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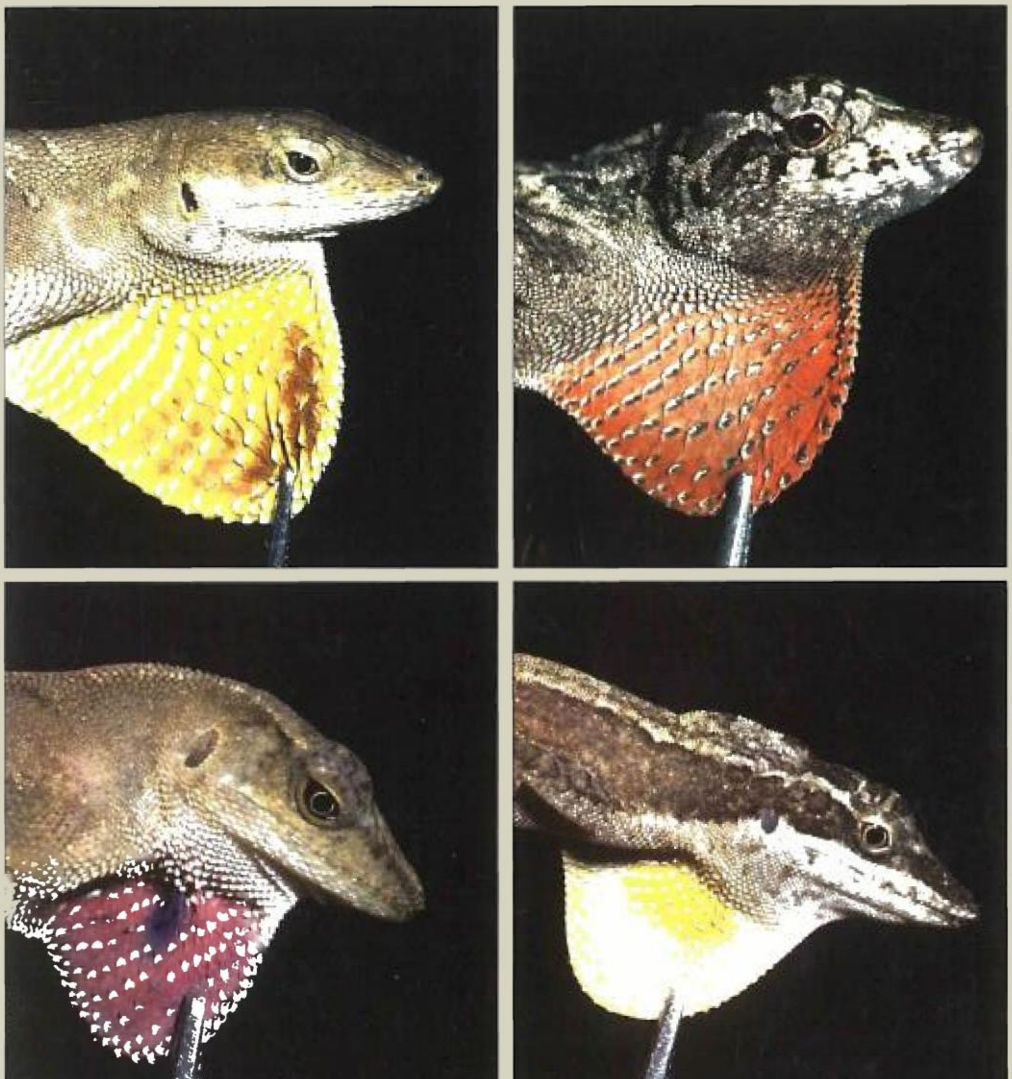

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THE HERPETOLOGICAL BULLETIN

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Front cover illustration. Dewlap patterns of male anoles from Belize. Clockwise from top left: *Norops tropidonotus, N. lemurinus, N. uniformis, N. rodriguezii.* See article on page 10. Photographs © Peter Stafford/The Natural History Museum.

EDITORIAL

Retiring President; Dr Robert Bustard (1997–2005).

Bob (as he prefers to be called) Bustard has had two over-riding interests throughout his life. Live animals – especially reptiles – and conservation of wildlife *and* its habitats. These interests led him to study Zoology where he gained his Ph.D. degree for a study of the ecology of five species of geckos and a skink in northern New South Wales, Australia. This was the first ecological study of a population of geckos in the wild of any duration and was continued for 10 years. The study showed how the numbers of animals in the population were controlled by behavioural means well below the level where food supply would become in short supply. It was the demonstration of this fact that led Bob to realise that manipulation of population parameters would be an invaluable tool in conservation.

Bob joined the BHS, aged 15, when he had some 500 animals in his private 'zoo'. This was also the time when he was responsible for the conservation of the Aldabra giant tortoises – his first schoolboy conservation initiative. He never liked to purchase from pet shops being unhappy about their selling exotics, a view he still holds firmly today. Hence he is a keen supporter of captive breeding, and is also very keen on dissemination of information. As a schoolboy he was a regular contributor to the magazines 'Water Life' (now long deceased) and 'The Aquarist'.

Half way through his Ph.D. he initiated a post-doctoral on sea turtles on the Great Barrier Reef. Quite apart from the scientific output and two books, the best known of which is 'Sea Turtles: Natural History and Conservation' (Collins, 1972), he was able to use his work and close contacts within Governments in Australia in 1968 to have total protection extended to all five species of sea turtles occurring in Australian waters. He informs me that IUCN (The International Union for the Conservation of Nature and Natural Resources) – the scientific arm of WWF (World Wildlife Fund) hailed this achievement as 'by far the most significant legislation in turtle conservation that has yet been enacted anywhere in the world'. He then turned his attention to Australia's two species of crocodiles, *Crocodylus porosus* and the smaller freshwater *C. johnsoni*. These efforts resulted in total protection across the whole of their Australian habitat from Western Australia to Queensland in the east.

Internationally Bob sat on many IUCN specialist groups. He was a founder member of the Marine Turtle Group and also sat on the reptile & amphibian group and the 'umbrella' alert group. He founded the crocodile specialist group and was its Secretary for a number of years.

Probably Bob is best known for the eight years he spent in India working to save the Gharial from almost certain extinction. He got on extremely well at the highest levels with the Government of India as well as the representatives of the states (India having a federal structure). This work was quickly expanded to include the endangered Saltwater crocodile and greatly depleted Indian mugger crocodile, and the initial projects (one for each species) in the state of Orissa rapidly grew to 35 projects spread across 10 states of the Indian Union. Bob also advised other countries in the region including Nepal and Bhutan on Gharial conservation and helped set up the Nepalese Gharial conservation project.

With Bob at the helm, the Government of India decided to set up the Central Crocodile Breeding & Training Institute, located in Hyderabad, which offered nine month training courses in crocodile and wildlife management to appropriate staff from the states. Bob himself supervised 7 PhD scholars, funded by Government with guaranteed ongoing employment thereafter, so that there would be scientifically-trained personnel to replace him when he finally left.

When he left India the 60–70 remaining wild Gharial from his initial India-wide surveys had increased to some 2500. Furthermore the assessment 25 years after the initiation of the project remained extremely favourable.

After 19 years abroad Bob returned to his native Scotland. In 1997 he agreed to be the Presidential candidate for the BHS (the Presidency was then in the gift of Council) because he felt his interests not only bridged the 'gulf' between captive breeding and conservation but that he had contributed extensively over the years to the four main pillars of the Society's interests – captive breeding, conservation, education and research. Asking him about the first of these, he said that the enclosure he designed for what became the world's first captive breeding of the Gharial was soon producing more young Gharial for return to the wild *each year* than the total wild population throughout its entire Indian range at the start of the project.

The Society owes much to Bob for his work and dedication, often behind the scenes, to promote the BHS and its interests, including the conservation of our native herpetofauna. He has always been of the view that Council is over-large and would like to see it reduced to around 12 members including the four person executive and the important regional representation. Asked to comment specifically he said he was a firm believer in democracy 'which is a fragile beast at best' and 'underlined the need for the four main officers of the Society to work closely together to provide the checks and balances without which the Society would no longer be able to operate as it should'. 'The interplay' he said 'between the President and Chairman is critical, each providing a natural check on the other'. In the absence of a Chairman for six and a half of this eight years Bob acted as de facto Chairman as well as President.

He is retiring two years before completion of his second five year term and feels that he can now spend his limited free time more effectively on conservation outside of the Society. Asked about his regrets during his time in office he said that he wishes he had been able to involve the Society more effectively in the conservation of the UK herpetofauna where he believes – from his work on natterjack toads in Dumfriesshire (Bustard, 1998) – that there is an urgent need for a much greater effort and nowhere more so than in his native Scotland.

Finally, Bob has said he remains fully supportive of the BHS, of which he has been an active member for more than half a century, and wishes to continue assisting and promoting the Society in whatever capacity he can.

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ED.

OBITUARIES

MICHAEL R. K. LAMBERT

Michael Lambert was an outstanding friend of the BHS and played a leading role in its affairs over an uninterrupted period of 20 years (1971–1991), firstly as Chair of the Conservation Committee (1971–1977) and then as Chairman of the Society from 1977–1991. Many of those who have been members over the past 20 years will remember him for the wonderful series of evening meetings that Michael arranged and which were held regularly throughout the winter months.

Michael's numerous contacts, combined with his tact and great charm, enabled him to obtain a marvellous – and apparently never-ending – range of speakers year after year. Members travelled great distances to attend these meetings which were held in Burlington House, Piccadilly, in the Linnaean Society Lecture Hall. Michael's Chairmanship of the Society embraced the last four years of Dr J.F.D. Fraser's Presidency of the Society (Dr Fraser was President for 26 years!).

Although he did all the work in arranging and organising the meetings, he vacated the Chair when the President was present and I remember in his twilight years the President dozing off in the great high-backed alligator hide chair while the lecture proceeded. Michael always had someone primed to give an excellent vote of thanks and encouraged the discussion of herpetological matters to continue thereafter in the pub and then at a meal. I was present at a number of these late evening events and recall on one occasion leaving the table – at which 22 of us had sat down to a meal in an excellent Indian restaurant (I had then been in India for six years working on the gharial and India's other crocodilians so thought I knew a good curry) at 2.10 am!

A decade of his Chairmanship coincided with Lord Cranbrook's' Presidency and this included a period when I was an ordinary member of Council. During the winter meeting programme Council meetings were held in a small room at the Linnean Society and preceded by an hour or so the evening lecture. Here again I well remember Michael in the Chair only to vacate it when Lord Cranbrook arrived post haste from the House of Lords.

In the absence of the President, at either general meetings or of Council, Michael took the Chair and here again his perfect manners – for Michael was an English gentleman – and great efficiency were to the fore even at the most difficult times making him a superb Chairman.

Indeed I am sure that Michael will be remembered as the greatest Chairman the Society has ever had both in terms of the energy he threw into the task and the very lengthy period for which he served.

In later years he became very involved with the European Herpetological Society but he never forgot the B.H.S. and was invariably present at our AGM's until his recent illness.

Professionally Michael worked at the Anti-Locust Research Centre in Queen's Gate, which gave him great scope for travel, and more latterly at the Natural Resources Institute, part of the University of Greenwich. I well remember his visit to us at the Zoology Department of the Australian National University in Canberra in the mid-60's. Everyone who came to Australia came to the ANU and Michael's visit predated the founding of the Research School of Biological Sciences by several years.

Like all Englishmen of his period (Angus Bellairs was the epitome of this) he dressed rather formally when in the tropics. On this occasion he wore a very smart safari suit and stood out from the rest of the academic staff. We took him out in the field where his great enthusiasm was constantly to the fore among Australia's wonderful reptilian fauna.

Michael was very interested in tortoises and published some very fine papers on them – notably on *Geochelone sulcata* – in the *Herpetological Journal.*

His great efficiency and generosity of spirit – he was always ready to lend a helping hand – meant that he was a first choice to turn to for advice and information. My last contact with Michael was to seek some information which came through quickly with his usual courtesy.

Michael's last major task on behalf of the Society was to write a detailed historical account of the first fifty years of the Society (1947–1997). This was published in the *Herpetological Journal*, Vol.7 pp 129–141 in our fiftieth year. Like all Michael's work this was a meticulously researched, very detailed, and a generously written account of the Society, its workings, its officers and publications. I am sure it will remain the official record of this fascinating period in the Society's history.

Michael died last year after a lengthy fight against cancer. He will be fondly remembered by his many friends and his ready advice will be greatly missed.

