



Biodiversity Express Survey Mount Mulanje and Malawi hills August 2019



Biodiversity Inventory for Conservation

Biodiversity Express Survey (BES) 9, Mount Mulanje and Malawi hills, Malawi, 2019

20 December 2019

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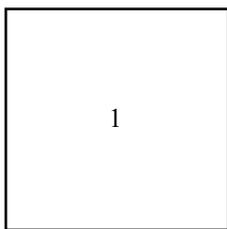
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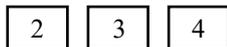
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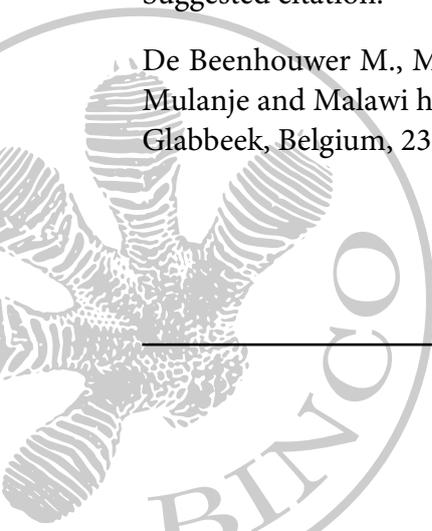
1. Matandwe Forest - photo courtesy of Ruben Foquet 2. *Rhampholeon chapmanorum* - photo courtesy of Delpport Botma 3. *Batis fratrum* - photo courtesy of Ruben Foquet 4. *Dasypeltis medici* - photo courtesy of Delpport Botma



BINCO Express Surveys (BES) are snapshot biodiversity studies of carefully selected regions. Expeditions typically target understudied and/or threatened areas with an urgent need for more information on the occurring fauna and flora. The results are presented in an Express Report (ER) that is made publicly available online for anybody to use and can be found at <https://www.BINCO.eu>. Teams consist of a small number of international specialists and local scientists. Results presented in Express Reports are dynamic and will be updated as new information on identifications from the survey and from observations in the area become available.

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EXPEDITION FACT SHEET

Location

Mount Mulanje Forest Reserve, Mulanje District, Southwest Malawi.
Matandwe Forest Reserve, Nsanje District, South Malawi.

Date

18 – 31 August 2019

Expedition Members – Expertise

Steven Mphamba – Forest Research Institute of Malawi – Plant taxonomist
Ruben Foquet – BINCO – Birds, Reptiles
Delpont Botma – BINCO – Reptiles, Photography
Matthias De Beenhouwer – BINCO – Birds, Amphibians, Mammals and Reptiles

Permits

A research permit (Ref. N° 03/08/2019) was obtained from the Forest Research Institute of Malawi.

Cooperation

This expedition was made possible with help of:

Forest Research Institute of Malawi (FRIM), Zomba

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QUICK OVERVIEW OF RESULTS

Table 1. Overview of the currently identified taxa and the survey techniques used for detection: Opportunistic observations (OO), Acoustic survey (AS), Visual Encounter Survey (VES).

Taxa	# Species	Survey Technique
Amphibians	7	OO
Reptiles	29	VES
Mammals	10	OO
Birds	84	AS and VES

ABSTRACT

Malawi is a densely populated country with an overall high pressure on the remaining natural resources. The highest deforestation is observed in the Southern region close to the border with Mozambique.

Across the Malawi Hills region, a small isolated block of lowland rainforest and some degraded Miombo forest inside the Matandwe Forest Reserve is left, mostly because of its difficult access on steep mountain slopes. Apart from botanical surveys, relatively little is known about the regions' biodiversity. This forest, however, is home to a unique species of pygmy chameleon (*Rhampholeon chapmanorum*, Tilbury) described in 1992. With increasing pressure on the forests in this region a clear concern about the survival of this species was voiced, following an IUCN assessment as Critically Endangered facing imminent extinction. We completed a rapid biodiversity survey to gain insight into the distribution and population size of this endemic pygmy chameleon. We also collected data on selected other taxa (other reptiles, birds and large mammals) to further document the biodiversity value of these forest blocks and their relevance for biodiversity conservation. We used a combination of visual encounter surveys, acoustic surveys and opportunistic observations. Provisionally, we identified 10 mammal, 7 amphibian, 29 reptile, and 84 bird species including a number of species with small distribution ranges and IUCN red listed species (three globally threatened reptile species and seven globally threatened bird species). Species identification is ongoing and this survey report will be updated as more information becomes available. Since human disturbance is increasing rapidly throughout the region, we propose a species action plan for *R. chapmanorum* and point out the need for a long-term monitoring protocol to enable the detection of changes related to encroachment, habitat conversion and climate change.

1 Introduction

Malawi is a country with a high human population density (145 persons / km²) and a low forest cover (< 12%). Threats to the Malawian forests are numerous as a result of the rapidly growing population and the high demand for fuel wood. Deforestation is widespread and associated with an increasing demand for new settlements and agricultural land. In addition, local forest exploitation for short-term needs such as timber, fuel wood and bushmeat are continuously increasing pressure on the remaining forest ecosystems, negatively affecting flora and fauna.

Mount Mulanje Forest Reserve was gazetted in 1931 and measures 65,000 ha. The area above 1,800 m is just under 20,000 ha. Four main forest-types can be recognized. On the west, north and eastern sides the foothills have an extensive belt of Miombo (*Brachystegia spp.*) or transition woodland while the rain-facing southern and south-eastern slopes used to support extensive evergreen forest (Birdlife, 2019). The high plateaux have mainly montane grassland and shrubland, with small patches of *Widdringtonia* cedar forest (above c.2,250 m these turn into shrubland). The *Widdringtonia* forest on the western plateau of Chambe was replaced in the 1950s with exotic pine plantations. Lowland rainforest from 600 to 950 m (*Newtonia-Khaya-Albizia* dominated), mid-altitude rainforest at 950–1,500 m (with flat-topped *Newtonia buchananii* clearly dominant). A good example of this forest type is present in Ruo Gorge on the southern slopes where our field surveys took place. Montane rainforest can be found between 1,500–1,900 m, with what used to be *Widdringtonia* monodominant forest above that, which due to unsustainable logging, has been cut. By the early 1980s, total rainforest forest cover was still c. 7,000 ha (c.200 ha lowland, 1,800 ha mid-altitude, 5,000 ha on upper slopes and plateaus). The site includes the northern extension of Mchese Mountain, where the forest is currently in much better condition than on Mulanje itself. Most of the land around the mountain reserve was cleared for tea cultivation at the beginning of the twentieth century.

