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A STUDY OF THE SPECIES OF THE GENUS
BASILISCUS

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No. 1 — *A Study of the Species of the Genus Basiliscus*

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INTRODUCTION

Five species have been described in the genus *Basiliscus*: *B. vittatus* Wiegmann 1834, *B. plumifrons* Cope 1876, *B. basiliscus* Linnaeus 1758 (= *americanus* Bocourt 1874), *B. barbouri* Ruthven 1914, and *B. galeritus* A. Duméril 1851. Of these five species only *B. vittatus* and *B. plumifrons* have overlapping ("sympatric") geographic distributions, both occurring in the same localities in various parts of Costa Rica and northwest of Panama. *B. vittatus*, however, has a range extending up to Tamaulipas and Michoacan in Mexico, while *B. plumifrons* is restricted to the northwest of Panama, Costa Rica, Nicaragua, and part of Honduras. The remaining three species, on the other hand, are at present known with certainty only from non-overlapping ("allopatric") territories: *B. basiliscus* from Panama and Atrato Region in Colombia, *B. barbouri* from the north of Colombia and (new records not previously published) from Venezuela, and finally, *B. galeritus* from Gorgona Island and the Choco in Colombia, and from Ecuador.

All of these species were distinguished originally on the morphological examination of relatively few specimens (Boulenger, 1885; Ruthven, 1914). Furthermore, no analysis of this genus has been carried out in modern terms — considering the species "as actually or potentially interbreeding populations" (Mayr, 1942) rather than mere morphological types. In these circumstances, it appeared to me that a restudy of the genus was desirable, examining from a modern point of view the morphological variability of the various forms in preserved specimens. The present work represents an attempt to do such a study. The evidence that I present here may not be conclusive, but to the degree that it is based on the analysis of a larger sample than the original discussions, it may be expected to provide a better basis for the assessment of the biological status of the various forms and for future more formal revisions. (Material and ecological data in the critical area of southern Costa Rica has been gathered by a party from the University of Southern California and will be reported by

them.) I have also tried to indicate some of the questions and problems which should be considered in future field studies of the genus.

MORPHOLOGICAL ANALYSIS

In 1885 Boulenger recognized four species in the genus *Basiliscus*: *B. vittatus*, *B. plumifrons*, *B. americanus* and *B. galeritus*, synonymizing with these several forms previously considered distinct species. No change in the systematics of the genus has occurred since, except for the description of a new species, *B. barbouri*, by Ruthven in 1914, and the change of name from *B. americanus* to *B. basiliscus* by Barbour in 1905.

The characters used by Boulenger in his discussion of the species of this genus were the following:

1. Head crest: shape of the crest and size of the scales.
2. Dorsal crest: relative height with respect to the body height, and size of the scales.
3. Caudal crest: relative height with respect to the body height, and size of scales.
4. Number of labials to below the center of the eye.
5. Number of chin-shields in contact with the infralabials.
6. Lateral fringe of the toes (toe flap): relative width (large or small).
7. Abdominal scales: keeled or not keeled.
8. Coloration.

Of these characters, 1, 2 and 3 are adult male features which vary with the size of the animal. Character 8 shows differences in color and pattern between the several forms but also ontogenetic changes within each form and it is as a rule difficult to evaluate in preserved specimens. The other characters, however, may be studied in individuals of both sexes and all ages. No additional features were used by Ruthven in his description of the species *B. barbouri* and, indeed, I have found only a few new characters present in both sexes and all ages useful in the present study. It has been possible, however, to assess on a much broader basis the systematic value of those previously used.

In this study I have examined 440 specimens, most of these from the collection of the Museum of Comparative Zoology. A few come from the collection of the Museo de Biología, Caracas, Venezuela, and some from the collection of the American Museum of Natural History. The species are very unequally represented: 283 *B. vittatus*; 38 *B. plumifrons*; 71 *B. basiliscus*;

17 *B. barbouri*, a wide geographic area it inhabits is forms occur. Tail and size of all ind

In what follows and analyze their moment and for the named population

1). *Head crest.* line of the head, laterally compressed crest finds its fullness and seems to tapers to appear.

The head crests profiles, as is shown degree of variability the division of the anterior lobe being general profile is Colombian form, Ruthven (1914) the head crest. The head crest single, ribbonlike, narrow narrow lobe." The crest of *basiliscus* is more variable in the of bending over the crest of *basiliscus* single morphological 'typical' Colombian either of sampling fortunately, no in *Basiliscus* in the area in Colombia, the *barbouri*, might con

The females of instead a hoodlike l

17 *B. barbouri*, and 38 *B. galeritus*. This reflects in part the wide geographic range of *B. vittatus* but also the fact that the area it inhabits is better collected than the areas where the other forms occur. Table 2 shows the geographic distribution, sex, and size of all individuals studied.

CHARACTER ANALYSIS

In what follows I describe the characters used in this paper and analyze their variability in the several forms. (For the moment and for the purpose of the discussion I shall treat all the named populations as if of equivalent taxonomic value.)

1). *Head crest*: The head crest originates in the middorsal line of the head, behind the pineal eye. It extends backwards, laterally compressed, to end in the middle of the neck. The head crest finds its fullest expression in the adult males of all populations and seems to be one of the earliest secondary male characters to appear.

The head crests of the different forms have rather different profiles, as is shown in Figures 1 and 2, but there is a good degree of variability around these modal shapes. In *plumifrons* the division of the crest into two lobes is characteristic, the anterior lobe being always small and narrow; in *galeritus* the general profile is rounded and in *vittatus* is triangular. The Colombian form, *barbouri*, was separated from *basiliscus* by Ruthven (1914) mainly, if not exclusively, by the shape of the head crest. Thus, he described *barbouri* as having "the head crest single, not erect but pendent on the side of the neck, ribbonlike, narrowing rapidly from its base . . . to form a narrow lobe." This description could also apply to the head crest of *basiliscus* in Panama, although these populations may be more variable in the length of the narrow lobe and in its degree of bending over the neck (Fig. 2). The variability of the head crest of *basiliscus* and of *barbouri* appears to center around a single morphological pattern; the divergence found between the 'typical' Colombian and Panamanian forms could be the result either of sampling or of intraspecific geographic variation. Unfortunately, no information appears to exist about the genus *Basiliscus* in the area between Golfo de Uraba and Santa Marta in Colombia, the region where the two forms, *basiliscus* and *barbouri*, might come into contact.

The females of all groups do not have a true head crest, but instead a hoodlike lobe on the posterior part of the neck.

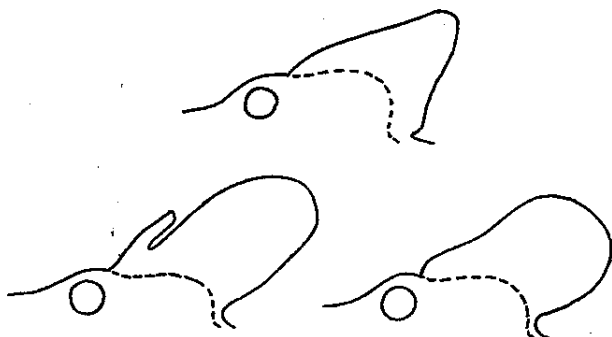


Figure 1. Head crests of adult male *Basiliscus*. Top: *B. vittatus*. Bottom left: *B. plumifrons*. Bottom right: *B. galeritus*.

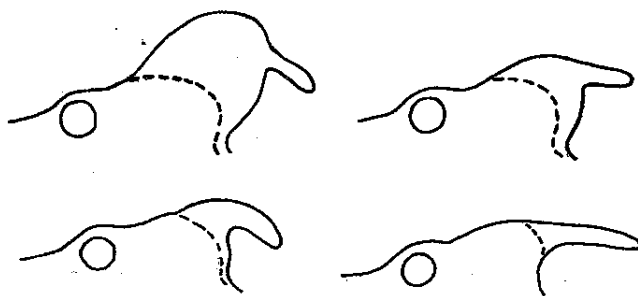


Figure 2. Head crests of adult male *Basiliscus*. Top left: typical *B. basiliscus*. Bottom right: typical *B. barbouri*. Top right and bottom left: intermediate variants occurring in both Panama and Colombia.

