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Djomnang Nkwala AL
Laboratory of Biology and Applied Ecology, Department of Animal Biology, Faculty of Science, University of Dschang, PO Box 067 Dschang, Cameroon.

Chahdini Gbambie A
Laboratory of Biology and Applied Ecology, Department of Animal Biology, Faculty of Science, University of Dschang, PO Box 067 Dschang, Cameroon.

Mpoame Mbida
Laboratory of Biology and Applied Ecology, Department of Animal Biology, Faculty of Science, University of Dschang, PO Box 067 Dschang, Cameroon

Wabo Poné J
Laboratory of Biology and Applied Ecology, Department of Animal Biology, Faculty of Science, University of Dschang, PO Box 067 Dschang, Cameroon.

Correspondence:
Wabo Poné J
Laboratory of Biology and Applied Ecology, Department of Animal Biology, Faculty of Science, University of Dschang, PO Box 067 Dschang, Cameroon.

Occurrence of ticks and gastrointestinal helminths in the house gecko (*Hemidactylus spp*) from Dschang in Cameroon

Djomnang Nkwala AL, Chahdini Gbambie A, Mpoame Mbida and Wabo Poné J

Abstract
House geckos (genus *Hemidactylus*) are small tropical lizards. Like all vertebrates, house geckos are susceptible to habour parasites which are vectors of some pathogenic agents. Between transition periods end of rainy season (September) and the start of dry season (December)] in 2014, a total of 240 geckos were caught in Dschang in the night using a broom and introduced into a plastic bucket. The bucket was immediately transported to the laboratory and the geckos examined for ecto and gastrointestinal parasites. An overall prevalence of 98.34% was recorded for ectoparasite infestations. Two (2) different genera of ectoparasites were identified: 98.34% *Argas* (Argasidae) and 24.17% *Rhipicephalus* (Ixodidae). The start of dry season was more favorable for the development of ectoparasites. Parasitism was not influenced by host sex. The infestation intensities were significantly ($P<0.05$) higher in adults (108.5 ± 98.31) than in juveniles (53.90 ± 79.22). The two genera of ticks identified infested all parts of the host. Ectoparasites were frequently found in sites with cutaneous folds or high numbers of scales. It is known that, ticks of the 2 genera identified are susceptible to feed on humans, in the absence of the natural host. For gastrointestinal parasites 2 species of nematodes [*Pharyngodon laevicauda* (63.30%) and *Parapharyngodon anomalus* (04.67%)] and one species of cestode [*Oochoristica jonnesi* (32.01%)] were identified. Male geckos suffered a higher gastointestinal parasitic pressure. Adult hosts were more infested than juveniles with prevalences of 25.00% and 12.99% respectively. The large intestine was the most exploited site for the nematodes (31.66%) while the cestode preferred the small intestine. The presence of the above mentioned parasites in the house gecko constitutes new host records.

Keywords: Parasitic fauna, *Hemidactylus*, external parasites, intestinal helminths, Cameroon.

1. Introduction
House geckos are commonly found in human dwellings in tropical countries, thus has a close association with human beings. They are mainly in the ceiling, nooks and at the back of calendars during the day but are active at night [1]. It may be of interest to study whether house geckos are infested by ticks, mites and infected by helminths. Direct and indirect contacts with geckos clearly represent a substantial risk for human health. According to Villeneuve (2012) [2], ticks can transmit many pathogens agents, responsible for barbesiosis, borreliosis, rickettiosis, encephalitis and some helminthiasis. Thus the aim of this study was to conduct a survey of the parasites of house geckos in Dschang (West-Cameroon) and to determine their zoonotic potential.

2. Materials and Methods
2.1 Study area
The study was carried out in Dschang (West-Cameroon). Dschang town is located between Latitude 5°20 N and Longitude 10°30 W at about 1407 m Altitude. There are 2 clearly marked dry and rainy seasons: from November – March and March – November respectively.

2.2 Collection of samples
In 2014, a total of 240 house geckos were caught in the night at 02 periods [end of rainy (September) to start of dry seasons (December)] using brooms in selected households in Dschang. Hosts were caught under bright electric bulbs and on the walls and put in transparent plastic buckets containing cotton, soaked with absolute formaldehyde (to conserve the hosts and parasites) and transported to the Laboratory of Biology and Applied Ecology of the University of Dschang for subsequent parasitological analysis.

