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Front cover illustration. American crocodile (*Crocodylus acutus*). © T. Manfrediz. See article on page 3.

THE BHS REPTILE MONITORING DAY, SURREY, U. K. - MAY 2009.

The challenge facing the organisers of this field visit was to ensure that BHS members could see all six species of British reptile in just one day. May is one of the best months to look for reptiles but the weather window has to be just right. The temperature is critical. If it's too cold they won't emerge from their shelters. If it is too warm they will either be very active or remain in their shelters therefore making them difficult to find. Other weather variables are also important. If it is too dry and hot or windy they are very hard to find even for the experienced reptile spotter. There is also precipitation and amount of sunlight to consider. Sunshine after rain or a period of dull weather can be optimal for spotting reptiles.

As herpetologists have no power over the weather the use of refugia can also maximise the chances of seeing reptiles over more varied weather patterns as they use them to assist thermoregulation. However if temperatures under the refugia are too cold or hot they will be avoided at all costs.

Twenty BHS members and three Herpetological Conservation Trust (HCT) reserves officers met at the Devil's Punchbowl Café near Hindhead and were soon looking for reptiles at HCT's Witley Reserve. This is a large site and is sensitively managed by the HCT for reptile populations. Fortunately the reptile weather window was operating and in just over one hour BHS members had spotted Sand Lizard (*Lacerta agilis*) (Fig. 1), Common Lizard (*Zootoca vivipara*) and Slow-worm (*Angius fragilis*). One young herpetologist spotted a small snake disappearing into the heather (Fig. 2) which could have been a Smooth Snake (*Coronella austriaca*).

Figure 1. Adult male sand lizard, *Lacerta agilis*. Photograph by Howard Inns.

The next reserve visited was HCT's Crooksbury reserve and by this time the early morning sunshine had given way to hazy conditions, even more conducive to spotting reptiles. HCT have created a maze of sandy paths to create egg laying sites for lizards and one specially created sandy bank offered good basking sites for several of last year's hatchlings. We found all five native species of reptile apart from the Grass Snake (*Natrix natrix helvetica*). Crooksbury obviously supports exceptional populations of sand lizards and smooth snakes, the former being originally translocated from Dorset sites during the 1970s.

A quick visit to Thursley National Nature Reserve revealed many common lizards basking on a boardwalk, seemingly quite oblivious to the people, pushchairs and bikes passing by. The group was also rewarded with the sixth reptile species seen this day, a very large female grass snake basking by the water.

It is ten years since I last visited Frensham Great pond and it was good to see the sand lizard habitat fenced off from the visitors to 'Surrey-on-sea'.

Figure 2. Searching among lowland heathland for reptiles. Photograph by Jan Clemons.

The Natterjack Toad (*Epidalea calamita*) ponds sadly lacked natterjacks and no spawn strings were found. The reason for this could only be debated but hopefully they may have spawned after the next rain.

Our day ended with a visit to the BHS/HCT Gong Hill reserve. The site was bought by the BHS and the HCT now takes care of and manages Gong Hill with the help of its employees. The site is a veritable 'jewel in the crown' and shows just how effective long term heathland management can be in boosting native reptile populations. The reserve supports five reptile species (no smooth snakes here) and we were fortunate to see all five species in the late afternoon.

I am indebted to the HCT especially Mike Preston, the HCT's Wealdon Reserves officer who planned the itinerary and in case of rain, had gone to the trouble of capturing animals prior to the day so we could see the six species anyway. With Herpetological Conservation Trust employees Rob Free & John Gaughan and HCT Trustee Howard Inns there was no shortage of expertise to show the BHS members where to look, and how to look, for reptiles.

Finally, for members to get a good idea of the success of the field visit, I include comments from attending BHS members:

'*It was a brilliant day!*'

'*I just wanted to say thank you for organising such a great day today. Please also pass on our thanks to the HCT for their knowledge, driving us around and finally for having the energy to get around all those sites in one day.*'

'*I have never seen all our six species of reptiles in one day and the photographic opportunities were wonderful*'

'*A most enjoyable and worthwhile day*'

'*I look forward to next year's safari!*'

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Possible decline of an American Crocodile (*Crocodylus acutus*) population on Turneffe Atoll, Belize

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ABSTRACT – Surveys of the American Crocodile (*Crocodylus acutus*) in Turneffe Atoll, Belize over the last decade have suggested that populations remain stable but are increasingly threatened by habitat loss, particularly human development of critical nesting beaches. In May, June and July 2008 we used a combination of spotlight surveys and nest counts to evaluate the current status of *C. acutus* populations in Turneffe Atoll. A total of 23 *C. acutus* was observed along 46.6 Km of survey route (0.49 crocodiles/Km) during spotlight surveys in May, and 8 crocodiles were observed along 45.3 Km of survey route (0.18 crocodiles/Km) during late June-early July, yielding an overall 2008 encounter rate of 0.34 crocodiles/Km. This encounter rate was significantly lower than that reported for surveys conducted in 2002. Two recently hatched nests, both on the same beach, were found during nest counts; no nests were found on other beaches known to have routinely yielded nests in the past. The number of nests found in this study is 4- to 10-fold lower than those reported from 1994 to 2004, suggesting a reduction in breeding females in the Turneffe Atoll crocodile population. Development of two important nesting beaches on Blackbird Cay since 2004 has likely rendered these habitats unsuitable for future nesting. The combination of low crocodile encounter rates, reduced nesting activity and human alteration of known nesting beaches observed in this study suggests a possible decline in the *C. acutus* population in Turneffe Atoll. Continued population assessments will be essential in monitoring the status of *C. acutus* in Turneffe Atoll, and immediate management and conservation efforts should be made to protect beaches on Blackbird, Calabash, and Northern Cays to provide critical nesting habitat for crocodiles.

THE American Crocodile (*Crocodylus acutus*) is widely distributed throughout the northern Neotropics, ranging from the southern tip of Florida, USA, the Caribbean islands of Cuba, Jamaica, and Hispaniola, along the Atlantic and Pacific coasts of Mexico and Central America, to coastal south America from northern Peru to eastern Venezuela (Platt & Thorbjarnarson, 2000a; Thorbjarnarson et al., 2006). From 1920 to 1970, *C. acutus* was widely hunted for its skin, and over-harvesting significantly depleted populations throughout its historical range (Thorbjarnarson et al., 2006). By the 1970s, population declines intensified owing to the development of coastal areas and subsequent loss of crocodile habitat (Thorbjarnarson et al., 2006). In 1973, *C. acutus* was listed as endangered under the United States Endangered Species Act, and in 1979 was included on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Groombridge, 1987; Platt & Thorbjarnarson, 2000a) where it remains today. Since that time, national and international trade restrictions and the availability of skins from other crocodilian species from ranching and farming programmes have significantly reduced the commercial hunting of *C. acutus*, leading to the recovery of populations in many regions within its range (Thorbjarnarson et al., 2006). Today, while some deliberate killing persists, habitat loss and fragmentation are recognized as the primary factors affecting the survival of *C. acutus* populations (Platt & Thorbjarnarson, 2000a; Thorbjarnarson et al., 2006), although additional factors such as accidental drowning in fishing nets and exposure to environmental pollution may also present a subtle yet significant long-term risk to populations (Platt & Thorbjarnarson, 1997; Wu et al., 2000; Rainwater et al., in press). Currently, *C. acutus* is recognized as 'vulnerable' by the International Union for the Conservation of Nature and Natural Resources (IUCN) and considered threatened by the Belize Department of Fisheries (McField et al., 1996; Platt & Thorbjarnarson, 2000a).

In the early 1990s, owing to a paucity of reliable population estimates, surveys of *C. acutus* in Belize were given high priority by the IUCN Crocodile Specialist Group (Thorbjarnarson, 1992; Ross, 1998). Preliminary surveys of offshore cays and atolls were initiated in 1994 and 1995 (Platt & Thorbjarnarson, 1996), and a country-wide survey of offshore and mainland habitats was completed in 1997 (Platt & Thornjarnarson, 1997; 2000a; Platt et al., 1999b; Platt et al., 2004). Survey results suggested that fewer than 1000 non-hatchling *C. acutus* inhabit Belize, and that the largest *C. acutus* population (ca. 200-300 non-hatchlings, 15-25 breeding females) and the highest concentration of nesting activity occurs on Turneffe Atoll (Platt et al., 1999a; Platt & Thorbjarnarson, 2000a; Platt et al., 2004). In addition, Turneffe Atoll is thought to serve as a source population for *C. acutus* elsewhere in the coastal zone of Belize, and therefore believed to play a critical role in regional metapopulation dynamics (Platt & Thorbjarnarson, 2000a; Platt et al., 2004).

Reproduction of *C. acutus* in Turneffe Atoll is highly dependent on elevated beach ridges composed of coarse sand, and owing to a combination of natural and anthropogenic factors suitable nesting beaches are rare in the atoll (Platt & Thorbjarnarson, 2000a; Platt et al., 2004). Because nesting beaches are increasingly threatened by development, Platt & Thorbjarnarson (2000a) concluded that the conservation status of *C. acutus* in Turneffe Atoll should be considered tenuous at best, and recommended a long-term monitoring programme based on spotlight surveys and nest counts to determine population trends (Platt et al., 2004). Since completion of the country-wide survey in 1997, additional *C. acutus* population assessments were conducted in Turneffe Atoll in 2002 and 2004 (Platt et al., 2004). Results of these assessments suggested that the *C. acutus* population in Turneffe Atoll was stable and possibly increasing. Here, we provide results of a recent population assessment of *C. acutus* in Turneffe Atoll conducted in May, June, and July 2008.

METHODS AND MATERIALS

Fieldwork was conducted from 18th to 23rd May and from 28 June to 4 July 2008 in Turneffe Atoll, Belize (Fig. 1).

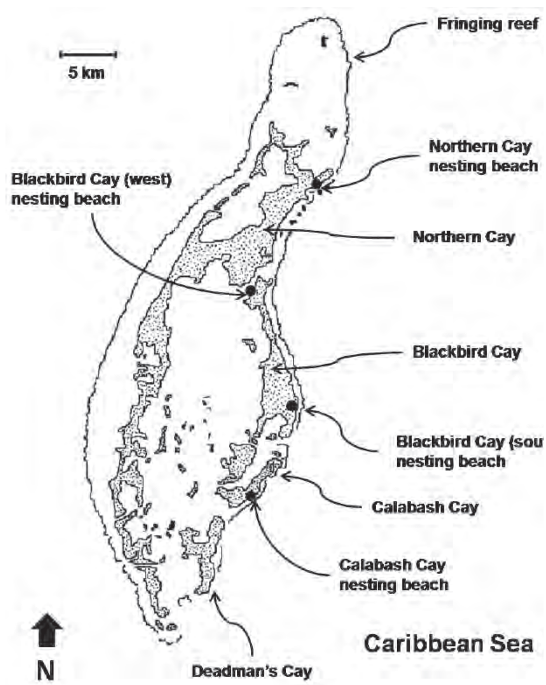

Figure 1. Map of Turneffe Atoll showing localities mentioned in text. Black dots indicate the primary nesting beaches surveyed during this study and correspond to those listed in Table 4.

Turneffe Atoll, located approximately 35 Km east of the Belize mainland, is 50 Km long (north-south), 16 Km wide (east-west), and has an estimated surface area of 533 Km^2 (Perkins, 1983; Platt et al., 2004). Mean annual rainfall is 1347 mm/year, with a pronounced wet season from June through November (Hartshorn et al., 1984). Rainfall is negligible in April and May, but this may vary annually (Hartshorn et al., 1984). The topography, climate, vegetation, biodiversity and history of the atoll have been previously described elsewhere (Stoddart, 1962; 1963; Perkins, 1983; McField et al., 1996; Platt et al., 1999a, 2000, 2004).

The *C. acutus* population in Turneffe Atoll was censused using both spotlight surveys (Bayliss, 1987) and nest counts. Census methods were previously described by Platt et al. (2004). Briefly, spotlight surveys were conducted from a 5 m motorized skiff beginning 15 to 30 minutes after sunset. Crocodile eye-shines were detected using a 3,000,000 candlepower Q-beam spotlight. All crocodiles sighted were estimated by total length (TL) as hatchlings (TL < 30 cm), juveniles (TL = 30-90 cm), subadults (TL = 90-180 cm), or adults (TL > 180 cm). Crocodiles that submerged before TL could be determined were classified as 'eyeshine only' (EO). The beginning and endpoints of each survey route and the distance traversed was determined with a Garmin® GPS Map 60. Encounter rates were calculated as the number of crocodiles observed per kilometer of survey route (Platt & Thorbjarnarson, 2000a; Platt et al., 2004).

Nesting areas identified during previous surveys were revisited (Platt & Thorbjarnarson, 1996; 1997; Platt et al., 2004) and searched for signs of nesting activity. *Crocodylus acutus* in Belize generally nests in mid-April, and eggs hatch from late June to mid-July following the onset of the annual wet season (Platt & Thorbjarnarson, 1997; 2000b; Platt et al., 2004). Female crocodiles typically excavate nests to remove neonates, leaving a readily obvious hole containing eggshell fragments and membranes (Platt & Thorbjarnarson, 1997; 2000b; Platt et al., 2004). Nests are typically difficult to detect during May and early June, as wind and rain in the weeks following oviposition usually obscure or eliminate crocodile scrapes and drag marks useful in identifying nest locations. However, old (previous year) nests can often be located during this period (Platt & Thorbjarnarson, 1997). In addition to known nesting areas, potentially suitable beaches where nesting has yet to be documented were also searched (Platt et al., 2004).

RESULTS

Spotlight Surveys

Spotlight surveys were conducted along the eastern and western shores of Blackbird Cay and the western shore of Calabash Cay in May (Table 1) and in late June-early July (Table 2), 2008. Beginning and endpoints of surveys are contained in field notes archived in the Campbell Museum (Clemson University, South Carolina). In May, a total of 23 *C. acutus* was observed along 46.6 Km of survey route (encounter rate = 0.49 crocodiles/Km) (Table 1). Of these, 9 (39.1%) were classified as EO, and 14 (60.9%) were approached closely enough to estimate size; these included 2 (14.3%) juveniles, 7 (50.0%) subadults, and 5 (35.7%) adults. In late June-early July, a total of 8 *C. acutus* was observed along 45.3 Km of survey route (encounter rate = 0.18 crocodiles/Km) (Table 2). Of these, 4 (50%) were classified as EO, and 4 (50%) were approached closely enough to estimate size; these included 3 (75%) subadults and 1 (25%) adult. Combining results of all surveys in

Date	General Survey Location	Distance Surveyed (km)	Crocodiles Encountered	Encounter Rate (Crocodiles/Km)
18 May	Blackbird southeast	5.36	3	0.56
19 May	Blackbird northwest	14.9	11	0.74
21 May	Blackbird southwest	15.5	3	0.19
22 May	Blackbird northeast	5.13	2	0.39
23 May	Calabash northwest	5.68	4	0.70
Total / Overall encounter rate		46.6	23	0.49

Table 1. Results of spotlight surveys conducted in May 2008 to assess American Crocodile (*Crocodylus acutus*) populations in Turneffe Atoll, Belize.

