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THE AMPHIBIANS AND REPTILES OF THE LOWER ONILAHY RIVER VALLEY, A TEMPORARY PROTECTED AREA IN SOUTHWEST MADAGASCAR

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***Abstract.*—We surveyed the Belomotse Forest in southwest Madagascar for amphibians and reptiles. We recorded six amphibian and 55 reptile species by direct sampling and pitfall trapping in the first published survey to focus on this area. Consequently, all of the species found were new records for the area. The most threatened elements of this herpetofauna are the 11 species that appear to be regionally endemic. The 2007 Red List of Threatened Species includes 11 of these species and CITES appendices lists 10 of them. According to the current literature, 8% of the species found at the Belomotse Forest are "gap species" that are previously unknown from the existing system of protected areas in Madagascar. This paper contributes to the current understanding of Malagasy patterns of biodiversity by documenting the composition, geographical, seasonal, and ecological distribution of the herpetofauna in an area within the internationally recognized spiny forest eco-region of south Madagascar. This important regional center of endemism includes several unique habitats such as spiny forest, riparian forest, and non forest wetlands. It is subject to numerous human-induced environmental problems such as habitat destruction, subsistence hunting, and specimen collection for the wildlife trade and warrants high prioritization for conservation. We provide conservation recommendations for this highly diverse site of herpetological importance. We suggest strongly that the area, which is found within the Lower Onilahy River Valley Temporary Protected site, be fully incorporated into the system of protected areas in Madagascar.**

Key Words.—Amphibia; Belomotse Forest; conservation; Lower Onilahy River Valley; Madagascar; Reptilia; Sept Lacs

INTRODUCTION

The Belomotse Forest occurs in the Toliara region of southwest Madagascar along the north bank of the Onilahy River (Fig. 1). It lies between the villages of Antafoky and Ifanato at the western edge of the Mahafaly Plateau, a limestone formation that extends south from Toliara to Cap Sainte Marie. The altitude of this region ranges between 40 and 250 m and has numerous high-standing hills and plateaus interspersed with channels, gullies, and caves. The climate is semi-arid, with an annual average rainfall of around 400 mm. Over 85% of this annual rainfall falls during the wet season, lasting from November to March (Nicoll and Langrand 1989). Average maximum temperatures vary from 26ºC in the dry season to 36ºC in the wet season, occasionally reaching 42ºC with high humidity (Du Puy and Moat 1996). The vegetation is a mosaic of unique habitats, including spiny forest ,which dominates the hillsides and plateaus, riparian forest, and non forest wetlands, which are limited to the valleys (Fig. 2, Plates A-D). Within the region there are a number of villages that are composed of several different tribes. Therefore, as a result of associated anthropogenic activity, the region also contains large areas of agricultural land and disturbed habitat. Importantly, the areas of riparian forest are the only remaining fragments found along the northern bank of the Onilahy River (Raxworthy, C.J. 1995. Field survey of amphibians, reptiles and small mammals from the Toliara region, Madagascar. Unpublished field report, University of Michigan, Michigan, USA).

To protect these habitats from the anthropogenic threats highlighted above and from outside interests (e.g., urban developers), the Department of Eaux et Forets implemented a conservation initiative called Gestion Locale Sécurisée (Secure Local Management [GELOSE]) in the area of the Belomotse Forest known as Sept Lacs in March 2000 (WWF-Madagascar 2002). To implement this plan, the regional division of the National Environment Office (ONE) called Service d'Appui à la Gestion de l'Environnement (SAGE), worked in conjunction with socio-economic advisors from international NGOs such as the World Wildlife Fund (WWF). The principal aim of the GELOSE is to

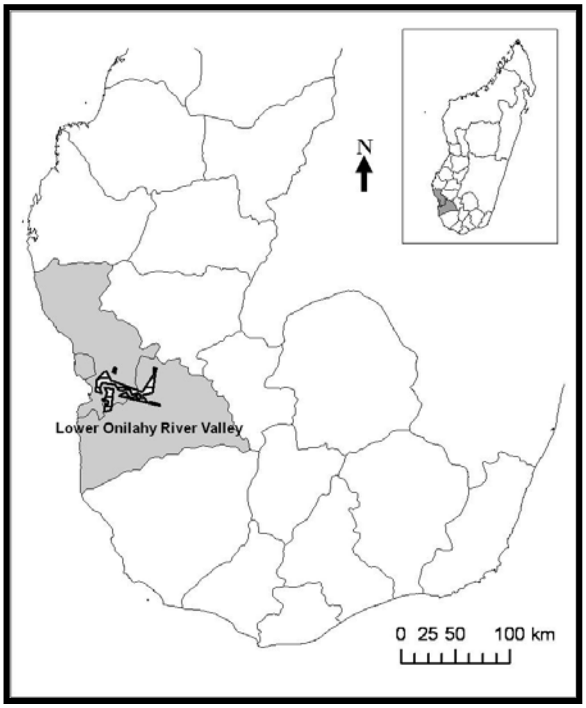

FIGURE 1. Map of Madagascar and the Lower Onilahy River Valley Temporary Protected Area.

provide local community associations called Communautés de Bases (COBA) with the authority to manage and direct the sustainable use of the remaining natural resources (Seddon et al. 2000) at minimal cost to the government and conservation donors (Hockley and Andriamarovololona 2007). Current conservation strategies in Madagascar also include the identification of priority areas for threatened or overall species diversity and their inclusion in protected nature reserves (Ganzhorn et al. 1997; ANGAP 2001). As part of this strategy, in late 2007 the Belomotse Forest received Temporary Protected Area Status as part of a larger Category V community managed Protected Area known as the Lower Onilahy River Valley (Fig. 1).

The amphibians and reptiles of Madagascar are extremely diverse and display a level of endemism surpassed only by that of the Caribbean and Meso-America (Myers et. al. 2000). In Madagascar, the recently designated biogeographical zone known as the "South" (Boumans et al. 2007; in particular the bigeographical zone described as "South-West" by Angel [1942]) has very high levels of floral and faunal diversity and endemism (Nicoll and Langrand 1989; Seddon et al. 2000). Furthermore, in 1997 WWF identified five ecological regions in Madagascar on which to concentrate their present and future efforts. One of these was the spiny forest eco-region of the southwest (WWF 2003). Despite this, until recently the Belomotse Forest and the surrounding area remained excluded from the system of protected areas in this eco-region. We hypothesize that this is chiefly because comparatively few biodiversity surveys from the region exist, and there is very little reliable or comprehensive data (Sussman and Rakotozafy 1994), which is the case for the majority of non protected areas in Madagascar (Andreone et al. 2003; D'Cruze et al. 2006). Although an Earthwatch team undertook brief surveys in the Belomotse Forest during a short visit to the area (Raxworthy 1995. *op. cit.*), their results remain unavailable.

Given the lack of published information on this important site of biological endemism, we conducted a detailed survey of amphibians and reptiles to identify the composition, geographical, ecological, and seasonal distribution of the species found within the Belomotse Forest. Herein, we report these findings, highlight the herpetological importance of this area, identify the current threats to its conservation, review the existing conservation initiatives, and provide recommendations to facilitate the development of a plan for its effective management.

MATERIALS AND METHODS

Study sites.—Our study site encompassed an area of ca. 170 km^2 and ca. 35 km along the north bank of the Onilahy River. Spiny forest (Fig. 2) dominates the calcareous Mahafaly plateau, and a core area contains lakes, marshes and riparian forest. This core area, the Sept Lacs region (23º28'S - 23º31'S, 44º04'E - 44º10'E), covers over 3,000 ha (elevation = 40–250 m; WWF-Madagascar 2002), and occurs between two villages, Antafoky and Ifanato. West of this core area is Antafoky Lake, which includes a large riparian forest (23º28'S, 044º03'E). The lake covers ca. 150 ha and the gallery forest covers 150 ha. We classified the four primary habitat types as "wet" (non forest wetland and riparian) or "dry" (dry deciduous forest and spiny forest) to further aid interpretation of the data collected during this survey.