2). *Dorsal crest*. This is also an adult male character, present in four of the five forms: *vittatus*, *plumifrons*, *basiliscus* and *barbouri*. It is not present in *galeritus*, where it is replaced by a periodic pattern in a row of large triangular scales separated at regular intervals by two to four small intervening scales (Fig. 3). This replacement of the dorsal crest by a distinctive pattern of scalation appearing in both sexes and in juveniles as well is a constant character in *galeritus*. In the other groups, females and young individuals do not have a dorsal crest nor does their middorsal row of scales resemble that of *galeritus* since there is not the same striking variation in size of the scales nor the same well-defined periodicity (Fig. 3).

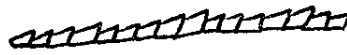
Figure 3. Dorsal crest (top), in juveniles

The dorsal crest is a series of bony rays which are long and pointed towards both sides. In *basiliscus* and *barbouri* the crest is serrated, because of the bony rays. In *vittatus* the crest is similar. In *vittatus* the bony rays are long and pointed towards both sides. The dorsal crest is especially in *vittatus*.

3). *Caudal crest*. In *galeritus* there is a well-defined crest which has the appearance to the dorsal crest. It is developed in *vittatus* and *barbouri*. In *galeritus* the crest is replaced by a row of scales, at least at the base.

4). *Number of infralabials*. This is a well-defined character. Conditions are identical in each of them. In *galeritus* groups:

Condition 1. The infralabials, the infralabials, the infralabials; this partial or total series of three large ch



character, presence, *basiliscus* and it is replaced by scales separated at the scales (Fig. 3). The inactive pattern of the scales as well as a group, females do not do their scales since there is no scales nor the

3). *Caudal crest*. In *plumifrons*, *basiliscus* and *barbouri*, there is a well developed caudal crest, which is similar in appearance to the dorsal crest, but less high. This crest is poorly developed in *vittatus* where it has no serrated border and appears simply as a compression of the upper border of the tail. In *galeritus* the caudal crest is absent and, like the dorsal crest, it is replaced by a single row of alternating large and small scales, at least at the beginning of the tail.

Condition 1. Three to four large chin-shields in contact with the infralabials, no small scales between them.

Condition 2. One or two large chin-shields in contact with the infralabials; this contact is incomplete and small scales cause a partial or total separation between them. Only occasionally two or three large chin-shields appear in complete contact with the

infralabials at one side, but the very small scales are found farther back and on the other side (Fig. 4).

Condition 1 is found in *plumifrons*, *basiliscus*, *barbouri* and *galeritus*. Condition 2 is found only in *vittatus*. The number of chin-shields is not necessarily the same on the two sides. The character can be easily recognized in adults and in juveniles.

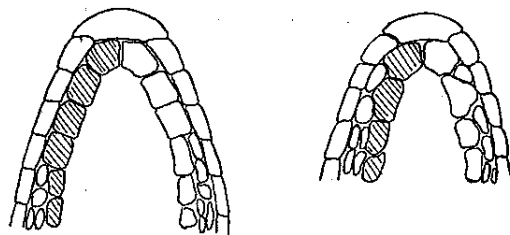


Figure 4. Pattern of chin-shields. *Basiliscus vittatus* (right); species of southern group (left). The two sides of each figure show the extremes of variation.

5). *Lateral fringe of the toes.* All members of the genus have on the external border of the toes a fringe in the form of a scaly flap extending over the whole length. This feature has been taxonomically used in a very imprecise way by simply stating that the fringe is larger in one group than in the other; it is difficult to measure it adequately. However, its relative width can be estimated by observing whether it covers, when folded, more or less than half of the ventral width of the toe. Furthermore, the number of scales in the flap can be used as a measure of the length of the toe or size of the foot. As these animals have bipedal habits and are even able to run on the surface of water, the size of the fringe, reflecting the size of the functional surface of the foot, probably correlates with their habitat preferences and aquatic behavior.

The number of scales in the flap of the fourth toe varies within certain definite limits in each population. Thus, both *basiliscus* and *barbouri* have a range of between 33 and 41 scales; specimens which have less than 35 scales in the flap are rare. In *galeritus* we find a range of 37 to 46 scales, and in *plumifrons*, which is sympatric with *vittatus*, we find a range of variation of 36 to 46 with a rather uniform distribution. In *vittatus* the situation deserves special comment since this form has a very

wide geographic range in Mexico (see n. s.). It is sympatric with *plumifrons* between 28 and 30 degrees latitude. Towards the north it is a range between 30 and 35 per cent of the total length.

With respect to the lateral fringe, *plumifrons*, *basiliscus*, and *galeritus* have a flap of the animal's body, to such an extent that an expansion of the situation is difficult to see as in *plumifrons* different (Fig. 4). The ones at the level of the foot surface (up to between 1/2 and 1/3 of the foot surface) onwards, however, while it remains most of the body length. *vittatus* of different preferences.

6). *Abdominal scale pattern.* Abdominal scales keeled. Keeling can be present over the whole body.

7). *Coloration pattern.* Pattern obvious in *vittatus* and significant individuals have to the body, the n. s. leg to the orbit the groin to the tail. This band merges with the body. There are also one or two on the

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wide geographic distribution extending from Panama to central Mexico (see map). In Panama and Costa Rica where it is sympatric with *plumifrons* the number of scales in the flap ranges between 28 and 36, but 95 per cent of the population has between 30 and 34, and the most frequent numbers are 32 and 33. Towards the north the number of scales in the flap increases to a range between 32 and 44 in Mexico, but here more than 90 per cent of the specimens have over 35 scales.

With respect to the relative width of the flap, this is more than half the width of the ventral surface of the toe in *plumifrons*, *basiliscus*, *barboursi*, and *galeritus*. In *vittatus* the width of the flap is generally smaller, although it varies with the size of the animal. The adults have exceedingly small scales in the flap, to such a degree that it loses its characteristic aspect of an expansion of the border of the toe. In young individuals the situation is different and the flap is proportionately almost as wide as in *plumifrons*; the shape of scales, however, is slightly different (Fig. 6) with a clear tendency to have the smaller ones at the level of the articulations. The flap in young *vittatus* (up to between 52 and 62 mm) looks as efficient in increasing the foot surface as in any of the other forms. From that size onwards, however, the flap becomes relatively smaller in *vittatus* while it remains wide in *plumifrons* and the other forms, covering most of the undersurface of the toe, even at 100 to 120 mm of body length. This difference in relative width of the toe flap in *vittatus* of different sizes probably reflects differences in habitat preferences.

6). *Abdominal scales*. The presence or absence of a keel on the abdominal scales is a clear cut feature. Only *vittatus* has abdominal scales keeled; all the others have them smooth. Usually the keeling can be recognized easily in every individual and is present over the whole abdominal surface.

7). *Coloration*. Coloration offers two variables, color and pattern. Pattern seems to be in general uniform and is specially obvious in *vittatus*, although there are variations whose constancy and significance are difficult to assess. In general, young individuals have two bright longitudinal bands along each side of the body, the more dorsal one going from the base of the hind leg to the orbit; the lower band, less conspicuous, extends from the groin to the axilla and thence to the angle of the mouth. This band merges with the clear coloration of the abdomen. There are also transverse dark bands, five on the dorsum and one or two on the neck. These bands maintain their width as far

as the dorsal midline in *vittatus*, but taper dorsally in *basiliscus* and *barbouri*. This pattern is more or less clearly retained in adult *vittatus*, *basiliscus* and *barbouri*, the last two being practically indistinguishable in color and pattern. In *plumifrons* the longitudinal lines break into two rows of bright spots in the adult although the juvenile shows the usual pattern of longitudinal and transverse bands in a very dark ground color. In *galeritus* the pattern is never very clear and while small individuals show a very uniform brownish coloration, the adults have brown spots on the sides and brown transverse bands on the dorsum. The ground color itself varies from clear brown to olive brownish in *vittatus*, *basiliscus*, and *barbouri*, but is dark green in *plumifrons* and olive green in adult *galeritus*.

8). *Number of scales between the supraorbital semicircles.* This character has not commonly been used in the genus. The number of rows of scales between the supraorbital semicircles (minimal number) varies from 1 to 5 in the whole genus, but the individual groups have a more restricted variability. In *vittatus* the variation is from 1 to 3, but 75 per cent have 2 and 13 per cent have 1 in the specimens examined. In *plumifrons* 1 to 5 rows of interorbital scales may be found, but 75 per cent of the specimens have 3 or more. In *basiliscus* most (86 per cent) individuals have only one row of interorbital scales, the rest have 2. Of the 17 specimens of *barbouri*, 9 have 2, 5 have 3, and 3 have 1. In *galeritus*, most specimens have 2 (74 per cent) (Fig. 5).

