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A SURVEY OF AMPHIBIANS AND REPTILES AT DEGRADED SITES NEAR POINTE-NOIRE, KOUILOU PROVINCE, REPUBLIC OF CONGO

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***Abstract.*—We report here the findings of a faunal survey of amphibians and reptiles included in an environmental impact assessment carried out in a heavily anthropogenically degraded area near the city of Pointe-Noire, Republic of Congo. Specifically, we use these results as an opportunity to investigate the effects of habitat destruction and fragmentation on herpetofauna, an increasingly widespread yet rarely studied phenomenon in sub-Saharan Africa, in one of the most poorly surveyed countries in the world. Among the 37 identified species (12 amphibians and 25 reptiles), we report here for the first time in the Republic of Congo, three species: the frog *Hemisus perreti*, the skink *Afroablepharus tancredi*, and the tortoise *Kinixys homeana*.**

***Résumé*.—Nous rapportons dans cet article les résultats d'un inventaire sure les populations d'amphibiens et de reptiles réalisé dans le cadre d'une évaluation de l'impact environnemental sur les populations d'amphibiens et de reptiles dans une région fortement dégradée du fait de l'homme, celle de Pointe Noire en République du Congo. Nous nous sommes en particulier penchés sur les effets de la destruction et du morcellement des habitats sur l'herpétofaune, un phénomène de plus en plus répandu mais jusqu'à maintenant rarement étudié en Afrique sub-saharienne, dans l'une des contrées les moins étudiées de la planète. Parmi les 37 espèces recensées (12 amphibiens et 25 reptiles), nous signalons les premières captures en République du Congo de trois espèces: la grenouille *Hemisus perreti*, le scinque *Afroblepharus tancredi* et la tortue *Kinixys homeana*.**

Key Words.—Africa; Amphibia; anthropogenic habitats; biodiversity; Congo Basin; Reptilia

INTRODUCTION

Habitat degradation and loss are important contributors to declines and extinction of amphibians and reptiles around the world (Stuart et al. 2004). In Africa, anthropogenic modifications of habitats have occurred on recent (e.g., Conte 2004; Fasona and Omojala 2009; Hall et al. 2009), historical (e.g., Schmidt 1994; Delègue et al. 2001; Ehret 2002; Brncic et al. 2007), and possibly even much deeper time scales (e.g., Oslisly and Peyrot 1992; Tutin and Oslisly 1995). Within Central Africa, there is evidence that significant modifications of the landscape and forested habitats took place during the past several thousand years (Hart et al. 1996; Fay 1997; White and Oates 1999; Brncic et al. 2007). Moreover, the rate of habitat degradation in many places in sub-Saharan Africa has likely increased substantially during the past century (e.g., McCann 1999; Conte 2004; Hall et al. 2009), which undoubtedly affects the distribution of associated flora and fauna. However, the general lack of historical faunal surveys makes it difficult to evaluate the effect of long-term or even recent habitat change in sub-Saharan Africa. Several recent studies have detected changes in the composition of amphibian faunas at specific localities during the past 40 years (Lea et al. 2005; Adeba et al., 2010), but even these exceptional studies may be compromised by methodological differences between the historical and recent surveys. There is thus a need for rigorous baseline surveys of faunas, even in already degraded areas, in order to understand the effects of future anthropogenic degradation of forest and savanna habitats on vertebrate faunas.

We present the results of a faunal survey conducted near Point Noire in the Kouilou Region of the Republic of Congo at localities comprising habitats degraded or transformed by human occupation. This survey is one component of an impact assessment of the potential social and environmental effects associated with construction of a potash-production industrial complex near the city of Pointe Noire by the company MagMinerals Inc. Since 2005, the staff of GENIVAR, an environmental consulting company commissioned by MagMinerals, have carried out detailed surveys of plants, animals, and hydrogeology. Research to assess the potential sociological effects on villages within the zone is still underway. The goal of these combined studies is to ensure that this construction project minimizes negative impacts and to identify positive measures to mitigate the potential negative effects of building this industrial complex. However, this survey also is an opportunity to study the fauna in a landscape