Matandwe Forest Reserve was gazetted in 1931 and, along with Mulaka and Natundu Hills, is part of the Malawi Hills present in Nsanje district, at the tip of the Rift Valley in Southern Malawi. (Fig. 1). The soils are lithosols and the vegetation is open canopy Miombo woodland of hills and scarps dominated by *Brachystegia* species, especially *B. boehmii*, and a degraded form of *Uapaca kirkiana* (Mwafongo, 2012). In the Southern part of the reserve, lowland rainforest (*Newtonia-Khaya-Albizia* dominated) occurs on the south-facing slopes of the hills. The area of the FR is estimated to be 26,000 ha, however, it has been encroached and excised several times. A plant survey in 2012 recorded a total of 107 plant species in 39 families (Mwafongo, 2012). In the Northwest the Forest is bordered by Mwabvi Game Reserve whereas in the West, the boundary is formed by the border with Mozambique..

Rhampholeon chapmanorum is one out of nine chameleon species occurring in Malawi and one of three species endemic to the country together with *Nadzikambia mlanjensis* and *Rhampholeon platyceps*. It is only found at Malawi Hills (more specifically, in the Natundu Hills), near Nsanje, Malawi (Fig. 1, Tolley et al. 2014). It was described from a small lowland seasonal rainforest remnant (50 ha) on the upper south-east facing slope within Matandwe Forest Reserve (Tilbury 1992). This is typified by an average annual rainfall of 1,500 mm and a mean annual temperature of 21-24 °C (Chapman & White, 1970). Based on satellite imagery, this rainforest was estimated to measure more than 1,000 ha in 1984 (Google Earth, 2019). Nowadays, however, the indigenous forest of Malawi Hill has largely disappeared due to human encroachment for fertile land and timber. Satellite imagery indicates a total of ca. 0.6 km² as

suitable habitat in 2013 across two degraded and fragmented forest patches at the type locality (Tolley et al. 2014). Currently, these two fragment sizes are measuring 0.36 km² and 0.18 km² and are 1.2 km apart, separated since at least 1984 by highly transformed agricultural land (Google Earth, 2019). Up to now, there is no quantitative information on abundance although an *ad hoc* survey in 1998 produced some observations of this species (Tolley et al. 2014). Furthermore, it is unknown if the species occurs in both fragments, and if any other fragments may still harbour the species.