9). *Number of scales between the interparietal (pineal) scale and the supraorbital semicircles.* In the genus as a whole this number ranges from 0 to 3 and is not strictly symmetrical. There is wide overlapping in the variability of the different forms, but there are some regularities which suggest that these may have different types of variability. Thus, in Panama and Costa Rica *vittatus* almost always (more than 95 per cent) has one scale on one side; if the other side has a different number this is two. The majority of *basiliscus* also have one or none, while in the other groups, specially *plumifrons*, the majority of the individuals have two or more (Fig. 5).

10). *Number of scales in the dorsal and ventral midline in the breaking segment of the tail.* This character is also variable, but one difference is observable which splits the genus into two groups: *vittatus* has almost constantly the combination of 5 scales in the dorsal and 4 scales in the ventral midline of the breaking

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ventral, and a fr

	Minim of scc supra- circles
<i>vittatus</i>	1
	2
	3
	4
	5
<i>plumifrons</i>	1
	2
	3
	4
	5
<i>basiliscus</i>	0
	1
	2
	3
<i>barbouri</i>	1
	3
	4
	5
<i>galeritus</i>	1
	2
	3
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	5

Figure 5. Scale

rsally in *basiliscus* clearly retained in st two being prac-n. In *plumifrons* bright spots in the pattern of longi-ground color. In l while small indi-ration, the adults rverse bands on the lear brown to olive but is dark green s.

orbital semicircles. in the genus. The orbital semicircles whole genus, but ed variability. In er cent have 2 and ed. In *plumifrons* d, but 75 per cent us most (86 per orbital scales, the 9 have 2, 5 have 3, ve 2 (74 per cent)

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ventral midline in er is also variable, he genus into two ination of 5 scales ne of the breaking

rings, counted at the beginning of the middle third of the tail. When this count varies, it is usually in the direction of smaller numbers, i.e. 5 dorsal, 3 ventral or 4 dorsal, 4 ventral. The *vittatus* populations from Panama and Costa Rica have a high proportion of individuals with the combination 4/4—about 45 per cent. This proportion diminishes towards the north where less than 10 per cent have 4/4, while most have 5 dorsal, 4 ventral, and a few 5/5 or 6/4. The other forms have a larger

	Minimal number of scales between supra-orbital semi-circles:		Minimal number of scales between pineal scale and supra-orbital semi-circles:		Ratio of mid-dorsal to mid-ventral scales in tail rings:
		percent:		percent:	
vittatus	1	13 %			
	2	79	0		
	3	8	1	90 %	
	4		2	2	5/4 or less
	5		3		
plumifrons	1	3 %			
	2	13	0		
	3	58	1	4 %	
	4	23	2	74	6/4 or more
	5	3	3	1	
basiliscus	0	1 %			
	1	90	0	25 %	
	2	9	1	69	6/4 or more
	3		2	6	
	4		3		
barbouri	1	18 %			
		53	0		
	3	29	1	35 %	
	4		2	65	6/4 and 5/4
	5		3		
galeritus	1	16 %			
	2	74	0	3 %	
	3	10	1	21	
	4		2	76	6/4 and 5/4
	5		3		

Figure 5. Scale count differences between *Basiliscus* species.

number of dorsal scales in the breaking ring of the tail, 6 or 7, and 4 ventrals. Only *galeritus* and *barboursi* have occasionally 5 dorsals, 4 ventrals. This difference in the number of scales on the breaking rings of the tail seems to be related to a more general but less readily measurable feature, namely, that *vittatus* seem to have larger and fewer scales in the tail and dorsum than any of the other populations (Fig. 5).

11). *Pattern of scale arrangement in the toes.* (The third phalanx of the fourth toe has been selected as an arbitrary point of reference for the study of the scale pattern.) The pattern of scale arrangement of the dorsal and ventral surfaces of the toe is not uniform within the genus and there is variation within each population and even within each individual. Nevertheless, a few patterns can be described around which variation affecting the shape, number, and arrangement of the scales occurs. Two principal patterns of dorsal scale arrangement are clearly distinguishable.

Pattern A: Present in *vittatus*, characterized by three longitudinal rows of scales which have a pointed and serrated anterior border (Fig. 6, *top*). The lateral scale row, nearest to the flap, may be wanting in some places and the middle scales then become less pointed and wider. The pattern, however, remains distinct and recognizable.

Pattern B: Present in all other groups, characterized by a row of large broad and rectangular scales which reach the internal border of the toe, replacing the middle and internal rows of pattern A. The anterior border of these scales is serrated and of the same length as their bases. Sometimes an extra row of scales is present on the external side, near to the flap, a condition prevalent in *galeritus*, but not uncommon in the other forms which have this pattern (Fig. 6, *bottom*). In their variability these two patterns sometimes seem to approach each other, but a close examination always shows that they are clearly distinguishable.

In the ventral surfaces of the toes also, two patterns can be identified: pattern C, present in *vittatus*, and pattern D, present in all other forms (Fig. 7). The significant features in the ventral scale pattern are the number of scales which cover the ventral surface of the toe and the structure and color of the contact pad present in the medial border along it. This pad is nothing but the angular border of the scale that covers the internal side of the toe at the level where it bends sharply to

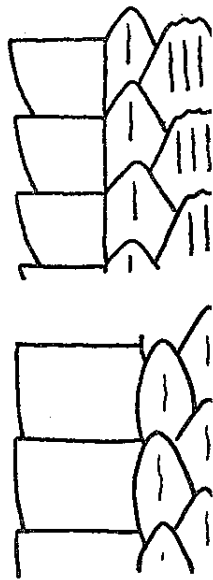


Figure 6. Scale
Top: *Basiliscus vittatus*
Bottom: species of
sation (right). Latera

cover the ventral if it were a distinct clear limits and a strong dark brown the scales themselves internal side of the the level of the contact with the flap producing partial pattern D the lateral toe covers only the flap is another large scales, or several frequent in *galeritus* found in the other *plumifrons*, *basili-*

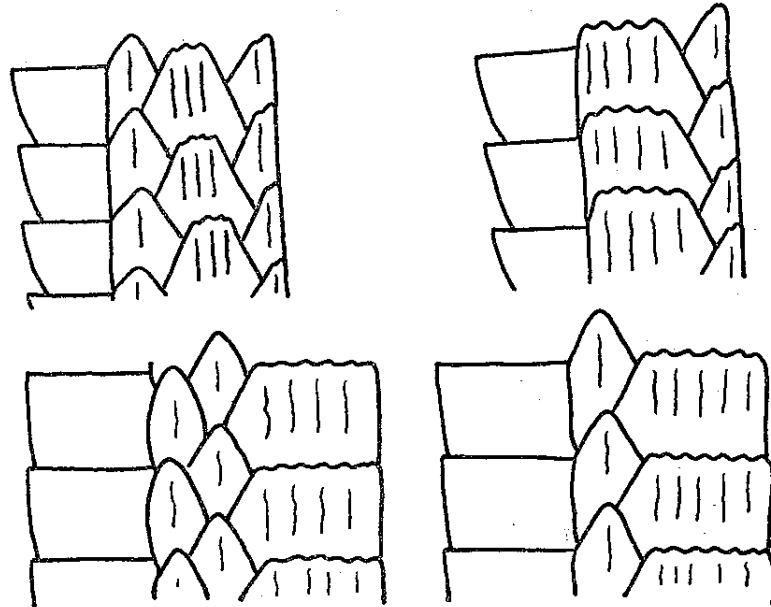


Figure 6. Scale pattern on dorsal surface of 3rd phalanx of fourth toe. Top: *Basiliscus vittatus*, pattern A, usual condition (left), variation (right). Bottom: species of southern group, pattern B, usual condition (left), variation (right). Lateral margin with toe flap to the left in each figure.

cover the ventral surface. In *vittatus*, however, it appears as if it were a distinct structure on the surface of the scale, with clear limits and outline; this is an appearance produced by its strong dark brown or black color (Figs. 7 and 8). With respect to the scales themselves, in pattern C the scale that covers the internal side of the toe, after bending to the ventral surface at the level of the pad, covers its whole width and comes into contact with the fringe of the toe. Small scales may be present, producing partial separation of this scale and the flap scale. In pattern D the large scale that covers the internal side of the toe covers only half of the undersurface; between this and the flap is another large scale, with or without additional small scales, or several rows of small scales. This last condition is frequent in *galeritus*, but the whole range of conditions can be found in the other populations which present this pattern: *plumifrons*, *basiliscus* and *barbouri* (Fig. 7, right).

