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The Asian House Gecko *Hemidactylus frenatus* *(Sauria: Gekkonidae)*, Contributes to the Control of Hematophagous Mosquitoes in Urban Areas of the Mexican State of Morelos

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ABSTRACT

In order to explore new methods for the control of domestic pests at low cost and without human disturbance, we examined the diet of *Hemidactylus frenatus* from the stomach content analysis of 53 females and 47 males. The specimens were captured in ten urban areas of the state of Morelos, Mexico; where *H. frenatus* is well established and where interactions with humans are frequent. The diversity (H´) of the food, the variation between the components, and the overlap of the trophic niche between males and females were examined; as well as the differences between the rainy and dry seasons. The diet consisted of eleven arthropod groups, the most representative being *Diptera* (*Culicidae*) 23.73%, *Araneae* 20.45%, *Hymenoptera* (*Formicidae* and *Cynipidae*) 17.05%, *Lepidoptera* 14.20% and *Coleoptera* (*Chrysomelidae*) 10.80%. There were no significant differences in the diet by sex, nor between the dry and rainy seasons. The diversity of food consumed between males and females showed a high overlap value (Ojk=0.94709). Although it is true that the diet is opportunistic and is associated with the availability of food in urban areas; the increase in the consumption of Lepidoptera and hematophagous mosquitoes (*Dipera*) in the rainy season, to almost double that which occurs in dry, suggests that geckos can contribute to the control of these insects. Experimental studies are suggested to test this hypothesisa.

INTRODUCTION

Hemidactylus frenatus geckos entered Mexico through the port of Acapulco, as a result of trade between Asia and Mexico between the years 1565-1815 [1,2]. Since its introduction, it has established itself in several regions of the Mexican Republic [3,4] and in almost all urban areas of the state of Morelos, at an altitude between 800 and 1,700 meters above sea level [5,6].

Because their populations have nocturnal activity and develop closely associated with human settlements, near artificial sources of light [7], we examine whether these lizards can contribute to the natural control of domestic insects such as cockroaches (*Periplaneta americana*) and mosquitoes. Cockroaches are a problem because they contaminate cooking utensils and food [8], and mosquitoes are carriers of diseases such as yellow fever and dengue among others [9,10].

Natural control has been an efficient technique for reducing insect populations throughout the world, but ceased to be used due to the introduction of chemical control. However, because of the problems caused by pesticides, biological control has once again become a viable alternative [11].

In order to assess the potential use of these lizards as a possible means of insect control in urban environments, this paper describes the diet of males and females, the variation between dry and rainy seasons, and the amplitude and overlap of the trophic niche between the sexes.

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MATERIALS AND METHODS

Between dry and rainy periods, 53 females and 47 males were obtained in a twilight and nocturnal schedule, between 18:00 and 03:35, inside houses in 10 urban zones of Morelos, Mexico **(Table 1)**.

The specimens captured with adhesive traps, rubber bands and using a noose were individually conserved in plastic bags and labeled with the following data: location, date, and time of capture, sex and season of the year dry November-May, rainy June-October [12] after were transported in a cooler, to be killed by cold. In the laboratory, we obtained the snout-vent length (SVL) of all the specimens, the stomachs were extracted by dissection and the content of each was identified taxonomically under a microscope [13,14]. The content of each stomach was homogenously extended in a Petri dish with millimeter grid (10 × 10 mm), to estimate by the total number of frames covered by the food, 100% of the diet of each individual [12]. The proportional consumption per group of food (*Pi*) was estimated with the expression:

Pi=(Total of frames covered with food/total of frames of the individual diet) x 100 [15]

The frequency of occurrence (FO) was calculated by FO=[ne/Ne] x 100

Where ne is the number of stomachs with a particular type of food and Ne the number of stomachs analyzed. The final value indicates the proportion of the food groups that make up the diet. The amplitude of the trophic niche was estimated with the Shannon diversity index (H´):

$$H' = \sum_{i}^{n} Pi \; In \; pi$$

Where *pi* is the percentage of ingestion of each food group and In *pi* the natural logarithm of *pi*. The overlap of the trophic niches, which produces a value of 0 for unused resources in common and a value of 1 as maximum overlap, was calculated with the expression of Pianka [16].

$$O_{jk} = \frac{\sum_{i}^{n} PiPik}{\sqrt{\sum p^2ij \sum p^2ik}}$$

Where Ojk is the overlap between males-females; p^2ij the total proportion of ingestion of resource i from the total resource used by species j (=females), p^2ik the total proportion of ingestion of resource i of the total resource used by species k (=males), n total number of food resources.

