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THE BRITISH HERPETOLOGICAL SOCIETY

BULLETIN

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BRITISH HERPETOLOGICAL SOCIETY

c/o Zoological Society of London
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Correspondence, membership applications, subscription renewals and purchase orders for the British Journal of Herpetology should be sent to the above address.

The British Herpetological Society was founded in 1947 with the broad aim of catering for all aspects of interest in reptiles and amphibians. Initiated by a small number of enthusiastic and well-known naturalists, including the first President and author of the standard textbook on British herpetofauna Dr. Malcolm Smith, the Society expanded rapidly and today enjoys national status with many international connections.

Activities of members range over a number of interrelated fields. In many cases the prime interest is in maintaining, breeding and observing various species in captivity and the Society acts as a forum for the interchange of experiences in this area. Others are concerned with the observation of animals in the wild state. There are active sub-committees which help to cater for these various tastes, notably the Captive Breeding Committee and the Conservation Committee. The former encourages the development of effective breeding techniques for captive specimens, thus providing animals for observation and study in vivaria, and for conservation purposes, while simultaneously reducing the need to take fresh stock from wild and possibly declining populations. The Conservation Committee is actively engaged in field study, conservation management and political lobbying with a view to improving the status and future prospects for our native British species. It is the accepted authority on reptile and amphibian conservation in the U.K. and has an advisory role to the Nature Conservancy Council (the statutory Government body). There are also professional scientists within the ranks of the Society engaged in increasing our understanding of all aspects of reptile and amphibian biology.

Meetings

About ten meetings covering a broad sphere of interests are held each year.

Subscriptions

Ordinary Members £15. Junior Members £5. (Junior Members do not receive the British Journal of Herpetology). Institution rates £25 (U.S. $40).
All subscriptions become due on the first day of January each year.

The Bulletin is 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:
Part of a brood of 13 Emerald Tree Boas *(Corallus canina)*, born on 15.9.88 following an 8.5 month gestation period. Mean weight of babies 38.3g, range 34-42g. These represent the first UK captive breeding of this species. (Simon Townson)

REMAINING MEETING 1988

NOVEMBER 30th — Mike Linley ('Survival', Anglia Television, London and chairman, Captive Breeding Committee) will show some herpetological films not previously screened by Anglia TV.

PHOTO CREDITS FOR PREVIOUS ISSUE

The credits for the colour plates in the previous issue of the Bulletin (No. 24, September 1988) were omitted in error.

The Cover Plate, of a Rhinoceros Viper, *Bitis nasicornis,* was by Stephen Peltz.

Plate 1, on page 25, of a West African Gaboon Viper, *Bitis gabonica rhinoceros,* is by Chris Mattison.

Plate 2, on page 25, of the head of a West African Gaboon Viper, is by Mike Nolan.

LONDON MEETINGS 1989

Meetings are held in the Lecture Theatre of the Linnean Society of London, Burlington House, Piccadilly, London, W1, and start at 7.00 pm, ending at 9.00 pm, unless indicated otherwise.

FEBRUARY 28th	Dr Peter Evans (Department of Zoology, University of Oxford): Herpetofauna of the Commonwealth of Dominica (Windward I., Lesser Antilles), West Indies.
MARCH 7th	A.G.M. (see separate Agenda) followed by a talk (speaker to be arranged).
APRIL 25th	Mr Daniel Bennett (Glossop, Derbyshire): Goannas, monitors and other varanid lizards in the world.
MAY 23rd	Dr Christopher Raxworthy (Biology Department, Open University): Herpetofauna of the threatened rain forests of Madagascar – a unique habitat.
JULY 4th	*Amphibia and Reptilia worldwide: their care and breeding.* A discussion organised by the Captive Breeding Committee (Chairman: Mike Linley). Members are encouraged to bring live animals, preserved specimens, amphibian voice recordings and 35mm colour slides for display and to illustrate discussions.
AUGUST 30th	Dr William Branch (Port Elizabeth Museum, South Africa): Herpetofauna of southern Africa.
SEPTEMBER	*Care and breeding of amphibians and reptiles: an open meeting.* Contributions from members – live animal display, slides etc. There will be the opportunity for the sale and exchange of members private home-bred stock. Venue and date to be announced.
OCTOBER 10th	Speaker to be arranged.
NOVEMBER 29th	Speaker to be arranged.

PROVISIONAL MINUTES OF THE 41st ANNUAL GENERAL MEETING OF THE BRITISH HERPETOLOGICAL SOCIETY held in the Lecture Theatre of the Linnean Society of London, Burlington House, Piccadilly W1 at 7.30 pm on March 29th 1988.

Twenty-eight members and one guest signed the attendance roster.

The President of the Society, the Earl of Cranbrook, took the chair.

1. Minutes of the previous A.G.M. Due to an oversight, the provisional minutes were not included with *BHS Bulletin* nos 21/22, Winter 1987, and were therefore read out by the Chairman of the Society.

2. Matters arising. The minutes would be published in a future Bulletin.

3. Treasurer's report and discussion. An audited account of income and expenditure had been circulated to members. The Society's bank balance was in a healthy condition. The old photocopier with a trade-in price of £450 had been replaced by an excellent new one. Money had been passed over for the publication of the Captive Breeding Committee's symposium volume. Mr W. Whitaker commented on the excess of assets over liabilities and Lord Cranbrook pointed out that the £8434 in the deposit account was a prudent reserve sum enabling bills to be paid promptly. The President thanked Mrs M. Green for her diligence and there was prolonged acclamation.

4. Election of Officers and Members of Council. Further nominations for Council had not been received and it was proposed by the President and agreed *nem. con.* that the persons named in the printed Agenda be elected *en bloc.*

5. Council's report and discussion. Concerning the Bulletin, Prof. G. Haslewood made the point that this should be published quarterly and is for the benefit of members. Dr S. Townson replied that although the Bulletin had sometimes been late, only two numbers, 21/22, had been telescoped. The report was accepted *nem. con.*

6. Report of the Education Officer (Junior Section). A full report will be included with the Bulletin. Mr V. Taylor had received 250 letters of enquiry, including membership applications. Mr C. Fitzsimmons was to be the Exhibitions Officer. At the end of 1988, there was to be a Christmas lecture on herpetology in London held jointly with the Zoological Society of London. Minutes were to be taken in future at Education Coimmittee meetings. There was acclamation in response to a vote of thanks by the President.

7. Report of the Conservation Committee. A full report will be included with the Bulletin. Prof. Haslewood has served as Chairman for five years up to the end of 1987. His place had been taken by Mr Whitaker. A special vote of thanks for all Prof. Haslewood's work, through which the Society had gained great credit, was made by the President and this was followed by prolonged acclamation.

8. Report of the Captive Breeding Committee. Mr M. Linley indicated that as with the other committees, a full report would be included with the Bulletin. He pointed out that the pamphlet on crested newts was still available and displayed an example. There was to be another joint British herpetological societies symposium on captive breeding and general herpetology at the Zoological Society of London on September 11th 1988. It was hoped to hold the Society's Saturday open meeting on the care and breeding of species during the afternoon before (10th September). Further leaflets on the captive breeding and husbandry of amphibians and reptiles were being written and/or revised. Mike Linley was writing one himself on *Physignathus* water dragons in response to demand. The President congratulated the committee on its activities which was followed by acclamation.

9. Report of the Research Committee. No report given.

10. Any other business. Mrs Green read out two letters that she had received from members regarding the Bulletin. One requested the publication of reports on meetings so that members unable to attend may be kept informed. Dr Lambert replied that it was current practice for speakers when thanked to be requested to let the Bulletin have a 100 to ca. 1000 word outline of their talks. Unfortunately, not all speakers wished to do this. The other correspondent requested that there should be articles on captive breeding/husbandry in the Bulletin as well as scientific ones. Dr Lambert pointed out that the Co-Editors depended on the material submitted for publication in the Bulletin and Dr Townson indicated that an attempt was made to maintain a reasonable balance of subject matter from one Bulletin number to the next.

Dr. Lambert announced that the 3rd European Chelonian Symposium (the first had taken

place at Nancy, France, in 1980 and the second at Oxford in 1981) was to take place in the Natural History Museum at Marseilles, France, 6-8 July 1988.

Lord Cranbrook announced that he had held a successful field course on tropical biology in Malaysia during 1987, and was going to take a Field Studies Council course to Sarawak in September 1988.

Mr. P. Curry enquired in what way could the BHS assist the First World Congress of Herpetology at Canterbury in 1989. Dr Lambert invited Dr R.A. Griffiths, the member of the UK National Executive responsible for coordinating the activities of volunteers, to reply. He indicated that among other functions, volunteers were required to run the various desks. Although the symposium speakers were by invitation only, he also pointed out that posters were to be contributed. Mr. Linley and Dr Townson expressed an interest in the Captive Breeding Committee mounting a display.

The formal business ended at about 8.00 pm and was followed by a talk by the Legal Officer, Mr Curry, on "A case for captivity". This prompted a lively discussion.

PROVISIONAL MINUTES OF AN EXTRAORDINARY GENERAL MEETING OF THE BRITISH HERPETOLOGICAL SOCIETY ON MAY 26th 1988

An Extraordinary General Meeting was held at 7.00 pm on May 26th 1988 in the Lecture Theatre of the Linnean Society of London, Burlington House, Piccadilly W1.

The Chairman of the Society, Dr. M.R.K. Lambert, took the Chair.

The Attendance Sheet was signed by 30 members and nine guests.

There was insufficient notice before the 41st A.G.M. on March 29th 1988 to include proposed Alterations to the Rules and circulate them to all members. Referring to the Society's Rules published in *BHS Bulletin* no. 12: 1-4, June 1985, the following changes were approved:-

(i) Rule 6. COUNCIL. (a). Composition. The representative of the British Museum (Natural History) Reptile and Amphibian Section (if none is already on Council) is to be an Official of the Society (as specified in Rule 6 (f)/. *(Nem. con.).*

(ii) Rule 6. COUNCIL. (b). Powers. A quorum at Council Meetings shall be seven Members. *(Nem. con.).*

The business of the Extraordinary General Meeting was followed by a talk by Mr David Ball "Captive breeding of reptiles in the London Zoo".

JOURNAL EDITOR'S REPORT, 1987

GENERAL MATTERS

Both editions of the Journal were produced and circulated on time in 1987. New aspects included a "Forum", in which controversial aspects of herpetology can be aired, and the promotion of advertising (starting in the December issue). It remains to be seen as to how much advertising can be attracted to the Journal, but my suspicion is that it will make only a minor contribution to the economics (input from December was £175). A circular expounding the merits of the Journal to potential authors was circulated in June, essentially in response to my survey of contributors in Autumn 1986. It may have had some effect on submission rate (see below), and it's handy to have for general publicity reasons. Also, a long-overdue index for volume 6 of the British Journal of Herpetology was produced and circulated with the June issue. Finally, I have reinstituted the publication of book reviews in the Journal, hopefully as a regular feature from now on.

COSTS

Production costs for the two 1987 editions totalled about £3,300, slightly up on 1986; partly

this was because printing costs rose, and partly because the December edition was a big one. Total expenditure (excluding postage) therefore amounted to £3,300 + £200 (leaflet) + £260 (BJH index), ie £3,760. In recompense, we received about £3,000 from institutional members, + £175 (advertising) + £100 for extra reprints, ie £3,275. There was therefore a "deficit" (ie a net cost to the Society) of about £500, a contrary situation to 1985 and 1986 when there was an apparent "profit". The deficit was of course mainly due to one-off costs (leaflet and index) unique to 1987, though the decline in institutional membership has also had an impact. This decline is being faced by many societies, as a result of cuts in library budgets, and is something we can do little to counter in the short term. Our only lever is to maintain/raise the standard of the Journal, so that more pressure is put on libraries to take it. This is a difficult game!

PAPERS SUBMITTED

30 papers were submitted to the Journal in 1987, of which 18 (60%) were accepted for publication. This compares with 27 & 22 (80%) respectively for 1986. The increase is larger than immediately apparent, since two of the 1986 papers were solicited reviews (no reviews were received in 1987, but I am trying!); so the "real" increase in submissions was 20% – a welcome reversal of the downward trend between 1982-6. Closer inspection of the figures shows that submission of non-UK papers has been relatively constant since 1980 (averaging 19, range 14-23; 20 in 1987) whereas UK papers created the submission "peak" of the early 1980s. UK numbers have varied 9-24, with 23/24 in 1982 & 1984, & 10 in 1987 (UK average = 16). So we need more UK papers!

As usual, I take the opportunity to thank referees of papers submitted in 1987 for their prompt and efficient assistance. These were: Dr. R.A. Avery; Dr. B. Clarke; Dr. C. Cummins; Dr. R. Dmi'el; Prof. C.H. Ernst; Dr. J.J. van Gelder; Dr. R.A. Griffiths; Dr. A. Hailey; Dr. M.R.K. Lambert; Dr. L. Lawrence; Dr. C.J. McCarthy; Mr. R. Meek; Dr. C. Reading; Dr. I.F. Spellerberg; Dr. I. Swingland; and Prof. Y.L. Werner.

I am indebted to all of them.

Trevor BeeBee January 1988

REPORT ON THE 4th ORDINARY GENERAL MEETING OF SOCIETAS EUROPEA HERPETOLOGICA AT NIJMEGEN, THE NETHERLANDS, 16-21 AUGUST 1987

The 4th O.G.M. of SEH was held at the Faculty of Science of the Catholic University of Nijmegen in the Netherlands on 16th-21st August 1987. The three members of the organizing committee were Dr. Jan J. van Gelder, Dr. Henk Strijbosch, and Mr. Jan H. Aalbers. A total of 176 participants from the following 23 countries registered for the meeting: FR Germany (35 participants), Spain (24), the Netherlands (22), France (16), Austria (13), Great Britain (11), Belgium (7), USA (7), Greece (6), Czechoslovakia (4), GDR (4), Sweden (4), Hungary (3), Israel (3), Italy (3), Poland (3), USSR (3), India (2), Switzerland (2), Australia (1), Nigeria (1), Norway (1) and Surinam (1). As usual during such events, not all registered participants were able to attend. It is particularly sad to have to note that the entire Soviet delegation was prevented from coming to the meeting. There were 11 registrants from the UK: Dr. E.N. Arnold (British Museum (Natural History), London), Dr. Trevor Beebee (University of Sussex, Brighton), Mr. Clive Cummins (ITE Monks Wood, Huntingdon), Mr. Keith Corbett (Chairman, SEH Conservation Committee), Dr. Richard A. Griffiths (UWIST), Dr. M.R.K. Lambert (BHS), Mr. Tom Langton (BHS), Dr. C.J. McCarthy (British Museum (Natural History), London), Mr. Chris Perkins (University of Bristol), Mr. David Stubbs (London) and Mr. Wolfgang Wüster (University of Aberdeen). Unfortunately, Dr. E.N. Arnold was unable to attend the meeting. The participants stayed at various hotels in and around Nijmegen, and some stayed on a camping site.

