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INSTRUCTIONS TO AUTHORS

1. The BHS Bulletin publishes a range of features concerned with herpetology. Emphasis is placed on captive breeding and husbandry, conservation and field notes, general natural history, veterinary and behavioural aspects. These features include major articles and scientific papers (sometimes illustrated), short notes, letters and book reviews.

2. For preference, major papers should be submitted in duplicate, typed in double-spacing, with wide margins; the addition of a computer diskette would be an advantage. Letters and book reviews should also be typed. However where this is not possible, handwritten articles are acceptable.

3. Slides are the preferred form of illustration, although it is possible to use prints for reproduction purposes. Colour plates are expensive and all pictures should be entirely relevant to the text. It is also possible to reproduce line drawings (black ink), graphs and charts.

4. For style and layout, authors should consult a recent copy of the Bulletin.

5. Authors will be informed of the receipt of their work and will be given a time-scale within which it may be published. Acknowledgement of the receipt of a piece of work **does not** indicate acceptance for publication. Decisions on this will be made by the editors as soon as possible and the authors informed.

6. The editors reserve the right to shorten or amend material.

7. Twenty-five off-prints and one complimentary copy of the Bulletin are provided free to authors. Further copies may be available from the editors at cost. Slides, prints and other original material will be returned.

8. The copyright of all material published in the Bulletin is held by the Society. None may be reproduced without the permission of the editors.

9. The significance and importance of some articles may be such that the editors will offer the author a year's free subscription to the Society for their work.

10. The editors are keenly aware that members may find some of these instructions difficult to carry out. They are anxious to open the pages of the Bulletin to as wide a range of correspondents as possible. Therefore, if you have any concerns about the publication of a piece of work, or would like to help in preparing it, please discuss this with John Spence, at the address and telephone number below.

The Bulletin was edited and produced by John Pickett and Simon Townson. Contributions and correspondence arising from the Bulletin should be sent to John Pickett, 84 Pyrles Lane, Loughton, Essex IG10 2NW.

FRONT COVER
Seychelles Giant Tortoise *(Dipsochelys arnoldi)*. See "Notes on some Seychelles Reptiles" by J. Gerlach p. 53.

BHS CAPTIVE BREEDING COMMITTEE – NEW INITIATIVE ON RESEARCH / FIELD PROJECTS

DR SIMON TOWNSON, CHAIRMAN CBC

During 1998 the Captive Breeding Committee has embarked on a major new initiative on behalf of the Society to collaborate with outside organisations and fund research proposals involving reptiles and amphibians. The Committee has been responsible for the solicitation, review and selection of proposals for funding based on their relevance to our interests (captive breeding, conservation, veterinary science, etc), on their credibility and on value for money. By the end of 1998 four proposals submitted by three distinguished biologists with long-term associations with BHS, were selected for sponsorship.

Funding for this initiative has come entirely from monies raised by the Captive Breeding Committee from various activities, although mainly from the rolling book programme which now has seven titles to its credit; the book programme was started in 1979/80 using a personal loan from Drs Townson and Millwood to the BHS. This situation has been achieved without taking any money from members' subscriptions which are presently consumed by publications, postage, services, etc., and will therefore provide additional interest, meetings and involvement for members at no additional cost to central funds. It is hoped that this initiative will significantly contribute to a needed invigoration of BHS and help to maintain a more international perspective to the Society. All four projects are also co-sponsored by other organisations.

In return, BHS will receive 1) regular progress reports for the Bulletin, 2) a final report/paper for the Bulletin and/or a new CBC book, 3) speakers on the funded projects to contribute to the BHS meetings programme and 4) recognition and acknowledgement for our contribution to important areas of applied herpetology.

Funded projects are described below, with details extracted from the original proposals.

(1) "HEALTH MONITORING OF GIANT TORTOISES (*GEOCHELONE GIGANTEA*) ON CHANGUU ISLAND, ZANZIBAR." *Principal investigator Prof. John E. Cooper FRCVS, Wildlife Health Services. Project will involve the study of diseases, including treatment, transmission, vectors, etc., and will set up a comprehensive health programme for these animals and to examine the feasibility of setting up a small laboratory and record centre for breeding. Will provide an important focus for management and conservation programmes. Work already completed by Prof. Cooper has provided an excellent "blueprint" for the development of health management systems for endangered chelonians.*

Plate 1: Prof John Cooper and Zanzibari Colleagues with Giant Tortoises awaiting relocation to Changuu Island

(photo: M. Cooper)

Background

The Giant Tortoises *(Geochelone gigantea)* of Changuu Island, Zanzibar are believed to have originated from Aldabra, in the Indian Ocean in the early nineteenth century. However, the only written records available refer to those presented earlier in this century. Whatever the date of their introduction to Changuu, there is no doubt that for much of this century the Giant Tortoises fared well and bred well. Until relatively recently, the island remained a safe haven. Although the Giant Tortoises are not an endangered species, their protection and conservation on Changuu is of importance for both scientific and cultural reasons – see later ("Benefits").

In the 1950's, it was reported that there were at least 200 tortoises (adult or sub-adult) on Changuu. However, in 1990 the population had dropped to 50. In 1996 Mr Steve Tolan drew attention to the threats from poaching that faced this population and the rapid decline in numbers that was taking place. A survey later in 1996 by the World Society for the Protection of Animals (WSPA) in collaboration with my wife and myself revealed that only nine adults remained on the island. Tortoises were being stolen at an alarming rate, probably to supply the international trade and that any adults would remain by the millennium seemed extremely unlikely.

At the time of the 1996 survey, there were also some baby tortoises on Changuu but these were kept in poor conditions in a locked shed. Originally babies had been released on the island when they reached five years of age but by 1996, the likelihood of them being stolen meant that they had to remain in the shed, with dwindling numbers of hatchlings joining them each year. It was disturbing news that in the 1996 survey, no small to medium sized tortoises were located on the island even though each year a new batch had been released from the rearing shed.

An emergency programme had to be instigated to save the Giant Tortoises and this was implemented by WSPA in collaboration with the Zanzibar Tourist Corporation and with the assistance of Drs Meredith Kennedy and Dennis Doughty, American veterinarians who were working in Zanzibar. I served as the veterinary co-ordinator. A combination of measures was introduced, including marking the adults on the island, transfer of the babies to a fenced compound on Zanzibar island, and attempts to recover poached tortoises from the East African coast. All these moves yielded encouraging results and, as a result, by 1998 the number of tortoises on Changuu stood at 37 (16 adults and 21 hatchlings) with 50 immatures still in isolation on Zanzibar awaiting to be returned to the island. There was one disaster, however, in that over half the youngsters translocated from Changuu were stolen from their supposedly safe compound on Zanzibar. This resulted in an increase in security and surveillance of all the animals.

A key consideration in returning tortoises to Changuu was that they did not introduce infectious diseases (including parasites) that might threaten the survival of the other tortoises on the island. This concern prompted the introduction of a health monitoring programme and in April 1998, a team led by myself which included veterinary students and a biologist, as well as representatives from organisations in Tanzania, carried out health sampling and screening of tortoises. Tortoises at liberty on Changuu and in isolation on Zanzibar were examined clinically and samples taken for laboratory investigation. As a result of this work , it was possible to recommend that the remaining tortoises on Zanzibar, with the exception of one deformed individual, could be returned to Changuu. However the health monitoring indicated that there were potential dangers on Changuu itself, including the presence of large numbers of ticks, which might possibly threaten the survival or productivity of the Giant Tortoises.

The future for this isolated population of Giant Tortoises on Changuu appears to be considerably brighter than it was in 1996, but much remains to be done if these animals are not to be continued to be poached and to be at risk from introduced diseases.

At the same time as measures to counter these dangers are underway, discussions are planned as to whether Changuu Island might be developed as a centre for wildlife research, with emphasis on the study of the Giant Tortoises and improving their management and captive breeding. Changuu is an ideal environment for these tortoises despite its small size (the island is less than a kilometre in length). Changuu also has a remarkably rich fauna and flora. However, most of these plants and animals, some indigenous and some introduced have not been censured or studied. A well-funded research programme on the Giant Tortoises would bring in its wake opportunities for fruitful collaboration on other topics between expatriate and Tanzanian scientists and students.

This proposal is for a project to enable health monitoring of the tortoises to continue and to be orientated towards studying their breeding behaviour and reproductive success and enhancing this as appropriate.

The programme of work

The work will involve at least one visit to Zanzibar/Changuu by myself in order:

a. to collect further samples from Giant Tortoises on Changuu with particular reference to ectoparasites and the possible transmission of blood borne diseases
b. to draw up a comprehensive health programme for these animals to be carried out in conjunction with Sokoine University of Agriculture and the University of Dar es Salaam with a strong input by local Zanzibaris (particularly herpetologists with experience of reptiles)

c. to discuss with Mr Andrew Katema, General Manager of Zanzibar Tourist Corporation and other local personnel the feasibility of renovating part of an existing building on Changuu and developing it as a small laboratory for studies on the Changuu tortoises and as a record centre for breeding data, etc.

Personnel

The main participants in this work will be:

Professor John E Cooper	Project leader
Mr Andrew Katema	General Manager, Zanzibar Tourist Corp
Professor Gabriel Mbassa	Faculty of Veterinary Med., Sokoine University of Agriculture, Tanzania
Mr Michael Pugh	World Society for the Protection of Animals (WSPA)
Mr Muhammed Ayoub Haji	Zala Wild Animal Park, Zanzibar
Mrs Margaret Cooper	Lawyer, general assistant and co-ordinator

Plus other staff from the Veterinary Department, University of Dar es Salaam, Wildlife Conservation Society of Tanzania (WCST) and others

Benefits

This programme of work will enable the health monitoring of the Giant Tortoises on Changuu to continue and for valuable data to be gained on this small, but unique, population. The results obtained will be submitted for publication and in addition will be used to develop a sound management programme for these and possibly other populations of Giant Tortoises.

The Giant Tortoises play an important role on Zanzibar. They are known and appreciated by the local people, including Zanzibari children who depict them in their drawings, their writings and other school work. The tortoises play in encouraging environmental awareness and the need to conserve wild animals. They also attract tourists and this brings much needed income to Zanzibar.

The proposed programme will not only provide much needed health monitoring for these tortoises. It will also help in the development of a longer-term management programme which will contribute to the conservation and management of Changuu Island and its possible development as a centre for studies on herpetology and other aspects of biology by Tanzanians

Quite apart from these direct regional benefits, work that has already been carried out on health monitoring of the Changuu Giant Tortoises, coupled with that which will be done in the immediate future, has provided an excellent "blueprint" for the development of health monitoring programmes for chelonians. The protocol for health monitoring of the Changuu animals was reviewed by the IUCN Specialists Group on Reintroductions (Chairman, Dr Mark Stanley Price) and as a result of comments from that Group (and others), has been modified and refined. It has proved highly successful on Zanzibar and was applied to work on Madagascar with the rare Ploughshare Tortoise *(Geochelone yniphora)* when these were monitored last October. The Giant Tortoises of Changuu have, therefore, played an important part in the development of a realistic and practicable health monitoring protocol for chelonians which takes into account the particular difficulties, both financial and logistic, of carrying out work in poorer countries. The continuation of study and research on the Giant Tortoises of Changuu will permit further modifications and refinements to protocols and the improvement of many of the techniques that must be standard when screening chelonians in future.

Changuu Island and its Giant Tortoises have, therefore, already contributed to chelonian health studies: adequate funding, coupled with a sound programme of work, should permit valuable research to be performed.

(2) "THE MALLORCAN MIDWIFE TOAD RECOVERY PROGRAMME".
Principal investigators John Hartley, Kevin Buley and Richard Gibson, Jersey Wildlife Preservation Trust. This multi-sponsored project is primarily aimed at securing the long-term future of Alytes muletensis *in the wild. The BHS sponsored part of the project will involve setting up new breeding facilities at the JWPT for three new breeding groups of toads to ensure production of sufficient animals for the re-introduction programme. In addition, health monitoring studies will be carried out on captive bred animals to enable an accurate assessment of the potential health risks involved in re-introduction.*

Plate 2: A re-introduced Midwife Toad *(Alytes mulentensis)* with eggs

Introduction
The Mallorcan Midwife Toad *Alytes* (formally *Baleaphryne) muletensis* was originally described in 1977 from fossil and sub-fossil remains. It wasn't until 1980 that live specimens of the toad were discovered, living in remote mountain gorges in the north of Mallorca. The species, believed to be widespread until about 2000 years ago, was excluded from large areas of otherwise suitable habitat by introduced predators and competitors from the continent, such as the Viperine Snake *(Natrix maura)*, Green Toads *(Bufo viridis)*, Green Frogs *(Rana perezi)* and small mammals, particularly Mustelids.

The largest remaining populations live in six separate gorges, and as a result are reproductively isolated. As a consequence of this severe fragmentation of an already small breeding nucleus, the IUCN classifies *Alytes muletensis* as 'critically endangered' in the 1996 Red List of Threatened Species.

As with any wildlife conservation project, the primary aim of the Mallorcan Midwife Toad recovery programme is to secure the long-term future of the species in the wild.

The Mallorcan Midwife Toad recovery programme seeks to achieve this objective by adopting an integrated approach with the co-operation and collaboration of six separate organisations;

- Mallorcan Department of Agriculture and Fisheries – the Conselleria d'Agricultura I Pesca (CDAP).
- Open University (OU) (probably discontinuing work in 1999).
- Durrell Institute of Conservation and Ecology (DICE) at the university of Kent.
- Barcelona Zoo.
- Stuttgart Museum.
- Jersey Wildlife Preservation Trust (JWPT).

The different aspects of the programme include:

- Captive-breeding of the species at a number of European institutions. Comparative analysis of parasitological and bacteriological status of captive and wild populations.
- Reintroduction of captive-bred animals into specially selected sites within the known historical range of the species, but distinct from existing wild populations.
- *In situ* monitoring of all natural and reintroduction sites on an annual basis, to establish the relative success of reintroductions and to determine the size and status of the various populations.
- Public education and media coverage in Mallorca and mainland Spain with the aim of increasing awareness of the toad and its plight and developing a national pride in their unique amphibian.
- Laboratory based research into the biology and behaviour of the toad and their tadpoles, with particular emphasis on the avoidance of introduced predators.

To date the success of the programme is best demonstrated by the following:

- 25% of wild population, at annual census, now originates from captive-bred toads.
- The distribution of the toad has increased by 100% since the instigation of the recovery programme: pre-human range ~1000km^2, pre-recovery programme range ~ 100km^2, current range ~ 200km^2.
- 13 original wild sites, 12 new sites established through re-introduction.
- 75 potential re-introduction sites have been identified. However three-quarters of these are on private estates and state finances cannot therefore be used to develop them. Ten sites are ready for use now, pending availability of suitable toads/tadpoles for release

Work proposed for 1999

i] Faecal sample analysis of wild toad populations

During July 1997 JWPT and CDAP staff conducted field work in Mallorca, the purpose of which included, the collection of faecal samples from wild toad populations, throughout the toad's range, for comparative analysis with captive-bred animals destined for wild release to be more effectively screened, and a more accurate assessment of the potential health risks involved for the re-introduction population and the existing wild populations.

An unavoidable combination of budgetary and time constraints has meant that the 100+ faecal samples, collected over 18 months ago, have yet to be examined by a qualified biologist. With the appropriate funding for 1999, a parasitologist can be employed to examine these very valuable samples and the BMNH identification fees covered.

ii] Renewed captive breeding efforts with newly improved stock
One of the other major objectives of the 1997 fieldwork was the capture of fresh stock from three separate wild sites, ensuring that as wide a genetic base as possible is represented in the captive colonies. Sub-adult/adult toads from three distinct wild sites are now being held at the JWPT's Herp. Dept. where it is hoped they will shortly breed, providing offspring for captive populations at other European institutions and animals for future re-introductions to the wild.

The existing Mallorcan Midwife Toad breeding room is currently in need of renovating, in order to accommodate adequately the three separate breeding groups (in the past, the room has only had to cope with one group). The husbandry, breeding and rearing of this species has proved relatively simple and the associated equipment/housing required is similarly uncomplicated. Large, clear plastic, lidded tanks with gravel substrate, hides and a large water bowl, coupled with an irrigation system for simulated rainfall has in the past, proved to be an effective set-up for breeding.

Funding for 1999 would ensure appropriate, and sufficient, breeding groups and their offspring, in addition to a more efficient and automated irrigation system.

(3) "CHELONIAN VIROLOGY INVESTIGATION". *Principal investigators Stuart McArthur MRCVS, Stephen Divers MRCVS* et al. *Project aims to study many aspects of chelonian viral diseases, including diseases in captive and wild populations, treatments and vaccinations, development of new methods, etc.*

Plate 3: Juvenile Green Turtle *(Chelonia mydas)* with grey patch disease

Project members:
Stuart McArthur B Vet Med. MRCVS (Overall organisation and co-ordination). Stephen Divers B Vet Med. BSc MRCVS (Overall organisation and co-ordination). Mike Jessop MRCVS (Overall organisation and co-ordination). Dermod Malley FRCVS (Associated veterinary surgeon). Dr Joan Rest MRCVS (specialist in veterinary pathology) and Dr MacDougall MRCVS (Histopathology and general (Electron Microscopy; Virus Isolation; Faecal Antigen test production). Elliot Jacobson DVM PhD (World specialist in this field Advisor to the project)

Introduction
It is the aim of the CVI project to establish a facility in the UK that will allow the investigation of chelonian diseases having a presumed viral aetiology, with a view to producing screening tests that can be used to survey the incidence of such diseases, assess the epidemiology of such diseases, and limit the spread of these diseases, within both wild and captive bred populations.

Once established, CVI will advertise this facility and make it available to conservation and captive breeding projects throughout the world.

Information obtained from this project will be published as soon as possible in veterinary and associated scientific journals.

Background Information
There are many papers that identify viral agents as being associated with significant outbreaks of disease in colonies of chelonia. The following are examples:

A herpesvirus has been associated with cases of runny nose syndrome, necrotic stomatitis, skin lesions, and forms of pneumonia in chelonia (Frye and others 1977, Heldstab and Besetti 1982, Cooper and others 1988, Lange and others 1989, Oettle and others 1990, Beynon and others 1992, Jacobson 1994, Mader 1996).

Rebell and others (1975) managed to transmit Grey-patch disease in *Chelonia mydas* using a purified bacteria free herpesvirus preparation. Other viruses such as iridovirus, poxvirus, togavirus, paramyxoviruses and sendiviruses have also been proposed as pathogenic agents in chelonia (Beynon and others 1992, Jacobson 1994, Mader 1996).

Oettle and others (1990) demonstrated both herpesvirus-like inclusions and paramyxovirus-like inclusions in an episode of 31 deaths over six months in a well managed tortoise colony. Epidemiological studies suggested a virus-like infection.

Lange and others (1989) found evidence of a herpesvirus as the cause of a 50% mortality in a group of 130 Hermann's Tortoises and Four Toed Tortoises during a three month disease epidemic in 1987. The post mortem findings included lesions of the upper digestive tract, liver and lower digestive tract. Virus particles were isolated from three animals but it was not possible to demonstrate their pathogenicity in turtle embryonic tissue culture.

Frye and others (1977) described a fatal herpesvirus like infection in two Pacific Pond Turtles where virus particles were located in spleen, liver and kidney.

Rebell and others (1975) described a herpesvirus type agent affecting *Chelonia mydas* hatchlings and implicated it as being the cause of Grey-patch diseases.

The disease was transmitted by a bacteria free preparation of virus particles. Haines and Kleese (1977) further investigated herpesvirus Grey-patch disease and demonstrated how external stress factors such as water temperature affected mortality rates.

