Abundance and morphometric study of some Lizards (Agama lizard, Skinks and Wall gecko) in the University Community in Nigeria: Obafemi Awolowo University as a case study

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Abstract

This study investigated the abundance and some morphometric parameters of lizards (*Agama. agama, Hemadactylus. brookii, Trachylepis. affinis* and *Trachylepis. quinquetaeniata*) in the University campus, Ile-Ife. The specimens were collected in five different locations in the University campus. The samples were collected with sweep nets in all the locations. A total of 624 specimen of lizards (324 of *A. agama*, 185 of *H. brookii*, 60 of *T. affinis* and 55 of *T. quinquetaeniata*) were caught in all the locations and external body measurement was carried out with the help of calliper. *A. agama* was found to be abundant in all the locations followed by *H. brookii*. The number of Skinks (*T. affinis* and *T. quinquetaeniata*) in the residential area was low but high in University parks and garden and markets. The morphometric parameters showed that *A. agama* was different in all the parameters measured compared to the rest specimens and it was expected since the specimens were not of the same family except the Skinks (*T. affinis* and *T. quinquetaeniata*). There were similarity in values of some of the measured body parts of *H. brookii*, *T. affinis* and *T. quinquetaeniata*. The Principal Components Analysis (PCA) showed that all the specimens differ in Tail length, Tail width, and Trunk length. In conclusion, the abundance of the Lizards in the University call for concern because their waste can contaminate food and cause infection since they are hosts to a number of parasites.

Keywords: Infection, Parasite, Trunk length, Head length

1.0 Introduction

Parasite causing infectious disease can be found in some lizards living around us (1) are of great fear to human existence. Parasites are found in lizards which are found everywhere in many of the tropical climates of the world. Although, most lizard species are harmless to humans unless provoked (2), but they can cause diseases if they lay eggs or excrete into human food. The population of lizards in Nigeria is high (33%), while the highest number is found in Southwest, Southeast and Southsouth region of the country where the temperature is not high.

In some parts of the world, lizards and other reptiles such as snakes, crocodiles are used for food (3). In Nigeria, the clouded–monitor lizard serves as a source of meat for people who likes games. Clouded-monitor lizard help in insect control in some agricultural areas since they feed on them. In Africa, the lizards commonly found are Agama lizard, Skinks, Gecko, Chameleons, Monitor lizard, Alligator lizard (4).

Agama agama was reported to serve as transport and reservoir host to several protozoan and helminth parasites (5). Parasites from most reptiles can be transferred into a human by carefree attitude. Humans can be infected with *Raillietiella* species, by contaminating their hands and food with the eggs, faeces or saliva of the reptile (6). Gecko (*Hemadactylus sp*) are house lizards commonly found in human dwelling in tropical countries. They are nocturnal lizards which feed mainly on insects and termites (7). Oluwafemi *et al*. (8) reported the presence of *Raileteilla frenatus* and *Paraphayngodon sp* in Wall gecko (*Hemidactylus freanatus*) species caught in Ile-Ife. These parasites can cause diseases for human if ingested into the human system.

Skinks of the genus Mabuya is found around the world and it contains about 90 species which are distributed around Sub-sahara Africa (9). Like all vertebrates, skinks are susceptible to parasitism in their niche. *Spirura sp* a nematode was found in skink (*Mabuya quinquetaeniata*) collected in Ile-Ife and Ibadan by Oluwafemi *et al*. (8). In Nigeria, there have been various studies conducted on the parasites of lizards and other reptiles (10, 11 and

12). It is important to study the population of these lizards in our locality to determine the best method to control them and reduce the risk of contamination of our foods.

Obafemi Awolowo University, Ile-Ife, Osun State where the research was conducted was one of the University with a large number of students in Nigeria. Similar research was conducted on the bait preference of Black rat (*Rattus rattus*) when the students' hostel was infected by black rat (13). This study was conducted in the University (Obafemi Awolowo University) to determine the most prevalence lizards (*A. agama*, Skinks and Wall gecko) in various part of the University. This is aimed at controlling the lizards in other to reduce the risk of infection among the University populaces.

3.0 Materials and methods

3.1 Study Location

This research work was carried out in Obafemi Awolowo University student's hostels, academic area and staff quarters, Ile Ife. The university is located between Latitudes 7º26'N and 7°32'N and between Longitudes 4º31'E and 4º35'E. The landmass is 5506 hectares with an altitude of 300 m above sea level.

