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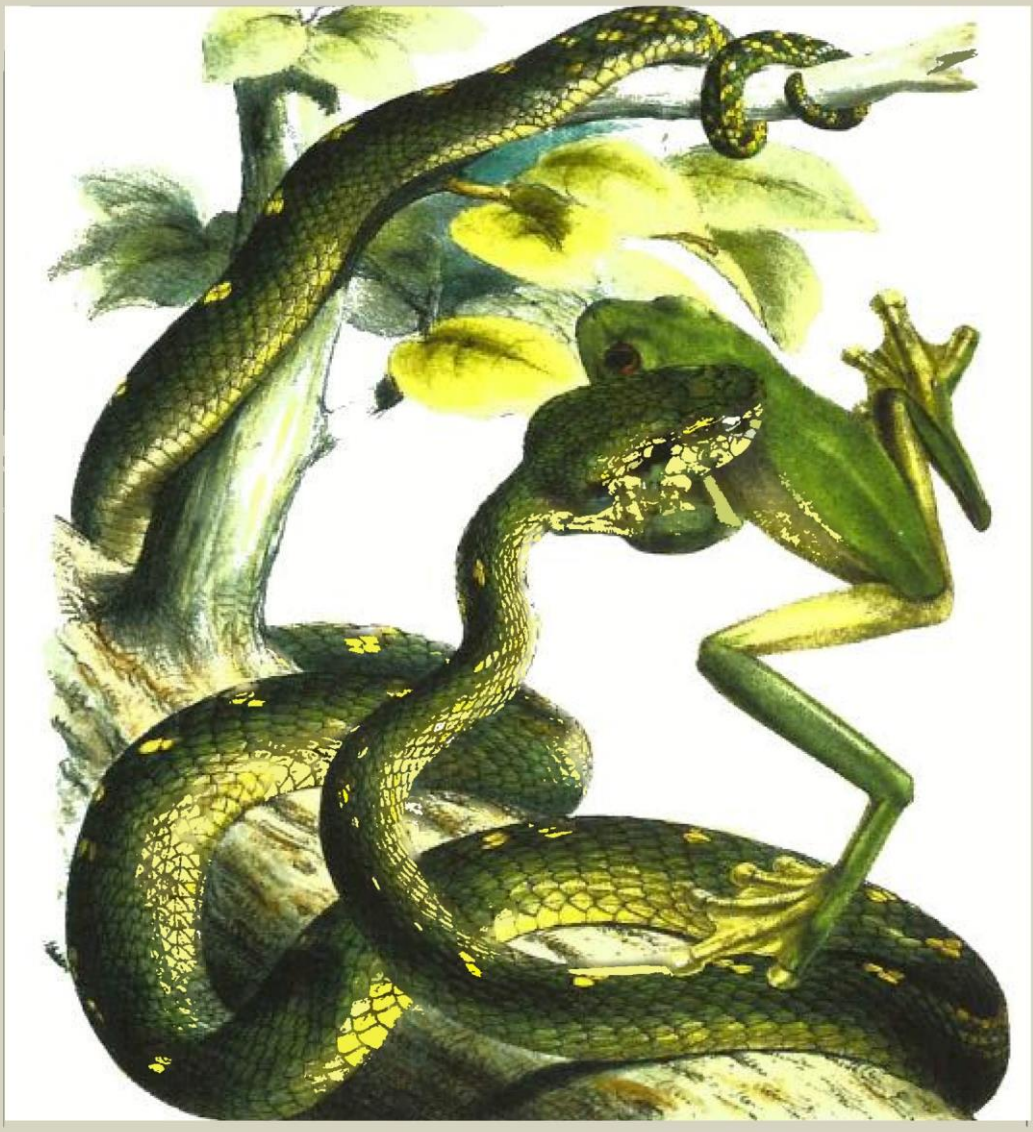

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THE HERPETOLOGICAL BULLETIN

The **Herpetological Bulletin** is produced quarterly and publishes, in English, a range of articles concerned with herpetology. These include full-length papers of mostly a semi-technical nature, book reviews, letters from readers, society news, and other items of general herpetological interest. Emphasis is placed on natural history, conservation, captive breeding and husbandry, veterinary and behavioural aspects. Articles reporting the results of experimental research, descriptions of new taxa, or taxonomic revisions should be submitted to The Herpetological Journal (see inside back cover for Editor's address).

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Front cover illustration
Yellow-blotched Palm Pitviper (*Bothriechis aurifer*) with Morelet's Treefrog (*Agalychnis moreletii*). From *Proceedings of the Zoological Society of London*, 1860. Reproduction courtesy of the Zoological Society of London.

EDITORIAL

Erratum

A CASE STUDY IN THE EVOLUTION OF CRESTED NEWT CONSERVATION by Arnold Cooke, *Herpetological Bulletin* number 78, pp. 16-20. On page 19, the final line of data was omitted from Table 2. This summarised counts for the receptor pond in 2001: for 4 counts, the mean number of Crested Newts ±SE was 28.3±7.7. Counts in 2001 confirmed establishment and survival of a translocated population.

Meet the council....

John W. Wilkinson, BHS Development Officer

At the last BHS Council Meeting of 2001, it was decided that, in order to facilitate greater communication between the BHS membership and its Council, we should take it in turns to write a short profile about ourselves and our Council functions. This may even have been my idea, which is probably why I got landed with doing the first one!

The picture is of me emerging from a clump of heather at Wem Moss National Nature Reserve in north Shropshire. This Moss is an internationally-important lowland raised peat bog which has never suffered from the ravages of peat extraction. On this occasion, I was with a friend who is involved in the Orthoptera Recording Scheme, searching for Bog Bush Crickets (*Metrioptera brachyptera*). We also found a rare Great Raft Spider (*Dolomedes fimbriatus*) and I am pleased to say that juvenile Common Frogs (*Rana temporaria*) and Viviparous Lizards (*Lacerta* [=*Zootoca*] *vivipara*) were much in evidence. I suspect that Adders (*Vipera berus*) would also be found in some areas of the site.

Such trips are really how I got into herpetology and I am now fortunate enough to be able to pursue herpetological conservation as a career. Since 1996 I have been International Coordinator of the Declining Amphibian Populations Task Force (DAPTF), based at the Open University in Milton Keynes. Our mission is to investigate the causes of global amphibian declines and to promote the means by which these declines can be halted or reversed. I also edit the newsletter *Froglog* and run the DAPTF network of more than 3,000 people around the world.

Aside from this professional role, I am especially interested in the breeding ecology of toads and maintain a number of species of *Bufo*, *Bombina*, *Kaloula* and others, with which I have had a certain amount of breeding success. I also breed other amphibians such as *Dendrobates truncatus* (the Rio Magdalena Poison Dart Frog) on which I hope to provide an article for a future Bulletin. Over the years I have probably successfully reproduced about 25 species of amphibian under captive conditions.

My role as Development Officer for the BHS is poorly-defined at present and what I tend to do is try to jump in where I'm needed, to help out with Council tasks for which there is no-one else and of which I am capable. I also seem to shout a lot at Council Meetings (!). The key word here, though, is development. This is a time of change for the BHS. The Society is slowly modernising and much discussion occurs at Council Meetings on the subject of how best to promote the Society whilst also providing something which members want and appreciate. This said, I invite anyone in the membership to contact me at the address at the back of this Bulletin or by e-mail at *phycodurusuk@yahoo.co.uk* with ideas for what they would like to see from their membership of the BHS. I will undertake to bring these ideas to the Council's attention and to report on any action taken as a result in the pages of the *Natterjack*. Council runs the Society on behalf of the other members and it is up to you to tell us what you want!

Anyone, incidentally, who would like more information on the work of the DAPTF is welcome to contact me at the same postal address, or at *daptf@open.ac.uk* by e-mail.

ORIGINAL ARTICLES

CAPTIVE-BREEDING OF EUROPEAN TORTOISES: BACKGROUND AND POTENTIAL PROBLEMS

ROBERT BUSTARD

THE *BHS* actively encourages the captive breeding of European tortoises, for which there is a substantial demand. I use the word 'European' as almost all those bred are of European stock as opposed to being of north African origin as in the case of *graeca graeca*. The sale of tortoises is legal provided these tortoises used for breeding are themselves captive-bred, i.e. the progeny offered for sale must be F2 generation at least.

I have recently referred in the *Natterjack* (issue 82, November 2001) to the key role of Monica Green in the protection of Mediterranean tortoises. I use the word 'Mediterranean' here as the bulk of the tortoises imported into the UK after the Second World War came from north Africa, mainly Morocco. It was as a result of very extensive pioneering work undertaken by Monica, ably assisted by her late father, that the Government initially restricted and then totally banned the import of wild Mediterranean tortoises in 1984. *This was a major step forward in protecting wild populations of tortoises from collection for the pet trade.*

It is important that younger readers realise that there was a huge trade in wild tortoises, which were imported into this country in disgusting conditions some 25-50 piled on top of each other in wicker baskets. Many arrived dead. The surviviors were then distributed to pet shops before being sold on to the public.

As a school boy I wrote regularly for the monthly magazine *The Aquarist*. In the April issue each year there was an advertisement by a Liverpool importer, Joe Grassby, which read 'Tortoises - first 10,000 due April 1st'. Many more 10,000 lots were imported by this and other dealers each year and tortoises were available *en masse* in all the pet shops in the land. At this time they cost half a crown (equal to 12.5p today). I would go into my local pet shop after school and tell the owner that there were several dead tortoises in the window (one window was completely given over to a 'pile' of tortoises) and he would reply 'Don't worry, nobody will notice'.

Because the pet shops knew little or nothing about the proper care of the tortoises the purchasers went off ignorant, or worse misinformed, about their care.

We have moved on, thankfully, from these days but we still need to keep a stringent check that tortoises are not being taken from the wild as tortoises remain very desirable. It is fashionable to say that habitat loss is now *the* problem, but illegal collection of tortoises, which is diffucult to quantify, continues. The population dynamics of tortoises — a potentially long adult lifespan, low reproductive rate as a result of advanced age at commencement of breeding and comparatively small and vulnerable egg clutches — leave them particularly threatened by the collection of larger individuals, the natural focus of the illegal trade.

Since I became President of the Society it has come to my attention that there is a substantial illegal trade in the UK of tortoises smuggled from the wild. In part this trade has continued due to the sheer demand for tortoises — which captive-breeding has been unable to meet. Furthermore, as a result of the 1984 legislation, there have been virtually no large legal tortoises for people to acquire. The illegal trade is fuelled by the comparatively high prices paid for tortoises — especially adults. *Hence, put simply, every captive-bred tortoise passed on to people who want to keep one reduces the chance of one being taken from the wild.*

It is important to appreciate that there *can be* a problem with captive-breeding farms in countries where tortoises or other 'farmed' reptiles occur naturally. This is that much of the stock (both

breeding and yougsters for sale) *may be* illegally taken from the wild. Only the most rigorous inspections by well-qualified and dedicated officers in the countries concerned will minimise this.

This was one reason why during my eight years involved in crocodilian conservation in India as a Chief Technical Adviser to the Government of India, and although in very many ways India was an ideal location, we took the decision not to authorise crocodile farming as it would in practice be virtually impossible to police, and would be bound to destroy, or at the very least seriously damage, the very resource we were trying to conserve.

