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### FRONT COVER

*Corytophanes cristatus*). See "Amphibians and Reptiles of Monkey Bay National Park, Belize" by Samuel T. Turvey and Anna G. Cooper p. 20.

### Editorial Note and Correction

The Spring and Summer Bulletins, 1999, were combined. The cover of the combined issue should have read No. 67 and 68. This issue, therefore, is No. 69.

# STATUS OF PROTECTED ENDEMIC SALAMANDERS (*AMBYSTOMA*: AMBYSTOMATIDAE: CAUDATA) IN THE TRANSVOLCANIC BELT OF MÉXICO

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## INTRODUCTION

Endemic species are common in the herpetofauna of México (Flores-Villela, 1992). Unfortunately, little is known about the biology of many of the endemic species in México, especially information pertinent to their status and potential conservation or management. A group of salamander species originally placed in the genus *Rhyacosiredon* but now placed in the genus *Ambystoma* (Family Ambystomatidae; see Reilly and Brandon, 1994) are restricted to the high mountains of the southern edge of the Transvolcanic Belt of México. These *Ambystoma* are of special concern because several species are endemic to the region surrounding México City, which is rapidly expanding. The sprawl of México City is potentially decreasing or degrading natural habitats in the Transvolcanic Belt. Urbanization and rapid growth of México City poses such a threat that the Secretaria del Medio Ambiente, Recursos Naturales y Pesca has accorded four species (*A. altamiranoi* Duges, *A. rivulare* Taylor, *A. leorae* Taylor, and *A. zempoalaense* Taylor and Smith) special protection due to their endemic status (in Diario Oficial de la Federación, 16 May 1994). The purpose of this paper is to report observations on the status of some populations of these *Ambystoma*, hopefully contributing to our knowledge of these endemic salamanders.

## MATERIALS AND METHODS

Between May 1991 and March 1996, we visited and surveyed ten localities including the type localities of all species. On each visit, we recorded number of individuals, sizes of observed individuals with the use of a plastic ruler, and number of individuals with and

without gills. We also recorded any environmental conditions that may have influenced or might be influencing the population in question.

## RESULTS

### *Ambystoma altamiranoi*

1) Rio de las Navajas (also known as Rio de los Axolotes), México, Municipio de Isidro Fabela, km 39.0 Mexican Highway 4 (Naucalpan - Ixtlahuaca) at 3,330 m elevation. We observed 33 individuals along a 1 km stretch of the stream on 15 August 1993. Twenty-nine were juveniles with very small gills or without gills. One adult was 80 mm SVL and three others had SVLs of near 70 mm. No larvae were found.

Rio de las Navajas was also visited in 1991. Eight individuals were seen on 7 August: one adult with an SVL of 89.0 mm, and seven larvae ranging in size from 45 to 57 mm SVL. All individuals were first observed in small cavities along the edge of the stream. On 23 August, 14 individuals were observed. Five were adults (one with an SVL of 85 mm, and four with SVLs between 60 and 62 mm). Four small larvae (12 mm SVL) and five large larvae (40 mm SVL) were seen. Individuals were seen under rocks, in small cavities along the edge of the stream, or in the middle of the stream.

2) Las Palomas, México, Municipio de Isidro Fabela, km 38.5 Mexican Highway 4 (Naucalpan - Ixtlahuaca) at 3,300 m elevation. This population along a 1 km stretch of the Arroyo las Palomas was visited several times from 8 June 1991 through 7 August 1991. All individuals were observed under rocks and in or near small cavities.

On 8 June, one adult and 11 larvae were observed. Only one adult was found during the visit on 24 June. Ten individuals (two adults and eight larvae) were found on 18 July. The highest number of individuals (34) was found on 25 July (3 adults, 31 larvae). Only three adults were found on 7 August.

3) A small permanent stream "Arroyo Puenteillas", Municipio de Naucalpan de Juarez, México, Carretera libre Naucalpan - Toluca, 3,060 m in elevation. This population was surveyed on 5 August 1993. Fifteen salamanders were observed. Of the ten individuals captured, nine were less than 40 mm SVL. All were first seen in small cavities on the edge of the stream. A pair of adults was found 35 m S of the main population in a pool 0.60 m deep and 1 m in diameter.

4) Llano Viborillas, Municipio de Xonacatlan, México, 2970 m elevation. This population was surveyed on 5 August 1993. Seven individuals were observed. Three were adults without gills, and the others were juveniles with SVL  $\leq$  40 mm.

### *Ambystoma leorae*

1) Arroyo Tonatzin, Puebla, 12 km east of Rio Frio, state of México, 3,210 m in elevation. On 12 August 1993, we observed 59 individuals along a 600 m stretch of the Arroyo Tonatzin. Three of these were adults without gills, two were larvae of 22.0 and 25.0 mm SVL, and the remaining individuals were juveniles (with gills) measuring 60.0 to 65.0 mm SVL. All individuals were first seen in shaded areas, and were quite wary. Upon detecting our presence they hid under rocks or logs. These salamanders are cryptic and often difficult to see. Individuals tended to be in groups ( $>$  five), and were rarely observed alone.

*Ambystoma leorae* were also abundant in a swamp at the headwaters of the Arroyo Tonatzin. However, in a seasonal stream flowing into the Arroyo Tonatzin, where the slope is often steep, no salamanders have ever been observed.

2) Campo Experimental Forestal "San Juan Tetla", municipio de Chiahutzingo, Puebla, 3,400 m in elevation. We observed six individuals along a 6 m section of the stream. Two were adults with gills (64.0 mm and 70.0 mm SVL), and the other four were juveniles with gills (33.0 - 42.0 mm SVL).

These salamanders have only been seen in limited regions of the Campo Experimental Forestal San Juan Tetla despite efforts to locate them throughout the area. Only three small creeks or streams have ever been found to have *A. leorae*: the small stream described here, the Rio Cotzala, and another small stream at 3750 m. However, no salamanders have been seen in the Rio Cotzala since local residents introduced fish into the stream.

#### *Ambystoma rivulare*

1) "El Salitre", Municipio de Villas Allende, state of México, 2600 m in elevation. We surveyed a small river (Arroyo El Salitre) on 10 March 1996. Visibility was low due to suspended particles and vegetation, therefore we used a net to sample the river. We caught three *A. rivulare* larvae. The river runs through the towns of El Salitre and San Felipe Santiago where local residents wash their clothes in the river.

2) Buenavista, state of México, km 19 Highway Toluca-Valle de Bravo, 3,100 m in elevation. On 26 July 1991, one adult (92 mm SVL) and 33 larvae (32 - 45 mm SVL) were observed along a 50 m section of a water canal. The adult was resting in a swamp that was 0.05 m deep. Most of the larvae (31) were seen along a 5 m section of the canal that was 0.30 m wide and 0.40 m deep. The other two larvae were seen in a swamp that was 0.10 m deep but which did not appear to be connected to the canal. Another 46 salamanders were observed on the same day at this locality but no data were collected on them. On 24 August 1991, 59 individuals were observed in the same locality. Thirty-eight were larvae ranging in SVL from > 55 mm, and 21 were larvae of 20 mm SVL.

The water in the canal originates in the sewers of Buenavista and La Puerta. Much of the canal was lined with garbage (e.g., plastic bags, tin cans, etc.) that the *A. rivulare* used as refugia. The sampled section of the canal was surrounded by houses.

#### *Ambystoma zempoalaense*

1) Vivero Acaextopan, Morelos, km 11.6 Highway Tres Marias-Zempoala, 2,750 m in elevation. We visited a swamp on the west side of Vivero Acaextopan several times between 12 October 1993 and 9 March 1996. Three streams enter the swamp. On 12 October 1993, there were 10-15 salamanders at each spot where one of the streams entered the swamp. We also observed three individuals (75 mm, 82 mm, 86 mm SVL) in a 4 m x 4 m pool (1.5 m deep). On the next visit (3 April 1994) we did not see any salamanders in the swamp as the area was quite dry and there was much more vegetation. However, two salamanders were seen in the 4 m x 4 m pool. Only one individual was seen in the pool on 11 June 1994, however it was raining and the water was not clear which may have prevented our seeing more. On the next visit (30 July 1994), seven salamanders were seen in the pool. On the last visit (9 March 1996), only four adults were seen in the pool.

## DISCUSSION

Our observations provide some insight into the status of these salamanders, and may provide some suggestions as to their future. For the most part, the populations of *Ambystoma* we surveyed had good numbers and few indications of human encroachment. In many of these populations reproduction has been occurring as evidenced by the presence of larvae and juveniles. However, some populations may be potentially threatened.

One potentially threatened population is the *A. leorae* population in the Rio Cotzala in the Campo Experimental Forestal San Juan Tetla. No *A. leorae* have been observed in this stream since the introduction of fish by local residents. Thus it would appear that further introduction of predatory fish into streams with *Ambystoma* could have a devastating effect (see Tyler et al., 1998).

Among other potential problems is pollution of streams near residential areas. The pollution may derive from sewage systems (as at the water canal near Buenavista that contains *A. rivulare*) or from local residents washing clothes in the stream, potentially introducing detergents or other cleaning chemicals into the stream (as in the case of *A. rivulare* in the Arroyo El Salitre), which may have negative consequences for the salamander populations.

Increased human encroachment into the range of *Ambystoma* in the Transvolcanic Belt is likely as México City expands. In addition to increased pollution of streams, alteration of natural habitats may have detrimental effects on the viability of *Ambystoma* populations. Nearly all of the populations we surveyed were surrounded by forest or grasslands. Increased demands may lead to the conversion of these natural habitats into agricultural or residential areas. In addition to probable changes in the quality of the water, such changes will potentially alter water use. Increased water use may cause many of the shallow but permanent streams that *Ambystoma* inhabit to become temporary, possibly resulting in the extirpation of some populations. The need for permanent water is evidenced by our observations. *Ambystoma leorae* occurs in a permanent stream that feeds into the Rio Tonatzin but does not occur in a seasonal stream that also joins the Rio Tonatzin. Also, *A. zempoalaense* were not observed in the swampy area near the Vivero Acaextopan during a dry period, and have not been observed there since.

While populations of *Ambystoma* in the Transvolcanic Belt of México appear to be relatively healthy, there are signs that unless management and conservation of natural habitats near México City begins now, these populations may be in danger of being eliminated.

## ACKNOWLEDGMENTS

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## REFERENCES

- Flores-Villela, O. (1992). Herpetofauna of Mexico: distribution and endemism. pp. 253-280 in: *Biological diversity of Mexico: Origins and distribution* Ramamoorthy, T.J., Bye, R., Lot, A., and Fa, J. (editors). New York, Oxford University Press.
- Reilly, S.M. and Brandon, R.A. (1994). Partial paedomorphosis in the Mexican stream ambystomatids and the taxonomic status of the genus *Rhyacosiredon* Dunn. *Copeia* 1994: 656-662.
- Tyler, T.J., Liss, W.J., Hoffman, R.L., and Ganio, L.M. (1998). Experimental analysis of trout effects on survival, growth, and habitat use of two species of ambystomatid salamanders. *Journal of Herpetology* 32: 345-349.

## A LARVAL ALBINO OF THE GOLDEN-STRIPED SALAMANDER, *CHIOGLOSSA LUSITANICA*

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Albinism is a pigmentary disease with a genetic origin (Parent, 1992). Although albinism is described for many species of amphibians (e.g. Dyrkacz, 1981; Crucitti & Gentili, 1987; Guyetant & Moine, 1992) it is rarely observed in nature. Albino and other odd-coloured amphibians were recently the focus of attention and the apparent increase in their frequency has been linked to environmental causes and inbreeding due to reduced gene flow between populations Beebee (1997).

The Golden-striped Salamander (*Chioglossa lusitanica*) is a streamside salamander endemic to the Northwest of the Iberian Peninsula. Until the 1980's the species was one of the least known European amphibians but has been thoroughly studied since (e.g. Arntzen, 1981, 1994a,b; Vences, 1990; Alexandrino *et al.*, 1997; Teixeira *et al.*, 1999). Two cases of albinism were reported for the species so far: one partially albino adult found near Porto, North Portugal, in 1960 (Brame & Freytag, 1963) and one totally albinotic larva collected in Valongo Mountains, also in the vicinities of Porto, in 1977 (Arntzen, 1999).

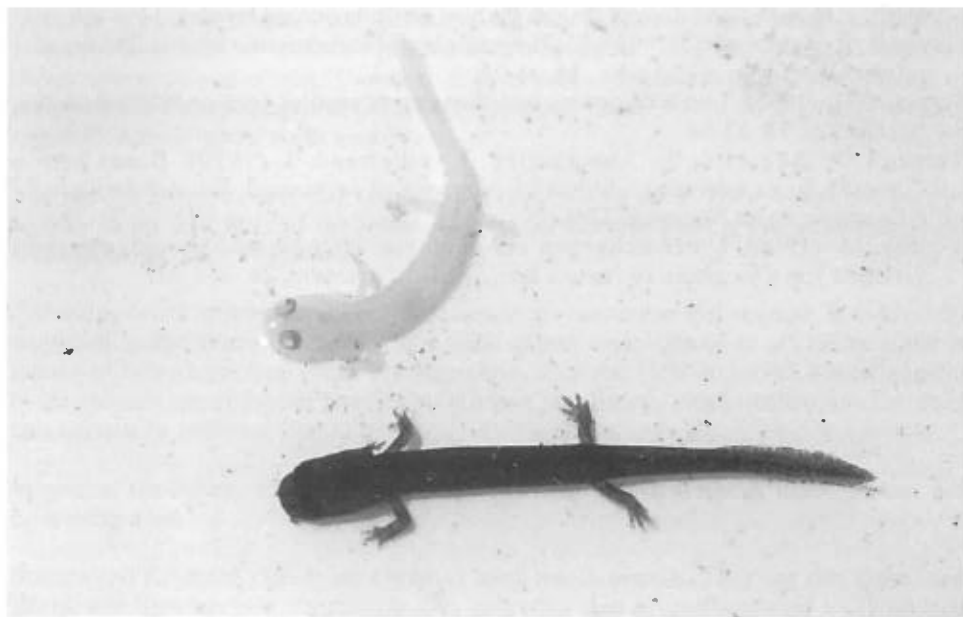


Plate 1: Albinotic and normally coloured larvae of Golden-striped Salamander, *Chioglossa lusitanica*.

A national survey of the distribution of *C. lusitanica* in Portugal was carried out from 1994 to 1998 (Teixeira *et al.*, 1999). We visited 374 potential habitats such as mountain brooks and mines. The species was detected in 200 squares U.T.M. 10x10 km. During this study a totally albino larva (see photo) was found in a mine near Candal in Lousã Mountains, Central Portugal. Hundreds of larvae (in different stages of development) and awith no pigmentary abnormality were also observed in the same place.

The low number of reported cases spanned over a large period of time suggest that albinism is rare in the Golden-striped Salamander.

## REFERENCES

- Alexandrino, J.; Ferrand, N. & Arntzen, J.W. (1997). Genetic variation in some populations of the Golden-striped salamander, *Chioglossa lusitanica* (Amphibia: Urodela), in Portugal. *Biochem. Gen.*, **34**: 371-381.
- Arntzen, J.W. (1981). Ecological observations on *Chioglossa lusitanica*. *Amphibia-Reptilia*, **1**: 187-203.
- Arntzen, J.W. (1994a). Allometry and autotomy of the tail in the Golden-striped salamander, *Chioglossa lusitanica*. *Amphibia-Reptilia*, **15**: 267-274.
- Arntzen, J.W. (1994b). Speedy salamanders: sedentariness and migration of *Chioglossa lusitanica*. *Rev. Esp. Herp.*, **8**: 81-86.
- Arntzen, J.W. (1999). *Chioglossa lusitanica* Bocage 1864 – der Goldstreifen salamander. in: K. Grossenbacher & B. Thiesmeier (Eds). *Handbuch der Reptilien und Amphibien Europas*. Aula Verlag. Wiesbaden. pp. 301-321.
- Beebee, T. (1997). Funny-coloured frogs. *Brit. Herp. Soc. Bul.*, **60**: 40.
- Brame, A.H. & Freitag, G.E. (1963). Ein halbalbina von *Chioglossa lusitanica*. *Zool. Gart.*, **27**: 130-131.
- Crucitti, P. & Gentili, G. (1987). Un fenotipo semialbino di *Triturus cristatus karelinii* (Strauch, 1870). *Atti. Soc. Ital. Sci. Nat. Milano*, **128**: 57-61.
- Dyrkacz, S. (1981). Recent instances of albinism in North American amphibians and reptiles. *Herpet. Circ. Society for the study of amphibians and reptiles*, **11**.
- Guyétant, R. & Moine, S. (1992). L'albinisme chez la salamandre tachetée *Salamandra salamandra* L. *Rev. Fr. Aquar.*, **19**: 91-92.
- Parent, G.H. (1992). L'utilisation des batraciens et ds reptiles comme bio-indicateurs. *Nat. Belges*, **73**: 33-59.
- Teixeira, J.' Sequeira, P.; Alexandrino, J. & Ferrand, J. (1999). Bases para a Conservação da salamandra-lusitânica, (*Chioglossa lusitanica*). *Estudos de Biologia e Conservação da Natureza*, **22**: 1-33.
- Vences, M. (1990). Untersuchungen zur okologie, etologie und geographischen variation von *Chioglossa lusitanica* Boc. 1864. *Salamandra*, **26**: 267-297.



## BEHAVIOURAL STUDY ON A GROUP OF MADAGASCAR IGUANA (*OPLURUS C. CUVIERI*) HATCHLINGS

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### ABSTRACT

Behavioural observations on a group of six three week old Madagascar iguanas (*Oplurus c. cuvieri*) were made over a period of 13 hours in order to find out whether a certain dominance and/or rank order among juveniles exists within a group.