3.2 Materials

3.2.1 Materials used in the research field

Sweep net: For trapping the specimens, Chloroform: To anesthetize the specimens, Killing jar: Where the specimens are kept immediately after collection, Cotton wool: Placed inside the killing jar for a smooth landing for the anesthetized specimens. Measuring ruler, Thread, Rubber gloves, Harvard trip balance, Camera

3.2.2 Method of collection

Agama lizards (*Agama agama*) and Skinks (*Trachylepis affinis*; *Trachylepis quinquetaeniata*) were caught by using a sweep net to cover them, and they were put inside killing jar

containing chloroform. Wall geckos (*Hemidactylus brookii*) were caught in the night using a broom. The broom was used to brush them into the sweep net after which they were transferred into the killing jar containing chloroform. The chloroform was used to anesthetize the specimens until they are taken into the laboratory after the approval was obtained from the ethic committee of the University

3.3 Identification of specimens

The Agama lizard (*Agama agama*) was identified by the descriptions given by Harris (14). The lizard was said to have a white underside, brown back limbs and a tail with a light stripe down the middle. Breeding males of this subspecies have brilliant orange heads, and an indigo blue or black body and legs. Their tail is bluish-white at the base and has an orange middle area and black tail tip. The non-breeding male is paler in colour and might not have the orange on the head. Females are brown and have olive green colour on their backs with some barring marks. Wall gecko (*Hemidactylus brookii*) was identified with some specification given by Bauer et al. (15). The snout of the specimen is longer than the distance between the eye and the ear opening, nearly twice the diameter of the orbit; the forehead is concave.

Skinks (*Trachylepis affinis*) has a yellow or white venter, not bright blue-green. Skink (*Trachylepis quinquetaeniata*) males have the side of the head yellow and the throat black. Juveniles and females have five white longitudinal stripes. Identification of skink species was done using identification guides by Branch (16) and Spawls *et al*., (17).

3.4 Data collection

The captured specimens from specific part of the study area (that have been anesthetized) were taken into the laboratory for sex identification and measurement of morphometric parameters. Specimens without sexual dimorphism (Agama Lizard) the sex was determined, they were tagged male or female before being weighed and measured. In the laboratory, the

sex of the geckos was determined using the presence of pores and hemi penal bulges at the base of the tail to identify the males while the absence of those aforementioned identified females. The sex of the skinks was determined by dissecting them and checking for the presence of ovaries. Those with ovaries are females while those without ovaries are males.

The following measurements were taken in cm:

1. Snout- vent length (SVL): from the tip of snout to anterior end of the cloaca.
2. Head height (HH): height of the head.
3. Head length (HL): ventral measurement from the tip of the lower jaw to immediately posterior to the jaw.
4. Head width (HW): the widest portion of the head anterior to the ear.
5. Tail length (TL): from the anterior end of the cloaca to the tip of the tail
6. Tail width (TW): measured at the base of the tail from one side to another
7. Trunk length (TRL): from where the forelimb originates to where the hind limb originates.
8. Mouth opening (MO): from snout to posterior border of the last supralabial scale

The weight of all specimens was measured in grams using the Harvard trip weighing balance.

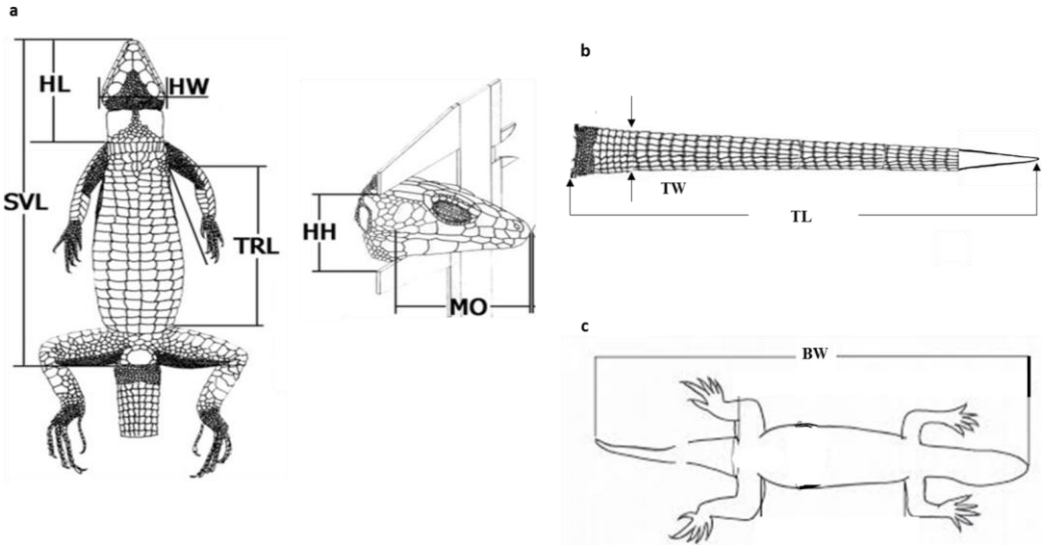

Figure 1: Diagram showing some of the measured morphometric parameters on the Lizards. Sources: (a & b) Modified from Kaliontzopoulou *et al*. (18), and (c) Modified from Uyeda *et al*. (19)

3.5 Statistical Analysis

One-way analysis of variance (ANOVA) was used to determine the significant difference between the means, while the significant mean was separated at $p \leq 0.05$ using Least Significant Difference (LSD) test from System Analysis Software (SAS Institute, 20). Principal Component Analysis (PCA) was carried out with IBM SPSS 20th version.

