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

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Front cover illustration. Adult male *Naja nivea*, defensive hooding. DeRust, Little Karoo, South Africa. © Tony Phelps. See article on page 29.

EDITORIAL

Ammendment

When considering the significance of the colours of venomous reptiles (*Herpetol. Bull*. **95**, 25–30, 2006), I suggested that possibly the only adult venomous snakes with conspicuous coloration whose function might be to warn possible predators to leave them alone are sea snakes (*Pelamis platurus* and *Laticauda* spp.), coral snakes of the genus *Micrurus* and *Micruroides* and the burrowing Australian bandy bandy (*Vermicella anulata)*. In this context I should also have mentioned the kraits (*Bungarus fasciatus* and *B. multicinctus*). The avoidance of coral snake banded patterns by free-ranging avian predators in Costa Rica was recorded by E. D. Brodie (1993, *Evolution* **47**, 227–235).

John Cloudsley-Thompson

Letter to the Editor

Dear Sir,

Here we report a case of illegal trade of Iberian amphibians and reptiles between European countries which may be of interest to readers of *The Herpetological Bulletin*, because it involves, amongst others, British traders.

In 1993, the *Boletín de la Asociación Herpetológica Española* (Bulletin of the Spanish Herpetological Society) published a new colour pattern of the Fire salamander (*Salamandra salamandra*) found in Tendi, a small valley of north-western Iberian Peninsula (Villanueva, 1993). Further papers gave more details concerning the singularity of this salamander population (Barrio & Fonoll, 1997; Günther, 1998; Pasmans & Keller, 2000). In the framework of the morphological and genetic complexity of this species in the Iberian Peninsula (e.g. Alcobendas *et al*., 1994; Garcia-Paris *et al*., 2003), Köhler & Steinfartz (2006) have recently described the Tendi population as a new subspecies, *Salamandra salamandra alfredschmidti*. Alarmingly, the author of the original note describing the existence of this form (A. Villanueva) recently contacted the Asociación Herpetológica Española (AHE, Spanish Herpetological Society) to report that salamanders from this area are on sale through internet websites based in the United Kingdom, Germany and Italy. Human perception of rare colour forms can accelerate illegal trade and precipitate their extinction, as has been theoretically and empirically demonstrated (Courchamp *et al*., 2006).

The specific aquatic habitats of the Fire salamander in the Iberian Peninsula, as well as the restrictive climatic conditions of this region, make this species highly vulnerable to local extinction (Buckley & Alcobendas, 2002). Potential threats for the Iberian fire salamanders include habitat destruction and water pollution, as well as the loss of small reproductive ponds (Buckley & Alcobendas, 2002). Although recent visits to Asturias have extended the known distribution of salamanders with this unusual colour pattern to adjacent valleys in the Tendi area (Pasmans *et al*., 2004), its overall range remains very small, and some parts have already lost suitable habitats due to cultivation and deforestation (Beukema, 2006). For this reason, removal of either the adults or larvae are likely to accelerate extinction of these small populations.

The Asociación Herpetológica Española absolutely disagrees with the illegal harvesting and exportation of wildlife, wherever and in whichever form it takes place. Although *Salamandra salamandra* is still not included in the Spanish List of Endangered Species (CNEA), its IUCN category in the last Red Book of the Spanish Herpetofauna is stated as Vulnerable (V) for the whole species and Near Threatened (NT) for the northern Spanish subspecies (Buckley & Alcobendas, 2002). The Fire salamander is also included in Annex III of the Bern Convention, and the Spanish law 4/89 forbids management and possession of wildlife without government permits. Unfortunately, this is not an isolate case as many other Iberian amphibians and reptiles are frequently offered on sale in European pet shops. Although some of these may have a CITES number that authorizes trade and selling outside the native country, we infer that many of these

animals have been illegally removed from natural habitats, hence increasing threats to their local survival. Herpetological Societies must encourage regional, national and international authorities to develop stronger environmental policies to urgently stop the illegal trade of fauna within the European borders.

Yours sincerely,

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The reptile fauna of The Gambia, West Africa

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BETWEEN March 1999 and July 2005 CE and LB surveyed the amphibians and reptiles of The Gambia by undertaking a survey of the marine turtles: Barnett *et al*. (2004), and by using drift fences in 2000, 2002 and 2004/5. The results of the amphibian survey have been published in Emms *et al.* (2005). In 2003 staff from Makasutu Wildlife Trust (MWT) and members of the British Army Ornithological Society (BAOS) surveyed the River Gambia during 'Exercise Night Heron' identifying and counting the aquatic reptiles (Barnett & Emms, 2005a). In addition MWT and the government Department for Parks and Wildlife Management (DPWM), Luc Paziaud of the Gambia Reptile Farm based in Kartong, and Rowland Jordan, an ex-pat based in the Bijolo/Kololi area have provided a free service to remove 'troublesome' snakes from people's compounds, releasing them into protected areas. This service provides a fairly regular source of information on the distribution of snake species within the western part of The Gambia. The Gambia Reptile Farm opened in 1999. It is an educational and research establishment licensed by DPWM, which has had some degree of success at breeding snakes and keeping a variety of reptiles in captivity.

In this paper we have collated the data from the existing literature including unpublished material from our own surveys and casual records to form an up-to-date checklist for The Gambia.

The Gambia

The Gambia lies on the western coast of tropical Africa and has a land mass of only 11,300km^2. The much larger country of Senegal surrounds it to the north, east and south (see Figure 1). The local climate is characterized by a long dry season from mid-October to early June, followed by a short rainy season from mid-June through to early October. July and September are the hottest months of the year when average daytime temperatures climb to around 30°C. The coolest part of the year is from December to mid-February, with average daytime temperatures of 24°C. Average rainfall per year is 1020 mm, but this is not evenly spread throughout the country with the western half of the country receiving up to 1,700 mm while in the east it may be as low as 800 mm.

The main habitats of The Gambia include a coastal strip of moist scrub and forest. Mangroves are well represented, especially around the mouth of the River Gambia and extend up the river for over 200 km. The main terrestrial habitats are moist southern Guinea savannah in the Western Division and in some parts of the North Bank Division. This is a habitat of tall trees growing fairly close together, forming closed canopy woodland. This gradually changes into Sudan savannah as you travel eastwards, a drier habitat with shorter trees spaced much further apart. A few relict patches of gallery forest still exist such as Abuko Nature Reserve (ANR), Pirang Forest and the 'big forest' at Makasutu Culture Forest (MCF). Parts of the river bank and several islands are also cloaked in gallery forest along the freshwater parts of the river. Freshwater marshes cover a fairly large proportion of Central River Division and ephemeral marshes are present in the Upper River Division during the rainy season.

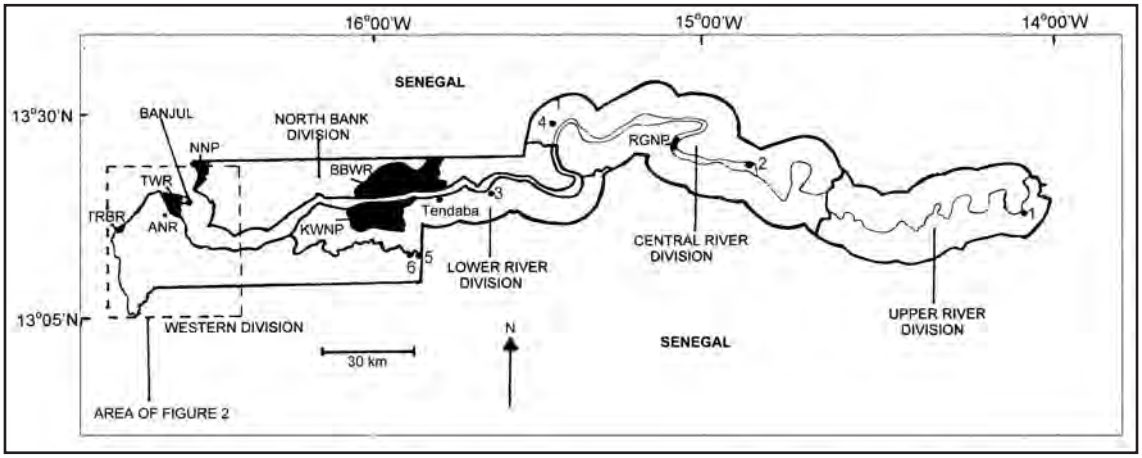

Figure 1. Map of The Gambia showing the regional divisions and protected areas. ANR = Abuko Nature Reserve; BBWR = Bao Bolon Wetland Reserve; KWNP Kiang West National Park; NNP = Niumi National Park; RGNP = River Gambia National Park; TBR = Tanji Bird Reserve; TWC = Tanbi Wetland Complex; 1= Fatoto; 2 = MacCarthy Island; 3 = Toniataba; 4 = Belel Forest Park; 5 = Sintet; 6=Kalagi.

However, many of these habitats are disappearing as more land is cleared for agriculture, including rice cultivation, and the amount of woodland cover and marshland in The Gambia is decreasing. The main reason for this fast degeneration appears to be the growing human population, numbering some one and a half million individuals in 2003, and making The Gambia the fourth most densely populated country in Africa. Many forests and woodlands are also subject to annual bushfires in the dry season, which further degrade these habitats. Over hunting, over fishing and over exploitation of other natural resources also appears to be a major problem facing Gambian biodiversity though this is largely undocumented and unquantified.

METHODOLOGY

Casual records have been kept for all reptiles located in the country between March 1999 and July 2005. During 1999-2001, information was also collected and collated on the marine turtles: Barnett *et al.* (2004).

Drift Fences

From June to September 2000, two drift fences were used in ANR: Barnett *et al.* (2001). During June 2002 seven drift fences were erected in western Gambia. Between May 2004 and July 2005 two drift fences have also been monitored in ANR by the staff of MWT as part of the capacity building and research undertaken on the Darwin Initiative Project funded by DEFRA of the UK Government. Details of the 2002 and 2004/2005 methodology have been published in Emms *et al.* (2005).

River Gambia Expedition

'Exercise Night Heron' was a collaborative venture between MWT and the BAOS, supported by the Gambian National Army and River Gambia Excursions. This boat-based expedition took place over eleven days in March 2003 and surveyed the River Gambia from Tendaba, a point just to the east of Kiang West National Park (KWNP), to the Gambian/Senegalese border beyond Fatoto in the Upper River Division. MWT staff (CE and LB) concentrated on surveying the river and its banks for mammals and reptiles while the BAOS members concentrated on the birds (Barnett & Emms, 2005a).

Identification of specimens

Some specimens were collected for identification purposes and as voucher material and are stored at the Zoology Museum of the University of Michigan, and the Darwin Field Station, ANR (in 70% ethanol). Registration numbers are provided for specimens retained in museums from the current surveys. The specimens have been identified by Greg Schneider of the Zoological Museum of the University of Michigan, by Eli Greenbaum of the Division of Herpetology of the

University of Kansas (*Chalcides armitagei*), by Roger Bour of the Paris Museum of Natural History (photographs of *Trachemys s. scripta*, *Pelomedusa subrufa olivacea* and *Pelusios castaneas*) and by Barry Hughes (photographs of *Toxicodryas blandingii*).

RESULTS

In the following systematic account we have included all known locations (except in a few cases where there are just too many to list), with references, for the individual species. Locations in the western half of Western Division are shown in Figure 2. Species new to The Gambia (i.e. previously unpublished) are marked with an asterix, *.

Order Chelonia

FAMILY TESTUDINAE

Kinixys belliana nogueyi Loveridge, 1953. Bell's hinged tortoise.
Widespread though not at all common (see Figure 3g). Most commonly encountered during the rainy season and believed to aestivate during the latter part of the dry season. Recorded in the coastal strip of Tanbi Wetland Complex (TWC); Barnett *et al.* (2000), Fajara (pers. obs.), ANR; Gruschwitz *et al.* (1991a), Sukuta; Håkansson (1981), Brikama, MCF, Sittanunka (pers.obs.) and MacCarthy Island; Andersson (1937) as subspecies *nogueyi*.

Kinixys erosa Gray, 1831. Serrated or Forest hinged tortoise.
Recorded by Loveridge & Williams (1957) and by Villiers (1958). The authors give no detail of the locations.

FAMILY DERMOCHELYIDAE

Dermochelys coriacea (Vandelli, 1761). Leatherback turtle.
Recorded as dead animals stranded on beaches at Solifor Point and Fajara; Barnett *et al.* (2004).

FAMILY CHELONIIDAE

Chelonia mydas (Linnaeus, 1758). Green turtle.
The commonest marine turtle and the only one nesting on Gambian beaches (June through to October), probably in low numbers; Barnett *et al.* (2004).

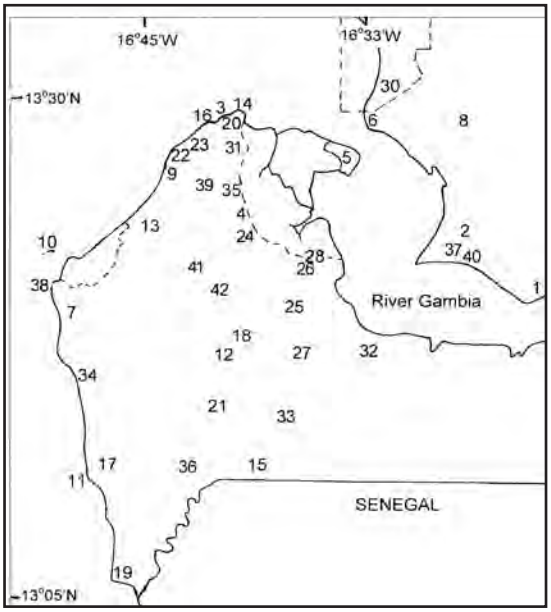

Figure 2. Map of the western half of Western Division, The Gambia showing the location of 1. Albreda; 2. Aljamdu; 3. Bakau; 4. Bakoteh; 5. Banjul; 6. Barrakunda; 7. Batakonko; 8. Berending; 9. Bijilo; 10. Bijol islands; 11. Bolon Fenyo; 12. Brikama; 13. Brufut; 14. Cape St. Mary; 15. Dimbaya; 16. Fajara; 17. Gunjur; 18. Kabafita Forest Park; 19. Kartong; 20. Katchikally; 21. Kiti; 22. Kololi; 23. Kotu stream; 24. Lamin; 25. Makasutu Culture Forest; 26. Makumbaya; 27. Mandinaba; 28. Mandinari; 29. Marakissa; 30. Niji Bolon31. Old Jeshwang; 32. Pirang Forest; 33. Radville Farm; 34. Sanyang Community Forest; 35. Serrekunda; 36. Sifoe; 37. Sittanunka; 38. Solifor Point; 39. Sukuta; 40. Toubakolong; 41. Towtoo; 42. Yundum.