ROBERT BUSTARD

A post-Hurricane Ivan assessment of frog and reptile populations on Grenada, West Indies

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ON 7th September 2004, Hurricane Ivan, a Category 4 storm with winds in excess of 140 mph, made a direct hit on Grenada, the southernmost island in the Lesser Antilles. Over 90% of the homes and buildings on the islands are estimated to have sustained some damage, and many were completely destroyed. Utility poles and power lines were down, and (except for cell phones) the island was effectively isolated from the rest of the world.

With the exception of assessments of *Eleutherodactylus* and *Anolis* populations in post-Hurricane Hugo Puerto Rico (Reagan, 1991; Woolbright, 1991), we know remarkably little about the effects of tropical storms on West Indian frogs and reptiles despite their recurring and often devastating presence in the region. One of us (RWH) has a 15-year history of snake-related fieldwork on Grenada, and CSB initiated work on Grenadian *Eleutherodactylus* in 2003. With data on pre-hurricane numbers of certain species in-hand, we were anxious to observe the effects of the hurricane on our current and previous study sites, and to assess the short-term impact of Hurricane Ivan on the herpetofauna.

Once the 1800-hour curfew was lifted, we made a short visit (10th–17th November 2004) to Grenada. The island is 310 km^2 in area (approximately 19 km east to west by 34 km north to south) and we drove more than 400 km visiting sites where we had previously worked. We tried to visit sites more than once, and by day and night. RWH last visited Grenada in June 2004, and CSB (with RWH) was last on the island in February 2004. We did not try to account for every species, as some were very rare prior to the hurricane (e.g., *Clelia clelia*), and others, because of their microhabitat, we assumed weathered the storm with relatively little difficulty (i.e., the litter dwelling lizards *Bachia heteropus* and *Gymnophthlamus underwoodi*, and the fossorial snake *Typhlops tasymicris*).

Sites visited

St. George: St. George's: Grounds of the Rex Grenadian Hotel on the Pointe Saline Peninsula (3 m): Although the hotel sustained considerable damage, the largely treeless grounds were relatively clear of hurricane debris when we arrived.

St. George: Mt. Hartman Estate (5 m): This site is described in some detail in Henderson (2002) and Henderson *et al.* (1998). Although we did not visit the site in November 2004, while assessing the post-hurricane status of the Grenada Dove, Bonnie Rusk did encounter *Corallus grenadensis*.

St. George: Westerhall Estate (ca. 60 m): This is the site of RWH's *Corallus grenadensis* project in 1993 (Henderson & Winstel, 1995; Henderson *et al.*, 1998) and subsequent work (Yorks *et al.*, 2003). This site has to some extent been developed since earlier fieldwork. Houses in the area were damaged and much of the site was inaccessible because of treefalls (Fig. 1).

St. David: Mt. William (ca. 400 m; = Mt. Providence?). This site does not appear on a 1958 map, but does appear on a 1985 map [both maps by Directorate of Overseas Surveys]. It should not be confused with the Mt. William that is near the northwest coast [Duquesne Bay] in St. Mark Parish); the forest here was hit extremely hard. Trees were downed or at sharp angles to the ground; many large branches were downed, and many standing trees were stripped of small branches and foliage. As elsewhere across the island, nutmeg trees (*Myristica fragrans*) were hit especially hard, and they had been common at this site. Some cacao (*Theobroma cacao*) remained standing, as did some tree ferns (*Cyathea* sp.).

St. Andrew: Grand Etang National Park (525 m): The forest here was devastated by the hurricane. Trees were snapped off at their trunks or completely uprooted. Others had large branches ripped off, and most trees were stripped of their foliage. What was once a closed-canopy forest with many trees attaining heights of 30 m (Beard, 1949) was now open and sun-drenched (Fig. 2). A data logger recorded temperature and relative humidity at this site during our February and November frog surveys. Despite the absence of canopy, the relative humidity at 0.5 m did not substantially differ between the two months (February: 83-100%; November: 86–100%). Air temperature in November was within the normal range (21.3–26.3°C) for Grand Etang (Henderson, 2002).

St. Andrew: Spring Garden Estate (460 m): A site comprised mainly of orchard trees (citrus, nutmeg, banana, cacao), it, like Grand Etang, sustained tremendous damage during the hurricane. We did not search for treeboas at this site since, as at Grand Etang, they are uncommon and most searches do not produce snakes (see Henderson, 2002).

St. Andrew: Birch Grove (ca. 150 m): A sprawling town on the leeward side of the central range of mountains, this was the only site where we routinely encountered *Leptodactylus validus* prior to Hurricane Ivan.

St. Andrew: Balthazar Estate (75 m): This site was dominated largely by orchard trees (see Henderson, 2002 for a description and photograph). We made a very brief visit on the night of 13th November. Many citrus trees were intact and heavy with fruit, but the trail was blocked by fallen trees.

St. Andrew: Pearls (5 m): This is RWH's current *Corallus grenadensis* study site. Upon our arrival at the site in November, we were unable to drive into the site because of trees and large branches felled by the hurricane (Fig. 3). Following the 520-m transect (established in 2002) was impossible, but we walked from one end to the other, either paralleling it or occasionally finding it among fallen trees and branches. The site had been chosen because it was navigable while searching for snakes, but the hurricane rendered it unworkable and future work will require a chainsaw to at least make a narrow path through the transect. We do not want to dramatically diminish the modifications made by Ivan.

Species assessments

Bufo marinus: We were surprised that we did not encounter this species during our surveys. It was often observed at Pearls in the water-filled ruts of a dirt road or on the abandoned runway of the old airport (which is now used as a thoroughfare for cars, trucks, and cows). Imagining this species being deleteriously impacted by anything is difficult and its absence from our surveys is undoubtedly due to insufficient effort in appropriate situations.

Eleutherodactlyus euphronides: This endemic frog was surveyed at Grand Etang and Mt. William. Although the absolute numbers counted during searches were comparable to those recorded during our February 2004 surveys, the encounter rates at specific transect sites were slightly higher in November. At Grand Etang in February, 27 *E. euphronides* were encountered along two 100-meter transects during 4 hours of timed searches (6.75 frogs/man hour). During November, 16 frogs were counted along these transects during 2 hours (8.0 frogs/man hour).

At Mt. William the encounter rate along a 50-meter transect in February was 2.0 frogs/man-hour. During November this transect yielded 3.0 frogs/man-hour during two 30-minute searches. This elevated encounter rate may be due to the fact that November is the wettest month of the year and February is one of the driest (Henderson, 2002).

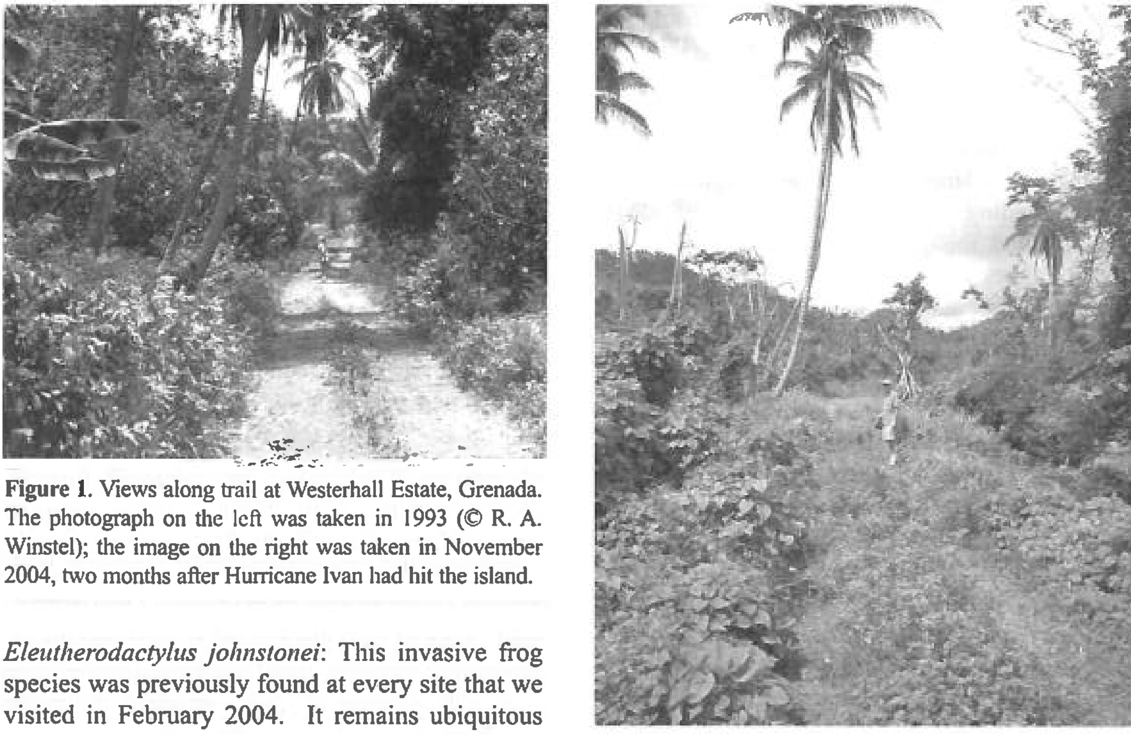

Figure 1. Views along trail at Westerhall Estate, Grenada. The photograph on the left was taken in 1993 (© R. A. Winstel); the image on the right was taken in November 2004, two months after Hurricane Ivan had hit the island.

Eleutherodactylus johnstonei: This invasive frog species was previously found at every site that we visited in February 2004. It remains ubiquitous and numerous juveniles were observed. Similar to its congener, the absolute numbers of this species counted during timed searches were also comparable to those recorded during our February 2004 surveys, and the encounter rates at specific transect sites were slightly higher in November. At Grand Etang in February, 163 *E. johnstonei* were encountered along two 100-meter transects during 4 hours of timed searches (40.8 frogs/man hour). In November, 89 frogs were counted along these transects during 2 hours (44.5 frogs/man hour).

At Mt. William the encounter rate along a 50-meter transect in February was 5.5 frogs/man-hour. During November this transect yielded 19.0 frogs/man-hour during two 30-minute searches. In all likelihood these frogs were more numerous due to the influence of November's increased rainfall.

Leptodactylus validus: We had previously encountered this frog in numbers only in a roadside ditch in Birch Grove (June 2002, February 2003, February 2004) and heard it calling at one site each in St. George's and the Pearls area. Occasional individuals (never more than one) were found elsewhere during surveys conducted in June 2002 (Germano *et al*., 2003). In November, we heard it calling day and night in every parish through which we passed (St. Andrew, St. George, St. David). It occurred in roadside ditches, in grass and water-filled depressions adjacent to pastures, and in the ruts created by vehicle tires on unpaved, muddy, roadways. Barbour (1914) reported this species from the shore of Grand Etang; in November we encountered it there for the first time despite having visited the area dozens of times over a 15-year period.

Hemidactylus mabouia: We encountered this human commensal every night (10th–14th November) at our guesthouse in Dunfermline (near Pearls in St. Andrew Parish).

Thecadactylus rapicauda: We observed this gecko active in the forest at Pearls at night on 10th November.

Anolis aeneus: This polychrotid was observed at every site we visited. At night, *A. aeneus* was often seen sleeping on dead branch and leaf surfaces, and its green coloration made it conspicuous against the brown of dead foliage. It remains ubiquitous and abundant.

Anolis richardii: Like *A. aeneus*, we observed this lizard at every site we visited; it remains ubiquitous and abundant.

Anolis sagrei: Two individuals of his recently introduced anole (Greene *et al.*, 2002) were observed at the Rex Grenadian Resort between 09:50 and 10:20 hrs on 11th November.

Iguana iguana: This large lizard was not observed, but it is infrequently encountered on Grenada. Although occasionally encountered at Pearls and near Levera Pond (St. Patrick Parish), its absence during our November surveys was undoubtedly due to insufficient effort in appropriate habitat rather than to the impact of Hurricane Ivan.

Mabuya sp.: This litter species is infrequently observed on Grenada. We assume that it was not severely impacted by the hurricane.

Ameiva ameiva: Prior to the hurricane, this species occurred in small enclaves in open, drastically altered habitats (e.g., grounds of resorts and guest houses). We found *A. ameiva* to be abundant on the grounds of the Rex Grenadian Resort. Between 09:50 and 10:20 hrs on 11th November, we observed 27 individuals representing all size classes. They were on the broad expanse of lawn, in flowerbeds, and on roads and walkways. We had never seen them in this abundance previously, nor as widely distributed throughout the resort grounds. This may be attributable to the resort being closed to guests because of hurricane damage. Because human activity was depressed, the lizards may have become bolder and expanded their areas of activity.