4.0 Results

The abundance of four types of lizards (*Agama agama, Hemidactylus brookii, Trachylepis affinis* and *Trachylepis quinquetaeniata*) studied at five different locations (University Hostels, University staff quarters, University Library, University Parks and garden and markets) are shown in Table 1. Among the four lizards studied, *A. agama* had the highest population in all locations (57.53, 48.02, 53.85, 54.33, and 49.30%), followed by *H. brookii* (30.97, 36.72, 30.77, 19.69, and 28.17%). Skinks (*T. affinis and T. quinquetaeniata*) have the least percentage from all the locations.

Table 1: The abundance of male and female of four lizard species (*Agama agama, Hemidactylus brookii*, *Trachylepis quinquetaeniata*, and *Trachylepis affinis*) caught on Obafemi Awolowo University, Ile-Ife.

Locations	Specimen name	Male	Female	Total	Percentage total (%)
University Hostels	Agama lizards (*A. agama*)	25	40	65	57.53
	Wall geckos (*H. brookii*)	20	15	35	30.97
	Skinks (*T. affinis*)	3	5	08	7.08
	Skinks (*T. quinquetaeniata*)	2	3	05	4.42
	Total	50	63	113	100
University Staff Quarters	Agama lizards (*A. agama*)	30	55	85	48.02
	Wall geckos (*H. brookii*)	25	40	65	36.72
	Skinks (*T. affinis*)	7	9	16	9.04
	Skinks (*T. quinquetaeniata*)	5	6	11	6.22
	Total	67	110	177	100
University Library	Agama lizards (*A. agama*)	15	20	35	53.85
	Wall geckos (*H. brookii*)	12	8	20	30.77
	Skinks (*T. affinis*)	2	4	06	9.23
	Skinks (*T. quinquetaeniata*)	1	3	04	6.15
	Total	30	35	65	100

University Parks & Garden	Agama lizards (*A. agama*)	27	42	69	54.33
	Wall geckos (*H. brookii*)	14	11	25	19.69
	Skinks (*T. affinis*)	7	8	15	11.81
	Skinks (*T. quinquetaeniata*)	7	11	18	14.17
	Total	55	72	127	100
University Markets	Agama lizards (*A. agama*)	28	42	70	49.30
	Wall geckos (*H. brookii*)	18	22	40	28.17
	Skinks (*T. affinis*)	7	8	15	10.56
	Skinks (*T. quinquetaeniata*)	8	9	17	11.97
	Total	61	81	142	100

In all the locations, the highest number of Agama lizard was collected in the University Hostels (57.53%) (Figure 2) followed by University parks and garden (54.33%), followed by University Library, followed by University markets (49.30%). The least percentage of Agama lizard was collected in University staff quarters (48.02%).

The highest value of *H. brookii* was collected in University staff quarters (36.72%), followed by University Hostels (30.97%) and University Library (30.77%). The least was collected in University parks and garden (19.69%). Skinks (*T. affinis* and *T. quinquetaeniata*) abundance was low in University Hostels (7.08 & 4.42%), University staff quarters (9.04 & 6.22%) and University Library (9.23 & 6.15%). The highest percentage of Skins (*T. affinis* and *T. quinquetaeniata*) were from University parks & garden (11.81 & 14.17%) and University market (10.56 & 11.97%).

The ratio of male to female of all the lizards did not follow a specific pattern in that female ratio was higher than male in *A. agama* in all the locations while the male ratio was higher than female in *H. brookii* collected in all the locations. The ratio of female Skins (*T. affinis* and *T. quinquetaeniata*) collected in all the locations were higher than the male in this study.

Table 2 showed the morphometric parameters measured on the male specimens collected in all the locations. *A. agama* had the highest average body weight (68.38 g) followed by

Trachylepic quinquetaeniata (23.55 g). The bodyweight of *Trachylepic affinis* (11.68 g) was higher than that of *Hemidactylus brookii* (8.99 g). The Height of the head (HH) of all the male specimens followed the same pattern with the bodyweight with *A. agama* having the highe