Weights and measurements of the six hatchlings were taken at the beginning and also at the end of the observations to see if there is any relation of body size and weight and dominance and if any relation exists between the possession of a territory and the increase of body size and weight.

Also a short behavioural study was made on two groups of 1.2 adult Madagascar iguanas in two different exhibits. During these 1½ hours of observations hardly any activities and/or interactions were seen.

### INTRODUCTION

*Oplurus c. cuvieri* inhabits the subhumid regions of northwestern Madagascar from western Diego-Suarez Province southwards into northern Tuléar Province and inland to the western slopes of the Tananarive Province, with an isolated population in northwestern Fianarantsoa Province (Burghardt and Rand, 1982). Angel (1942) already reported animals on the north west coast.

The species is highly arboreal and active throughout the day. They forage on trees as well as in the leaf litter of the forest floor on all kinds of insects and occasionally on fruits (Bloxam, pers. comm.).

The status of the species is probably one of serious conservational concern. It is severely restricted in distribution and there is a large export trade (Stuart et al. 1990). Little is known of behaviour, reproduction and feeding. Between 1991 and 1995 a total number of 29 animals was reared at Jersey Zoo (Gibson and Buley, 1996). Rotterdam Zoo bred two animals in 1994 and four in 1995.

In general hardly any studies of territorial behaviour of hatchlings of lizard species has been carried out.

Stamps and Krishnun (1994) have studied adult *Anolis aeneus*. They say that there is an interaction between size and familiarity, indicating that juveniles tended to avoid first encounters that they were unlikely to win and conversely, to initiate first encounters when the odds of winning were more favourable.

At Rotterdam Zoo from 1990 - 1993 African Spiny-tailed Agama hatchlings (*Uromastyx acanthinurus*) were reared in small groups. Dominance and stress is briefly discussed by Zwartepoorte (1994)

In the group of six juveniles at Jersey Zoo at the start of my observations a certain "rank order" seemed already established

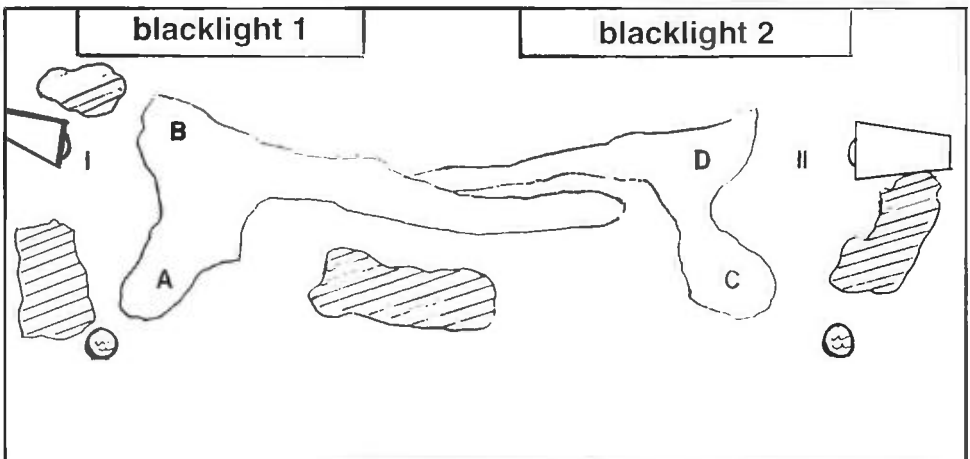
### MAINTENANCE OF ANIMALS

The six animals were born on 30 July 1995 and were housed in a small enclosure which measured 100x60x40 cm (lxwxh). See Fig 1.

The decoration was basic but functional. Different hiding places were created and on both sides there were two places on branches where the animals could bask. On both sides of the enclosure a small waterbowl was present. On the bottom of the bowls pebbles were placed to prevent the animals from drowning.

The four different basking places were heated by one 60 Watt bulb on each side. Two black light tubes (Philips 15W/05) were present on the floor at the back side of the enclosure. They provided additional U.V. light. The animals sometimes used the black lights for warming themselves up.

The temperatures of the frame of the tubes went up to 65 degrees Celsius and the animals sat on it for several minutes with their toes lifted to prevent burning. The floor was covered by a 2 cm layer of wood chippings.



**Figure 1.** Diagram to show the general layout of the enclosure. Letters A - D refer to the four different basking areas on the branches. The two circles at the left and right front are water bowls. The striped areas are terra cotta pot sherds. I and II are the 60 Watt bulbs.

At the beginning of the observations all the animals were individually marked with red nail polish (four animals on one different leg, one on the tail and one on the back between the shoulders). Body weight and snout vent length(SVL) plus total length(TL) were taken. Little difference was noted, although nos. 4 and 1 were the heaviest with respectively 6.2 gr. and 6.0 gr. Nr 2 was the lightest.

From the start all the animals showed a variety of activities. A few animals were clearly more aggressive and stronger than the others. The activities could be defined as different social interactions(See Table 2) and observations were made to determine whether there was a certain dominance linked to the possession of a territory or not, and if the dominance was related to body weight and size.

**Four different methods of observation were carried out:**

1. I started with an ad hoc pilot observation of two hours in order to get to know the animals; when they are were moving fast it was sometimes difficult to see which was which.

During this pilot observation I observed a certain dominance of the animals 1 and 4 having their territory on A/B and C/D on respectively the left and right side of the enclosure.

The animals 2 and 6 did not show any sign of aggression to one-another and were often chased away by 1 and 4 from areas A/B and/or C/D. In two hours time no 2 was chased away by 1 and 4 four times in different places of the enclosure.

The reactions of no. 2 in these social interactions varied from running away and pressing his body to the surface to just stepping aside for about 10 cm.

During these two hours no. 6 had three social interactions with nos. 1 and 4. He did not show the frightened and subordinate behaviour that no. 2 showed. At the end of the pilot observation my conclusion was that there was rank dominant behaviour from nos. 1 and 4 and a low place at the “rank order” for nos. 6 and 2. No. 3 and 5 played an intermediate role in the interactions, as they showed dominant behaviour such as head bobbing, bites and chases but only towards nos. 6 and 2.

Temperatures were measured at spots A,B,C, and D as well as in the middle of the enclosure. See Table I.

Date	Time	Temperature on Area				Ambient temp.
		A	B	C	D	
8/8	12.40	35	35	34	34	30
8/8	14.00	36	36	35	35	31
9/8	9.15	33	33	32	32	29
9/8	10.45	33	33	33	33	29
9/8	12.00	-	-	-	-	30
9/8	14.35	36	36	35	35	31
10/8	10.30	34	34	33	33	30
10/8	11.30	33	33	33	33	30
10/8	14.10	-	-	-	-	31
10/8	15.30	-	-	-	-	32
11/8	10.45	33	33	33	33	32
11/8	12.05	-	-	-	-	32
14/8	15.35	36	34	35	34	31

**Table I.** Showing temperatures measured in degrees Celsius varying during the day during the observation period.

Bite	: a fast single bite at a short distance towards another animal.
Chasing	: prolonged pursuance.
Head bobbing	: distinct, rhythmic, vertical head movements
Lunging	: fake attack, no contact.

**Table II.** Showing different types of behaviour performed during social interactions.

After the first ad hoc pilot observation I decided to use three more different observational methods.

A. Instantaneous observation on one animal (no. 1) during one hour at two minute intervals in order to see where he is at that particular moment.

B. Registration of the possession of the four different basking places (A,B,C,D) by the different animals at two minute intervals over one hour.

### SOCIAL INTERACTIONS

Observation method A showed that animal no. 1 spent most of the time at basking places A and B. Between 14.12 and 14.44 o'clock at a particular day he was there almost continuously. Within the hour he showed head bobbing behaviour twelve times. Ten out of these twelve times the result was that the approaching animal disappeared. Nine times he was recorded on the floor of the enclosure. During the observation hour animal no. 4 spent most his time at baskingplaces C or D, so that it seemed that there were two territories (from now one called Territory I on the left side and Territory II on the right side of the enclosure). It therefore appeared that there was a borderline between the two areas that demarcated the territory boundaries.

Observation method B ( a two minute interval check) one day later proved that there were two significant territories with a border line in the middle. See Table III.

Animal No.	A	B	C	D	Upon		Underneath		Elsewhere
					BL1	BL2	BL1	BL2	
1	2	-	-	-	3	1	10	4	10
2	2	4	-	-	-	-	4	1	19
3	7	7	-	2	1	3	3	-	7
4	12	1	6	1	2	2	-	2	4
5	11	3	3	-	-	-	4	2	7
6	7	-	-	1	3	2	5	-	12

**Table III.** Showing observations on the animals spending times at the different places (A,B,C,D, and Black-Lights 1 and 2) in the enclosure on 9/8 from 9.20 till 10.20 o'clock (a two minute interval check).

The branch in the middle actually formed a bridge between the different territories and was used by all the animals as a way of avoiding crossing the borderline on the floor. In the middle they stayed there only for a few seconds.

Observation method C involved two hours of observations on all the different social interactions among all the animals mentioned in Table II.

This method was carried out between 10.45 and 13.00 o'clock with a break of 15 minutes from 11.45 till 12.00 o'clock.

These observations showed a much better pattern of overall behaviour. See Table V. Animal no. 4 showed dominant behaviour towards no. 2 which meant head bobbing (4 times), lunging (3 times); all these activities took place on the floor of the enclosure while no. 1 sits high on basking place A.

No. 4 showed also dominant behaviour towards no. 3; there were fifteen interactions between the two, including lunging(six times), head bobbing(six times) and bites(three times). In all these cases no. 3 seemed not to react and on only two occasions he ran away and in all the other interactions he simply stepped aside and stayed at a 10 cm. distance.

In fifteen interactions no. 1 was involved, and he showed dominant behaviour towards no. 3 (four times), no. 2 (three times), no. 5 (2 times) and no. 6 (three times) that consisted mainly of lunging and head bobbing. Only once did no. 1 show an interaction with no. 4 in territory II.

At this time it became more obvious that there were two territories; territory no. I owned by no. 1 and territory no. II by no. 4. No. 2 was probably the lowest ranking individual. During the two hours of observation he showed more and more escape-behaviour at the right side of the enclosure. During this period no. 4 showed a remarkable feeding on small flies on the ground.

Animals	no.	1	4
Head bobbing	5	14	
Chase	-	5	
Bite	2	3	
Lunging	1	6	

**Table V.** Showing the number of different social interactions of the animals nos. 1 and 4 during two hours of observation from 10.45 till 11.45 and 12.00 till 13.00.

The fact that there was hardly any interaction between nos. 1 and 4. could mean that they are equal in dominance also related to their body weight and size. They both were the longest and heaviest from the beginning till the end of the study.

The observations made early in the morning between 9.00 and 10.00 o'clock showed a different basking behaviour. Nos. 1 and 4 started heating up on the black lights; they tolerated the others on the basking places A,B,C and D. Later on in the morning nos. 1 and 4 moved to their look out places to get a better control over their territories.

Observations with method C one day, later showed a pattern that was a little different from the day before. During 1½ hours' observation (10.30-13.00) subordinate behaviour within the group was showed by no. 3 and it was usually directed towards nos. 2(2 times) and 6 (3 times). Nos. 1 and 4 seemed to tolerate his behaviour; they spend most of their time equally in territory I and II.

On one occasion nos. 1 and 4 were seen at point A in territory I with one eye closed preventing visual contact with each other; a behaviour seen more often in lizards (for example on Chuckwalla (*Sauromalus obesus*) hatchlings in my private collection and on

## African Spiny-tailed Agama (*Uromastyx acanthinurus*) hatchlings at Rotterdam Zoo).

During 1½ hours of observation between 14.10 and 16.00 o'clock the rank order changed completely. The dominant role was taken over by no. 5. In eight social interactions with no. 1 as well with no. 4 he showed bites (4 times) and head bobbing (7 times). These interactions took place in territory I at point A/B or in the surrounding of it. Also no. 3 was seen in five social interactions in which he took the initiative; once towards no. 2, once towards no. 6 and three times towards no. 4.

A one hour observation with method C from 10.45 till 11.45 o'clock showed again the more important role for nos. 3 and 5. Their dominant behaviour was mainly shown towards nos. 1 and 4 and they mainly took place on the baskingplaces A/B and C.

Escape behaviour by no. 2 was often seen in the right front corner of the enclosure during the first two days of the observations. On the third day at 10.45 o'clock a piece of black polythene was taped on the outside of the glass. After one hour the escape behaviour and scratching at the glass disappeared and during the rest of the observation only twice did he scratch at the glass in the back corner on the right.

### FEEDING AND SOCIAL INTERACTIONS

During six times of feeding nos. 1 and 4 were seeing feeding more aggressively than the others. This occurred during the period when they played a dominant role (the first two feedings); they also kept on searching for food longer than the other animals. During the other four feedings no dominant behaviour was observed. All the animals ate the same amount of crickets. Even no. 2 fed very quickly and he did not show the subordinate behaviour that he showed at the first feeding. At the last feeding on 15/8 all the animals ate about six crickets just after being weighed. The weight of six crickets is 1.8 g.

Animal no.	SVL in cm	TL	Weight in grammes		%Increase in body weight	Condition		
			8/8	11/8		14/8	Before	After
1	5.3	7.4	6.0	6.8	6.9	15	4.03	4.63
2	4.9	7.0	4.3	5.1	5.3	23	3.65	4.50
3	5.1	7.6	5.8	6.1	6.2	7	4.37	4.67
4	5.4	7.5	6.2	6.4	6.6	6	3.93	4.19
5	5.4	7.3	5.4	5.6	5.9	9	3.43	3.75
6	5.1	7.4	5.8	6.1	6.1	5	4.37	4.60

**Table IV.** showing body weight, snout-vent length (SVL), total length(TL), % increase in body weight and condition(body weight related to body length) - as WT/SVL<sup>3</sup>

### CONCLUSIONS

A constant rank order from 1 to 6 is not likely to exist within the group. Depending on temperature and time of day there seems to be a constant testing of each others' capacities by nos. 1,3,4 and 5 with a slightly stronger and aggressive behaviour for the nos. 1 and 4 which can be caused by their heavier body weight. See Table IV. Nos. 2 and 6 did not show any dominant behaviour at all and they always avoided confrontations. During certain hours of the day they were tolerated by the others on the places A,B,C and D ; this was during periods that the other four were at the warmest places for heating up upon or underneath the blacklights for example.

From the beginning of the observations no. 2 has been the lightest in body weight. Probably due to giving him more attention at feeding, such as offering him some additional crickets, his body weight increased during the observations. Also his escape behaviour disappeared. Maybe the stress-factor causes lesser appetite and worse digestion.

More intensive observation over a longer period is necessary to obtain a better view of the development of dominant behaviour within a group of hatchlings. It would be interesting to enlarge the enclosure in order to observe a possible change of behaviour.

On 16/8 the head-width of all the animals was measured. The results were as followed:

Nr. 1	13.4 mm.
Nr. 2	12.0 mm.
Nr. 3	12.7 mm.
Nr. 4	13.2 mm.
Nr. 5	12.8 mm.
Nr. 6	12.4 mm.

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### REFERENCES

- Angel, F. (1942): Memoires, Acad. Malgache. *Bulletin Mus.nat.hist.nat.*, Paris 1950(2), 22(5): 553.
- Blanc, C.P. (1982): Biogeographical aspects of the distribution of Malagasy Iguanids and their implications. *Iguanas of the world*. Noyes Publications, New Jersey, U.S.A. : 34-35.
- Gibson, Richard C. and Kevin R. Buley (1996): Captive management and breeding of Madagascar spiny iguanas *Oplurus cuvieri cuvieri* Gray, 1831. *The Dodo. Journal of the Wildlife Preservation Trust*, Vol. 32: 137-143.
- Stamps, J.A. and V.V. Krishnun (1994): Territory acquisition in lizards 1, First encounters. *Animal behaviour*, part six. Academic Press Limited: 1375-1385.
- Stamps, J.A. and V.V. Krishnun (1994): Territory acquisition in lizards 2, First encounters. *Animal behaviour*, part six. Academic Press. Limited: 1387-1400.
- Stuart, S.N., R.J. Adams and M.D. Jenkins (1990): Biodiversity in Sub-Saharan Africa and its islands. Conservation, Management and Sustainable use. *Occasional Papers of the I.U.C.N. Species Survival Commission* No. 6.
- Zwartepoorte, H.A., (1994): Verzorging, paargedrag en meervoudige kweek met de Afrikaanse doornstaartagame (*Uromastix acanthinurus*). *Lacerta* Vol 52, no. 3: 70-75.

## NOTES ON THE PARADOX FROG, *PSEUDIS PARADOXA*, IN BOLIVIA

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### INTRODUCTION

The South American Paradox Frog, *Pseudis paradoxa* (Plate. 1) is primarily a dweller of open, lowland areas, where it inhabits marshes, ponds and other types of lentic water bodies. It has a discontinuous distribution from Colombia to Argentina. Inter-population differences primarily in colour pattern, as well as in some other features, have led to the recognition of seven subspecies [*P. p. bolbodactyla* and *P. p. fusca* were recently proposed to be elevated to specific status (Caramaschi and Cruz, 1998)].