PROGRAMME

The programme for the meeting consisted of a brief opening ceremony, a total of 18 scientific sessions, 3 workshops, the Ordinary General Meeting, a choice of two field excursions and several social occasions.

OPENING CEREMONY. The meeting was opened by the President of SEH, Professor Benedetto Lanza, who welcomed the participants to the meeting. This was followed by a brief speech by Dr. Ir. L.H.J. Wachters, Director of the Faculty of Science of the University of Nijmegen.

SCIENTIFIC PROGRAMME. A total of 67 papers was read during the 18 scientific sessions. The sessions were as follows:

Session on Convergence. Chairman: W. Böhme (Bonn)
Session of Taxonomy and Phylogeny I. Chairmen: B. Lanza (Florence and G. Macino (Pisa).
Session of Ecology of Amphibia I. Chairmen: L. Berger (Poznan) and R. Günther (Berlin).
Session on Development. Chairmen: B. Sanchiz (Madrid) and E. Olmo (Napoli).
Session of Threats and Conservation. Chairmen: A. Stumpel (Arnhem) and K. Grossenbacher (Bern).
Miscellaneous Session. Chairman: H. Schneider (Bonn).
Session on Telemetric Studies. Chairmen: J.W. Gibbons (Aiken, S.C.) and T. Pilorge (Paris).
Session on Taxonomy and Phylogeny II. Chairmen: U. Joger (Darmstadt) and G. Nilson (Göteborg).
Session on Reproduction of Reptiles. Chairman: M.S. Hoogmoed (Leiden).
Session on Vocalization and Behaviour. Chairman: H. Hemmer (Mainz).
Session on Ecology of Amphibians II. Chairmen: J. Lescure (Paris) and J. Rafinski (Krakow).
Session on Morphology. Chairmen: B. Viertel (Mainz) and Z. Rocek (Prague).
Session on *Lacerta vivipara*. Chairmen: A. Bea (San Sebastian) and D. Glandt (Metelen).
Session on Ecology of Reptiles. Chairmen: R. Barbault (Paris).
Session on Taxonomy and Phylogeny III. Chairman: C. Andrén (Göteborg).
Session on Distribution. Chairman: J. Eiselt (Wien).
Miscellaneous Session. Chairmen: Z. Korsós (Budapest) and M. Lambert (London).
Session on Old World Urodela. Chairmen: G. Degani (Kiryat Shmona) and R. Klewen (Koln).
The opening session of the scientific programme, on convergence, was to have been co-chaired

by Dr. Dick Hillenius (Amsterdam). Sadly, Dr. Hillenius died just two months before the meeting, in May, and a minute of silence was observed at the start of the session as a mark of respect for his contribution to herpetology. An Obitury was published in *Amphibia-Reptilia* 8(3) in August 1987.

In addition to the oral contributions, approximatley 50 posters were on display in the foyer near the lecture rooms, covering subjects ranging from cytogenetics to conservation, and from systematics to morphology and ultrastructure.

Participants' attention was particularly drawn to two of the sets of posters on display. One by Suzette E. Stumpel-Rienks was a list of vernacular names of the European reptiles and amphibians (compiled from different literature sources), which participants were asked to check and complete. The other, a display of eleven posters, had been compiled by the members of the SEH Conservation Committee (C. Andrén, E. Balletto, K. Corbett, B. Groombridge, K. Grossenbacher, J. Martinez Rica, R. Podloucky and A. Stumpel): "Critical habitat and biogenetic reserve recommendations for Europe's most threatened herpetofauna". The work has been undertaken as part of a Council of Europe project instigated by the Environmental Conservation and Management Division (Head: Dr. Jean-Pierre Ribout). The work was financed by the World Wildlife Fund Project 3167 Europe: Identification of critical habitats of amphibians and reptiles. Keith Corbett (Chairman, SEH Conservation Committee) talked about the work at the BHS 40th AGM in 1987. The display was excellent and warrants separate consideration as follows:-

1. Marine turtles – loggerhead *(Caretta caretta)* and green turtle *(Chelonia mydas)* Biogenetic reserves (BRs) at a) Italy (2), b) Greece (3, including a strong recommendation for Zakynthos), c) Turkey (2, including a strong case for Dalyan) and d) Cyprus (6).

2. *Rana latastei.* BRs in Italy at a) Boscadella Fontana, near Mantua, and b) Oasi Le Bine, between Cremona and Mantua.

3. *Pelobates fuscus insubricus.* BR in Po Valley, N. Italy.

4. *Alytes (Baleaphryne) muletensis.* BR on Mallorca (Spain).

5. *Bombina bombina.* BR in River Elbe flood plain, east of Brunkendorf, FR Germany.

6. *Pordarcis lilfordi, P. pityusensis.* BRs in the Balearic Islands, on several islets off Mallorca, Ibiza and Menorca, including Cabrera, Maltona, Vedrà and Dragonera.

7. *Vipera lebetina schweizeri* and *Podarcis milensis.* BR on western part of Milos island (Greece).

8. *Vipera ursinii rakosiensis* (meadow viper). An innocuous, mainly insectivorous species of the puszta habitat, Danube flood plain, Hungary and E. Austria. Critically endangered, but no BR yet designated.

9. *Vipera ursinii ursinii.* BR proposed for Campo Imperatore of Gran Sasso, Appenines, C. Italy. Species occurs on southern slopes, 1400-2400 metres.

10. E. Sardinia (Golfo di Orosei to Baunei), a BR proposed. Includes endemic Sardinian species and subspecies: *Hydromantes genei flavus, Euproctus platycephalus* and *Natrix natrix cetti;* and Tyrrhenian species and subspecies: *Discoglossus sardus, Hyla arborea sarda, Phyllodactylus europaeus, Algyroides fitzingeri, Podarcis tiliguerta* and *Podarcis sicula cettii.*

11. Evros, Greece, A BR would include *Ophisops elegans, Lacerta praticola* and *Vipera xanthina* (Ottoman viper). Shell remains of *Testudo graeca* and *T. hermanni* were found in the nest of a golden eage, emphasising the fact that this is also an area of international importance for the conservation of birds of prey.

In addition, there were workshops on telemetry (Chairman: M. Stanner, Tel Aviv), vocalization (Chairman: H. Schneider, Bonn) and on *Lacerta vivipara* (Chairman: D. Bauwens, Hasselt).

ORDINARY GENERAL MEETING OF SOCIETAS EUROPAEA HERPETOLOGICA

The business meeting of the Society was held in the morning of Tuesday 18th August in the Faculty of Science at the University of Nijmegen. Dr. Marinus Hoogmoed (Leiden) was

elected to the chair. Dr. J.P. Gasc (Paris) was elected to the post of Vice-President, replacing Dr. J. Lescure; Dr. U. Joger (Darmstadt) replaced Dr. M.S. Hoogmoed (Leiden) as General Secretary of SEH; Dr. K. Grossenbacher (Bern) took the place of Dr. F. Tiedemann (Wien) as Vice-Treasurer, and Dr. J.J. van Gelder (Nijmegen) replaced Prof. H. Hemmer as First Co-Editor, leaving the post of Second Co-Editor unoccupied. Dr. R.A. Avery was elected to this post. Several other points were discussed during the meeting, including the advisability of distribution of *Herpetofauna News* together with *Amphibia-Reptilia*, and alleged editorial bias in the latter journal. A large amount of time was spent discussing the thorny and emotion-laden subject of language: a proposed change of statutes would have made the English language compulsory for oral contributions. This was very unpopular with certain continental delegations, and the change of statutes was amended to make the use of English "strongly recommended" rather than mandatory, especially since *Amphibia-Reptilia* publishes over 80% of papers in English, notwithstanding the four language options presently available. It was also proposed that the dates of SEH meetings should be fixed so as to avoid clashes with those of herpetological societies in America, thus making attendance easier for Americans; liaison on dates should be better in the future. The venue of the next OGM (1989) will be Canterbury as part of the first World Congress of Herpetology of which SEH is Co-Host; the offer of Florence by Prof. B. Lanza for the 1991 meeting was greeted by acclamation.

SOCIAL PROGRAMME

One of the main reasons why scientists attend international meetings is that they represent a good opportunity to meet their colleagues socially and to have a few drinks with them (in this instance genever gin or beer, according to taste). Every good congress therefore offers a substantial range of social occasions to its participants. In this respect (and not only in this respect, we hasten to add), the 4th O.G.M. of the SEH was a good congress. The first social occasion of the meeting was a social drink at the Hotel Erica, just outside Nijmegen, on the evening of Sunday 16th August, a most welcome event for the herpetologists who had just arrived from all parts of Europe by the least inconvenient means of transport that their generally impecunious state allowed. After the final session on Monday 17th August, the participants were to be found enjoying a welcome drink at the Faculty of Science, which was followed by a wholly excellent dinner at a Chinese restaurant in Central Nijmegen. On Tuesday, the participants were left to forage for themselves in Nijmegen, a rather expensive pastime in the Netherlands, were it not for Indonesian restaurants. On the evening of Thursday 20th August, those participants still present were rewarded with a festive dinner at the Hotel Erica. The field excursions on the Wednesday 18th August will be dealt with below.

EXHIBITIONS AND DISPLAYS

Most congresses boast a variety of events and exhibits as sidelines, and for the purposes of this report, it seems not inappropriate to treat them as part of the social programme. There was a display of extremely good drawings of the 16 Netherlands amphibian species by the Dutch wildlife artist Bas Teunis, which were for sale, and an exhibition of telemetry equipment; some of this was seen in action during the field excursions.

Particularly noteworthy was an exhibition of live specimens of all the herp species occurring in the Netherlands, with the exception of the highly endangered *Bombina variegata* and *Podarcis muralis*. This exhibition took the form of a somewhat unusual self-service buffet, visitors being free to help themselves to any of the specimens in order to take photographs of them in natural light or in the empty "photo-cages" provided. Among the more interesting exhibits were the land phases of the four Dutch species of *Triturus* (the three British species and *T. alpestris)*, which, unlike the aquatic phases, are rarely seen in nature. The Spadefoot Toad *(Pelobates fuscus)* was generally found to be of high entertainment value. These rather rotund toads with enormous bulging eyes have the habit of burrowing into the sand within seconds after being released onto it; for this reason, any attempt to photograph the animals involved excavating them from the substrate in their cage, and subjecting the unfortunate creatures to a quick, cold shower under a tap in order to wash off the sand and make them look fit to be photographed. Another exhibit of high entertainment value was the Adder cage, where one could observe the amusing spectacle of large numbers of European herpetologists confronting venomous snakes. Since being bitten by an adder in front of several dozen colleagues during a congress is probably one of the worst ignominies that can befall a herpetologist,

many of the participants exercised greater caution than usual while handling these snakes, or simply desisted altogther. One interesting handling method demonstrated by the technical assistants was the "snake in the tube" technique: the Adder is picked up by the tail, and then persuaded to crawl up a transparent plastic tube with a diameter just greater than that of the snake. Once the front half of the snake is in the tube, the rear end can be safely held and manipulated. This technique is particularly useful for operations such as the clipping of ventral or subcaudal scales in field studies. We look forward to seeing it performed in the field on black mambas and taipans!

DAY EXCURSIONS.

There were two whole-day excursions on the Wednesday (19 August). One was to the nature reserves of De Hamert and Meynweg in the Province of Limburg (the south-eastern part of the Netherlands), and included a visit to the Natural History Museum at Maastricht; the other started with a visit to Hartertse en Overasselte vennen, a nature reserve near Nijmegen with a wide range of ponds in an inland dune system rich in amphibians, followed by a visit to the delta control mechanism in the Province of Zeeland.

A final call by Jan van Gelder and the coach load of herpetologists bound for the south-east departed from the University faculty forecourt in dull overcast conditions and made its way through the Province of Gelderland to Limburg. After an hour and a quarter's journey along the N271 from Nijmegen (Michelin map 212) through green, intensely cultivated flat land, we turned left onto a dirt track at De Hamert, precisely according to plant. After a kilometre or so, the coach came to a halt scarcely a kilometre from the German border and we piled out. We were met by the Warden of the reserve and two assistant. Jan led his flock a further kilometre or so down the rough track to a large pond surrounded by reed vegetation. Three adult *Rana esculenta* in the pond had been fitted with radio transmitters and the telemetric method of locating them was demonstrated by a student, Leo Hesen. The position of one frog was successfully ascertained on the 121-125 mhz wave length. A splendid explanation of the principle was provided by Jan (clear evidence of his lecturing experience coming across!). An amphibian trap had also been placed into position earlier and on being brought to an open area at the edge of the pond revealed newly metamorphosed *Triturus helveticus* together with three similarly metamorphosing *Rana arvalis* with their tails still in the process of being resorbed. Unfortunately, neotenous *T. helveticus,* which also occur in the pond, were not found in this trap. Three further newly metamorphosed frogs were found in grass by the side of the mixed mud and compacted sand track along which the herd of trampling herpetologists subsequently proceeded before slowly climbing up to a dune ridge. Jan informed us that *Lacerta agilis* occurred in the area together with *Coronella austriaca.* Transmitters had been fitted to ten of the snakes, including pregnant females, enabling their hibernacula to be located. Non-pregnant females behaved like males. About 100 c. *austriaca* occurred in the area and the movement of those fitted with transmitters had been recorded for up to six months. Acid rain from industry had affected the *Calluna* heather and the growth of trees. Cows are allowed to graze the area. As part of the Reserve's habitat management programme, the top layer of heather is removed to encourage new growth on the exposed area. Upon returning to the coach, the ever inquisitive herpetologists revealed two *Anguis fragilis,* one by WW and another by Max Sparreboom, this time in his homeland, whose ability to find species we remembered from the SEH meeting's field excursions from Leon (Spain) in 1983.