Jacobson (1996) reviews much of the literature available on tortoise mortality and infectious diseases and identified a herpesvirus like agent in Argentine tortoises during an episode where 1,200 of 2,200 recently imported tortoises died. He also reviews papers that describe probable herpes-virus, iridovirus, poxvirus and togavirus infections of tortoises.

Mader (1996) reviews viral disease of chelonia and discusses iridovirus, herpesvirus and papoviridae infections; interestingly there is also mention of lymphosarcoma in *T. hermanni.*

McArthur, Rest, Drury, Malley, Roberts, Macdougall & Holden (In preparation) document an episode of lymphoproliferative disease in the UK associated with a herpesvirus in a group of twenty five Herman's Tortoises *(T. hermanni)* and four Leopard Tortoises *(Goechelone pardalis)* This disease has a 100% morbidity and a 100% mortality. This paper also describes a second outbreak of this disease in the UK just over 16 months later. Again *G. pardalis* was fatally affected.

Project Aims
CVI will attempt to:

- Investigate fully the clinico-pathology of chelonian diseases with a presumed viral aetiology
- Investigate methods of transmission of these diseases between individuals
- Investigate methods of identification of causative viral agents from EM (Electron Microscopy) through to-FAT (Faecal Antigen Testing)
- Investigate methods of isolation of causative viral agents (Cell lines – passage)
- Centralise the storage and preservation of viral agents from chelonia
- Compare antigenic relationships of viruses
- Investigate the viability of FAT or other forms of screening for these diseases
- Undertake field studies to investigate the incidence of these diseases in the wild.
- Undertake studies to investigate the incidence of these diseases in captive populations.
- Consider methods of preventing captive bred animals transmitting these diseases to the wild populations in the field e.g. when release programmes are undertaken .
- Investigate the viability of vaccinating wild and /or captive populations for such diseases.

Suitable diseases for CVI Investigation:

- Epidemics with colonies both within the UK and abroad.
- Chronic intractable Runny Nose Syndrome (RNS)
- Acute pneumonia
- Overwhelming multiple infection syndromes e.g. fungal enteritis + RNS
- Para or quadraparesis with no obvious aetiology
- Necrotic stomatitis
- Immune collapse e.g. lymphoproliferative diseases in *T. hermanni* and *G. pardalis*
- Grey Patch Disease / fibropapillomatosis in marine turtles

Project Funding:
We are proposing a major venture into chelonian disease investigation. A lack of domestic animal involvement will currently prevent both government and public

veterinary funding, therefore private funds are currently the only available sources of funding.

It is anticipated that £5000 will be required to fund a pilot study. This will enable the investigators to attempt to determine if such viral problems are widespread and deserve further research into their control and management.

The final goal of producing screening tests and possibly a vaccine would require considerably more funds and such work will depend on the results of the initial pilot study. If these diseases are considered to be of low incidence we may merely need to learn how to limit their dissemination.

The veterinary surgeons involved will be giving up their professional time free of charge, but significant funding will be required for appropriate laboratory tests.

- Haematology/biochemistry and related blood work
- Histopathology
- Virus isolation
- Virus culture
- Chelonian and related cell line production
- Electronmicroscopy

(4) "IMPROVEMENT OF HUSBANDRY OF FARMED NILE CROCODILES *(CROCODYLUS NILOTICUS)* IN UGANDA." ***Principal investigator Prof. John E. Cooper FRCVS, Wildlife Health Services. Project will involve a short training course for local staff, ongoing health monitoring and study of diseases, production of management programme for the crocodiles particularly with a view to ensuring that a proportion of young healthy crocodiles are returned to the wild.***

Plate 4: Prof John Cooper teaching East African students the principles of handling and examining Nile Crocodiles

(photo: M. Cooper)

Background

The "farming" of Nile Crocodiles *(Crocodylus niloticus)* is well established in many parts of Africa. In Uganda it is a relatively recent venture and at present consists almost entirely of "ranching", whereby eggs are taken from the wild and hatched in captivity, rather than propagation of crocodiles in captivity.

A visit to Uganda's largest crocodile farm on the edge of Lake Victoria in December 1997 revealed that the animals on the farm were in need of improved management and attention to their health and welfare. Husbandry methods at the farm are poor and there are disease problems, many of which could be rectified if the staff were properly trained and if appropriate equipment and medication were available.

The trip to this farm was carried out (at the Coopers' personal expense) in the company and at the request of Dr Gladys Kalema, Head of the Veterinary Dept., Uganda Wildlife Authority (UWA). Dr Kalema is anxious to improve conditions at this and other crocodile farms in Uganda and, in December, was primarily seeking my advice and assistance on this matter. Following our visit Dr Kalema produced a report for the authorities and, amongst other things, recommended a) a co-ordinated health, welfare and management programme (including a code of practice) for farmed crocodiles in Uganda and b) training for staff working on such farms and also for UWA personnel who might be expected to give advice in the future.

At the present time, funding is not available in Uganda to implement the two points above. However, there remains an urgent need – not least on welfare grounds, to tackle the problems at that particular farm and to apply lessons learnt there to other similar establishments. Dr Kalema is willing to participate in this programme, if necessary in her own time and has requested my assistance and that of my wife.

The aim of this proposal is to provide such assistance.

Programmes of work

a. A two day course at the crocodile farm for staff and UWA personnel. This will have a strong practical element, including handling, examination and treatment of animals, water sampling and hygiene and husbandry practices. There will also be lectures and each person on the course will receive printed notes (in English) for personal use.

   During the course of the practical, sampling methods will be demonstrated and specimens taken.

   Dr Kalema and I will lecture on veterinary and health matters, my wife (a lawyer) on CITES and other laws and the importance of adhering to legislation and appropriate codes of practice.

b. Thorough health monitoring of the farm, its crocodiles, water supplies, the food and the environment. This will involve clinical and *post-mortem* examination of animals, sampling of crocodiles, water and environment and collation of relevant data.

   Some samples will be examined at the farm using portable field equipment. The majority will be transported to Kampala where bacteriology and other tests can be performed.

c. Production of a management programme for the crocodiles, with particular emphasis on good husbandry techniques that will keep animals in good health and, in due course, enhance the prospects of successful captive breeding.

An integral part of the programme will be to ensure that young crocodiles that are returned to the wild (this is a legal requirement in Uganda) are in optimal health and not only likely to survive in the wild but unlikely to introduce infectious disease into free living populations.

Personnel
The course and training will be carried out primarily under the direction of Dr Gladys Kalema, UWA. My wife will also be participate (see above) and the others from UWA and from Makerere University will be involved where appropriate.

A number of authorities have already been consulted over the crocodiles in Uganda and have provided information. In particular, Dr F W Huchzermeyer from South Africa, an internationally acknowledged expert on crocodiles and crocodile farming, has given advice and will be consulted regularly. He and others will be kept appraised of developments in Uganda so that modifications can be made to the programme as and when necessary.

Likely benefits of the project
It was clear from the visit in December 1997 and from subsequent correspondence with Dr Kalema that changes and improvements at the farm and the provision of training would be welcomed both by existing staff and by UWA personnel. The farm has considerable potential but is hampered by the various factors discussed earlier.

The programme proposed should result in the following:
(a) Training of relevant staff in techniques that will enable them to manage crocodiles more successfully, to recognise ill health and to take appropriate action.
(b) Diagnosis of the various infectious and non-infectious conditions that at present cause disease and death at the farm and implementation of treatment or control.
(c) Production of guidelines and protocols that will assist in the evolution of crocodile management in Uganda from the present "ranching" system, whereby eggs are collected and the young that are returned to the wild are often unhealthy and a possible threat to the free-living population, to a sustainable system of farming whereby adult crocodiles breed in captivity. This should produce a gradual reduction in the drain on the wild population and the production of young crocodiles that are likely to survive when released.

Other benefits
The information gained in this programme will be made available to other crocodile farms, to the authorities in Uganda and, where appropriate, to similar projects in other areas of East Africa.

In addition, a full report will be provided to the British Herpetological Society and articles submitted for publication. A lecture will be offered to the Society and made available to other interested groups.

It is envisaged that this 7-10 day visit will be only a preliminary contribution, but that it will lead to a programme, supervised by colleagues in Uganda, with a regular advisory input from the Coopers and others. Periodically visits will be made to Uganda to provide top-up assistance in terms of training, health monitoring and improved husbandry.

REPRODUCTIVE ACTIVITY AND EMBRYO GROWTH OF THE SPECTACLED SALAMANDER *SALAMANDRINA TERDIGITATA* (LACEPÉDE, 1788) IN SOUTHERN LATIUM (CENTRAL ITALY)

LUIGI CORSETTI

Via Adige 45/2 – 04100 Latina – Italy
Museo di Storia Naturale, via G.B. Vitelli 10 – 03010 Patrica (FR) – Italy

ABSTRACT

This paper summarises observations carried out in nature on populations of *Salamandrina terdigitata* in Southern Latium, where the species is widely distributed, if localized, in the hilly and mountainous areas. The laying period studied was notably wide: laying females were observed in nature at the end of October and larvae at the first stage of growth in the first days of November. This species, in the Mediterranean habitat and in the locations where the danger of late spring-summer drought is greater, uses different reproductive strategies: it begins egg-laying early in the autumn (starting from the first days of October) and winter months, which is the time in the study area of maximum rainfall (generally highest in November).

Furthermore, observations in nature and in the laboratory confirmed the relationship between water temperature and the duration of embryo growth.

INTRODUCTION

The data on the reproductive activity of *Salamandrina terdigitata* (Lacépède, 1788) has until now been generic, in spite of the high biogeographic interest of the species (endemism of the Italian fauna); few available data come from observation in captivity. For the Southern Latium anti-Apennines, observations relative to a few populations of *Salamandrina terdigitata* are reported in works of general character on the Italian herpetofauna (Bruno, 1973) and in some other contributions (Carruccio, 1990; Naviglio, 1971; Zerunian & Sciscione, 1984; Bonifazi & Carpaneto, 1990; Corsetti & Capula, 1992; Corsetti, 1994a, 1994b). The research on this group of mountains (an area of about 2,200 square kilometres) has identified the location of a high number of populations with different surrounding habitat characteristics.

As in most amphibians, reproduction is cyclic and seasonal, and in the species living in temperate areas it is generally annual. The potentially long reproductive activity of some species that can extend their breeding cycle up to January or the end of December has been noticed in the Mediterranean surroundings (Guarino, Caputa & Angelini, 1992; Corsetti, 1994b) but under no circumstances are there autumnal layings.

This paper describes the reproductive activity in nature of the populations of *Salamandrina terdigitata* in Southern Latium and it underlines the duration of the laying period. Further data has emerged on the length of embryo growth in relation to the water temperature.

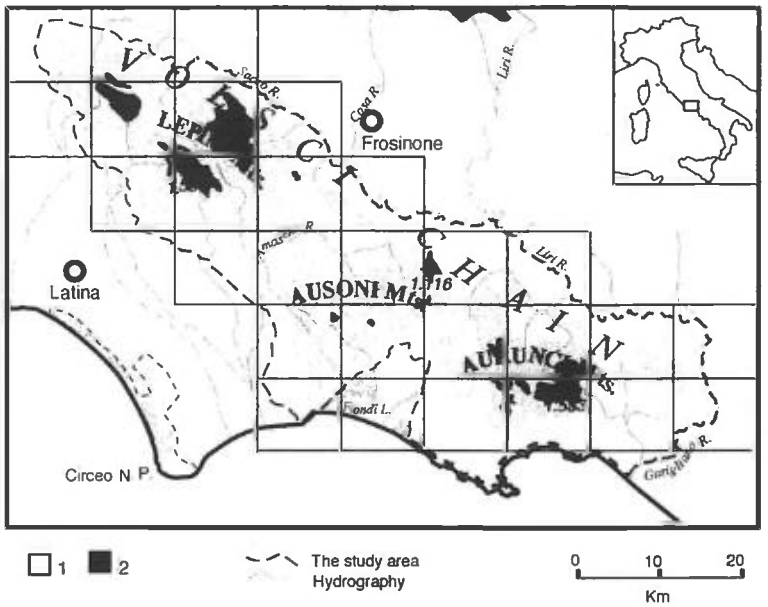

Fig. 1. Map of the Volsci Chain with grid reference, based on 1:25.000 I.G.M. (Military Geographic Institute) cartographic system. 1: areas included between 500 m and 1,000 m above sea level. 2: areas over 1,000 m.

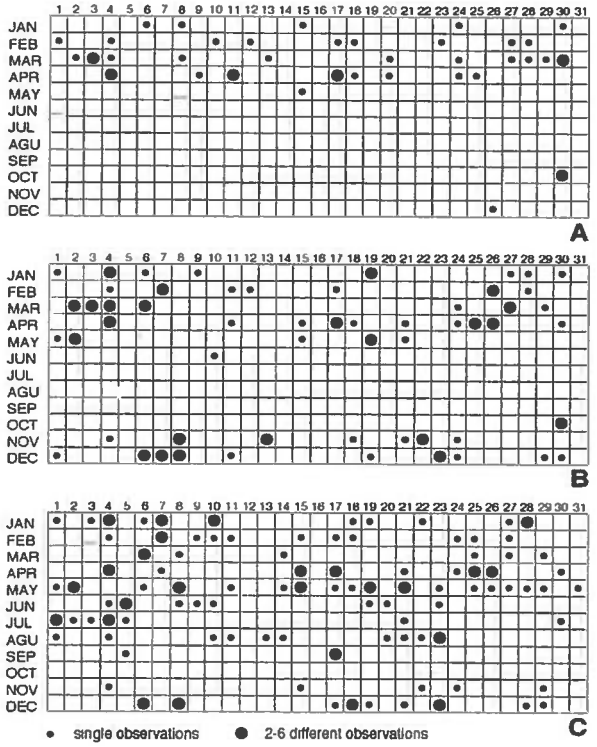

Fig. 2. Calendar of the presence of adult specimens (A) in water, eggs (B) and larvae (C) of *Salamandrina terdigitata*, collected in the years 1991-1996, in Southern Latium.

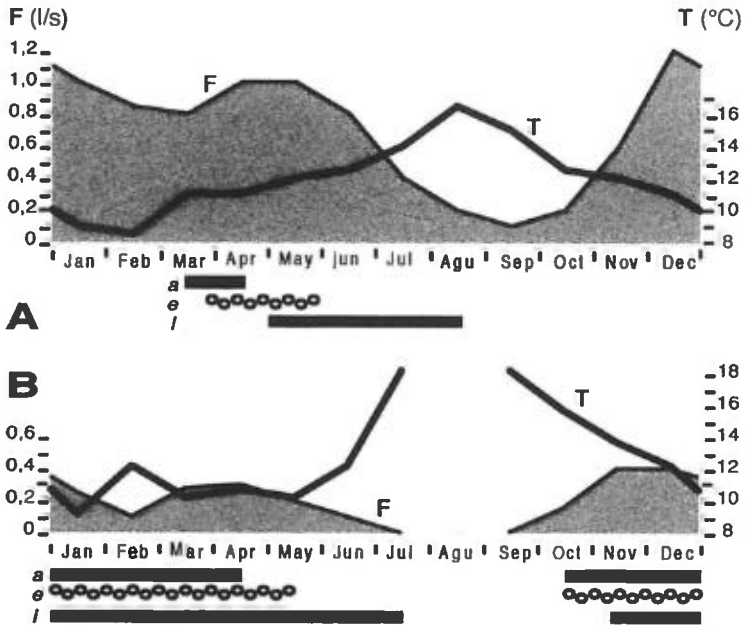

Fig. 3. Reproductive cycle of *Salamandrina terdigitata* in two locations, in relation to the flow (F) and temperatures of the water (T). a: presence of laying females; e: presence of eggs; l: presence of larvae.

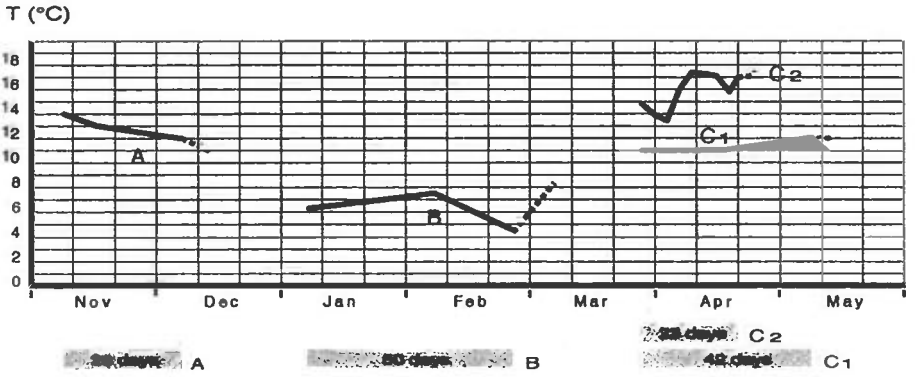

Fig. 4. The length of the embryo growth observed in 3 different locations of the studied area (A-B-C1) and in lab (C2) in relation to the water temperatures.

DESCRIPTION OF THE STUDY AREA

The area examined is in the southern Latium "anti-Apennine", or Volsci Chain, that includes the Lepini Mts., Auson Mts. and Aurunci Mts. (Fig. 1) which form a homogeneous and well defined geographic and geologic entity located in the administrative provinces of Rome, Frosinone and Latina. This area, of about 2,000 sq. km., extends mainly in the direction NW-SE and includes heights from sea level to 1.536 m (Mt. Semprevisa, Lepini Mts.).

The Volsci Chain is made up of Mesozoic Limestone and is characterised by both hypogean and superficial carsism.

According to the bio-climatic map of Italy (Tomaselli, Balduzzi & Filipello, 1973), the study area belongs to the Thermo-mediterranean and Meso-mediterranean subregions. On the southern slopes of the basal plain, the vegetation is represented by the relics of the Mediterranean forest of Holm Oak (*Quercus ilex*), often reduced to low bushes, or degraded steppes of *Ampelodesmos mauritancus*. On the mountainous southern slopes, in the basal northern slopes and in internal areas, the vegetation is a mixed association of *Quercus pubescens, Quercus cerris, Ostrya carpinifolia.* Moreover, in a few relict areas the vegetation is represented by Beech woods (*Fagus sylvatica*) with the presence of Holly (*Ilex aquifolium*) and Yew (*Taxus baccata*).

METHODS

The study is based firstly on data collected by means of regular field observations from 1991 to 1996 spending little more than 300 hours in the field; some first-hand data were partially obtained by irregular observations from 1981 to 1990 in spring and summer months.

A careful cartographic inspection of the whole area in order to point out all potential sites for the species preceded the field survey. Each of the 28 I.G.M. (Istituto Geografico Militare = Military Geographic Institute) maps 1:25.000 scale were examined (Fig. 1) and 199 potential sites were scheduled. *Salamandrina terdigitata* was observed in 57 sites (28.6%), with 75 laying sites. The locations are distributed at heights between 150 m and 1,150 m above sea level.

When it was required, larvae were captured by means of a close mesh net and then released in the same place. During this research I adopted a methodology respectful of the herpetologic fauna without the harvest of specimens, according to the regional law (no. 18 dated April 5, 1988). Only in March 1993 were some eggs collected in a site situated on the Lepini mountains, and after hatching in captivity, the larvae were released in the same places.

From October 1992 two sample locations were monitored for the whole year, with one or more visits each month, to study the reproductive strategies adopted by this species.

RESULTS

According to Lanza (1983) *Salamandrina terdigitata* egg-laying occurs between March and April but it may start at the end of December as well, as observed by Naviglio (1971) near Tivoli (Roma); earlier observations by Chiarugi (1899, 1900) reported it in January in the environs of Florence. Only recently have the first observation of eggs and larvae in November been reported on the Lepini mountains (Corsetti 1994a).

