Effect of Habitat on Diet, Morphological Parameters, and Sex Morphism of Common Wall Gecko (*Hemidactylus frenatus*) Abeokuta, Ogun State, Nigeria

O.A. Akintunde* and S.A. Olayiwola

Federal University of Agriculture, Abeokuta, Nigeria.

E-mail: akintundeoa@funaab.edu.ng*

ABSTRACT

This study was carried out to determine the effect of habitats on gecko (*Hemidactylus frenatus*) in five different locations in Abeokuta (Quarry Site, Federal Medical Centre (FMC) hospital, FUNAAB campus, Mechanic village and in Ewekoro cement factory area), Ogun State, Nigeria. Fifteen geckos from each location (N=75), purposefully collected manually at night, were assessed to determine their diet composition, morphological variations, and sex. Consumed prey items were identified taxonomically to Order, and their numbers and frequencies were recorded. The most abundant prey items in the diet were Lepidoptera (26.5%) and Isoptera (24.2%), and less common prey items were Hymenoptera (2.9%) and Hemiptera (2.6%). Prey items composition was relatively high in the gut of geckos captured in FUNAAB campus (85) and FMC hospital (72), compared to Mechanic village (51), Quarry site (49) and Ewekoro cement factory area (47).

The experiment indicated that there was no significant difference in the gut contents of geckos collected from the various locations ($P>0.05$). Both adult males and adult females tended to feed on small-sized prey, some of which are household pests (43.4%). Head length, snout-vent length and weight did not significantly differ between geckos from the study locations ($P>0.05$), whereas significant differences ($P<0.05$) were recorded in head width and tail length among the two sex categories. The study indicated that habitat as well as microhabitat conditions influence both the diet and morphology of common wall gecko.

The study further established economic importance of geckos. Geckos in human habitations check insect pests populations by feeding on them acting as a biological control agent of pest of crops, fruit, vegetables, plant seeds, cereals and household Environmental awareness/campaigns against industrial effluent discharges into the environment and proper care of human surroundings, homes and environments were parts of suggested recommendations.

(Keywords: diet, habitat, location, sex, morphometry, economic importance, gecko).

INTRODUCTION

Geckos are lizards belonging to the infra order Gekkota found in warm climates throughout the world (Borsuk Bianlynicka, 1990).They range in size from 1.6 cm to 60 cm in length. Unlike other lizards, geckos are usually nocturnal and great climbers. Geckos are unique among lizards in vocalization, making chirping sounds in social interactions with other geckos.

The house gecko (*Hemidactylus frenatus*) is a native of south eastern Asia and Northern parts of Africa (Cook, 1990). However, they have been introduced to many other countries including Eastern Africa, New Guinea, Mexico, Madagascar, Australia, and Nigeria. They are mainly in the ceiling, nooks and at the back of calendars during the daytime but are active at night. They move with remarkable agility usually in search or pursuit of insect preys (Gurgel, et. al., 2010).

This species is an effective colonizer and nocturnal predator that is usually associated with human buildings where they feed on insects, worms, and spiders. *Hemidactylus frenatus* is well known for using areas around artificial light sources as hunting grounds (Perry, et al., 2008). *Hemidactylus frenatus* eats a variety of arthropods such as insects and arachnids. It can survive without eating for relatively long period of time due to the morphological and functional

plasticity of hepatocytes (De Brito-Gitirana, et. al., 1998).

Different factors affect the diet of lizards, including temperature fluctuations, an ontogenetic shift in prey preferences, body size, sex and foraging tactic (Censky, et. al., 2003; Lei and Booth, 2014; DeVoe, 2015). The size of feeding structures can influence or at least limit the type and size of prey that may be ingesting. As a result, mouth size may affect diet composition which may result in differences between males and females and/or between the young and adults (Teixeira-Filho et al., 2003).

The common house gecko is an agile nocturnal lizard often seen running along walls, in search of moths and other insects. (Ineich, 2010). Adult *Hemidactylus frenatus* can measures between 3-6 inches (975-1500mm). A significant adaption of its anatomy is the modification of its foot to climb along walls and ceilings. The claws are enlarged and the toes have adhesive toe-pads (Crandell, et. al., 2014).The modification of its eyes allows it to see very well in the dark; the time when it is most active. The eyes are binocular with a low convergence ratio and a high visual cell density. This increases visual sensitivity in the dark (Roll, 2001).

