

# Papéis Avulsos de Zoologia

## NOTES ON THE ECOLOGY AND LIMB PROPORTIONS OF AMAZONIAN *MABUYA MABOUYA* (SAURIA, SCINCIDAE)

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### INTRODUCTION

*Mabuya mabouya* is a moderately common forest lizard (Crump, 1971). It stands well the presence of man and may occur in thinned and frequented forests, at times in edge situations (but always in the shade), and occasionally in houses. In the forest it is seen mostly on fallen or standing tree trunks (the latter generally thick, 1 meter or so in diameter), from ground level to a height of about 1.5 meters. It tries to escape to the far side of the trunk or to the ground. It is not commonly seen in leaf litter. In some places it is found on the thick tangle of felled trees on the edge of slash-and-burn agricultural plots.

The field work on which these notes are based was done as part of the program of the Expedição Permanente da Amazônia (EPA), maintained by this Museum, by the Fundação de Amparo à Pesquisa do Estado de São Paulo and by the Museu Goeldi, Belém, Pará.

When working at As Pedras, a highly productive locality on the Rio Cuminá-Mirí (Trombetas drainage) in Pará, one of us (PEV) observed several young specimens, but no adults, in the thatch roof, about 4 m above ground, of a Brasil-nut warehouse. This suggested that there might be an ontogenetic change of ecological niche, with reflections on body proportions and food preferences. The present study is an attempt to investigate these points; it fails to discover the predicted differences, but reveals some puzzling features of geographical differentiation.

### MATERIALS

We have used 83 specimens from 21 localities (Map), as follows:

BRASIL, PARÁ: Belém, 4 ♂♂, 4 ♀♀; Igarapé Taperebá, mun. Chaves, Marajó, 2 ♂♂; Marajó (no further data), 1 ♀; Breves, 1 ♂, 1 ♀; Corcovado, nr. Breves, 1 ♀; Oriximiná, 14 ♂♂, 13 ♀♀; Boca do Cuminá-Mirí, 2 ♂♂; As Pedras, 8 ♂♂. AMAZONAS: Vila Amazonas, nr. Parintins, 1 ♀; Itapiranga, 1 ♂;

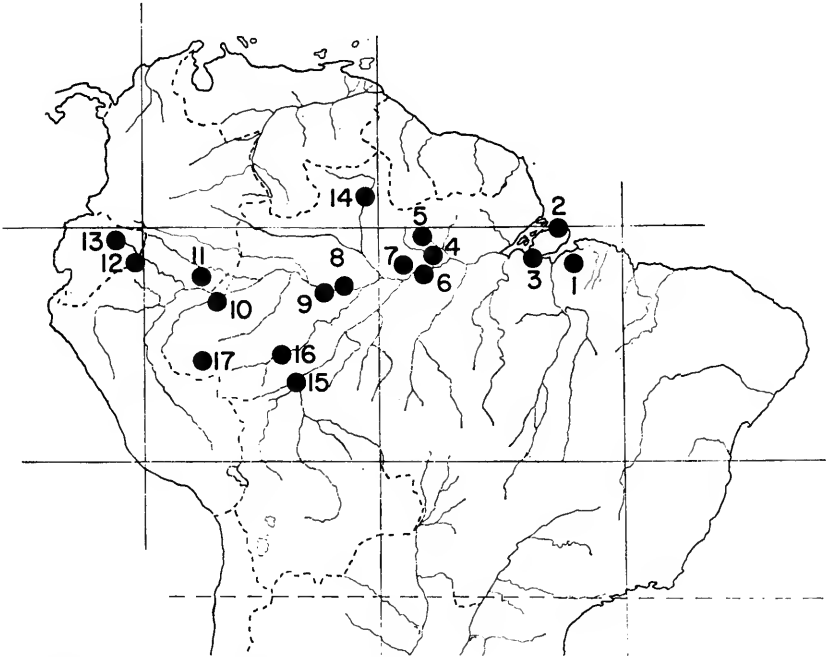
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Codajás, 1 ♂, 1 ♀; Coari, 3 ♂♂; Benjamin Constant, 2 ♂♂, 3 ♀♀; Middle Purus, 4 ♂♂, 1 ♀. RORAIMA: Baixo Mucajaí, 1 ♂. RONDONIA: Porto Velho, 2 ♂♂. ACRE: Tarauacá, 1 ♂.