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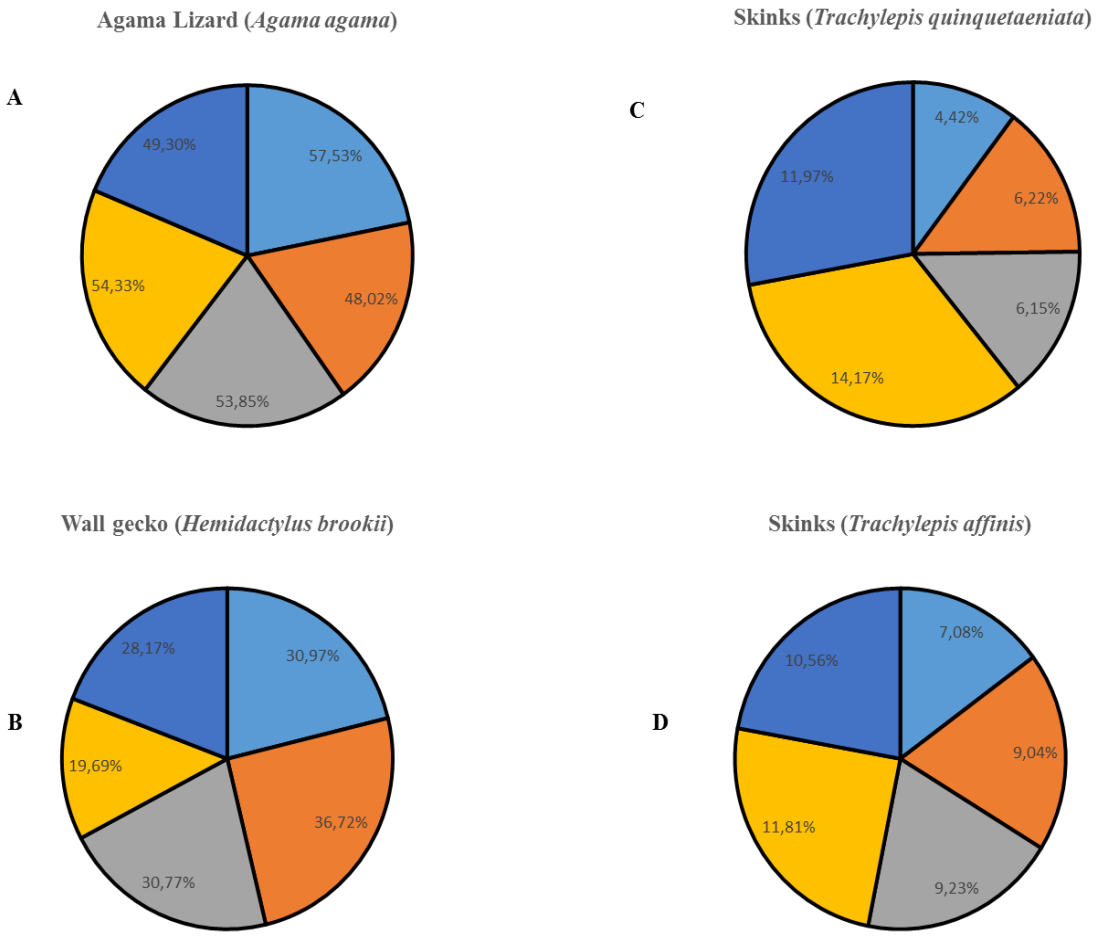

Figure 2: Percentage of four different lizards (Agama Lizard (*Agama agama*), Wall gecko (*Hemidactylus brookii*), Skinks (*Trachylepis quinquetaeniata* & *Trachylepis affinis*) in various collections site on the University

Table 2: The morphometric parameters of male of the four lizard species (*A. agama*, *H. brookii*, *T. affinis* and *T. quinquetaeniata*) caught on Obafemi Awolowo University, Ile-Ife.

Species	Statistics	BW (g)	HH (cm)	HL (cm)	HW (cm)	TL (cm)	TW (cm)	TRL (cm)	MO (cm)	SVL (cm)
AA	Mean	68.38^{d}±1.2	1.10^{d}±0.1	3.82^{c}±0.1	3.45^{b}±0.1	16.85^{c}±0.5	0.86^{a}±0.1	5.09^{c}±0.4	1.99^{c}±0.1	12.87^{d}±0.2
	Range	50.4-80.8	0.7-1.5	2.8-4.5	2.5-4.0	11.6-20.9	0.4-1.6	3.0-8.0	1.3-2.6	11.2-14.6
HB	Mean	8.99^{a}±0.3	0.55^{a}±0.1	1.86^{a}±0.1	1.16^{a}±0.1	5.50^{a}±0.3	0.65^{a}±0.1	2.69^{a}±0.1	1.04^{b}±0.1	5.87^{a}±0.1
	Range	7.4-12.4	0.4-0.8	1.6-2.4	0.6-1.5	4.0-7.0	0.4-0.9	1.7-3.1	0.6-1.7	5.4-6.4
TA	Mean	10.68^{b}±0.4	0.75^{b}±0.12	1.93^{a}±0.2	1.15^{a}±0.2	11.18^{b}±0.4	0.71^{a}±0.1	4.52^{b}±0.3	0.89^{a}±0.1	7.15^{b}±0.5
	Range	10.1-14.0	0.5-1.5	1.1-2.6	0.6-2.0	9.3-12.9	0.6-1.1	3.5-5.4	0.5-1.3	5.4-9.4
TQ	Mean	15.55^{c}±0.7	0.90^{c}±0.1	2.15^{b}±0.5	1.65^{a}±0.1	13.00^{b}±0.6	0.90^{a}±0.1	4.10^{b}±0.4	1.35^{b}±0.1	9.20^{c}±0.3
	Range	20.8-26.3	0.8-1.0	2.0-2.3	1.6-1.7	12.4-13.6	0.8-1.0	3.7-4.5	1.3-1.4	8.9-9.5