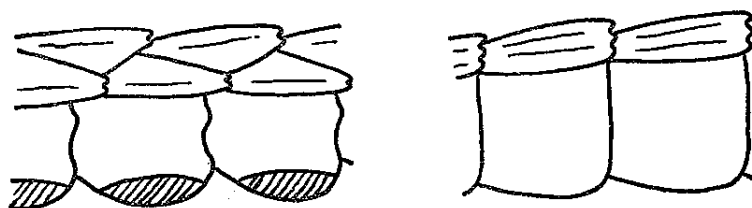


Figure 7. Medial aspect of 3rd phalanx of fourth toe to show the appearance of the contact pad and of the dorsal scales in a side view. *Left*, *Basiliscus vittatus* with dark contact pad. *Right*, any member of the southern group. In these the contact pad is not marked off by dark coloration.

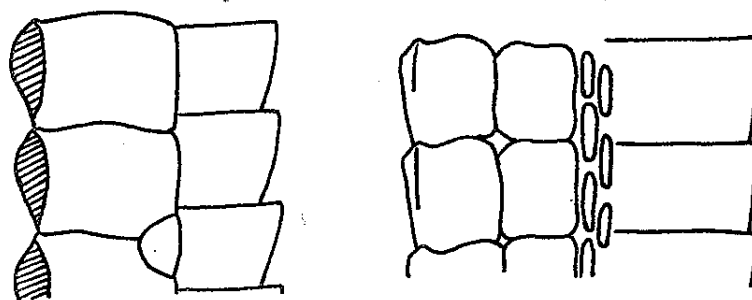
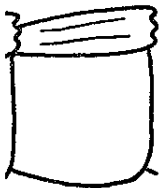


Figure 8. Scale pattern on ventral surface of 3rd phalanx of fourth toe. *Left*: *Basiliscus vittatus*, pattern C with dark contact pad. *Right*: species of southern group, pattern D. Medial margin to the left in each figure.

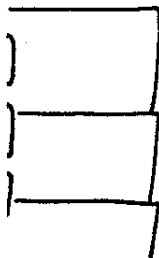
Figures 5, 9, and 10 afford a general summary of the characters studied in the various populations. It will be noticed that *vittatus* can be distinguished in more ways from all the remaining forms than any of these among themselves. Table 1 presents the data of Figures 5 and 10 arranged in a different way. Here it will be evident that there are indications of what is called "character displacement" (Brown and Wilson 1956) between *vittatus* and the other forms which I shall call "the southern group." These points will be amplified and discussed below.

Head Crest		
Dorsal Crest	Low	
Chin shield pattern: number of chin-shields in contact with infralabials.		
Scale pattern in dorsal surface of toes. 3rd phalanx of 4th toe.		
Scale pattern in ventral surface of toes. 3rd phalanx of 4th toe.		
Abdominal scales: Keeled, or not.	Yes	

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Head Crest	Dorsal Crest	Chin shield pattern: number of chin- shields in contact with infralabials.	Scale pattern in dorsal surface of toes. 3rd phalanx of 4th toe	Scale pattern in ventral surface of toes. 3rd phalanx of 4th toe	Abdominal scales: keeled, or not.
	Low				Yes
	High				No

Figure 9. Crest and scale pattern differences between *Basiliscus* species.

ADDITIONAL DATA: ECOLOGY AND DISTRIBUTION

The populations currently distinguished appear on the whole to have similar ecological preferences. They are consistently found near the streams or on the seashore, and feed on terrestrial as well as on aquatic insects. Small aquatic vertebrates may also be eaten (Barden, 1943a).

In Panama and Costa Rica where *vittatus* and *plumifrons* are found sometimes in the same general localities, *vittatus* is found on the seashore, where the forest ends, while *plumifrons* is found along the streams and rivers which open into the sea (C. Gans, personal communication). In inland streams far from the coast, *plumifrons* is also reported, but not *vittatus*.

In the northern part of its range, Guatemala and Mexico, information about the habitat of *vittatus* is incomplete but, according to Conant (1951) it is found near the coast and in inland rivers and ponds. In general, it seems in the north to occupy niches similar to those that *plumifrons* occupies in Costa Rica and appears to replace it ecologically, although *vittatus* may also occupy drier regions than *plumifrons*.

In Panama *basiliscus* has been found in inland and in seashore areas, at the side of streams or where the forest comes to the border of the sea (Barden, 1943b). In Santa Marta, Colombia, *barbouri* is also found along the streams. *Galeritus* also lives near the streams at the border of the forest (Fowler, 1913).

All populations have been reported to have bipedal habits and *basiliscus*, *plumifrons* and *galeritus* have been observed running on the water surface (Snyder, 1949, 1954; Evans, 1947). The absence of any habit of running on the surface of water in *vittatus*, on the other hand, may be correlated with the foot structure. The functional surface of the foot in *vittatus*, especially in adults, is smaller than in the other forms. This is due both to the smaller number of scales in the toe flap (which reflects shorter toes) and to the narrower toes and toe fringes. Whether this situation changes towards the north, where *vittatus* seems to replace *plumifrons* in inland streams, is not known. Nevertheless, juveniles up to 60 mm in body length have feet and toes which appear as well adapted to aquatic behavior as the other groups do, and probably they exploit the aquatic (i.e. the water surface) habitat while the adults behave otherwise. A change like this in habitat preferences when passing from juvenile to adult would not be surprising in itself, and it is probable that it also occurs in the other forms in which young are known

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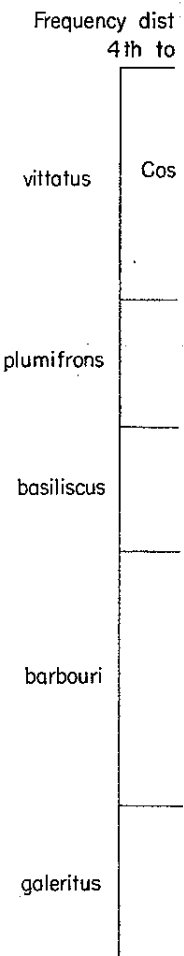


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Further information about the ecology may also be provided by the fact that *basiliscus* and *barboursi* are the only groups in

Frequency distribution of minimal number of scales in toe fringes.

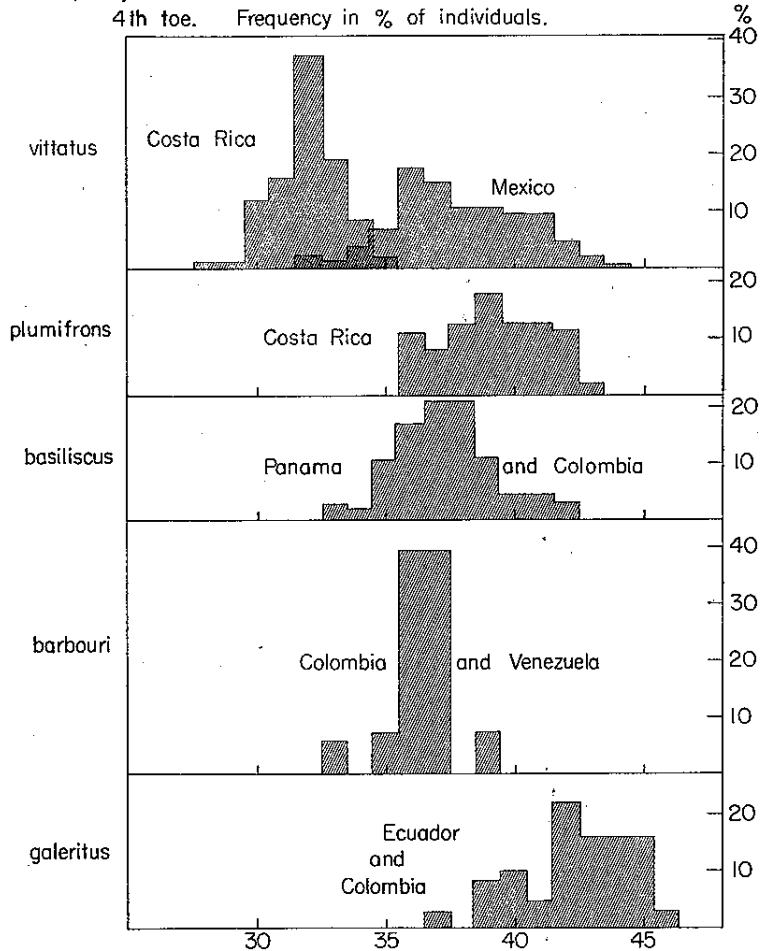


Figure 10. Histograms of scale count frequencies in *Basiliscus* species.

which ectoparasites were found. These were ticks which attached themselves strongly to the head crest and toe flap in adults as well as in young individuals. The significance of this situation is not clear, but it would appear to represent either a similarity in habits which exposes the two forms to similar infestations, or that they have a comparable susceptibility to the ectoparasites.