Recorded by Gruschwitz *et al.* (1991a), being identified from confiscated carapaces held at the wildlife department. Also along the coast at Niumi National Park (NNP), Brufut, Tanji River Bird Reserve (TRBR), Bijol Islands, Solifor Point and Kartong by Barnett *et al.* (2004), Bolon Fenyo near Gunjur (pers. obs.) and Jinack Island; Barnett *et al.* (2000).

Eretmochelys imbricata (Linnaeus, 1766). Hawksbill turtle.
Uncommon to rare visitor to Gambian offshore waters. Identified by Gruschwitz *et al.* (1991a) from confiscated carapaces held at the wildlife department, and Barnett *et al.* (2004) from a confiscated carapace of a turtle reportedly caught by fishermen off Gunjur.

Lepidochelys olivacea (Eschscholtz, 1829). Olive ridley turtle.
Infrequent visitor to Gambian offshore waters. Recorded by Gruschwitz *et al.* (1991a) and identified by Pauwels & Meirte (1996) from confiscated carapaces held at the wildlife department. Barnett *et al.* (2004) made a single observation of a severed head of this species taken from a turtle reportedly captured off Gunjur.

FAMILY TRIONYCHIDAE

Cyclanorbis senegalensis (Duméril & Bibron, 1835). African flapped soft-shelled terrapin.
Three records exist: Andersson (1937) on MacCarthy Island and Jones (1990) without details of location. Eva-Maria Minuth recorded it at Marrakissa (pers. comm.).

Trionyx triunguis (Forskål, 1775). African or Nile soft-shell turtle.
Recorded twice; in the Gambia River by Loveridge & Williams (1957) and in Barrakunda by Reeve (1912).

FAMILY EMYDIDAE

*Trachemys s. scripta** (Schoepff, 1792). American red-eared terrapin.
One specimen recorded in Kotu Stream in 2002 (pers. obs.). Confirmed by Roger Bour from photographs (see Figure 3c). It is assumed that this individual was a pet that had been released as this species is not native to Africa.

FAMILY PELOMEDUSIDAE

Freshwater turtles and terrapins appear to be relatively common in the River Gambia. During Exercise Night Heron in 2003, 15 unidentified turtles were recorded in the river in Central River Division and Upper River Division.

Mauremys leprosa (Schweigger, 1812). Stripe-necked turtle.
Recorded by Loveridge & Williams (1957) in the Gambia River and by Villiers (1958) with no location, both times as *Clemmys leprosa*.

*Pelomedusa subrufa olivacea** Loveridge, 1941. Marsh or Helmeted terrapin.
Recorded in 2003 (pers. obs.) in Fajara, determined by Roger Bour from photographs (see Figure 3b).

Pelusios adansonii (Schweigger, 1812). Adanson's hinged terrapin.
Recorded by Jones (1990) and is mentioned as a possibility by the National Environment Agency (1997). Although there appears to be no reference to specimens taken in The Gambia, Miles *et al.* (1978) did discover this species in the Casamance (southern Senegal) and therefore its presence in The Gambia remains a distinct possibility.

Pelusios c. castaneus (Schweigger, 1812). West African mud turtle.
Widespread and common, found in both brackish and fresh water. Recorded in Banjul; Böhme (1978), Gunjur (in a well in a garden), Kartong, ANR, Albreda and Sittanunka (pers.obs.) and MacCarthy Island; Andersson (1937) (as P. subniger). Recorded by Jones (1990) without details of location. An unidentified *Pelusios* species, probably of this species was recorded by Gruschwitz *et al.* (1991a) in ANR.

Order Squamata

FAMILY LEPTOTYPHLOPIDAE

Leptotyphlops narirostris Villiers, 1950. Thread snake.
Recorded in ANR, where it is commonly forced above ground by floods during the rainy season; Barnett *et al.* (2001). In addition an unidentified species of *Leptotyphlops* was recorded in Sifoe (in a rotten palm trunk); Håkansson (1974). Four specimens are stored at the Zoology Museum, University of Michigan (UMMZ 227299-302).

Rhinoleptus koniagui (Villiers, 1956). Thread snake.
Recorded by Jones (1990) with no details of its location. There appears to be no mention of specimens taken so this record should be treated with caution until supporting voucher material is obtained.

FAMILY TYPHLOPIDAE

Typhlops punctatus (Leach, 1819). Spotted blind snake.
Widespread though difficult to say whether or not it is common. Most specimens are seen at times of heavy flooding during the rainy season, or by farmers ploughing their land. Recorded in ANR;

Gruschwitz *et al.* (1991b) and Barnett *et al.* (2001) and Fajara (pers. obs.), Sittanunka; Barnett & Emms, (2002), NNP; Barnett et al. (2000) and MacCarthy Island; Andersson (1937). Seven specimens are stored at the Zoology Museum, University of Michigan (UMMZ 227303, UMMZ 227304, UMMZ 229245-229249).

FAMILY BOIDAE

*Gongylophis muelleri** Boulenger, 1892. Sand boa (see Figure 3d).
Recorded in Bao Bolon Wetland Reserve (BBWR); Barnett & Emms (2002). The specimen is stored at the Zoology Museum, University of Michigan (UMMZ 229244).

Python regius (Shaw, 1802). Royal python.
Much less common than the rock python, though still fairly widespread. Recorded in Gunjur and Old Jeshwang (pers. obs.), ANR; Gruschwitz *et al.* (1991b), Barnett *et al.* (2001) and Håkansson, (1981), Towtoo and MCF (pers. obs.), the TWC; Barnett *et al.* (2000), Kartong, Sittanunka, Aljamdu and Toubakolong (pers. obs.) and MacCarthy Island; Andersson (1937). Jones (1990) recorded this species with no details of location.

Python sebae (Gmelin, 1788). Northern/Central African rock python.
Widespread and common though larger specimens are scarcer than they were a decade or so ago. Recorded by many herpetologists; e.g. Gruschwitz *et al.* (1991b), Barnett *et al.* (2001) and Håkansson (1974 and 1981). Adults and juveniles (August) have been seen on a regular basis at ANR during the 2004-5 survey.

FAMILY COLUBRIDAE

Crotaphopeltis hotamboeia (Laurenti, 1768). Herald or White-lipped snake.
Extremely widespread and common. Recorded by Gruschwitz *et al.* (1991b), Håkansson (1974), Andersson (1937) and in ANR on a regular basis during the 2004-5 survey. Prey items include *Bufo regularis* (Håkansson, 1974). Three specimens are stored at the Zoology Museum, University of Michigan (UMMZ 227438, UMMZ 229235, and UMMZ 229236).

Figure 3a. Armitage's skink, *Chalcides armitagei* (preserved specimen).

Dasypeltis fasciata Smith, 1849. Western forest egg-eating snake.
Fairly widespread and common. Recorded in Cape St Mary; Gans (1959), ANR; Barnett *et al.* (2001), Kartong, Sukuta and Sittanunka (pers.obs.). Jones (1990) recorded this species with no details of location. One specimen is stored at the Zoology Museum, University of Michigan (UMMZ 227295).

*Dasypeltis scabra** (Linné, 1758). Common egg-eating snake.
Recorded in TRBR; Barnett & Emms (2002), Kartong, Sittanunka and Toubakolong (pers. obs.). One specimen is stored at the Zoology Museum, University of Michigan (UMMZ 229237).

Dispholidus typus (Smith, 1829). Boomslang.
Recorded in ANR (Gruschwitz *et al.*, 1991b) and Albreda (de Rochebrune, 1884).

Grayia smithi (Leach, 1818). Smith's water snake.
Recorded in ANR (Gruschwitz *et al.* 1991b) based upon a photograph supplied by Mr Edward Brewer OBE. The only other record is by de Rochebrune, 1884 (as *Graya silurophaga*) and labelled simply as 'Gambie'. Although both of these records are unsupported by collected material this species does appear to be a likely candidate for inclusion in the Gambian checklist as it has been recorded in south-eastern Senegal and in Guinea Bissau (Chippaux, 2001). However, these records should be treated with caution until a voucher specimen has been obtained.

Grayia tholloni Mocquard, 1897. Thollon's water snake.
Recorded in Kotu Stream (Hughes, 1983). The specimen is stored at the Natural History Museum, London and has been positively identified by Hughes (1983), and Pauwels & Meirte (1996).

Hapsidrophys smaragdina (Schlegel, 1837). Emerald snake.
Recorded in the remnant patch of gallery forest in ANR; Gruschwitz *et al.* (1991b) and Håkansson (1981). Jones (1990) recorded this species with no details of location. There have been three recent sightings in ANR during June, July and November 2005 (pers. obs.).

Lamprophis fuliginosus (Boie, 1827). Brown house snake.
Widespread and fairly common. *Lamprophis fuliginosus* is expected to be iridescent black in life, becoming grey in preservative, but without any sign of lines (see also note under *L. lineatus*). A specimen from Fajara stored at the Natural History Museum, London (1956.1.7.76) has been identified by B. Hughes as *L. fuliginosus* (pers. comm.). Also recorded in Kartong (pers. obs.) and ANR; Gruschwitz *et al.* (1991b) and Barnett *et al.* (2001), NNP; Barnett *et al.* (2000), Sittanunka and Toubakolong (pers. obs.), and MacCarthy Island; Andersson (1937) as *Boaedon fuliginosum*. Jones (1990) recorded this species (as *Boadon fuliginosum*) with no details of location.

Lamprophis lineatus (Duméril, Bibron & Duméril, 1854). House snake.
Differs from *L. fuliginosus* in that it is light brown with yellow head lines, with one or two often prolonged onto the body. Barry & Hughes (1969) treated *L. fuliginosus* and *L. lineatus* as separate species, although Roux-Estève and Guibé (1965) concluded that the lack of differences in scalation meant they were of the one species. Recorded twice in ANR; Barnett *et al.* (2001) and once in Kartong (pers. obs.). Two specimens are stored at the Zoology Museum, University of Michigan (UMMZ 229238, UMMZ 229239).

Lamprophis virgatus (Hallowell, 1856). Braid house snake.
Recorded in Fajara; Håkansson (1974) as *Boaedon virgatus* and Håkansson (1981) as *B. virgatum*, and in Sittanunka (pers. obs.).

Lycophidion semicinctum (Duméril, Bibron & Duméril, 1854). Wolf snake.
Records of this species in The Gambia appear to be confused with *L. albomaculatum* which was originally classified as a distinctive subspecies of *L. semicinctum*. Condamin (1994) has subsequently treated *L. semicinctum* as a separate species from *L. albomaculatum* which has been followed by Chippaux (2001). It is thus unclear which of the previous records refer to *L. semicinctum* as a full species although a specimen taken in September 2000 at ANR by Barnett *et al.* (2001) has been positively identified as this species. This specimen is stored at the Zoology Museum, University of Michigan (UMMZ 227296).

Lycophidion albomaculatum Steindachner, 1870. Wolf snake.
Widespread and fairly common – however see notes for the previous species, as this species has often been recorded as *L. semicinctum albomaculatu*m. Recorded in Bakau; Håkansson (1981), Batakonko (EvaMaria Minuth pers. comm.), Kartong and Towtoo (pers. obs.) and ANR; Gruschwitz *et al.* (1991b) and Barnett *et al.* (2001), NNP; Barnett *et al.* (2000) and Sittanunka (pers. obs.). Jones (1990) recorded this species with no details of location. Prey items include *Agama agama* (Barnett *et al.*, 2001). One specimen is stored at the Zoology Museum, University of Michigan (UMMZ 229240).

Lycophidion irroratum (Leach, 1819). Wolf snake.
Recorded in ANR; Barnett *et al.* (2001). This specimen is stored at the Zoology Museum, University of Michigan (UMMZ 227297).

*Meizodon coronatus** (Schlegel, 1837). African smooth snake.
Recorded at Sittanunka and Toubakolong (pers. obs.). One specimen is stored at the Zoology Museum, University of Michigan (UMMZ 227436).

Philothamnus irregularis (Leach, 1819). Common bush snake.

Very widespread and common. Recorded by Andersson (1937), Loveridge (1958), Gruschwitz *et al.* (1991b), Barnett *et al.* (2000) and Jones (1990).

Philothamnus semivariegatus (Smith, 1847). Spotted bush snake.
Widespread and common. Recorded in Sanyang Community Forest, ANR, near Mandinari, MCF and BBWR (pers. obs.) and MacCarthy Island; (Andersson, 1937). The record in BBWR was of a snake being eaten by a Grey heron, *Ardea cinerea*.

Prosymna meleagris (Reinhardt, 1843). Shovel-snouted snake.
Fairly widespread, though not common. Recorded in Fajara, Kartong and Sittanunka (pers. obs.) and MacCarthy Island; Andersson (1937) as *P. m. laurenti*. This species has been synonymised with *P. m. greigerti* by Broadley (1980) who considered the MacCarthy specimen to be intermediate between the two subspecies. Jean-François Trape regards the two subspecies to be distinct species (Jean-François Trape, pers. comm.). Further investigation needs to be carried out in order to give us a clearer picture of this species in The Gambia.

Prosymna greigerti Mocquard, 1906. Shovel-snouted snake.
Recorded from St. Mary's Island (Banjul) and many times from neighbouring areas of Senegal (Jean-François Trape, pers. comm.). Please refer to notes in previous section.

Psammophis elegans (Shaw, 1802). Slender African beauty snake.
The most widespread and common member of its genus (possibly of all the snakes) in The Gambia. Recorded by many herpetologists including Gruschwitz *et al.* (1991b), Barnett *et al.* (2001) and Håkansson (1974 and 1981). Specimens have also been collected from Toniataba, Lower River Division; USNM 162152 and Kundang, MacCarthy Island; 162145 (Barry Hughes pers. comm.)

Other *Psammophis* spp.
P. phillipsi (Hallowell, 1844), *P. rukwae* Broadley, 1966 and *P. sibilans* (Linne, 1758) have all been recorded in The Gambia; Gruschwitz *et al.* (1991b), Barnett *et al.* (2001), Håkansson (1974 and 1981) and Pauwels & Meirte (1996). Whilst the occurrence of *P. phillipsi* does not seem to be disputed despite the paucity of specimens to support this, the occurrence of *P. sibilans* and *P. rukae* appears to be more of a contentious issue.

