# Natural history observations of a dwarf 'green' gecko, *Lygodactylus conraui* in Rivers State (Southern Nigeria)

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**ABSTRACT** - *Lygodactylus conraui* is the only green gecko species occurring in West Africa, and is also one of the smallest gecko species of the African continent. Here, some aspects of the natural history of this species are documented for Rivers State, southern Nigeria. In total, 108 *L. conraui* individuals were observed in 1996-2016 in southern Nigeria. Individuals of this species were mainly observed at originally forested sites that were heavily altered by human inclusion. In southern Nigeria, *L. conraui* may be a pioneer species that quickly colonises microhabitats at ecotonal sites of recently deforested or rapidly re-growing forest areas. In each site, the number of observed lizards was significantly positively influenced by the percent of available shade within each habitat type. These geckos were found most commonly at 0.8-3.2 m height. Their activity was especially concentrated during the wet season months. Mean distance between individuals in each demes was 1.35 m (range 0.70-3.2 m).

## INTRODUCTION

Geckos are among the most speciose groups of lizards worldwide (Rösler, 2000). They have explored a wide variety of ecological niches in both temperate and tropical ecosystems, but most of them are nocturnal and dull in coloration (Rösler,1995; Bauer, 2013). Nonetheless, there are several mostly tropical species, belonging to different groups of geckos, that are diurnal, and with green dorsal coloration (Rösler,1995). *Lygodactylus conraui*, the only West African 'green' gecko, inhabits the West African Guinea savannahs and open forests (Trape et al., 2012) and also occurs in swamped and dry forests of southeastern Nigeria (Akani et al., 1999; Luiselli et al., 2007) and Cameroon (Chirio & LeBreton, 2007). The ecology of this species in the field is very little known (but see Luiselli et al., 2007; Rugiero et al., 2007), with studies showing that it is mainly diurnal and that it is found in different types of forest in Nigeria, where however it is one of the apparently least common of the forest zone geckos (Luiselli et al., 2007). The species appears to be relatively uncommon in other parts of its range: for instance, in Togo it has been reported for the first time just recently (Bauer et al., 2006) and no other data have been collected during devoted long-term field studies on the lizards of this country (Segniagbeto et al., 2015). In the rainforest zone of Nigeria, this species appears to be less generalist in dietary habits than sympatric geckos, its elective prey being adult lepidopterans of very small size (Rugiero et al., 2007). Considerable anthropochoristic habits have been observed in Benin (Manners & Goergen, 2015). The rest of the data concerning the biology of this species comes essentially from captive specimens (e.g., Hofman, 2011) or from mostly distributional accounts (e.g., Hoogmoed, 1979, 1980; Bauer et al., 2006; Segniagbeto et al., 2015). In this note, we report additional natural history data on *L. conraui* in southern Nigeria, with emphasis on habitat use and climbing heights, seasonal activity patterns and inter-individual distances. We also include original data on the local distribution of the species on the basis of original field surveys. Although preliminary, our field data may be useful to enhance our general knowledge on the ecological strategies of tropical diurnal green geckos.

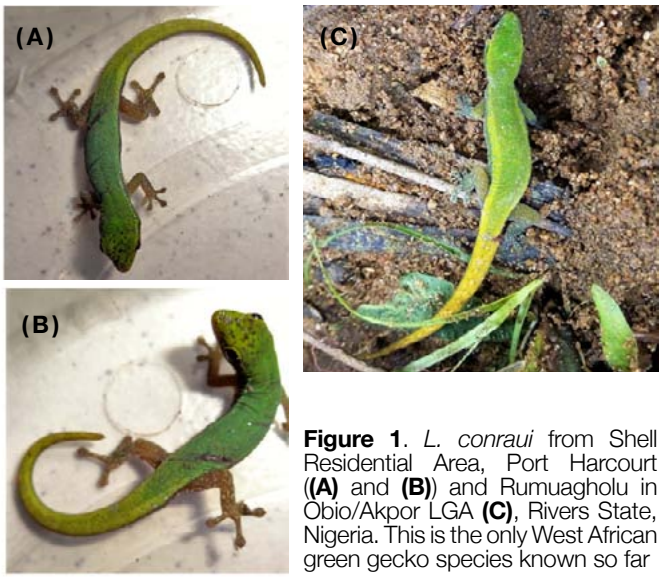


**Figure 1**. *L. conraui* from Shell Residential Area, Port Harcourt (**(A)** and **(B)**) and Rumuagholu in Obio/Akpor LGA **(C)**, Rivers State, Nigeria. This is the only West African green gecko species known so far