Corallus grenadensis: The distribution of this species on Grenada has been the focus of research since 1988, and a mark-recapture project was initiated at Pearls in 2002. Seven *C. grenadensis* were encountered at Pearls in 80 minutes (2.6 snakes/man-hour) on 10th November. Six of the snakes were young-of-the-year and one was a yearling. In comparison, in November 2003, treeboas were encountered at rates of 2.0–4.0/man-hour. *Corallus grenadensis* has been encountered at rates exceeding 10.0/man-hour (Henderson, 2002) at Pearls.

Figure 2. A cleared trail at Grand Etang National Park along which *Eleutherodactylus* surveys were conducted. Prior to Hurricane Ivan, this trail was under a closed canopy.

On 12th November at Mt. William, treeboas were seen foraging in the crowns of trees that were on the ground. Others were moving through leafless trees and in low shrubs above a roadcut. A 600-m transect was established along the road (narrow and infrequently used by vehicular traffic). Seven *C. grenadensis* were seen in 65 min (6.4 snakes/man-hour). They included young of the year and large (>1.25 m SVL) adults. On 14th November along the same transect, four treeboas were encountered in 52 min (4.6/man-hour). At this site in June 2004, eight treeboas were observed at the rate of 2.7/man-hour.

A brief search was made at Westerhall Estate on 12th November, and we found one *C. grenadensis* in a 30 min search (1.0/man-hour). One treeboa was seen during a similarly brief visit in June 2004 (0.67/man-hour).

A 20-min search at Balthazar Estate on 13th November failed to yield any treeboas. This site

Figure 3. Trail at the Pearls *Corallus grenadensis* study site. Downed trees and branches made use of this trail impossible.

had not been searched since 2000 when *C. grenadensis* was encountered at the rate of 3.8/man-hour (Henderson, 2002). Our search was inadequate to assess the impact of the hurricane on treeboas at this site.

Mastigodryas bruesi: This colubrid was not encountered. It is not a common species on Grenada, but it was observed at Westerhall (D. Yorks, in litt.) and Morne Delice (St. David Parish; CSB, pers. observ.) in 2003. Its absence during our surveys can be attributable to lack of sufficient effort rather than consequences of the hurricane.

DISCUSSION

The damage wrought on forest habitats by Hurricane Ivan was alarming to see and, undoubtedly, frogs, lizards, and snakes were killed during the hurricane due to high winds, falling trees and branches, and heavy rains. We were gratified, nonetheless, to find species of frogs and reptiles at the respective sites where they were last encountered prior to the hurricane, and in comparable numbers. Certainly the four species identified by Germano *et al.* (2003) as ubiquitous (*E. johnstonei*, *A. aeneus*, *A. richardii*, and *C. grenadensis*) remained so after Ivan.

The most obvious habitat alteration based on our observations was the physical restructuring of substrates for foraging by frogs, lizards, and snakes, and for calling by *Eleutherodactylus*. Structural habitat is critical in resource partitioning by species of *Anolis* and among different size classes of *Corallus grenadensis*. At many sites structural aspects of the habitat were dramatically altered and future fieldwork will examine how various species respond to those alterations.

Despite observing reassuring numbers of certain species, some localized populations of frogs and reptiles probably will be negatively impacted by the severe habitat alteration inflicted by Ivan. Our November visit occurred during the height of the rainy season and it is possible that dry season (December-May) conditions in previously forested (closed canopy) areas may have a deleterious impact on members of the herpetofauna. Conversely, this is not the first hurricane to hit Grenada, and frog and reptile populations on the island have undoubtedly been impacted by tropical storms for millennia and have managed to sustain viable populations. Whether West Indian animals are adapted to withstand the impact of something as unpredictable and intermittent as a hurricane is open to conjecture, but finding animals where they were prior to Hurricane Ivan should not be surprising. In fact, we would have been more surprised had we not found them. But, as noted by Tanner *et al.* (1991), determining the impact of hurricanes on animals in the Caribbean should be a top priority. We will continue to monitor *Eleutherodactylus* and *Corallus* populations in hurricane-altered habitats for the next several years.

ACKNOWLEDGEMENTS

Our fieldwork in November 2004 was funded largely by the Zoological Society of Milwaukee County. Additional funding came from the Windway Foundation and the Milwaukee Public Museum. Fieldwork by RWH in June 2004 was, in part, funded by NSF Grant No. DBI-0242589 to Robert Powell. The Windway Foundation supported RWH's November 2003 work on Grenada; February 2004 fieldwork was funded by the Zoological Society of Milwaukee County and the Windway Foundation.

Alan Joseph, Head of the Forestry Department on Grenada, has, without fail, approved our research goals and provided necessary permits and other documentation in order to facilitate our efforts.

Robert Powell reviewed an earlier version of this paper and made helpful suggestions for its improvement.

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Addendum: We returned to Grenada during 8th–17th February 2005. *Eleutherodactylus euphronides* was encountered in numbers comparable to (Mt. William) or greater than (Grand Etang) what we observed in November 2004. At Pearls, *Corallus grenadensis* was encountered at the rate of 1.03/man-hour (10.28 man-hours of searching). Most snakes observed were juveniles in their first year; one presumed adult was seen from a distance. The study transect was, not surprisingly, more overgrown than in November 2004. We used a chainsaw in order to navigate about 370 m of the original 520 m transect. *Corallus* numbers have been declining at Pearls for several years (before the impact of Hurricane Ivan), and the encounter rate for February was about 50% lower than in November. In addition, adult *C. grenadensis* have become extremely rare at the site. At Mt. William, treeboas were encountered at the rate of 4.1/man-hour (1.03 man-hours of searching). Four out of five snakes observed were in their first year; the fifth snake was a yearling. A large adult (1600 mm SVL) was encountered outside of the 600 m transect. The February fieldwork was funded by the Windway Foundation.

Natural history observations of sympatric *Norops* (Beta *Anolis*) in a subtropical mainland community

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ABSTRACT – During an approximately four week period the natural history of a mainland forest community of *Norops* (Beta *Anolis*) was studied in Belize. Five species were observed to occur sympatrically (*N. uniformis*, *N. lemurinus*, *N. rodriguezii*, *N. tropidonotus* and *N. capito*). These taxa are all traditionally placed in the *A. auratus* series as originally recognized by Etheridge (1960). Until recently the majority of field research concerned with anoles has focused on species in the Caribbean islands, with mainland communities having generally received far less attention. The primary aim of this paper is to help redress this imbalance by describing the morphology, habitat and behaviour of species in a hitherto unstudied mainland community.

ANOLIS is a large clade of Neotropical lizards that is renowned for the tremendous amount of variation displayed by its members in colour, shape, size, ecological affinity and behaviour (e.g. Schoener, 1968; Williams, 1969; Losos, 1994). This diversity typically permits anoline communities to be composed of several often closely related species that successfully co-exist in the same ecosystem, presenting numerous opportunities for behavioural observations of species interactions, geographical comparisons and experimental manipulations. Consequently, communities of *Anolis* are widely utilized by biologists as experimental models to address some of the most complex questions in both ecological and evolutionary biology (Nicholson, 2002).

This genus is widely distributed across the New World tropics and subtropics with species found throughout the Caribbean islands, southeastern United States and mainland Americas from Mexico to South America (Etheridge, 1960). However, scientific research has not been equally divided between these localities. For decades, Caribbean communities have been the focus of numerous in-depth studies investigating an impressive array of concepts ranging from resource partitioning and community structure to phylogenetic relationships and speciation (e.g. Schoener, 1968; Williams, 1983; Losos, 1994; Leal *et al.*, 1998). As a result, an abundance of information is available regarding the morphology, behaviour, habitat and general natural history of island populations. In contrast, the mainland *Anolis* communities have generally received far less attention (but see Stuart, 1956; Fitch, 1975; Pounds, 1988), leaving a multitude of questions unanswered. Recently several papers have been published concentrating on mainland *Anolis* (e.g. Irschick *et al.*, 1997; Mancrini *et al.*, 2003; Nicholson, 2002), comparing findings to those in the Caribbean in order to redress the imbalance. In this paper I follow this example by providing natural history observations of a mainland community of *Anolis* in Belize.

STUDY AREA AND METHODS

Study site

The study was conducted on the Las Cuevas Research Station, which is situated at approximately 500 m elevation (16°44' N, 88°59' W) within the Cayo district of Belize. As part of the Chiquibul Forest Reserve, it lies within a much larger area of protected forest in the region totaling about half a million hectares. Typical rainfall in this deciduous semi-evergreen and deciduous seasonal tropical forest averages around 2,000 mm per year. The vegetation in the immediate vicinity has been classified as 'Broadleaf Class 2, Seasonal forest' (Penn *et al.*, 2004). It is characterised by an approximate canopy height of 20–30 m and much of the older growth trees possess buttresses and stilt roots covered with epiphytes (Stafford & Meyer, 2000). In addition, this vegetation type possesses an abundant palm layer (Penn *et al.*, 2004) and tree ferns are present where edaphic conditions permit (Stafford & Meyer, 2000). A comprehensive species list of the vegetation surrounding the station site is provided by Penn *et al.* (2004).

Norops (Beta *Anolis*)

Several species of *Norops* are known to occur sympatrically in the vicinity of Las Cuevas Research Station. In this study the name *Norops* is used to refer to the clade corresponding to the former beta section of the genus *Anolis* as suggested by Nicholson (2002). This follows the classification advocated by Guyer & Savage (1986; 1992) that also recognizes four additional genera [*Anolis (sensu stricto)*, *Ctenonotus*, *Dactyloa*, and *Xiphosurus*] in place of the former alpha section. It is customary to use the term *Anolis* to refer to either the alpha section only (and use *Norops* for the beta section), or to use *Anolis* for all included species (alpha and beta section) as in the sense of Etheridge (1960) (Nicholson 2002). However it is also important to note that opinion is still divided upon this controversial subject. For example, a recent phylogenetic study carried out by Poe (2004) suggests that this genus is in fact monophyletic and does not warrant division into several genera.

Field observations

Fieldwork was carried out from the 22nd May to the 12th June 2004, at the beginning of the summer rainy season. Random searches were carried out throughout the day and evening, but individuals were only seen during the day. Most lizards were caught by hand or net whilst basking on leaf litter scattered on the ground near trails, on the stems of vines, on the buttresses of trees or on the trunks of trees. For each species detailed notes regarding habitat and microhabitat conditions were taken and the habitat variables of mean perch height and diameter data were gathered following the guidelines outlined by Losos & Irschick (1996).

Individual lizards were observed from a distance of 5–10 m with intervening vegetation used as a blind in order to quantify aspects of inter- and intraspecific behaviour. Captured specimens were also placed in confinement together with members of their own and other species in order to further analyze the interactions of these lizards. Descriptions of these observations are documented later in this paper.

Table 1. Mean morphological and ecological values for 4 mainland anole species (values for sole *N. capito* specimen are included). Note: figures correspond to mean ± SE (first number), range (second number), and sample size (third number). Perch height and diameter are the ecological variables and are in millimeters. The remaining variables are morphological and are in millimeters with the exception of body mass and lamellae number.

Species	SVL (mm)	Body Mass (g)	Tail Length (mm)	Forelimb (mm)	Hind-limb (mm)	Lamellae number	Perch height (mm)	Perch diameter (mm)
N. tropidonotus	50.2 – 0.4 (46-56) N = 34	2.1 – 0.04 (2-3) N = 34	95.2 – 1.1 (81-104) N = 32	25.1 – 0.16 (23-27) N = 34	47.4 – 0.4 (42-50) N = 34	24.4 – 0.2 (23-28) N = 34	76.2 – 18.8 (10-440) N = 34	75.3 – 16.9 (18-410) N = 34
N. uniformis	33.5 – 0.5 (30-39) N = 17	1 – 0 (1-1) N = 17	43 – 0.7 (40-51) N = 15	15.3 – 0.5 (11-17) N = 17	28.6 – 0.5 (25-32) N = 17	26 – 0.5 (23-30) N = 17	295.9 – 50.9 (30-720) N = 17	275.6 – 23.6 (20-425) N = 17
N. Lemurinus	63.1 – 0.9 (56-73) N = 18	3.5 – 0.2 (2-6) N = 18	135.9 – 3.0 (103-150) N = 17	28.1 – 0.36 (26-32) N = 18	53.2 – 0.7 (49-60) N = 18	37 – 0.2 (34-38) N = 18	631.9 – 94.4 (40-1270) N = 18	232 – 30.3 (30-370) N = 18
N. rodriguezii	34 – 0.9 (30-37) N = 11	1 – 0 (1-1) N = 11	38.4 – 0.9 (31-41) N = 11	15.7 – 0.3 (15-17) N = 11	26 – 0.4 (25-28) N = 11	34.1 – 0.6 (31-37) N = 11	885.5 – 156.9 (170-1380) N = 11	98.5 – 18.9 (15-230) N = 11
N. capito	87 (na, na, 1)	19 (na, na, 1)	160 (na, na, 1)	38 (na, na, 1)	74 (na, na, 1)	40 (na, na, 1)	3100 (na, na, 1)	300 (na, na, 1)

Norops rodriguezii. All photographs © N. D'Cruze.

