ISSN 0260-5805

THE BRITISH HERPETOLOGICAL SOCIETY

BULLETIN

No. 55
Spring 1996

THE BRITISH HERPETOLOGICAL SOCIETY

c/o Zoological Society of London
Regent's Park, London NW1 4RY
Registered Charity No. 205666

The British Herpetological Society was founded in 1947 by a group of well-known naturalists, with the broad aim of catering for all interests in reptiles and amphibians. Four particular areas of activity have developed within the Society:

The Captive Breeding Committee is actively involved in promoting the captive breeding and responsible husbandry of reptiles and amphibians. It also advises on aspects of national and international legislation affecting the keeping, breeding, farming and substainable utilisation of reptiles and amphibians. Special meetings are held and publications produced to fulfil these aims.

The Conservation Committee is actively engaged in field study, conservation management and political lobbying with a view to improving the status and future prospects of our native British species. It is the accepted authority on reptile and amphibian conservation in the UK, works in close collaboration with the Herpetological Conservation Trust and has an advisory role to Nature Conservancy Councils (the statutory government bodies). A number of nature reserves are owned or leased, and all Society Members are encouraged to become involved in habitat management.

The Education Committee promotes all aspects of the Society through the Media, schools, lectures, field trips and displays. It also runs the junior section of the Society - THE YOUNG HERPETOLOGISTS CLUB (YHC). YHC Members receive their own newsletter and, among other activities, are invited to participate in an annual "camp" arranged in an area of outstanding herpetological interest.

The Research Committee includes professional scientists within the ranks of the Society, organises scientific meetings on amphibian and reptile biology and promotes The Herpetological Journal, the Society's scientific publication.

Meetings
A number of meetings and events take place throughout the year, covering a wide range of interests.

Publications
The BHS Bulletin, Herpetological Journal and YHC Newsletter are all produced quarterly. There are in addition a number of specialised publications available to Members and produced by the various Committees, such as notes on the care of species in captivity, books and conservation leaflets.

Subscriptions
All adult subscriptions become due on the first day of January each year. Payment by Banker's Order is much preferred.

Ordinary Members	£20	(Receive Bulletin only)
Full Members	£25	(Receive Bulletin and Journal)
Family Members	£30/£37.50	(Without/with Journal) Family members with children also receive the YHC Newsletter
Student Members	£18	(Receive Bulletin and Journal)
Institutional rates	£36	(Receive Bulletin and Journal)
YHC (Age 9-18):		
Basic Membership	£6	
Bulletin Membership	£12	(Receive YHC Newsletter)
Group Membership	-	For Schools, Youth Groups etc. Contact Education Officer (Address on inside of back cover for details)

Correspondence, Membership applications, subscription renewals and purchase orders for publications should be addressed to the Secretary (address as at page top) EXCEPT for YHC matters. YHC Membership and renewal details are available from the Education Officer (address on inside of back cover). PLEASE INCLUDE A STAMP-ADDRESSED ENVELOPE WHEN WRITING TO THE SOCIETY.

The Society does not, as a body, hold itself responsible for statements made or opinions expressed in the Bulletin; nor does the Editorial necessarily express the official opinion of the Society.

The Bulletin is edited and produced by
Simon Townson and John Spence.
Contributions and correspondence arising from the Bulletin should be sent to:
John Spence, 23 Chase Side Avenue, Enfield, Middlesex EN2 6JN

FRONT COVER
Dendrobates azureus -Surinam - see article on P.17 by Bob and Val Davies

REMAINING BRITISH HERPETOLOGICAL SOCIETY MEETINGS FOR 1996

Meetings are usually held at Birbeck College, Malet Street, London WC1, unless otherwise stated

May 4/5	Conservation & Education event in Jersey. There will be a chance to visit Jersey Zoo with a guided tour around the reptile department, and visits to areas of herpetological interest on the island. Details will follow in a flier.
Mid May	Visit to Bream Brook – details to follow.
May 25th	Captive Breeding meeting – Birbeck College: Terry Thatcher – Temperate and Tropical Reptiles in Captivity.
July 20th	Captive Breeding meeting – Birbeck College: Pat Wisniewski – Captive Care of Amphbians/Barry Pomfret - Nutrition and Captive Breeding.
October 12th	Captive Breeding meeting – Lord Grey School, Milton Keynes: Joint meeting with Milton Keynes H.S.: Stephen Divers – Captive Care of the Green Iguana.
October 26th	Autumn General Meeting. Birbeck College London. (a) Prof. J. Davenport, Isle of Cumbrae, Scotland: "Intertidal Maderian Lizards – Miniature Marine Iguanas". (b) To be arranged.
October 27th	Captive Breeding Open Day – New Denham.
December 7th	Research meeting – Birbeck College.

BHS NORTH WEST MEETINGS 1996

April 16th	'India' - Katie Hampson and Allan Guy.
June 11th	'A Herpetologist in Australia' – Reg Webster
August 3/4th	Reptile Rally at Wildfowl and Wetlands Centre, Martin Mere, 10.00 - 5.00 pm.
October 8th	Yet to be decided.
December 3rd	Christmas Social

All meetings commence at 8.00 pm except where stated and are all held at Wildfowl and Wetlands Centre, Martin Mere, Burscough, Lancs. Tel: 01704 895181.

THE BRITISH HERPETOLOGICAL SOCIETY CONSERVATION COMMITTEE REPORT 1994 & 1995

The past two years have been eventful for herpetological conservation and the aim of this report is to highlight the major events during this period and the role of the Conservation Committee.

CONSERVATION COMMITTEE MEMBERSHIP

The following individuals have been members of the committee during the past two years: Mr B. Banks, Dr T. Beebee, Mr D. Bird, Mr A. Braithwaite, Mr J. Buckley, Mr R. Calff, Ms J. Clemons (Chairman), Mr C. Davies, Mr P. Edgar, Mr C. Fitzsimmons, Mr J. Gaughan, Mrs M. Green, Dr R. Griffiths, Mrs E. Haslewood, Mr H. Inns, Mr M. Langford, Mr N. Moulton, Mr M. Noble, Mr M. Preston, Mr P. Reynolds, Mr K. Sherrard, Dr M. Swan, Mr J. Webster, Mr W. Whitaker.

It is with regret that Mr A. Braithwaite has moved away from Surrey. The Conservation Committee are grateful for all the hard work undertaken by Mr A Braithwaite in field herpetology and management work. His knowledge of rare reptiles, especially the Smooth Snake is outstanding and herpetologists in Wales should benefit from his experience.

We are also grateful to the following individuals who have acted as advisors to the committee: Dr H. Arnold (ITE), Dr J. Baker (DAPTF), Dr K Corbett (HCT), Dr T. Gent (English Nature), Mr T Langton (HCI).

SITE PROTECTION AND ACQUISITION

The most important case has been the threat to Europe's largest population of Great Crested Newts at Orton Brickpits, Peterborough. The Conservation Committee have maintained that the newts should be left *in-situ* as opposed to a large scale translocation to newly created habitat within the Peterborough Southern Township. This is a complex case and at this time, the Conservation Committee's position is that of independent observer.

Mrs E Haslewood's efforts to protect a Common Lizard colony in Shorham-on-Sea were rewarded when the planning application for a housing development was withdrawn. A Grass Snake site at Herald Way SSSI in Coventry was also saved from development. This is the only recorded site for this species within the city boundary.

Several other cases involving Great Crested Newts came to our attention. Unfortunately in most of these cases outline planning permission had already been granted as the presence of the newts was unknown. Mitigation in the form of new ponds and translocation to receptor ponds is usually all that can be achieved at this stage.

Land fund interest amounting to £2000 has been used to secure a 99 year lease for land saved from a landfill threat at Holnest, N Dorset. A management plan for a Great Crested Newt reserve has been completed for the 1.1 acre site which will aim to increase the number of ponds in a natural progression. Mr K. Sherrard has been co-opted onto the Holnest Management Committee.

HABITAT MANAGEMENT AND MONITORING PROGRAMMES

These programmes are arranged in conjunction with our sister organisation the Herpetological Conservation Trust (HCT) who are able to implement large scale programmes with full-time employees. This has made an enormous contribution to the management of over 80 sites supporting herpetofauna in Surrey, Sussex, Hampshire and Dorset. A programme of BHSCC/HCT Sunday tasks is scheduled from September to March to coincide with the reptile hibernation period and we are grateful to all volunteers who attended the tasks. During the 1994/1995 season over 70 volunteers took part in the management programme. Such

contributions are most valuable as the table below illustrates.

It is encouraging to note that the number of volunteer days worked has increased since the last report (BHS No. 47) but the area cleared has decreased. The reason is that with larger work parties we can concentrate on clearing very dense vegetation such as stands of pine, birch and mature gorse, which is very labour intensive over a relatively small area.

Table 1. Total amount of scrub clearance undertaken by BHSCC/HCT volunteers

Year	Area Cleared (Hectares)	Number of Volunteer Days worked
Sept 1993-March 1994	9.9	295
Sept 1994-March 1995	7.6	292

The monitoring programme concentrates in compiling site records for the rare species, namely the Smooth Snake, Sand Lizard and Natterjack Toad. Such work is vital to evaluate breeding success, expansion or contraction of a known population's range and in monitoring the success of re-introductions. The information is also important in compiling the management programme and the two programmes are very interrelated. Almost 2000 1994/1995 rare species survey records have been entered into the BHSCC database by Mr N. Clemons, database manager.

SPECIES PROTECTION

The Sand Lizard Recovery Programme: A tripartite agreement between English Nature, World Wide Fund for Nature and the Herpetological Conservation Trust, is now in its second year. BHSCC are assisting in this programme which aims to build on the work of the last 25 years to secure in the long term, the self-sustained survival of our rarest lizard. This contract has provided valuable funding for management work, research, improving captive breeding facilities and re-introductions planned for 5-12 sand-dune systems in Southern England and Wales, therefore extending the range of the Sand Lizard.

The Natterjack Toad Sub-Committee continues to update the site register and the annual committee visit was to Subberthwaite Common, Cumbria in 1994 and sites in the Weald in 1995. The Natterjack Toad Recovery Programme entered its third year of research, management and two translocations were undertaken in 1994 in Norfolk and Suffolk. 1995 was the programme's final year and three translocations to sites in the Weald and Clwyd were carried out. After the Recovery Programme ended, the Herpetological Conservation Trust created and funded a Natterjack Officer post and appointed Mr John Buckley (Chairman of the BHSCC Natterjack Sub-committee).

As a result of the Common Species initiative, herpetological conservation is gaining impetus throughout the UK. The chair of the Conservation Committee continues to be a member of the steering group for the Common Species Officer post which was created in 1994. Many new Amphibian and Reptile Groups have been established and the 1995 Grass Snake campaign was most successful. The campaign centred around the provision of egg-laying sites on nature reserves and gardens.

Several committee members attended and gave presentations at the annual Herpetofauna Recorders Meeting in Manchester (1994) and Cardiff (1995). The annual field trips to

places of herpetological interest were most successful in terms of attendance and herpetofauna seen. The visit to the Surrey Heaths in May 1994 had to be run twice because of the demand to attend and the visit to the Sefton Coast in May 1995 resulted in a large number of Natterjack Toad records. We are grateful to Mr M Preston (HCT Wealdon Officer) and Mr P Rooney (Sefton Coast Ranger Service) for their help with these events. Committee members continued to publish a number of reports and papers and Mr H Inns has a regular feature in British Wildlife Magazine. We are grateful to English Nature for grant aid towards a reprint of the BHSCC "Save Our Reptiles" booklet.

CONSULTATIONS

During 1994/95, the Committee contributed to the following:

Wildlife & Countryside Act Quinquennial Review
Biodiversity Action Plans for Biodiversity Challenge Group & DoE
Reptile & Amphibian Recording Schemes - JNCC
EC Habitats Directive SAC list - DoE

LAND FUND

The capital sum has now passed a significant milestone of over £40,000. To date this sum has earned interest amounting to £10,287 which has been spent on site purchases and leases. Unfortunately 1994 was the worst year for fund raising since 1988 (£157) but the rate of income in 1995 was an improvement raising a total of £645. We are grateful to the following individuals for donations to the land fund: Dr Baksh, B. Banks, D. Bird, J. Buckley, J. Clemons, E. Haslewood, P. Herrity, H. Inns, M.A. Talbot.

ACKNOWLEDGEMENTS

The Conservation Committee would like to thank the following individuals for survey reports: W. Atkins, P. Benson, F. Bowles, M. Buckley, J. Christian, C. Christie, D. Crane, D. Day, R. Eastman, T. Gent, E. Grist, M. Hollowell, J. McCleary, H. Newell, M. Phillips, D. Porter, P. Smith, Malcolm Watkins, T. Woodhams, H. Wraight, T. Wynne.

We are also grateful to HCT for obtaining the necessary funding to help the Committee carry out their conservation work.

Jan Clemons
BHSCC Chairman.