### DISTRIBUTION AND SUBSPECIES IN BOLIVIA

For taxonomic and biogeographical reasons, the lowlands of Bolivia are an interesting area with respect to this frog. The distribution of the species in this country is poorly known. The first Bolivian record of *P. paradoxa* was provided by Müller and Hellmich (1936) at San Fermiín, Department of Santa Cruz. Since then, it was reported at some other localities, mostly in the Department of Santa Cruz [see De la Riva (1990) and below]. It was interesting that it was also discovered at two localities in southeastern Peru (Duellman and Salas, 1991; Henle, 1992). These discoveries made plausible that it ranges throughout the intermediate area of extensive, suitable habitat of humid savannas in the Bolivian Department of Beni. However, there is a surprising scarcity of published records for this huge and relatively (by Bolivian standards) well surveyed zone. Bosch *et al.* (1996), pointed out that there was a gap of about 800 km between the Peruvian populations and the westernmost Bolivian record of *P. paradoxa*, Nueva Moka, a locality in the Department of Santa Cruz reported by Gallardo (1964). De la Riva (1990) and Bosch *et al.* (1996) overlooked Cochran's (1955) record of the species in the Department of Beni based on a specimen housed at the Museum of Zoology of the University of Michigan (UMMZ 57527) collected at Rurrenabaque and tentatively considered as *Pseudis bolbodactyla* (= *P. paradoxa bolbodactyla*). Reichle (1997), provided the second record of the species in Beni, at the Estación Beni, in the southwestern part of the Department. To date, *P. paradoxa* has been reported at seven localities in Bolivia. In this paper I summarize these published records and report additional localities based on personal observations and specimens housed at the American Museum of Natural History (AMNH), Carnegie Museum (CM), Colección Boliviana de Fauna (CBF), and Natural History Museum of the University of Kansas (KU). In all, there are now 16 records, six of them in the Department of Beni (see Fig. 1), which represent a further step towards a more realistic picture of the distribution of the Paradox Frog in the country. However, at the regional level, it still seems that this species has a patchy distribution, paralleling that shown at continental level. For example, despite some survey efforts, it has not been found in the suitable area of the Pampas del Heath, on the Peruvian-





Plate 1: Calling male of *Pseudis paradoxa occidentalis* at La Bola, Department of Santa Cruz, Bolivia.



Plate 2: Giant tadpole of *Pseudis paradoxa* (CBF 694) from Estancia Espíritu, Department of Beni, Bolivia (total length, 260 mm).

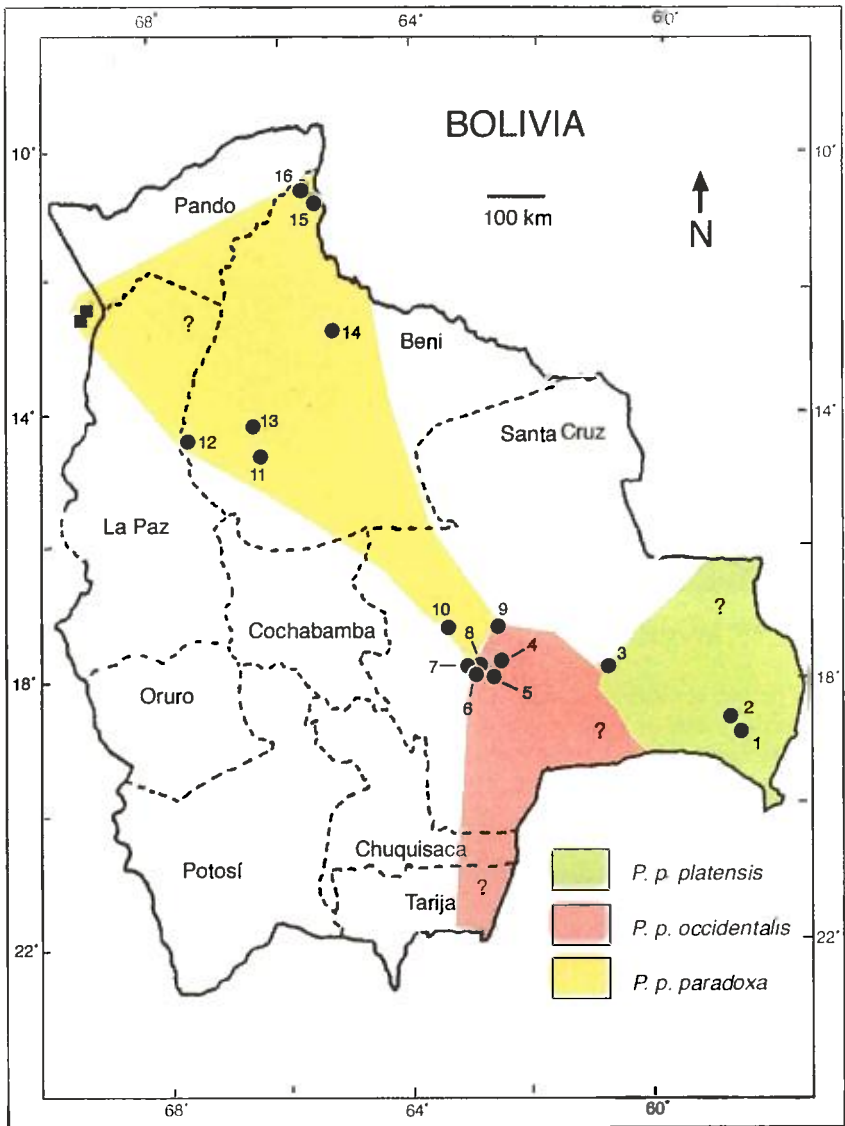


Fig. 1: Localities and putative distribution of the three subspecies of *Pseudis paradoxa* reported in Bolivia. 1) El Carmen (Gans, 1960); 2) San Fermín (Müller and Hellmich, 1936); 3) San José de Chiquitos (this paper; 4) El Pailón (Gans, 1960); 5) La Bola (Bosch *et al.*, 1996); 6) El Palmar del Oratorio (this paper); 7) Estancia Cedrito (this paper); 8) Santa Cruz (CM); 9) Okinawa 1 (KU); 10) Nueva Moka (Gallardo, 1964); 11) Estación Biológica Beni (Reichle, 1997); 12) Rurrenabaque (Cochran, 1955); 13) Espíritu (this paper); 14) Puerto Siles (AMNH); 15) Guayaramerín (AMNH); 16) Río Yata, on road from Guayaramerín to Cachuela Esperanza (AMNH). The squares represent Cuzco Amazónico (Duellman and Salas, 1991) and Lower Tambopata River (Henle, 1992), in the Department of Madre de Dios, Peru.

Bolivian border (Icochea, 1992; Pérez, 1997). Likewise, the species is present in the northern Chaco of Bolivia and in the Argentinian and Paraguayan chaco but there are no records from the intermediate Bolivian area [it has not been found even in marshy, suitable places as the Banados del Izozog (Gonzáles, 1997)].

In spite of the few records known previously, up to four subspecies of *P. paradoxa* have been recognized in Bolivia. Gans (1960) considered the eastern Santa Cruz populations as *P. p. bolbodactyla*, probably following Cochran's (1955) tentative identification of the Rurrenabaque specimen. This subspecies is now restricted to the San Francisco River basin, in eastern Brazen (Gallardo, 1961). Gallardo (1961) stated that, in Bolivia, *P. p. occidentalis* occurs in the Chaco, and *P. p. platensis* in the subhumid tropical lowlands (Cerrado formation) north and east of the Chaco. Later, Gallardo (1964) referred the Nueva Moka population to *P. p. paradoxa* and stated the Beni populations would belong to this subspecies as well. Henle (1992) commented on the supratympanic fold and colour pattern of the Peruvian specimens and suggested (apparently overlooking Gallardo's statement on the subspecific status of Beni populations) that they might be *P. p. occidentalis*; however, he found some differences such as, for example, the presence of patterned throat and venter, rather than immaculate. This last character would suggest that these populations are referable to *P. p. paradoxa*. It is not clear where would be the boundaries separating these three subspecies (Fig. 1).

## THE TADPOLE

The Paradox Frog is famous because it has a huge tadpole, whereas the adult is medium-sized, a fact to which the species owes its common name. However, accurate data on the maximum size attained by the larvae are scarce. For instance, Goin & Goin (1962) stated that they can reach "more than 25 cm long,..."; Kenny (1969) reported "230 mm"; Cochran (1961), "more than 25 cm"; Cogger & Zweifel (1992), "up to 25 cm"; Zug (1993), "220 mm"; Pough *et al.* (1998), "250 mm". Most of these reports are not based on particular specimens, or at least no voucher specimens were cited. The most comprehensive study on this topic is Emerson's (1988). She clearly stated that *P. paradoxa* has the largest tadpole of any species of Anuran, and reported a museum specimen of 220.5 mm as the largest examined by her (but she did not report the voucher specimen). The largest larvae ever reported is that of Bokerman (1967) (Bokerman's collection number, WCAB 38700), from Macapá (on the north bank of the Amazon river, close to its mouth), which attained 270 mm. This author stated that the specimen has the tail broken and it might have attained 320-330 mm in total length when it was still alive.

Cei (1980) and Emerson (1988) commented on the geographic variation in tadpole size of *P. paradoxa*, and stated that the largest tadpoles are from the Guianas and Trinidad [where, respectively, the subspecies *P. p. paradoxa* and *P. p. caribensis* occur; Bokerman's (1967) tadpole, collected near the Guianas, would belong to the nominal subspecies] and the smallest tadpoles are from Paraguay and Bolivia. There are some precise data on tadpole sizes for the two subspecies of this last region. Gallardo (1964) reported a maximum tadpole size of 169 mm for *P. p. platensis* and 117 mm for *P. p. occidentalis*. Dixon, *et al.* (1955) reported tadpoles of *P. p. platensis* of 135 mm in northern Argentina.

Taking these data into account, it was surprising that Reichle (1997) commented on a huge Bolivian larvae of *P. paradoxa* approaching 30 cm housed at the Colección Boliviana de Fauna, La Paz. This specimen (CBF 694) (Plate 2), was also examined by me. It was collected on 11 May, 1986 by W. Hanagarth, J. Sarmiento and J. Salazar at Espíritu, Provincia Ballivián, Department of Beni. It has well developed hind limbs and

its total length is 260 mm. The tail, measured from the starting point of the musculature, is 200 mm long; the body high is 72 mm and the tail high 92 mm. This tadpole is almost four centimetres longer than Emerson's largest one, and only one centimetre shorter than Bokerman's (1967) absolute record. Apparently, it was almost 30 cm long at the time of collection (Reichle, personal communication), and perhaps it shrunk afterwards as a consequence of the processes of fixation and preservation.

## DISCUSSION

This huge tadpole from Espíritu represents one more record for the Department of Beni but, what is more important, it also provides new information concerning two issues commented above, that of the geographic variation in larval size, and the subspecific status of the populations occurring in the Beni area. The fact that this specimen represents by far the largest tadpole of *P. paradoxa* reported for central South America and that only northern populations attain a size comparable to it, might support the statement by Gallardo (1964) about the status of the Beni populations as belonging to the nominal subspecies. The same might be true for the Amazonian population reported by Vanzolini (1986) based on three tadpoles collected in Rôndonia (unfortunately, no data were provided on the size of these tadpoles). However, there is still a gap of more than 1000 km between these populations and those from northern South America. With some differences, the distribution of *P. paradoxa* could parallel that of other open formation species, as *Leptodactylus labyrinthicus*, which occurs in open areas of northern and central South America but also inhabits isolated patches of savanna within the domain of the central Amazon rainforest. Within this context, it could be that Beni populations of *P. paradoxa* are phylogenetically closer to northern pupulations than to neighbouring populations from the Chaco and Paraná basin. However, it is also necessary to gather more information on maximum tadpole size throughout the range of the species. Overall, there is still a great lack of knowledge on the biology and distribution of the species as a whole, the subspecific or specific units into which it should be split, and the distribution and phylogenetic relationships of the resulting lineages.

## RESUMEN

La ditribución de la rana paradójica, *Pseudis paradoxa*, en Bolivia es aún mal conocida. La falta de citas en el Departamento de Beni, donde hay hábitats ideales para la especie, era particularmente difícil de explicar teniendo en cuenta que es bien conocida en Santa Cruz y se halla también en el sudoeste de Perú. En este trabajo se dan nuevas citas en Beni que llenan parcialmente este vacío informativo. No obstante, la distribución de *P. paradoxa* en el país es desigual. Se aportan asimismo datos sobre un enorme renacuajo de 260 mm que apoyaría la hipótesis de que la subespecie que se encuentra en la region beniana es la misma que hay en el norte de Sudamérica, *P. p. paradoxa*, o quizá una forma filogenéticamente más próxima a ella que a las vecinas subespecies *P. p. occidentalis* y *P. p. platensis*.

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## REFERENCES

- Bokerman, W. C. (1967). Girinos de anfibios brasileiros; sobre un girino gigante de *Pseudis paradoxus*. *Revista Brasileira de Biologia* 27: 209-212.
- Bosch, J., I. De la Riva and R. Márquez (1996). The calling behaviour of *Lysapsus limellus* and *Pseudis paradoxa* (Amphibia: Anura: Pseudidae). *Folia Zoologica* 45 (1): 49-55.
- Caramaschi, U. and C. A. G. Cruz (1998). Notas taxonômicas sobre *Pseudis fusca* Garman e *P. bolbodactyla* A. Lutz, com a descrição de uma nova espécie correata (Anura, Pseudidae). *Revista Brasileira de Zoologia* 15(4): 929-944.
- Cei, J. M. (1980). Amphibians of Argentina. *Monitore Zoologico Italiano (N. S.) Monografia* 2: 1-609.
- Cochran, D. M. (1955) Frogs of southeastern Brazil. *Bulletin of the United States National Museum* 206: 1-423.
- Cochran, D. M. (1961). *Living Amphibians of the World*. Doubleday, Garden City, New York.
- Cogger, H. G. and R. G. Zweifel (editors). (1992). *Reptiles and Amphibians*. Smithmark, New York.
- De la Riva, I. (1990). Lista preliminar comentada de los anfibios de Bolivia con datos sobre su distribución. *Bolletino del Museo regionale di Scienze naturali – Torino* 8(1): 261-319.
- Dixon, J. R., C. Mercolli and A. A. Yanosky (1995). Some aspects of the ecology of *Pseudis paradoxa* from Northeastern Argentina. *Herpetological Review* 26(4): 183-185.
- Duellman, W. E. and A. W. Salas (1991). Annotated checklist of the amphibians and reptiles of Cuzco Amazónico, Perú. *Occasional Papers of the Museum of Natural History, The University of Kansas* 143: 1-13.
- Emerson, S. B. (1988). The giant tadpole of *Pseudis paradoxa*. *Biological Journal of the Linnean Society* 34: 93-104.
- Gallardo, J. M. (1961). On the species of Pseudidae (Amphibia, Anura). *Bulletin of the Museum of Comparative Zoology, Harvard* 125(4): 111-134.
- Gallardo, J. M. (1964). Una nueva forma de Pseudidae (Amphibia, Anura). *Acta Zoologica Lilloana* 20: 193-209.
- Gans, C. (1960). Notes on a herpetological collecting trip through the Southeastern lowlands of Bolivia. *Annals of the Carnegie Museum* 35: 283-314.
- Goin C. J. and O. B. Goin (1962). *Introduction to Herpetology*. Freeman, San Francisco.
- González, L. (1998). La herpetofauna de Izozog. *Ecología en Bolivia* 31: 45-52.
- Henle, K. (1992). Zur Amphibienfauna Perus nebst Beschreibung eines neuen *Eleutherodactylus* (Leptodactylidae). *Bonner zoologische Beitrage* 43(1): 79-129.
- Icochea, J. (1992). Herpetofauna del Santuario Nacional Pampas del Heath, Madre de Dios, Perú: diversidad y conservación. In: Castillo, E. (Ed.), *Memorias X Congreso nacional de Biología*, Pp. 351-354. Lima.
- Kenny, J. S. (1969). The Amphibia of Trinidad. *Studies on the fauna of Curaçao and other Caribbean Islands* 29: 1-78.
- Müller, L. and W. Hellmich (1936). *Wissenschaftliche Ergebnisse der Deutschen Gran Chaco-Expedition. Amphibien und Reptilien. I. Amphibia, Chelonia, Loricata*. Strecker und Schröder, Stuttgart.
- Pérez, M. E. (1997). Una evaluación preliminar de los anfibios y reptiles de las Pampas del Heath (Provincia Inturralde, Departamento La Paz). *Ecología en Bolivia* 30: 43-54.
- Pough, F. H., R. M. Andrews, J. E. Cadle, M. L. Crump, A. H. Savitzky and K. D. Wells (1998). *Herpetology*. Prentice Hall, Upper Saddle River.
- Reichle, S. (1997). Frösche des Savannengebietes der Estación Biologica del Beni (EBB), Bolivien. I. *Herpetofauna* 19(106): 5-11.
- Vanzolini, P. E. (1986). Levantamento herpetológico da Area do estado de Rondônia sob a influência da rodovia BR 364. *Programa Polonoroeste, Subprograma Ecologia Animal. Relatório de Pesquisa* 1: 1-50.
- Zug, G. R. (1993). *Herpetology. An introductory biology of amphibians and reptiles*. Academic Press, San Diego.

## AMPHIBIANS AND REPTILES OF MONKEY BAY NATIONAL PARK, BELIZE

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### INTRODUCTION

Monkey Bay National Park (MBNP; sometimes referred to by other sources as 'Monkey Bay Nature Reserve') is an approximately square-shaped, 2,250 acre area of protected land situated between Belize City and Belmopan, at the western edge of Belize District, Belize. A qualitative herpetofaunal survey of MBNP was conducted for 25 days between July and September 1997, by four students from Oxford University and a graduate of University College, Belize. This was carried out in collaboration with the Conservation Division of the Belizean Government, to provide base-line data on a previously little studied area of Belize. A full report of the expedition's findings has already been produced (Turvey *et al.*, 1999); this paper serves to present a brief account of these results to a wider audience.