*Means within column with different Superscript are significantly different ($P \leq 0.05$) from each other

Footnotes

AA is *Agama agama* (Agama Lizard), HB is *Hemidactylus brookii* (Wall gecko), TA is *Trachylepis affinis* (Skinks) and TQ is *Trachylepis quinquetaeniata* (Skinks)

BW is the Body weight, HH is the Height of the head, HL is the Head length, HW is the Head width, TAL is the Tail length, TAW is the Tail width, TRL is the Trunk length, MO is the Mouth opening and SVL is the Snout-vent length

There was no significant difference ($p > 0.05$) in Head length average value among three male specimens (*H. brookii*, *T. affinis* and *T. quinquetaeniata*) measured when compared to *A. agama* (3.45 cm). The Head width average value of male specimens collected in all the locations showed that there was no significant difference ($p > 0.05$) between *H. brookii* and *T. affinis*. There was a significant difference ($p < 0.05$) between the average Head width of A. agama (3.45 cm) and *T. quinquetaeniata* (1.65 cm).

The Tail length (TL) average value of A. agama (16.85 cm) was the highest and *H. brookii* (5.50 cm) have the least value of TL. There was no significant difference ($p > 0.05$) between the TL of *T. affinis* and *T. quinquetaeniata*. The Tail width (TW) of all the specimens (A. agama, *H. brookii*, *T. affinis* and *T. quinquetaeniata*) showed no significant difference at $p > 0.05$, while the average value of TW for *T. quinquetaeniata* was the highest (0.90 cm) among all the male specimens. *A. agama* has average TAW value of 0.86 cm followed by *T. quinquetaeniata* (0.71 cm) and *T. affinis* (0.65 cm).

The average Trunk length (TRL) of *T. affinis* (4.52 cm) and *T. quinquetaeniata* (4.10 cm) have no significant difference ($p > 0.05$), while average TRK of A. agama (5.09 cm) and *H. brookii* (2.69 cm) showed a significant difference at $p < 0.05$. *H. brookii* have the list average TRL value (2.69 cm) and A. agama have the highest value of TRL (5.09 cm). The average value of Mouth opening (MO) of all the specimens was significantly differenced at $p < 0.05$. *A. agama* has the highest value of MO (1.99 cm) and *T. affinis* have the least value of MO (0.89 cm). *H. brookii* and *T. quinquetaeniata* have MO average values of 1.04 and 1.35 cm respectively. The Snout-vent length (SVL) average of all the specimens showed a significant difference at $p > 0.05$. *A. agama* has the highest value of 12.87 cm, followed by *T. quinquetaeniata* (9.20 cm). *T. affinis* have an average value of 7.15 cm for SVL, while *H. brookii* have an average value of 5.87 cm for SVL.

The values of morphometric parameters measured from female specimens (*A. agama, H. brookii, T. affinis* and *T. quinquetaeniata*) were shown in Table 3. The average Body weight (BW) of *A. agama* was the highest (35.23 g) followed by Skinks (*T. affinis* (11.67 g) *and T. quinquetaeniata* (15.40 g)) and *H. brookii* (6.23 g). The of Height of head (HH) of all the specimens collected in different locations showed a significant difference ($p < 0.05$) with *T. quinquetaeniata* having the highest value (0.70 cm) and *A. agama* having the least (0.34 cm). There was no significant difference ($p > 0.05$) among the average value of Head length (HL) among three lizards (*H. brookii, T. affinis* and *T. quinquetaeniata*). There was a significant difference ($p < 0.05$) in HL value between *A. agama* and the rest of the specimen. The average value of the Head width (HW) of A. agama was the highest (2.15 cm) followed by *H. brookii* (1.55 cm), followed by *T. affinis* (1.14 cm) and *T. quinquetaeniata* (1.06 cm).

The least value of Tail length (TL) was recorded from *H. brookii* (5.23 cm), while the highest average TL was recorded for *A. agama* (14.15 cm). The average value of the Tail length (TL) of the specimens showed a significant difference ($p < 0.05$) between *A. agama* (14.15 cm) and *H. brookii* (5.23 cm). There was no significant difference ($p > 0.05$) in TL between the two species of Skins (*T. affinis* and *T. quinquetaeniata*). Tail width (TAW) followed the same pattern as TL. There was a significant difference ($p < 0.05$) between TW of *A. agama* and *H. brookii*, while there was no significant difference ($p > 0.05$) in TW between *T. affinis* and *T. quinquetaeniata.*

Table 3: The morphometric parameters of female of the four lizard species (*A. agama*, *H. brookii*, *T. affinis* and *T. quinquetaeniata*) caught on Obafemi Awolowo University, Ile-Ife.