Norops capito; adult male.

Norops lemurinus; adult male.

Norops tropidonotus; mating pair.

Norops tropidonotus; adult female.

Norops tropidonotus; the darker colour is a probable response to handling stress.

Morphological data were also gathered for the Belizean mainland anole species for comparison with previous studies. Table 1 provides a list of the species names and sample sizes for individuals collected in this study. For each of the species the following six morphological traits were measured: snout-vent length (SVL), body mass, number of lamellae underlying the fourth toe of the hind-foot, and lengths of the forelimb, hind-limb and tail. Length of the forelimb and hind-limb were measured as the distance from the insertion point of the limb to the longest toe of each foot. All morphological traits were measured on living individuals that were subsequently released at the point of capture. All measurements were taken by a single investigator (N. D'Cruze), precluding the need to correct for individual measurement error.

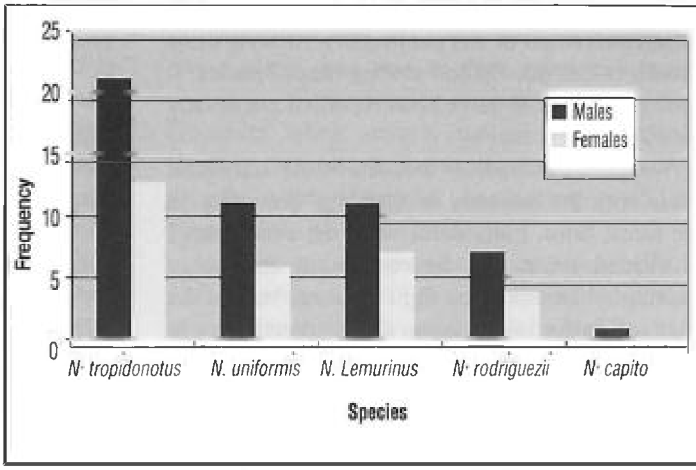

Figure 1. Frequency of captured lizards.

RESULTS AND DISCUSSION

Five species of *Norops* (*N. uniformis*, *N. lemurinus*, *N. rodriguezii*, *N. tropidonotus* and *N. capito*) were observed to occur sympatrically in this community. It is important to note that populations of *N. lemurinus* found in Belize are recognized by some authorities (e.g. Campbell, 1998) as distinct from those in lower Central America and are referred to as *N. bourgaei*. Similarly, *N. uniformis* has been previously recognized as a subspecific race of *N. humilis*.

All species were most active during late morning and early afternoon with few observations before 10:00 and after 18:00 hrs. Table 1 presents a summary of the morphological and habitat data gathered for the total number of lizards sampled (83). Figure 1 shows the frequency of each species encountered. It clearly demonstrates that *N. tropidonotus* was the most abundant and commonly encountered species of anole (or lizard for that matter) and that *N. uniformis* and *N. lemurinus* were also relatively abundant in this community. Despite efforts to increase the sample size of *N. rodriguezii* and *N. capito* these species were least abundant. *N. capito* was particularly rare and only one lone individual was observed. Figure 1 also highlights that males were more commonly observed than females with regards to all five species.

Natural history observations

Natural history observations and descriptions of the five species encountered at Las Cuevas are listed below. More detailed descriptions of these species are provided by Stuart (1955), Taylor (1956), Fitch (1975), Stafford & Meyer (2000), Lee (2000) and Savage (2002).

Norops tropidonotus (Peters)

Diagnosis and habitat: This is a medium-sized lizard readily identified by the presence of deep axillary pockets and enlarged medial dorsal scales that are of almost equal size to those of the venter (Stafford & Meyer, 2000). In addition males possess a relatively large dewlap that is bright yellow in colour with a burnt orange lower edge. The lizards encountered during this study were much smaller than previously described with an average snout vent length of 50 mm; the largest captured specimen possessed a snout-vent length of just 56 mm. Although the average unbroken tail length was around 95 mm, some unbroken tail lengths were recorded to up to 19 mm shorter than previously described. Examination of the fourth toe of the hind foot indicates that these lizards typically possess 24 to 28 sub-digital lamellae. Small pink larvae of trombiculid mites, typically ranging from 5 to 20 in number, were observed in the axillary pockets of all individuals. There is significant evidence of sexual dimorphism in this species as males were typically larger in size and mass than females, which were observed to possess rudimentary dewlaps. Although colour and pattern are known to be highly variable in this species (Lee, 2000) an additional scalloped or 'diamond' dorsal pattern was observed in several females captured in this community. Although this pattern is not uncommon among anole species, it does not appear to have been recorded previously for *N. tropidonotus*.

Norops tropidonotus was the most terrestrial anole with the majority of sightings occurring on the forest floor. Individuals were not encountered in shaded areas, but instead found commonly basking in the sun or on light coloured bark at the edge of paths away from dense vegetation. In accordance with Stafford & Meyer (2000), this species appears to be ecologically replaced by the smaller *N. uniformis* in wetter conditions of the forest surrounding the Las Cuevas Research Station, as only one individual was collected from what could be considered a moist microhabitat. However, both species were caught on trees less than 1 m away from each other, which suggests that the two species do come into contact with each other at least on an occasional basis.

Intraspecific interactions and escape behaviour: Occasionally males were found at higher positions on the lower parts of tree trunks. Here they were observed to engage in territorial and courtship displays, extending their brightly coloured dewlap, bobbing up and down and ferociously chasing any competitors away for distances up to a metre. When placed together with several other males in a container, further vigorous displays towards each other were observed to occur. Whilst in confinement, members of this species were observed in amplexus when left for several minutes. In males the dorsal pattern markings are known to disappear under conditions of stress (Stafford & Meyer, 2000). This behaviour was witnessed several times with threatened individuals on several occasions turning from the typical tan brown to pitch black in colouration.

When pursued, individuals of this species ran for distances less than 3 m and then paused motionless in leaf litter in a superficial situation, relying on cryptic behavior to avoid capture. This behaviour is in contrast to that of certain other terrestrial lizards (e.g. *Ameiva festiva*), which when disturbed continued to move into deeper foliage until safely out of sight. No lizards were seen to 'dive under leaf litter to escape' as described by Lee (2000).

Norops uniformis (Peters)

Diagnosis and habitat: This is a small, stubby bodied species that can also be identified by the presence of deep axillary pockets (Stafford & Meyer, 2000). However, it can be distinguished from *N. tropidonotus* by the scales found on the venter, which are smaller than the enlarged medial dorsal rows (Stafford & Meyer, 2000). Males have a dewlap that is relatively large, bright red in colour with dark scales and a yellow outer edge (Fitch, 1975).

The lizards encountered during this study were slightly smaller than previously described, with an average snout vent length of 33.5 mm. The maximum unbroken tail length was 51 mm, which is around 30 mm shorter than previously described. Sexual size dimorphism is not apparent in this species as males and females were similar in size and mass. Lizards possessed the typical number of 23 to 30 sub-digital lamellae under the fourth toe of the hind foot, as described by Savage (2002), and the larvae of trombiculid mites were found in the axillary pockets of all individuals.

This species has been described as the most terrestrial of all the Central American anoles (Fitch, 1975). However, for the lizards observed at Las Cuevas this was not the case. Although it was always found close to the forest floor, individuals were typically found perched on the buttresses or lower trunks of trees rather than the ground. The average perch height of 295.9 mm observed for this species was higher than that of the more terrestrial *N. tropidonotus* (76.2 mm). All but one individual observed in this study was found perched in wet conditions, with a high majority perched in the shade or on dark coloured bark, supporting claims that it is a thermoconfromer that prefers a warm wet climate (Fitch, 1975; Savage, 2000).

Intraspecific interactions and escape behaviour: Males of this species appeared secretive in comparison to the bolder *N. tropidonotus* and were not observed to engage in any territorial or courtship displays. In addition, when individuals collected in this study were placed together in a container, previously recorded threat displays (Fitch, 1975) were not observed.

When disturbed these anoles were observed to run to the base of a tree and crouch on the opposite side to that of the investigator, or run over root buttresses, pausing under screening vegetation as described by Fitch (1975). Individuals did not move again threatened at close range, relying on cryptic behaviour to avoid detection. When escaping, this species tended to seek refuge on or very close to the ground, rather than ascending to higher elevation in accordance with the observations of Taylor (1956).

Norops lemurinus (Cope)

Diagnosis and habitat: This is a medium-sized lizard that can be readily identified by the absence of axillary pockets and presence of imbricate and strongly keeled midventral scales (Stafford & Meyer, 2000). Males have low nuchal and caudal crests (Savage, 2002) and a large dewlap which ranges in colour from dark maroon with black scales (Fitch, 1975) to reddish to light orange with a deep orange border, typically contrasted with scales of pure white (Stafford & Meyer, 2000).

The lizards encountered during this study were very similar in size to previous descriptions with an average snout vent length of 63 mm. However, one exceptionally large individual had a snout- vent length of 73 mm, a tail length of 150 mm, and weighed a massive 6 grams. The average unbroken tail length was around 136 mm, a good 16 mm longer then previously described. Lizards possessed the typical 31 to 38 lamellae under the fourth toe of the hind foot (Savage, 2002). Sexual size dimorphism was evident in this species with females typically larger than males in size and mass.

In this study this relatively abundant species appeared to be highly arboreal and was most commonly perched openly on tree trunks with an average perch height of 632 mm. However, individuals were observed to make occasional forays to the ground and several individuals were encountered on the forest floor.

Intraspecific interactions and escape behaviour: No intraspecific interactions involving this species were witnessed during this study. This is not surprising because *N. lemurinus* is commonly found alone, and due to their relative scarcity, observed intraspecific encounters are rare. However when several males were confined together they also failed to display and no actual attacks were observed, concurring with the observations of Fitch (1975).

In contrast to previous observations (Fitch, 1975; Savage, 2000) the numerous individuals observed in this study appeared to be highly active. When disturbed they were seen to dash around the tree and stop motionless on the opposite side to that of the investigator. Only then did they rely on their cryptic coloration, remaining motionless until threatened at close range. If disturbed again, this species escaped by fleeing upward along the trunk, often to considerable heights of around 5 m as described by Savage (2002).

Norops rodriguezii (Bocourt)

Diagnosis and habitat: This is a small lizard that also lacks axillary pockets. It can be distinguished from *N. lemurinus* by the presence of subconical to smooth or weakly keeled midventral scales (Stafford & Meyer, 2000). Males have a relatively large dewlap that is pastel yellowish orange in colour with a burnt orange central spot (Stafford & Meyer, 2000).

The lizards encountered during this study were much smaller than previously described. The average snout vent length of all of the lizards sampled was only 34 mm; the largest specimen caught possessed a snout vent length of just 37 mm. The average unbroken tail length was only around 38 mm which is also a great deal shorter than previously described. Lizards sampled in this study possessed 34 to 37 lamellae under the fourth toe of the hind foot.

This was one of the most arboreal of all the anole species encountered in this habitat with an average perch height of 885.5 mm and was commonly observed perched high on the thinner branches of trees. Some individuals were also encountered in small bushes and the lower parts of trees. The findings of this study conflict with Lee (2000) as it was most abundant in dense vegetation, away from forest edges near paths. It was commonly seen basking in sunlight which indicates that it is not a thermoconformer.

Intraspecific interactions and escape behaviour: This species was commonly found alone and because of their scarcity, no intra-specific encounters were witnessed during this study. In addition no territorial or courtship displays were observed in confinement.

When disturbed these anoles were observed to attempt escape by fleeing upward along the trunks of trees, often to considerable heights in a very similar manner to the other arboreal species *N. lemurinus*. Only when safely out of reach did they pause motionless and rely on their cryptic colouration.

Norops capito (Peters)

Diagnosis and habitat: This is a large anole that is unlikely to be confused with any other allied form because of its extremely short head (Savage, 2002). It was both the largest and the rarest anole observed in this habitat as only one specimen was sighted and caught. This individual had a snout-vent length of 87 mm, a tail length of 160 mm and possessed 40 sub-digital lamellae. The dorsum of this species is typically tan to olive-brown in Belize (Stafford & Meyer, 2000). However the individual caught in this study was very green in colouration, noticeably more so than previous descriptions.