The northern border of MBNP is defined by the Sibun River, the area's major water feature, which lies at an elevation of approximately 30 metres above sea level. The land climbs slowly towards the south of the Park, where the topography is characterised by numerous limestone karst towers (some exceeding 120 metres in height) associated with large numbers of caves. These features form part of the ecologically sensitive Karst Land Formation, which occurs predominantly in protected areas in southwest Belize (Parker *et al.*, 1993; Iremonger and Sayre, 1994); the Formation remains relatively unprotected in Belize District, where it constitutes the northern extremity of the foothills of the Maya Mountains. Several creeks flow through MBNP into the Sibun. Lentic habitats are represented by variable patches of standing water, termed *bajo*, which form after rain within pockets of poorly drained, strongly hummocked 'potato' soils found throughout the gently undulating topography north of the Park's karstic region.

Recent investigations by Boston University (unpublished) indicate that MBNP was inhabited by Mayans during the pre-colonial era. Forested areas around the Sibun were logged heavily in the nineteenth and early twentieth centuries. Reduced logging operations continued in the region into the 1960's, at which time the northwestern part of MBNP formed part of the citrus and mango plantations of the Glenwood Estate. Although isolated houses can be found close to the Park's boundaries, the nearest settlement to MBNP today is La Democracia, a village (population approximately 100) situated two miles to the northeast; the village of Churchyard, recorded as being located on the opposite side of the Sibun to MBNP, has effectively ceased to exist.

MBNP was designated as a National Park in 1992. Access can be gained from the adjoining Monkey Bay Wildlife Sanctuary (MBWS), a 1070 acre protected area immediately north of the Sibun consisting of pine savanna and pine-fig forest. MBWS is situated at Mile 31.5 on the Western Highway, and was established in 1990 (see Kather,





**Plate 1.** Broadleaf forest in MBNP, dominated by Cohune Palm (*Orbigyna cohune*).



**Plate 2.** Bajo in MBNP.



**Plate 3.** *Gastrophryne elegans*.

1992, for treatment of land stewardship in MBWS and MBNP). Together MBWS and MBNP form a protected habitat corridor spanning the Sibun River Valley and connecting other protected areas in Belize.

The survey was conducted during Belize's rainy season, which lasts from June to January. During this period, Belize District usually receives between 200 and 300 mm rainfall per month, with humidity remaining in excess of 80%, and temperatures remaining between mid-20's to approximately 30°C (Brosnahan, 1994). However, during the survey period there was considerably less rainfall than is typical for the time of year. MBNP is situated close to the boundary between Belize's northern and southern hardwood forest regions, referred to respectively as Semi-Evergreen Seasonal Forest, and Evergreen Broadleaf Forest or 'rainforest' (Meyer and Farneti Foster, 1996), and contains component species from both vegetation types. This transition zone has been described as the Tropical Moist Transition to Subtropical ecological lifezone (Hartshorn *et al.*, 1984, *sensu* Holdridge, 1967). The geographical region between the Sibun and Mullins Rivers, an area encompassing MBNP, was further described by Meyer and Farneti Foster (1996) as Karst Hills Forest Vegetation; this has much in common with their Semi-Evergreen Seasonal Forest, particularly with respect to tree species and seasonal leaf loss, but does not reach the heights encountered in the other two vegetation types, and has less developed buttress roots and epiphytic growth.

Due to former logging practices, MBNP contains secondary forest, composed of subclimax successional vegetation in which the canopy is lower and more open than in primary Karst Hills Forest Vegetation. The well-drained floodplain adjacent to the Sibun consists of riparian forest, characterised by riparian figs (*Ficus* spp.) and patches of dense, impenetrable thicket made up largely of the exotic bamboo *Guadua spinosa*. The transitional and broadleaf secondary forest occurring further away from the Sibun is dominated by Cohune Palm (*Orbigyna cohune*), and the forest floor is littered with large decomposing palm fronds. Other tree species in this region include the Give and Take Tree (*Cryosophila argentea*), the Prickly Yellow (*Xanthoxylum kellermannii*), the Cockspur or Bullshorn Acacia (*Acacia cookii*), the Stinking Toe (*Cassia grandis*), and a few large buttress-rooted trees such as Mahogany (*Swietenia macrophylla*) which were missed during logging operations. At the western edge of MBNP, on the site of the former Glenwood Estate plantation, Lemon (*Citrus limonia*) and Mango (*Mangifera indica*) trees are found growing alongside these other species. Understorey vegetation is rather sparse except in areas of bajo, where dense woody vegetation forms a tangled, multistemmed thicket containing few taller emergent hardwoods.

The Belizean herpetofauna has been treated by Hoevers and Henderson (1974), Henderson and Hoevers (1975), more recently by Garel and Matola (1996) and Meyer and Farneti Foster (1996), and extensively by Lee (1996). A further review will also soon be available (Stafford and Meyer, 1999). 34 species of amphibian and 111 species of reptile are recognised by Lee (1996) to occur in Belize, and Stafford and Meyer (1999) list a further 11 reptile species. Almost half of these inhabit forested areas (Stafford, 1991). Belize's modern faunal affinities lie in the zoogeographical area of nuclear Central America (Iremonger and Sayre, 1994), belonging to the 'Caribbean lowland' assemblage (Kather, 1992). The Belizean biota is particularly rich, because it supports both North and South American species in addition to species shared with the Greater Antilles (Iremonger and Sayre, 1994). Duellman (1966) recognised six distinct herpetological biociations in Central America, principally based upon physiognomic characters of vegetation, with moisture and temperature as the principal environmental factors affecting species distribution in the region. However, MBNP contains herpetological components of both his Humid Tropical Assemblage and his Arid



Tropical Assemblage, and a more useful approach is to describe the fauna of Belize's drier north as similar in character to that of Yucatecan Mexico, whereas that of the wetter south is more similar to that of eastern Guatemala. As with vegetation, MBNP is geographically situated in a transitional area between these two faunal regions (Kather, 1992). Campbell and Vannini (1989) considered all of Belize, along with the northern portion of Guatemala and the lower Polochic and Motagua valleys, to fall within the 'Petén faunal area', one of eight such areas used by these authors to describe herpetofaunal distributions in Guatemala and Belize.

In comparison with other tropical areas, herpetological diversity is rather low in the Yucatán Peninsula (comprising southeast Mexico, northeast Guatemala and all of Belize), due to its relatively homogeneous topography (Lee, 1996). However, the Peninsula is rich in endemic plant and animal species, and the uniqueness of the Yucatecan biota has long been appreciated by naturalists, who have often treated the area as a distinct biotic province. 14% of the Yucatecan herpetofauna is endemic (Lee, 1996). Surprisingly little is known about the distribution or natural history of many of the Peninsula's herpetofaunal species, with researchers often having to rely on information obtained from populations found elsewhere in Latin America (Lee, 1996). When the recognised global decline in amphibian populations (eg. Wake, 1991) is also taken into consideration, with further declines probably occurring on a local scale in Central America due to factors such as fungal pathogens (Lips, 1999) and increasing air temperatures following the warming of tropical oceans (Pounds *et al.*, 1999), then obtaining base-line distributional and ecological data on Yucatecan herpetofaunal species becomes a priority.

Surveying was carried out with diurnal and nocturnal visual encounter surveys, and with a 30 metre 'L'-shaped drift fence with pitfall and funnel traps (O'Shea, 1992). The drift fence proved to be surprisingly effective, catching even relatively large herpetofaunal species such as *Kinosternon acutum* and *Corytophanes hernandezii*. Only one specimen (belonging to *Rhinophrynus dorsalis*) was found in a funnel trap.

A total of 35 species of amphibians and reptiles were discovered in MBNP. These consisted of 202 individuals, belonging to 7 amphibian and 11 reptile families. Further discussion with local people increased the number of herpetofaunal species known to inhabit MBNP to 39. Specimens collected for verification are now held by the University Museum, Oxford; these are denoted by the letters 'OUM' followed by a specific catalogue number. All specimens represent adult individuals except for OUM 21620, 21624 and 21630 (newly metamorphosed individuals) and OUM 21638 and 21639 (tadpoles).

## SPECIES ACCOUNTS

### CLASS AMPHIBIA

#### Order Caudata

##### Family Plethodontidae

1. *Bolitoglossa mexicana* Duméril, Bibron and Duméril OUM 21612

Remarks: Three individuals only, all caught on the same night within half an hour of each other on vegetation above bajo. Possibly congregating to breed, or emerging from more typical cryptic habitats following unusually hot weather.

#### Order Anura

##### Family Rhinophrynidae

2. *Rhinophrynus dorsalis* Duméril and Bibron OUM 21637

Remarks: Caught only after heavy rain. No vocalising males heard during survey;

individuals therefore remain active at night throughout the wetter months, after breeding stops.

Family Leptodactylidae

3. *Leptodactylus labialis* (Cope)

OUM 21624, 21630

Remarks: 32 newly metamorphosed juveniles were found between late August and early September; because tadpoles of this species usually metamorphose in less than two weeks (Meyer and Farneti Foster, 1996), adults probably breed in early August in this region of Belize.

Family Bufonidae

4. *Bufo marinus* (Linnaeus)

5. *Bufo valliceps* Wiegmann

OUM 21620, 21621, 21639

Remarks: The most abundant herpetofaunal species encountered in MBNP. The majority of individuals were newly metamorphosed adults, found from mid-August onwards; tadpoles belonging to this species were also observed in bajo pools. Individuals varied in colour from orange to dark olive, but despite this it is unlikely that any represented the poorly known *B. campbelli* Mendelson, which is believed only to inhabit moderate to high elevation primary rainforest.

Family Hylidae

6. *Agalychnis callidryas* (Cope)

7. *Hyla picta* (Günther)

8. *Scinax staufferi* (Cope)

OUM 21638

9. *Smilisca baudinii* (Duméril and Bibron)

Remarks: The most abundant treefrog encountered in MBNP. Duellman (1966) maintained that this species does not breed in ponds surrounded by dense vegetation, instead requiring open, shallow pools; however, the bajo habitat where all specimens were captured, and presumably also bred, was surrounded by relatively dense thicket. Following capture, individuals changed colour from green to brown, whilst retaining the same background mottled pattern.

Family Microhylidae

10. *Gastrophryne elegans* (Boulenger)

OUM 21631

Remarks: 20 individuals were captured in MBNP in August and early September, mainly overnight in the drift fence, making *G. elegans* the fourth most commonly encountered herpetofaunal species encountered in the Park. The abundance of this species was surprising, as *G. elegans* has only been recorded four times previously from Belize; it was described as 'enigmatic' and not commonly encountered anywhere in Central America by Meyer and Farneti Foster (1996), and 'uncommon' by Lee (1996). Capture was probably aided by greasing the inner rims of the drift fence pitfall buckets with petroleum jelly, as individuals demonstrated an ability to climb out of ungreased buckets.

Breeding has never been reported for this species, but the majority of individuals (13) were caught in MBNP in early August, suggesting that they may have been congregating to breed during this period. Two females caught in late August and early September were both much larger than previously examined individuals, and may have been gravid. One of these females was discovered by day under leaf litter beside a small ant nest on the forest floor relatively far from any water body, supporting Nelson's (1972) suggestion that the species is myrmecophagous and cryptozoic. Individuals ranged in dorsal ground colour from dark grey to pale brown, and varied in snout-vent length from 22 to 27 mm.

It is possible that *G. elegans* has been overlooked in other herpetofaunal surveys in Belize, as it is a small, well-camouflaged anuran, but it is more likely that the species has a patchy distribution in northern Central America, with more specific habitat preferences than 'humid lowland forests' (Henderson and Hoevers, 1975) or 'humid evergreen tropical forests' (Nelson, 1972), and may only be found in secondary regrowth forest.

The possibility that this species is locally abundant is supported by its locality records elsewhere in Belize; of the four sites at which it has been previously detected in the country, one is in Belize District, 30.5 miles WSW of Belize City, very close to MBNP.

Family Ranidae

11. *Rana vaillanti* Brocchi

## Class Reptilia

Order Crocodylia

Family Crocodylidae

12. *Crocodylus moreletii* Duméril and Bibron

Remarks: Not observed in MBNP, but known to inhabit the Sibun and MBWS (see Appendix One); its presence in the northern part of MBNP adjacent to the Sibun can thus reasonably be inferred.

Order Testudines

Family Dermatemydidae

13. *Dermatemys mawii* Gray

Remarks: As for *Crocodylus moreletii*.

Family Kinosternidae

14. *Kinosternon leucostomum* Duméril and Bibron

15. *Kinosternon acutum* (Gray)

Remarks: One of the two recorded individuals was caught in a drift fence bucket.

16. *Kinosternon scorpioides* (Linnaeus)

Family Emydidae

17. *Trachemys scripta* (Schöepf)

Remarks: As for *Crocodylus moreletii*.

Order Squamata

Family Gekkonidae

18. *Sphaerodactylus glaucus* Cope OUM 21618

19. *Sphaerodactylus millepunctatus* Hallowell

OUM 21627, 21628, 21629

20. *Thecadactylus rapicauda* Houttuyn

OUM 21613

Remarks: Only detected within caves in karst towers. At the edge of its recorded range in MBNP, but presumably found in caves throughout the Sibun Karst Land Formation. Individuals were aggressive when caught, emitting harsh barking calls and trying to bite.

Family Corytophanidae

21. *Basiliscus vittatus* Wiegmann

Remarks: Observed in vegetation near to the Sibun.

22. *Corytophanes cristatus* (Merrem)

23. *Corytophanes hernandezii* (Wiegmann)

OUM 21611

Remarks: *Corytophanes* species are only rarely observed in Central America and Mexico; they appear to have very low population densities, and cryptic morphology and behaviour makes them appear much rarer still (Andrews, 1979; Bock, 1987). Two individuals of *C. cristatus* and three of *C. hernandezii* were found in MBNP on vegetation above water, in a similar position to that described by Ream (1964); one of the *C. cristatus* individuals was sleeping on a branch over a bajo pool at night.

Family Iguanidae

24. *Ctenosaura similis* (Gray)

Remarks: Not observed in MBNP, but found in similar secondary regrowth forest continuous with the Park's eastern boundary; its presence in MBNP can thus reasonably be inferred.

25. *Iguana iguana* (Linnaeus)

Remarks: Observed in vegetation near to the Sibun.

Family Polychrotidae

26. *Anolis biporcatus* (Wiegmann)

Remarks: Rare compared to other species of *Anolis* in MBNP; only one individual observed.

27. *Anolis lemurinus* (Cope)

OUM 21615, 21616, 21622, 21623, 21636

Remarks: Although colouration and dorsal patterning of individuals in MBNP was quite variable (as recorded elsewhere for the species; eg. see Lee, 1996), many displayed the 'diamondback' pattern described by Stafford (1994, illustr. p.24) for individuals in the Upper Raspaculo river basin. A similar pattern is apparently restricted to females in Costa Rica (Taylor, 1956); insufficient study was conducted to determine whether this was also true for individuals in MBNP.

28. *Anolis rodriguezii* Bocourt

OUM 21617, 21635

29. *Anolis uniformis* Cope

OUM 21614, 21625, 21626, 21632, 21633, 21634

Remarks: 22 individuals were caught, making this the most abundant reptile found in MBNP, and the third most abundant herpetofaunal species. Stuart (1948) considered it one of the most reliable indicators of virgin tall forest in Alta Verapaz, Guatemala, and elsewhere in Belize it is also typical of primary forest (eg. Stafford, 1991, 1994; classified as *Anolis* or *Norops humilis* in these references). Lee (1996) described the species as generally terrestrial, and only occasionally found low on vegetation. Neither ecological observation is borne out by its presence in the secondary regrowth forest of MBNP, where it is on the edge of its recorded range; it was found mainly on low vegetation or fallen logs and rarely on the forest floor or on rocks at the base of limestone karst towers. However, Duellman (1966) regarded *A. uniformis* as a sciophilic species found in a range of different forest habitats.

Family Scincidae

30. *Sphenomorphus cherriei* (Cope)

OUM 21619

Family Teiidae

31. *Ameiva undulata* (Wiegmann)

Family Xantusiidae

32. *Lepidophyma flavimaculatum* A. Duméril

Remarks: One individual found under rotting wood during the day.

Family Colubridae

33. *Leptophis ahaetulla* (Linnaeus)

34. *Masticophis mentovarius* (Duméril, Bibron and Duméril)

Remarks: Described by Duellman (1966) as heliophilous and never entering forest.

35. *Ninia sebae* (Duméril, Bibron and Duméril)

Remarks: One individual found under leaf litter, and two more within rotting wood, a microhabitat in which Greene (1975) reported that the species was relatively infrequently found in Veracruz, Mexico. All of the individuals had a predominantly red dorsum with few small, dark bands, similar to those from populations from the north of the Yucatán Peninsula. When caught, one individual adopted the defensive display described by Greene (1975); it also bit its handler, a behaviour which both Greene (1975) and Lee (1996) have maintained is not generally adopted by this species.

36. *Oxybelis aeneus* (Wagler)

37. *Sibon sanniola* (Cope)

Family Elapidae

38. *Micrurus diastema* (Duméril, Bibron and Duméril)

OUM 21610

Remarks: Two individuals of this species were discovered in MBNP. One of these, a male found under a rotting log and preserved as a museum specimen, had a total length of 876 mm (tail 124 mm), making it the largest specimen apparently ever recorded for the subspecies *M. d. sapperi* Roze; the second largest specimen of *M. d. sapperi*, a female cited by Roze (1996), has a total length of 810 mm (tail 91 mm). This observation is of interest in that males of the closely related and sympatric species, *M. hippocrepis*, appear to be smaller than females (Campbell and Lamar, 1989; Lee, 1996; Roze, 1996).

Both individuals encountered in MBNP were docile in temperament and could be manipulated into collecting containers with relative ease; this contrasts with descriptions of temperament for other *Micrurus* species (eg. *M. fulvius*, described in Neill, 1957).