Date	General Survey Location	Distance Surveyed (km)	Crocodiles Encountered	Encounter Rate (Crocodiles/Km)
29 June	Blackbird east	9.2	0	0.00
30 June	Blackbird southwest	11	2	0.18
2 July	Calabash west	12	2	0.17
4 July	Blackbird northwest	13.1	4	0.31
Total / Overall encounter rate		45.3	8	0.18

Table 2. Results of spotlight surveys conducted in June-July 2008 to assess American Crocodile (*Crocodylus acutus*) populations in Turneffe Atoll, Belize.

2008 yielded an overall encounter rate of 0.34 crocodiles/Km (Table 3), with subadults and adults accounting for 89% of the crocodiles for which TL could be estimated (Fig. 2). This encounter rate was significantly lower ($\chi^2 = 37.2$; $df = 1$; $P < 0.05$) than that reported in a similar *C. acutus* survey conducted in 2002 (1.2 crocodiles/Km) (Table 3; Platt et al., 2004).

Nest Counts

During May 2008, no active nests were found during three days of searching at known and potential nesting beaches on Blackbird, Northern, and Calabash Cays. One old nest containing two egg shells, likely from 2007, was found on the nesting beach at Northern Cay. Multiple crocodile slides and tracks were observed on this beach

Location	Date	Season	Distance surveyed	Crocodiles encountered	Encounter rate (Crocodiles/Km)
Blackbird Cay (Eastern shore)					
	Nov. 1996	Wet	2.7	7	2.59
	Feb. 1997	Dry	2.7	11	4.07
	April 1997	Dry	2.7	6	2.22
	May 2008	Dry	10.5	5	0.48
	June-July 2008	Wet	9.2	0	0
Blackbird Cay (Western shore)					
	Nov. 1996	Wet	15.7	6	0.38
	Feb. 1997	Dry	15.7	7	0.45
	April 1997	Dry	15.7	11	0.70
	May 2008	Dry	30.4	14	0.46
	June-July 2008	Wet	24.1	6	0.25
Calabash Cay					
	Nov. 1996	Wet	2.4	6	2.50
	Feb. 1997	Dry	2.4	8	3.33
	April 1997	Dry	2.4	7	2.92
	May 2008	Dry	5.7	4	0.70
	June-July 2008	Wet	12.0	2	0.17
Turneffe Atoll (Sites combined)					
	1996	Wet	20.8	19	0.91
	1997	Dry	41.6	50	1.20
	2002	Wet	40.1	49	1.22
	2008	Dry, Wet	91.9	31	0.34

Table 3. Spotlight survey data for American Crocodile (*Crocodylus acutus*) in Turneffe Atoll, Belize, 1996-2008 (Data from Platt and Thorbjarnarson 1997; Platt et al. 2004; this study).

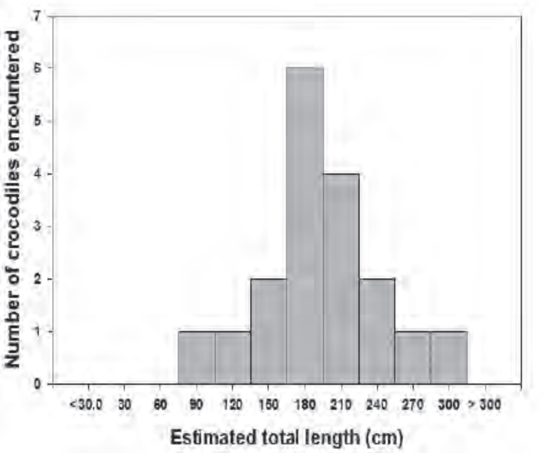

Figure 2. Size-class distribution of American Crocodiles (*Crocodylus acutus*) encountered during spotlight surveys of Blackbird Cay and Calabash Cay (Turneffe Atoll, Belize) conducted in May, June and July 2008.

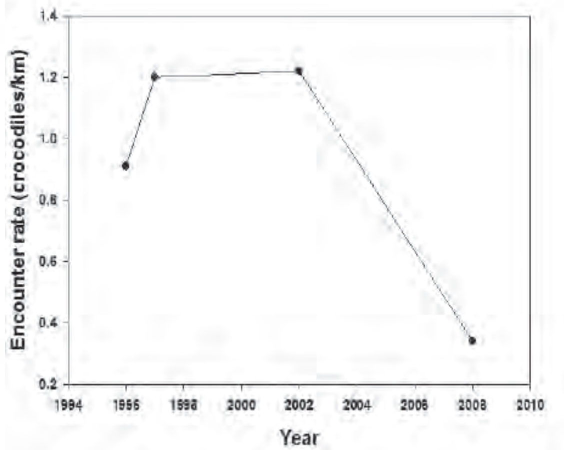

Figure 3. Encounter rates (crocodiles/Km shoreline) of American Crocodiles (*Crocodylus acutus*) along Blackbird Cay and Calabash Cay (Turneffe Atoll, Belize) during spotlight surveys conducted in 1996, 1997, 2002 and 2008.

suggesting movement from the sea to a nursery lagoon behind (west of) the beach (Platt & Thorbjarnarson, 2000a; Platt et al., 2004) and vice versa. One juvenile crocodile was observed in the nursery lagoon (ca. 11:30 hrs).

During June-July 2008, a total of two recently excavated crocodile nests was found during searches of the same (and additional) nesting beaches searched in May (Table 4). Both nests were found on a single beach on Northern Cay on 3 July. This beach is considered the most significant *C. acutus* nesting site in the entire coastal zone of Belize (Platt et al., 2004). Both nests were hole nests and contained dried egg shells (five and nine, respectively), and four hatchlings were observed among vegetation in a shallow, brackish lagoon approximately 15 m from one nest. On 1 July, a researcher (Tino Chi) stationed at Calabash Cay informed us that approximately 10 days before, he had found a recently excavated nest on this same beach. This nest contained one unhatched egg. In addition, Mr. Chi provided a photograph of a pod of approximately 15 hatchlings on the edge of the brackish lagoon. It is likely that the unhatched egg and hatchlings originated from one of the two nests found on 3 July as no other nests were found after intensive searching of this beach. No nests were found on other known and potential nesting

Location	**1994**	**1995**	**1996**	**1997**	**2002**	**2004**	**2008**
Calabash Cay	0	NA	0	0	1	2	0
Blackbird Cay (south)	0	NA	5	3	1	3	0
Blackbird Cay (west)	2	1	1	2	0	0	0
Northern Cay	8	NA	7	10	6	11	2
Total	10	1	13	15	8	16	2

Table 4. Counts of American Crocodile (*Crocodylus acutus*) nests at various beaches in Turneffe Atoll surveyed from 1994 to 2008. Data are from Platt & Thorbjarnarson (1997), Platt et al. (2004), and the present study. Note that 1995 counts are based on incomplete survey data. NA = Not available.

beaches on Blackbird Cay and Calabash Cay (Platt et al., 2004). Coordinates of nest locations are contained in field notes archived in the Campbell Museum.

DISCUSSION

During 2008, the overall crocodile encounter rate for June and July (0.18 crocodiles/Km) was lower than that observed in May (0.49 crocodiles/Km). Due to the relatively short period (approximately 40 days) between these surveys, it is unlikely that the lower encounter rate observed in June and July reflects a population decrease during that time. Rather, this may reflect seasonal differences in habitat use. The wet season in Belize begins in early June (Johnson, 1983; Platt, 1996), and the resulting influx of rainwater often reduces the salinity of brackish lagoons in the interior of the atoll (Platt & Thorbjarnarson, 1997; 2000b) and also creates small, ephemeral fresh water lagoons. Crocodiles otherwise restricted to marine habitats during the dry season may move into these brackish and fresh water interior lagoons during the wet season for access to less saline water (Mazzotti et al., 1986; Richardson et al., 2002; Leslie & Taplin, 2001; Rainwater & Platt, pers. obs.) and therefore go undetected during spotlight surveys along the shoreline of the atoll.

Data from previous spotlight surveys of Turneffe Atoll are equivocal with regard to the influence of season on crocodile encounter rates. If availability of brackish or fresh water in the interior of the atoll is the primary factor influencing the number of crocodiles present in marine habitat, encounter rates in marine habitats could be expected to increase from wetter to dryer conditions as brackish habitats become more saline and fresh water habitats disappear. This pattern was observed from 1996-1997 on the western shore of Blackbird Cay, with crocodile encounter rates increasing from the wet season (November 1996) to the early dry season (February 1997) to the late dry season (April 1997) (Table 3). However, from 1996-1997, the crocodile encounter rate on the eastern shore of Blackbird Cay during the wet season (November 1996) was lower than that in the early dry season (February 1997) but similar to that in the late dry season (April 1997) (Table 3). Yet a different pattern was noted along Calabash Cay, where crocodile encounter rates remained relatively constant throughout the same period (Table 3). Future spotlight surveys of these areas during consecutive wet and dry seasons will be useful in determining the influence of season on crocodile encounter rates along Turneffe Atoll. Other factors such as weather, location of area surveyed (windward or leeward side of the atoll), tide, and access to interior brackish or fresh water habitats should also be considered.

The most important result of spotlight surveys conducted in this study is that the overall crocodile encounter rate in Turneffe Atoll for 2008 is markedly lower than those observed over the last 12 years (Table 3, Fig. 3). The overall crocodile encounter rate in Turneffe Atoll for 2008 (0.34 crocodiles/Km) is 2.7-, 3.5-, and 3.6-fold lower than that observed in 1996, 1997, and 2002, respectively (Table 3, Fig. 3). Whether or not this difference actually reflects a decrease in crocodile population size in Turneffe Atoll is unknown. Spotlight surveys are inherently variable, and as such long-term monitoring is generally required to detect population changes (Bayliss, 1987; Platt et al., 2004). Prior to this year, crocodile encounter rates on Turneffe Atoll (specifically Blackbird and Calabash Cays) have increased each year spotlight surveys have been conducted. This is the first year a reduction in the overall number of crocodiles has been observed. Future spotlight surveys of these areas will be critical in determining whether the lower overall encounter rates observed in 2008 are the result of survey variability or reflect actual population change. As noted by Platt et al. (2004) in previous surveys, the high proportion of subadults and adults during this investigation is likely due in part to sampling bias; hatchlings and juveniles often remain concealed in mangrove vegetation and escape detection during spotlight surveys.

While the low encounter rate observed in 2008 suggests a possible decline in the Turneffe Atoll *C. acutus* population, of greater concern is the low number of crocodile nests found during nest surveys (Table 4). Only two nests were found in 2008, and both were on the same beach at Northern Cay. No nests were found on three other beaches that yielded nests in previous years (Blackbird Cay south, Blackbird Cay west, Calabash Cay) (Table 4, Fig. 1). One of these beaches (Blackbird Cay south) has been significantly altered by human activities since the last nest survey was conducted in 2004. One nesting area on the southern end of the beach has been covered by debris (primarily dead mangrove) following the construction of an airstrip, likely rendering this site unsuitable for crocodile nesting. The primary nesting area on the northern end of this beach has been impacted by the construction of a fish camp. The overall number of crocodile nests found on our study sites in Turneffe Atoll in 2008 is 5-, 6.5-, 7.5., 4-, and 8-fold lower than that found in 1994, 1996, 1997, 2002, and 2004, respectively (Table 4, Fig. 4). It is possible that some clutches had not yet hatched at the time of the survey and corresponding nests went undetected. However, it is expected that at least 50% of 2008 clutches would have hatched by early July, as hatching of *C. acutus* clutches in Turneffe Atoll is known to occur from late June to mid-July (Platt & Thorbjarnarson, 1997; 2000b; Platt et al., 2004). If only one half of crocodile nests had hatched by the time the survey was conducted, this suggests a possible total of four nests constructed at known nesting beaches in Turneffe Atoll in 2008, still a substantial decrease in nesting compared to previous years (Table 4). Future nest surveys will be crucial in determining whether the low number of *C. acutus* nests found in Turneffe Atoll in 2008 reflect a decrease in the number of nesting females in the atoll or annual variability in nesting effort (Platt et al., 2004).

Finally, we learned that, during the past year one crocodile (estimated TL = 150 cm) was shot and killed in the lagoon behind (west) Blackbird Cay Resort. Owing to the relatively small *C. acutus* population in Belize and the high importance of the Turneffe Atoll population (Platt & Thorbjarnarson, 1997; 2000b; Platt et al., 2004), the loss of even a single subadult or adult crocodile, especially a female, may have a significant impact on the overall population of *C. acutus* in Belize.

To summarize, the combination of low crocodile encounter rates, reduced nesting activity, and human alteration of known nesting beaches on Blackbird Cay observed during this study strongly suggests a decline in the *C. acutus* population in Turneffe Atoll. Following crocodile surveys conducted in 2002, Platt et al. (2004) reported that with the exception of Northern Cay, nesting beaches in Turneffe Atoll remained relatively undisturbed. However, while the nesting beach at

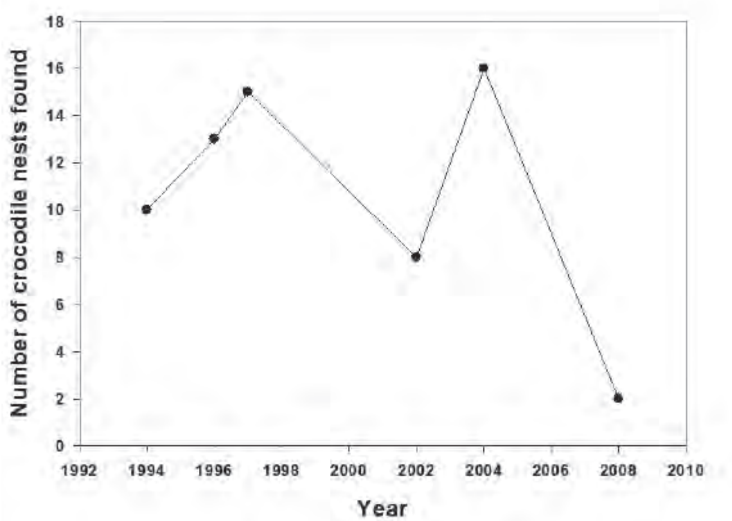

Figure 4. Number of American Crocodile (*Crocodylus acutus*) nests found during nest counts conducted on Blackbird Cay and Calabash Cay (Turneffe Atoll, Belize) in 1994, 1996, 1997, 2002 and 2008.

Northern Cay has since been designated a Temporary Reserve and is currently protected, alteration of nesting habitats on Blackbird Cay since 2004 has likely rendered this beach unsuitable for future nesting. Management and conservation efforts should be made to protect critical nesting beaches on Blackbird, Calabash, and Northern Cays. In addition, spotlight surveys and nest counts are essential for monitoring the status of the *C. acutus* population in Turneffe Atoll and should be continued.