With respect to distribution, the various groups, as has been mentioned, appear on the evidence available to me to be allopatric, with the exception of *vittatus* and *plumifrons* (Maps 1-3). In reality, I do not have accurate information about the actual range of all forms or about the regions of contact, if they exist. Thus, as far as the available data go, *galeritus* and *barboursi* have been found in areas separated by a few hundred miles, with *basiliscus* in between. *Basiliscus* and *galeritus* meet along the Pacific coast of Colombia in Choco. *Barboursi* and *basiliscus* appear to be less widely separated, but there is a stretch of about 150 miles of coast between Golfo de Uraba and Santa Marta in Colombia from which I have no records. There is no obvious reason to suppose that the genus is not represented in the intermediate regions and it seems more probable that the lack of data from these areas is a sampling problem.

Although *basiliscus* has been reported from many places in Panama, both on the coast and inland, it has not been reported from Almirante where *vittatus* and *plumifrons* are found. The absence of *basiliscus* in the region of Almirante may be significant and related to an actual territorial competition, rather than only to sampling in collections. Along a line uniting Almirante to Puerto Armuelles there is a zone of potential contact between *basiliscus* and *plumifrons* and/or *vittatus*, but, although the information is scant, there is no evidence of sympatry or hybridization. The coloration of *vittatus* and *basiliscus* (and *barboursi*) is extremely similar, although there are differences in the intensity and clarity of the stripe pattern. It seems that this coloration may be related to the preference that *vittatus* (Gans, personal communication) and *basiliscus* (Evans, 1947) show for sandy and exposed areas near the coast and inland, in contradistinction to the marked preference for shady areas in the woods at the border of streams shown by *plumifrons* (Gans, personal communication). *B. basiliscus*, however, seems also to share the arboreal habits of *plumifrons*, as well as the aquatic preferences (Evans, 1947; Barden, 1943b). In these circumstances, it may well be that *basiliscus* is able to replace ecologically both *vittatus* and *plumifrons* in Panama, a condition which



Map 1. Distribution of *vittatus* and *plumifrons* examined on the Pacific coast of Colombia.



Map 2. Distribution of *basiliscus* examined on the Pacific coast of Colombia.

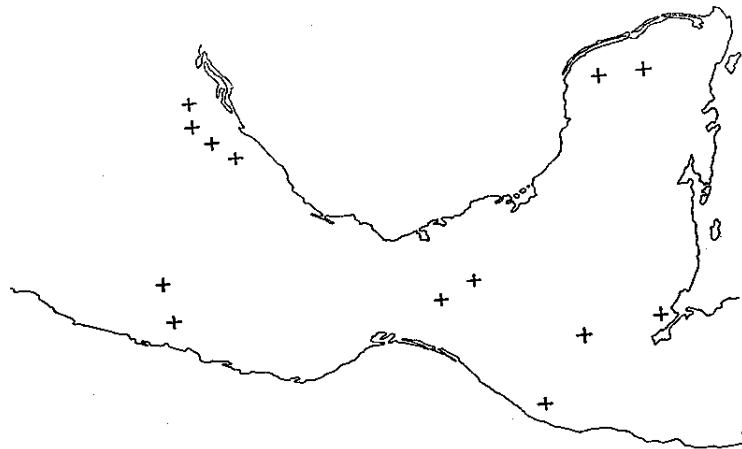
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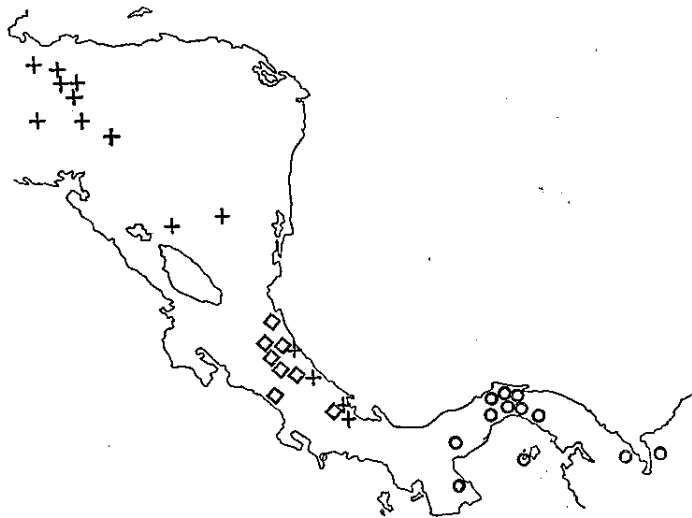
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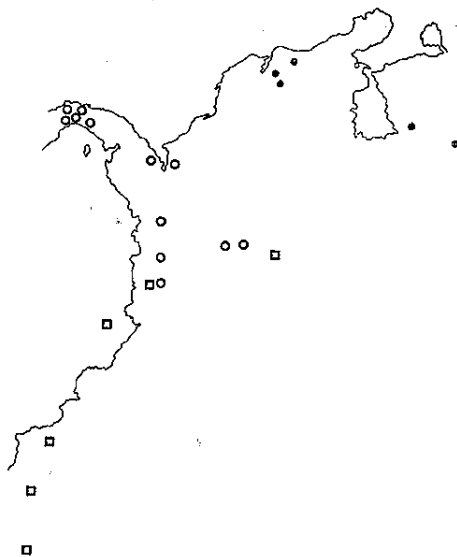
Map 1. Distribution of the species of *Basiliscus* (based on the specimens examined only). Southern Mexico to Guatemala. Crosses = *B. vittatus*.



Map 2. Distribution of the species of *Basiliscus* (based on the specimens examined only). Guatemala to northern Colombia. Crosses = *B. vittatus*; squares = *B. plumifrons*; circles = *B. basiliscus basiliscus*.

may account for the absence of sympatry between *basiliscus* and the other forms.

In Costa Rica, *plumifrons* probably occupies the whole country. It has been observed on both coasts and in the inland, while *vittatus* has been found only on the Atlantic side in several localities where *plumifrons* is also found. From northern Nicaragua to Mexico *vittatus* is found on both coasts and inland; the extreme north of its range seems to be Tamaulipas and Michoacan.



Map 3. Distribution of the species of *Basiliscus* (based on the specimens examined only). Southern Panama, Colombia, Ecuador and Venezuela. Circles = *B. basiliscus basiliscus*; solid circles = *B. basiliscus borbouri*; squares = *B. galeritus*.

DISCUSSION

From the morphological analysis it seems evident that the five species studied form two main groups: (1) *vittatus* with a northern distribution, and (2) all the other forms which together constitute a rather sharply set off southern group (see Fig. 8 and Table 1). These two groups, of course, have many characters in common and differ in many others, but in four of the features studied they differ sharply and clearly enough to permit the distinction of every individual. These features are: the two scale patterns of the toes, the keeling of the abdominal

scales and the pattern of the study that *vittatus* differs from other forms by almost all characters. This suggests a close relationship between it and all the other forms. The magnitude of the differences to consider *vittatus* and its range.

As has been said same general local. They are, however, they have opportunity to come together at the. Furthermore, these can be found simultaneously and even here they to be inferred in their individuality. not known what of ecological preference from the overall difference all the other southern genetic exchange.

Although *vittatus* it is not strictly a variation. This is a scale pattern. Thus the orbital semicircle Costa Rica to 44 Guatemala-Mexico. (minimal number) increases from 2 p in Honduras and a comparable shift occurs in the tail, see Table 1. Count of scales in the flaps (minimal numbers) Guatemala-Mexico. rarer and there is a distribution. The two of the shape of the appearance of the associated, like body color.

