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# THE BRITISH HERPETOLOGICAL SOCIETY

# BULLETIN

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## THE BRITISH HERPETOLOGICAL SOCIETY

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

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

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

The Education Committee promotes all aspects of the Society through the media, schools, lectures, field trips and displays. It also runs the junior section of the Society - THE YOUNG HERPETOLOGISTS CLUB (YHC). YHC Members receive their own newsletter.

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

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

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

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

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Correspondence, Membership applications, subscription renewals and purchase orders for publications should be addressed to the Secretary (address as at page top) PLEASE INCLUDE A STAMP-ADDRESSED ENVELOPE WHEN WRITING TO THE SOCIETY.

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

The Bulletin is edited and produced by
**John Pickett and John Spence.**
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John Spence, 23 Chase Side Avenue, Enfield, Middlesex EN2 6JN

**FRONT COVER**
*Cynops ensicauda popei*,. originating from Zamami-jima, Japan. Male (right) displaying to female.
See: Maintenance and breeding of newts of the genus *Cynops*, by Max Sparreboom, p.3.

# BHS CONSERVATION MEETING, JUNE 1998

The Conservation Committee is organising a meeting on Sunday June 28th, at the University of Sussex, **to which all BHS members are invited**. The morning session will run from 11 a.m. to 1 p.m., and include short talks by Conservation Committee members on their work over the past year. Tea/coffee and biscuits will be provided, and there will be time for informal discussions and a general chat.

There is a local pub which provides snack meals for anyone wishing to stay after 1 p.m., and there will therefore be opportunities for further chinwags over lunch. The Conservation Committee has a formal business meeting between 2-4 p.m., in the course of which next year's Committee and Support Group will be elected. Any members with a strong interest in conservation, and who might like to become associated with either of the above, are encouraged to attend as observers.

Finally, at 4 p.m. there will be a field trip (weather permitting) to the nearby Castle Hill National Nature Reserve. This is situated on the South Downs and has been the beneficiary of a grant from the BHS Land Fund for the installation of a new dewpond for Great Crested Newts. The round trip (mostly walking) is likely to take about an hour.

So all BHS members are welcome; the University is situated about halfway between Brighton and Lewes, and is easily reached by rail or road. The meeting will be in the Terrace Room, on the third floor of the Refectory building. Anyone requiring further details can contact me:

- by telephone at home, 01273 305634 (evenings/weekends)
- by telephone at work, 01273 606755 extension 2690
- by email: t.j.c.beebee@sussex.ac.uk
- by post: 434 Falmer Rd, Woodingdean, Brighton BN2 6LG.

Do come!

Trevor Beebee

## A REQUEST – SERUM SAMPLES FROM REPTILES

Professor Patricia Nuttall, Director of the Institute of Virology & Environmental Microbiology is anxious to obtain serum samples from reptiles, especially lizards, for her studies in Lyme disease – an important infection in both humans and animals. She has asked me to publicise this amongst veterinary and herpetologist colleagues.

At least 50 microlitres of serum are needed. EDTA must not be used. The samples should be sent on ice by DHL or other carrier. Any reasonable expenses incurred in providing sera will be reimbursed.

If you wish to help and need further information please contact Professor Nuttall direct at the Institute of Virology & Environmental Microbiology, Mansfield Road, Oxford, OX1 3SR, UK (phone (44)(0) 1865 281 636, fax 281696, e-mail pan@mailnec-oxford.ac.uk.

JOHN E. COOPER

## FROM THE EDITORS

### APPEAL FOR ARTICLES

The editors of the Bulletin are anxious to receive articles and notes on all aspects of captive husbandry of reptiles and amphibians. We are also seeking papers, field notes, or letters on the natural history and conservation of British reptiles and amphibians.

Members who have such papers or notes to submit are invited to discuss with the editors any help they need in preparing their papers for publications. Preparation need not be elaborate. Hand written items are quite acceptable.

In the first place, contact John Spence at the address or telephone number shown at the back of this issue.

# MAINTENANCE AND BREEDING OF NEWTS OF THE GENUS *CYNOPS*

MAX SPARREBOOM

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## INTRODUCTION

Newts of the genus *Cynops* are distributed in East Asia. Presently seven species are recognised: *C. chenggongensis, C. cyanurus* and *C. wolterstorffi* occur at higher altitudes in the Chinese province of Yunnan; *C. orientalis* occurs in East-central China; *C. orphicus* has been widely described from the Chinese province of Guangdong (Zhao & Adler, 1993). *C. pyrrhogaster* is widely distributed in Japan on the islands Hondo, Shikoku and Kyushu; *C. ensicauda* is found exclusively on the Japanese Ryukyu islands (Thorn, 1968).

These newts have been the subject of study for a number of years: I have studied the sexual behaviour of *C. ensicauda* and *C. orientalis* by staging encounters of males and females in controllable tanks (Sparreboom, 1994; 1996; Sparreboom & Faria, 1997) and by observing *C. ensicauda popei* in the natural habitat (Sparreboom & Ota, 1995). Most animals used for these scientific observations are still in good health (January 1998), showing reproductive behaviour and laying fertilised eggs. They do not only make good subjects for study but are also attractive and hardy animals in our aquariums. Some species of *Cynops* are occasionally imported to Europe through the pet trade. *C. pyrrhogaster* was commonly seen on the markets in the nineteen seventies, *C. ensicauda* in the eighties and *C. orientalis* in the eighties and nineties. There is a substantial body of literature, much of it in German and Dutch, about their maintenance and breeding in indoor aquariums (for instance Gerlach, 1933, 1934; Sparreboom, 1982; Van Leeuwen, 1984; Van Leeuwen & Muddle, 1984; Zaremba, 1993; for further references, see Sparreboom, 1994).

The present paper reports my own experience in breeding the species *C. pyrrhogaster, C. orientalis, C. cyanurus* and *C. ensicauda,* from 1975 onwards. For part of this period, especially since 1989, I kept a diary of events such as onset of courtship, breeding, diseases and deaths, and growth of juveniles. There is not one exclusive method to obtain breeding success, and I do not claim that my way of keeping the animals is better than that of others. My main purpose has been to observe the behaviour of the animals. Consequently I have given visibility of the animals a higher priority than rearing the greatest possible number of offspring. I have paid much individual attention to each of my over 70 animals, taking care to offer them sufficient space, hiding places and a variable diet. I do not have exact data of the numbers of juveniles which I raised successfully and passed on to others, nor can I offer a fool-proof recipe for captive breeding.

## GENERAL REQUIREMENTS

*Cynops* species are basically pond breeders, although they may occasionally also be found in slowly running water. Their life history and reproduction, or what is known of it, resembles that of European species of *Triturus* in various respects: both sexes come to

Plate 1: *Cynops pyrrhogaster sasayamae,* originating from the surroundings of Kyoto, Japan. Male (right), displaying to female.

Plate 2: *Cynops orientalis,* unknown collection locality (China). Female laying an egg, in upside down position.

Plate 3: *Cynops cyanurus,* unknown collecting locality (China).
Close-up of female, showing distinctive orange patch on cheek.

Plate 4: *Cynops ensicauda,* originating from Amami-oshima, Japan.
Male, left, depositing a spermatophore in front of the female.

the pond for breeding and may stay in the water well beyond the breeding period. In nature the animals live on land for at least several months in winter and lead a largely hidden life during that period. In captivity it is mostly possible to keep the animals in water all year round. Whether this affects their readiness to mate or may otherwise influence their behaviour is not entirely clear, but in my experience the timing of their sexual activities under these circumstances is not very different from life in the natural habitat. A positive practical effect of keeping the newts constantly in water is that it enables one to control the animals better and keep an eye on their feeding condition. Furthermore, juveniles grow quicker when reared in water. A floating piece of cork serves as a semi-terrestrial refuge in my aquariums.

## THE AQUARIUMS

My animals are housed in some twenty glass tanks of different sizes. The minimum size for two or three *C. ensicauda,* the largest species, is 60 x 30 x 30 cm. A container of this size can accommodate two couples of *C. pyrrhogaster* or *C. cyanurus,* or three couples of *C. orientalis.* An aquarium of 30 x 20 x 20 cm suffices for two or three *C. orientalis,* the smallest *Cynops* species.

The aquariums are covered by two sheets of glass, one fixed under the light tube, the other removable. Illumination is by one fluorescent light tube of 36 W, covering two aquariums at a time, or through Philips OL electronic/C lamps between 20 and 36 W (1500 lumen). The lamps are placed on the glass sheet and are covered by a simple sheet of aluminium foil. An automatic timer regulates the day-night rhythm, which varies per season: the animals are given some 12 hours light in summer and 18 hours in winter. I do not adhere to this scheme very strictly. Often the lights are also switched on in the evenings. Surprisingly, this appears to activate, rather than to disturb the newts.

## PLANTS

Only the strongest plants are used, such as *Sagittaria, Fontinalis, Elodea, Ceratophyllum, Hydrocotyle.* These plants are good hiding places for the newts and are used by the females to attach their eggs. The plants are arranged in such a way that the front window and some space in the middle of the aquarium are left open to allow observation and to allow the light to penetrate.