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Range extension of *Kaestlea beddomeii* (Boulenger, 1887) (in part) (Reptilia: Sauria: Scincidae)

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THE lygosomine skink genus *Kaestlea* (Eremchenko & Das, 2004) comprises five nominate species of small, semi-fossorial lizards that are endemic to the Western Ghats of southern India (Eremchenko & Das, 2004). They are recognized by the following combination of characters; lacking supranasals, a transparent disc in the lower eyelid, four supraoculars, six or seven supralabials, one or two pairs of enlarged preanals (Eremchenko & Das, 2004). So far no authenticated report on the natural history of these species has been reported. The IUCN status of *Kaestlea* sp. has been declared as Vulnerable (VU). But in accordance with the Indian Wildlife (Protection) Act, 1972, it is listed in Schedule IV (Anonymous, 2001). Smith (1935) stated that the distribution of *Kaestlea beddomeii* ranges from the Travancore hills, Nilgiris (Coonoor), while Murthy (1985) stated this species to be distributed in Nilgiris and the hills of south Kerala, all of which are located in the southern Western Ghats (8˚ to 11˚ N lat.). The sighting recorded herein is based on a live specimen of *Kaestlea beddomeii* recorded during reptile surveys in Agumbe Rainforest, Karnataka, India.

METHODS AND MATERIALS

We used visual encounter surveys (Crump & Scott, 1994) to spot the taxa and collect ecological data. The sighted specimen was subjected to physical diagnosis and photo-documentation. Physical diagnosis (i.e., meristic and mensural data) was recorded using a hand lens and without using any restraints or chemical immobilizing agents. The specimen was released after recording data and was not retained or preserved, due to the want of permits. Lepidosis nomenclature followed Andreone & Greer (2002). Symmetrical head scalation character values were given in left first and then right. Mensural data included snout-vent and tail lengths (in millimeters) and were measured using a standard measuring tape (Butterfly® brand, L. C = 1 mm). All photographs of the skink were taken in life, on respective natural habitat background, using a Canon® Powershot S3 IS model camera. Geographic coordinates and altitude of the locality were recorded using a Garmin® 12 channel Global Positioning System. Habitat type followed Champion & Seth (1968). Generic name followed the latest accepted, which is *Kaestlea* (Eremchenko & Das, 2004) and we use this name to refer to all congeneric taxa throughout this paper, including while quoting reference citations from previously (i.e., pre- 2004) published literature.

Colour in Life (Fig. 1, 2 & 4)
Dorsum brown with two dark dorso-lateral stripes extending from post nasal region to the base of tail. Lateral sides of tail were bluish. Ventral, labial, gular, humeral and femoral scales grayish with a dark crescentic band. Para-vertebrals were lighter than lateral scales.

Habitus
Head depressed, body slender, neck slightly distinct, limbs moderately developed and relatively short. Tail relatively long.

Ecological Notes
The specimen was found in mid-elevation evergreen forest, in dense, moist leaf litter, close to a hill-stream. Other skink species *Eutropis macularia*, *Ristella beddomeii* were recorded to be syntopic with *Kaestlea beddomeii*.

Figure 1. *Kaestlea beddomeii* (entire) showing general external morphology

Figure 2. Head showing divided fronto-parietals

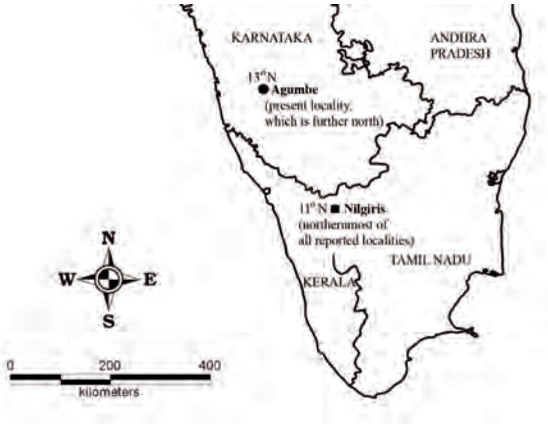

Figure 3. Map showing range extension

Figure 4. *Kaestlea beddomeii* showing nuchals and paravertebrals

Locality (Fig. 3)
The specimen was observed in Agumbe (13˚ 50.87' N, 075˚ 09.59' E; 557 m asl.), located within the Central Western Ghats, Tirthahalli taluk, Shimoga district, Karnataka state in July 2008, during the southwestern monsoon season.

DISCUSSION

Meristic Analysis (Table 1.)
The following characters; smooth body scales, 4 supraoculars, absence of supranasals, 6-7 supralabials, and a transparent disc on sub-ocular region indicated that the specimen belonged to the genus *Kaestlea* (Eremchenko & Das, 2004). There are five species of *Kaestlea* in the south Indian region; *Kaestlea beddomeii*, *Kaestlea bilineata*, *Kaestlea palnica*, *Kaestlea laterimaculata* and *Kaestlea travancorica*.

Our specimen had completely divided fronto-parietals (vs. *K. travancorica*: single or partially divided; *K. palnica*: always entire) (Smith, 1943; Murthy, 1985) and thus could have qualifyably been recognised as either *K. laterimaculata*, *K. beddomeii* or *K. bilineata*. However, by possessing twenty mid-body scale rows and seventeen sub-digital lamellae under the 4th pes respectively (vs. *K. travancorica*: 22-26 & 18-24; *K. palnica*: 28-30 & 18-24; *K. laterimaculata*: 26-28 & 20-25; *K. bilineata*: 22-26 & 16-20) (Murthy, 1985; Smith, 1943), our specimen more closely resembled *K. beddomeii*.

Historical Distribution
The following are the type localities of all five species of *Kaestlea* (*K. travancorica*: Travancore Hills; *K. palnica*: Kodaikanal and Palni Hills; *K. beddomeii*: Travancore Hills; *K. laterimaculata*: summit of Sivagiri Hills and Tinnevelly district; *K. bilineata*: summit of Nilgiris) (Smith, 1935).

Ishwar et al. (2001) stated that *K. laterimaculata* in particular, was the most common lizard in high elevation (c. 1200 m) forest sites of Kakachi, in Kalakkad-Mundanthurai in southern Tamil Nadu. Anonymous (2001) stated, that *Kaestlea* spp. occur in areas like Anaimalais, Palnis, Travancore / south Kerala Hills and Nilgiris (Coonoor) in the states of Tamil Nadu, Kerala and Karnataka respectively. However, as Anonymous (2001) lacked precise locality data, distribution of *Kaestlea* sp. in Karnataka State is dubious. Moreover, *Kaestlea* is reported to occur in relatively higher elevations of above 1000 m, such as the summit of Nilgiris (c. 2500 m) and Sivagiri Ghat (c. 1300 m), Kakachi (c. 1200 m) and Kodaikanal / Palnis (c. 2700 m).

Characters	Qualities / Numbers
Supralabials	6, 7
Suproculars	4
Prefrontals	completely separated from one another
Frontals	as long as fronto-parietal and interparietal
Fronto-parietals	completely divided
Supraciliaries	7, 8
Nuchals	4 pairs
Canthus rostralis	distinct, to post-circumorbitals
Mid body scale rows	20
Paravertebrals	53
Subdigital lamellae (4th pes)	17
Relative length of digits	manus: 4>3>2>1>5; pes: 4>3>2>5>1
Mid-ventrals	57
Preanals	two pairs enlarged
Subcaudals	median row transversely enlarged; hexagonal
Snout-vent length	49.0 mm
Tail length	79.0 mm

Table. 1. Lepidosis and mensural data of the *Kaestlea beddomeii*.

Malhotra & Davis (1990) recorded *K. travancorica* from Srivilliputhur Hills (at 9˚ North latitude) due simply from surveying at higher elevation, 1060–1690 m, while Inger et al. (1984) did not record any *Kaestlea* sp. in Ponmudi Hills (at 8˚ North latitude), due to the relatively lower elevation in Ponmudi Hills (100 – 1095 m), despite the presence of similar wet evergreen forest habitat. It is interesting to note that the many *Kaestlea* spp. have been recorded only from higher elevation hills of the southern Western Ghats (elevation > 1100 m); from Travancore Hills (8° N), Nilgiris (11° N) (S. R. Ganesh, pers. obs.).

CONCLUSION

Lepidosis of our specimen is in accordance with *Kaestlea beddomeii* and thus recorded from Agumbe (13˚ 50.87' N 075˚ 09.59' E; 557 m asl.), Tirthahalli taluk, Shimoga district, Karnataka state, in Central Western Ghats is the first authentic distribution record of the genus *Kaestlea* in the State of Karnataka. Our specimen was encountered in a locality, which is outside the known distribution range of the congeners. Therefore, our observation presents a range extension for the genus *Kaestlea* by approximately 250 Km further north and 644 m lower in altitude.

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The herpetofauna of Koanaka South and adjacent regions, Ngamiland, Botswana

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ABSTRACT - The Koanaka South locality of western Ngamiland, Botswana, is a Plio-Pleistocene cave deposit. While this deposit has produced numerous reptile and amphibian fossils, a lack of comparative osteological material from the region has hampered taxonomic diagnosis, particularly below the level of family. In addition, the lack of a published account of the modern herpetofauna from the area prevents documenting how the reptile and amphibian faunas have changed over the last two million years. A collecting trip to Koanaka South in the winter dry season (19–30 June 2008) resulted in the collection of 38 specimens of nine species belonging to seven squamate families (Agamidae, Chamaeleonidae, Gekkonidae, Lacertidae, Scincidae, Viperidae). Two additional species, the gekkonid *Ptenopus garrulous* and the elapid snake *Dendroaspis polylepis* are documented from sound and sight records, respectively, and one additional lacertid, *Heliobolus lugubris*, is vouchered by older museum material. No amphibians were observed during the survey. Nine taxa are explicitly reported from the Koanaka Hills or in quarter degree square 2021 Aa for the first time and a range extension and size record are reported for *Pedioplanis namaquensis* and *Ichnotropis squamulosa*, respectively. Based on collections made in the surrounding quarter degree square (2021 Aa), as well as published range maps, we provide a list of 39 additional reptiles and amphibians expected, but not yet documented, in the vicinity of Koanaka South.

RECENT excavations in a Plio-Pleistocene cave system in the Koanaka Hills of the Ngamiland Province in northwestern Botswana (Fig. 1) have yielded a large assemblage of microvertebrate fossils (Pickford & Mein, 1988; Pickford, 1990). Among these fossils, 46 of the elements were identified as squamates and seven were identified as anurans (Kennedy & Bhullar, 2007). However, the lack of relevant comparative material representing the extant regional herpetofauna limits the taxonomic resolution for these fossils, and most elements are identified only to the level of family. Additionally, no published account of the modern herpetofauna of the Koanaka Hills exists. As such, reconstructing regional environmental change over the last two million years by comparing the modern and fossil herpetofauna is currently impossible. These difficulties highlighted the need for sampling the herpetofauna from the Koanaka Hills, and a collecting trip was undertaken from 19–30 June 2008.

Three hills make up the Koanaka Hills, with Koanaka North and Koanaka South separated by ca. 0.5 Km. The third hill is 12 Km to the west. As the caves containing fossils are in Koanaka South, this is where our collecting efforts were based. Koanaka South (20° 09.451’ S, 21° 11.7612’ E, quarter degree square [QDS] 2021 Aa) is approximately 130 Km southwest of the westernmost of the main channels of the Okavango Delta and 20 Km east of the Namibian border (Fig. 2). The hills are composed primarily of dolomitic rocks (Fig. 3) and breccia infills (Cooke, 1965)

Figure 1. Map of Botswana illustrating the position of the Koanaka Hills in Ngamiland. Map prepared using Google Earth Pro®.

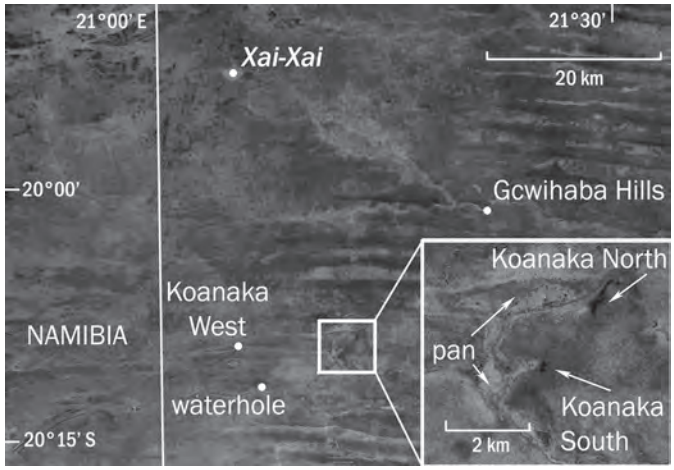

Figure 2. Map of a portion of northwestern Botswana showing landmarks and place names mentioned in the text. Inset shows Koanaka North and Koanaka South in greater detail. The pans adjacent to Koanaka South were the primary collecting site for lacertids. 'Waterhole' indicates the nearest open water source to Koanaka South located during the June 2008 survey. Map prepared using Google Earth Pro®.

Figure 3. Slope of Koanaka South showing its composition of dolomitic rock. The entrance to the Plio-Pleistocene cave is near the summit of ca. 50 m hill.

Figure 4. Semi-arid dense shrub savanna on low sandy ridge immediately surrounding Koanaka Sth.

Figure 5. Heavily elephant trampled waterhole 15 Km southwest of Koanaka South.▼

Figure 6. View of Koanaka South from edge of dry pan to the west of the ca. 50 m hill.◄

and, at ca. 50 m tall, represent the only topographic relief for over 18 Km. The modern climate of the Koanaka area is semi-arid with annual rainfall of 400-450 mm occurring only during the austral summer months (Van Regenmortel, 1995). Annual temperature variation near the Koanaka Hills varies from -8.5°C to 42.2°C (Botswana Department of Meteorological Services). Habitat around the hills varies, but is considered a semi-arid dense shrub savanna (Fig. 4) often referred to as the Kalahari Thirstland (Pickford & Mein, 1988). The closest water source found during our survey was a small waterhole 15 Km west of Koanaka South (Fig. 5), although topographic maps based on a 1966 survey indicate three springs approximately 5 Km south of the site. Two pans (ephemeral ponds) are located approximately 200 m to the west of Koanaka South (Fig. 6), although neither the frequency with which these pans contain water nor the duration of their water retention are known.

During the period of collection daytime temperatures averaged 26°C, night time temperatures averaged 2°C, and there was no precipitation.

METHODS AND MATERIALS

New collections were made chiefly within a 5 Km radius of Koanaka South with collecting teams of one to three persons. Collecting was concentrated on rocky outcrops of the hill, as well as in the dry pan west of the hill. Searches were made during both day and night, although temperatures dropped rapidly after sunset, precluding most reptile activity. As a result, most specimens were caught during daylight hours. Pitfall traps were also utilised in the collection process. Species identifications followed standard regional references (e.g., Auerbach, 1987; Branch, 1998; Alexander & Marias, 2007).