2.3 Examination of geckos for parasites
This study focused on exploring the body and intestinal tract of 240 house geckos. Hosts weighing between 1.0 and 8.6 g were grouped in adults [male and female (168)] and juveniles (72). Their sizes varied between 4.0 and 14.5 cm. The skin of geckos was thoroughly examined under a stereomicroscope for ectoparasites. They were then carefully extracted from their location (head, back, abdomen and armpit, anterior and posterior legs, tail) using tweezers, scalpel or fine combs. These parasites were then transferred into Petri dishes containing 70% alcohol and examined under a microscope using the 10 X objective, for identification [3]. For gastrointestinal parasites examination, the geckos were dissected using tongs and scissor. Their intestinal tracts were collected and divided into 2 parts (large and small intestine). The wall of each portion was scraped with pincers to release the worms which were hanging. The content of each portion was diluted thereafter with water, and then washed several times by successive decantation until a clear suspension was obtained allowing an easy detection of the parasites.

2.4 Identification of parasites
The identification of parasites was based on the work of Kemp and Margret (1978) [4] for ectoparasites, Cruz and Mills (1970) [5] for gastrointestinal helminths**.**

2.5 Statistical analysis
The mean intensities and prevalence of infection were recorded per transitional period, host sex, host age and parasite site location (Bush *et al*., 1977) [6]. For comparisons of mean intensities of infestation, One Way Analysis of Variance (ANOVA 1) was used followed by a Duncan Post-Hoc (Zar, 1999) [7]. All statistical analyses were computed using Excel 2007 and Statistical Package for Social Sciences (SPSS) 20.0 and were considered significant at $P<0.05$.

3.1. Results
3.1.1. Parasites identified
Ectoparasites and gastrointestinal parasites harvested and their prevalence are presented in Table 1.
The 22101 ectoparasites collected belonged to two genera: *Rhipicephalus* (Ixodidae) and *Argas* (Argasidae). Concerning gastrointestinal helminthes, 406 individuals were collected. They belonged to two nematodes (*Pharyngodon laevicauda* and *Parapharyngodon Anomalus*) and one cestode (*Oochoristica Jonnesi*).

3.1.2. Effect of transitional period on the parasitic load
Figure 1 shows the mean intensity of infestations of gecko ectoparasites with respect to the transitional periods [end of rainy season (September), start of dry season (December)]. We observed that, the distribution of ectoparasites in the population of geckos varies with transitional periods. Whatever the type of ectoparasite and sites considered, pests are more abundant in the start of dry season than in end of rainy season. Thus, the start of dry season seems to be more favorable for the development and the proliferation of ticks. Moreover, infestations by the genus *Rhipicephalus* appear to have a uniform distribution in the host populations during the start of dry season. This period has been very favorable for the development of *Rhipicephalus*.
Figure 2 indicates the distribution of the gastrointestinal parasites identified in the age groups according to the transitional periods. This reveals that the end of rainy season (September) remains more favorable to development of the helminths compared with the start of dry season (December) in the two age groups. Adults are infested by three species of helminths in the end of rainy season whereas in the start of dry season only two species are observed. In juvenile, *P. anomalus* was absent in the two periods. In addition, these individuals presented high parasitic loads in the end of rainy season. A significant difference ($p<0.05$) was observed between the parasitic loads observed at the juvenile ones between the two periods with regard to the infestations with *O jonnesi*.

3.1.3. Influence of host sex on parasitic load
Table 2 shows the intensity of infestations according to host sex. Whatever the type of ectoparasite considered, male geckos harbor relatively more parasitic load, when compared to female peers. Female geckos seem to be more attracted by ticks of the genus *Rhipicephalus* than males.
Generally for gastrointestinal helminths, the female geckos present high parasitic loads compared to males with regards to the infestations with nematodes. The situation is different with regard to the cestode. As for the total prevalence of the infestations, a male gecko undergoes more parasitic pressures.