## FLOOR

The floor of the aquarium is covered with gravel, sand or peat only. *Sagittaria* will grow well without additions to the sand, gravel or peat. Coarse gravel creates a larger surface, that gives room to a rich micro-fauna. In aquariums without a filter such as mine, this helps to absorb organic excretory matter. With few plants rooted in the soil, the substrate can be cleaned easily during the routine cleanings which are carried out once a month. During these cleanings, algae and detritus are removed, plants cut back, and one third of the water replenished.

## AERATION

The water is only aerated occasionally when tanks temporarily contain a greater number of animals then mentioned above. Small capacity water filters are rarely used. The animals appear to be disturbed by moving water. They become restless and try to swim away from the stream.

## FOOD

All species receive the same food items, bigger animals take larger prey than the smaller ones. A favourite food is the earth worm (*Lumbricus terrestris*). The dung earthworm (*Eisenia foetida*), which is frequently offered in pet shops, is taken less readily or

refused. Maggots, mosquito or midge larvae (*Chironomus*), *Mysis* and *Artemia* are regular food items. Many species of water insects are taken such as *Daphnia* and *Cyclops,* as well as small slugs, *Tubifex* and millipedes thrown into the water. Small pieces of lean meat such as heart, liver and fish are taken, but if left uneaten pollute the water rapidly. A great advantage of keeping *Cynops* is that the animals recognise and accept dead food items, even if these do not move. High quality foods such as *Artemia* and *mysis* can be offered in deep-frozen form all year round. I feed juveniles *ad libitum,* the adults are fed about twice per week. If well-fed, the animals can endure at least three weeks without food, without apparent sign of deprivation. Although the newts survive on earthworms or a single other food item, they are best given a variable diet and not too much *Tubifex* as this food is rich in fat, it may contain pollutants and can be the cause of gas in the stomach. Individuals of all species are known to eat their own species' eggs, even shortly after having been fed. *C. ensicauda* is a notorious predator of its own eggs. This behaviour has also been observed in the natural habitat (Sparreboom & Ota, 1995) and does apparently not represent an anomaly of life in captivity or a habit resulting from food deprivation. Frog spawn is eaten as well.

TEMPERATURE

Very probably, a combination of seasonal temperature fluctuations and the changing day-night regime influence or determine the timing of reproduction. In captivity the male newts develop secondary sexual characteristics such as swelling of the cloaca as soon as temperatures drop in Autumn: from October onward, when water temperatures fall from round 20° to 10°-15°C and the light regime is reduced, the first courtship activities can be observed. In my aquariums sexual behaviour can be observed until mid May and in *C. ensicauda* until mid summer. I do not influence the water temperature through a heater. By placing the tanks on top of one another on storage racks, the top aquariums are warmed up by the lighting on the aquariums below. Keeping the tanks in unheated rooms is better than in centrally heated apartments, except for *C. ensicauda* which is used to temperatures well above 20°C and will do fine in centrally heated apartments.

## SPECIES ACCOUNTS

***Cynops pyrrhogaster***

The Japanese Fire-Bellied Newt used to be a common pet among keepers of newts, but is less frequently seen at present. This may partly be caused by the sharp decline of this once common species in the natural habitat (Terutake Hyashi, Hidetoshi Ota, pers. comm.), by saturation of the market, or for unknown reasons. I have kept and bred animals belonging to the subspecies *C. p. sasayamae* for over 10 years since 1975 and have kept them again from 1994 until now. (Typical for the behaviour of the Sasayama race is the leaning of the foot on the female's neck during tail fanning by the male).

The males come into breeding condition every year; courtship can be observed from November to May; egg-laying has been irregular. Other forms than the Sasayama race, the collection locality of which was unknown, have not reproduced in my aquariums. To come into breeding condition, this species requires a period of hibernation, with temperatures falling to about 5°C. If the room or the aquarium cannot be cooled, the animals can be kept in a refrigerator in small plastic boxes filled with moss during the winter. The humidity must then be checked regularly. Eggs are best removed to avoid predation by the parents. Usually a few eggs escape predation and develop well in the parental aquarium. I once reared a few juveniles in a small plastic box furnished with pieces of cork bark and sphagnum for shelter. Food consisted of *Tubifex,* small earthworms and insects, held before the snout of the juveniles. These reached adult size in three years.

The sexual behaviour is described by Tsutsui (1931), Kawamura & Sawada (1959) and Arnold (1972). Accounts of breeding are common and can, for instance, be found in Klingelhöffer (1956), Thorn (1968) and Van Leeuwen (1983).

***Cynops orientalis***

The Chinese Fire-Bellied Newt is the smallest species of *Cynops*, measuring from 7 to 9 cm. It is imported from time to time, occasionally in large quantities. These shipments usually come from Hong Kong, but the collecting locality of the newts is unknown.. Very little is known about habits and life-history of this species (cf. Chang & Boring, 1936; Thorn, 1968). I kept about six specimens for about five years in the eighties and I have kept them again since the summer of 1994. They are very lively and eat dead prey easily. Their requirements are similar to *C. pyrrhogaster*. They also require a winter break with lower temperatures for good breeding results.

In captivity breeding starts in December and continues until May. Egg laying was observed from March until the end of June. Eggs are laid in a similar way to *C. pyrrhogaster*, between leaves of water plants. I removed the eggs and put some peat in the water to raise the level of acidity to help prevent moulding and infections. The larvae are similar to those of *C. pyrrhogaster*, their rearing is unproblematic until metamorphosis when many larvae die. The first metamorphs were found at the end of July. The juveniles are small, about 33 mm, and have a tendency to go on land, which is only natural but makes them difficult to feed. I have not reared animals to adulthood, but their propagation has been achieved by other breeders, who succeeded in keeping juveniles in the water after metamorphosis. The best results have been obtained in aquariums with a dense vegetation of *Sagittaria* and other plants.

For records of breeding see Freytag (1961) and Koepernik & Herrmann (1991). In aquarium books this species is sometimes mistaken for *C. pyrrhogaster* (Staniszewski, 1995, where *C. orientalis*, not *pyrrhogaster*, is depicted on p. 177 and 264). The sexual behaviour differs in some temporal aspects from that of other *Cynops* species (Sparreboom & Faria, 1997).

***Cynops cyanurus***

This species has incidentally turned up in the pet trade, but may often go unnoticed, due to its superficial resemblance to other *Cynops* species. Moreover, newts have occasionally been mis-identified as *cyanurus*, when it actually concerned *orientalis* or *pyrrhogaster* (see also Grosse & Laubner, 1988; Grosse & Koepernik, 1993). This species is characterised by a distinct vertebral ridge, a rather rough skin with many small granules, and especially by an orange-red spot at the corner of the mouth, as well as by distinct outer metacarpal and metatarsal tubercles. The male develops a shining bluish tail in the reproductive season (Lieu et al., 1962). Little is known about this species. The courtship repertoire is not entirely known, but seems to follow the pattern of the other *Cynops* species (Fei & Ye, 1988 and personal observations). I hope to study the sexual behaviour of this species in more detail in the coming years.

I have kept three pairs of this species from 1985 to 1989. They were sensitive to diseases, that caused parts of the skin and extremities to rot away. After observing a progressive infection of the tail in some specimen during some weeks, I decided to cut off the rotting part of the tail. The wound then healed within days and the tail almost fully regenerated in a year's time. The fact that these animals proved more difficult to keep in good condition may be due to a greater sensitivity of this species to water quality and temperature, which in the natural mountain habitat might be rather different from what we can offer in an indoor aquarium. The care and maintenance was in my case

similar to that of the other species, which might be an error. Even so, the animals reproduced successfully in 1987. A conspicuous feature was the fact that in larvae the orange spot on the cheeks was already visible well before metamorphosis. Metamorphosis took place in October/November. I did not rear juveniles to adult size.

Fei & Ye (1988) describe a subspecies *C. cyanurus chuxiongensis* from Chuxiong in Yunnan (altitude 2100-2400 m) for which water temperatures of 18° to 27°C in the breeding season are recorded. These authors have bred animals and also report that development from egg to sexual maturity takes about two years. Recently *C. cyanurus* was bred by Dr Jürgen Fleck (Hanau, Germany). In 1997 I acquired three adults and some of his F1 offspring, some hardly 40 mm long juveniles living entirely on land, eating *Drosophila* larvae, springtails and *Chironomus* larvae.

***Cynops ensicauda***

The attractively coloured Sword-Tailed Newt is imported irregularly and has been bred in captivity many times since Gerlach (1934; and see references in Sparreboom, 1994). With a total length of 11 to 15 cm this is the largest species of *Cynops*. Little is known of its life history. In 1993 I collected a small number of animals in the Ryukyu archipelago in southern Japan (see Sparreboom & Otaa, 1995). All these animals belong to the subspecies *popei*. Fourteen specimens of the nominate race (*C. e. ensicauda)* were sent to me that same year from Amami-oshima. All individuals of the nominate race are uniformly chocolate brown on the dorsum with yellow dorso-lateral stripes in some specimens, whereas all specimens of *popei* have a pattern of more or less bright-coloured spots on the back, which is black (Inger, 1947). One difference between the two subspecies stands out, but has to my knowledge not been reported earlier: in the breeding season, males of *C. e. ensicauda* develop a silver stripe in the tail, similar to but not as clearly demarcated as in European Crested Newts, whereas this has thus far never been observed in *C. e. popei*. Until now I have observed no subspecific variation in behaviour patterns.