Specimens were euthanised with intraperitoneal injections of sodium pentabarbatol. Samples of either liver or tail tissue were taken from each specimen for future DNA sequencing. When present, stomach contents and parasites were also collected. The first two specimens of each taxon collected were prepared as osteological specimens and associated skins were preserved in 70% ethanol. Every third specimen of a taxon collected was fixed in 10% formalin in the field and later transferred to 70% ethanol. All material was deposited in either the Texas Natural History Collections (TNHC) at the University of Texas at Austin, Austin, Texas, USA or the Botswana National Museum (BNM), Gaborone, Botswana.

Our 2008 records are supplemented by data from a small, previously unpublished, collection made by Wulf Haacke at the Koanaka Hills in 1965. This collection is housed at the Transvaal Museum (TM) in Pretoria, South Africa. Occurrences based on literature records, as well as reliable, but unvouchered, sight or sound records were also compiled. Our confirmed species list includes all species represented by specimens actually collected in the Koanaka Hills, as well as those from elsewhere in QDS 2021Aa. Species not confirmed, but expected to occur in the Koanaka Hills, based on literature and museum records, are listed in Table 1 (see Appendix).

SPECIES ACCOUNTS

The species observed at the Koanaka Hills are listed alphabetically within genera and by corresponding higher taxonomic group. Specimens collected during the 2008 survey are noted under the heading ‘Material’. ‘Other records’ refers to Transvaal Museum material collected by Wulf Haacke at the Koanaka Hills in 1965, unvouchered sight and sound records, and to literature records based on unspecified museum material. Comments under the heading ‘Habitat’ relate to the specific habitat where the specimens were collected, as well as the precise GPS coordinate data for that capture. Additional information, such as size records or range extensions, is noted under heading ‘Comments’.

Squamata: ‘Lacertilia’

Agamidae

Agama aculeata Merrem, 1820

Material: Four specimens: TNHC 68737–40.

Other records: TM 30778 from ‘Koanaka Hills.’

Habitat: TNHC 68737, TNHC 68738, and TNHC 68739 were collected in a dry pan at 20°08.30’ S, 21° 11.40’ E. TNHC 68740 was found on a sandy track in dense shrub 100 m north of Koanaka South.

Comments: As Auerbach (1987) did not cite the specimen collected by Haacke in 1965, this record constitutes the first published finding of this species for the Koanaka Hills and QDS 2021 Aa.

Chamaeleonidae

Chamaeleo dilepis Leach, 1819 (Fig. 7)

Material: One specimen: BNM (registration number pending).

Habitat: This specimen was located in a tree around 20:00 in dense shrub surrounding Koanaka South, 21° 11.355’ E, 20° 09.167’ S.

Comments: Although the Koanaka area was included within the range maps of Branch (1998) and Clauss & Clauss (2002), this specimen represents the first published record of voucher material of this species for the Koanaka Hills and QDS 2021Aa.

Gekkonidae

Chondrodactylus turneri (Gray, 1864) (Fig. 8)

Material: Two specimens: TNHC 68749–50.

Other records: Visser (1984a) plotted the occurrence of this species in QDS 2021 Aa (source locality not mentioned) and Haacke collected specimens from Drotzky's Cave, approximately 23 Km to the northeast in 2021 Ab.

Habitat: Both specimens were observed inside the entrance to a cave at the top of Koanaka South at 20° 09.451' S, 21° 11.712' E.

Comments: Benyr (1995) provided evidence for the separation of the more tropical *Pachydactylus turneri* from the temperate *Pachydactylus bibronii* (Smith, 1846). Bauer & Lamb (2005) demonstrated that the affinities of this large-bodied gecko were with the genus *Chondrodactylus* and subsequently reallocated the species to this genus.

Ptenopus garrulus (Smith, 1849)

Material: No specimens were collected in 2008.

Other records: Visser (1984b) and Auerbach (1987) recorded this species in QDS 2021 Aa, the later citing Transvaal Museum material from the Koanaka Hills (although the nearest specimens in the records we obtained were from Kwia, Camp 2, 15 Miles SE Kaikai in 2021 Ab). This highly vocal species was heard calling sporadically from approximately one hour before sunset until one hour after sunset on most evenings during the survey.

Habitat: Found in tall grass on loose sand substrate near the 2008 campsite, 50 m west of Koanaka South at 20° 09.451' S, 21° 11.712' E.

Lacertidae

Heliobolus lugubris (Smith, 1838)

Material: No specimens were collected in 2008. Additional specimens. TTM 30779; TM 30792 from 'Koanaka Hills.'

Comments: As Auerbach (1987) did not cite these specimens, this constitutes the first published record of this species for the Koanaka Hills and QDS 2021 Aa.

Ichnotropis capensis (Smith, 1838) (Fig. 9)

Material: Five specimens: TNHC 68743–47 from the 'Koanaka Hills.'

Habitat: TNHC 68743 was observed on a sand ridge northwest of Koanaka South. TNHC 68744 and TNHC 68745 were observed on a sandy track in dense shrub west of Koanaka South at 20° 09.167' S, 21° 11.355' E. TNHC 68746 and TNHC 68747 were caught in pitfall traps placed in dense shrub near Koanaka South.

Comments: Although the Koanaka area was included within Branch's (1998) range map for this species, these specimens represent the first published record of voucher material for the Koanaka Hills and QDS 2021 Aa.

Ichnotropis squamulosa Peters, 1854 (Fig. 10)

Material: One specimen: TNHC 68748.

Habitat: TNHC 68748 was collected in a dry pan at 21° 11.40' E, 20° 08.30' S.

Comments: This female specimen (79 mm SVL, 12 g) is slightly larger than the largest reported size for this species (75 mm; Branch, 1998). Although the Koanaka area was included within Branch's (1998) range map for this species, this specimen represents the first published record of voucher material for the Koanaka Hills and QDS 2021 Aa.

Pedioplanis namaquensis (Duméril & Bibron, 1839) (Fig. 11)

Material: 18 specimens: TNHC 68751–68. Other records. TM 3077 was collected at 'Koanaka Hills, Western Hill.'

Habitat: All *P. namaquensis* collected were active in and around the bases of shrubs in dry pans at 20° 08.30' S, 21° 11.40' E and 20° 08.46' S, 21° 11.14' E.

Comments: Auerbach (1987) did not cite the specimen collected by Haacke in 1965 and the range mapped by Branch (1998) did not include the Koanaka region, thus this constitutes the first published record of this species for the Koanaka Hills and QDS 2021 Aa.

Scincidae

Trachylepis varia (Peters, 1867)

Material: Four specimens: TNHC 68769–72.

Other records: Five specimens: TM 30774–76; TM

Figure 7. *Chamaeleo dilepis* found from dense shrub savanna surrounding Koanaka South (Photograph by Johan Marais).

Figure 8. *Chondrodactylus turneri* from cave at Koanaka South site. ▲

Figure 12. *Bitis arietans* from pan adjacent to Koanaka South (Photograph by Johan Marais).►

Figure 9. *Ichnotropis capensis* from sand ridge adjacent to Koanaka South (Photograph by Johan Marais).

Figure 10. Large female specimen of *Ichnotropis squamulosa* from pan adjacent to Koanaka South (Photograph by Johan Marais).

Figure 11. *Pedioplanis namaquensis* from pan adjacent to Koanaka South (Photograph by Johan Marais).

30786–87 from the 'Koanaka Hills.'

Habitat: All specimens collected in 2008 were found on Koanaka South running in and out crevices between the dolomitic rock.

Comments: Although the Koanaka area was included within Branch's (1998) range map for this species Auerbach (1987) did not cote Haacke's (1966) 1965 material. This report is the first published record of voucher material for the Koanaka Hills / QDS 2021 Aa.

Trachylepis wahlbergii (Peters, 1869)

Material: One specimen: TNHC 68773.

Other records: TM 30788 from 'Koanaka Hills.' This specimen was presumably the basis of Auerbach's (1987) record from the area.

Habitat: TNHC 68773 was found on a termite mound adjacent to a waterhole heavily used by elephants, 8 Km WSW of Koanaka South and 12 Km E of the Namibian border at 20° 11.37' S, 21° 06.33' E.

Comments: Until the work of Broadley (2000) this species was treated by most authors as a subspecies of *Trachylepis* (then *Mabuya*) *striata*, and earlier references to this species in northwestern Botswana are under this name.

Squamata: Serpentes

Elapidae

Dendroaspis polylepis (Günther, 1864)

Material: No specimens were collected in 2008.

Other records. B. Williams (pers. comm.) reported observing this species at Koanaka South in a cave entrance on Koanaka South in 1996.

Comments: Although not included in the species range map of Branch (1998), it was regarded as occurring in the Koanaka area by Clauss & Clauss (2002). This sight record is the first for the Koanaka Hills and QDS 2021 Aa.

Psammophiidae

Psammophis trinasalis Werner, 1902

Material: No specimens were collected in 2008.

Other records: TM 26922 was collected from Nguia, 24 Km SE of Kaikai (= Xai Xai), approximately 37 Km northwest of Koanaka South. Broadley (1990) recorded this species from QDS 2021 Aa, probably based on this specimen, which is also entered into the Transvaal Museum database with the QDS 2021 Aa, although the locality actually lies near the border of 1921 Cc and 1921 Cd, probably in the latter. Auerbach (1987) also plotted a locality in 2021 Aa presumably based on a Transvaal Museum record from the Gcwihaba Hills, although this locality actually lies in 2021 Ab.

Comments: On two occasions a *Psammophis* sp. was observed at the Koanaka South site, but these were not captured so specific identity could not be established unambiguously. It is probable that *Psammophis trinasalis* was the species present, but several congeners are expected to occur in the region (Table 1).

Viperidae

Bitis arietans Merrem, 1820 (Fig. 12)

Material: One specimen: TNHC 68742.

Habitat: This specimen was found in a dry pan at 20° 11.37' S, 21° 06.45' E.

Comments: An additional specimen, TNHC 68741, was captured crossing a dirt road en route to the Koanaka Hills at 20° 42.2' S, 21° 36.58' E. Both specimens collected were heavily infested with nematode worms in the alimentary canal, lungs, peritoneum, and pericardium. Both Branch (1998) and Clauss & Clauss (2002) included the Koanaka region in their shaded range maps for this species, but this represents the first vouchered published record from the Koanaka Hills and QDS 2021 Aa.

DISCUSSION

The herpetofauna of Ngamiland was first commented upon by Wahlberg in 1856, who noted the presence of a Puff Adder (*Bitis arietans*) near Lake Ngami (Wahlberg, 1994). However, the region, and in particular, those areas distant from Lake Ngami and the edges of the Okavango, have been poorly surveyed overall. Indeed, the herpetological literature pertaining to Botswana as a whole is relatively limited. The whole of the country is included in a number of southern African herpetological guides and references (e.g., FitzSimons, 1943; Visser, 1984c; Broadley, 1990; Branch, 1998; Channing, 2001), but the only book length herpetological references specific to Botswana are Auerbach (1987) and Clauss & Clauss (2002). In addition Auerbach (1985) deals specifically with the herpetofauna of the Gaborone areas and Butchart (2000) with that of the Okavango Delta. Most of these references, however, are not of relevance to Ngamiland (Auerbach, 1985), do not provide distribution maps of any kind (Butchart, 2000), cover only selected species (Clauss & Clauss, 2002), or contain almost no records from northwestern Botswana (FitzSimons, 1943). Only Visser (1984c, lizards only), Broadley (1990, snakes only), and Auerbach (1987) provide quarter degree square records, while Channing (2001) provides degree square records, and Branch (1998) and Clauss & Clauss (2002) present general (non-point or QDS) distribution maps. Most of these sources are ultimately based on specimen records from southern African museums. In addition, a relatively small number of technical publications have discussed the herpetofauna of selected regions or have dealt with selected taxonomic groups (e.g., Haacke, 1966; Auerbach, 1984; 1986; McLachlan 1981).

Knowledge of the herpetofauna of western portions of Ngamiland is especially limited. Indeed, Auerbach (1987) recorded only four species of reptiles in degree square 2021 and neither he nor Channing (2001) gave any amphibian records for the same area. This is, in large part, due to the minimal collecting effort in this part of Ngamiland, chiefly because of difficulty of access. However, the region is also likely to be depauperate by southern African standards. It is relatively uniform in topography and does not provide, except in the Koanaka Hills and other nearby low hills (e.g., Gcwihaba Hills, Aha Hills), any significant rocky habitat. Rocky substrates are typically favored, for example, by *Pachydactlyus* spp. geckos, and landscapes dominated by mountains or kopjies usually support a diversity of *Pachydactylus* spp., as well as *Trachylepis* spp., and other lizards (Bauer, 2000). Indeed, many such rocky areas in southern Africa support highly localised rupicolous endemics, such as *Pachydactylus tsodiloensis* in the Tsodilo Hills, 175 Km north of the Koanaka Hills, *Pachydactylus waterbergensis* and *Pedioplanis rubens* on the Waterberg, and *Pachydactylus otaviensis* in the Otavi Hills, both about 400 Km to the west in Namibia. However, our survey did not reveal the presence of any such localised, substrate-specific species, and virtually all of the species recorded, or previously signaled from the region are generalists with broad distributions in southern Africa.

Despite the probable absence of specialists in the region, our review of previously collected material and literature records plus our own collections, yield a probable species list of six frogs and 46 reptiles for the site (Table 1). Nine of these (all reptiles) are confirmed by our collection of 38 specimens made in June 2008. An additional species, the lacertid *Heliobolus lugubris*, was not observed in 2008 but was confirmed by specimens collected in 1965. We also consider as confirmed for the Koanaka Hills, the barking gecko *Ptenopus garrulus*. Although we could not confirm the supposed museum voucher for the area cited by Auerbach (1987), we regularly heard the characteristic call of this gecko at Koanaka South.

The presence of two other snakes is supported by sight records and nearby vouchers. We thus consider the total confirmed herpetofauna for the Koanaka Hills to include 13 squamate reptile species. For nine of these species, this report constitutes the first published record of occurrence in the Koanaka Hills or in quarter degree square 2021 Aa. While nearly all of these have been considered likely to occur in the region (Branch, 1998; Clauss & Clauss, 2002), our records of *Pedioplanis namaquensis*, vouchered by both new material and an older museum specimen, represents a slight extension to the hitherto recognised range of the species. Our material also includes a new size record (79 mm SVL) for *Ichnotropis squamulosa*.

The harsh winter conditions at Koanaka South (no precipitation and near-freezing night-time temperatures), as well as the limited time and collecting effort precluded the compilation of a complete species list for the area. Additional species expected but not observed at Koanaka

South certainly include all of the taxa represented by material in the Transvaal Museum from nearby localities, including Drotzky's Cave and the Gcwihaba Hills (~ 23 Km NE), Nguia, Gewisha, Kwia, and Khibo, all southeast of Xai-Xai (also sometimes spelled Kaikai or Nxai-Nxai), approximately 28–37 Km northeast of Koanaka South, and Dobe, approximately 67 Km north-northwest of Koanaka South. For the most part, these specimens also form the basis for the inclusion of these expected species in the regional herpetofaunal literature (Table 1). As noted above, all of the 39 additional species considered as probable in the region are more or less widespread in southern Africa and suitable habitats for each of these species occurs in and around the Koanaka Hills. We believe that a collecting expedition during the summer months (November-March) would be optimal. This period coincides with the rainy season in Botswana and are the months in which the dry pans are most likely to be filled.