Family Viperidae

39. *Bothrops asper* (Garman)

## DISCUSSION

This preliminary investigation indicates that the herpetofaunal diversity of MBNP is of a similar level to that documented in rapid ecological assessments or more specific surveys conducted in other forested areas in Belize, such as the Bladen Nature Reserve (Iremonger and Sayre, 1994), the Columbia River Forest Reserve (Parker et al., 1993) and the Upper Raspaculo river basin (Stafford, 1991, 1994) over similar lengths of time. Many of the species found in MBNP, notably *Scinax staufferi*, *Smilisca baudinii*, *Ameiva undulata* and *Anolis rodriguezii*, are typical inhabitants of secondary forest (Lee, 1996), although *Anolis uniformis* is characteristic of primary forests elsewhere in its range. Some of the herpetofaunal species found in MBNP, such as the two species of *Corytophanes* and in particular *Gastrophryne elegans*, are quite uncommon in the Yucatán Peninsula, and other species such as *A. biporcatus*, *A. uniformis* and *Thecadactylus rapicauda* are close to the edges of their recorded ranges in the area.

Although the survey's objective was to provide an account of herpetofaunal diversity in MBNP, observations were also made concerning the autecology of several species. In particular, many supposedly strictly nocturnal species, such as the two *Bufo* species and *Leptodactylus labialis*, were found also to be active diurnally. Further quantitative research is required to analyse potential habitat partitioning between the sympatric pairs of *Sphaerodactylus* and *Corytophanes* species detected in MBNP; initial observations suggest that *S. glaucus* may occur among rocks at the base of karst towers, whereas *S. millepunctatus* was only detected in leaf litter on the forest floor. Possible future herpetofaunal research in MBNP should also involve an investigation into ecological relationships between the different *Anolis* species present in MBNP; Stafford (1994) reported that between 1991 and 1993 a sudden appearance of the previously unrecorded *A. lemurinus* apparently displaced the smaller *A. uniformis* from a semi-arboreal niche in the Upper Raspaculo, but both species were recorded in large numbers in MBNP, with *A. uniformis* only rarely observed on the ground. Although protection in MBNP may improve the survival chances of the uncommon herpetofaunal species recorded above, further work also needs to be conducted on the metapopulation requirements of these taxa, to determine the additional amount of similar habitat outside the Park boundaries required to sustain viable populations in the area. Such research is particularly important for *Gastrophryne elegans*, a species abundant in MBNP during the time of the survey but apparently very uncommon everywhere else in its range, and with virtually unknown specific ecological requirements.

Further herpetofaunal investigations would also inevitably detect additional amphibian and reptile species present in MBNP. Not only might rare or cryptic taxa have gone undetected, but both treefrog and snake species were encountered surprisingly infrequently during the survey, possibly due to the relatively low levels of precipitation during the survey period, which have been demonstrated to decrease activity in both groups elsewhere in Belize (Henderson and Hoevers, 1977). A more detailed analysis into the actual number of herpetofaunal species present in MBNP, and the possible identity of undetected taxa, can be found in Turvey *et al.* (1999).

## ACKNOWLEDGEMENTS

Fieldwork was conducted in Belize by C. Gadd, L. Michalowicz and K. Thompson in addition to the authors. Various funding bodies and institutions made this research possible, notably Oxford University and the Royal Geographical Society. The help of M. Miller, M. Wahls, J. Marlin, S. Platt and R. Manzanero in Belize is gratefully acknowledged, and particular thanks go to P. Stafford (The Natural History Museum, London) for advice at various stages of the research and writing of this paper.

## APPENDIX ONE

A herpetofaunal survey was conducted in MBWS in 1994-5 by J. Marlin (BFREE, PO Box 129, Punta Gorda). The following species were recorded. Asterisks indicate that the species is also present in MBNP.

*Rhinophrynus dorsalis* \*  
*Eleutherodactylus laticeps*  
*Leptodactylus melanonotus*  
*Bufo marinus* \*  
*Bufo valliceps* \*  
*Agalychnis callidryas* \*  
*Hyla ebraccata*  
*Hyla loquax*  
*Hyla microcephala*  
*Hyla picta* \*  
*Phrynohyas venulosa*  
*Scinax staufferi* \*  
*Smilisca baudinii* \*  
*Crocodylus moreletii* \*  
*Dermatemys mawii* \*  
*Kinosternon scorpioides* \*  
*Kinosternon leucostomum* \*  
*Rhinoclemmys areolata*  
*Trachemys scripta* \*  
*Sphaerodactylus glaucus* \*  
*Thecadactylus rapicauda* \*  
*Basiliscus vittatus* \*  
*Corytophanes cristatus* \*  
*Ctenosaura similis* \*  
*Iguana iguana* \*  
*Sceloporus variabilis*  
*Anolis spp. (many)* \*  
*Eumeces schwartzei*  
*Ameiva undulata* \*  
*Boa constrictor*  
*Coniophanes imperialis*  
*Drymarchon corais*  
*Drymobius margaritiferus*  
*Imantodes cenchoa*  
*Leptodeira frenata*  
*Leptodeira septentrionalis*  
*Leptophis ahaetulla* \*  
*Leptophis mexicana*

*Masticophis mentovarius* \*  
*Ninia sebae* \*  
*Oxybelis aeneus* \*  
*Oxybelis fulgidus*  
*Sibon nebulata*  
*Spilotes pullatus*  
*Thamnophis marcianus*  
*Thamnophis proximus*  
*Tretanorhinus nigroluteus*  
*Xenodon rabdocephalus*  
*Micrurus diastema* \*  
*Bothrops asper* \*  
*Crotalus durissus*

A further species, *Oxyrhopus petola*, was discovered in MBWS by members of our survey team after leaving MBNP on 5th September 1997.

## REFERENCES

- Andrews, R.M. (1979). The lizard *Corytophanes cristatus*: an extreme "sit-and-wait" predator. *Biotropica*, 11(2): 136-139.
- Bock, B.C. (1987). *Corytophanes cristatus*. Nesting. *Herpetological Review*, 18(2): 35.
- Brosnahan, T. (1994). *Guatemala, Belize and Yucatán - La Ruta Maya*. 2nd edition. Lonely Planet.
- Campbell, J.A. and Lamar, W.W. (1989). *The Venomous Reptiles of Latin America*. Cornell University Press, Ithaca, New York.
- Campbell, J.A. and Vannini, J.P. (1989). Distribution of amphibians and reptiles in Guatemala and Belize. *Proceedings of the Western Foundation of Vertebrate Zoology*, 4(1): 1-21.
- Duellman, W.E. (1966). The Central American herpetofauna: an ecological perspective. *Copeia*, 1973: 700-719.
- Garel, T. and Matola, S. (1996). *A Field Guide to the Snakes of Belize*. The Belize Zoo and Tropical Education Center, Belize.
- Greene, H.W. (1975). Ecological observations on the red coffee snake, *Ninia sebae*, in southern Veracruz, Mexico. *American Midland Naturalist*, 93: 478-484.
- Hartshorn, G.S., Nicolait, L., Hartshorn, L., Belvier, G., Brightman, R., Cal, J., Cawich, A., Davidson, W., Dubois, R., Dyer, C., Gibson, J., Hawley, W., Leonard, J., Nicolait, R., Weyer, D., White, H. and White, C. (1984). *Belize: Country Environmental Profile: A Field Study*. Robert Nicolait & Associates Limited, Belize City, Belize.
- Henderson, R.W. and Hoevers, L.G. (1975). A checklist and key to the amphibians and reptiles of Belize, Central America. *Milwaukee Public Museum Contributions in Biology and Geology*, 5: 1-63.
- Henderson, R.W. and Hoevers, L.G. (1977). The seasonal incidence of snakes at a locality in northern Belize. *Copeia*, 2: 349-355.
- Hoevers, L.G. and Henderson, R.W. (1974). Additions to the herpetofauna of Belize (British Honduras). *Milwaukee Public Museum Contributions in Biology and Geology*, 2: 1-6.
- Holdridge, L.R. (1967). *Life Zone Ecology*. Revised edition. Tropical Education Center, San Jose, Costa Rica.
- Iremonger, S. and Sayre, R. (1994). *A Rapid Ecological Assessment of the Bladen Nature Reserve, Belize*. The Nature Conservancy, Virginia, USA.

- Kather, M. (1992). *A Land Stewardship Plan for Monkey Bay Wildlife Sanctuary and Monkey Bay Nature Reserve*. State University for New York College of Environmental Science and Forestry. Unpublished.
- Lee, J.C. (1996). *The Amphibians and Reptiles of the Yucatan Peninsula*. Comstock Publishing Associates, Cornell University Press, Ithaca and London.
- Lips, K.R. (1999). Fungal pathogen involved in decline of anuran populations in Panama and Costa Rica. *Conservation Biology*, 13(1): 117-125.
- Meyer, J.R. and Farneti Foster, C. (1996). *A Guide to the Frogs and Toads of Belize*. Krieger Publishing Company, Malabar, Florida.
- Neill, W.T. (1957). Some misconceptions regarding the Eastern Coral Snake, *Micrurus fulvius*. *Herpetologica*, 13: 111-118.
- Nelson, C.E. (1972). Systematic studies of the North American microhylid genus *Gastrophryne*. *Journal of Herpetology*, 6(2): 111-137.
- O'Shea, M. (1992). *Expedition Field Techniques. Reptiles and Amphibians*. Expedition Advisory Centre, Royal Geographical Society, London.
- Parker, T.A., III, Holst, B., Emmons, L. and Meyer, J. (1993). *A Biological Assessment of the Columbia River Forest Reserve*. RAP Working Papers No. 3. Conservation International, Washington DC, USA.
- Pounds, J.A., Fogden, M.P.L. and Campbell, J.H. (1999). Biological responses to climate change on a tropical mountain. *Nature*, 398: 611-615.
- Ream, C.H. (1965). Notes on the behavior and egg laying of *Corytophanes cristatus*. *Herpetologica*, 20(4): 239-242.
- Roze, J.A. (1996). *Coral Snakes of the Americas; Biology, Identification and Venoms*. Krieger Publishing Company, Malabar, Florida.
- Stafford, P.J. (1991). Amphibians and reptiles of the Joint Services Scientific Expedition to the Upper Raspaculo, Belize, 1991. *British Herpetological Society Bulletin*, 38: 10-17.
- Stafford, P.J. (1994). Amphibians and reptiles of the Upper Raspaculo river basin, Maya Mountains, Belize. *British Herpetological Society Bulletin*, 47: 23-29.
- Stafford, P.J. and Meyer, J.R. (1999). *A Guide to the Reptiles of Belize*. Academic Press, San Diego, USA.
- Stuart, L.C. (1948). The amphibians and reptiles of Alta Verapaz Guatemala. *Miscellaneous Publications of the Museum of Zoology, University of Michigan*, 69.
- Taylor, E.H. (1956). A review of the lizards of Costa Rica. *University of Kansas Science Bulletin*, 38(1): 3-322.
- Turvey, S., Cooper, A., Gadd, C. and Michalowicz, L. (1999). *Oxford University Expedition to Monkey Bay National Park, Belize. Herpetological Survey, July to September 1997*. Unpublished.
- Wake, D.B. (1991). Declining amphibian populations. *Science*, 76: 61-84.



## **PRELIMINARY OBSERVATIONS ADDRESSING HERPETOFAUNAL DIVERSITY IN SOUTHERN ROMANIA (AUGUST 1997)**

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### **INTRODUCTION**

Among publications on the herpetofauna of Romania, early papers by Fuhn (1960), Fuhn and Vancea (1961) and Fuhn (1969) describe the amphibians and reptiles. Most records of Romanian species in Gasc et al (1997) were made before 1970. The number of amphibian records for the country have been increased from approximately 500 in Fuhn (1960) to 2800 as a result of recent work by Arntzen, Bugter, Cogalniceanu & Wallis (1997), Cogalniceanu (1991, 1997a, 1997b, 1997c), Cogalniceanu & Andrei (1992), Cogalniceanu & Tesio (1993) and Cogalniceanu & Venczel (1993). It is useful to document further records in order to provide an up-date on current species' distribution, and as a basis for stimulating further ecological studies now that Romania is fully open to outside visitors. Moreover, two species of land tortoise are known to be present in Romania near the northern ends of their Balkan distribution, but there is little known on their status, whether populations are potentially threatened by habitat changes due to agricultural and other development that may resulting from the country's political changes.

Following the 3rd World Congress of Herpetology in Prague, Czech Republic (2-10 August 1997), there was an opportunity to meet-up at Brasov in Transylvania (central Romania), and to travel by road from 17 to 21 August through the southern part of Romania, recording amphibians and reptiles in a range of habitats and at different localities.

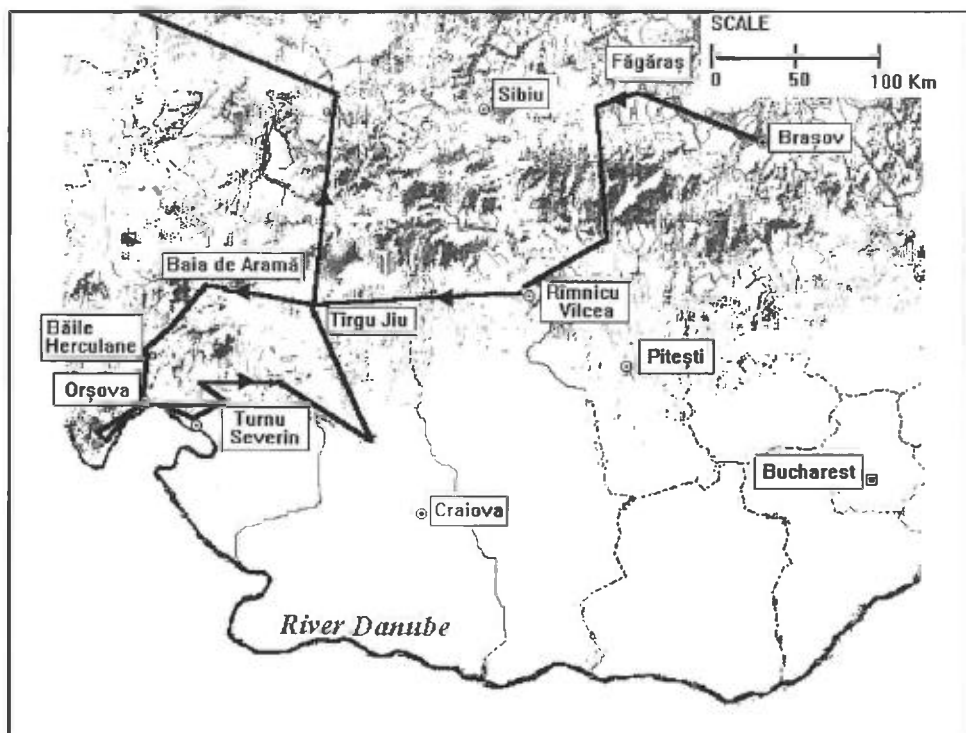
#### **Itinerary**

Names of places follow those used in the 1994 Romania Atlas Rutier scara 1:350,000, and the route taken was computer-traced onto the accompanying sketch map of the region.

*15 August:* From Hungary, enter Romania near Bors, proceed over the western Carpathians and arrive 19 km W. of Cluj-Japoca.

*16 August:* Continue through Cluj-Napoca, Targu Mures and Sighisoara, and arrive at Poiana Brasov, near Bran [the castle fabled to be that of Count Vlad Tepes – Vlad the Impaler – inspirer of Bram Stoker's Dracula tale].

*17 August:* Rendezvous at Brasov; proceed west through Fagaras, and then due south at Arpasu de Jos, over a pass of the southern Carpathian range (highest point 1690 m), across the dam at Lake Vidraru, past Poinari Castle [on a lofty peak – truly the home of Vlad Tepes] and arrive at Corbeni.



Sketch map of southern Romania, showing route taken during survey, 17-22 August 1997. Shading represents land over 1000 m.

**18 August:** Contine from Corbeni south to Curtea de Arges [visit monastery], west through Ramnicu Valcea, Baia de Fier [inspect Pestera Muierii – Women's Cave], Targu Jiu, Frinesti village, Baia de Arama, and, in the Cerna valley, arrive at a site 20 km N.E. of Baile Herculane.

**19 August:** Depart site and visit another 12 km N.E. of Baile Herculane, and then the spa town itself. Continue south to Orsova on the River Danube [wide at this point, with Serbia on the opposite bank], and then 8 and 11 km S.W. of Orsova (southeast-facing sites by Ieselnita village), and arrive at the dam, in the Mraconia valley, some 13 km S.W. of Orsova.

**20 August:** Depart dam site and visit another 2 km S.W., then Dobova (Ponicova River valley), and return, back through Ieselnita, to Orsova. Continue along the north bank of the Danube, pass the dam construction of Portile de Fieri, Gura Vaii (above the dam), and proceed to Drobeta-Turnu Severin [an old town of Roman origin], then towards Motru, and arrive at the village of Schitul Topolnita [with wood-constructed Monastery] at a stream tributary of the Topolnita River.

**21 August:** [Beating of a simple wooden-drum instrument at ever increasing speed at sunrise was a call to monks to prayer at the Monastery; and, representing reveille, was also a cue to rise and break camp]. Depart village and visit a site near Izvoru Birzii. Continue to Filiasi [D.C. returns by train to Bucharest], and then to Targu Jiu, proceed over a low altitude pass through the southern Carpathians, stop at a site 3km N.W. of Bilteni, and arrive at the village of Ohaba-Ponor (between Petrosani and Hateg).

**22 August:** Depart village and proceed along the Mures valley in western Romania, and via Deva and Arad, cross the border at Badlac back to Hungary.