The next coach halt was for coffee at the Jachthut (= hunting lodge) opelen Hamer, a roadside cafe-restaurant on the River Maas and not far from the village of Arcen en Velden. Fruity pastries accompanying the coffee ensured that body and soul of the visiting herpetologists were most effectively kept together! The coach continued a further 50 or so kilometres by way of Venlo and along the N273 to arrive at the most delightful old cobble-street village of Thorn, on the Belgian border (just 11 km south-west of the small town of Roermond), and set at the edge of a series of flood channels making up a meandering part of the Maas. Lunch was provided by De Waterput (= waterwell) Restaurant opposite the 11th century abbey church with its fine clock tower. Upon completing our meal, Jan, by now accompanied by his staff colleague, Henk Strijbosch, led us through the streets of the village and over a bridge back to the coach. We continued to the Meynweg reserve, where again, completely according

to plan to which we were becoming accustomed, we were met by the Warden clad in his green uniform. Henk gave us some herpetological background to the area. Ponds in the river terraces yielded ten species of amphibians: four newts, *Triturus alpestris, T. helveticus, T. vulgaris* and *T. cristatus;* three toads, *Pelobates fuscus, Bufo bufo* and *B. calamita,* and three frogs, *Rana lessonae, R. esculenta* and *R. arvalis.* Henk had also carried out research on egg-laying in *Lacerta agilis* in the area, finding 500 eggs during Summer 1986. A quick search in one of the duckweek-covered ponds soon revealed a splendid male *Rana esculenta;* an adult female *R. lessonae* was also found and the distinction from *R. esculenta* in the enlarged metatarsal tubercles on the heels of the hind limb carefully pointed out. A dip with a net brought up two neotenous *Triturus helveticus.* Led by Hank and accompanied by the Warden and his assistants, we then followed a track parallel with the German border scarcely a hundred or so metres away through an area of mixed grass and heather.

By now, at nearly 3.00 pm, the sky was clearing with sporadic bursts of sunshine several *Lacerta agilis* were seen as the herpetologists started to range over a wide area; a male, a female and immature specimens were disturbed as they started to bask. *Lacerta vivipara* adults were also seen, in addition to two recently metamorphosed brown frogs, probably *Rana arvalis.* Snakes also started to emerge with the bursts of sunshine – first a juvenile *Vipera berus* with a very short tail. The combined effort of Wolfgang Böhme and Konrad Klemmer then produced an adult female *V. berus,* like the juvenile, a reddish-coloured form, and an adult *Coronella austriaca.* A student accompanying the party had also by then caught two more female *V. berus,* also reddish – one just having given birth, and a male. Two clutches of *Larcerta agilis* eggs were carefully revealed in the sand spoils outside a rabbit burrow which were about 12 cm deep. Henk indicated that the clutches averaged 6.7 eggs (range two to 12).

With the green-uniformed Warden, we returned along the sandy track to the coach, which then proceeded from Meynweg through villages with such names as Herkenbosch, Melick, St. -Odilienberg and Linne back to the N271 and thence the last 30 km by the A2 motorway to Maastricht, the main town of Limburg. Set on the River Maas, many heavily-laden barges, such a characteristically Dutch feature, were chugging by. This part of Limburg extrudes between Belgium and Germany and, the southern part known to the Dutch as Little Switzerland, includes the villages of Vaals set at 322m, the highest point in the Netherlands. Rather later than intended (there was much of herpetological interest at Meynweg!), we reached the Natuurhistorisch Museum at 4.40 pm and were met by the Director, Mr Mayer. The Museum was established in 1912, just two years after the Natural History Society of Limburg had been founded. Of herpetological interest, twelve Midwife Toads *(Alytes obstetricans)* had been liberated into the small botanical garden attached to the Museum some years ago and still survived. There were also fossil reptiles on display that had been found between 1766 and 1770 in Upper Cretaceous layers on nearby Sint Pieters Berg, and included a big reptilian skull of *Mosasurus hoffmanni.* Other fossil remains included *M. lemonnieri* and the skeleton of a sea turtle, *Allopleuron hoffmanni,* with a carapace length of about 1.3 m. It was fatal informing a bunch of herpetologists that *Alytes* had been liberated into the botanical garden which still survived without expecting them to go and inspect for themselves as soon as the opportunity presented itself! remarkably, the first "likely-looking" stone at the edge of a small rockery turned by WW revealed one of these little toads.

Upon emerging from the Museum, there were another 1-2 hours until our pre-arranged dinner at the Cafe-Restaurant Fort Sint Pieter on the peak of that name that yielded the Museum's fossils in the southern side of the town. Herpetologists therefore freely roamed the city of Maastricht, a delightful old town with its narrow streets and gastronomic tradition. The only locality for the wall lizard, *Podarcis muralis,* in the Netherlands, and northernmost in Europe, is situated at Maastricht.

With Scott Moody – Konrad Klemmer not far behind us – we decided that hommage to this outrider population of the wall lizard was warranted and a visit to the locality of this species, otherwise so abundant further south in Europe, should be made. With careful instructions provided by Henk Stribjosch, we set off, street map in hand. After a brisk half hour or so's walking, needless to say, despite Henk's careful directions, taking a somewhat circuitous route, we tracked down the site and inspected the old wall making up the species' habitat with its many cracks and outgrowing vegetation. The sun was out by now but at this time in the

late afternoon low in the sky, and we feared that the lizards would by then have sought refuge. Fortunately, the morning had been overcast and presumably delayed emergence, for suddenly a movement and a big adult male gave itself away by shifting its basking position. We were elated, and having "got our eyes in" soon saw two more, both immature specimens. Much gratified that our efforts had been rewarded, we departed the site and wound our way back across town to the dinner point much appreciating a glass of cooling Dutch beer upon arrival! Max Sparreboom, who arrived shortly after us, made a point of ordering a big one! About half-an-hour later, Konrad Klemmer arrived having also found the wall lizard site and reported that he had counted 18 animals, representing half the total population of this species in the Netherlands! Taking his time, he had recorded the lizards by carefully scouring the whole length of the creatures' wall and confirmed to us the tale of the wise "old bull"!

It was dark by the end of dinner and in a relaxed state at the end of a good outing with a sound meal and a drink or two behind us, there was no more to contemplate than a long restful road-journey home. It had been a successful day, providing a break from the lecture theatre, and the weather fortuitously had been kind to us; not too hot to have sent all the reptiles we hoped to see into early refuge, and not actually raining in the morning, combined with emergence of the sun during the middle of the afternoon. We were grateful to Jan and Henk for all their guidance and diligent instruction.

CONCLUSIONS

One can only say that the 4th OGM of SEH was most successful, meticulously organised by our Dutch colleagues with characteristic attention to detail and maximum use of available resources. Such excellent organisation encourages an unfraught atmosphere, and with the confidence of every support, participants were able to give their whole attention to the herpetological matter at hand. As is inevitable at a meeting with papers offered by participants themselves, the quality was mixed, but hopefully the occasion provided the opportunity for members to meet and discuss their work with colleagues in the same field of research. This should allow alleviation of difficulties and result optimistically in enhanced research output in the future. Again with characteristic quiet efficiency, as a record of the meeting, the Proceedings have been published (van Gelder, Strijbosch & Bergers, 1987) – containing nearly 100 contributions making up 473 pages, and one should comment on the rapidity (four months) in which they were produced and the high standard of presentation. Apart from variations in type-face, perhaps one should also point out a difficulty in printing papers from camera-ready copy of the authors, although undoubtedly an economical and more rapid method of production obviating the need for proofs to be read. It was very evident that several authors without English as their mother tongue had difficulty in expressing their ideas, especially with a strict draft-length. Linguistic adjustment of manuscripts during the editorial process was required in the case of some authors, as was carried out for the proceedings of the previous SEH (Prague, 1985) meeting, although this results inevitably in a delay in publication and puts an onus on herpetologists in the UK, the only English mother-tongue speaking nation in Europe, whose assistance appropriately was sought. While supply allows, the Proceedings are available to non-members of SEH for 90 dutch florins from: Dr. H. Strijbosch, Fac. Wiskunde en Natuurwetenschappen, Toernooiveld, NL-6525 ED Nijmegen, The Netherlands.

It was regrettable that no herpetologist was able to attend the meeting from the Soviet Union, but those from western Europe and elsewhere who were freely able to attend enjoyed themselves in the hospitable, liberal and tolerant environment of the Netherlands. What was noticeable perhaps is that regular attendees of SEH's OGMs are really beginning to understand each other; joint authorship is beginning to be considered far more and researchers are able to discuss mutual herpetological problems without reserve. Undoubtedly, SEH is now established, due in part no doubt to the unstinting efforts put into achieving this by the retiring General Secretary, Rinus Hoogmoed (Leiden). We wish his successor to this post, Ulrich Joger (Darmstadt), every success in maintaining the good relations that the Society has engendered within the specialist herpetological community in Europe. Our congratulations should surely also go to Jan van Gelder, Henk Strijbosch and Jan Aalbers, and their team of local organisers, for carrying out arrangements for the 4th OGM so efficiently and making it such a success.

ML would like to express his gratitude to Eric Schellekens of the University Department of Animal Ecology for providing him with accomodation in Nijmegen during the course of the

meeting which was much appreciated. WW wishes to thank the Science and Engineering Research Council for a travel grant which enabled him to attend the meeting.

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M.R.L. Lambert
(Chairman, BHS)

Wolfgang Wüster
(Univ. Aberdeen)

World Congress of Herpetology

NOMINATIONS SOLICITED FOR NEW OFFICERS AND MEETING SITE

Pursuant to the WCH Constitution *pro tem,* nominations of persons are hereby solicted for election to the Executive Committee (EC) and International Herpetological Committee (IHC) of WCH, as well as proposals for the venue of the Second Congress. All persons are eligible to nominate.

EC. Nominations to the EC must be seconded by any two present members of the EC or IHC (list printed in the Registration Circular available from the Secretariat, WCH, Ecology Research Group, Rutherford College, University of Kent, Canterbury, Kent CT2 7NY, UK; or Telex 965449 UKCLIB G).

IHC. Nominations to the IHC must be seconded by any two present members of the EC or IHC or by the governing body of an Affiliated Organization (list also printed in Registration Circular). In addition, the governing bodies of Affiliated Organizations may nominate to the IHC.

Venue. Individuals or groups who wish to propose sites for the Second Congress (to be held 1992 to 1994) should submit one-page-maximum proposals indicating meeting and housing facilities, names of persons who might serve on local Organizing Committee, and special attractions of the site.

Deadlines. All seconded nominations and venue proposals should be submitted to the Secretary-General: Professor Kraig Adler, Cornell University, Seeley G. Mudd Hall, Ithaca, New York 14853, USA; or Telex WU1 6713054). *Nominations must be received by 1 June 1989;* venue proposals should be received no later than 1 September 1989 so they can be copied for distribution and voting at the Canterbury Congress.

POPULATION ECOLOGY OF TWO MEDITERRANEAN TORTOISES IN NORTHERN GREECE - ACCOUNT OF THE UCNW-UEA EXPLORATION CLUBS TORTOISE EXPEDITION, GREECE 1985

JONATHAN WRIGHT

Department of Zoology, University of Oxford

An abstract of a talk given to the BHS on March 3rd 1988 in the Lecture Theatre of the Linnean Society of London

The aim of this conservation orientated expedition was to provide base line data on the populations and ecology of two sympatric species of Mediterranean tortoise, *Testudo hermanni* (T.H.) and *Testudo graeca* (T.G.).

Four sites along the coast of northern Greece were visited within a six week period in the summer of 1985. One of these sites was Alyki to the west of Thessaloniki, where previous work has been carried out by Stubbs et al (1980). This was an area of open heath and scrub that had been devastated by fire and plough in 1980 (Stubbs, 1981). To the east of Thessaloniki the three other sites visited were Epanomi, Keramoti and Porto Lagos. Each of these sites suffered from human disturbance in the form of goat grazing and tourism. Epanomi consisted of more open coastal heaths and sand dunes. Keramoti was made up of contrasting grazed dry heaths and dense oak woodlands. Lagos had a large dry heath and plantation of Shore Pine.

Food plants identified during quantitative plant surveys at each site were:- The Common Rock Rose *(Helianthenum nummularium);* Sea Spurge *(Euphorbia spp.)* and Sea Holly *(Eryngium maritinum)* when young and tender; Knapweeds *(Centura spp.);* and the flowers and seeds of Mullan *(Verbascum spp.).*

Tortoises were searched for by walking transects across the sites twice a day, once in the morning and again in the evening. This allowed us to use a technique for estimating population densities using the sighting frequency (SFE) of Hailey (1988). These density estimates could then be compared to mark release recapture (MRR) estimates made by individually marking the scutes of each tortoise upon capture (Stubbs et al, 1984)

All four sites contained relatively dense populations of both species, except Alyki where only a small isolated population of *T. graeca* exists. The SFM estimates of all the population densities was seen to be much more accurate, and appropriate for this type of animal, than the MRR methods.

Population structures were investigated using maximum scutal length size classes as a measure of age. Only the data from those individuals captured could be analysed in this way, and so this did not represent a true cross-section of the population as a whole (i.e. the younger, smaller size classes were consistently under-represented in our samples because of difficulties in sighting them). Captures of both species at one site, Lagos, showed an inexplicable absence of almost any juveniles (<10cm), and some concern exists as to the long term survival of these populations.

The sex ratios of captured tortoises were uneven in all four populations of *T.hermanni,* giving a ratio for all the sites combined of three males to one female. Males frequented more open areas, making them easier to spot than the females, and this could have resulted in the excess of males in our sample. Body temperatures and tick infestation levels of male *T. hermanni* were higher than that of the females. In the hotter more open areas the vegetation is scarce and so more ticks congregate on each plant to infest any one browsing tortoise. Subsequently, infestation levels are greatest on individuals found in the more open sites. No such sex differencies exist in the *T. graeca* populations, but they do show consistently higher tick infestation levels and body temperatures than *T. hermanni.* Correspondingly, *T. graeca* were seen to inhabit the more open vegetation at any site and to tolerate higher substrate temperatures. At the

edge of the oak woodland at Keramoti this species specific choice of vegetation was most obvious, with all the *T. graeca* caught out in the open and nearly all the *T. hermanni* being found in the woods.

In northern Greece there is an overlap in the distributions of these two species of approximately 350km. *T. graeca* is traditionally a tortoise of more open habitats and its distribution in northern Greece is probably the result of it spreading north and west from Turkey. *T. hermanni* inhabits the woods and scrublands of the northern Mediterranean and has extended its range into Greece from the west. It is clear that a separation of these two sympatric species on the basis of habitat can satsifactorily explain their ability to coexist following the changes in species distributions.

Other members of the expedition included:- Eric Steer and Anna Dubiel from University of East Anglia; Leslie Dean, Jeannette Lunt and Brian Moulden from University College of North Wales; and Karen Barnett. Dr. Adrian Hailey assisted us in the field.

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HERPETOFAUNA OF THE NORTHERN MAURITIAN ISLANDS (INDIAN OCEAN)

DAVID J. BULLOCK

School of Life Sciences, Leicester Polytechnic

Outline of a talk given at a BHS Meeting on April 27th 1988

A scientific expedition visited Round Island in 1975 and found that introduced rabbits and goats had destroyed most of the vegetation, threatening the survival of the reptiles that depended on it and causing soil erosion (Bullock, 1977). Eradication of the goats and rabbits was recommended. Seven years later, after the former had been eliminated, the 1982 Round Island Expedition was launched to monitor the reptile, palm and alien mammal populations on this and other of the islands off the north coast of Mauritius, and reported striking changes (Bullock & North, 1984).