In Great Britain this species is apparently less common among breeders (Mattison, 1993, p. 95 depicts a poorly discernible *Pachytriton,* mistaking it for *C. ensicauda).C. ensicauda* occurs at tropical latitudes and in captivity requires temperatures from 20° to 30°C in summer and 12° to 15°C in winter. These temperature requirements probably are a reason why the animal breeds so readily in our homes. No hibernation is therefore required to elicit breeding, the animals are hardy and eat practically all food items mentioned above. I started with two adult pairs purchased in 1983. Presently three of these individuals are still alive (January 1998). I acquired more specimens via the pet trade in 1989 and kept them and their offspring, until 1997. Most of the animals that I caught as adults in 1993 are alive and reproducing yearly until today. This species can reach a respectable age. Thorn (1968) reports an individual of 20 years old. Animals whose origin can be traced back to 1957 and which possibly originated from specimens bred by Gerlach (1934), are still alive in the collection of Wolfgang Mudrack in Berlin (W. Mudrack, pers. comm, October 1997).

Sato (1943) reports that in the natural habitat eggs are laid from March to July/August. In my aquariums breeding and egg laying starts in October, continuing until the end of June. But eggs are laid in practically all parts of the year and larvae can be found at all times. Animals bred in 1992 and kept in water at room temperature after metamorphosis, reached sexual maturity after two years and reproduced in 1994. At metamorphosis the juvenile newts measure between 40-50 mm.

## REARING THE LARVAE

I have reared the larvae of all *Cynops* species in a similar way, by raising them in aquariums filled with tap water and furnished with some water plants. Food consists of *Cyclops, Daphnia, Artemia, Chironomus, Tubifex* and occasionally *Mysis.* The larvae prefer living food but will also take deep-frozen *Artemia* and *Mysis.* Larvae grow bigger in larger (for instance 35 litre) than in small (for instance one litre) containers. The best results I obtained were by leaving a number of larvae in the 60 x 30 x 30 cm aquariums with the adults and catching them upon metamorphosis. Once the larvae are in the free-swimming stage, they manage to escape from the adults who occasionally snap at them. The larva spurts away if an adult newt comes in the close vicinity of the larva. It is unclear if eye-sight or lateral line senses alert the larva to the approach of a predator.

Rearing the larvae is unproblematic, but raising metamorphosed juveniles is more difficult and requires much individual attention. The metamorphs normally creep on land and look for moist places where they can keep their feet and rest of the body dry. Food given on land consists of springtails, mosquito larvae, *Drosophila* larvae and *Tubifex.* Even so, it is hard to control growth and who is eating what; the small containers in which the animals are kept can easily turn into rotting newt cemeteries within a day. I get the best results if I manage to keep juveniles in water. They are housed in small plastic shoe boxes with 2 cm water and some peat, moss and water plants, allowing them to sit in water with their heads raised out of the water. Food given in water consists mostly of mosquito larvae. Growth is usually slow, even when the animals are kept at room temperature all year. The young reach maturity in two to three years time. I have kept juveniles of *C. ensicauda popei* and *C. e. ensicauda* in this way, others have reared *C. orientalis* in this manner. For juvenile *C. pyrrhogaster* and *C. cyanurus,* which I only managed to keep on land, I am not aware of any results with aquatic rearing. For *C. ensicauda* it has been emphasised by many breeders from Gerlach (1934) onward, that the larvae and young must be kept warm (20° to 30°C), an observation that I can confirm. There is still much room for experimentation in finding out the best methods of raising the young to adulthood.

Captive bred newts occasionally have yellow or orange belly colours, instead of the bright red ventral coloration often found in the wild animals. Most probably, this is due to carotene deficiencies in their diet during the larval and early post-metamorphic stages of development. Feeding insects rich in carotene such as *Daphnia* and *Artemia* usually results in young animals with brighter colours. Animals with a bleaker coloration are apparently not weaker than the bright-coloured ones and show the same behaviour in captivity. In natural populations of *Cynops ensicauda* the belly colours are very variable, with red and yellow coloured individuals occurring in the same population. One juvenile *C. ensicauda popei* which by accident spent a year in the soil of my (fenced) garden in Strasbourg (1992) showed deep red colours when I found her, 85 mm long, but I don't know what she had eaten. In my experience, red belly colours – especially in *Cynops pyrrhogaster* – may fade a little after some years of captivity. This is probably also the result of nutritional deficiencies.

## DISEASES

Over the years a number of animals have been affected by diseases, many of which proved fatal in the end. All the well-known disorders of amphibians can also be found in *Cynops.* The disease that occurs most frequently among my animals is the rotting away of toes and extremities and the occurrence of holes in the skin on head, neck and other body parts. This disorder can sometimes be cured by baths of Pottasium permanganate

and may then disappear temporarily, but can be very resistant. The wounds may heal and do not necessarily lead to the death of the animal. The cause may be a bacterial infection.

Other diseases are deformities in the hands and feet, slow emaciation and refusal of food, swellings around the joints of the legs and under the skin and the disease commonly known as 'Molch-pest'.

It is not possible to identify specific causes for each disease, let alone a reliable cure. Among breeders in Germany a drug called Baytril has proved to be a good remedy against various sorts of infection, but I have no experience with it myself. For a recent survey on amphibian diseases the reader may be referred to Jarofke & Herrmann (1997).

## ACKNOWLEDGEMENTS

The Dutch society for herpetology and terrarium keeping, LACERTA, and the German society for herpetology and terrarium keeping, SALAMANDRA, each have working groups focusing entirely on the study and breeding of salamanders. Among these groups there exists a large body of experience, which has been enormously useful to me up to this day and a source of inspiration and pleasure. Furthermore I am grateful to Hidetoshi Ota for sending me a number of newts from Japan and for translating relevant passages of Sato (1943).

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# CAPTIVE BREEDING AND REARING OF HONG KONG NEWTS *(PARAMESOTRITON HONGKONGENSIS)*

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## INTRODUCTION

On November 6th, 1996, I carefully selected a trio of freshly imported adult Hong Kong Newts (1.2.0.) from my local reptile shop. The male showed a good cloacal lump and a slightly iridescent, violet band running laterally through his tail. At 4½", he was an inch shorter than the females and more lightly built. All shared the same, uniform brown dorsal colouring, laterally trisected with slightly raised, oranges ridges; not worth calling a crest and black venters, mottled with orange.

## BREEDING

Knowing only that these regular and sometimes long-term inhabitants of the shop's 18 x 12 x 12" tank of water had never bred in situ, I realised that I was completely on my own. My understanding of Banded Newts (*T. vittatus)* proved to be the catalyst. I put the 3 Hong Kong Newts into a vacant, well established tank (2' x 15" x 18" deep), planted lightly with straight *Vallisneria* in a one inch bed of fine gravel and serviced by an old-style Fluval No 3 filter with some cork pontoons available. As with *T. vittatus,* I had a hunch that deep water might be the answer.

On November 18th I sat and watched the entire courtship ritual between the male and one of the females. There was much rapid tail fanning and nonchalant stalking about the gravel before the female picked up the spelrmatophore. It was then that I decided to drop the water flow output of the pump from full power to about 50-70%. (Water temperature was about 57°F).

On November 25th, I introduced a small bunch of *Elodea,* giving them two kinds of aquatic leaf form. On November 28th, I added a 12" air bar, optimistically planning ahead to oxygenate the water for the larvae I was expecting. I had the stone on quite a powerful pump and soon decided to reduce the flow, using an in-line control screw.

By December the 2nd, at a temperature of 61°F there were eight eggs on the *Elodea.* This set the pattern for the days ahead: half a dozen or so eggs on alternate nights until, eventually I had about thirty eggs and the female stopped spawning. Only a few eggs appeared on the *Vallisneria, Elodea* definitely proving the obvious choice. The eggs were pretty typical: creamy-white, about 2/3mm and some appearing more oblong than round. A leaf of *Elodea* was wrapped around the majority, whilst a few appeared stuck to the upright, reedy stems of *Vallisneria.*

On December 14th, I recorded one of the females climbing up the *Vallisneria,* passing by an egg and then attempting to eat a second, higher one. (This is known to be common behaviour of the other newt species).

## HATCHING

By December 20th, I had removed the adults and had provided several more bunches of *Elodea* to provide cover for yet to emerge larvae, which were now becoming visible within the eggs in the form of elongated black shapes. I had been adding five drops of Myxazin, almost daily since the eggs appeared and kept this up to prevent any infection. By January 18th, at 63°F, the eggs appeared a little opaque but this was just natural development, not mould.

By the end of January, I had added a Gro-Lux strip to the tank and had observed larvae on the gravel. At this point I recorded the larvae as being jet black, with a white trim, with obvious gills and eyes. In the first week of February, I removed the Fluval filter and replaced it with a sponge filter. I started adding Liquifry No 1 Egglayers food at a rate of fifteen drops per day, morning and evening, and now had over a dozen larvae. I added some daphnia which was not taken.