PERU, LORETO: Estirón, R. Ampiyacu, 1 ♂, 2 ♀♀.

ECUADOR, NAPO-PASTAZA: Conambo, 1 ♂, 1 ♀; Rio Bobonaza, entre Sarayacu y Canelos, 2 ♂♂, 3 ♀♀.



Localities cited. 1, Belém. 2, Igarapé Taperebá. 3, Breves. 4, Oriximiná. 5, Boca do Cumina-Miri and As Pedras. 6, Vila Amazonas and Parintins. 7, Itapiranga. 8, Codajás. 9, Coari. 10, Benjamin Constant. 11, Estirón. 12, Conambo. 13, Rio Bobonaza. 14, Baixo Mucajaí. 15, Porto Velho. 16, Middle Purus. 17, Tarauacá.

#### LIMB PROPORTIONS

It is a very serious shortcoming of our data (and of most *Mabuya* collections) that not enough intact tails are available for statistical study. The tail of *Mabuya* is longer than the body, thick, non-prehensile, and it is impossible to ignore its mechanical importance. Unfortunately it is very fragile, and a large proportion of specimens caught have broken tails, and healed breaks near to the tip are not easy to recognize. It is very hard to avoid further breaking during capture, preservation, transportation and handling in the laboratory. Thus we have an insufficient number of complete tails and are limited here to the study of limb proportions.

## METHODS

Limb measurements were taken to the nearest millimeter, by stretching the limb alongside a ruler held perpendicular to the body, touching with moderate firmness the axilla or the base of the tail. Independent measurements of the same specimens varied usually by 1 mm, but the very high correlation coefficients observed show that such variations are irrelevant to present purposes. Body (rostranal) length was measured with the same ruler; almost all specimens were collected and prepared by professional herpetologists, and this was a very consistent measurement.

The specimens were sexed by inspection of the gonads at the time of removal of the viscera for stomach contents analysis.

Body proportions were studied by routine statistical methods, found in the usual texts, the only exception being an extension to regression coefficients of Kramer's method of multiple comparisons of means (Duncan, 1970); further extension of the method to regression constants is obvious.

Before a linear regression model was adopted, the second degree was tested in all cases, as well as the usual logarithmic transformations, none of the alternative models affording any improvement on the simple straight line.

Given the scattered geographical distribution of the specimens, it was necessary to establish a standard of homogeneity to judge the propriety of lumping several geographically compatible localities into samples with a reasonable number of specimens. The Oriximiná sample containing 14 males and 13 females, all collected within 2 years by Museum parties in a well known area, provided the standard. All groupings made were checked against this sample, and adopted only when significant increase in variability resulted.

It is evident that our materials are insufficient for a proper study of geographical differentiation. The comparisons made attempt only to gain some preliminary insight on the ecological meaning of the body proportions.

The following composite samples were used:

*Baixo Amazonas*: Oriximiná, Boca do Cuminá-Mirí, As Pedras, Vila Amazonas, Parintins and Itapiranga: 25 ♂♂, 15 ♀♀. Preliminarily the specimens from localities other than Oriximiná were grouped and the resulting sample compared with Oriximiná; since the two samples were in good agreement, they were fused. This became the fundamental sample for all further comparisons. It must be noted that "Baixo Amazonas" (Lower Amazon) in Brazilian usage refers to the area between the mouth of the Negro and the channels that limit to the west the island of Marajó.