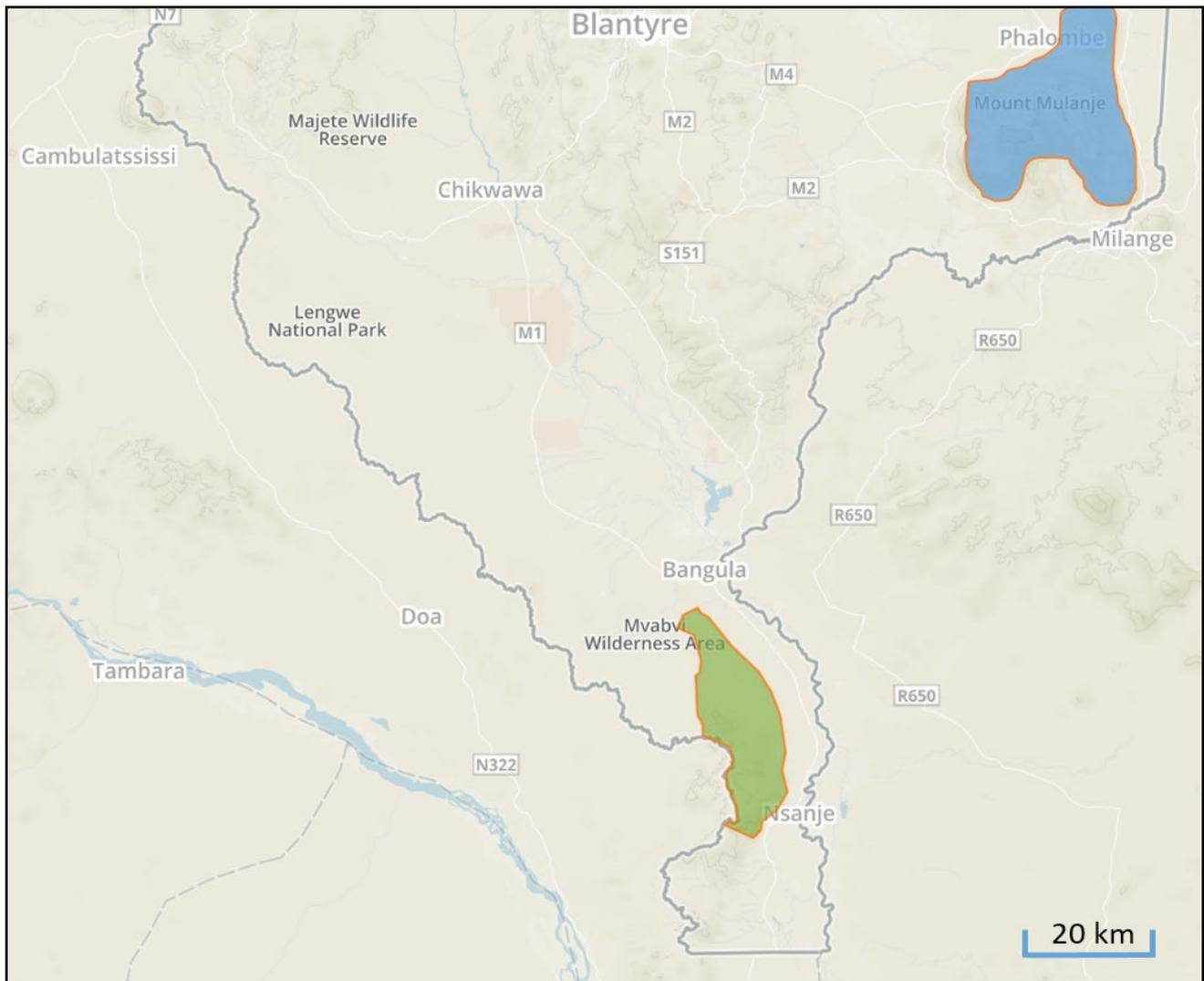


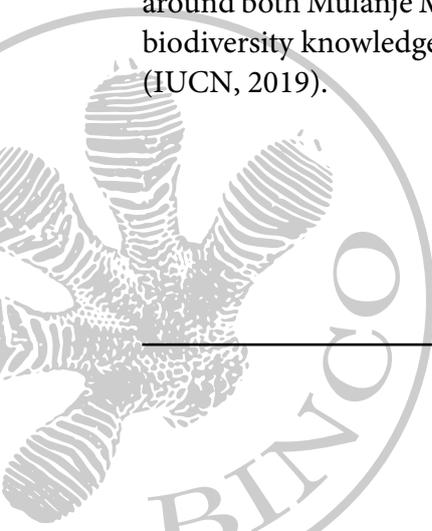
Fig. 1. Southern Malawi with Blantyre city, Mount Mulanje forest reserve (Blue area) and Matandwe forest reserve (Green area) indicated (Source: Protected Planet, accessed 28/11/2019).

2 Goal

The main goal of this field survey was to gather population and distribution data of the Critically Endangered and endemic, *Rhampholeon chapmanorum*. More specifically we aim to answer some recently phrased doubts about the continued existence of the species and associated recognized data gaps by the IUCN red list (Tolley et al., 2014). These included collection of the following research data:

Research Needed		Notes
1. Research	1.2. Population size, distribution & trends	An immediate survey is needed to determine if the sole population of this species is still extant, as well as an assessment of whether any original habitat remains.
	1.5. Threats	An assessment of whether any original habitat remains is needed as soon as possible.
2. Conservation Planning	2.1. Species Action/ Recovery Plan	If any individuals are left in the original population, translocation and/or in situ programs should be considered.
	2.2. Area-based Management Plan	The remaining forest should be protected, and restoration of the forest should be considered.
3. Monitoring	3.1. Population trends	If the original population is still intact, abundance surveys (capture-mark-recapture) should be carried out over the long term.
	3.2. Habitat trends	Additional habitat loss should be quantified to establish the rate at which the forest is still being lost.
4. Education & awareness	4.2. Training	The local community will need to be involved in any species recovery and/or restoration actions.

Additionally, observations of other reptile and amphibian species, birds and large mammals in and around both Mulanje Mountain Forest Reserve and Matandwe Forest Reserve were collected to advance biodiversity knowledge in the country and gather information on the occurrence of threatened species (IUCN, 2019).



3 Biodiversity surveys

The data presented in this study consist of one field campaign to Malawi: a two-week survey starting mid-August 2019 in the Mulanje Mountain Forest Reserve (4 nights, from 18th to 22nd August) and South of the Matandwe Forest Reserve (9 nights, from 22nd to 31st August). Three base camps were made on the following locations:

- First 4 nights at 1,068 m asl. (**Fig. 2**; 15°57'33"S, 35°39'14.80"E): exploring the forest North of the camp up to an altitude of 1,454 m (15°56'32.78"S, 35°38'47.61"E).
- Following 2 nights at 509 m asl. (17° 5'42.61"S, 35°7'4"E): exploring the forest South (17° 6'16"S, 35° 7'11"E) of the camp up to an altitude of 713 m (17° 6'3.26"S, 35° 7'9.32"E).
- Last 6 nights at 660 m asl. (16°58'53.18"S, 35° 7'42.30"E): exploring the forests Southeast (16°59'18.16"S, 35°7'57.19"E) and Northeast 16°57'55.28"Z, 35°9'31"E) of the camp up to an altitude of 929 m (16°58'20.58"S, 35°9'3.29"E).

The biodiversity surveys have resulted in approximately 11 nights of chameleon surveying, and 14 days of general field sampling (surveys and opportunistic observations).



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Fig. 2. Basecamp in Mount Mulanje Forest reserve, habitat of two out of three endemic chameleons of Malawi: *Nadzikambia mlanjensis* and *Rhampholeon platyceps*.

In the following sections we summarize the observations made during our surveys. Surveys mainly focused on collecting chameleon data, however opportunistic observations of other vertebrates (mammals, birds, reptiles and amphibians) were also documented. The following sections will be updated based on expert opinions and slower identification of herpetofauna over time. New updates will be uploaded online (<https://www.BINCO.eu>) when this information becomes available.

3.1 Herpetofauna

Botma D., De Beenhouwer M., Foquet R.

The herpetofauna of Malawi is reasonably well known and studied compared to its neighboring countries. However, distribution data are often scarce and species lists are generally restricted to national parks. Therefore, we provide an overview of species encountered opportunistically and during the nocturnal surveys for the pygmy chameleons. Identification was done in the field where possible, no samples (vouchers or DNA) were collected and identification is based on literature and pictures taken in situ. No DNA samples were collected. For identification of amphibians (Fig. 3), we used the “Field guide to the Frogs & other amphibians of Africa” by A. Channing and M-O Rödel (2019). For reptiles, the recently published “Reptiles of Malawi” by G. Brown (2018) was used.

Table 2. Amphibians and reptiles observations from Mount Mulanje Forest Reserve (MMFR) and Matandwe Forest Reserve (MaFR). ‘End’ indicates that the species is endemic for Malawi. IUCN Red list of Threatened species (IUCN, 2019) is listed: LC= Least concern, VU= Vulnerable, EN= Endangered, CR = Critically Endangered and NE= not evaluated.