The following specimens of *P. sibilans* have been collected from The Gambia; Gambia without locality (BMNH 46.10.23.24) from Whitfield Collection via Lord Derby, dated 1846 which is probably one of the first specimens collected from The Gambia; Cape St Mary (BMNH 1923.11.30.A; 1927.2.2.68), Farafenni (ZFMK 17564); MacCarthy Island by Andersson (1937) (NRM 5484) (Barry Hughes, pers. comm.).

Chippaux (2001) shows *P. sibilans* to be absent in this part of West Africa. Using the recently published key in Chippaux (2001), two specimens from the *Psammophis* genus stored at the Zoology Museum, University of Michigan (UMMZ 227439 and UMMZ 229241) previously identified as *P. sibilans* have been recently re-examined and shown to be *P. rukae* (the specimens have divided anal scales and two dark longlitudinal lines on their ventral surfaces).

Due to the current lack of specimens and the inherent taxonomic difficulties with this group of snakes, further collection and study of specimens is needed to obtain a clearer picture of the species occurring in The Gambia.

*Rhamphiophis oxyrhynchus** (Reinhardt, 1843). Western beaked snake (see Figure 3f).
Restricted to the north bank of the River Gambia. Recorded in BBWR; Barnett & Emms (2002), Toubakolong and Belel Forest Park (pers. obs.). One specimen is stored at the Zoology Museum, University of Michigan (UMMZ 227437).

Telescopus variegatus (Reinhardt, 1843). West African cat snake.
Widespread but not common. Recorded in ANR; Gruschwitz *et al.* (1991b), in coastal scrub around Bijilo (Rowland Jordan, pers. comm.) and in KWNP; Barnett & Emms (2002). One specimen is stored at the Zoology Museum, University of Michigan (UMMZ 229242).

Figure 3b. Marsh or Helmeted terrapin, *Pelomedusa subrufa olivacea*.

Figure 3c. American red-eared terrapin, *Trachemys s. scripta*.

Figure 3d. Sand boa, *Gongylophis muelleri.*

Figure 3e. Senegal chameleon, *Chameleo senegalensis*.

Figure 3f. Western beaked snake, *Rhamphiophis oxyrhynchus.*

Figure 3g. Bell's hinged tortoise, *Kinixys belliana nogueyi.*

Figure 3h. Ground cobra, *Elapsoidea semiannulata moebiusi.*

*Toxicodryas blandingii** (Hallowell, 1844). Blanding's tree snake.
Recorded in the rafters of the headquarters building at TRBR in 1999. Barry Hughes identified the specimen as a young snake from photographs, the haloes around the black blotches being indicative of its age. This record is not surprising as previous records of this species in northern Senegal and Guinea Bissau straddle The Gambia (Chippaux, 2001).

FAMILY ATRACTASPIDIDAE

Amblyodipsas unicolor (Reinhardt, 1843). Western purple-glossed snake.
One voucher specimen from Makumbaya is stored at the Musée Royal d'Afrique Centrale, Tervuren, Belgium; Pauwels & Meirte (1996). Another specimen from ANR is stored at the Zoology Museum, University of Michigan (UNMZ 227298).

Atractaspis atterima Günther, 1863. Black burrowing viper.
Recorded by Jones (1990) with no location mentioned.

Atractaspis dahomeyensis Bocage, 1887. Brown burrowing viper.
Recorded by Jones (1990) with no location mentioned.

Atractaspis irregularis (Reinhardt, 1843)
The occurrence of this species is possible, although it remains unconfirmed at the present time. Pauwels & Meirte (1996) say that it is known to be present in The Gambia, albeit without quoting a referenced source. Despite the fact that the distribution map in Chippaux (2001) shows that its nearest incidence to The Gambia is southern Guinea, this is a common rainforest species and thus may occur in the gallery forest along the River Gambia.

FAMILY ELAPIDAE

Dendroaspis viridis Hallowell, 1844. Hallowell's green mamba.
Recorded in ANR, where it is fairly common; Gruschwitz *et al.* (1991b), Barnett *et al.* (2001), Håkansson (1974 and 1981) and Starin & Burghardt (1992), Radville Farm; Barnett *et al.* (2001) and Pirang Forest Park; Ellenberg *et al.* (1988). Jones (1990) recorded this species (as *D. viridis hallowelli*) with no details of location.

Elapsoidea semiannulata moebiusi Werner, 1897. Ground cobra or Garter snake.
Fairly widespread but uncommon (see Figure 3h). Recorded in Kartong (pers. obs.) and ANR; Gruschwitz *et al.* (1991b) and Barnett & Emms (2002), Sittanunka (pers. obs.), River Gambia National Park (RGNP) (pers. obs. - swimming in the river). Jones (1990) recorded this species with no details of location. An old record for Guidimaka (Loveridge, 1944, from Håkansson, 1981) may be in either The Gambia or Senegal. One specimen is stored at the Zoology Museum, University of Michigan (UMMZ 229243).

Naja melanoleuca Hallowell, 1857. Forest or Black cobra.
Common but seems to be found more in wetter areas. Appears to vary in its coloration in that snakes in the Western Division have very pale or white markings on their underside whilst those found in the more eastern part of the country have much darker yellow markings. Recorded by many herpetologists including Gruschwitz *et al.* (1991b), Barnett *et al.* (2001) and Andersson, (1937). Prey items include *Bufo regularis* (Barnett *et al.* 2001).

Naja nigricollis Reinhardt, 1843. Black-necked spitting cobra.
Common but is usually associated with more arid areas. In The Gambia the ventral bands on this species are pink. Recorded by Gruschwitz *et al.* (1991b), Andersson (1937) and Håkansson (1974 and 1981). Prey items include *Varanus niloticus* (pers. obs.).

FAMILY VIPERIDAE

Bitis arietans (Merrem, 1820). Puff adder.
Very widespread and common and seems to account for the majority of snake bites on humans (which are sometimes fatal). Recorded by Gruschwitz *et al.* (1991b), Barnett & Emms (2002), and Håkansson (1981).

Causus maculatus (Hallowell, 1842). Night adder. Previously recorded in The Gambia as *Causus rhombeatus* (Lichstenstein, 1823); Andersson (1937) who mentions three specimens from MacCarthy Island. He did not distinguish *C. rhombeatus* from *C. maculatus*, and Hughes (1977) later attributed all specimens from The Gambia to *C. maculatus*. The observation by Hughes that *C. rhombeatus* is absent from this area of West Africa has been followed by Chippaux (2001). *C. maculatus* has been recorded in Kartong in the current survey (pers. obs.).

*Echis ocellatus** Stemmler, 1970. Carpet viper.
Uncommon to rare. Recorded in BBWR; Barnett & Emms (2002). This specimen is stored at the Zoology Museum, University of Michigan (UMMZ 229250).

Family Amphisbaenidae

Cynisca feae (Boulenger, 1905). Worm lizard.
Widespread, at least in the Western Division, but has probably been overlooked elsewhere. Recorded in Brikama; Gans (1987), and Makumbaya, Brufut, Kiti and Mandinaba; Pauwels & Meirte (1996). Jones (1990) recorded this species with no details of location.

Family Scincidae

Chalcides armitagei Boulenger, 1922 Armitage's skink.
The only known vertebrate that is endemic to The Gambia (Emms & Barnett, 2005). Appears to forage in the sand at the top of beaches. The locations of the four known specimens span almost the entire length of the Gambian coast on the south bank of the River Gambia. First described by Boulenger (1922), who discovered two specimens, at least one of them labelled 'Cape St Mary'. Another specimen was discovered by Gruschwitz *et al*. (1991a) on a 'beach near Serrekunda'. In addition a living specimen was captured on the beach at Kartong in 2003 and was given to Luc Paziaud for his reptile farm. This specimen later died and was confirmed as *C. armtagei* by Eli Greenbaum at the University of Kansas (see Figure 3a). In the wet season of 2005, two more individuals were found in the sand dunes at Kartong. Jones (1990) recorded this species with no details of location and without a supporting specimen. Almost nothing is known of the biology of this species. One specimen is stored at the Darwin Field Station, ANR (DFS1).

Panaspis nimbense Angel, 1922. Snake-eyed skink. Recorded in ANR; Barnett *et al*. (2001) and Sittanunka; Barnett & Emms (2002). Both specimens are stored at the Zoology Museum, University of Michigan (UMMZ 227305, UMMZ 229256).

Mabuya affinis (Gray, 1838). Brown-flanked skink. Very widespread and common. Occurs in many different habitats and is active throughout the year. Eggs have been recorded in September in The Gambia (pers. obs.). Recorded by many herpetologists including Gruschwitz *et al*. (1991a), Barnett *et al*. (2001), Barnett & Emms (2002), Pauwels & Meirte (1996) and Håkansson (1974 and 1981). Six specimens are stored at the Zoology Museum, University of Michigan (UMMZ 181152, UMMZ 227306, UMMZ 229257-60).

Mabuya perrotetii (Duméril and Bibron, 1839). Orange-flanked skink.
Very widespread and common. Occurs in many different habitats, though appears to be active only during the rainy season and the early part of the dry season. Recorded by many herpetologists including Gruschwitz *et al* (1991a), Barnett *et al*. (2001), Barnett & Emms (2002), Pauwels & Meirte (1996) and Håkansson (1974 and 1981). Seven specimens are stored at the Zoology Museum, University of Michigan (UMMZ 229261-229267).

Family Varanidae

Varanus exanthematicus (Bosc, 1792). Bosc's or Western savannah monitor.
Once regarded as common but appears to be suffering from illegal hunting pressure as its flesh is considered good to eat. Aestivates during the dry season. Recorded near Gunjur, in Tanji (pers. obs.), ANR; Gruschwitz *et al.* (1991a) and Håkansson, (1981), Mandinari; Håkansson (1981), Pirang Forest Park; Emms & Barnett (2004), Sittanunka; Barnett & Emms (2002) and NNP; Barnett *et al*. (2000).

Varanus niloticus (Linnaeus, 1766). Nile monitor. Found in almost all habitats where there is water. Large specimens of up to two metres in length appear to be getting less common. Prey items include *Bufo regularis* (pers. obs.). Observed to be the prey of *Naja nigricollis* (pers. obs.) and the Ratel, *Mellivora capensis* (Michael Woods pers. comm.).

The closely related Ornate monitor, *Varanus ornatus* (Daudin, 1803), which has been treated as a subspecies of *V. niloticus* until recently, has not been confirmed in The Gambia. Böhme and Ziegler (1997) state that this species has a distributional pattern restricted to the upper Guinean and western lower Guinean forest block, with some records at the eastern margin of the latter. It therefore seems unlikely to occur in The Gambia.

FAMILY AGAMIDAE

Agama a. agama (Linnaeus, 1758). Agama.
The Gambia's most common, widespread and conspicuous lizard. During the rainy season males develop bright coloration with yellow or orange-yellow on the head, bright blue on the body, legs and most of the tail, and a black tip to the tail. Recorded just about everywhere in the Western and North Bank Divisions e.g.; Gruschwitz *et al*. (1991a), Miles *et al*. (1978), Barnett *et al*. (2001), Pauwels & Meirte (1996), Håkansson (1974 and 1981).

*Agama weidholzi** Wettstein, 1932. Weidholz's agama.
Recorded near KWNP in 2001; captured by Ms EvaMaria Minuth and determined by Prof. Dr. Wolfgang Böhme of Koenig Museum, Bonn, Germany (EvaMaria Minuth, pers. comm.).

FAMILY CHAMAELEONIDAE

Chamaeleo gracilis Hallowell, 1842. Graceful chameleon.
Widespread and common and is often found in the same habitats as the Senegal chameleon. Recorded in Sifoe; Håkansson (1974), Gunjur (pers. obs.), ANR; Gruschwitz *et al*. (1991a), Barnett *et al*. (2001) and Håkansson (1981), Mandinari; Håkansson (1981), MCF (pers. obs.), NNP; Barnett *et al*. (2000) and MacCarthy Island; Andersson (1937). Jones (1990) recorded this species with no details of location. Two specimens are stored at the Zoology Museum, University of Michigan (UMMZ 227434-5).

Chamaeleo senegalensis (Daudin, 1802). Senegal chameleon. Figure 3e.
Widespread and common. Recorded in Sifoe; Håkansson (1974), Kartong (pers. obs.), ANR; Gruschwitz *et al*. (1991a), Barnett *et al*. (2001) and Håkansson (1981), Mandinari; Håkansson, (1981), Pirang Forest Park; Ellenberg *et al*. (1988), NNP; Barnett *et al*. (2000) and MacCarthy Island; Andersson (1937). Jones (1990) recorded this species with no details of location.

FAMILY GEKKONIDAE

Hemidactylus brooki angulatus Hallowell, 1852. Brook's house gecko.
Widespread and common, especially around human habitation. Recorded in TWC; Barnett *et al*. (2000), Fajara; Håkansson (1974), Kotu (pers. obs.), Lamin; Gruschwitz *et al*.(1991a), ANR; Gruschwitz *et al*. (1991a), Håkansson (1974) and (pers. obs.), near Bakoteh; Pauwels & Meirte (1996), in Sintet & Kalagi; Miles *et al*. (1978), RGNP; Gruschwitz *et al*. (1991a), NNP; Barnett *et al*. (2000) and BBWR; Barnett & Emms (2002). Jones (1990) recorded this species with no details of location. Two specimens are stored at the Zoology Museum, University of Michigan (UMMZ 229252-3).

Hemidactylus f. fasciatus (Gray, 1831/1842). Banded gecko.
Recorded by Jones (1990) with no details of location. Branch & Rodel (2003) state that it is a forest dweller that might range into the savannah region by making use of gallery forests, so it could possibly be found in The Gambia.

Hemitheconyx caudicinctus (Duméril, 1851). Fat-tailed gecko.
Recorded at two locations. The first record reported in Gruschwitz *et al*. (1991a) was by Mr Edward Brewer OBE in Kabafita Forest Park in 1973. The second record in 2001 was in forest around Sittanunka (pers. obs.). Jones (1990) recorded this species with no details of location.

Lygodactylus gutturalis (Bocage, 1873). Painted or Forest dwarf gecko.
Widespread and common. Recorded in Bakau, Fajara, Kololi (pers. obs.), Sifoe; Håkansson, (1981), ANR and MCF (pers. obs.) and Tendaba; White (1984). One individual gecko was recorded living on a large wooden pirogue (a local type of boat) based at Lamin Lodge, which regularly plies the River Gambia to and from MacCarthy Island (pers. obs.). Jones (1990) recorded this species with no details of location.