*Eastern Pará*: Belém, Marajó, Igarapé Taperebá, Breves, Corcovado:  
7 ♂♂, 7 ♀♀.

*Western Amazonia*: Codajás, Coari, Benjamin Constant, Estirón:  
7 ♂♂, 6 ♀♀.

No further grouping was possible due to geographical heterogeneity, and the remaining specimens were not used for the study of limb proportions.

## REGRESSION OF FORE LIMB LENGTH ON BODY LENGTH

The relevant data on the regressions are shown in Table 1. Graph 1 shows the individual points for males and females in the Baixo Amazonas sample, graph 3 the geographical variation (all samples).

It is at once evident that all regressions show excellent fit, the lowest coefficient of determination being .88 (Eastern Pará). The Baixo Amazonas sample has a slightly better fit than the geographically homogenous Oriximiná sample because its range of body lengths is wider.

It is also seen that only one regression constant (*a*) is significant, that for Western Amazonian females. In all other cases the lines may be said to pass through the origin, i.e., limb length is an approximately constant proportion (given by the regression coefficient) of body length throughout the range of body lengths sampled.

TABLE 1  
Regression of fore limb length on body length

	N	R <sub>x</sub>	b	a	y <sub>30</sub>	y <sub>90</sub>	r <sup>2</sup>
Males							
Oriximiná	14	54 - 103	.34 ± .026	-3.65 ± 1.97	6.6	27.1	.93
B. Amazonas	25	30 - 103	.31 .018	-1.38 1.20	8.0	26.8	.95
E Pará	7	65 - 98	.31 .051	-.97 4.40	8.4	27.1	.88
W Amazonia	7	47 - 80	.27 .030	.51 1.93	8.6	24.8	.94
Females							
Oriximiná	13	70 - 105	.27 .024	-.47 2.09	7.7	24.0	.92
B. Amazonas	15	48 - 105	.27 .017	-.35 1.46	7.8	24.0	.95
E Pará	7	33 - 100	.27 .021	.72 1.64	8.9	25.3	.97
W Amazonia	6	39 - 88	.20 .011	5.53 .71	11.4	23.2	.99

N	number of individuals	y <sub>30</sub>	limb length at body length 30 mm
R <sub>x</sub>	range of the independent variable	y <sub>90</sub>	limb length at body length 90 mm
b	regression coefficient plus or minus its standard deviation	r <sup>2</sup>	coefficient of determination (square of the correlation coefficient)
a	regression constant plus or minus its standard deviation		

It may also be seen in Graph 1 that Baixo Amazonas adult females have shorter limbs than males of the same body length. This turns out to be the case in all samples. In the case of the Western Amazonian sample the regression coefficients differ. In the other cases they do not, but the regression constants (recalculated on the basis of an average regression coefficient) do differ. However, further grouping of samples homogeneous for the character reveals differences between regression coefficients, so it

can be accepted that females have shorter fore limbs, and that the difference tends to increase with age. Inspection of Graph 1 indicates that the difference becomes noticeable at body lengths between 70 and 80 mm. The same happens in the Eastern Pará sample. In the Western Amazonia sample the range of body sizes is insufficient for a decision.

Finally, there is geographical variation of limb length. Eastern Pará and Baixo Amazonas males practically coincide, but Western Amazonas males have significantly shorter fore limbs, of about the same length as Eastern Pará females. The three samples of females differ among themselves: the Eastern Pará females have longer limbs than those from Baixo Amazonas, although the lines are parallel; the Western Amazonia line crosses the other two.

#### REGRESSION OF HIND LIMB LENGTH ON BODY LENGTH

Everything said for the fore limb is true for the hind limb (table 2 and graphs 2 and 4): (i) all regressions show excellent fit; (ii) only one sample, and again Western Amazonian females, has a significant regression constant; (iii) females have shorter hind limbs, and the difference tends to increase with age and to become noticeable between body lengths 70 and 80 mm in all 3 samples; (iv) the geographical pattern is similar, but Western Amazonian females tend, at higher body lengths, towards values found in Baixo Amazonas.