## Herpetofaunal richness and ecology

1. **19 km W. of Cluj-Napoca:** *Rana esculenta-ridibunda*, two adult males calling, in a pond.
2. **Baia de Fier (Pestera Muierii – Women's Cave):** *Rana esculenta-ridibunda* and *Bombina variegata*, observed in small rainpools of an adjacent muddy track.
3. **Frincesti:** *Rana esculenta-ridibunda*, *Bombina variegata* and *Hyla arborea*, in a floodpool and small stream of a roadside field.
4. **20 km N.E. of Baile Herculane, Cerna valley:** *Anguis fragilis* (adult male and juvenile) and *Natrix tessellata* (juvenile) found by edge of a field adjacent to the Cerna river.
5. **12 km N.E. of Baile Herculane, Cerna valley:** *Bufo bufo* (one) and *Lacerta agilis* (two), observed at a hillside site in the morning.
6. **By the village of Ieselnita (8 and 11 km S.W. of Orsova):** *Lacerta agilis*, *L. viridis* and *Vipera berus*, on southeast-sloping site above the Danube, and *Vipera ammodytes* as a road kill, while searching for, but not finding *Testudo hermanni boettgeri* in the late afternoon (15h50-16h30) (19.viii). *Coluber caspius* was recorded as a fresh road-kill on tarmac surface (20.viii).
7. **Mraconia dam:** *Testudo hermanni boettgeri*, a male (carapace-over-the-curve length (CCL) 210 mm and midline plastron length, between gular and anal notches (PL), 165 mm), observed basking in morning sunshine at the end of a bramble clump making up hillside scrub. A further male (CCL 155 mm and PL 125 mm) was found at (09h51; 19°C) during a 35 min search by two people (1.7 per man-h of searching), together with the first (10h04; 19°C), not far from its release point the previous evening. *Lacerta viridis* (many), and *Bufo bufo*, *Bombina variegata* and *Rana esculenta-ridibunda*, and snakes *Natrix natrix* and *N. tessellata* were also recorded. An adult *Emys orbicularis* was floating in still water near where the Mraconia River entered the dam.
8. **2 km S.W. of Mraconia dam:** No *Testudo hermanni boettgeri* found (0.5 man-h search; 12h01; 26°C) on valley hillsides, partly cultivated.
9. **Dobova, Poncova River valley:** No *Testudo hermanni boettgeri* (1.5 man-h search; 12h26; 26°C), although recorded there previously. *L. agilis* (two recorded), *L. viridis*, and newly metamorphosed *Rana esculenta-ridibunda* complex (many).
10. **By the village of Schitul Topolnita, Topolnita River:** *Bombina variegata*, *Rana esculenta-ridibunda*, *Bufo viridis*, and a juvenile *Natrix natrix* were recorded by a stream tributary, a total of four species.
11. **1 km northwest Izvoru Birzii village:** A total of 20 *Testudo hermanni boettgeri* were found after a 4.5 man-h search (4.4 per man-h) in diffuse sunshine (09h55; 22.5°C) at a site adjacent to quarry workings, with patchy scrub-covered hillside. *Lacerta viridis* (many) and *L. agilis* (several). [with a fair total of tortoises recorded and measured, time at this site was a splendid finale to any herpetofaunal survey in the south of Romania].
12. **3 km N.W. of Bilteni:** *Rana esculenta-ridibunda*, many newly metamorphosed and young immature, one of which was collected (BMNH 1996.442), observed in a rainpool of a muddy track (during return journey from Filiasi).

## SPECIES LIST

### AMPHIBIA

#### Anura

*Bombina variegata*. Localities 2, 3, 7, 10.

*Bufo bufo*. Localities 5, 7.

*Bufo viridis*. Locality 10.

*Rana esculenta-ridibunda*. Localities 1, 2, 3, 7, 9, 6, 10, 12.

*Hyla arborea*. Locality 3.

## REPTILIA

### Chelonia

*Testudo hermanni boettgeri*. Localities 7, 11.

*Emys orbicularis*. Locality 7.

### Sauria

*Lacerta agilis*. Localities 5, 6, 9, 11.

*Lacerta viridis*. Localities 6, 9, 11.

*Anguis fragilis*. Locality 4.

### Serpentes

*Coluber caspius*. Locality 6.

*Natrix natrix*. Localities 7, 10.

*Natrix tessellata*. Localities 4, 7.

*Vipera ammodytes*. Locality 6.

*Vipera berus*. Locality 6.

## CONCLUSIONS

A total of fifteen species was recorded (ten reptiles and five amphibians) during this short survey in southern Romania which exceeded the number of species in Britain. Observations were insufficiently systematic on this occasion to come to any specific conclusions concerning herpetofaunal diversity *per se*, nor was it possible to determine species composition (percentage frequency), or relative abundance at most sites. However, an indication of species richness at certain sites was obtained, and the relative abundance of tortoises *Testudo hermanni boettgeri* at the two sites where they were observed, notwithstanding differences in temperature and time of day, was 1.7 and 4.4 per search-hour. At sites with mixed habitat, a wide range of species was recorded, e.g.



Plate 1: *Testudo hermanni boettgeri*, adult female recorded in the Banat valley, 10 km W. of Drobeta-Turnu Severin, southern Romania. Carapace length ca. 20 cm. Observer: G. Praedicow. Photographer: Uwe Prahaph (Dresden, Germany).

Mraconia dam, with eight species: five reptiles and three amphibians. Only single individuals of *Bufo viridis*, *Hyla arborea*, *Emys orbicularis*, *Coluber caspius*, *Vipera ammodytes* and *V. berus* were observed. Except for *Testudo hermanni boettgeri* and *Coluber caspius* (both confined to the south), the majority of species are widespread in Romania (Gasc et al., 1997).

This short survey could be a prelude to a more systematic survey, which has the potential to provide valuable data on herpetofaunal diversity for conservation requirements by recording the number of individuals of different species during visual encounter surveys. This would enable species composition to be determined. For purposes of comparison in different areas, relative density as an expression of abundance may be established by additionally recording the time spent at sites to yield numbers per search-hour, taking into account time of day and air temperature. Further systematic surveys of this kind could provide additional information on variation of herpetofaunal diversity in different areas of Romania.

### ACKNOWLEDGEMENTS

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### REFERENCES

- Arntzen, J.W., Bugter, R.J.F., Cogalniceanu, D. & Wallis, G.P. (1997). The distribution and conservation status of the Danube crested newt, *Triturus dobrogicus*. *Amphibia-Reptilia* **18**(2), 133-142.
- Cogalniceanu, D. (1991). A preliminary report on the geographical distribution of amphibians in Romania. *Rev. Roum. Biol. - Biol. Anim., Bucuresti* **36**(1-2), 39-50.
- Cogalniceanu, D. & Andrei, M. (1992). A bibliographical checklist of herpetology in Romania. *Trav. Mus. Hist. nat. "Grigore Antipa"* **32**, 3321-346.
- Cogalniceanu, D. & Tesio, C. (1993). On the presence of *Rana lessonae* in Rumania. *Amphibia-Reptilia* **14**(1), 90-93.
- Cogalniceanu, D. & Venczel, M. (1993). Considerations regarding the present status of amphibians and reptiles in Romania. *Ocrot. nat. med. inconj.* **37**(2), 109-14 [In Romanian].
- Cogalniceanu, D. (1997a). Distribution and status of the yellow-bellied toad (*Bombina variegata*) in Romania. *Naturschutzreport, Jena* **11**, 225-230.
- Cogalniceanu, D. (1997b). *Triturus montandoni*. In *Atlas of amphibians and reptiles in Europe*, 84-85. Gasc, J.-P. et al. (Eds). Paris: Societas Europaea Herpetologica and Muséum National d'Histoire Naturelle (IEGB/SPN).
- Cogalniceanu, D. (1997c). A proposed model for amphibian conservation in Romania. In *Herpetologia Bonnensis*, 63-69. Böhme, W., Bischoff, W. & Ziegler, T. (Eds). Bonn: Societas Europaea Herpetologica. 416 pp.
- Fuhn, I.E. (1960). *Fauna Republicii Populare Romine; Vol. 14(1), Amphibia*. Bucharest: Editura Academiei Republicii Populare Romine. 288 pp.
- Fuhn, I.E. (1969). *Broaste, serpi, sopirle*. Bucharest: Editura stiintifica.
- Fuhn, I.E. & Vancea, S. (1961). *Fauna Republicii Populare Romine; Vol. 14(2). Reptilia. (Testoase, Sopirle, Serpi)*. Bucharest: Editura Academiei Republicii Populare Romine. 352pp.
- Gasc, J.-P., Cabela, A., Crnobrnja-Isailovic, J., Dolmen, D., Grossenbacher, K., Haffner, P., Lescure, J., Martens, H., Martinez Rica, J.P., Maurin, H., Oliveira, M.E., Sofianidou, T.S., Veith, M. & Zuiderwijk, A. (Eds) (1997). *Atlas of amphibians and reptiles in Europe*. Paris: Societas Europaea Herpetologica and Muséum National d'Histoire Naturelle (IEGB/SPN). 496 pp.

## **TOLERANCE OF LOW TEMPERATURES IN *PELOBATES FUSCUS* EGGS**

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### **ABSTRACT**

We experimentally investigated the fraction of hatching eggs as a function of low temperatures in a population of *Pelobates fuscus* situated on the northernmost part of its distribution range. Eggs were not sensitive to the range of temperatures chosen (2°C, 7°C and 9°C, respectively). We speculate that some years' low temperatures in the breeding pond are partly responsible for observed low reproductive output.

### **INTRODUCTION**

Recently a lot of attention has been paid to the decline of amphibians (see for example Balustein and Wake 1990, Wyman 1990, Wake 1991, Elmberg 1993, Blaustein *et al.* 1994). The main part of the declines are doubtlessly real and worrying phenomena, but as Pechman *et al.* (1991) and Blaustein *et al.* (1994) point out separating long term declines from short term fluctuations is crucial for predicting and managing the development of populations. Amphibian populations are known to fluctuate considerably in numbers between years (Jehle *et al.* 1995; Hecnar and M'Closkey 1996), particularly as a response to climatic variability (Duellman and Trueb 1994 and references therein). It would therefore be valuable to investigate each causal factor separately, to get a more fundamental understanding of what lies behind fluctuations and thereby better being able to distinguish between natural variations and general declines.

### **MATERIALS AND METHODS**

We analysed the hatching success of eggs of the Common Spadefoot Toad (*Pelobates fuscus* Laurenti) within a range of prevalent low water temperatures. The population studied is situated on the northern fringe of its distribution range at the Djursland peninsula, Denmark (56°26'N, 10°34'E), and low water temperatures may be a key factor for some years' observed low numbers of froglets.

Three egg bands aged one to two days were collected from a known *P. fuscus* breeding pond. A number of eggs from each of the three bands were incubated in aquaria for 10 days in the laboratory at 2°C, 7°C, and 9°C, respectively. After 10 days the fraction of hatching was evaluated.

The breeding pond was encircled by a drift fence with pit fall traps by the fence at 10m intervals (Dodd and Scott 1994). This way, six males and six females were captured and in pairs put into cages (1.5m x 0.75m plywood with a plastic net serving as a bottom).

The cages were placed at approximately 0.5m depth in the pond. After egg-laying, the egg bands were transferred to smaller cylindrical cages in the pond (0.40m long, diameter 0.08m covered with fine meshed net to allow for passage of water but not eggs or larvae). After hatching, the cages were taken back to the laboratory and the number of larvae as well as the fraction of hatching evaluated. The temperature was measured in the pond occasionally during the experiment (23/4-15/5) close to the cages 10 cm below water surface. Eight measurements were taken before 8 am, whereas fifteen were taken in the afternoon.

## RESULTS

The overall fraction of eggs hatched at 2°C, 7°C and 9°C was 0.77, 0.76 and 0.66 respectively (table 1). There was no general relationship between temperature and hatching success. The fraction of eggs hatched was, however, significantly different in the three egg bands ( $\chi^2=6.95$ ,  $df=2$ ,  $P<0.05$ ); number 3 having a larger fraction of hatching than the other two (0.62, 0.65 and 0.86 respectively, table 1).

Hatching success in the breeding pond was very high. Out of 9707 eggs in six egg bands, 9101 hatched (93.8%). This was significantly higher than hatching success in the laboratory taken as a whole ( $\chi^2=18.88$ ,  $df=1$ ,  $P<0.01$ ).

Mean values for morning and afternoon temperatures in the pond were 7.8°C and 8.3°C, respectively.

## DISCUSSION

There are no trends in the data indicating a temperature dependence of hatching success within the experimental temperature range. Mikulski (1938; in Nöllert 1990) states a survival range of temperatures from 2°C to 26°C for the Spadefoot Toad, which is in accordance with our results. Fog *et al.* (1997), however, states that temperatures below 6°C are critical for survival of embryos of *P. fuscus*.

In the aquaria we used water from the pond from which the eggs originated, in order to simulate development in the field as closely as possible. Contrary to our expectations the fraction of hatched eggs was significantly lower in the aquaria than in the pond. Probably, the eggs in the aquaria suffered from oxygen deficiency since the aquaria were not aerated. Another possible explanation might be that eggs taken to the laboratory were inbred and therefore less viable. This, however, is highly unlikely since the population in question is a fairly large one (approximately 450 adults in 1997), and a source population of the area (Hels, in prep.) showing no other apparent signs of inbreeding, such as a high prevalence of physical abnormalities or unusually low number of eggs in each egg band.

In 1996 when the experiment was conducted, very few metamorphosed froglets of *P. fuscus* left the pond, despite a large number of eggs laid (Hels, in prep.). This was also the case in 1995, where there were periods of low temperatures all through May (Hels, in prep.); whereas in 1994 with a warm spring, many froglets left the pond later that summer (Nielsen and Dige 1995). The number of metamorphs leaving the pond in 1996 was low, although the fraction of eggs hatched in the sample used from the pond in this study was high (93.8%). There was some evidence for density dependent factors (e.g. intraspecific competition among the larvae, cannibalism of the larvae by adults) regulating larval survival of the population in question (Hels, in prep.). Beside the density dependent factors mentioned, temperature acting on larval development could be an important responsible factor for year to year variation in reproductive output. Not only are low temperatures during larval development possibly responsible for a lower

fraction of animals metamorphosing, but also for a lower larval growth rate. This makes larvae susceptible to predation for a longer period of time, further reducing the reproductive output (Brodie and Formanowicz 1983, Formanowicz 1986). Temperatures are more often critically low for a species on the northern border of its distribution range than in the central part. Therefore, it is particularly important to consider high mortality rates due to low temperatures in fringe populations.

**Table 1:** The number of eggs of *Pelobates fuscus* incubated at different temperatures and the numbers hatched

Temperature	Egg band 1		Egg band 2		Egg band 3	
	Total	Hatched	Total	Hatched	Total	Hatched
2°C	59	34	55	35	97	93
7°C	76	48	93	88	96	65
9°C	86	55	65	16	104	97
<b>Total</b>	<b>221</b>	<b>137</b>	<b>213</b>	<b>139</b>	<b>297</b>	<b>255</b>

## REFERENCES

- Blaustein, A.R., Wake, D.B. (1990): Declining Amphibian Populations: A Global Phenomenon? *Trends in Ecology and Evolution* 5(7): 203-204.
- Blaustein, A.R., Wake, D.B., Sousa, W.P. (1994): Amphibian Declines: Judging Stability, Persistence, and Susceptibility of Populations to Local and Global Extinctions. *Conservation Biology* 8(1): 60-71.
- Brodie, E.D., Formanowicz, D.R., (1983): Prey size preference of predators: Differential vulnerability of larval anurans. *Herpetologica* 39(1): 67-75.
- Dodd, C.K. and Scott, D.E. (1994): Drift Fences Encircling Breeding Sites. Pp. 125-130 in Heyer, W.R.; Donnelly, M.A.; McDiarmid, R.W.; Hayek, L-A.C.; Foster, M.S. (eds.) 1994: *Measuring and Monitoring Biological Diversity. Standard Methods for Amphibians*. Smithsonian Institution Press, Washington and London. 364 pp.
- Duellman, W.E., Trueb, L. (1994): *Biology of Amphibians*. Johns Hopkins. 670 pp.
- Elmberg, J. (1993): Threats to Boreal Frogs. *Ambio* 22(4): 254-255.
- Fog, K., Schmedes, A., Rosenørn de Lasson, D. (1997): *Nordens padder og krybdyr (Amphibians and reptiles of the Nordic countries)*. GAD. 365 pp. In Danish.
- Formanowicz, D.R. (1986). Anuran tadpole/quatic insect predator-prey interactions: tadpole size and predator capture success. *Herpetologica* 42(3): 367-373.
- Hecnar, S.J., M'Closkey, R.T. (1996): Regional dynamics and the status of amphibians. *Ecology* 77(7): 2091-2097.
- Jehle, R., Hödl, W., Thonke, A. (1995): Structure and dynamics of central European amphibian populations: A comparison between *Triturus dobrogicus* (Amphibia, Urodela) and *Pelobates fuscus* (Amphibia, Anura). *Australian Journal of Ecology* 20: 362-366.
- Nielsen, S.M., Dige, T. (1995): *Padder på Djursland. (Amphibians on the peninsula of Djursland)*. 160pp. Master's thesis, Univ. of Århus, Denmark. In Danish.
- Nöllert, A. (1990): *Die Knoblauchkröte. (The Spadefoot Toad)*, 2.ed., Die Neue Brehm-Bücherei. 144 pp. In German
- Pechman, J.H.K., Scott, D.E., Semlitsch, R.D., Caldwell, J.P., Vitt, L.J., Gibbons, J.W. (1991): Declining Amphibian Populations: The Problem of Separating Human Impacts from Natural Fluctuations. *Science* 253: 892-895.
- Wake, D.B. (1991): Declining amphibian populations – a global phenomenon? Findings and recommendations. *Alytes* 9(2): 33-42.
- Wyman, R.L. (1990): What's Happening to the Amphibians? *Conservation Biology* 4(4): 350-352.