The analysis of the annual averages of the rainfall in the mountainous area studied, indicates a peak in autumn, generally in November, and a minimum in July. In the locations in which the danger of drought at the end of spring-summer is greater, *Salamandrina terdigitata* has adopted a different breeding strategy: it begins laying earlier, in the autumn-winter months, when rains are more abundant, so that larvae have a greater probability of completing their metamorphosis. The *Salamandrina terdigitata*, besides winter and spring, lays in autumn, beginning in the days following the first abundant rains of the season. In 45.6% of the locations the laying period occurs chiefly between October and January but, rather often, in some sites eggs were observed up to the following spring. In the remainder of the locations (54.4%) the females enter the water exclusively between February and May.

The first laying in nature was observed on October 30, 1993 in two location of the Lepini mountains. On this occasion 3 females were observed in the water, in the first location, and 2 in the second location. In 1992, November 8, there were already several eggs ready to hatch present, and in 1996, November 4, in another location, in addition to several eggs, there were also some larvae at the first stage of growth (cf. Lanza 1983): their laying probably occurred in the first days of October, considering the long period of time necessary for the development of the embryos at low temperatures. In 1994 in the first locations at two of the Lepini Mountains, the laying took place in the second half of November, only after the first abundant rains of the season, occurring at the beginning of the month.

In Fig. 2 are shown all the observations of eggs, larvae and adult specimen of *Salamandrina terdigitata* observed in the study area between 1991 and 1996.

In Fig. 3 are synthesized all the observations made in two locations of the Lepini mountains considered as a sample and examined for a complete year, with one or more monthly visits, beginning from October 1992 (for a more effective exposure of the data I considered the solar year from January to December. The activity pattern of the two populations of *Salamandrina terdigitata* is considered in relation to the flow and to the temperature of the water. The first (Fig. 3A) is an old spring whose water comes from a source; the second (Fig. 3B) is a small source, usually subject to drainage in the summer months: in 1994 the drought exceeded 3 months.

All the females of location A went down into water in spring and finished their laying in little more than a month. Those of location B laid more than once, with a better concentration in two different periods: in November-December and March-April.

In literature, the available information on the duration of the embryonic development of *Salamandrina terdigitata* originates from observations made in the laboratory. Lanza (1983) states that "in the laboratory and in conditions which are similar to nature, the hatching occurs after twenty days"; also Vanni (1980) reports that the hatching, occurring in the laboratory with a water temperature of about 14°C, needs 20 days. Chiarugi & Banchi (1896) and Chiarugi (1899) observed that the water temperature influences the duration of the process of segmentation of the eggs of *Salamandrina terdigitata* and recently other authors have studied, in the laboratory and in nature, the duration of the embryonic development of some anurans, in relation to the water temperatures (Guyetant 1969; Guarino 1992).

During the autumn-winter of 1992-93 I made observations in 3 different locations of the studied area, on the duration of the embryonic development in relation to the water temperatures (Fig. 4). In the first station (A), on November 8, 1992, there were 64 eggs

under a big stone; on December 6, they still contained embryos, almost all of them ready to hatch, and only on December 12 (water temp.: 11°C) it was possible to ascertain the hatching of 62 eggs.

In the second location (B), on January 7, 1993 there were some tens of eggs among the mud, probably laid the day before; some of them were not completely submerged (water temp.: 6.3°C). On February 7 the eggs were still at the first stage of embryonic development. In the visit of February 26 (water temp.: 4.5°C) the same eggs had embryos ready to hatch; only on March 6 did I see the first larvae (water temp.: 8.5°C).

In the third location (C1) on March 27 I observed numerous eggs at the first stage of development, laid on a small submerged branch. The same eggs were present on April 17 and only on May 8 was it possible to see the hatch beginning.

In the aforesaid cases a very slow embryonic development has been observed due to the low temperatures of the water. Experiments in the laboratory have confirmed the relationship between the water temperature and the duration of embryonic development. In the third location some of the eggs laid (14) in the same day and maybe by the same female were withdrawn. They were put in a plexiglass tank (C2) filled with water from the spring (renewed every three days), and maintained at a temperature which was higher than that of the site of origin (13.5-16.5°C). Such eggs required 23-28 total days for their hatching, while in nature at 11-12°C, some of the eggs under observation still contained embryos after 42 days.

DISCUSSION

Continuous observations in the study area have allowed us to ascertain that the laying period is longer, in the course of the year, with respect to the pre-existing data in literature and in comparison with other species of urodeles (Cei, 1946; Galgano, 1944; Bell & Lawton 1975; Lanza, 1983; Verrell, Halliday & Griffiths, 1986; Guarino et al. 1992).

The data collected in the course of this research points out that the species can resort to different breeding strategies: in the Mediterranean surroundings and in locations in which the limiting factor is the availability of water, it begins to lay eggs in the autumn,when the rains are more abundant, avoiding in this way the summer droughts. In fact the locations in which laying occurs in winter and autumn are only those with modest values of waterflow and subject to drainage in the summer months.

The potentially long reproductive activity in *Salamandrina terdigitata* depends also on the availability of sperm from late-summer or autumn, to the next spring. In this species there is not a complete halt in the activity of the testis during the winter months, but there is a "hemistasis" (Brizzi, Calloni & Vanni, 1985). Spermiation occurs with a period of courtship interactions that goes on, depending on the climatic variations, from autumn to the next spring (Lanza, 1983).

Interesting knowledge emerged also from the observations in nature on the duration of the embryonic development in relation to the temperature of the water, aspects that will be the object of subsequent and deeper investigations.

Additionally the higher number of stations of *Salamandrina terdigitata* present in Southern Latium (57), compared to the rare presences observed in other mountainous groups or regions of the Italian Apennines, further confirms the high naturalistic value of the area, which deserves a more effective protection through the institution of natural parks (Parks of the Lepini, Ausoni, and Aurunci Mountains) awaited for a long time (Corsetti 1979).

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To my mother, Rina Cellini, my last thanks.

REFERENCES

Bell, G. & Lawton, S.H. (1975). The ecology of the egg and larvae of the smooth newt *(Triturus vulgaris (L.)). J. Anim. Ecol.* **44**, 393-423.

Bonifazi, A. & Carpeneto, G.M. (1990). Indagine preliminare sugli anfibi e sui rettili dei Monti Ausoni-Aurunci (Lazio meridionale). *Centro Reg. Docum. Beni Cult. e Amb., Ass. Cultura Regione Lazio,* Roma.

Brizzi, R., Calloni, C. & Vanni, S. (1985). Spermatogenetic cycle in *Salamandrina terdigitata* (Lacépède, 1788) (Amphibia: Salamandridae). *Z. mikrosk.-anat. Forsch,* Leipzig **99**, 251-292.

Bruno, S. (1973). Anfibi d'Italia: Caudata. *Natura* **64** (3-4), 209-450.

Cei, G. (19446). Note biologiche e osservazioni in natura sull'attivitá riproduttiva annuale del Tritone minore (*Triturus vulgaris meridionalis*). *Atti Soc. Toscana Sc. Nat.* **53**, 118-122.

Carruccio, A. (1900). Nuove indicazioni sull'habitat della *Salamandrina perspicillata. Boll. Soc. Zool. It.* **9**, 92-94.

Chiarugi, G. (1899). La segmentazione delle uova di *Salamandrina perspicillata. Monit. Zool. It.* **10**(7), 176-187.

Chiarugi, G. (1900). Alcune osservazioni sulla vita sessuale della *Salamandrina perspicillata. Monit. Zool. It.* 11 Suppl., 41-43.

Chiarugi, G. & Banchi, A. (1896). Influenza della temperatura sullo sviluppo delle uova di "*Salamandrina perspicillata*". Nota preliminare. *Monit. Zool. It.* **7**(12), 286-291.

Corsetti, L. (1979). Appunti per una proposta di Parco Naturale nei Monti Lepini. *Boll. Italia Nostra,* **176**, 12-14.

Corsetti, L. (1994a). Osservazioni sulla ecologia e biologia riproducttiva di *Salamandrina terdigitata* nei Monti Lepini (Lazio) (Amphibia Salamandridae). In Ricerche sulla fauna dei Monti Lepini, 111-130. Corsetti, L. and Nardi, G. (Eds). *Quad. Mus. St. Nat.* Patrica (FR), 4.

Corsetti, L. (1994b). Anfibi e Rettili dei Monti Lepini. *Quad. Mus. St. Nat.* Patrica (FR), 5.

Corsetti, L. & Capula, M. (1992). The amphibians and reptiles of the Lepini Mountains (Latium, Central Italy): Checklist and provisional atlas. *British Herpetol. Soc. Bull* **39**, 8-16.

Galgano, M. (1944). Il ciclo sessuale in *Triturus cristatus carnifex* (Laur.). I-Il ciclo naturale nei due sessi. *Arch. Ital. Anat. Embriol.,* Firenze **50**, 1-148.

Guarino, F.M. (1992). Durata dello sviluppo di *Rana italica* (Amphibia, Anura, Ranidae) e osservazioni sul numero delle serie di cheratodonti per la determinazione del girino. *Boll. Mus. Reg. Sci. Nat.* Torino **10** (1), 179-186.

Guarino, F.M., Caputa, V. & Angelini, F (1992). The reproductive cycle of the newt *Triturus italicus, Amphibia-Reptilia* **13**, 121-133.

Guyetant, R. (1969). Influence du facteur température sur le développement embryonnaire de *Rana temporaria* L. et *Rana dalmatina* B. *Vie et Milieu,* **20**, 231-242.

Lanza, B. (1983). Anfibi, Rettili (Amphibia, Reptilia). Guide per il riconoscimento delle specie animali delle acque interne italiane. *CNR*, Roma **27**, 1-196.

Naviglio, L. (1971). Il periodo degli amori della *Salamandrina terdigitata* (Amphibia, Caudata). *Notiz. Unione Erpetologica Italiana* **1** (2), 39-43.

Tomaselli, R., Balduzzi, A. & Filipello, S. (1973). Carta bioclimatica d'Italica. *Collana verde, Ministero Agricoltura e Foreste,* Roma.

Vanni, S. (1980). Note sulla Salamandrina dagli occhiali, *Salamandrina terdigitata* (Lacépède, 1788), in Toscana (Amphibia Salamandridae). *Atti Soc. Tosc. Sci. Nat.,* Mem. **87** (serie B), 135-159.

Verrell, P.A., Halliday, T.R. & Griffiths, M.L., (1986). The annual reproductive cycle of the smooth newt (*Triturus vulgaris*) in England. *J. Zool. Lond.* (A) **210**, 101-119.

Zerunian, S. & Scisione, L. (1984). Primi dati sulla riproduzione e sviluppa larvale di *Salamandrina terdigitata* (Laépède) nei Monti Lepini (Amphibia, Salamandridae). *Boll. Zool.* **51** (suppl.), 117.

IDENTIFYING INDIVIDUAL ADDERS, *VIPERA BERUS*, WITHIN AN ISOLATED COLONY IN EAST YORKSHIRE

PAUL A. BENSON

14 St. Nicholas Gate, Hedon, East Yorkshire, HU12 8HS

ABSTRACT

During the past three years the author has regularly visited a small nature reserve in East Yorkshire to see the colony of Adders *Vipera berus* living there. In order to monitor the behaviour and movement of individual Adders during the year, a procedure has been developed which facilitates identification without handling or significantly disturbing the snakes. So that each Adder is correctly recognised, with some degree of certainty, whether from a fleeting glimpse or from photographs, several working aids to identification have been used so far. Work is in progress and record keeping has involved the use of codes using abbreviations and numbers. Other workers have used the distinct head markings of adders to identify individual snakes; this study uses the same technique, together with the arrangement, shape and number of head scales, body colour and dorsal markings.

INTRODUCTION

It is well known that Adders are highly variable in their markings and no two Adders are identical (Smith, 1951; Frazer, 1983; Arnold and Burton, 1978; Sheldon and Bradley, 1989; Evans, 1992). Head markings can be diverse and have been used previously by workers identifying Adders in the field (Sheldon and Bradley, 1992). Head scale number and arrangement can also be highly variable and extremely useful as identification guides (Sheldon, pers. corres. 1998). Body colour and dorsal markings can also be variable.

Although head markings can be the most obvious and 'easy to view' feature between two individuals, they do not always appear grossly different in the field. Body colour and dorsal markings can be useful identification aids 'in the field', but only for a few unique individuals. The shape, arrangement and number of head scales can be significantly different from Adder to Adder, but require the observer to be close to the Adder. It is usually more convenient to examine these features on photographs after a visit. Using scale counts, dorsal marking type and colour code a simple reference system has been developed to improve recording and as a check against previously recorded individuals.

STUDY AREA

The main area consists of 5.7 hectares of open heathland, surrounded by coniferous forestry on three sides and turf-growing land on the fourth. The reserve is managed by the Yorkshire Wildlife Trust. It consists of mixed areas of vegetation with several areas of the Heather, *Calluna vulgaris* and Cross-Leaved Heath, *Erica tetralix*, separated by Tufted Hair-Grass, *Deschampsia caespitosa*. There are also areas of Bracken, *Pteridium aquilinum*, which are kept under control. Silver Birch, *Betula pendula*, and Gorse, *Ulex europaeus*, grow in small stands with Scots Pine, *Pinus sylvestris*, being represented by single maturing specimens. The birch has been greatly reduced within the reserve and the cut branches and twigs have been stacked as habitat piles of various heights. Adders are frequently found together in two small areas, a small raised mound surrounded by heather and an open area containing a low habitat pile of birch branches surrounded by

PLATE 1: Adder F5/SM/140598 from the study group

PLATE 2: Adder F8/SM/270798 from the study group

Tufted Hair-Grass. Individual Adders are found throughout the reserve, either basking in open areas or in the front of vegetation e.g. adjacent to dense groups of birch saplings or gorse. Juvenile Adders are frequently found away from the communal areas sitting on grass tussocks, tree stumps or supported in old heather. Away from the reserve Adders can be found along the transecting forest rides. A particularly good area is along the line of high voltage electrical cables, supported by pylons, which runs parallel to pine forest. In order to maintain access to the pylons the area is kept clear of potentially tall vegetation and Adders are found basking in open areas or on grass tussocks.

METHODS

Within the author's records, each Adder previously found in the field is represented by one or more photographs together with a record card. The record card information consists of two types of coded information, diagrams of head markings (pigmentation and scales) and field notes.

Photographs are used as an obvious first reference and are used in the field. On finding a new individual the head marking and scale pattern are drawn onto blank templates using photographs of that specimen. A standard 8 times magnifying lupe is useful for this exercise. The head marking is drawn out only where the level of contrast against the background is sufficient to allow recognition, at some small distance from the snake e.g. 1 to 2 m. In Figure 1 a typical head marking is shown and for each Adder the apex of the dorsal zig-zag, inverted 'V', eye-lines and continuous area over the parietal, supraocular, frontal, prefrontal and internasal scales are subject to individual variation. Figure 2 shows examples of head marking taken from record cards. In addition, coloured arrows are used to highlight unique features. For example, F5/SM/140598 has a ring of lighter pigmentation surrounding a darker centre on the frontal scale and a small patch of orange pigmentation arranged centrally invading both parietals. Figure 3 shows examples of head scale patterns, again taken from record cards, for the same individuals shown in Figure 2.

Field notes are added to each record when Adders are seen again. Information on when and where they were observed, general condition, evidence of sloughing etc. are transferred from a note pad to the cards after each visit.

The first piece of coded information consists of the letter M, F or U and a number and is intended for filing purposes only. The letter indicates whether the Adder is a male, female or unknown and the number is simply a file number. U for unknown sex is required when the shape of the Adder's tail has not been observed because it has covered it's tail with its body, it has moved off too quickly or the Adder is immature. Next comes the place code, which is where and when first seen. Examples from record cards include F5/SM/140598 – that is a female, number 5, first seen on the small mound in the reserve on 14th May 1998 and F16/PT/080898 – a female, number 16, first seen adjacent to the picnic table along a forest ride on 8th August 1998.

A second piece of coded information allows rapid analysis and is an aid to finally confirming identification or a new listing. It is also listed in a file using a computer word processing facility which allows a match to be quickly obtained to confirm whether the snake is already known. Once again this data is a mixture of abbreviations and numbers that code for several visual features that can be observed on every snake, whether in the field or from photographs later. The first 7 number code refers to the number of head scales, which have proved to be vary variable for the study group. Although there are several snakes, within the study group, that have the same number of scales within each scale group they are still different in size, shape and arrangement on the head.

In Figure 4 (a typical example) the 7 scale groups are shown. In the unusual circumstance where scales number more than 9, the number is underlined. In the case of the typical example, the 7 number code would be 6231332. From Figure 3 the head scale codes would be for F5/SM/140598-4231442 and for F15/OA/080898-62312332. Once again, it is certainly far easier and more accurate to collate this data from a photograph.

The following two letters refer to the main body colour of the Adders e.g. DB – dark brown, LG – light grey etc. and the next variable number of letters refer to the type of dorsal body marking (see Figure 5). Although the scale number should remain constant throughout life, the body colour can change depending on rate of maturity and sloughing. The name for the dorsal body markings are idiosyncratic and suggested by their shape and form. It may be that a particular Adder has an apex zig-zag that then turns into a mirror wave, which brakes up into ovals and then becomes diamonds on the tail, then the code would be ZZMWOD. The order is not relevant as the zig-zag can often break up into 'Ms' and 'Ws' in several places, being indispersed with oval markings a number of times. A large majority of the Adders have a distinct body stripe, where the characteristic zig-zag or parallel wave pattern has been lost. The body stripe may be solid – SS or have a lighter middle band – LS. Dorsal body marking may also be subject to change, as suggested above and for the same reasons. In which case, both pieces of information will be updated as the study continues.

To summarize the above, the Adder in Plate 1 is filed as F5/SM/140598 and F5/231442/LG/ZZOD and Plate 2 is filed as F8/SM/270798 and F8/6231222/LB/LSD.

The records and a camera are taken to the study site on every visit. Visits take place in the morning whilst Adders are warming up, although they can be extended into the early afternoon if cloudy. On carefully approaching a basking Adder a sequence of features are observed in order to try to identify the snake. The colour, shade and type of dorsal body marking are carefully observed. At this stage positive identification can be achieved for particular specimens, either because of certain obvious unique features or because they have been observed before at that place. For example, a small number of specimens in the reserve are particularly pale, one specimen has several bands of different colours running over the body and a regularly observed grey specimen has dorsal markings that are practically all ovals. On approaching closer head markings and scales can be observed and compared with photographic or diagrammatic records. If the Adder has not been identified at this stage, photographs are taken, if possible including full body and head only. Care must obviously be taken not to get too close, such that the snake moves off or possibly become aggressive. If the snake has moved off prematurely, time is allowed for it to return to it's basking spot, when the above procedure can be attempted again.

Using photographs the head scales can be more easily examined and comparisons made with Adders already on file. If the snake is not known a new file card is prepared.

CONCLUSION

Working within a known area where a population of Adders use the same basking spots day after day, certain individual snakes can be identified at some distance, using the unique body colour or dorsal markings. On approaching closer the head marking and scales are the next features that are most significant, again they can be compared with hand-held photographic or diagrammatic records. If the observer can get as close as possible, without making the snake aggressive, photographs can be taken and viewed later. In particular, the shape, arrangement and number of head scales can finally confirm the identity of an individual Adder or produce a new record.