Eight or nine species of reptile occur on the northern Mauritian islands (Table 1). Round Island is the last refuge of four species: *Phelsuma guentheri, Leiolopisma telfairii, Bolyeria multocarinata* and *Casarea dussumieri,* which together with four more species form a relict herpetofauna of great scientific and conservation interest (Bullock, 1986). The reptile fauna of the neighbouring island of Gunner's Quoin has been reduced to four species, probably because of habitat destruction (burning) and the effects of ships' rats *(Rattus rattus).* Round Island has also suffered habitat destruction through introduced mammals but because of its remoteness, rats are absent. Conservation of the Round Island ecosystem was discussed; the remaining of the alien herbivores, the rabbit *(Oryctolagus cuniculus),* has recently been eradicated and conservation education on the value of the rare herpetofauna, especially for the local Mauritian population, is recommended. The bolyerine boid snake, *B. multocarinata,* has not been seen since 1975 and is possibly now extinct. A gecko new to science, *Nactus coindemirensis,* has been described from Gunner's Quoin (Bullock, Arnold & Bloxham, 1985).

TABLE 1

Summary of the distribution and Status of reptiles on the Northern Mauritian Islands (after Bullock, 1986)

	RDB category	*Mauritius*	*Gunner's Quoin*	*Flat Island*	*Serpent Island*	*Round Island*
Gekkonidae						
Phelsuma guentheri	Endangered	E	–	–	–	+
Phelsuma ornata	–	+	+	+	+	+
Nactus serpensinsula	Rare	E	–	–	+	+
Nactus coindemirensis sp. nov.	Rare	–	+	–	–	–
Scincidae						
Leiolopisma telfairii	Rare	E	E	E	–	+
Scelotes bojerii	–	+	+	+	+	+
Cryptoblepharus boutonii	–	+	+	+	–	+
Tropidophidae						
Casarea dussumieri	Endangered	E	E	E	–	+
Bolyeria multocarinata	Endagered/ Extinct?	–	E	E	–	E?

RDB, Red Data Book; E, Extinct; + Extant; – not recorded. One or both tropidophid snake species were formerly present on gunner's Quoin and Flat Island.

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THE TURTLE INDUSTRY OF BALI

JOHN DAVENPORT

School of Ocean Sciences, University College of North Wales, Marine Science Laboratories, Menai Bridge, Gwynedd, North Wales.

INTRODUCTION

The Hindus of the Indonesian island of Bali are traditional eaters of turtle meat, and such meat is eaten on ceremonial and religious occasions. In this they differ from the bulk of Indonesians who regard turtle flesh as unclean (but consume turtle eggs in large numbers). Bali has therefore been a focus of trade in adult turtles, particularly the green turtle *Chelonia mydas* L., for centuries, indeed it is probably the largest single point market in the world (IUCN/WWF, 1984). On a recent visit to the island (in January 1988) I was able to make some assessment of the current extent of exploitation and conservation, with the help of a Bahasa-speaking friend. In large measure the information given here is not new, but unfortunately investigators of the trade have not published their findings. Instead, they have limited themselves to reports circulated within the professional conservation community (e.g. IUCN/WWF, 1984; Schulz 1984, 1987).

CAPTURE AND TRANSPORT

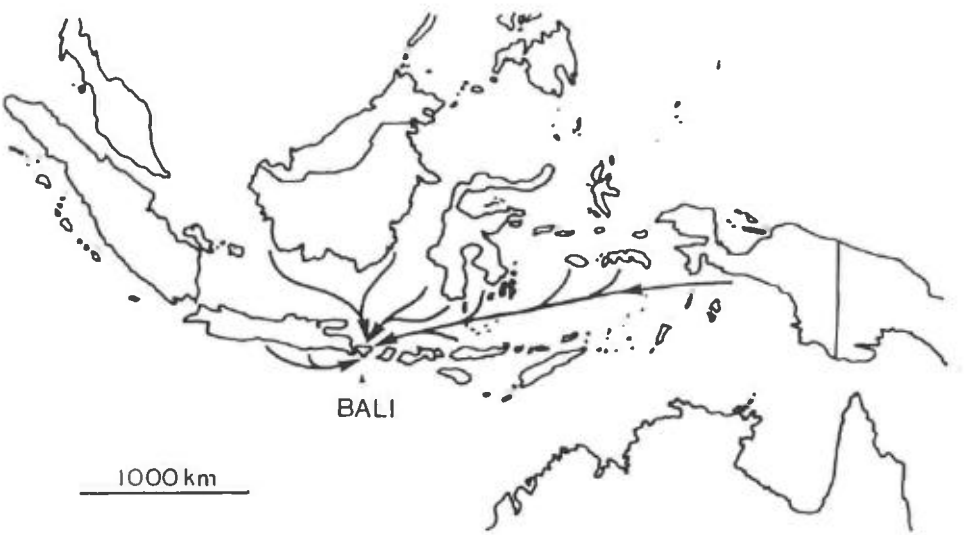

Figure 1. Map of Indonesia; arrows show turtle trade routes to Bali

Table 1. Areas supplying turtles to Bali (in approximate descending order of importance)

1. Maluku Islands

2. S. Sulawesi
3. S.E. Sulawesi
4. S. & E. coasts of Kalimantan
5. S. coast of Irian Jaya
6. S. coast of Central Java
7. S. coast of E. Java

Few turtles are found on or near Bali itself, indeed Sumertha Nuitja (1974) reported that Balinese populations were seriously depleted by 1950 and IUCN/WWF (1984) present good evidence of local overfishing around Bali. However, the values of the animals is such that fishermen scour a large proportion of the coast of Indonesia to supply the trade (Fig. 1, Table 1). Some turtles are taken on nesting beaches, but most are caught 10-20km offshore from small boats using trammel nets made of thick (3mm) monofilament, and having a coarse mesh (10-15cm). Their subsequent fate is rather variable. Sometimes fishermen take their catch directly to Bali, but more often the turtles are accumulated in holding pens looked after by local intermediaries. A typical pen (on eastern Lombok) is shown in Fig. 2. About 7m long, 5m wide and 1.5m high, it was sited at the mouth of a small stream and was constructed of bamboo and palm. Trees provided some shade, but the roof ensured a cool interior. Such a pen would hold up to 50 adult green turtles. If the animals were kept in the pen for more than a day or two, the villagers fed them upon green sea weed.

Figure 2. Village turtle holding pen on east coast of Lombok.

Transport to Bali is invariably by prahus (basically sailing vessels, 10-20m long, which nowadays have auxiliary inboard motors) which still dominate Indonesian inter-island trade as their shallow draught allows them to operate off beaches as well as harbours (Fig. 3). Some travel as much as 2500km to deliver turtles to Bali, and each prahu carries 30-50 turtles.

Figure 3. Transport prahu.

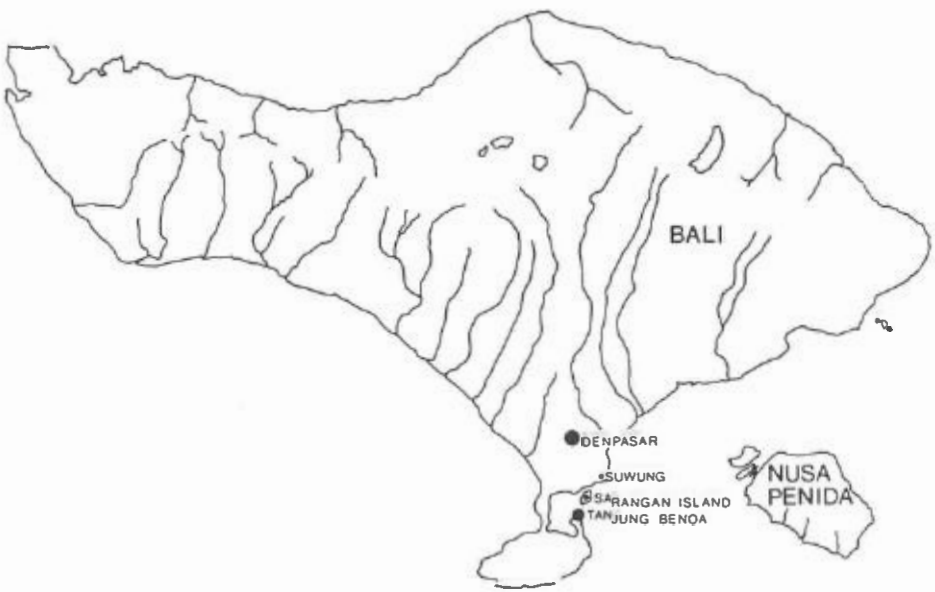

Figure 4. Map of Bali.

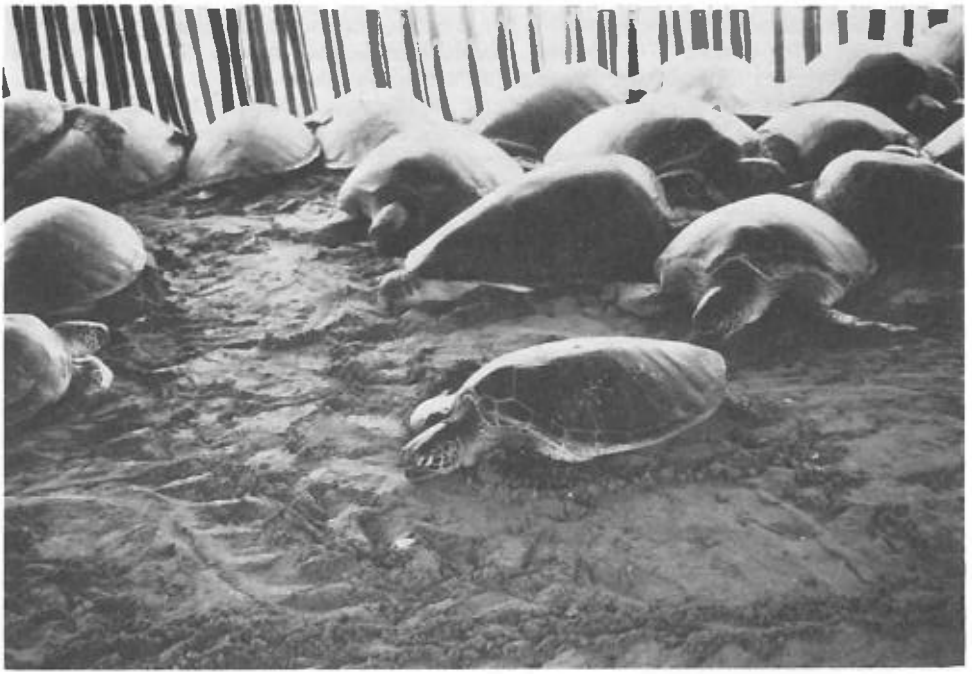

Figure 5. Inside a turtle pen at Tanjung Benoa.

MARKETING

Most turtles taken to Bali (95% according to IUCN/WWF, 1984) are brought to a single village, Tanjung Benoa, near the southern tip of Bali (Fig. 4). The village has several large turtle pens on the foreshore, flushed and cleaned by tidal action. Stoutly constructed of bamboo with a high roof (4-5m), they are cool and dark inside. The pens (Fig. 5), roughly 10m square, are continuous with one another, stretching for about 80m. On the day I visited the village around 400 green turtles were present. About 2/3 were large adults (predominantly females) with shell lengths of 80cm or more, the rest were sizeable subadults (above 50cm shell length). In conversation with Mr. Ashar, a merchant reputed to control 75% of the Bali trade, I established that the animals remained in the pens for 3-6 days, during which period they were not fed. They generally appeared healthy, and each pen featured a small blackboard on which was chalked the number of animals remaining in the pen, the level of mortality during holding (very low) and the date of purchase from the fishermen. The total number of turtles being handled by the trade is difficul to assess. Polunin and Sumertha Nuitja (1982) reported that more than 20,000 turtles were sold on Bali each year during the mid 1970s (IUCN/WWF (1984) reported a peak of 30,121 turtles landed in 1978), and if it is assumed that some 400 turtles pass through the pens of Tanjung Benoa every 6 days then a figure of around 24,000 would still be true today. If accurate, this latter total would suggest no significant decline in catches over the past 4 years since IUCN/WWF (1984) recorded a catch of about 9,500 between April and July in 1984. Everyone concerned in the operation indicated that landings at Tanjung Benoa were similar to those in previous years, so on balance it seems sensible to work from the throughput figures given above. With a few smaller operations elsewhere on the island, together with the scope for direct sales by fishermen, it seems probable that the whole Bali turtle trade still approaches 30,000 animals annually. Only a small percentage (perhaps 2%) is collected around Bali and its small neighbour, Nusa Penida.

Nothing appears to be wasted at Tanjung Benoa; a small stone pen was filled with the maggot-ridden carapaces of large green turtles, which had presumably died en route to the village or shortly after. Cleaned of adhering flesh, they would be polished and varnished for the tourist curio trade.

Many turtles are sold directly from Tanjung Benoa to consumers, but some pass through another trader's hand at Suwung, where a few pens are sited at the margin of a mangrove swamp. Containing around 50 large adults on the occasion of my visit, Suwung is nearer and more convenient to the capital Denpasar than Tanjung Benoa (Fig. 4). Trade was brisk, the seller (Mr. Pan Pasir) disposing of a couple of large females during our brief conversation. Mr. Pasir's pens could hold perhaps 150-200 animals, and he feeds the animals each day on green sea weed. His turtles were eating algae readily during my visit; it is probable that this makes up the bulk of their natural diet as sea grass beds are rather patchy in Indonesia.

Up to the time of sale the turtles are handled reasonably carefully (IUCN/WWF (1984) reported that mortality in transit from collection zones was normally below 3% except on the longest voyages from Irian Jaya and Maluku) and exhibit few signs of damage. When a sale is agreed the position changes somewhat; holes are bored in the turtle's foreflippers which are lashed together in front of the head with raffia. Partly this is to prevent flapping of the flippers, but mainly to allow the animals to be slung from bamboo poles and carried along the narrow alleyways of Tanjung Benoa to waiting pickup trucks (Fig. 6).

Figure 6. Subadult turtles being carried to a purchaser's truck.

CONSUMPTION

Although turtle meat can be purchased in Balinese restaurants, mainly as a novelty dish at the tourist traps of Kuta Beach, it seems certain that the bulk of consumption is by private individuals or families in the Badung regency of Bali who butcher turtles themselves or purchase meat from slaughterers (in Tanjung Benoa and Denpasar). The turtles are either barbecued, or the flesh is pounded with spices and then fried to form a dish known locally as "abon".

There is no specific importation of turtle eggs to Bali, but a high proportion of the turtles butchered are females containing eggs. Generally these eggs are not eaten by the turtles' Hindu purchasers, but are sold to local Moslems.