N°	Species	Vernacular name	IUCN	MMFR	MaFR
Amphibia					
1	<i>Amietia delalandii</i>	Delalande’s River Frog	LC	X	
2	<i>Amietia johnstoni</i>	Johnston’s River Frog	EN, End	X	
3	<i>Amietophrynus sp.</i> ¹	Toad			X
4	<i>Arthroleptis stenodactylus</i>	Common Squeaker	LC		X
5	<i>Breviceps mossambicus</i>	Mozambique Rain Frog	LC		X
6	<i>Hyperolius substriatus</i>	Mainland Reed Frog	LC	X	
7	<i>Leptopelis flavomaculatus</i>	Yellow-spotted Tree Frog	LC	X	
Reptilia					
1	<i>Afroablepharus sp.</i>				X
2	<i>Afroedura sp.</i>				X
3	<i>Agama kirkii</i>	Kirk’s agama		X	X
4	<i>Agama mossambica</i>	Mozambique agama		X	
5	<i>Boaedon fulliginosus</i>	African house snake			X
6	<i>Chameleo dilepis</i>	Flap-necked chameleon			X
7	<i>Chondrodactylus turneri</i>	Turner’s thick-toed gecko			X
8	<i>Crotaphopeltis hotamboeia</i>	Herald snake			X
9	<i>Dasypeltis medici</i>	East African egg-eater			X

N°	Species	Vernacular name	IUCN	MMFR	MaFR
10	<i>Duberria shirana</i>	Shire slug-eater		X	
11	<i>Gerrhosaurus validus</i>	Giant plated lizard			X
12	<i>Hemidactylus sp.</i>			X	X
13	<i>Homopholis sp.</i>				X
14	<i>Lygodactylus capensis</i>	Cape dwarf gecko			X
15	<i>Lygodactylus rex</i>	King dwarf gecko		X	
16	<i>Mochlus sundevalli</i>	Sundevall's writhing skink			X
17	<i>Nadzikambia mlanjensis</i>	Mulanje chameleon	EN, End	X	
18	<i>Naja subfulva</i>	Forest cobra			X
19	<i>Nucras sp.</i>				X
20	<i>Pachydactylus sp.</i>				X
21	<i>Phylothamnus sp.</i>			X	
22	<i>Platysaurus mitchelli</i>	Mitchell's flat lizard	NE, End	X	
23	<i>Rhampholeon chapmanorum</i>	Chapman's pygmy chameleon	CR, End		X
24	<i>Rhampholeon platyceps</i>	Mulanje pygmy chameleon	EN, End	X	
25	<i>Telescopus semiannulatus</i>	Eastern tiger snake			X
26	<i>Thelotornis mossambicanus</i>	Eastern vine snake			X
27	<i>Trachylepis sp.</i>				
28	<i>Trachylepis margaritifera</i>	Rainbow skink		X	X
29	<i>Trachylepis mlanjensis</i>	Mulanje skink	LC, End	X	

¹ Not designated at species level due to the morphological ambiguity



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Fig. 3. Mozambique rain frog (*Breviceps mossambicus*) was found, despite being the middle of the dry season, just South of the Matandwe Forest reserve during a night survey.

- Mulanje chameleon (*Nadzikambia mlanjensis*, EN): This species was found regularly on two of the four nights surveying in the MMFR (**Fig. 4**). It was found between 1,050 and 1,450 m asl. In total, 26 individuals were found and gps marked, which represents the largest dataset so far of this species, as far as we are aware. The average perch height at night was 4.3 m above the ground.



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Fig. 4. Mulanje chameleon (*Nadzikamboia mlanjensis*) photographed on a night survey in situ in the Mount Mulanje Forest reserve.

- Mount Mulanje pygmy chameleon (*Rhampholeon platyceps*, EN): This species was regularly found on three of the four nights surveying in the MMFR (**Fig. 5**). It was found from 1,050 to 1,850 m asl. In total, 16 individuals were found and gps marked. The average perch height at night was 1.1 m above the ground.



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Fig. 5. Mount Mulanje pygmy chameleon (*Rhampholeon platyceps*) photographed on a night survey in situ in the Mount Mulanje Forest reserve.

3.2 Mammals

Foquet R., De Beenhouwer M., Botma D.

The community of mammals in the forest was assessed opportunistically during both day and night surveys (**Table 3**). One mammal was observed through fresh dung (Duiker spec.) but could not be assigned to species level and is therefore not included here, whereas others were visually observed.

Table 3. Mammal observations from Mount Mulanje Forest Reserve (MMFR) and Matandwe Forest Reserve (MaFR). ‘End’ indicates that the species is endemic for Malawi. IUCN Red list of Threatened species (IUCN, 2019) is listed: LC = Least concern.

N°	Species	Vernacular name	IUCN	MMFR	MaFR
1	<i>Cercopithecus mitis</i>	Blue Monkey	LC	X	X
2	<i>Dendromus nyikae</i>	Nyika Climbing Mouse	LC	X	X
3	<i>Galagoides granti</i>	Mozambique Dwarf Galago	LC	X	
4	<i>Heterohyrax brucei</i>	Yellow-spotted Rock Hyrax	LC	X	
5	<i>Genetta maculata</i>	Large-spotted Genet	LC	X	
6	<i>Otolemur crassicaudatus</i>	Thick-tailed Greater Galago	LC		X
7	<i>Papio cynocephalus</i>	Yellow Baboon	LC	X	
8	<i>Paraxerus cepapi</i>	Smith’s Bush Squirrel	LC		X
9	<i>Paraxerus palliatus</i>	Red Bush Squirrel	LC	X	X
10	<i>Procavia capensis</i>	Cape Rock Hyrax	LC		X

3.3 Birds

Foquet R., De Beenhouwer M.

Birds were identified using visual and acoustic observations. Birds were assessed during early morning surveys and on an *ad hoc* basis throughout the expedition. Bird species were documented as much as possible through either sound records or photographic evidence. Species observed are listed below, separated by area (**Table 4**). Birds were identified using the field guide “Birds of Africa – South of the Sahara” by Ian Sinclair and Peter Ryan. Since sampling was conducted during the European summer, no migratory birds were observed.