3.1.4. Influence of host age on parasitic load
Figure 3 shows the influence of host age on the parasitic load. Generally adults were significantly ($P<0.05$) infested by *Argas* than juvenile. Whatever the host harvested, the intensities of infestation by ticks of the genus *Rhipicephalus* were low between the two age groups.
Concerning gastrointestinal helminths, Table 3 shows that adults are infested than the juvenile. Generally, *P. laevicauda* was more prevalent (35.91%) followed by O. *jonnesi* (19.88%) and finally *P. anomalus* (4.97%). This latter was pledged to adults.

3.1.5. Distribution of parasites according to the sites of infestations
Distribution of ectoparasites of the house geckos, based on infestation sites is showed in Table 4. On the overall, the genus *Argas* has the preference for the posterior legs (92.92%), followed by the back (92.08%), tail (88.75%), abdomen and armpit (88.33%), the anterior legs (66.67%) and the head (57.5%). The genus *Rhipicephalus* meanwhile it seems to have a preference for the back (10%), followed by the posterior legs (7.91%). Head and abdomen are solicited by this tick with the same prevalence (7.5%). The least requested sites by the species of the genus *Rhipicephalus* are the tails and anterior legs. For gastrointestinal helminths, *P. laevicauda* was as well collected in large intestine as well as small intestine. However, prevalences were higher in large intestine of hosts with a significant difference ($P<0.05$). *Parapharyngodon anomalus* was collected exclusively in the large intestine of the geckos. On the other hand, *O jonnesi* was collected only at the level of the small intestine of the geckos of the study.

4. Discussion
The present work was aimed at an inventory of ecto and gastrointestinal parasites in house geckos in Dschang town. Ninety eight (98.34%) percent of geckos were infested by only two genera (*Argas* and *Rhipicephalus*). The overall prevalence of infestations by ectoparasites observed was

higher than that obtained (45%) by Obi *et al.* (2013) [8] in a similar study conducted in Nigeria. The difference could be due to: - the methods used. In fact, in this study, the exploration of ectoparasites was done under a dissecting microscope with tweezers and a mounted needle. While Obi *et al.* (2013) [8] examined the skin of their specimens scraped with a sharp blade using an optical microscope. These authors may have lost a number of parasites in the scraping in tegument. - The study area which can also influenced parasitism [9]. In fact, when considering different zones, parasite virulence and host susceptibility may vary [10].

The number of genera (2) identified in this study is close to the one obtained (3) in 2005 by Ameh [11] and Obi & collaborators in 2013 [8]. The first author (Ameh), along with genus *Argas*, identified 2 genera (*Aponomma* and *Trombicula*) absent from Dschang. The latter authors identified 2 genera: *Trombicula* and *Ixodes*. The latter, was absent in the first two studies. The differences observed could be due to the environmental variations such as climate, temperature, precipitations, etc in the sites of collection of house geckos. Obi and collaborators worked in the Anambra state of Nigeria, while Ameh sampled in the centre of Nigeria and the present study was conducted in Cameroon. For gastrointestinal parasite, the three helminths identified in this study were also obtained in 2013 by Obi and collaborators.

Transition periods affected the distribution of parasites. The start of dry season was more favorable for the development of ectoparasites. In fact, this period offers ideal conditions such as temperature (24 ° ≤ T ≤ 27 °C) in favor of the life cycle development of ticks [12]. For gastrointestinal parasites, end of rainy season remains more favorable to the development of the helminths compared with the start of dry season in the two age groups. The adults are infested by the three species of helminths in end of rainy season whereas in start of dry season only two species are observed.

Host gender seems to have a negligible effect on parasitism. Concerning intensities of infestations of geckos, the situation is less obvious from one area to another. However, for *Argas* ticks and gastrointestinal parasite, males were more infected than females. In fact, during the breeding season, male geckos are more vulnerable to parasitic infections due to the secretion of testosterone [13]. The vulnerability of male gecko's results: from the inhibition of immune response of the host and the conquest of the territories for searching females (Lumbad *et al.,* 2011) [14].