We surveyed these areas over five 10-week periods from July 2001 to September 2002. A different group of volunteers assisted during each sampling period (an average of 12 volunteers per group). We surveyed 16 sites across a wide range of altitudes and habitats, in all seasons. Field-camp sites were near Antafoky (23º28'S, 44º03'E), Mahaleotse (23º30'S, 44º04'E), and Ifanato (23º31'S, 44º10'E), with research satellite camps at representative altitudes and habitats throughout the area. A second team of researchers and volunteers conducted additional fieldwork from the Ifanato field-camp site (23º31'S, 44º10'E) at the Sept Lacs region site in February 2005 for two weeks.

We used pitfall trap-lines with drift fences (Raxworthy and Nussbaum 1994). Pitfall traps consisted of buckets (275 mm deep, 290 mm top internal diameter, 220 mm

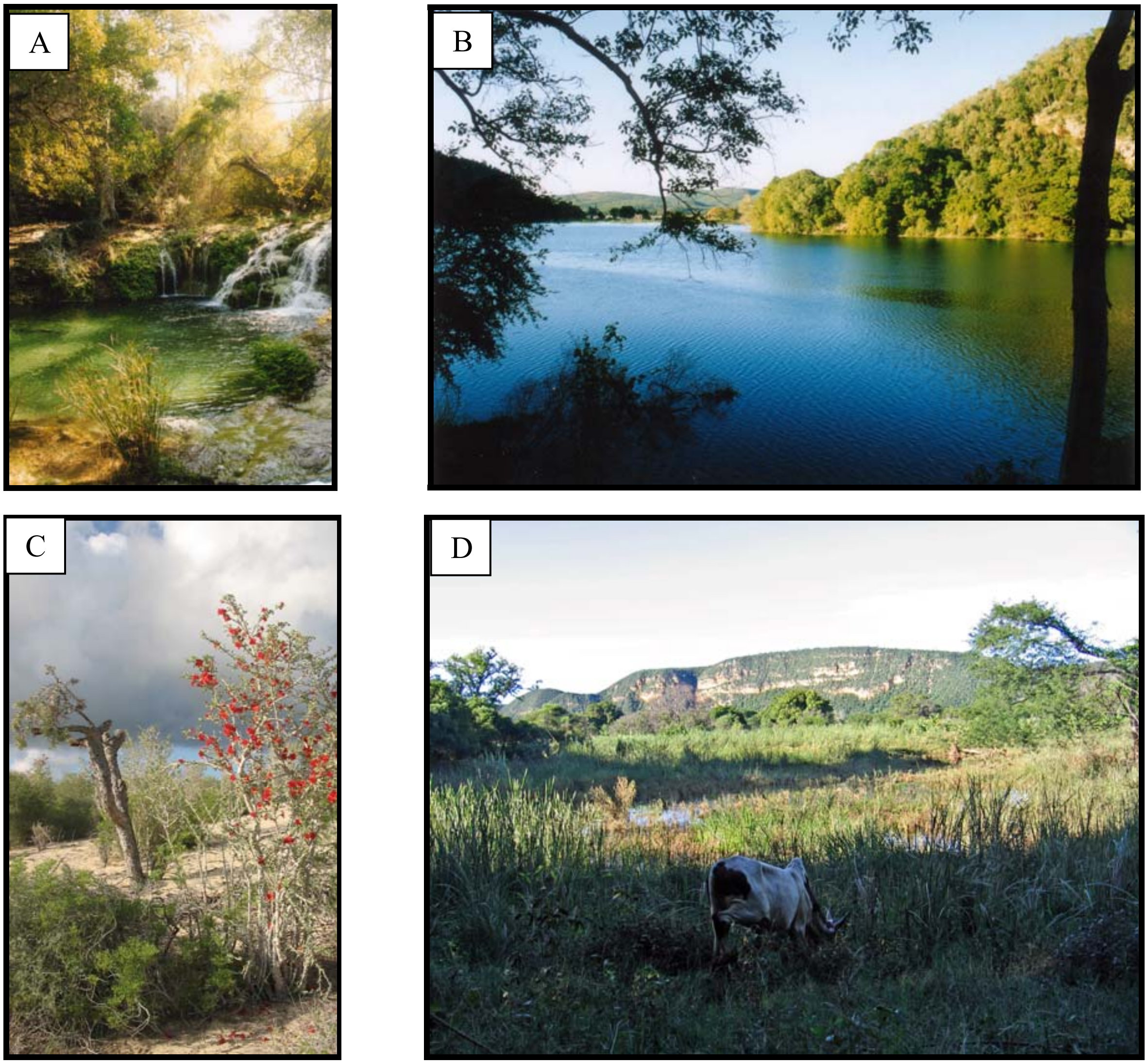

FIGURE 2. Photographic documenation of the different habitat types found within the Belomotse Forest, Lower Onilahy River Valley Temporary Protected Area, Madagascar. A. Riparian habitat at Sept Lacs , B. Riparian habitat at Antafoky Lake, C. Spiny Forest, D. Agricultural land. (A and B Photographed by David Emmett. C Photographed by Jeremy Sabel. D Photographed by Neil D'Cruze).

bottom internal diameter). We removed the handles and drilled small holes into the bottom to allow water to drain. We placed the buckets into the soil at 10 m intervals along a drift fence, with their upper rims flush with the ground. We made the drift fence from black plastic sheeting (0.5 m high) and 100 m long. We attached it in a vertical position to thin wooden stakes and positioned it to bisect the middle of each pitfall trap. We buried the bottom of the plastic about 50 mm deep into the soil to prevent individuals from passing underneath the fence. We checked and removed all captures from the pitfall traps in the early morning andlate afternoon each day. We used three drift fence-pit fall arrays at each site for eight nights. We erected 50 pitfall lines during the survey.

We conducted opportunistic searches across the full range of altitudes and habitats, in all seasons (Raxworthy and Nussbaum 1988), to reveal the presence of species not captured by the other methods. We also made direct counts of species along line transects. We specifically targeted amphibians after each rainfall. Search locations included wetlands, agricultural areas, cliff faces, rocks, fallen trees, and forest canopy. We classified the 61 species encountered during this survey using a system (D'Cruze et al. 2006) as follows: abundant (large numbers encountered on a regular basis), common (encountered on a regular basis), infrequent (unpredictable, few individuals seen), or rare (rarely seen).

For each specimen we recorded the snout-vent length

TABLE 1. Conservation status and distribution of the amphibian and reptile species found during this survey of Belomotse Forest, Lower Onilahy River Valley Temporary Protected Area, Madagascar. Abbreviations: Relative Abundance- A = abundant, C = common, I = infrequent, R = rare; Ecological Distribution- AB = arboreal, T = terrestrial, S = semiaquatic; Habitat- RIP = riparian, DDF = dry deciduous forest, NFW = non-forest wetland, SP = spiny forest; Survey and Seasonal Data- + = present. *Continued on next page.*

Species	IUCN	CITES	Relative Abundance	Ecological Distribution	Altitude (m)	Habitat	Antafoky Survey 2001-02	Sept Lacs Survey 2001-02	Sept Lacs Survey 2005	Seasonal Data Wet	Dry
Amphibia											
Microhylidae											
Scaphiophryne brevis	LC		C	T, S	60-150	RIP, DDF, NFW		+	+	+	
Scaphiophryne aff. *calcarata*	LC		I	T, S	60-150	RIP, DDF, SP	+	+	+	+	
Ranidae *sensu lato*											
Ptychadena mascareniensis	LC		A	T, S	40-110	RIP, NFW	+	+	+	+	+
Mantellidae											
Boophis doulioti	LC		C	AB, T	40-110	RIP	+	+		+	+
Laliostoma labrosum	LC		C	T	40-110	RIP	+	+		+	
Mantidactylus sp.			C	T, S	60-110	RIP		+	+	+	+
Reptilia											
Crocodylidae											
Crocodylus niloticus	LR/lc	I & II	I	S	40-50	NFW	+		+	+	+
Chamaeleonidae											
Brookesia brygooi		II	R	T	60	RIP		+			
Furcifer lateralis		II	C	AB	50-100	RIP, NFW	+	+	+	+	+
Furcifer oustaleti		II	A	AB	40-240	RIP, DDF, NFW, SP	+	+	+	+	+
Furcifer verrucosus		II	A	AB	40-240	RIP, DDF, NFW, SP	+	+	+	+	+
Gekkonidae											
Blaesodactylus sakalava			R	AB	80-240	DDF, SP	+			+	+
Geckolepis cf. *typica*			C	AB	40-80	RIP	+	+		+	+
Geckolepis cf. *petiti*			C	AB	40-80	RIP	+	+		+	+
Hemidactylus frenatus			I	AB	40-100	RIP, DDF, NFW		+	+	+	+
Hemidactylus mercatorius			A	AB	40-230	RIP, DDF, NFW, SP	+	+	+	+	+
Lygodactylus tolampyae			C	AB	40-240	RIP, DDF, SP	+	+	+	+	+

TABLE 1 *Continued*.