Table 4. Bird observations from Mount Mulanje Forest Reserve (MMFR) and Matandwe Forest Reserve (MaFR). 'End' indicates that the species is endemic for Malawi. IUCN Red list of Threatened species (IUCN, 2019) is listed: LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered.

N°	Species	Vernacular name	IUCN	MMFR	MaFR
1	<i>Amblyospiza albifrons</i>	Grosbeak weaver	LC		X
2	<i>Andropadus importunus</i>	Sombre greenbul	LC	X	
3	<i>Apalis chariessa</i>	White-winged apalis	NT	X	
4	<i>Apalis flavida</i>	Yellow-breasted apalis	LC		X
5	<i>Apalis flavigularis</i>	Yellow-throated apalis	EN	X	
6	<i>Apalis melanocephala</i>	Black-headed apalis	LC	X	
7	<i>Arizelocichla fusciceps</i>	Black browed mountain greenbul	LC	X	
8	<i>Arizelocichla milanjensis</i>	Stripe-cheeked greenbul	LC	X	
9	<i>Batis capensis</i>	Cape batis	LC	X	
10	<i>Batis fratrum</i>	Woodward's batis	LC		X
11	<i>Bradypterus lopezi</i>	Evergreen forest warbler	LC	X	
12	<i>Bubo africanus</i>	Spotted eagle-owl	LC		X
13	<i>Bycanistes brevis</i>	Silvery-cheeked hornbill	LC		X
14	<i>Bycanistes bucinator</i>	Trumpeter hornbill	LC		X
15	<i>Camaroptera brachyura</i>	Green-backed camaroptera	LC		X
16	<i>Camaroptera brevicaudata</i>	Grey-backed camaroptera	LC		X
17	<i>Campephaga flava</i>	Black cuckooshrike	LC		X
18	<i>Campethera abingoni</i>	Golden tailed woodpecker	LC		X
19	<i>Cercotrichas leucophrys</i>	White-browed scrub robin	LC		X
20	<i>Chamaetylas choloensis</i>	Thyolo alethe	VU	X	
21	<i>Chlorophoneus nigrifrons</i>	Black-fronted bushshrike	LC	X	
22	<i>Chrysococcyx klaas</i>	Klaas cuckoo	LC		X
23	<i>Cichladusa arquata</i>	Collared palm thrush	LC		X
24	<i>Cinnyris chalybeus</i>	Collared sunbird	LC		X
25	<i>Cinnyris venustus</i>	Variable sunbird	LC		X
26	<i>Colius striatus</i>	Speckled mousebird	LC		X
27	<i>Coracias caudatus</i>	Lilac-breasted roller	LC		X
28	<i>Corvus albicollis</i>	White-necked raven	LC	X	
29	<i>Corvus albus</i>	Pied crow	LC		X
30	<i>Cossypha anomala</i>	Olive-flanked ground-robin	NT	X	
31	<i>Cossypha heuglini</i>	White-browed robin-chat	LC		X
32	<i>Crithagra citrinipectus</i>	Lemon-breasted canary	LC		X
33	<i>Cyanomitra olivacea</i>	Olive sunbird	LC	X	

N°	Species	Vernacular name	IUCN	MMFR	MaFR
34	<i>Cypsiurus parvus</i>	African palm swift	LC		X
35	<i>Dendropicos fuscescens</i>	Cardinal woodpecker	LC		X
36	<i>Dicrurus adsimilis</i>	Fork-tailed drongo	LC		X
37	<i>Dicrurus ludwigii</i>	Common square tailed drongo	LC	X	
38	<i>Dryoscopus cubla</i>	Black-backed puffback	LC	X	X
39	<i>Elminia albonotata</i>	White-tailed crested flycatcher	LC	X	
40	<i>Estrilda astrild</i>	Common waxbill	LC		X
41	<i>Falco chicquera</i>	Red-necked falcon	LC		X
42	<i>Geokichla gurneyi</i>	Orange ground thrush	LC	X	
43	<i>Hedydipna collaris</i>	Collared sunbird	LC	X	
44	<i>Hieraaetus ayresii</i>	Ayres' hawk eagle	LC		X
45	<i>Hieraaetus wahlbergi</i>	Wahlberg's eagle	LC		X
46	<i>Hypargos niveoguttatus</i>	Red-throated twinspot	LC		X
47	<i>Indicator indicator</i>	Greater honeyguide	LC		X
48	<i>Indicator variegatus</i>	Scaly-throated honeyguide	NT	X	
49	<i>Laniarius major</i>	Tropical boubou	LC		X
50	<i>Leptoptilos crumenifer</i>	Marabou stork	LC		X
51	<i>Lonchura cucullata</i>	Bronze mannikin	LC		X
52	<i>Lonchura nigriceps</i>	Red-backed mannikin	LC		X
53	<i>Lophaetus occipitalis</i>	Long-crested eagle	LC		X
54	<i>Malaconotus blanchoti</i>	Grey-headed bush-shrike	LC		X
55	<i>Milvus aegyptius</i>	Yellow-billed kite	LC		X
56	<i>Motacilla aguimp</i>	African pied wagtail	LC		X
57	<i>Motacilla clara</i>	Mountain wagtail	LC	X	
58	<i>Mycteria ibis</i>	Yellow-billed stork	LC		X
59	<i>Oena capensis</i>	Namaqua dove	LC		X
60	<i>Phyllastrephus flavostriatus</i>	Yellow-streaked greenbul	LC		X
61	<i>Plegadis falcinellus</i>	Glossy ibis	LC		X
62	<i>Ploceus bicolor</i>	Dark-backed (forest) weaver	LC	X	X
63	<i>Ploceus ocularis</i>	Spectacled weaver	LC		X
64	<i>Ploceus xanthopterus</i>	Southern brown-throated weaver	LC		X
65	<i>Pogoniulus bilineatus</i>	Yellow-rumped tinkerbird	LC	X	
66	<i>Pogonocichla stellata</i>	White-starred robin	LC	X	
67	<i>Polemaetus bellicosus</i>	Martial eagle	VU		X
68	<i>Polyboroides typus</i>	African harrier-hawk	LC		X
69	<i>Prinia erythroptera</i>	Red-winged warbler	LC		X
70	<i>Prinia subflava</i>	Tawny-flanked prinia	LC		X