Intraspecific interactions and escape behaviour: As a result of its scarcity, no intraspecific encounters were witnessed. Previous studies indicate that this species tends to segregate on different tree trunks, maintaining exclusive territories with surface areas of about 145 m^2 (Fitch, 1975). This territorial behaviour goes some way in explaining the scarcity of this species. When released the individual attempted to escape by fleeing up the trunk of a large tree to a height of around 10 metres.

Interspecific interactions

A previous study carried out by Fitch (1975) is very informative regarding the interspecific interactions of the lizards described in this study. In this study a community composed of 17 anole species in Costa Rica at Finca Le Selva was observed and revealed that *Norops uniformis* alone was associated with 11 other species. Interspecific interactions of the five anole species found in this community from Belize are discussed below and are compared to the findings of Fitch (1975).

N. uniformis* and *N. rodriguezii

Fitch (1975) speculated that interactions must be most frequent between the small abundant species. He claimed that since *Norops uniformis* and *N. rodriguezii* were abundant in the same habitat, interactions between them must have been frequent and important to both. However, observations made in this study indicate that although the two species are very similar in size they probably do not come into direct contact with each other very often, and therefore interactions between the two are limited. Firstly, the two species differ greatly in habitat. *Norops uniformis* is a predominantly terrestrial anole that was not seen to venture above 720 mm, whereas *N. rodriguezii* is a predominantly arboreal species with an average perch height of 885.5 mm. Secondly, the two species differ greatly in climactic preferences. *Norops uniformis* was typically found in wet and shaded vegetation, whereas *N. rodriguezii* was found in drier, more open vegetation.

N. uniformis* and *N. tropidonotus

Fitch (1975) suggested that when *Norops* of similar size occur together the competition of the more abundant terrestrial species might exert selective pressure for arboreality on the other. This observation is of particular relevance because in this complex system it seems that the larger and more abundant terrestrial *N. tropidonotus* has – and possibly still is – exerting dominance over the rarer *N. uniformis*, forcing it into a more arboreal niche. *Norops uniformis* has been described as 'the most terrestrial of all the Central American anoles' (Fitch, 1975) and was typically found on the buttresses of trees with an average perch height of 296 mm. However, it was *N. tropidonotus* that was found to dominate the forest floor with an average perch height of just 76 mm. Interactions between the two species are limited by the fact that the two species differ in microhabitat and climactic preferences. *Norops uniformis* was sighted in much wetter and denser vegetation than *N. tropidonotus*, which was typically perched in drier and more open vegetation.

N. uniformis* and *N. lemurinus

Interspecific interactions involving *Norops uniformis* and *N. lemurinus* were speculated by Fitch (1975) as individuals from both species were found in the same habitat, sometimes on the same tree trunks. However, in this Belizean community interactions between the two species are limited by the fact that *N. lemurinus* is a predominantly aboreal lizard whereas *N. uniformis* is a predominantly terrestrial anole. It is important to note that *N. uniformis* is typically only about / of the mass of *N. lemurinus*. Therefore as Fitch (1975) suggested *N. lemurinus* is large enough to be a potential predator of young *N. uniformis*.

N. lemurinus* and *N. rodriguezii

In this study these two species were observed to be highly arboreal and are likely to come into contact with each other frequently. As Fitch (1975) commented the two species differ greatly in size which is reflected in the results of this study and means that *Norops lemurinus* is a potential predator of the smaller *N. rodriguezii*. However interactions between the two species are limited by their differences in microhabitat preferences. *Norops lemurinus* was sighted on tree trunks where as *N. rodriguezii* was typically perched on branches and twigs.

N. capito

Fitch (1975) claimed that *Norops lemurinus* was more similar to *N. capito* in habitat than any other species. In this study both species were observed on the trunks of large trees in the forest. Fitch (1975) also pointed out that in addition to the similarity in habitat preference, *N. capito* can reach up to three times the bulk of *N. lemurinus* and is a known predator on other smaller lizards. It is not difficult to speculate that, as well as feeding on *N. lemurinus*, this large arboreal species may also prey upon all of the other anole species found in this mainland forest community.

Other Interspecific interactions

Interspecific interactions between *Norops tropidonotus* and *N. lemurinus* and *N. tropidonotus* and *N. rodriguezii* were not discussed by Fitch (1975). They are not likely to occur in this community because *N. tropidonotus* is a predominantly terrestrial species where as the other two are predominantly arboreal in nature.

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Recent observations of reptiles in the Comoro islands (Western Indian Ocean)

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THE Comoro Islands constitute a volcanic archipelago, geologically recent (between 0.13 MY for Grand Comoro and 7.7 MY for Mayotte based on age of the oldest exposed lavas; Emerick & Duncan, 1982) located in the Mozambique Channel, approximately halfway between Madagascar and northern Mozambique (separated by 300 km from both; Fig. 1). As expected for similar insular systems, the reptile fauna is typically impoverished, unbalanced but rich in endemics. Some recently introduced species are also present. The lizard fauna is dominated by gekkonids and scincids but two chameleons, one agamid and one iguanid (= oplurid) are also present, whereas snakes are represented by two typhlopids and three colubrids (Meirte, 1992; Glaw & Vences, 1994; Henkel & Schmidt, 2000; Meirte, 2004). Regardless of all this published information, many doubts persist concerning some taxonomically complex groups or about the autochthonous status of some of the species.

Here we present the results of a three-week herpetological trip to this archipelago carried out in October – November 2003. A total of 61 localities from the four main islands of the archipelago were surveyed (Fig. 1, Table 1). Specimens were collected for morphological identification but just a minor part of them were kept as vouchers in the CIBIO collection (Vairão, Portugal). However, considering the complexity of the systematics and the degree of knowledge of the reptile fauna in this area we confirmed the morphological diagnoses using sequencing data from tissue samples. Details of the analytical methods, GeneBank accession numbers and phylogenetic conclusions are already available elsewhere for the genera *Furcifer* (Rocha *et al.*, in press), *Hemidactylus* (Rocha *et al.*, 2005), *Phelsuma* (Rocha *et al.*, unpubl. data) and *Cryptoblepharus* (Rocha *et al.*, 2004).

Family Agamidae

Agama agama (Linnaeus 1758)
Localities and dates: Grande Comore 21a (18-19/10/2003), 21b (01-02/11/2003).

This large agamid is widespread in Sub-Saharan Africa occupying an impressive range between Senegal, Egypt, Angola and Tanzania. In eastern Africa, it is usually found lower than 1500 m in mesic habitats where rocks and trees are available and it is common in human settlements (Spawls *et al.*, 2001). Specimens collected on Grande Comore displayed the typical external features diagnostic for this species (Branch, 1998, Spawls *et al.*, 2001; Hallermann, pers. comm.) including distinct occipital scale, homogeneous dorsal scales, yellow-orange heads in males and green-speckled heads in females. Subadults and juveniles were greyish and with striped throats (Fig. 3).

About 40 specimens were observed at least eight different sites (21a and between 21a and 21b). Individuals were usually aggregated in colonies which included one or two adult males, several females, subadults and juveniles. All observations corresponded to urban habitats, namely walls, buildings (both inhabited and abandoned), stone piles, gardens and road edges. Most individuals, but especially adults, were observed climbing higher than 2 m. Adult males with brightly coloured heads usually displayed head-bobbing to the observer.

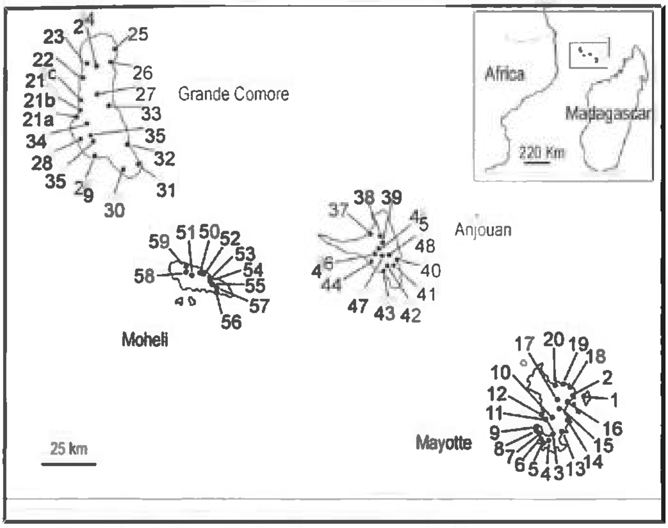
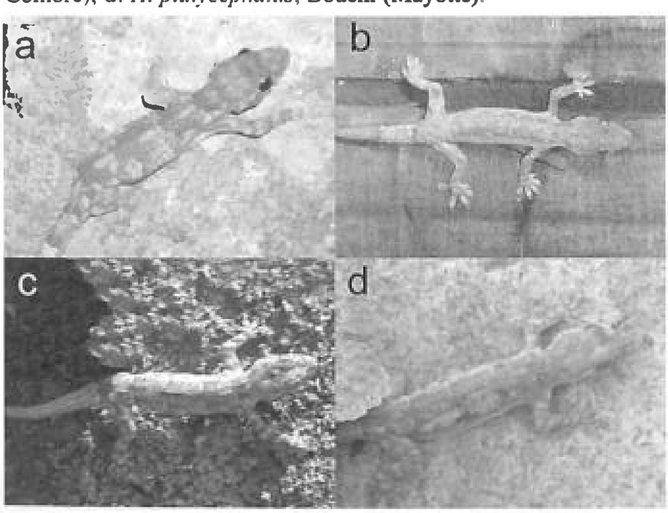


Figure 1. Location of the Comoros archipelago and sampling sites (for numbers see table 1).

We do not know if other similar populations exist in the Comoros but similar search effort expended in the same season in other urban, rural and undisturbed habitats of Grand Comoro as well as on the other big islands of the archipelago produced negative results. The distribution, restricted to a port city with intense trading relationships, traditional and present, with mainland Africa, the lack of previous observations of this conspicuous lizard, the association with urban habitats and the poor distinction with respect to the continental forms support the hypothesis of a recent, human-mediated introduction of this species. Meirte (2004) indicates 1998 as the probable date for this introduction. A previous record from Reunion Island (Glaw, pers. comm. in EMBL, 2005) previously considered questionable, may be re-evaluated in light of this finding. We can only speculate on the possible effects of this introduction: no predation on local lizards is expected since diet is usually comprised chiefly of ants and termites (Spawls *et al*., 2001) and competitive relationships with the ecologically similar *Oplurus cuvieri* are at present negligible since the latter is restricted to some cliffs on the N and NE coasts of the island (Meirte, 1992, 2004) about 25–30 km from Moroni.

Figure 2. *Hemidactylus* species from Comoro Islands. **a**: *H. brooki*, Moutsamoudou (Anjouan); **b**: *H. frenatus*, Bouéni (Mayotte); **c**: *H. mercatorius*, Moroni (Grande Comore); **d**: *H. platycephalus*, Bouéni (Mayotte).



Family Chamaeleonidae

The two Comorean chameleons, endemic to Grande Comore and Mayotte, respectively, belong to the genus *Furcifer*. They are, however, not closely related but derived from two independent colonisation events from Madagascar (Rocha *et al*., in press).

Furcifer cephalolepis (Günther 1880)
Localities and dates: Grande Comore 24 (19/10/2003), 35 (31/10/2003).

This species, endemic to Grande Comore, was observed in the two nuclei of mountain in the island forest (La Grille and Karthala), far from human settlements.

Furcifer polleni (Peters 1874)
Localities and dates: Mayotte 12 (17/10/2003), 14 (17/10/2003), 17 (03/11/2003), 18 (04/11/2003), 20 (04/112003); Mayotte (Petit Terre) 1 (18/10/2003).

This chameleon is endemic to Mayotte where it occurs on both the main island and Petit Terre. It has also been reported as an

Figure 3. Subadult *Agama agama* from Moroni (Grande Comore). In the upper right corner, detail of throat.