# PROVISIONAL RESULTS FROM STUDY OF FACIAL FEATURES AS A MEANS OF INDIVIDUAL IDENTIFICATION IN *NATRIX NATRIX*. (Abridged Version)

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## INTRODUCTION

The difficulties involved in 'tagging' or identifying individual snakes are well documented and any field study undertaken where migration or interaction between males, females, adults and juveniles is of particular interest, has in the past, required wholesale capture and recapture of the study group in order to maintain an accurate record of movements. This is primarily because the similarity between both sexes (although *Vipera berus* has some difference in colour/shade) and individuals has necessitated the use of methods, such as the removal and part removal of alternate scales along the snakes body, so as to determine each snake from the next, with identification only being possible by close inspection.

The major drawback to building a log of movements from this form of I.D. is that the movements themselves are, at best, interrupted, or at worst, completely altered, by the very process of identifying each snake as it is found. This may defeat the object, with the snakes being forced into unnatural behaviour, ie: moving away from their residence within a particular study area.

In the United Kingdom, we are perhaps fortunate that at least one of our own native species of snake may be able to offer an alternative to the problems mentioned above, for not only are the chequered markings on its ventral scales completely individualistic, but, it appears also to possess characteristics in its facial markings. *Natrix natrix*, the good old Grass Snake, may, at first glance, seem indistinguishable from its neighbour, but, careful examination reveals an almost limitless number of determining factors, both obvious and subtle. Everything and anything from size and shape of collar, both yellow and black; thicknesses and inclination of slashes around the eye and across the mouth, to the block patterns on the neck, all assist in the build up of a character profile, which is both of a permanent nature and as reliable as any other system of marking/I.D. Similar means of identification is now accepted as standard practice when considering groups of mammals such as the Killer Whale (*Orcinus orca*), but to my knowledge has never been attempted on a species of reptile. Indeed, there are instances where the ground colour alone is sufficient to identify an individual but these instances are few and far between. The beauty of using a photographic profile as a means of telling 'A' from 'B', is that field study can be carried out at distance, by using photographic equipment such as Macro and Telephoto lenses. It is then possible to transfer the profiles, by utilising the colour photocopying facilities that are available at many high street shops, enabling most enthusiasts to participate in and further advance this facet of Herpetology. It eliminates the need to unduly interrupt the snakes' chosen movements with unnecessary capture and possible injury to snake (especially when gravid, see plate 2) and herpetologist alike.

Anybody that has tried to corner *Natrix natrix* when in a pond will no doubt appreciate the difficulties involved in a repeated capture technique, especially when the pond is up to twenty feet deep, and it is here that the photographic option is preferable by being more practical. The study itself is only limited by the presence and height of herbage, especially in late Summer, and from experience, any similar studies should concentrate the strengths of the photographic option in the early Spring to early Summer before new growth has become established.

## PHOTOGRAPHIC STUDY

The opportunity came to test the limitations of the photographic technique when, in 1994, a random search of several areas was carried out by the author, and revealed that a sizeable group of Grass Snakes was apparent in a location that could fairly easily be monitored for activities, such as mating. Readers may recall that 1994 had especially hot weather in March and April, but an exceptionally cold June, so that numbers of female Grass snakes died, apparently egg bound. It was during the search above that 3 mature females were found lifeless, but in a gravid condition, and an on site post mortem examination of one of the corpses revealed what appeared to be a ruptured spleen. Advice was sought from local snake keepers regarding this observation and the general consensus of opinion was that freak weather had been to blame. It was then decided that an attempt at a log record of the local population would require more than a simple number count, in order to monitor the group, and 'mug shots' seemed the ideal solution. Since that date it has been noted that the group appears to remain at around 20 in number, although, the reasons for this will be discussed later in the conclusions. It has also been noted that when considering this study group, although the faces of each individual have been found to be all but symmetrical, (see plates 3, 4 and 5), in rare instances the block patterns of the neck may differ slightly and would require both left and right profile 'mug shots' to be completely sure of identification.

Obviously, when *Natrix natrix* moves into water, the section of body most prominent and which is therefore clearly visible, is its head and neck; and this fact has greatly assisted this study, as the study area included a lake frequented by the group. It was, and is, relatively easy to record movement and interaction, from the moment that the group emerges from hibernation through to the early Summer migration to the lake, but throughout July becomes progressively more difficult with increasing obstructions to the line of sight. Since this study has started (in varying degrees of intensity since 1994), several interesting aspects, both physiological and behavioural, have been noted. The first and possibly most important, not least because of its implications in terms of predicting climatic change, is that mating can and does take place at lower temperatures than was previously considered. A mating pair were photographically recorded on the 18th of March 1998, when the temperature did not rise above 13°C. Previous estimates indicated that the male would only be 'triggered' into sexual activity at 18-21°C. Having established and recorded this lower trigger to sexual activity, the capture of a juvenile on May 28th 1996, which had just sloughed measuring 205mm and which was previously thought to be the result of an 'over wintered egg', may have been the result of an extremely late Autumn mating and egg laying in very early Spring. This would also provide a satisfactory explanation for the observations in plate 1, where a gravid female appeared awaiting ovulation on 5th June 1998, and yet displayed mating behaviour (a pronounced physical jerking and entwining of tails) just seven days later on the 12th June 1998. This is important in that it could point to the Grass Snakes being capable of "Double Clutches" in any one year, provided that conditions were suitable. It is doubtful that such observations and recordings could have been made using repeated capture techniques.

From the examples within the group of some sixteen positively identified individuals (and maybe four or so not yet photographed in sufficient detail to determine) in behavioural terms, it appeared far more common for the female to hiss as a form of defence, especially in the more mature individuals, which tend to protest in this manner long after capture. Both male and female discharged the usual foul smelling secretion that one expects in roughly equal quantities. Preliminary sexing was assumed visually, (which appears quite reliable in the field) as the mature female (it is more difficult with juveniles/sub adults) has a noticeably more triangular head as opposed to the rather more slender and elongated head of the male. Obviously, once a pair is identified in the mating process, both individuals are recorded photographically so that further sexing is unnecessary. Probing was not used as it was deemed to be unwise when mating would be imminent and the author wished to avoid inhibiting reproduction. Capture and recording of individuals was always most successful on generally overcast days, which were obviously too cool for the snakes to actively seek prey, but where intermittent sunshine provided the incentive for the snakes to bask continually. Occasionally when in the process of shedding, the Grass Snakes were found coiled in light drizzle and were disinclined to move, even when physically disturbed. The crucial factor appeared to be strength of wind. On any occasion where similar climatic conditions applied, but where the breeze had begun to move the surrounding grass and vegetation, all the snakes returned to their covered quarters. Quite often these quarters included large logs where splits and holes allowed access into the rotting timber behind the bark; within the roots systems of live trees as well as deep within the banks of mature Heather and Bramble. In Summer, these hideaways are often replaced by the simple bank overhangs around the lake, or beneath piles of old leaves.

## LOCALITY INFORMATION ON STUDY AREA

The area of study chosen for the provisional examination of the photographic technique was an area of approximately six acres within Epping Forest, Essex, which stands as a scrubby clearing at the north, with an open aspect of grass, Heather (*Calluna vulgaris*), Bracken (*Pteridium aquilinum*), young Birch (*Betula pendula*) and occasional mature Oak (*Quercus robur*), which then enters heavier woodland as progress is made south, until reaching the valley's lake. The lake itself is "connected" to the scrubby clearer plain by two ditches, conveniently situated at each side of the plain and which each provide a "migration passageway" down to the lake, as they promote the growth of Bramble (*Rubus fruticosus*) and thick vegetation that, in turn, provides the essential cover to enable the snakes to overcome the clear floor of the heavy forest in-between. This is especially significant because at one stage along the route a car park is situated just a few metres distant which is visited regularly by members of the public. The lake is open to angling; however, the northern end has restrictions and has a healthy fringe of Reeds (*Phragmites communis*) with a boggy marsh like appearance and banks which overhang in places providing extra cover at intervals.

Hibernation takes place on the plain, in old Rabbit burrows that are situated at both the mid and northern ends of the clearing but only in those that have been excavated into slightly higher banks or mounds than that of the surrounding area in general. The first appearances in 1998 did not take place until the beginning of March, when the air temperature was 8°C, despite the warm February, however, as previously mentioned, mating followed shortly after in the surrounding Bracken and Heather. In previous years it has been noted that the majority of snakes start to move toward the lake in late April, early May, and further mating takes place in the fringes of the heavier woodland. More mature females are the last to be seen on the plain, as late as mid June, and this is

perhaps due to older individuals having a preference for particular egg laying sites, or that they have mated for a second time and will only move on when ovulation is complete. However, previous sightings also suggest that they at least visit the lake with the males and return to the plain in late May. Temporary migration? Such a complex pattern of movement can only be unravelled with time.

The lake is some 300 metres from the northern part of the plain, and it is therefore possible that migration is not too arduous a trek for adult females to endure more than once a year. What the study has set out to prove though, is that the twenty or so individuals that make this journey, do so year after year for the duration of their lifetimes and barring untimely interruption, are habitual in their activities. What is yet to be determined is where most of the twenty individuals migrate to between mid July and October as they appear to leave the pond to the newly hatched and yearlings/ juveniles. What is also unclear is why the size of the study group remains more or less constant, and what proportion of newly hatched go on to maintain the group or move away to other quarters in the forest. It is intended to promote a wider and wider search of the surrounding areas during this time until the fuller picture can be completed.

It should not be assumed that this group is in any way an average population by division per acre, as the suitable habitat found here is equalled only once or twice within the whole of Epping Forest, with vast areas of heavy woodland and spaces which are more accessible to the public for recreational purposes being void of a Grass Snake population. This study will not attempt to examine the peculiarities of the forest population as a whole as this may lead to a less intense study of actual behaviour within the group itself. Of those twenty or so group members there are only six exceptionally large females; however, when considering the losses of females in 1994, the ratio between the sexes appears to favour a higher count of females in each clutch. [see conclusions]

By monitoring the snakes by photographic means, the previous haphazard study of personal log sightings can be replaced with a far more complex picture of movements and interactions and it is possible, for instance, to record newer snakes to the area, and those individuals that did not reappear following hibernation. It can provide a much more exact information on mating habits and provide clues as to the incidence of 'inter breeding' (if any), and what effect this may have on the population. Ultimately, the continued study will reveal average longevity of male and female and exact weight per year ratios upon emergence. Weights and lengths have begun to be recorded within the study group and apologies are made for the approximation of measurements but this was because it proved difficult to pin point millimetres when the snakes would not keep still!!!

Up to this point in time, 'identical twins' have not been noted in the study area, and those that have strong similarities between facial markings have some tell tale giveaway in collar and neck; however, it may be fair to assume that if any example of 'twins' exists, then they may well be from the same clutch of eggs and indeed related. Occasionally, there are individuals that appear that do not need close inspection to be able to identify them, for example, one animal found was almost leucistic, with few markings, and another had two bold green stripes along the length of the back.

It is hoped that other members can offer advice if similar studies have been carried out and how this study may yet be refined further.

## CONCLUSIONS

Several conclusions are to be made from the provisional study and which appear to contradict previous assumptions made in relation to *Natrix natrix*. Firstly, *Natrix natrix*, although tending to travel further afield than the Adder (*Vipera berus*) are nonetheless creatures of habit and predictable in their behaviour. Once the habitual tendencies of the study group have been established, over a period of several years if necessary, it is possible to predict where and when certain individuals will appear in relation to the study area, especially during Spring and early Summer.

It is apparent from the weight length ratios observed that females will definitely consume prey items before egg laying and during mating. How else can a female recorded at 5 centimetres shorter than another record a weight of nearly hundred grammes in excess. Although there is not a weight/length ratio for an individual snake, mainly because prey items can drastically affect the weight of a snake at any given time, if earlier studies are considered (ie. Malcolm Smith) using just a length measurement to determine age, then males are mating within three years from hatching and have an average length of 24 inches/61 cms. The average length of mating females this year were 38 1/2 inches/98cms in comparison. The largest female in the group measured 43 inches/ 110 cms. The longest confirmed male was 26 inches/66 cms.

Mating takes place at temperatures at around 13°C and above and is not necessarily interrupted when the snakes are disturbed. Both pairs shown in the attached plates were locked together, before, during, and after capture. Females may mate more than once a year! To the author's knowledge this has not been previously considered.

For the sake of more accurate study, it may be beneficial to install artificial egg laying sites within the study area which are fully accessible so that:-

- 1) Upon hatching, each snake can be photographically recorded and compared to other members of the same clutch to log similarities.
- 2) Accurate temperature readings can be taken daily during the incubation of the eggs, under normal climatic conditions, as this may determine the frequency of males/females in the sexes ratio. Previous studies on colubrid Milk Snakes (*Lampropeltis triangulum campbelli*) have suggested that lower average temperatures during incubation can produce higher rates of female offspring, and this would provide an explanation as to the fact that there seems to be an imbalance toward females within the study group in general despite female losses in 1994.
- 3) Accurate records of clutch sizes could be kept merely by logging each visit per female and then counting the eggs deposited. This would also assist in the calculation of length and age of individual to clutch size without the need to harm any of the study group for use in post mortem examinations.

Prey items may not be preferential but merely coincidental with the location of the study group and at any given time of year. In other words, it seems unlikely that *Natrix natrix* will pass up the opportunity to take a toad because a frog may be nearby. If this were the case, this would lead to the expectation of finding large numbers of Grass Snakes around ponds mainly inhabited by frogs, and several such ponds exist within the forest but which do not hold a Grass Snake population. Similarly, the expectation would also be of finding Grass Snakes only on clearings where there are frogs in sufficient numbers to sustain the group. Again, definitely not the case when considering this study group.

During four years of study there has not been a single sighting of a frog on the plain, although they appear in large numbers around the lake itself during the transition from aquatic to terrestrial froglets. This may of course hold the key to the study itself, in that migration in *Natrix natrix* may be a circular affair, constantly moving in the pursuit of prey throughout the year and leading inevitably back to the hibernation site. This would satisfy the observation that Grass Snakes make their way to the lake/pond as quick as they can, not only because newts are still active, but, because small fish tend to be spawning at this time of year and therefore easier to catch. It has been noted on more than one occasion that when a fish has been grasped/captured by *Natrix natrix*, it is usually held aloft until consumed. This sometimes involves the snake in a difficult turnaround procedure as it reverses tail first from the water's edge, presumably because the prey is too heavy to lift over the muddier fringes of the lake with forward motion.

Apart from the isolated instances of colour variation, no alien snakes have been noted within the area of study.

### ACKNOWLEDGEMENTS

The author is grateful to the Corporation of London for their efforts in coordinating works within Epping Forest which keep the plains free from encroachment by heavier forest. Without the continued efforts of the Corporation and the many forest volunteers that work tirelessly in clearance etc, this project of study could never have been started and certainly would never reach conclusion.

*Ed Note: the author provided a large number of plates and a map to illustrate this article and the points made therein, but because of inadequate resolution of the original material, it has been possible to reproduce only a few of these.*



Plate 1: Female facing left displaying mating behaviour with 2 males. June 12th 1998, 7 days after egg laying. See also other gravid female centre right.

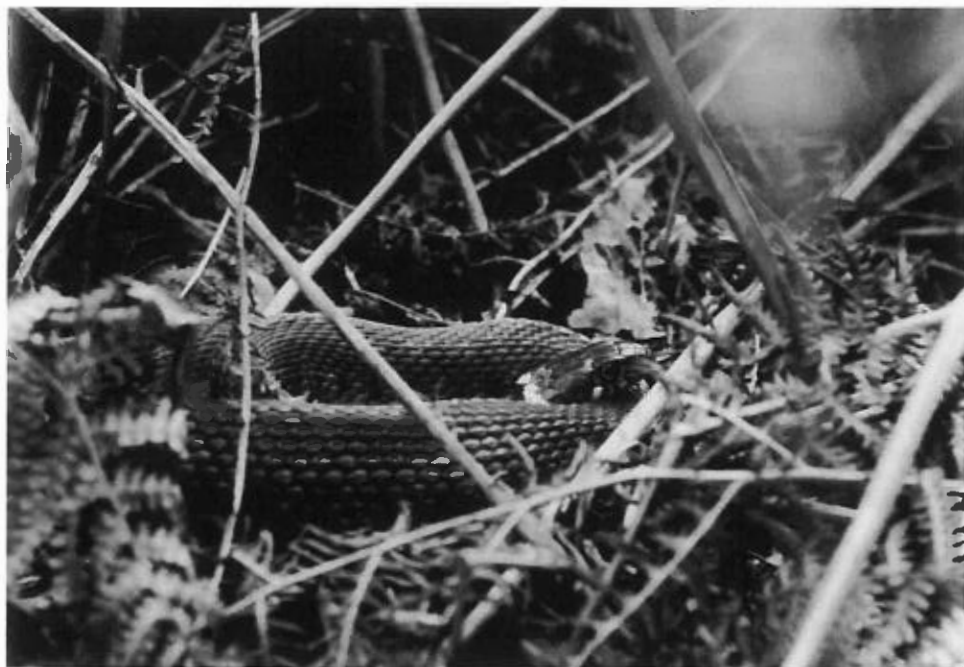
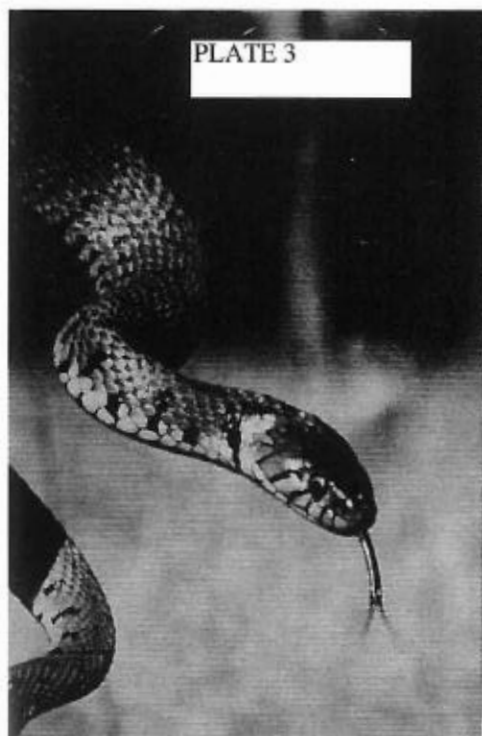
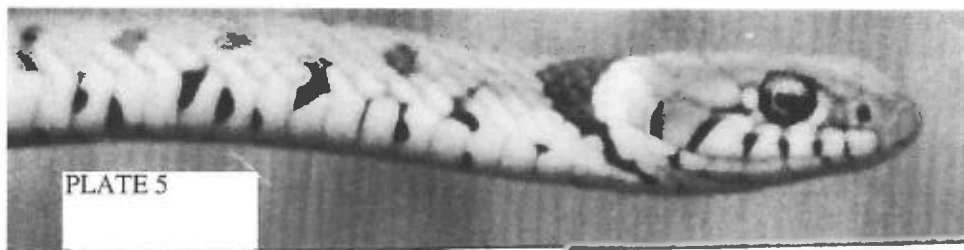


Plate 2: June 5th 1998. Female *Natrix natrix* awaiting ovulation late p.m.