The preliminary enumeration of the Koanaka amphibians and reptiles compiled here is the first herpetofaunal list for the region and provides a starting point for comparisons with the paleofauna of the Koanaka South site. Material collected and prepared as osteological specimens will serve as comparative material for the identification of fossils recovered from the Plio-Pleistocene cave system and will be invaluable in determining how the reptiles and amphibians have been impacted by climate change and the appearance of humans in Ngamiland during the Pleistocene. Future trips are planned for the summer months in order to obtain comparative osteological material of a more representative sample of the modern herpetofauna of Koanaka South.

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APPENDIX

Table 1. Checklist of observed and expected taxa at the Koanaka Hills. Confirmed species include those recorded from Koanaka Hills or otherwise known from QDS 2021Aa (a maximum of ~20 Km distant from the Koanaka Hills) 1 = collected in 2008, 2 = collected in 1965, 3 = unvouchered record, 4 = literature record (see species accounts). Unless noted by an asterisk (*), taxa in the list of expected species were plotted with ranges including the Koanaka region by Branch (1998). Additional literature records including the Koanaka Hills in shaded range maps or from neighboring quarter degree squares are also indicated: Visser (1984c) [a], Auerbach (1987) [b], Broadley (1990) [c], Channing (2001) [d], Clauss & Clauss (2002) [e], Wüster & Broadley (2007) [f], as are Transvaal Museum specimens not previously cited in the literature (TM).

	Taxon	**Confirmed**	**Expected**
AMPHIBIA: ANURA			
Brevicipitidae	*Breviceps adspersus* Peters, 1882		d,e
Hyperoliidae	*Kassina senegalensis* (Duméril & Bibron, 1841)		e
Microhylidae	*Phrynomantis bifasciatus* (Smith, 1847)		d
Pyicephalidae	*Cacosternum boettgeri* (Boulenger, 1892)		TM
	Tomopterna cryptotis (Boulenger, 1907)		d,e
	Tomopterna tandyi Channing & Bogart, 1996		d
REPTILIA: TESTUDINES			
Pelomedusidae	*Pelomedusa subrufa* (Bonnaterre, 1789)[1]		e
Testudinidae	*Geochelone pardalis* (Bell, 1828)		e
	Psammobates oculifera Kuhl, 1820		e
REPTILIA: SQUAMATA: 'LACERTILIA'			
Agamidae	*Agama aculeata* Merrem, 1820	1,2	e
Amphisbaenidae	*Dalophia pistillum* (Boettger, 1895)		
	Monopeltis anchietae (Bocage, 1873)		
	Monopeltis sphenorhynchus Peters, 1879		e
	Zygaspis quadrifrons (Peters, 1862)		
Chamaeleonidae	*Chamaeleo dilepis* Leach, 1819	1	e
Gekkonidae	*Chondrodactylus turnerii* (Gray, 1864)	1	e
	Lygodactylus capensis (Smith, 1849)		TM
	Pachydactylus capensis (Smith, 1845)		
	Pachydactylus punctatus Peters, 1854		a
	Ptenopus garrulus (Smith, 1849)	3	e
Gerrhosauridae	*Gerrhosaurus multilineatus auritus* Boettger, 1887		a,b
Lacertidae	*Heliobolus lugubris* (Smith, 1838)	2	e
	Ichnotropis capensis (Smith, 1838)	1	
	Ichnotropis squamulosa Peters, 1854	1	
	Pedioplanis namaquensis (Duméril & Bibron, 1839)	1	*
Scincidae	*Lygosoma sundevalli* (Smith, 1849)[2]		e
	Trachylepis varia (Peters, 1867)	1,2	
	Trachylepis punctulata (Bocage, 1872)		a,b
	Trachylepis wahlbergii (Peters, 1869)	1,2	e
	Typhlacontias rohani Angel, 1923[3]		
	Typhlosaurus lineatus Boulenger, 1887		
Varanidae	*Varanus albigularis* (Daudin, 1802)		e

Table 1. cont.

REPTILIA: SQUAMATA: SERPENTES			
Leptotyphlopidae	*Leptotyphlops scutifrons* (Peters, 1854)		e
Typhlopidae	*Rhinotyphlops boylei* (FitzSimons, 1932)		
Colubridae	*Dasypeltis scabra* (Linnaeus, 1758)		e
	Telescopus semiannulatus Smith, 1849		e
Lamprophiidae[4]	*Amblyodipsas ventrimaculata* Roux, 1907		
	Atractaspis bibronii Smith, 1849		e
	Xenocalamus bicolor Günther, 1868		e
	Lamprophis capensis (Duméril, 1854)[5]		e
	Psammophis jallae Peracca, 1896		b
	Psammophis mossambicus Peters, 1882		*,e
	Psammophis subtaeniatus Peters, 1881		b,e, TM
	Psammophis trinasalis Werner, 1902	3,4	
	Psammophylax tritaeniatus (Günther, 1868)		
	Pseudaspis cana (Linnaeus, 1758)		e, TM
Elapidae	*Aspidelaps scutatus* (Smith, 1849)		c
	Dendroaspis polylepis (Günther, 1864)	3	*, e
	Elapsoidea sundevallii fitzsimonsi Loveridge, 1944		b,c
	Naja anchietae Bocage, 1879[6]		e
	Naja mossambica Peters, 1854		b,f
Viperidae	*Bitis arietans* Merrem, 1820	1	e

[1] See Savage (2003) and ICZN (2005) for discussion of authorship of this species.
[2] This species is sometimes allocated to the genus *Mochlus*.
[3] Mapped in the Koanaka region by Branch (1998) as *Typhlacontias brevipes* (Fitzsimons, 1938). See Haacke (1997).
[4] We here follow Vidal et al. (2007; 2008) in recognizing the Lamprophiidae, including snakes assigned by other authors to the Psammophiidae and Atractaspidae (e.g., Kelly et al., 2007).
[5] Mapped in the Koanaka region by Branch (1998) and Clauss & Clauss (2002) as *Lamprophis fuliginosus* (Boie, 1827). See Hughes (1997).
[6] Mapped in the Koanaka region by Branch (1998) and Clauss & Clauss (2002) as *Naja annulifera*. See Broadley & Wüster (2004).

Prodichotomy in the snake *Oreocryptophis porhyraceus coxi* (Schulz & Helfenberger, 1998) (Serpentes: Colubridae)

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ABSTRACT - The first occurrence of prodichotomy in the colubrid snake genus *Oreocryptophis* is reported herein. A stillborn *Oreocryptophis porhyraceus coxi* specimen with two heads, necks and short parts of the trunk bears kyphoscoliotic malformations and small pattern aberrations. The difference in vertebral number between the left and the right side is 22%, and so far this is the highest recorded disparity in any snake. The maximum bifurcation percentage is 15% in SVL and vertebrae number, while it is only 10% in ventrals. The prodichotomic specimen is smaller than its normal siblings; the difference is 35% in SVL and 24% in weight. Pattern variability in the duplicated parts is discussed; and it is presently unclear whether this is of genetic or epigenetic origin.

PRODICHOTOMY is a case of somatodichotomy, when the head and anterior part of the body are duplicated to at least some extent, although they are not necessarily completely separated (Smith & Pérez-Higerada, 1987). According to Wallach (2007), no clear dividing line exists between prodichotomy and another somatodichotomy category recognized by Smith & Pérez-Higerada (1987), proarchodichotomy, where there is more than a half of the body anterior to the anus duplicated. There were 680 definite cases of various types of somatic duplication in snakes reported by 2006. Prodichotomy, with a prevalence of 61.4%, was the most common type (Wallach, 2007). Most cases were recorded in the family Colubridae, possibly because it is the largest snake family and also partly due to its popularity with snake breeders.

Herein I report the first case of prodichotomy and somatodichotomy in a colubrid snake *Oreocryptophis porphyraceus coxi* (Schulz & Helfenberger, 1998), which also represents the first record in the species *Oreocryptophis porphyraceus* (Cantor, 1839) and in the genus *Oreocryptophis* (Utiger, Schätti & Helfenberger, 2005). A freshly dead prodichotomic female snake was found in an egg from a clutch of 4 eggs laid by a F2 captive-bred female (Fig. 1). Three females without visible malformations successfully hatched from the remaining eggs. One of the females had a reduced striped pattern on the anterior part of the body. This pattern abnormality is described elsewhere (Jandzik, 2009). The pattern of the two remaining specimens corresponded with the subspecies diagnosis of Schulz & Helfenberger (1998).

The parent snakes were ca. 2 years old when bred. They were descendants of snakes originating from the type locality in province Loei, Thailand (K.-D. Schulz, pers. comm.). At the time of breeding, they measured 85 cm, showed no visible deformations and were considered healthy. They were kept under standard terrarium conditions described by Schulz (2000) and the breeding concerned was their first reproduction. Later the same year, the female laid a clutch of infertile eggs. Next year, this repeated twice, and thereafter the adult female died. The eggs were incubated in the dark on wet vermiculite at stable temperatures of 27-28ºC. The incubation period was 54 to 56 days. No chemical cleaners were used in housing or in the incubator. The eggs of seven other colubrid species, *Lampropeltis getula*, *Lampropeltis triangulum*, *Natrix tessellata*, *Pantherophis guttatus*, *Pantherophis obsoletus*, *Rhynchophis boulengeri* and *Zamenis situla*, were incubated under the same conditions and no malformed specimens occurred in any of these clutches.

The anterior part of the body of the prodichotomic specimen is duplicated in the horizontal plane (i. e., there is a left and a right head with a neck and a short part of the body). The right side measured 26 mm from the rostrum to the bifurcation, while the left side at 20 mm was shorter. Just posterior was a 15 mm long transition zone, where both parts were externally fused, while the vertebral columns were separated. The length of the body posterior to the bifurcation (including the transition zone) was 146 mm and the tail length was 37 mm. The left side thus represented 77% of the right side length and the duplicated parts of the body represent 12 and 15% of the SVL (snout-vent length), respectively. Although both heads were normally developed without visible deformities, the left head was 12 mm in length, and smaller than the right one, which was 14 mm. An axial kyphoscoliotic malformation was present 15 mm posterior to the bifurcation. This had a prominent dorsal convexity almost at right angles to the right oriented horizontal scoliotic deformity (dextroscoliosis), which is of only moderate extent. Another, smaller and almost entirely horizontal dextroscoliosis occurred on the left side at the bifurcation level. Due to this deformity, the right side was more in line with the body axis than the left. Beside these scoliotic deformations, other small defects were present on the posterior half of the body along the vertebral line. These were in the form of scale malformations with underlying small fibrous and muscular bumps that were joined by striped pattern irregularities (Fig. 1). There was 19 dorsal scales around the mid-body, 21 ventrals (including the pre-ventrals) on the right side and 18 on the left anterior to the bifurcation. The trunk was covered with 183 ventrals posterior to the bifurcation, while the lower side of the tail had 63 subcaudals. These scale counts are in accordance with those typical for the subspecies *O. p. coxi* (200 to 213 ventrals, 62 to 72 subcaudals) reported by Schulz & Helfenberger (1998). The bifurcation in ventrals is 10 and 9%, respectively, which is lower than in SVL. There were a few incomplete ventrals inserted on both duplicated sides. The ventrals, occurring in the region of kyphoscoliotic deformations, were not completely developed and some were fused together. Also 20 subcaudal pairs, almost one third of their entire number, were fused together. Apparent on the radiograph were 27 vertebrae on the right side and 21 on the left side anterior to the bifurcation. The difference in vertebral number between each side is therefore 22%. This is 2% higher than the highest previously recorded difference in any snake, according to the most recent and comprehensive review of Wallach

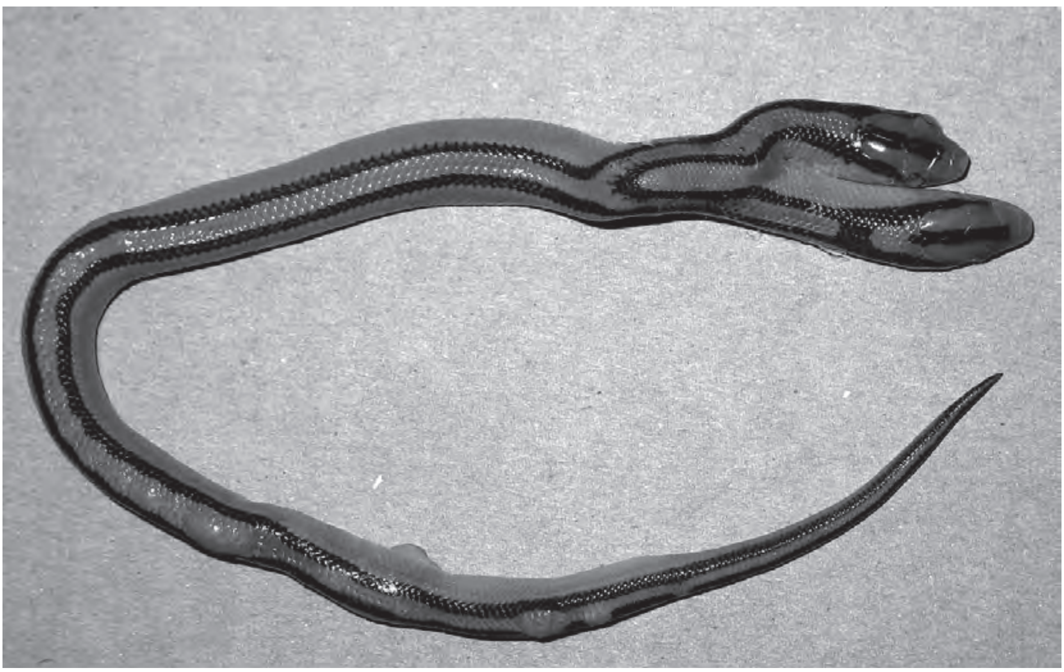

Figure 1. The dorsal view of the prodichotomic *Oreocryptophis porhyraceus coxi* specimen.

(2007). The fusion zone comprised 7 vertebrae and there was about 145 trunk vertebrae posterior to the fusion zone (± 15; the posterior trunk vertebrae were not completely distinguishable on the radiograph). The total body vertebrae number was thus ca. 179 on the right side and about 173 on the left, respectively. The bifurcation expressed in vertebral number is therefore ca. 15% and 12%, respectively. This is the same as the bifurcation percentage in SVL, but differs from the lower bifurcation percentage in ventrals.

This malformed *O. p. coxi* specimen was considerably smaller than its siblings. The difference in SVL (mean SVL of 3 siblings = 265 mm) was 35% on the right side and 37% on the left, while the difference in the tail length was only 24% (mean tail length of 3 female siblings = 49 mm). In total length (SVL + tail length), the difference forms 33% on the right side and 35% on the left side (mean total length of 3 siblings = 314 mm). However, weight difference was less prominent. The weight of the prodichotomic specimen was 6.6 g before preservation, whereas the mean weight of its siblings was 8.7 g, and therefore the difference is 24%. This is in contrast to the general trend in snakes, where normal specimens usually differ more in weight than in length, when compared to their hatchling twin siblings (Wallach, 2007). A weight comparison of prodichotomic snakes with their normal siblings has not yet been published (Wallach, pers. comm.), and therefore no comparison with other snakes is possible.