N°	Species	Vernacular name	IUCN	MMFR	MaFR
71	<i>Pycnonotus tricolor</i>	Dark-capped bulbul	LC		X
72	<i>Quelea quelea</i>	Red-billed quelea	LC		X
73	<i>Scopus umbretta</i>	Hamerkop	LC		X
74	<i>Serinus mozambicus</i>	Yellow-fronted canary	LC		X
75	<i>Smithornis capensis</i>	Broadbill	LC		X
76	<i>Stephanoaetus coronatus</i>	Crowned eagle	LC	X	
77	<i>Streptopelia semitorquata</i>	Red-eyed dove	LC		X
78	<i>Strix woodfordii</i>	African wood owl	LC		X
79	<i>Tauraco porphyreolophus</i>	Purple-crested turaco	LC		X
80	<i>Tchagra senegalus</i>	Black-crowned tchagra	LC		X
81	<i>Terathopius ecaudatus</i>	Bateleur	NT		X
82	<i>Turtur tympanistria</i>	Tambourine dove	LC		X
83	<i>Uraeginthus angolensis</i>	Blue waxbill	LC		X
84	<i>Zosterops senegalensis</i>	African yellow white-eye	LC	X	X

- Martial eagle (*Polemaetus bellicosus*, VU): a single bird was observed and photographed, perched high up in a tree in one of the forest fragments South of the MaFR.
- Bateleur (*Terathopius ecaudatus*, NT): One individual was seen soaring over agricultural fields at the edge of MaFR. Although it was not photographed, it was identified by multiple observers as an adult male.
- Yellow-throated apalis (*Apalis flavigularis*, EN): This species was abundantly seen and heard on bird surveys on 4 consecutive days in the MMFR (Fig. 6). It was present across the elevational gradient surveyed and could be found in degraded and fragmented forest patches on the mountain.
- White-winged apalis (*Apalis chariessa*, NT): Only one individual was found high in the tree tops of a *Newtonia* tree on the side of the Ruo river at 1050 m. a.s.l. It was identified by multiple observers being a typical apalis but with the white-wing bar clearly visible.
- Thyolo alethe (*Chamaetylas choloensis*, VU): This species was often heard and regularly seen on bird surveys on 4 consecutive days in the MMFR. It was present across the elevational gradient surveyed but could be found exclusively in denser forest interior.



Fig. 6. Yellow-throated apalis (*Apalis flavigularis*) was found abundantly along an elevation gradient in Mount Mulanje Forest reserve © Matthias De Beenhouwer.

- Olive-flanked ground-robin (*Cossypha anomala*, NT): This species was found only on the higher elevation surveys on the third and fourth day in MMFR. It was found close to ant-trails and generally kept to the ground-layer.
 - Lemon-breasted canary (*Crithagra (ex-Serinus) citrinipectus*, LC): This Eastern endemic reaches its northern limit of distribution in the Lower Shire valley. Dowsett-Lemaire (2015), describes the species as “nowhere common but has been recorded in Lengwe National Park and adjacent Wildlife Reserves (Majete and Mwabvi).” A small group was observed at the forest edge of one of the visited forest patches of the Malawi hills. At least two males with distinctive yellow breasts were seen amongst the group.
 - Woodward’s batis (*Batis fratrum*, LC): This species is known as an Eastern endemic of lowland evergreen and deciduous forest. Malawi Hill within Matandwe Forest Reserve was important for a population of *Batis fratrum*, estimated at over 100 pairs in 1983 (Birdlife International, 2019). Due to accelerating forest destruction in the Malawi Hills in the 1990s, the species was almost gone by 1999. Dowsett-Lemaire (2015) listed the species as a suspected local extinction. One individual was observed sleeping at night during a chameleon night survey. The following day, one individual was photographed foraging in a mixed flock in the mid-stratum of the same forest fragment visited.
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4 Chapman's pygmy chameleon

4.1 Data collection

Chameleon data were collected in 20 m by 20 m survey plots, established through stratified random sampling across the elevational gradient in both remaining forest fragments. Seven plots in total were surveyed (Table 5). Plots were set up during the day time with ropes. Firstly, all chameleons within the plot were surveyed at night by three experts with strong head torches. The plot was surveyed in six parallel lines to avoid disturbance with on average 55 minutes search time. Search time was measured but not standardized because of great variety in vegetation density, complicating a full chameleon count within the plot. Therefore, it was agreed to continue surveying along the parallel lines until satisfactory surveyed (min. 45 min – max. 70 min). All chameleons were counted and communicated to avoid double counting. Chameleons were also classified in age categories based on length: juveniles (< 2 cm Snout Vent Length or SVL), subadults (2 – 4 cm SVL) and adults (> 4 cm SVL). Moreover, for a specific subsample of chameleons, perch height above ground at night and SVL were measured in detail. All data were recorded through an MDC (Mobile data collection) app. The following day, vegetation data were collected from the same plots with the shrubs and trees identified to species and their circumference at breast height (CBH) measured (for all CBH > 10 cm.). In each corner, a 2m by 2m subplot was established where all smaller vegetation was identified to species or genus level and an estimate (%) was made of its ground cover within the subplot.

Table 5. Overview of the specific pygmy chameleon plots that were established across its known distribution area. Seven plots of 20 m by 20 m were established.

N°	Date	Central GPS coordinate		Condition	Elevation (m asl.)	Survey (min.)
1	26/08/2019	16°59'16"S	35°7'53.7"E	Forest edge	858	45
2	27/08/2019	16°59'16.33"S	35°7'56"E	Forest interior	837	60
3	27/08/2019	16°59'19"S	35°7'55.3"E	Forest interior	820	50
4	28/08/2019	16°59'18.67"S	35°7'58"E	Forest edge	782	55
5	28/08/2019	16°59'14"S	35°7'54"E	Banana plantation	848	50
6	30/08/2019	16°58'26"S	35°9'E	Forest edge	891	50
7	30/08/2019	16°58'22"S	35°9'2"E	Forest interior	922	70

4.2 Results

This study represents the largest dataset of this species ever recorded. In total, 240 individuals were found across six nights in two forest fragments. Of the 240 individuals found, 90 were measured, resulting in an average SVL of 3.6 cm (juveniles incl.) and a mean perch height (sleeping) of 88 cm (min. 10 cm, max. 250 cm) above the ground.