Some years ago I brought a classic case of alleged reptile farming to the attention of the DOE (as it was called then). This was the so-called 'farming' of Royal Pythons in West Africa. I was in touch with people locally including one of those involved in the 'farming', so knew precisely what was going on. Gravid female royals were collected and 'thrown onto an island'. In due course the young pythons were collected and exported to Europe and the US and *then* the spent females were sold in the food market. So the so-called 'farming' of Royal Pythons was not only taking the wild egg production, but was destroying the resource, by, after egg-laying, using the females as food!

Coincidentally, while I was writing this article I was telephoned by a dealer from an Eastern European country now resident in the UK. He told me that he is returning home to breed tortoises. He also told me where he would collect both his 'breeding' stock and young ones for sale. 'You get them in the fields there and put them as [= make it appear that] you bred them. Chip them and all is OK'. I will, of course, be monitoring this situation and will report further when appropriate in the *Natterjack*.

As breeders of all livestock will know there is a growing awareness in the population of a) the advantages of captive-bred animals, and b) that animals should no longer be taken from the wild. So acquiring a young, as opposed to an adult, tortoise can be presented in a positive light. Obtaining captive-bred stock direct from breeders has been given a tremendous boost by a growing public perception which is anti-trade and anti-pet shops in particular. Undoubtedly this sentiment has developed as a result of the conduct of less responsible outlets combined with the failure of many councils to monitor pet shops properly.

An adult male Marginated Tortoise - note the flared posterior marginals. This tortoise reaches a large size (up to about 30 cm shell length and a weight of up to 3 kg) and adults are greatly elongated. Photograph by author.

It is for *conservation* reasons that I have been keen to promote the captive-breeding of tortoises. The idea being that the puiblic would a) get a captive-bred tortoise, and b) obtain the young tortoise - NOT as a hatchling, but at an appropriate age (see below) - *direct from the breeder* hence cutting out the trade. I breed some *hermanni* and (*graeca*) *ibera* myself to assist this process.

At what age should captive-bred tortoises be sold?

From what I hear — and what I have seen at reptile shows — many captive-bred baby tortoises are being sold within a matter of *weeks* of hatching. I consider this practice to be wrong as many of these baby tortoises will not survive in inexperienced hands. It is crucial to appreciate that 'tortoise people' are rarely herpetologists so we are not discussing a parallel situation to handing over a neonate snake, which is now feeding, to an experienced snake-keeper. Tortoises should be grown on, ideally to an age of about two years, before being offered to the general public. This is the age at which I offer the tortoises which I breed to the general public. I would hope that tortoise breeders would sell their surplus direct to

interested parties exactly as a pedigree cat or dog breeder would do and not offer them to the trade. The age at which they are sold is a matter we should discuss at Council as it is important that the BHS has a stated policy on such matters. Since, due to Monica's efforts, the Society is seen to have played a key role in having European tortoise imports banned — on welfare grounds — we certainly do not want to fall into the trap of supporting the sale of tiny baby tortoises which then die with their new owners. That would not be progress.

In a recent article in the *Daily Telegraph* Jill Martin of the Tortoise Trust is quoted as saying that new tortoise owners should aim to buy one about two years old, which I am in agreement with. Once again members, especially tortoise breeding members, should make known their own views, either through the *Natterjack* or by writing to me.

UK CAPTIVE-BREEDING OF EUROPEAN TORTOISES 1997-2000: SUPPLY AND DEMAND

ROBERT BUSTARD

DEMAND FOR TORTOISES

I am unaware of any quantitative literature on the demand for European tortoises in the UK at the present time, hence it is worth recording preliminary information on Scottish demand and extrapolating this to the UK as a whole.

Any quantitative assessment of current demand must take price into account. Although disposable income has risen enormously, tortoises, now that they are no longer imported, are comparatively very much more expensive, costing from £100 plus to about £200 for individuals up to 2 years old. These prices compare with half a crown (12.5p) for *adult tortoises* when I was at school. Taking inflation into account this 12.5p becomes around £5 — a far cry indeed from £100-200! Much of the difference between these prices reflects the fact that tortoises are now all supposed to be captive-bred *and supply does not begin to meet the demand at present.*

The comparatively high price has put tortoises beyond the reach of many 'tortoise people' who had one previously and would like another now if they could afford one. So present demand is very much smaller than formerly. Conversly, if captive-breeding takes off — as appears likely — then a better balance between supply and demand will result in a substantial fall in price. This in turn will result in a much increased demand for tortoises as these fall into the affordable price range of many more 'tortoise people'.

I pointed out the strength of the demand for pet European tortoises in Scotland at the October 2001 meeting of Council, and I am sure the strength of this surprised many of those present. Part of this is worthy of repetition. In the four months to 21st September 2001, seven hundred and twenty-three 'tortoise people' in Scotland were in touch with me. I said, in order to put this figure in numerical perspective, that I did not think that in that period I was in touch with anything like 10% of the Scots 'tortoise people'. It is impossible to give a figure, but I would suggest, as an attempt at an informed guess, 5%. That would imply that there are some 14,500 'tortoise people' in Scotland. Many of these may not currently own a tortoise for the reason given above — lack of availability.

The figures become even more interesting when tentatively applied to England, which has a population some ten times that of Scotland. The potential figure for the number of 'tortoise people' (as defined above) for England would be much greater than a simple x10 of the Scots figure because there is a much greater interest in

'exotics' in England than in Scotland. Even without making any allowance for this extra factor, it seems reasonable to talk of at least a potential 160,000 'tortoise people' — and probably a great deal more — in the UK as a whole. This figure, as it must be stressed, remains a guesstimate and the true figure could be very much larger.

It is important to realise that these 'tortoise people' are not reptile people. They are almost invariably quite separate from the reptile-keeping fraternity. 'Tortoise people' *are a breed apart.*

Tortoises and the Society

I also pointed out to Council — here is a large potential market to tap for Society membership, one which we should not largely ignore as at present. If only 1% of the guesstimate figure joined the Society that would be an extra 1,600 members. Of course, to attract and keep these as members we would have to be relevant to their needs with regular good articles on all aspects of keeping tortoises. I attempted to start a 'Tortoise Group' through the *Natterjack* some years ago but at the time had no takers. If anyone is now interested in running a tortoise group within the Society I would be pleased to hear from them. I have again (December 2001) tried to go some way towards catering for tortoises by the creation of a 'Tortoise Corner' in the *Natterjack* which I hope will receive your support.

SUPPLY OF CAPTIVE-BRED TORTOISES

As part of my investigation into how far captive-breeding of European tortoises could be expected to be able to supply the legitimate demand - and so cut illegal imports - I asked DEFRA to provide me with recent figures relating to the issue of Article 10 certificates for captive-bred European tortoises. I had originally asked for 10 years data but apparently this was a huge task due to the way their records are maintained and the capabilities of their current software, but they kindly agreed to provide data for the last four years. This information is set out in Table 1. They did not, incidentally, have data on captive-breeding of *horsfieldi*.

These data are very interesting. However, several caveats should be noted:

1. DEFRA do not separate *graeca* into its 'components'. All the North African races/ species (other than *kleinmanni*) are grouped together with the European (*graeca*) *ibera* as *graeca.* However, it seems safe to assume that the overwhelming majority of the hatchlings reported are (*graeca*) *ibera*, i.e. the European race, as it is the one much more widely kept and bred.

2. I am advised that in the early years the figures may be somewhat exaggerated by breeders ordering too many certificates based on numbers of eggs laid, not all of which hatched. DEFRA state that they are not likely to give out certificates on that basis nowadays. Hence, if anything, the growth in captive-breeding has been even more dramatic than the data would suggest.

3. As people come to understand and be fully aware of the Regulations, the number applying for Article 10 certificates will increase. It is not known how important this factor is quantitatively.

4. A small number of certificates are issued again, i.e. duplicated for the same tortoise following further sales.

DEFRA's present software is not sophisticated enough to be able to deal with these variables. My own opinion is that these variables are of a fairly minor nature and do not detract from the clearly recorded growth in captive breeding as detailed in Table 1.

Year	*graeca*	*hermanni*	*marginata*
1997	1179	789	139
1998	750	748	135
1999	1284	1280	206
2000	1289	2119	418

Table 1. Total number of captive-bred European tortoises 1997-2000 based on DEFRA licensing.

Whereas the number of *graeca* bred has remained fairly static between 1997-2000, the numbers of the other two species have increased dramatically. It is worthwhile to consider the data for the three species separately:

A. '*graeca*'

At a time when, as one might expect, the numbers of captive-bred tortoises are increasing by leaps and bounds, the number of *graeca* being bred has remained relatively static over the last four years, apart from a marked fall of 36% to 750 in 1998, the reason for which is not known to me (Table 1). The percentage increase over the four years 1997-2000 is only 9%.

B. *hermanni*

In contrast there has been an almost threefold increase (168.5%) in the number of *hermanni* captive-bred over the same period - from 789 in 1997 to 2119 in 2000. As with *graeca* there was a fall in 1998, but unlike *graeca* the fall was small (5%). The 1999 figure represents an increase of 71% over the previous year and the figure of 2119 for 2000 is a *further* increase of 65.5% over that figure.

Hermanni, starting in 1997 from a figure of only some 2/3 of *graeca*, has become the main species bred over the four year period.

C. *marginata*

Equally interesting is the *number* of *marginata* now being bred. The figures are very creditable for a tortoise which was seldom kept in captivity in this country. There has been a threefold increase from 139 to 418 over the period 1997 to 2000 (200.7%) as well as a *doubling* (103%) between 1999 and 2000. Again, as with the other species, there was no increase, indeed a slight fall, between 1998 and 1999 (3.6%) — very similar to the 5% fall in *hermanni*. This contrasts with the 36% fall reported for *graeca*.

BHS role in captive-breeding

It would be interesting to know the input of BHS members in these figures. It is proposed to update and comment on these figures on an annual basis in future and I would like to be able to highlight the BHS contribution. By the time you read this I will be collating the figures for 2001, so if you have not already sent these to me in response to my request for this information in the *Natterjack*, I would appreciate receiving any data members may wish to provide as soon as possible. As stated in the *Natterjack*, anonymity is guaranteed where requested.

A nesting Hermann's Tortoise moving the most recently laid egg. Note the greatly elongated claws on the hind feet of females. These function like rigid fingers in digging the nest and in moving the eggs around to prevent the hard-shelled eggs from falling on top of one another. Photograph by author.

The role of captive-breeding in conservation of European tortoises.

One reason for giving 'ball park' figures for 'tortoise people' above was to allow consideration of how far captive-breeding of tortoises is meeting or is likely to meet the UK demand for European tortoises. At the current figure of 3826 tortoises bred in the year 2000, and assuming there is no increase (whereas there is likely to continue to be a large annual increase), approximately 40,000 captive bred tortoises will have been bred over the 10 year period to 2010. This has to be viewed not only as a major achievement in our country, but as now making a significant contribution to meeting the demand at prices currently being charged for young tortoises.

The future

There is a further aspect not considered above. This is the development of commercial tortoise farming which is going to be a — possibly *the* — most significant factor in the future supply of captive-bred tortoises. There are already large-scale tortoise farms in central Europe and commercial farms are now appearing in the UK. These will be a topic of a future article.

