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UNISEXUAL *CNEMIDOPHORUS LEMNISCATUS* IN THE AMAZONAS VALLEY: A PRELIMINARY NOTE (SAURIA, TEIIDAE)

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Unisexual populations of lizards, demonstrably or presumably parthenogenetic, are known from the Caucasus (*Lacerta*: Darevsky, 1966), from the southwestern United States to the coast of Yucatan and the adjacent island of Cozumel (*Cnemidophorus*: Wright & Lowe, 1968), and, with less certainty, from other areas (*Gymnophthalmus*: Thomas, 1965; *Hemidactylus*: Mertens, 1960). I now report the presence of all-female populations of *Cnemidophorus lemniscatus* over a large part of the Amazonas valley.

In December, 1967, my colleague Regina Rebouças-Spieker, who was then studying the stomach contents of a large sample of the teiid *Tretioscincus agilis* from Oriximiná, in the state of Pará, dissected, for comparison, a series of *Cnemidophorus lemniscatus* collected in January, 1967, at the same locality (Vanzolini & Rebouças-Spieker, 1969). She called my attention to the absence of males in the sample at hand. I checked our collection and noticed that in 2 fairly large series, from Oriximiná and from a locality much to the east, Corcovado, only females were to be found. Since these collections had been made routinely, I was cautious about their meaning and availed myself of a trip made to Oriximiná, for other purposes, in early 1968, to make sure of the unisexuality of the population. Once this was ascertained, a campaign was planned and executed in August and September of the same year with the object of collecting *Cnemidophorus* between Belém and Oriximiná and, if possible, obtaining materials for caryotype studies. The trip was successful and the preliminary results seem to deserve publication in advance of the more detailed studies in progress.

ECOLOGY

Cnemidophorus lemniscatus is a small "macroteiid" (Vanzolini & Valencia, 1965; Burt, 1931), large males reaching about 85 mm snout to vent length, females 75 mm.

We have collected in the last 3 years some 2500 specimens in Amazonia, and never found one in undisturbed situations, but only in and around towns and sizable settlements: it is really a "weed" in the sense of Wright & Lowe (1968). Where it exists it is always the most abundant lizard, made more obvious still by foraging preferentially in open areas covered by short, sparse grass,

such as back country air strips, where population densities are characteristically high. Back yards, empty lots and soccer fields are also favored.

This strict adherence to urban and periurban environments results, in the Amazonas valley, where cities are separated by forest, in a series of nuclei of very dense populations, separated by broad areas where density is zero or negligible (see below discussion of the Óbidos-Oriximiná road). At the present stage of human occupation of the region, *C. lemniscatus* appears to behave as an insular species.

The only common teiid that shows partial ecological overlap with *C. lemniscatus* is *Ameiva ameiva*, which prefers, however, denser cover, such as tall grass or second growth bushes, or (in other areas of Brasil) open areas with clumps of small trees, among whose roots it has its burrows.

The food of *C. lemniscatus* in Central Amazonia consists, of course, of grass-living arthropods, especially Coleoptera (Vanzolini & Rebouças-Spieker, 1969).

DISTRIBUTION

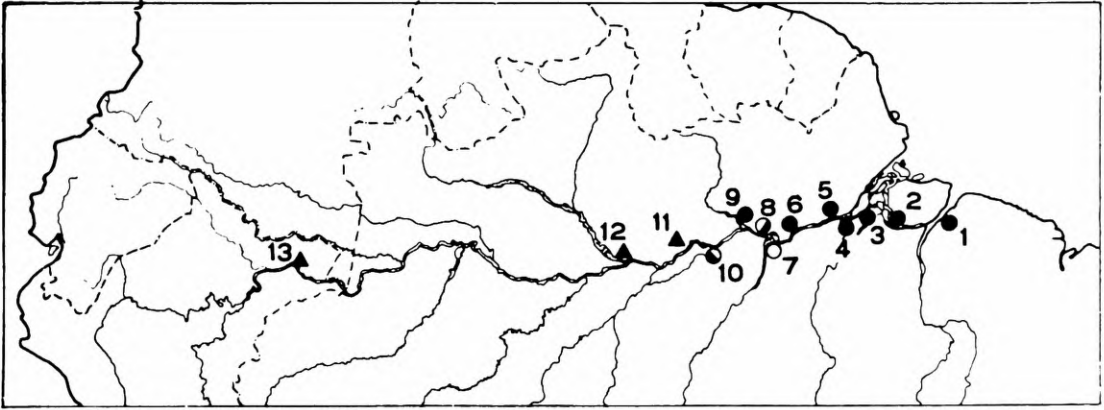
Cnemidophorus lemniscatus extends from Central America through Colombia into the Guianas and Amazonia. The southernmost localities known at present are those on the right bank of the Amazonas cited in the literature and in this note (Map) and especially those on the Tapajós. The easternmost locality is so far Belém. Burt (1931: fig. 8, p. 38) shows a locality deep into the caatingas (semi-arid formations) of northeastern Brasil, but this is certainly a mistake, as none of the places he lists on his page 37 match the dot on his map, which is, in fact, a very inexact one.