CONSERVATION OF THE GOLDEN TOAD: A BRIEF HISTORY

J. ALAN POUNDS* and MICHAEL P. FOGDEN†

*Monteverde Cloud Forest Preserve, 500 W, Tropical Science Center, Santa Elena, Puntarenas 5655, Box 73, Costa Rica, Central America
†Department of Biology, University of Miami, P.O.Box 249118, Coral Gables, Florida 33124*

The endemic Golden Toad (*Bufo periglenes*) disappeared from Costa Rica's Monteverde Cloud Forest Preserve after a sudden population crash in 1987 (Crump *et al.*, 1992; Pounds and Crump, 1994). Two years ago, we were tempted to respond to Harding (1993), who argued that this endangered species has been "neglected" and that its disappearance was the result of "too much science and not enough common sense". We chose to wait, however, in the hope of having good news to report regarding the toad's status. Unfortunately, little has changed. The Golden Toad, along with 19 of 49 other anuran species that previously inhabited our 30 km^2 study area, is still missing eight years after the crash (Pounds *et al.*, unpubl. Ms).

Harding (1993) categorised conservationists as "talkers" and "doers". To his way of thinking, the latter are absent from Monteverde, and the "laissez-faire" talkers have stood by, doing nothing to save the Golden Toad. In fact, and as we will show, it would be difficult to find a more effective group of "doers" than the conservationists that reside in Monteverde. The amphibian crash was a sudden, catastrophic event that lay far beyond their control. Harding proved himself to be the worst sort of "talker", one who is willing to talk about things of which he knows far too little.

It is no minor point that Monteverde's conservationists founded the cloud forest preserve to protect the Golden Toad, which was discovered in the early 1960's (Savage 1966). That is why a toad appears along with the panda logo of the World Wide Fund for Nature (WWF; previously the World Wildlife Fund) on the sign marking the preserve's entrance. In 1972, with the help of WWF and the Tropical Science Center (the Costa Rican organisation which manages the preserve), U.S. scientists George and Harriet Powell and Quaker settler Wilford Guindon set aside the 328 hectare Brillante tract. This elfin woodland includes the best-known breeding sites of the Golden Toad. Along with a tract the Quakers had set aside for watershed protection, it formed the nucleus around which the preserve would grow. Without the Powells and Guindon, the Golden Toad's habitat would have been logged and turned into farmland long ago. Ironically, Guindon was also a member of "Crump's team", accused by Harding of having failed the Golden Toad in 1987.

The same people who, according to Harding, were responsible for "25 years of comparative neglect" brought about the much-needed expansion of the preserve. In the mid-1980's, as a BBC crew filmed the Bare-Necked Umbrellabird in the Peñas Blancas valley (then outside the preserve), squatters began to chain-saw the forest around them. This emergency helped stimulate a grass-roots movement of local residents and visiting scientists who formed the Monteverde Conservation League (MCL). With the help of the WWF, the Nature Conservancy, and a host of smaller groups and individuals, the League and the Tropical Science Center tripled the size of the preserve to 10,500 ha. Likewise, with the help of children around the world, especially the Swedish organisation Barnens Regnskog, it set aside the adjacent 16,00 ha Children's International Rainforest.

This expansion was vital to amphibian conservation. It won protection of Golden Toad habitat not included in the original preserve and reduced the threat of local climate change due to deforestation. But perhaps most importantly, it provided the only ray of hope that amphibians might eventually recover from the 1987 population crash: 20% of the species which were missing from our study area in 1990 recolonised from outlying protected habitats during 1991-1994 (Pounds *et al.*, unpubl. Ms). Thanks to Monteverde's grass-roots conservationists, the preserve is more than a small island of forest in a sea of pastureland.

We cannot overemphasise that the Golden Toad's disappearance was sudden and unexpected. Populations seemed healthy shortly before their demise, and concern focused more on Baird's Tapirs, Mountain Lions, and Bare-Necked Umbrellabirds. It is clear in hindsight that captive breeding of the Golden Toad would have been, as Beebee (1993) put it, "a prudent measure", but the absence of toads in recent years has made this impossible. We also agree with Beebee that captive breeding is a limited option in conservation; there are too many endangered species to cope with.

Contrary to what Harding implied, there were no warning signals in 1987. Breeding pools dried up, killing the embryos, but this had happened in many previous years and was hardly a "catastrophe". As Beebee (1993) pointed out (and Harding should have known) mass mortality of eggs and tadpoles is common for toads that breed in temporary pools. There is absolutely no reason that Martha Crump should have thought it necessary to interfere with the natural processes that she was trying to study.

Harding seemed to believe that if he had been present he would have single-handedly saved the day: "I can say with my hand on my heart that I would not have let those Golden Toad eggs desiccate and die". Nevertheless, his common-sense plan of "topping-up pools" would not have helped. Of the 1500 adults observed at Brillante in 1987, only one appeared in 1988 (Crump *et al.* 1992). As discussed in Pounds and Crump (1994), this precipitous decline implies high adult mortality, not failed reproduction. Harding stated that "the case for water shortages in temporary pools as the principal cause of the demise of the Golden Toad is overwhelming and all but proven". This is simply not true. The whole anuran fauna declined regardless of breeding mode or habitat. Many of the affected species were not subject to the vagaries of ephemeral pools. They included, for example, stream-breeding Glass Frogs (*Centrolenella*), treefrogs (*Hyla*), and Harlequin Frogs (*Atelopus*) as well as terrestrial-breeding Rain Frogs (*Eleutherodactylus*).

Harding's other common-sense solution to the Golden Toad's predicament was that of "waterproofing" breeding pools with "plastic membranes". Beebee (1993) warned that this might cause the toads to abandon sites. There is another problem which is obvious to those with some knowledge of the Golden Toad's habitat: the breeding pools form around the stilt-like roots of elfin forest trees. It would be physically impossible to install "plastic membranes" without first removing the roots. The use of chain saws would be called for, and this would ensure that there is no habitat to which Golden Toads might one day return.

We remain hopeful that the toads will reappear. Although the species seems to be extinct in our study area, populations might still exist on inaccessible, outlying ridges. Recolonisation of empty habitats would literally be a dream come true. Were it not for Monteverde's conservationists, however, even this dream would be gone.

ACKNOWLEDGEMENTS

A grant from the U.S. National Science Foundation (Grant # DEB 9200081 awarded to J. Savage) provided support to JAP during the preparation of this paper, which is a contribution in Tropical Biology, Behaviour, and Ecology from the University of Miami. Thanks to C. Rojas and also P. Fogden, J. Savage, and M. Wainwright for their comments on the manuscript.

REFERENCES

Beebee, T. (1993). Conservation of the Golden Toad. *British Herpetological Society Bulletin* **46**: 28.

Crump, M.L., Hensley F.R. & Clark, K.L. (1992). Apparent decline of the Golden Toad: underground or extinct? *Copeia* 413-420.

Harding, K.A. (1993). Conservation and the case of the Golden Toad. *British Herpetological Society Bulletin* **44**: 31-34.

Pounds, J.A. & Crump, M.L. (1994). Amphibian declines and climate disturbance: The case of the Golden Toad and the Harlequin Frog. *Conservation Biology* **8:** 72-85.

Savage, J.M. (1966). An extraordinary new toad (*Bufo*) from Costa Rica. *Revista de Biologia Tropical* **14:** 156-167.

ARTIFICIAL REFUGES WITH TRANSECTS AS A POSSIBLE REPTILE SURVEY METHODOLOGY

MIKE A. BARKER* AND DESMOND D HOBSON†

Sir William Halcros and Partners, Burderop Park, Swindon, Wilts, SN4 0QD

†RPS Clouston, The Old Barn, Deanes Close, Steventon, Abingdon, Oxon, OX13 6SY

ABSTRACT

A review is made of the suitability of existing methodologies of reptile survey in a British environment. The assessment is supported by field data obtained from survey of a heathland in southern England, using artificial refuges with transects. The paper provides an indication of the effectiveness of this methodology. Recommendations are made regarding a potential standard survey methodology that could be suitable for use by herpetologists in cool, high latitude climates.

INTRODUCTION

At present there is no standard methodology for quantitatively surveying terrestrial reptile species in Britain. The Guidelines for Baseline Ecological Assessment in the UK (Institute of Environmental assessment, 1995) states that:

"No standard quantitative technique exists for surveying reptiles, although a qualitative method based on sightings is available."

An information note produced by English Nature (Gent, 1994) usefully reviews some reptile survey and monitoring methods and discusses their UK licensing requirements.

The purpose of this paper is to review briefly the main reptile survey methods and discuss one particular method used recently in southern England. We deal only with methodologies not involving land-based or semi-aquatic testudines (ie not tortoises or terrapins) since only a small number of established alien populations of this group occur within Britain.

The requirement for a quantitative reptile survey is to provide a cost- and time-effective methodology for assessing species composition and also to provide a preliminary indication of population density. To provide reliable population data the methodology also needs to include elements such as 'mark and recapture'. Additional considerations for a survey methodology include low raw material costs, a low maintenance requirement, and in areas of high public access, some resistance against vandalism.

EXISTING REPTILE SURVEY METHODS

Many of existing reptile survey methodologies have been developed in the USA. The climatic conditions in the States tend to provide warmer and sunnier summers, the season during which reptiles are most active and these areas tend also to have more diverse reptile communities, containing higher densities of individual reptiles.
Methodologies commonly used in the USA include: direct observation and transect walking; night-time car cruising (Karns, 1986); active (limited area or timed) search and

seize techniques sometimes involving removal (Bury, 1982; Karns, 1986); pitfall and funnel trapping coupled with drift (barrier) fencing (Gibbons and Semlitsch, 1981; Campbell and Christman, 1982; Vogt and Hine, 1982); and with the use of artificial refuges (Grant, Tucker, Lovich, Mills, Dixon, Givvons & Gibbons, 1992; Peterson and Dorcas, 1992).

One of the most effective, but high input (in terms of time and costs) methods used in the USA is the drift fence with traps technique, which utilizes a solid barrier to direct moving animals into the associated pitfall or funnel traps. This method has been found by Campbell *et al* (1982) to give good quantitative estimates of the reptile (and amphibian) community and reduce the inherent observer bias associated with observation and search methods. It is also noted as being effective in a wide range of habitat types from temperate grasslands (Vogt and Hine, 1982) to tropical cloud forests (Barker, unpubl. obs., 1988). However even this technique must be used with other methodologies, such as direct observation to obtain a complete herpetofaunal species list. The use of artificial refuges (coverboards) has also more recently been put forward by Grant *et al* (1992) as a successful means to quantify herpetofaunal communities.

In Britain, with a predominantly cool and cloudy maritime climate, even during summer many of the existing methodologies are often unsuitable due to the reduced activity of the reptiles. The effectiveness of the technique is also hampered by the low densities at which reptiles often occur in Britain. For example, night-time car cruising would only be worthwhile in large areas of good reptile habitat where an extensive network of quiet roads exists.

The low density and diversity of reptile communities also makes the drift fence trapping method unsuitable on many survey sites due to the large effort required in setting up a series of arrays. In addition, the method relies on the mobility of individuals for capture so the relatively sedentary British lizard species are less likely to be captured than more widely foraging species occurring elsewhere. The traps also require regular checking to ensure the welfare of target and non-target animals, and are susceptible to interference.

ARTIFICIAL REFUGE AND TRANSECT METHODOLOGY

The use of artificial refuges is suggested as a possible method by Gent (1994) and the survey results published from the USA are generally encouraging, for example as found by Campbell *et al* (1992). Recently a quantitative reptile survey was required for a project in an area of lowland heath in southern England during the summer of 1994. The work thus provided an opportunity to test the effectiveness of the artificial refuge methodology under British conditions.

On account of its ecological importance the study area is designated as a Site of Special Scientific Interest, indicating its ecological importance. The site is characterised by large expanses of heath, predominantly heather (*Calluna vulgaris*) and cross-leaved heath (*Erica tetralix*) with purple moor grass (*Molinia caerulea*), together with extensive areas of gorse (*Ulex europeus*).

The site is known to contain five of the six species of reptile found in Britain; Grass Snake (*Natrix natrix*), Adder (*Vipera berus*), Viviparous Lizard (*Lacerta vivipara*) and Slow Worm (*Anguis fragilis*). Sand Lizards (*Lacerta agilis*) have recently been reintroduced to part of the heath. The site may have originally also supported Smooth Snakes (*Coronella austriaca*) but no historical records exist and recent fires are likely to

have eliminated any remnant population.

Overall the site is prime reptile habitat, though in common with most other English lowland heaths extensive scrub and woodland invasion is reducing its value for these species.

It was necessary to develop a low-cost methodology suitable for establishing the presence or absence of these reptile species in one part of the heath as part of an assessment of a potential development. Constraints to the survey were cost and distance. Due to the distance to the heath it was necessary to devise a methodology which did not require daily inspection. For this reason techniques requiring regular monitoring such as pitfall and funnel trapping along drift fencing were discounted.

It was decided to use coverboards placed along a fixed transect, combined with visual analysis of heathland along the transect route. The coverboards selected were Welsh slate roofing tiles (approximately 60 cm x 30 cm) obtained from a local reclamation yard. Their black colour would permit maximum absorption of incoming solar radiation and their matt texture made them relatively unobtrusive, thus minimising the risk of vandalism. Furthermore, they were relatively inexpensive.

Supplementary coverboards were provided from rubber car floor mats obtained from scrapyards. These had similar advantages to Welsh slates in that they were matt and black. Second-hand corrugated metal roof sheeting and wooden boards were not locally available in sufficient numbers for use in this study. The high conductivity of metal sheeting means that it heats and cools rapidly, thus reducing its value in unsettled weather. On the other hand Welsh slates retain some heat during the late afternoon and through brief periods of rain, although it is relatively slower to warm in the morning. Metal sheeting has, however, been used with success at another heathland site without public access in Dorset (Mahon, pers. Comm.).