Concerning the infestation intensities, study revealed that they were significantly ($P<0.05$) higher in adults (108.5 ± 98.31) than in juveniles (53.9 ± 79.22) for ectoparasite. For gastrointestinal parasite, infestation intensities were not significantly ($p>0.05$) in two host age groups. This corroborates earlier observations made by Ameh in 2005 [11]. The difference between the parasitic loads could be due to the fact that (i) adult geckos are more territorious compared to juveniles (ii) for the reasons of nutrition and reproduction, they occupy large territory that expose them to infections [15]. In contrast, juvenile needs are just nutrition and also, to avoid competition with adults, they move less (Obi *et al.,* 2013) [8]. Ticks identified have the potentials to colonize all parts of the host. These results are similar to those of Delfino *et al.* (2011) [16] obtained during their works on the ectoparasites of the lizard *Tropidurus hispidus*. In fact, these authors showed that, ectoparasites (acarines) were attached throughout the host integument. However, it should be noted that the areas where the parasites were encountered most are sites containing skin folds (kinds of pockets) or are covered by a high number of scales [16]. These sites in one hand protect ticks, and in other hand offer ideal conditions for sucking blood. It is this micro-habitat that justifies the relatively high densities of ticks in their preferential sites (posterior leg, back, abdomen and armpits, and tail) [17]. The presence of nematodes in large intestine could be justified by the fact that, this portion of intestine contains not digested food residues being used as shelter to the nematodes. The presence of the cestode only in small intestine finds its justification in the biology of this parasite. Indeed, the cestodes are obligatory parasites because their organization is deprived of certain numbers of apparatus of which the digestive system. These animals do not nourish osmotrophie and consequently they place in sites rich in nutriment [18].

Table 5 shows some pathogens transmitted by the genera *Rhipicephalus* and *Argas* recorded from the literature [19, 12]. It appears that, *R. sanguineus* and *A. persicus* are species involved in the transmission of pathogens. However, *R. sanguineus* is proving to be most dangerous, because these species is a carrier of multiple pathogens including those that infect humans.

5. Conclusion

Geckos in human habitations, though they check insect pests by feeding on them, have been found to be harmful to man. This therefore, calls for health awareness campaign for war against geckos in human habitation. The tick ectoparasites identified, are susceptible to feed on humans, in the absence of the natural host. Knowing that acarines are vectors of numerous pathogenic agents, the presence of geckos in houses constitutes a potential risk for the transmission of emerging zoonosis. Furthermore, studies on geckos-human association are advocated to find out the measures for their control.

Table 1: Prevalence and mean intensities of parasites of house geckos harvested in Dschang town

Parasites	Localization	Prevalence	Mean intensity ± SD
Ectoparasites			
Argas (Argasides)	Skin	98.34%	17.25±18.61
Rhipicephalus (Ixodides)	Skin	24.14%	1.64±1.02
Gastrointestinal helminths			
Pharyngodon laevicauda	Large and small intestine	63.30%	3.59±2.71
Parapharyngodon anomalus	Large and small intestine	04.67%	1.16±0.91
Oochoristica jonnesi	Small intestine	32.01%	3.42±2.39

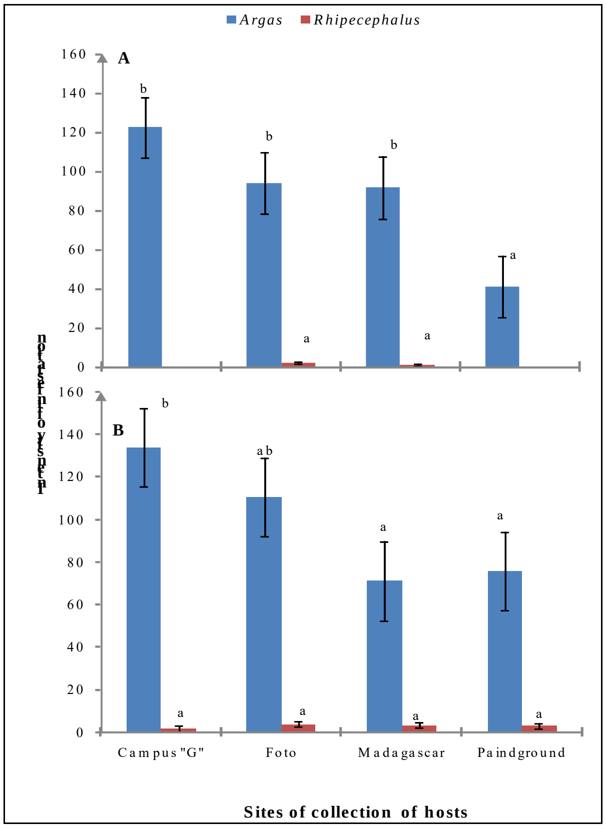

Fig 1: Intensities of infestations of house geckos in the end of the rainy season (A) and start of dry season (B).