Species	IUCN	CITES	Relative Abundance	Ecological Distribution	Altitude (m)	Habitat	Antafoky Survey 2001-02	Sept Lacs Survey 2001-02	Sept Lacs Survey 2005	Seasonal Data Wet	Seasonal Data Dry
Lygodactylus tuberosus			C	T, AB	40-240	RIP, DDF, SP	+	+	+	+	+
Paroedura androyensis			I	T	40-80	RIP	+	+		+	+
Paroedura bastardi			C	T	40-240	RIP, DDF, SP	+	+		+	+
Paroedura picta			I	T	70-240	DDF		+		+	+
Phelsuma mutablis		II	A	AB	60-240	RIP, DDF, NFW, SP	+	+	+	+	+
Phelsuma standingi	VU	II	R	AB	210	DDF, SP	+			+	+
Gerrhosauridae											
Tracheloptychus madagascariensis			C	T	40-130	DDF, NFW, SP	+	+		+	+
Zonosaurus karsteni			C	T	40-160	RIP, DDF, SP	+	+		+	+
Zonosaurus laticaudatus			A	T	40-180	RIP, DDF, SP	+	+	+	+	+
Iguanidae											
Chalaradon madagascariensis			C	T	40-80	DDF, NFW, SP	+	+		+	+
Oplurus cyclurus			C	AB, T	80-240	DDF, SP	+	+	+	+	+
Oplurus quadrimaculatus			C	AB, T	40-240	RIP, DDF, SP	+	+		+	+

(SVL), body mass (BM), age, sex, date and time of capture, latitude, longitude, habitat, microhabitat, and altitude. We also took photographs. We preserved voucher specimens in 10% buffered formalin. Reptile and amphibian specimens were verified by Achille Raselimanana. We deposited vouchers and the associated tissue samples in the Department for Animal Biology at the University of Antananarivo (Appendix I).

RESULTS

During this survey, we recorded six amphibian and 55 reptile species in the Belomotse Forest (Table 1; Fig. 3). Photographic evidence of some of the species encountered during this study are provided in Figure 3 Plates A-D. Although we surveyed the area for a combined period of ca. 12 months, species accumulation curves (Fig. 4) suggest a high probability that we encountered all of the species of reptiles and amphibians in the area after eight and six months respectively. The herpetofauna of Belomotse consists of at least one crocodilian (2%), three chelonians (5%), 30 saurians (49%), 21 serpentes (34%) and six anurans (10%; Fig. 5).

Conservation status.—Most of these species (95%) are endemic to Madagascar, as just one (*Leioheterodon madagascariensis*) occurs on other Indian Ocean islands, and two (*Pelusios castanoides* and *Ptychadena mascareniensis*) also occur on the African mainland. We recorded 11 species that are regional endemics restricted to only a few places in south Madagascar (Table 2).

Abundance and activity patterns.—Nine (15%) species were abundant, 27 (44%) were common, 16 (26%) were infrequent, and nine (15%) were rare (Table 1). Little information about activity of herpetofauna (especially Amphibia) in the dry season exists (Blommers-Schlösser 1979; Andreone 1994; Andreone et al. 2000; Glaw and Vences 2003). Of the 61 species

TABLE 1. *Continued*.

Species	IUCN	CITES	Relative Abundance	Ecological Distribution	Altitude (m)	Habitat	Antafoky Survey 2001-02	Sept Lacs Survey 2001-02	Sept Lacs Survey 2005	Seasonal Data Wet	Seasonal Data Dry
Scincidae											
Amphiglossus ornaticeps			C	T	40-170	RIP, DDF, SP	+	+	+	+	+
Androngo trivittatus			I	T	40-70	RIP	+	+			+
Madascincus igneocaudatus			A	T	50-90	RIP, DDF, SP	+	+	+	+	+
Trachylepis dumasi			C	T	40-110	RIP	+	+		+	+
Trachylepis elegans			A	T	40-240	RIP, DDF, NFW, SP	+	+	+	+	+
Trachylepis gravenhorstii			C	T	70-210	DDF, SP	+	+		+	+
Trachylepis vato			C	T	40-220	RIP, DDF, SP	+	+		+	+
Voeltzkowia fierinensis			C	T	50-100	RIP, DDF, SP	+	+		+	+
Boidae											
Acrantophis dumerili	VU	I	I	T, AB	40-160	RIP, DDF, SP	+	+	+	+	+
Sanzinia madagascariensis	VU	I	I	T, AB	40-120	RIP	+	+	+	+	+
Colubridae *sensu lato*											
Dromicodryas bernieri			C	T	40-200	RIP, DDF, NFW, SP	+	+	+	+	+
Heteroliodon occipitalis			C	T	50-210	RIP,DDF, SP	+	+		+	+
Ithycyphus oursi			R	AB, T	80	RIP		+			+
Langaha madagascariensis			R	AB, T	50-80	RIP	+	+			+
Leioheterodon geayi			R	T	50-100	RIP, DDF, SP	+			+	+
Leioheterodon madagascariensis			R	T	40-140	RIP, DDF		+	+	+	+
Leioheterodon modestus			A	T	40-180	RIP, DDF, NFW	+	+	+	+	+
Liophidium torquatum			R	T	50	RIP	+	+		+	+
Liophidium trilineatum			I	T	40-60	RIP	+			+	+
Liophidium vaillanti			I	T	40-80	RIP	+	+	+	+	+

encountered, we found eight (13%) only during the wet season. We found two species (3%), *Ithycyphus oursi* and *Langaha madagascariensis*, only during dry season (Table 1). However, their low population densities, arboreal affinity, or otherwise cryptic nature may explain the observed seasonal distribution of these species. We found 50 (82%) species in both the wet and dry seasons.

The seasonal distribution for several of the amphibian species within the survey area (*Scaphiophryne brevis*, *Scaphiophryne* aff. *calcarata* and *Laliostoma labrosum*)

TABLE 1. *Continued.*

Species	IUCN	CITES	Relative Abundance	Ecological Distribution	Altitude (m)	Habitat	Antafoky Survey 2001-02	Sept Lacs Survey 2001-02	Sept Lacs Survey 2005	Seasonal Data Wet	Seasonal Data Dry
Bibilava lateralis			I	T	70	RIP		+		+	+
Madagascarophis cf. *colubrinus*			C	T, AB	40-90	RIP	+	+	+	+	+
Madagascarophis meridionalis			C	T, AB	40-110	RIP	+	+		+	+
Madagascarophis ocellatus			C	T, AB	40-80	RIP	+	+	+	+	+
Mimophis mahfalensis			C	T	40-100	RIP, DDF, NFW, SP	+	+		+	+
Pseudoxyrhopus quinquelineatus			I	T	40-240	RIP	+			+	+
Stenophis cf. *gaimardi*			I	T, AB	40-60	RIP, DDF, SP	+			+	+
Typhlopidae											
Typhlops arenarius			C	T	40-200	RIP, DDF, NFW, SP	+	+		+	+
Typhlops decorsei			I	T	110-240	DDF, SP	+	+	+	+	
Testudinidae											
Astrochelys radiata	VU	I	R	T	50-240	DDF, SP	+			+	
Pelomedusidae											
Pelomedusa subrufa			I	T, S	50-70	NFW		+		+	
Pelusios castanoides	LR/lc		I	T, S	50-80	NFW, RIP	+			+	

has a peak in species abundance during the wet season. These species are explosive breeders that emerge after the first rains of the wet season but remain dormant in their burrows during the dry season (Glaw and Vences 2007). The remaining species we observed are prolonged breeders (Glos 2003). They show a high affinity to water, and their abundance is fairly constant throughout the year (Table 3).