The coverboards were distributed in twenty groups of five sheets (4 tiles and one rubber mat) along the transect. At each location they were placed in a variety of microclimatic locations. Microclimates chosen included:

morning sun; full midday sun; afternoon sun; full shade; north facing slope (reduced insolation levels); south facing slope (maximum insolation levels); bare ground; bare ground/scrub boundary; scrub; "woodland" (dense scrub and young trees); damp site; dry site

It was considered that optimisation of microclimatic variation would permit reptiles to vary the coverboards used according to the weather. For example during hot and sunny weather reptiles would be unlikely to be found under a coverboard exposed to the midday sun; in these conditions the coverboard became extremely hot. However, during cool and cloudy weather reptiles might be more likely to be found under the tile exposed to maximum incoming solar radiation.

The coverboards were placed on site in mid June 1994 and monitored regularly until their removal on 24 November 1994 on completion of the study. Although there is some evidence put forward by Grant *et al* (1992) that coverboards only reach their maximum efficiency approximately 2 months after installation, monitoring was commenced immediately. The reason for this 'lag time' is unclear but probably relates to conditions under the boards and time taken for the reptiles to locate them.

During the duration of the experiment, monitoring visits were undertaken on 12 occasions, concentrated from July to September. Visits were chosen to coincide with a variety of weather conditions and at different times of day. On each occasion all coverboards were lifted and replaced after inspection. These were lifted to face away from the researcher in case of the presence of venomous species.

An important additional feature in the study was the recording of incidental observations of reptiles along the twenty set transects connecting the groups coverboards.

RESULTS

The following species were recorded during the survey. The results include sightings of species recorded during the transect walk.

Lacerta vivipara
Vipera berus
Natrix natrix (sloughed skin)

Bufo bufo (Common Toad, amphibian)

A summary of the results obtained during the study are given in Table 1. In the twelve site checks, the total number of encounters for both refuge and transect records was 18 reptiles or amphibians. Of these 7 records came directly from refuge encounters and 11 from observations along the associated transects. The total number of refuge checks during the study was 1200, providing 7 encounters, or an average encounter rate of approximately 1 animal per 100 refuges.

Grant *et al* (1992) in their more comprehensive studies in South Carolina recorded an average encounter rate of between 5-6 animals per 100 refuges. This is well above our encounter rate and a number of possible reasons are given in the discussion section below.

Although great care had been taken to conceal the coverboards a significant proportion (approximately 25%) were removed or destroyed during the course of the study. These were not replaced.

Table 1

Summary of Results

	No. of individuals noted		Encounter Rate (%)
Species	Refuges	Transects	
Lacerta vivipara	5	7	0.58
Vipera berus	0	3	0.25
Natrix natrix	0	2	0.17
Bufo bufo	1	0	0.08

DISCUSSION

This study was of limited success, which could be attributed to the following factors:

There was a lag-time effect on the refuges - for the first few weeks no encounters were recorded from the refuges.

The late start of the study may have also reduced the effectiveness of the survey technique because the productive late spring/early summer survey period was missed.

The unusually hot summer during 1994 is likely to have reduced the effectiveness of coverboards. Extended periods of high temperatures and sunshine (c. 25 °C) meant that the reptiles were not dependent on coverboards for warmth; indeed those in full sun became so hot that had reptiles used them they would probably have perished. During this period monitoring surveys were only effective when undertaken during early to mid-morning.

Greater success was recorded during the cooler temperatures of late summer and autumn. Indeed a juvenile Common Lizard was recorded under a coverboard on 24 November when most reptiles were hibernating. The reasons for this are likely to include the lower air temperatures that occur in autumn and thus the increased value of warmed coverboards to reptiles, together with the longer period since establishment.

Although fragile and vulnerable to both deliberate and accidental trampling, the Welsh slates were effective as coverboards. The flexible nature of the rubber mats made them slightly more difficult to examine safely, although they also proved to be reasonably effective.

It is felt that the relatively small size of the coverboards used may have reduced their desirability to reptiles, although further investigation would be necessary to establish this. However, any benefits of larger coverboards would need to be countered by consideration of the greater area of ground cover that would be lost by the use of larger boards.

RECOMMENDATIONS FOR FUTURE SURVEYS

As a result of data review and field survey it is recommended that a standard reptile survey methodology should include the following features:

1. The use of coverboards of varying size and materials. These could include large Welsh roofing slates, secondhand (and therefore rusted) corrugated sheeting, and large wooden boards. Pieces of plywood would be ideal for this purpose. It may be of benefit to paint some of the boards white for use by reptiles during hot weather to minimise heating. On some sites, however, this may be visually unacceptable. Car floor mats and similar materials could also be used.

2. Although wooden boards were not used in this experiment they have been used with success by Grant *et al* (1992) in the United States. They state that "...far more animals were encountered beneath wood", though the fact that his work was undertaken in South Carolina, which is substantially warmer than Britain suggests that metal coverboards may have become too hot for reptiles. Further work within a cool, temperate climate, will be necessary to establish the relative value of wooden coverboards in British conditions.

3. Ideally coverboards should be put in place at least two months before the monitoring is undertaken, though the reasons for this apparent 'lag-time' are currently unknown. The boards should be placed so as to include as wide a range of microclimates as possible so that reptiles may be recovered during a variety of weather conditions.

4. Monitoring visits should be undertaken at different times during the day, though it should be borne in mind that coverboard searches during the middle of the day in hot and sunny conditions are unlikely to be successful.

5. It is recommended that a coverboard survey be undertaken along a fixed transect, similar to the Pollard Walk used for butterfly surveys, and details of reptiles recorded along the transect be systematically recorded.

6. Although other methodologies were not assessed under British conditions the authors consider that a coverboard based survey is likely to be most successful, particularly during cool and cloudy weather and at higher latitudes and altitudes, such as in mountainous areas and in northern Britain.

7. Other methods, such as drift fencing with funnel and pitfall traps are not recommended, except where they can be monitored daily and in areas where there is limited, or no public access. There are few areas where reptiles are sufficiently frequent near roads in Britain to justify night-time 'car-cruising'.

CONCLUSIONS

A literature search combined with a field experiment undertaken on an area of heathland in southern England indicates that the optimum methodology for reptile survey in Britain is likely to include the issue of coverboards combined with direct observation. Success has been obtained from using coverboards made of large Welsh roofing slates and corrugated roofing sheets. The use of large wooden plywood boards is also likely to be successful. The coverboards used should be sited to include the broadest possible range of microclimates.

There is a clear need, however, for concentrated survey work and assessment to be undertaken to determine the optimum methodology for surveying the six species of reptile occurring in Britain. This research is currently being undertaken by English Nature.

ACKNOWLEDGEMENTS

This work was undertaken under licence from English Nature.

REFERENCES

Institute of Environmental Assessment (1995). *Guidelines to the Baseline Ecological Input to Environmental Assessment in the UK*. London: E & F Spon.

Bury, R.B. (1982). Structure and Composition of Mojave Desert reptile communities Determined with a removal method. In *Herpetological Communities: A Symposium of the Society of Amphibians and Reptiles and the Herpetologists' League, August 1977*, 135-142. Wildlife Research Report 13. Washington DC: United States Department of the Interior, Fish and Wildlife Service.

Cambell, H.W. & Christman, S.P. (1982). Field Techniques for Herpetofaunal Community Analysis. In *Herpetological Communities: A Symposium of the Society of Amphibians and Reptiles and the Herpetologists' League, August 1977*, 193-200. Wildlife Research Report 13. Washington DC: United States Department of the Interior, Fish and Wildlife Service.

Gent, T. (1994). *Survey and Monitoring of Reptiles.* Peterborough: English Nature Information Note.

Gibbons, J.W. and Semlitsch, R.D. (1981). Terrestrial drift fences with pitfall traps: An effective technique for quantitative sampling of animal populations. *Brimleyana*, 7, 1-16.

Grant, B.W., Tucker, A.D., Lovich, J.E., Mills, A.M., Dixon, P.M. & Gibbons, J.W. (1992). The use of coverboards in estimating patterns of reptile and amphibian biodiversity. In *Wildlife 2001: Populations*, 379-403. McCullough, D.R. & Barrett, R.H. (eds). Chapman and Hall, London.

Karns, D.R. (1986). *Field Herpetology: Methods for the study of amphibians and reptiles in Minnesota.* James Ford Bell Museum of Natural History. Occasional Paper 18. University of Minnesota.

Peterson, C.R. & Dorcas, M.E. (1992). The use of automated data-acquisition techniques in monitoring amphibian and reptile populations. In *Wildlife 2001: Populations*, 369-378. McCullough, D.R. & Barrett, R.H. (eds). Chapman and Hall, London.

Vogt, R.C. & Hine, R.L. (1982). Evaluation of techniques for assessment of amphibian and reptile populations in Wisconsin. In *Herpetological Communities: A Symposium of the Society of Amphibians and Reptiles and the Herpetologists' League, August 1977*, 201-218. Wildlife Research Report 13. Washington DC: United States Department of the Interior, Fish and Wildlife Service.

FROG MASS MORTALITY: SCURRILOUS DISEASE OR PANIC ATTACK?

TREVOR BEEBEE

434 Falmer Road, Woodingdean, Brighton, BN2 6LG

There can be few naturalists who have not heard by now about the problem of disease in British Common Frog populations. The subject has featured in many popular press articles over the past few years, appeared on television, and received scientific study supported by the RSPCA. Frog disease in its worst outbreaks is a horrible spectacle and fully warrants serious investigation, but my concern is that, paradoxically, the results of all this attention may not be in the best interests of frog conservation. Over the past couple of years, the main advice emerging on how to cope with frog disease has amounted to a moratorium, or at least a substantially reduced effort, in moving frog spawn between ponds. I wonder whether this is really a sensible way to proceed in light of the evidence now available.

The pertinent facts about frog disease include the following:

1. Outbreaks became particularly noticeable in the late 1980s, with many reports in the early 1990s. Anything from a few to a few hundred frogs were found dead or dying at each locality, almost always in or near ponds in garden environments and usually during summertime. Frog mortality is commonly high during the early spring breeding season from a variety of other natural causes, and sometimes also in winter when ice persists for a long time on ponds where frogs are hibernating; in neither of these circumstances should frog deaths be confused with those due to disease.

2. The disease has not struck everywhere equally, but has been particularly concentrated in southern and eastern England.

3. Within a year of an outbreak, it is usually still common to find good numbers of frogs in or around the same areas where the mortality occurred, although some may bear lesions characteristic of the disease.

4. The primary cause of the disease remains uncertain, though Dr Andrew Cunningham's study at the Institute of Zoology indicates that there may be two forms, one characterised by high infestation with red-leg bacilli and the other possibly with infection by pox or iridoviruses.

Perhaps equally important as these basic facts are other less well-discussed aspects of frog disease. These are:

1. There is no epidemiological evidence to suggest that frog diseases are devastating in the way that, for example, myxomatosis has been to rabbits. Outbreaks of frog disease are sporadic and very localised, even though frog populations in suburban areas are generally high and often linked between dozens or hundreds of small ponds spread over several kilometres.

2. There is no evidence to suggest that disease is or can be spread by the movement of spawn or tadpoles.

3. There is no evidence to suggest that an outbreak of disease has anything but the most transient of consequences, with populations generally recovering quickly after such an episode.

Taken together, this does not seem like the effect of a dangerous novel pathogen but much more like a natural population-regulatory process. Such occurrences are well documented in other species, a notable example being ulcerative dermal necrosis (UDN) in Atlantic salmon. Outbreaks of this disease, with its characteristic skin lesions, caused great concern among fishery managers all over Britain in the late 1960s. However, because salmon fishing has a long and well-documented history, it was quickly discovered that the disease had struck before and may recur in its most severe form every 60-70 years or so; salmon stocks subsequently recovered from disease attacks, but not unfortunately from multiple other problems such as pollution and overfishing.

There could be an important message here for frog conservation. The disease struck at a time when frog populations might have been particularly vulnerable to stress, because numbers in many suburban gardens had become extremely high. I estimated that there were more than 400 rather emaciated adults per hectare in my part of Sussex in the mid 1980s, and the summers of 1989, 1990 (and 1995, with another outbreak) were especially hot and dry. This could have precipitated a crisis for frogs, particularly in the south and east where the weather was at its most extreme, manifest as outbreaks of disease in animals already in very poor physical condition.

What we do know is that efforts to promote garden ponds and their use by amphibians during the 1970s and 1980s proved extraordinarily successful as a conservation tool. During this period, frogs recovered from what was perceived as a national crisis following agricultural intensification in the post-war countryside to a situation in which built-up areas as far apart as Brighton and Sunderland maintained thousands of populations as a reservoir from which open countryside could be (and is being) repopulated. Now there is a risk that overreaction to frog disease might reduce this conservation gain, by urging us not to move spawn around (or, bizarrely, to confine movements to within an arbitrary 1 kilometre radius) and to leave new garden ponds to populate naturally - passive rather than active conservation. In my opinion the facts simply do not warrant such a cautious response that may discourage people from an interest in conservation as well as putting the brakes on an unmitigated urban success story. Of course new facts may come to light that justify the present panic measures, but it seems to me that at the moment the balance is wrong. Moving frogspawn works wonderfully well; frog disease is patchy and inconsequential. Keep up the good work, I say.