## REARING

By the middle of February there were a couple of dozen larvae and I was giving the water an occasional pinch of powdered fry food and even floated a crushed cricket in the tank. It was now that I decided to take a potential risk and add a heater to the water, raising the temperature by some 10° to 70°F. Some of the larvae had now attained ¾" in length. I was allowing them eleven hours of light and noted how they favoured hours of darkness (which I observed by pen light) hiding out beneath a piece of resin 'bark' during the daylight hours. For the next two months the larvae grew on a diet of *Daphnia*, bloodworm and *Tubifex*. Some larvae had turned brown, as opposed to jet black and these were partially transparent. April also saw the first white spots appear on their venters and by halfway through the month I had 1½" newts, losing their gills and emerging from the water.

At the end of April, with little brown newts emerging and favouring the cork bark portions, I tried my first translocation attempt. I put six baby newts into a tank lined with Examon (Zeolite) and with a beach into the water taken from the main tank. I offered them bloodworms, both in the water and in a jar lid. A few days after I conceded defeat and put the few barely surviving newts back into the big tank. They were dried into position and barely moved until they had had a soak. A week later I tried again, this time adding damp moss. The result was the same: the newts simply dried up on the top of the moss. Through June I tried offering hatchling crickets and by July I had all the surviving newts in a set-up of an inch of water and a piece of cork bark. I was still offering bloodworms and hatchling crickets and suffering steady losses.

In desperation I rang Marc Staniszewski for advice. He suggested that the temperatures that they were being kept in were too high for them and that I should try putting them in the fridge. Although there were some initial losses, the practice of putting them in the fridge for twelve hours a day seemed to work.

At the end of July a further piece of information from Richard Kingham, based on breeding successes in Bruges, led me to try the system I still have in use today. I use an inch of water lapping against a large area of bark chippings, a hide cover of cork bark and a diet of aphids. The lack of availability of aphids led me to substitute hatchling crickets again. By the end of August I had stopped refrigerating the newts and even with an ambient temperature now around the mid 70°Fs, they seemed to have got over the delicate stage where they needed cool temperatures. Since then I have lost no more newts.

## CONCLUSION

To summarise I would say breed them in deep water and hatch them in cold, well-oxygenated water. Raise them in a fridge and feed them all the aphids you can find.

## ACKNOWLEDGEMENTS

My thanks to Marc Staniszewski and Richard Kingham for their invaluable help with this project.

# DECLINING AMPHIBIAN POPULATIONS TASK FORCE (DAPTF)

*MEDIA BRIEFING: 23rd February 1998*

**The DAPTF funds 11 new projects on declining amphibian populations.**

One of the primary objectives of the DAPTF is to encourage innovative research into the distribution and causes of population declines through its Seed Grant programme. Thanks to a number of generous donations, we have recently been able to fund 11 new projects, for a total outlay of $22,000.

Two projects, one in the UK, one in the US, will look at the impact of nitrates on amphibians. Nitrates are widely used as agricultural fertilisers and are known to adversely affect amphibians in lab studies, but their potential impact in the wild has not yet been studied. Another potential hazard for amphibian populations are polychlorinated biphenyls (PCBs), widespread pollutants that accumulate in the fat bodies of animals, from which they are released in high concentration during breeding. A study in the Netherlands is investigating the hypothesis that PCBs interfere with the secretion of thyroid hormones that control metamorphosis in amphibians. Another project will study a number of localities in Canada's St Lawrence Valley where large numbers of deformed frogs were seen in 1995/96, with the objective of determining whether these deformities are caused by pesticides.

The last few years have seen dramatic outbreaks of fatal disease among amphibians in several parts of the world. We are funding a project looking for the pathogen responsible for a disease outbreak in Panama, and another that will investigate the virus that causes periodic outbreaks of disease in the Sonoran Tiger Salamander, an endangered subspecies endemic to Arizona.

Two projects aim to provide more accurate information about the status of amphibians in specific localities. One, in California, will synthesise data gathered by numerous local studies. The other, in Hungary, will carry out a detailed survey of an area in the Pilis Mountains that was surveyed in detail between 1952 and 1954.

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# 'CATCH 22' FOR THE GREAT CRESTED NEWT
## Observations on the breeding ecology of the Great Crested Newt *Triturus cristatus* and its implications for the conservation of the species

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**ABSTRACT**

The Great Crested Newt is a widespread species of amphibian in northern Europe, with England and Wales representing areas of international significance. It has experienced a rapid decline of perhaps 50% over the past forty years or so and many populations have been lost or fragmented; as a consequence it receives full legal protection under British and European legislation. However, there is evidence that it continues to decrease and reasons for this may not always be addressed by legal protection alone. For example, pond loss due to neglect and succession and also the introduction of fish into ponds require a more detailed examination as they affect the breeding ecology of many newt populations.

The Crested Newt is more vulnerable to local extinctions than the other native newt species, the Smooth *Triturus vulgaris* and Palmate *Triturus helveticus* newts mainly because of its more restricted breeding requirements (only 2% of ponds sampled in a national survey had Crested Newts compared with around 25% for the other two species). In particular the larvae require relatively large but mainly fish-free ponds in which to develop; this is the 'Catch 22' at the centre of this article – the probability of fish presence in a waterbody increases with the size of the waterbody because of the decreased risk of desiccation. Thus the majority of Crested Newt populations tread an ecological tightrope, risking larval desiccation or starvation in ephemeral and small ponds or larval predation by fish in more permanent waterbodies such as large ponds and lakes.

Clearly Crested Newts do manage to survive well in suitable areas, and this is largely achieved by breeding successfully in a few ponds at a time which are within the range of a 'metapopulation' of animals. This means that some ponds may be temporarily unsuitable for breeding by virtue of fish presence or being dry, but others will be suitable and thus will offset the losses in the former type of pond. In time the suitability of a particular pond will change, but the metapopulation as a whole may persist.

Sometimes atypical populations exist where particular circumstances allow a different pattern to develop – for example several very large populations are known from old gravel workings and clay pits, where the waterbodies are several hectares in size – the isolation from river systems and other ponds as well as restricted access maintains their fish-free status, and the newts take full advantage. In rarer cases, coastal waterbodies may receive a winter dose of salt-water killing freshwater fish and 'cleansing' the ponds ready for the newts the next spring.

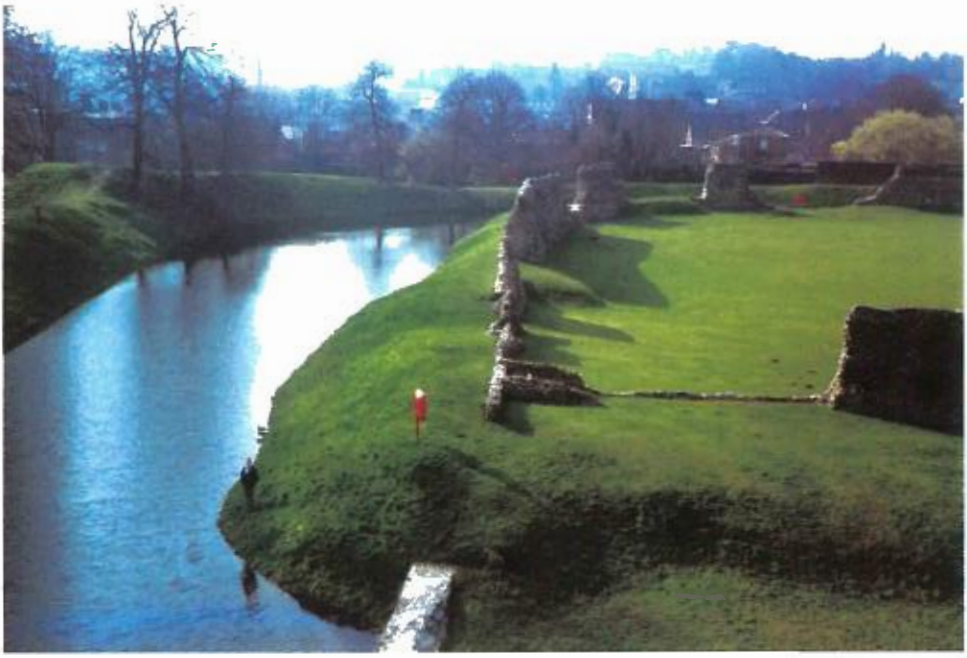

Plate 1: View of the widest arm of the castle moat, home to thousands of Crested Newts (see text for details).

Plate 2: A typical male Crested Newt from the 'large' size cohort found in the moat in 1993.

The final possible breeding population is one which relies on a single waterbody which dessicates often enough to maintain fish-free status but not so often that the newt population itself becomes extinct. Clearly the chances of finding a very large single waterbody Crested Newt population are low and such a situation could be worthy of designation as a SSSI (Site of Special Scientific Interest). The article finishes with a summary of ten years of observations on just such a single waterbody population which was estimated to contain between two and three thousand adult newts in the mid 1990's by several professional herpetologists; the newts breed in an ephemeral castle moat in southern England, where the nearest known ponds are roughly a kilometre from this. Only two years out of the previous ten have allowed successful metamorphosis before the water has disappeared and whether the current situation will permit the continued viability of the population is considered as well as recommendations for the conservation of the moated newts and the species in general.