Plates 3 and 4: Examples of *Natrix natrix* head markings referred to in text.





Plates 5 and 6: Examples of *Natrix natrix* head markings referred to in text.



Migration passageway from plain to lake.

## REFERENCES

- Appleby, L.G., (1971). *British snakes*. John Baker, London.
- Chinery, M., (1987). *Field guide to the plant life of Britain and Europe*. Kingfisher. London.
- Frazer, D., (1989). *Reptiles and Amphibians in Britain*. Bloomsbury books. London.
- Malenoir, G. (1963). Further notes on the reptile and amphibian survey of Epping Forest 1959-61. *Essex Nat.* 31, 190-193.
- Mara, W.P., (1994) *Milk Snakes*. T.F.H. Publications. Inc. Neptune City. U.S.A.
- Smith, M.A., (1969). *British amphibians and reptiles*. (4th edn). Collins, London.



## A METHOD OF ATTACHING RADIO TRANSMITTERS TO DESERT MONITORS, *VARANUS GRISEUS* IN ZARANIK PROTECTED AREA, NORTH SINAI, EGYPT

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Radiotelemetry has afforded a conclusive method for studying several aspects of ecology. Monitors have been equipped with transmitters by various methods; externally to the pelvic region (Green and King, 1978; Stanner and Mendelssohn, 1987), and on the tail (Weavers, 1993; Phillips, 1995; Thompson, 1992, 1994, 1995). Transmitters with attached antennae were implanted in the body cavity (Stebbins and Barwick, 1968; Weatherhead and Anderka 1984), with the aerial under the skin of the tail (Christian and Weavers, 1994), and under skin folds of the lateral side of abdominal wall (Thompson *et al.*, 1999). Reinert and Cundall (1982) illustrated a technique in which the transmitter is deposited into the posterior coelomic cavity of snakes and the whip antenna is escalated through the body wall and is implanted subcutaneously. They claimed that their technique bypasses the problem of post-ingestion behaviour, as well as the perpetual complexity of regurgitation or defecation of the ingested transmitter elements. Wang and Adolph (1995) examined the effect of transmitter implantation surgery on behavioural thermoregulation in the western fence lizard, *Sceloporus occidentalis*. They found a small but potential effect on behavioural thermoregulation for the first two days after surgery. This effect was short-lived and vanished by the third day after surgery. In this study, temperature sensitive transmitters were embedded subcutaneously and their whips were externally attached. The same type of transmitters were previously implanted under skin in snakes and both the snakes and transmitters behaved normally (Ibrahim *et al.*, 1998).

Five healthy, *Varanus griseus* (snout to vent length 30.2- 36.0 cm; tail length 39.7-44.8 cm, and mass 295- 455 g) were captured in the Zaranik protected area in North Sinai, Egypt (31° 07' - 02' N, and 33° 25' - 52'E) for studying their home range, movements and activity from 14 July 1997 to 30 June 1998.

SI-2T temperature sensitive transmitters with a whip antenna (24 cm standard nylon coated stainless steel wire) (Holohil Systems Ltd, Canada) were used. The transmitter is cylindrical, its body length is 35 mm, and the diameter of its base is 9 mm. It weights eight g and is operated by a lithium battery with a life of about 14 months at 20°C. Transmitter signals were detected with a RX-1000 portable radiotelemetry receiver with a three element - Yagi Antenna (Wildlife Materials Inc., USA).

Prior to implantation, monitors were placed in cloth bags, and cooled in the fridge at 3°C for 3-4 hours. This hypothermic anaesthesia rendered the monitor to be moderately motionless. Implantation was initiated by making a horizontal 10-15 mm incision in the skin, at the left aspect of abdomen wall, about one cm anterior to the left hind limb using a Bard scalpel (Becton Dickinson Acute Care, USA). A little connective tissues were found between the dermis and the muscular layer, therefore, no tissues were removed.

Another incision (about 10 mm) was made in the muscular layer immediately below the first incision. This incision was made about 3 mm deep, but not reaching the body cavity. Transmitter was inserted with the thumb in the incision starting with its base, then the whole body of the transmitter was interjected by rotating and pushing it with thumb and fore finger, thus enlarging the hole slightly, and leaving the long antenna outside of the body. When the transmitter was deposited in the muscular layer, the incision was closed by 3 to 4 sutures. Thus, the transmitter was held in place and kept off from moving. Five to six sutures were used to close the outer incision, sealing the skin and leaving no space around the antenna wire. Incision sites were cleaned with iodine solution and 70% ethyl alcohol. Sterile gloves, and sterilized surgical equipments were also used. The antenna was then, traversed over the left thigh, positioned along the mid-dorsal line of the tail, and taped there by a strong heat resistant (up to 80°C) plastic tape (Manco, Inc., USA) to the tip of the antenna. Fixing antenna in both positions in the skin and on the tail resulted in creating untaped bridge-like part of the antenna. This position kept the antenna from moving and hence, kept the sutured hole from being enlarged.

Wounds healed within four to five days, and the monitors were released to the wild. Each monitor appeared to have normal behaviour and were monitored for one year. The monitors maintained a home range size up to 22.8 ha, but one male moved about 8 km in two months following its release, and crossed two marshes of high salinity; another increased its body mass by 480g during the year. High air temperature, rocky terrain, and lizard movements, resulted in some of the attachment tapes holding the antenna in lace coming loose a few weeks before the end of study (one year). These lizards were not recaptured to replace the tape because their movements and the transmitter signal appeared to be normal. At the end of the study, it was noted that the wounds were completely dry, and the antenna was firmly fixed. To get the transmitters out, monitors were cooled in the fridge again as before, and the same incisions were reopened. Incisions were sutured back again. and the monitors were released to the wild.

This method of attaching temperature-sensitive transmitters whip whip antenna may avoid problems associated with the placement of transmitters in the stomach, or in the coelomic cavity. The taping of the antenna along the mid-line of the dorsal surface of the tail seemed to function well for signal detection.

## REFERENCES

- Christian, K. and B. Weavers (1994). Analysis of the activity and energetic of the lizard *Varanus rosenbergi*. *Copeia* 2: 289-295.
- Green, B. and D. King (1978). Home ranges and activity patterns of the sand goanna, *Varanus gouldii*. *Aust. J. Wild. Res.* 5: 417-424.
- Ibrahim, A., J. R. Dixon and I. Abdel-Nabi (1998). An ecological study on the Texas black rate snake, *Elaphe obsoleta lindheimeri* (Baird and Giraldo, 1853) in Brazos country, Texas, using radiotelemetry. *J. Union Arab Biol., Cairo* 10 (A): 259-280.
- Phillips, J. (1995). Movements patterns and density of *Varanus albigularis*. *J. Herpetology* 29 (3): 407-416.
- Reinhert, H. K. and Cundall, D. (1982). An improved surgical implantation method for radio-tracking snakes. *Copeia* (3): 702-705.
- Stanner, M. and H. Mendelssohn (1987). Sex ratio, population density, and home range of the desert monitor. *Varanus griseus* in the southern coastal plain of Israel. *Amphibia-Reptilia* 8: 153-164.
- Stebbins, R. and R. Barwick (1968). Radiotelemetric study of thermoregulation in a Lace monitor. *Copeia* 3: 541-547.
- Thompson, G. G. (1992). Daily distance travelled and foraging areas of *Varanus gouldii* (Reptilia: Varanidae) in an urban environment. *Wild. Res.* 19: 743-753.

- Thompson, G. G. (1994). Activity area during the breeding seasons of *Varanus gouldii* (Reptilia: Varanidae) in an urban environment. *Wild. Res.* 21: 633-641.
- Thompson, G. G. (1995). Foraging patterns and behaviours, body postures and movement speed for goannas, *Varanus gouldii* (Reptilia: Varanidae) in a semi-urban environment. *J. Roy. Soc West Aust* 78: 107-114.
- Thompson, G. G., De Boer, M and Pianka, E.R. (1999). Activity areas and daily movements of an arboreal lizard, *Varanus tristis* (Squamata: Varanidae), during the breeding season. *Australian Journal of Ecology* 24: 117-122.
- Wang, J.P. and Adolph, S.C. (1995). Thermoregulatory consequences of transmitter implant surgery in the lizard *Sceloporus occidentalis*. *J. Herpetology* 29 (3): 489-493.
- Weatherhead, P.J. and Anderka, F.A. (1984). An improved radio transmitter and implantation technique for snakes. *J. Herpetology* 18 (3): 264-269.
- Weaver, B. W. (1993). Home range of male lace monitors, *Varanus varius* (Reptilia: Varanidae), in south-eastern Australia. *Wild. Res.* 20: 203-213.

## IDENTIFYING INDIVIDUAL TORTOISES

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The Department of the Environment requires that captive-bred European tortoises *Testudo graeca/ibera*, *T. hermanni*, and *T. marginata* have micro-chips inserted when they reach a size of 100mm (4") flat shell length. They also require that the breeding stock be micro-chipped.

This raises two key questions:

(1) **do pet tortoises need to be individually identifiable?** [The *raison d'être* is presumably to distinguish such legal tortoises from illegal (i.e. smuggled tortoises)]. The onus is on those who aver that this need does exist to demonstrate its **practical** usefulness. Unless there are to be random checks of privately-kept pet tortoises, there does not appear to be any justification for micro-chipping/individual recognition.

If it can be shown that they do need to be individually identifiable then the second question is: **how best can this be achieved in practice?**

The present legislation in relation to micro-chipping would appear to be a typical 'red tape'-type requirement. It is unsatisfactory in that there is no way of knowing if the tortoises are chipped on reaching 100mm flat shell length. One must assume – in the absence of evidence to the contrary – evidence which the Department will have, as it issues the individual CITES paperwork and requires that on chipping the paperwork be returned to the Department for amendment – that only a small proportion of tortoises are ever micro-chipped. In other words the current law is being flouted. Laws which do not have the support of the community and which cannot be policed are unsatisfactory.

Reasons for people not carrying out the required micro-chipping are many and varied. They include: feeling chipping is cruel, having no competent vet with any knowledge of tortoises (let alone microchipping) within a reasonable distance [I write this as one with many MRCVS in the family], not wishing to make the outlay, [under the 1999 revision to the legislation the onus is on the purchaser to (a) buy the chip, (b) to pay the vet to insert it, and (c) under proposed new charges for CITES-related work, pay the Department to issue a new certificate]. Common sense dictates that many/most people will not bother.

Many animal species have been shown to have distinctive markings or patterns which are unique to each individual. Among reptiles and amphibians my own work with LAK Singh on tail 'finger-printing' in the gharial (*Gavialis gangeticus*) in the 1970's and last year's work on a population of over 500 natterjack toads (*Bufo calamita*) using dorsal stripe/throat markings (Bustard, in prepn.) are two examples in which all members of a population can be distinguished individually.

It has been suggested that for *T. graeca* and possibly for *T. hermanni* the pattern of dark markings on the pale background of the plastron (lower shell) is unique to each particular

tortoise and hence can be used to identify it (British Chelonia Group). This work has been based on adult tortoises. If this is correct, there is no need to micro-chip the adult breeding stock which can be plastral finger-printed with a copy of each photograph held by the DOE, if it so wishes *and is prepared to undertake this work at its own expense*. To charge the breeder for co-operation is unacceptable.

Recently the DOE has stated that a plastral photograph will be adequate for baby tortoises until they reach the mandatory 100mm shell length when micro-chipping has to take place. One wonders why, if a plastral photograph is satisfactory for the first few years of life, it is not deemed to be satisfactory thereafter. In particular one wonders why this is not acceptable for adults (see above) where the technique is less debatable.

I know of no scientific research on changes in the plastral 'finger print' with growth, so instigated work on *T. hermanni* hatchlings. In, any *hermanni* the black markings develop on new growth areas. This in itself does not invalidate the method as clear growth rings are laid down in testudines and the finger print is concerned only with the area present at the time of hatching, if the method is to be used as a whole of life individual record. Due to the growth rings it is a straightforward matter to identify the original area of each scute. What still needs to be determined is whether the pattern, present at birth, remains unchanged on that area of scute throughout life. This is the focus of my current research, in which, commencing with hatchlings, individual tortoises are plastral photographed at six monthly intervals. If it can be demonstrated that this birth pattern remains throughout life then we have a simple yet effective, method of individual tortoise recognition and there would be no need for intrusive surgery.

If there is a legitimate need to identify individual tortoises in order to separate legal and smuggled animals, and if plastral 'finger-printing' is shown to be a reliable method, then the DOE can require that (a) all breeders deposit with them a photograph of the plastron of all their breeding stock, (b) supply a plastral photograph of each tortoise sold (both to the purchaser and to the DOE), and (c) that a copy of this photograph remains with the exemption certificate throughout the tortoise's life.

Incidentally, there can be no question of these photographs being used in conjunction with a smuggled tortoise in order to legalise it as they will not match. It has been suggested that chips may be recycled in this way.

These are purely personal views. Mike Hines has sent out a circular seeking opinions on these topics and he will be publishing the results of his survey in due course. Mike has seen this in advance of publication for the benefit of his survey. It is, of course, important, if the Society is to play its proper role, that the Society has a position on these matters and I will be raising this at Council.

## OBITUARY NOTICE

*George Webster*

George Webster who has died aged 79 will best be remembered for his pioneering work with European Lacertids, and in particular, their maintenance in outdoor reptiliaries. He was regularly breeding Green and Eyed Lizards in the garden of his home in South Benfleet, Essex, as far back as the early 1970's, and many specimens in his collection lived for well over 20 years. He was acutely aware of the importance of natural sunlight in promoting good health, and viable eggs, and in the design of his enclosures he was able to maximise his lizards exposure to sunlight, whilst at the same time providing the necessary shelter from an often inclement British climate.

George Henry Webster was born on July 7th 1920. From an early age he had been fascinated by all aspects of natural history and eventually this interest focused towards the fields of Herpetology, Ornithology and Palaeontology. He maintained a life-long interest in all of these subjects and was also a keen gardener and plantsman with his gardens at South Benfleet and later St. Osyth, displaying unusual specimens from all around the world.

As a young man he joined the army, serving for a time in India on the North West Frontier. At the outbreak of World War II he was stationed in France and at the time of the Dunkirk evacuation was at Calais where he was wounded and captured by the Germans. Sent to a P.O.W. camp in Poland, he escaped, joined up with partisan fighters and spent the rest of the war very eventfully before returning home.

In later years he lived at South Benfleet and then St. Osyth. He was a frequent visitor to the London Zoo, where he became a friend of the Overseer of Reptiles, David Ball, and other members of staff, to whom his knowledge and enthusiasm were a great inspiration at a time when the Reptile Department was going through a transitional period, aimed at bringing it into line with other modern international collections.

George Webster was an amateur in the true sense, he really did love his chosen subjects and derived great pleasure from his investigation of them. He was also very modest and a true gentleman who will be missed by all of his friends.

He died on June 1st 1999.

D.J. Risley  
G. Newland

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## EDUCATION OFFICER

Vacant. Enquiries to Mrs. Green (above)

## Co-Opted

<b>Land Fund</b>	Mr Brian Banks	14 Wilderness Gardens, Northam, E. Sussex
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## Observer Status

Dr C.J. McCarthy, Dept. of Zoology Natural History Museum Cromwell Road, London SW7 5BD 0171-938 9123	Herpetological Conservation Trust, c/o Jonathan Webster 655a Christchurch Road Boscombe, Bournemouth Dorset BH1 4AP
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## Past Presidents (retiring date)

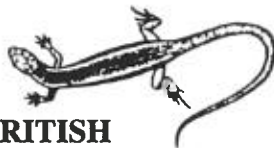
Dr M.A. Smith (1956), Dr J.F.D. Frazer (1981), The Earl of Cranbrook (1990), Prof. J.L. Cloudsley-Thompson (1996)  
Roger Avery (1997).

## Honorary Life Members (maximum 10)

Mrs M. Green (1960), Prof. J.L. Cloudsley-Thompson (1983), Prof. R. Conant (1983), Dr D.G. Broadley (1983),  
Prof. H. Saint Girons (1984), Mrs. E. Haselwood (1990), Dr H. Fox (1992), Dr T.J.C. Beebe (1995).

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