All Hemidactylus conserved many primitive morphological features. These include the skull structure and the presence of 26 presacral vertebrae. Some derived features include a laterally expanded un-regenerated tail, enlargement of dorsal scales and the reduction or loss of dorsal tubercles and femoral pores (Carranza and Arnold, 2006).

In Nigeria, very few research efforts have been conducted on the common wall gecko (*Hemidactylus frenatus*) and they are often considered as pests where found. Obi, et al., (2013) conducted a research on the ectoparasites and endoparasites of geckos (*Hemidactylus frenatus*) on man. According to him geckos are likely zoonotic pathway to human health based on the parasites recovered in the study.

Afia, et. al., (2017) stated that direct and indirect contacts with geckos clearly represent a substantial risk to human health based on a research carried out to determine the prevalence of endoparasites of wall gecko (*H. frenatus*) in selected Local Government Areas of Akwa-Ibom State, Nigeria. However, Ngwoke, et. al., (2015) carried out a research on the antimicrobial activity of crude methanol extract of fecal droppings of common house lizard/gecko (*Hemidactylus frenatus*).The result of the study revealed the potential of the fecal droppings of common wall gecko for use as a source of antimicrobial agents, which is in contrast to the previous studies. This study, therefore, was designed to examine the gut contents and some morphological features of the common wall gecko, and to determine their economic importance.

METHODOLOGY

Description of the Study Area

This research was carried out in four (4) different locations in Abeokuta and in Ewekoro, Ogun State. Ogun State is situated within the tropics, with a total land area of 16,762 square km which lies within latitude 6°20' South and 7° 58' North in the tropics and longitude 2° 40' West and 4° 35' East of the Greenwich Meridian, and has an estimated population of 4,054,272. The state borders Lagos state to the south, Oyo and Osun states to the north, Ondo state to the east and Republic of Benin to the west. Ogun lies in fertile country of wooded savanna, the surface of which is broken by masses of grey granite (Wikipedia, 2017).

This area is populated mostly by farmers, few civil servants, students and traders. Two main climatic conditions exist; the rainy season lasting from seven to eight months between April and October with an interruption in August, and the dry season, running through November till February. Annual rain fall of About 963 mm and the temperature is usually between 260C and 280C). The vegetation of the area consists of trees, shrubs and grasses; it is a derived savanna (Wikipedia, 2017).

The specific study locations in Abeokuta area were:

- Ewekoro cement factory area (lat 7° 11'10" N, long 3° 25' 58" E)
- Quarry sites (lat 7° 13'42" N, long 3° 27' 10" E)
- Federal Medical Centre Hospital area (lat 12° 27'18" N, long 4° 12' 17" E)

- FUNAAB campus (lat 7° 11'56" N, long 3° 27' 1" E)
- Mechanic village (lat 6° 56'9" N, long 3° 13' 24" E)

Sampling Procedures

Fifteen (15) samples of common wall gecko (*Hemidactylus frenatus*) were purposively captured in randomly selected households in Abeokuta at five different locations making a total of seventy and five (75) samples in all. The geckos were collected by hand using brooms and buckets during the period between 6pm and 8pm for a period of two (2) weeks in each study location, Samples were collected on building walls, on ceilings, under artificial lights in the wall fences, behind hanged calendars and wall clocks in the study locations. Specimens captured were immediately euthanized with cotton wool soaked in chloroform and placed in airtight container. The specimens were weighed, morphologically measured, and preserved in formalin solution for further studies in the laboratory.

Sex Identification, Morphometric Parameters and Diet Composition Assessment of Gecko

The gonads of specimens were thoroughly examined for sex identification while snout–vent length (SVL), tail length (TL), head length (HL), and head width (HW), were measured and samples' stomach were dissected for gut content analysis. prey items were sorted and identified in each sample's stomach taxonomically to Order according to Foulk (2004). Ingested food items were assessed regarding frequency and number (quantity). Unidentified items and other materials, such as sand and stones, were considered as accidental ingestions and excluded from the analysis.