ECONOMICS OF TRADE

As a rough guide, fishermen receive £20-£25 for each turtle they catch, so a prahu loaded with 50 turtles has a cargo value of £1000-£1250. The amount of money demanded by local intermediaries who control small holding pens in remote areas is difficult to estimate; a fisherman on the Alas Strait, regarded as a rather soft-hearted individual, took only £1-£2 per turtle. The Balinese middlemen take a large profit (especially those who own fishing boats too), since turtles sell to the consumer for £40-£50 apiece. Assuming a total yearly sale of 25,000-30,000 turtles, the wholesale/retail turtle meat trade is worth some £1-£1.5 million per annum, with a proportion being dispersed to fishing villages in all parts of Indonesia (except Sumatra), some as much as 2500km away. Restaurant profit margins on Bali undoubtedly add an unknown sum, as does the sale of the clutches of eggs collected post mortem (Suwelo *et al* (1982) reported that the eggs attracted higher prices than chicken eggs). IUCN/WWFA (1984) reported that some raw turtle meat is exported to Java and frozen flesh is exported further afield.

Much economic activity is also generated by the trade in non-edible parts of turtles; large numbers of immature animals are being gutted, dried, stuffed and varnished as tourist curios (selling on Bali for £5-£10 each, but also being exported to Japan). Carapaces of adults may sell for as much as £50. (IUCN/WWF (1984) reported that the trade in non-edible parts exceeded the value of the meat trade, at least as far as small turtles are concerned). I also saw prahus unloading sacks of sea weed to be fed to turtles.

The sums of money involved in the trade have to be considered in an Indonesian context. To a westerner a value of £20 per turtle to a fisherman, or £50 to a consumer may seem unexceptional, and sailing 2500km across oceanic waters in a small vessel a dangerous exercise to set against a £1000 profit. However, most Indonesians have to work extremely hard to earn £300 in a year, and this may have to cover the needs of a large family. By catching and selling 15-20 turtles, a fisherman can earn as much money as an experienced teacher or civil servant takes home in a year. Turtles form a highly prized (and priced) product when related to average national income!

"TURTLE VILLAGE" – SARANGAN ISLAND

The turtle pens at Tanjung Benoa are off the tourist track; visitors to Bali are directed instead to Sarangan Island where an unusual mixture of attempted conservation and exploitation of green turtles takes place. For information about this operation I am indebted to a fieldworker in the village (Mr. I. Made Madu) who has been trained by the Conservation Group of the Indonesian Government.

The island, reached either by sea from the beaches of the package tour hotels, or by dugout canoe through a mangrove swamp, is low lying. It has a muddy shore on the landward side and a sandy beach plus reef on the seaward, eastern shore. The island's village is heavily dependent on the tourist trade, but there is some fishing and crop growing. In the centre of the village stands a large concrete and bamboo pen, scoured by the tide. Here, visitors are invited to be photographed with adult and juvenile green turtles, after a small entry fee is levied. Notices announce that a conservation programme is in operation. A nearby shop sells turtle curios (mainly green turtles, but I saw one or two juvenile hawksbill turtles, *Eretmochelys imbricata),* including the polished carapaces of some large adults. Numerous sea shells, including those of *Nautilus* were also on offer. Dotted around the village are stone or bamboo pens containing green turtles of various sizes.

The basis of the village operation lies in the collection of about 1000 turtle eggs each year from a beach on the south coast of Central Java. The eggs are transferred to Sarangan Island and incubated in wire-protected artificial nests in the sand of the eastern beach. Hatching success, about 70%, is quite high, and half of the hatchlings (some 350 animals) are taken out beyond the reef and released as a conservation measure. This release has now been done annually for some 5 years.

The remaining hatchlings are reared together in concrete tanks for about 6 months. At this stage they are distributed amongst families in the village that have pens on the foreshore. Throughout, the hatchlings and juveniles are fed mainly upon sea weed, with occasional fish/shellfish supplementation. Mortality is low during the 6 months of communal rearing, but

rises sharply afterwards. Most of the deaths are probably attributable to a low protein diet; the villagers know that young green turtles should be fed regularly on fish or molluscs (they are encouraged to do so by the Conservation Group), but cannot afford the financial/food loss involved. The turtles are held in the pens indefinitely. Few are eaten by the villagers, and some have survived for several years to reach shell lengths of 60cm or more. However, most die and are prepared as curios; I saw three being brought to the village shop during my visit. Effectively, therefore, the operation is a small ranching programme aimed at the tourist trade, and is almost certainly supplemented by additional small turtles caught at sea rather than being reared (the village has been a focus of small turtle slaughter and stuffing for many years – IUCN/WWF (1984) – the families' stone pens are obviously much older than the "conservation" progamme!). The villagers believe their hatchling release programme to be effective; there is no appreciation of the probability of failed beach imprinting in these animals. Even the "conservation" programme may itself be in decline; Schulz (1987) reported that 5000 eggs were imported from Java in 1986 (not the 1000 described by Mr. Made Matu for 1987/88). Certainly the wire-protected nests present in January 1988 represented no more than 1000 eggs.

DISCUSSION

Worldwide, the total population of adult green turtles is probably above 400,000, causing Mrosovsky (1983) to doubt the species' "endangered" status. However, it is generally agreed that *Chelonia mydas* is a 'species complex' of discrete populations, largely or entirely isolated genetically from one another, and that almost all populations are in decline (IUCN, 1982). Polunin and Sumertha Nuitja (1982) presented egg production data which indicated that at least 25,000 females nested annually in western Indonesia during the late 1970s, but that falling egg yields already suggested a general decline in numbers; they also reported an increased demand for adults. The size of the turtle trade of Bali (and its high proportion of capture of females) is such that the equivalent of about 70% of this number are being taken annually, usually *before* they have a chance to lay their last egg clutch (and this takes no account of the large numbers of small turtles killed for the curio trade). IUCN/WWF (1984) pointed out that many of the "Indonesian" green turtles killed on Bali may equally be regarded as "Australian" or "Malaysian", since the trade takes animals which feed in Indonesian waters but nest elsewhere. Their report indicated that the Bali trade was not only grossly overexploiting Indonesian green turtle populations (i.e. populations which nest on the Indonesian coast), but was also depleting the populations of neighbouring countries. The report (written in mid 1984) stressed that the turtle predicament in Indonesia was "grave" and recommended a number of immediate steps to be taken. These included the following: that capture and sale of turtles less than 60cm or above 85cm curved carapace length should be banned, that the sale of turtle meat in all public eating places be prohibited, that turtles should not be collected in pens before transshipment or sale. From my observations and those of Schulz (1987) it is quite clear that *none* of these critical recommendations has been implemented in the past 4 years, and that the trade is virtually unaltered despite the introduction (in 1984) by Prof. Emil Salim (the Indonesian Minister of the Environment) of a widely supported, comprehensive Wildlife Protection Act. Enforcing such legislation is difficult in a country where the bulk of the population is poor and strong cultural or religious traditions exist. Environmental concern is increasing amongst the Balinese, especially the young, and some Hindus have responded by substituting pork for turtle meat in their rituals (apparently the idea that turtle meat is *essential* to religious ritual is false; turtle meat has been used because it has generally been slightly cheaper than pork). The Sarangan Island "conservation" operation, though futile because of the tiny numbers of hatchlings released and the likelihood that their beach imprinting is faulty, also demonstrates concern. However, set against these positive signs are the pressures of a rising Balinese population, which is generally more prosperous (because of tourism) than most other parts of the Indonesian archipelago. The continued demand for turtle meat in tourist restaurants is particularly disturbing.

How important biologically is the drain on Indonesian and neighbouring turtle populations? Coming to grips with the population dynamics of sea turtles, particularly the migratory *Chelonia mydas* is extremely difficult, not least because estimates of age of sexual maturity have been revised from the 4-6 years accepted in the 1950s to current estimates ranging from 15-50 years. In the case of the Indonesian populations little or no tagging is being carried out, so information

about survival of adult females or recruitment to the nesting stock is not available. Only recently have age estimates for sea turtles been validated; it is probable that adult green turtles live well beyond the age of 50 years, with a proportion of individuals living much longer, perhaps exceeding a century. If it is assumed that most animals have two decades of reproductively active life, and that females nest in alternate years, laying perhaps 500 eggs per nesting season, then a female may lay about 5000 eggs during her life. Very high natural mortality, especially caused by predation on eggs and hatchlings (which probably kills more than 95% of individuals in the first year of life), offsets most of this fecundity, but in an undisturbed population the adult animals have a low vulnerability to predation. High fecundity in sea turtles in general has led several scientists to stress the wastefulness of killing adult animals (on economic as well as energetic and conservation grounds), and suggest that taking eggs alone is a less undesirable form of exploitation (e.g. Hendrickson, 1958; Mrosovsky, 1983). If it is assumed that each female killed on Bali had the potential of laying eggs for only 5 further seasons, then the killing wastes 2500 eggs, or perhaps 44 million eggs per year for the whole Balinese catch (taking an estimate of 25,000 animals fished per year and assuming about 70% to be female – IUCN/WWF (1984)). Whether this lost productivity is viewed as a food source for man, or as the raw material for future turtle populations, it is clear that the Bali turtle trade is enormously wasteful.

From a conservation point of view, the trade may be even more damaging than these figures suggest. Any effects of exploitation of adult turtles will presumably take 20-50 years before they are fully expressed in the form of reduced recruitment to the breeding stock; the trade is currently killing adults which probably hatched between the late 1930s and the late 1960s – before the great expansion of the trade since 1969. Conservation measures have an equal time lag for effectiveness.

Although no precise estimate of the total population of adult green turtles for the whole of the Indonesian archipelago is available, it is unlikely to exceed 120,000-150,000. This estimate stems from the finding of Schulz that about 30,000 females nest annually in Indonesia (in scattered fashion; there are no major nesting beaches according to IUCN, 1982) and assumes a) that females nest in alternate years, and b) that there are equal numbers of males and females. Such a number would be made up of several year classes (how many is obscure; anything between 10 and 20 is fairly likely). The current Bali turtle industry is removing a high proportion of this number (20-25%) from waters around the archipelago *each year,* and it is obvious that the greatest catches are from areas far away from Bali (Table 1), a classic sign of overfishing, and probably indicating a heavy toll of turtles which nest outside Indonesia. In the late 1970s Sumbawa and Flores (islands fairly close to Bali) provided a high proportion of the catch – they are of much less importance now. By the time landings at Bali start to fall it will almost certainly be too late to prevent a population crash – or a spread of the trade to an even larger part of Asia.

Unfortunately the Balinese turtle industry encapsulates most of the difficulties met in attempting to conserve wildlife in the Third World. Relatively balanced cultural exploitation has been distorted by rising human populations, the introduction of a cash economy and (especially) tourism, combined with the motorization of transport (in this case prahus) which lengthens viable supply lines. CITES legislation, designed to inhibit trade in endangered species between nations, is obviously powerless to control a large country's unpoliced internal markets (though much non-edible turtle material is exported from Indonesia, especially to Japan, but also by tourists from many countries including, unfortunately, U.K. citizens who do not know/care that they may not legally import such material). The positive forces of conservation are handicapped by inadequate funds and the slowness of information transfer from the predominantly western scientific literature to workers in the field. However, the rapacious level of turtle exploitation on Bali is quite unacceptable; the conservation measures taken are miserably inadequate.

ACKNOWLEDGEMENTS

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A NOTE ON THE APPENNINE YELLOW BELLIED TOAD, *BOMBINA VARIEGATA PACHYPUS* BONAPARTE

JOHN PICKETT

84 Pyrles Lane, Loughton, Essex IG10 2NW

It is pleasant, when walking in the mountains, to encounter small breeding groups of *Bombina,* always active and boisterous, almost appearing playful to the human observer. In my wanderings about the Italian mountains such encounters have stimulated further thought, which prompts this note, informal and subjective in nature, based as it is on passing, casual observations.

Bombina variegata pachypus is found in the Italian peninsular, south of the basin of the Po Valley, its range approximately that of the Appennine Mountains. It occurs in scattered populations in hilly or mountainous country, usually wooded or semi-wooded. It is not rare, but because of its habits it is seldom found in large numbers anywhere. I have no knowledge of the northern part of its range, but in the drier mountains of central Italy it is not especially frequent; it becomes more common in the south, and is probably most common in the mountain forests of Calabria.

While the habits of *pachypus* are generally similar to those of other *variegata,* it seems – at least this is the impression I have – more restricted to upland areas, preferably forested, than other races. It is not seen in the kind of warm, open exposed country where *variegata (kolombatovici)* is often found in the coastal karst of Yugoslavia (Dalmatia), for example.

Like other races of *variegata, pachypus* prefers to breed in tiny bodies of water not inhabited or used by any other amphibians or potential aquatic predators, and almost always temporary by nature. Favourite places are puddles formed in wheel ruts along tracks in woods, usually in a sunny position, or roadside ditches or pools formed where a road blocks the passage of a tiny stream or water seepage of a roadside bank. Other places are drinking troughs for farm livestock, roadside drinking fountains, and the water-filled hoof prints of horses or cattle. For such ephemeral bodies of water the reproductive strategy of *Bombina variegata* is ideally suited: mating and egglaying continue intermittently throughout the summer, usually from May to August, and is stimulated by fresh rainfall and the renewed filling of its breeding puddles.

The small pools chosen of course can support only limited numbers of toads, and for this reason their colonies are seldom great in size. The fairly small numbers of eggs laid by a female at any one time (usually far less than 100) are a further adaptation to the limited carrying capacity of the breeding pools – small clutches of eggs laid opportunistically over an extended period in scattered puddles presumably maximise the chances of successful development and survival of the tadpoles. However, as puddles and ditches of only a few inches deep probably seldom hold water long enough for tadpoles to reach metamorphosis, average survival and recruitment are probably low. To endure as a species in these conditions (if the conditions are in fact so – this is an unverified hypothesis) *Bombina variegata* would have to be long lived and with few enemies. Its enemies, or lack of them, present a puzzle. I doubt if mammals or birds would normally take *Bombina* in significant numbers: the skin toxins must be some deterrent, and an animal with such small and scattered populations could hardly form a regular food source for a warm-blooded predator, which would require more abundant and consistently available prey; *Bombina* would probably only be taken coincidentally and occasionally. For similar reasons man is not a direct threat: systematic commercial collection of this species is unknown and the small value of the animals would not warrant the covering of long distances, and expense, necessary to find any number. In any case, the "all restricting" Berne Convention, by erroneously listing this species as in need of strict legal protection throughout its range, has effectively stopped collecting for any purpose in Europe.

