uranothauma confusa Kielland, 1989	12	6	F
Uranothauma (Mt. Namuli)	12	5	F
Lepidochrysops delicata (Bethune-Baker, [1923])	12	-	-
Lepidochrysops neavei (Bethune-Baker, [1923])	12	-	-
Neptis neavei Rothschild, 1918	12	-	F
Neptis collinsi Richardson, 2020	12	-	F
Cymothoe baylissi van Velsen, *et al.,* 2916	12	4,5	F
Cymothoe melanjae Bethune-Baker, 1926	12	4-6	F
Cymothoe zombana Bethune-Baker, 1926	12	5	F
Cymothoe (Mt. Mangochi)	12	3	F
Acrae (Actinote) sp. aff. *ansorgei*	12	-	F
Eriboea margaretae (Rydon, 1980)	12	3-5	F
Eriboea martini (van Someren, 1966)	12	4	R
Bicyclus sp. (Mt. Mabu)	12	4	F
Total number of endemics = 31			
Transgressors to the Chain:			
Papilio pelodurus Butler 1895	5,6,7,8,9,10,11,12	(1)2-5	F
Neptis incongrua Butler 1896	7,8,9,10,11,12	4-6	F
Tuxentius ertli Aurivillius 1907	5,6,7,8,9,10,11,12	3-6	F

Table A9 – EASTERN HIGHLANDS.

	Distribution	Altitude	Habitat
Mylothris carcassoni van Son, 1948	13	5	F
Aloeides mullini Henning and Henning, 1996	13	6	Oh
Mimacraea neokoton Druce, 1907	13	4	?W
Hypolycaena tearei Henning, 1981	13	3	F
Lepidochrysops barnesi Pennington, 1953	13	5,6	Oh
Lepidochrysops coxii Pinhey, 1945	13	6	Oh
Lepidochrysops inyangae Pinhey, 1945	13	6	Oh
Lepidochrysops ruthica Pennington, 1953	13	6	Oh
Lepidochrysops violetta Pinhey, 1945	13	4,5	Oh
Cymothoe vumbui Bethune-Baker, 1926	13	6	F
Neptis swynnertoni Trimen, 1912	13	6	F
Eriboea alpinus (van Someren and Jackson, 1957)	13	6	F
Acraea (Acraea) pseudatolmis Eltringham, 1912	13	5,6	Oh
Pseudonympha arnoldi van Son, 1941	13	6	Oh
Pseudonympha cyclops van Son, 1955	13	6	Oh
Total number of endemics = 15			
Transgressor to the Chain:			
Issoria smaragdifera (Butler 1895)	8,9,10,11,13	4-6	Oh

Table A10 – ALBERTINE RIFT.

	Distribution	Altitude	Habitat
Graphium gudenusi Rebel, 1911	14	5	F
Papilio leucotaenia Rothschild, 1908	14	6	F
Papilio ufipa Carcasson, 1961	14	3-6	F
Apallaga hecqui (Berger, 1976)	14	-	F
Apallaga kivuensis (Joicey & Talbot, 1921)	14	4-6	F
Metisella alticola Aurivillius, 1925	14	3-6	F
Willema carsoni (Butler, 1898)	14	5-6	F
Astictopterus bruno Evans, 1937	14	4-6	Oh
Gretna bugoma Evans, 1947	14	-	F
Parosmodes onza Evans, 1956	14	-	F
Acleros neavei Evans, 1937	14	5-6	F
Andronymus bjornstadti Congdon, *et al*., 1999	14	3	F
Chondrolepis cynthia Evans, 1936	14	3-5	F
Platylesches fosta Evans, 1937	14	-	F
Zenonia crasta Evans, 1937	14	-	F
Mylothris alberici Dufrrane, 1940	14	4	F
Mylothris celisi Berger, 1981	14	-	F
Mylothris croceus Butler, 1896	14	4	F
Mylothris mafuga Berger, 1981	14	4	F
Mylothris ochrea Berger, 1981	14	-	F
Mylothris polychroma Berger, 1981	14	-	F
Mylothris ruandana Strand, 1909	14	4	F
Mylothris schoutedeni Berger, 1952	14	-	F
Lachnocnema inexpectata Libert, 1996	14	-	F
Spalgis jacksoni Stempffer, 1967	14	2	F
Cigaritis dufranei (Bouyer, 1991)	14	-	F
Cigaritis tanganyikae (Kielland, 1990)	14	3-5	F
Iridana bwamba Stempffer, 1964	14	2	F
Iridana obscura Stempffer, 1964	14	2	F
Epitola pulverulenta Dufrane, 1953	14	2	F
Cephetola bwamba (Jackson, 1964)	14	2	F
Cephetola mittoni Jackson, 1964	14	2	F
Cephetola subgriseata (Jackson, 1964)	14	2	F
Cephetola tanzaniensis Libert, 1999	14	3-4	F
Ornipholidotos Kigoma Kielland, 1983	14	3	F
Alaena bjornstadi Kielland,1973	14	3-5	Oh
Alaena kiellandi Carcasson, 1965	14	3-5	Oh
Telipna kayonza Jackson, 1969	14	3-5	F
Telipna sheffieldi Bethune-Baker, 1926	14	3-4	F
Telipna plagiata Joicey & Talbot, 1921	14	-	F
Liptena subsuffusa Hawker-Smith, 1933	14	5	F
Falcuna iturina Stempffer & Bennett, 1963	14	-	F
Falcuna semliki Stempffer & Bennett, 1963	14	-	F
Micropentila bunyoro Stempffer & Bennett, 1963	14	-	F
Toxochitona ankole Stempffer, 1967	14	4-5	F
Toxochitona vansomereni Stempffer, 1954	14	5-6	F
Mimacraea paragora Rebel, 1911	14	-	F
Deudorix (Virachola) edwardsi (Gabriel, 1939)	14	4-6	F
Deudorix (Virachola) ufipa (Kielland, 1978)	14	5-6	F
Pilodeudorix ankoleensis (Stempffer, 1953)	14	4	F
Iolaus (Epamera) mongiro Stempffer, 1969	14	2	F
Iolaus (Epamera) pseudofrater Stempffer, 1962	14	4-6	F
Iolaus (Epamera) pseudopollux Stempffer, 1962	14	4-6	F,R
Iolaus (Iolaphilus) henryi Stempffer, 1961	14	4-6	F
Iolaus (Philiolaus) kayonza Stempffer & Bennett, 1958	14	4-6	F
Iolaus (Philiolaus) montana (Kielland, 1978)	14	4-6	W
Iolaus (Philiolaus) sp. nr. *iturensis* (Joicey & Talbot, 1921)	14	5	W