Statistical Analysis

The data collected was subjected to descriptive statistical analysis, such frequency and mean, and inferential statistics; one-way analysis of variance (ANOVA) at 5% significant level was used to determine the association between location and ingested prey items, and between location and morphometric parameters of adult male and adult female geckos. SPSS package (V20) was used to analyse the collected data.

RESULTS

Gut Content of Gecko from the Five Locations

The result of gut content of geckos found in the five locations is presented in Table 1. The result showed that there was no significant difference in the treatments. The highest population of Aranea with mean of 2.14±1.78 was found in Hospital area, and it was not significantly different (P>0.05), to the lowest population with mean of 1.17±0.41 found in Quarry area. The highest population of Blattoda with mean of 1.33±0.58 was found in Ewekoro, but was not significantly different (P>0.05). Diptera had the highest population in Ewekoro, Mechanic village and FUNAAB campus, followed by FMC hospital, and the lowest found in Quarry area with no significant difference (P>0.05). Isoptera had the highest population in Mechanic village with mean of 2.00±0.63, and the lowest population in FUNAAB campus with mean of 1.55±0.52, but was not significantly different (P>0.05). Lepidopthera had the highest population in FUNAAB campus with mean of 3.00±1.52, and Orthopthera was highest in FMC Hospital (1.33±0.58) but with no significant difference (P>0.05).

Composition of Gut Content of Adult Males and Adult Females of *Hemidactylus frenatus*

Table 2 showed number, frequency and percentage of prey composition in the gut of gecko of *Hemidactylus frenatus*. The result showed that the dominant prey items in the gut of *H. frenatus* in terms of number were Lepidoptera (26.5%),and the least common were Hemiptera (2.6%). For adult males, Isoptera (26.7%), and Lepidoptera (26%) were dominant and the least common were Blattoda (2.1%), for adult females, Lepidoptera (26.9%), Isoptera (21.9%) and Aranea (18.1%) were dominant, Hemiptera (1.9%) were least common. In terms of frequency, the order Isoptera (25.1%) was the most important food item, and the least common was Hemiptera. The most frequent prey items for adult males were Orthopthera (29.2%) and Isoptera (18%), the least common were Blattoda.

Table 1: Comparison of Mean of the Gut Content of Gecko from the Five Locations.

Parameters	EWEKORO CEMENT FACTORY AREA	FMC HOSPITAL	FUNAAB CAMPUS	MECHANIC VILLAGE	QUARRY AREA	SIG. P
Arachnida (Aranea)	1.75±0.50	2.14±1.78	2.00±0.54	1.57±0.79	1.17±0.41	0.21
Blattoda	1.33±0.58	0.00±0.00	0.00±0.00	1.00±0.00	1.25±0.50	0.51
Coleoptera	0.00±0.00	1.50±0.58	1.33±0.52	0.00±0.00	1.00±0.00	0.06
Dipetera	1.75±0.50	1.67±0.58	1.75±0.96	1.75±0.50	1.40±0.90	0.46
Hemiptera	0.00±0.00	1.50±0.71	1.25±0.50	0.00±0.00	0.00±0.00	0.12
Hymenoptera	0.00±0.00	1.00±0.00	1.00±0.00	0.00±0.00	0.00±0.00	0.00
Isoptera	1.56±0.73	1.64±0.67	1.55±0.52	2.00±0.63	1.57±0.54	0.60
Lepidoptera	2.33±1.03	3.00±1.52	2.20±0.92	2.00±0.63	1.80±0.84	0.77
Orthopthera	1.00±0.00	1.33±0.58	1.29±0.41	1.25±0.50	1.00±0.00	0.83

Table 2: Number (N), Frequency (F) and Percentage (%) Composition of Gut Content of Adult Males and Adult Females of *Hemidactylus frenatus*.