White (1984) observed breeding in this species by captured specimens. They laid eggs from the end of January through to the end of July with an incubation period of 10–12 weeks. White also observed that this species includes ants and tree sap in its diet.

Tarentola spp.
Two species of gecko belonging to the genus *Tarentola* have been recorded in The Gambia. The Fig tree gecko, *Tarentola ephippiata* O'Shaughnesy, 1875 is most frequently encountered and probably widespread and common, especially around human habitation but also on fig trees. Recorded in Bakau; Gruschwitz *et al*. (1991a), Gunjur; Håkansson (1981), Sifoe; Håkansson (1974, 1981), Dimbaya (pers. obs.), TWC; Barnett *et al*. (2000), Yundum & Lamin; Gruschwitz *et al*. (1991a), ANR; Gruschwitz *et al.* (1991a), Barnett *et al.* (2001) and Håkansson (1974, 1981), near Bakoteh; Pauwels & Meirte (1996), in Kalagi; Miles *et al*. (1978), NNP and BBWR; Barnett *et al*. (2000). Jones (1990) recorded this species with no details of location. One specimen of this species is stored at the Zoology Museum, University of Michigan (UMMZ 229254).

The second species, *Tarentola annularis** (Geoffroy, 1798) has been recorded once from KWNP; Barnett & Emms (2002). The specimen which is stored at the Zoology Museum, University of Michigan (UMMZ 229255) is a juvenile and in poor condition. Interestingly Miles *et al*. (1978) caught a number of geckos in Sintet & Kalagi that they were unable to definitely assign to either of these species as they showed a mixture of *annularis* and *ephippiata* characters, as well as characters intermediate between the two taxa. In addition, Joger (1984) identified specimens from Senegal adjacent to The Gambia as *T. ehippiata senegambiae*. In order to examine the variation of *Tarentola* individuals in The Gambia, it would thus be beneficial to collect further specimens in order to determine how many species are present.

Order Crocodylia

FAMILY CROCODYLIDAE

Crocodylus cataphractus Cuvier, 1825. African Slender-snouted crocodile.
Recorded on MacCarthy Island; Andersson (1937), RGNP in 1987 and Fatoto in 1970; Gruschwitz *et al*. (1991a). There was also a possible sighting in the RGNP by a member of the BAOS in March 2003 when a 'smallish crocodile with a long thin snout' surfaced very briefly next to a boat during Exercise Night Heron; Barnett & Emms (2005a). It may be possible that this species is surviving in low numbers in suitable parts of the River Gambia.

Crocodylus niloticus (Laurenti, 1768). Nile crocodile.
Fairly widespread and common, in both fresh and saltwater habitats. The sacred crocodile pools of Katchikalli (in Bakau), Kartong Folonko and Berending, along with ANR appear to form protected breeding populations from which crocodiles often disperse into the surrounding countryside. Recorded in Bakau; Moiser and Barber (1994) and Håkansson (1981), ANR; Gruschwitz *et al*. (1991a) and Barnett *et al*. (2001), Sintet; Miles *et al*. (1978), Kartong Follonko and sand mines; Moiser and Barber (1994) and Barnett & Emms (2000), MCF (pers. obs.), TWC; Barnett *et al*. (2000), Niji Bolon (pers. obs.), Berending; Moiser and Barber (1997) and Håkansson (1981), BBWR ; Barnett *et al*. (2000), MacCarthy Island; Andersson (1937), RGNP; Gruschwitz *et al*. (1991a) and the stretch of the River Gambia in between (pers. obs.).

Osteolaemus t. tetraspis Cope, 1861. African dwarf crocodile.
May now be extinct in The Gambia, though there are persistent rumours that it may still be extant in a few remote and unsurveyed forests in the country. The

Month	No. of days sampled	Habitat	Typhlopidae	Colubridae	Scincidae	Varanidae	Agamidae	Gekkonidae	Totals
July	11	GF			5	2			7
2004	11	GS			1				1
August	15	GF	1	1	2	1			5
2004	15	GS							0
September	15	GF			3				3
2004	15	GS		1	2				3
October	13	GF		3	2				5
2004	13	GS			1		2		3
November	7	GF	1	2	3			1	7
2004	7	GS	1						1
December	15	GF	2	3	2				7
2004	15	GS			1		1		2
January	14	GF			8				8
2005	14	GS							0
February	15	GF			9			1	10
2005	15	GS			1			2	3
March	9	GF			3				3
2005	9	GS							0
April	9	GF			3				3
2005	9	GS							0
May	11	GF			2				2
2005	11	GS			1			2	3
June	18	GF		1	4				5
2005	18	GS		1				1	2

Table 1. Reptile drift fence catches in Abuko Nature Reserve. GF = Gallery Forest; GS = Guinea savannah.

only definite records have come from ANR; Jones (1990), Gruschwitz *et al*. (1991a), Starin & Burghardt (1992) and the area around ANR; Håkansson (1974) and (1981). Although the Dwarf Crocodile Project (Jones, 1990) attempted to reintroduce this species into ANR at the beginning of the 1990s, they have not been recorded there since.

Drift Fence Catches in ANR

Monthly catches recorded in the drift fences located in the gallery forest and Guinea savannah habitats of ANR during the 2004–2005 survey are summarised in Table 1. Nine species of reptile were caught belonging to seven families. The greatest number of individuals were caught in the gallery forest drift fence (65 individuals of five species), and the greatest number of species in the Guinea savannah drift fence (18 individuals of eight species). Whereas *Typhlops punctatus*, *Crotaphopeltis hotamboeia*, *Mabuya affinis* and *Hemidactylus brooki angulatus* were caught in both fences, *Varanus niloticus* juveniles were only captured in the gallery forest fence and *Psammophis* sp., *Mabuya perrotetii*, *Agama agama* and *Tarentola* sp. in the Guinea savannah fence.

The most regular and abundant species caught was *Mabuya affinis* (72% of the total catch in gallery forest and 39% in Guinea savannah) with numbers peaking in January and February. Geckos were the only other reptiles caught during the dry season, in single numbers. Other reptile species tended to be recorded during the wet season and for up to three months following the end of the wet season.

The results from the drift fence survey offer an insight into the relative abundancies of reptiles in the two habitats studied and provide guidance for obtaining the maximum number of species and individuals in future studies in The Gambia (drift fences should be sited in or near to forest habitat and surveys should be carried out during and just after the wet season).

DISCUSSION

The information presented in this paper was collected through reviewing past records and papers and carrying out fieldwork, including gathering casual records, surveying the entire

coastline for marine turtles, surveying almost the entire length of the River Gambia, establishing and monitoring drift fences at various times and translocating 'troublesome' snakes, during the period 1999–2005. During this period ten new species have been added to the Gambian checklist; *Trachemys s. scripta*, *Pelomedusa subrufa*, *Gongylophis muelleri*, *Dasypeltis scabra*, *Meizodon coronatus*, *Rhamphiophis oxyrhynchus*, *Toxicodryas blandingii*, *Echis ocellatus*, *Agama weidholzi*, and *Tarentola annularis*. The study has also extended the known range of several species within the country and brings the number of reptile species recorded in The Gambia to 74 species. Through reviewing and collating the available data from published records it has become apparent that some of the species records for The Gambia are not corroborated with specimens (or even good quality photographic evidence). Such a situation makes it difficult to be absolutely certain about the validity of some of the species listed here. In the species descriptions we have therefore endeavoured to highlight areas where more specimen collection would help to clarify the situation (e.g. the *Prosymna*, *Psammophis*, *Tarentola*, *Lamprophis* and *Atractaspis* species), especially when it may be necessary to revisit specimens for re-determination. In addition, the recent work of Chippaux (2001) provides us with distribution maps of some snake species that have been recorded in both northern and southern Senegal, but not in The Gambia. Further herpetological research in The Gambia is therefore likely to reveal as yet unrecorded reptile species for the country (e.g. *Dromophis praeornatus* (Schlegel, 1837), *D. lineatus* (Duméril, Bibron & Duméril, 1854), *Naja haje* (Linné, 1758), *N. katiensis* Angel, 1922, *Dendroaspis polylepis* Günther, 1864). In addition, the sand and grass snakes may include *Psammophis sudansensis* Werner 1919 which has recently been acknowledged to occur in Senegal (Hughes, pers. comm.).

As with most of the biodiversity in The Gambia, almost nothing is known of the reptile fauna of the country east of BBWR and KWNP and much more work needs to be done to survey this area. Potential good areas for reptiles include the border areas between north Senegal and The Gambia and the Casamance (south Senegal) and The Gambia especially in the moister areas up to 50 km from the coast; the gallery forests fringing the banks and the islands of the freshwater part of the River Gambia; the extensive freshwater marshes in Central River Division and the dry savannah and laterite hills and ridges of Upper River Division. This task is made a little easier with the presence of field workers who have been trained to erect and monitor drift fences during the various surveys and the presence of a country field guide on the common species of reptiles; Barnett & Emms (2005b) produced during the Darwin Initiative project by MWT.

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The colubrid snake *Geophis rhodogaster* (Cope) in Honduras

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GEOPHIS rhodogaster (Cope) is a small semifossorial snake that occurs in disjunct montane populations on the Pacific versant and along the Atlantic versant headwaters from eastern Chiapas, Mexico, to northwestern El Salvador (Downs, 1967; Smith, 1995). We spent 21st–24th June 2006 in the village of El Mojanal, Ocotepeque (1350m elevation), in extreme southwestern Honduras. All streams in the area feed into the Río Lempa, which empties into the Pacific Ocean along the coast of central El Salvador. On two occasions, we climbed a nearby mountain known as Cerro El Chuctal where we were fortunate enough to collect two specimens of *G. rhodogaster*, the first known records of the species from Honduras. One was taken under a log at 1830 m elevation on top of a ridge and the other was inside a rotten tree stump at 1800 m near a small stream. Cerro El Chuctal is in the Lower Montane Moist Forest formation of Holdridge (1967). The forests where the specimens were collected are largely broadleaf, but scattered pines are also present. *Geophis fulvoguttatus* was also collected on Cerro El Chuctal.

Pertinent data for the two Honduran *G. rhodogaster* (USNM 563347–48; both females), respectively, are: SVL 255, 304 mm; total length 296, 359 mm; ventrals 146, 144; subcaudals 30, 35. Both specimens have six supralabials and infralabials, 17–17–17 smooth dorsal body scale rows, 0+1 temporals, a single loreal that borders the eye, and a single postocular. Supraoculars are absent in both. These data are in agreement with that provided for the species by Downs (1967).

Colour in life of USNM 563348 (Fig. 1; colours and colour codes from Smithe, 1975–1981): all dorsal surfaces uniform Greenish Olive (49), except lower two and one-half scale rows on each side Spectrum Yellow (55) with Greenish Olive stripe on upper edge of scale row 2 and lower edge of scale row 3; incomplete Greenish Olive stripe also present along upper edge of scale row 1; supralabials and lower edge of loreal Spectrum Yellow; all ventral surfaces Spectrum Yellow; tail spine Greenish Olive on all surfaces; iris Greenish Olive.

The Honduran locality for this species lies only 6 km NNE of the highest peak of Cerro Montecristo. *Geophis rhodogaster* was previously known from the El Salvadoran side of Cerro Montecristo (Downs, 1967).

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Figure 1. Adult female (USNM 563348) of *Geophis rhodogaster*. © J. R. McCranie.

Evidence of amphibian occupation of artificial hibernacula

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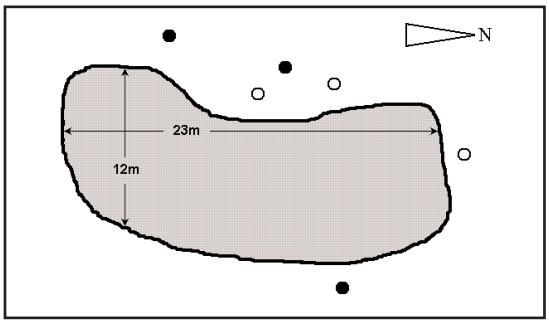
ABSTRACT – Evidence is presented that *Triturus vulgaris* and *Rana temporaria* successfully overwinter in artificially constructed hibernacula of a design recommended by conservation bodies in the U.K. However, *T. cristatus* while present at the site, was not found to use the hibernacula. After emergence, Common frogs showed a tendency to move away from the hibernacula in the direction of the pond.

THE use of artificial hibernacula in amphibian conservation is widely accepted within the U.K., often as part of mitigation associated with land use change (e.g., Marshall *et al.*, 1997). Hibernacula are created to provide suitable overwintering sites where otherwise there may be a shortage, and so help maintain population numbers from one season to the next (Beebee & Griffiths, 2000; English Nature, 2001). While there is evidence that artificial hibernacula have been effective in the conservation of some threatened or endangered species elsewhere (Packard & Packard, 1997; Seburn & Seburn, 2000; Ernst, 2003), and newts have been shown to overwinter in areas containing artifical hibernacula (Kinne, 2004), there is, as yet, no evidence that in Britain, the recommended design effectively fulfils its purpose.

In the UK, artificially constructed amphibian hibernacula are particularly associated with conservation of the Great crested newt *Triturus cristatus*. Briefly they consist of a mound of logs, rocks and bricks loosely filled with topsoil and covered with turf or moss (Langton *et al.*, 2001:31). The mound can be a metre tall above ground level where drainage is relatively poor, or can be buried within the ground and flat-topped in free-draining soils. While there seems to be a general acceptance that the design is effective, and there is anecdotal evidence for the same (e.g., Butt *et al.*, 2002), we considered it useful to test the design more quantitatively. We did this by monitoring vernal emergence from hibernacula using polythene fencing and pitfall traps, which also allowed us to record the direction of emergence and look for patterns therein.

Figure 1. Dimensions of Harris Park Pond and relative positions of hibernacula. Filled circles are hibernacula included in this study.