Habitat and distribution.—One (2%) species (*Paroedura picta*) occurred only in dry deciduous forest, and two (3%) species (*Crocodylus niloticus* and *Pelomedusa subrufa*) occurred only in non-forest wetland. We found 20 species (33%) solely in riparian areas, which highlights the conservation importance of this habitat (Table 1; Fig. 6). Surprisingly, no species were endemic to spiny forest habitat. Just eight species (13% of the total fauna; *Furcifer oustaleti, Furcifer verrucosus, Hemidactylus mercatorius, Phelsuma mutabilis, Trachylepis elegans, Dromicodryas bernieri, Mimophis mahfalensis, Typhlops sp.*) occurred in all identified habitat types. We encountered 54 (89%) species in ≥ 1 of the wet habitats. Seven (11%) species occurred in ≥ 1 of the dry habitat types (Fig. 6).

Terrestrial habitat accounted for the exclusive occurrence of 31 species (51%). We found 11 (18%) species only in arboreal situations, and 12 (20%) species occurred in both terrestrial and arboreal habitats (Table 1). We observed six (10%) species in both semi-aquatic and terrestrial situations, and one (2%) species, *Crocodylus niloticus*, only in semi-aquatic situations.

Elevational distribution.—Despite its small range in elevation, the Belomotse Forest, species diversity decreased with increased elevation (Fig. 7). The diversity of reptiles is greatest (54 species) at the lowest elevation (0–99 m). No species occurred at the highest elevation (200–250 m).

DISCUSSION

The Herpetofauna of the Belomotse Forest.—The first intensive herpetological survey work to focus on the Belomotse Forest was documented in an unpublished

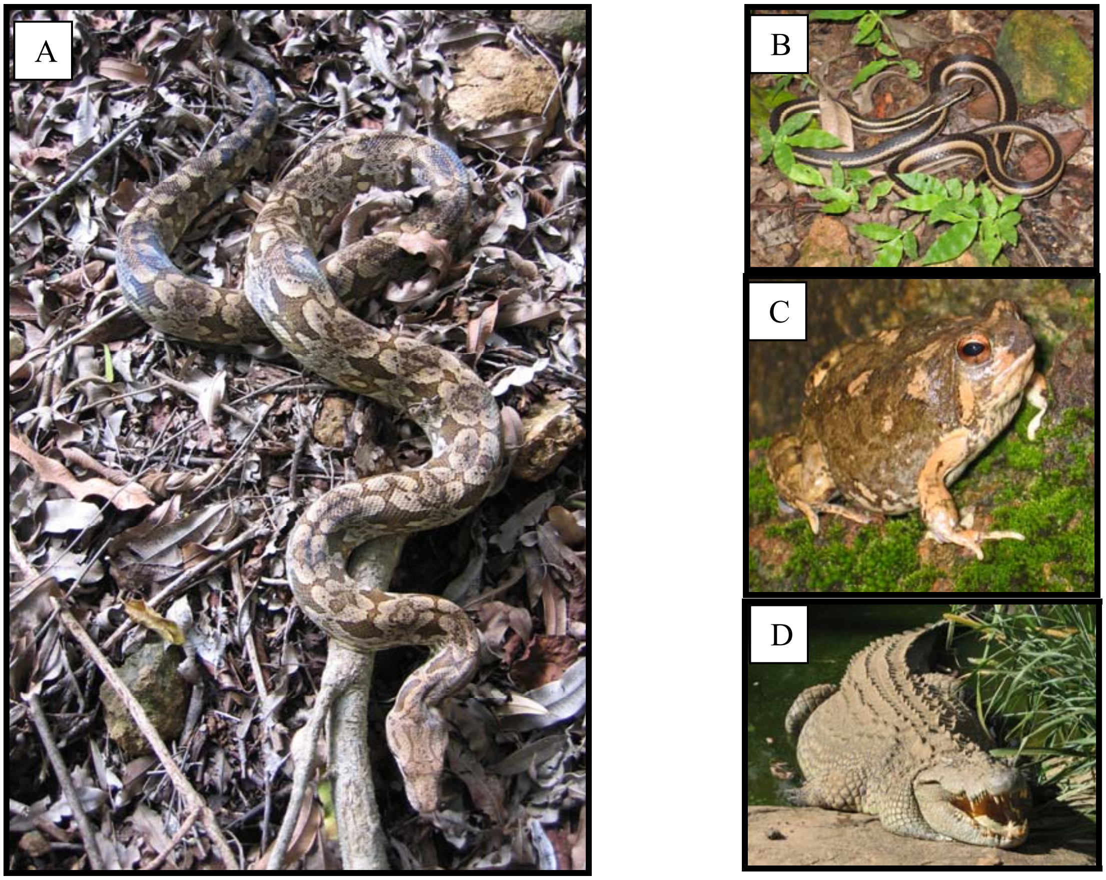

FIGURE 3. Photographic documentation of some of the species encountered in the Belomotse Forest, Lower Onilahy River Valley Temporary Protected Area, Madagascar. A. Dumeril's Boa (*Acrantophis dumerili*), B. Bernier's Striped snake (*Dromicodryas bernieri*), C. Madagascar Brown Burrowing Frog (*Scaphiophryne brevis*), D. Nile Crocodile (*Crocodylus niloticus*). (Photographed by Neil D'Cruze)

report by Raxworthy (1995. *op. cit.*) as part of a broader survey of the Toliara region with the intention of "improving the status of the current research data and potentially facilitating the establishment of new protected areas." Raxworthy spent two days at a camp in Sept Lacs 23°31.5'S, 44°09.2'E at the end of the wet season and encountered a total of 34 reptile and amphibian species (Table 2). We encountered all 34 of these species previously known from this area (Table 2; Raxworthy 1995. *op. cit.*).

The lack of variation in the seasonal herpetofaunal composition observed throughout the year is surprising when the degree and length of seasonal variation of this area is taken into account. However, the abundance of many of these species was considerably lower during the dry season which is typical of reptile species throughout Madagascar (Glaw and Vences 2007). This might be an adaptation to lower temperatures, reduced food availability, or increased predation. Furthermore, it may also be directly linked to reduced reproduction (Glaw and Vences 2007). We noticed reduced dry season activity for nocturnal species of Boidae, Colubridae, and Chameleonidae. We also observed several *Furcifer verrucosus* in a dormant state, buried in shallow soil as previously described for this species (C. Raxworthy, pers. comm.).

The relatively low amphibian species richness of this area can probably be attributed to the dry climate of this locality and subsequent paucity of suitable habitat. The species collected during this survey are typical of other dry habitats within south Madagascar.

The extremely high level of endemism at both the regional and national level emphasizes the importance of the Belomotse Forest as a site of herpetological importance. Four of these species have listing status of vulnerable and eight are of least concern (IUCN 2007). CITES lists 10 of these species on the appendices.

We observed that herpetofaunal species diversity decreased with increased elevation. This trend probably reflects differences in habitat arising from elevation in the Belomotse Forest. Higher elevations typically have spiny forest or dry deciduous forest with little or no permanent bodies of water.

However, the base camp was at an elevation of 30 m and we note that this trend might represent an artifact of the greater sampling time spent at the 0–99 m elevational

TABLE 2. Species encountered at Sept Lacs during a prior unpublished survey, species which occur at Andohahela Parcel 2 (see text for literature sources), gap species, regional endemics and range extensions for species found in this study at Belomotse Forest. Endemic Status- E = endemic, RE = regional endemic, N = non-endemic; Survey Data- + = present; Gap Species- + = gap species, ? = status unknown; Range Extension- + = range extension. *Continued on next page*.