Prey	Female (n=39)		Male (n=36)		Total (N=75)	
	F(%)	N(%)	F(%)	N(%)	F(%)	N(%)
Arachnida (Aranea)	18 (17.6)	29 (18.1)	14 (15.7)	21 (14.4)	32 (16.8)	50 (16.3)
Blattoda	5 (4.9)	6 (3.8)	2 (2.2)	3 (2.1)	7 (3.7)	9 (2.9)
Coleoptera	9 (8.8)	10 (6.3)	5 (5.6)	8 (5.5)	14 (7.3)	18 (5.9)
Dipetera	11 (10.8)	17 (10.6)	9(10.1)	16 (11)	20 (10.5)	33 (10.8)
Hemiptera	3 (2.9)	3 (1.9)	3(3.4)	5 (3.4)	6 (3.1)	8 (2.6)
Hymenoptera	4 (3.9)	4 (2.5)	5 (5.6)	5 (3.4)	9 (4.7)	9 (2.9)
Isoptera	22 (21.6)	35 (21.9)	16 (18)	39 (26.7)	48 (25.1)	74 (24.2)
Lepidoptera	19 (18.9)	43 (26.9)	9 (10.1)	38 (26)	35 (18.3)	81 (26.5)
Orthopthera	11 (10.8)	13 (8.1)	26 (29.2)	11 (7.5)	20 (10.5)	24 (7.8)
TOTAL=		**160 (100)**		**146 (100)**		**306 (100)**

Table 3: Comparison of the Morphometric Parameters of Geckos from the five Locations.

Parameters	EWEKORO CEMENT FACTORY AREA	FMC HOSPITAL	FUNAAB CAMPUS	MECHANIC VILLAGE	QUARRY AREA
Weight (g)	4.80±0.38	5.05±0.29	5.02±0.47	5.17±0.41	4.87±0.37
Snout-vent Length	48.20±5.50	50.33±3.42	51.00±3.42	50.67±2.53	49.20±5.31
Tail Length	48.40 ± 4.20^{a}	96.60 ± 9.30^{b}	50.87 ± 5.01^{b}	52.80 ± 4.19^{b}	47.67 ± 2.94^{a}
Head Length	18.93±1.10	18.60±0.83	18.60±0.83	18.40±0.63	18.80±1.21
Head Width	10.73 ± 0.70^{b}	11.13 ± 0.35^{c}	11.20 ± 0.35^{c}	11.13 ± 0.35^{c}	10.67 ± 0.82^{a}
Full Length	96.60±9.30	100.80±7.29	102.20±7.23	103.47±5.78	96.93±7.99

Means were significantly different (P<0.05).

Table 4: Economic Importance and Percentage Composition of Insects Identified in Gut contents of *Hemidactylus frenatus*.

Order	Percentage (%)	Common Name	Economic Importance
Arachnida (Aranea)	16.3	Spiders	Scavengers and Household pests.
Blattoda	2.9	Cockroach	Household pests.
Coleoptera	5.9	Beetles	Destructive to plant seeds, and roots of beans cotton and cereals.
Dipetera	10.8	House fly	Household pests.
Hemiptera	8.5	Bugs	Injurious to crops, fruits and vegetables.
Hymenoptera	2.9	Bees	Useful (bees).
Isoptera	24.2	Termites	Household and poultry pest.
Lepidoptera	26.5	Moths	Beneficial to crops (pollinators).
Orthopthera	10	Crickets	Injurious to crops, fruits and vegetables.

For adult females, Isoptera (21.6%), Lepidoptera (18.9%) and Aranea (17.6%) were the most common prey items, and Hemiptera (2.9%) were least common.

Comparison of the Morphometric Parameters of Gecko from the Five Locations

The result of gut content of geckos found in the five locations is presented in Table 3. The highest weight was recorded in FMC hospital with mean of 5.05g, and the lowest weight (4.87g) in quarry area which was not significantly different ($p>0.05$). The longest SVL was recorded in FUNAAB campus (51 mm), and the lowest SVL in quarry area (47.67 mm), and was not significantly different ($p>0.05$). The longest tail length was recorded in FUNAAB campus (50.87 mm) and the lowest tail length in quarry area (47.67 mm), which was significantly different ($p<0.05$). The longest head width was recorded in FMC hospital (11.20 mm), and the lowest head width recorded in quarry area (10.67 mm), which was significantly different ($p>0.05$).