**Figure 2**. Habitat characteristics of the study sites where individuals of *L. conraui* were observed during the present study

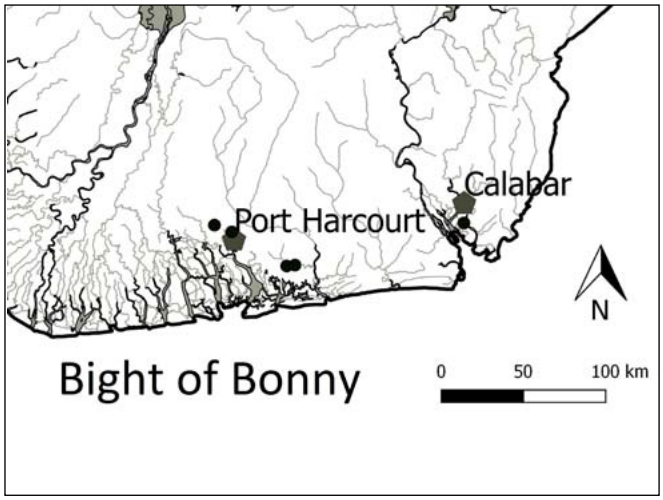


**Figure 3**. Map of southeastern Nigeria showing the localities of capture/observation for *L. conraui* during our field investigations, years 1996-2016. In dark grey, the area subjected to seasonal inundations. Only original data (not bibliographic compilation of presence sites) is presented in this map.

## STUDY AREAS

This study is based on (i) opportunistic presence records obtained during field surveys for reptiles conducted between 1996 and 2016 in southern Nigeria, and (ii) ecological observations, specifically focused on *L. conraui*, that were carried out at two distinct study sites.

The main study sites (Fig. 2) were two distantly separated stations in Rivers State, Nigeria, namely at Shell Residential Area, PH (04°51.022'N; 07°4.143'E) (site 1) and Taabaa (04°39.881'N; 07°22.193'E) (site 2). The two stations in Rivers State are approx. 43 km apart and lie on the north eastern flank of Port Harcourt, the capital city of Rivers State of Nigeria. These sites lie in the humid equatorial bioclimate, with an annual rainfall well over 2500mm annually, and with rainy season concentrated between April and September.

The various habitat types available at the study sites were categorised as follows:

**Site 1 (9.5 ha area)** – (a) Orchards (2 ha); this habitat was dominated by shade-producing trees (*Roystonea regia*, *Delonix regis*, *Anthocleista vogelii*, *Terminalia catappa*), with grassy ground, and about 60% of the area was shady at midday. (b) Ornamental garden (3.5 ha); this habitat was predominantly characterised by plants of *Roystonea regia* and *Pseudotsuga menziesii*. Wide pedestrian paths occurred in this habitat, and were bordered on both sides with oil palms *Elaeis guineensis* and with *Hylocereus undatus* and *Terminalia superba*. This habitat was less shaded than the previous one (about 30% at midday). (c) Shaded forest (2.5 ha); this habitat was characterised by a remnant secondary forest and bush fallow, including trees of *Elaeis guineensis*, *Ficus* spp., *Psidium guajava*, bush orange trees, and *Persia americana*. This is the most shaded habitat available at the site (about 80% at midday). Despite being the most natural place (although with many nonnative species), it was the habitat type closest (less than 500 m distance) to human settlement. (d) Human settlement (1.5 Ha); this habitat was characterised by houses and compounds, with just a few ornamental flower plants and trees (*Terminalia* spp). Shade was about 40%.

**Site 2 (9.5 ha)** – (i) Bamboo hut (0.5 ha); this was a small bush-house made of mud, with the roof made of palm fronds. This place was situated at the border of Taabaa village. This is the most shady habitat of site 2 (about 70% by midday). (ii) Bush fallow (2.5 ha); this habitat type was an abandoned farmland with weeds, rhizomes, bulbs and corms, plus stems of uprooted cassava and plantains. Shade was not much (about 15%). (iii) Freshwater swamp (6.5 ha); this habitat type was more elaborated than the previous ones, with Raphia palms, umbrella trees (*Musanga cecropoides*), *Harungana madagascariensis*, and weeds such as *Chromolaena odorata*, *Urena lobata* and *Aspilia Africana*. Shade was high (60% at midday).