STUDY AREA AND METHODS

The investigation was carried out around a pond at Harris Knowledge Park, Preston, Lancashire. Surveys in 2002 revealed populations of *T. cristatus*, *T. vulgaris* and *Rana temporaria* to be present at the Park, and individuals of these species were relocated to the pond as part of mitigation during building an extension to one of the nearby buildings. Six hibernacula of a design intermediate between those for impermeable and permeable soils (Langton *et al.*, 2001) were constructed at this time as further mitigation (Landmark Environmental Ltd., 2002), see Figure 1. The pond had relatively gently sloping banks, and was the only water body in the area, though there are some wetter areas, including a ditch, within a hundred metres. Our own survey in April and May 2004 showed that populations of all three species were still present, *T. cristatus* through the presence of eggs, and *T. vulgaris* and *R.*

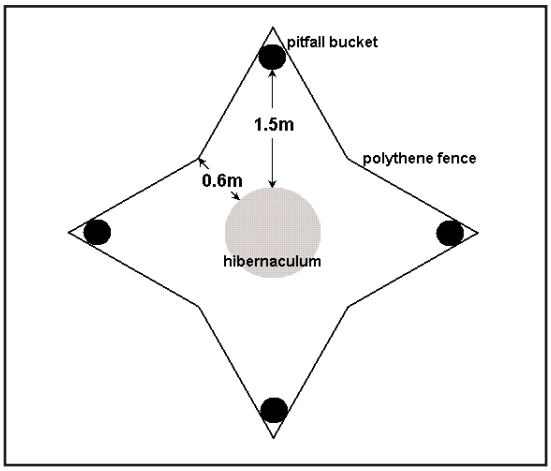


Figure 2. Layout of fencing and pitfall traps with respect to hibernacula.

temporaria through the presence of eggs and adults (bottle traps and torchlight survey).

We set up enclosures around three of the hibernacula in mid December 2004 after a torchlight survey failed to reveal amphibians within the pond. The walls of the enclosures were made of one metre black polythene sheeting, sunk approximately 30 cm into the ground. The nature of the ground at the other three hibernacula made enclosure impossible. The arrangement was a four-pointed star orientated to the points of the compass with a pitfall trap (plastic bucket with mammal ladder) at the tip of each point (Figure 2). One of the points pointed directly towards the pond. The rationale was that the 0.6 m around the hibernaculum allowed an individual to follow a direction different to that of the exit of the hibernaculum, in case exits were restricted to certain locations.

Traps were checked daily between 2nd January and 12th March before 11:00 h. All captives were recorded (species, gender and trap location) before being released to other suitable refuge points around the pond. Whether one direction was followed over others was explored statistically using the Rayleigh *z* - test which determines whether the distribution is random or clustered, and the Rayleigh *u* – test which compares a distribution with a predetermined direction to deduce whether it is significantly different.

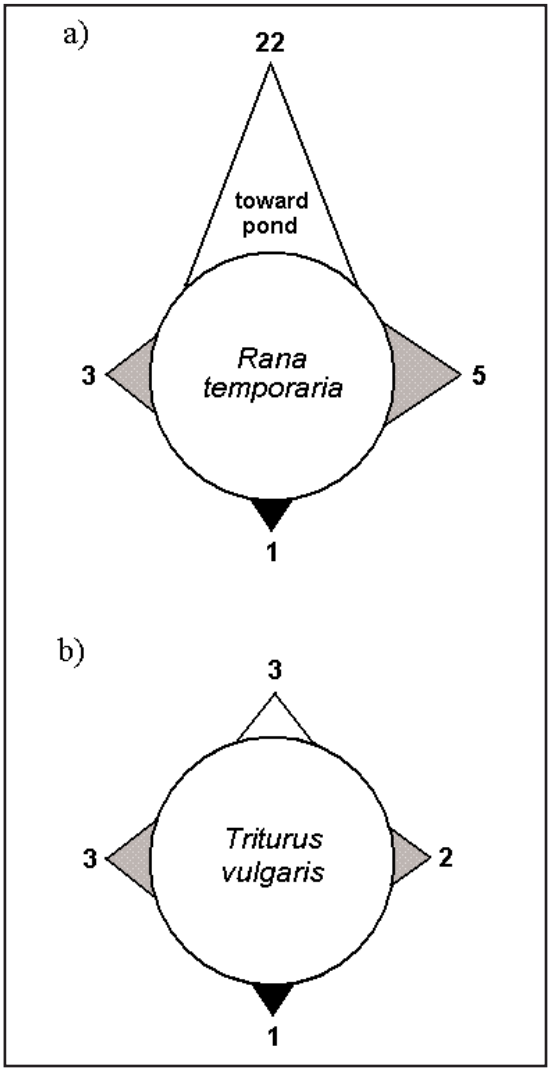


Figure 3. Distribution of captured individuals with respect to direction of pond.

RESULTS AND DISCUSSION

A total of 40 amphibians were trapped of which 31 were *R. temporaria* (20 males, 11 females) and nine were *T. vulgaris* (six males, three females), although three of these were retrieved from beneath the pitfall buckets. This shows that hibernacula are to some degree effective, though the absence of *T. cristatus* from the traps poses some questions. Perhaps *T. cristatus* prefers hibernacula further from ponds, consistent with Duff's (1989) observations that more than 120 m was typical for a population at Little Wittenham in Oxfordshire.

Figure 3 shows the distribution of individuals of both species in relation to the direction of the pond. Results of the Rayleigh tests shows that *R. temporaria* (3a) were significantly clustered (z = 13.03, P <0.001, n = 31) in the direction of the pond (u = 5.095, P<0.001), but whether it is breeding or feeding that is of primary concern after emergence was not addressed within this study. *T. vulgaris* (3b) were distributed randomly (z = 0.556, P >0.5, n = 9) around the hibernacula, though a stronger pattern may have been evident had more individuals emerged.

Temperature (maximum and minimum) and humidity data from the weather station at Harris Park were compared to the emergence dates of the amphibians, but no significant correlations were revealed.

These results support the claim that this design of hibernaculum is effective at providing overwintering sites for some amphibians, but perhaps their location requires further consideration, particularly regarding *T. cristatus*.

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Thirty years of garden ponds

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THIS is the third decadal account of amphibians living wild in a series of garden ponds that were first established in 1977. The garden is at around 80 m elevation above sea level, on the South Downs in East Sussex. To the west is a main road and then open fields with no standing water for over 1 km, making natural colonisation by amphibians very unlikely from this direction. However, to the east there are many gardens, some with ponds. Populations of Common frogs *Rana temporaria*, Smooth newts *Triturus vulgaris* and at least one of Common toads *Bufo bufo* certainly occur and have been potential sources of colonists. Four anuran and four urodele species currently breed in my ponds, and all were introduced deliberately by me irrespective of whether some natural colonisation occurred. In the first decade, a large population of Common frogs (more than 200 adults) became established, as did a small mixed population of water frogs (*Rana lessonae/ esculenta*) and substantial numbers of four newts (Smooth newts *T. vulgaris*, Palmate newts *T. helveticus,* Great crested newts *T. cristatus* and Alpine newts *T. alpestris*). The non-native species (water frogs and Alpine newts) were introduced before such activity became illegal under the Wildlife & Countryside Act of 1981. By 1986, Smooth newts in particular were extremely abundant (Beebee, 1986). Over the next decade, Common frogs and all the newts except alpines declined while the water frogs remained fairly stable but in low numbers (Beebee, 1996). The newt declines followed the introduction of Three-spined sticklebacks *Gasterosteus aculeatus* into one of the two large ponds in 1991, in a deliberate attempt to control newt numbers and relieve what had become very high predation pressure on frog spawn. Throughout the first 20 years various attempts to encourage Common toads *Bufo bufo* all failed. In this paper I describe events in the third decade, including an overview of the entire 30-year period.

The garden site

An outline of the main ponds used by amphibians, approximately to scale, is shown in Figure 1 together with dates in which the various ponds were created. The two largest ponds (1 and 3) are illustrated in Figure 2. Ponds 1–5 are all concrete (though 1, 2 and 3 started out as butyl liners), while ponds 6 and 7 are butyl. The numbering system for ponds 1–3 follows that of previous publications (Beebee, 1986; 1996), while ponds 4–7 were all created after 1996. Ponds 4 and 5 are connected by pump, with running water, and are little used by amphibians for breeding. Ponds 2, 3, 4, 5 and 7 receive sun for most of the day. Pond 1 is partly, and pond 6 very shaded. Pond 1 is the favourite of all four newt species and the only breeding site for *T. cristatus*, though many newts of the other species also use ponds 6 and 7. Common and water frogs, and recently Common toads, always spawn in pond 3. Pond 3 was also heavily used by newts prior to the introduction of sticklebacks, and this is the only pond with fish.

Amphibian numbers

Anurans – The numbers of Common frog spawn clumps laid in the garden over the past 30 years, more than 98% of which were in pond 3, are shown in Figure 3. The population increased rapidly during the first decade to a peak of more than 200 adults (assuming an equal sex ratio), but declined dramatically in the second decade. Since the mid 1990s the population has apparently stabilised in the region of 20–30 pairs, with indications of a revival over the past five years after a nadir in 1998. The decline in the late 1980s was commensurate with the development of large newt populations, and newts were watched after dark attacking spawn and eating the embryos. Frog tadpoles, let alone froglets, were virtually never seen at this time. However, the introduction of sticklebacks in 1991 was followed by declines in the newt population, especially that of great crested newts, specifically in pond 3 (see later). Since then, frog tadpoles and froglets have been observed fairly regularly though never in the numbers of the first decade. Immature frogs, and

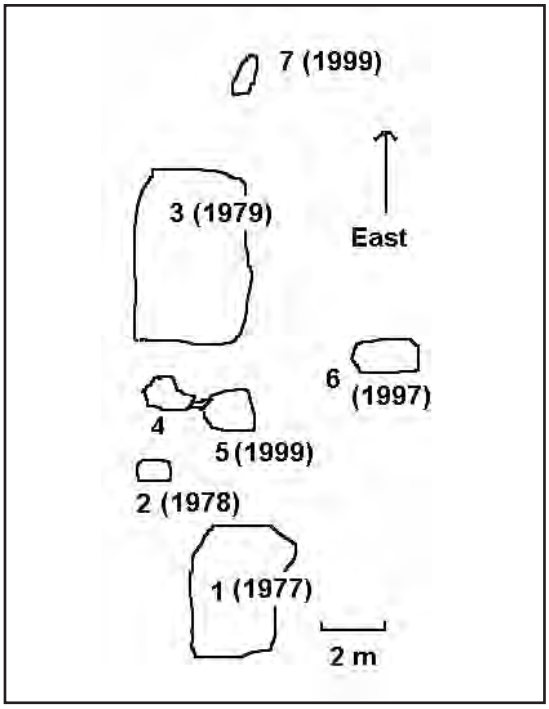

Figure 1. Layout of the garden ponds. Year of creation is in brackets.

small adults at breeding time, are now seen again every year. Common toads made sporadic attempts to breed, mostly in pond 3, during the early 1980s and again in the mid 1990s. Usually just one or two pairs spawned, and the subsequent tadpoles disappeared before metamorphosis. However, following the release of tadpoles in the newly created pond 6 in 1998, Common toads started to do well and have produced toadlets consistently (though never in pond 6!) since 2000, and especially in the last three years. In the springs of 2005 and 2006 pond 3 teemed with Common toad tadpoles. Forty adults, including 10 pairs, were seen on the best night in March 2006.

I have not tried to quantify water frog numbers, but there have certainly been some interesting changes. During the 1980s I could sometimes count up to 20 basking at any one time in summer, mostly a mixture of Pool and Edible frog adults. Although they spawned every year, much of the output was not viable (presumably due to *esculenta* x *esculenta* matings) and juveniles were rarely seen. By the late 1990s, however, best counts were 40–50 individuals and almost all were Pool frogs. Reproduction is now successful in most years, and a range of sizes including adults and immatures occurs.

Urodeles – The fate of newts in the garden ponds is summarised in Table 1. Numbers were estimated in the Aprils of 1986, 1996 and 2006 using a capture-mark-recapture approach. Multiple newt traps (Griffiths, 1985) were set in the ponds overnight. All newts caught in the traps were toe-clipped the following morning, and released immediately back into the pond where they were caught. Before dark, on the same day, the ponds were netted and all the newts caught were recorded as to whether they were clipped or not. Population sizes in each pond (1, 2, 3, 6 and 7) were estimated according to the equation:

$$N = \frac{a(n+1)}{r+1}$$

Where N = estimate of population size, a = number of newts toe-clipped, n = number of newts caught in second round (by netting), and r = the number of netted newts with toe clips.

Standard deviations (SDs) were estimated (per individual pond) by:

$$SD = \sqrt{\frac{a^2(n+1)(n+r)}{(r+1)^2(r+2)}}$$

These estimates of course only refer to newts in the ponds at the time, and there may also have been some living away from the ponds. I attempted to choose the time of peak numbers visible in the ponds during the three springs when the mark-recaptures were carried out, but if I got this wrong in any substantial way then the inter-year comparisons would be unreliable. I believe, however, that any such errors were minor relative to the numbers estimated. Although they have fared rather differently, the four species were still present 30 years after their introduction. All except the alpines seemed to decline in the second decade, relative to the first 10 years, but the three natives stabilised or recovered ground in the third. Thus Smooth newts increased dramatically in the first decade, declined by some 80% in the second, and remained at that level or a little higher during the third. Great crested newts, always the rarest species, are now fewer than in the 1980s probably because sticklebacks excluded them from pond 3 during the early 1990s. However, their numbers in pond 1 are essentially unchanged over 30 years. Palmate newts have remained stable or perhaps increased slightly, and seem to do particularly well

in the relatively new pond 7 (data not shown in Table 1). Alpine newts thrived from the start, and by 2006 were the most abundant species, accounting for more than half of all the newts present in the garden ponds.

The effects of introducing sticklebacks into pond 3 can be inferred from Table 2. Between 1986–2006, Smooth newts declined by 74% overall in the garden, but by 90% in pond 3. Palmate newts increased by 50% overall, but declined by 45–50% in pond 3. Great crested newts declined by about 30% overall, but by at least 86% (and as a breeding species by 100%) in pond 3. By contrast, Alpine newts increased by 140% overall, and by 80% even in pond 3. Alpines are now the dominant species in all the ponds, and this is particularly marked in pond 3. Total newt numbers in pond 1 rose by about 25% between 1986 and 2006, whereas total newts in pond 3 declined by about 73% over the same period (and by about 37% in the garden as a whole, almost entirely due to the crash in Smooth newt numbers in pond 3).

Figure 2. Ponds 1 (above) and 3 (below), May 2006.