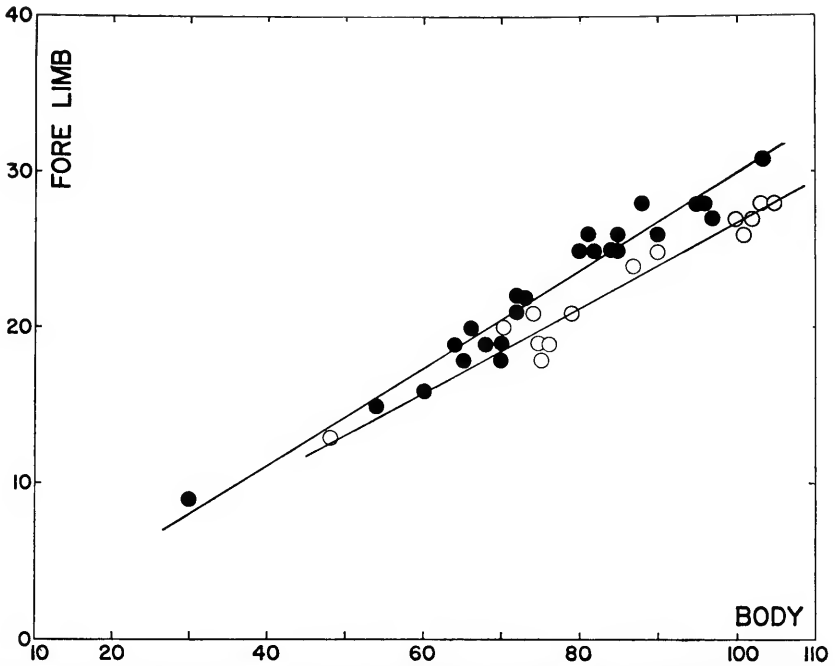
#### REGRESSION OF FORE LIMB LENGTH ON HIND LIMB LENGTH

Table 3 and Graph 6 demonstrate the remarkable uniformity of this relationship.

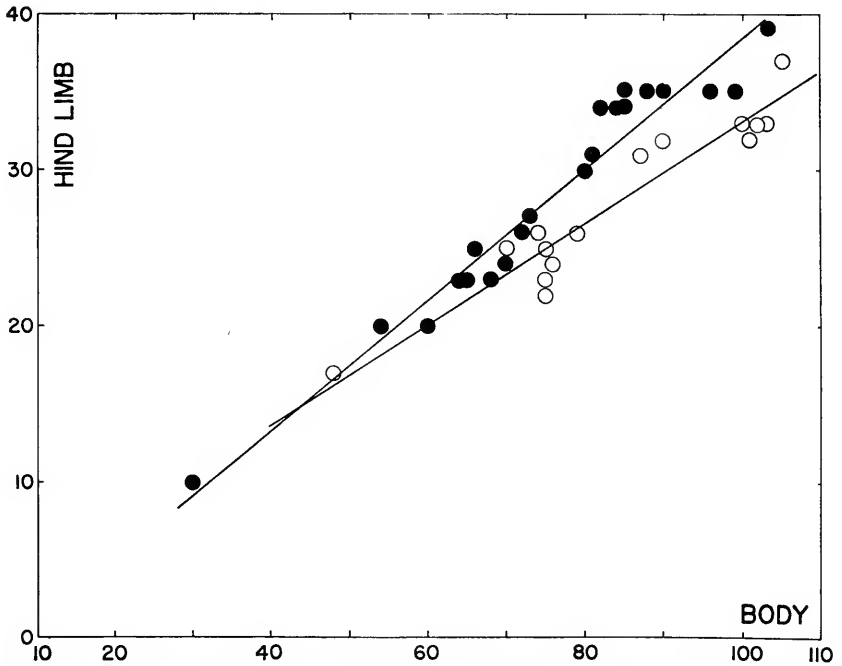
TABLE 2  
Regression of hind limb length on body length