PRELIMINARY OBSERVATIONS ON HERPETOFAUNAL DIVERSITY IN THE ALMATY REGION, SOUTHERN KAZAKHSTAN (SEPTEMBER 1998)

MICHAEL R.K. LAMBERT

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ABSTRACT.— During field inspections in 11 localities over five days in early September 1989, a total of 2 Amphibia and 15 Reptilia (out of totals of respectively 4 and 27 in the Almatinskoi Oblasti) were recorded in the Almaty District of southern Kazakhstan. The lizards, *Phrynocephalus h. helioscopus* and *Eremias a. arguta*, and snake, *Coluber ravergieri*, are characteristic of open steppe areas in the Charyn River Canyon area. Beside the anurans, *Rana ridibunda* and *Bufo v. viridis/danatensis*, near water, the snake *Natrix tessellata* was observed by the Kaskelen River. Geckos, *Alsophylax pipiens* and *Cyrtopodion r. russowi*, were found at a cliff base by the Ili River rock drawings. The agamid *Trapelus sanguinolentus aralensis*, an open steppe species, was recorded on the Kerbulak massif, which supported a dense population of the steppe tortoise *Agrionemys horsfieldi*. *Trapelus s. aralensis* were also recorded amongst bushes on vegetated sand dunes by the artificial Lake Kapchagay; geckos, *Teratoscincus s. scincus*, were also recorded here after darkness. Herpetofaunal diversity was apparently higher in the less arid Ili River than in the Charyn River Canyon area.

THE amphibians and reptiles of Kazakhstan have been described in two basic texts (Paraskiv, 1956; Iskakova, 1959), as already indicated in Lambert (1995a, 1995b), and are included with other works for the former Soviet Union generally (Terentev & Chernov, 1949; Bannikov et al., 1971). Subsequently, species were covered in a field guide by Bannikov et al. (1977). The lizard fauna of deserts in Kazakhstan has been described by Brushko (1993), and information from ecofaunistic investigations on amphibian and reptile species throughout Kazakhstan were reviewed by Brushko & Kubykin (1998). They indicated that only the far north of the North Kazakhstan Region still remained largely unexplored herpetologically. Subsequently, a list of species was compiled specifically for the Almaty Region by R.A. Kubykin (in litt.), indicating that the region is very well known herpetofaunally, and this list is reproduced here (see Appendix). Bounded to the north by Lake Balkash and to the south by the Tien Shan range, the Semirechensk area, making up the Almatinskoi Oblasti, has been well surveyed and its species are well known. However, few observations specifically on herpetofaunal richness and diversity have yet been made, and as a basis for more detailed work in the future, preliminary observations are presented here.

During a field excursion on 3rd September for the 3rd International Asian Herpetological Meeting held at the Al-Farabi Kazakh State National University, Almaty, 1st-5th September 1998, the journey by road followed the Issyk river valley, entered the Ile-Alatau National Park, and continued towards Akci above the tree line at a height of 2300 m (some 45 km E of Almaty) in the Tien Shan range. Only two lizards — probably *Eremias a. arguta* (by bushes on a rock outcrop) — were sighted during midday at this altitude. Following the Meeting, an opportunity was taken during a four-day field excursion, 6-9th September 1998, to make further observations on species at localities in a variety of habitats at lower altitudes elsewhere in the Almaty District of southern Kazakhstan. Species sightings during visual encounter surveys allowed richness to be recorded in several localities, and preliminary information

on herpetofaunal diversity (species composition and relative abundance) was provided at the same time. The following observations will also give those unfamiliar with this part of the world some idea of the amphibians and reptiles that can be observed during quite cursory field surveys.

Itinerary

Names of places were recorded when visited, and use was also made of Sheet TPC F-6C of the 1:500,000 Tactical Pilotage Chart (July 1981 revision), published by the Defense Mapping Aerospace Center, St Louis, Missouri (USA), and a 1:1,000,000 map Almatinskaya Oblasti of the Kartograficheskaya Firma Geo, predlagaet Karty (1998).

Figure 1. Almatinskoi oblasti, southern Kazakhstan. Observation localities are denoted by solid circles. See text for numbering.

6th September: Depart Almaty by road east, and via Chilik, arrive at the Charyn River Canyon [some 180 km ENE of Almaty].

7th September: Depart Charyn River Canyon by road west via Almaty, and then north, via Kapchagay [some 72 km N. of Almaty], and arrive at the Ili River (rock drawings), 29 km NNE of Kapchagay town.

8th September: Depart Ili River, and via Kerbulak Massif, arrive Lake Kapchagay, 18 km ENE of Kapchagay town.

9th September: Depart Kapchagay Lake, and via Kapchagay town and Kaskelen River [50 km N of Almaty], arrive Almaty.

HERPETOFAUNAL RICHNESS AND ECOLOGY

In eleven localities (Fig. 1), a total of seventeen species was recorded during site inspections: two Amphibia and fifteen Reptilia. Reptiles were represented by one tortoise, ten lizards and four snakes. Fifteen lizard species are known to occur in the area (Brushko, 1972).

40 km ESE of Chilik (GPS: 43°30.18'N, 78°37.37'E; 961 m), 6.ix.98, hillside gully with shrubs. Species: nil [2.2 search-hours; 31°C].

66 Km ESE of Chilik (GPS: 43°20.49'N, 78°55.79'E; 1261 m), 6.ix.98, flat plain with low shrubs. Species (three): *Phrynocephalus h. helioscopus* (three); *Eremias a. arguta* (four); *Coluber ravergieri* (two skins) [2.9 search-hours; 32°C].

Charyn River Canyon (GPS: 43°27.31'N, 79°2.86'E; 1121 m), 6-7.ix.98, plateau above gorge, rocky surface with low shrubs, and by river with trees and shrubs. Species (eight): *Rana ridibunda* (two), *Bufo v. viridis/danatensis* (one), *Phrynocephalus h. helioscopus* (one), *Alsophylax pipiens* (two), *Cyrtopodion r. russowi* (eight), *Eremias a. arguta* (eighteen), *Elaphe dione* (two + two skins), *Psammophis lineolatus* (one) [10.7 search-hours; 24-31°C in morning, 26°C in evening]. *Eremias v. velox* was also recorded here.

Ili River (rock drawings), 29 km NNE of Kapchagay town (GPS: 44°3.87'N, 76°59.73'E;

451 m), 7-8.ix.98, cliff base and riverbank. Species (seven): *Rana ridibunda* (four), *Bufo v. viridis/danatensis* (one), *Alsophylax pipiens* (five), *Cyrtopodion r. russowi* (five), *Eremias lineolata* (one), *Coluber ravergieri* (three), *Natrix tessellata* (one) [5.1 search-hours; 28°-25°C in evening, 27°-28°C in morning].

Ili River, 23 km NNE of Kapchagay town (GPS: 44°2.12'N, 77°0.31'E; 452 m), 8.ix.98, dunes above riverbank. Species (three): *Rana ridibunda* (one), *Eremias s. scripta* (five), *Coluber ravergieri* (one) [1.1 search-hours; 30°C].

Kerbulak massif, 29 km N of Kapchagay town (GPS: 44°3.79'N, 77°2.87'E; 848 m), 8.ix.98, flat plain with low shrubs. Species (one): *Trapelus sanguinolentus aralensis* (road-kill - one).

Kerbulak massif, 29 km N of Kapchagay town (GPS: 44°3.59'N, 77°3.62'E; 754 m), 8.ix.98, flat plain with low shrubs. Species (one): *Agrionemys horsfieldi* (dried-up juvenile; skeletal remains of adult - two).

Kerbulak massif, 29 km N of Kapchagay town (GPS: 44°2.60'N, 77°5.25'E; 690 m), 8.ix.98, flat plain with low shrubs. Species: nil.

Lake Kapchagay, 18 km ENE of Kapchagay town (GPS: 43°55.85'N, 77°17.38'E; 501 m), 8-9.ix.98, part vegetated sand dunes by lakeshore. Species (three): *Rana ridibunda* (five), *Trapelus sanguinolentus aralensis* (20 +), *Teratoscincus s. scincus* (six) [5.5 search-hours; 30°C in afternoon, 23°-21°C in evening].

3 km SE of Kapchagay town (GPS: 43°48.08'N, 77°1.99'E; 504 m), 9.ix.98, open sand dunes, with light mainly annual herbaceous vegetation. Species (three): *Eremias s. scripta* (two), *Eremias grammica* (one), *Psammophis lineolatus* (one - skeleton) [2.8 search-hours; 18°-20°C].

Kaskelen River, 48 km N of Almaty (GPS: 43°41.49'N, 77°1.36'E; 492 m), 9.ix.98, riverine habitat. Species (two): *Rana ridibunda* (four), *Natrix tessellata* (two) [2.4 search-hours; 18°-21°C].

Alsophylax pipiens, SVL 60 mm, collected during early hours of darkness, cliff base, by Ili River (rock drawings), 29 km NNE of Kapchagay town, S. Kazakhstan, 7.ix.98. Photograph © Lee Grismer.

SPECIES OBSERVED

AMPHIBIA

1. *Rana ridibunda*: localities: 3, 4, 5, 9, 11 (n = 16); 2. *Bufo v. viridis/danatensis*: localities: 3, 4 (n = 2).

REPTILIA

3. Testudinidae: *Agrionemys horsfieldii*: locality: 7 (dead) (n = 2); 4. Agamidae: *Phrynocephalus h. helioscopus*: localities: 2, 3 (n = 4); 5. *Trapelus sanguinolentus aralensis*: localities: 6 (dead), 9 (n = 20+); 6. Gekkonidae: *Alsophylax pipiens*: localities: 3, 4 (n = 7); 7. *Cyrtopodion r. russowi:* localities: 3, 4 (n = 13); 8. *Teratoscincus s. scincus*: locality: 9 (n = 6); 9. Lacertidae: *Eremias a. arguta*: localities: 2, 3 (n = 22); 10. *E. lineolata*: locality: 4 (n = 1); 11. *E. multiocellata*: locality 3 (n =1); 12. *E. s. scripta*: localities: 5, 10 (n = 7); 13. *E. grammica*: locality: 10 (n = 1). 14. *Eremias v. velox*: locality 3 (n = 1); 15. Colubridae: *Coluber ravergieri*: localities: 2 (? - skins only), 4, 5 (n = 6); 16. *Elaphe dione*: locality: 3 (n = 4); 17. *Natrix tessellata*: localities: 4, 11 (n = 3); 18. *Psammophis lineolatus*: localities: 3, 10 (n = 2).

DISCUSSION AND CONCLUSIONS

Phrynocephalus h. helioscopus, *Eremias a. arguta* and *Coluber ravergieri* [recorded 66 km ESE of Chilik (locality 2)] are species characteristic of open steppe areas in southern Kazakhstan.

During timed searches, a total of eight species was observed in each of the Charyn River Canyon (locality 3) area (n = 37; 9.0 search-hours) and in

Cyrtopodion r. russowi, SVL 65 mm, Charyn River Canyon, S. Kazakhstan, rocky surface with low shrubs, 6-7.ix.98. Photograph © Lee Grismer.

Teratoscincus s. scincus, SVL 70 mm, collected during early hours of darkness, part vegetated sand dunes by lakeshore, Lake Kapchagay, 18 km ENE of Kapchagay town, S. Kazakhstan, 8.ix.98. Photograph © Lee Grismer.

Eremias v. velox, SVL 80 mm, Charyn River Canyon, S. Kazakhstan, rocky surface with low shrubs, 6-7.ix.98. Photograph © Lee Grismer.

Asymblepharus alaicus kucenkoi, SVL 85 mm, collected on mountain near Almaty, S. Kazakhstan, 2.ix.98. Photograph © Lee Grismer.

Coluber ravergieri, SVL 500 mm, collected during late afternoon, cliff base, by Ili River (rock drawings), 29 km NNE of Kapchagay town, S. Kazakhstan, 7.ix.98. Photograph © Lee Grismer.

