Title: Potential range shifts and climatic refugia of rupicolous reptiles in a biodiversity hotspot of South Africa
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We used environmental niche modelling to assess potential range shifts and climatic refugia of eleven rupicolous species from the Soutpansberg Mountains in South Africa. We selected rupicolous reptiles as our study subjects as they are likely to have limited dispersal abilities due to their strict microhabitat requirements (Penman *et al*. 2010; Croak *et al*. 2012). The Soutpansberg Mountains were chosen as our study area of choice due to it being a biodiversity hotspot which has been largely understudied. There are 16 rupicolous species that occur on the mountain but five had to be excluded from our analyses due to small sample sizes ($N \leq 10$). The eleven species that were included in our study were *Afroedura pienaari*; *Chondrodactylus turneri*; *Cordylus vittifer*; *Lygodactylus incognitus*; *Lygodactylus soutpansbergensis*; *Platysaurus intermedius*; *Platysaurus relictus*; *Smaug depressus*; *Trachylepis margaritifer*; *Trachylepis punctatissima* and *Vhembelacerta rupicola*.

Afroedura pienaari is a gecko endemic to the Soutpansberg Mountain range, with its distribution occurring extensively along the northern slopes, entering the southern areas in both the far west and east (Petford *et al*. 2019). This species' distribution is negatively influenced by annual rainfall and mean diurnal temperature range, thus occurs in areas with low rainfall and small fluctuations in temperature (Petford *et al*. 2019). This species is primarily nocturnal and was recently described in 2014, as with all geckos in the genus, *A. pienaari* is dorsoventrally flattened, facilitating its access to rock cracks and crevices (Jacobsen *et al*. 2014).

Chondrodactylus turneri is a large, nocturnal gecko occurring extensively throughout southern Africa, mostly associated with tropical areas, including arid desert regions such as in Namibia and Botswana (Bates *et al*. 2014). These geckos are associated with large rocks, occurring underneath and within crevices (Eifler *et al*. 2017; Pers. obs.).

Cordylus vittifer occurs in the north-eastern area of South Africa, with its distribution also extending slightly into southern Botswana (Bates *et al*. 2014). The Soutpansberg Mountains are the at most northerly tip of this species distribution. This small, flat bodied cordylid lizard is associated with rocky outcrops in grasslands where they frequent crevices (Branch 1998). Selected body temperature in laboratory settings for this species is low, at 32.1°C (Skinner 1991).

Lygodactylus incognitus is a small diurnal gecko and is endemic to the Soutpansberg Mountains. Occurring only in the western Soutpansberg, this species is restricted to elevations above 1100 m and only occurs on the southern slopes (Petford *et al*. 2019; Petford & Alexander 2020). The distribution of this species appears to be predominantly influenced by temperature, with locations with high average temperatures considered unsuitable (Petford *et al*. 2019). *Lygodactylus incognitus* selects moist microhabitats and occurs on rocky outcrops where it utilises crevices, this species can also be found on trees (Petford & Alexander 2020).

Lygodactylus soutpansbergensis is a small, diurnal gecko, endemic to the Soutpansberg Mountains. This gecko also only occurs on the western Soutpansberg, as *L. incognitus,* but has a wider distribution, occurring at all elevation levels and on both the southern and northern slopes (Petford *et al*. 2019; Petford & Alexander 2020). This distribution of *L. soutpansbergensis* is predominantly influenced by temperature, with locations with high average temperatures considered unsuitable (Petford *et al*. 2019). This species occurs on rocky outcrops and small to medium loose rocks and boulders, the presence of suitable rocky structures appears to be an important aspect of where this species will occur (Petford & Alexander 2020).

Platysaurus intermedius is a dorsoventrally-flattened, cordylid lizard endemic to South Africa where it occurs in the north-western regions of Limpopo and Mpumalanga (Bates *et al*. 2014). This species occurs on rocky outcrops where it can be found in crevices and cracks (Branch 1998).

Platysaurus relictus is a dorsoventrally-flattened, cordylid lizard endemic to the Soutpansberg Mountains where it is largely restricted to the western Soutpansberg (Petford *et al*. 2019). The species does not occur in areas with high temperatures or high rainfall and is predominantly associated with pink quartzite and sandstone rock formations (Petford *et al*. 2019).

Smaug depressus occurs in the Limpopo province of South Africa where it is largely associated with mountainous areas and rocky outcrops (Bates *et al*. 2014). This cordylid is a large, spiny species with a flattened body (Branch 1998).

Trachylepis margaritifer is a widely distributed skink species, occurring in savannah throughout eastern southern Africa and into southern East Africa (Bates *et al*. 2014). It can be found on rocky outcrops, utilising rock crevices, and is particularly associated with igneous

and metamorphic rock formations (Branch 1998; Spawls *et al*. 2018). *Trachylepis margaritifer* is likely limited in its distribution by temperature, with environmental temperatures lower than 22°C being considered unsuitable due to constraints on digestive ability (Miller 2016).

Trachylepis punctatissima occurs throughout southern Africa, occurring as far north as Malawi (Bates *et al*. 2014). Found on rocky outcrops in grasslands and savannah where it inhabits rock crevices and can be found under larger rocks (Branch 1998; Bates *et al*. 2014; Pers. obs.).

Vhembelacerta rupicola is a lacertid lizard, endemic to the Soutpansberg Mountains. It is largely confined to the western and central areas of the mountain range (Petford *et al*. 2019). The distribution of this species is presumably restricted by temperature and precipitation with areas with high temperatures and high precipitation seasonality being unsuitable (Petford *et al*. 2019). This species is dorsoventrally flattened, inhabiting rock crevices on rocky outcrops and slopes where it prefers those on a southern aspect (Branch 1998; Kirchoff & Richter 2009).

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