Statistical Analysis

A Mann-Whitney U test was used to estimate differences in the amount of diet components between the sexes and the dry and wet seasons. The differences in the magnitude of the trophic niche (H ') of males and females, was estimated with a T-student test.

RESULTS

Females have an average SVL of 46.04 mm (31.63-61.34, STD ± 5.95, n=53) and males 48.98 mm (32.86–58.45, STD ± 6.23, n=47), which are only 3.23 mm larger than females (T=2.41, P=0.0176).

Table 1. Number of *Hemidactylus frenatus* obtained by location, season and sex.

Locations	Drought November-May		Rains June-October	
	Females	Males	Females	Males
Cuautla 18˚ 48’ 38” N 98˚ 57’ 24.43” O	2	3	2	3
Cuernavaca 18˚ 54’ 59” N 99˚ 13’ 54” O	4	1	3	2
E. Zapata 18˚ 50’ 28” N 99˚ 11’ 5” O	3	2	3	2
Jiutepec 18˚ 52’ 54” N 99˚ 10’ 26” O	1	3	2	4
Jojutla 18˚ 36’ 51” N 99˚ 10’ 35” O	4	2	3	1

Temixco 18˚ 50’ 53” N 99˚ 13’ 31” O	3	3	3	1
Tlaltizapan 18˚ 41’ 8” N 99˚ 7’ 2” O	1	4	3	2
Tlaquiltenango 18˚ 37’ 42” N 99˚ 9’ 38” O	3	2	3	2
Xochitepec 18˚ 46’ 56” N 99˚ 18’ 48” O	2	3	3	2
Zacatepec 18˚ 39’ 30” N 99˚ 11’ 21” O	4	3	1	2
Total	**27**	**26**	**26**	**21**

Table 2. Components of the diet of female *Hemidactylus frenatus* from Morelos, Mexico. Frequency of occurrence, percentage of consumption of each group of food consumed in drought and rains.

Prey group	Drought		Rains	
	Frequency of Occurrence (FO) n=23 %	Percentage of Consumption n=23 %	Frequency of Occurrence (FO) n=30 %	Percentage of Consumption n=23 %
Araneae	9	39.13	9	30.00
Blattoptera	2	8.70	2	6.67
Coleoptera	4	17.39	6	20.00
Diptera	**8**	**34.78**	**16**	**53.33**
Embioptera	2	8.70	0	0.00
Hemiptera	0	0.00	2	6.67
Homoptera	1	4.35	0	0.00
Hymenoptera	7	30.43	7	23.33
Isopoda	0	0.00	1	3.33
Lepidoptera	3	13.04	13	43.33
Orthoptera	0	0.00	1	3.33

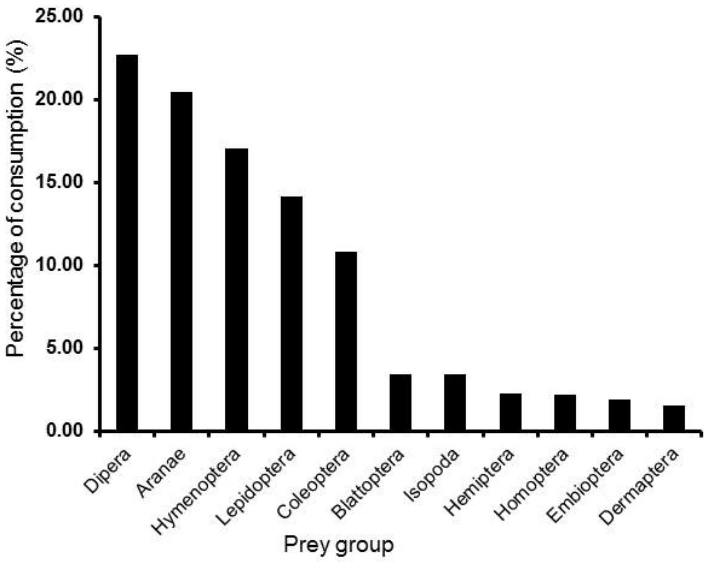

Figure 1. Components of the diets of males (n=47) and females (n=53) *Hemidactylus frenatus* from Morelos, Mexico.