## METHODS

A total of 31 days were spent in the field at site 1 (in 2011) and 21 days at site 2 (in 2015). Out of the 52 field days, 29 were spent during the dry season and 23 during the wet season. In each field day, an effort was made to cover regularly the whole study areas during different parts of the day, and at least 8 hours were spent in the field. Overall, the search effort was 251 man-hours at site 1 and 172 man-hours at site 2. Geckos were captured by hand or were noosed. For each specimen we also recorded the time of activity, its habitat type (see above for the description of habitat types in the two study areas) and its height of climbing from the soil. Once a lizard was seen and its exact spot was noticed, we also searched visually all throughout in order to find other conspecifics. And when another individual was seen, its linear distance (cm) from the other individual was measured with a ruler (precision 5 cm).

The percentage of shade, related to a vertical plane, was also recorded at each spot where a given gecko was

observed. Measuring the percentage of shade along a vertical plane was necessary because the lizards are living on tree trunks and other vertical or near vertical surfaces above ground.

In order to evaluate the use by lizards of different height levels, we classified all sightings into four categories of height at which each individuals was observed: (i) < 0.80 cm from the ground; (ii) 0.81 – 1.60 m (iii) 1.61 – 3.2m and (iv) > 3.21m. The statistical differences in terms of utilisation of the four categories of heights by lizards and by site were analysed by $\chi^2$ test. The relationship between the number of observed lizards and the percent of shade within each habitat type was tested by Pearson's correlation coefficient, after having (log + 1) transformed the variables in order to achieve normality. Inter-seasonal difference in the frequencies of observation of the study species was analysed by $\chi^2$ test. All statistical analyses were performed with a PAST software, with alpha set at 5% and all tests being two-tailed.

## RESULTS AND DISCUSSION

**Local distribution and general habitat characteristics**

In total, 108 *L. conraui* individuals were observed in 1996-2016 in southern Nigeria, with 25 individuals captured at study site 1, 32 at study site 2, and the rest (n = 51) in other few localities (Fig. 3). As a general pattern, individuals of this species were mainly observed at originally forested sites that were heavily altered by human inclusion. For instance, the species reached apparently high density of individuals at Rumuagholu community in Obio/Akpor Local Government Area (LGA) and at Wilyaakara community in Khana LGA, in recently deforested sites (Fig. 2). However, *L. conraui* appears generally uncommon, and indeed it has not been observed during careful field investigations in protected forests such as the Upper Orashi Forest Reserve (Akani et al., 2014a), Taylor Creek Forest Reseve (Akani et al., 2014b), and Edumanom Forest Reserve (Akani et al., 2014c), all situated in the Niger Delta region. In addition, the species was also not observed in coastal forests (such as at Bonny island, Akani & Luiselli, 2009, and Brass, see Akani et al., 2010) and in eight distinct types of plantation situated in the surroundings of Yenagoa (Bayelsa State), Port Harcourt (Rivers State) and Eket (Akwa-Ibom State) (Akani et al., 2014d). The apparent rarity of this species in Nigeria may be a reason for that it was wrongly considered absent from the country by some available literature (e.g., the 'Reptile Database', available at: http://reptile-database.reptarium.cz/species?genus=Lygodactylus&species=conraui, lastly accessed on 5th February 2017). The bulk of our observations suggests that, in southern Nigeria, *L. conraui* may be a pioneer species that quickly colonises microhabitats at ecotonal sites of recently deforested or rapidly re-growing forest areas (when shade is dominant, see below; and see also Scott, 1982), becoming rarer or even absent from more stable habitats such as mature forests as well as extended/intensive plantations. Apparently, Nigerian populations of *L. conraui* are not at all linked to rocks and stony places, differently from other *Lygodactylus* species from South Africa (e.g. *L. lawrencei*, *L. ocellatus*, see Branch, 1988).

**Ecological observations**

At site 1, 100% of the lizards (n = 25) were observed in habitat (c), and at site 2, 100% (n = 32) were observed in habitat (i). Thus, these lizards appeared to be habitat specialists in both the study sites, despite the two preferred habitats were quite different each from the other (i.e. a shaded re-growing secondary forest versus the surroundings of a bamboo hut). Adding the other 51 individuals observed by us in south-eastern Nigeria to the sample sizes from sites 1 and 2, it resulted that the number of observed lizards was significantly positively influenced by the percent of shade within each habitat type ($r=0.640$, $n = 13$, $r^2=0.410$, $P < 0.02$) (Fig. 4). Thus, it is likely that an important correlate of their habitat selection within each presence site would be the relative availability of shade. Indeed, these lizards were often observed while moving in the shade: in Tabaa, for instance, these geckos preferred a shaded bush near a hut made of bamboo, and they were often observed to move from this bush to the hut to forage on insects (especially termites) they find in the bamboo hut. Pooling all the data recorded by us in southeastern Nigeria