	N	$R_x$	b	a	$y_{30}$	$y_{90}$	$r^2$
<b>Males</b>							
Oriximinã	14	54 - 103	.42 ± .030	-3.72 ± 2.28	8.8	33.9	.94
B. Amazonas	25	30 - 103	.42 .020	-3.52 1.59	9.1	34.2	.95
E Pará	7	65 - 98	.46 .050	-6.56 4.25	7.2	34.9	.95
W Amazonia	7	47 - 80	.37 .036	-.84 2.32	10.3	32.6	.95
<b>Females</b>							
Oriximinã	13	70 - 105	.34 .040	-.59 3.52	9.6	29.9	.87
B. Amazonas	15	48 - 105	.32 .028	.68 2.41	10.4	29.9	.91
E Pará	7	33 - 100	.36 .007	.02 .56	10.8	32.2	.998
W Amazonia	6	39 - 88	.26 .013	6.09 .78	13.9	29.5	.991

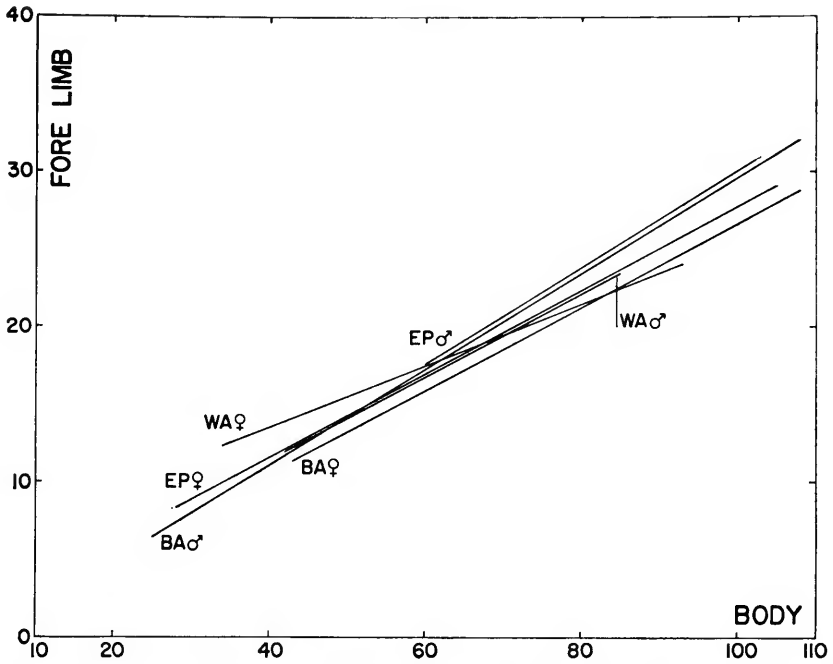
Abbreviations as in Table 1



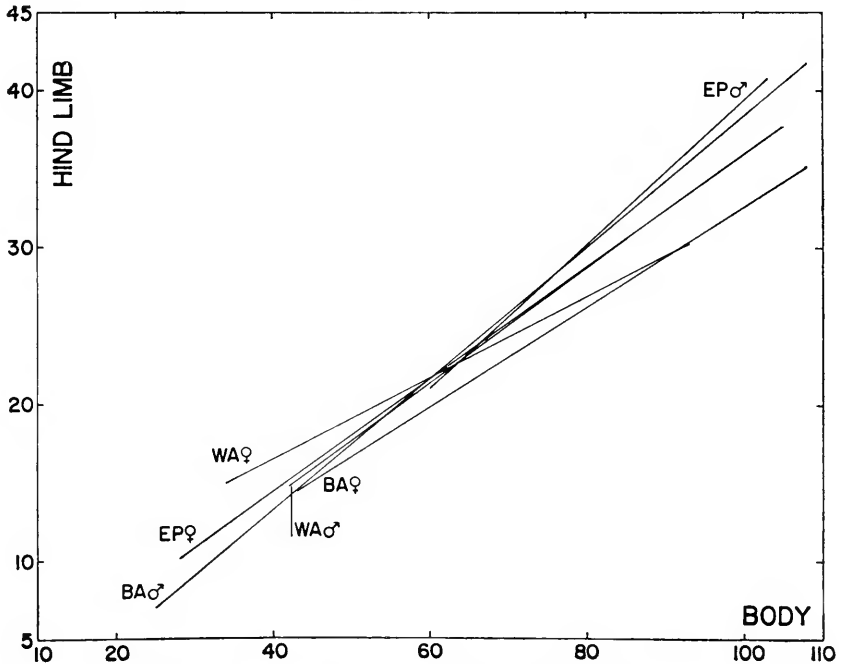
Graph 1. *Mabuya mabouya*, sample Baixo Amazonas, regression of fore limb length on body length. Light circles, males; dark circles, females.



Graph 2. *Mabuya mabouya*, sample Baixo Amazonas, regression of hind limb length on body length. Light circles, males; dark circles, females.



Graph 3. *Mabuya mabouya*, all geographical samples, regression of fore limb length on body length.



Graph 4. *Mabuya mabouya*, all geographical samples, regression of hind limb length on body length.