Species	Statistics	BW (g)	HH (cm)	HL (cm)	HW (cm)	TL (cm)	TW (cm)	TRL (cm)	MO (cm)	SVL (cm)
AA	Mean	35.23^{d}±1.6	0.34^{a}±0.1	2.74^{b}±0.2	2.15^{c}±0.1	14.15^{c}±0.3	0.39^{a}±0.1	4.05^{b}±0.2	1.51^{c}±0.1	10.28^{c}±0.2
	Range	44.7-52.8	0.1-1.3	1.9-4.5	1.5-3.4	11.3-16.7	0.2-1.0	2.2-6.0	1.2-2.2	8.6-13.6
HB	Mean	6.23^{a}±0.2	0.48^{b}±0.1	1.64^{a}±0.1	1.55^{b}±0.4	5.23^{a}±0.2	0.53^{b}±0.1	2.69^{a}±0.1	0.88^{a}±0.1	5.35^{a}±0.14
	Range	4.2-7.5	0.3-0.6	1.4-2.2	0.8-1.0	3.3-6.4	0.3-0.9	2.0-4.1	0.7-1.2	3-6.2
TA	Mean	11.67^{b}±0.3	0.58^{c}±0.1	1.68^{a}±0.2	1.14^{b}±0.1	10.62^{b}±0.6	0.69^{c}±0.1	4.35^{b}±0.2	0.91^{b}±0.1	6.98^{b}±0.3
	Range	9.6-13.4	0.3-0.9	1.0-2.6	0.4-1.9	5.0-13.0	0.4-0.9	3.1-5.8	0.3-1.4	5.0-8.9
TQ	Mean	25.40^{c}±0.8	0.70^{d}±0.1	1.67^{a}±0.1	1.06^{a}±0.1	11.3^{b}±0.4	0.63^{c}±0.1	4.14^{b}±0.1	1.03^{b}±0.1	7.30^{b}±0.2
	Range	13.2-20.0	0.5-0.9	1.4-1.9	0.8-1.3	9.1-12.2	0.4-0.9	3.8-4.4	0.7-1.4	6.5-8.0

*Means within column with different Superscript are significantly different ($P \leq 0.05$) from each other

Footnotes

AA is *Agama agama* (Agama Lizard), HB is *Hemidactylus brookii* (Wall gecko), TA is *Trachylepis affinis* (Skinks) and TQ is *Trachylepis quinquetaeniata* (Skinks)

BW is the Body weight, HH is the Height of the head, HL is the Head length, HW is the Head width, TAL is the Tail length, TAW is the Tail width, TRL is the Trunk length, MO is the Mouth opening and SVL is the Snout-vent length

The Trunk length (TRL) average value of three specimens (*A. agama*, *T. affinis*, and *T. quinquetaeniata*) have similar values (4.05, 4.35, and 4.14 cm) without significant difference ($p > 0.05$), but differed from *H. bookii* (2.69 cm) which have the least value. The Mouth opening (MO) average value of *A. agama* was the highest (1.51 cm) and *H. brookii* (0.88 cm) have the least MO value. There was no significant difference ($p > 0.05$) in MO value of *T. affinis* and *T. quinquetaeniata*. Snout-vent length (SVL) of *A. agama* was the highest (10.28 cm) followed by *T. quinquetaeniata* (7.30 cm). The SVL value of *H. brookii* was the least (5.35 cm) and there was no significant difference ($p > 0.05$) in SVL of *T. affinis* and *T. quinquetaeniata.*

Figure 3 showed the Principal Component Analysis (PCA) scatter plot of the morphometric relationship among the lizards (*A. agama, H. brookii, T. affinis* and *T. quinquetaeniata*) captured in various location in the University. From the figure, the morphometric parameters measured on *A. agama* were different from other specimens. Although, it can be said that there was a slight similarity between *A. agama* and *T. affinis*. The remaining specimens (*H. brookii, T. affinis* and *T. quinquetaeniata*) have morphometric similarities with *T. affinis* having morphometric parameters common to the remaining two specimens (*H. brookii* and *T. quinquetaeniata*).