Figure 1: Dorsal view of Adder head
Vipera berus illustrating a typical head marking

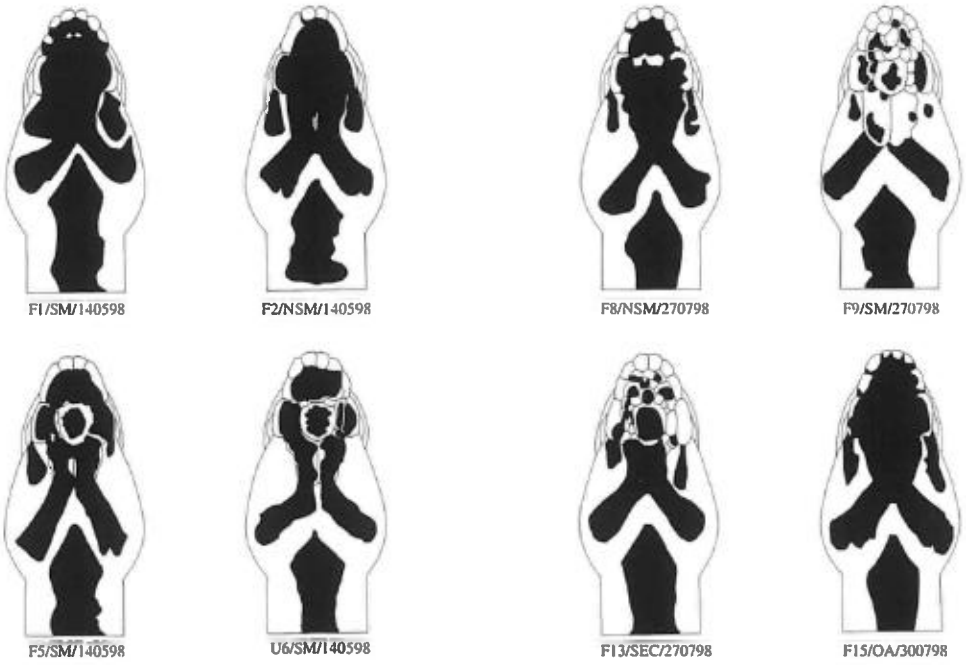

Figure 2: Examples of head markings for Adders with the study group

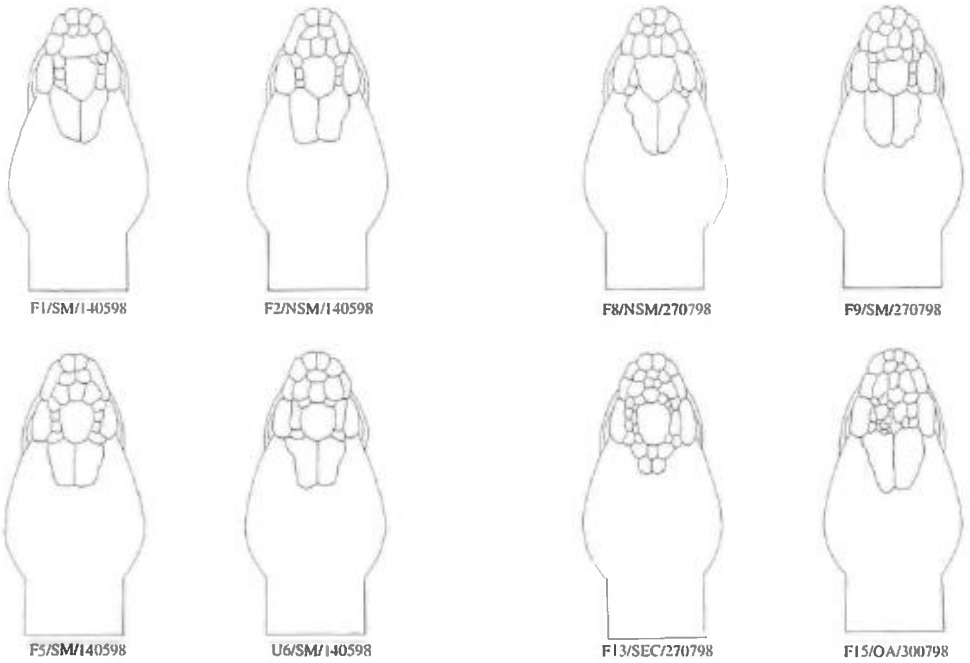

Figure 3: Examples of head scales for Adders within the study group

Figure 4: Dorsal view of Adder head
Vipera berus illustrating scale groups

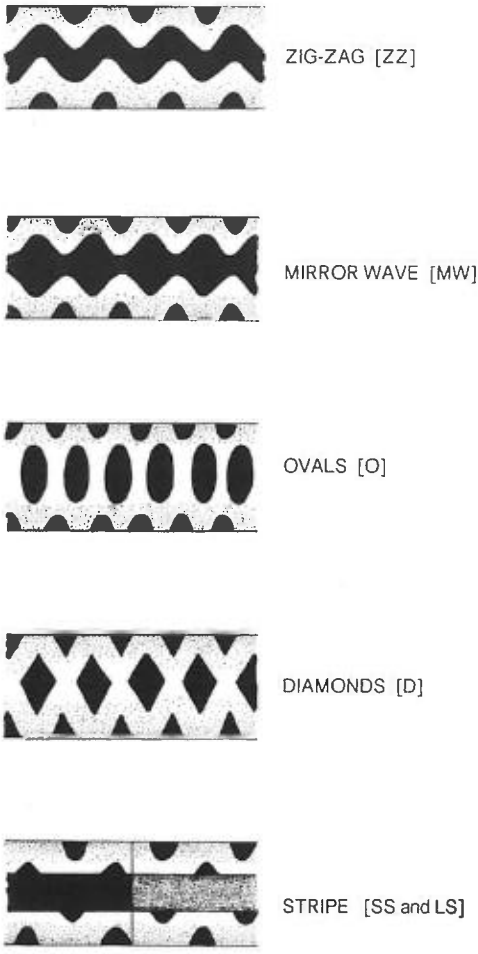

Figure 5: Examples of dorsal body markings for Adders within the study group

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REFERENCES

Arnold, E.N. & Burton, J.A. (1978). *A Field Guide to the Reptiles and Amphibians of Europe.* London: Wm Collins & Sons.

Evans, G. (1992). Pattern variation in Maer Adder (*Vipera berus*) Populations. *The Herptile; J. of the IHS,* Vol 14, No. 2, pp. 86-88.

Frazer, D. (1983). *Reptiles and Amphibians in Britain.* London: Wm Collins & Sons.

HGBI. (1998) Adders in Amphibian and Reptile Group casework.

Sheldon, S. & Bradley, C. (1989). Identification of Individual Adders (*Vipers berus*) by their Head Markings. *British Journal of Herpetology* Vol. 1pp. 392-396.

Smith, M. (1964). *The British Amphibians and Reptiles.* London: Wm Collins & Sons.

Stafford, P. (1987). *The Adder.* Shire Publications.

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HABITAT AND PREY SELECTION IN THE LAKE FROG, *RANA LEVANTINA* IN NORTHERN CYPRUS

K. FARQUHAR & J.R. DOWNIE[1]

Division of Environmental and Evolutionary Biology, Graham Kerr Building, University of Glasgow, Glasgow G12 8QQ

[1]*Author for correspondence*

INTRODUCTION

Three species of amphibian are native to Cyprus (Demetropoulos & Lambert, 1986; Bowles, 1989; Böhme & Wiedl, 1994), a toad, a tree-frog and a lake frog. As is commonly the case with island fauna which are part of widely-distributed species complexes, species determination has been controversial. Boehme & Wiedl's review regards the toad as *Bufo viridis*, not distinct enough from mainland populations to be regarded as a sub-species, though smaller and showing a greater range of colour patterns; the tree-frog is *Hyla savignyi*, now regarded as a distinct species, rather than a sub-species of *Hyla arborea.* Schneider and Sinsch (1992) and Schneider *et al* (1992) concluded on bioacoustical grounds that the widely distributed lake frogs previously all referred to *Rana ridibunda* should be sub-divided into three separate species, *R. ridibunda, R. balcanica* and *R. levantina.* Later allozyme analysis (Sinsch & Eblenkamp, 1994) supported this conclusion. On bioacoustic and morphological evidence, the Cyprus lake frog is *R. levantina* though there are doubts over the validity of the name (Böhme & Wiedl, 1994): this species is also found in Israel, the Nile delta and western Turkey.

As distinct from taxonomic investigation, very little work has been reported on the habits and ecology of *R. levantina*, especially from the northern part of the divided island of Cyprus. The observations reported here were made during July and August, the middle of the dry season. It rarely rains at this time of the year and skies are generally clear, resulting in day-time temperatures that often exceed 40°C. In Northern Cyprus, there are no running streams at this time and the only water-bodies are man-made reservoirs and ponds.

LAKE FROG DISTRIBUTION

Lake frogs were abundant in all four reservoirs we visited, distributed throughout Northern Cyprus (Fig. 1). We concentrated our efforts on a small reservoir near our base at Alagadi beach on the north coast, 10 km east of Girne (Kyrenia). Preliminary observations showed that the frogs emerged from the water to forage on the banks between 18.00-19.00h each evening allowing counts of distribution to be made.

Four distinct habitats occurred at the water's edge: open mud, reeds, rocks and floating weeds. A perimeter walk established the relative abundances of these habitats and the numbers of frogs found (Table 1). Though open mud was the commonest perimeter habitat type, frogs chose mainly the other three habitats, especially weeds.

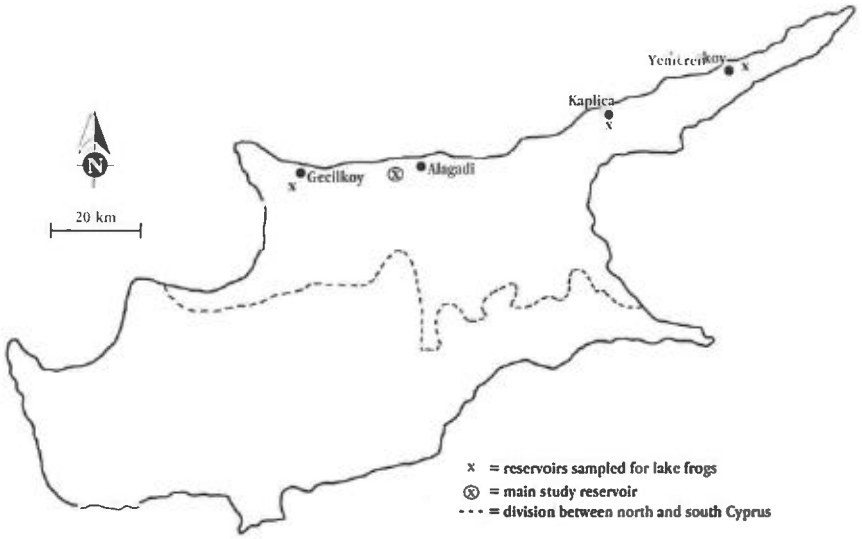

Figure 1. Sketch map of Northern Cyprus, showing reservoirs sampled for Lake Frogs, and base at Alagadi

The frogs could easily be allocated to two size classes: small, 2-3 cm body length; and large 3-9 cm. To check whether small and large frogs favoured the same habitats, two 10 metre lengths of each habitat type were checked for large and small frogs on five different occasions. Results are shown in Table 2. They confirm the overall habitat preference shown in Table 1 but additionally show a strong size-related preference: large frogs were absent from the weeds where small frogs were extremely abundant. However, large frogs predominated amongst the rocks, especially considering the overall distribution of about three small frogs to each large frog in the sample counted overall. X^2 calculations confirmed the statistical significance of these preferences.

EXPERIMENTAL POND

To allow more frequent observations of frog behaviour, an artificial pond was established at our base at Alagadi. An area of 1.5m² was dug to 0.5m deep and lined with polythene sheet. Once filled with water, the pond was divided into four quadrats and these were then set up to simulate the four habitats found at the reservoir perimeter (open, rocks, weeds and reeds) using vegetation and rocks brought from the reservoir. A sample of six large and eight small frogs was captured at the reservoir by hand-netting and released into the pond. After a day's acclimatisation, the distribution of the frogs in the pond was noted at different times around the clock over a period of three weeks. Results are shown in Table 3 using a habitat preference index corrected for the numbers of large and small frogs.

Although there were small differences around the clock, the distributions of the large and small frogs remained remarkably consistent, but showed some differences from the findings at the reservoir. As at the reservoir, neither large nor small frogs were found commonly in the open habitat; as at the reservoir large frogs were found among rocks more commonly than small frogs, and small frogs more commonly among weeds than large frogs. The main difference from the reservoir was that in the pond, both large and small frogs were most commonly found amongst reeds.

PREY SELECTION

Frogs were captured from the different habitat types around the reservoir perimeter, immediately after the twilight foraging period (18.00-19.00h). Frogs were then cooled and killed by freezing. Body sizes were measured and stomachs removed and preserved in formalin. Contents were later counted, measured and identified to Class or Order. Numbers and distribution of prey types related to foraging habitat are shown in Table 4. The commonest prey type was ants, followed by beetles and flies. In terms of prey items caught per frog, rocks were the most productive habitat and weeds conspicuously the poorest: amongst weeds, though numbers are small, spiders were the commonest prey, though representing only 7% of prey items taken by the whole sample.

Table 5 shows the size distribution of prey items, heavily skewed towards prey less than 3.0 mm long, mainly ants and small beetles. There is probably a tendency for larger frogs to capture larger prey: the largest prey item recorded was a 55 mm locust taken by a 69 mm long frog. However, our sample only included 5 frogs over 31 mm and there was no evidence that larger frogs ceased to capture small prey.

DISCUSSION

The main factors likely to influence the spatial distribution of lake-frogs such as *R. levantina* are predation, desiccation and food availability. During summer time in North Cyprus there is rarely any rainfall and the land is baked dry by the very hot sun. Lake frogs consequently spend much of the day in the water at reservoir perimeters, emerging to forage late in the day.

Frogs were not evenly distributed round the perimeter of the reservoir we studied. Though open mud was the commonest habitat, frogs were rarely found there: instead, they congregated in areas of rocks and vegetation. This pattern of distribution was essentially repeated in our experimental pond and was shown not to be the twilight hours. A somewhat similar result was found by Hovingh (1993) in a study of the Spotted Pond Frog *Rana pretiosa*. Rocks and vegetation are likely to provide better protection from predation and desiccation than an open mud bank, and may also be richer in food resources.

It was particularly interesting that large and small frogs preferred different habitats. This could be for several possible reasons. Cannibalism by large frogs on smaller conspecifics is not unknown: we saw no evidence of this, but our stomach contents sample for larger frogs was quite small. The weedy areas may offer better escape opportunities for small frogs and may be difficult for larger individuals to move through. The stomach contents sample was particularly interesting: if it relates well to prey availability, it suggests that the weedy area is poor in prey, and that the smaller frogs may use it mainly as a refuge, emerging into the reeds and rocky areas to forage.

This study is obviously limited by having been carried out only in the dry season: it would be of considerable interest to examine the life of these frogs at wetter and cooler times of the year. It is obvious that nowadays reservoirs are of vital importance for the maintenance of amphibian populations in Northern Cyprus. This study suggests that a varied perimeter, especially including rocks and vegetation, is essential if amphibians are to survive there.

Table 1
Distribution of habitats and frogs round the edge of a small reservoir in Northern Cyprus

Habitat type	Total length of habitat (m)	Frog density (number per metre)
open	571	0.03
reeds	185	0.5
rocks	77	0.4
weeds	22	3.2

Table 2
Mean numbers of large and small frogs observed in the different reservoir perimeter habitats (per 10 m length)

Habitat type	Large frogs	Small frogs
open	0.1	1.2
reeds	0.4	5.9
rocks	5.6	2.7
weeds	0	13.9

Table 3
Habitat preferences[4] at different times of day in the experimental pond

	Large frogs				Small frogs			
Time of day	open	reeds	rocks	weeds	open	reeds	rocks	weeds
Early morning[1]	0.9	3.8	1.7	0.8	0.3	3.8	0.2	2.7
Full day[2]	0.1	4.3	1.6	0.7	0.1	4.1	0.2	1.9
Night[3]	0.1	3.4	0.5	1.2	0.2	3.4	0.3	2.4

1: Early morning = 0.500-09.00h, sampled 23 times

2: Full day = 11.00-17.00h, sampled 34 times

3: Night = 19.00-02.00h, sampled 18 times

4: The habitat preference index shown in the table was calculated by totalling all sightings, then dividing by the number of times sampled and the number of large or small frogs in the pond (x10).

Table 4

Numbers and distribution of prey items related to reservoir perimeter habitat

Prey		Habitat type			
type	total	open	reeds	rocks	weeds
flies	13	4	3	6	-
beetles	24	3	5	16	-
ants	30	6	10	10	2
locusts	1	-	-	1	-
spiders	6	1	2	-	3
unidentified	1	-	1	-	-
Total	75	14	23	33	5
mean per frog[1]	2.1	2.8	3.8	4.1	1.0

1: 28 frogs in total were captured, 8 from rocks, 6 from reeds and 5 each from open and weeds.

Table 5

Size distribution of all prey items recorded (%)

0.6 - 3.0 mm	3.1 - 5.0 mm	5.1 - 7.0 mm	>7.1 mm
78	13	4	5

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REFERENCES

Böhme, W. and Wiedl. H. (1994). Status and zoogeography of the herpetofauna of Cyprus, with taxonomic and natural history notes on selected species (genera *Rana, Coluber, Natrix, Vipera*). *Zoology in the Middle East* **10**, 31-52.

Bowles, F.D. (1989). A note on the herpetofauna of south-east Cyprus. *British Herpetological Society Bulletin* **30**, 22-4.

Demetropoulos, A. and Lambert, M. (1986). Herpetology in Cyprus. *British Herpetological Society Bulletin* **17**, 22-7.

Hovingh, P. (1993). Aquatic habitats, life history observations and zoogeographic considerations of the spotted frog (*Rana pretiosa*) in Tule Valley, Utah. *Great Basin Naturalist* **53**, 168-79.

Schneider, H. and Sinsch, U. (1992). Mating call variation in lake frogs referred to as *Rana ridibunda* Pallas, 1771: taxonomic implications. *Zeitschrift für zoologische Systematik und Evolutionsforschung* **30**, 297-315.

Schneider, H. and Sinsch, U. and Nevo, E. (1992). The lake-frogs in Israel represent a new species. *Zoologischer Anzeiger* **228**, 97-106.

Sinsch, U. and Eblenkamp. B. (1994). Allozyme variation among *Rana balcanica, Rana levantina* and *Rana ridibunda* (Amphibia, Anura); genetic differentiation corroborates the bioacoustically detected species status. *Zeitschrift für Systematik und Evolutionsforschung* **32**, 35-43.

HERPETOLOGICAL NOTES FROM MAINLAND AND INSULAR GREECE

V. Pérez Mellado *, E.D. Valakos #, M.J. Gil *, F. Guerrero *, J. Lulch $, P. Navarro $ and P. Maragou #

* *Department of Animal Biology, Universidad de Salamanca, 37071- Salamanca. (Spain), e-mail: valentin@gugu.usal.es*

 # Department of Biology, Section of Animal & Human Physiology, University of Athens. GR-15784 Illisia, Athens, Hellas (Greece), e-mail: evalakos@biology.db.uoa.gr

$ Department of Animal Biology (Parasitology), Universidad de Valencia, Burjassot, Valencia (Spain)

INTRODUCTION

Although the herpetofauna of Greece is well known (see for example, Werner, 1938; Wettstein, 1953, 1957; Ondrias, 1968; Chondropoulos, 1986, 1989), several distributional questions still remain unclear, mainly for the mainland but also for islands.

In this paper we present some chorological information from a field trip of one month (April 1990) to mainland and insular Greece (see Figs 1 and 2 and appendix I for a complete list of localities).

RESULTS AND DISCUSSION

Amphibians

Salamandra salamandra. 07.04.90: 1 specimen from Loc. 4 and 1 specimen from Loc. 7 on 09.04.90.

Triturus alpestris. 07.04.90: 1 adult specimen from Loc. 4. First record for the Katara region. Observed on a grassland area at 1705 m.a.s.l.