Therefore, the following recommendations can be made in relation to the needs for research on the species formulated by the IUCN specialist group.

1.2 Population size, distribution & trends: An immediate survey is needed to determine if the sole population of this species is still extant, as well as an assessment of whether any original habitat remains.

- Our survey showed that the species is still extant in considerable numbers in two forest fragments that are considered to be part of the original habitat (**Fig. 7**).
- Our survey showed that, where tall canopy trees could not be found, and thus suitable habitat is unlikely, the species was not present (anymore).



Fig. 7. *Rhampholeon chapmanorum* photographed in situ on a night survey.

1.5 Threats: An assessment of whether any original habitat remains is needed as soon as possible.

- Our survey showed that the total extent of suitable habitat is now limited to 2 fragments, which at the 31st of January 2019 measured 18.1 hectares and 38.3 hectares (**Fig. 8**). Therefore, the total suitable habitat has been found to decline from 61 ha (Tolley et al., 2014) to 56.4 ha. Two other former forest fragments that used to contain the largest tropical lowland rainforest (50 ha up to 2010) and thus probably the largest population potential for the species, have been completely deforested between 2010 and 2018 and no pockets larger than 1 ha could be found (**Fig. 8**). These areas are devoid of large trees and thus considered unsuitable for the chameleon to survive. However, just North of the larger forest fragment, two small forest remnants measuring 0.17 ha and 0.13 ha were found to harbour the species.

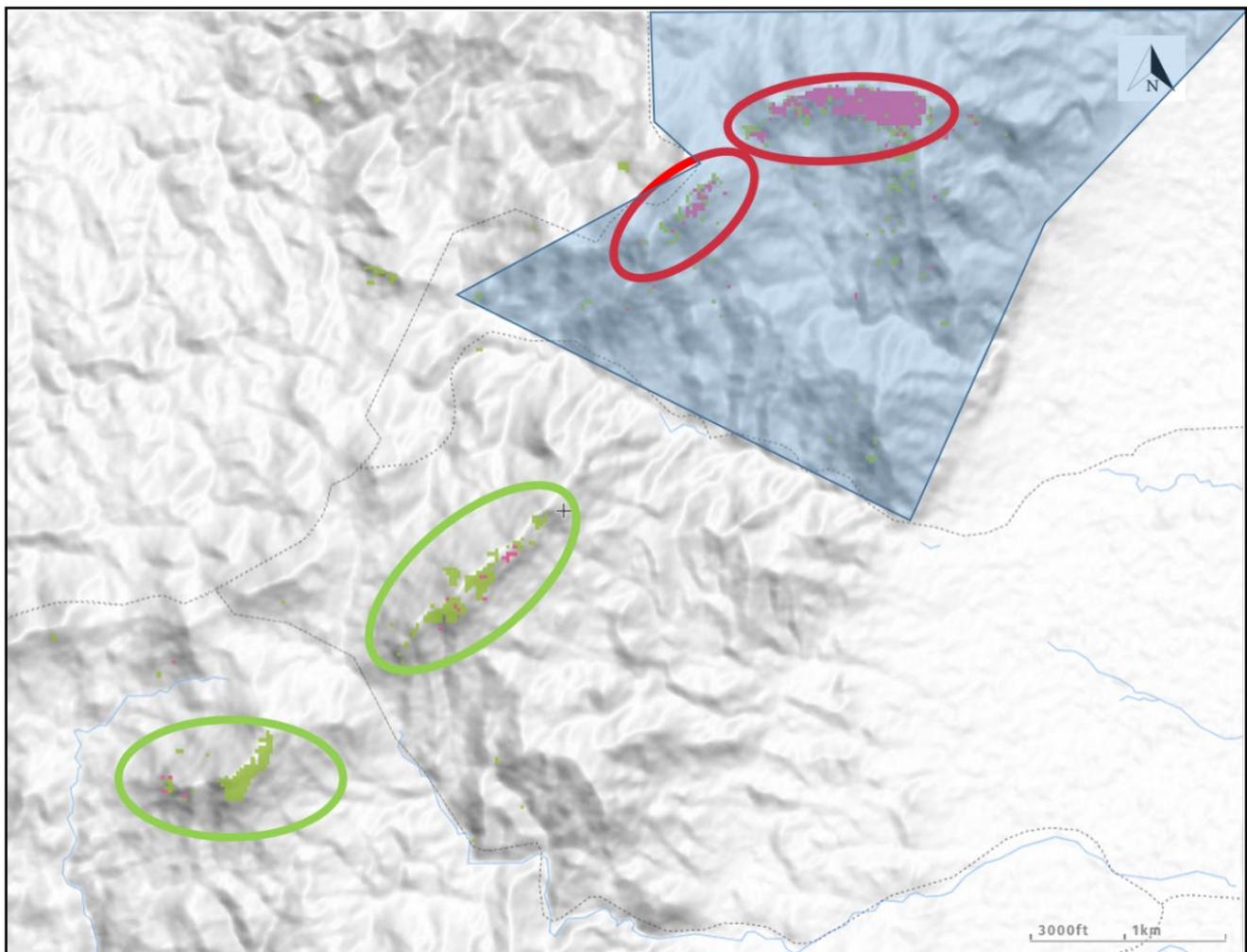
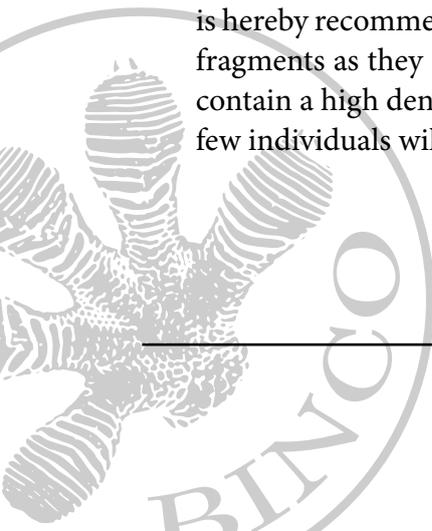


Fig. 8. Recent deforestation data (2014 – 2018) on Global Forest Watch, accessed 15/09/2019. The two forest fragments circled in red in the Matandwe Forest reserve (blue polygon) with previous presence of the pygmy chameleon have completely disappeared between 2014 and 2018. Rainforest patches circled in green are the only two patches with confirmed presence of the pygmy chameleon from this study and lay outside of the protected zone.