## INTRODUCTION

Long term data on the population dynamics of amphibians are scarce but urgently required in order to explain observed declines in many species as either genuine negative trends or simply part of the natural fluctuations characteristic of many amphibian species. At first glance, the Crested Newt would seem to be well buffered against short or medium term problems with its aquatic habitat, adults having a lifespan which can be measured at least up to a decade in some cases in the wild and with the potential to breed annually and for each female to lay several hundred eggs.

However the breeding niche used by the species is often much more narrow than for all native amphibians with the exception of the much rarer (in Britain) Natterjack Toad *Bufo calamita.* This is largely a reflection of the larger size of the newt when compared with the Smooth and Palmate newts. There are important consequences for the choice of suitable waterbodies for breeding; first, the larvae of the newts are larger than the other species – at up to 8cm they can be larger than some adult Smooth and Palmate newts. In turn this means that they require more food to complete their development successfully than the larvae of the smaller species and also that they require longer to develop as larvae before metamorphosing and thus becoming independent of the water. This means that a waterbody must have a higher carrying capacity for Crested Newt larvae and a greater degree of permanence (typically water should be present until September as a minimum to allow moderate success) than for smaller newt species. The National Amphibian Survey (Swan and Oldham, 1992) showed the typical area of a Crested Newt pond to be in the range of 500-750 square metres. This size may be described as 'large pond or farm pond' on the one hand or 'lake' on the other.

Some smaller and very common freshwater niches are thus rendered immediately unsuited to Crested Newts for successful breeding – these include various ditches, natural ephemeral ponds, flood marshes and of importance in the context of modern amphibian conservation, the phenomenon of the artificial garden pond.

Garden ponds are known to have offset the increased rarity of Smooth Newts and Common Frogs *Rana temporaria* and to a lesser extent Common Toads *Bufo bufo* and Palmate Newts in rural areas (see for example Beebee, 1996), but this effect has rarely occurred with Crested Newts. In cases where Crested Newts are found in garden ponds, they are atypical in that they may be close to a natural population and thus harbouring outlier animals, they may be 'farmed' especially for newts by enthusiasts (often doomed when the owners move house) or they may be large 'Victorian' type ponds in country houses or enclosed 'wild' ponds etc. My own experiments in garden pond Crested Newt

culture over the past fifteen years have shown the short term success and long term failure of Crested Newts in suburban ponds, and it is worth examining these semi-natural ecological 'manipulation' type experiments briefly to draw some general conclusions about the breeding biology of the animals.

I began with a pond whose total area was 4 square metres, and about 0.5 to 1 m deep. This tiny pond had its goldfish removed and a couple of pairs of Crested Newts were added under licence in 1984. Within a few years I could observe about 50 adults crammed into the pond managing somehow to maintain breeding condition for several months before leaving the water for the summer. Virtually no larvae survived to metamorphosis in the pond itself, being rapidly converted back to adult newt tissue by their cannibalistic parents. The vastly inflated number of adults was the result of some over-zealous rearing of larvae in aquarium tanks, which were themselves voracious feeders on *Daphnia*, *Tubifex* and other bought live-foods. Once they had metamorphosed, the newtlets were released into the typical suburban garden and my records show on average over a ten year period a metamorph to adult survivorship of 20%, a high figure. The adult annual survivorship was roughly 70%, and taken together they clearly show that the terrestrial component of a suburban or garden environment is admirably suited to the supporting of Crested Newts. The problem, as mentioned already, is the aquatic element of their habitat.

Clearly it is unreasonable to claim that Crested Newts cannot survive in small ponds through adult cannibalism of larvae when the number of adults was inflated artificially in the first place by rearing larvae in tanks (although it does suggest that crowding, aggression, territoriality, competition for food etc. between adults is not the major determining factor which limits the lower pond size for Crested Newts). The question still remained whether a small but stable population could persist in a garden pond without 'farming' ie. adding extra food for the larvae and a second experiment was required.

On moving to a new house, I constructed a larger pond measuring 5m by 3m mainly for Crested Newts. I allowed the population to develop without tank-rearing of larvae, but in the first year I added extra food for the larvae in the pond and about 60 metamorphs were produced. The following year, with the same number of adults present, I added no top-up food, and a handful of metamorphs resulted. Observations showed several larvae in poor condition in the pond overwintering, clearly thinner than 'normal' overwintering larvae and invertebrate food was scarce. All this suggests that even in those small ponds which may not dry out too early, that lack of sufficient larval food supply may determine the lower limit of ponds used successfully by Crested Newts.

In the 'wild' the smallest Crested Newt ponds of which I know are 30-40 sq m in area and often close to the other larger ponds which hold the species. One isolated pond has about a dozen adults breeding but until a few years ago was part of a system of ponds which have been fragmented by roads, housing developments and a new golf course. Since Crested Newts cannot use isolated small ponds effectively, it is worrying that the 1995 resurvey of all London Crested Newt ponds by the London Amphibian and Reptile Group for English Nature revealed not only a 42% decline in the number of waterbodies used for breeding by Crested Newts over the past fifteen years (ie. since statutory legal protection was introduced!) but also a contraction in range and that the number of populations in London relying on a single waterbody had risen from 30% to 70%. If problems of in-breeding recently raised for garden frog and isolated Natterjack populations are correct, then the London Crested Newts may face a more insidious genetic threat from isolation than simple dependence on a single pond for breeding, as well.

Under normal circumstances, the inability of a species to exploit a small habitat type for reproduction would be expected to be offset through the larger size of the animal permitting survival and breeding in larger habitats. Adult Crested Newts are indeed large – and toxic enough – to avoid predation by most fish species, but the larvae are not. In addition, another element of the 'Catch 22' of their ecology comes into play: smaller newt species can coexist with fish species in large ponds and lakes. Although their larvae are palatable to many fish including the most harmful species, Sticklebacks *Gasterosteus spp.*, they and their larvae are cryptic and occupy the shallower parts of the lake and most vitally the larvae use aquatic vegetation, especially filamentous algae, to hide and forage in. Crested Newts larvae, requiring much more food, as we saw earlier, soon become nektonic (that is, swim in open water, very visibly) and are predated apparently with devastating efficiency by Sticklebacks and also other fish. Ironically, the Stickleback is a common type of fish which can occupy very small ponds through to large lakes, and its adaptability reduces the number of waterbodies available for the Crested Newt dramatically.

There is a range of evidence to suggest that fish presence is of great importance as a factor causing the extinction of Crested Newt populations or preventing their colonisation of areas in the first place; for example, the deliberate introduction of Sticklebacks into one of his garden ponds by Trevor Beebee resulted in the complete extinction as a breeding species from the pond of only Crested Newts although the other newt species persisted in reduced numbers. In the London Crested Newt resurvey, only 5% of ponds with Crested Newts contained fish whereas around 30% of ponds are estimated to contain fish on average (National Amphibian Survey). Additionally, the 5% of ponds with fish tended to have only a few largely herbivorous fish such as Cyprinid species and not Sticklebacks. Conversely, the same survey found a pond which had dried out only the year before, killing the Sticklebacks, had been colonised by several Crested Newts from a nearby pond, whilst they had not been seen when the pond contained Sticklebacks (this almost suggests that adult newts have some way of detecting fish presence and abandoning a pond once used for breeding, but I am not aware of any experimental work having been done on this). An account by McLee and Scaife (1992) records the rapid colonisation by Crested Newts of a pond in a nature reserve where piscicide was applied to eliminate Sticklebacks which were previously present, and the newts were not.

To summarise so far: Crested Newts will always be less common than the smaller native species because of their specific requirements for breeding habitat. Being a large species with particularly voracious larvae, they cannot use small ponds for breeding, since the larvae will not metamorphose in sufficient numbers to maintain a population. Additionally, small ponds are prone to mid-season desiccation leaving the larvae 'high and dry' since they need longer to reach the critical size at which they can metamorphose than the larvae of the smaller newts. On the other hand, the potential breeding niche of large waterbodies is rarely available to the species since lakes, reservoirs etc. usually contain fish. Because of their food requirements, the larvae of Crested Newts are nektonic, ie. they occupy open water and search for food in the water column. This makes them highly vulnerable to fish predation, and although the adult newts are toxic and rarely predated, the population cannot sustain itself because of fish predation. As a result of these upper and lower pond size-limiting factors, Crested Newts will be rarer than smaller newts, more vulnerable to developments and less able to offset losses in the countryside of farm ponds etc. by using smaller garden ponds, which usually provide all the wrong conditions for the larvae, ie. small waterbodies with scant invertebrate prey and plenty of fish! Populations of Crested Newts may rarely exist in large numbers where the above factors are not applicable; most often this will mean a series of ponds

which alternate in suitability as breeding sites as time goes on, but overall the 'metapopulation' continues to exist because breeding is usually successful at least in a proportion of the ponds within its range. The implication is that a population of Crested Newts reduced to breeding in one or a few ponds will 'put its eggs in one basket' and be vulnerable to extinction if the pond silts up or is subject to a chance event such as fish introduction. Sadly, as stated earlier, for London Crested Newts this situation has become more the norm than fifteen years ago, with so many populations (70%) dependent on a single waterbody.