Natrix tessellata, SVL 450 mm, collected during late afternoon, in riverine habitat by tributary rivulet of the Kaskelen River, 48 km N of Almaty, 9.ix.98. Photograph © Lee Grismer.

the comparably surveyed two sites (localities 4 and 5) of the Ili River area (n = 28; 6.2 search-hours). Surveying was not systematic, although a site-search technique was common to each (the Charyn River Canyon and Ili River valley both included searches after darkness). Numbers recorded from visual encounters were not therefore absolute, and recording in the Charyn River Canyon may in fact have been deficient, with rather lower sighting frequency than in the Ili River area. The Ili River habitats were damper than the generally arid conditions of the Charyn River Canyon. Shannon-Wiener Index of Diversity - H ' (Magurran, 1988) was respectively 1.530 (evenness 0.736) and 1.935 (evenness 0.930), indicating that diversity was higher (also evenness greater, as expected) in the Ili River than in the Charyn River Canyon area, and the difference was significant ($t = 2.37$, d.f. 21, $P<0.05$).

The lizards *Eremias lineolata* and *E. s. scripta* and snakes *Coluber ravergieri* and *Natrix tessellata* were not recorded at the Charyn River Canyon, nor in the Ili River valley were the lizards *Eremias a. arguta*, *E. v. velox* and *Phrynocephalus h. helioscopus*, and snakes *Elaphe dione* and *Psammophis lineolatus*, which are more steppe and plateau dwelling than river valley species. Locality records for *Eremias lineolata* have only been made north of Lake Kapchagay, particularly in the Ili valley, and likewise *E. s. scripta* in its eastern zone (Bannikov et al., 1977). *Natrix tessellata*, also recorded by the Kaskelen River (locality 11), is undoubtedly associated with water in southern Kazakhstan, as it is elsewhere in its range, and was not recorded in dry steppe country.

The agamid *Trapelus s. aralensis* is another open steppe species, being recorded in an area vegetated by low shrubs on the Kerbulak massif (locality 6), which also supports a dense population in open grassland of the steppe tortoise *Agrionemys horsfieldi* (Kubykin, 1988). Many *T. s. aralensis* were also recorded amongst bushes of vegetated sand dunes by the artificial Lake

Eremias a. arguta, SVL 80 mm, collected during afternoon, plateau above gorge with stony surface and low shrubs, Charyn River Canyon, S. Kazakhstan, 6.ix.98. Photograph © Lee Grismer.

Kapchagay (locality 9), and it was here, associated with dunes, that *Teratoscincus s. scincus* was recorded after darkness, even with the air temperature down to 23°C (wind 5-15 kph). A number of *Rana ridibunda* were observed basking in sunshine by the lakeshore, always by water as elsewhere in southern Kazakhstan.

These preliminary observations give some indication of common species that may be sighted in certain of the habitats in southern Kazakhstan, and their relative abundance. The information enables more systematic surveys to be designed for hard data to be yielded on species richness, composition and relative density. These are components intrinsic to biodiversity, and the species assemblages may then be used as a bioindication of the influence of anthropogenic factors on populations in the field. Certain species will be found to be characteristic bioindicators of pristine conditions, and others of habitat disturbance due to agricultural development; further common species would be used as bioindicators of contamination levels from chemical spills and treatment of crops with pesticides. As a link in the food chain between invertebrate prey and higher-up predators, the residue loads of lizards sampled from the field and subject to whole body residue analysis will be biomarkers of the levels of pesticides entering wildlife food chains.

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Appendix 1

List of amphibians and reptiles in the Almaty region [Almatinskoi Oblasti], southern Kazakhstan (compiled by R.A. Kubykin, in litt.)

AMPHIBIA
Order ANURA
Family Bufonidae
Genus *Bufo* Laurenti, 1768
B. danatensis Pisanetz, 1978*
B. viridis viridis Laurenti, 1768
Family Ranidae
Genus *Rana* Linnaeus, 1758
R. asiatica Bedriaga, 1898*
R. ridibunda Pallas, 1771

REPTILIA
Order TESTUDINES
Family Testudinidae
Genus *Agrionemys* Khozatsky & Mlynarski, 1966
A. horsfieldi (Gray, 1844)

Order SQUAMATA
suborder SAURIA
Family Agamidae
Genus *Phrynocephalus* Kaup, 1825
P. guttatus guttatus Gmelin, 1789
P. helioscopus helioscopus Pallas, 1771
P. mystaceus (Pallas, 1776)
P. versicolor paraskiwi Semenov, Brushko, Kubykin & Shenbrot, 1987*
Genus *Trapelus* Oliver, 1804
T. sanquinolentus aralensis Lichtenstein, 1823
Family Gekkonidae
Genus *Alsophylax* Fitzinger, 1843
A. pipiens (Pallas, 1814)
Genus *Cyrtopodion* Fitzinger, 1843
C. russowi russowi Strauch, 1887
Genus *Teratoscincus* Strauch, 1863
T. scincus scincus Schlegel, 1858
Family Lacertidae
Genus *Eremias* Wiegmann, 1834
E. arguta arguta Pallas, 1773

E. grammica (Lichtenstein, 1823)
E. intermedia (Strauch, 1876)
E. lineolata (Nikolsky, 1896)
E. multiocellata (Günther, 1872)
E. scripta scripta Strauch, 1867
E. velox velox Pallas, 1771
Genus *Lacerta* Linnaeus, 1758
L. agilis Linnaeus, 1758
Family Scincidae
Genus *Ablepharus* Lichtenstein, 1823
A. deserti Strauch, 1868
Genus *Asymblepharus*
Eriomtschenko & Szcerbak, 1980
A. alaicus kucenkoi Nikolsky, 1902
suborder SERPENTES
Family Boidae
Genus *Eryx* Daudin, 1803
E. miliaris tataricus
Lichtenstein,1823
Family Colubridae
Genus *Coluber* Linnaeus, 1758
C. ravergieri Menetriés,1832
Genus *Elaphe* Fitzinger, 1832
E. dione (Pallas,1773)
Genus *Natrix* Laurenti, 1768)
N. natrix scutata Pallas,1771
N. tessellata (Laurenti,1768)
Genus *Psammophis* Fitzinger, 1826
P. lineolatum (Brandt,1838)
Family Crotalidae
Genus *Agkistrodon* Beauvois, 1799
A. halys caraganus Eichwald,1831
Family Viperidae
Genus *Vipera* Laurenti, 1768
V. ursinii (Bonaparte,1835)

Amphibia: Number of species in Kazakhstan - 11; number of species in the Almatinskoi Oblasti - 4 (36.4%).

Reptilia: Number of species in Kazakhstan - 51; number of species in the Almatinskoi Oblasti - 28 (54.9%).

Appendix 2

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ANTS AND TERMITES ARE THE DIET OF THE MICROHYLID FROG *ELACHISTOCLEIS OVALIS* (SCHNEIDER, 1799) AT AN *ARAUCARIA* FOREST IN RIO GRANDE DO SUL, BRAZIL

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ABSTRACT.— The diet of *Elachistocleis ovalis* was studied based on material from the Serra Geral in the Brazilian state of Rio Grande do Sul. Stomachs of 16 frogs captured in their natural environment were flushed. *Elachistocleis ovalis* had an insectivorous diet composed exclusively of Hymenoptera and Isoptera. Ants of the subfamilies Myrmicinae, Dolichoderinae, Ponerinae and Ecitoninae were the most common prey items. Feeding experiments in the laboratory showed that *E. ovalis* has a defensive reaction which consists of crouching and attempting to burrow its head into the ground when offered ants of the subfamily Formicinae.

THE anuran fauna of the subtropical Rio Grande do Sul in the south of Brazil is remarkably diverse. Braun & Braun (1980) recorded 62 species and subspecies for this state. The most recent checklist (Kwet, 2001) comprises 79 species. The greatest number of species in the region is found in the state's northeastern mountains of the Serra Geral, at altitudes of around 1000 m, and on the adjacent Atlantic-facing slopes. About 50 species of frogs and toads occur in the rain forest of these upland areas (Kwet, 2000). The local anuran community has been intensively studied, and 36 taxa alone have been found in the *Araucaria* forest reserve Pró-Mata (Kwet & Di-Bernardo, 1999). Most of these species belong to the Hylidae (19) and Leptodactylidae (12) with, in addition, two microhylids, two bufonids and one pseudid. The two Microhylidae are *Elachistocleis erythrogaster* Kwet & Di-Bernardo, 1998 and *E. ovalis* (Schneider, 1799). The taxonomic status of the latter is unresolved (Frost, 1985) and we follow Klappenbach & Langone (1992) and Kwet & Di-Bernardo (1998, 1999) in considering *E. bicolor* (Valenciennes, 1838) a junior synonym of *E. ovalis*. Data available on the natural history of this small microhylid are limited and little is known about its diet. Cei (1980) called the species termitophagous whereas Langone (1994) mentioned ants as typical prey. Kwet & Di-Bernardo (1999) described *E. ovalis* as a fossorial form, feeding mainly on termites and ants. In order to obtain more precise information on presumed prey selection, we studied the stomach contents of this frog at the Pró-Mata reserve.

MATERIALS AND METHODS

The study was carried out December 2000 through March 2001 in the Pró-Mata reserve, located in the municipality of São Francisco de Paula, Rio Grande do Sul, at 29°S and 50°W. At the collecting site near the entrance of the reserve are small temporary ponds in an area of open grassland (campos); these fill with water after rains in springtime and may dry out in summer. Average annual precipitation, as measured at the nearby reserve's weather station, is about 2200 mm.

Sixteen adult *E. ovalis* were collected after heavy rainfall. Their stomachs were flushed as described by Patto (1998) and prey items identified under a stereomicroscope to genus level. In a feeding experiment, ten frogs were kept for 48 hrs in a terrarium at the field station. All specimens were placed in separate plastic boxes measuring 10 x 10 x 8 cm, containing earth and small stones as hiding places. After a period of two hours, all frogs had burrowed into the earth with only their snouts visible. Prey tests were conducted with ants of the nine most abundant species at Pró-Mata (four Myrmicinae, two Formicinae, one Ecitoninae, one Ponerinae and one Dolichoderinae) and termites of two species. Single prey items were offered with forceps to the frogs at 5 mm distance from the head and left in this position for ten seconds. If the prey was not taken during this time, it was removed and the next item was presented. The tests were run at intervals of one minute. If a frog attempted to feed upon the item, its reaction time was recorded.

Prey taxa	***n***	%
Insecta		
Hymenoptera		
Dolichoderina		
Linepithema	12	8
Ecitoninae		
Neivamyrmex	14	9
Formicinae		
Paratrechina	4	3
Myrmicinae		
Cyphomyrmex	25	16
Pheidole	22	15
Solenopsis	20	13
Wasmannia	1	1
Ponerinae		
Gnamptogenys	1	1
Hypoponera	2	1
Isoptera	50	33
Total	**151**	**100**

Table 1. Stomach prey content of 16 adult *Elachistocleis ovalis*. The four most frequent (>10%) items are given in bold italics.