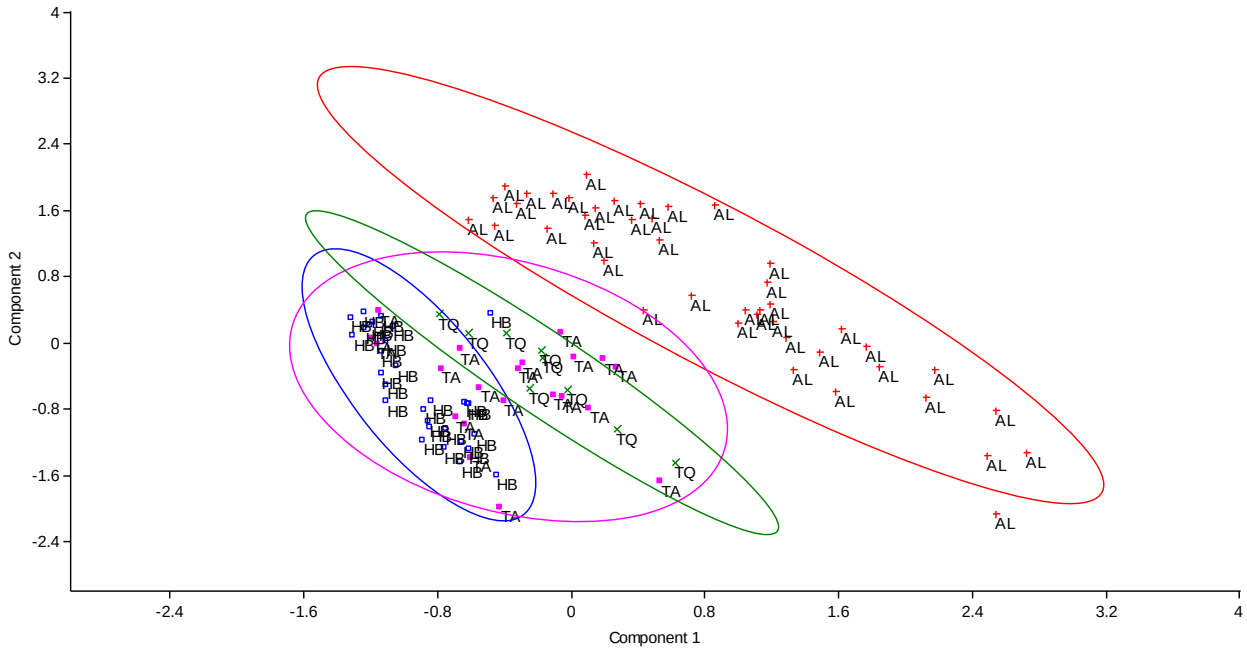

Figure 3: Principal Component Analysis (PCA) Scatter Plot showing Morphometric relationship in lizard species captured in O.A.U. (Y-axis is component 1, while X-axis is component 2)

Keys
Red colour is Agama Lizard (*Agama agama)*
Blue colour is Wall gecko (*Hemidactylus brookii*)
Pink colour is Skinks (*Trachylepis affinis*)
Green colour is Skinks (*Trachylepis quinquetaeniata*)

The Principal Component Analysis (PCA) loading showed some of the morphometric parameters that were different in the specimens (Figure 4). Tail length, Tail width and Trunk length were differed from one specimen to another with cut off of 0.4.

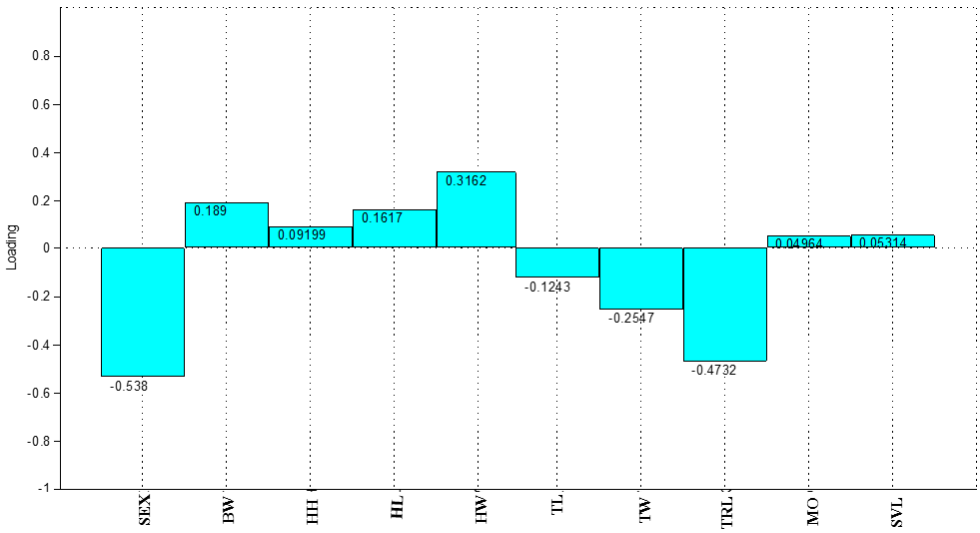

Figure 4: PCA loading Plot showing the significant morphometric parameters within the four species of lizard with a cut off of 0.4.