Hypolycaena jacksoni Bethune-Baker, 1906	14	4-6	F
Leptomyrina makala Bethune-Baker, 1908	14	-	F
Uranothauma lunifer Rebel, 1914	14	4-6	F
Harpendyreus argenteostriata, Stempffer 1961	14	5-6	S
Harpendyreus kisaba Joicey & Talbot, 1921	14	5-6	S
Harpendyreus reginaldi Heron, 1909	14	-	Oh
Harpendyreus marlieri Stempffer, 1961	14	6	F
Lepidochrysops carsoni Butler, 1901	14	-	Oh
Lepidochrysops chala Kielland, 1981	14	6	Oh
Lepidochrysops mpanda Tite, 1961	14	5	Oh
Thermoniphas albocaerulea Stempffer, 1956	14	4	F
Thermoniphas caerula Stempffer, 1956	14	4	F
Thermoniphas kigezi Stempffer, 1956	14	4	F
Cymothoe collarti Overlaet, 1942	14	5	F
Cymothoe howarthi Rydon, 1981	14	-	F
Cymothoe ochreata Grose-Smith, 1890	14	-	F
Euphaedra barnsi Joicey & Talbot, 1922	14	4	F
Euphaedra christyi Sharpe, 1904	14	-	F
Euphaedra confina Hecq, 1992	14	3	R
Euphaedra ducarmei Hecq, 1977	14	-	F
Euphaedra graueri Rothschild, 1918	14	-	F
Euphaedra margueriteae Hecq, 1978	14	4-6	F
Euphaedra olivacea Grünberg, 1908	14	-	F
Euphaedra phosphor Joicey & Talbot, 1921	14	3	F
Euphaedra xerophila Hecq, 1974	14	-	F
Euriphene (Euriphene) alberici Dufrane, 1945	14	3	F
Euriphene (Euriphene) excelsior Rebel, 1911	14	-	F
Euriphene (Euriphene) ituriensis Jackson & Howarth, 1957	14	-	F
Bebearia hargreavesi D'Abrera, 1980	14	4	F
Euptera debruynei (Hecq, 1990)	14	-	F
Neptis lugubris Rebel, 1914	14	4-6	F
Kumothales inexpecta Overlaet, 1940	14	4	F
Viridixes montis Jackson, 1956	14	4-6	F
Viridixes schiltzei Bouyer, 1991	14	4-6	F
Eriboea gerdae Rydon, 1989	14	2-3	F
Eriboea grahamei van Someren, 1969	14	2-3	F
Eriboea mafuga van Someren, 1969	14	4-6	F
Eriboea opinatus Heron, 1909	14	4-6	F
Eriboea turlini Minig & Plantrou, 1978	14	-	F
Charaxes alticola Grünberg, 1911	14	3-6	F
Acraea (Acraea) hamata Joicey & Talbot, 1922	14	5-6	F
Acraea (Acraea) kia Pierre, 1990	14	3	F
Acraea (Acraea) turlini Pierre, 1979	14	6	F
Acraea (Actinote) amicitiae (Heron, 1909)	14	4-6	F
Acraea (Actinote) burgessi (Jackson, 1956)	14	-	F
Acraea (Actinote) grosvenori (Eltringham, 1912)	14	2-3	F
Acraea (Actinote) hecqui (Berger, 1981)	14	5-6	S
Acraea (Actinote) pierrei (Berger, 1981)	14	5-6	S
Gnophodes grogani Sharpe, 1901	14	4-6	F
Bicyclus aurivillii (Butler, 1896)	14	4	F
Bicyclus mahale Congdon *et al*., 1999	14	2	F
Bicyclus matuta (Karsch, 1894)	14	4-6	F
Bicyclus neustetteri (Rebel, 1914)	14	4-6	F
Bicyclus persimilis Joicey & Talbot, 1921	14	4-6	F
Bicyclus similis Condamin, 1963	14	4-6	F
Bicyclus tanzanicus Condamin, 1983	14	4-6	F
Total number of endemics = 113			
Transgressors to the Chain:			
Harpendyreus major (Joicey & Talbot, 1924)	8,10,11,14	5,6	S
Euchrysops unigemmata (Butler, 1895)	8,10,11,14	6	Oh