RESULTS

In most of the frogs (15 out of 16), the flushed stomachs contained food. On average about 10 prey items were found per stomach. The maximum content comprised remnants of 34 insects. One stomach contained only one prey item. Based on the identification of 151 items, 10 prey categories could be distinguished (Table 1). Ants

Feeding tests with individual frogs	Prey items presented to the frogs, adult *Elachistocleis ovalis*, and the lag time in seconds until the insect was captured										
	Solenopsis saevissima	*Pheidole* sp.	*Acromyrmex crassispinus*	*Cyphomyrmex* sp.	*Camponotus* sp.	*Brachymyrmex* sp.	*Neivamyrmex* sp.	*Hypoponera* sp.	*Linepithema humile*	Termite sp.1	Termite sp.2
1	6	7	-	-	dr	dr	-	6	-	-	-
2	7	8	-	-	dr	dr	3	5	-	-	3
3	5	6	-	-	dr	dr	-	6	-	-	3
4	5	9	-	-	dr	-	-	-	-	-	6
5	10	-	-	-	dr	dr	10	10	-	-	8
6	3	5	-	-	dr	dr	4	4	-	-	7
7	6	6	-	-	dr	dr	-	8	-	-	8
8	-	5	-	-	dr	dr	-	10	-	-	6
9	5	6	-	-	dr	dr	-	8	-	-	6
10	-	3	-	-	dr	dr	9	-	-	-	3

Table 2. Reactions of 10 laboratory-maintained adult *Elachistocleis ovalis* to live ants and termites. The test items were offered in sequence to the same frog, and thereafter the next frog was tested. For those items not accepted by the frogs, their alternative reaction, as dr = defensive reaction or - = no feeding attempt, was recorded.

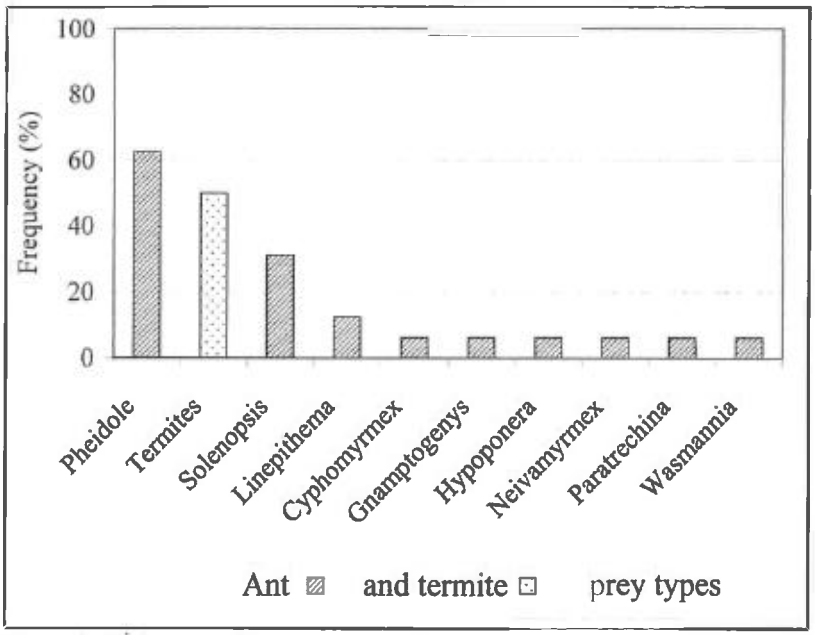

Figure 1. Diet composition in *Elachistocelis ovalis.*

predominated in the diet, representing (2/3) of all items. All the rest were termites. The latter were found in half of the stomachs. Of the ants, workers of two taxa were frequently found: about (2/3) of the stomachs contained *Pheidole* and about (1/3) *Solenopsis* ants (Figure 1).

In our feeding experiments, most of the ten adult *E. ovalis* accepted ants of the subfamilies Myrmicinae, Ponerinae and Ecitoninae. In contrast, when ants of the subfamily Formicinae were presented, they showed defensive behaviour, which consisted of crouching and attempting to burrow their head into the earth. Of the two undetermined species of termite, the workers of one were accepted whereas the others were ignored. The minimum time from presenting the prey until the frog made a feeding attempt was three seconds. During the first three seconds fast movement of the nostrils were observed in all frogs, suggesting that prey selection in *E. ovalis* is in part olfactorial.

DISCUSSION

At our study site, the south Brazilian *Araucaria* forest reserve Pró-Mata, the diet of adult *Elachistocleis ovalis* was found to consist of ants and termites only. Ants of the genera *Pheidole* and *Solenopsis* were the most frequent prey. Only two stomachs contained ants of the genus *Cyphomyrmex*; one individual contained 23 *Cyphomyrmex*. Two species of this genus, *minutus* and *olitor*, are common in Pro-Mata and occur syntopically. In one stomach, remnants of 14 individuals of the ant genus *Neivamyrmex* were found, a group of relatively rare taxa due to their nomadic life (Gotwald, 1995).

According to our data based on stomach contents, the microhylid *Elachistocleis ovalis* should be regarded an ant and termite specialist, as indicated by Simon & Toft (1991). Specialisation on ant prey is documented for various species of the subfamily Microhylinae, e.g., *Chiasmocleis ventrimaculata*, *Hamptophryne boliviana* (Schlüter & Salas, 1991) and *Microhyla ornata* (Hirai & Matsui, 2000), and may be a common pattern of nutrition in adults of this group.

In our feeding experiments, *Elachistocleis ovalis* accepted ants of the subfamilies Myrmicinae, Ponerinae and Ecitoninae. However, they showed defensive reactions towards Formicinae which may be due to the strong formic acid secretion in ants of this subfamily. Similar defensive behaviour when handled has been observed in *E. erythrogaster* (Kwet & Solé, in press). Defensive behaviour against ants has been also recorded for the African microhylid *Phrynomantis microps* (Rödel & Braun 1999) when placed in containers with the ant species *Paltothyreus tarsatus*; the frogs immediately crouched and, after some seconds, elevated the posterior part of the body and laid their heads between their forelegs.

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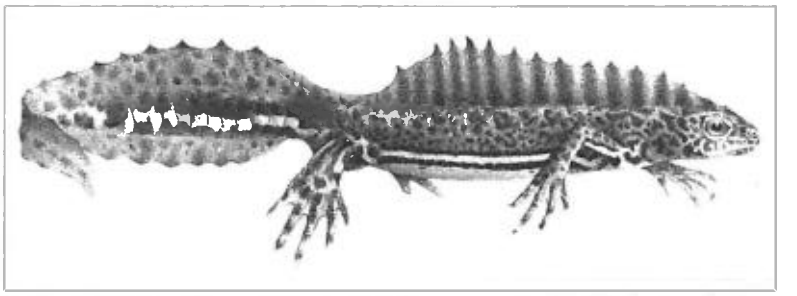

Molga vittata (= *Triturus vittatus).* From *Proceedings of the Zoological Society of London*, 1896. Reproduction courtesy of the Zoological Society of London

THREATS FACING ENDEMIC HERPETOFAUNA IN THE CLOUD FOREST RESERVES OF ECUADOR

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ECUADOR is a small equatorial country (283,520 sq. km) on the western coast of South America. Colombia is to the north and Peru to the south. Its diverse natural history, striking scenery, and fascinating anthropology continually inspire questions about its geographical and ecological make-up. Ecuador is one of the world's 'mega-diverse' countries, having more plant species as a country than the whole of Europe (Rachoweiki, 1997). It is a link in an arc of distinctive biodiversity stretching from the Eastern Andean base of Venezuela right through to Bolivia. There are four geographical regions; coastal lowlands, Andean highlands (Sierra), Amazonia (El Oriente), and the famous Galapagos archipelago, where animals exhibit no apparent fear of man (Jackson, 1993).

The coastal region is a mix of cliff headland, large estuarine rivers, grove forests, meandering rivers, and flat valleys. The Andean highland mountains stretch north to south of the country and have an eastern and western ridge (9900-13,200 ft / 3-4000 m) with a dip separating them (altiplano 6600-9900 ft / 2-3000 m) that stretches 10-20 km wide. This parallel mountain chain boasts gigantic snow covered volcanoes, paramó, and cloud forest environments. The Amazonian region equates to nearly 50% of Ecuador's territory and has four major rivers flowing in a southeasterly direction to one of the main tributaries of Peru and Brazil.

Ecuador's climate is typical of many tropical regions and is split into wet and dry seasons depending on geography. The Galapagos and coastal climate are affected by oceanic currents from the warm equatorial Pacific. They are hot and rainy between January and April, overcast during July / August and are generally cooler from May - December. El Oriente is wettest during April - June and drier from August-December, although rain in the region is often irregular. The highlands and paramó are dry from June-September and after a short dry spell during December becomes progressively wetter, with most rain falling in April. Rain does not fall daily during the wet season. Day time temperatures are around 20-22°C (68-72° F) for the highlands and they have a year round low of 7-8° C, 45-48°F, based on data from Quito (Rachoweiki, 1997). Despite this apparent trend all regions can be unpredictable in their weather patterns.

DESCRIPTION OF STUDY AREAS

Cashca Tortoras is located in the Bolivar province and is named after the native Cashca Tree (Cunoniaceae). The Bolivar province is home to a large agricultural fraternity despite having an elevation of just 200 m at its lowest point. Cashca Tortoras consists of approximately 10 ha of Tropical Montane Cloud Forest (Holdridge, 1967) of which 2 ha is owned by the Universidad De Bolivar. Cashca Totoras research station is located at the top of a basin of forest (1° 43' 03.7" S, 078° 58' 40.8" W: 3100 mamsl) and was built in 1994. The forest has a northern ridge and stream gullies that percolate south joining a central stream in a herringbone fashion. The stream gullies trickle water at a depth of barely a few inches and are usually less than 1 m wide, the main stream being approximately 2 m at its widest point and rarely more than 1 ft deep. The slopes are very steep and clouds roll beneath the research station into the valley basin. Rainfall in this valley can occur both above and below the station. The forest vegetation has a mixture of shrubs (local names in italics)

from the Araceae (Camacho), Asteraceae, Ericaceae (Mortiño; edible berries, well used by locals), Graminae, Gunneraceae, Moraceae, Pipperaceae, and *Polylepis* (Cascarilla paper bark trees). The Araceae leaves are broad with a waxy appearance. They stand anything from 15-30 cm and frogs use them for 'sit and wait' ambush or vocalising posts. Several tropical orchid species can also be found. Cashca Totoras boasts some incredible fauna — parakeets, tarantulas, large beetles, stunningly diverse Lepidoptera and phasmids (stick insects) are just a few to mention. Several secretive ground -dwelling mammals that were not identified also patrol the area. General conditions at Cashca Totoras are 10-17°C (50-63°F), elevation 9070-11340 ft, and 1000-1500 mm annual rainfall.

Andean Paramó and puna are areas above tree-line that superficially resemble an alpine tundra, but are unique because of the extreme temperature fluctuations. This habitat is characterised by high winds, large amounts of precipitation, and increased UV light levels. Due to these environmental extremes, the flora has evolved specific morphological features such as short stature, thick stems, and persistent leaf bases. Paramó flora includes spongy lichens, hardy wildflowers, dense thickets, and clumps of tussock grass. Among its various animal inhabitants are Marsupial Frogs, endangered condors, Pumas, Andean Spectacled Bears, Pudu Deer, ducks, falcons, and Paramó Hummingbirds. Over 1400 Ha of paramó habitat surrounding Cashca Tortoras is protected by national legislation. Many of the amphibians found in this habitat are extreme opportunists and can breed in the smallest pools. Temperatures range from 3-6°C (37-43°F), annual rainfall from 500-1500 mm. Elevations range from 12960-14250 ft.