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scales and the pattern of chin-shields. It is also evident from this study that *vittatus* can be clearly distinguished from each of the other forms by almost the same degree of morphological difference. This suggests that there is the same order of genetic gap between it and all members of the southern group. To assess the magnitude of this genetic gap, however, one can only consider *vittatus* and *plumifrons* which are sympatric in part of their range.

As has been said, *vittatus* and *plumifrons* are found in the same general localities in parts of Panama and Cost Rica. They are, however, ecologically separated in such a fashion that they have opportunity for contact only where their habitats come together at the opening of rivers and streams into the sea. Furthermore, these seem to be the only places where both forms can be found simultaneously (Gans, personal communication), and even here they remain clearly distinct and separate. It is to be inferred in these circumstances that these two forms retain their individuality by maintaining reproductive isolation. It is not known what other isolating mechanisms in addition to the ecological preferences maintain this separation, but it appears from the overall difference between *vittatus* and *plumifrons* (and all the other southern forms) that there can be little or no genetic exchange.

Although *vittatus*, as the northern group, seems to be a unit, it is not strictly uniform and shows some noticeable geographic variation. This is mainly in the frequency distribution of some scale patterns. Thus, the frequency of 3 rows of scales between the orbital semicircles increases from 8 per cent in Panama-Costa Rica to 44 per cent in Honduras and 54 per cent in Guatemala-Mexico. Similarly, the frequency of two scales (minimal number) between the pineal scale and orbital semicircles increases from 2 per cent in Panama-Costa Rica to 35 per cent in Honduras and to 40 per cent in Guatemala-Mexico. A comparable shift occurs in the formula of the breaking rings of the tail, see Table 1. Changes also occur with respect to the number of scales in the flaps of the toes, which from a range of 23 to 35 (minimal numbers) shifts to 31-38 in Honduras and to 32-44 in Guatemala-Mexico. The lower numbers become increasingly rarer and there is a progressive flattening of the curve of distribution. The two first-mentioned characters may be a function of the shape of the head, and as characters correlated with the appearance of the animals they may, in a certain sense be associated, like body coloration and shape of crests, with intraspecific

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recognition. The number of scales in the toe fringes, on the other hand, seems to be related to aquatic habits and its variability may be of some significance in relation to the ecological preferences of *vittatus* along its range. As the number of these scales increases towards Mexico there are also some indications that the flap may remain for a longer time wide enough to be useful in water dwelling in the northern populations. This is inferred from the body size at which the flap becomes clearly smaller than half of the width of the ventral surface of the toe. In Panama-Costa Rica this size is about 52 mm body length while in Mexico it is about 62 mm. Whether or not this is related to a more aquatic habit of the young individuals is not clear. If success in water dwelling is to be judged by *plumifrons* or *basiliscus* in which the flap of the toes produces a great increase in the foot surface, *vittatus* is far behind in the more mature stages of development if not so much so in the very juvenile stages. Towards the north the maximal size attained by adult *vittatus* increases from 135 mm to 175 mm (which is about the same length that *plumifrons* attains in Costa Rica) but the wide flap is retained only to about 62 mm of body length.

It is not clear whether *vittatus* replaces *plumifrons* ecologically in the part of its territory where *plumifrons* is not found, but it seems that this may be the case. In this allopatric part of its range *vittatus* is found near the inland streams as well as at the coasts, always near water, and can be caught during the night underneath bridges or nearby stones in the river margin (Conant, 1951). It seems likely also that the juveniles of *vittatus* are more aquatic than the adults, and that the higher variability of the northern populations of this group is the result of a wider ecological distribution. Examining Table 1 and Figure 10 it will be noticed that northern *vittatus* tends to differ less in some characters from *plumifrons* than does Costa Rican *vittatus*. This phenomenon which has been called "character displacement" (Brown and Wilson, 1956) is obviously related to the ecological separation which occurs in closely related species in the regions of sympatry. This ecological separation produces a different emphasis in the selective pressure which can be expected to result in the divergence of a whole complex of characters which otherwise could have remained similar. In these circumstances, beyond the regions of sympatry, if there is ecological replacement, a certain convergence towards the replaced type could be expected to occur. This may possibly happen to some degree in *vittatus*

which appears to be found in Central America and Mexico. It is possible that the replaced type will have some features which are of ecological significance. There are also some problems. There is a question on the amount of variation within the species. Thus, for example, there may be more aquatic forms with more scales in the toe than others in the scale pattern of the flap.

In the case of *vittatus* there are many of morphological forms, 5, 9 and 10 clearly distinct. It differs from the northern forms from *plumifrons* and *basiliscus*. These forms are not as well adapted as our forms. Between this group there is a significant and distinct difference.

That the southern forms are opposed to *vittatus* are important characters. In the south of the geographical range (Taylor's description [Taylor, 1956]) *basiliscus* stands clearly in the absence of a distinctive pattern of coloration. These forms which show the pattern of coloration which head crest of the head is a notable difference. There is a possible significance in the possible significance to have attained.

Among the reasons for its coloration and pattern. The number of scales between the pineal region is a characteristic feature in *basiliscus*. There is a

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which appears to replace *plumifrons* in the inland in Guatemala and Mexico. It should be said that this convergence to the replaced type will only be of a very general nature, unless there are features which represent unique solutions to certain ecological problems. The degree of convergence will also be dependent on the amount of genetic difference accumulated in the two species. Thus, for example, the possible tendency of *vittatus* to be more aquatic appears in the increased number and width of scales in the toe flaps, but this is not accompanied by a change in the scale pattern of the toes, or in the shape of the scales of the flap.

In the case of the southern group, examination of the summary of morphological characters in Table 1 and in Figures 5, 9 and 10 clearly shows that none of the species which compose it differs from the others in the same degree as *vittatus* differs from *plumifrons*. Thus, inference from morphology alone that these forms are reproductively isolated is not on nearly so secure a footing as our decision that reproductive isolation exists between this group and *vittatus*. Nevertheless, several facts are significant and deserve close consideration.

That the southern group represents a phylogenetic unit as opposed to *vittatus* seems evident, but it is also evident that there are important discontinuities. Thus, *galeritus* in the extreme south of the genus range looks to some extent like an isolate. (Taylor's description of young "*galeritus*" from Costa Rica [Taylor, 1956] is, I believe, based on young *plumifrons*.) *Galeritus* stands clearly apart from the rest of the southern group in the absence of a dorsal crest (which is replaced by a sharply distinctive pattern of dorsal scales) as well as in typical body coloration. These features are also diagnostic in the juveniles which show the peculiar dorsal scale pattern and a characteristic coloration which, however, is different from the adult one. The head crest of the adult males is also typical. Judging by these notable differences from the rest of the southern group and their possible significance in sexual recognition, *galeritus* appears to me to have attained specific status.

Among the remaining forms, *plumifrons* can be recognized by its coloration and shape of the head crest, when this is present. The number of interorbital scales and the number of scales between the pineal eye and the orbital semicircles vary in a rather characteristic way for this form and are consistently larger than in *basiliscus*. The shape of the head and dorsal crests, as well

as color, are of special significance, being secondary sexual characters which are probably used in display for intraspecific recognition. This may also apply to the shape of the head, the width of which is reflected in the number of interorbital scales. As these lizards (*Basiliscus*) are in general diurnal animals and some of them exhibit arboreal habits, visual clues may be important for the sexual behavior. For these reasons I believe that the constant difference in color and shape of the head crest between *basiliscus* and *plumifrons* is a sign of reproductive isolation and a strong argument in favor of their specific status.