Economic Importance and Percentage Composition of Insects Identified in Gut Contents of Hemidactylusfrenatus.

Economic importance of common gecko is presented in Table 4. The result showed that *Hemidactylus frenatus* were found to consume 9 different types of food items. It was evident that

they consumed 10.7% of insects which are injurious to crops, fruits and vegetables (Orthopthera), 8.5% of insects injurious to cotton (Hemiptera), 5.9% of garden pests (Coleoptera), 5.9% of insects destructive to plant seeds, roots of beans and cereals (Coleoptera), and 16.3%, 10.8% and 24.2% (49.3%) of insects that are household pests (Isoptera, Diptera and Isoptera, respectively). Hymenoptera (2.9%) and Lepidopthera (26.5%) are beneficial to crops.

Plates

Picture of a female (A) and male (B) common gecko is shown in Plate 1. There is presence of sexual organ (gonads) present in the male gecko, which is absent in female gecko. The dorsal (back) and ventral (front) view of dissected geckos is shown in Plate 2.

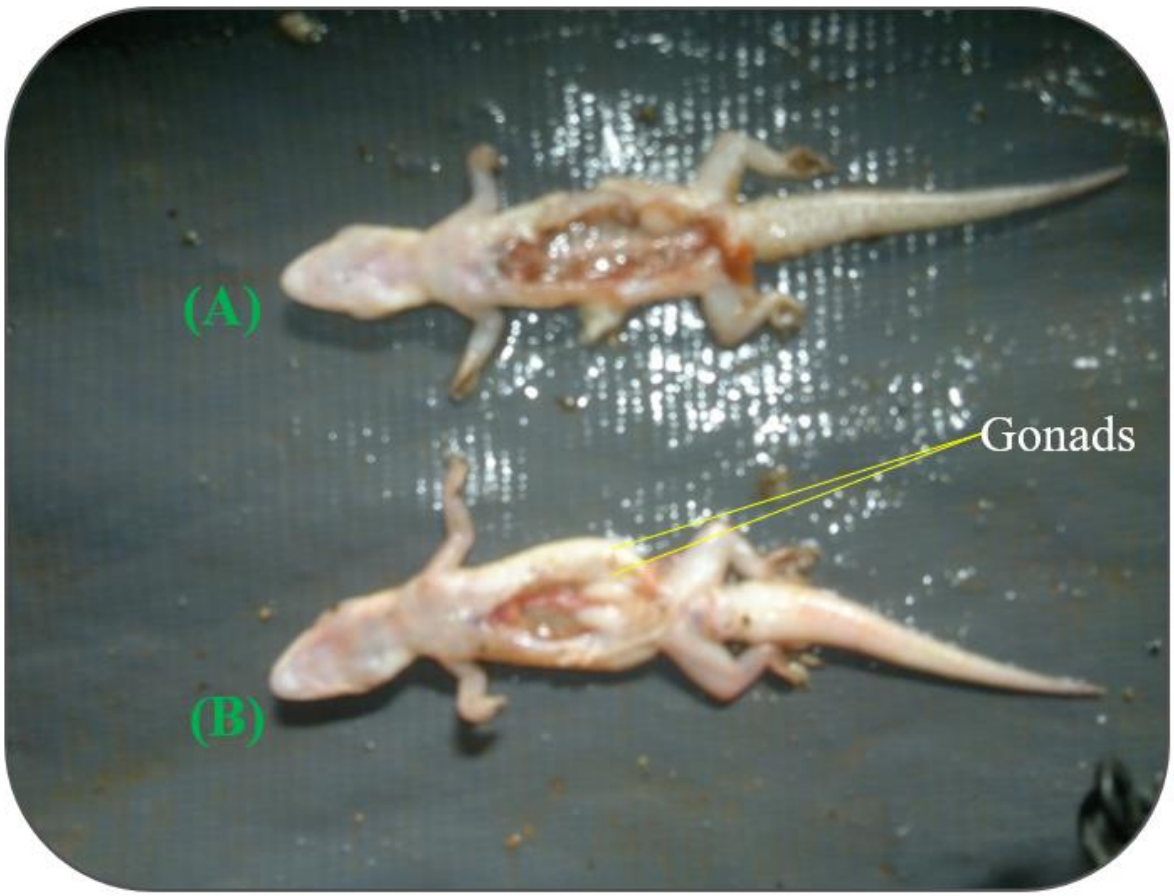

Plate 1: A Female (A) and Male (B) Common Wall Gecko.