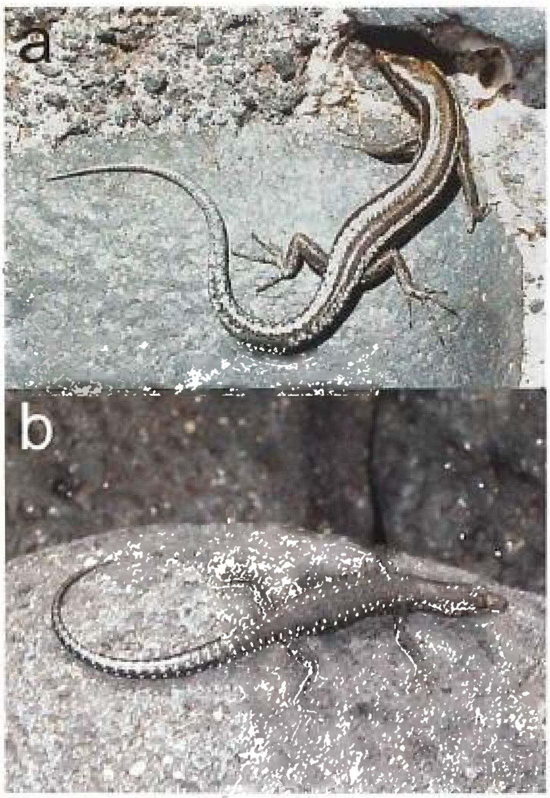


Figure 5. Two of the Comorean forms of *Cryptoblepharus boutoni*. **a**: *C. b. mohelicus* Djoyézi, Moheli; **b**: *C. b. ater* north of Moroni, Grande Comore.

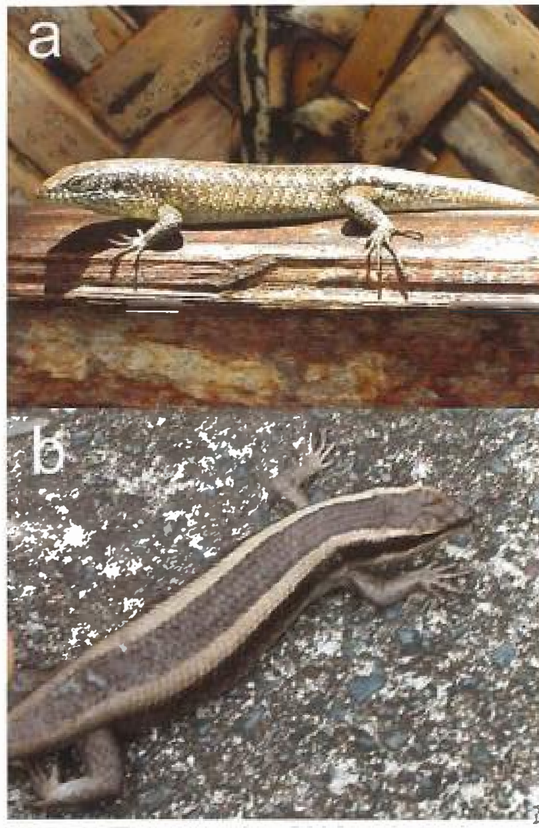


Figure 4. The two species of *Mabuya* in the Comoros. **a**: *M. maculilabris*, Fomboni, Moheli; **b**: *M. striata*, Haiko, Anjouan.

Figure 6. *Typhlops comorensis.* Boboni, Grande Comore.

introduced species in Anjouan (Mierte, 2004). In contrast with its congener, observations were made not only in pristine forest but also in disturbed habitats such as plantations, agricultural plots and urban gardens. In one case (locality 14), an adult male and female were found near a stream.

Family Gekkonidae

Geckos constitute the bulk of the reptile diversity of the Comores with both introduced and endemic species.

Ebenavia inunguis Boettger 1878

Localities and dates: Grande Comore 35 (27/10/2003).

This species is found on all four islands as well as in Madagascar and the Mascarenes (Henkel & Schmidt, 2000). Our only observation was made in an area of montane forest on Mount Karthala. The specimen was found on a *Pandanus* plant.

Geckolepis maculata Peters 1880

Localities and dates: Grande Comore 29 (27/10/2003).

This species, recognisable by the large semicircular scales that are easily shed when touched, is found in Madagarscar and in the Comoros (Glaw & Vences, 1994). One individual was observed climbing the base of a big tree in an area of humid forest.

Genus *Hemidactylus*

These nocturnal or crepuscular geckos are abundant throughout the archipelago where they can be sighted on any kind of vertical surface, either natural or artificial. Although just two species, *H. frenatus* and *H. mabouia* are reported by Meirte (2004), in fact, recent studies involving morphometrics and molecular analysis (Vences *et al.*, 2004, Rocha *et al.*, 2005) indicate that four species are present (Fig. 2). The biogeographic relationships between the different populations of these species are obscured by their proven abilities for natural overseas dispersal as well as the association with humans involving repeated introductions (Vences *et al.*, 2004, Rocha *et al.*, 2005).

Figure 7. Communal clutch of *Hemidactylus platycephalus*, Chiroungoui (Mayotte).

Hemidactylus brookii Gray 1845

Localities and dates: Anjouan 37 (16/10/2004), 40 (27/10/2004).

This species ranges across Central Africa from the Gulf of Guinea to the eastern coast, the Indian Subcontinent and SE Asia, as well as scattered populations in the Caribbean (EMBL, 2005). In the western Indian Ocean, it is only found in the Mascarenes and the Comoros (Vences *et al.*, 2004). Genetic analysis indicated mtDNA haplotypes close to those from Mascarenes and Sri Lanka, together with the low levels of variation suggests recent colonisation (Rocha *et al.*, 2005).

The two observations in this study were from a population found in a urban context and a juvenile in a plantation by the coast. The first one was in syntopy with *H. platycephalus*.

Hemidactylus frenatus Duméril & Bibron 1836

Localities and dates: Mayotte 7 (16/10/2004); Grande Comore 21a (18/10/2004), 25 (19/10/2004); Moheli 50 (26/10/2004).

This species is found worldwide in tropical and subtropical regions in the Pacific, Australia, SE Asia, Indian Peninsula, the eastern Africa coast and in isolated introduced populations in the Caribbean (EMBL, 2005). In the western Indian Ocean, it can be found in the Seychelles, the Mascarenes, Madagascar and the Comoros (Vences *et al.*, 2004). The individuals analysed shared mtDNA haplotypes with Malagasy populations or were closely related ones with them, again pointing to introduction (Rocha *et al.*, 2005).

Observations were made in an isolated building in a coastal forest on Mayotte and urban buildings on Moheli where it was in sympatry, but not in syntopy, with the larger and more strongly tubercular *H. platycephalus*.

No.	Locality	Island	Coordinates	Habitat
1	Dzaouzi, airport road	Mayotte (Petit Terre)	12° 46' 60S; 45° 16' 60E	disperse urban, plantations
2	Mamoutzu	Mayotte	12° 46' 46S, 45° 13' 38E	urban
3	Chirongui	Mayotte	12° 55' 55S, 45° 8' 54E	isolate building, forest
4	road Chirongui-Kani-Kéli	Mayotte	12° 57' 34S, 45° 7' 28E	isolate buildings, forest
5	Kani-Kéli	Mayotte	12° 57' 13S, 45° 6' 12E	isolate building, forest
6	M'zouazia	Mayotte	12° 55' 32S, 45° 6' 4E	forest and plantationms
7	Bouéni (road to)	Mayotte	12° 54' 9S, 45° 4' 34E	coastal forest
8	Bambo Ouest	Mayotte	12° 55' 19S, 45° 5' 14E	beach and palms
9	M'boueanatsa	Mayotte	12° 56' 30S, 45° 5' 59E	beach and palms
10	Ouangani	Mayotte	12° 50' 47S, 45° 8' 10E	buildings, forest
11	Mangajou	Mayotte	12° 50' 30S, 45° 6' 50E	forest
12	Sada	Mayotte	12° 50' 53S, 45° 5' 51E	plantations
13	Bambo Est	Mayotte	12° 55' 34S, 45° 10' 26E	beach and palms
14	Bandrélé	Mayotte	12° 54' 24S, 45° 11' 29E	coastal forest
15	Koualé	Mayotte	12° 47' 43S, 45° 9' 51E	riverine forest, plantations
16	Passamenti	Mayotte	12° 47' 56S, 45° 12' 37E	coastal forest
17	Vahibé	Mayotte	12° 46' 55S, 45° 10' 14E	forest
18	Majikavo	Mayotte	12° 44' 59S, 45° 13' 43E	coastal forest
19	Trévani	Mayotte	12° 43' 51S, 45° 11' 46E	coastal forest
20	Longoni	Mayotte	12° 43' 54S, 45° 9' 40E	coastal forest
21a	Moroni	Grande Comore	11° 42' 15S, 43° 14' 25E	urban
21b	Itzandra	Grande Comore	11° 40' 16S, 43° 15' 17E	urban
21c	Gouni (Sandini)	Grande Comore	11° 39' 13S, 43° 15' 24E	rocky coast
22	N of Moroni airport	Grande Comore	11° 31' 1S, 43° 16' 40E	volcanic scrublands
23	Mouadja	Grande Comore	11° 28' 5S, 43° 17' 13E	plantations
24	Foret de La Grille	Grande Comore	11° 28' 40S, 43° 19' 5E	mountain forest
25	Hantsindzi	Grande Comore	11° 25' 45S, 43° 24' 8E	banana plantations
26	Itzandzéni	Grande Comore	11° 28' 22S, 43° 23' 4E	plantations
27	Itsoundzou	Grande Comore	11° 37' 23S, 43° 20' 24E	grasslands
28	Mouandzaza Ambouani	Grande Comore	11° 46' 16S, 43° 13' 59E	urban, plantations
29	Mbambani	Grande Comore	11° 50' 59S, 43° 19' 52E	forest
30	Ifoundihé Chambouani	Grande Comore	11° 54' 1S, 43° 24' 44E	forest, plantations
31	Foumbouni	Grande Comore	11° 51' 42S, 43° 29' 3E	urban, plantations
32	Bandanadzi	Grande Comore	11° 47' 4S, 43° 26' 40E	plantations
33	Koimbani	Grande Comore	11° 37' 23S, 43° 21' 24E	urban, plantations
34	Mvouni	Grande Comore	11° 42' 58S, 43° 15' 53E	forest, plantations
35	Belvedere	Grande Comore	11° 43' 38S, 43° 16' 29E	isolated building, forest
36	Boboni	Grande Comore	11° 45' 9S, 43° 16' 49E	mountain forest
37	Moutsamoudou	Anjouan	12° 9' 46S, 44° 23' 47E	urban
38	Bazimini	Anjouan	12° 10' 45S, 44° 26' 56E	plantations, m. forest
39	Chandra	Anjouan	12° 11' 42S, 44° 27' 53E	riverine forest
40	Mboúeladoungou	Anjouan	12° 16' 28S, 44° 31' 35E	beach, plantations
41	Adda-Douéni	Anjouan	12° 17' 33S,44° 29' 50E	urban, plantations
42	Foret de Moya	Anjouan	12° 18' 24S, 44° 27' 42E	forest
43	Moya	Anjouan	12° 18' 24S,44° 26' 16E	rocky coast, plantations
44	Pomoni	Anjouan	12° 16' 48S, 44° 24' 32E	urban, plantations
45	Dindi	Anjouan	12° 12' 36S, 44° 27' 9E	plantations
46	Mchakojou	Anjouan	12° 13' 45S, 44° 26' 6E	plantations, m. forest
47	Haiko	Anjouan	12° 14' 32S, 44° 25' 11E	grasslands, plantations
48	Koni-Djodjo	Anjouan	12° 13' 47S, 44° 28' 54E	urban, plantations
49	Houngouni	Anjouan	12° 12' 57S, 44° 29' 13E	scrublands, plantations
50	Fomboni	Moheli	12° 16' 48S, 43° 44' 33E	urban
51	Badjo	Moheli	12° 17' 31S, 43° 41' 52E	mountain forest, plantations
52	Fomboni "harbour"	Moheli	12° 16' 48S, 43° 44' 41E	rocky coast
53	Djoyézi	Moheli	12° 17' 51S, 43° 46' 24E	rocky coast
54	Gnombéni	Moheli	12° 18' 2S, 43° 46' 41E	platations
55	Ouhoni	Moheli	12° 19' 11S, 43° 47' 39E	forest
56	Sambia	Moheli	12° 22' 1S, 43° 47' 46E	coastal forest, beach
57	Ouanani	Moheli	12° 20' 15S, 43° 47' 51E	palms
58	Mbouerani	Moheli	12° 16' 46S, 43° 41' 3E	mountain forest
59	Mbatsé	Moheli	12° 15' 34S, 43° 41' 52E	plantations

Table 1. Samplings sites in the Comoro islands.

Hemidactylus mercatorius Gray 1842
Localities and dates: Mayotte 2 (15/10/2004), 7 (16/10/2004), 12 (17/10/2004), 13 (17/10/2004), 3 (18/10/2004); Mayotte (Petit Terre) 1 (18/10/2004); Grande Comore 21a (10/18/2004).
This gecko ranges across the eastern African coast, Seychelles, Mascarenes, Madagascar and the Comoros. The relationships of this taxon with *H. mabouia* (Moreau de Jonnès, 1818), distributed through sub-Saharan Africa, South America and the Caribbean, are complex (Vences *et al.*, 2004, Rocha *et al.*, 2005) and further genetic research is needed to clarify the status of both forms. This is also true for the Comoro Islands, since available mtDNA analysis indicates high genetic diversity in Mayotte where most samples are clearly related to N Madagascar but also to the Gulf of Guinea (theoretically, *H. mabouia*). However, one sample from Mayotte (locality 2) and the one from Grande Comore belong to a Central Madagascar clade (Rocha *et al.*, 2005), indicating that occasional introductions from Madagascar may in fact occur.