Rio Azuela is located north east of Quito toward Cayambe, close to the borders of the Napo and Sucumbios provinces. The areas of forest surveyed at Rio Azuela follow the banks of the Rio Grada River, which is located in a deep valley, making the terrain steep. Two trails were surveyed. The first was a flat ridge walk that followed a southerly winding stream that eventually looped back on itself. It joined a larger stream that would eventually connect with the main tributary. The site trails extended at their furthest to San Rafael falls. They proceed upstream to a small area of local accommodation and cross the stream many times. The stream was fast flowing, 2 m at its widest point, and pools were no more than 60 cm deep. One trail was further north of our accommodation in a small roadside patch of forest and had a pool. This area was dense and its trails needed to be re-cut before surveying. The forest vegetation of Rio Azuela mirrored that of Cashca Totoras, although understorey shrub layers were more dense. Orchids, melastomes, bromeliads, and bryophytes are present illustrating the site's floral diversity. Rio Azuela was warmer than Cashca Totoras due to a drop in elevation (18-22°C / 64-72°F, 5640 ft). It was also notably more humid (1500-2000 mm annual precipitation) and is classified as Cloud Forest (Holdridge, 1967).

SPECIES DESCRIPTIONS

The following papers and guides were used for classification and identification: Coloma (1995), Duellman & Hillis (1987), Lynch & Duellman (1997), Miyata (1982). The survey results and morphometric data collected in the field are excluded from this report as it is to be collated with further surveys for relative distribution analysis and publication by PUCE. Key: CT = Cashca Totoras / RA = Rio Azuela / (p) = paramó.

AMPHIBIA

ANURA: Hylidae

Gastrotheca pseustes, San Lucas Marsupial Frog (Duellman & Hillis, 1987), CT (p). — Adults of this species were not found. The individuals we encountered were a mixture of young and developing tadpoles. *Gastrotheca pseustes* tadpoles are easily identified by their large black bodies. The developing individuals were in stage 43-44 (Gosner, 1960; also see Duellman & Trueb, 1986), having fully developed front and rear limbs and well formed jaws and tongue. Those that were in stage 41 (without emerging front limbs) still had larval mouthparts. The developing tadpoles had

blotched tan coloured markings and a dark band through the eyes. Each dorsal blotch had a gold ribbed edge. They exhibited a golden underside, blunt snout, and block-shaped head. This species is known to be susceptible to Chitrid fungus (Berger, et. al, 1999).

Osteocephalus verruciger, Slender-legged Treefrog (Werner, 1901), RA. — The single specimen caught was an adult male with a SVL of 5.0 cm. A medium-sized treefrog with a warty dark brown/green body and head. It has an orange-brown groin and has a creamy blotched underside and throat. It has bulging eyes, wide nostrils, and a large tympanum. Its large hind limbs are dark green and the feet are a blend of pink and orange with pronounced toe-pads, indicating its arboreal habits.

Leptodactylidae

Eleutherodactylus marmoratus, Marbled Robber Frog (Boulenger, 1900), RA. — This frog has a marbled upper body with no dorso-lateral folds. It has a rounded snout, red/pink throat, white spotted underside, small back legs and, large mushroom shaped toe-pads. The specimen we caught had a SVL of 3.0 cm.

Eleutherodactylus peruvianus, Peru Robber Frog (Melin, 1941), RA. — This tan brown robber frog has prominent dorso-lateral folds, mushroom shaped toepads and striped eyes that have two black spots behind them. Its underside is yellow, the groin red, and its dorsum brown. This frog was common at Rio Azuela.

Eleutherodactylus phoxocephalus, Cotopaxi Robber Frog (Lynch, 1979), CT. — This medium sized frog had golden yellow spots on the lateral region, a cream belly, and light brown back. It has a small, sharp snout and mushroom shaped toe-pads. Markings of *E. phoxocephalus* are highly variable. Most of the specimens had tan coloured chevron arrangements on the back. The species has a large, lemon yellow vocal sac.

Eleutherodactylus prolatus, Hidden Robber Frog (Lynch & Duellman, 1980), RA. — The dorsal surface of this frog has only a few warts. It has a large tympanum, long head and an 'H' shaped occipital mark. The underside is cream and there are brown streaky patterns on its cream throat.

Eleutherodactylus pyrrhomerus, Lynch's Pilalo Robber Frog (Lynch, 1976), CT. — Males have a yellow spot/area on the groin and females a red spot. Both sexes have long toes. *Eleutherodactylus pyrrhomerus* is a very common species at Cashca Totoras and can be found close to streams, under logs, and nestled in moss. Juvenile males were also observed. They have a mottled grey throat with a light yellow belly. The lower portion of the throat was pinkish and they had mottled brown backs. Juveniles have a central zip-type line on the underside, a key feature in their identification.

Eleutherodactylus quaquaversus, Rio Coca Robber Frog (Lynch, 1974), RA. — Adult females of this species had the appearance of a short, plump frog with mushroom-shaped toe pads. They had a non-uniform, mottled, eggshell-coloured back with a few tiny black dots. They were easily distinguished by two dark brown chevrons on each thigh. *Eleutherodactylus quaquaversus* has a short snub snout and eyes that are beige with a creamy pink horizontal pupil. Juveniles had a striking bright orange bar between the eyes and a greenish groin. *Eleutherodactylus quaquaversus* may be identified by the presence of elbow, heel, and eyelid tubercles.

Eleutherodactylus simonbolivari, Simon's Robber Frog (Wiens & Coloma, 1992), CT. — This small brown frog is endemic to Cashca Totoras and has a dusky red orange colour on its palms. Its groin flash markings are conspicuous and consist of a black patch with a single white or orange spot. *Eleutherodactylus simonbolivari* has a deep red throat and white speck on its legs. It has a rounded snout, round pupil and golden iris. A key feature of this species is its enormous vocal sac. Several males were observed calling and each had vocal sacs almost as large as the frog itself. Its call is comprised of two high pitched 'chinks' spaced by a two second interval.

Eleutherodactylus truebae, (Lynch & Duellman, 1997), CT. — Adult *E. truebae* have three distinctive stripes on each hind thigh and dorso-

lateral folds. Two white stripes run dorso-laterally from the snout, over the eye ridges toward the groin. They have lemon yellow throats and a white spotted stomach. Juveniles do not have the dorso-lateral striping, but have a dark brown dorsum, and a small light brown cap on the tip of the snout. Both adults and juveniles have a dark eye stripe that distinguishes juveniles of this species from other eleutherodactylines at Cashca Totoras.

REPTILIA

SERPENTES: Colubridae.

Leptodeira annulata, RA. — Only juveniles were encountered. They had a white rostral stripe, white collar, and bead-like eyes. The head was noticeably wider than the wiry body. The dark saddle markings on its body were white lined and several white bands were present on the neck. The saddles were interspersed with grey and white bands. SVL approximately 10-15 cm.

LACERTILIA: Hoplocercidae.

Enyalioides cofanorum, Duellman's Dwarf Iguana (Duellman, 1973), RA. — A medium-sized lizard (10-12 cm SVL/10-15 cm TL) with a pointed snout, rounded triangular head, and scaly-ridged eyelids. It has prominent eyebrow ridges and its small dewlap has a dark spot on the base. The dark green background skin colour is covered with granular green spots yet the belly is a simple light green. It has a yellow spot behind the ear and a short spiky crest on its head that stretches down its back, almost in line with its venter; this was not continuous with the tail and had simple dark banding. *Enyalioides cofanorum*'s claw-like toes (front - ca. 2 cm, rear - ca. 4 cm) advertised its agile climbing ability and made capture difficult. This species is a little erratic when handled, persistently gaping its mouth displaying its pink mouth. It occasionally bluffed a bite.

Teiidae: Gymnophthalmidae (Microteiids).

Proctoporus cashcaensis, Kizirians Lightbulb Lizard (Kizirian & Cucoma, 1991), CT. — A small, black-bodied lizard with white throat specks and orange/white marks on the underside of its tail base. It has a pointed snout, granular dorsal scales, large belly plates, high eyebrow scales, and a pink mouth lining. The specimen encountered had a complete tail and was approximately 4.5 cm SVL (5.0 cm TL). It was found unintentionally, outside of survey time during a leaf litter examination. Interestingly, five tiny eggs (identified as possibly belonging to *P. cashcaensis*) were found close by during a second leaf litter examination. They were small, dull white, and rotund in shape. This species bites frequently when handled.

Enyalioides cofanorum. Rio Azuela. Photograph by Tim Aplin and Todd Lewis.

DISCUSSION

Ecuador is the world's third leading country in amphibian diversity (415 species) and about half of its species are endemic. Declines of several species of anurans have already occurred in the Equadorean Andes (Coloma, 1995; Stebbins & Cohen, 1995). Species that are known to have declined are listed in the Appendix, although this may change and such decline patterns could eventually become extinctions. The exact magnitude of these declines is unknown and concern is now great. Unusually, there are very few scientific publications that specifically address the problem for Equador, despite the fact that the number of possibly affected species is comparable to those of countries like Costa Rica or Panama where amphibian declines have

received considerable attention and publicity (Pounds & Crump, 1994; Lips, 1998; Lips, 1999; Ron & Merino, 2000). Investigations on this theme are currently being undertaken by staff and students of the Pontificia Universidad Catolica del Equador. *Colostethus* have been missing from both areas mentioned in this report, where in such ideal, fast flowing aquatic habitats they have previously been abundant. During our visit we failed to find any *Colostethus* species and it is feared that chitrid fungus could be to blame. Chytridiomycosis has been responsible for deaths in *Gastrotheca pseustes*, *Telmatobius niger*, and *Atelopus bomolochos* in Equador and can cause fast and high levels of mortality in anuran populations (Berger, et al. 1998). Funded by the DAPTF, researchers Santiago Ron, Luis Coloma, Andrés Merino, and Juan Guayasamín of Pontificia are acting swiftly to try to establish the geographic and taxonomic range of Chytridiomycosis. The need for research has become so critical that a network has been set up to facilitate exchange of information, and to motivate institutional cooperation about the decline problem. The 'Jambato' network, as it is known, takes its name from the popular name of the bufonid *Atelopus ignescens*, a once common inhabitant of the high Andes which is now extinct (Vázquez & Romo, 2000).

Chitrid fungus is not the only threat. Agriculture has had an alarming toll on Ecuador's natural habitats. The rise in farming is largely fuelled by population increases and short-term trade gain efforts. Ecuador's major industries include bananas, shrimp, fish, coffee, textiles, metal work, paper products, wood products, chemicals, plastics, fishing, lumber, and oil exploration / extraction. In the Sierra region of northeastern Ecuador approximately 60% of cropland has been hastily abandoned because of inappropriate agricultural practices creating severe soil erosion and degradation (Southgate & Whitaker, 1992). The Ministry of Agriculture and Livestock report that 84% of soils in hill forest areas should never have been cleared for pastures because of increased erosion of soil that is already limited in fertility (Southgate & Whitaker, 1992).

Deforestation is the most dangerous threat to all physiographic regions of Ecuador (western coastal lowland, central Andean highlands, and eastern Amazonian lowlands). Deforested slopes eventually become a mix of strip agriculture for consumable crops, timber plantations, cash crops, or grassland for livestock. The western coastal lowlands were heavily forested but have suffered over many years due to expanding shrimp ponds supplying the export trade. Nearly 95% of western lowland slopes are farmed, mostly for bananas (Rachoweiki, 1997). The less disturbed western provinces of Los Rios, Manabi and El Oro are threatened by oil extraction and increasing human population. Unfortunately, highland cloud forest areas on and below paramó habitats are often clear felled and planted with pine trees for the timber trade. *Pinus patula* and *P. radiata* are widely used in the areas surrounding Cashca Totoras. They are highly competitive and can dominate the landscape. Even selective removal of timber from cloud forest areas can easily be a threat and cause alteration of the ecosystem. Studies by Pearman (1997) have shown that removal of trees from sensitive areas (i.e. those with less hardy and often endemic species) can alter the species composition of amphibians within a forest.