DENDROBATID FROGS IN CAPTIVITY

BOB AND VAL DAVIES

5 Richards Road, Standish, Wigan, WN6 0QU, U.K.

(Presented at the BHS Scottish Symposium 1994)

INTRODUCTION

The Dendrobatids inhabit the rainforest of South and Central America from Panama to Peru. One species (*Dendrobates auratus*) was introduced to Hawaii in the late 1920's and is now established there. They are commonly called Poison-Arrow frogs. This however is a misnomer because as far as it is known they were never used for tipping arrows but the skin toxins of three species were used for tipping blowpipe darts by the Choco Indians of Colombia. The Southern Choco used *Phyllobates terribilis*, the Northern Choco *P. bicolor* and *P. aurotaenia* which are some twenty times less toxic than *P. terribilis*. Indians who used poisoned arrows tipped them with vegetable poisons such as curare.

In a paper by Myers and Daly it is claimed that the skin of one adult wild-caught *P. terribilis* contains sufficient toxin to kill 20,000 mice. As far as is known no antidotes exist as yet. Recent research suggests that toxins from certain species may well have medicinal uses in the treatment of heart disease and arthritis, and at least one (epibatidine from *Epipedibates tricolor*), may be a painkiller more powerful than morphine but certain toxic elements need yet to be removed.

Most Dendrobatids have bright, warning (aposematic) colours but the degree of toxicity varies, some possessing little or none. As far as is known there is no information on the relative toxicities of different species - some may not even have been investigated. A recently discovered species *Aromobates nocturnus*, reported to be drab and non-toxic is named the Venezuelan Skunk Frog as it protects itself by emitting an evil-smelling secretion.

The bright colours of Dendrobatids have made them popular vivarium subjects and in recent years many species have been bred in captivity. The toxins of wild-caught specimens have been shown to reduce in captivity and captive-bred specimens do not possess toxins. In any case frogs should be handled as little as possible - apart from moving them to a different vivarium. Should the keeper have any qualms then disposable plastic gloves could be used. Obviously wild-caught specimens should be treated with respect unless known to be a non-toxic species. Escaped specimens tend to desiccate in a very short time so there is little chance of them terrorising the populace.

TAXONOMY

Taxonomy is in the usual state of flux with occasional revisions and disputes. Some species are known from only one specimen - no living specimens have been observed since. New species are occasionally discovered - *D. castaneoticus* from Brazil is a fairly recent discovery - no doubt others will be found and taxonomy revised. The generally accepted genera are as shown below:-

Dendrobates	approx	26 species
Epipedibates		25
Minyobates		8
Phyllobates		5
Colostethus		110
Aromobates		1

Other genera such as *Allobates, Phobobates* etc. have been proposed but have been disputed.

This article does not deal with the Rocket/Stream Frogs (*Colestethus*) as very few species are kept in captivity. The more colourful species tend to be most popular but at the moment relatively few species exist in Britain, far more being kept in other European countries and in the U.S.A. The following is not necessarily the only way of keeping and breeding Dendrobatids but has proved to be extremely successful for the authors working with nine species.

CARE IN CAPTIVITY

The natural habitat is mainly warm rainforest where high humidity permits the terrestrial breeding habits of these frogs. Interestingly, a recently discovered species, *D. rufulus* (Venezuela), lives at 2100 m to 2600 m with a mean annual temperature of 14°C, the minimum air temperature dropping as low as 1°C. Commonly kept species need warmth (24°C - 28°C day, 18°C - 20°C night). A permanent maximum temperature is not advisable as the frogs' metabolism will be in 'top gear' with resultant exhaustion due to constant breeding. In winter the temperature can be lowered a degree or two and the photoperiod reduced from 14 hours to 10 hours.

THE VIVARIUM

Many keepers use normal all-glass aquaria with a ventilated lid and part cover-glass. The ventilation needs to be fine enough to prevent the escape of fruitflies, micro-crickets etc.. Too large a ventilation area will reduce the humidity necessitating frequent spraying. Purpose-built, front-opening vivaria are easier to furnish and service but the opening glass must be a good fit to avoid food items escaping. A 36" x 12" x15" aquarium is adequate for 4 average-sized frogs such as *D. auratus*, but a slightly smaller one would house small species such as *E. tricolor* and *D. reticulatus*. Overcrowding must be avoided. A tall vivarium is preferable as it allows the plants to grow - small vivaria soon become overgrown as the plants will thrive in the humid atmosphere necessitating frequent pruning.

HEATING

Methods of heating depend on the situation. In a warm room the fluorescent tube may provide sufficient extra heat but cannot be thermostatically controlled. Other heating methods employed are heater mats, soil cables and spotlamps beamed down through the cover glass, all controlled by a thermostat - the 'dimmer type' being best with spotlamps to avoid alternating light and dark periods. In a tall vivarium temperatures in the upper and lower parts must be checked.

LIGHTING

There is some debate over the necessity for ultraviolet light with Dendrobatids, one view being that sufficient Vitamin D3 for calcium metabolism can be provided by dietary means alone, but the authors have produced large numbers of healthy young frogs by using Tru-lite ® tubes inside the vivarium. Moisture-proof aquarium type leads are used because of the humidity and the control unit placed outside the vivarium for safety. (Dusted food is also supplied). In one experiment, half the froglets from one clutch were retained in Wisconsin and raised under Tru-lite and the other half were raised without Tru-lite in Hawaii. After twelve months the Wisconsin frogs were larger and had brighter colours, showing less black in their coloration.

FURNISHING

Furnishing is a matter of individual taste, for aesthetic reasons a variety of plants is better. Cork bark, bogwood etc. also adds to the effect. The system outlined here has been used successfully in many vivaria, including one for 15 years although it has never contained more than four frogs (*D. auratus*). One wild-caught specimen survived in it for 13 years, others for slightly less periods.

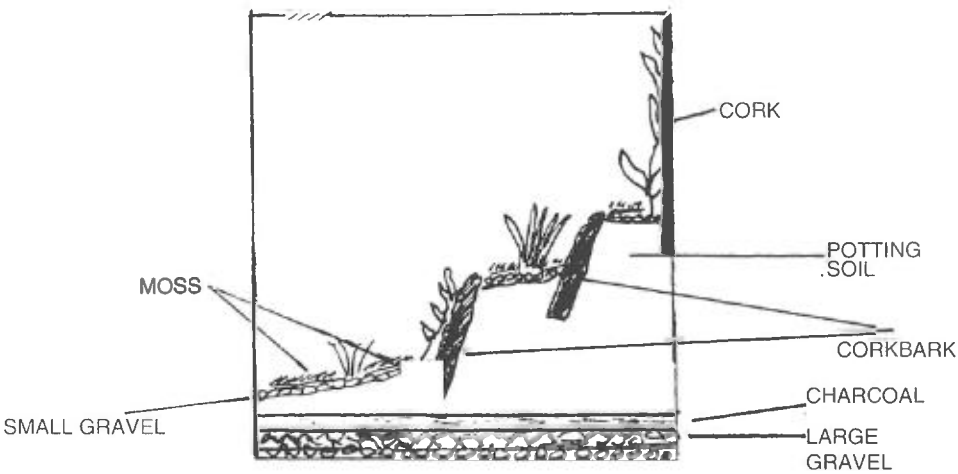


Fig 1. A basic vivarium for Dendrobatids.

The theory behind this system is that with regular spraying the waste is gradually washed into the substrate and is converted by soil organisms into nitrates which are taken up by the plants. The potting compost is loam (soil) based. Planting is best done before adding the final layer of gravel and moss. Tall/climbing plants are planted at the rear as in aquaria. The moss used is the short, encrusting type found on stones. Moss will often die off at first, possibly because the light or new substrate may be unsuitable, occasionally it will then start to grow again, but planting new moss on the dead one is often successful. Some writers proscribe the use of gravel claiming that it injures the frogs' tender skin but the authors use well-rounded, small aquarium gravel and have experienced no problems whatsoever. It is even used in the metamorphosis containers - the froglets climb out on to a shelving gravel bank (see breeding).

The vivarium is lined inside with 1 inch thick granulated cork slabs. This is ideal for climbing plants such as Creeping Fig (*Ficus pumila*), Devil's Ivy (*Scindapsis aureus*), Sweetheart Vine (*Philodendron scandens*) etc.. Various other houseplants can be tried, especially species recommended for bottle gardens as well as certain aquarium plants which will grow immersed e.g. Amazon Sword, *Anubias nana* etc.. The success of the plants is determined by the light levels and sometimes by their position in the vivarium i.e. some are more successful in the higher, better drained areas. Trial and error may be necessary. Bromeliads are only necessary if the 'Egg-feeders' are kept (see below). Constructing terraces increases the floor area, provides drained areas and spawning sites and gives the frogs climbing facilities.

Dendrobatids do not need deep water. A small pool is provided by creating a depression in the top gravel layer and keeping the water level in the substrate at an appropriate depth (about $^1/_2$" is adequate). If preferred a small dish can be sunk in the substrate, the water in it being changed when necessary. The water level in the vivarium can be controlled by siphoning off surplus. The frogs are often seen sitting in the water before and after spawning. An open area is left for feeding at the front of the vivarium. Other refinements, depending on the keeper's financial state, include ultrasonic misters, rain chambers, waterfalls, drainage taps etc..

This is not the only possible system. Vivaria with a partial or complete undergravel filter powered by a small pump (with optional waterfall) have been successful. Planted islands were provided using seed trays. Small cobbles, partially buried in the gravel provided extra 'land' areas. Whatever system is used it must not be overcrowded - it can only cope with a certain amount of waste.

FOOD

Dendrobatids have a relatively small mouth so food must be of the appropriate size, the usual food being wingless *Drosophila*. The larger, winged, flightless *Drosophila* can be used for most Dendrobatids but some smaller species such as *D. reticulatus* may not be able to consume them. Crickets of suitable size can also be supplied. Winged and wingless green aphids are extremely nutritious but as with 'sweeping' there is always the risk of pesticides. Small waxmoth larvae will be eaten but should not constitute too large a part of the diet. They need to be supplied on a shallow lid as they soon die when in contact with the moist substrate. Springtails can be temperamental to culture but are eagerly devoured and are especially useful for the young of small species. They may even breed in the vivarium. A small piece of fruit placed on a lid in the open area will help to concentrate the *Drosophila*. Crickets and *Drosophila* are dusted with a fine multivitamin powder at least three times a week, but some products are too coarse to adhere to small insects. Aphids and Springtails are not dusted. The frogs are fed on a daily basis.

CAPTIVE BREEDING

Dendrobatids are notable for their breeding behaviour, especially brood care. As far as captive-breeding is concerned they can be divided into two main groups with an intermediate group. Captive breeding behaviour may not always exactly replicate that in the wild.

Plate 1. *Phyllobates terribilis* - Colombia - described as the 'most toxic animal in the world'.

Plate 2. *Dendrobates auratus* - Costa Rica, Nicaragua, Panama - green and black form. One of the commonest in captivity - regularly bred.

Plate 3. ***Dendrobates tinctorius*** **- French Guyana - another common, 'easy' species.**

Plate 4. ***Dendrobates pumilio*** **- Costa Rica, Nicaragua, Panama - an oophage - typical colour form but numerous variations occur especially in Panama.**

SEXING

Sexing is not always easy but generally speaking mature females tend to be larger in length and girth. In *Dendrobates* at least, the males have wider 'plates' on the toes of the front feet (although there are exceptions). Finally in some species with a pale underside it may be possible to see a wrinkled or darkish throat patch on the male. The surest way of sexing is to observe behaviour and to see the male's throat expand as in some cases isolating a suspected male in a small container and spraying him may stimulate calling. Calls may be a low 'buzz' which is barely audible or pleasant trill. Certain species (e.g. *D. lehmanni*) can be difficult to sex visually.

SEX RATIOS

Some species have bred with a 1.1 ratio but we have achieved better results with 2.1, 3.1, and in one case 4.1. In the confines of a vivarium, having more than one female frequently results in eggs being eaten. Occasionally dominant females will press another female to prevent her mating. The pressed female remains prone for a short time as the other moves off to mate. This behaviour can be seen when a male starts to call. An exception to using these sex ratios is *D. ventrimaculatus* (formerly *quinquevittatus*), which can be kept in larger groups. Communal spawning may be triggered by one male starting to call.

COURTSHIP AND SPAWNING

Group 1 - 'Detritus Feeders'

In the first group the tadpoles would normally be transported (usually by the male) to small pools where they would feed on detritus or whatever happened to be in the pool. Their captive breeding is as follows:

Generally speaking there is no amplexus although in a few species cephalic amplexus occurs (e.g. *E. tricolor*). Males are usually territorial - courtship starts with one calling which will attract others. Pressing down is attempted but is usually resisted and results in a 'wrestling contest'. A defeated male runs off into the plants frequently pursued by the victor. A responsive female approaches a calling male and paws or strokes his back sometimes accompanied by a butting movement. Courtship may last for several days or an hour or two. Eventually the male leads the female to the selected spawning site.