Other amphibians, such as the Edible Frog *(Rana esculenta/lessonae)* and the Crested Newt *(Triturus cristatus/carnifex),* which would undoubtedly take tadpoles or very young *Bombina,*

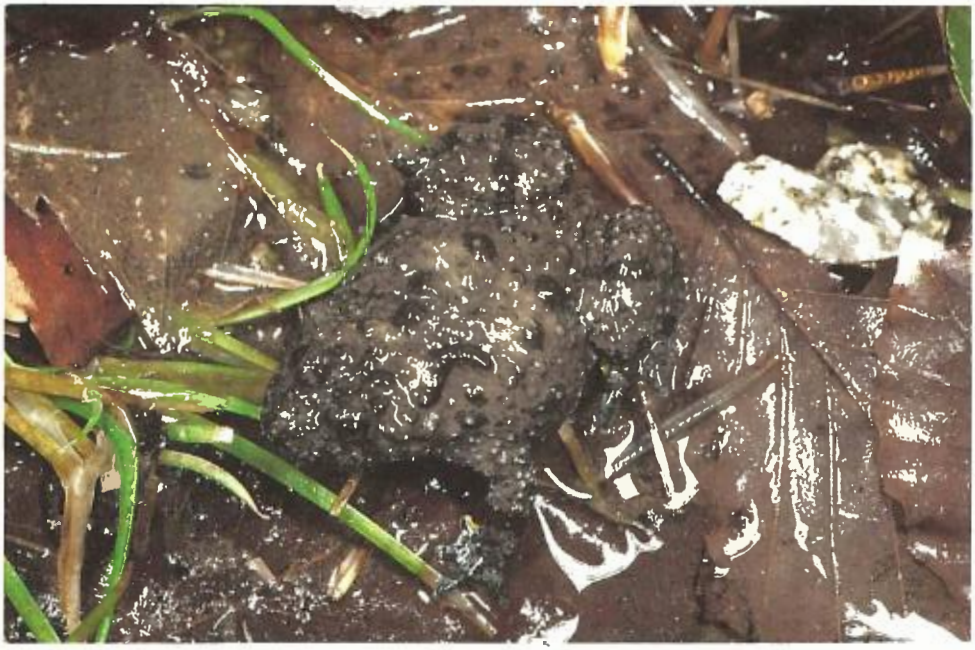

Plate 1: Adult female *Bombina variegata pachypus,* Aspromonte, Calabria, Italy
Photo: Georgio Di Cesare

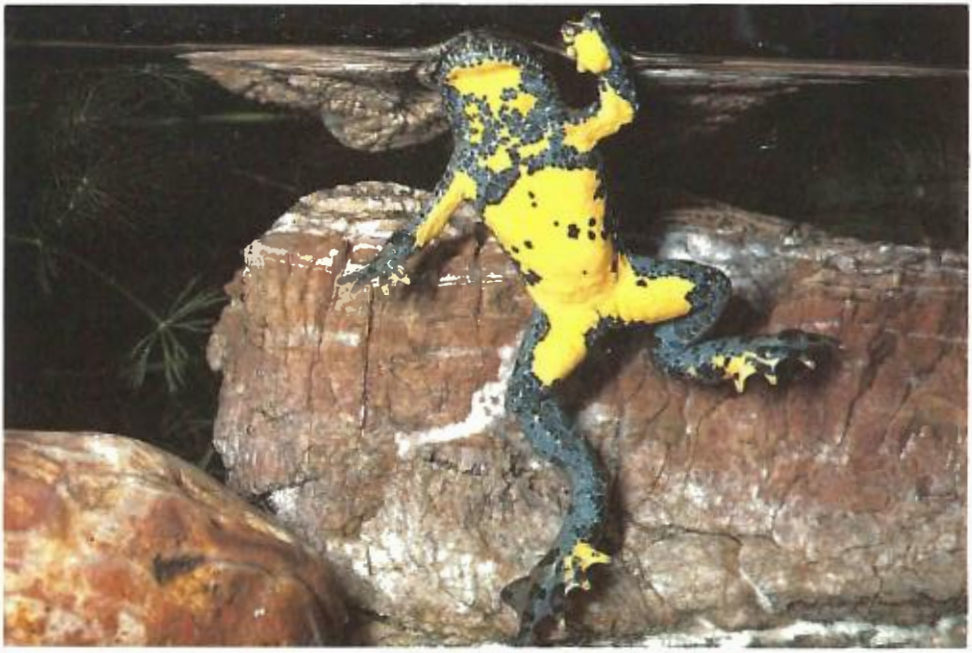

Plate 2: Underside of *Bombina variegata pachypus,* showing typical ventral colour and pattern of this subspecies. Adult female from mountains of Abruzzo, Central Italy. Photo: Georgio Di Cesare

Plate 3: Pair of *Bombina variegata pachypus* at breeding site in wheel rut in road through Silver Fir *(Abies alba)* forest near Serra San Bruno, Calabria, Italy. May 1987. Photo: Georgio Di Cesare

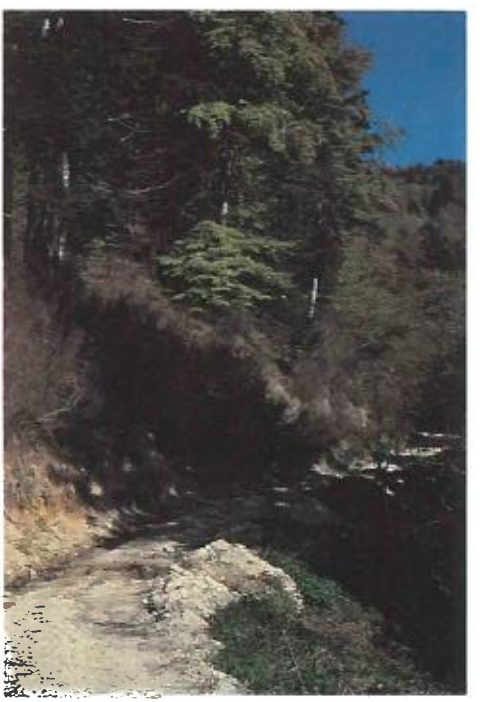

Plate 4: Characteristic habitat of *Bombina variegata pachypus* in southern Italy. Puddles and wheel ruts along the road are used for breeding. *Bombina* of all ages are found in these small bodies of water and beneath rocks around tiny roadside streams, springs, and water seepages.

Photo: Georgio Di Cesare

and would be significant predators, are avoided by the habit of *variegata* of occupying only the very smallest water bodies which are never used by the other species (at least this is the case in those localities I know of in Italy).

More problematical are snakes, specifically the Grass Snake, *Natrix natrix,* which I would think is a potentially serious predator of *Bombina,* being both a specialist feeder on amphibians, common throughout the range of *B. variegata,* and an active, wandering animal. However, perhaps even in this case the chosen habitat of *variegata* affords some defence: it is often found in densely wooded areas – in fact woodland tracks and roadsides are characteristic habitats of *pachypus* in Italy – and *Natrix* does not establish itself in dense woodland, though it may wander into wooded country occasionally and is at home in open woodland. On a densely forested mountain ridge in Calabria, *pachypus* was very common, but there were no snakes. Elsewhere, it is difficult for me to conceive how *Bombina variegata* survives in the presence of *Natrix.* Unlike *Rana* and *Bufo,* which form the main prey of *Natrix natrix, Bombina variegata* is not prolific with comparatively large and widespread populations. Its small colonies, reproducing on a modest level, could easily be severely and rapidly depleted by a few *Natrix,* especially since *Bombina* by its habits is easy prey for such a snake: it is active during the day, not secretive, and not rapid of flight. I would welcome any observations on this by readers who have more field experience of the species.

Though its enemies are not well known, its friends are more obvious. We often think of man's effect on nature as being a wholly negative one, but this is not so in the case of *Bombina variegata pachypus.* Most of its breeding sites have been created, directly or indirectly, by human activity: roadside ditches, wheel ruts, livestock drinking troughs, etc. "Natural" breeding sites are by comparison few. At least in this case, the works of Man have been beneficent.

The mode of life of the species and its distribution do not make it vulnerable to catastrophic changes of land use, in the way that *Bombina bombina* has suffered from intensive agriculture in its lowland habitat. Its dispersed and irregularly distributed colonies in upland country, suited only to pastoralism and woodlands, are fairly safe from widespread destruction. This primitive, inconspicuous animal, though nowhere occurring in vast numbers, is in its lowly way successful, and will doubtless survive indefinitely.

HERPETOLOGY IN GHANA (WEST AFRICA)

BARRY HUGHES

c/o J.R. Simpson, 26 Greenheys Drive, London E18 2HB

Take flights from London, follow the Greenwich meridian south for 3,000 miles, and six hours later you can be in Accra, capital of Ghana. Formerly known as the Gold Coast and bounded on the north, west and east, respectively, by francophone Burkina Faso, Cote d'Ivoire and Togo, Ghana became an independent member of the Commonwealth in 1957. At 92 100 square miles (228 538 km^2) it is a country about the size of Great Britain (ie UK less Ireland) but with a fifth the number of fellow humans and a tropical herpetofauna of 220 species: 70 amphibians, 14 turtles, 41 lizards, 92 snakes and 3 crocodilians.

As the Gold Coast Colony, Ghana was once notorious as "the White Man's grave" – life expectancy for the newly-arrived "oburoni" (Twi for white man) being counted in months rather than years. More recently the first African country to gain indpendence after the Second World War, Ghana's flamboyant first president, Kwame Nkrumah, has ensured himself and Ghana being well known by his precipitant political actions, such as deporting unwelcome critics. But with smallpox extinct, yellow fever unheard of and cholera about as common as in the UK, life expectancy for the visitor has improved: I survived 26 years and suffered nothing worse than malaria and an odd boil or two, and the occupational hazard of snake bite! Harder economic times have brought political pragmatism, but the good cheer, friendliness and politeness, not to say respectability of Ghanaians has survived all. Referring to the last – respectability, visitors are expected to be of good behaviour and to conform to that British stereotype of the stiff upper-lipped, unflappable, and above all fair and courteous gentleman. Such eccentricities as the handling of live snakes are as acceptable as the topee and spine pad once were!

Historically Ghana has contributed more herpetologically than its small size would lead one to expect. Its natural habours – sandy beaches (often palm-fringed) nestled between rocky headlands – reminiscent of Devon and Cornwall, provided ports of call for ships bound for India rounding the Cape of Good Hope and led to specimens from the "Guinea" and "Slave" coasts reaching dealers and eventually collections, where they are still to be found, often wrongly attributed to modern Guinea. For example, the type of *Typhlops punctatus* was collected by the Bowdich Expedition to "Ashantee" in 1812, described by Leach in 1818, and is now in the British Museum (Natural History). Much of the early West African material came from Ghana, especially when the Dutch instructed their officials resident in the coastal forts ("castles") – some like Elmina originally built by Portuguese slave traders in the 15th century, to collect for the Leiden Museum. Pel (Holthuis 1968) collected around the forts of Sekondi, Elmina, Accra and Butre and at Dabocrom and his material survives in Leiden and other museums with which Leiden exchanged. Later, in the 19th century, missionary activity led to collections reaching Hamburg (Fischer 1856, 1886) and Frankfurt (Boettger 1887) and Boettger's "List of reptiles from Accra on the Goldcoast" (my transl. of German) was the first (and last!) list ever published for Accra. British "suzerainty" over most of what is now Ghana (the Volta region, once part of German Togoland, is well represented in the Berlin collections) was established by the last of the Ashanti wars (1903) and led to a colonial network of administrators, educators, foresters, miners and the like. The outstanding collector amongst this expatriate population was George Cansdale, later of fame as the Superintendent of London Zoo and the first to present live animals on British TV. But previously, for 14 years, George was a Gold Coast forester and collected live mammals, birds and reptiles for the London Zoo and left behind a collection of beetles. George's experience of Gold Coast herps is available in three popular books (1946, 1955, 1961) of which only the last – on West African snakes, remains in print. His original papers in the *Nigerian Field* (1948, 1949a, 1949b, 1949c, 1951) provide many photographs of snakes and lizards. Another expatriate was Leeson whose uninspiring book (1950), "Snakes of the Goldcoast" should be mentioned although the only authoritative treatment is by Villiers (1974), "Les Serpents de l'ouest Africain", of wider scope and also in French. The last author has also treated of the turtles and crocodilians (1958),

but one has to turn to Dunger's (1967a, 1967b, 1967c, 1968a, 1968b, 1972, 1973) series of Nigerian lizards for coverage of that group. The amphibians have fared worst of all in print: Schiotz's extensive collecting has resulted in a list (1964) which is incomplete and replete with inaccurate names but an indispensible monograph on the "treefrogs" (1967) covering *Leptopelis, Kassina, Afrixalus* and *Hyperolius* among others. The results of Hoogmoed's (1979a, 1979b, 1980a, 1980b, 1980c, 1980d, 1980e, 1980f) collecting in Ghana have been published in Dutch, partly duplicated in German, and an English version is currently in preparation.

Since colonial days of Cansdale and Leeson, collector expatriates have included Gerrard and Leston (1970a, 1970b, 1968 with Hughes) at Tafo, Swiecicki (1965) in Tarkwa and Tamale, Barry (1969 with Hughes) in Kumasi, Harper (1963) in Tema, Sapwell (1970, 1972) in Cape Coast, and Spawls (1980, 1982, 1983) in Wa. The last talked about the Savannah Snakes in Northern Ghana at a BHS meeting on February 23rd 1982. Ghanaians have been involved – one of Cansdale's "boys" (Osunmanu Moshie) taught me how to catch snakes and Philip Mensah and Daniel Boakye contributed much live material to Achimota Zoo (now defunct). But Ghanaian publications have been academic rather than natural history or taxonomic e.g. Eyeson (1970, 1971a, 1971b) and Yeboah (1982) on *Agama* which had attracted expatriates earlier – Chapman & Chapman (1964) on reproductive biology and Harris' (1964) classic on the behaviour of *Agama agama* in Nigeria.