The 94% of the stomachs examined contained food. Eleven groups of arthropods constitute the diet of *H. frenatus*, among them *Diptera* (22.73%, *Culicidae*), *Araneae* (20.45%, *Salticidae*), *Hymenoptera* (17.05%), *Lepidoptera* (14.20%) and *Coleoptera* (10.80%, *Chrysomelidae*) **(Figure 1)**. Among the *Diptera*, 90% were mosquitoes of the genera *Anopheles sp.*, *Culex sp.*, and *Aedes sp.*; and among the Blattoptera only domestic Periplaneta americana cockroaches were found.

The analysis of the frequency (FO) and percentage of food consumption between dry and rainy seasons showed that *Araneae*, *Diptera*, *Hymenoptera*, *Coleoptera*, *Lepidoptera,* and *Blattoptera* were the groups consumed most frequently by females **(Table 2)**. All the components reveal a significant trophic diversity of the order of H´= -2.56 (T=3.40, n=12, P=0.0058). Similarly, *Araneae*, *Diptera*, *Hymenoptera*, *Lepidoptera*, *Coleoptera*, and *Isopoda* were also the groups most frequently consumed by males **(Table 3)**; and these have a significant trophic diversity with a value of H´=-2.57 (T=3.79, n=11, P=0.0035).

Table 3. Components of the diet of males *Hemidactylus frenatus* from Morelos, Mexico. Frequency of occurrence, percentage of consumption of each group of food consumed in drought and rains.

Prey Group	Drought		Rains	
	Frequency of Occurrence (FO) *n*=27 %	Percentage of Consumption *n*=27 %	Frequency of Occurrence (FO) n=20 %	Percentage of Consumption n=20 %
Aranea	11	40.74	7	35.00
Blattoptera	1	3.70	1	5.00
Coleoptera	6	22.22	3	15.00
Dermaptera	1	3.70	0	0.00
Diptera	**8**	**29.63**	**8**	**40.00**
Hemiptera	0	0.00	2	10.00
Homoptera	2	7.41	1	5.00
Hymenoptera	11	40.74	5	25.00
Isopoda	4	14.81	1	5.00
Lepidoptera	4	14.81	5	25.00

The Mann-Whitney U test did not reveal significant differences in the amount of components ingested between the rainy and dry periods (U=83, P≤0.938). The analysis of the overlap of the diet (0jk=0.94709) between males-females was significant, especially in the consumption of *Diptera*, *Araneae* and *Hymenoptera* **(Figure 1)**; that is, males and females consume practically the same groups of insects.

Variations of the order of almost double the consumption of Diptera (*Anopheles sp*., *Culex sp*., and *Aedes sp.* **(Tables 2 and 3)** between periods of drought rain, suggest that *H. frenatus* could help control these insects.

DISCUSSION AND CONCLUSIONS

While it is true that the diet consisted of eleven groups of insects; those that stand out due to high consumption were Arachnids of the *Salticidae* family and *Diptera* of the *Culicidae* family (*Culex sp*., *Aedes sp*., *Anopheles sp*.). This contrasts with the diet of another population of *H. frenatus* in urban areas of Colombia, where the highest consumption concentrated on *Hemiptera*, *Hymenoptera* and *Diptera* [17]. In Costa Rica, the highest consumption was of *Lepidoptera*, *Orthoptera* and *Araneae* moths [18]; very similar to that observed in urban areas of insular environments [19]. This indicates an opportunistic diet that had previously been observed in *H. frenatus* and Phyllodactylus reissi [17,20].