Amphibian breeding times

The dates upon which the first spawn of Common frogs and water frogs was laid in the garden ponds are shown in Figure 4. I inspect the ponds every day during the respective breeding seasons, so the dates should be accurate to within 24 hours. There has been no tendency for common frogs to spawn earlier over the past 30 years ($r = -0.172$, $P = 0.382$). The average for the period was day 58, i.e. February 27th, counting January 1st as day 1. The earliest date was February 13th, achieved in both 2002 and 2005, while the latest was March 13th in 1979. By contrast, there has been a dramatic change in the onset of spawning by water frogs and a highly significant trend towards earliness ($r = -0.608$, $P = 0.001$). Between 1978–1990 the average date was June 4th, while between 1991–2006 it was May 15th, an advance of nearly three weeks. Even so, 2005 and 2006 were both late following unusually cold spells in March.

First arrivals of all four species of newts have appeared earlier over the past 30 years. Dates for Smooth newts (those for Palmate and Great crested newts are almost identical) and for Alpines are shown in Figure 5. Ponds were inspected by powerful torchlight almost every night, excepting when frosts occurred, between November and February and data should be accurate at least to within 48 hours. Although the trends were all similar, Alpine newts consistently arrived later than the three native species, by an average over the 30 years of around 38 days. Overall the trend to earliness was significant for Smooth newts ($r = -0.623$, $P<0.001$) and for Alpines ($r = -0.786$, $P<0.0001$). Moreover, the trends were highly correlated between these two species ($r = -0.705$, $P<0.0001$), and among these and the others (data not shown). For Smooth newts the regression line indicates that first arrivals have become some 50 days earlier over the past 30 years, from late

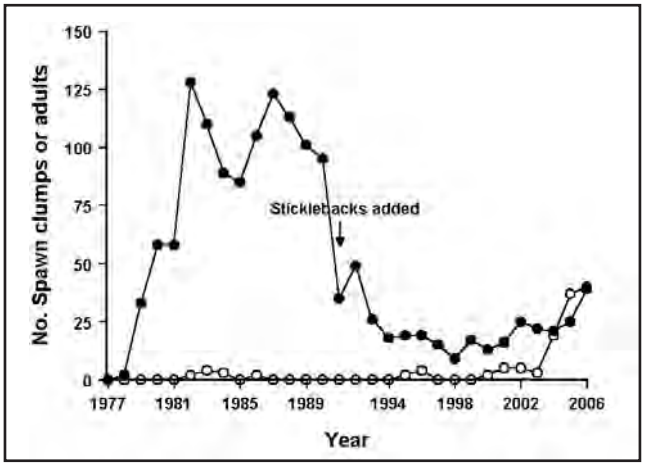

Figure 3. Numbers of common frogs and toads breeding in the garden ponds. Solid circles, numbers of frog spawn clumps; open circles, largest number of common toads seen on a single night. Arrow shows when sticklebacks were added to pond 3.

January (circa 27/28th) in the late 1970s to early December (circa 5/6th) in the early 2000s. The corresponding change for Alpine newts has been greater at around 75 days, from circa March 20th to circa January 5th. However, the regression lines are somewhat misleading because the changes for both species over time were not linear. Between 1978–1992 there were strong and significant trends for both species (Smooth newts, r = - 0.778, P<0.001; Alpine newts r = - 0.833, P<0.0001), but between 1993-2006 there was no subsequent change (Smooth newts r = - 0.084, P = 0.785; Alpine newts r = - 0.027, P = 0.928). The same biphasic pattern also was seen with Great crested and Palmate newts. The scatter of first arrival timings over the past 10 years has been large for all species, but is still notable that the earliest arrivals (November 16th for Smooth newts in 2003, and December 2nd for Alpine newts in 2004) have all been in the last decade.

Table 1. Changes of total newt numbers during three decades.

Year	Smooth newts	Great crested newts	Palmate newts	Alpine newts	Total newts
1986	527	19	26	98	670
1996	103	9	15	103	230
2006	135	13	39	234	421

DISCUSSION

Current concerns about global amphibian declines (e.g. Beebee & Griffiths, 2005) make long time-series of population dynamics potentially important if we are to understand factors that may predispose extinction. Although these garden ponds are of course artificial, with the exception of Common toads there has been no manipulation of the species numbers since the original introductions which finished in 1981. The main breeding ponds also retain their original sizes and shapes, though extra small pools have been added within the last 10 years. I believe that over three decades the Woodingdean garden site has provided some interesting insights about the functioning of amphibian communities, but also posed some unanswered questions.

Frogs, newts and fish

The introduction of sticklebacks to pond 3 resulted in the outcome I hoped for, i.e. a reduction in the newt population and the revival of the frog population, albeit after a substantial lag phase of 5 years or so. Of course I cannot be sure that this was cause and effect, it could be coincidental, but it makes biological sense because newt larvae are now almost never seen in pond 3. Therefore the garden has retained its full amphibian biodiversity and even expanded it with the recent toad success, which may also be related to the presence of fish as toads generally do well in fishponds. The mechanism of fish avoidance by newts is interesting. Great crested newts can clearly recognise and avoid fishponds, but I believe this only works with potential new immigrants. Some, I guess those born in pond 3, continued to try and breed there in progressively smaller numbers in the few years following stickleback introduction (Beebee, 1996). Maybe philopatry is dominant over fish avoidance mechanisms in this species. As a minor aside, sticklebacks have never appeared in any of the other ponds over the past 15

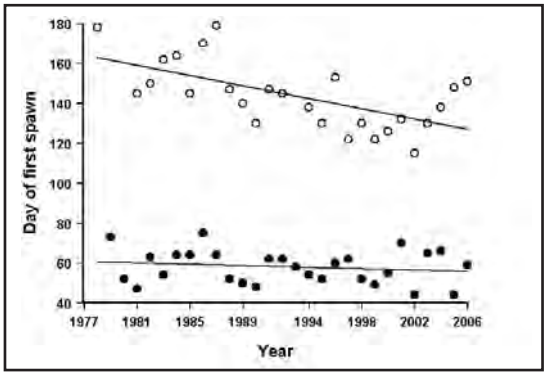

Figure 4. First spawn dates for Common frogs (solid circles) and water frogs (open circles).

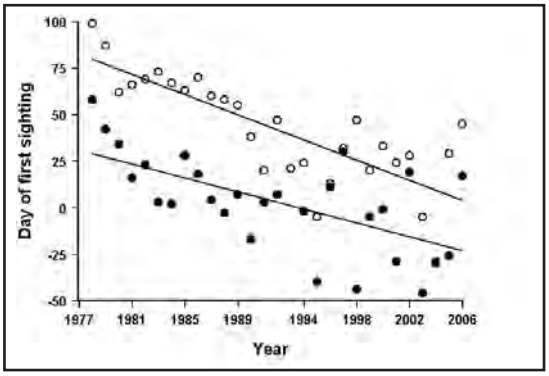

Figure 5. First arrival times of Smooth newts (solid circles) and Alpine newts (open circles).

years. This is despite the proximity of the pools, and their regular use for bathing by many birds. Evidently these small fish do not disperse easily in this kind of situation.

Non-native species

Alpine newts have prospered, but apparently not at the expense of the three native species despite my earlier concerns about Smooth newt declines (Beebee, 1986). The implication is that despite remarkably high densities of newts in most of the garden ponds (much higher than I have seen in most rural ponds), interspecific competition has not been severe over this 30-year timescale. Perhaps this is not too surprising, since all these species coexist in parts of France (Arntzen & de Wijer, 1989). Alpine newts surely have the potential to spread widely in Britain, and I find it surprising that they have not yet done so. The water frogs have fared increasingly well, partly I think because Edible frogs in the original mixture, obtained from Beam Brook in Surrey (Gillett, 1988), have mostly died out leaving Pool frogs that produce viable spawn and are probably better adapted to northern climates than the hybrid *esculenta*. I suspect that adding extra ponds has also helped. The segregation of juveniles into pond 7, for example, is very noticeable and in general a mosaic of pools is considered highly conducive to the maintenance of water frog metapopulations (Sjogren Gulve, 1994).

Breeding times

With Common and water frogs, breeding in the garden is relatively explosive and most spawn is deposited within a week or two of the initial clump. First spawning dates are therefore an accurate indication of overall breeding time. Common frogs have not changed their breeding season significantly, while the water frogs now breed much earlier in most years than they did in the 1980s. The spread of water frogs in south east England in recent decades (Wycherley & Anstis, 2001) may well be a result of this change, and a consequent increase in metamorphic success, since the tadpoles now have longer to develop before winter sets in. In my ponds, water frog tadpoles still in the ponds when ice forms – even a thin and incomplete cover – invariably die, and litter the pond bottom. For newts, the story is rather different because first arrivals do not accurately reflect overall breeding times. It

Table 2. Changes of newt numbers in pond 1 (no fish) and pond 3 (fish added in 1991).

Year	Smooth newts		Great crested newts		Palmate newts		Alpine newts	
	Pond 1	*Pond 3*	*Pond 1*	*Pond 3*	*Pond 1*	*Pond 3*	*Pond 1*	*Pond 3*
1986	115(32)	364(111)	12(4)	7(2)	8(3)	13(4)	43(12)	39(21)
1996	23(12)	55(29)	7(2)	0(0)	9(5)	6(3)	33(19)	41(10)
2006	72(34)	35(16)	12(6)	1(0)	12(5)	7(3)	128(42)	70(29)

remains true that most newts arrive much later than the vanguard, and though I have not tried to quantify peak time it is evidently in March and early April for all the species in most years. This is probably an advance on the situation 30 years ago, but not by anything like as much as the vanguard records suggest. In mid-Wales, median migration times of Smooth and Palmate newts were one to three weeks earlier in the late 1990s than they were in the 1980s (Chadwick *et al*., 2006).

Presumably all these differences represent responses to climate change, and they certainly correlate with temperatures that are likely to be important for gamete maturation (Beebee, 1995). With newts, the vanguard may be approaching a limit on potential earliness in November, perhaps because there is a minimum time needed after the previous breeding season to accumulate resources for reproduction. The question remains, however, as to whether the main newt breeding season will eventually advance to catch up with the vanguard.

Common toads

Toads have been the most perplexing species in the garden. It remains unclear why they experienced such poor breeding success in the early years. Pond 6 was constructed with toads in mind, and produced many toadlets from introduced spawn in 1998 and 1999, but returning adults in subsequent years never used it and have suddenly started to prosper in pond 3. Actually pond 6 is particularly odd because over the past three years five female toads have entered it and died for no obvious reason. Other amphibians visit pond 6 regularly with no ill effects. As usual there is always more to learn, but garden ponds are excellent and convenient outdoor laboratories with, I am sure, much more to offer.

ACKNOWLEDGEMENTS

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Observations of the Cape cobra, *Naja nivea* (Serpentes: Elapidae) in the DeHoop Nature Reserve, Western Cape Province, South Africa

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ABSTRACT – During September 2004 the author began research on the Southern adder, *Bitis armata*, and the Puff adder, *Bitis arietans*, at DeHoop, a National Nature Reserve and biodiversity 'hotspot', managed by the Western Cape Nature Conservation Board (now Cape Nature). It soon became apparent that the Cape cobra was a prominent species on the reserve, and presented an opportunity to extend the research programme to include this familiar but little studied venomous snake. The current study included general observations throughout the reserve, but also more detailed observations were undertaken of individual cobras at their respective refugia. Results so far have shown that the Cape cobra is essentially a diurnal species, and exhibits a pronounced degree of sedentary behaviour. Observations have also shown that this species is a feeding generalist; in addition to a diet of rodents, birds, snakes and other reptiles, observed feeding behaviour also included cannibalism of conspecifics, and scavenging road-killed snakes.

THE Cape cobra, *Naja nivea*, is a common monotypic elapid species in the Western Cape, and is responsible for most fatal incidents of snakebite in the province (Branch, 1998). The venom is also the most potent of all the South African cobras (Broadley, 1983). It is perhaps therefore surprising that virtually nothing is known about the ecology, habitats and behaviour of this widespread and potentially dangerous species.

Naja nivea is a habitat generalist, and can be found in a wide variety of biomes across southwestern Africa, including dune thicket, coastal and mountain fynbos, karroid sandveld, and semi desert. Unlike most other African cobras this species shows a wide range of colour variation; from yellow and golden brown to dark brown and black. In addition, individuals show a varying degree of black or pale stippling and blotches, and although it has been stated that colour and marking are geographically related, it is also possible to observe virtually all colour varieties at one location. For example, it is well known that the Kalahari specimens in Botswana are usually more consistently yellow than the more southerly populations (Spawls & Branch, 1995; Branch, 1998). However, at DeHoop, and other specific locations in the Western Cape, all colour variations have been recorded (pers. obs.). It is not a particularly large cobra; average adult size is around 1.5 metres, and females are somewhat smaller than males. The largest specimen recorded at DeHoop was a male with a total length of 1.85 metres.

The Cape cobra is a timid snake, always seeking to escape when encountered, although when aroused it has been described as willing to bite readily (Spawls & Branch, 1995; Branch, 1998; Marais, 2004). It has also been stated that the Cape cobra is more aggressive during the mating period (Broadley, 1983; Spawls & Branch, 1995). However, passive observation of another notorious South African elapid, the Black mamba, *Dendroaspis polylepis*, has shown that in normal circumstances this species exhibits alert but calm behaviour (Phelps, 2000). Observations of the Cape cobra at refugia so far at DeHoop have indicated very similar behaviour.

The Cape cobra is a diurnal species and actively forages throughout the day. During very hot weather it may become crepuscular, but is rarely if ever observed during the hours of darkness (Pers obs.). There is no current information with regard to size of home range, population densities, or sex ratio. Detailed accounts of such as reproductive and feeding behaviour are also lacking, and past and current information has tended to be anecdotal, or repetitive in popular literature. For

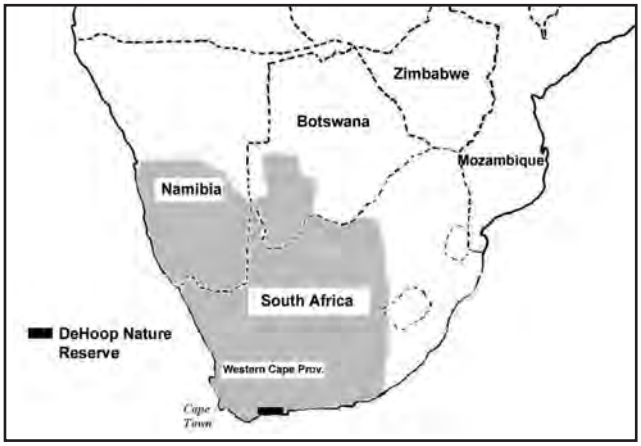

Figure 1. Distributional range of *Naja nivea*.

example, the accounts of the Cape cobra climbing and preying on sociable weaver (*Philetaurus socius*) in the Kalahari has been quoted many times (MacLean, 1973).