2.1 Species recovery plan: If any individuals are left in the original population, translocation and/or in situ programs should be considered.

- Translocation of individuals has taken place in the 1990's and these newly established populations are said to do well. No permission was obtained from government to translocate more individuals. It is hereby recommended to supply the ex-situ population with individuals from the remaining forest fragments as they are 1) at considerable threat of deforestation in the near future and 2) shown to contain a high density of chameleons within the right habitat, indicating that the translocation of a few individuals will not have a major effect.



2.2. Area-based Management Plan: The remaining forest should be protected, and restoration of the forest should be considered.

- What is considered as fragment 1 here, measuring 18.1 ha is included in a community forest management plan, with a village forest resource committee overseeing the protection of the forest. Indeed, relatively little disturbance (logging) was taking place, and these trees were said to be legally harvested by the committee, since they were reaching logging age. The larger fragment however, measuring 38.3 ha, was found to contain a much higher degree of disturbance. Practically everywhere across 38.3 ha, banana plantations were being established and subsequently large trees were being felled. There was said to be a Village Natural Resource Management Committee (VNRMC) responsible for the area but no further information was obtained. The identification and/or establishment of a VNRMC for fragment 2 should be considered as the highest conservation priority.

2.3. Habitat & natural process restoration: Habitat restoration is urgently needed, assuming this species is not extinct.

- Though this was outside the scope of this study, it is here predicted that habitat restoration will be very challenging (even unrealistic) because of the high pressure on fertile land and high population increase in the area. The two fragments have been isolated already for a long time indicating that this will be a challenging task at best.

3.1. Population trends: If the original population is still intact, abundance surveys (capture-mark-recapture) should be carried out over the long term.

- Although no capture-mark-recapture surveys were done, we did establish 20m x 20m survey plots where, with a team of three experts, night surveys were done by walking six parallel lines with powerful spotlights. Plots were surveyed for between 45 and 70 minutes, depending on vegetation density, during which all encountered pygmy chameleons were counted. Seven plots, varying in distance to forest edge (0 – 150 m.) and elevation (750 – 920 m asl) were established and on average, each plot contained 19.9 individuals (SD: 13.2).

3.2. Habitat trends: Additional habitat loss should be quantified to establish the rate at which the forest is still being lost.

- Although the forests are characterized by a high degree of edge effects, this was not shown to have a negative effect on the population of pygmy chameleons. The remaining forest in fragment 2 continues to degrade, with at least 5 ha deforested recently. Looking at the forest fragment of 50 ha that was lost predominantly over the course of three years, chances are high that this habitat loss will continue.

4.2. Education and awareness: Given that the sole reason for this species decline is habitat loss of its forest habitat due to anthropogenic activities, the local community will need to be involved in any species recovery and/or restoration actions.

- A workshop was organized with representatives of three of the four villages surrounding the two remaining forest patches. The importance and uniqueness of the chameleon was brought forward,

and a discussion followed where current activities and future actions to protect the forest were highlighted (Fig. 9). More details can be found in a separate report submitted to the Mohamed bin Zayed Species Conservation Fund. Local community involvement in conservation should be considered one of the top conservation priorities with 1) alternative income sources for VNRMC that are limited to NTFP and agricultural intensification to keep motivating the committee to patrol and manage fire breaks and 2) establish an active VNRMC for forest fragment 2, the largest fragment with higher deforestation rate.



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Fig. 9. Workshop organized with community leaders in a primary school next to the Mabungwa forest fragment.

4.3 Species Action Plan

A detailed Species action plan has been developed, which can be found online (on Researchgate and the BINCO website). The species is now considered extinct inside the forest reserve but was still found abundantly in two forest fragments on customary land. The smallest of these two fragments was less disturbed and was looked after by a Village Natural Resource Management Committee (VNRMC). Therefore, a quick establishment and operationalization of a VNRMC in the largest forest fragment should be prioritized to halt the current encroachment there. VNRMCs with financial resources and technical capacity were proposed by the community as a valuable conservation measure. It is necessary to keep showing interest and potential support from (inter)national stakeholders to be engaged in the conservation of the forest, to keep the VNRMCs motivated in the short term. No previous support to the forest (either national or international) was identified during a community workshop.

5 Conclusion

Despite the pressure on the forest, the survey showed a remarkable diversity present in the two areas sampled, with the continued presence of all three endemic chameleons as well as several other globally threatened species (ten IUCN red listed species in total). This survey focused on data collection of distribution and population of one of the rarest chameleons in the world, the Chapman's pygmy chameleon. Our survey showed that the total extent of suitable habitat for the pygmy chameleon is now considerably smaller than 60 hectares. We found it to be generally abundant within suitable habitat (approx. 500 individuals per hectare) and it was even present in very small relict forest (< 0.2 ha). Based on the data collected, both through surveys and community meetings, we propose a Species Action Plan for *Rhampholeon chapmanorum* and suggest the need for a long-term monitoring protocol to enable the detection of changes related to encroachment, habitat conversion and climate change.

Our survey also collected data from several other species that are threatened with extinction and from a previously un-sampled forest. These data add to the current biodiversity knowledge of Malawi's pressured forests. In all the forests sampled, a high degree of human disturbance was observed, which in some areas such as Mwanambeli forest is considered unsustainable in the short-term.

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