The pattern of the prodichotomic specimen is exhibited clearly on Fig. 1. It is important to notice the difference between the neck patterns. The right neck bears a dark blotch, while this is absent on the left neck. According to the subspecies diagnosis, the dark blotches are either present or absent on the anterior part of the body (Schulz & Helfenberger, 1998), thus both pattern forms could be considered ‘normal’. This pattern difference may represent a case of phenotypic plasticity, where two different variants from the same genotype are expressed under different conditions. However, whether this was the proximate cause of variable pattern expression in the specimen remains unclear because partial fusion of two embryos is also a developmental mechanism believed to cause prodichotomy (Wallach, 2007). Both anterior parts may possibly represent genetically different specimens. In this case, the different patterns would then only be a result of different genotypes expression. Further genetical investigation would be needed to test these hypotheses and answer such complex questions about prodichotomy in snakes.

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Reptiles and amphibians from the Kenyan coastal hinterland

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THIS article is a contribution to the knowledge of the distribution and natural history of the herpetofauna in the cultivated zone of the Kenyan coastal hinterland. Although agricultural communities have existed for at least 2,000 years on the Kenyan coast, the last 100 years have seen an unprecedented increase in population, urban expansion and tourism development. These processes have transformed the environment by reducing the forest cover, expanding cultivation and human habitations. The effects of such changes on the distribution of reptiles and amphibians are poorly known. The present report is based on observations of reptiles and amphibians collected during residence in the coastal hinterland of Kenya from 1985 to 1986. Most observations were made around Kaloleni town, a small market center 25 Km northwest of Mombasa, situated on the coastal ridge ca. 20 Km inland from the coast (Fig. 1).

The East African coast represents an important biogeographical region with high herpetological species diversity and endemism (Broadley, *unpublished*). The herpetofauna differs markedly from that of the dry interior of eastern Africa (Schiötz 1976). While the majority of its species are representatives of a south-central African fauna, the region also includes many endemics and, in the north, several representatives of the Somalian fauna occur. As is typical for the rest of eastern Africa, the ecology, systematics and zoogeography of the coastal reptiles and amphibians is poorly known. There are very few published accounts that include collections from the Kenyan coastal strip (i.e., Loveridge, 1936a/b; Schiötz, 1975) and only one from the immediate hinterland (Malonza et al., 2006). Drewes has posted an article on the website of the California Academy of Sciences about the amphibians in the Arabuko-Sokoke forest north of Malindi (see Drewes & Altig [1996]). Although the recent publication of two books, *A Field Guide to the Reptiles of East Africa* (Spawls et al., 2002) and *Amphibians of East Africa* (Channing & Howell, 2006) have made an immense advance in East African herpetology, further local faunal studies are still important to gather knowledge on species distribution and diversity. Such basic research is crucial to conservation programmes for the region's changing ecology that results from human transformations of local environments.

White (1983) distinguishes the coastal area from southern Somalia to northern Mozambique as a distinct floristic region - the Zanzibar-Inhambane Regional Mosaic. Prior to the introduction of agriculture and pastoralism the area was characterized by widespread forest mixed with wooded grassland and a high number of endemic forest trees (92 out of 190 species). During the last 1,000 years these forests formed patches of varying sizes, depending on human and animal activities, in a belt extending from the central Kenyan coast to the central coast of Tanzania. Today, the main forest remnants have been partially destroyed by cutting for cultivation or firewood and have become secondary wooded grassland. The remaining coastal forests are Arabuko-Sokoke, Shimba Hills and the small Kaya forests between Kwale and Kilifi. The latter have been preserved as sacred forests, called MaKaya in the language of the Mijikenda peoples who inhabit the coastal ridge.

From the border of Tanzania, to the Tana River, the Kenyan coast is characterized by relatively high rainfall exceeding an average of 1,000 mm / year, falling in two seasons, October-November and March-June. The average annual precipitation decreases rapidly toward the dry nyika thorn bush to the west, which receives 250-500 mm per annum. The severe heat of the dry season is tempered by high humidity ensuring no month is completely

Figure 1. Map of study area.

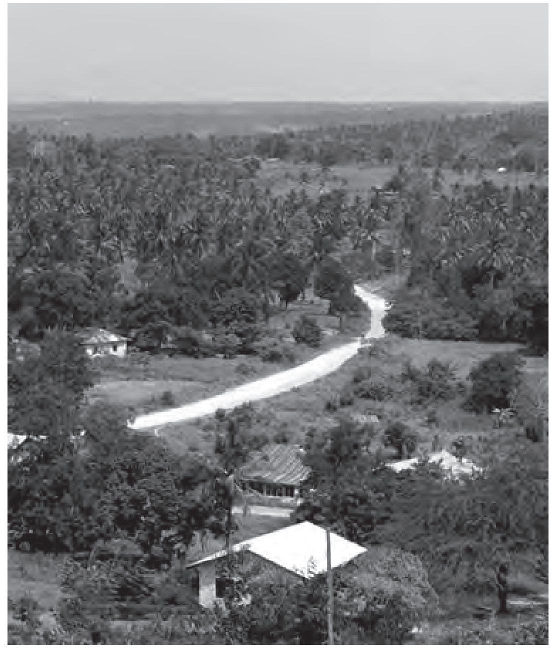

Figure 2. A view of the land around Kaloleni, July 2007.

dry. The coastal biogeographical region consists of a narrow coastal plain and ca. 15-25 Km from the shore, a ridge that culminates in a fault line at an elevation of 200-250 m above sea level. The coastal strip with high rainfall is only ca. 25 Km wide and its vegetation is wooded grassland with remnants of semi-deciduous forest. Today the coastal ridge is covered with Coconut palms and fields of Maize, Cassava, Bananas interspersed with small trees or scrubs, and Rice fields in the valleys (Fig. 2).

In addition to the ubiquitous palm plantations, rice fields with adjacent gardens and maize fields distinguish the habitat around Kaloleni. The Rice fields hold water only during the rainy season and become breeding sites for amphibians. Fields with Maize stalks, low bushes and Banana trees, as well as local mud-walled and palm thatch-roofed houses, form a habitat where snakes such as *Lamprophis fuliginosis*, *Philothamnus punctatus* and *Psammophis mossambicus* are common. During the rains, seasonal pools form along the road ditches in depressions on farmland and in Coconut palm plantations. These water logged areas are dense with amphibians that are preyed upon by snakes such as *Philothamnus hoplogaster*, *Crotaphopeltis hotamboeia*, *Crotaphopeltis braestrupii*, and *Dipsadoboa flavida*. The amphibians are mostly active during the long rainy season, which in 1985 occurred during May-July, as well as during the short rains in November and December. As one would expect, very few frogs were observed during the dry seasons. Snakes were active during both the rainy and dry seasons with a slight variation between species. Species such as the Green Night Adder (*Causus resimus*) was conspicuously absent during the dry periods when frogs and toads (which are its main prey) are scarce.

Of the 48 species of snakes found in the Zanzibar-Inhambane Regional Mosaic of coastal Kenya, 21 are restricted to the coast but three of these also occur in the extreme west of the country (Hughes, 1983). The coast has 56% of species in common with the inland fauna of central and western Kenya.

With respect to amphibians, Schiötz (1999) recognises an East African lowland tree frog fauna occupying a region extending from the coastal area down to tropical regions of south Africa. Only widely distributed forms such as *Kassina senegalensis*, *Hyperolius nasutus* and *Hyperolius viridiflavus* are found further west from Kenya to West Africa.

METHODS AND MATERIALS

This collection was undertaken during seven months of residence in Kaloleni from 1984-1986 during visits with my wife, who was conducting anthropological fieldwork, and for my own anthropological research. Frogs and many snakes were found during night excursions with a strong head-lamp. I also established a network for snake reports by offering a small reward to anyone whom could exhibit a live snake.

All the amphibians and reptiles reported here were photographed and catalogued. Many were also preserved in alcohol and donated to the National Museums of Kenya in Nairobi (NMK indicates specimens donated to that museum). Alec Duff-Mackay and Damaris Rotich at the National Museums of Kenya identified most of the amphibian species. Those are indicated in the species list by NMK. My taxonomic nomenclature follows Spawls et al. (2002) and I avoid the use of trinomials because of the often unclear evolutionary status of morphological variation in many populations. All records are from the Kaloleni area unless stated otherwise.

SPECIES ACCOUNTS

AMPHIBIA

Xenopus muelleri - NMK
A large population frequented a rectangular concrete well enclosure.

Bufo gutturalis
This toad is extremely common and occurred calling in most waterbodies, even in the dry season.

Bufo maculatus - NMK
It was only found in a dry creek bed at the Kaya Kambe forest, none occurred in cultivated areas.

Phrynomantis bifasciatus - NMK
These colourful frogs are abundant during rains when they congregate around temporary ponds. They often remain inactive, emerging to breed only after several days of rain.

Pyxicephalus edulis - NMK
This species was uncommon. I observed only six individuals, of which five were males, calling from a temporary pool during the rains in December 1985. The edible bullfrog is found along the coastal plains from northern south Africa to southern Somalia (Lanza, 1981; Channing & Howell 2006). Although having a primarily coastal distribution the species has also been recorded from the Tana River Primate National Reserve (Malonza et al., 2006) and the Kora National Park (Cheptumo et al., 1986) about 80 and 300 Km from the coast respectively. The exact taxonomic status of Kenyan *Pyxicephalus* sp. has been unclear for some time. According to Alec Duff-Mackay (pers. comm.) and Robert Drewes (pers. comm.) specimens on the Kenyan coast are not *Pyxicephalus adspersus*, and, in 1985, Duff-Mackay (pers. comm.) suggested that they should be classified as *Pyxicephalus flavigula*. Lanza (1981) lists Somali specimens as *P. adspersus*, but proposes that their status is not clear and merits genetic investigation (B. Lanza, pers. comm.). However, Channing & Howell (2006) categorize the coastal populations as *P. edulis*, and the specimen depicted in their book conforms to those that I collected.

Phrynobatracus ukingensis ssp. - NMK (Fig. 3a)
This species is very common around ponds and occurs in at least two morphs; grayish with darker patches, and with a light mid-ventral strip from nose to vent. A. Duff-Mackay (pers. comm.), an authority on Kenyan amphibians, tentatively assigned them as an undetermined subspecies. *P. ukingensis* is also listed by Drewes & Altig (1996) as occurring in the Arabuko-Sokoke forest. However, Channing & Howell (2006) do not include Kenya in the distribution of this frog.

Phrynobatracus acridoides - NMK
Common around water bodies and occurs in several morphs; 1. Grayish brown with darker patches. 2. Same as above but with light tan mid-ventral strip from snout to vent. 3. Gray with a green mid-ventral stripe.

Arthroleptis stenodactylus - NMK
Except for one individual in Kaloleni, all others were found among dead leaves at the bottom of a dry creek in Kaya Kambe forest.

Ptychadena oxyrynchus - NMK
Very common around different water bodies.

Ptychadena mossambica - NMK
Very common, occurs in two morphs, either with a yellow or light green longitudinal dorsal line.

Chiromantis xerampelina - NMK
The Southern Foam-nest Frog is very common around Kaloleni. It is active during the rainy seasons when it breeds in the temporary ponds that form in farm land and along road ditches. One female was observed forming a nest together with three males with one clinging to her neck and another to her lower body above the hind legs. A third male sat close to the female. According to Channing & Howell (2006) the peripheral males fertilize a proportion of the eggs. Interestingly female reproductive strategies involving multiple fathers are currently being discovered among many vertebrates, for example European Adders (*Vipera berus*) (Madsen et al., 1992).

Afrixalus fornasini - NMK
Common around temporary and permanent water, these frogs occurred in two morphs; one uniform yellow, which predominates, and one with a longitudinal light band from nose to vent. The latter form probably constituted less than a quarter of the observed specimens. The males were calling from reeds and grasses in the water or at the immediate edge. I observed one pair in amplexus on a reed at the end of the short rains in mid December.

Afrixalus sylvaticus - NMK (Fig. 3b)
Very common in the rice fields around Kaloleni. This small (ca. 20 mm long) tree-frog was first described by Schiötz (1974) and was previously known only from the type locality in Kwale south of Mombasa. In the collections of the California Academy of Sciences there are also three specimens from Shimba Hills, Kwale District, collected in 1981. Its distribution to the north of Mombasa is poorly known. Schiötz (1974) writes that some frogs from the Tana River may belong to this species. It seems to be restricted to the highland ridge. There are no specimens from the coastal strip in the extensive collection in the California Academy of Sciences. The species identification was corroborated from a photograph by Robert Drewes (pers. comm.).

Afrixalus brachycnemis - NMK
This species is common and found in the same localities as *A. sylvaticus*. The Short-legged Spiny Reed Frog is a savanna species that is known from several localities along the Kenyan and Tanzanian coasts (Channing & Howell, 2006).

Leptopelis argenteus - NMK
Very common during the long rains in June - July when it is usually found on scrubs and maize stalks at some distance from water sitting at 1.0-1.5 m height. During the short rains in November - December it was virtually absent. I found only a few individuals and none were calling.

Kassina senegalensis - NMK
Several individuals were heard calling at the side of a temporary pond. Although widespread and common in Kenya, this species was only found in two ponds in Kaloleni.

Kassina maculatus - NMK
These frogs were commonly found in temporary ponds where several males floating in the water could often be seen and heard calling.

Hyperolius tuberilinguis - NMK
Common around temporary waters during rainy seasons, these frogs call from low positions among grass in and around pools.

Hyperolius pusillus
The Translucent Reed Frog was observed in a single pond at Rabai, a few kilometers south of Kambe.

Hyperolius parkeri - NMK
This species was only found at one permanent pond on the road to Mariakani. Two individuals were observed on large grass tussocks at the edge of the water at ca. 1.5 meters above ground.

Hemisus marmoratus - NMK
A few specimens were found on the ground near temporary ponds in the cultivated landscape.

REPTILIA

CHELONIANS

Pelusios castanoides

This turtle was common in rainy season ponds. One specimen was also found in a flooded dirt track.

Kinixys spekii / *Kinixys belliana*

Spawls et al. (2002) tentatively recognize these as separate species but adds that intermediates exist on the northern coast. Bell's Hinged Tortoise (*K. belliana*) has a domed carapace with a radial pattern while *K. speeki* has a flat shell with a 'zonary' pattern. Both forms were very common in the areas where they were found; in gardens, on footpaths and crossing the roads during the day.

SQUAMATA

Lygodactylus picturatus

This diurnal gecko was common on tree trunks and banana stems. It is also recorded from the lower Tana River (Malonza et al., 2006).