Plate 2: The Dorsal (back) and Ventral (front) View of Dissected Geckos.

DISCUSSION

The analysis of the gut contents in Table 1 showed that there was no significant difference (P>0.05) in prey items (Aranea, Blattoda, Coleoptera, Diptera, Isoptera, Hemiptera, Hymenoptera, Lepidoptera and Orthopthera) found in the gut contents of geckos from the five locations. The diet of *H. frenatus* in the study area consisted essentially of Arthropods, coinciding with other studies on the species (Lei and Booth, 2014).

In general, the data indicated that this population is generalist and opportunistic. The high contribution of flying arthropods in the diet of *H. frenatus* could be explained by the fact that most of the captures took place in microhabitats under artificial lights. Intraspecific diet composition of a nocturnal lizard is known to differ in terms of category of consumed prey between populations that inhabit urban environments and those living in natural ones (Bonfiglio, et al., 2006).

In urban environments with light (Hospital, residential areas, FUNAAB campus area), the flying groups (such as Lepidopterans and Isopterans) have a higher number and frequency of occurrence in the diet of geckos, because these are attracted by artificial light while sit-and-wait behavior has been reported to be highly successful for gecko species (Aowphol, et. al., 2006). However, in local environments without light (Ewekoro and Quarry), the number and frequency of non-winged groups (such as

Aranea, Orthoptera, Lepidoptera and Isoptera) is comparatively higher (Colli, et. al., 2003).

The main difference in diet observed among the two sex/ages categories from the five locations was the absence of Hemiptera in the diet, and the relatively low numbers of ingested prey items in the gut of geckos captured in Ewekoro area and Mechanic village. The absence of Hemiptera and low percentage of ingested prey items in the gut contents of captured geckos can be explained by two reasons. First, due to the fact that captures took place in the early hours of the night, the geckos were emerging and did not have enough foraging time to catch prey (Howard et al., 2001). Second, unfavorable habitat may be responsible for the absence of Hemiptera in the study area due to the presence of pollutants. Different habitat associations can lead to availability of different prey items. Microhabitat selection therefore seems to be a major factor in determining diet composition.

In Table 2, Lepidoptera (26.5%) represented the most common dietary item for all of the two sex/age categories (adult males and females), followed by Isoptera (24.2%), Aranea (Spiders 16.3%) and Diptera (housefly 10.8%), Orthoptera (7.8%), Coleoptera (5.9%), Blattoda and Hymenoptera (2.9% each), and Hemiptera (2.6%). The high number of termites (Isoptera) found in the gut of *H. frenatus* can be considered as an unusual result, compared to previous studies. This is so probably because the study was carried out during the rainy season when termites are nesting and they profited from that opportunity. Compared to previous studies, the proportion of empty stomachs among the analyzed individuals was relatively low.

While this result is in agreement with Lei and Booth (2014) and populations of the congeneric species *H. turcicus* (Aowphol, et. al., 2006), it differs in respect to other populations of *H. mabouia* (Bonfiglio, et. al., 2006). The low percentage of empty stomachs (8%) can be explained by two reasons. First, this study was performed during the wet season. Population densities of arthropods difference significantly between the dry season and wet season in, where a reproductive explosion and increased prey availability extraordinarily increases during the wet season (Núñez and Barro, 2003). Second, due to the fact that most of the captures took place in the late hours of the night, the geckos had enough foraging time to catch prey. Howard, et al. (2001) reported that the peak of foraging activity occurred in late night hours, between 20:00 and 01:00 h, in a population of *H. mabouia* from Angilla Island, Lesser Antilles.