Spawning Sites

The clutch is usually laid in a secluded spot. For this we provide two or three laboratory watch glasses (concaves) which have a piece of green plastic on them. These are covered with a piece of coconut shell with a small entrance cut in one side. These sites are usually utilised but occasionally a clutch may be deposited on a leaf or even on the substrate. If laid on a leaf they may be kicked off as the male fertilises them. Instead of a watch glass a shallow plastic lid will suffice - some keepers use petri dishes.

The number of eggs varies according to species and also would seem to be dependent on frequency of breeding, but most species produce small clutches (4-8 eggs in many cases but *P. vittatus* regularly produced 15-17 eggs). *D. ventrimaculatus* tends to stick eggs in a variety of locations rather than using a spawning site.

Care of Eggs

The plastic (with eggs) is removed to a petri dish and 2-3 mm of water (vivarium temperature) added - just sufficient to touch the base of the eggs. The eggs must not be covered with water. After 10 to 14 days (according to species and temperature) the eggs hatch and the tadpoles (after one or two days) are removed to individual tubs (margarine/butter etc.) containing 1.5 cm of water which has been allowed to stand for 24 hours. The tadpoles are separated to prevent cannibalism - but some species (*D. auratus, truncatus*) can be raised communally in an adequate sized container provided they are well fed. Using tubs the water is changed daily (dechlorinated which has stood for 24 hours) and food added. Food is made up as follows:

3 parts tropical fish flake food
1 part Tetra ® condition food
2 'pinches' powdered cuttlefish bone
1 'pinch' multivitamin powder

The ingredients are ground together to produce a fine powder. The tadpoles will not feed for a day or two but a very small amount of food can be added, gradually increasing as the tadpole starts to grow. Adding too much food must be avoided and it is advisable to stir the food slightly to make it sink. Feeding usually occurs at night.

When the tadpoles have all four legs and the tail has almost disappeared they are removed to a small aquarium with facilities for climbing out of the water - usually a small covered aquarium with a shelving area of small aquarium gravel and 2.5 cm of water. On the gravel is a clump of moss. Once the tail has disappeared the froglets are removed to small ventilated containers (glass food storage jars) containing wet moss and provided with wingless *Drosophila*. They do not feed for 2 or 3 days until the mouth is fully adjusted to the new diet. Once they are known to be feeding they can be transferred to a simple nursery vivarium with Tru-lite ®.

Group 2 - Egg Feeders

This group contains species such as *D. lehmanni, D. histrionicus, D. pumilio* etc.. They are not as easy to breed as the 'Detritus Feeders'. Males are very territorial and a large vivarium is advisable. There are reports of tadpoles being reared on powdered egg yolk suspension and proprietary fish fry foods but some keepers report failure with these methods. It is probably better to let them breed normally as outlined below.

Breeding

Courtship and spawning is similar to that above but tadpoles are removed by the female to bromeliads and placed singly in a water-filled axil. Several bromeliads are needed, the eggs being normally laid on the leaf of these or other plants. As stated brood care is normally done by the females but we have observed a *D. pumilio* (Panama form) male guarding and moistening eggs and also transporting larvae - even calling when he was carrying the tadpole. Once the tadpoles have been deposited in the bromeliad the female will regularly visit them and deposit infertile eggs on which they will feed. In both groups larval transport is accomplished by the adult placing its posterior near the hatching larvae which will then wriggle on to the dorsal surface. In Group 1 several may be carried at one time - in Group 2 it is usually done singly although *D. pumilio* and *D. reticulatus* have been observed carrying 2 larvae. The larvae can survive in surprisingly

Plate 5. A set-up for oophages - contains bromeliads for tadpoles.

Plate 6. Tadpole rearing system (non-oophages).

Plate 7. ***Dendrobates reticulatus*** **female depositing tadpole in** bromeliad.

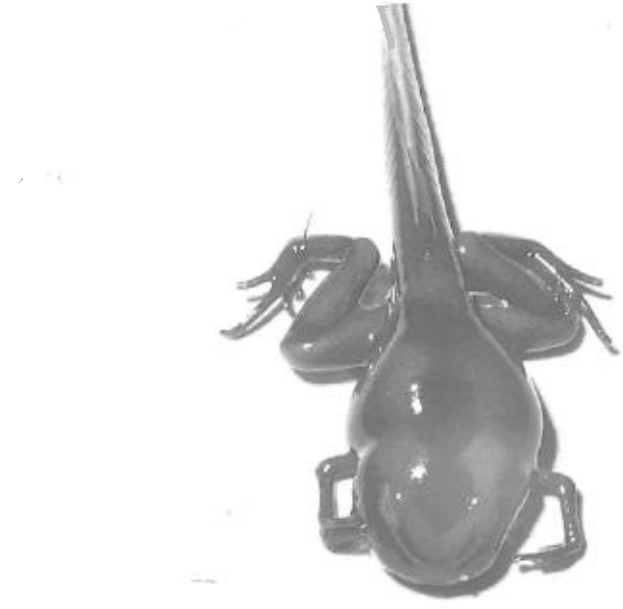


Plate 8. ***Dendrobates auratus*** **froglet showing spindly-leg syndrome.**

small amounts of water. *D. granuliferous* (Costa Rica) tadpoles were found living in less than half a teaspoon of water in a bromeliad. Another amazing feature is the females' ability to remember where the tadpoles have been deposited.

Group 3 - Intermediate

There are some frogs which in captivity will raise their tadpoles in bromeliads, feeding them infertile eggs, or the tadpoles can be removed and raised as in Group 1. Both methods have been used by the authors to breed *D. reticulatus* and *D. ventrimaculatus*. In artificial rearing the resultant froglets were larger and took less time to metamorphose. On occasion some Group 1 frogs have deposited eggs in inaccessible corners and later transported the tadpoles to a small pool in the vivarium. Probably due to lack of food they were also smaller at metamorphosis than those reared artificially although they eventually attained normal size.

PROBLEMS

Obtaining stock from a reputable source and quarantining for several weeks in a simple set-up will help to avoid many problems. If a diseased frog is introduced to the main vivarium then it may become contaminated and will probably lead to later introductions becoming infected. Emptying and sterilising a furnished vivarium is a major undertaking. Complete 'wipe-outs' have been known to occur when wild-caught *Mantella* have been introduced to captive-bred Dendrobatids and disease has been passed on via plant cuttings given by one keeper to another. There would seem to be less available information on frog diseases than on reptile diseases and among keepers treatment tends to be limited to the topical application of antibiotics and wormers. This is carried out by dribbling the medication onto the frog's dorsal surface in the hope that sufficient will be absorbed by the permeable skin. Such treatment for external (skin) disease is probably more effective than for internal conditions. Oral administration of drugs is difficult with such small creatures and expert help would be needed.

Antibiotics etc. can only be obtained from vets - a number of which are now expanding the treatment of exotic animals and it is worthwhile trying to find one when starting to keep reptiles and amphibians.

A common problem is 'spindly-leg syndrome' in newly metamorphosed froglets - the forelegs are very thin and practically useless. They may also be curved inwards or even wrongly positioned. It can usually be detected in the tadpole before metamorphosis. The 'body' may be over-large and flabby looking, often with a 'figure-eight' shape. The envelope of skin over the forelegs has a rectangular rather than triangular shape and the legs cannot break out of it properly. The condition is irreversible. The cause is not fully understood but evidence would seem to point to some nutritional deficiency in the adult female, and could be aggravated by intensive breeding. Various preventive measures have been suggested - vitaminising the adults every feed, full spectrum lighting over the tadpoles and feeding adults with rice flour beetle larvae. A varied nutritious diet combined with a reduction in breeding would seem to be the best bet. In the authors' collection spindly-leg appeared a few years ago in one group towards the end of a fairly intensive breeding season. The adult frogs were separated and kept at slightly lower temperatures and the vivarium allowed to dry a little. Food items were dusted and offered four times a week and as much variety as possible provided. After six months they were allowed to breed again which they did, although not as intensively as before, and no problems were experienced with spindly-leg again.

CONCLUSION

Using the above methods, the authors have been successful in breeding substantial numbers of certain species. Given the right conditions and adequate care Dendrobatids are not difficult to keep and can be surprisingly long-lived e.g. wild caught *D. auratus* 13 years, captive-bred *D. auratus* 10 years and various reports of others upto 17 years (*D. azureus*). They are attractive, fascinating creatures and there remains much scope for observation and investigation.

We would however make a plea to potential keepers to avoid inbreeding and hybridisation. Inbreeding leads to numerous problems such as infertility and can only be detrimental. Hybridisation - since there are relatively few Dendrobatids in the U.K., it would be a tragedy if the pure forms were lost in a sea of hybrids.

VETERINARY AND LEGAL IMPLICATIONS OF THE USE OF SNAKES IN TRADITIONAL DANCING IN EAST AFRICA

JOHN E. COOPER, F.R.C.V.S.*
MARGARET E. COOPER L.L.B.†

*Faculty of Veterinary Medicine, Sokoine University of Agriculture, P.O. Box 3021, Morogoro, Tanzania
†Durrell Institute of Conservation and Ecology, University of Canterbury, Kent, CT2 7PD, U.K.

INTRODUCTION

Dancing is a long established part of culture in East Africa and often plays an important role in uniting communities. In recent years, attempts have been made to encourage, and where necessary to revitalise, dances in order to ensure that ethnic (tribal) customs and rituals are not forgotten.

Although most Africans dislike snakes and many are superstitious about them (FitzSimmons, 1962; Mbindyo & Okelo, 1979), there are tribes that include snakes in their folklore and revere them (Pitman, 1938). On Ukerewe Island, Lake Victoria, for example, green snakes are considered to be a good omen, especially if found in the house. A few Africans, such as the WaSukuma of Tanzania, handle snakes and use them in their traditional ceremonies.

Mbindyo and Okelo (1979), writing about Kenya, state that, "There are no snake charmers in the country". This may be true if snake charming is defined as practised in India, but there is no doubt that certain East Africans are able to handle snakes with great skill, some because of a tradition in this respect, others because they have worked at a snake park and gained practical experience of reptiles. Dance troupes have capitalised on this and there are several groups that advertise themselves as performing "ngoma za nyoka" (snake dances) and travel considerable distances to dance in front of both indigenous and expatriate audiences.

Little has been published on the use of snakes in traditional dancing nor the health and welfare considerations that may arise. In this paper we discuss veterinary and legal implications, with particular reference to Tanzania.

MATERIALS AND METHODS

The data in this paper were collected primarily during the course of work with one group, based at a Roman Catholic Mission, near Morogoro, Tanzania.

In addition, relevant information was obtained by discussion with individuals who are involved in, or knowledgeable about, traditional dancing in East Africa.

BACKGROUND

The snakes used in dances are captured in the wild. Valuable (usually large) specimens may be collect from hundreds of kilometres away. Local people receive payment for notification or assistance.

On arrival, a snake is usually given a cursory examination. If there are many ticks (usually *Aponomma* spp.) present, these are pulled off by hand. Forceps or pliers are then used to remove the fangs of venomous species, such as mambas (*Dendroaspis* spp.) and most of the large teeth of pythons and sizeable colubrids. The purpose of tooth removal is to protect handlers by minimising physical damage and/or envenomation if the snake bites.

Often the snakes are accommodated in the box in which they were transported. One or two dance teams are now housing pythons and other larger species in specially designed cages or enclosures.

Water is usually provided. Whether the snakes feed or not depends upon the knowledge and approach of the staff involved. Some snakes are never fed or are offered a totally unsuitable diet: at one location pythons were given "unga" (flour) on the assumption that they would eat this, and it was only when a small dog found its way into the enclosure and was swallowed by a python that the dancers accepted and believed that snakes are carnivorous! The long-term survival of some pythons prior to that time may have been due to their eating rodents that were attracted to the flour.

The level of hygiene also varies enormously. Rudimentary cleaning of boxes or cages to remove faeces and slough is routine but often infrequent and inadequate. Likewise, water containers may go days without attention, possibly because many Tanzanians believe that snakes do not drink water.

Use of the snakes during and in preparation for a dance seems to be almost standard. They are brought into the dance area in a wooden box or basket and then are either removed by hand or allowed to "escape" on to the floor. One or more of the dancers hold the snakes or, if it is a python (usually *Python sebae*), the handler drapes it around his body. Members of the audience may be invited to touch or to handle the reptile during the performance, but usually told nothing about the snake at this time. Sometimes people have a snake forced upon them, usually causing consternation and alarm. From time-to-time snakes are teased - for example, by threatening them so that they attempt to strike.

Each performance lasts less than an hour, after which the snakes are put back into their box or basket.

It has not proved possible to ascertain with any accuracy for how long the snakes used in dances live, but judged from the need to collect replacement specimens, the lifespan of small species may only be a few weeks. Large pythons fare better and a number are still alive and in reasonable condition 2-3 years after first being captured.

VETERINARY IMPLICATIONS

Other than the Mission near Morogoro, which consults the Faculty of Veterinary medicine, Sokoine University of Agriculture, veterinary attention for snakes used in dances is the exception rather than the rule.
The main veterinary problems appear to be as follows:-

a) traumatic injuries arising from capture or transportation.