a, b: for the same season, the same textures assigned with the same letter are not significantly different

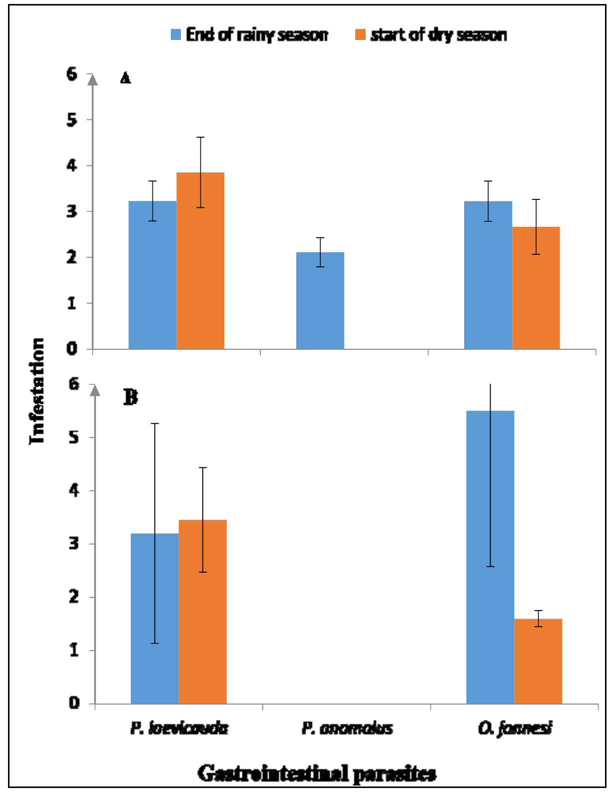

Fig 2: Distribution of identified helminths according to the transitional period at the adults (A) and juveniles (B).

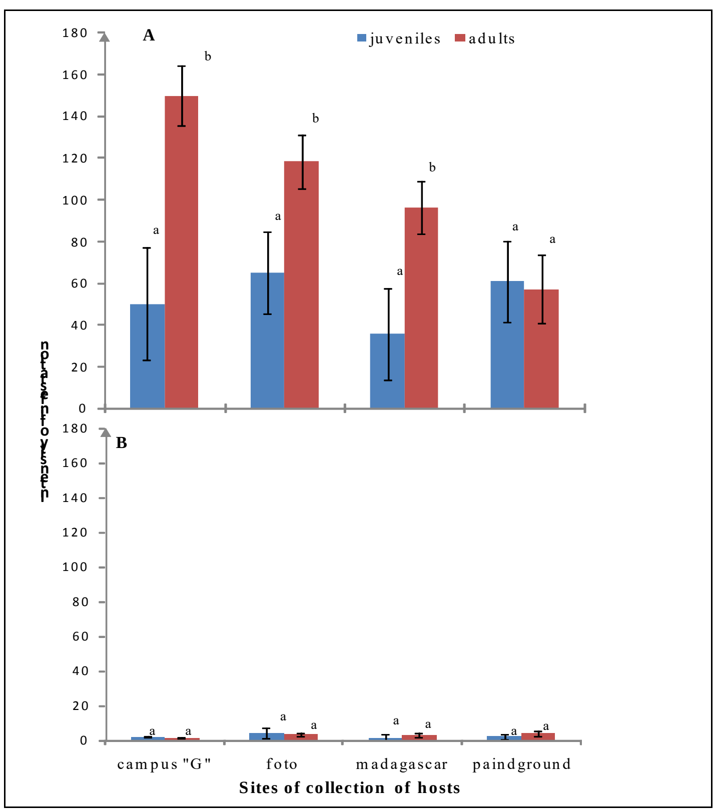

Fig 3: Intensities of infestations of house geckos by the genus *Argas* (A) and the genus *Rhipicephalus* (B) within the two age groups of the hosts.

a, b : for the same site of hosts collection, values that carry the same letter for the same genus of ectoparasites are not significantly different.