Species	Sept Lacs Raxworthy 1995	Andohahela Parcel 2 Nussbaum et al. 1999	Gap Species	Endemic Status	Range Extension
Amphibia					
Microhylidae					
Scaphiophryne brevis	+	+		E	
Scaphiophryne aff. *calcarata*		+		RE	+
Ranidae *sensu lato*					
Ptychadena mascareniensis	+	+		N	
Mantellidae					
Boophis doulioti	+			E	
Laliostoma labrosum	+	+		E	
Mantidactylus sp.	+		?	?	
Reptilia					
Crocodylidae					
Crocodylus niloticus				N	+
Chamaeleonidae					
Brookesia brygooi				E	+
Furcifer lateralis	+	+		E	
Furcifer oustaleti	+	+		E	
Furcifer verrucosus	+			E	
Gekkonidae				E	
Blaesodactylus sakalava		+		E	
Geckolepis cf. *typica*	+	+		E	
Geckolepis cf. *petiti*			+	RE	
Hemidactylus frenatus				N	
Hemidactylus mercatorius	+	+		N	
Lygodactylus tolampyae				E	+
Lygodactylus tuberosus	+		+	RE	
Paroedura androyensis		+		RE	
Paroedura bastardi	+	+		E	
Paroedura picta	+	+		E	
Phelsuma mutablis	+	+		E	
Phelsuma standingi				RE	
Gerrhosauridae					
Tracheloptychus madagascariensis	+	+		RE	
Zonosaurus karsteni	+			E	
Zonosaurus laticaudatus	+	+		E	
Iguanidae					
Chalaradon madagascariensis	+	+		E	
Oplurus cyclurus	+	+		E	
Oplurus quadrimaculatus	+	+		E	
Scincidae					
Amphiglossus ornaticeps	+	+		E	
Androngo trivittatus	+			RE	
Madascincus igneocaudatus	+	+		E	
Trachylepis dumasi	+	+		E	+
Trachylepis elegans	+	+		E	
Trachylepis gravenhorstii	+	+		E	
Trachylepis vato	+	+		E	
Voeltzkowia fierinensis	+		+	RE	

band. More data is clearly needed to confirm elevational trends in herpetofaunal diversity within the Belomotse Forest and other regions of Madagascar.

Range extensions.—The presence of *Crocodylus niloticus* at this locality is noteworthy because

TABLE 2 *continued.*

Species	Sept Lacs Raxworthy 1995	Andohahela Parcel 2 Nussbaum et al. 1999	Gap Species	Endemic Status	Range Extension
Boidae					
Acrantophis dumerili		+		E	
Sanzinia madagascariensis				E	
Colubridae *sensu lato*					
Dromicodryas bernieri		+		E	
Heteroliodon occipitalis				E	
Ithycyphus oursi				E	
Langaha madagascariensis	+			E	+
Leioheterodon geayi		+		E	
Leioheterodon madagascariensis				E	
Leioheterodon modestus				E	
Liophidium torquatum				E	+
Liophidium trilineatum				RE	
Liophidium vaillanti				E	
Bibilava lateralis				E	
Madagascarophis cf. *colubrinus*		+		E	+
Madagascarophis meridionalis			+	E	
Madagascarophis ocellatus	+		+	RE	
Mimophis mahfalensis	+	+		E	
Pseudoxyrhopus quinquelineatus	+			E	
Stenophis cf. *gaimardi*	+			E	+
Typhlopidae					
Typhlops arenarius	+			E	
Typhlops decorsei		+		E	
Testudinidae					
Astrochelys radiata				RE	
Pelomedusidae					
Pelomedusa subrufa				N	
Pelusios castanoides				N	+

surprisingly little is known about the distribution of crocodiles in Madagascar (Glaw and Vences 2007).

Although commonly encountered in western Madagascar and also found along the east coast, precise records are scarce (Kuchling et al. 2003; Glaw and Vences 2007). This location currently represents the most southern distribution record for this species in Madagascar. *Pelusios castaniodes* is known from eight specific locations (Glaw and Vences 2007) throughout the sambirano, north, west, and central bigeographical zones of Madagascar identified by Boumans et al. (2007). Its presence at this locality represents the first record of this species from south Madagascar and indicates a range extension of ca. 400 km to the south of Miandrivazo. The known distribution of *Stenophis gaimardi* is currently restricted to just 5 precise localities (Glaw and Vences 2007). If the species recorded as *Stenophis* cf. *gaimardi* during this study has been identified correctly, then this represents the first distribution record for south Madagascar and indicates a range extension of ca. 600 km to the south of Moramanga.

The presence of *Liophidium torquatum* at this locality is noteworthy because although this species has been recorded throughout Madagascar, prior to this survey, its distribution in the south was believed to be limited to the east (Glaw and Vences 2007). Similarly, although the highly cryptic *Langaha madagascariensis* is known from 17 locations throughout Madagascar (Glaw and Vences 2007), this species does not appear to have been documented previously in southwest Madagascar. In addition, the distribution of several species already known to occur in south Madagascar (Glaw and Vences 2007) has been extended by ca. 200 km, including *Brookesia brygooi*, *Lygodactylus tolampyae*, *Madagascarophis colubrinus*, *Trachylepis dumasi,* and *Scaphiophryne* aff. *calcarata*.

Comparisons with other sites.—Currently, eight protected areas occur in the Toliara province of south Madagascar. Of these protected areas, five are Parc National (PN): Andohahela, Midongy du Sud, Kirindy Mitea, Tsimanampetsotsa, and Zombitse Vohibasia. The

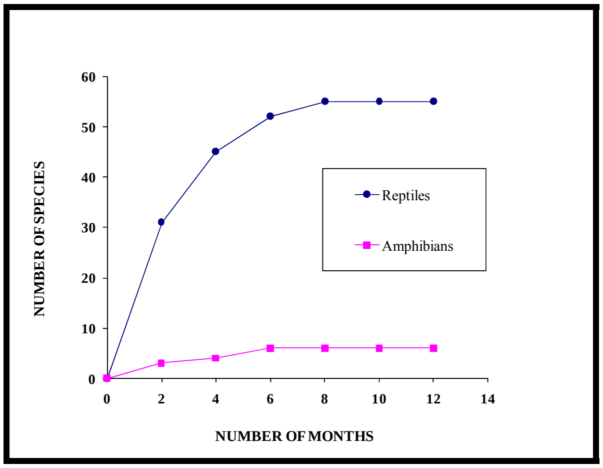

FIGURE 4. Species accumulation curve for amphibians and reptiles in the Belomotse Forest, Lower Onilahy River Valley Temporary Protected Area, Madagascar.

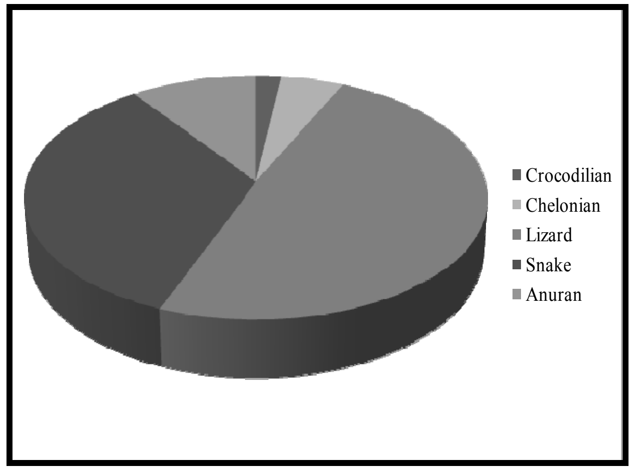

FIGURE 5. Composition of the major herptofaunal groups found in this study at the Belomotse Forest, Lower Onilahy River Valley Temporary Protected Area, Madagascar.

TABLE 3. Amphibians and their summarized ecological characteristics found at the Belomotse Forest, Lower Onilahy River Valley Temporary Protected Area, Madagascar. EB = explosive breeder, PB = prolonged breeder; N = nocturnal, SUR = eggs as surface film.

Species	Embryonic Development	Breeding Strategy	Diurnal/ nocturnal	Spawn characteristics	Pond use
Scaphiophryne brevis	< 24 h	EB	N	no data	G
Scaphiophryne aff. *calcarata*	< 24 h	EB	N	SUR	G
Ptychadena mascareniensis	no data	PB	N	SUR	G
Boophis doulioti	< 24 h	PB	N	SUR	G
Laliostoma labrosum	< 24 h	EB	N	SUR	G
Mantidactylus sp.	no data	PB	N	no data	S

remaining three are Réserves Spéciales (RS): Andranomena, Bezaha Mahafaly, and Cap Sainte Marie.