Broadley (1983) states that the Cape cobra uses rodent burrows and other animal holes as a more or less permanent retreat, but other information regarding sedentary behaviour or the occupation of permanent refugia also appear to be anecdotal.

STUDY AREA AND METHODS

DeHoop Nature Reserve is situated on the south coast of the Western Cape Province, South Africa, at 34°S 20°E, and represents part of the most southerly distribution for the Cape cobra in southern Africa, the most southerly distribution being found at Cape Agulhas some 70 km south west from DeHoop. The reserve covers an area of 50 km of coastline, (not including the Marine reserve), and extends inland for distances ranging from 10 to 20 km. The habitat consists of a mosaic of dune thicket, sand and limestone fynbos, and restioveld at altitudes from sea level to 300 metres.

The climate is temperate with rainfall occurring mainly during the winter months which are typified by cold nights and sunny, but cool days. Summer temperatures can reach as high as 35°C with night time temperatures between 18°C and 22°C. Daytime temperatures during the spring period can reach 30°C, but average between 24°C and 28°C.

Study period – The study is ongoing, but the initial period has so far covered 68 days from October 2004 until March 2006. No study was undertaken during the winter months (May-August).

Method – The present study was prompted by the discovery and subsequent observation of a male and female Cape cobra at one particular refuge during October 2004 at DieMond, which is situated in the south-western corner of the reserve. The refuge consisted of two connecting burrows, and was situated at the edge of a gravel road. The animals were observed from a vehicle at a distance of just three metres; four other refugia were also monitored in a similar manner at distances of five to fifteen metres. The cobras at refugia were passively observed, often with the aid of binoculars, and not physically handled or disturbed. A number of cobras, which were opportunistic sightings, were captured and sampled. Other cobras were observed from a distance with binoculars to record foraging behaviour. It was also necessary to remove a number of cobras from potential dangerous situations, and move them locally to a place of safety.

Captured cobras were measured and sampled for DNA by ventral scale clipping, and in some cases caudal vein

Figure 2. Map of DeHoop Nature Reserve.

Figure 3. Adult male *Naja nivea* in fynbos habitat, Oudtshoorn, Little Karoo. All photographs © T. Phelps.

Figure 4. Adult male *Naja nivea* DN01 basking next to refugia burrow. DeHoop Nature Reserve, Western Cape.

Figure 5. Adult male *Naja nivea* DN01 emerging from refugia burrow. DeHoop Nature Reserve, Western Cape.

Figure 6. Immature *Naja nivea* DOR killed while eating *Duberria lutrix*. DeHoop Nature Reserve, Western Cape.

Figure 7. Juvenile *Naja nivea* in *Protea* bush, Gansbaai, Western Cape.

Species	Qty	Source
Rodents		
Rattus rattus	3	Obs+SC
Rhabdomys pumulio	3	SC
Birds		
Francolinus capensis	1	Obs
Ploceus capensis	1	SC
Snakes (inc carrion)		
Duberria lutrix	1	SC
Psammophylax rhombeatus	3	Obs+SC
Psammophis notisticus	2	SC
Bitis arietans (immature?)	1	SC
Lizards		
Agama atra	1	SC
Trachylepis capensis	1	SC
Conspecifics		
80 cm ?	1	SC
95 cm ?	1	SC

Table 1. Recorded prey species of *Naja nivea* at DeHoop Nature Reserve. Obs = Observation. SC = Stomach contents.

puncture. The scale clips were also used for identifying individual snakes. As additional aids to identification snakes were photographed, and colour, markings, permanent injuries and scars were noted, and each snake allocated a field number. Snakes were always handled in a gentle and safe manner, and restrained in tubes of appropriate size for close examination and sampling.

RESULTS

From October 2004 to March 2006 a total of twenty eight Cape cobras were recorded, plus eight dead specimens found on roads (DORs). Of the living cobras, fourteen were males and fourteen females. All were in excess of one metre in length, and as such were deemed to be adults. The dead specimens consisted of two juveniles, two adult females, and four adult males.

Eight snakes were observed at five separate refugia; the DieMond site contained a male and female, another site was occupied by two males and one female, the remaining three were occupied by single individuals (two males, and a female). The DieMond refugia consisted of two burrows one metre apart situated in sand fynbos. The remainder also consisted of two or more burrows, three were situated in well vegetated limestone fynbos; the other on more open ground, and also in limestone fynbos.

Daily activity – From mid October 2004 the DieMond refuge was observed from dawn until dusk for twelve consecutive days, and the times of emergence and retreat for the male DN01 were recorded (Figure 9). On cloudless sunny days the air temperature reached between 22°C and 25°C by 09:30 h. Clear sunny days were apparent for eight days for the twelve day observation period One morning was overcast after overnight rain, and temperatures within the above range were not recorded until 11:15 h. Emergence was recorded when the air temp was between 26°C and 28°C, with a mean of 27.2°C for the twelve day period. The corresponding surface temperature at times of emergence for the period was between 28°C and 33°C, with a mean of 29.5°C.

Emergence was a slow process. Firstly, the tip of the snout and flicking tongue would be apparent at the lip of the burrow. The cobra would then slowly move up with hood spread, fully alert (Figure 5), and then turn the head a full 180°). The cobra usually remained at the mouth of the burrow for a full five minutes or so before moving off to bask a metre or so away, (Figure 4). The male DN01 was easily identified due to a truncated tail. The duration of basking varied little on clear sunny days with a minimum of twenty minutes, and a maximum of twenty eight minutes. On overcast days the basking period extended to a maximum of forty two minutes. Regardless of weather conditions the basking posture never varied; the cobra extended the body for its entire length exposing maximum surface to both ground and available sun. Following the morning basking sessions the cobra would move off slowly into the surrounding vegetation, but return a short while later after a period of between thirty and sixty minutes. On returning to the site the cobra would either engage in a brief lying out session, or retreat into the burrow using either of the two entrances. This behaviour was consistent for the twelve day period.

The female cobra, DN02, was never observed engaged in early morning basking sessions at the site, although basking was observed at other times of the day around the burrow entrance. Although it was obvious that the burrow was occupied by both snakes at times during the day, they were never observed basking together. During the observation period it became apparent that this site was probably not the female cobra's permanent home, and that the activity pattern strongly suggested that it was visiting the site.

During the hottest part of the day both cobras remained together in retreat within the burrow for a period ranging from two to three hours. At mid-afternoon, always between 15:00 and 15:45 h, the female cobra would emerge from the right side burrow and move off immediately into the surrounding vegetation. Between ten and fifteen minutes later the male would emerge, and after a very short period of lying out would move off. On its return, never later than 17:00 h, the male went into retreat immediately. For the entire twelve day period this represented the last sightings of the day for both male and female.

Although not as intense, observations were made at the four other refugia. This included monitoring morning basking, and checking for presence during the mid-afternoon. Three of the refugia contained single cobras, two males and one female. The fourth was unusual in that three cobras were seen to be consistently in residence; two males and one female. The cobras at this refuge exhibited passive behaviour toward each other, and it was the only occasion where communal basking was observed.

The periods and timing of morning emergence and basking was similar to the first refuge. However, although return was observed during late afternoon, occasional observations strongly suggested that the cobras at these refugia were away for much longer. A total of five cobras, were positively identified at significant distances away from their respective refugia from late morning until mid-afternoon.

Mating behaviour – During the study period so far, no actual physical mating has been observed. The initial observation period at the DieMond site was within the known mating period for the species.

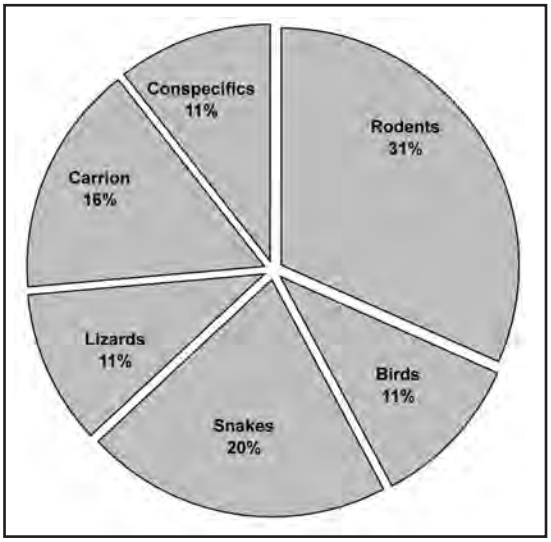

Figure 8. Recorded prey items for *Naja nivea* at DeHoop from October 2004 to March 2006.

The long periods spent together in retreat suggested that mating may have been taking place. There were several other clues to suggest mating activity. On one occasion another cobra, assumed to be a male, entered the left side of the burrow only to exit rapidly with the resident male in pursuit. The resident male returned quickly and re-entered the same burrow. Another clue was when on one morning the female emerged with a small bead of blood showing on the rear of the hood approximately four centimetres behind the head. However, it has not yet been shown that fang penetration is a factor of mating behaviour for this species.

Although a good number of male cobras were observed moving around in general during the mating period, it was difficult to distinguish between potential behavioural aspects. Unless actually witnessed feeding, it was assumed that mate-searching could have been an equally likely alternative.

Foraging & feeding – Nineteen prey items were recorded and identified, either by first hand observation, or the examination of stomach contents of road-killed individuals (Table 1; Figure 6). The sample was thought large enough to indicate that the Cape cobra is a feeding generalist; the percentage of prey types is shown in Figure 8.

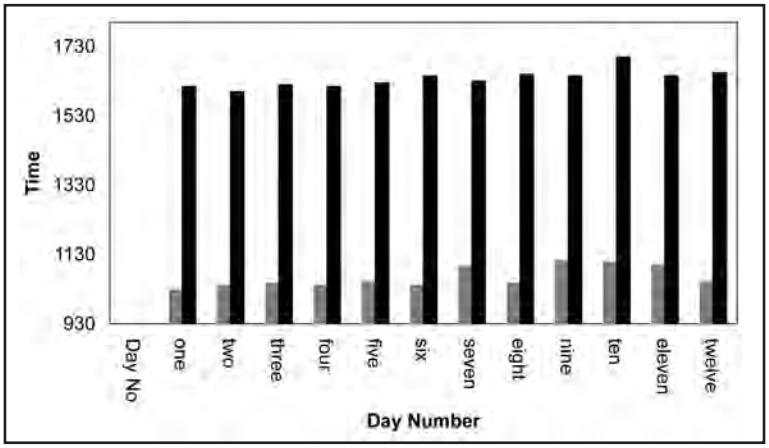

Figure 9. Emergence and retreat times of male *Naja nivea* (DN01), October 2004.

One interesting feeding observation occurred when a cobra was seen to emerge from a burrow in open ground amid a covey of Cape francolin, *Francolinus capensis*, which included a number of very small young. The cobra, still only partly emerged from the burrow, snatched the nearest young bird and withdrew back into the burrow. Another cobra was encountered with an adult Skaapstecker, *Psammopylax rhombeatus*, partly ingested. Interestingly, although the snake was not disturbed, it was moving slowly with head raised during the swallowing process. On two occasions cobras were observed near staff quarters consuming rats, *Rattus rattus*. These cobras were eventually removed to another location some one kilometre distant.

Cobras were seen scavenging and feeding on carrion on two occasions (Phelps, 2006). Both were road-killed snakes, the first, an adult *P. rhombeatus*, the second an adult Karoo whip snake, *Psammophis notostictus*.

Cobras were seen foraging at virtually anytime from mid-morning onwards, even during the hottest part of the day. However, much of the foraging behaviour involved moving in and out of burrow systems. Although hypothetical, it was thought that this partly subterranean behaviour offered scope for optimum thermoregulation. Six of the cobras observed foraging were identified as originating from their respective refugia. The furthest straight line recorded distance travelled from refugia was for a female (DN05), at 2 km. Other cobras were recorded at distances of between two hundred metres and one kilometre from the respective refugia.

Research at DeHoop on other snakes, namely the Puff adder, *Bitis arietans*, and Southern adder, *B. armata*, involved searches at dusk until two to three hours after nightfall throughout spring and summer. During this time no cobra activity was observed.

Site fidelity – All the cobras observed exhibited a pronounced attachment to their respective refugia. Even though some were seen to be highly vagile, and move long distances, all returned to the home base. There was some variation; the female at the DieMond site disappeared after two weeks, leaving the male in sole occupation. Another roadside refugia containing one male was damaged during road grading operations, and the cobra was not seen again. During March 2006 five of the Cape cobras were still in residence at their respective refugia.

Additional observations – Since January 2006 Cape cobras have been observed and monitored around the author's home at Oudtshoorn in the Little Karoo. Here the Cape cobra is extremely abundant, and can be frequently encountered within the town limits. Many records were typically 'problem' cobras taken from gardens and work places. Four neonate Cape cobras were taken in three days from the Police Training College (Figure 7). On one day during March five cobras were taken from a variety of situations, including gardens and cars, all within the town limits.

Future work in the Little Karoo will include identifying individual refugia in nearby karroid sandveld, and to observe and record the cobras in a similar manner to DeHoop.

DISCUSSION

Nocturnal activity of the Cape cobra is poorly documented (Spawls & Branch, 1995) and although there appears to be some consensus with

regard to it being a diurnal species, some literature still states that the Cape cobra is largely active by night (Trutnau, 2004). This study strongly suggests that the Cape cobra is totally diurnal, even during very hot weather when it appears to maintain an optimum temperature because of the partly subterranean habit during any one day.

The lack of data regarding mating and courtship was disappointing; it was thought as the study has so far encompassed two mating seasons then more would have been revealed. It could be that mating is a secretive affair, and may take place beneath ground; the observations at the one site suggest this. The recorded blood on a female also suggests that fang penetration may be a component part of mating; other cobras are known to exhibit this behaviour (Phelps, 1989). However, observing more than one cobra at refugia indicates some gregarious behaviour, and that the Cape cobra is not necessarily a solitary species.

Results show very clearly that the Cape cobra is a feeding generalist. There are records of other cobras scavenging and feeding on road-kill snakes (Loehr, 2005). Except for scavenging of an injured Mole Snake in the Kalahari recorded by Clauss & Clauss (2002) the observations for this study represent the first record of scavenging on actual dead snakes for the Cape cobras as far as is known.