Table 2: Means infestations intensities ($\bar{X}$) and prevalences (%) of parasites of house geckos in Dschang according to the host sex.

Parasites	Prevalence		Intensities	
	Male hosts	**Female hosts**	**Male hosts**	**Female hosts**
Ectoparasites				
Argas	98.87%	98.73%	113±103.89	105.08±92.22
Rhipicephalus	22.73%	27.84%	3±3.66	3.3±4.38
Gastrointestinal parasites				
Pharyngodon laevicauda	35.6%	33%	3.25±2.42	3.76±3.1
Parapharyngodon anomalus	12.5%	5.5%	2±1.15	2.2±2.16
Oochoristica jonnesi	17.8%	21.97%	3.75±2.77	2.55±1.95

Table 3: Means intensities of infestations ($\bar{X}$) and prevalence (%) of gastrointestinal helminths in Dschang depending on the ages groups.

Age groups	Gastrointestinal helminths	Prevalence (%)	Means intensities + SD
Adults	*Pharyngodon laevicauda*	35.91	3.38±2.75
	Parapharyngodon anomalus	4.97	2.11±1.69
	Oochoristica jonnesi	19.88	3.08±2.39
Juvenile	*Pharyngodon laevicauda*	27.11	3.37±3.36
	Parapharyngodon anomalus	00	0.00±00
	Oochoristica jonnesi	11.86	2.71±2.81

Table 4: Means intensities of infestations ($\bar{X}$) and prevalences (%) of parasites of house geckos in Dschang depending on the site of infestation on the host.

Infestation sites	Parasites	Prevalence (%)	Means intensities +SD
Ectoparasites			
Head	*Argas*	57.5	4.02±4.8
	Rhipicephalus	7.5	1.82±1.33
Abdomen and armpit	*Argas*	88.33	22.17±23.87
	Rhipicephalus	7.5	1.33±0.84
Back	*Argas*	92.08	22.78±24.44
	Rhipicephalus	10	2.54±1.77
Anterior legs	*Argas*	66.67	4.09±3.97
	Rhipicephalus	2.5	1.00±0.00
Posterior legs	*Argas*	92.92	29.8±33.63
	Rhipicephalus	7.91	1.8±1.51
Tail	*Argas*	88.75	20.65±20.98
	Rhipicephalus	4.16	1.4±0.7
Gastrointestinal helminths			
Large intestine	*Pharyngodon laevicauda*	31.25	3.38±2.8
	Parapharyngodon anomalus	1.66	3.00±2.16
	Oochoristica jonnesi	0.00	00±00
Small intestine	*Pharyngodon laevicauda*	2.91	3.71±34
	Parapharyngodon anomalus	0.00	0.00±00
	Oochoristica jonnesi	17.91	3.02±2.4

Table 5: List of some pathogens transmitted by genera *Rhipicephalus* and *Argas*.

Groups of Pathogens	Pathogens	Tick vector	Transmission to human
Protozoa	Barbésioses :		
	Barbesia canis canis	*Rhipicephalus sanguineus*	NO
	B. canis vogeli	*R. sanguineus*	NO
	B. gibsoni	*R. sanguineus*	NO
	Hépatozoonosis :		
	Hepatozoon canis	*R. sanguineus*	NO
Rickettsia	Rickettsioses :		
	Rickettsia conorii	*R. sanguineus*	YES
	Hémobartenelloses :		
	Hémobartenellosa felis	*R. sanguineus*	NO
	Bartonelloses :		
	Bartonella sp.	*R. sanguineus*	YES
Bacteria	Borreliosis :		
	Borrellia burgdorferi	*R. sanguineus*	YES
	Anserina gallinarum	*Argas persicus*	NO
	Q fever :		
	Coxiella burneti	*R. sanguineus*	YES

Source: Rodhain and Perez (1985) [19]; Drevon-Gaillot (2002) [13].

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