TABLE 3  
Regression of fore limb length on hind limb length

	N	$R_x$	b	a	$y_{10}$	$y_{40}$	$r^2$
<b>Males</b>							
Oriximinã	14	20 - 39	.80 ± .048	- .21 ± 1.34	7.8	32.0	.96
B. Amazonas	25	10 39	.73 .033	1.71 .95	9.0	30.9	.96
E Parã	7	22 38	.65 .116	4.29 3.81	10.8	30.4	.86
W Amazonia	7	15 29	.70 .097	1.74 2.23	8.7	29.7	.91
All males	39	10 39	.74 .027	1.45 .79	8.8	30.9	.95
<b>Females</b>							
Oriximinã	13	22 - 37	.76 .048	1.20 1.42	8.8	31.7	.96
B. Amazonas	15	17 - 37	.80 .041	.05 1.15	8.0	32.0	.97
E Parã	7	12 - 33	.76 .056	.71 1.61	8.3	31.2	.97
W Amazonia	6	17 - 29	.76 .022	.92 .49	8.5	31.1	.996
All females	28	12 37	.78 .024	.48 .64	8.3	31.6	.98
All specimens	67	10 - 39	.75 .019	1.07 .52	8.6	31.1	.96

$y_{10}$  fore limb length at hind limb length 10 mm

$y_{40}$  fore limb length at hind limb length 40 mm

Other abbreviations as in Table 1

In both Graphs 3 and 4 we see a spread of the lines from lower to higher values of the body length. In Graph 5 we see a completely different picture: all lines form a tight bundle, showing homogeneity across all the area covered and total absence of sexual differences.