Pristine alpine paramó is a unique and threatened ecosystem that takes a long time to recover from human disturbance. The widely used name 'paramó' encompasses many natural grasslands and can sometimes be confused with grassland for grazing. Much of the existing paramó-type habitat with bunch grass that occurs below 4300 m is not natural habitat (Laegaard, 1992). Evidence suggests that a large proportion of the high Andes (4000-4300 m) was probably covered by *Polylepis* woodland in ancient times (Ellenberg, 1958; Fjeldså & Kessler, 1996). Pristine paramó that has not been grazed can exhibit oddly shaped 'frailejon' plants and spine ridden 'achupalla' that grow to more than three metres in height. Distinguishing which grassland areas need priority protection could be essential in the creation of reserves (see Battersby, 1999). Over 4500 ha of paramó is protected compared with 1400 ha of forest habitats (for Bolivar

region). Such designation of restricted status can also help prevent illegal poaching, provided the land is monitored. Pine timber and the clear felling of forest areas for cattle grazing are currently the major threats to Cashca Totoras paramó areas due to the unsuitably harsh conditions preventing the successful cultivation of alternative crops.

Cashca Tortoras' montane forest is at risk from encroaching human activities. The site has already reduced significantly in size and this reduction could affect the 'carrying capacity' for its biodiversity. It is slowly becoming isolated by increasing pressures on and around the buffering zone that separates it from agricultural plots. Agriculture is encroaching from the eastern slopes (mainly clear felling for livestock), and an area on the steep northern tip of the forest area had been burned and exhibited a scar on the landscape. If the areas above the gullies are ever used for crop cultivation (even though it may have limited success), leaching of agrochemicals could become a potential threat to aquatic flora and fauna (due to steep slope run off and persistent precipitation). Local farmers and communities are informed that the area is a reserve and relationships between the University and satellite villages remains healthy, providing an element of security for this pocket of rainforest.

Illegal stripping of land tenure is also common in parts of Ecuador. Some large organisations support colonisers who occupy and clear forested land even though the original land titles are not their own. After land is cleared, the colonisers sell their parcels of land to the supporting organisations at a meagre cost. The original landowners are then left with nothing and have no means of rectifying any habitat change (Southgate & Whitaker, 1994). In recent years the Equadorean government has had much trouble in financing the protection of land. One example is the forests of the Mache-Chindul mountains in the northeast of the country. The forests here are a sanctuary for many threatened species, including Jaguars (*Panthera onca*) and Giant Anteaters (*Myrmecophaga tridactyla*). Ecuadorian conservationists had asked INEFAN (the Ministry of Parks and Conservation) to set aside 20,234 ha of the region as a national park but only a fraction of this has been protected because INEFAN's budget is too small to buy the land titles. This has let the way clear for loggers to buy land rights from indigenous communities and local landowners (BBC Wildlife, 1997).

It is not just Ecuadorean's who are placing pressure on their natural resource. In 1999 a US-based pharmaceutical company developed a powerful painkiller that had no side effect and whose active ingredient is derived from the poison secreted by a poison-dart frog of the *Dendrobates* genus (Saavedra, 1999). It was found only in the foothills of the Ecuadorean Andes. Two Ecuadorean environmental organizations believe that 750 poison-dart frogs were taken into the USA in 1996 without permission (Saavedra, 1999). The projected earnings from the new analgesic (ABT-594) should have enabled Ecuador to benefit from the discovery but the country has no legal means for seeking compensation because the USA has not ratified international conventions dealing with biological resources (Saavedra, 1999). Ecuador's economic climate has changed drastically since dollarisation. The government recently decided to replace the national currency with the US dollar in an attempt to pull the country out of the worst economic crisis in its 170-year history. This means the economy will need a serious injection of dollars — fast. Environmentalists and Amazon natives fear the government will do this by implementing a 'no holds barred' oil extraction program in the Amazon basin (Elton, 2000).

Despite the pressures on its environment, Ecuador still attracts thousands of visitors, particularly to its rainforests. The Indian natives and highland hiking attract many travellers. Tourism is perhaps the fourth largest source of revenue, although how much of this gets recycled back into conservation and preservation is unknown. In the Galapagos, ecotourism has fortunately been restricted by the avoidance of large resort hotels in favour of qualified warden-led tours. Galapagos would seem to be a successful example of how to exploit a highly sensitive habitat, and still keep it intact.

Fragmentation and its effects on the biodiversity of neotropical habitats are slowly beginning to be understood through the analysis of long term data (Battersby, 1999). However, even protected reserves that appear safe are at risk from declines (Pounds et al., 1997). New species are still being discovered every year in Ecuador (Wild, 1994; Gluesenkamp, 1995; Kizirian, 1996; Formas, 1997; Caramashci, 1998; Ron & Pramuk, 1999; Dixon, 2000; Dunn & Mathew, 2000) and their potential value to rainforest ecosystem, conservation and our society (Badio et. al., 1994; Harvey, 1999) is still poorly understood. It would thus seem vital to keep the pressure on studying these impressively diverse countries before we lose any more species that we never knew existed. With the spotlight currently focusing on the desperate issue of amphibian declines (Alford & Richards, 1999), herpetologists are indeed fast becoming, as one researcher recently phrased, 'extinction biologists' (Halliday, 2001).

SUMMARY

This report documents species of herpetofauna found in three cloud forest habitats and comments on the conservation, ecology, and precarious situation of herpetofauna in tropical Ecuador. The expedition was organised with the Pontificia Universidad Catolica del Ecuador (PUCE) and 'Earthwatch' during October 2000. Thirteen species were observed over two weeks, however one species that was previously abundant had disappeared. Ecuador's diverse herpetofauna continues to be threatened by both anthropocentric and environmental changes to its habitats.

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Appendix

List of Ecuadorian amphibian species that are believed to be facing severe population declines (see Reference section for source of data, QCAZ = Record from curators of vertebrates at Museo de Zoologica, Dept. Biol. Sci. Pont. Catol. Univ. Del Ecuador).

Species	**Last recorded date of species in its natural habitat**	**Reference**
Bufonidae		
Atelopus arthuri	1987	Coloma, 1992
Atelopus bomolochos	1994	QCAZ
Atelopus elegans	1987	Coloma, 1992
Atelopus sp. A.	1988	Coloma/in prep.
Atelopus ignescens	1988	QCAZ
Atelopus longirostris	1987	Coloma, 1992
Atelopus sp. B.	1989	Coloma / in prep.
Atelopus pachydermus	1996	QCAZ
Atelopus planispina	1983	QCAZ
Centrolenidae		
Centrolene buckleyi	1989	Coloma, 1992
Dendrobatidae		
Colostethus jacobuspetersi	1990	Coloma, 1995
Colostethus pulchellus	1996	QCAZ
Colostethus lehmanni	1990	QCAZ
Colostethus elachyhistus	1986	QCAZ
Colostethus delatorreae	1989	Coloma, 1995
Colostethus vertebralis	1997	QCAZ; Coloma, 1995
Minyobates abditus	1974	Myers & Daly, 1976
Hylidae		
Gastrotheca guentheri	1989	QCAZ
Leptodactylidae		
Telmatobius niger	1992	QCAZ
Telmatobius vellardi	1987	QCAZ
Eleutherodactylus cryophilus	1989	Coloma, 1992
Eleutherodactylus modipeplus	1970	Coloma, 1992
Microhylidae		
Nelsonophryne aecfuatorialis	1989	Coloma, 1992

A LOOK AT LIGHT

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FOR several years I have had an interest in the various types of lighting and it's uses in vivarium design. Nowadays we are spoilt for choice; open any current commercial herptile magazine and numerous adverts extolling the virtues of a particular light seem to be present on every other page. It seemed to be a suitable time to review our knowledge of light and to discuss the possible benefits of the lighting systems currently available.

Firstly, however, we must try and understand some basic physics. It should be remembered that the light which reaches the Earth is our ultimate source of energy. The light particles or photons, when they strike certain types of matter, are capable of sending electrons into higher energy levels. This brief period of time powers the process of photosynthesis in plants, the mechanism by which simple chemical substances are formed into complex organic molecules used for metabolism. Light is not only involved in this process, however, but is also an important factor which limits, controls and orientates animal processes.

Light can be characterised in two very different ways, with modern theories of quantum physics accepting that light has properties associated with particles while on the other hand it also exhibits wave-like properties. Each of these concepts can be used in certain contexts and precise quantitative relationships between them can be calculated.

There is an enormous range of electromagnetic spectrum which falls onto the Earth, from gamma rays up to radio waves. As herpetologists or herpetoculturists we tend to think only about the narrow band which we call light; this ranges in wavelength from approximately 380 nm to 760 nm. The significance of this is that it causes an effect on the retina of the human eye — we can 'see' these wavelengths. We should not however confine our attention to this particular band. Wavelengths of 300 nm to 350 nm seem to have significant effects on many amphibian and reptile species, several important photobiological processes being controlled by these.

The ultraviolet wavelengths are limited by the ozone layer which surrounds the Earth in its upper atmosphere, which cuts off the wavelengths below 300 nm. The use of lamps producing wavelengths below this figure may have serious consequences on reptiles kept in captivity in close proximity to these levels of radiation. It is now well documented that wavelengths below 300 nm will damage the delicate bonds which hold together proteins and, in particular nucleic acids; this action will result in the living cells of the organism being destroyed. In fact some forms of biological sterilisation utilise powerful U.V.C. wavelength lamps to destroy micro-organisms. The low-level U.V. wavelengths may also damage molecules by displacing electrons. However, other U.V. wavelengths bring about the activation of molecules by photochemical processes.

As humans we are well aware of the effect known as sunburn. This is due to the action of U.V. wavelengths acting on the skin. Many herptiles however seem to enjoy the effects of these wavelengths and in some species exposure to high levels appears to be a necessity. The function of U.V. light in this respect is known as photodynamic action and in some cases can cause death in certain invertebrates. It is thought that the damage is caused by proteins being oxidised, which releases toxic by-products which then damage cells. Reptiles are protected from this damage by the scales affording increased screening and therefore cutting off the U.V. from

the actively dividing layers of the epidermis. It is quite interesting to note that glass used in windows and vivarium design will also significantly reduce wavelengths below 320 nm. This figure is also significant in that the wavelengths below this are responsible for the production of vitamin D3, which is an important vitamin in the formation of bones and the utilisation of calcium in the diet. Wavelengths below 320 nm are responsible for the photochemical production of the vitamin from sterols. It is possible, however, to administer this vitamin in the diet by providing a suitable quantity of supplement dusted onto the captive animal's food supply.

It is interesting to note that in humans diet is perhaps more important than the quantity of sunlight — there is no question, however, of the importance of vitamin D during growth, and of the limited amount of effective sunlight for this purpose in some regions of the Earth. Rickets may he almost unknown among Eskimos who are at the greatest disadvantage as far as sunlight is concerned. We are still in an area where the answers are unknown. Lighting vivariums is still very much a hit or miss affair, but what we do know with some degree of certainty is that D3 cannot be synthesised in the body without U.V. light, and that D3 is essential for the absorption of calcium. So we can say that it is likely that most diurnal herptiles will benefit from a quantity of U.V. waves and that they are an important factor in any artificial lighting system, and possibly essential for long term success.