Some specimens are already damaged when caught, others have wounds inflicted as a result of the use of sticks or tongs. Snakes that are sloughing are particularly prone to

skin injury (Cooper & Jackson, 1981). Infection is often a sequel to wounds, especially when hygiene is poor. Many of the bacteria involved are Gram-negative opportunists such as *Pseudomonas aeruginosa* and *Aeromonas hydrophila*.

b) stomatitis caused by a combination of tooth removal and rostral damage caused when the snake strikes or rubs its head against the wall of its enclosure; again Gram-negative bacteria are usually implicated (Cooper & Sainsbury, 1994).

c) initiation and dehydration, usually as a result of the snake's not feeding or having inadequate access to water but also often following skin wounds or stomatitis.

d) bacterial septicaemia and death as a sequel to infection of wounds but also possibly associated with immunosuppression of the snake following prolonged exposure to environmental stresses, as postulated by Cooper and Needham (1983).

The main thrust of the work with the Mission near Morogoro was to teach handlers how to reduce ill-health and death in their snakes and, at the same time, to provide instruction that would minimise the risks to handlers from zoonotic and environmental organisms such as *Salmonella* and *Pseudomonas* spp. respectively. Tuition primarily consisted of advice on housing and feeding different species of snake, hygiene and provision of basic treatment.

Advice on aspects of management such as housing and feeding is well accepted by dancers and usually implemented. Although members of the troupe may be remarkably confident about catching and handling snakes, their knowledge of reptile biology is usually very limited. For example, simple advice on how to help a snake to shed its skin is welcomed and generally followed. Books and articles about reptiles can help in educating such people but in Tanzania many of those involved speak little English; there is a need for literature in Swahili.

As mentioned earlier, training in hygiene had the dual effect of protecting snakes and staff. Hot water was advocated as the cheapest and best disinfectant and when chemical agents were used there were local products which could be purchased easily, used safely and appeared to have no deleterious effects on humans or reptiles.

Any guidance on treatment of snakes had to take into account the low income of the personnel involved; medicines cost money and if they are to be used, must be as cheap as possible. In addition, the measures recommended needed to be sustainable when there was no longer expatriate advice and assistance available. Thus, for example, the staff were taught how to remove ticks and mites manually or by application of local preparations, rather than by use of expensive and potentially dangerous modern parasiticides. Skin wounds or lesions on the mouth were not treated with antibiotics but cleaned by washing thoroughly under a water tap (or in the river!) and protected from infection primarily by hygienic measures and irrigation with mild disinfectant. A gift of adhesive polyurethane dressings ("OpSite": Smith and Nephew) provided an opportunity to teach the staff how to apply this product to wounds and it proved to be an excellent method of treatment, as has been reported previously (Cooper, 1981).

The question of tooth removal remains contentious. Ideally one would like to outlaw it. The procedure can sometimes be discouraged, when the species is non-venomous, but nearly all dancers consider tooth removal essential when working with poisonous snakes.

Plate 1. A python (*Python sebae*), used in dances, is handled prior to treatment of skin lesions. (Photo: Margaret Cooper)

An alternative approach to rendering these snakes relatively safe might be to ligate their venom ducts (Cooper, 1974), but this technique needs to be carried out under anaesthesia by an experienced veterinary surgeon and if the snake is not adequately marked, there is the danger that non-operated and operated snakes may be confused and transposed.

The authors' experiences in Tanzania indicate that the use of snakes in dances is very likely to lead to health and welfare problems. This is supported by observations elsewhere. For example, Hodges (1993) said in the context of similar snake dances in Java, "some of the dance antics can hardly have been beneficial".

LEGAL CONSIDERATIONS

While no legislation in East Africa specifically relates to snakes used in dancing, some statutes are relevant. Thus, for example, the Tanzanian Wildlife Conservation Act No. 12 of 1974 provides protection for most species of wildlife, including reptiles, and therefore the collecting and keeping of snakes should be permitted only under licence.

Welfare legislation may also be applicable, In Kenya, for instance, The Prevention of Cruelty to Animals Ordinance (Chapter 360), Revised 1963 - which is largely based on the British Protection of Animals Act 1981 (Cooper, 1987), provides penalties for those who cause unnecessary suffering to captive animals, including (apparently) reptiles.

CONCLUSIONS

The use of snakes in dances presents a dilemma for those who care about the health and welfare of reptiles and yet who also believe that African cultural traditions should be preserved and encouraged. It is most unlikely that, in the foreseeable future, the use of

snakes for this purpose will be banned or tightly controlled. To most Africans snakes are of no intrinsic importance and their "welfare" is not worthy of serious consideration.

Therefore, assuming that this use of snakes will continue, the following approaches are suggested:-

1 There is a need for stricter enforcement by the authorities of the legislation that applies to the taking and keeping of protected species and the welfare of captive animals. Such measures could reduce the number of snakes caught and might encourage better care of them once they are in captivity;

2 A code of practice for those who keep and use snakes for dancing is worthy of consideration. The code could cover such issues as housing, feeding and handling, and provide guidelines on the frequency with which a specimen is put on public display and how this is done. Codes of practice are increasing and feature other types of animal usage in East Africa - for example, covering the farming (ranching) of ostriches and crocodiles (Cooper, 1995) - and the compilation of one covering snakes would not be difficult. Adherence to such a code could prove beneficial to those who use snakes, as well as to the reptiles themselves, since (a) specimens that die because of poor management have to be replaced, at a cost (b) many of the audiences that watch the dancing are expatriate visitors and it is only a matter of time before tourists question the way in which the snakes they see are caught, kept and used, and (c) exhibition of live snakes to local people can, if carried out humanely, be very educational (Muhairwa, personal communication) and do much to promote the welfare and conservation of these reptiles;

3 Local veterinarians should be encouraged and helped to take an interest in these reptiles to provide help and advice when needed. This move will be helped by the development in recent years of courses in wildlife diseases at the Faculties of Veterinary medicine in Kenya, Tanzania and Uganda.

4 Advantage should be taken of the expertise and experience already available in some parts of East Africa - for example, at the better snake parks and serpentaria in Kenya - in order to build up and disseminate information, preferably in Swahili and other local languages, on the biology, care and management of captive reptiles.

The authors would welcome comments from others with experience or knowledge of this subject.

ACKNOWLEDGEMENTS

We are grateful to Father Harry Tullemans and the staff of the Msongozi children's Theatre Group for helpful discussions, and other friends and colleagues in East Africa for their opinions and experiences. Mrs Alyette de Munck provided access to her (1938) copy of Pitman's *The Snakes of Uganda*. The British Small Animal Veterinary Association (BSAVA) presented a copy of their *Manual of Reptiles*, and Smith and Nephew generously donated samples of "OpSite". An early draft of this paper was read and commented upon by Jim Crees, MRCVS, A.P. Muhairwa, BVM and Maxwell Cooper, BSc.: we are indebted to them for their help.

REFERENCES

Cooper, J.E. (1974). Ketamine hydrochloride as an anaesthetic for East African reptiles. *Veterinary Record* **95**, 37-41.

Cooper, J.E. (1981). Use of a surgical adhesive drape in reptiles. *Veterinary Record* **108**, 56.

Cooper, J.E. and Jackson, O.F. (1981). Editors *Diseases of the Reptilia*. Academic Press, London and New York.

Cooper, J.E. and Needham, J.R. (1983). Isolation of potentially pathogenic bacteria from healthy mambas (*Dendroaspis* species). *Veterinary Record* **113**, 135-136.

Cooper, J.E. and Sainsbury, A.W. (1994). Oral diseases of reptiles. *Herpetological Journal* **4**, 117-125.

Cooper, M.E. (1987). *An Introduction to Animal Law*. Academic Press, London and New York.

Cooper, M.E. (1995). Legal and ethical aspects of new wildlife food sources. *Biodiversity and Conservation* **4**, 322-335.

FitzSimmons, V.F.M. (1962). *Snakes of Southern Africa*. MacDonald, London.

Hodges, R. (1993). Snakes of Java with special reference to East Java Province. *British Herpetological Society Bulletin* **43**, 15-32.

Mbindyo, B.S. and Okelo, G.B.A. (1979). *Common Venomous Bites and Stings in Kenya*. Health Education Division and Audio-Visual Aids Centre, Nairobi.

Pitman, C.R.S. (1938). *A Guide to the Snakes of Uganda*. The Uganda Society, Kampala.

REPTILES THAT JUMP AND FLY

JOHN CLOUDSLEY-THOMPSON

10 Battishill Street, Islington, London, N1 1TE

INTRODUCTION

When, as an undergraduate, I returned to Cambridge after the War, I had the good fortune to be supervised by Dr Hugh B. Cott, who had been in charge of army camouflage in North Africa. We remained very good friends until his death about 15 years ago. Hugh's interests ranged from adaptive colouration in animals (Cott, 1940), through various aspects of tropical biology to the edibility of birds and their eggs; but his favourite animals were birds and reptiles, especially crocodiles. This latter interest culminated in his important study of the Nile Crocodile (1961).

I shared his liking for herpetology - as a child, my own favourite animals had always been crocodiles, followed by elephants. It was only later that I added jumping-spiders and Solifugae (Camel-spiders) to the list. (When I was a child, amphibia were easy to come by, Crested, Smooth and Palmate newts, frogs and toads were all fairly common. Reptiles were naturally seen less often although, according to my diary, I found four Adders, two of them black, within 100 yards of each other at Effingham, Surrey, on 6 May 1935).

Cott was strongly of the opinion that predation is, by far, the most important of the selective factors that are responsible for animal adaptation, and his enthusiasm for the subject aroused my own interest in the subject of defensive responses among animals (cf. Cloudsley-Thompson, 1980; 1994; 1995). He was a superb photographer and an accomplished artist. Of all the lecturers who taught me, he was the only one ever to use the adjective 'beautiful' whilst describing a species of animal (or plant). 'Interesting' or 'intriguing' were the more usual expressions.

JUMPING

But there was one thing about which Hugh Cott did not tell me. Surprisingly, some lizards and snakes are able to enhance their chances of escape from predatory enemies by jumping, or saltation. This is particularly marked in Pygodidae of the genera *Aclys*, *Delma,* and *Ophidiocephalus* : *D. tincta* is one of the most excitable species known. When an individual is disturbed, it is said to twist its body and jump about in a fantastic display of aerobatics.

Over 30 species of snake-lizards (Pygopodidae) are distributed throughout Australia, Tasmania, and New Guinea. Their tails are extremely long, exceeding the length of the head and body, and there are no front limbs. The back legs are reduced to mere flaps, which are often quite small, and their movement is snakelike. Pygopodidae is the only reptile family endemic to the Australasian region: and it is allied to the geckos (family Gekkonidae). Although saltations may account for a high rate of success in escaping predation, escape *per se* is probably not the sole function of the response. Rather, it appears to be a mechanism for startling or disorienting potential predators, and for eliciting misdirected strikes. Furthermore, the long tail is readily autotomised. When first

broken off, its lively movements serve to confuse the enemy long enough for a snake-like lizard to make its escape.

Other lizards, such as the Asian desert *Phrynocephalus mystaceus* (Agamidae) are also capable of jumping. *P. mystaceus* sometimes burrows rapidly into the sand when threatened. If the source of danger is nearby, however, the lizard jumps, rises high on its legs, and faces the intruder, threatening defensively. Many fast-running species make jumps when escaping speedily - as do others, such as *Basiliscus basiliscus* (Iguanidae), *Crotaphytus collaris* (Iguanidae) and *Chlamydosaurus kingii* (Agamidae) which adopt a bipedal posture under such conditions. Doubtless many of the lighter bipedal dinosaurs would also have been able to leap and jump like fighting cocks, to judge by the massive claws on their back legs. This would apply, for example, both to Coelurosaurs such as *Deinonychus* and *Velociraptor*, as well as to ornithomimosaurians including *Ornithomimus, Callimimus* and *Struthiomimus* spp.

Whereas, in other carnivorous dinosaurs, the third toe was the longest, the second and fourth being considerably shorter, in *Deinonychus anterrhopus* the fourth and third toes were of equal length and the dinosaur walked and ran only on these two toes. The first toe was short, with a small backward-pointing claw from which the animal got is generic name which means 'terrible claw'. When the dinosaur walked along, this claw was raised clear of the ground. It could, however, have been swung through a very long arc and, when brought into action in defence, or when disembowelling prey, would have been driven backwards with the power of the entire limb. Not only would *Deinonychus* have had to balance on one leg whilst tearing prey that was grasped by the long-clawed fingers of the hands, but it might well have jumped and slashed at an enemy with the claws of both legs simultaneously. The discovery of the remains of about five individuals with those of a large herbivore weighing some six times as much as a single *D. anterrhopus* suggests that these dinosaurs may well have hunted in packs, just as lions do today, and were thus able to tackle prey very much larger than themselves (Halstead & Halstead, 1981).