Comparison result of the morphometric parameters of gecko (Table 3) showed that there was significant difference in tail length and head width of geckos within the various locations. Geckos from FMC hospital, FUNAAB campus and Mechanic village have longer tails and broader head than those found in Quarry site and Ewekoro area. This may be attributed to the presence of favorable conditions in the three former locations such as food and relatively low level of contaminants than in the two latter locations, which may lead to increase or decrease in growth performance of the species (*Hemidactylus frenatus*). Snout-vent length did not significantly differ between sexes, which is in agreement with studies of other populations of similar species (Howard, et al., 2006 and Bonfiglio, et. al., 2006).

Table 4 showed that *Hemidactylus frenatus* were found to consume nine (9) different types of insect Orders, eight (8) of which are injurious to crops, fruits and vegetables (Orthopthera), injurious to cotton (Hemiptera), garden pests (Coleoptera), destructive to plant seeds, roots of beans and cereals (Coleoptera) and household pests (Isoptera, Diptera, and Isoptera). Hymenoptera is beneficial, while the economic importance of Lepidoptera is unknown. This result therefore established that *Hemidactylus frenatus* act as a biological control agent of pest of crops, fruit, vegetables, plant seeds, cotton, garden pest, cereal and household pests.

CONCLUSION

This present study suggests that habitat as well as microhabitat conditions influence both the diet and morphology of common wall gecko. It also established that geckos serve as biological control agent of pests and environmental cleaning through scavenging. This contradicts the belief that geckos are agricultural and household pests. The results of the gut content of geckos found in the study locations indicated that common wall gecko (*H. frenatus*) were majorly insectivores, with a diet composed mainly of Arthropods (Lepidopthera, Isoptera and Araneae), which are relatively high in terms of number and frequency. Habitat conditions

seem to have significant effect on morphometric parameters of *H. frenatus*. Such as head widths and tail lengths of geckos found in FMC hospital, FUNAAB campus and Mechanic village, which were longer than those of geckos found in Ewekoro and quarry area. This may be attributed to favorable habitat condition such as availability of food resource, water and air, which plays an important role in growth and development of living organisms.

The result of this analysis has shown the role of *H. frenatus* in feeding on insects which are injuries to crops, fruits and vegetables. Also, geckos in human habitations check insect pests populations by feeding on them acting as a biological control agent of pest of crops, fruit, vegetables, plant seeds, cereals and house hold.

RECOMMENDATIONS

Environmental awareness and campaign against the release of pollutants into the environment should be encouraged and the knowledge and proper understanding of geckos and their economic importance should be taught in schools. Though serve as biological control agents and environmental scavengers, further researches on their ecological lives in relation to human and their environment to assess them as carriers/hosts of pathogenic diseases; potential poison(s) in their saliva, urine or body and their socio-economic benefits are recommended.

REFERENCES

1. Afia, U.U., E.C. Egwali, and C.E. Lazarus. 2017. "Endoparasites of Wall Gecko (*Hemidactylus frenatus*) in Selected Areas of AkwaIbom State, Nigeria". *Journal of Science and Technology Research*.14:1

2. Aowphol, A., K. Thirakhupt, J. Nabhitabhata, and H.K. Voris. (2006). "Foraging Ecology of the Tokay Gecko *Gekko gecko* in a Residential Area in Thailand". *Amphibia-Reptilia*. 27: 491-503.

3. Bonfiglio, F., R.L. Balestrin, and L.H. Cappellari. 2006. "Diet of *Hemidactylus mabouia* (Sauria, Gekkonidae) in Urban Area of Southern Brazil". *Biociencia, Porto Alegre*. 14:107-111.

4. Carranza, S. and E.N. Arnold. 2006. "Systematics, Biogeography, and Evolution of *Hemidactylus geckos* (Reptilia: Gekkonidae) Elucidated using Mitochondrial DNA Sequences". *Molecular Phylogenetics and Evolution*. 38(2): 531-545.

5. Censky, E.J., V.D. Karim, D. Hodge, and P. Robert. 2003. *The Reptiles and Amphibians of Anguilla British West Indies: Species Accounts – Lizards*. Anguilla National Trust: Anguilla, BVI.

