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First record of Seven Species of Lizards in Taï National Park (South West, Côte d'Ivoire)

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Abstract
This study aims to confirm the presence of seven (7) species of lizards (*Agama agama* (Agamidae), *Chamaeleo gracilis* (Chamaeleonidae), *Hemidactylus* sp. (Gekkonidae), *Hemidactylus pseudomuriceus* (Gekkonidae), *Lygodactylus conraui* (Gekkonidae), *Mochlus fernandi* (Scincidae) and *Panaspis togoensis* (Scincidae) in the Taï National Park and to collect additional data regarding their activities during their observations, their habitats and their conservation status. The habitats surveyed were secondary forests, characterised by the presence of herbaceous plants, shrubs and dwellings, and primary forests, marked by the presence of large trees with more than 80% closed canopy and more than 90% leaf litter. Sampling of lizards in the park took place over a period of twenty-five (25) days (15 May to 25 October 2018). The presence of these species in the primary and secondary forests of the Taï National Park and in the peripheral agrosystems would be linked to their ecological plasticity.

Keywords: Lizards, tropical biodiversity, agriculture, taï national park, southwestern Côte d'Ivoire

Introduction
Found in all continental and even aquatic environments, lizards present a great specific diversity and many species highly remarkable by their appearance or their biology. They are, however, a very understudied group in West Africa, where several species new to science have only been discovered in recent years (Tape *et al*, 2012) [20]. There is little doubt that other species of lizards still unknown in Côte d'Ivoire and in the Taï National Park remain to be discovered. One year later Grell *et al.* (2013) [11] recorded a total of eight (8) species of lizards (*Hemidactylus albivertebralis, Hemidactylus angulatus, Hemidactylus mabouia, Hemidactylus fasciatus, Trachylepis affinis, Trachylepis paucisquamis* and *Varanus* sp.) including two (2) newly observed in the Taï National Park (*Hemidactylus angulatus, Hemidactylus mabouia*) and one newly observed in Côte d'Ivoire *Hemidactylus albivertebralis*).
Thus, in 2022, the present publication aims to confirm *Agama agama* (Agamidae), *Chamaeleo gracilis* (Chamaeleonidae), *Hemidactylus* sp. (Gekkonidae), *Hemidactylus pseudomuriceus* (Gekkonidae), *Lygodactylus conraui* (Gekkonidae), *Mochlus fernandi* (Scincidae) and *Panaspis togoensis* (Scincidae) in Taï National Park. Then to collect additional data on their activities during observation, their habitats and their conservation status.

Materials and Methods
Presentation of the study area
Taï National Park (TNP) is located in the southwest of Côte d'Ivoire, between the Cavally and Sassandra rivers, and the towns of Guiglo, Buyo, San Pedro and Tabou. It lies between 05°08' and 06°24' north latitude and 06°47' and 07°25' west longitude (OIPR, 2015) [14]. The climate of the TNP is sub-equatorial with four seasons, a long rainy season from mid-March to July, a short dry season in August, a short rainy season from September to October and a long dry season from November to mid-March. However, this regular seasonality has changed somewhat in recent years. The average annual rainfall is 1800 mm, ranging from 1700 mm in the north to 2200 mm in the south of the park (Chatelain *et al.*, 2001) [5]. The average monthly temperature ranges from 24°-28°C (Koné, 2004) [12]. The average monthly relative humidity is always high, varying from 85% to 90% under the forest canopy, and generally reaches 100% at night (Bousquet, 1978) [2]. The West African dry season wind, the harmattan, is irregular and has little impact in the area; it usually lasts only one to two weeks

in December or January (Adou *et al.*, 2005) [1]. With regard to plants, the TNP is part of the large Guinean-Congolian floristic region (Dupuy *et al*., 1999) [8]. It is the largest dominant rainforest area in the Upper Guinean biodiversity hotspot (Myers *et al*., 2000) [13]. The flora of TNP includes more than 1350 plant species, of which 80 are endemic (Chatelain and Kadjo, 2000) [4]. In terms of fauna, the park is home to approximately 145 species of mammals, which corresponds to 93% of the mammalian fauna of the West Guinean forest zone (Riezebos *et al.*, 1992) [15], 234 species of birds (Demey, 2006) [7], 60 species of fish (Grell *et al*., 2013) [11] and 56 species of amphibians (Rödel and Ernst, 2004; Ernst *et al.*, 2006) [16, 10]. Compiling the work done by Rodel & Mashberg (2000) [17], Ernst & Rodel (2002) [9] and Grell *et al*., (2013) [11] on Reptiles in Tai National Park give, 54 species of reptiles including eight (8) species of lizards are known in TNP.