Hemidactylus mabuya - NMK

Ubiquitous in and outside houses and also found on cliffs by Kombeni River at Rabai.

Hemidactylus brookii - NMK

The only observed specimen was found on a large rock in Rabai.

Chamaeleo dilepis

The Flap-necked Chameleon is very common in the Kaloleni area. It was found in the low branches of trees and frequently on scrubs of about 1.0 m in height. Although I found many juveniles with body lengths of ca. 3 cm in May and November, I observed only a few adults during these months. This possibly indicates two breeding periods corresponding to the two rainy seasons. I also observed several individuals of this species in Malindi. These specimens had noticeably larger flaps than those found in Kaloleni. Spawls & Rotich (1997) discuss the variation in ear flaps in this species and note that the Somalian populations have smaller flaps than those found on the Kenyan coast. Interestingly, I have found several specimens of *C. dilepis* on the North Pare Mountain in northeastern Tanzania, which lack visible flaps. These were deposited in the Department of Zoology at the University of Dar-es-Salaam in 1989.

Rieppeleon kerstenii

Commonly found at night sleeping on straws and grasses ca. 20 cm above ground. The average body length was 5.5 cm. When captured this species emitted a low frequency sound and vibrations.

Mabuya planifrons - NMK

One animal was found in forest litter at Rabai close to the Kombeni River.

Gerrhosaurus flavigularis

These lizards were sporadically observed along hedges and close to large bushes into which they retreated when disturbed.

Gerrhosaurus major

This species was observed more frequently than *G. flavigularis*. It was particularly common around termite mounds into which it retreated.

Varanus niloticus

This monitor species was occasionally encountered along footpaths in the cultivated zone but would quickly and noisily disappear into undergrowth.

SERPENTES

Causus resimus

Three specimens were found in the month of June in the day near a large rice field during the long rains. No Green Night Adders (*C. resimus*) were observed between November and June despite searching. This snake has an undeserved reputation among local people who called it 'Mganga uya' which means 'doctor go back' in the Giriama language. The name implies that a bite causes instant death and the doctor may as well return home. In reality its venom is quite weak and it is the envenomation apparatus that is often inefficient (Spawls & Branch, 1995). These snakes subsist predominantly on frogs and toads.

Bitis arietans

The Puff Adder is a widespread savanna species in sub-Saharan Africa. No live specimens were encountered within habitats but two dead specimens, killed on the road were observed. Both were about 120 cm total length.

Atractaspis bibronii - NMK
I found one 64 cm male crossing a tarmac road at 21:00 and a smaller specimen, ca. 30 cm long, was found under a banana leaf around 22:00. The latter bit me in the middle finger of the left hand. I felt immediate sharp pain followed by rapid swelling of the hand that then spread to the fore-arm. The swelling disappeared after a week. Further information about the bite can be found in Udvardy & Håkansson (1996).

Dendroaspis angusticeps
The only Green Mamba (*D. angusticeps*) found was a ca. 180 cm long gravid, irascible female that had taken up residence in the palm-thatched roof of a house. According to Spawls & Branch (1995) this is a favorite place of shelter. Despite intensive search I never found another. Hence, one would guess that it is probably not as common on the coastal ridge of the area, which is unusual considering that the Green Mamba is reputed to be abundant along the coastal strip. This is a species typical of eastern semi-deciduous forests, riverine vegetation and highland rain forests like those around Amani, East Usambara.

Naja ashei
The only specimen found was a 165 cm long male that had lodged itself in the roof beam of a latrine. This uniformly brown Spitting Cobra was formerly known as *Naja nigricollis* but has recently been described as a new species and named after the late James Ashe in honour of his contributions to east African herpetology (Wuster & Broadley, 2007). It is the largest of the spitting cobras reaching a length of 2700 mm, and is distributed along the coast from southern Somalia, and southeastern Ethiopia to southern Kenya. The northern and western limits of its range are still unclear.

Lamprophis fuliginosus
This common snake is usually found in close proximity to, and inside, houses. One afternoon I observed a *L. fulginosus* consuming a house gecko (*Hemidactylus mabuya*).

Psammophis mossambicus (Fig. 4a)
Two males and one female were captured for measurements. Their coloration was light brown with a longitudinal row of black-edged scales along the back and with total lengths of 150, 150, and 115 cm respectively. The female captured in January was gravid. These snakes were abundant in the area, often found close to human habitation, and were active diurnally. This species has often been killed by cars whilst crossing roads in search of prey. The scale counts of the specimens followed Broadley's (2002) description but their ventral counts were at the lower end of the variation, 150-180. *P. mossambicus* may reach 190 cm in Tanzania (Broadley & Howell, 1991). The genus *Psammophis* is currently taxonomically unstable, especially the two species treated herein. Most of the work conducted by Broadley (2002) has been on southern African material and no comparative systematic studies exist on snakes from eastern Africa. Most recently Spawls et al. (2002) have attempted to clarify the *Psammophis sibilans* / *Psammophis subtaenitaus* complex

Psammophis orientalis (Fig. 4b)
Four specimens of the Western Stripe-bellied Sand Snake were found. Two were found hiding on the ground and two on top of low bushes. According to Broadley (pers. comm.), who examined photographs of the largest specimen, it strongly resembled individuals from Mozambique with an ill defined dorso-lateral stripe but with strongly marked black ventral lines. The largest was a 132 cm (90 SVL + 42 TL) male resting under a palm trunk. This snake had 170 ventrals and 103 subcaudals. For males of this species, Spawls et al. (2002) gives the number of subcaudals as 94 -116 and ventrals as 146 -170. The character that immediately distinguishes *P. orientalis* from *P. mossambicus* is the pair of black ventral lines on yellow background and the more rounded head that lacks the 'Roman nose' of the latter. It also attains a smaller size. Spawls et al. (2002) give a maximum length for for this species in east Africa of 122 cm.

Philothamnus hoplogaster - NMK
Although probably common, this species was only observed near water where they slept on reeds at the

Figure 3a. *Phrynobatracus ukingensis*, Kaloleni. ◄
3b. *Afrixalus sylvaticus*, Kaloleni. ► ▲

Figure 5. *Crotaphopeltis braestrupi*, Kaloleni. ▲

Figure 4a. *Psammophis mossambicus*, Kaloleni. ▲
4b. *Psammophis orientalis*, Kaloleni. ▼

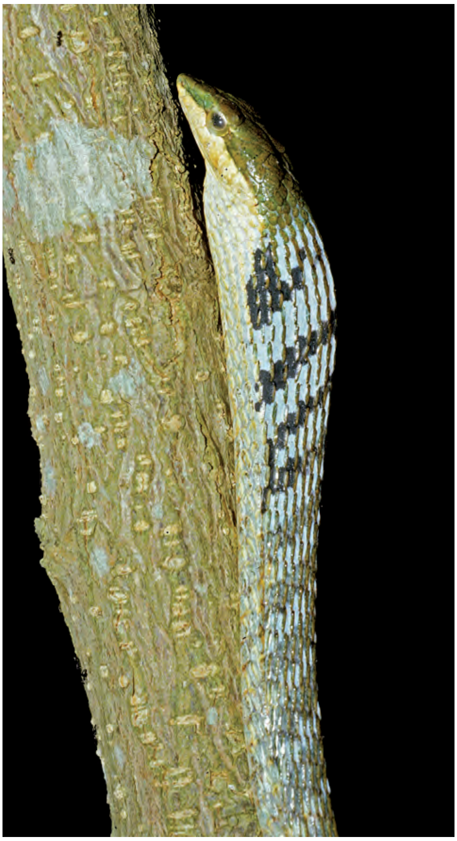

Figure 6a. *Thelotornis mossambicanus*, from Kaya Kambe. ► **6b.** *Thelotornis usambaricus* (tentative). ◄ **6c.** *Thelotornis usambaricus* (tentative); note the black dorsal chevrons; from Kaya Kambe. ▲

edge of ponds. The systematics of the Green Water Snakes of the genus *Philothamnus* is unclear. While Spawls's (1978) lists the Green Water Snakes on the coast as *Philothamnus irregularis*, Hughes (1985) later confined *P. irregularis* to West Africa, while assigning the coastal populations in east Africa to *Philothamnus battersbyi* and *P. hoplogaster*. The main characteristics distinguishing these two species are higher numbers of ventrals and subcaudals for the latter. According to Hughes (1985), numbers of ventrals for *P. battersbyi* usually exceed 160 and the subcaudals 100. The specimens collected in Kaloleni were typical *P. hoplogaster*. I also examined two specimens mislabeled *Philothamnus semivariegatus* at the NMK (nr. 2637 and 2629) from Kakuyuni, 5 Km west of Malindi, which conformed to *P. hoplogaster* with 147 and 149 ventrals respectively. The Southeastern Green-snake occurs along the east African coast from Lamu to southern Tanzania where it is also widespread westwards to Zambia, and south through Zimbabwe and eastern south Africa. The distribution of *P. battersbyi* extends through west and central Kenya.

Philothamnus punctatus
This was the most commonly observed snake in the Kaloleni area. It was found in banana groves, small trees in gardens, and it often ventures into palm-thatched roofs and walls of houses and latrines. This species was formerly subsumed under *Philothamnus semivariegatus* but established by Hughes (1985) as a separate taxon distributed along the coast from Mozambique to northern Somalia and in the interior of northern Kenya.

Crotaphopeltis hotamboeia
One individual was found near a pond at night.

Crotaphopeltis braestrupi (Fig. 5)
Two males, 60 and 57 cm long, were found active at night close to ponds where they were probably seeking frog prey. Both specimens were black. Rasmussen (1985) based his separation of *C. braestrupi* from *Crotaphopeltis hotamboeia* on the uniform black colour and lack of white spots on the scales, and longer hemipenis. According to R. Taylor (pers. comm.) at Bioken in Watamu, Kenyan coast, black specimens with white dots on the scales (as is typical of the usually grey – brown *C. hotamboeia*) also occur on the coastal strip.

Dipsadoboa flavida (NMK)
Three males were collected measuring 60, 47, 35 cm respectively, of which one was preserved. This attractive little snake reaches its northernmost distribution in southeastern Kenya. Three specimens were found on reeds in a pond at 22:00 hours probably hunting for frogs. One specimen kept in a cage ate reed frogs (*Afrixalus* sp.).

Telescopus semiannulatus
One specimen was found on a field in Watamu south of Malindi. Although these snakes are common along the coastal strip none were encountered around Kaloleni on the coastal ridge. This species may be confined to the coastal strip in Kenya where it reaches its northernmost distribution around the mouth of the Sabaki River in Kenya (Spawls et al. 2002).

Dispholidus typus
One ca. 60 cm brown female was killed in a village and another was dead on a road outside Kaloleni. A juvenile was found in a bush in Watamu.

Thelotornis mossambicanus/usambaricus - NMK
Three specimens were found in Kambe Kaya forest (see Fig. 6a, b, c). Four visits to Kaya Kambe produced three individuals, each about 125 centimeters long. The snakes were found at night sleeping in trees overgrown with creepers in dense forest at about 2.5 m. The scale counts conformed to Broadley's (2001) description of coastal east African *Thelotornis*. The top of the head of two snakes was reddish brown, infused with small patches of green on the dorsal side of the head conforming to colour patterns common in southeast Zaire, northeast Zambia and north Malawi (Broadley, 1979). However, the head colour of one of the specimens was green on both top and sides, which accords with Broadley's (2001) latest description of *T. usambaricus*. Another characteristic that conformed with *T. usambaricus* was the presence of black anteriorly directed chevrons (see Figs. 6a, b, and c). For an

overview of the taxonomic history of the genus, readers are referred to Wahlgren (2006).

DISCUSSION

Broadley & Howell (1991) arranged the Tanzanian reptiles according to White's (1983) classification of floristic regions in order to understand biogeographical and macro-ecological relationships of the east African herpetofauna. Interestingly, their analysis of reptile distributions corresponds well with Schiötz's (1976) map of amphibian distributions in eastern Africa.

In order to further test the usefulness of this regional classification I arranged observations herein according to White's regions. Fourteen of the 27 reptile species (52%) and 16 of 21 amphibians (76%) found were associated with the Zanzibar-Inhumbane Regional Mosaic in Kenya and Tanzania (Broadley, [unpublished] calls this biogeographical region the east African coastal mosaic). Of these species, 13 reptiles and 13 amphibians have a primarily south-central African distribution. Two additional reptile species that are also found in the interior of Kenya are primarily southern African; *Pelomedusa subrufa* and *Chamaeleo dilepis*. Hence, the coast reptile fauna differs substantially from that of inland Kenya.

Except for *Dendroaspis angusticeps* and *Thelotornis mossambicanus* / *usambaricus*, none of the reptiles found on the coast seemed to be forest dependent while several amphibians were restricted to forest habitats. Drewes' (Online) research in the coastal forest of Arabuko-Sokoke revealed 25 species of amphibians of which *Mertensophryne micranotis*, *Leptopelis flavomaculatus*, and *Phrynobatrachus ukingensis* are forest species (Howell, 1993). Most of the 21 species of amphibians in the sample herein are affiliated with the moist coastal savanna, but two species are associated with forest; *Hyperolius sylvaticus* and *Phrynobatrachus ukingensis*. Hence, the majority of the species of the coastal ridge herpetofauna herein are associated with humid savanna / woodland rather than forest. The coastal floristic region possibly may not have been a continuous forest habitat. Although forests have been cleared by human activity it is likely that the large number of species of southern African affinities dominated the fauna before humans drastically changed the vegetation cover.

With the exception of the larger coastal forests of Arabuko-Sokoke and Shimba Hills, it is questionable whether the drier coastal Kaya forests contain as many endemic reptile and amphibian species. Although my investigations of the Kaya forests do not warrant any definitive conclusions I confirm that the only species restricted to the coastal forests that I found was *Thelotornis mossambicanus* / *usambaricus*.

While forest habitats must be conserved to preserve biodiversity, the varied environment of the cultivated landscape can provide a rich environment for herpetofauna. Rice fields, permanent ponds, gardens, houses and refuse heaps all provide a variety of habitats for frogs and their ophidian predators. Human activities also increase the rodent population and possibly the lizard population which in turn are regular prey items for many snakes.

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NATURAL HISTORY NOTES

NUCRAS TAENIOLATA Smith, 1838 (Striped Sandveld Lizard) (SAURIA, LACERTIDAE): ADDITIONAL RECORDS. On 4 August 2008 an adult female *Nucras taeniolata* was found sheltering under a thin slab of concrete on a disused bridge across a tributary of the Coega River, Amanzi Estate, 25 Km north of Port Elizabeth, Eastern Cape Province, South Africa (33° 42' 04.5" S, 25° 31' 01.9" E; 3325 DA; 83 m asl.). The predominant vegetation type in the region was Sundays Doringveld Thicket which is categorised as Endangered due to extensive clearance and degradation for agricultural developments. The collecting site was extensively shaded by alien vegetation including eucalyptus trees and sedge.

The specimen was deposited in the Port Elizabeth Museum herpetological collection (PEM R17628). It measured 61 + 134 mm (SVL + tail). Typical marking and colour is shown in Fig.1a/b.