We are far from having adequate distributional data for any species of reptile along the main course of the Amazonas, however, for the last two years the "Expedição Permanente da Amazônia", maintained by a group of Brazilian institutions, has been working systematically along the river, and some preliminary data are available. *Cnemidophorus lemniscatus* is very abundant from Belém to the Rio Nhamundá, a stretch of some 1.000 km. Burt (1931) cites specimens from Parintins, in the Museum of Comparative Zoology (MCZ 1159, 2 males and one female, Dr. Marcus leg. et don., 1863). Further west it has not been collected. Since the regions west of the Rio Trombetas have been so far little explored, this negative datum must be taken with caution; however, three areas (Manaus, Itapiranga, and the lower Ampiyacu) have been well collected, and the species was not found there.

There seems to be nothing in the area not inhabited by *C. lemniscatus* that would impede its existence there. The right type of environment is of course widespread and is not occupied by any form that could be a direct competitor. The most likely explanation for the lack of penetration of the species is that its spread into Amazonia is recent, and started from the east — the areas not occupied have not been reached yet.

We have no data on the mode of spreading of *C. lemniscatus*. If the direction of the process is really westward, rafting should be

excluded. A more probable mechanism would be gradual expansion along the deforested banks of rivers. However, we have not found the species yet in farms and pastures, and this aspect needs more investigation.



1, Belém. 2, Breves and Corcovado. 3, Gurupá. 4, Pôrto de Móz (near the mouth of the Xingu). 5, Almeirim. 6, Monte Alegre. 7, Santarém (mouth of the Tapajós) and Alter do Chão (50 km upstream). 8, Óbidos. 9, Oriximiná (mouth of the Nhamundá on the Trombetas, near mouth of the Trombetas on the Amazonas). 10, Parintins. 11, Itapiranga. 12, Manaus. 13, Mouth of the Ampiyacu. 1-6, 9: unisexual populations of *C. lemniscatus*. 7: bisexual populations. 8: shift from bisexual in 1965 to unisexual in 1968. 10: bisexual population in 1863, not explored recently. 11-13, no *C. lemniscatus*.

Between Belém and the Rio Nhamundá we have explored adequately 11 localities. With one exception, males were found only in the Rio Tapajós, at Santarém, on the mouth, and at Alter do Chão, some 50 km upstream. The exception is Óbidos. There I collected, in 1965, two males and three females. In 1968, in a broad area enclosing the 1965 locality, only females were to be found among 108 specimens collected. This shows (besides some possibly important evolutionary consequences discussed below) that distributional data of sex ratios of this lizard are meaningless if not qualified as to date.

Outside of the main course of the Amazonas only bisexual populations are known to me.

ORIGIN OF UNISEXUALITY IN *C. LEMNISCATUS*

I think it may be accepted as a working hypothesis that these all-female populations of *C. lemniscatus* are parthenogenetic. Maslin (1966) lists all the mechanisms that can conceivably lead to the finding of all-female samples; of these parthenogenesis is convincingly demonstrated in several forms of *Cnemidophorus* (e.g. Cuellar, 1968), and the other explanations appear to me far-fetched.

In all cases adequately investigated, caryological (Wright & Lowe, 1966) and biochemical evidence (Neaves & Gerald, 1968) point to hybridization as the mechanism responsible for the

origin of parthenogenetic species of *Cnemidophorus*; this is also true, and was first discovered, in *Lacerta* (Darevsky, 1966). In the present case such an explanation is extremely improbable.