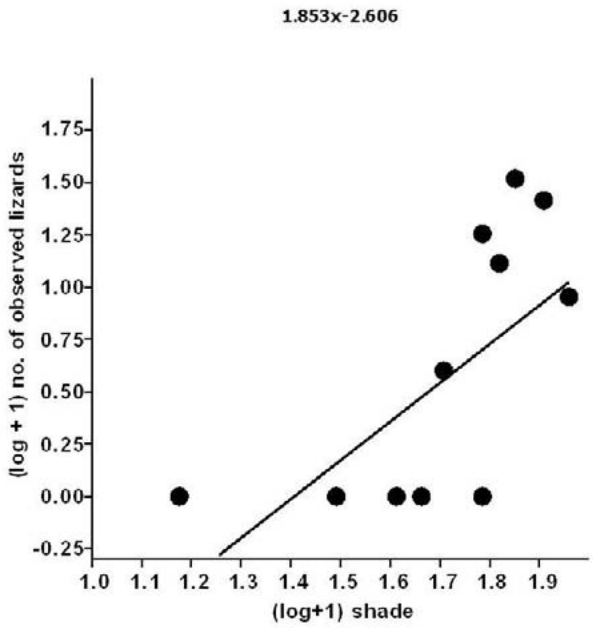


**Figure 4**. Relationships between percent of shade and number of observed individuals of *L. conraui* in each habitat in the various presence sites in southern Nigeria. For statistical details, see the text.

(n = 108 geckos), there was a significant difference in terms of utilisation of the four categories of heights of climbing by lizards ($\chi^2 = 10.89$, $df = 3$, $P < 0.05$), with at all sites geckos being found most commonly at 0.8-3.2 m height (Fig. 5). Although it is possible that the decreasing frequency of observations of geckos at over 3.2 m height may be due to observational biases (due to small size of the

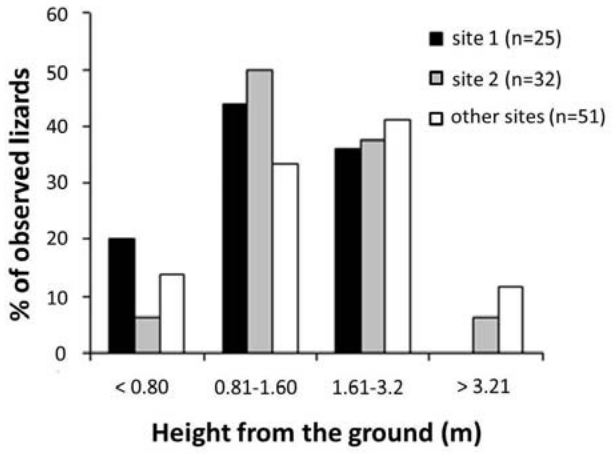


**Figure 5**. Perpendicular height (m) from ground of *L. conraui* individuals (total n = 108) observed at the various study sites. Most of the individuals were observed on trees, but occasionally also on palm fronds, houses and other walls. For the statistical comparisons, see the text.

animals and their cryptic colouration), their low frequency of occurrence at ground level and at low heights was surely not biased. Our quantitative observations confirmed that *L. conraui* is clearly a climbing, mostly arboreal species, as the great majority of the about 60 species of *Lygodactylus* worldwide (an exception being *L. gravis* from Tanzania; Msuya et al., 2014).

Despite the higher survey effort in the dry season (see methods), 81 out of 108 (75%) individuals (data from all sites being pooled) were observed in the wet season (inter-seasonal difference: $\chi^2 = 14.4$, df = 1, $P < 0.0001$). The statistically higher activity of these geckos during wet season mirrors more general data on the seasonal activity of reptiles in the Niger Delta, that consistently revealed wet season activity peaks for these animals (e.g., Akani et al., 2014a).

Distance between individuals (m) was measured in 17 cases, and was 1.35 m (range 0.70-3.2 m) on average, thus suggesting that the demographic structure of these reptiles may be characterised by small groups of individuals that live very close each another, probably concentrating in sites with suitably high prey density and appropriate microclimatic conditions. Another possibility is limited retreat and or egg-laying sites, and if this is the case, certainly this would dictate local distribution and spacing in at least some other geckos. Both these hypotheses remain merely conjectures in absence of larger data samples and will require further investigations.

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