We provide a comparison of the shared herpetofaunal diversity between Belomotse and the Andohahela National Park (Table 2), which is the only protected area in the Toliara province for which a published herpetofaunal inventory currently exists (Andreone and Randriamahazo 1997; Nussbaum et al. 1999). We chose Parcel 2 as the focus of this comparison because this area is drier than the rainforest covering Parcel 1 and like the Belomotse Forest, it supports both spiny and some gallery forest (Nussbaum et al. 1999). Thirty of the 61 species encountered during this survey receive protection within Parcel 2 of Andohahela National Park. Therefore, according to the current literature, 8% of the species found at Belomotse are "gap species" (Rodrigues et al. 2004) and are in immediate danger conservation-wise because it cannot be immediately assumed that they are protected within the existing system of protected areas in Madagascar. We strongly recommend additional herpetological surveys should be conducted in the remaining seven sites in the Toliara Province. This research may reveal that certain species of reptiles and amphibians are more widespread than is currently known and/or reveal that apparently widespread species actually represent several different forms (Glaw and Vences 2003). This information is vital in order for informed conservation decisions to be made.

Anthropogenic threats.—There are five permanent Malagasy settlements within the Belomotse area (Antafoky, Ifanato, and Befas, Bevolavo, and Manderano, which collectively constitute the settlement known as Mahaleotse). All of these occur along the Onilahy River. The inhabitants at these settlements compriseca. 800 residents, all of whom are members of the Mahafaly, Tandroy, and Masikoro tribes. Socio-economic factors such as rapid population growth, poor education, and aspects of Malagasy culture influence the exploitation of natural resources via harmful agricultural methods and other environmentally unfriendly activities (Durbin et al. 2003) that can threaten amphibians and reptiles (Glaw and Vences 2007).

The most significant threat to herpetofaunal species diversity in Belomotse is habitat loss. On the plateau, residents employ traditional slash-and-burn clearing (known locally as "tavy") of gallery and spiny forest to facilitate maize cultivation and cattle grazing.

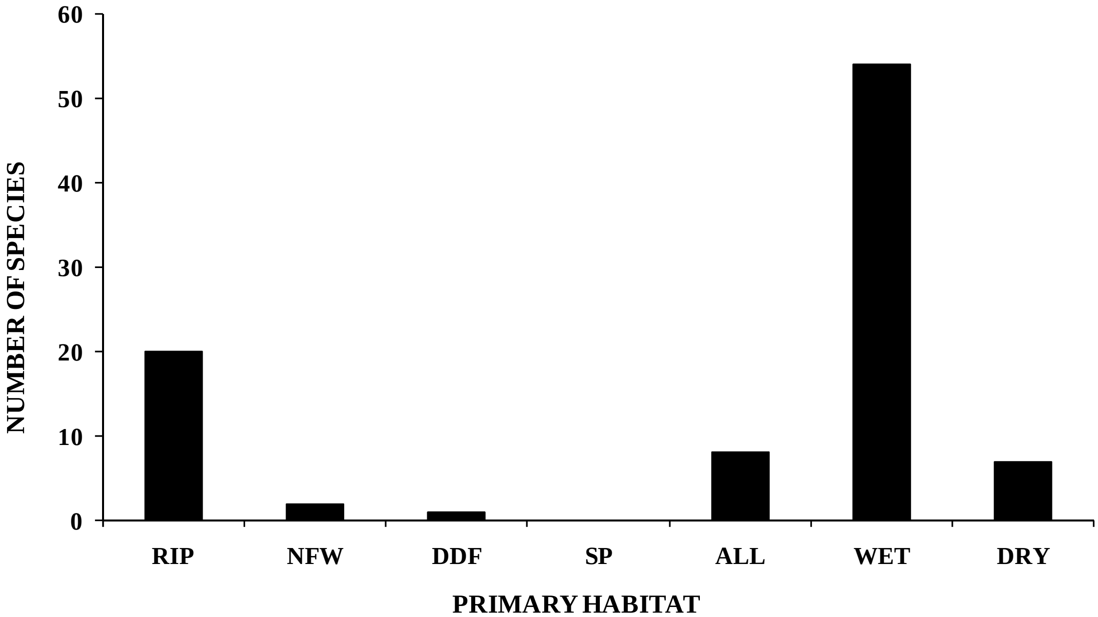

FIGURE 6. The number of species found in each of the primary habitats surveyed at the Belomotse Forest, Lower Onilahy River Valley Temporary Protected Area, Madagascar. Habitat- RIP = riparian, DDF = dry deciduous forest, NFW = non-forest wetland, SP = spiny forest, WET = riparian and non-forest wetland habitat, DRY = dry deciduous forest and spiny forest.

Additionally, clear felling for charcoal production, construction of pirogues (dugout canoes), and commercial timber also leads to degradation and fragmentation of the remaining natural habitat. Draining of wetlands along the Onilahy River for rice cultivation is a significant threat. These pressures on natural resources impart a major impact at a national level (Myers et al. 2000 estimated that more than 90% of the original natural vegetation has already been lost in Madagascar) and constitute the most severe threat to reptiles and amphibians in Madagascar (Vallan 2002; Vallan 2003; Andreone et al. 2005; Glaw and Vences 2007).

Subsistence hunting of Chelonia in the Belomotse Forest is a significant threat. We observed residents of local communities around Antafoky Lake trap and collect *Pelusios castanoides*. Although previously thought to be common in Madagascar (Kuchling and Garcia 2003), current distribution records suggest that this species is rarely encountered in south Madagascar (Glaw and Vences 2007) and risk of extirpation of the turtle from this biogeographical zone is significant. We found shell fragments of the Radiated Tortoise (*Astrochelys radiata*) around the village of Antafoky, including the shell of a specimen that was part of a mark-release study earlier that year. This is one of four species of land tortoises endemic to Madagascar, all of which human activities currently threaten (Pedrono and Smith 2003). As only five individuals appeared during our 15-month survey, this species may be subject to local extirpation.

Although poorly studied, harvest for the pet trade and other markets threaten the herpetofauna of the Belomotse Forest as in the rest of Madagascar (Andreone et al. 2005). These activities often stimulate severe population declines, which can lead to extinctions (Seddon et al. 2000). Collectors target reptiles for their skins and for the European and American pet trade (Seddon et al. 2000). Each year, collectors export large numbers of certain amphibian species (e.g., *Mantella*, *Scapiophryne*, *Dyscophus* sp.) to Europe, North America, and Japan (Behra and Raxworthy 1991). Although there is not a recent history of amphibian or reptile collection in the surveyed areas, if specimen collection for the wildlife trade establishes itself, it would probably target *Phelsuma standingi*, which is particularly vulnerable to extinction because of its small distribution and unique habitat requirements (Raxworthy and Nussbaum 2000). In addition, *Astrochelys radiata* is in such low densities at the Belomotse Forest that exploitation could rapidly cause its extirpation. In contrast, *Sanzinia madagascariensis* and *Boa dumerili* were common throughout the survey areas. Boas are considered to be among the most common snakes in Madagascar (Raxworthy 2003). However, the slow reproductive rates of these species place local populations at a significant threat if collection becomes

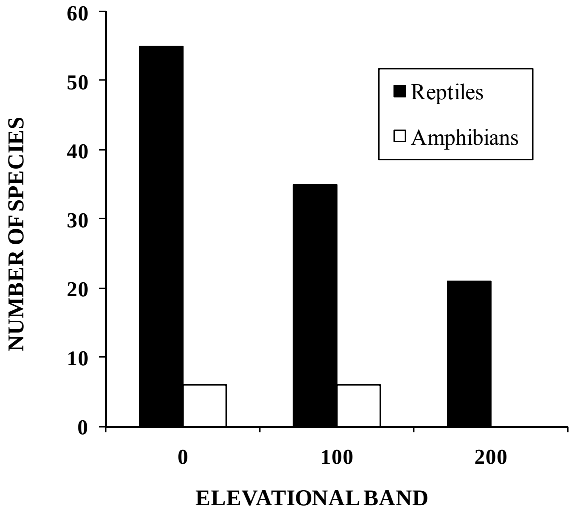

FIGURE 7. The number of reptile and amphibian species as a function of elevation at the Belomotse Forest, Lower Onilahy River Valley Temporary Protected Area, Madagascar. The number of species is per 100 m elevational increments with the minimum and maximum elevations used to calculate the average elevational range of each species.

established (Glaw and Vences 2007). Although *Crocodylus niloticus* is not endangered in Madagascar (Kuchling et al. 2003), illegal hunting of this species for the domestic trade of crocodile oil and finished skin products is problematic, and often takes place in protected areas of Madagascar (e.g., Ankarafantsika; Kuchling et al. 2003). The locals consider crocodiles in Lake Antafoky as taboo (known locally as "fady") and do not hunt them.