The fact — if it is a fact — that these species of the southern group are non-sympatric deserves a special comment. There is a significant difference between separation produced by a geographic barrier and separation in which such a physical barrier does not exist, and geographic as well as ecological continuity seem to be present. The first is usually described by the term allopatry. This kind of separation may not be accompanied by a biologically significant discontinuity expressed by the presence of reproductive isolating mechanisms (although it may eventually lead to this), and is maintained primarily by the geographic barrier itself. The second kind of separation with no geographic barrier or gross ecological discontinuity (which amounts to the same thing) is maintained by a biological process and requires the presence of isolating mechanisms. This type of separation may be called parapatry. The situation found in *basiliscus* and *plumifrons*, which occupy neighboring regions but are not found together (and which show no obvious territorial interpenetration), may correspond to the latter type. The territorial separation of *vittatus* and *basiliscus* may be a similar case. If one considers what situation is most likely to be the origin of this kind of separation one finds that ecological competition appears as the best candidate. As is well known, for ecological competition to occur there must be close similarities in the ecological preferences of the forms in contact; if this is not the case and the habitats intermingle the result will be sympatry. It is also necessary that the forms be reproductively isolated at least by one efficient isolating mechanism; otherwise, hybridization will occur with the resulting fusion into a single form. If, however, reproductive isolation exists, the populations can be expected to compete when they first meet and become separated at the level of an ecological boundary. On its own side of this boundary each population will have some sort of

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advantage which does not need to involve the factor in regard to which there is competition. The nonsympatric condition of *basiliscus* and *plumifrons*, if it is real, seems to depend on this kind of phenomenon since no obvious geographic or ecological barrier appears responsible for their separation. In any event this situation can be used as an argument in favor of the specific status of *plumifrons* and *basiliscus*: *basiliscus* and *plumifrons* may be separated by ecological preferences not yet detected, but such separation would appear to imply reproductive isolation. Since *basiliscus* appears to replace *vittatus* ecologically on the coast, in the same manner that it seems to replace *plumifrons* in the interior, the presence of *vittatus* in this critical region is of similar significance for the assessment of the reproductive isolation between these forms. However, as I have said above, the nature of the boundary between these species is not at all clear and requires further study. Collecting in a line uniting Puerto Armuelles and Almirante, and on the Pacific and Caribbean coasts in both directions from these points, together with a more detailed study of the ecological preferences and behavioral habits of these animals will certainly contribute to the solution of the problem.

In the case of *basiliscus* and *barbouri*, the situation is different. The gap which separates these two forms, making them allopatric, may be entirely due to sampling since there is a region of about 150 miles between Golfo de Uraba and Santa Marta in regard to which there seems to be no information. It is in this region that intergradation of the two forms may occur, and the great resemblances between them indicate this as a strong probability. The shape of the head crest, for example, suggests a single pattern of variation in the whole range of the two forms, and even in the absence of knowledge from the intermediate region this situation suggests gene flow between *basiliscus* and *barbouri*. The two forms are furthermore indistinguishable in body coloration. There are indeed differences in the number of interorbital scales and in the number of scales between the pineal eye and the orbital semicircles, but these differences may well correspond to extremes of variability in a single form. On the whole, there seems to be insufficient ground to infer reproductive isolation between *basiliscus* and *barbouri*.

Thus, in conclusion, it is possible to say that the genus *Basiliscus* is composed of two groups: a northern group formed by *vittatus*, and a southern group formed by all the other species.

B. vittatus appears to be a strongly marked species and stands out clearly as a phylogenetic unit as compared to the southern group. The latter also appears to be a phylogenetic unit, but it is composed of three species: *B. plumifrons*, *B. basiliscus* and *B. galeritus*. In *B. basiliscus* should be included the form from Santa Marta, Colombia, and Venezuela (*barboursi*) since all the available data suggest that it is conspecific.

There are considerable gaps in the knowledge of the distribution of these four species. Further information is necessary to demonstrate or clarify the apparent allopatry of the species of the southern group; in particular, a more detailed study of the region of contact between *plumifrons* and *basiliscus* is needed. Also, more needs to be known about the distribution of *galeritus*, especially in the area where it seems to meet *basiliscus* in Choco, Colombia. In general, a more complete study of the ecological preferences and behavioral habits of all populations is required, and in particular investigation of the aquatic habits of *vittatus* in various parts of its range. If my interpretations of the morphological observations are correct, this further evidence should not alter the specific distinctions here supported. Nevertheless, proof of these interpretations can only be obtained by direct observation and the conclusions here presented should be considered as a probable working hypothesis for further research.

Key to the species of *Basiliscus*

1. Keeled abdominal scales; pattern A for the scale arrangement on the dorsal surface of the toes, and pattern C for the ventral surface *vittatus*
No keeled abdominal scales; pattern B for the scale arrangement of the dorsal surface of the toes, and pattern D for the ventral surface; southern group 2
2. In the dorsal midline a clear alternation of large and small scales, 1 large for each 2 to 4 small ones; no dorsal crest in the adult male *galeritus*
Middorsal line with scales of nearly uniform size with some semiperiodicity; adult males with dorsal crest 3
3. Minimum number of scales between the orbital semicircles 1 to 2 and brownish coloration *basiliscus*
Minimum number of scales between the orbital semicircles 3 to 5, rarely 2, and blue-green coloration; bifurcated head crest in the adult males *plumifrons*

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ACKNOWLEDGMENTS

I wish to express my gratitude and appreciation to Dr. E. E. Williams for his help, guidance, and criticism. I am grateful also to Dr. E. Mayr who stimulated me to undertake the study here presented. I am indebted also to Mr. C. M. Bogert of the American Museum of Natural History for the loan of Panamanian and Colombian specimens.

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TABLE 1
Morphological characters of the specimens examined

	<i>galeritus</i>		<i>barboursi</i>		<i>basilisus</i>		<i>plumifrons</i>		Costa Rica		Nicaragua		<i>vittatus</i>		Guatemala	
	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
Minimal no. of scales	0	3	1	25	1	1	3	1	13	12	2	2	5	4		
between pineal scale	1	21	8	35	6	62	13	5	79	75	54	52	42	36		
and supra-orbital	2	74	28	53	9	6	58	22	8	8	44	44	53	43		
semicircles.	3	10	4	29	5		23	9								
	4						3	1								
	5															
Minimal no. of scales	0	3	1	25	17				98	96	65	61	64	57		
between pineal scale	1	21	8	69	47	10	4		2	2	35	33	36	32		
and supra-orbital semi-	2	76	29	6	4	74	28									
circles.	3					16	6									
	4/4	12	4						45	41	10	9	7	6		
	4/5	3	1													
	5/4	15	5	35	6	3	1		55	50	88	82	84	75		
	5/5	9	3										3	3		
Ratio of mid-dorsal to	6/4	38	13	35	6	46	26	37			2	2	6	5		
mid-ventral scales in	6/5	17	6	12	2	3	1	14								
tail rings.	7/4	3	1	18	3	39	33	45								
	7/5	3	1			3	2	13								
	8/4					3	1	3								
	8/5					3	1	2								

TABLE 1 (Cont.)

<i>galeritius</i>	<i>barboursi</i>	<i>basilisus</i>	<i>plumifrons</i>	<i>vittatus</i>					
%	No.	%	No.	%	No.	%	No.	%	No.
						Costa Rica	Nicaragua	Guatemala	
						Honduras	Mexico		

mid-ventral scales in tail rings.	3/5	9	3	6	46	26	37	14
6/4	38	13	35					
6/5	17	6	12	2	3	1		
7/4	3	1	18	3	39	33	45	17
7/5	3	1			3	2	13	5
8/4					3	1	3	1
8/5					3	1	2	1

TABLE 1 (Cont.)

[illegible]

TABLE 2
Distribution, sex, number and size of the specimens examined

Form	Country	Locality	Sex	No.	Size ranges in cm
<i>B. galeritus</i>					
	Ecuador	"Ecuador"	M	1	15.0
	"	Bucay, Guayas	F	1	11.0
			M	1	16.0
			J	7	4.0- 8.8
	"	Ventura, Río Chanchan	M	1	17.0
	"	Esmeraldas	F	1	14.0
			M	1	14.0
			J	4	4.3- 4.9
	Colombia	Gorgona Island	F	6	11.0-16.5
			M	3	15.0-19.0
			J	6	4.4- 5.5
	"	Gorgonilla Island	J	1	4.5
	"	Boyacá	J	2	4.1- 4.6
	"	Río Puné, Atrato Region, Chocó	M	1	9.0
			J	1	5.9
<i>B. barbouri</i>					
	Venezuela	Trujillo, Trujillo	F	1	10.0
	"	Valencia, Esperanza	J	1	4.1
	Colombia	Santa Marta:			
		Palomino	M	1	18.0
		Fundación	M	1	17.2
		Río Frío	M	3	13.0-17.0
		" "	F	1	10.1
		" "	J	5	4.4- 7.2
	"	Concepcion	J	4	4.4- 5.1
<i>B. basiliscus</i>					
	Colombia	Mendellin, Antioquia	F	2	11.5-13.0
			M	1	11.0
			J	5	4.5- 7.3
	"	Envigado, Antioquia	J	1	4.2
	"	Ensenada Coredó	F	1	10.0
	"	Atrato Region, Chocó	J	4	4.7- 8.7
	"	Río Puné, Atrato Region, Chocó	J	2	8.0- 8.7
	"	Boca de la Raspadura, upper Quibdó, Chocó	F	2	12.2-13.5
			M	4	13.5-18.5
	"	Río Sn. Juan, Meta, Andagoya (Pacific)	F	2	11.7-14.5