6. Colli, G.R., D.O. Mesquita, P.V.V. Rodrigues, and K. Kitayama. 2003. "Ecology of the Gecko *Gymnodactylus geckoidesama*-rali in a Neotropical Savanna:. *Journal of Herpetology*. 37: 694- 706

7. Cook, R.A. 1990. "Range Extension of the Darion House Gecko (*Hemidactylus frenatus*)." *Herpetofauna*. 20:23-27.

8. Crandell. K.E., A. Herrel, M. Sasa, J.B. Losos, and K. Autumn. 2014. "Stick or Grip? Co-evolution of Adhesive Toepads and Claws in Anolis Lizards". *Zoology (Jena)*. 117(6):363-369.

9. De Brito-Gitirana, L. and V. Storch. 1998. "Der Einfluß von Nahrungsentzug auf die Ultrastruktur der Hepatocyten von *Hemidactylus frenatus* (Lacertilia: Gekkonidae) mit Besondererberück Sichtigung der Peroxisomen". *Annals of Anatomy – AnatomischerAnzeiger*. 180:193-202.

10. DeVoe, R.S. 2015. "Chapter 7 – Lacertilia (Lizards, Skinks, Geckos) and Amphisbaenids (Worm Lizards)". *Fowler's Zoo and Wild Animal Medicine*. 8:52-60.

11. Gurgel, S., A. Pablo, and M.X.F. Eliza. 2010. "Communal Nests of *Hemidactylus mabouia* (Moreau de Jonnes, 1818) Squamata: Gekkonidae in a Remnant of Atlantic Forest in Northeastern Brazil." *Biotemas*. 23(3):231-234.

12. Ineich, I. (2010). "How Habitat Disturbance Benefits Geckos: Conservation Implications". *Comptes Rendus Biologies*. 333(1):76-82.

13. Lei, J. and D.T. Booth. 2014. "Temperature, Field Activity and Post-Feeding Metabolic Response in the Asian House Gecko, *Hemidactylus frenatus*". *Journal of Thermal Biology*. 45:175-180.

14. Ngwoke, K.G., P.M. Eze, and C.O. Esimone. 2015. "Antimicrobial Activity of Crude Methanol Extract of Fecal Droppings of Common House Lizard/Gecko (*Hemidactylus frenatus*)". *Journal of Applied Life Sciences International*. 2(2):65-70.

15. Núñez, R.A. and A.C. Barro. 2003. "Composición y Estructura de dos Comunidades de Mariposas (Lepidoptera: Papilionoidea) en Boca de Canasí, La Habana, Cuba". *Revista Biología* (Univ. de La Habana) 17:8-17.

16. Obi, Z.C., L.C. Anyaegbunam, and N.A. Igboanugo. 2013. “The House Gecko (*Hemidactylus frenatus*) and Parasitaemia”. *International Journal of Fauna and Biological Studies*. 1(2):13-15.

17. Perry, G., B.W. Buchanan, R.N. Fisher, M. Salmon, and S.E. Wise. 2008. “Effects of Artificial Night Lighting on Amphibians and Reptiles in Urban Environments”. Salt Lake City, Utah: Society for the Study of Amphibians and Reptiles. In: Mitchell J.C., Jung R.E., Bartholomew, B., Ed., *Urban Herpetology. Herpetological Conservation*. 3:239-256.

18. Roll, B. 2001. “Gecko Vision—Retinal Organization, Foveae and Implications for Binocular Vision”. *Vision Research*. 41(16):2043-2056.

19. Teixeira-Filho, P.F., C.E.D. Rocha, and S.C. Ribas. 2003. “Relative Feeding Specialization may Depress Ontogenic, Seasonal and Sexual Variation in Diet: The Endemic Lizards *Cnemidophorous littoralis* (Teiidae)”. *Brazilian Journal of Biology*. 63(2): 321-328

20. Wikipedia. 2017. “Ogun State”. http://www.wikipedia.com. Retrieved 20 November, 2017.

SUGGESTED CITATION

Akintunde, O.A. and S.A. Olayiwola. 2020. “Effect of Habitat on Diet, Morphological Parameters, and Sex Morphism of Common Wall Gecko (*Hemidactylus frenatus*) Abeokuta, Ogun State, Nigeria”. *Pacific Journal of Science and Technology*. 21(2):310-319.