The data obtained here allow us to establish that the diet is more associated with the fauna of arthropods that live in the vicinity of houses.

We suggest that the placement of traps with attractants in urban environments could facilitate the capture of domestic insects by geckos.

Because *H. frenatus* are the only lizards that live in close contact with humans, and have crepuscular and nocturnal habits as well, we suggest that they do not compete with other geckos of Morelos such as *Phyllodctylus lanei* and *Coleonyx elegans* that are typical inhabitants of tropical dry forest [6]. However, for now we have no data on the possible dispersion from urban areas to natural environments and their effects on other lizards, making it necessary to evaluate this issue in the future.

REFERENCES

1. Grant C. The gecko *Hemidactylus frenatus* in Acapulco México. Herpetologica 1957;13:153.
2. Chrapliwy PS. Extensions of know range of certain amphibians and reptiles of Mexico. Herpetologica 1956;12:121-124.
3. Valdez-Villavicencio JH and Peralta-Garcia A. *Hemidactylus frenatus* (Sauria: Gekkonidae) en el noroeste de Mexico. Acta Zoologica Mexicana 2008;24:229-230.
4. Farr WL. Distribution of *Hemidactylus frenatus* in Mexico. The Southwestern Naturalist 2011;56:265-273.
5. Castro-Franco R. New records of reptiles from the Mexican State of Morelos. Bulletin of the Chicago Herpetological Society 1987;22:69-70.

e-ISSN:2321-6190
p-ISSN:2347-2294

6. Castro Franco R and Bustos ZMG. Lagartijas de Morelos, Mexico: distribucion, habitat y conservacion. Acta Zoologica Mexicana 2003;88:123-142.

7. Marcellini DL. Ethoecology of *Hemidactylus frenatus* (Sauria, Gekkonidae) with emphasis on acoustic behavior. PhD Dissertation, University of Oklahoma, Oklahoma, USA 1970.

8. Mera A. Control de cucarachas y sus efectos en hembras grávidas. Universidad del Cauca, Popayan. Departamento de Quimica 2000.

9. Salvatella R. Aedes aegypti (Linnaeus, 1762) (Diptera, Culicidae), el vector del dengue y la fiebre amarilla. Facultad de Medicina. Universidad de la Republica. Montevideo, Uruguay 2004.

10. Torres-Galicia I, et al. Dengue en Mexico: analisis de dos décadas. Gaceta Medica de Mexico 2014;150:122-127.

11. Nicholls ECI. Control Biologico de Insectos un enfoque agroecológico. Edit. Universidad de Antioquia. 2008; p: 261.

12. Castro-Franco R, et al. Diet composition of Sceloporus horridus horridus (Sauria: Phrynosomatidae) in tropical deciduous forest, México. Acta Zoologica Mexicana 2017;33:443-449.

13. Morón MA and Terron R. Entomologia práctica. Instituto de Ecología, Mexico DF 1988; p: 500.

14. Borror DJ, et al. An Introduction to the Study of Insects. 6th edn. Saunders College Publishing, Philadelphia, USA 1992.

15. Windell JT and Bowen SH. Methods for study fish populations. In: Bagenal TB (ed.), Methods Assessment of Fish Production in Fresh Water. Oxford: Blackwell Scientific 1978.

16. Pianka E. The structure of lizard communities. Annual Review of Ecology, Evolution and Systematics 1973;4:53-74.

17. Diaz PJ, et al. Dieta de Hemidactylus frenatus (Sauria: Gekkonidae en un area urbana de la region caribe Colombiana. Acta Zoologica Mexicana 2012;28:613-616.

18. Abarca J. Gecos caseros (Hemidactylus): biología e impacto en Costa Rica. Revista Ambientico 2006;159:2-6.

19. Galina-Tessaro P, et al. Colonization of Socorro Island (Mexico), by the tropical house gecko Hemidactylus frenatus (Squamata: Gekkonidae). Revista de Biología Tropical 1999;47:237-238.

20. Jordan J. Dieta de Phyllodactyllus reissi (Sauria: Gekkonidae) en la Zona Reservada de Tumbes, Peru. Revista Peruana de Biología 2006;13:121-123.of