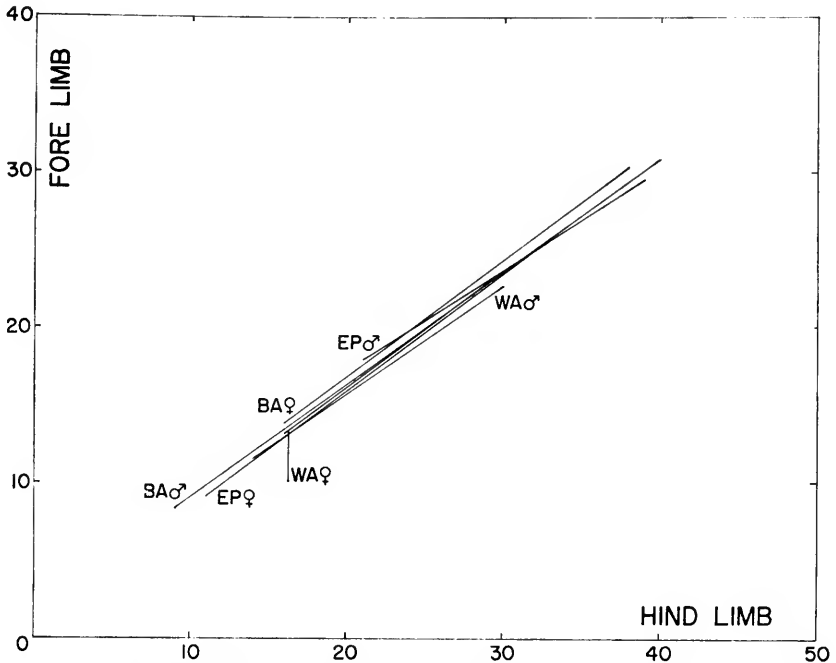
#### COMMENTS

We have thus the following data:

1. All regressions studied show remarkably good fit.
2. Limb length tends to maintain a constant relationship with body length, not with body volume or weight.
3. There are significant sexual and geographical differences both in fore and hind limb length taken against body length.
4. The relationship between fore and hind limb is also remarkably precise and shows neither sexual nor geographical variation in the materials at hand.

The very high values of the coefficient of determination would indicate that limb proportions are subject to strong selective pressures, leading to restricted variability. The presence of sexual differences that become significant at body lengths between 70 and





Graph 5. *Mabuya mabouya*, all geographical samples, regression of fore limb length on hind limb length.

80 mm indicates that either the sexes occupy different structural niches or the limbs play some important role in sexual behavior, perhaps in sex recognition, courtship or copulation. The presence of geographical variation would suggest that the structural niche very probably plays a role in the process.

The lack of sexual and geographical variation in the relationship between fore- and hindlimb, as opposed to the pronounced differences in the relationships between these variables taken individually against body length is the most puzzling feature of this study. The coefficients of determination are exactly of the same order of magnitude as those for the limbs on body. It is difficult to imagine why the relationship between the limbs is so constant when individual limb proportions are so sensitive to sex and geography. Many variables at present not accessible will have to be studied before we gain an insight on the meaning of this phenomenon.

#### STOMACH CONTENTS

Among our 83 stomachs, 66 contained identifiable food remains. Non-identifiable contents were found in 8 stomachs, and another 8 were empty. One contained only dirt.

The state of preservation of the contents prevented any but the very roughest quantitative approach. We scored only the presence of a given type of animal prey, ignoring if it was represented by one or more species or specimens. Thus what we are here calling one "food item", for want of a better term, means only the presence of an invertebrate type in a given stomach. For example, a stomach that contained one specimen of an erotylid beetle, one specimen of a curculionid beetle, several grasshopper legs and some unidentifiable remains, was scored: "beetle, 1; grasshopper, 1". Of course the primary notes are as detailed as possible, and remain available for further use.

The identification of stomach contents was pushed as far as possible; unfortunately this was not very far, due to the degree of digestion and to the lack of precise knowledge of Amazonian invertebrates.

Table 4 lists the 105 food items, distributed in 14 systematic categories, recovered from the 66 stomachs. Part of the beetles and spiders were identified to family.

The main purpose of this analysis being to investigate possible ontogenetic changes in food preferences, we divided the specimens in 2 groups: up to 77 mm body length and larger than that. This was done because the largest specimens caught on the thatch roof was 68 mm long. For brevity and to avoid commitment, we are calling these body length classes "smaller" and "larger". Our samples comprehend 35 smaller and 70 larger specimens.

As a first step we tried to find types of prey that could be unambiguously assigned either to the ground or to high stations on the vegetation.

There are 7 food items that can be identified with fair certainty as having been eaten on the ground or near it: Isopoda, found twice; crickets, twice; and wolf spiders (Lycosidae), 3 times. With the exception of one spider, found in the stomach of a larger female from Oriximiná, all specimens were found in the stomachs of smaller males. These data are not adequate for statistical treatment but seem suggestive — and of exactly the contrary of our initial ecological hypothesis.