This species seems to be more abundant in Mayotte than in the rest of the Archipelago. Most observations were associated with urban habitats but also with isolated buildings in more natural habitats. Sympatry with *H. platycephalus* and *H. frenatus* has been detected.

Hemidactylus platycephalus Peters 1854
Localities and dates: Mayotte 3 (16/10/2004), 5 (16/10/2004), 7 (16/10/2004), 8 (16/10/2004), 9 (16/10/2004), 12 (17/10/2004), 18 (04/11/2004); Grande Comore 21a (18/10/2004), 25 (19/10/2004), 27 (19/10/2004), 28 (19/10/2004), 30 (20/10/2004), 31 (20/10/2004), 33 (20/10/2004), 34 (20/10/2004), 36 (31/10/2004); Anjouan 37 (22/10/2004), 44 (23/10/2004); Moheli 50 (26–28/10/2004).

This species ranges across eastern Africa, northern Madagascar and the Comoros, where it is clearly the most abundant member of its genus (Vences *et al.*, 2004; Rocha *et al.*, 2005). Identical mtDNA haplotyes in the samples analysed from all islands indicate the recent arrival of this species in the archipelago (Rocha *et al.*, 2005).

This gecko can be found in buildings and very disturbed habitats but also in well-conserved, humid forests where it usually climbs the trunks of big trees. In the most anthropogenically effected areas, it can be observed in sympatry with any of the other *Hemidactylus*. Communal clutches, assigned to this species through genetic analysis (locality 3, Rocha *et al.*, 2005), were found under stones surrounded by forest (Fig. 7). It can be easily recognised in the field because it is the member of the genus in the Comoros displaying regional integumentary loss (Carretero *et al.*, in press).

Paroedura santijohannis (Günther 1879)
Localities and dates: Mayotte 4 (16/10/2003), 6 (16/10/2003).

This species, restricted to the Comoros, constitutes the only member of its genus occurring out of Madagascar (Glaw & Vences, 1994). The two observations correspond to forest habitats and confirm the presence of the species on this island, previously reported by Vaillant (1887).

Genus *Phelsuma*
This genus of arboreal, diurnal geckos has mainly diversified in Madagascar (21 species, 16 of them endemic, Glaw & Vences, 1994) but some representatives reach different islands of the Indian Ocean including the Mascarenes, the Seychelles, Zanzibar, Pemba, the Andamans and, of course, the Comoros where several endemics are found together with more widespread species (Henkel & Schmidt, 2000, Mierte, 2004). Of the seven members of this genus previously reported, six were detected in this study. A seventh species, *P. nigristriata* endemic to Mayotte, was not detected.

Phelsuma comorensis (Boettger 1913)
Localities and dates: Grande Comore 24 (19/10/2003).

This species, endemic to Grande Comore, can be found in mountane forest habitats of the north of the island (La Grille).

Phelsuma dubia (Boettger 1881)
Localities and dates: Grande Comore 21a

(18/10/2003), 27 (19/10/2003), 28 (20/10/2003), 31 (20/10/2003), 33 (20/10/2003)), 34 (20/10/2003), 35 (31/10/2003); Anjouan 37 (25/10/2003); Moheli 50 (26-28/10/2003), 58 (29/10/2003), 59 (29/10/2003).

This day gecko occurs in Madagascar, the east African coast (Tanzania, Kenya, Mozambique), Zanzibar and the Comoros. Genetic variation within Comoros and between Comoros and Zanzibar is minimal suggesting recent colonisation. probably from Madagascar (Rocha *et al.*, unpubl. data).

This species was observed in urban habitats, banana and palm plantations and even in rain forest clearings. A juvenile was collected in Mayotte (locality 2). It can be found in syntopy with *Phelsuma v-nigra comoraegrandensis* on Grande Comore.

Phelsuma laticauda (Boettger 1880)
Localities and dates: Mayotte 2 (15/10/2003), 3 (16/10/2003), 10 (17/10/2003), 12 (17/10/2003), 16 (03/11/2003), 20 (04/11/2003); Mayotte (Petit Terre) 1 (05/11/2003); Anjouan 37 (22–25/10/2003); 38 (23/10/2003).

This large species is found in northern Madagascar, the Comoros and the Seychelles, and one population has been reported from Hawaii. Null haplotype variation in mtDNA of Comoran samples confirms the introduced status proposed for this species (Rocha *et al.*, unpubl. data).

Many observations correspond to urban habitats but it also occupies plantations and open forest. It has been observed in syntopy with *P. robertmertensi* on Mayotte.

Phelsuma pasteuri (Meier 1984)
Localities and dates: Mayotte 15 (17/10/2003).

Originally described as a subspecies of *Phelsuma v-nigra* this Mayotte endemic is now considered a full species on the basis of morphology (lack of mental "V", Mierte, 2004) and genetics (Rocha *et al.*, unpubl. data). Instead, its phylogenetic affinities are with *P. robertmertensi*. The only locality in which it was found corresponds to a inland area of forest and plantations.

Phelsuma robertmertensi Meier 1980
Localities and dates: Mayotte 6 (16/10/2003), 16 (03/11/2003), 20 (04/11/2003).

Endemic to Mayotte, this species is related to *P. pasteuri* (Rocha *et al.*, unpubl. data). It has been found in forested coastal localities. A blue specimen was observed at locality 20.

Phelsuma v-nigra Boettger 1913
Localities and dates: Grande Comore 21a (18/10/2003), 26 (19/10/2003), 32 (20/10/2003), 33 (20/10/2003), 34 (20/10/2003), 35 (31/10/2003); Anjouan 42 (23/10/2003), 49 (24/10/2003); Moheli 51 (26/10/2003), 54 (27/10/2003), 57 (27/10/2003).

This species, endemic to the Comoros, is divided into three subspecies; *P. v. comoraegrandensis* Meier 1986 on Grande Comore, *P. v. anjouanensis* Meier 1986 on Anjouan and *P. v. v-nigra* Boettger 1913 on Moheli (Mierte, 2004). Our genetic analysis (Rocha *et al.*, unpubl. data) confirms that these three forms are related but not to the form *pasteuri* from Mayote, which corresponds to a different species.

Most *P. v-nigra* were observed in association with forest sometimes opened by plantations. In such cases (for instance in Grande Comore), they can be in sympatry with the more opportunistic *P. dubia*.

Family Scincidae
Amphiglossus johannae (Günther 1880)
Localities and dates: Anjouan 46 (24/10/2003).

This Comorean endemic inhabits all four islands of the archipelago but it was recorded only on Anjouan for this study. Recently, Whiting *et al.* (2004) and Schmitz *et al.* (2005), using several molecular markers, have demonstrated that *Amphiglossus* is paraphyletic and that the morphological features used for diagnostic (number of presacral vertebrae) are not definitive, this name being restricted to one of the species clades but, unfortunately, *A. johannae* has still to be analysed (see also Andreone & Greer, 2002). One individual of this fossorial species was found under a stone in a mountain area, recently deforested.

Cryptoblepharus boutonii (des Jardins 1831)
Localities and dates: Mayotte 2 (01/11/2003); Grande Comore 21a (21/10/2003), 21c (02/11/2003); Anjouan 37 (23–25/10/2003), 43 (25/10/2003); Moheli 52 (27/10/2003), 53 (19–27/10/2003).

The genus *Cryptoblepharus* occupies two separated ranges in the western Indian Ocean and in Australia and Pacific Ocean. Traditionally, only one species, *C. boutonii*, has been recognized with as many as 36 subspecies, most restricted to single island, based on colour pattern and minor scalation differences (Mertens, 1931; Brygoo, 1986). In the Comoros, the forms found are: *C. b. mayottensis* Mertens 1928 (four clear stripes) on Mayotte, *C. b. ater* Boettger 1913 (melanistic, Fig. 5) on Grande Comore, *C. b. degrigjsi* Mertens 1928 (five clear stripes, blue tail) on Anjouan and *C. b. mohelicus* Mertens 1928 (two clear stripes, blue tail, Fig. 5) on Moheli. The systematics of this group are complex and some of the forms may deserve full specific status whereas others may be just ecotypes. The genetic analysis of Comorean specimens together with others from the Indian Ocean (Rocha *et al.*, 2004) indicates relatively low variation supporting present subspecific arrangement. Phylogeographic structuring of the populations with consistent interinsular differentiation suggests natural colonisation and two independent groups: Mayotte and Anjouan, related to NW Madagarcar and Moheli and Grande Comore whose external relations are unknown (Rocha *et al.*, 2004).

These littoral skinks are restricted to the rocky coasts with low, gradual slope where they are found in high densities feeding on invertebrates and small fish in the intertidal zone. This unusual way of life in a lizard, with all the physiological adaptations involved, make them good candidates for natural overwater dispersal.

Mabuya maculilabris (Gray 1845)
Localities and dates: Mayotte 3 (16/10/2003), 5 (16/10/2003), 6 (16/10/2003), 7 (16/10/2003), 10 (17/10/2003), 11 (17/10/2003), 12 (17/10/2003), 13 (17/10/2003), 14 (17/10/2003), 16 (03/11/2003), 18 (04/11/2003), 19 (04/11/2003); Mayotte (Petit Terre) 1(18/10/2003); Grande Comore 21a (18/10/2003), 21b (02/11/2003), 21b (02/11/2003), 22 (19/10/2003), 25 (19/10/2003), 26 (19/10/2003), 28 (20/10/2003), 29 (20/10/2003), 32 (20/10/2003); Anjouan 37 (23/10/2003), 38 (23/10/2003), 39 (23/10/2003), 40 (23/10/2003), 41 (23/10/2003), 42 (23/10/2003), 44 (23/10/2003), 45 (23/10/2003), 46 (24/10/2003), 47 (24/10/2003), 48 (24/10/2003); Moheli. 50 (26-28/10/2003), 51 (26/10/2003), 54 (27/10/2003), 56 (27/10/2003), 57 (27/10/2003), 58 (29/10/2003), 59 (27/10/2003).

Although, the *Mabuya* species of Comores has been often referred as *Mabuya comorensis* (Peters 1854), in fact, this form is genetically identical to *M. maculilabris causarinae* Broadley 1974. from Mozambique using sequence data (Jesus *et al.*, 2005). The problematic *M. maculilabris*, occupying an enormous range across tropical Africa, probably constitutes a species complex (Jesus *et al.*, 2005). If eventually it has to be split in several taxa, *casuarinae* would take precedence over *comorensis* for designating the Comorean form which, however, would not be restricted to this archipelago but is also present in the eastern African coast.

This lizard (Fig. 4) was, without any doubt the most abundant and ubiquitous, in the archipelago. Populations were abundant in urban and heavily degraded habitats but also in plantations alternating with cleared forest. However, they were very scarce in intact forest. Specimens living in more covered, humid sites tended to be smaller, darker and more striped.

Mabuya striata (Peters 1844)
Localities and dates: Anjouan 47 (24/10/2003).

The status of this species, widespread in south and east Africa, has usually been considered doubtful in the Comoros and even erroneous (Mierte, 2004). Two individuals were observed in a severely deforested mountane area where agricultural land and grassland had replaced forest. *Mabuya maculilabris* was also present in strict syntopy. This observation definitively confirms the presence of this species in the archipelago.

Family Typhlopidae

Ramphotyplops braminus (Daudin 1803)

Localities and dates: Mayotte 10 (17/10/2003); Moheli 50 (28/10/2003).

This parthenogenetic, fossorial snake is widely distributed in the tropics and on many islands of Indian and Pacific Oceans as well as the Caribbean. It has recently reported for the Gulf of Guinea (Jesus *et al*., 2003). Both localities in the Comoros are associated with highly modified urban habitats. On Mayotte, two adult specimens were found in a village near a small stream under the same stone. On Moheli, two individuals were found separately in urban gardens.

Typhlops comorensis Boulenger 1889

Localities and dates: Grande Comore 36 (31/10/2003).

The only previous citation of this species corresponds to the description of Boulenger (1889) based on a single specimen from British Museum collection labelled as 'Comoro Island' which has been considered doubtful (Mierte, 2004). This new citation (Fig. 6) confirms the existence of an endemic *Typhlops* in the archipelago. The observation was made at an abandoned human settlement in the mountain forest of Mount Karthala.