Hybridization presupposes the syntopic presence of parental species in or adjacent to the area occupied by the parthenogenetic populations. In no place in South America is there geographical overlap of two species of *Cnemidophorus*. There is ample overlap, geographical and even ecological, between *C. lemniscatus* and *Ameiva ameiva*. It is very probable that these species are congeneric (Vanzolini & Valencia, 1965; Gorman, in prep.) but they differ too much in size to be considered as eventual mates. Adult *Ameiva ameiva* in Amazonia measure 150 mm or more, snout to vent, about twice as large as a large *Cnemidophorus*.

One other important feature of the present case is the rapid shift of the Óbidos population from bisexual in 1965 to unisexual in 1968 (no collections from intermediate dates are available). It could be imagined that there has been no actual change within one population, but that the old Óbidos bisexual stock has been superseded and replaced by an immigrant unisexual strain. This possibility was made acutely important by the opening in 1966 of a road through the forest from Óbidos to the neighboring town of Oriximiná, where I found in 1965 the first unisexual population. As soon as I noticed in 1968 that males were absent in Óbidos, I started work along the 90 km of the road.

Three places showed apparently ideal conditions for *Cnemidophorus*: large open clearings, covered with short grass. Very careful collecting revealed no specimens. Other stretches of the road, 4-5 km long, with margins covered with tall dense grass or second growth bushes, were examined systematically. *Ameiva* was common, but again no *Cnemidophorus* was seen. It seems safe to say that this road has not functioned as a corridor for the migration of *C. lemniscatus* at a rate sufficient to explain the Óbidos shift. Of course, we cannot discard the possibility of migration of a unisexual strain by the (still unknown) means the species is using to spread upstream. But neither can we rule out the possibility of intrinsic genetic mechanisms inside the Óbidos population.

COMMENTS

It is unnecessary to stress the preliminary character of these notes. Since the discovery of the phenomenon only one field trip was made, and the data then gathered are still being processed. However, there are some features of this case that appear most interesting even at this early stage:

1. *Cnemidophorus lemniscatus* seems to be in the process of expanding its range along the main course of the Amazonas, proceeding westward, upstream.
2. It occupies peri-anthropic environments, ecologically well defined; there is possibly little gene flow between local populations.
3. In the area between Belém and the Rio Trombetas all populations studied are unisexual; only in the Rio Tapajós bisexual populations have been found.

4. As shown by the case of Óbidos, the shift from bisexuality to unisexuality seems to be still in progress, and to be a fast process.
5. It is unlikely that unisexuality in *C. lemniscatus* is due to hybridization. More research is needed to show whether the present geographical distribution of unisexual populations reflects the spread of a single original strain with superior powers of migration and selective advantages over local bisexual populations, or unisexuality has been evolving locally in different areas.

PERSPECTIVES

The peculiar features of the distribution and unisexuality of *C. lemniscatus* mentioned above indicate some obligatory lines of research.

Taxonomic studies should have a high priority. In first place it is necessary to compare the pattern of differentiation of the unisexual populations with that of bisexual populations both inside and outside the Amazonian valley. This comparison will afford an insight into the peculiarities of clone evolution and into the history of the spread of unisexuality. It is also necessary to consider the elements contributed by older collections from the area. These studies have been undertaken in this Museum by Ana Maria M. Ramos.

It is obvious that essential information will be provided by caryotypic studies. The materials collected during the 1968 trip from Belém to Oriximiná are being studied by Miss Denise M. V. M. Peccinini (Faculdade de Filosofia, Ciências e Letras, Universidade de São Paulo) who took part in the trip and obtained usable slides from 11 populations, one of which bisexual. Additionally, biochemical studies should be undertaken as soon as possible.

All these studies must be pursued for a number of years, on fresh collections, as we may be witnessing fast evolutionary phenomena. The Oriximiná population has already been followed for 3 years, and periodical visits to selected localities are planned. Especially important are Santarém and Alter do Chão, the only places where bisexual populations have so far been found. These places must be watched for changes in sex ratios.

It is also necessary to map carefully the occurrence of *C. lemniscatus* west of Oriximiná and to survey repeatedly the region, checking for eventual signs of range expansion.

Finally, the rather meager ecological information now available must be expanded, especially with regard to a proper description of the niche, to the amount of contact between neighboring populations and to the mode of spread along the river.

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