A second, much rarer situation in which Crested Newts might exist at unusually high densities could theoretically arise if a large body of water were available for breeding but without the danger of fish being present. This type of situation is rare because of the correlation of waterbody size, water permanence and therefore suitability for fish. One possibility might be a manmade waterbody located at a distance from rivers, other lakes etc; indeed there are several very large 'single-waterbody populations' of Crested Newts recorded from clay and chalk pits where this has occurred.

The final scenario is perhaps ecologically the most interesting. It is where a large shallow body of water occurs ephemerally in a site, holding water frequently and often enough to allow a large population of newts to build, whilst drying out at irregular intervals to prevent domination by fish. The rest of this article describes observations on the population dynamics at such a site, namely a castle moat in southern England.

## THE MOAT POPULATION – A DESCRIPTION

It would be easy to overlook the newt population at the moat entirely for much of the time; indeed it was two years after I first walked around the site that the animals – or rather their eggs – revealed themselves, because this was the first time for at least two years that the moat had held water. Suddenly the moat in April revealed apparently by 'spontaneous generation' a wide variety of aquatic flora and attached to some of their leaves, the unmistakable large white-embryo eggs of Crested Newts.

A half hour torchlight count revealed 50 adults in just one corner of the moat, which now had several thousand square metres area of water in it. By late July the moat was dry and thousands of dead well-grown larvae were littering the moat bed. This raised various questions – first, would the population survive this apparent calamity? Answer, yes. Second, would the water stay long enough to allow successful breeding in future? Answer, gain yes. Thirdly for how many years can a population maintain its numbers, or even persist at all, without successful breeding? Of course this is a rather difficult question, but we can make some predictions based on trends observed from the late 1980's onwards.

Finally, a couple of conservation questions to be raised – first, why was the water apparently more reluctant to stay into early autumn with each passing year? Answer, probably a number of factors but mainly low rainfall and low aquifer levels over the past decade, like many areas in southern England. Secondly, could anything be done to help this unusual ecological situation involving several thousand highly protected and declining animals? Answer, nothing was achieved for many years in spite of achieving English Nature's threshold SSSI status counts of 100 adults comfortably for the three years successfully required. However there may be some hope of a little action being taken in future.

It could be argued that amphibian populations are naturally prone to large fluctuations and that if it is 'natural' for the moat population to wane after its waxing then we should allow it to happen. However Crested Newts are not as well adapted to this boom and bust cycling as Natterjack Toads for example, which are much more specialist at living life on the edge. Natterjacks share the ability to achieve fairly low mortality with Crested Newts and most other amphibians, but they lay more eggs and crucially their tadpoles are genetically programmed to develop at one of the fastest rates of any European amphibian, in complete contrast to the Crested Newt. As a result they may lose a year's breeding effort in a very dry year, but are able to exploit temporary pools in dunes and heaths etc. far better than Crested Newts. The odd season with no success is fine for the newts, but a sequence of 'blanks' will affect the population seriously.

I have only been able to trace two other examples of such 'single waterbody' Crested Newt populations. One is a current site in a pasture in Yorkshire where there is only a gentle dip to indicate that water may sometimes accumulate in part of the field, yet when it does, about a thousand newts appear from nowhere (the field is well grazed) and breed (T. Gent, pers comm). The other reference is from a seasonal dune slack near Cardiff in the 1920's (D. Frazer), where water apparently was present only during October to April, yet it was estimated to contain a thousand Crested Newts and tens of thousands of smaller Smooth Newts. The lack of water prevented fish colonising, yet it was supposedly present at the very time of year when newts do not breed! Perhaps the newts had shifted their breeding to autumn/winter in this mild part of Britain; more likely there was water present into late summer in a few years, often enough to allow the newt population to persist at high numbers but rarely enough to escape human attention.

## RECORDS AT THE MOAT

After the 1990 season, I began to record several kinds of data at the moat:

(1) The number of adults counted breeding in the moat in those years when it held water, under standard methodology to allow a rough cross comparison from year to year. Additional to providing purely scientific data, peak counts can be used as a guideline to judging whether a population reaches the criteria to be designated with SSSI (Site of Special Scientific Interest) status. The accepted 'score' was taken to be three years of counts successively with a minimum of 100 adults in the waterbody.

(2) The years in which water was present in the moat and, for those years, when it dried out.

(3) The estimated 'breeding success' of the population. Without quantitative methods, this can only be a relative measure, hence it was defined arbitrarily as '100%' if the water was present throughout the year when most of the larvae would achieve metamorphosis, ie until the end of October, and '0%' for years in which the water dried up before the end of July, with a gradually ascending 'success' value in the intervening months.

The methodology for the breeding census was to use a standard series of walked transects along several areas of bankside using the 2m width of the torchbeam to give the transect width. All meteorological parameters were kept as constant as possible, with counts taking place in late evening during early to mid May. Since the moat is managed in winter and excess vegetation removed, the ease of surveying remained unchanged and the water was clear and not choked with aquatic plants. Thus I think it is fair to say that variables which could have affected surveying were controlled as fully as possible.

Overall, due to the steepness of banks in many places and the large perimeter available for surveying, less than 10% of the moat banksides were surveyed, with the transects being taken from several regions to provide a representative selection of the aquatic habitat of the moat.

**Table of results**

**Crested Newt census and estimated breeding success results, 1989-1997 inclusive**

| Year | Number of adults counted | Estimated breeding success |
|---|---|---|
| 1989 | 0 | 0% |
| 1990 | 50 (partial census only) | 5% |
| 1991 | 0 | 0% |
| 1992 | 0 | 0% |
| 1993 | 263 | 100% |
| 1994 | 190 | 100% |
| 1995 | 259 | 5% |
| 1996 | 0 | 0% |
| 1997 | 0 | 0% |

## DISCUSSION OF RESULTS

From the tables above the following conclusions can be drawn:

(1) In the 9 years surveying, the moat has contained water in the spring in only 4 years, ie. less than 50% of the time.

(2) In only 2 of these years, ie. 1993 and 1994 has breeding been very successful, ie. less than 25% of the time.

(3) However, in two other years, 1990 and 1995, if water had remained for only another month or two, very successful years would also have resulted. This shows that there would have been considerable value in an artificial 'top up' of water **only in cases where water is present in spring** as a valuable management scheme.

(4) It was possible to undertake a census in the three consecutive years 1993, 1994 and 1995. The total number of adults counted each time was 263, 190 and 259 respectively, clearly exceeding the SSSI criteria described earlier. It was fortunate that there were three consecutive years allowing the counts, since irregular water is precisely the characteristic of this population, illustrating the inflexible and poorly thought-out original Crested Newt SSSI criteria. English Nature is now trying to adopt different and more flexible approaches than the one given above, and this is to be encouraged.

(5) The numbers given above resulted in an estimate of the total adult population at the site being made of between two and three thousand adults in 1995 by professional herpetologists Dr Tony Gent and Dr Richard Griffiths, making this the largest population in the county and probably the largest single-waterbody population in the country, at least in 1995.

## OBSERVATIONS ON THE STRUCTURE OF THE POPULATION, 1993-1995

At first sight, it looks as if the newts are well buffered from breeding failure judging by the counts in these three years. The numbers are fairly similar, at 263, 190 and 259. At the start of this article I asked if there was evidence that Crested Newts could weather several poor years of breeding by virtue of their adult longevity and survivorship. The data appear to support this point of view, since the adult count remains high and even increases in the last of the three years.

However, the data are somewhat misleading. In fact the population fell fairly rapidly from 1993 to 1994, from 263 to 190 represents an annual adult mortality (or loss from the moat breeding population at least) of 30%, if we accept that survey variables were well controlled between the two years.

In 1995 the figure indeed rises by almost 30% from 1994, but to see what is happening it is necessary to look at the size of adults in 1995 and also their sex....

During the first census of 1993 the majority of newts were in a large size class, with a visual estimate of between 140 and 150mm total length of most adults. In 1995 the absolute number was only four fewer than in '93 but there had been a shift from large and older animals to small younger individuals of about 100 to 120mm. That these represented newly mature animals was confirmed by the male-biased sex ratio of 4 to 1 rather than 1 to 1 two years previously, as males seem to mature a year sooner than most females.
The key conclusion is that a population which from raw data alone seemed very stable when examined closely revealed itself to have changed rather dramatically over two years – relatively few adults from 1993 appeared to survive to breed in 1995, although this was offset by successful breeding in '93 producing large numbers of newly mature animals, mostly males, in 1995. Further evidence for the changing nature of the population is obtained by looking at the 1994 census, when the numbers although high had been reduced to 190, a decrease of 30% on the previous year. Because there was no successful breeding in 1992, this mortality was not offset by recruitment and so we can see the real vulnerability of the population.