An interesting area of research amongst avian breeders has shown that U.V. deficiencies amongst parrots produces an excess of cock birds from the offspring, but when U.V. output from the breeder's lighting systems were boosted to more natural levels, a more normal 50:50 hen/cock ratio was restored. No scientific theories have been put forward as to the possible reasons for this, nor is it conclusive that a valid cause/effect relationship exists, but the consistency of the reports (with always a surplus of males) indicates that some statistical correlation probably exists.

Within this article most emphasis has been placed upon the U.V.'s relationship to the metabolism of calcium. Light has other beneficial actions which may be as important or perhaps even more so. All living things are strongly rhythmical, the rhythms can change or disappear unless reinforced or corrected by environmental change. Light is a very strong influence in the regulation of these cycles, with it's persistent and constant differences from day to night and summer to winter. As herpetologists we work with many different species and a fundamental problem is understanding the needs of each individual. Each species will have a spectral exposure cycle that is of greatest benefit to that species, and, as we stand currently, these are unknown. More research is needed to provide the answers.

Circadian rhythms indicate activity around a period of time relating to approximately 1 day. Research has shown that in many animals the activity rhythms are short of 24 hours and may vary with temperature. They can also be altered by light exposure. My pair of Green Iguanas show this form of behaviour in an easy to observe manner; on most days they climb to their 'sleeping shelf' just prior to the time-switch cutting off the lights and plunging the vivarium into darkness, following which they quickly fall into a deep sleep. If the time-switch is adjusted to vary the photoperiod the rhythm is disrupted for a few days before being corrected by the environmental change. Here we have a diurnal light cycle that has imposed an activity rhythm on the iguanas. The response to light and it's changing values has significant effects on a cycle which can take full advantage of changing seasonal conditions. This effect, known as photoperiodism, is a response to seasonal timing, which as well as light can be influenced and affected by temperature, rainfall, availability of food and other environmental cues.

It is thought that the mechanism which controls this biological clock is photosensitive pigments, and that it does not necessarily involve the normal visual receptors. Many species of lizards have an easily identifiable third 'eye' known as the parietal

gland which can be seen on top of the skull. It is thought that this is involved in photoreceptive activities, with the dorsum of the brain acting as a probable photoperiodicity site. One type of compound which is widespread and may act as a pigment used in this process is the pterins, the absorption range occurs between 340 nm and 370 nm, and so it may be necessary to have wavelengths within this range to activate the photosensitive pigments involved in the control of photoperiodic responses.

It has been put forward that the formation of gametes (sex cells) are controlled by this process and a large amount of research has shown that sexual maturation in domestic fowl is controlled by photoperiodic cycles. It thus seems likely that this is also a factor in the production of viable gametes in herptiles.

With an increasing number of companies offering lighting systems for vivariums the herpetologist is spoilt for choice. Prices for full spectrum tubes are much cheaper nowadays and bargains can be obtained by contacting lighting wholesalers. In an article of this length it is difficult to give advice on lighting systems for individual species, although my own set-ups have used several types of lamps which have both given good results in the past. I used Thorn EMI Artificial Daylight tubes for many years. These have a similar output to Durolite Tru-lite but are approximately one third of the price. For tubes producing greater quantities of U.V. I have used Philips Actinic 09 but eventually changed to Actinic 05; the latter has a good output at the 310-340 nm wavelength but it is quite dangerous to human eyes. These tubes should only be used with lizards that have a high requirement for sunlight, for example Bearded Dragons, *Uromastyx* spp. and iguanas. One disadvantage of U.V.-producing tubes is that, although they have a long life, they must be replaced annually, with some dealers recommending every six months as the U.V. output deteriorates more rapidly than the rest of the spectrum. The replacement of what appears to be perfectly good fluorescent tubes annually by costly new versions is a disagreeable chore, and if you possess an extensive collection lit by large numbers of full spectrum tubes it is a major investment. Other full spectrum tubes which may be considered apart from Artificial Daylight are G.E. Chroma 50 and Westinghouse Colourtone 50. The major lighting manufacturers are now producing a bewildering array of specialist tubes with added U.V.B. levels of light. One of the most popular with experienced reptile keepers is the Reptisun 5.0; this produces adequate quantities of U.V.B. for most diurnal species and is available at a competitive price.

There are many well documented cases where owners have taken normally docile animals outside and exposed them to natural sunlight. The exposure has radically changed the behaviour from a gentle, docile individual to an aggressive and dangerous specimen. This type of change seems particularly prevalent amongst large Green Iguanas although I have heard of large Burmese Pythons acting in a similar manner. We must remember that the animals in our care are not domesticated creatures; they are wild animals and the effect of natural sunlight on many species which are normally confined to captive indoor conditions may well bring about changes in character and increased responses to a variety of stimuli.

Lighting and it's effect on herptile behaviour is a complex field and an important part of long-term husbandry and breeding. The various mechanisms we have used to successfully keep different species need to be researched and thoroughly documented, as do procedures which have been less successful. It is time for us to devote some of our resources and energies into solving the problems and challenges associated with keeping these magnificent animals, with which many of us so enjoy sharing our lives.

EGG-LAYING HABITS OF THE MIDDLE AMERICAN ARBOREAL LIZARD *LAEMANCTUS LONGIPES*, WITH PARTICULAR REFERENCE TO NEST SITE SELECTION

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THE genus *Laemanctus* (Corytophanidae) consists of two moderately large (ca. 150 mm SVL) iguaniform lizards characterised by a unique, flat-topped cephalic casque. One species, *L. longipes* Wiegmann, occurs in wet-subhumid forests from eastern Mexico to Nicaragua, and the other, *L. serratus* Cope, is endemic to areas of more xeric deciduous forest in southern Mexico and the Yucatán Peninsula (McCoy, 1968; Lang, 1989). Both are highly arboreal species that rely on crypsis and immobility to avoid detection, and relatively uncommon, which probably explains why so little is known of their behaviour and ecology. Information on reproduction in these distinctive-looking lizards is especially limited.

In this note we describe the egg-laying habits of *L. longipes* (Eastern Casque-headed Basilisk), as demonstrated by a female observed during fieldwork in Belize on 29th April 1993. At approximately 08:30 hrs the lizard was found in a small clearing on a hilltop at GR CP088595, (elevation 520 m) in semi-evergreen broadleaf forest. This clearing had been made the day before to facilitate installation of a temporary observation tower (for bird inventory work), and apart from a few saplings left uncut to promote subsequent recovery of the site was otherwise devoid of vegetation. On the ground there was only a sparse covering of leaf litter. The nest itself was a shallow scrape between roots at the base of one of the smaller felled trees, approximately five metres away from the forest edge. When first observed the lizard was beginning to move away from the nest, which had been left uncovered, probably as a result of her having been disturbed, and contained three eggs. These were removed to avoid the possibility of them being trampled during the ensuing operations, and incubated artificially at ambient temperatures. All three, however, failed to hatch. Measurements of the eggs taken shortly after deposition were 25 x 14 mm, 26 x 15 mm, and 26 x ? mm (dented) respectively. Air temperatures on the day in question ranged from (shade readings in parentheses) 25(25)°C at 06:30 hrs to 39.5(27)°C at 12:00 hrs and 34(27)°C at 18:00 hrs. There

Female *Laemanctus longipes* at nest site. The nest scrape and clutch of eggs are visible in the lower left corner of the picture. Photograph by E. Mallory.

had been no significant rain in the previous weeks, but barometric pressure was falling and a period of regular heavy downpours followed between 9th and 14th May.

An interesting feature of this lizard's egg-laying activity is its choice of nest site, located some distance from tree cover in a relatively open clearing. McCarthy (1982) reported on a gravid female *L. longipes* that he had found also in a small clearing and which deposited eggs in captivity a day later. Such behaviour may seem somewhat irregular for an arboreal and reclusive deep forest species, but appears to be not unusual within the Corytophanidae. In Tamaulipas, Martin (1958) found individuals of *L. serratus* excavating nests in the middle of forest trails, and similar behaviour has been observed in *Corytophanes cristatus* (Taylor, 1956; Bock, 1987; Lazcano-Barrero & Gongóra-Arones, 1993) and *C. hernandezi* (Pérez-Higareda, 1981). Given the presumably increased risk of predation, both to the adult lizard during oviposition and hatchlings at the time of emergence, the strategic value of such behaviour is not clear. Many species of lizard are known to lay eggs in relatively 'exposed' areas, among them other bascilicines (e.g. Lieberman, 1980; Hirth, 1963; Fitch, 1973), but in most cases these are less specialised, often gregarious forms that rely more on 'flight' than crypsis to avoid predation. A possible explanation is that nests placed in open areas with minimal vegetation and leaf litter cover may reduce detection of the buried eggs by certain predators, as suggested for *C. cristatus* by Lazcano-Barrero & Gongóra-Arones (1993). Alternatively, the greater intensity of sunlight at ground level in forest clearings suggests that heat (incubation temperature) or substrate moisture level (drier than beneath canopy, thus reducing the possibility/extent of contamination of the eggs by fungi), may be the primary factor(s) controlling nest site selection in these species.

According to most reports, *L. longipes* breeds during the wet season. Campbell (1998) gives the egg laying period as June-September, with reported hatching dates ranging from 16th June (Campbell, 1998) to 30th August (Duellman, 1963). The deposition of eggs in late April by the specimen described here probably represents a very early wet season record, but also suggests the possibility of an extended breeding season and the production in some individuals of more than one clutch per year. Clutch size and egg dimensions fall within the ranges specified for *L. longipes* by Campbell (1998).

Laemanctus longipes does not seem to use its head as an earth-moving 'scoop' during nest excavation, as has been reported for *Corytophanes* spp. (Peréz-Higareda, 1981; Bock, 1987; Lazcano-Barrero & Gongóra-Arones, 1993). When captured for closer examination, no obvious accretions of earth could be found on the lizard's head or forebody, and it is probable that nest holes are dug using only the front feet, as indicated by Martin (1958) for *L. serratus*.

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TRITURUS ALPESTRIS IN BRITAIN

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IT is well known that there are established colonies of introduced Alpine Newts in Britain. Recently, whilst reading though some old field notes, I realised that I had recorded a colony which has, I believe, not been referred to in literature.

The Fourth Baron Lilford of Lilford Park in Northamptonshire was well known for his interest in zoology, especially birds. He was one of the group of people instrumental in the introduction of the Little Owl, *Athene noctua*, into the British Isles (Blackewell, 1972. He also maintained an aviary complex of captive birds, and enclosures of other animals within the park. The Fifth Lady Lilford, being a keen botanist, established the extensive Rock Garden complex within the park in the early 1900s. This complex contains a group of elongate pools, which are linked when the water table is high, and it is in these pools that the Alpine Newts exist.

Throughout the time the Lilford family occupied the estate, meticulous records of the animals introduced to the collection or released into the wild were kept. Yet no reference to these newts appears in the records. On discovering this I began asking older members of the estate staff what they knew of the newts, and immediately received the unanimous reply that they were introduced during the Second World War by an American serviceman. During this time, the headquarters of the USAAF regional hospital was based in the park, and facilities for up to 2000 casualties built.

But why would an American serviceman, recently returned from mainland Europe, release newts into the Rock Garden? I can only speculate, as a herpetologist, that the serviceman believed he was being sent back to the USA, and decided to take some Alpine Newts with him, perhaps for a friend. On recovery and learning that he was to return to Europe, he saw no reason for keeping the animals any longer. Whatever the circumstances, the introduction was successful, and to my knowledge a viable population existed into the 1980s, and since the Rock Garden is listed, I imagine still exists. The Lilford Park estate is no longer occupied by the Lilford family but by a tenant, and the park no longer open to the public, the animal collection having been dispersed.

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