Sampling methodology

Selection of study sites

Qualitative sampling was conducted from May to October 2018, during the long and short rainy season, as well as the short dry season. We established a total of 40 plots of 50 x 50 m, divided into 25 plots in the park and 15 plots in farming systems (Figure 1). In the TNP, 18 plots were set up in primary forest and seven plots in degraded forest. At the periphery of the TNP, five plots are located in coffee/cocoa plantations, five in rubber plantations and five in rice fields.

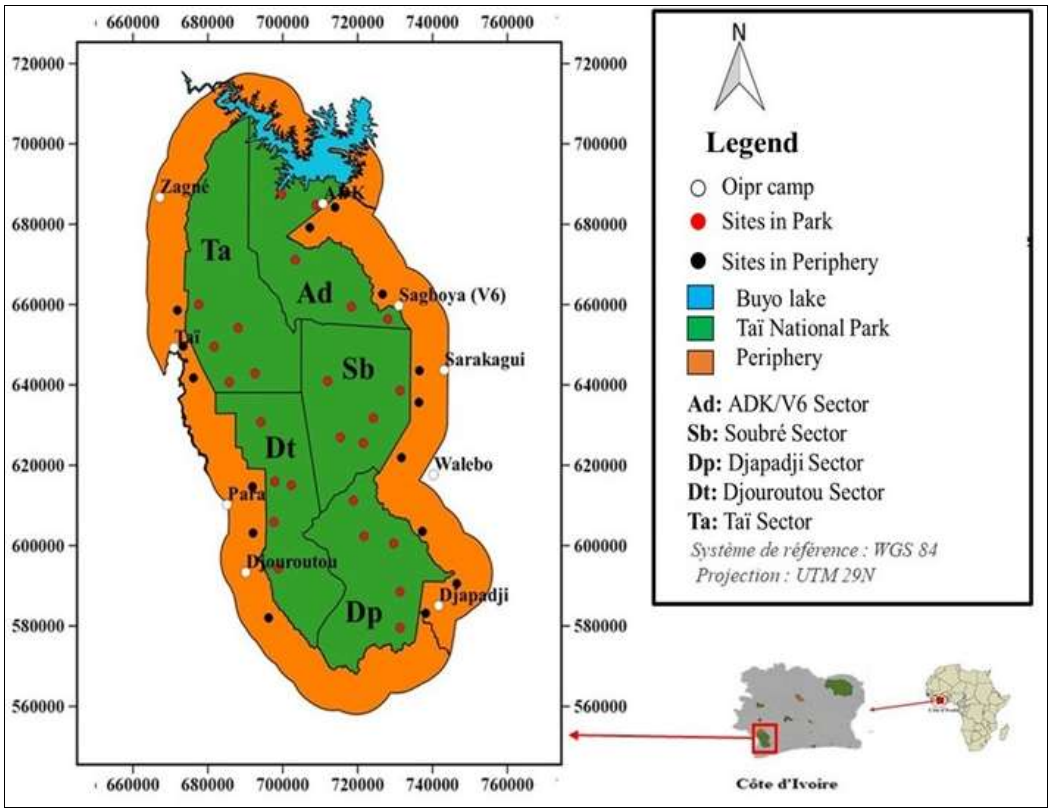

Fig 1: Location of the 40 sampling sites in the Taï National Park and surrounding agrosystems.

Description of the study areas

These environments, selected according to the degree of openness of the vegetation and the presence or absence of water, are grouped into three habitat types (PF: primary forest, DF: secondary forest and SA: agricultural systems).

PF: located in Tai National Park in a primary forest consists of three micro-habitat types: Closed wet habitat with closed understory, Closed dry habitat with closed understory and Closed dry habitat with open understory (Figure 2 A, B and C).

DF: Also located in the park not far from its periphery in a secondary forest, it is characterised by Dry Open Habitat with Herbaceous Soil, Wet Open Habitat with Herbaceous Soil and Wet Open Habitat with Bare Ground (Figure 2 D, E and F).

SA: Situated around Tai National Park, in agricultural systems, is represented by sparse anthropised habitats consisting of rice field (RF), rubber plantation (RP) and a mosaic of coffee and cocoa plantation (MCC) (Figure 2 G, H and I).

PF: Primary forest (A, B and C); DF: Highly degraded forest (E, F and G); SA: agricultural system (RP: rubber plantation (G); MCC: Cocoa and coffee plantation (H); RF: rice field (I)).