All of this is of more than academic importance – it has an important message for Crested Newt conservation. What may appear to be a stable population is likely to require successful breeding at least every few years if the population is not to dwindle. A few elderly individuals will survive over a decade as with most amphibians, but these will be vulnerable to chance extinction. Furthermore, the old SSSI criterion of three years successive counts over 100 takes no account of the likely fluctuations in many newt populations, and might lead to a site not being included because of this. In fact in spite of actually obtaining the high counts required for SSSI status, the bureaucracy of the system prevented English Nature from designating the site anyway, so the effort was wasted from a conservation perspective. It would still be worthwhile trying to implement the 'top up'regime mentioned earlier, ie. to ensure that some water remains during the years when breeding is possible in the spring by adding water artificially to the moat to try and maintain the possibly uniquely high numbers of animals using a single waterbody. At the time of writing this article, in December 1997, the moat has been dry throughout the year, but recent heavy rain might perhaps permit another successful season next year. I hope so, because without it the moat population will dwindle to a handful of individuals early in the next millennium and we shall be ecologically poorer as a result.

## ACKNOWLEDGEMENT

I should like to thank the weekend warden at the castle, Mr Stevens, for permission to access the moat after dark on many occasions.

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# NOTES ON THE NOCTURNAL ACTIVITIES OF THE NORTHERN VIPER *VIPERA BERUS* IN SOUTHERN ENGLAND

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Several of the European viper species are, to a greater or lesser degree, nocturnal in their habits and, although the Northern Viper *Vipera berus* has been found to be nocturnal in the southern parts of its range, in Britain and further north it is considered to be diurnal. Mattison (1986) states that a number of vipers, "notably the adder *Vipers berus,* hunt mostly during the day . . ." Stafford (1987) suggests they "emerge" as early as 0700 hours in the morning, whilst Prestt (1971) concluded that *V. berus* is diurnal after "extensive night searches failed to reveal a single active viper".

Having made an in-depth, twenty-year study of *V. berus,* in the vivarium, in an outdoor reptiliary and in the wild in both the north-west and the south of England it was my firm belief that this species was active during at least part of the night. Captive, vivarium-held specimens were frequently found to be moving around at different times throughout the night and would often slough and feed under the cover of darkness. Those contained in a large outdoor reptiliary were also found to be active between dusk and dawn on warm summer evenings.

These activities, however, all took place in captivity and the conditions were therefore obviously artificial. It was, of course, entirely possible that human activity in the vicinity of the captives during the day inhibited the snakes from acting normally, forcing them to carry on their usual routines under the security of darkness. Having maintained a variety of reptiles in captivity over a period of some forty years I was also well aware that what occurs in the confines of an enclosure, no matter how large or how closely it resembles an animal's natural habitat, is not necessarily what occurs in the wild.

During 1996 I visited several sites in the Dorset Purbecks, which I knew to have sizeable viper populations. It was a good summer and frequently so hot that many days passed without seeing a single specimen later than 0830 hours or earlier than 1630 hours. Several of those which were caught in the early morning, between the hours of 0600 and 0800, regurgitated undigested mice. Could these rodents have been hunted and eaten the previous night? Other vipers were observed moving through, or lying in, low vegetation or drinking from dew-covered foliage. Had these individuals been abroad all night or had they only just emerged from their sleeping quarters? I wanted the answers to these questions. I wanted to find out just exactly what happens in the life of *V. berus* after dark.

Watching even the largest of animals at night is difficult enough but looking for reptiles presents a real challenge. Their excellent camouflage and relatively small size makes them hard enough to locate in daylight never mind in the dark. They are also highly sensitive to movement and vibration, added to which most have a liking for habitats which have plenty of thick ground cover.

Fig 1: *Vipera berus* Heavily Gravid

Fig 2: The Study Site containing the Hibernaculum

Over a dozen night searches were made between May and June but, unfortunately, each one had to be aborted. I was ripped to pieces by gorse and brambles as I waded through waste-high undergrowth; I made too much noise as I stumbled over stones and boulders in disused quarries; the beam from my lamp was either too weak, or so strong it would have frightened away anything and everything upon which it fell long before I was near enough to see it; my head, neck, face and limbs were under a continual attack from a myriad of tiny biting insects; or a heavy sea mist would suddenly descend at a vital moment. Then, on a warm August evening some six weeks later I saw something which made me want to try again.

I had spent the day at Studland, taking photographs and looking at the local fauna and flora. It had been very hot with clear skies and a noon temperature of 28°C. Despite the area being home to all six of Britain's reptile species, with the exception of two sightings of adult female Sand Lizards, *Lacerta agilis* I saw no other reptiles, due almost certainly to the, at times almost uncomfortable, heat from an unforgiving sun.

I had wandered across the heath for several miles that afternoon and it was getting dark as I arrived back on the Ferry Road. I had not gone far when I was suddenly aware of something moving in the road just ahead of me. In the twilight I could just make out the familiar silvery-grey body and characteristic black markings of an adult male Northern Viper.

It was 2045 hours and here was, what seemed to be, evidence that *V. berus* is definitely active later than 1930 hours – the latest time recorded by Presst (1971). The heath borders each side of the Ferry Road and I hastened the snake's passage across the road and into the heather where I quickly lost sight of it.

Encouraged and excited by this I decided to plan another night search but, first, I needed to find a suitable site, and I needed to find a better method of illuminating what I was looking at. It all came together a year later in August of 1997.

I was engaged in photographing different colour variations in *V. berus* along the Dorset coast and was searching rough pasture and chalk grassland at Swanage, when I came upon three adult females, one heavily gravid (fig. 1). They had seen me approach and slid away into a hole in the bank on which they had been basking. I went away and revisited the spot on my way back some three hours later to find that there were now five individuals present around two entrances.

I checked the site (fig. 2) the following day but found only two adults. The next day there were four laying out around the entrances – three females and a male. A further two smaller males were nearby in long grass. I had found a hibernaculum to which the vipers were returning for the oncoming winter. As it was located in the bank of a deep hollow, possibly an old stone excavation site, it was ideally situated for watching the vipers' activities from the opposite bank without them being too aware of my presence.

I have always been dubious about the merits of watching the nocturnal behaviour of animals with the aid of a spotlight or such similar forms of lighting. I cannot see how one can be certain that the subject is acting naturally after it suddenly finds itself illuminated with a bright light.

Recent wildlife documentaries on television in which animals are filmed in complete darkness with special infra-red cameras and equipment which amplify available light have been impressive. I was therefore extremely fortunate to be given the opportunity of

using just such a piece of equipment – a Moonlight Night Vision 100 Compact – which meant I would now be able to sit and observe, unseen, in total darkness.

After one night of drizzly rain and several with heavy sea mists I finally had one where the conditions were just right. Monday 25th August had been hot and humid and as the afternoon progressed any clouds were quickly burnt away to reveal a clear blue sky.

I arrived at the hibernaculum at 1930 hours, some thirty minutes before sunset, and found myself a position from which I would have an unrestricted view of the entrance holes and immediate surroundings. I briefly searched the area and disturbed two snakes, about three metres from each other, both of which disappeared into the grass in the bottom of the hollow. Returning to my position I sat down and waited.

For a while I tested the Night Vision equipment by focusing on a dry stone wall, foliage, and trees nearby. Finally, peering through the scope's eye-piece, I panned it to the left and right aiming at the top of the bank and working my way down in a zig-zag motion. Immediately I noticed a movement in the opening of one of the holes. It was a viper. I followed it with the scope as it left the hole and slowly moved off into the grass. It was now 2040 hours and a second viper was moving down the bank from above. It came to rest on a rocky ledge where it remained in loose coils. There was a possibility that it could feel warmth that the rock had absorbed during the day although I must admit I could not detect any warmth in the rocks or soil around me.

For the next two hours I watched seven different individual vipers. Three remained within two or three metres of the hibernaculum while the other four seemed to leave the site altogether, possibly to search for food. I was beginning to feel a bit chilly by this time and, for a while, I thought the snakes were too for the three that remained on the bank retired into a hole and disappeared from view.

The view through the Night Vision scope scope shows everything in various shades of green. It was fairly simple however to distinguish male vipers from females, in most cases, by the tone of their markings, and one specimen from another by the markings on their heads and necks which are unique to each individual.

At 2235 hours a viper emerged from a different crevice in the bank and, tongue flicking rapidly, followed the trail of the three I had been watching earlier into the inner depths of the bank. Everything then remained still with no activity noticed, although a rustling from an unidentified source was heard in the grass nearby. The temperature at this time was 16°C.

Thirty five minutes later, at 2310 hours, I aimed the night scope in the direction of yet another rustling coming from nettles at the base of the bank on which I was sitting. After a minute or two a very large female viper emerged from the grass and slowly climbed the opposite bank towards one of the entrances to the hibernaculum. As she neared it I noticed that there was another snake just inside. I could not determine the sex of this individual but as their heads met they both became very excited, crawling over each other for some minutes, their tongues flicking continually, before they finally disappeared inside.

Apart from three or four short breaks of some fifteen minutes each, to stretch my legs and warm myself a little with a hot drink, I stayed in position at the site all night. Although activity in and around the hibernaculum appeared to decrease somewhat as the night went on, individual vipers continued to come and go until 0305 hours after which

no more were seen again until an adult male was observed entering another crevice, some two metres from the main entrance, at 0453 hours.