We combined the elements of Table 4 in various ways, in an effort to "dredge" significant or at least suggestive relationships from the data. The resulting tables are omitted, as they show practically nothing.

Table 4 shows that 5 food items are responsible for 86 per cent of the occurrences. So we started our analysis by considering individually these 5 categories and lumping the remainder as "others".

The starting point was the Baixo Amazonas sample. A contingency table was built with 24 cells: 6 categories of food items x 2 sexes x 2 body sizes. The value of chi square was not nearly significant: the test was repeated omitting the group "others", but the result was the same. The materials were grouped then successively by sex and by body size; again  $X^2$  was far from significant.

TABLE 4  
Frequency of food items

	Frequency	per cent of total	accum. per cent
Grasshoppers (Acridoidea)	27	25.7	25.7
Arachnida <sup>1</sup>	24	22.9	48.6
Beetles (Coleoptera)	20	19.0	67.6
Roaches (Blattaria)	12	11.4	79.0
Hymenoptera (other than ants)	7	6.7	85.7
Caterpillars (Lepidoptera, larvae)	3	2.9	88.6
Other Orthoptera	2	1.9	
Hemiptera Heteroptera	2	1.9	
Crustaceans (Isopoda)	2	1.9	
Crickets (Gryllidae)	2	1.9	96.2
Termites (Isoptera)	1	.95	
Gryllotalpidae	1	.95	
Ants (Formicidae)	1	.95	
Hemiptera Homoptera	1	.95	100.0

105

1. Spiders (20) and Opiliones (4).

The two other samples (Eastern Pará and Western Amazonia) were submitted to the same treatment, with the same results.

Next we looked for geographic differentiation, by testing the Eastern Pará and Western Amazonia samples against Oriximiná. This could only be done by grouping sexes and body sizes, as otherwise the frequencies would be insufficient. No significant differences were found.

Based on this result we next lumped all the samples, and repeated the tests done for the Baixo Amazonas sample; still no significant differences.

Then we started manipulating the food item categories, by successively removing to the "others" class the less frequent of the individualized classes, first Hymenoptera, and next Blattaria. Once more no significant differences were found.

It is obvious that all this manipulation does not advise one to take levels of significance too seriously. But this sort of analysis is not meant to precisely test hypotheses, but rather to fish (or "dredge") for clues to be followed by further investigation. So, as a final step, we built tables of the expectations of the distribution of the totality of the materials (sexes grouped), in order to check which cells showed excessive or defective frequencies, even if, as already seen, not significant.

We found excesses in: (i) spiders in the smaller lizards; (ii) grasshoppers and hymenopterans in the larger lizards. Repeating the analyses by considering only these categories, we obtain values of  $X^2$  (6.93, 2 df) significant at the 5% level. This meager result took, as seen, considerable dredging to obtain, and we have to conclude that our present data do not indicate any marked ontogenetic change in food habits.

## REFERENCES

CRUMP, M.

1971. Quantitative analysis of the ecological distribution of a tropical herpetofauna. *Occas. Papers Mus. Nat. Hist. Univ. Kansas* 3: 1-62.

DUNCAN, D. B.

1970. Multiple comparison methods for comparing regression coefficients. *Biometrics* 26 (1): 141-143.

VANZOLINI, P. E.

1972. Miscellaneous notes on the ecology of some Brazilian lizards. *Papéis Avulsos Zool.*, S. Paulo, 26 (8): 83-115.

VANZOLINI, P. E. & R. REBOUÇAS-SPIEKER

1968. On a large and surprising sample of *Calliscolincopus agilis* from Brasil, with the invalidation of the genus (Sauria, Teiidae). *Papéis Avulsos Zool.*, S. Paulo, 22: 123-144.