Bufo bufo. 07.04.90: Several clutches at Loc. 3; 09.04.90: 42 specimens collected at Loc. 6; 09.04.90: 6 specimens from Loc. 7, and 2 specimens from Loc. 9; 10.04.90: 2 specimens from Loc. 10, and 7 specimens from Loc. 13. Also observed at Loc. 8.

Bufo viridis. 13.04.90: 4 specimens from Loc. 16; 18.04.90: 2 specimens collected at Loc. 39, and choruses from Loc. 40 and 41. Also observed at Loc. 18 on 13.04.90.

Rana eppeirotica. 08.04.90: 19 specimens and 09.04.90: 2 specimens from Loc. 5, and 4 specimens from Loc. 6.

The Lake frog present at Lake Ioannina was recorded by Tunner & Heppich (1982) as the "Corfú taxon". However, on Corfú island both species, *Rana eppeirotica* and *Rana ridibunda* coexist (Keymar, 1985, `986). Thus, *Rana eppeirotica* is a cryptic species formerly taken as *Rana ridibunda* (Keymar, 1986). For this reason, the assignment of our sample from Ioannina to this species seems to be difficult without an electrophoretical confirmation. In addition, a morphometrical comparison between these marsh frogs and those from other Greek locations could be helpful in this respect.

Rana graeca. 07.04.90: 7 specimens from Loc. 4; 09.04.90: 4 specimens from Loc. 6; 10.04.90: 1 specimen from Loc. 13. Also observed at Loc. 7 and Loc. 10.

Rana ridibunda; 07.04.90: 14 specimens from Loc. 13, and 1 specimen from Loc. 14; 11.04.90: choruses from Loc. 16; 15.04.90: 1 specimen observed at Loc. 24 and 25 respectively, 7 specimens collected at Loc. 29, 5 specimens collected at Loc. 30, and 2 specimens from Loc. 31; 18.04.90: 1 specimen collected at Loc. 39; 19.04.90: 12 specimens collected at Loc. 33, and 1 specimen from Loc. 36; 20.04.90: 9 specimens from Loc. 37; 26.04.90: 17 specimens collected at Loc. 17, also observed at Loc. 41.

Hyla arborea; 10.04.90: 39 specimens from Loc. 12, and 4 specimens from Loc. 13; 11.04.90: 4 specimens from Loc. 14; 11.04.90: choruses of several individuals at Loc. 15 and 16; 15.04.90: 4 specimens from Loc. 30; 18.04.90: choruses at Loc. 39 and 41; 26.04.90: choruses at Loc. 17.

Reptiles

Emys orbicularis. 14.04.90: 1 specimen observed at Loc. 19: 15.04.90: 1 specimen observed at Loc. 30 (second record for Lesvos Island, the first was from Broggi, 1978); 26.04.90: 2 individuals observed at Loc. 17.

Mauremys caspica. 14.04.90: 1 specimen observed at Loc. 19, and 1 specimen observed at Loc. 20; 15.04.90: 1 specimen observed at Loc. 24; 19.04.90: 6 specimens observed at Loc. 34, and 1 specimen observed at Loc. 38; 20.04.90: several specimens observed, in both cases at Loc. 39, and 2 specimens observed at Loc. 37; 23.04.90: 1 specimen observed at Loc. 43; 24.04.90: 1 specimen from Loc. 45; 26.04.90: extremely common at Loc. 17.

Testudo hermanni. 07.04.90: 1 specimen observed at Loc. 3; 10.04.90: 2 adult specimens observed at Loc. 11.

Testudo marginata. 07.04.90: 1 adult male observed at Loc. 2.

Only recently recorded for some northern localities of mainland and insular Greece (Keymar & Weissinger, 1987).

Anguis fragilis. 08.04.90: 1 adult specimen from Loc. 6.

Ophisaurus apodus. 26.04.90: 1 specimen collected at Loc. 17.

Ablepharus kitaibelli. 06.04.90: 1 specimen from Loc. 1; 24.04.90: 1 specimen from Loc. 44.

Chalcides ocellatus. 19.04.90: 18 specimens from Loc. 36; 20.04.90: 3 specimens from Loc. 33, 1 specimen observed at Loc. 39, and 1 specimen observed from Loc. 42 and also observed at Loc. 38.

Algyroides nigropunctatus. 08.04.90: Two specimens (ad. and subad.) in Loc. 6 and also observed at Loc. 7.

Ophisops elegans ehrenbergii. 14.04.90: 14 specimens from Loc. 19; 14.04.90: 1 specimen from Loc. 18, and 1 specimen from Loc. 20; 15.04.90: 1 specimen observed at Loc. 21, 18 specimens collected at Loc. 23, and several specimens observed at Loc. 25 and 26.

Very common. Recorded from at least in 12 aegean islands (Kühnelt, 1986).

Lacerta trilineata. 14.04.90: 1 specimen observed at Loc. 19; 14.04.90: 2 specimens collected at Loc. 18; 15.04.90: 2 specimens observed at Loc. 21 and 24; 19.04.90: 1 specimen observed at Loc. 34, 1 specimen observed at Loc. 35, 1 specimen observed at Loc. 36, and 1 from Loc. 38; 20.04.90: 2 specimens collected at Loc. 31, several specimens observed at Loc. 39, and 2 specimens collected at Loc. 42; 23.04.90: 1 specimen observed at Loc. 48; 24.04.90: 1 specimen from Loc. 49; 26.04.90: 2 specimens from Loc. 52 and 1 from Loc. 53.

Lacerta vidiris. 07.04.90: 4 specimens collected from Loc. 2; 1 specimen from Loc. 3; 08.04.90: 1 specimen from Loc. 5. and also observed at Loc. 7. 14.04.90: One adult specimen of *Lacerta*, was captured at Loc. 22 in area of Lesvos island with a quite wet environment. Its back pattern, coloration and pholidosis seems to match the species *L. viridis*, but, obviously, we can say nothing conclusive without a biochemical confirmation of its specific status (Mayer & Tiedemann 1981).

Podarcis erhardii. 21.04.90: 46 specimens collected at Loc. 50; 22.04.90: 9 specimens collected at Loc. 51; 26.04.90: 6 individuals observed at Loc. 52 and 53, both from Sifnos island where *Poddarcis erhardii* seems to be extremely scarce. Sifnos island is occupied by *P.e.erhardii* (Grillitsch & Tiedemann, 1984). The subspecies *P.e.myconensis* was recorded from Thira by Frör & Beutler (1978).

Podarcis muralis. 08.04.90: 39 specimens from Loc. 5.

Podarcis taurica. 08.04.90. 7 specimens from Loc. 6.

Laudakia stellio. 15.04.90: 1 specimen observed at Loc. 24, and 1 specimen in Loc. 25, 27 and 28 respectively. It was recorded at Lesvos Island by Werner (1938), Ondrias (1968) and Broggi (1978), but its presence was not mentioned by Xyda (1986) who considered that lizards from Samos, Hios and other neighbouring islands have to be included in a new subspecies not nominated in his work.

Cyrtodactylus kotschyi. 23.04.90 and 24.04.90: several specimens observed at Loc. 43, 44, 46, 52 and 53. The species is recorded for the first time by Tiedemann & Haüpl (1982) from Thira (Santorini) and Thirassia.

Hemidactylus turcicus. 20.04.90: 1 specimen collected at Loc. 37.

Tarentola mauritanica. 18.04.90: 1 specimen observed at Loc. 32; 19.04.90: 1 specimen collected at Loc. 34.

Typhlops vermicularis. 10.04.90: 2 specimens from Loc. 11. It is considered as a common species in mainland Greece (Dimitripoulos, 1986).

Coluber gemonensis. 06.04.90: 1 subadult individual from Loc. 1; 20.04.90: 1 specimen collected at Loc. 33. A relatively invariable species of Colubridae, common in mainland Greece (Dimitropoulos, 1986).

Natrix natrix. 08.04.90: 1 specimen from Loc. 5 and 1 specimen from Loc. 6.

Natrix tesselata. 08.04.90: 2 specimens collected at Loc. 5; 09.04.90: 1 specimen from Loc. 10: 10.04.90: 1 specimen from Loc. 13; 26.04.90: 2 individuals observed at Loc. 17.

Vipera lebetina schweizeri. 23.04.90: Observed at Loc. 44. Recorded in the Milos archipelago (Kühnelt, 1986) where it seems to be extremely common but threatened by the persecution from scientific collectors (Dimitropoulos, 1986).

Appendix I. Localities cited in the text (see Figures 1 and 2)

Mainland (Figure 1)

1. Kaza 38° 25' N, 23° 30' E
2. Meteora 39° 50' N, 21° 20' E
3. Meteora (Pinios river) 39° 40' N, 21° 20' E
4. Katara 39° 50' N, 21° 10' E
5. Ioannina (Lake Pamvotida) 38° 25' N, 23° 30' E
6. Ioannina (Lake Pamvotida near to the islet) 39° 40' N, 20° 40' E
7. Kipi (Zagori) 39° 50' N, 20° 40' E
8. Kopani (Louros river) 39° 20' N, 20° 40' E
9. Fillipiada 39° 20' N, 20° 40' E
10. Trichonida lake 38° 40' N, 21° 20' E
11. Pleuron 38° 20' N, 21° 20' E
12. Souli 38° 00' N, 22° 30' E
13. Stimfalos 37° 50' N, 22° 30' E
14. Kastania 37° 40' N, 22° 20' E
15. Argos 37° 40' N, 22° 40' E
16. Road Argos-Isthmia 37° 40' N, 22° 50' E
17. Shinias (Marathonas) 38° 10' N, 24° 00' E

Lesvos Island (A, Figure 2)

18. Moria 39° 20' N, 26° 30' E
19. Moria 39° 15' N, 26° 30' E
20. Alykes Kallonis (Arisvi) 39° 10' N, 26° 20' E
21. Arisvi 39° 10' N, 26° 15' E
22. Road Mithimna-Vafios 39° 50' N, 26° 10' E
23. Mistegna 39° 20' N, 26° 20' E
24. Mantamados 39° 30' N, 26° 20' E
25. Road Pelopi-Ypsilometopo 39° 20' N, 26° 20' E
26. Road Rodotichos-Kastreli 39° 10' N, 26° 10' E
27. Agra 39° 10' N, 26° 00' E
28. North of Asropotamos river 39° 15' N, 26° 30' E
29. Mylopotamos river 39° 20' N, 26° 20' E
30. Moni Myrtiotissas-Filia 39° 20' N, 26° 10' E
31. Moria 39° 10' N, 26° 25' E

Crete Island (E, Figure 2)

32. Knossos 35° 20' N, 25° 50' E
33. Fodele 35° 20' N, 24° 50' E
34. Road Rizinia-Festos 35° 10' N, 24° 50' E
35. Pano Moulia 35° 00' N, 24° 50' E
36. Gortina 35° 00' N, 24° 50' E
37. Vori 35° 50' N, 24° 40' E
38. Kamilari 35° 00' N, 24° 40' E
39. Lavris (Geropotamos river) 35° 20' N, 24° 50' E
40. Moyri 35° 15' N, 24° 10' E
41. Dramia 35° 20' N, 24° 30' E
42. Rethimno 35° 20' N, 24° 30' E

Milos Island (B, Figure 2)

43. Adamas 36° 40' N, 24° 20' E
44. Filakopi 36° 40' N, 24° 20' E
45. Alykes 36° 40' N, 24° 20' E
46. Provatas 36° 35' N, 24° 20' E
47. Sakoula 36° 35' N, 24° 20' E
48. Sakoula 36° 35' N, 24° 20' E
49. Kimolos (Kimolos Island) 36° 45' N, 24° 20' E

Santorini Island (C, Figure 2)

50. Thira 36° 25' N, 25° 20' E
51. Nea Kamenni 36° 25' N, 25° 15' E

Sifnos Island (D, Figure 2)

52. Apollonia 36° 35' N, 24° 40' E
53. Kamares 37° 00' N, 24° 30' E

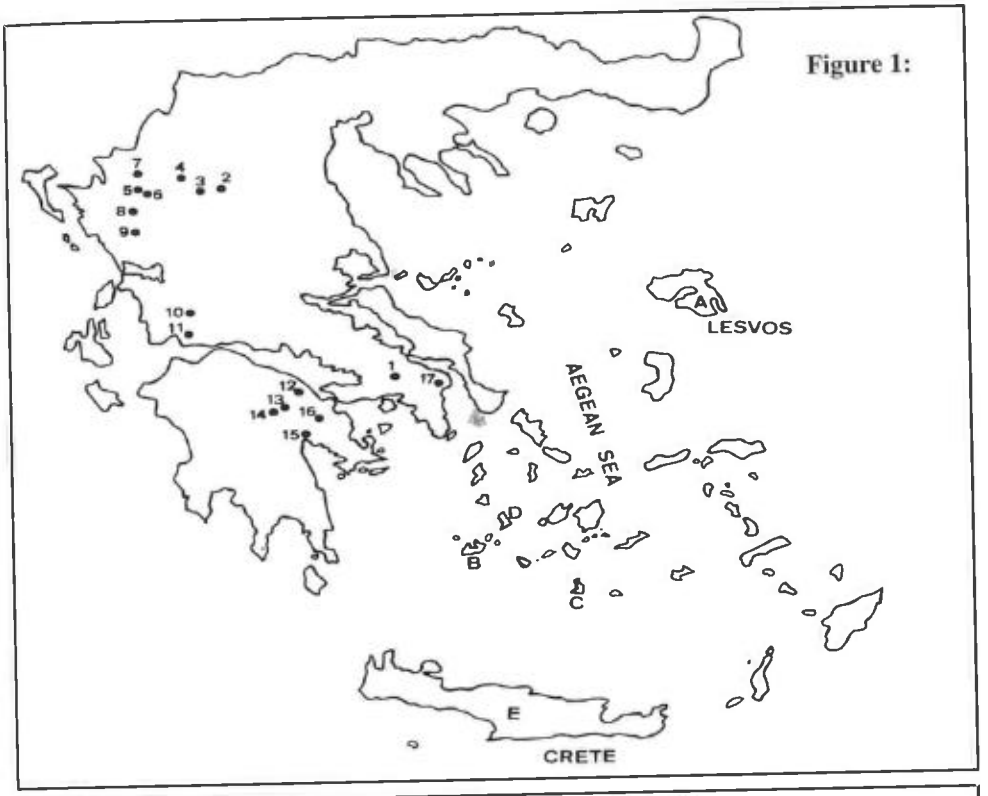

Figure 1:

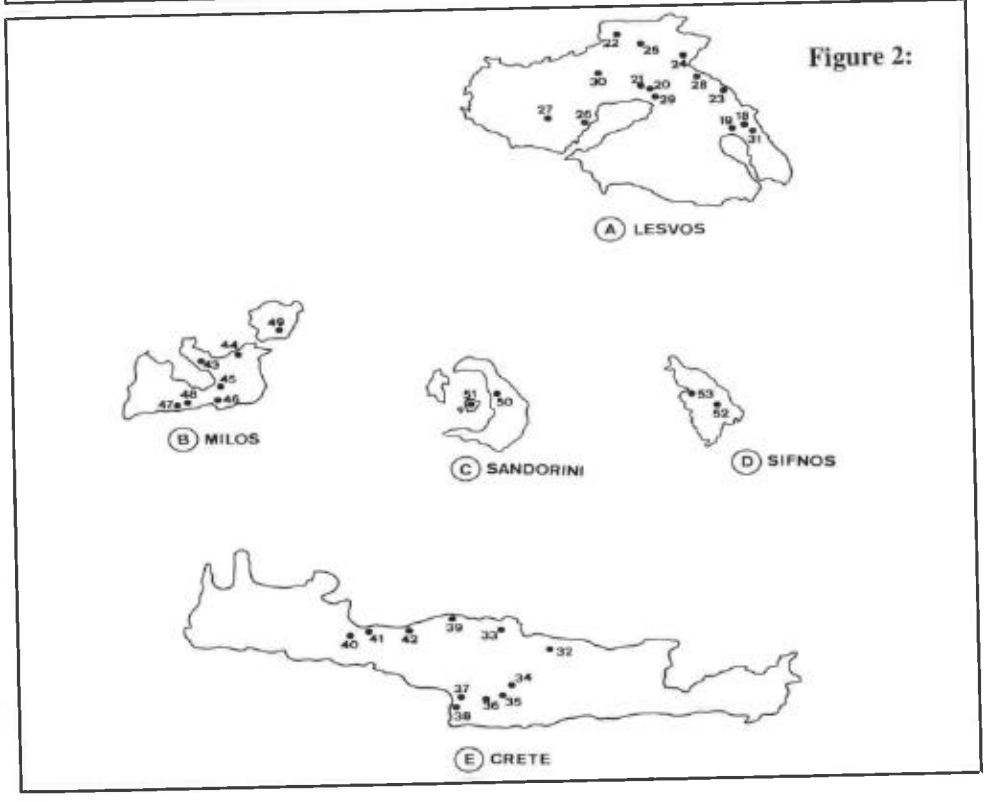

Figure 2:

REFERENCES

Broggi, M. (1978). Herpetologishe Beobachtungen auf der Inseln Lesbos (Griechenland). *Salamandra* **14(4)**: 161-171.

Chondropoulos, B.P. (1986). A checklist of the Greek reptiles. I. The lizards. *Amphibia-Reptilia* 7: 217-235.

Chondropoulos, B.P. (1989). A checklist of the Greek reptiles. II. The snakes. *Herpetozoa* **2 (1/2)**: 3-36.

Dimitropoulos, A. (1986). Some notes on the colour and pattern variation of the Greek snake fauna in relation to geographic distribution. *Biologia Gallo-hellenica* **12:** 463-471.

Frör, E. & Beutler, A. (1978). The herpetofauna of the oceanic island in the Santorini-archipelago, Greece. *Spixiana* **1:** 301-308.

Grillitsch, H. and Tiedemann (1984). zur Herpetofauna der griechischen Inseln Kea, Spanopoula, Kithnos, Sifnos, Kitriani Cycladen), Alonnisos und Piperi (Nördliche Sporaden). *Ann. Naturhist. Mus. Wien* **86:** 7-28.

Keymar, P.F. (1985). Additional remarks on: "Some amphibians and reptiles of Corfu with a special note on the occurrence of the nose-horned viper (*Vipera ammodytes*)" (Stafford P. Herptile 9(3) Sep. 1984 pp. 105-108). *Herptile* **10(1):** 25.

Keymar, P.F. (1986). Die Amphibien und reptilien der Ionischen Region (Griechenland) – Analyse ihter rezenten Verbreitungsmuster und Überlegungen zu ihter Ausbreitungsgechichte. *ÖGH-Nachrichten* 1986 **(6/7):** 3-26.

Keymar, P.F. and Weissinger, H. (1987). Distribution, morphological variation and status of *Testudo marginata* in Greece. In: *Proc.Fourth Ord.Gen.Meet. S.E.H.* J.J. van Gelder, H. Strijbosch & P.J.M. Bergers(eds.) Nijmegen 1987 pp.219-222.

Kühnelt, W. (1986). Contributions to the knowledge of historical biogeography of Balkan peninsula, especially of Greece. *Biologia Gallo-hellenica* **12:** 71-84.

Mayer, W. and Tiedemann, F. (1982). Chemotaxonomical investigation in the collective genus *Lacerta* (Lacertidae, Sauria) by means of protein electroforesis. *Amphibia-Reptilia* **2:** 346-356.

Ondrias, J. C. (1968). Liste des Amphibiens et des Reptiles de Gréce. *Biologia Gallo-hellenica.* **1:** 111-135.

Tiedemann, F. and Häupl, M. (1982). *Cyrtodactylus kotschyi* (Steindachner, 1870) in the Santorin archipelago. *Amphibia-Reptilia* **3:** 377-381.