As the sun rose at 0610 hours I was able to scan the site without the aid of the Night Vision equipment and could see two females lying together in tight coils on bare chalky soil on the top of the bank. As the sun rose still higher one moved off into the dew-covered grass at the bottom of the bank while the other merely shifted position.

I wandered around the area, treading softly and moving slowly. During the next two hours I watched two of the individuals I had seen leave the hibernaculum the previous night return. One had a noticeable bulge and looked as if it had recently fed but I was unfortunately unable to examine it closely.

I finally left the area at 0840 hours, by which time only one viper was to be seen at the mouth of the main entrance to the hibernaculum – a large and very gravid female. The day turned out to be another hot one and I returned to the site again that night, between 2030 and 2230 hours, during which time I watched one viper enter the bank, two leave and a third, a sub-adult, moving about inside one of the entrances.

I was pleased with what I had seen over just two nights but, regrettably, could not devote any more nights to it. However, further night time field work is planned for 1998 to ascertain, if possible, whether nocturnal activity occurs at other times of the year, in other weather conditions, and in other locations.

## ACKNOWLEDGEMENTS

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# THE MOROCCAN GLASS LIZARD, *OPHISAURUS KOELLIKERI* (GÜNTHER, 1873), A NEW SPECIES IN ALGERIA

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*Ophisaurus koellikeri*, the only known anguid in Africa, is considered an endemic Moroccan species mostly found in forests, particularly those of *Cedrus atlantica, Quercus faginea* and *Q. ilex*, in subhumid areas (Schleich *et al.*, 1996; Bons & Geniez, 1996). It is abundant in the Middle Atlas, not so numerous in the Rabat-Casablanca-Essaouira area, and in parts of the High Atlas, including the Jbel Siroua. It is rare in the Souss plain. In eastern Morocco this species has been collected in the Jbel Tazzeka (Bons, 1960). Its presence in Gaada of Debdou (Mellado & Mateo, 1992) and Debdou (Bons & Geniez, 1996) suggests that it may also be found in Algeria.

One specimen of *Ophisaurus koellikeri* (EBD 19809) is kept in the reptile collection of the Estación Biológica de Donana. It comes from the Tlemcen mountains (north-western Algeria) and more precisely from the Tal Terny (wilaya of Tlemcen). The animal was caught by J. Pena on May 7, 1986. It is an adult male with a snout-vent length of 152 mm and total length of 375 mm. Its back is black-spotted but the blue spots evident on Moroccan male Glass Lizards are absent. The country where this animal was found was woodland at 1200 meters altitude. The other reptiles found in this site were *Lacerta tangitana, Podarcis hispanica, Psammodromus algirus* and *Malpolon monspessulanus.* This site is at the eastern and northern extremities of the range of *Ophisaurus koellikeri* and is close to the Mediterranean sea. It extends the geographic distribution of this species 170 km towards the North-East.

The presence of *Ophisaurus koellikeri* in Algeria was predicted by Bons and Geniez (1996) on the basis of three observations: (i) the relative proximity of the Debdou area to the Algerian frontier; (ii) the similarity of the Debdou and Tlemcen mountains which led Brosset (1961) to consider <<the Debdou-Tlemcen mountain dorsal>> as a single geographic entity; (iii) the existence of old unconfirmed descriptions of apod lizards in central and eastern mediterranean Algeria, for example *Anguis fragilis* and *Ophiomorus miliaris (= 0. punctatissimus)*, European reptiles unknown in Africa. Doumergue (1901) citing Gervais (1836) reported *Anguis fragilis* and *Ophiomorus miliaris* in Algier and Bône (now Annaba). Moreover, H. Martin found an apod lizard which was named *A. fragilis* in the south-east of Algier, in Aumale (now Sour el Ghozlane) (Olivier, 1894).

The capture of *Ophisaurus koellikeri* in the West Algerian highlands suggests that its range may extend further across the mountains to the east.

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# HERPETOFAUNA ASSOCIATED WITH *ERYNGIUM PANICULATUM* SHRUB IN SUBTROPICAL SAVANNAS FROM THE NORTHEAST OF ARGENTINA

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During herpetological studies in the subtropical savannas of northwestern Corrientes province (Argentina), we removed bushes of *Eryngium paniculatum* (Umbelliferae), a species with a foliar anatomy similar to that of Bromeliads (water storing and provides dry refuges at the base of senecent dry leaves). We discovered a high species richness and abundant herpetofauna associated with *Eryngium*. Each leaf was removed by means of a hoe. We captured sixty specimens of fourteen species (Table 1) during twenty hours of field sampling.

The snakes showed greater species richness and abundance (6 species and 44 especimens) than the lizards and amphibians (2 species and 9 specimens, and 5 species and 8 specimens, respectively). The Wormsnake *(Typhlops brongersmianus)*, a poorly represented species in Argentinian herpetological collections, was the most abundant (15 individuals). Egg clutches of three species, *T. bronsgermianus, T. oculatus* and *Philodryas patagoniensis,* were found. Those of the first two species were in the dry leaves of the base and the *Philodryas's* eggs in an ant nest of the genus *Atta.*

The high abundance of herpetofauna could be explained by the refuges offered by dry leaves, the abundance of associated microfauna as a feeding resource, and the breeding sites available. On the other hand, the presence of termite nests inside these plants gives refuges to termitophilous and mirmecophilous species.

There are few studies on fauna associated with *Eryngium.* Elizalde y Lallana (1992) compiled information on the insects and they comment that many species of Diptera, Coleoptera, Hemiptera, Lepidoptera, Himenoptera, Homoptera and Neuroptera live inside the leaves. Amongst birds, the Saffron-Cowled Bird *(Xanthopsar flavus)* and the Straight-Billed Bird *(Limnoctites rectirostris)* use these plants for nesting (Fraga & Babarskas, com. pers.) and in the subtropical grasslands several amphibians take refuge on the leaves, principally *Argenteohyla siemersi, Hyla berthae, Hyla pulchella, Hyla nana, Hyla sanborni, Physalaemus henseli, Scinax squalirostris* and *Scinax nasica* (Barrio, 1962; Cei, 1980; Gallardo, 1987; Gallardo y Varela de Olmedo, 1992). No data about reptiles were found in the literature.

**Table 1. Herpetological fauna associated with *Eryngium paniculatum* shrub in Corrientes province, Argentina**

| Taxa | Common name | Number of specimens |
|---|---|---|
| AMPHIBIA (ANURA) | | 8 |
| BUFONIDAE | | 2 |
| *Melanophryniscus* cf. *stelzneri* | Red Belly Toad | 2 |
| HYLIDAE | | 1 |
| *Scinax nasica* | Lesser snouted-Tree Frog | 1 |
| LEPTODACTYLIDAE | | 5 |
| *Leptodactylus chaquensis* | Criolla Chaquenian Frog | 2 |
| *Leptodactylus gracilis* | Striped Frog | 1 |
| *Physalaemus albonotatus* | Menwing Frog | 2 |
| REPTILIA | | 52 |
| LACERTILIA | | 9 |
| TEIIDAE | | 2 |
| *Teius oculatus* | Green Lizard, Teyú | 2 |
| ANGUIDAE | | 7 |
| *Ophiodes intermedius* | Mboi Capií | 7 |
| SERPENTES | | 44 |
| TYPHLOPIDAE | | 15 |
| *Typhlops brongersmianus* | Wormsnake | 15 |
| COLUBRIDAE | | 28 |
| *Liophis poecilogyrus* | Common Water Snake | 5 |
| *Oxyrhopus guibei* | False Coral Snake | 1 |
| *Oxyrhopus rhombifer rhombifer* | False Coral Snake | 6 |
| *Philodryas patagoniensis* | Savanna Racer Snake | 4 |
| *Sybinomorphus turgidus* | NCN | 13 |

The expansion of *Eryngium* in the local savannas is related to agricultural development and road building (Lallana *et al,* 1991; Sabattini, *et al.,* 1991); therefore we can suppose that the expansion is recent, having unknown consequences on the herpetological community. This pattern should be studied in more detail.

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**Education Officer**

Vacant. Enquiries to Mrs. Green (above)

**Observer Status**

| | | |
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| Dr C.J. McCarthy<br>Dept. of Zoology<br>Natural History Museum<br>Cromwell Road<br>London SW7 5BD<br>0171-938 9123 | Herpetological Conservation Trust<br>c/o Dr I.R. Swingland<br>Durrell Institute of Conservation<br>& Ecology<br>University of Kent<br>Canterbury CT2 7NX<br>Tel: 01227 764000 | Dr M. Lambert (IUCN)<br>Environmental Sciences Dept.<br>Natural Resources Institute<br>Central Avenue, Chatham Maritime<br>Kent ME4 4TB, UK<br>Tel: 01634 883201 (work)<br>0171 589 3558 (home) |

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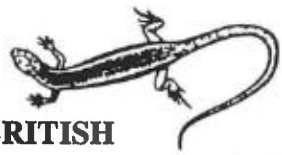

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