Broadley (1972) last revised the *Nucras tessellata* group, recognizing four species (some with races), i.e., *N. taeniolata* (2 races), *N. tessellata* (2 races), and the monotypic *Nucras intertexta* and *Nucras caesicaudata*. Subsequent amendments have raised *Nucras tessellata livida* (Branch & Bauer, 1987) and *Nucras taeniolata ornata* (Jacobsen, 1989) to specific status, and revived *Nucras holubi* from the synonymy of the latter (Jacobsen, 1989). *N. taeniolata*, now monotypic, was separated by over 250 Km from the northern *N. t. ornata* and has the most restricted range of any Sandveld Lizard. It was known to Broadley (1972) from only 18 specimens and two quarter-degree squares (the traditional mapping unit in southern Africa). The majority of specimens (13) available to Broadley (1972) were from Grahamstown, to which he restricted the type locality. They formed part of the Albany Museum collection that was subsequently incorporated into the Port Elizabeth Museum collection.

Subsequent published records include four specimens from the Addo Elephant National Park (AENP) (Branch & Braack, 1987), and two specimens from the Great Fish River Reserve complex and an adjacent commercial farm (Fabricius et al., 2003).

Only a few specimens have been collected in the last 25 years, and this additional material is summarized as follows; PEM R9366 (CDENC 11281), Andries Vosloo Kudu Reserve, Albany District, Eastern Cape Province, South Africa (3326 BB, 33° 07' 00' S, 26° 45' 00' E), 17 Nov. 1983, W. Berrington; PEM R9365 (CDENC 11280), Andries Vosloo Kudu Reserve, Albany District, Eastern Cape Province, South Africa (3326 BA, 33° 08' 00' S, 26° 43' 00' E), 15 Jan. 1980, C. Wels; PEM R10135 (CDNEC 1213), Farm Handsworth, Albany District, Eastern Cape Province, South Africa (3326 AD, 33° 21' 03' S, 26° 20' 50' E), 21 Oct 1973, J. C. Greig; PEM R5070 (CDNEC 10174), Thomas Baines Nature Reserve, Albany District, Eastern Cape Province, South Africa (3326 AD, 33° 23'44' S, 26˚ 28'44' E), 09 March 1990, M. Burger; PEM R5075 (CDNEC 10173), same locality and collector, 2 March 1990; PEM R13767 (CDNEC 11049), Double Drift Game Reserve, Albany District, Eastern Cape Province, South Africa (3226 DD, 32° 57'30' S, 26° 48'25' E), 29 Aug. 1993, M. Burger; PEM R8226 (CDNEC 10648), Groendal Conservation Area, on trail from offices to Blindekloof, Uitenhage District, Eastern Cape

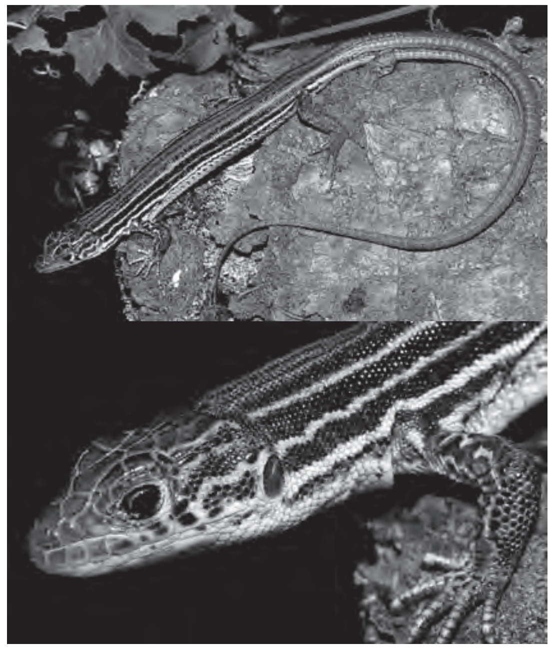

Figure 1 a/b. *Nucras taeniolata*, Amanzi Estate (PEM R17628. Photograph by W. R. Branch)

Province, South Africa (3325 CB, 33° 42'38' S, 25° 18'32' E), 26 Sept. 1992, M. Burger; PEM R3432, 3466, Addo Elephant National Park, Kirkwood District, Eastern Cape Province, South Africa (3325 BC), 2 Oct. 1981, W. R. Branch; PEM R4875-76, Addo Elephant Park, Zuurkop, (3325 BC), W. R. Branch.

The Amanzi specimen, along with the unpublished record from Groendal, extend the known range approximately 100 Km west of the Albany records. They occur 25-30 Km from records from the AENP, and west of the intervening Sunday's River valley. Currently the species is restricted to two populations within the Algoa Bay region of the Eastern Cape Province, South Africa. The typical population, centred around the restricted type locality (Broadley, 1972), occurs in the Albany region (Thomas Baines Nature Reserve, north through Grahamstown to the Great Fish River Reserve complex), whilst the other population (Groendal to AENP) occurs in the western Algoa Bay hinterland. However, the species is terrestrial and secretive and easily overlooked within the dense mesic succulent thicket from which most records are known. Additional specimens from the intervening area may be discovered with more detailed surveys.

The species remains rare in collections (only 33 specimens are known) and, together with *Bitis albanica*, *Cordylus tasmani*, *Acontias orientalis*, *Scelotes anguineus*, and *Bradypodion taeniabronchum*, is endemic to the Algoa Bay region and forms a minor centre of endemism in the Eastern Cape.

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OREOCRYPTOPHIS PORPHYRACEUS COXI (Thai Bamboo Ratsnake). PATTERN ABNORMALITY. *Oreocryptophis porphyraceus* (= *Elaphe porphyracea*) is a snake species characterized by a highly variable colour pattern which plays a key role in its sub-specific taxonomy. There are two subspecies groups differentiated by their distinctly different pattern. The *O. porphyraceus*-group has dark stripes restricted to the posterior part of the body, or alternatively stripes are completely absent, while the *O. nigrofasciatus*-group has stripes covering the entire body (Schulz & Helfenberger, 1998). The subspecies *Oreocryptophis porphyraceus coxi,* which is assigned to the *O. nigrofasciatus*-group, is diagnosed by the possession of stripes which are up to 2 dorsals wide. These stripes may be accompanied by 1 or 2 dark blotches on the anterior part of the body.

On 5 August 2006, a juvenile female with aberrant pattern hatched from a clutch of 4 eggs laid by a *O. p. coxi* F2 captive-bred female (origin: Thailand, Loei province) after incubation on wet vermiculite at 27-28ºC. This juvenile had no dark blotches and stripes were absent on the anterior third of the body. Although two dark dorsolateral stripes were slightly visible on the middle part of the body, they were normally developed on the posterior part of the body and on the tail. The head pattern was normal, with two dorsolateral stripes abruptly terminating in the neck region. Normally coloured female specimens hatched from two other eggs of the same clutch while the remaining egg contained a normally-patterned dead prodichotomic (two-headed) embryo. The specimen with the aberrant pattern is still being kept alive and after 18 months its colouration has become less contrasted, although the pattern itself has not undergone any change.

Stripes are common in snakes´ colour pattern, and they are believed to be related to the avoidance of predators (Shine, 1991). The striped pattern and uniform colouration create the illusion of immobility when the snake is moving forward (Bittner, 2003). Compared to the uniformly coloured snake, this illusion may be enhanced in a striped snake as its body looks narrower. Stripes also function disruptively making the pattern more cryptic (Jackson et al., 1976). This could confer a selective advantage in comparison to conspicuous uniformly coloured *O. p. coxi* specimens and could explain why no wild specimens with reduced pattern have been found so far. The pattern reduction observed in the juvenile may be caused by inbreeding under human care, although the taxon has not been subjected to multi-generational selective breeding. Another possible explanation is epigenetic, where the pattern may represent an example of phenotypic plasticity influenced by artificial incubation.

Figure 1. The freshly hatched *Oreocryptophis porphyraceus coxi* showing the pattern reduction on the anterior part of the body.

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NOROPS SAGREI (Brown Anole) PATHOLOGY AND ENDOPARASITE. An introduced population of the Brown Anole, *Norops sagrei* (= *Anolis sagrei*), was discovered July 2000 in Taiwan (Norval et al., 2002). To date, the only reported pathologies from this population were two cases of hepatic granulomas (Norval et al., 2005) and an abnormal testis (Norval et al., 2006). Here we report the presence of a gular cyst and a nymph of the pentastome *Kiricephalus pattoni.*

On 17 June, 2007, an adult *N. sagrei* male (SVL – 58 mm. TL – 120 mm, 5.2 g) was collected by hand at night, from a Betelnut Palm (*Areca catechu*) plantation in Santzepu, Sheishan District, Chia-yi County (23º 25’ 43’ N, 120º 29’ 05’ E; datum: WGS84), as part of a trial to test the feasibility to exterminate this species in Taiwan. After returning from the field, the lizard was examined and found to have a large lump in the right lateral gular region posterior to the ear and a smaller lump anterior to the right hind leg (Fig. 1). The lizard was killed with ether, and dissected by making a mid-ventral incision, to examine the causes of the lumps.

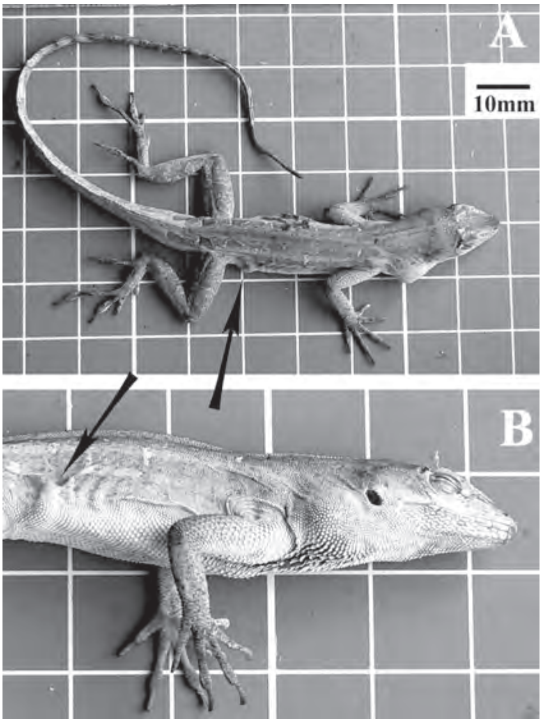

Figure 1. A dorsal and right lateral view of the male *Norops sagrei* prior to dissection. Note the gular lump, and the smaller one near the hind limb (black arrow).

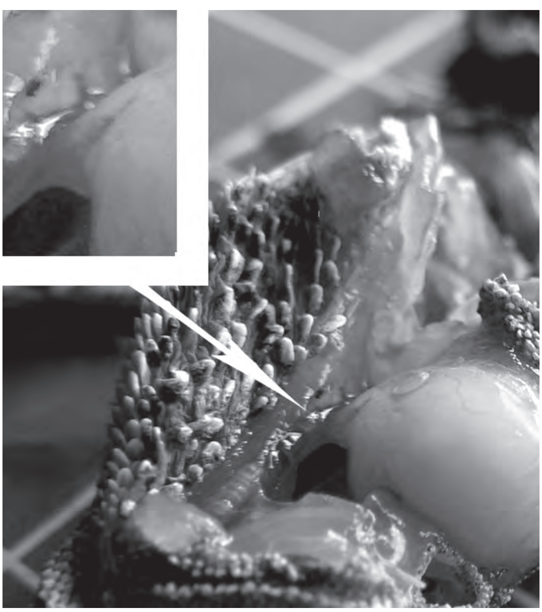

Figure 2. The gular nodule as seen during dissection. Note how the nodule is free from the surrounding tissue, except for where it is attached to the trachea (inset).

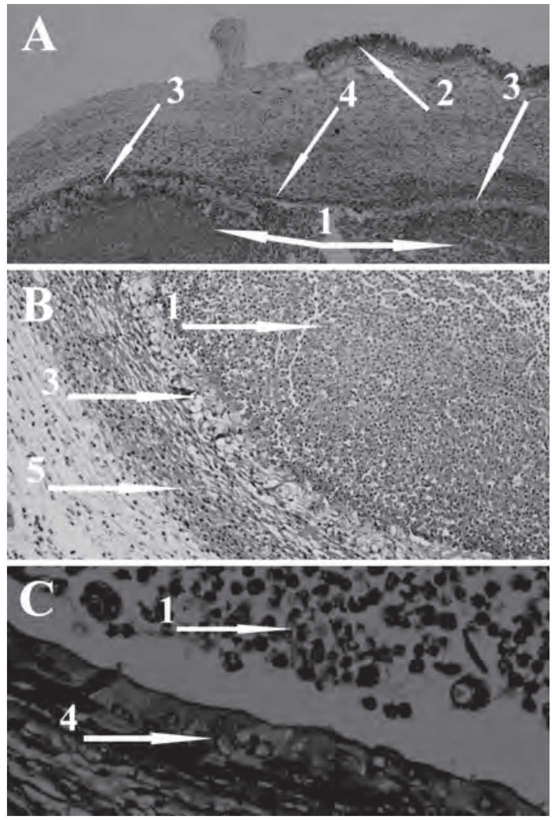

Figure 3. A – a section of the nodule, showing its connection to the trachea; B – a closer view of the nodule, showing the immune response; and C – a closer view of the of the epithelial invagination (1. inclusion of the cyst with central necrotic debris, which is composed of a mixture of necrotic tissue debris and degenerated leukocytes, 2. overlying tracheal respiratory epithelium, 3. collections of macrophages and multinucleated giant cells surrounding the necrotic focus, 4. metaplastic cuboid epithelium that lines the cyst, and 5. the outer fibrotic wall).

The gular lump contained a creamy-yellow nodule (0.2 g), which, apart from being attached to the trachea (Fig. 2), was free from all other surrounding tissue. The smaller lump near the right hind limb contained a parasite, which was identified as a nymph of the pentastome *Kiricephalus pattoni*. In addition to the nodule, the lungs, heart, liver, pancreas, and right testis were also removed, fixed in 10% formalin, and submitted for biopsy. All the submitted tissue samples were embedded in wax, sectioned at 8 μ and stained with Ehrlich's hematoxylin and eosin, and examined under a compound light microscope. The nodule consisted of necrotic tissue and cellular debris, surrounded by chronic inflammatory tissue consisting of pleomorphic histiocytes and invaginated epithelium (Fig. 3). Other tissues presented normal histological patterns. Although the exact cause of the nodule could not be determined, the origin was most likely due to penetration from the interior of the trachea. Because pentastomes utilize airways of the host, the possibility that the nymph may have induced the cyst cannot be excluded. Nymphs of *K. pattoni* have been reported in the lizards *Hemidactylus frenatus* and *Japalura swinhonis* as well as several frogs and snakes (see Bursey & Goldberg, 2004); *N. sagrei* represents a new host record for nymphs of *K. pattoni*. The parasite was deposited in the United States Parasite Collection, USNPC, Beltsville, Maryland as USNPC 100978.

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