Tunner, H.G. and Heppich, S. (1982). A genetic analysis of water frogs from Greece: evidence for the existence of a cryptic species. *Z.zool. Syst. Evolut.-forsch.* **20:** 209-233.

Werner, F. (1938). Die Amphibien und Reptilien Griechenlands. *Zoologica* **35**: 1-117.

Wettstein, O. (1953). Herpetologia aegaea.*Sitz.-ber. Österr.Akad.Wiss.,Math.-naturwiss.*Kl. **166:** 123-164.

Xyda, A. (1986). Supplementary evidence on the biometry and ecology of the lizard *Stellio stellio* of Greece and Cyprus. *Biologia Gallo-hellenica* **12:** 451-458.

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PREDATORS OF THE COMMON LIZARD *(ZOOTOCA VIVIPARA)* IN A HABITAT OF FOREST GLADE IN SW POLAND

ROBERT MAŚLAK and LUKASZ PAŚKO

University of Wroclaw, ul. Sienkiewicza 21, Wroclaw 50-335, Poland

ABSTRACT

Ecological studies were carried out in 1992-1995 in a population of *Zootoca (Lacerta) vivipara* inhabiting a humid meadow surrounded by a forest in SW Poland. The studies included, among others, identifying vertebrate predators of this species. Three amphibian species, 2 reptile species, 21 birds and 12 mammals are regarded as potential predators. Attempted attacks by the Kestrel and numerous attacks by the Jay on the lizards were observed. The opinion that a high proportion of lizards with regenerated tails unequivocally testifies to a high predation pressure is discussed.

INTRODUCTION

Zootoca (Lacerta) vivipara is one of the best known reptile species. Numerous studies on various aspects of its biology have been conducted in Europe. The lizard's life span is usually 3-4 years, quite exceptionally longer than 7 years. The most critical period of life is the juvenile phase and the age of first reproduction (e.g. Pilorge and Castanet 1981; Heulin 1985; Strijbosch & Creemers 1988; Castanet 1994).

Predation is among the most important mortality factors. A high proportion of individuals with regenerated tails, finger damage etc. is associated with it. A review of anti-predatory strategies employed by Lacertidae can be found in Bauwens & Thoen (1981) and Gramentz (1995).

The lizards fall prey to invertebrates (McCormick & Polis 1982; Schwammer & Baurecht 1988; Bauer 1990; Blondheim & Werner 1990; Jehle et al. 1996) and vertebrates (e.g. Kabisch & Belter 1968; Osennegg 1995). This study was aimed at recognizing potential vertebrate predators of *Zootoca vivipara* in a forest glade near Wroclaw (Lower Silesia, Poland). In addition, the proportion of specimens with body damage in the population was estimated.

MATERIALS AND METHODS

The meadow which was the study area is located on the left bank of the Hystrzyca River valley, on a higher Holocene terrace, at the base of a Baltic terrace, at 118 m a.s.l. (Walczak 1970; Szczepankiewicz 1972; 1989). The location of the area results in a difficult water outflow. This is testified to by the fact that marshy ground forms a considerable part of the area, in spite of a network of drainage ditches which also cross and partly surround the meadow and the adjacent forests. The meadow is approximately rectangular, 250 x 140m, surface area 3.5 ha. Its eastern part is crossed by a drainage ditch. A similar ditch runs along the northern edge of the meadow. In the spring and after

heavy rains the ditches are filled with water which then floods a small belt along the eastern border of the meadow. The vegetation can be classified as belonging to the order Molinietalia.

The study area is surrounded by a forest. On the southern and eastern side *Alnus glutinosa* dominates, on the northern side *Betula pubescens* and *Pinus silvestris*, on the western side *Picea abies*. Besides, there are single trees of *Quercus robur, Populus tremula* and *Fraxinus excelsior*. The margins of the ditch that crosses the meadow are overgrown by *Betula pubescens* and *Frangular alnus*.

The studies carried out in 1992-1995 included an array of aspects of the ecology of *Zootoca vivipara*. Within the studies, 467 individuals were marked individually by toe-clipping. Individuals with regenerated tails and damaged legs were registered. The observations each year started in the middle of March and ended at the beginning of October. The lizards were caught mainly in the morning and early afternoon.

Observations of potential predators of the lizard were carried out on the meadow and in the adjacent forest. The methods involved both direct observation and studying traces of predator's feeding, faeces etc. The results were compared with literature data.

RESULTS AND DISCUSSION

A considerable proportion of individuals with regenerated tails were found in the population (Table 1). This may testify to a high predation pressure. The proportion of specimens with damaged toes is much lower. Besides these, a male with a completely missing fore leg was found.

In the study area the Field Frog *(Rana arvalis)* is very numerous; the Common Frog *(Rana temporaria)* and the Common European Toad *(Bufo bufo)* were found less often. Data from the analysis of stomach contents indicate that they devour vertebrates only exceptionally (e.g. Pisarenko & Usakov 1985; Juszczyk 1987; Baruś et al. 1992a; own data). They can, however, constitute a threat, especially in the morning, when the first lizards leave their night shelters and still move slowly.

The Slow-Worm *(Anguis fragilis)* was observed on the meadow only a few times. Cases of consuming other lizards by this species were noted (Brown 1957; Radek 1964; Dely 1981; Petzold 1995).

The Grass Snake *(Natrix natrix)* was met often, especially in the summer, near the ditch crossing the meadow and in the forest. It sometimes devours lizards, mainly when amphibians are not available in sufficient numbers (e.g. Kabisch 1974; Kratzer 1974; Baruś et al. 1992b; Osenegg 1995).

Twenty one bird species – potential predators of the lizard – were recorded.

Storks were often observed in the study area. The White Stork regularly nests in a village ca. 1.5 km away from the meadow. However, it foraged on the meadow only rarely and always in the early morning hours. The White Stork, depending on local food conditions, may consume considerable numbers of lizards. For example in the area of Kherson (Ukraine) it feeds mainly on orthopterans and lizards, and only then frogs, snakes and small mammals (e.g. Szijj 1956/57; Kabisch & Belter 1968). Likewise, the Black Stork may feed on lizards (Cramp 1982a). The Black Stork in flight was seen often, especially in 1992. However, it was never observed to forage on the meadow.

Among Accipitriformes, the Buzzard and the Goshawk regularly visited the meadow, while the Sparrowhawk was seen only once. The Sparrowhawk in Silesia is not an abundant species (Dyrcz et al. 1991). Though cases of killing lizards by that bird are known, it was never observed to eat them (Cramp 1982b). In the studies conducted in Poland by Kochan (1979) none of 69 examined alimentary tracts of the Goshawk contained a reptile. A considerable threat for the studied population could be constituted by the Buzzard which was often seen above the meadow. Though the food basis of this species is constituted by small mammals, reptiles, first of all Lacertidae, are under certain conditions an important supplement. Sometimes they can be consumed in considerable quantities. For example in Rügen (Germany) young Buzzard are to a large extent fed with birds and reptiles. Also in the case of easy availability of reptiles their proportion in the diet increases. For example in Italy and Spain these birds most often eat insects, then reptiles, and only then mammals. In France carrion, amphibians, reptiles and fish counted together constitute ca. 5-10% of consumed food (Glutz von Blotzheim et al. 1971; Garzon 1974; Cramp 1982b). In the studies carried out in Poland only one reptile was found in 104 examined alimentary tracts; it was *Zootoca vivipara* (Kochan 1979). With respect to mass, lizards constituted only 0.07 to 0.1% of consumed food (Czarnecki & Foksowicz 1954; Truszkowski 1976). Pomarnacki (1982), during a two-day observation of a low-situated nest, noted that the young were fed to a considerable degree with reptiles, as many as 3 lizards for each 4 mammals brought.

The only falconiform species in the study was the Kestrel. With respect to abundance this is the second bird of prey in Silesia (Dyrcz et al. 1991). It visited the meadow regularly. Once an attack by the Kestrel on a lizard was observed. It was, however, unsuccessful, the lizard having managed to escape in tall grass. Lizards may constitute a few per cent of the food of the Kestrel. In studies in Hungary it was demonstrated that out of 94 stomachs analysed, besides remnants of 45 mammals and 9 birds, there were remnants of as many as 49 lizards *(Lacerta agilis)*; in the Netherlands 900 stomachs examined contained 7.1% lizards *(Lacerta agilis).* In Germany the proportion was 5.2% (Glutz von Blotzheim et al. 1971). Among the amphibians and reptiles caught by the Kestrel, lizards of the genus *Lacerta* are a decidedly dominating group. In some conditions, e.g. in early spring, at the absence of small mammals, the number of consumed lizards may equal that of birds (Cramp 1982b). They can be also a supplementary food brought by parents for young in the nest (Piechocki 1952). Ortlieb (1963) observed that out of 41 vertebrates brought to the nest, 4 were lizards.

In the Owl, food lizards are found very rarely, because of the activity falling in different hours of the day (Cramp 1985). Ca. 700 m away from the study area, once the Long-Eared Owl was observed, but the Tawny Owl is an inhabitant of the surrounding forest. In the studies on the food of these owl species, carried out in Poland, no reptile remains were found (Kochan 1979). In Germany during 6 years of studies only 1 specimen of *Lacerta agilis* was found in the food of the Tawny Owl (Wendland 1963).

Among the observed galliform birds, only the Pheasant *(Phasianus colchicus)* sometimes eats small vertebrates, including lizards. It was noted that it consumed *Lacerta agilis* and *Eremias arguta* (Cramp 1982a). The pheasant is often met in the Odra River valley in the vicinity of Wroclaw.

Placing the Black-Headed Gull on the list of potential lizard predators may seem surprising. There are, however, reports from the former USSR, on the sporadic consumption of reptiles (including lizards) by that species (cf. Cramp 1984). In the region of studies, passing gulls of this species were rarely seen, only in the early spring,

when they forage especially actively on refuse heaps and fields. The Black-Headed Gull never stopped on the meadow; the species never takes prey in places with tall grassy vegetation.

Among Passeriformes the only numerous species in the adjacent forest are the Blackbird and Mavis. Both species only exceptionally consume lizards. There exists an exact description of an attack of the Mavis on *Zootoca vivipara,* concluded with consumption of the lizard's rejected tail (Chater 1965; Cramp 1988).

The Robin was regularly seen in the study area. Sporadically, it can consume lizards. After killing the reptile, the bird picks small bits and eats them (Cramp 1988; Heath 1988). Representatives of the family Laniidae – the Red-Backed Shrike and the Great Grey Shrike – were only rarely seen in the study area. In south-western Finland 47.5% of the Great Grey Shrike's food during the reproductive period consists of vertebrates, 26.7% of these being *Zootoca vivipara* (Grönlund et al. 1970; Cramp 1993). Among the Corvidae, the Jay, Raven, Hooded Crow and Magpie visited the meadow the most often. The Jay, actively hunting lizards, was observed in the study area. The birds looked for lizards in the region of the ditch that crosses the meadow from low branches of the birches on its margins. During the summer heat the lizards were especially numerous there. However, the attempts at catching lizards were mostly unsuccessful. The birds that succeeded escaped with their prey to the upper parts of trees. On the day when these observations were made, the birds repeatedly returned to that place. In the corvid food lizards are usually found in small quantities (Cramp 1994). In studies on the Raven in Turkmenistan, among the remnants of 66 vertebrates, 7 lizards: 1 Agama and 6 unidentified, were found (Dementev et al. 1953). In the Magpie food lizards may constitute several per cent (Eigelis 1964) of the diet.

Of mammals, the European hedgehog and shrews sometimes catch lizards (e.g. Serafiński 1956; Reeve 1994; Osenegg 1995).

The study area is penetrated by the Red Fox. Lizards are rarely found in the food of this species, and mainly in the population inhabiting southern Europe. The proportion of this food is low, reaching 0.4%, though locally it may be higher which to a large degree depends on lizard availability (Rzebik-Kowalska 1972; Goszczyński 1974; Ciampalini & Lovari 1985; Goszczyński 1986; Doncaster et al. 1990; Serafini & Lovari 1993).

The mustelids, though represented by several species, were observed only outside the meadow, from 300 m. (Weasel) to ca. 1 km (Stone Marten) away. No Badger tracks were found, but reliable information on its occurrence in the area was obtained. All the species mentioned consume lizards only occasionally, and in the studies on their stomach contents in Poland usually no lizards remains are found (Lockie 1961; Fruziński 1964; Goszczyński 1976; Ciampalini & Lovari 1985; Goszczyński 1986; Serafini & Lovari 1993, Sumiński & Goszczyński 1993). The proportion of reptiles in their food is low also in southern Europe. In Spain it was demonstrated that out of 66 vertebrates consumed by the Stone Marten 6 were lizards (Delibes 1978). In the diet of 4 Polecat in the former USSR the proportion of lizards was as high as 17% (Rzebik--Kowalska 1972).

Placing the Wild Boar on the list of potential predators needs discussion. Traces of the presence of this species were found on the meadow each year. The animals left their rooting traces mainly in the early spring, when they were probably looking for plant shoots and wintering insect larvae. It cannot be excluded, however, that they could devour lizards that wintered not very deep, especially considering that the Wild Boar also eats lizards, when an opportunity arises (Haber 1964; Günther & Völkl 1996).

Dogs were seen several times in the study area, and – more often – cats were observed. The latter especially may be persistent lizard hunters. The animals came most probably from the farms ca. 1 km away.

A full list of potential predators recorded from the studied meadow and within 1 km from it is presented in Table 2.

A considerable proportion of lizards with regenerated tails may testify to a high predation pressure. Similar results were obtained by Kornacker (1993) – 38.5% adult males and 51.9% adult females with regenerated tails.

The autotomy ability is probably the same in both sexes, though in males the tails are longer than in females. The length of the autonomous part remains similar in both sexes (Barbarillo et al.. 1995).

A higher number of females with regenerated tails may result from the fact that they are more vulnerable during pregnancy. This is especially important in viviparous species, in which all the embryonic development takes place in the female's body. This affects the female's behaviour, and thus the ability to successfully avoid danger created by predators (Bauwens & Thoen 1981; Damme et al. 1989).

Besides, some authors suggest that the higher proportion of individuals with regenerated tails in a population should not be associated with a higher predation pressure, but with a higher agility and efficiency of escape on the part of the lizards, or with a low efficiency on the part of predators. Where the predators are more efficient, all the attacked lizards should be killed and theoretically there should be no individuals with regenerated tails (Jaksić & Nunez 1979; Schoener 1979; Jaksić & Fuentez 1980; Jaksić & Greene 1984).

Damage to young is decidedly less frequent. This is probably because they are more often consumed whole than the adults. The mortality of the young in their first year may reach 90% (Avery 1975). Certainly, such a high mortality results not only from predation, but also from a lower survival of the young during their first winter, which is associated with the impossibility of accumulating adequate energy reserves (Avery 1970; Avery et al. 1974; Bauwens 1981). Adult lizards tolerate the winter decrease in temperature very well and their survival during hibernation is considerable (Bauwens 1981; Grenot 1994). The number of individuals with damaged toes should be regarded as low. Middelburg and Strijbosch (1988) report that out of 934 specimens of *Zootoca vivipara* collected during 4 years, as many as 8% had damaged toes.

Table 1: Proportion of individuals with regenerated tails and damaged toes

categories	% specimens with regenerated tails	% specimens with damaged toes
adult males	40.5	2.5
adult females	52	3.4
overwinters	15.3	0.8
young	5.1	0

Table 2: Vertebrates – potential predators of *Zootoca (Lacerta) vivipara* – recorded from the study area and its immediate vicinity.
++ – regularly observed, + – sporadically observed

SPECIES		OCCURRENCE
AMPHIBIA		
common European toad	*Bufo bufo*	++
common frog	*Rana temporaria*	++
field frog	*Rana arvalis*	++
REPTILIA		
slow-worm	*Anguis fragilis*	+
grass snake	*Natrix natrix*	++
AVES		
white stork	*Ciconia ciconia*	++
black stork	*Ciconia nigra*	++
goshawk	*Acipiter gentilis*	++
sparrowhawk	*Acipiter nisus*	+
buzzard	*Buteo buteo*	++
kestrel	*Falco tinnunculus*	++
tawny owl	*Sirix aluco*	++
long-eared owl	*Asio otus*	+
pheasant	*Phasianus colchicus*	++
black-headed gull	*Larus ridibundus*	+
blackbird	*Turdus merula*	++
mavis	*Turdus philomelos*	++
robin	*Erithacus rubecula*	++
red-backed shrike	*Lanius collurio*	+
great grey shrike	*Lanius excubitor*	+
raven	*Corvus corax*	++
hooded crow	*Corvus corone*	++
jackdaw	*Corvus monedula*	+
rook	*Corvus frugileus*	+
magpie	*Pica pica*	++
jay	*Garrulus glandarius*	++

MAMMALIA		
European hedgehog	*Erinaceus europaeus*	++
shrew	*Sorex sp.*	+
red fox	*Vulpes vulpes*	++
ermine	*Mustela erminea*	+
weasel	*Mustela nivalis*	+
polecat	*Mustela putorius*	+
pine marten	*Martes martes*	+
stone marten	*Martes foina*	+
badger	*Meles meles*	+
wild boar	*Sus serofa*	++
cat	*Felis sylvestris* f. catus	++
dog	*Canis lupus* f. familiaris	+

REFERENCES

Avery, R.A. (1970). Utilization of caudal fat by hibernating Common Lizards *Lacerta vivipara. Comp. Biochem. Physiol.* **37**, 119-121.

Avery, R.A. (1975). Age structure and longevity of common lizard *(Lacerta vivipara)* populations. *J. Zool.,* London **176**, 555-558.

Avery, R.A., Shewry, D.R. & Stobart, A.K. (1974). A comparison of lipids from the fat body and tail of the Common Lizard, *Lacerta vivipara. Brit. J. Herpetol.* **5**, 410-412.

Barbadillo, L.J., Bauwens, D., Barahona, F. & Sánchez-Herraiz, M.J. (1995). Sexual differences in caudal morphology and its relation to tail autotomy in lacertid lizards. *J. Zool.* **236**, 83-93.

Baruš, V. & Oliva, O. (1992a). *Obojživelnici-Amphibia.* Fauna CSFR, vol. 25. Praha: Academia.

Baruš, V. & Oliva, O. (1992b). *Plazi-Reptilia.* Fauna CSFR, vol. 26. Praha: Academia.

Bauer, A.M. (1990). Gekkonid lizards as prey of invertebrates and predators of vertebrates. *Herpetological Review* **21**, 83-87.

Bauwens, D. (1981). Survivorship during hibernation in the european common lizard *Lacerta vivipara. COPEIA* **3**, 741-744.

Bauwens, D. & Thoen, Ch. (1981). Escape tactics and vulnerability to predation associated with reproduction in the lizard *Lacerta vivipara. Journal of Animal Ecology* **50**, 733-743.

Blondheim, S. & Werner, Y.L. (1989). Lizard predation by the widow spiders *Latrodectus pallidus* and *L. revivensis (Theridiidae). British Herpetological Society Bulletin* **30**, 26-27.

Brown, F.C. (1957). Notes on Slow-worm. *Brit. J. Herpetol.* **2**, 95.

Castanet, J. (1994). Age Estimation and Longevity in Reptiles. *Gerontology* **40**, 174-192.

Chater, A.O. (1965). Song Thrush taking lizard. *British Birds* **58**, 501.

Ciampalini, B. & Lovari, S. (1985). Food habits and trophic niche overlap of the Badger *(Meles meles* L.) and the Red Fox *(Vulpes vulpes* L.) in a Mediterranean coastal area. *Z. Säugetierk* **50**, 226-234.

Cramp S. (1982a). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic,* Volume I: *Ostrich to Ducks.* Oxford: Oxford Univ. Press.