4.1 Discussions

The increase in the population of *A. agama* compared to other specimens (*H. brookii*, *T. affinis* and *T. quinquetaeniata*) in all the location in the University can be attributed to their ability to feed on different varieties of insects and plant materials (21). *A. agama* is regarded as frugivorous and seed dispersion as well as insectivorous animals. The abundance of *H. brookii* residence (University Hostel, University staff quarters and University Library) may be attributed to easy accessibility to food since they are commonly found in the house. Tkaczenko et al. (22) reported that *Hemidactylus* species are highly adapted to living close to people since they feed on insects that are attracted to artificial light sources which are commonly found where people live. The report of Tkaczenko et al. (22) was supported by Weterings (23). He reported that *Hemidactylus spp* also forages in garbage bins and on tables where they feed on leftover foods.

In case of Skinks (*T. affinis* and *T. quinquetaeniata*), the decrease in their population in most of the locations (University Hostel, University staff quarter and University Library) may be attributed to the absence of grasses and shrubs. The presence of grasses and shrubs in the University market and University parks and garden may be responsible for the increases in the amount of Skinks specimens collected in both locations. Kadry et al. (24) report on five-lined Skinks showed that Skinks are ground-dwelling and associated with grasses and shrubs for protection against predators. They also reported that grasses and shrubs provided suitable temperature for Skins behaviour.

Apparently there is no pattern for the males and females rates in this study, but one can think that lizards may depend on environmental temperature to define their embryo sex. Each species may have a particular range that defines it, so it can be suspected that the environmental temperature of each lizard niche and specie may have some influence on the sex ratio. The ratio of the female specimen in this study was higher than that of the male

specimen in all the locations in the University. The ratio of the female specimen in this study may be due to the search for food and early sexual maturity. Female lizards (e.g *A. agama*) reach sexual maturity between fourteen and eighteen months, while it takes two years for male *A. agama* to sexual maturity (25). Also, the reduction amount of male specimen in this study may be attributed to competition and territorial behaviour which may lead to death or accessibility to the predator (26). This result was similar to our previous findings on the Black rat (*Rattus rattus*) in Obafemi Awolowo University (13).

Variation in the measured morphometric parameters of the specimens may be due to different factors. Some of the factor to be considered are sex, age, habitats, an abundance of food and predator (27). The report of phenotypic analysis of sexual size dimorphism of lizards showed that female small lizard's species tend to be smaller than males, while males of large species have higher body weight than female (28). In this study, the bodyweight of *A. agama* male was higher than the female, while the bodyweight of female Skinks (*T. affinis* and *T. quinquetaeniata*) was higher than male. Maturity in respect to the age of the species may also be responsible for variation in measured morphometric parameters. Although the age of the specimens was not considered in this study, the report of Jena et al. (29) showed that young lizards morphometric parameters are lower when compare with the older ones.

The habitats of lizards may be important when considering the differences in their morphometric parameters. Lizards being commonly found in a warm climate but leave in cold climate may develop some adaptive measure to survive the cold condition (30). Kaliontzopontou et al. (31) reported that morphology and habitat is a central theme in evolutionary biology because it reflects the way organisms adapt to their environment. The reports of Kohlsdorf et al. (32) showed that there is always a relationship between morphology and habitat which affect the body size and other parts of lizards.

The abundance of food is a major factor of life that determines how an individual's species allocate energy among competing demands and maturation (33). Food abundance in lizards can have direct long-lasting effects on external morphometric of lizards (34). The abundance of food may also attract the predator such as snakes to the habitat where lizards dwell. Lizards serve as food for snakes and other predators like Hawks (35).

The difference in the morphometric parameters of *A. agama* may be responsible for the differences seen in the scatter plot (Figure 3). *A. agama* can be considered bigger lizard when compared with Wall gecko (*H. brookii*) and Skinks (*T. affinis* and *T. quinquetaeniata*) used for this study. It was shown from the morphometric parameters that *A. agama* have higher values in all the parameters measured that the rest species. Among the rest species (*H. brookii*, *T. affinis* and *T. quinquetaeniata*), there was interaction in all the parameters measured and the interaction may be attributed to similarity in average values of the measured parameters. Although the Principal Component Analysis (PCA) loading plot (Figure 4) showed that Sex, Tail length (TL), Tail width (TW) and Trunk length of all the lizards' species differs. The difference in the above mentioned parameters may be due to the difference in species of lizard studied. The tail of male *A. agama* was reported used in fighting when defending their territory (36) while *H. brookii* do not use tail in the fighting. This may be responsible for an increase in TL, TW, and TRL in *A. agama* than the rest species.

The abundance of *A. agama* and *H. brookii* in University Hostels, University staff quarters and Library call for great concern since they are parasite carrier which can cause a great health concern when defecated of die in the food or excrete inside the food. It is important for the University authority to look for the best way to reduce the percentage of these lizards in the University.

Conclusion

This study shows that *A. agama* and *H. brookii* are the most abundant species among all the lizards collected in the study locations in relation to food availability, shelter and protection against predators. The morphometric parameters measure show a significant difference in all the lizards measured with *A. agama* having the highest value among specimens, although most of the specimens are not from the same family. The abundance of these lizards calls for attention in the University.

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Conflict of interest

Authors have declared that no competing interests exist.

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