What one sees on a visit depends on the time of year and where one is, the deciding element being the time of arrival and duration of the main rains. The coldest months in the UK are the hottest and driest (December-February) in Ghana, the northerly Harmattan wind bringing a haze of dust as far south as Accra and drying and flaking one's skin, turning the soil to dust and stunting the vegetation crisp and brown. This time is also one of "bush fires", usually started to drive out "game" (in practice most often a monitor or snake) or produce fresh growth but often running amok through crops and habitations. Turtles may be netted in shrinking pools where fish and *Xenopus* will be concentrated. Puddle frogs *(Phrynobatrachus)* still call from pond margins, emaciated chameleons *(Chamaeleo gracilis* and *C. senegalensis)* may be found wavering on shimmering road surfaces, a rustle of dry leaves may indicate where a sand snake *Psammophis)* was, and monitors *(Varanus exanthematicus* and *niloticus)* may be seen more readily in their search for water. But real, tropical life comes with the rains, beginning in March, intensifying in frequency and amount in April when humidity may seem insufferable to us, but the temporary pools provide joy to early breeders *(Afrixalus, Hyperolius,* and especially the raucous *Bufo* and *Ptychadena).* Snakes, mostly nocturnal, now become active and subterranean ones may be driven above ground by heavy rain and perhaps higher surface temperatures (Hughes, 1978). On the coast the rains peak in June, inland in July to September, and this brings down air temperatures to make life more bearable for the northern visitor but July and August are dull with overcast days and virtually no herp activity. Thence onward, apart from some "small rains" during September-October in the southern half of the country which may induce some amphibian activity, things hot up into a new dry season and the cycle repeats. As the rains travel inland it is possible, at least in theory, to travel with them and reap a rich herpetological harvest, especially with night work. In the dry season may be seen lizards *(Agama,* especially the ubiquitous and commensal rainbow lizard whose orange-headed males contrast with their harem of dull brown females, *Mabuya – M. affinis* being the most ubiquitous, and *Lygodactylus)* by day and other lizards *(Cophoscincopus* – an aquatic skink, *Hemidactylus* – including the commensal house gecko, *Mochlus* – fossorial skinks, and *Ptyodactylus* – a tree gecko), terrapins *(Pelomedusa* and *Pelusios),* and crocodilians by night.

The species one may expect to find will depend also on where one is (Table 1). The coastal thicket ("scrub") of the Accra Plains extends from Cape Coast, through Accra to the Volta Delta. The rain forest forms an inland belt extending patchily onto the Togo Hills in the east (former German Togoland). Inland is the wetter, more wooded "Guinea" savanna, and north of about 10°N the drier, more open "Sudan" savanna (Lawson, 1966), Hopkins 1974). A list of species presently known from these areas is given in Table 1.

Whilst no longer the "white kman's grave", malaria and bilharzia are still endemic and the visitor should be warned not to leave with an unwanted souvenir, perhaps to be reminded for the rest of his or her life of having forgotten to take a prophylactic or pair of wading boots; sun-hat and "darks" are also useful.

TABLE 1. CHECKLIST OF THE HERPETOFAUNA OF GHANA

Taxa arranged alphabetically. The numbered species are known from Ghana; un-numbered, not yet but good reason to be expected (?); Vegetation Zones as used by Lawson (1966) and Hopkins (1972). New records asterisked.

Genus	species	Vegetation Zones 1 Coastal thicket	2 Rain forest	3 Moister (Guinea) savanna	4 Drier (Sudan) savanna
Order: ANURA					
Family: ARTHROLEPTIDAE					
Arthroleptis (Squeakers)	1. *poecilonotus*	+	+	+	
	2. *variabilis*				
Astylosternus	3. *occidentalis**		+		
Cardioglossa	4. *leucomystax*		+		
Schoutedenella	5. *bivittata*				
	6. *zimmeri*	+			
Family: BUFONIDAE					
Bufo (True toads)	7. *maculatus*	+	+	+	+
	8. *pentoni**				+
	9. *regularis*	+	+	+	+
	10. *superciliaris*		+		
	11. *togoensis**		+		
Family: HEMISIDAE					
Hemisus (Shovel-nosed frogs)	12. *guineensis*	+	+	+	+
	marmoratus				?
Family: HYPEROLIIDAE					
Afrixalis (Leaf-folding frogs)	13. *dorsalis*	+	+		
	14. *laevis*		+		
	15. *nigeriensis*		+		
	16. *vittiger*	+		+	+
	17. *weidholzi*				+
Hyperolius (Reed frogs)	18. *baumanni*		+		
	19. *bobirensis*		+		
	20. *concolor*	+	+		
	21. *fusciventris*		+		
	22. *guttulatus*	+	+		
	23. *laurenti*		+		
	24. *nasutus*	+		+	
	25. *picturatus*		+		
	26. *sylvaticus*		+		
	27. *torrentis*		+		
	28. *viridiflavus*	+		+	+
	29. *viridigulosus*		+		
Kassina (Running frogs)	30. *arboricola*		+		
	31. *cassinoides*				+
	32. *fusca*				+
	33. *senegalensis*	+		+	+
Leptopelis (Tree frogs)	34. *bufonides*				+

Genus	species		Vegetation Zones 1	2	3	4
Leptopelis (Tree frogs) (cont)	35.	***hyloides***		+		
	36.	*macrotis*		+		
	37.	*occidentalis*		+		
	38.	*viridis*	+		+	+
Family: MICROHYLIDAE						
Phrynomerus (Rubber frogs)	39.	*microps*	+		?	+
Family: PIPIDAE						
Xenopus (Clawed toads)	40.	*muelleri*				+
	41.	*tropicalis*	+	+		
Family: RANIDAE						
Aubria	42.	*subsigillata*		+		
Conraua	43.	*alleni*		+		
	44.	*derooi**		+		
Dicroglossus (Common frog)	45.	*occipitalis*	+	+	+	+
Hildebrandtia (Ornate frog)	46.	*ornata*				+
Hylarana	47.	*albolabris*		+		
	48.	*galamensis*	+		+	+
	49.	*occidentalis*		+		
Phrynobatrachus (Puddle frogs)	50.	*accraensis*	+	+	+	+
	51.	*alleni*		+		
	52.	*batesii*		+		
	53.	*calcaratus*	+	+		
	54.	*francisci*			+	+
	55.	*ghanensis*		+		
	56.	*gutturosus*		+	+	
	57.	*liberiensis*		+		
	58.	*plicatus*	+	+		
	59.	*villiersi*		+		
Ptychadena (Sharp-nosed frogs)	60.	*aequiplicata*		+		
	61.	*floweri*				+
	62.	*longirostris*	+	+	+	+
	63.	*maccarthyensis*	+	+	+	
	64.	*mascareniensis*	+	+	+	+
	65.	*oxyrhynchus*	+		+	+
	66.	*schubotzi*	+		+	+
	67.	*superciliaris*		+		
	68.	*trinodis*				+
Family: RHACOPHORIDAE						
Chiromantis (Foam-nest tree frog)	69.	*rufescens*		+		
Order: GYMNOPHIONA						
Family: CAECILIDAE						
Geotrypetes	70.	*seraphini*		+		
Order: TESTUDINATA						
Family: CHELONIDAE (Sea turtles)						
Caretta (Loggerhead turtle)		*caretta*	– m a r i n e –			
Chelonia (Green turtle)	71.	*mydas*	– m a r i n e –			
Eretmochelys (Hawkshill turtle)	72.	*imbricata*	– m a r i n e –			
Lepidochelys (Ridley turtle)	73.	*olivacea*	– m a r i n e –			
Family: DERMOCHELYIDAE						
Dermochelys (Leathery turtle)	74.	*coriacea*	– m a r i n e –			

Genus		species	Vegetation Zones 1	2	3	4
Family: PELOMEDUSIDAE (Side-necked terrapins)						
Pelomedusa (Marsh terrapin)	75.	*subrufa*	+		+	+
Pelusios	76.	*castaneus*	+		+	+
Felusios (Gaboon terrapin)	77.	*gabonensis*		+		
	78.	*niger*		+		
Family: TESTUDINIDAE						
Kinixys (Hinge-back tortoises)	79.	*belliana*	+		+	+
	80.	*erosa*		+		
	81.	*homeana*		+		
Family: TRIONYCHIDAE (Soft-shelled turtles)						
Cyclanorbis	82.	*elegans*			+	+
	83.	*senegalensis*			+	+
Trionyx	84.	*triunguis*	+	+	+	
Order: SQUAMATA						
Suborder: LACERTILIA						
Family: AGAMIDAE						
Agama	85.	*agama*	+	+	+	+
	86.	*gracilimembris*				+
	87.	*paragama*		+		
	88.	*sankaranica*	+		+	+
Family: AMPHISBAENIDAE						
Cynisca	89.	*kraussi*			+	
	90.	*leucura*	+		+	+
	91.	*muelleri*		+		
	92.	*williamsi*			+	
Family: CHAMAELEONIDAE						
Chamaeleo	93.	*gracilis*	+	+	+	+
	94.	*senegalensis*				+
Family: GEKKONIDAE						
Ancylodactylus	95.	*spinicollis*	+	+		
Hemidactylus	96.	*brookii*	+	+	+	+
	97.	*fasciatus*		+		
	98.	*mabouia*	+			
	99.	*muriceus*		?		
Hemitheconyx (African fat-tailed gecko)	100.	*caudicinctus*			+	+
Lygodactylus	101.	*conraui*	+	+		
	102.	*picturatus*		+		
Ptyodactylus	103.	*hasselquistii*				+
Tarentola	104.	*delalandii*	+			
	105.	*ephippiata*			+	+
Family: GERRHOSAURIDAE (Plated lizards)						
Gerrhosaurus	106.	*major*	+		+	+
Family: LACERTIDAE						
Acanthodactylus (Spiny-footed lizards)	107.	*boueti*			+	
	108.	*guineensis*				+
Holaspis	109.	*guentheri*		+		
Family: SCINCIDAE						
Chalcides	110.	*thierryi*				+
Cophoscincopus	111.	*durus*		+		
Lygosoma	112.	*fernandi*		+		

Genus		species	Vegetation Zones 1	2	3	4
Mabuya	113.	*affinis*	+	+	+	+
	114.	*albilabris*		+		
	115.	*buettneri*			+	
	116.	*maculilabris*			+	
	117.	*perrotetii*	+		+	+
	118.	*polytropis*		+		
	119.	*quinquetaeniata*	+		+	+
	120.	*rodenburgi*		+	+	
Mochlus	121.	*guineensis*		+		
	122.	*sundevalli*	+		+	+
Panaspis		*nimbaensis*				
	123.	*togoensis*	+	+		
Family: VARANIDAE (Monitors)						
Varanus	124.	*exanthematicus*	+		+	+
	125.	*niloticus*	+	+	+	+
Suborder: OPHIDIA						
Family: BOIDAE						
Calabaria (Calabar Ground python)	126.	*reinhardti*		+		
Eryx (Sand Boa)	127.	*muelleri*				+
Python (Royal python)	128.	*regius*	+		+	+
(African python)	129.	*sebae*	+	+	+	+
Family: COLUBRIDAE						
Afronatrix (Water snake)	130.	*anoscopus*	+	+	+	+
Amblyodipsas	131.	*unicolor*	+		+	+
Aparallactus (Centipede-eaters)	132.	*lineatus*	+			
	133.	*lunulatus*				+
	134.	*modestus*		+		
Atractaspis (Burrowing vipers)	136.	*corpulenta*		+		
	137.	*dahomeyensis*	+		+	+
	138.	*irregularis*		+		
	139.	*reticulata*		+		
Boiga (Blanding's tree snake)	140.	*blandingi*	+	+	+	+
(Powdery tree snake)	141.	*pulverulenta*		+		
Bothrophthalmus (Red-lined snake)	142.	*lineatus*		+		
Chamaelycus	143.	*fasciatus*	+	+		
Coluber	144.	*dorri*				+
Crotaphopeltis	145.	*hippocrepis*	+		+	+
	146.	*hotamboeia*	+		+	+
Dasypeltis (Egg-eating snakes)	147.	*fasciata*	+	+	+	+
	148.	*scabra*	+		+	+
Dipsadoboa	149.	*duchesni*		+		
	150.	*unicolor*		+		
Dispholidus (Boomslang)	151.	*typus*	+		+	+
Gonionotophis (Lesser file snake)	152.	*granti*	+			
	153.	*klingi*		+		
Grayia (Smyth's water snake)	154.	*smythii*	+	+	+	+
Hapsidophrys (Green-lined snake)	155.	*lineata*		+		
	156.	*smaragdina*	+	+		
Hormonotus	157.	*modestus*		+		

Genus	species		Vegetation Zones 1	2	3	4
Lamprophis (House snakes)	158.	*fuliginosum*	+		+	+
	159.	*lineatum*	+		+	+
	160.	*olivaceum*		+		
	161.	*virgatum*		+		
Lycophidion (Wolf snakes)	162.	*irroratum*	+	+		
	163.	*laterale*		+		
	164.	*nigromaculatum*		+		
	165.	*semicinctum*	+		+	+
Mehelya (File snakes)	166.	*crossi*	+		+	+
	167.	*guirali*		+		
	168.	*poensis*	+	+	+	
	169.	*stenophthalmus*		+		
Meizodon	170.	*coronatus*	+		+	+
	171.	*regularis*	+		+	+
Natriciteres (Marsh snakes)	172.	*fuliginoides*		+		
	173.	*olivacea*	+		+	
	174.	*variegata*	+	+		
Philothamnus (Green tree snakes)	175.	*carinatus*		+		
	176.	*heterodermus*	+	+		
	177.	*heterolepidotus*	+			
	178.	*irregularis*	+		+	+
	179.	*nitidus*		+		
	180.	*semivariegatus*	+		+	+
Polemon	181.	*acanthias*		+		
	182.	*barthi*		+		
	183.	*neuwiedi*	+	+	+	
Prosymna (Shovel snouts)	184.	*meleagris*	+		+	+
Psammophis (Sand snakes)	185.	*elegans*	+		+	+
	186.	*phillipsi*	+	+	+	+
	187.	*rukwae*				+
	188.	*sibilans*	+		+	+
Rhamphiophis (Rufous beaked snake)	189.	*oxyrhynchus*	+		+	+
Scaphiophis (White spotted beaked snake)	190.	*albopunctatus*	+			
Thelotornis (Twig snake)	191.	*kirtlandii*	+	+	+	
Thrasops (Black tree snake)	192.	*aethiopissa*		+		
	193.	*occidentalis*		+		
Family: ELAPIDAE						
Dendroaspis (Mambas)	194.	*jamesoni*	+	?		
	195.	*viridis*	?	+		
Elapsoidea (Burrowing cobras)	196.	*semiannulata*			+	+
Naja (True cobras)	197.	*haje*				+
	198.	*katiensis*				+
	199.	*melanoleuca*	+	+	+	+
	200.	*nigricollis*	+		+	+
Pseudohaje (False cobras)	201.	*goldi*		+		
	202.	*nigra*		+		
Family: LEPTOTYPHLOPIDAE (Worm Snakes)						
Leptotyphlops	203.	*bicolor*	+	+	+	+
	204.	*macrorhynchus*	+			?
	205.	*narirostris*	+	+	+	

Genus	species		Vegetation Zones 1	2	3	4
Leptotyphlops (cont)	206.	*sundevalli*		+		
Family: TYPHLOPIDAE (Blind snakes)						
Typhlops	207.	*caecatus*		+		
	208.	*lineolatus*	+		+	+
	209.	*punctatus*	+	+	+	+
Family: VIPERIDAE						
Atheris (Tree vipers)	210.	*chlorechis*		+		
	211.	*squamigera*		+		
Bitis	212.	*arietans*	+		+	+
	213.	*gabonica*	+	+	+	
	214.	*nasicornis*		+		
Causus (Night adders)	215.	*lichtensteini*		+		
	216.	*maculatus*	+	+	+	+
Echis (Carpet viper)	217.	*ocellatus*	+		+	+
Order: CROCODILIANS						
Crocodylus (Nile crocodile)	218.	*cataphractus*		+		
	219.	*niloticus*	+		+	+
Osteolaemus (Dwarf crocodile)	220.	*tetraspis*		+		
		TOTALS:	98	130	86	91

NOTES on NAMES used: no. 28 represents *nitidulus*, now considered a subspecies; 36 may be a subsp. of *palmatus;* 37 may be subsp. of *boulengeri;* 76 previously known as *derbianus* and "*subniger*"; 87 as *sylvanus;* 95 often synonymised with *Cnemaspis;* 102 subsp. *gutturalis;* 113 long known as *blandingi;* 123 *kisoni* is syn.; 131 formerly *Calamelaps;* 135 current opinion places these hinge-fanged snakes here; 155 *Gastropyxis* has been syn.; 158 *Boaedon* has been syn.; 181 includes *Miodon* and *Cynodontophis;* 187 on basis of *leucogaster* Spawls 1983 being treated as a subsp. of *rukwae* by Boehme 1987; 212 sometimes *lachesis;* 216 long confused with *rhombeatus;* 217 often *carinatus* in error.