Existing conservation initiatives.—In recent years much criticism has targeted the GELOSE approach to conservation at Sept Lacs and numerous other sites throughout the country (Antona et al. 2004; Hockley and Andriamarovololona 2007; Pollini 2007). Some argue that despite good intentions on the part of external stakeholders, the implementation of GELOSE, together with the wider policy landscape, is deeply unfavorable to COBAs. Much of this arises from a substantial disconnect between communities and the centre, and a lack of realism on the part of policy makers (Hockley and Andriamarovololona 2007). This threatens the benefits that COBAs impart on their communities and wider society, and reduces the stability of GELOSE contracts (Hockley and Andriamarovololona 2007).

Despite this criticism, it is widely accepted that when created under favorable conditions, COBAs offer an efficient and equitable mechanism for achieving forest conservation in Madagascar (Sneddon et al. 2000; Antona et al. 2004; Hockley and Andriamarovololona 2007; Pollini 2007). In fact, the only viable option for areas where communities identify strongly with the forest may be some form of community management (Hockley and Andriamarovololona 2007). Consequently, a recent economic analysis funded by United States Agency for Internatioinal Developemtn (USAID; Hockley, J., and M.M. Andriamarovololona. 2007. The Economics of Community Forest Management in Madagascar: Is There a Free Lunch? An Analysis of Transfert de Gestion. USAID.) recommended that external agencies should institute a system that provides independent verification of a COBA's performance, and connects COBAs to those who benefit from ecosystem services. Reviews of the GELOSE highlight the significant potential of small-scale ecotourism (Hockley and Andriamarovololona 2007) combined with support of a ban on forest clearing by direct compensation via subsidies (Pollini 2007).

Future conservation initiatives.—Protection of the herpetological diversity of Belomotse Forest requires immediate action. Our findings and the review of the existing GELOSE initiatives support the following conservation recommendations for this highly diverse site of herpetological importance:

(1) Establish a large core protected area that incorporates a large area of gallery forest.

(2) Develop and implement a regionally connected, COBA that is a more sustainable and focused management system, and includes payments for ecosystem services like biodiversity conservation and carbon sequestration.

(3) Further assessment and monitoring of natural resource use. In particular, there must be restriction of the clearing of gallery forests, and careful monitoring of the remaining areas.

(4) Development of small scale eco-tourism as a workable alternative to non-sustainable resource use including such activities as guided walks, boat trips and the bird watching with specially designed bird hikes.

(5) Promote sustainable agriculture practices and improve human conditions via village-based education programs that demonstrate alternative crops and energy systems which are compatible with local traditions.

(6) Raise awareness about environmental problems through village-based programs which target all socioeconomic groups.

(7) Implement additional biodiversity surveys that focus on other taxonomic groups found within the Lower Onilahy River Valley.

Conclusion.—The data collected in this study contributes to our understanding of the biodiversity patterns of Malagasy herpetofauna in the spiny forest eco-region of south Madagascar; a threatened area with high biodiversity that needs full protection (Sussman and Rakotozafy1994; Dupuy and Moat 1996; Smith 1997; WWF 2003). This is only the second published herpetological inventory for the Toliara province and there needs to be additional published surveys for south Madagascar. The extremely high level of regional and national endemism in the herpetofauna immediately emphasizes the importance of Belomotse as a biological refuge. This herpetofauna is subject to numerous anthropogenic pressures. We intend for these recommendations to facilitate the development of an effective management plan for an important part of the Lower Onilahy River Valley Temporary Protected Area known as the Belomotse Forest.

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APPENDIX I.

Voucher Specimens from Belomotse Forest, Lower Onilahy River Valley Temporary Protected Area, Madagascar.—Sept Lacs: *Amphiglossus ornaticeps* (MGF 019/2002, MGF 070/2002, MGF 102/2002, MGF 144/2002, MGF 145/2002); *Androngo trivittatus* (MGF 109/2002, MGF 172/2002, MGF 198/2002, MGF 199/2002); *Blaesodaactylus sakalava* (MGF 186/2002); *Boophis doulioti* (MGF 033/2002, MGF 034/2002); *Brookesia brygooi* (MGF 242/2002); *Chalarodon madagascariensis* (MGF 137/2002); *Dromicodryas bernieri* (MGF 068/2002, MGF 168/2002, MGF 190/2002); *Furcifer oustaleti* (MGF 012/2002; MGF 164/2002); *Geckolepis* cf. *typica* (MGF 108/2002, MGF 191/2002. MGF 193/2002); *Geckolepis* cf. *petiti* (MGF 103/2002, MGF 147/2002); *Hemidactylus mercatorius* (MGF 013/2002, MGF 049/2002, MGF 050/2002, MGF 096/2002, MGF 181/2002, MGF 196/2002); *Heteroliodon occipitalis* (MGF 021/2002, MGF 098/2002, MGF 174/2002); *Ithycyphus oursi* (MGF 171/2002); *Laliostoma labrosum* (MGF 116/2002, MGF 118/2002, MGF 030/2002, MGF 031/2002, MGF 039/2002, MGF 117/2002, MGF 303/2002); *Langaha madagascariensis* (MGF 135/2002, MGF 163/2002, MGF 169/2002); *Liophidium torquatum* (MGF 266/2002); *Liophidium trilineatum* (MGF 053/2002, MGF 176/2002, MGF 179/2002); *Liophidium vaillanti* (MGF 131/2002, MGF 167/2002, MGF 200/2002); *Stenophis* cf. *gaimardi* (MGF 062/2002, MGF 138/2002); *Lygodactylus tolampyae* (MGF 150/2002); *Lygodactylus tuberosus* (MGF 015/2002, MGF 016/2002, MGF 022/2002, MGF 023/2002, MGF 029/2002, MGF 041/2002, MGF 100/2002); *Mabuya dumasi* (MGF 018/2002, MGF 025/2002, MGF 058/2002, MGF 097/2002, MGF 182/2002, MGF 194/2002); *Mabuya elegans* (MGF 026/2002, MGF 027/2002, MGF 133/2002, MGF 141/2002, MGF 149/2002, MGF 247/2002); *Mabuya gravenhorstii* (MGF 057/2002, MGF 059/2002, MGF 142/2002, MGF 148/2002, MGF 165/2002, MGF 261/2002); *Mabuya vato* (MGF 042/2002, MGF 043/2002, MGF 185/2002, MGF 188/2002); *Madagascarophis colubrinus* (MGF 069/2002); *Madagascarophis meridionalis* (MGF 024/2002, MGF 055/2002, MGF 056/2002); *Madagascarophis ocellatus* (MGF 067/2002); *Madascincus igneocaudatus* (MGF 061/2002, MGF 107/2002, MGF 177/2002); *Mantidactylus* sp. (MGF 037/2002, MGF 038/2002, MGF 119/2002, MGF 120/2002, MGF 301/2002, MGF 302/2002); *Mimophis mahfalensis* (MGF 054/2002, MGF 270/2002, MGF 288/2002); *Oplurus cyclurus* (MGF 244/2002, MGF 104/2002, MGF 136/2002, MGF 192/2002); *Oplurus quadrimaculatus* (MGF 245/2002, MGF 051/2002, MGF 139/2002); *Paroedura bastardi* (MGF 011/2002, MGF 093/2002, MGF 180/2002); *Paroedura picta* (MGF 063/2002, MGF 064/2002); *Paroedura androyensis* (MGF 014/2002, MGF 091/2002, MGF 092/2002); *Phelsuma mutabilis* (MGF 105/2002, MGF 162/2002, MGF 195/2002); *Phelsuma standingi* (MGF 187/2002); *Pseudoxyrhopus quinquelineatus* (MGF 045/2002, MGF 095/2002); *Pseudoxyrhopus quinquelineatus* (MGF 101/2002); *Ptychadena mascareniensis* (MGF 032/2002, MGF 035/2002, MGF 036/2002); *Pygomeles braconnieri* (MGF 178/2002); *Scaphiophryne brevis* (MGF 040/2002, MGF 110/2002, MGF 113/2002, MGF 114/2002, MGF 115/2002, MGF 304/2002, MGF 305/2002); *Scaphiophryne* aff. *calcarata* (MGF 111/2002, MGF 112/2002); *Tracheloptychus madagascariensis* (MGF 243/2002, MGF 052/2002, MGF 134/2002, MGF 140/2002, MGF 173/2002, MGF 183/2002); *Typhlops decorsei* (MGF 161/2002, MGF 166/2002, MGF 175/2002, MGF 189/2002); *Typhlops arenarius* (MGF 020/2002, MGF 044/2002, MGF 099/2002); *Voeltzkowia fierinensis* (MGF 017/2002, MGF 047/2002, MGF 048/2002, MGF 106/2002); *Voeltzkowia fierinensis* (MGF 170/2002); *Zonosaurus karsteni* (MGF 200/2002, MGF 246/2002, MGF 028/2002); *Zonosaurus laticaudatus* (MGF 197/2002, MGF 241/2002, MGF 060/2002, MGF 143/2002).