Fig 2: Examples of views of habitats in and around Taï National Park where lizards were sought

Survey

Plots were visited once (40 days in total) with a constant sampling intensity of 8h/visit, either a total of 320h of sampling. Lizards were searched visually in all the different habitats, by three people, day and night (per visit: 09:00-16:00 h & 18:00-19:00 h GMT) following Roux and Slimani (1992) [18]. The sampling effort is 24 person-hours per plot visit and was kept constant throughout the study. The sampling method adopted consisted of a visit to sites that were favourable on the face of it, using a slow and silent walk, punctuated by frequent stops. The lizards were detected visually and indirectly by clues: cadavers and eggs. Surveys are directed towards attractive sites where observations are easy: roadsides, edges, watering holes, riparian forests, exhibition plots. During each survey, excavations were also made in places of refuge, by lifting stones, dead trunks, searching inside the vegetation. In the field, samples and photos of the different specimens are examined in order to identify individuals down to the lowest possible taxonomic level following the nomenclature proposed by Trape *et al*. (2012) [20]. Additional data on their activities during their observations, their habitats and their conservation status were noted. In addition, representatives of some species were collected and preserved in 70% ethanol. The reference specimens were deposited in the collection of the Hydrobiology Unit of the Laboratoire de Biologie et d'Ecologie Tropicale of the Université Jean Lorougnon Guédé, Côte d'Ivoire.

Results and Discussion

The seven (7) new species of lizards (Figure 3) were collected in the habitats of the Taï National Park and its periphery. These are: one specie of Agamidae (*Agama agama*), one specie of Chamaeleonidae (*Chamaeleo gracilis*), two species of Scincidae (*Mochlus fernandi* and *Panaspis togoensis*) and three species of Gekkonidae (*Hemidactylus* sp., *Hemidactylus pseudomuriceus*, *Lygodactylus conraui*). This number is similar to those reported by Grell *et al*. (2013) [11], who recorded eight (8) species of lizards for the first time in Tai National Park. These consisted of one species of Agamidae (*Agama africana*), Varanidae (*Varanus* sp.), two species of Scincidae (*Trachylepis affinis, Trachylepis paucisquamis*) and four species of Gekkonidae (*Hemidactylus albivertebralis, Hemidactylus angulatus, Hemidactylus mabouia* and *Hemidactylus fasciatus*). Among the seven (7) species recorded for the first time in the study area, a Gekkonidae (*Hemidactylus* sp.), is new to Côte d'Ivoire (Trape *et al.*, 2012) [20]. The presence of these new species in the study area is thought to be due to the fact that this group is very poorly studied (Tape *et al.*, 2012) [20].

The total list of species, habitat preferences, iucn status, species activity during observation and observation habitats in the study area are given in Table 1. The seven (7) new lizard species recorded for the first time in the study area belong to 4 families and 6 genera (Table 1). The number of genera recorded in this study is higher than that recorded by Grell *et al*.(2013). This difference in numbers is attributed to the study area, sampling method and effort. Indeed, Grell *et al.* (2013) [11] surveyed mainly aquatic fauna for thirty-nine (39) days in streams of the TNP.

While ours was carried out over forty (40) days in the park, in closed, open, wet and dry habitats on the one hand, and in the agrosystems on the periphery of the TNP on the other, consisting of rubber plantations, a coffee and cocoa mosaic and a rice field.

In addition, the highest number of lizard species was observed in TNP in degraded forests (6 species), followed by primary forests (3 species). The lowest species richness was recorded at the periphery of the TNP with two species

in rice, coffee and cocoa plantations and one species in rubber plantations. *Chamaeleo gracilis* is the only species observed in forest environments. It is therefore limited to these forest environments which contribute to its development (Branch and Rödel, 2003) [3]. Indeed, this species has also been recorded in other tropical forest areas in West Africa (Branch and Rödel, 2003) [3]. The presence of this species in forest blocks is thought to be related to its preferred habitat which is confined to fairly well preserved forests. The presence of these species in the TNP is nevertheless important as it gives an indication of the conservation status of the TNP. The absence of the species *Chamaeleo gracilis* from the anthropised environments of the park and its periphery is explained by the fact that this reptile species is very vulnerable to habitat degradation (Rubio and Simonetti, 2011; Uribe and Estades, 2015) [19, 21]. In addition, *Agama agama* and *Mochlus fernandi*, species not assessed, were found to be the most common of the five study habitats. The species *Agama agama* is generally found in savannah and degraded forest areas and also in urban areas (Trape *et al.*, 2012) [20] and its presence in TNP is a clear indication of the anthropogenic pressure experienced by the park.

The specie is also found in West Africa (Branch and Rödel, 2003) [3]. The presence of this specie in the forest blocks would be related to its preferred habitat which is confined to fairly well preserved forests. The presence of these species in the TNP is nevertheless important as it gives an indication of the conservation status of the TNP. The absence of the specie *Chamaeleo gracilis* from the anthropised environments of the park and its periphery is explained by the fact that this reptile species is very vulnerable to habitat degradation (Rubio and Simonetti, 2011; Uribe and Estades, 2015) [19, 21].