This study showed that the Cape cobra exhibits pronounced site fidelity but also shows a high degree of vagility, moving long distances during a day. Further study will gain more detail with regard to the actual home range of individual cobras.

ACKNOWLEDGEMENTS

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Appendix

Syntopic snake species and numbers recorded at DeHoop Nature Reserve.

Typhlopidae	
Rhinotyphlops lalandei	7
Colubridae	
Lamprophis capensis	2
Lamprophis inornata	1
Pseudaspis cana	4
Duberria lutrix	12
Prosyma sundevalli	2
Psammophis notostictus	15
Psammophis crucifer	24
Psammophylax rhombeatus	35
Dispholidus typus	23
Atractaspididae	
Homoroselaps lacteus	2
Viperidae	
Bitis arietans	28
Bitis armata	15

A reliable customer: hunting site fidelity by an actively foraging neotropical colubrid snake

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ABSTRACT – Snakes are known to employ two major hunting strategies, ambush or wide foraging. Whatever the strategy a snake supposedly chooses potentially profitable hunting grounds. Whereas hunting site fidelity is recorded for a few ambushing species, there seems to be no records available for such fidelity for a widely foraging snake. We report on hunting site fidelity by the Eastern green whiptail (*Philodryas olfersii*), a widely foraging colubrid, in southeast Brazil.

SNAKES employ two major hunting strategies; ambush or sit-and-wait, and active or wide foraging (see Reinert *et al*., 1984; Mushinski, 1987). An ambushing snake waits for its prey in a previously chosen site (e.g., Reinert *et al.*, 1984), whereas an actively foraging snake searches for its prey in a wider area (e.g., Marques & Souza, 1993; Marques & Sazima, 2004). In both strategies the snakes supposedly choose potentially profitable hunting grounds (e.g., Reinert *et al*., 1984; Strüssmann & Sazima 1990; Marques & Souza 1993; and Hartmann *et al*., 2003). Whereas hunting site fidelity is recorded for a few ambushing species, mostly viperids (e.g., Reinert, *et al*., 1984; Hartmann *et al*., 2003) no record seems available for hunting site fidelity by a widely foraging snake. Here we report on hunting site fidelity by a widely foraging xenodontine colubrid, the Eastern green whiptail (*Philodryas olfersii*), in southeast Brazil. This species is a diet generalist, preying on several vertebrate types including birds (Hartmann & Marques, 2005).

We recorded an adult *P. olfersii* (total length *ca.* 120 cm) visiting, and successfully foraging on, a small tree for a span of *ca.* two months (January–March 2006). The snake was recognized by irregularities on two ventral scales and a light fleck on the belly. The tree, *ca.* 3 m high, was in a garden in the suburban area of Campinas (22°49'35"S, 47°04'16"W), São Paulo, southeast Brasil. It bore small berries and had a bird feeder regularly supplied with peeled bananas, both fruits sought by several perching bird species throughout the daytime.

This snake was sighted three times on the tree for a span of 54 days, each time securing an adult or a fully grown juvenile bird prey (Table 1) swallowed headfirst (Figure 1). In two hunting episodes one or both of the wings of the caught bird locked within the snake's jaws, rendering the prey difficult to swallow. When this happened the snake moved backwards, dragging the prey over the branches.

Each time the snake secured a prey, several bird species (including conspecifics of the prey) gathered around and mobbed the predator. The loudest and most actively mobbing one was the Chalk-browed mockingbird (*Mimus saturninus*) (Figure 2) but the alarm calls of the fruit-eating birds also attracted the attention of some bird species that do not fed on the fruits, such as the Rufous hornero (*Furnarius rufus*) and the Rufous-

DATE (2006)	TIME OF SIGHTING	BIRD SPECIES
22nd January	~10:00 h	*Passer domesticus* (House sparrow)
31st January	~11:30 h	*Coereba flaveola* (Bananaquit)
16th March	~11:15 h	*Thraupis sayaca* (Sayaca tanager)

Table 1. Hunting periods and bird prey of an Eastern green whiptail (*Philodryas olfersii*) in three visits made to the same tree in a garden in southeast Brazil.

collared sparrow (*Zonotrichia capensis*), which also mobbed the snake. In the first preying episode, the snake was mobbed by *ca.* 20 individuals of eight bird species. Mobbing is a type of harassing behaviour employed by birds in the presence of potential predators including snakes (McFarland, 1981; Sick, 1997).

Philodryas olfersii is regarded as a semi-arboreal snake, foraging both on vegetation and on the ground, which feeds on a variety of prey types (Sazima & Haddad, 1992; Hartmann & Marques, 2005). Birds were the third most important dietary item, preceded by frogs and mammals, in the most complete study on this snake species in southern Brazil (Hartmann & Marques, 2005). However, most of the bird prey of *P. olfersii* reported by Hartmann & Marques (2005) were nestlings. Additionally, several other Neotropical species of colubrid snakes are known to prey mostly, if not only, on nestlings (Marques & Sazima, 2004; our pers. obs.). The venom toxicity of *P. olfersii* (Assakura *et al*., 1992) likely favours capture of adult or fully grown juvenile birds and allows some snakes to specialize on this particular prey over a given time period. Birds were found in the dietary study of this species mostly in the austral spring/summer (Hartmann & Marques, 2005), which is consistent with our report.

The hunting site fidelity demonstrated by the individual of *P. olfersii* reported here indicates that some species of actively searching snakes are able to revisit a successful hunting spot (likely by learning processes) for a span of at least two months. Additional field records will probably disclose further instances of hunting site fidelity for snakes with diverse dietary types and belonging in different phylogenetic groups. Potential candidates are species of the genus *Chironius* (Colubrinae) known to inspect bromeliads while foraging for frogs (Carvalho-Silva & Fernandes, 1994; Marques & Sazima, 2004), and fish predators such as species of the genus *Helicops* (Xenodontinae, Hydropsini) recorded to hunt on particular spots in some streamlets in the Pantanal, western Brazil (IS, pers. obs.) or *Liophis miliaris* (Xenodontinae, Xenodontini) reported to forage in marine tidal pools by the Atlantic forest, southeast Brazil (Marques & Souza, 1993).

Figure 1. An adult Eastern green whiptail (*Philodryas olfersii*) at the beginning of swallowing a female House sparrow (*Passer domesticus*) caught on a particular tree in a garden in southeast Brazil (top). The same snake at the end of swallowing a fully grown juvenile Bananaquit (*Coereba flaveola*) caught on the same tree nine days later (bottom). © I. Sazima.

Note added in proof – the same snake was sighted again on the same tree referred to in the text, on 30th December 2006 at ~11:30 h (thus, about nine months and two weeks after its last sighting). The snake was mobbed by a family group of Chalk-browed mockingbirds (*Mimus saturninus*) feeding on fruits, and missed a strike at one of the birds. It then left the tree and found an adult Eared dove (*Zenaida auriculata*) sitting in an empty nest in a wall. The snake missed again a strike at the bird, which it tried to grab from behind the tail (the nest was above the foraging snake). It is noteworthy that the snake attacked two bird species considerably larger (21 and 26 cm, 60 and 70 g) than its largest previous prey (17 cm, 40 g). The large size was likely the main cause of the snake's

Figure 2. A mobbing Chalk-browed mockingbird (*Mimus saturninus*) perched above an Eastern green whiptail (*Philodryas olfersii*) that caught a House sparrow (not visible in photograph). © I. Sazima.

two failed preying attempts. Two weeks latter (14th January 2007 at 13:10 h), the snake was recorded on the same tree and again was thoroughly mobbed by a group of mockingbirds and Bananaquits (*Coereba flaveola*). The snake left the tree and returned to it four times in a period of about 90 min, but secured no prey. During the time the snake searched for prey on the branches no bird fed on the fruits, likely alerted by the mobbing group. As the fruiting tree was used by the same mockingbird group for two consecutive years, the birds possibly developed a searching image of the snake and hampered its preying attempts on that particular tree.

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Amphibians and Reptiles of Pakistan

by Muhammad Sharif Khan

Krieger Publishing Company, 2006

ISBN 1-89464-952-3. Hardback. xvi+311 pages.
Price $145.00 / £77.30

I have to be honest, the first response to this title – before one even beholds the actual book – is that $145 is expensive. Most other national or regional herpetofaunal guides from Krieger are priced more modestly between $40–80. So why the high price, and, more importantly, is it worth it?

Well first off, this is a 300+page book, not the more usual 100, 200+pages, but quantity is no substitute for quality and an additional 100 pages would not justify the price-hike. So it must be the contents – perhaps the publisher had to enter into a fierce bidding war with rival publishers. No, this is M. S. Khan, not J. K. Rowling and the title falls into what publishers like to tell authors is a niche market (great, brought down to earth by a biological term!)

To be honest I cannot explain the high price of this volume and possibly I think it would be more fairly priced around $90-100, but I do know something about the gestation of this title. It has been some time coming, and now it has arrived it will certainly be a useful addition to the library of anyone interested in S. Asian or Middle Eastern herpetology.

I met M. S. Khan, as he seems to prefers to be known, back in 1996 at the *International Conference on the Biology and Conservation of the Amphibians and Reptiles of South Asia* in Kandy, Sri Lanka, and although we came from two completely different cultures we seemed to hit it off straight away. He seemed the epitome of a popular uncle or grandfather, quietly and wisely spoken, smartly attired in long white ropes and white cap with a tidy white beard. I dread to think what he thought of me, slightly unkempt hair and beard, and mottled bush clothes (I was also doing a recce for a film on cobras at the time and had been slopping around in paddi-fields). We spoke long and often during the conference and continued our correspondence afterwards when I returned to the UK and he to Pakistan.

Some years later he moved to the U.S.A. and asked me to retrieve a manuscript for him. He has agreed to write a book on the herpetology of Pakistan for a British publisher and sent over the first (and only) draft manuscript but the publisher had folded, and refused, or ignored, all requests to return the manuscript to its rightful owner. Could I do anything to help?

It took several phone calls and the threat of a personal visit but I did manage to retrieve the manuscript and forward it to Khan in the States. It was from that document, and his extensive knowledge of the herpetology of his homeland, that the author produced first *A Guide to the Snakes of Pakistan* (Edition Chimaira, 2002) and now *Amphibians and Reptiles of Pakistan*. So I know this title has undergone a long gestation and I feel slightly connected to it's being.

Returning to the volume in hand, the next thing one notices is its size. This is a large and relatively heavy hardback of the style apparently favoured by Krieger, they publish several other national herpetofaunas in the same format. This suggests it is intended as a library reference rather than a field guide, its dimensions preventing secretion in a large jacket pocket, its price ruling out being shoved in a smelly rucksack. Khan's 2002 *A Guide to the Snakes of Pakistan* might be better suited to the rigours and restrictions of fieldwork, but then that does not cover all reptiles and amphibians, and that is the point, to the best of my knowledge this is the first and only guide to the entire herpetofauna of Pakistan published in the English language.

The hardback cover bears a photograph of perhaps one of the most iconic South Asian reptiles, the Ganges gharial (*Gavialis gangeticus*), an adult male with snout protuberance, swimming in the shallows, obviously taken with a long lens with some movement-blur of the snout apparent, but none-the-less a good choice. Finding this wonderful creature on the cover of a book on Pakistan herps is particularly poignant since the

species is making a comeback in Nepal and India, where I have visited the Karnali and Chambl River populations respectively, but its future is still not secure within the national borders of Pakistan. Anything that can be done to highlight this fact must be considered positive.

Pakistan is located on that cross-over between South Asian and Middle Eastern herpetofaunas. It contains high mountains, plains and plateaus, alternating scorched and freezing deserts and the watershed of the mighty Indus River as it heads south to the Arabian Sea. The importance of the region was not lost on eminent herpetologists such as Robert Mertens (1894–1975) and Sherman A. Minton (1919–1999), both of whom contributed to the herpetological development of the author, and it appears Minton even edited the text before his death, a lasting stamp of approval, should one ever be needed. Kraig Adler of Cornell contributes a glowing Foreword and draws the reader's attention to the author's experience and knowledge spanning almost 40 years of research. Adler uses the term 'foremost expert' to link M.S. Khan with the herpetofauna of Pakistan, and you can't go far wrong with a recommendation like that.

The first seven of the twelve chapters are devoted to a checklist and keys to the species, and the four families of amphibians and approximately 26 families of reptiles (Khan does not recognize Pythonidae but does recognize Hydrophiidae and Crotalidae as distinct from Elapidae and Viperidae respectively, but then family level taxonomy is often a cause for debate). Chapter 8 might be termed a zoogeographic chapter since it examines the affinities of the Pakistan herpetofauna with those of the Middle East, the Indian Subcontinent and even Indo-China via the Indo-Gangetic Plain. Routes of invasion are considered and discussed along with the taxa which have entered from west, east and southeast. Chapter 9 considers how habitat, climate and flora affect the distribution of Pakistan's amphibians and reptiles with extensive species distribution charts, while Chapter 10 goes into more depth with regards to altitudinal distribution, again with excellent charts. Chapter 11 concerns snakebite, a major factor in Pakistan, which may suffer 1,000 fatalities a year. Conversely Chapter 11 is devoted to man's threat to the existence of reptiles and amphibians in Pakistan. All in all this is a very well rounded book simply packed with photographs, figures, keys and distribution maps. Each species account begins with a rather handy Diagnosis, which numerically lists the distinquishing factors for that species and saves the reader the effort of extracting such details from within the prose of a normal species description.

On the whole the colour plates are quite good and some are very good, some even originating from Sherman A. Minton's personal slide library, but there are a few disappointing photographs in this book. Virtually all the agamids seem to be either preserved specimens, recently dead specimens or specimens restrained with a pair of forceps or a loop of string. It is a fact today that good quality photographs help to sell books and a little time taken to achieve high quality results pays dividends. I appreciate, only too well, the difficulties of photographing fast-running diurnal lizards and I also respect that if a species is particularly rare, a photograph of a preserved specimen may be all that is available, but page after page of restrained or deceased specimens is a little disappointing, especially in a book of this price. Interestingly most of the snakes do appear to be living specimens, although a few are clearly dead, even eviscerated, and posing them in natural coils on a rock does seem slightly pointless.

However, a few less than perfect photographs cannot detract from what is a very useful and informative volume which will stand as the standard reference work on the amphibians and reptiles of Pakistan for a great many years to come. I am very pleased we were able to persuade the defunct UK publisher to relinquish that manuscript.

MARK O'SHEA

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