APPENDIX II
Pitfall lines used to capture amphibians and reptiles at Belomotse Forest, Lower Onilahy River Valley Temporary Protected Area, Madagascar.

Season	Line	Habitat	Latitude	Longitude	Altitude (m)	Start date	Finish date	Days	Trap days
Dry	1	Gallery forest	23º28.45'S	44º03.59'E	65	29/06/01	07/09/01	8	88
Dry	2	Gallery forest	23º28.45'S	44º03.59'E	65	29/06/01	07/09/01	8	88
Dry	3	Gallery forest	23º28.45'S	44º03.59'E	65	29/06/01	07/09/01	8	88
Dry	4	Gallery forest	23º29.16'S	44º04.39'E	50	29/06/01	07/09/01	8	88
Dry	5	Gallery forest	23º29.16'S	44º04.39'E	50	29/06/01	07/09/01	8	88
Dry	6	Gallery forest	23º29.16'S	44º04.39'E	50	29/06/01	07/09/01	8	88
Dry	7	Thorny scrub	23º28.24'S	44º04.23'E	85	29/06/01	07/09/01	4	44
Dry	8	Thorny scrub	23º28.24'S	44º04.23'E	85	29/06/01	07/09/01	4	44
Dry	9	Thorny scrub	23º28.24'S	44º04.23'E	85	29/06/01	07/09/01	4	44
Dry	10	Gallery forest	23º31.42'S	44º 09.20'E	65	29/06/01	07/09/01	8	88
Dry	11	Gallery forest	23º31.42'S	44º 09.20'E	65	29/06/01	07/09/01	8	88
Dry	12	Gallery forest	23º31.42'S	44º 09.20'E	65	29/06/01	07/09/01	8	88
Dry	13	Gallery forest	23º 28.45'S	44º 03.59'E	50	01/10/01	10/12/01	8	88
Dry	14	Gallery forest	23º 28.45'S	44º 03.59'E	50	01/10/01	10/12/01	8	88
Dry	15	Gallery forest	23º 28.45'S	44º 03.59'E	50	01/10/01	10/12/01	8	88
Dry	16	Gallery forest	23º29.16'S	44º 04.39'E	50	01/10/01	10/12/01	8	88
Dry	17	Gallery forest	23º29.16'S	44º 04.39'E	50	01/10/01	10/12/01	8	88
Dry	18	Gallery forest	23º29.16'S	44º 04.39'E	50	01/10/01	10/12/01	8	88
Dry	19	Gallery forest	23º31.42'S	44º 09.20'E	65	01/10/01	10/12/01	10	100
Dry	20	Gallery forest	23º31.42'S	44º 09.20'E	65	01/10/01	10/12/01	10	100
Dry	21	Gallery forest	23º31.42'S	44º 09.20'E	65	01/10/01	10/12/01	10	100
Dry	22	Gallery forest	23º31.42'S	44º 08.18'E	60	01/10/01	10/12/01	8	88
Dry	23	Gallery forest	23º31.42'S	44º 08.18'E	60	01/10/01	10/12/01	8	88
Dry	24	Gallery forest	23º31.42'S	44º 08.18'E	60	01/10/01	10/12/01	8	88
Wet	25	Gallery forest	23º28.45'S	44º 03.58'E	50	09/01/02	20/03/02	8	88
Wet	26	Transitional forest	23º28.45'S	44º 03.58'E	50	09/01/02	20/03/02	8	88
Wet	27	Gallery forest	23º28.45'S	44º 03.58'E	50	09/01/02	20/03/02	8	88
Wet	28	Gallery forest	23º29.23'S	44º04.31'E	50	09/01/02	20/03/02	8	88
Wet	29	Transitional forest	23º29.23'S	44º04.31'E	115	09/01/02	20/03/02	8	88
Wet	30	Transitional forest	23º29.23'S	44º04.31'E	248	09/01/02	20/03/02	8	88
Wet	31	Transitional forest	23º31.29'S	44º09.33'E	120	09/01/02	20/03/02	10	100
Wet	32	Transitional forest	23º31.29'S	44º09.33'E	120	09/01/02	20/03/02	10	100
Wet	33	Transitional forest	23º31.29'S	44º09.33'E	120	09/01/02	20/03/02	10	100
Wet	34	Gallery forest	23º31.27'S	44º05.34'E	50	22/04/02	01/07/02	8	88
Wet	35	Gallery forest	23º31.27'S	44º05.34'E	50	22/04/02	01/07/02	8	88
Wet	36	Transitional forest	23º31.27'S	44º05.34'E	50	22/04/02	01/07/02	8	88
Wet	37	Gallery forest	23º30.36'S	44º04.58'E	-	22/04/02	01/07/02	8	88
Wet	38	Gallery forest	23º30.36'S	44º04.58'E	-	22/04/02	01/07/02	8	88
Wet	40	Gallery forest	23º28.45'S	44º03.58'E	50	22/04/02	01/07/02	8	88
Wet	41	Transitional forest	23º28.45'S	44º03.58'E	80	22/04/02	01/07/02	8	88
Wet	43	Gallery forest	23º29.23'S	44º04.40'E	-	22/04/02	01/07/02	8	88
Wet	44	Gallery forest	23º29.23'S	44º04.40'E	-	22/04/02	01/07/02	8	88
Wet	46	Gallery forest	23º31.34'S	44º05.26'E	120	22/04/02	01/07/02	8	88
Wet	47	Transitional forest	23º31.34'S	44º05.26'E	150	22/04/02	01/07/02	8	88
Dry	48	Transitional forest	23º31.15'S	44º08.35'E	150	26/06/02	07/09/02	8	88
Dry	49	Gallery forest	23º31.15'S	44º08.35'E	150	26/06/02	07/09/02	8	88
Dry	50	Gallery forest	23º31.15'S	44º08.35'E	150	26/06/02	07/09/02	8	88

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DAVID HENSON (not pictured) has conducted field research in Madagascar. After obtaining a BSc in environmental biology from the University of York in 2000, he spent several years carrying out ecological and biodiversity surveys in the Eastern Arc forests of southern Tanzania and the dry forests of southwest Madagascar, before returning to complete an MSc in Natural Resource management at Edinburgh University in 2003. Since then, he worked at the Conservation Development Centre in Nairobi, Kenya where his work focuses on the development of stakeholder driven management plans for major protected areas such as the Serengeti and Mahale National Parks in Tanzania, and the Masai Mara National Reserve and Tsavo and Meru Conservation Areas in Kenya.

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DAVID EMMETT received a Zoology degree at Imperial College, London in 1995. He spent two years in Malawi teaching biology and tropical agriculture, and setting up wildlife clubs in local schools. He then worked in Tanzania, conducting herpetological surveys in the East Usambara Mountains, after which time he moved to the dry spiny forests of Madagascar to work with Frontier to initiate a terrestrial biodiversity conservation program. In 2003, David moved to Cambodia to work for Conservation International as their regional herpetologist, specializing in chelonian research and conservation. In recent years, David has shifted his role into a more technical capacity, and is now the regional director for CI Indo-Burma. (Photographed by Anonymous).