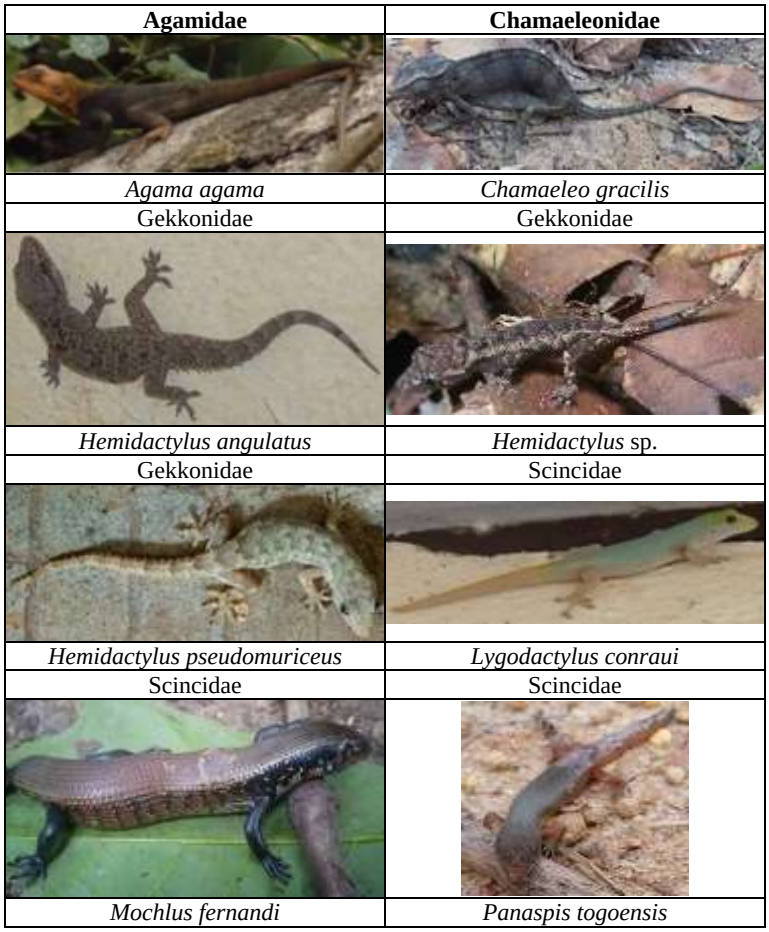

Fig 3: Reptile species collected in Tai National Park and surrounding agricultural systems.

Table 1: Newly recorded lizard species in Tai National Park and surrounding agricultural systems, with recorded sites and general habitat preferences of the species.

	Habitats	Biotopes	IUCN status	Activities	TNP Habitat		Surrounding agricultural systems			Sites
					PF	DF	MCC	RP	RF	
Sampling units (days)					18	7	5	5	5	
Research effort (p-h)					432	168	120	120	120	
Family / Species										
Agamidae										
Agama agama	Savannah and man-made forest	land	NE	Solar exposure and power supply	0	1	1	1	1	Ad, Sb, Dp, Dt.

Chamaeleonidae										
Chamaeleo gracilis	Savannah and open forest	arboriculture	LC	Moving to shrubs and laying eggs in the ground	1	0	0	0	0	Ad, Sb.
Gekkonidae										
Hemidactylus pseudomuriceus	forest	land	NE	Moving on a wall	0	1	0	0	0	Ad
Hemidactylus sp.	-	-	-	Moving on the ground litter near a windfall	0	1	0	0	0	Ad
Lygodactylus conraui	Dense and anthropised forest	land	NE	Moving on a wall	1	1	0	0	0	Ta
Scincidae										
Mochlus fernandi	Dense forest	land	NE	Exiting a termite mound and moving onto the litter	1	1	1	0	0	Sb, Ta.
Panaspis togoensis	Savannah	land	LC	Displacement on wetland litter	0	1	0	0	1	Ad.
Total 4 /7					3	6	2	1	2	

PF= primary forest; DF= degraded forest; MCC= mosaic of coffee and cocoa plantations; RP= rubber plantation; RF= rice field. 1: Presence / 0: Absence, NE= Not Evaluated; LC= Least Concern; CR= Critically Endangered.

Conclusion

This study allowed us to observe for the first time seven species of lizard. This large number of species recorded in the study area indicates the good conservation of Taï National Park. However, the presence of *Agama agama*, a species characteristic of highly anthropised environments, reveals that TNP is under anthropic pressure.

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