Cramp, S. (1982b). *Handbook of the Birds of Europe the Middle East and North AFrica. The Birds of the Western Palearctic*, Volume II; *Hawks to Bustards.* Oxford: Oxford Univ. Press.

Cramp, S. (1984). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic,* Volume III: *Waders to Gulls.* Oxford: Oxford Univ. Press.

Cramp, S. (1985). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*, Volume IV: *Terns to Woodpeckers.* Oxford: Oxford Univ. Press.

Cramp, S. (1988). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*, Volume V: *Tyrant Flycatchers to Thrushes.* Oxford: Oxford Univ. Press.

Cramp, S. (1993). *Handbook of thee Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*, Volume VII: *Flycatchers to Shrikes.* Oxford: Oxford Univ. Press.

Cramp, S. (1994). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*, volume VIII: *Crows to Finches.* Oxford: Oxford Univ. Press.

Czarnecki, Z. & Foksowicz, T. (1954). Observations on the composition of the food of Buzzard. *Ekologia Polska* **2**, 477-484.

Damme, R., Bauwens, D. & Verheyen R.F. (1989). Effect of Relative Clutch Mass on Sprint Speed in the Lizard *Lacerta vivipara. Journal of Herpetology*, **23**, 459-461.

Delibes, M. (1978). Feeding habits of the stone marten, *Martes foina* Erxleben, 1777 in northern Burgos, Spain. *Z. Säugetierk.* **43**, 282-288.

Dely, O. (1981). *Anguis fragilis* Linnaeus 1758 – Blindschleiche. - In *Handbuch der Reptilien und Amphibien Europas, Echsen* I, 241-258. Böhme W. (Eds). Wiesbaden: Aula.

Dementev, G.P., Kartaśev, N.N. & Soldatova, A.N. (1953). Die Ernährung und praktische Bedeutung einiger Raubvögel in Süd-West-Turkmenien.

Doncaster, C.P., Dickman, C.R. & Macdonald, D.W. (1990). Feeding ecology of red foxes *(Vulpes vulpes)* in the city of Oxford, England. *J. Mammal.* **71**, 188-194.

Dyrez, A., Grabiński, W., Stawarczyk, T. & Witkowski J. (1991). *Ptaki Śląska.* Wroclaw: Uniwersytet Wroclawski.

Eigelis, J.K. (1964). Feeding habits and economic importance of the magpie *(Pica pica* L.) in deciduous and pine stands of the steppe and forest-steppe of the european part of USSR. *Zool. Z. (Zoologiczeskij Zurnal)* **43**, 1517-1529.

Fruziński, B. (1964). Szkic monograficzny lownych gatunków z rodziny lasicowatych (Mustelidae). Czesc II, rodzaje: lasica *(Mustela)* i wydra (Lutra). Zachodini Poradnik Lowiecki **5**, 17-26.

Garzon Heydt, J. (1974). Contribution al Estudio del Status, Alimentacion y Proteccion de la Falconiformes en Espana Central. *Ardeola* **19**, 279-330.

Glandt, D. (1988). Populationsdynamik und Reproduktion experimentell angesiedelter Zauneidechsen *(Lacerta agilis)* und Waldeiechsen *(Lacerta vivipara).* In: Biologie und Schutz der Zauneidechse *(Lacerta agilis)*, 167-177. Glandt, D. & Bischoff, W. (Eds.). Bonn: *Mertensiella* 1.

Glutz von Blotzheim, U.N. (1971). *Handbuch der Vogel Mitteleuropas* 4. Frankfurt a. Main: Frankfurt Akad. Verlagsges.

Goszczyński, J. (1974). Studies on the food of foxes. *Acta theriol.* **19**, 1-18.

Goszczyński, J. (1976). Composition of the food of martens. *Acta theriol.***21**, 527-534.

Goszczyński, J. (1986). Diet of foxes and martens in Central Poland. *Acta theriol.* **31**.

Gramentz, D. (1995). Zur Mobilität und Antiprädationstrategie von *Lacerta agilis* LINNAEUS, 1758 (*Reptilia: Squamata: Lacertidae). Zool. Abh. Mus. Tierkd.* Dresden **48/16**, 279-292.

Grenot, C. (1994). The natural supercooling of the european lizard, *Lacerta vivipara*. V Symposium on Cold Hardiness in Animals and Plants – Arnhem, The Netherlands 1993. *Cryo-Letters* **15**, 12-13.

Grönlund, S.J., Itämies, J. & Mikkola, H. (1970). On the food and feeding habits of the great grey shrike *Lanius excubitor* in Finland. *Ornis fennica* **47**, 167-171.

Günther R., Völkl W. (1996). Waldeidechse – Lacerta vivipara. In *Die Amphibien und Reptilien Deutschlands*, 588-600. Günther, R. (Eds). Jena: Gustav Fischer Verlag.

Haber, A. (1969). *Dzik.* Warszawa: PWRiL.

Heath, P.J. (1988). Robin attacking common lizard. *British Birds* **81**, 238.

Heulin, B. (1985). Densité et organisation spatiale des populations du lézard vivipare *Lacerta vivipara* (Jacquin 1787) dans les landes de la région de Paimpont. *Bull. Ecol.* **16**, 177-186.

Jaksić, F., M. & Fuentes, E.R. (1980). Correlates of tail losses in twelve species of *Liolaemus* lizards. *J. Herp.* **14**, 137-141.

Jaksić, F., M. & Greene H.W. (1984). Empirical evidence of non-correlation between tail loss frequency and predation intensity in lizards. *Oikos* **42**, 407-411.

Jaksić, F., M. & Nunez H. (1979). Escaping behaviour and morphological correlates in two *Liolaemus* species of Central Chile *(Lacertilia: Iguanidae). Oecologia* (Berlin) **42**, 119-122.

Jehle, R., Franz, A., Kapfer, M., Schramm, H. & Tunner H.G. (1996). Lizards as prey of arthropods: Praying Mantis *Mantis religiosa* (LINNAEUS, 1758) feeds on juvenile Sand Lizard *Lacerta agilis* LINNAEUS, 1758. *Herpetozoa* **9**, 157-159.

Juszczyk, W. (1987). *Plazy i gady krajowe.* cześć II – *Amphibia.* Warszawa: PWN.

Kabisch, K. (1974). *Die Ringelnatter, Natrix natrix* (L.). Wittenberg-Lutherstadt: Ziemsen.

Kabisch, K. & Belter, H. (1968). Verzehen von Amphibien un Reptilien durch Vögel. *Zool. Abh. Mus. Tier, Dresden* **29**, 191-226.

Kochan, W. (1979). Materialy do skladu pokarmu ptaków drapieznych i sów. *Acta zool. Cracov.* **23**, 213-146.

Koenig, A. (1890). Ornithologische Forschungsergebnisse einer Reise nach Madeira und den cancarischen Inseln. *Journal für Ornithologie* **191-192(38)**, 257-488.

Kornacker, P.M. (1993). Populationsökologische Untersuchungen an einer Bahndamm-Population von *Lacerta vivivpara* im Rheinland. *Salamandra* **29**, 97-118.

Kratzer, H. (1974). Beobachtungen über den Nahrungserwerb bei der Milos-Ringelnatter *(Natrix natrix schweizeri). Salamandra* **10**, 49-54.

Lockie, J.D. (1961). The food of the pine marten *Martes martes* in West Ross-shire, Scotland. *Proc.Zool.Soc.Lond.* **136**, 187-195.

McCormick, S. & Polis, G.A. (1982). Arthropods that prey on vertebrates, *Biol.Rev.* **57**, 29-58.

Middelburg, J.J.M. & Strijbosch, H. (1988). The reliability of the toe-clipping method with the common lizard *(Lacerta vivipara). Herpetological Journal* **1**, 291-293.

Ortlieb, R. (1963). Über die Brutbiologie des Turmfalken. *Die Falke* **10**, 39-42.

Osenegg, K. (1995). Untersuchungen zum Spektrum der Freßfeinde der Waldeidechse, *Lacerta vivipara* im Südwesten Frankreichs. *Die Eidechse* **6/14**, 6-16.

Petzold, H.-G. (1995). *Blindschleiche und Scheltopusik. Die Familie Anguidae.* Westarp Wissenschaften, Magdeburg.

Piechocki, R. (1952). Beobachtungen zur Brutbiologie des Turmfalken *(Falco tinnunculus* L.). *Orn. Mitt.* **4**, 25-33.

Pilorge, T. & Castanet, J. (1981). Détermination de l'âge dans une population naturelle du lézard vivipare *(Lacerta vivipara,* Jacquin 1758). *Acta Oecol. Gen.* **2**, 3-16.

Pisarenko, S.S. & Ušakov, V.A. (1985). Rasprostranennost i formy kanibalizma u bezchvostnych. *Voprosy gerpetologii,* Leningrad **6**, 165-166.

Radek, G. (1964). Zur Ernährung der Blindschleiche. *Aquarien Terrarien Zeitschrift.* Stuttgart, **17**, 317-318.
Reeve, N. (1994). *Hedgehogs.* London: T. & A.D. Poyser.
Rzebik-Kowalska, B. (1972). Badania nad pokarmem ssaków drapieznych. *Acta zool.Cracov.* **17**, 416-504.
Schoener, T.W. (1979). Inferring the properties of predation and other injury-producing agents from injury frequencies. *Ecology* **60**, 1110-1115.
Schwammer, H. & Baurecht, D. (1988). Der Karstläufer, *Podarcis melisellensis fiumana* (Werner, 1891), als Beute der Europäischen Schwarzen Witwe, *Latrodectus mactans tredecimguttatus* (Rossi, 1970). *Herpetozoa* **1**, 73-76.
Serafini P. & Lovari S. (1993). Food habits and trophic niche overlap of the red fox and the stone marten in a Mediterranean rural area. *Acta theriol.* **18**, 233-244.
Serafiński, W. (1956). *Jeze.* Warszawa: PWN.
Strijbosch, H. & Creemers, R.C.M. (1988). Comparative demography of sympatric populations of *Lacerta vivipara* and *Lacerta agilis. Oecologia* **76**, 20-26.
Sumiński, P., Goszczyński, J. & Romanowski, J. (1993). *Ssaki drapiezne Europy.* Warszawa: PWRiL.
Szczepankiewicz, S. (1972). Nizina Ślaska, In *Geomorfologia Polski,* 224-239, t. 2.
Szczepankiewicz, S. (1989). Ziemie poludniowo-zachodniej Polski – morfogeneza i dzieje czwartorzedowe. *Studia Geograficzne* **48**, *Acta Universitatis Wratislaviensis* No 1029, Wroclaw.
Szijj, J. (1956/7). Adatok A Fehérgolya *(Ciconia c. ciconia* L.) Táplálkozábiológiájához. *Aquila* **9/62**, 83-94.
Truskowski, J. (1976). Role of the Common Buzzard *(Buteo Buteo* L.) in Agrocenosis of the Middle Wielkopolska. *Polish Ecological Studies* **2**, 101-108.
Walczak, W. (1970). *Obszar przedsudecki.* Warszawa: PWN.
Wendland, V. (1963). Fúnfjáhrige Beobachtungen an einer Population des Waldkauzes *(Strix aluco)* im Berliner Grunewald. *Journal für Ornithologie* **104**, 46-50.

EVIDENCE OF TERRESTRIAL FEEDING IN THE 'ARBOREAL' LIZARD *ENYALIUS BILINEATUS* OF EASTERN BRAZIL

CLAUDIO ZAMPROGNO[1,2], MARIA DAS GRAÇAS F. ZAMPROGNO[1], AND MARK WILKINSON[3]

[1]*Departamento de Biologia, Universidade Federal do Esp'rito Santo, 29040-090 Vitória, Esp'rito Santo, Brazil*
[2]*Deceased*
[3]*School of Biological Sciences, University of Bristol, Bristol BS8 1UG, UK and Department of Zoology, Natural History Museum, London SW7 5BD*

Enyalius bilineatus is a poorly-known polychrotid lizard of the Atlantic rain forest of eastern Brazil (Peters & Donoso-Barros 1970). Very little information is available concerning the ecology and natural history of this species. It has been asserted that members of the genus *Enyalius* are arboreal (Etheridge, 1969). However, Vanzolini (1972) presented evidence from analysis of gut contents of 42 specimens that *E. catenatus* spends much time foraging on the ground, Sazima & Haddad (1992) observed *E. iheringii* both in leaf litter and on tree trunks, and Vitt, Avila-Pires & Zani (1996) reported that *E. leechi* roosts in trees but is also found on the forests floor during the day. In addition, Jackson (1978:35) described *Enyalius* as "a ground-feeder preying on arthropods", but presented no evidence in support of this view. Vanzolini (1972) also reported gut contents of two specimens of *E. bilineatus* but drew no conclusions from this small sample. To our knowledge, Vanzolini's (1972) report is the only published dietary information for *E. bilineatus*. Here we report on the diet of *E. bilineatus*, based on analysis of the gut contents of 48 specimens, and present some observations on habitat use.

Lizards were caught by plantation workers in the remnants of hilly Atlantic rainforest near S'tio Três Marias, municipality of Marechal Floriano, State of Esp'rito Santo, eastern Brazil (ca. 20°24'S, 40°49'W; 600-700 m elevation), from February 1995 to September 1996. In the study area, the climate is seasonal with well defined dry/cold (June-September) and rainy/warm (October-March) seasons (Féboli, 1993). All lizards were killed upon capture, fixed in 10% formalin, and preserved in 70% alcohol. Snout-vent length was recorded from preserved specimens. Stomach contents were removed and prey items were identified to order and counted. Diet composition is described in terms of total numbers of food items and total numbers of stomachs containing particular food types. Length and width of intact and nearly intact prey items were measured with callipers. Incomplete (partly digested) prey was excluded from analyses of prey size. Voucher specimens are deposited in the Coleção Zoológica da Universidade Federal do Esp'rito Santo (ZUFES) and Museu de Zoologia da Universidade de São Paulo (MZUSP).

Of the 48 lizards examined (SVL = 57.9 - 85.0 mm; mean = 72.1; sd = 0.74) only 3 had empty stomachs. A total of 98 prey items representing 9 arthropod orders were identified

(Table 1). Orthoptera represented the most important food item in terms of both total numbers of stomachs, followed by Hymenoptera and Dictyoptera. Coleoptera, Lepidoptera (larvae), Araneae, Diplopoda, Hemiptera, and Homoptera constituted the remainder of the food items. Vanzolini (1972) reported Homoptera in one and Hymenoptera, Dictyoptera, Orthoptera and lizard skin in the other of his two specimens of *E. bilineatus*. The skin was presumably the lizard's own.

The number of prey items per stomach ranged from 1 to 8 (mean - 2.1; sd = 1.5). The length of complete prey (n=54) ranged from 2.0 to 28.2 mm (mean = 9.6; sd = 5.9), and the width ranged from 1.0 to 8.0 mm (mean = 3.5; sd = 1.7). Correlation between the number of prey, length and width of prey, and snout-vent length (SVL) of *E. bilineatus* was not significant (Pearson correlation test; $P > 0.05$).

Stomach content analysis shows that *E. bilineatus* utilises a broad range of arthropod prey types and sizes, and can be considered an arthropod generalist. The diet of lizards can be related to the type of microhabitat, activity time, and foraging strategy (Vrcibradic & Rocha, 1996), and a generalist diet may be related to a sit-and-wait foraging strategy (*sensu* Pianka, 1973), which is the strategy of polychrotid lizards (Vitt, Zani & Durtsche, 1995; Vitt & Zani, 1996). The observations of Sazima & Haddad (1992) on *E. iheringii* are consistent with its use of a sit-and-wait strategy.

Polychrotid lizards are considered a primarily arboreal group, although some species are terrestrial (see Martins, 1991; Duellman, 1987; and Vitt *et al.* 1995 for examples). Most of the prey items found in *E. bilineatus* are considered common inhabitants of leaf litter in neotropical rainforests, and constitute important food resources for small, terrestrial anurans and lizards (Vitt & Caldwell, 1994)). Similar items in the diet of *E. catenatus* (Dictyoptera, coleoptera larvae, Orthoptera, Diplopoda, Chilopoda, Phalangida and Oligochaeta) led Vanzolini (1982) to conclude that this species engaged in terrestrial foraging. Some of the items found in *E. bilineatus* could equally have been obtained through terrestrial or arboreal foraging, but the presence of Diplopoda, which are not generally found on tree trunks provides particularly strong evidence that *E. bilineatus* forages in leaf litter on the ground. In addition, two stomachs contained dry leaf fragments, probably ingested along with arthropod prey on the forest floor.

We observed *E. bilineatus* both on tree trunks and on the ground within the study area but did not observe feeding. The forest floor consists of a layer of leaf litter over decayed humus on clay. The colour of *E. bilineatus* (see Etheridge, 1969 for detailed excellent camouflage (Plate 1). Its stationary sit-and-wait foraging strategy may also protect this lizard against visually oriented predators.

The limited data indicate that species of *Enyalius* exploit both terrestrial (leaf litter) and arboreal habitats and are not strictly arboreal. Indeed, while these data indicate that *Enyalius* species feed in leaf litter there is no clear evidence of feeding in arboreal habitats. It is possible that *Enyalius* species feed in both terrestrial and arboreal habitats and that the diversity of feeding opportunities the two habitats provide partly explains their use of both habitats. Alternatively, arboreal habitats may be used primarily for roosting and for avoiding predators. More data are needed to distinguish between these alternatives. If polychrotid lizards are ancestrally arboreal then there would appear to have been a shift in habitat use in the evolution of *Enyalius*. However, too little is known about the natural history, ecology, and phylogenetic relationships of polychrotid lizards other than anolines to allow firm conclusions on the direction of the shift in habitat use or its specificity to *Enyalius*.

Plate 1: Adult male *Enyalius bilineatus*, showing its cryptic coloration against a typical background of forest floor

Table 1: Summary of the diet of 48 *Enyalius bilineatus* of eastern Brazil

Prey type	Percentage of stomachs	Percentage of items
Empty	6.25	–
Araneae	15.55	9.18
Coleoptera	20.00	11.22
Dictyoptera	24.44	13.26
Diplopoda	13.33	9.18
Hemiptera	13.33	6.12
Homoptera	2.22	1.02
Hymenoptera	24.44	17.34
Lepidoptera	17.88	8.16
Orthoptera	46.66	24.49

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REFERENCES

Duellman, W.E. (1987). Lizards in an Amazonian rain forest community: resource utilization and abundance. *Natl. Geogr. Res.* **3**, 489-500.

Etheridge, R. (1969). A review of the iguanid lizard genus *Enyalius*. *Bull. British Mus. (Nat. Hist.) Zool.* **19**, 233-260.

Féboli, W.L. (1993). *Programa levantamentos geológicos básicos do Brasil. Domingos Martins, Folha SF.24-V-A-III. Estado do Esp'rito Santo.* Bras'lia: DNPM/CPRM.

Jackson, J.F. (1978). Differentiation in the genera *Enyalius* and *Strobilurus* (Iguanidae): implications for pleistocene climate changes in Eastern Brazil. *Arq. Zool. S. Paulo* **30**, 1-79.

Martins, M. (1991). The lizards of Balbina, Central Amazonia, Brazil: a qualitative analysis of resource utilization. *Stud. Neotrop. Fauan Environ.* **26**, 179-190.

Peters, J.A. & Donoso-Barros, R. (1970). Catalogue of th Neotropical Squamata Part II. Lizards and Amphisbaenians. *Bull. U.S. Natl. Mus.* **297**, 1-293.

Pianka, E.R. (1973). The structure of lizard communities. *Ann. Rev. Ecol. Syst.* **4**, 53-74.

Sazima, I. & Haddad, C.F.B. (1992). Répeis da Serra do Japi: notas sobre história natural. In *História natural da Serra do Japi: ecologia e preservação de uma área florestal no Sudeste do Brasil,* 212-236. Morellato, L.P.C. (Org.). Campinas: Editora da Unicamp.