It is by no means unexpected that bipedal, and even quadrupedal reptiles, should be able to jump. It is more surprising to learn that some snakes are able to do the same. For instance, the 'jumping viper' *Bothrops nummifer* (Crotalinae), which receives its Spanish name 'mano de piedra' from its resemblance in appearance to an implement used in crushing corn for tortillas, is particularly savage. A stocky, terrestrial pit-viper of Mexico, Guatemala, Honduras, San Salvador and Panama, it spends the day basking on, or sheltering beneath or inside fallen logs, piles of leaves and so on. At dusk, it becomes more active and may forage actively or wait in ambush for the small rodents, lizards and frogs on which it preys. It lives up to its name by sometimes striking with such force that it actually leaves the ground and makes a short jump. When striking from the side of a log, or from a bank, it may even be able to propel itself from more than a metre. It strikes defensively as well as in offence and, when thoroughly frightened, flails about, striking wildly, and turning quickly to keep the enemy in view. Similar behaviour has been observed in other ground-dwelling species of the genus, and provides and explanation for their popular name, 'lance snakes'. Some speedy Colubridae, such as the large green rat snake (*Ptyas nigromarginatus*) of southern Asia, can hurtle through the air down steep slopes for considerable distances in pursuit of prey or escape from enemies. *Chrysopelea* spp. (see below) are also able to jump from the branches of the trees among which they live. Finally, cryptozoologists have reported a mysterious jumping snake from the environs of Sarajevo. Could this be *Coluber viridiflavus*, the Western Whip Snake?

GLIDING AND FLYING

No modern reptiles are able to fly, but some can glide for considerable distances. Of these, the most remarkable are the flying dragons (*Draco* spp.: Varanidae) of South East Asia, flying geckos (*Ptychozoon* spp.: Gekkonidae) of the same region, and flying snakes. In *D. volens* and related species, the body is depressed and can be extended sideways by five or six elongated ribs. These flying lizards glide through the air, buoyed up by scaly fingers which run along the sides of the head, limbs, body and tail, and by webs between the digits (Fig. 1). *Kuehneosaurus* sp. (Fig. 2) of the Upper Triassic Period, about 220 million years ago, was another well adapted flying lizard.

Fossils of another Triassic reptile, *Sharovipteryx mirabilis*, show that this, too, was a glider. Its hind limbs were more than three times as long as the fore legs. Their proportions exceeded those of agamid lizards, such as *Otocrypsis* and *Amphibolurus* spp., which run and jump with the trunk elevated so that the forelimbs may, or may not, touch the ground between strides. *S. mirabilis* was probably a runner and jumper too which, like modern flying lizards, inhabited the terminal branches of trees. The membrane or 'patagium' between its limbs and elongated tail almost certainly served as a gliding membrane. It may also have aided camouflage, reducing the outline of the creature as, for instance, do the lateral flaps of certain Pacific geckos (Cloudsley-Thompson, 1994).

Back-fanged colubrid tree snakes of the genus *Chrysopelea* (e.g. *C. ornata*) not only scale the trunks of forest trees by pressing the coils of their bodies against irregularities in the bark; but they can glide obliquely through the air with bodies rigid and ventral surface concave so that they present maximum resistance to the air. They can also spring from one branch to another by coiling their bodies and then rapidly straightening them.

Only four taxa of animals have acquired powered flight with true wings. These are insects, pterosaurs, birds and bats. Whereas the early pterosaurs would have been gliders, later forms possessed large, keeled breast-bones for the attachment of the powerful wing muscles necessary for true flapping flight. The pterosaurs first appeared in the fossil record during the Upper Triassic, and flourished until the close of the Cretaceous Period, some 155 million years later. Two separate types are recognised: the Rhamphorhynchoidea which had long, stiff tails, and the Pterodactyloidea (Fig. 3) whose tails were short. Many of the members of both groups were no larger than pigeons, but some of the Cretaceous pterodactyls were huge. *Quetzacoathus* had an estimated wing span of 11 m and was the largest flying animal known. Computer studies of *Pteranodon* have shown that pterosaurs were adapted for low-speed flying and, like large birds, would have soared on weak thermals. Their low stalling speeds enabled them to take off by facing into the wind with wings extended, and they probably did not fly when strong winds were blowing. The long crest on the back of the head (Fig. 3) would have counteracted the twisting effect of wind on the beak (McGowan, 1991).

CONCLUSION

Escape from enemies and capture of prey are undoubtedly the two components of natural selection that have most influenced the morphology and life styles of reptiles. Which of them has been the more important in the evolution of the ability to jump, glide or fly, cannot easily be determined because those three endowments have multiple functions and are used both in defence and offence.

Fig. 1. Flying dragons (*Draco volens*) (From Cloudsley-Thompson, 1994. After H. Gadow, 1901) (Length approx. 15 cm).

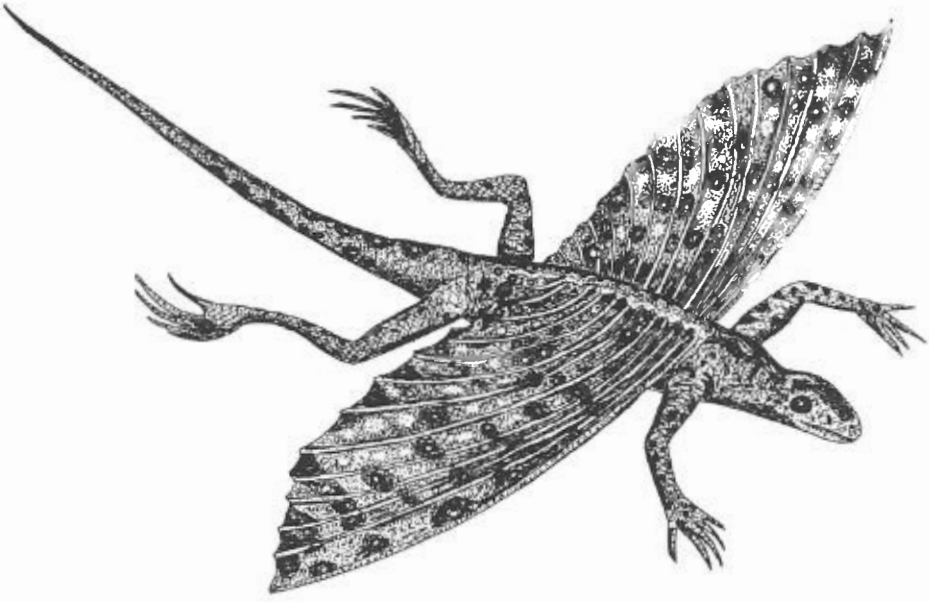


Fig. 2. Reconstruction of *Kuehneosaurus* sp.: Upper Triassic. (From Cloudsley-Thompson, 1994. After A. Charig, 1979) (Length approx 75 cm).

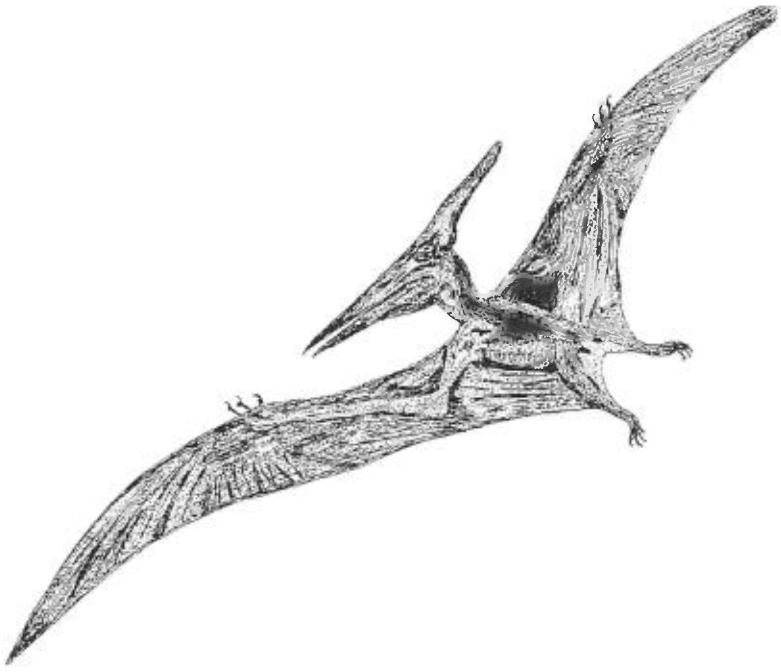


Fig. 3. Reconstruction of *Pteranodon* sp.: Upper Cretaceous. (From Cloudsley-Thompson, 1994) (Wing span approx 7 m).

Certainly, however, nobody who has studied the behaviour of reptiles in the field would disagree with the opinion expressed by Hugh Cott that the most conspicuous adaptations seen in most animals have been engendered in response to predation.

REFERENCES

Cloudsley-Thompson, J.L. (1980). *Tooth and Claw. Defensive Strategies in the Animal World.* J.M. Dent & Sons, London. 252 pp

Cloudsley-Thompson, J.L. (1994). *Predation and Defence Amongst Reptiles.* R & A Publishing, Taunton, Somerset. *viii* + 138 pp

Cloudsley-Thompson, J.L. (1995). A review of the anti-predator devices of spiders. *Bulletin of the British Arachnological Society*, **10**(3): 81-96.

Cott, H.B. (1940). *Adaptive colouration in animals.* Methuen, London. *xxxii* + 508 pp

Cott, H.B. (1961). Scientific results of an enquiry into the ecology and economic status of the Nile Crocodile (*Crocodilus niloticus*) in Uganda and Northern Rhodesia. *Transactions of the Zoological Society of London*, **29**: 211-356.

Halstead, L.B. & Halstead, J. (1981). *Dinosaurs.* Blandford Press, Poole, Dorset. 170 pp

McGowan, C. (1991). *Dinosaurs, Spitfires, and Sea Dragons.* Harvard University Press, Cambridge, Mass. *x* + 365 pp.

The following article has been reprinted from **New Scientist,** *3 February 1996.*

FROGS FIND DIVERSITY IN ADVERSITY

V. KIERNAN

Human development is supposed to wreak havoc with biodiversity as it chews up natural habitats into ever smaller fragments. But frogs living in the central Amazon rainforest have not got the message. More species of frogs live in isolated wooded fragments than in the nearby pristine forest, ecologists have found.

Mandy Tocher of the University of Canterbury in Christchurch, New Zealand, and her colleagues at the National Institute for Amazon Research in Manaus, Brazil, and Conservation International in Toronto studied frog populations in an area 70 kilometres north of Manaus between 1992 and 1994. They counted the numbers of species in 10 forest reserve-zones of primary forest that were left isolated after the surrounding forest land was razed for farming or ranching 7 to 10 years ago.

Four of the reserves covered only one hectare, four were 10 hectares in area, and two extended over some 100 hectares. For four of the reserves, the researchers had data on frog populations from before the arrival of the chainsaws. For the other, the post-fragmentation figures were compared to frog species counts made between 1983 and 1990 in equivalent areas within a nearby 2000-hectare region of undisturbed primary forest.

As expected, the larger reserves contained more species than the smaller fragments. But the real surprise was that all of the reserves were home to a more diverse collection of frog species than the pristine forest. On average, the fragments held 10 more species than an equivalent undisturbed area. One 100-hectare reserve contained 15 species before the surrounding forest was cut down, but boasted 32 afterwards.

At first sight, these results reflect well on the ability of isolated reserves to conserve wildlife in the face of deforestation. Because they need highly specific habitats to live and breed, frogs are often considered to be sensitive biological indicators of the health of ecosystems. If they are in decline, many scientists argue, other species are likely to be in trouble too. Conversely, if frogs are thriving, then an ecosystem must be in reasonable shape.

Tocher believes this view is too simplistic. "I wouldn't automatically say that the frogs are doing OK," she says. The fact that fragments have more species than the original forest is not necessarily an advantage, Tocher points out. "It may not be good if your goal is for the fragments to contain the exact community that was there before".

It is not yet clear why the number of species is so high in the fragmented areas. But it is possible that the effect is only temporary, caused by an influx of refugees forced from their former homes when the surrounding forest was razed. Tocher says that only further studies will show whether so many species can continue to live together under such cramped conditions. "We don't know what impact the new arrivals may be having on the older species."

There is already evidence that the population densities of some species are changing. Tocher and her colleagues studied four species in detail. One, *Eleutherodactylus*

fenestratus, was more abundant in the forest remnants than in equivalent pristine areas. This species lays its eggs on the forest floor, and the fragments had thicker layers of dead leaves than the undisturbed forest, Tocher notes, which would have prevented the frogs' eggs drying out. Two more species were equally abundant in fragmented and pristine areas, while the fourth - *Colostethus spepheni* - was less common in the remnants than in the undisturbed forest.

Tocher also cautions against assuming that frogs elsewhere in the world will fare so well if their habitats are fractured. What has a positive effect on species diversity in Brazil may hurt frog communities elsewhere, she says.

LETTERS TO THE EDITORS

ESTIMATING THE SIZE OF COMMON FROG (*RANA TEMPORARIA*) POPULATIONS

I dug my small garden pond, measuring approximately 1.5 m in diameter and about 23 cm deep, in the spring of 1989. Although there was an existing frog population locally, I had just missed the spawning season and so introduced a single clump of spawn in order to establish a colony as soon as possible. By the spring of 1991 and from then onwards, a considerable population of the Common Frogs had become established in and around my little pond. Every March the pond appears to be 'alive' with adult frogs, but with usually only 7 or so clumps of spawn produced (too much for such a small pond!). However, the pond was emptied on May 6, 1995 to repair a leak; I was surprised to find that there were 27 adult and 5 subadult frogs in the pond, and a considerable number of others, not counted, jumping around the garden. All specimens appeared to be healthy and of good or reasonable body weight, and all 32 frogs were given to a friend to establish another garden colony, there being a good number remaining in my garden.