Form C
B. basiliscus Colo

Pan

Pan

B. plumifrons Pan

Cos

ens examined

Size
ranges
No. in cm

Form	Country	Locality	Sex	No.	Size ranges in cm
<i>B. basiliscus</i>					
	Colombia	Boca de la Raspadura,			
		Río Sn. Pablo, Chocó	F	1	14.3
	"	Golfo de Urabá	F	2	14.1-14.4
	Panamá	Río Esnapé	M	1	18.7
	"	Pintupó	J	3	3.9- 7.0
	"	Darien:	J	1	6.7
		Río Tapia	M	1	18.3
			F	1	14.5
			M	2	4.3- 7.5
		Camp Townsend	M	1	17.0
		Río Sucubti	F	1	16.5
		Río Chico	F	1	12.6
		Camp Creek	J	1	5.9
	"	La Chorrera	J	1	4.5
	"	Los Santo, Punta Mala	J	1	4.3
	"	El Valle de Anton, Coclé	J	1	2.9
	"	Pedro Gonzales, Archi- piélago de las Perlas	F	1	15.5
	Panamá	San Jose Island, Chiriquí, Gulf of Panamá	M	2	19.5-20.0
			F	2	11.5-13.5
	"	Canal Zone:			
		Río Chagres	M	1	16.8
			F	3	14.5-16.0
		Albrook Field	M	1	16.5
		Frijoles	M	2	17.0-17.5
		Barro Colorado	F	1	16.0
			M	1	14.0
			J	1	8.2
	"	Panamá	M	1	17.5
	"	Panamá City	F	2	12.5-14.5
			M	3	16.7-17.0
	"	Río Sn. Pablo	F	1	14.6
			M	1	14.6
	"	Puerto Armuelles	J	4	6.5- 9.7
<i>B. plumifrons</i>					
	Panamá	Almirante	M	2	15.0-16.0
	"	United Fruit Co. Farm No. 6	F	1	14.0
	Costa Rica	Río Zent	F	1	15.2
			M	2	9.1-16.0
			J	3	4.5- 9.0

1 15.0
1 11.0
1 16.0
7 4.0- 8.8
1 17.0
1 14.0
1 14.0
4 4.3- 4.9
6 11.0-16.5
3 15.0-19.0
6 4.4- 5.5
1 4.5
2 4.1- 4.6
1 9.0
1 5.9

1 10.0
1 4.1

1 18.0
1 17.2
3 13.0-17.0
1 10.1
5 4.4- 7.2
4 4.4- 5.1

2 11.5-13.0
1 11.0
5 4.5- 7.3
1 4.2
1 10.0
4 4.7- 8.7
2 8.0- 8.7

2 12.2-13.5
4 13.5-18.5

2 11.7-14.5

TABLE 2 (Cont.)

TABLE 2 (Cont.)					Size
Form	Country	Locality	Sex	No.	in cm
<i>B. plumifrons</i>					
	Costa Rica	Turrialba	M	1	
			J	3	4.5- 9.0
	"	Tortuguero	F	1	12.0
			J	1	6.6
	"	Salamanca, Cordillera	F	2	12.9-15.5
			M	3	10.4-17.0
			J	3	4.6- 6.7
	Costa Rica	Guapiles	F	1	14.2
			J	1	3.9
	"	Navarro	J	1	5.1
	"	Río Barú	J	8	4.0- 8.7
	Nicaragua	Sn. Juan del Norte	M	1	20.5
	"	Matagalpa	M	1	13.2
			F	1	14.5
	Honduras		F	1	12.0
<i>B. vittatus</i>					
	Panamá	Almirante	M	6	8.5-13.5
			F	2	10.6-10.7
			J	1	6.0
	"	Río Torres	M	1	11.7
	Costa Rica	Río Zent	M	3	10.5-12.5
			F	1	10.4
			J	5	3.3- 6.3
	"	Tortuguero	M	11	8.2-13.5
			F	3	8.9- 9.1
			J	64	4.1- 7.5
	Nicaragua	Camoapa	M	1	
	Honduras	Tegucigalpa	J	5	4.1- 7.4
	"	Río Yequare	J	3	3.6- 6.7
	"	Caparrosa	F	1	13.2
	"	Lago Yojoa	F	2	11.2-11.5
	"	Río Ardilla	M	1	
	"	El Negrito	M	1	8.2
	Honduras	Valle Subirana	J	2	5.1- 6.6
	"	Siguantepeque	J	1	4.7
	"	Sn. Pedro Sula	M	1	7.9
	"	Río Uluá	J	6	5.2- 6.1
	"	Sula	M	9	8.2-14.5
			F	13	7.5-11.9
			J	50	4.2- 7.4
	British Honduras		J	1	7.7

Form Cc
B. vittatus Guat

Mexi

Mexi

Maximal measured

B. gal

B. bar

B. bas

B. plu

B. viti

a-

b-

c-

Sex	Size ranges		Form	Country	Locality	Sex	No.	Size ranges in cm
	No.	in cm						
<i>B. vittatus</i>								
				Guatemala	Chimoxan	J	1	7.0
M	1			"	El Paso, Río Sn. Pedro	M	1	12.2
J	3	4.5- 9.0		"		F	1	11.8
F	1	12.0		"	Seapulas	J	2	6.1- 6.2
J	1	6.6		"	Finca Ciprés	M	1	11.0
F	2	12.9-15.5		"		J	1	4.7
M	3	10.4-17.0		"	Chamá	M	1	16.0
J	3	4.6- 6.7		"		F	1	12.9
F	1	14.2		"	La Primavera	M	1	12.2
J	1	3.9		Mexico	Yucatan, Merida	M	2	14.5-15.5
J	1	5.1				F	4	10.6-13.2
J	8	4.0- 8.7		"		J	9	6.1- 8.2
M	1	20.5		"	Chichen Itza	M	1	12.1
M	1	13.2		"		J	4	6.3- 7.3
F	1	14.5		"	Tehuantepec	M	1	17.0
F	1	12.0		"	Chiapas, Monte Libano	J	3	4.1- 5.1
				"	Ocosingo	M	1	10.1
				"		J	2	3.6- 4.0
M	6	8.5-13.5		"	Laguna Ocotal	M	1	8.5
F	2	10.6-10.7				F	1	11.4
J	1	6.0				J	4	3.3- 3.9
M	1	11.7		Mexico	Oaxaca, Ispan Alepec	M	9	10.7-15.7
M	3	10.5-12.5				F	14	8.6-14.7
F	1	10.4				J	13	4.2- 7.2
J	5	3.3- 6.3		"	Guerrero,			
M	11	8.2-13.5			Chilpancingo	M	1	14.0
F	3	8.9- 9.1			Montzorongo	M	2	12.1-13.6
J	64	4.1- 7.5				J	1	9.1
M	1				Potrero	M	1	14.0
J	5	4.1- 7.4		"	Vera Cruz,			
J	3	3.6- 6.7			Miramar	F	2	12.4-13.4
F	1	13.2			Córdoba	F	1	13.0
F	2	11.2-11.5			Cerro del Gallo	J	1	4.6
M	1					M	1	11.0
M	1	8.2			Jalapa	M	1	16.5
J	2	5.1- 6.6				F	1	14.5
J	1	4.7						
Maximal measured body length:								
M	1	7.9			<i>B. galeritus</i>			19.5 cm
J	6	5.2- 6.1			<i>B. barbouri</i>			18.0 cm
M	9	8.2-14.5			<i>B. basiliscus</i>			20.0 cm
F	13	7.5-11.9			<i>B. plumifrons</i>			20.5 cm
J	50	4.2- 7.4			<i>B. vittatus</i> :			
					a—in Panama-Costa Rica			13.5 cm
J	1	7.7			b—in Nicaragua-Honduras			14.5 cm
					c—in Guatemala-Mexico			17.0 cm