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Ed. note: The author was a Senior Lecturer until 1986 in the Department of Zoology, University of Ghana at Legon, and has been a BHS member for many years.

THE FLANDRIAN HISTORY OF RARE HERPTILES IN BRITAIN: A CONSIDERATION OF THE HYPOTHESES OF BEEBEE AND YALDEN

DAVID M. WILKINSON

Department of Applied Biology, UNWIST, Llysdinam Field Centre, Newbridge-on-Wye, Llandrindod Wells, Powys, LD1 6NB, Wales, UK.

INTRODUCTION

The distribution of the three rare British herptiles *Bufo calamita, Lacerta agilis* and *Coronella austriaca* has been described by Beebee (1978). This stimulated a debate on the history of these species in Britain (Yalden, 1980a, b; Beebee 1980) which produced two different hypotheses describing the colonisation of Britain during the Flandrian (Post Glacial) period by these animals. These were summarised by Beebee (1980) as follows:

Yalden's hypothesis

1. Invasion by the three species (among others), 10000-9000 BP (Before Present).

2. Restriction due to forest growth, 9500-500 years BP followed by expansion around developing heathlands etc.

Spellerberg/Beebee hypothesis

1. Invasion over period 7000-500 BP, restricted to a few suitable areas by prevalence of forest.

2. Expansion around coasts or with heaths both after 5000 BP.

Following this both hypotheses suggest that the rare herptile populations would have fluctuated with the changing fortunes of their heathland habitat. Beebee suggested a corridor of heathland through the west midlands to north west England, although as Yalden (1980a,b) points out there is little evidence for this. It is worth noting that Beebee (1980) makes the mistake of assuming that the amount of Royal Forest Protection was positively correlated with the amount of tree cover. This need not be the case. The Royal Forests were areas where the King had a right to keep deer: 'to the medievals a Forest was a place of deer, not a place of trees' (Rackham, 1986).

This paper is concerned with the early history of these rare herptiles in Britain using recent evidence to discriminate between the Yalden and the Spellerberg/Beebee hypotheses and to consider the possible location of glacial refugia.

DISCUSSION

The Colonisation of Britain

Recent palaeontological work by Holman (1985, 1988) has provided fossil evidence which allows one to differentiate between the two hypotheses. He has examined the herpetofauna from two sites in southern England; Ightham Fissures, Sevenoaks, Kent (Holman, 1985) and Cow Cave, Chudleigh, Devon (Holman, 1988). Holman considers both sites to be late Devensian (last glacial) or Early Flandrian in the composition of their mammal faunas. At this date the Spellerberg/Beebee hypothesis would suggest there were no rare herptiles in Britain; however remains of *B. calamita* and *C. austriaca* were found at Ightham Fissures and *B. calamita* at Cow Cave.

There was a fourth British rare herptile, *Emys orbicularis,* which is now extinct and so not considered by Beebee or Yalden. Its fossil occurences have been reviewed by Stuart (1979). The remains of three individuals of *E. orbicularis* have been recovered from East Wretham, Norfolk. Pollen analysis of associated peats by A.R. Hall (in Stuart, 1979) suggests that they came from pollen zone VIIa *(sensu* Goodwin, 1975) of the Flandrian (this gives a pre *Ulmus* decline date of approximately 6000-7000 BP). If the distribution of *E. orbicularis* in Britain is plotted for all Pleistocene localities (not just the Flandrian) then it exhibits a distribution

similar to that of the modern rare herptiles, being found in southern England as far west as Somerset and in East Anglia (Stuart, 1979. Fig 2). This raises the possibility that the present distribution of rare herptiles in Britain may have been repeated in other interglacials. The modern ecology of *E. orbicularis* suggests that in line with the other rare herptiles it favours warm conditions (July temperatures at least 2°C warmer than currently found in southern Britain) and light soils exposed to the sun (Stuart, 1979).

Both Beebee and Yalden consider the development of heathlands and open conditions of great importance to the history of these species in Britain. The conventional view is that heaths are anthropogenic in origin mainly dating from the Neolithic and later, but some could have been created by Mesolithic activity (Dimbleby, 1984; Rackham, 1986). Recent work by Bush and Flenly (1987) has suggested that open chalk grassland may have existed at some sites throughout the Flandrian. It is not yet clear how common this may have been, but it is obviously of potential importance to the history of such species as the rare herptiles which are found in warm open habitats.

A more exact history of the rare herptiles can now be outlined. The early fossil occurences of *B. calamita* and *C. austriaca* suggests that they colonised Britain in the Late Devensian/ Early Flandrian, possibly along with *L. agilis* and *E. orbicularis*. This means that they can have crossed from continental Europe to Britain via the landbridge which existed until around 9500 BP (Yalden, 1982). This removes the problem inherent in the Spellerberg/Beebee hypothesis of how these herptiles colonised Britain after the English channel had formed. This would have posed particular problems for *B. calamita* which appears unable to survive in salinities greater than 60% sea water (Beebee, 1983). The native status of *Triturus vulgaris* and *Lacerta vivipara* in Ireland has also been suggested as evidence of a landbridge, in this case to mainland Britain (Wilson, 1986). The early arrival of *B. calamita* in Britain raises the interesting possibility that it may have been able to reach Ireland by such a landbridge (although the existence of this landbridge is controversial; see Devoy (1986), Yalden (1982) and references there in suggesting the Irish population may be native rather than introduced. Coleopteran evidence suggests that the climate in Britain around this time was at least as warm as to-day (Atkinson, Briffa and Coope, 1987) so that herptile distribution, at least in southern Britain, was unlikely to be limited by climate. The work of Holman (1985; 1988) suggests that in the early Flandrian at least some of the rare herptiles had a wider distribution in Britain than they do to-day.

The uncertainty surrounding the exact date of the fossil deposits at Ightham Fissures and Cow Cave allows the possibility that these faunal assemblages could have been formed during a warm stage of the Late Devensian and these species may not have survived subsequent colder events (eg. the Younger Dryas, 11000-10000 BP, Atkinson *et al* (1987)). Even if this was the case their presence in these faunas demonstrates the ease with which they could colonise Britain when conditions were suitable. This dating uncertainty and the lack of paleobotanical data from the sites prevents any conclusions being drawn about the contemporary vegetation. However if the fossils are indeed Late Devensian/Early Flandrian there could have been warm yet fairly open conditions, with forest not yet fully developed (Huntley and Birks, 1983).

The subsequent history of the rare herptiles in Britain appears to be one of decline. *E. orbicularis* became extinct sometime after 6000 BP presumably due to climatic deterioration. The small number of Flandrian fossils which have been discovered when compared to the more plentiful fossils of some previous interglacials suggests that conditions (climate?) were always marginal for this species in the British Flandrian (Stuart, 1979). For the other three species one can speculate (following Yalden) that they showed a decline between 9000-5000 BP when they were confined to relatively rare non forested sites. They probably expanded somewhat with the decline of the forest and development of extensive areas of open habitat such as heath only to decline again from perhaps the Seventeenth century onwards with the decline of heathland (Rackham, 1986).

GLACIAL REFUGIA

The evidence considered in this paper supports the early colonisation suggested by Yalden. This raises the question: colonisation from where? Where were the glacial refugia for herptiles in Europe? By analogy with the plant data from pollen analysis (eg. Huntley and Birks, 1983) one might suggest that they were in southern Europe, south of the Alps and Pyrenees. Indeed

Beebee (1983) suggests Iberia as a likely refugia site for *B. calamita*. Again fossil evidence is really required to confirm this. However, some support for these ideas can be obtained from modern distributions. If the location of European herptile species of limited distribution (arbitrarily taken as half the area of Iberia or less) is recorded, discounting island forms, using the maps of Arnold and Burton (1978), only one species is found north of the Alps/Pyrenees, while 43 were recorded south of this line. This distribution of non-insular endemics could give an indication of the locations of glacial refugia from which these species have not managed to 'escape' during the post glacial. Whereas the species which colonised Britain and northern Europe migrated from these areas as conditions improved. It is likely that the refugia were confined to southern Europe as north Africa was very arid during the last glaciation (Sutcliffe, 1985).

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MAINTENANCE AND BREEDING OF *TRITURUS KARELINI*

JOHN BAKER

Department of Biology, The Open University, Walton Hall, Milton Keynes, MK7 6AA

INTRODUCTION

There is little available information concerning the care and captive breeding of any urodele, with the exception of the Axolotl (eg Nace et al 1974), under laboratory conditions (but see Verhoeff-de Fremery et al 1987 for details relevant to *T. cristatus*). Today, however, with increasing pressures on natural populations and a corresponding increase in legislation dealing with the collection of animals from the wild, there is perhaps a greater need for laboratories and private individuals to breed and rear their own animals.

The following notes were made during the breeding and maintenance of *Triturus karelini* in a laboratory.

T. karelini has been recognised as a full species within the *T. cristatus* group (Bucci-Innocenti et al. 1983). It occurs throughout northern Turkey and across to the south of the Caspian Sea, the Crimea and East Balkans (Engelmann et al. 1986).

METHOD

Adult newts were captured in 1987 at two sites, Karacabey and Adapazari, in North-west Turkey by Chris Raxworthy as part of a comparative study of the courtship of *Triturus* species. At the time of capture (early April) adult males were in courtship dress and females were already ovipositing.

On arrival in the laboratory newts were housed in a 90 x 45cm tank, water depth of 15cm. Large numbers of ova were deposited in a short period of time, during the first two weeks of April. The females preferred to oviposit on bunches of polythene strips (15 x 1cm) rather than on *Ceratophyllum demersum*, the only weed in the tank.

Care of Larvae. Larvae were reared in shallow water in plastic containers (30 x 24cm) filled to a depth of 6cm. They were initially fed on zooplankton netted from a local pond and strained through a small hand net. As soon as the larvae had grown large enough *Tubifex* was added to the diet. They also ate the larvae of *Triturus vittatus* that were housed in the same containers. The water in the containers was changed as necessary and replaced with unconditioned tap water with no apparent ill effects to the newt larvae.

Ten larvae were reared to metamorphosis. As each one attained this stage of development, it was anaesthetized in MS-222 (Sandoz) and measured to the nearest 0.5mm. Sizes of the metamorphs (mm) were as follows:

	Mean	Range
Total length	61	47-72
Snout-vent length	33	26-38

Care of Juveniles. After metamorphosis the juvenile newts were housed in plastic tanks (39 x 25 x 21cm) filled to depth of about 10cm. A piece of expanded polystyrene was floated on the water surface to allow the newts to leave the water. However, the animals remained aquatic for most of the time. Occasionally an individual would leave the water during the night but would usually return during the course of the following day. The tanks were kept in a warm laboratory, so that water temperature fluctuated around 20°C.

The newts were fed on earthworms, pieces of beef heart, maggots (as sold to anglers) and a food pellet ('ReptoMin', a Tetra product). Food items were offered roughly five days a week, only feeding quantities that would be eaten at once.

'Wintering' Period. On 11-12-87 each newt was placed in an individual margarine tub with some damp tissue paper. They were given a period of cooling by placing in an incubator cabinet at 12°C for a week. They were then transferred to a refrigerator where they were kept for a further 60 days at a temperature of 4°C. During the wintering period no food was offered, but the containers were checked every week or so to ensure that the paper did not dry out. Mean weight loss during the wintering period was 3%.

On emergence from 'wintering' the newts were placed in a 60 x 30cm aquarium filled to a depth of approximately 15cm, placed in an unheated shed. Thus the newts were exposed to a natural photoperiod and temperature fluctuations. Males developed fully grown crests in less than a week and these showed no signs of regression until 15-5-88, ie the males were in breeding dress for about three months. Ova were first seen on 23-4-88, 67 days after emergence from wintering.

Size of five animals (total and snout-vent length) at one year old were as follows:

Sex	Total Length	Snouth-Vent Length	Breeding
Male	104	58	Yes
Male	104	58	Yes
Male	100	55.5	No
Female	120	63.5	Yes
Female	107	59.5	No

DISCUSSION

There are two points of note. Firstly, under laboratory conditions this species can be grown to sexual maturity in one year. Secondly the animals reared in the laboratory behaved differently (see below) to wild caught animals that are temporarily maintained in the laboratory for observational work. There are implications to both of these points.

Minimum age at first breeding for *Triturus* species in a field situation is probably two years (Beebee 1980). Growth under the captive conditions described is much faster than growth rates inferred from the field. Trendelenburg is reported to have reared *T. cristatus* to maturity in nine months, also under laboratory conditions (Verhoeff-de-Fremery et al., 1987). The speed with which these animals grew to sexual maturity would suggest that sexual maturity is not age limited, but more subject to growth rate and body size.

The behavioural differences observed are manifest by the length of time the males retained their secondary sexual characteristics. Usually workers capture newts during the aquatic phase and transfer them to aquaria releasing them again after the breeding season. However this suffers from the drawback that most species rapidly lose condition. Verrell (1982) described a technique for maintaining *Notopthalmus viridescens* in breeding condition, but this regimen does not work for some other species. One problem encountered when trying to observe the courtship of *Triturus cristatus* at the Open University is the fact that, after capture, males' crests rapidly regress and the animals are very unwilling to court. The same was true of the original stock of adult *T. karelini.* Use of laboratory-reared stock could circumvent the problem of certain species not performing sexual behaviour in the laboratory.

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