This led me to think, retrospectively, about an interesting recent *Bulletin* article concerned with estimating the number of clumps of spawn in a mass, and from this, estimating the size of the adult female breeding population (Griffiths and Raper, 1994). If a sex ratio of 1:1 is assumed (which is not always the case), then, some would argue,an estimate can be made of the total adult population. However, in the case of my pond, 7 clumps of spawn would indicate an adult population of 14, whereas in fact roughly double this number were taken from the water, with a number of others seen in the immediate vicinity. Of course it is difficult to interpret these observations without a proper study, but some of the possible explanations for such a large adult population and relatively few clumps, include 1) the adult frog sex ratio was not examined and there may have been an excess of males, 2) although my garden frogs have not appeared thin or in poor condition, it is possible that in a high density population, because of limited food supply or habitat, there may be a significant number of females which do not spawn annually, 3) there may have been a migration of additional frogs into my pond after the breeding season, although from my regular observations I think this unlikely.

I do not know if this ratio of about 7 clumps to 27+ adult frogs is typical for a suburban London garden, or how different this ratio or the constitution of the population may be in different geographical regions or in more open country areas. A reasonably accurate count of the number of clumps will provide a useful estimate of the number of breeding females in any one year, but may not provide a reliable estimate of the total adult frog

population. Systematic studies to examine some of these factors, involving absolute counts of spawn clumps and frogs (including sex ratio), using selected different populations, would be worthwhile.

References

Griffiths, R.A. & Raper, S.J. (1994). How Many Clumps Are There in a Mass of Frog Spawn? *Brit. Herp. Soc. Bull.* 50, 14-17

Simon Townson
96 The Avenue, Highams Park, London, E4 9RB

A CASE OF DICEPHALISM IN A SPECIMEN OF *NATRIX NATRIX HELVETICA* FOUND AT WINCHELSEA, NR. RYE, SUSSEX.

The specimen, which was discovered in a compost heap was given to the Living World, Nr. Seaford, Sussex for proper care and attention.

Obviously an occurrence such as this soon attracted media attention and subsequently a brief report appeared in two newspapers and it was filmed for a morning television show.

Upon arrival at the Living World it measured approximately 6 inches and had to be force-fed with slivers of freshly killed fish meat every few days.

When presented with water the right head would partake first, the left following about a minute later.

The right head was clearly the dominant one at all times. The snake died after four weeks measuring approximately 7 inches. It was freeze dried by the Booth Museum of Natural History in Brighton and is presently in the Living World collection.

Acknowledgements

I am very grateful to David Rushden of the Living World Natural History Exhibition, Nr. Seaford, East Sussex for his cooperation and full report regarding this occurrence.

References

Davies, M. (1974). A double-headed Grass Snake, *Natrix natrix helvetica*, found at Ladok, Truro, Cornwall. *British Journal of Herpetology* 5, 452-453.

Davies, M. (1976). A complete record of incidents of dicephalism occurring in the British snakes. *British Herpetological Society Newsletter* No. 15, 18-19.

Doe, G.M. (1915). *Journal of the Devonshire Association* **Vol. XLVII**, 84-85.

M. Davies
4 Whitely Close, Stapleford, Nottingham

A CASE OF PREDATION ON A MOUNTAIN CHAMELEON *CHAMAELEO MONTIUM* BY A WHITE CRESTED HORNBILL *BUCEROS ALBOCHRISTATUS*

During an ornithological and habitat survey trip on 2 November 1993 in the Mount Kupe Forest, South West Province, Cameroon, a small flock of hornbills was observed dashing excitedly among canopy branches of the forest at about 1000 m altitude. The site was located above the small village of Kupe, near Tombel, on the south-western slopes of the mountain (co-ordinates: 9°42'E, 4°46'N). On closer examination, the birds were identified as white-crested hornbills (*Buceros albochristatus*) numbering about five individuals. Due to the excitement in the canopy branches it was not initially apparent what the activity was all about. Then one of the hornbills flew away from the rest of the group and settled some 100 metres away, permitting a better view through the binoculars.

The bill of the bird seemed to have a most unusual shape and this was puzzling, provoking a closer examination. Then something dropped from the bill and, as it fell, it was immediately caught in mid-air only a few centimetres from the mandibles. It was now clear that the bird was carrying something in its mouth. Closer examination revealed a dark stocky figure with a concentrically curled tail.

The bird tossed the creature in and out of its mouth a number of times with accustomed dexterity and permitting confirmation that it was a chameleon. It was not observed however that the bird resorted to hitting the creature on the branches of the tree. It appeared to use its strong mandibles to crush the reptile, each time using them to turn the chameleon around. The chameleon was then swallowed whole. It was not certain how long the bird had had it, but the whole event lasted about 15 minutes.

Identification of the prey item to species was difficult but it was thought to be *Chamaeleo montium* based on circumstantial evidence, due to the fact it is the only member of the genus occurring within immediate proximity to the observation site, and is strictly the only species known to occur between 900 and 1100 m on Mount Kupe (Wild, unpubl. data). *C. Montium* is a locally abundant species in the pre- and submontane forest of Mt. Kupe between 550 and 1300 m elevation.

Reptiles, particularly lizards, are known to form part of the diet of some hornbill species, including the African-Pied White-Crested Hornbills (Praed and Grant, 1970; Kemp, 1988), but no previous record of predation by hornbills on chameleons in the African rainforest zone has been found to date.

References

Praed, C.W.M. and Grant, C.H.B. (1970). *African Hand Book of Birds, Series Three. West Central and Western Africa. 1.* Longman. London, New York.

Kemp, A.C. (1988). Order Corraciiformes: Bucerotidae, Hornbills. Pp 377-409, in: Fry, C.H., Keth, S. And Urban, E.K. (eds). *Birds of Africa, III.* Academic Press. London.

O'Kah Ebwekoh
Officer in Charge of Ecological Research and Tourism, Mount Kupe Forest Project, c/o WWF Cameroon, P O Box 2417, PMB 1, Bonanjo, Douala. Republic of Cameroon.

Chris Wild
38 Main Street, Normanton-on-Soar, Loughborough, Leics, LE12 5HB, United Kingdom

MATING IN *PLEURODELES WALTL*

When in breeding condition, male *Pleurodeles waltl* develop relatively very long tails with broad fins and blackened pads on their upper fore-arms and inner edges of lower forearms and on the palms of their hands. When ready to mate a male *Pleurodeles waltl* will raise his forearms into a 'hooked' posture and rush towards and underneath any nearby newt and attempt to clasp its legs. Sometimes forelimbs are clasped, sometimes hindlimbs, sometimes the pair face in opposite directions, sometimes in the same direction. If the clasping male has not successfully clasped the other's forelimbs then one of his arms is released and he attempts to stretch with his free arm towards the forelimb of the other newt. A female clasped by the hindlimbs usually tries to escape and a struggle sometimes follows with the female twisting around and the male stretching for a forelimb. When a female is successfully clasped she will often stop attempting to move and lie with her hind limbs stretched back along her tail, allowing the male to determine the motion of the pair by crawling on his hind legs or by powerful strokes of his tail. When the male is ready he releases one of his clasped arms (either one) and curls his body in an arc so that his cloaca is pressed against the snout of the female and his tail is curved around her front blocking her path. He rubs his cloaca against her snout and then nudges behind her neck with his snout. They then begin to rotate about the pivoted arm, clockwise if pivoted on right arms, anticlockwise if pivoted on left arms. As the male rotates he searches with his cloaca and hind feet for a suitable spot to deposit a spermatophore. When satisfied he stops rotating and deposits the spermatophore, which may take several seconds. Meanwhile he keeps a firm grip on the clasped arm of the female, who often attempts to continue to rotate by nudging the neck of the male. When he doesn't respond she stops nudging and waits. When the spermatophore is deposited the male quickly moves away and nudges behind the neck of the female again, who now begins to search for the spermatophore with her body and cloaca as the pair slowly rotate once more. When she feels the spermatophore beneath her she moves her cloaca towards it and picks up the sperm with movements of her hips over several seconds. The male remains clasped and when the female is finished he usually moves under her again to clasp her free arm and swims away with her. This may be repeated several times, sometimes the female fails to find the spermatophore and the male breaks the search by clasping her free arm and swimming away with her, particularly if the pair are disturbed by another newt. If several pairs are present in the same aquarium there are sometimes large numbers of spermatophores present, many of which still carry sperm and on occasions females pick up sperm from spermatophore left by other males, missing the spermatophore of the male clasping her. Sometimes a male stops rotating while searching for a spot to deposit his spermatophore, but fails to deposit, and when the pair continue to rotate the female searches for the spermatophore that isn't there. If she finds a spermatophore previously left she stops to pick up the sperm, but the male, knowing he hasn't deposited, continues to try to rotate, nudging behind the females neck. She may continue to pick up sperm and he may wait or reclasp her.

A.W. Read
3 Selby Close, Beckton, London E6 4SN

BRITISH HERPETOLOGICAL SOCIETY COUNCIL 1995/6

Society address: c/o Zoological Society of London, Regent's Park, London NW1 4RY

Members' addresses:

President:	Dr R. Avery	School of Biological Sciences, University of Bristol, Woodland Road, Bristol BS8 1UG
Chairman:	Vacant	
Secretary/ Treasurer:	Mrs. M. Green	28 Dollis Hill Lane, Cricklewood, London NW2 6JE Tel: 0181-452 9578
Editor: *The Herpetological Journal*	Dr R.A. Griffiths	Durrell Institute of Conservation & Ecology, University of Kent, Canterbury CT2 7PD Tel: 01227 764000
Editors, Bulletin	Mr J. Spence	23 Chase Side Avenue, Enfield, Middlesex EN2 6JN Tel: 0181-366 8127
	Dr S. Townson	96 The Avenue, Highams Park, London E4 9RB. Tel: 0181-531 1378
Librarian:	Mr D.R. Bird	Jacaranda Cottage, New Buildings, Spetisbury, Blandford Forum, Dorset DT11 9EE Tel: 01202 686712 (work), 01258 857869 (home)
Development Officer	Dr M. Swan	19 St. Judith's Lane, Sawtry, Huntingdon, Cambs PE17 5XE Tel: 01487 831984
Trade Officer	Mr P. Curry	106 Cranley Gardens, Muswell Hill, London N10 3AH
Chairman, Captive Breeding Committee:	Mr J. Spence	23 Chase Side Avenue, Enfield, Middlesex EN2 6JN Tel: 0181-366 8127
Chairman, Conservation Committee:	Ms J. Clemons	34 Montalt Road, Cheylesmore, Coventry CV3 5LU Tel: 01203 506416
Chairman, Education Committee:	Mr D. Freeman	272 Whaddon Way, Bletchley, Milton Keynes, MK3 7TP
Chairman, Research Committee:	Dr C. Cummins	19 St Judith's Lane, Sawtry, Huntingdon, Cambs PE17 5XE Tel: 01487 831984
North-West England Group Representative:	Mr P. Wisniewski	The Wildfowl Trust, Martin Mere, Burscough, Ormskirk, Lancs. Tel: 01704 895119
Scottish Group Representative:	Mr A.W. Darby	36 Newton Crescent, Dunblane, Perthshire FK15 0DZ. Tel: 01786 824120

Ordinary Members

Mr J. Buckley (1st year)
77 Janson Road
Shirley
Southampton, Hants SO1 5GL
Tel: 01703 782966

Mr R. Sprackland (2nd year)
Department of Anatomy
Rockerfeller Building
University College London
University Street
London WC1E 6JJ

Dr M. Wilkinson (2nd year)
Department of Zoology
University of Glasgow
Glasgow G12 8QQ

Dr A. Smart (2nd year)
Cannington Centre, Bristol Zoo
c/o Education Department, Bristol Zoo Gardens
Clifton, Bristol BS8 3HA
Tel: 0117 9466373

Mr L. Gillett (1st year)
1 Fleets Lane
Tyler Hill
Canterbury
Kent CT2 9LY

Mr S. Divers (3rd year)
Elands Veterinary Clinic
Station Road, Dunton Green
Sevenoaks, Kent TN13 2XA
Tel: 01732 452333

Education Officer

Mr C. Fitzsimmons, 45 Sycamore Close, Creekmoor, Poole, Dorset BH17 7YH. Tel: 01202 692378

Observer Status

Dr C.J. McCarthy
Dept. of Zoology
Natural History Museum
Cromwell Road
London SW7 5BD
0171-938 9123

Herpetological Conservation Trust
c/o Dr I.R. Swingland
Durrell Institute of Conservation
& Ecology
University of Kent
Canterbury CT2 7NX
Tel: 01227 764000

Dr M. Lambert (IUCN)
Environmental Sciences Dept.
Natural Resources Institute
Central Avenue, Chatham Maritime
Kent ME4 4TB, UK
Tel: 01634 883201 (work)
0171 589 3558 (home)

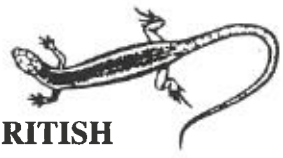
Past Presidents (retiring date)

Dr M.A. Smith (1956), Dr J.F.D. Frazer (1981), The Earl of Cranbrook (1990)

Honorary Life Members (maximum 10)

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

CONTENTS



BRITISH HERPETOLOGICAL SOCIETY

Metloc Printers Limited, Old Station Road, Loughton, Essex