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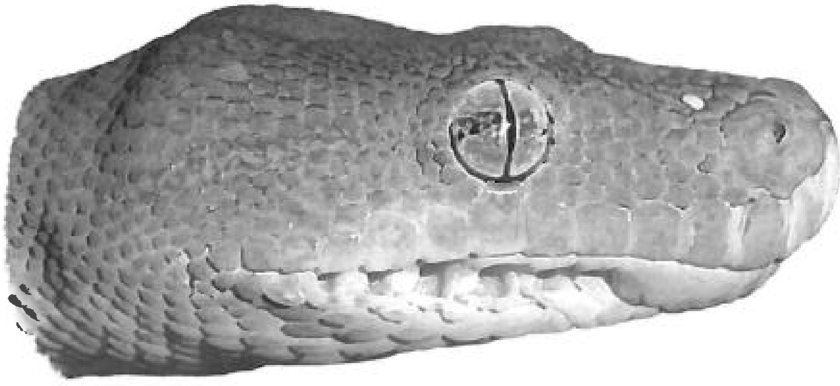

Morelia viridis (Aru Islands). Illustration by Will Brown, produced from original photograph enhanced and manipulated using digitial imaging software. www.//blueridgebiological.com

***LEPTODACTYLUS LABYRINTHICUS* (Pepper frog): REPERTOIRE OF DEFENSIVE BEHAVIOUR.** *Leptodactylus labyrinthicus* is a large sized terrestrial species that occurs in open biomes such as the Brazilian Cerrado and Caatinga (Heyer & Maxon, 1982; Machado *et al.*, 1999). Open habitats may expose frogs to visually oriented predators in a higher intensity when compared to frogs that live in forested habitats, where they may take advantage of a higher spatial heterogeneity (Martins *et al.*, 1993). Therefore, such conspicuous frogs may exploit different defensive tactics to avoid predators or, at least, reduce the risk of predation. Martins (1989) reported that individuals of *L. labyrinthicus* are able to perform a deimatic behaviour (puffing up the body, elevating the hind parts, and displaying aposematic marks on its inguinal region). However, no further information is available regarding to the defensive strategies of this species. Furthermore, the quantification of the frequency of occurrence of defensive behaviours is poorly documented (e.g., Hödl & Gollmann, 1986). Hence, we here describe and quantify unreported defensive strategies exhibited by adult males and females of *L. labyrinthicus*.

Most of the fieldwork was conducted at Itirapina Ecological Station (IES: 22°13'S, 47°54'W; approximately 700 m elevation), Municipality of Itirapina, State of São Paulo, southeastern Brazil, during two consecutive reproductive seasons of *L. labyrinthicus*, from February 2002 to February 2004. The IES is one of the last remnants of pristine Cerrado in the state of São Paulo. One single field expedition (November 2001) was made to an agricultural grassland site (IRC: 22°16'S, 47°42'W; approximately 650 m elevation) in the district of Itapé, Municipality of Rio Claro, State of São Paulo. The climate of both localities is mesothermic, with two well-defined seasons, a dry-cold season (April–August) and a wet-warm season (September–March).

We monitored individuals of *L. labyrinthicus* around flooded areas such as margins of streams and temporary ponds. When locating the individuals we recorded their defensive responses against the researcher approaching and during the subsequently handling. Distress calls were recorded with a Sony TCM 20 DC cassette recorder with a Leson MK2-Plus external microphone positioned at ca. 50 cm from the calling female. The sound analyses were made on a Macintosh computer, using the Canary 1.2.4 software, configured with 16 bits of resolution, 44.1 kHz of frequency sampling, FFT and frame length of 256 samples. The distress calls were recorded at IRC and the quantified data of the defensive strategies was obtained at IES.

Males and females combined exhibited nine different defensive strategies. Three of these were stimulated by human approach and eight by human handling (Figure 1). Motionlessness was the most common strategy in both situations. Body raising (observed as a complex of defensive mechanisms consisting of body lifting from the ground, puffing up the body, and displaying the bright reddish inguinal coloration), distress calls, and spine aggression were males-exclusive strategies at IES (distress call of a female was recorded at IRC); liquid cloacal discharge was female-exclusive. Aside from motionlessness, skin secretion and death feigning (thanatosis) were the most common defensive strategies among males and females during handling episodes, whereas body inflation and escape behaviour were quite scarce (Figure 1).

The distress call was emitted only when the individual frogs were handled. Two distress calls were recorded and analysed. Eight harmonic bands were identified with frequency varying from 0.3 to 9.37 kHz. The mean dominant frequency was 2.503 kHz on the third harmonic band. The call duration was 817.8 and 916.9 ms in both calls recorded (Figure 2).

Motionlessness was the most common performed defensive behaviour (both toward approach and handling) and may imply an avoidance of predator detection: a primary defence (Edmunds, 1974). Females showed themselves to be more skittish than males when approached; it may suggest that the presence of sexual spines on the chest and hands of the males, the only male-exclusive defence observed could be effective against predators (Villa, 1969). Besides the 10 defensive strategies observed, body tilting toward the direction of an external stimulus (e.g.,

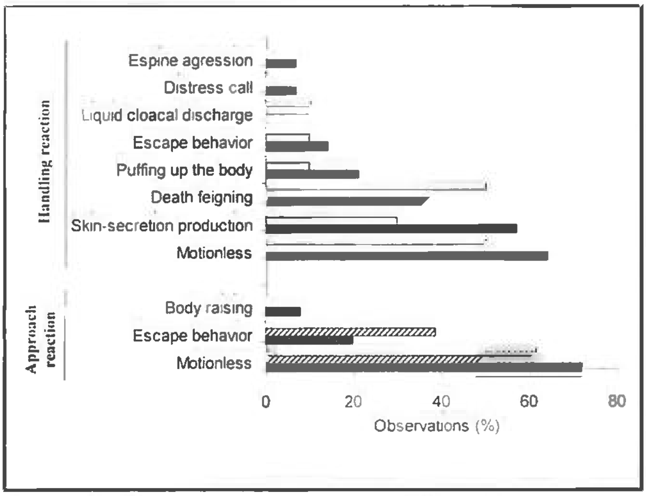

Figure 1. Human approach reaction (striped bars; *N*males = 25; *N*females = 18) and handling reaction (non-striped bars; *N*males = 14; *N*females = 10) of adult males (dark-grey bars) and adult females (white bars) of *Leptodactylus labyrinthicus* at the Itirapina Ecological Station, state of São Paulo, southeastern Brazil.

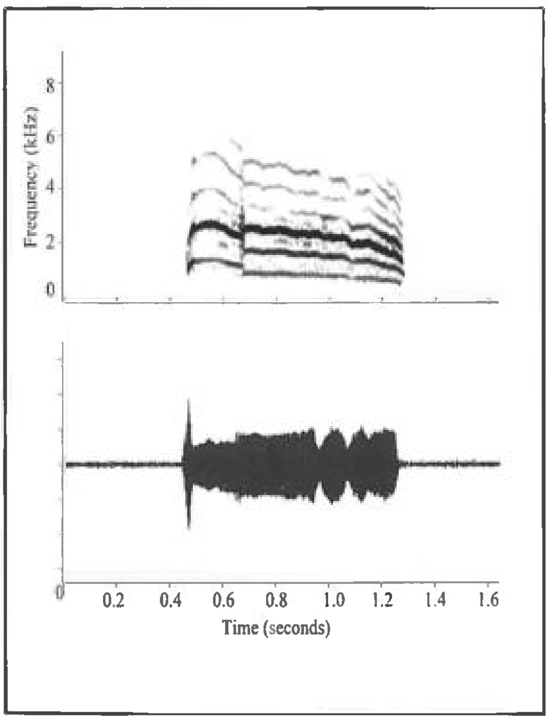

Figure 2. Sonogram (above) and oscilogram (below) of distress call emitted by an adult female *Leptodactylus labyrinthicus* recorded at the Municipality of Rio Claro; Air temperature = 20°C.

presence of predator or touching individuals' dorsum) was also exhibited by adults of *L. labyrinthicus* (C. F. B. Haddad, pers. comm.). It was not observed in the studied populations, probably due to lack of adequate stimuli experimentation.

Despite the large repertoire of defensive behaviours recorded, presence of toxic skin secretions, and large body size, adults of *L. labyrinthicus* are, at least, preyed upon by medium-to-large mammals at the IES (Prado *et al.*, in press). Therefore, the efficiency of any of the defensive strategies against natural predators still needs further investigation.

The complex of defensive repertoire might have originated due to the selective pressure of predation in open habitats, such as that occupied by *L. labyrinthicus* (Heyer & Maxon, 1982). Therefore, if environmental conditions (open or forested habitat) influences on the defensive strategies of the species of *L. pentadactylus* group (*sensu* Heyer, 1969), other species that inhabit forested habitats, such as *L. pentadactylus* and *L. flavopictus*, may exhibit fewer defensive strategies against predators.

Alternatively, defensive behaviours might be phylogenetically rather than ecologically dependent. In this case, individuals of closely related species may exhibit the same range of defensive strategies regardless of their habitat type (open or forested). In agreement with this hypothesis, *L. pentadactylus* was reported to exhibit eight defensive strategies out of the ten exhibited by *L. labyrinthicus* (Villa, 1969). In order to confirm whether or not the defensive behaviours are phylogenetic or ecologically dependent, however, more observations on the *Leptodactylus pentadactylus* species group (Heyer, 1969) are evidently required.

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GONGYLOMORPHUS BOJERII BOJERII **(Bojer's skink): ARBOREALITY.** The *Gongylomorphus*, or slit-eared skink genus, is an endemic of the Mascarene Islands (Vinson & Vinson, 1969) and is currently represented by two described subspecies on Mauritius and its islets. The elusive Macchabée skink (*Gongylomorphus bojerii fontenayi*) is found only on the mainland of Mauritius with sightings confined to the type locality of the Macchabée forest (Jones, 1988). The second subspecies Bojer's skink (*Gongylmorphus bojerii bojerii*) was once widespread throughout Mauritius but is now confined the northern islets of Round Island, Gunners Quoin, Flat Island, Gabriel Island and Serpent Island where it remains common (Figure 1). This species is described as being a generalized lizard with physiological adaptations for burrowing between dense vegetation and leaf litter (Jones, 1993). Previous literature regarding the ecology of *G. b. bojerii* is limited, however all sources describe Bojer's skinks as being strictly terrestrial (Jones, 1993; Vinson & Vinson, 1969 & Vinson, 1975). Hence, here I report observations made during a field study that show *G. b. bojerii* to exploit arboreal habitats.

Whilst conducting other research on Round Island, an adult Bojer's skink was observed (20th May 2004, 09:15 hrs) climbing from the base of a mature fan palm (*Latania loddigesii*) to the crown of the tree, at a height of approximately 3.5 m (Figure 2). The skink remained at the crown of the palm for a period of approximately five minutes, during which it was observed pursuing an unidentified beetle amongst the fronds in the palm's crown. It is unknown whether this pursuit resulted in a successful capture due to the restricted viewing position afforded by being at ground level. Following the skink's reappearance from amongst the palm fronds it was observed to climb back down the trunk of the palm to a position approximately 2 m from ground level. The skink moved around the trunk until it was in a position facing NW and remained still with its body flat to the trunk of the palm and its head towards the ground. This area of the trunk was in full sunlight and was of a noticeably darker colouration than the trunk surface in the region below this height.

Figure 1 (left): *Gongylomorphus bojerii bojerii* in typical basking pose on an area of bare rock, Round Island, Mauritius. **Figure 2** (below): *G. b. bojerii* near to the crown of a mature fan palm (*Latania loddigesii*), on Round Island, Mauritius. Photographs by author.

This single observation encompassed two clear uses of arboreal habitats by Bojer's skinks, not only was the skink observed to attempt to prey upon an insect in the crown of the palm but it was also observed to utilise the thermal properties of the palm's trunk to aid it's thermoregulation. It may also be that the crowns of fan palms may offer protection from predation by larger terrestrial Telfair's skinks (*Leiolopisma telfairii*), a species known to predate on Bojer's skinks from a young age (Pernetta *et al.*, in press). Further work examining the microhabitat use of Bojer's skinks may help to determine the importance of fan palms in the ecology of this species.

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Contents

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EDITORIAL

Erratum

Two of the illustrations on the front cover of the previous issue of *Herpetological Bulletin* were unfortunately printed in the wrong sequence. Viewing in a clockwise direction from top left, the third photograph (i.e., lower right) is of *Norops rodriguezii*, and the final picture is *N. humilis*. *ED*