Vanzolini, P.E. (1972). Miscellaneous notes on the ecology of some Brazilian lizards (Sauria). *Papéis Avulsos Zool., S. Paulo* **26**, 83-115.

Vitt, L.J. & Caldwell, J.P. (1994). Resource utilization and structure of small vertebrates in the Amazon forest leaf litter. *J. Zool., Lond.* **234**, 463-476.

Vitt, L.J. & Zani, P.A. (1996). Ecology of the South American lizard *Norops chrysolepis* (Polychrotidae). *Copeia* **1996**, 56-68.

Vitt, L.J., Avila-Pires, T.C.S. & Zani, P.A. (1996). Observations on the ecology of the rare Amazonian lizard, *Enyalius leechii* (Polychrotidae). *Herpetol. Nat. Hist.* **4**, 77-82.

Vitt, L.J., Zani, P.A. & Durtsche, R.D. (1995)). Ecology of the lizard *Norops oxylophus* (Polychrotidae) in lowland forest of southeastern Nicaragua. *Can. J. Zool.* **73**, 1918-1927.

Vrcibradic, D. & Rocha, C.F.D. (1996). Ecological differences in tropical sympatric skinks *(Mabuya macrorhyncha* and *Mabuya agilis)* in southeastern Brazil. *J. Herpetol.* **30**, 60-67.

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NOTES ON SOME SEYCHELLES REPTILES

J. GERLACH

53 River Lane, Cambridge CB5 8HP, UK.

INTRODUCTION

The Seychelles islands comprise some 140 islands (including rocks and sand cays). Reptiles are found throughout the group but are most diverse in the northern, granitic islands. In these 23 reptile species have been recorded, of which 15 are endemic species and 2 endemic sub-species.

The reptile fauna of the Seychelles islands is relatively well known in terms of basic taxonomy. The majority of species were described or identified by the 1950s with only two full species being described since then (the tortoise *Dipsochelys arnoldi* (Bour 1982) and the gecko *Ailuronyx tachyscopaeus* (Gerlach & Canning 1996)). Very few species have been studied in any detail and there is very little published information on the ecology of most taxa. This account summarises some recent observations on the distribution, behaviour and diet of some species of Seychelles reptiles and reports on the first confirmed sighting of a Yellow-Bellied Sea Snake in Seychelles waters.

Gekkonidae

Urocotyledon inexpectata Seychelles Sucker-Tailed Gecko (Plate 1).

Two Seychelles Sucker Tailed Geckos (male and female) were found in a house at Le Niol, Mahé in January 1995. These were kept in a vivarium for 12 days (9/1/95-21/1/95). Prior to capture they were observed for a week. The female was in constant residence in a crack between a piece of wood and a wall. The male was seen only on 3 days and appeared to move between at least two sites. The female measured 39mm snout-vent length, with a tail of 45mm; the male 37mm snout-vent, tail 47mm. Hemipenial bulges were visible on the male but no enlarged femoro-anal pores.

The sucker on the tail of *Urocotyledon* is known to be important to the genus as indicated by the regeneration of the sucker recorded in other species (Klugee 1983). A male *U. inexpectatus* was found in a nearby wood-shed with a fully regenerated tail, including a functional sucker. During locomotion the tail sucker is used constantly, being moved and pressed against the substrate after each leg movement cycle. This produces a characteristic tail mark on glass surfaces – a sucker trail of contiguous circles (diameter 0.75mm).

Throughout the period of observation both prior to and including the 12 days in captivity activity was not observed before dusk (18:15-18:55). The captive geckos consumed an average of 1.86±1.06 food items per day. During a single feeding observation the female spotted a 5.5mm long cricket *(Zarceus fallaciosus)* on the ground 20cm away. She jumped onto the ground and approached to 15cm, stopped, coiled to spring and watched the cricket for 95 seconds. She then approached another 1cm, coiled again and then jumped the intervening 14cm, knocking the cricket 1cm away. The cricket was stunned and remained immobile. The gecko licked her mouth, turned her head towards the cricket

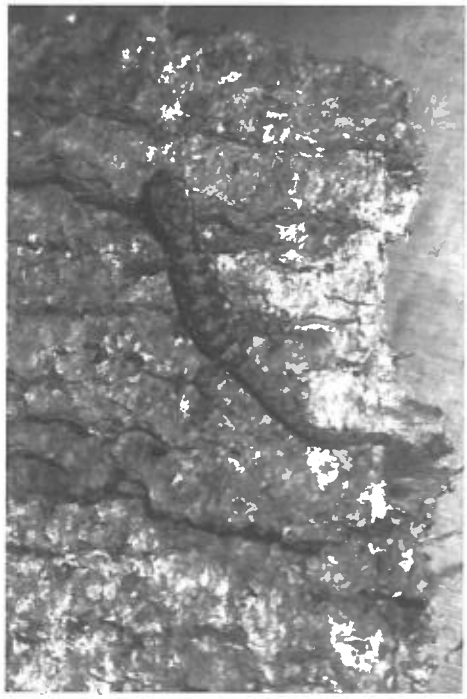

Plate 1. Seychelles Sucker-Tailed Gecko *(Urocotyledon inexpectata)*

Plate 2. Burrowing Skink *(Pamelascincus gardineri)*

Plate 3. Aldabran Giant Tortoise *(Dipsochelys dussumieri)*

Plate 4. Seychelles Giant Tortoise *(Dipsochelys hololissa)*

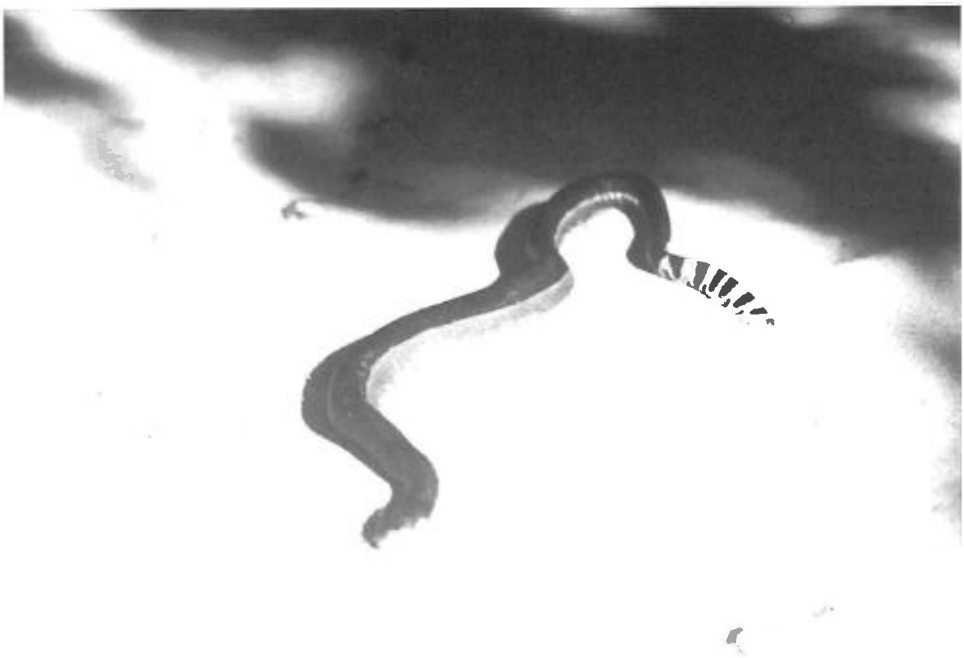

Plate 5. Yellow-Bellied Sea Snake *(Pelamis platurus)*. Photo by A. Skerrett

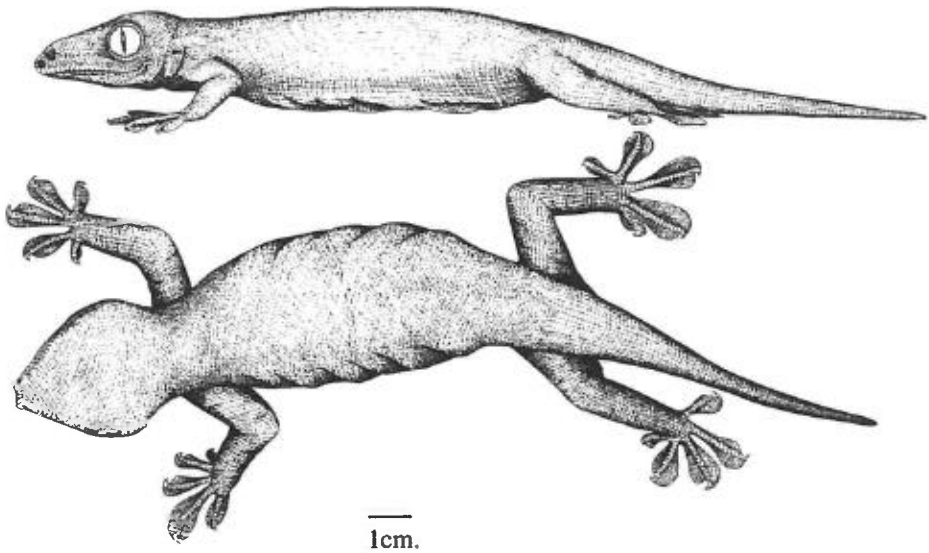

Fig. 1. Drawing of the giant bronze gecko *(Ailuronyx* cf. *trachygaster)*;

and ate it. She was very nervous on the ground and returned to a piece of bark straight away.

During the 12 days of captive observations a single courtship attempt was observed. At 18:35 the male and female were both active, 15cm apart. The male was on the ground and the female on a vertical piece of bark. The female was facing the male who was turned sideway, both were stationary. The male lifted his tail until its full length was held at an angle of 45° to the ground, exposing the bright yellow underside. He then slowly waved the last 2/3 of the tail from side to side. The female jumped at the male aggressively, ending the display. From this observation it would appear that the bright yellow colour on the underside of the male (the female's underside was grey) is associated with sexual selection and ritualistic display.

Ailuronyx spp. Bronze Gecko
Two species of *Ailuronyx* have been identified in the Seychelles; the large (81-116cm SV) *A. seychellensis* and the dwarf (56-84cm SV) species *A. tachyscopaeus* (Gerlach & Canning 1994). There have been reports of a giant form (Henkel & Zobel 1987) in the Vallee de Mai on Praslin. This form is regularly seen in the Vallee de Mai and Fond Ferdinand areas (J. Gemma pers. comm, to R. Gerlach). I have also seen it on two occasions. Both times it was on the leaves of the Coco-de-mer Palm *(Lodoicea maldivica)* some 7m above the ground and impossible to capture. It is an exceptionally large gecko and estimates derived from photographs suggest a snout-vent length of 26cm. A drawing of this animal is provided in Fig. 1. based on the available poor quality photographs and video footage and my field sketches. The large size, broad, wedge-shaped head, depression between the nostrils, disproportionately large feet and short tail all resemble the supposedly Madagascan *A. trachygaster. A. trachygaster* is known from a single 19th century specimen and it has been suggested previously that this may be a mis-labelled Seychelles species (Volobouev & Ineich 1994). Until a specimen can be caught this cannot be confirmed and all that can be said at present is that there is a 'giant' *Ailuronyx* on Praslin which closely resembles *A. trachygaster.*

During searches for the 'giant' *Ailuronyx* brief surveys of *Ailuronyx* abundance have been made in the Vallee de Mai. These are summarised in Table 2. These provide only minimum estimates of density but are reasonably consistent. More *A. tachyscopaeus* are recorded than *A. seychellensis* (at least 33% more). This is probably a result of geckos in lower vegetation being easier to find than those in the canopy and larger geckos excluding small ones from the favoured canopy sites. Consequently the *A. seychellenis* and the giant *Ailuronyx* are probably significantly under-represented in these transects.

Observations of activity on Aride island in January 1997 found *A. seychellensis* to be active only after dusk (18:15). The diet of this population was studied by dissection of faecal pellets (Table 3); cockroaches (Dictyoptera) and moths (Lepidoptera) make up most of the items consumed with large geckos eating more of the large cockroaches and smaller geckos eating more of the smaller prey items. The single ant consumed was of the large (10mm), aggressive species *Odontomachus troglodytes.*

Scincidae
Mabuya skinks
Activity patterns in the large skink of sea-bird colonies, *M. wrightii* (Wrights Skink), on Aride island were recorded in January 1997. This diurnal species was active until 18:25, 10 minutes after dusk. Similar patterns were observed for the smaller *M. seychellensis.* Single pairs of both species were found exhibiting mate guarding. For both species this occurred on the trunk of fallen coconut trees. In both cases the male was resting on the

back half of the female although mating was not occurring at the time. This behaviour started at some undetermined time in the late afternoon and continued until after dusk. The *M. seychellensis* pair separated at 18:30 when both individuals hid in leaf litter. The *M. wrightii* pair were found in this position at dusk (18:15) and remained motionless, in a very exposed position until 19:15 when they were disturbed. The skink population density on Aride is exceptionally high and the consequent likelihood of disturbance during mating may make mate guarding advantageous in this situation, despite the potential dangers of remaining exposed after dark.

The diets of *Mabuya* were investigated on Aride very briefly in January 1997. Of two faecal pellets of *M. seychellensis*, beetle remains were found in two and an ant *(Pheidole* sp.) in one. A single *M. wrightii* pellet contained two small beetles (5mm long) and scales identifiable as those of *M. seychellensis.* Large *M. wrightii* are often seen chasing smaller skinks (usually *M. seychellensis)* and this indication of predation on the smaller species is interesting. It is impossible to say whether this is evidence of predation or of carrion feeding although cannibalism in *M. seychellensis* has been seen elsewhere (pers. obs.). It is notable to note that both species consume large quantities of carrion in the sea-bird breeding season when skinks are often seen fighting over bird carcasses. This behaviour may mean that carrion eating skinks may be carriers of the bacterium *Erysipelothrix rhusiopathiae* which has been implicated in the deaths of skink predating birds on Aride in recent years. Paralysed and dead *M. wrightii* are frequently found on Aride (Betts pers. comm. and pers. obs.) although bodies of the smaller *M. seychellensis* are never encountered. This could be due to small immobilised skinks being easy prey to the larger species.

Pamelascincus gardineri
This burrowing skink occurs on several islands, from sea-level to high forest. Although there are no published records of the species from Cerf island an adult was found at the edge of the marsh on the island in January 1996. Unquantified observations indicate that the largest population is found on Silhouette island. A single individual (snout vent length 72mm, tail 54mm, weight 14g) was captured on Silhouette in January 1998 and observed for 4 days. During that time only diurnal activity was noted, the skink was seen to spend equal lengths of time foraging on the surface (Plate 2) and under leaf litter. It was fed crickets, house flies *(Musca* sp.), moths and a burrowing cockroach *(Pycnoscelus surinamensis)* but only the latter was eaten. Fresh faecal pellets contained beetle elytra. As beetles are abundant in the leaf litter on Silhouette and the single item eaten in captivity was a burrowing cockroach it is probable that this species feeds exclusively on arthropods inhabiting leaf litter.

Testudinidae
Dipsochelys Giant tortoises
Recent taxonomic work on the giant tortoises of the western Indian Ocean has established that three distinct living species can be recognised (Gerlach & Canning 1998). The majority of tortoises in Seychelles are the Aldabran *Dipsochelys dussumieri* (often called *Geochelone gigantea* or *D. elephantina*). Some 120,000 of these survive in the wild on Aldabra and there are also introduced populations on other islands, such as Fregate and Curieuse. This is a grazing species and, as with most tortoises of open grasslands, has a regularly domed shell (Plate 3). The recently rediscovered species include *D. hololissa* which originates from the high, forested islands. Although a grazing species it has a slightly flattened, broad shell which characterises tortoises from forests or scrubby habitats where some degree of streamlining is advantageous (Plate 4). This species is restricted to 8 known individuals in Seychelles and 2 elsewhere. The other rediscovered species is *D. arnoldi*, a saddle-backed species (see front cover).

The unmistakable shape of this species, with its long, flat shell and high shell opening, is characteristic of a browsing species. As with *D. hololissa* it barely clings to survival with 18 individuals identified to date (only 3 of these female).

Elapidae

Pelamis platurus Yellow-Bellied Sea Snake

Yellow-Bellied Sea Snakes have not been recorded in Seychelles waters although they are occasionally recorded in southern Africa. In January 1998 a snake was washed onto a beach on Mahé (Plate 5); this excited the interest of naturalists, divers and the Seychelles media and was extensively photographed and filmed. It was defined as a Yellow-Bellied Sea Snake and is the first unequivocal record for that species in Seychelles waters. Earlier the same month passengers on a cruise ship had observed a snake near Poivre island; this was not photographed but was described as having a yellow underside and may refer to the same species (G. Gerlach pers. comm.).

Table 1: Diet of captive *Urocotyledon inexpectata*

	Lepidoptera				**Diptera***	**Orthoptera**	**Homoptera**			**Trichoptera**	**Opiliones**
									all		
Size (mm)	<2	2-5	>5	all	<6	8	<5	>5	5-8	5	6
Eaten	6	4	10	20	4	3	2	0	2	0	0
Rejected	0	0	1	1	0	0	0	1	1	2	1
% eaten	100	100	91	95	100	100	100	0	67	0	0

* Diptera included the families Drosophilidae, Tipulidae, Chironomidae, Micropexidae

Table 2: Number of *Ailuronyx* seen on 6m wide transects with numbers per hectare in parentheses

Date	**Transect length (km)**	***seychellensis***	***tachyscopaeus***	**'giant'**	***A.* sp.?**	**Total**
26/6/1996	1.5	3 (3.3)	4 (4.2)	1 (1.6)	2 (2.2)	10 (11.2)
10/1/1997	3	6 (3.3)	9 (5)	1 (0.5)	–	16 (8.8)
11/1/1997	3	5 (2.8)	14 (7.8)	–	–	19 (10.5)

Table 3: Diet of *Ailuronyx seychellensis* on Aride (January 1997) – numbers of pellets containing each prey item

Prey	Large *Ailuronyx* (n=6)	Small *Ailuronyx* (n=15)	Total (n=21)
Dictyoptera	4	2	6
Coleoptera	1	3	4
Orthoptera	1	3	4
Formicidiae	1	0	1
Arachnida	1	0	1
Lepidoptera	0	8	8
Hymenoptera	0	1	1

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REFERENCES

Bour, R. (1982). Contribution á la connaissance des Tortues terrestres des Seychelles: définiton du genre endémique et description d'une esp´éce nouvelle probablement originaire des îles granitiques et au bord de l'extinction. *C.r. hebd. Séanc. Acad. Sc., Paris* **295**; 117-122.

Gerlach, J. & Canning, K.L. (1996). A new species of the western Indian Ocean gecko *Ailuronyx* (Reptilia; gekkonidae). *Herpetol. J.* **6**; 37-42.

Gerlach, J. & Canning, L. (1998) (in press). Taxonomy of the Indian Ocean giant tortoises *(Dipsochelys). Chelonian Conservation & Biology.*

Henkel, F.-W. & Zobel, R. (1987). Zur Kenntnis des Bronzegeckos, *Ailuronyx seychellensis* (Duméril & Bibron, 1836). *Herpetofauna* **9**(51); 12-14.

Kluge, A.G. (1983). Cladistc relationships amongst Gekkonkid lizards. *Copeia* (**1983**); 465-475.

Volobouev, V. & Ineich, I. (1994). A chromosome bandking study of *Ailuronyx seychellensis* (Reptilia, Gekkonidae) and its phylogenetic affinities. *J. Herpet.* **28**; 267-270.

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0171-938 9123

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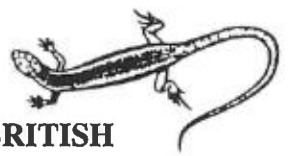

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Editorial Note and Correction

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