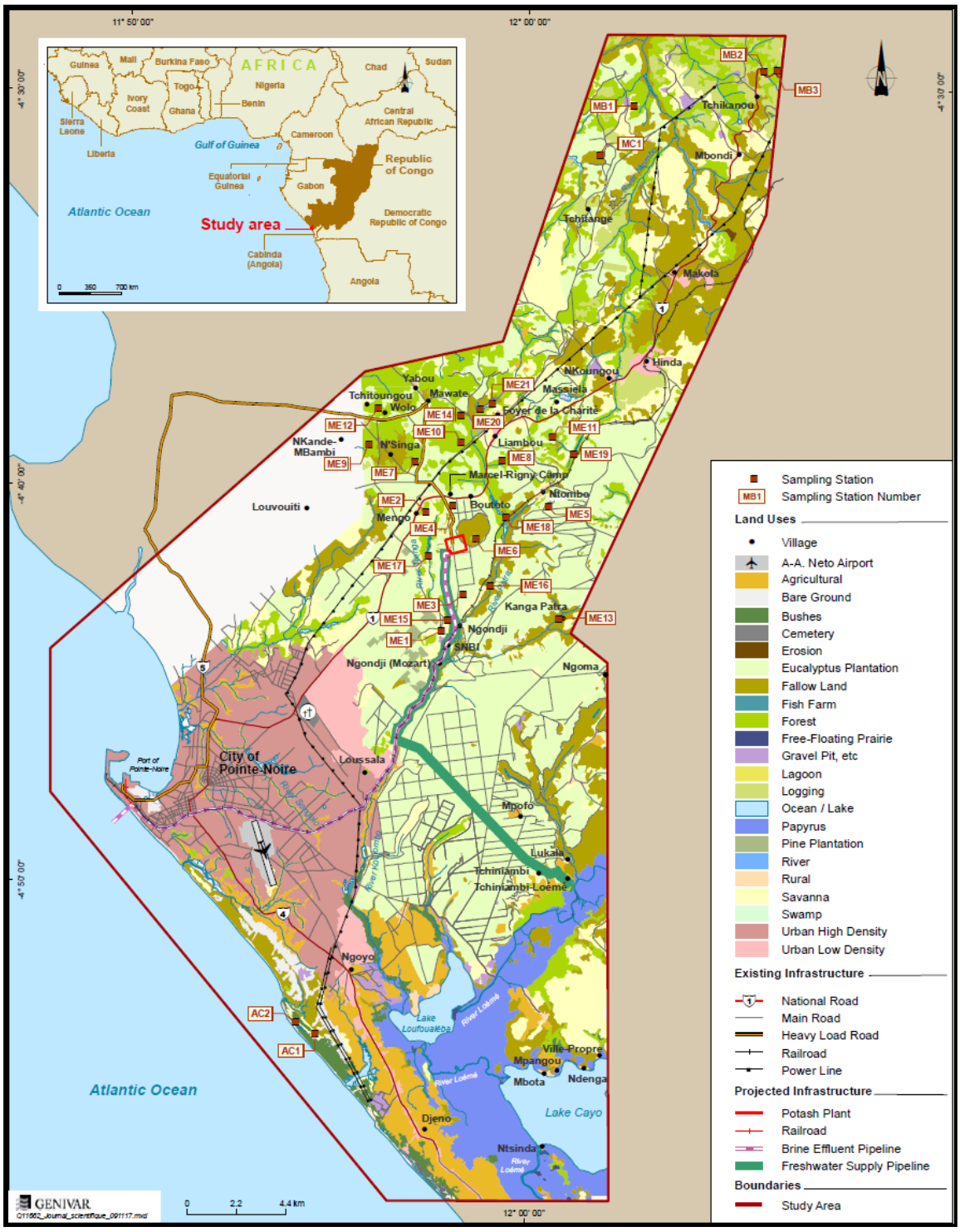

FIGURE 1. Map of the study zone in the Republic of Congo.

that has likely had substantial anthropogenic modifications during the past. As such, this survey may provide insight into those species capable of surviving long-term and active habitat modification in coastal Central Africa.

Beyond simply recounting the fauna at these localities, this study allows for an exploration of the biogeography of the coastal region of the Republic of Congo. This region is important biogeographically as a potential zone of overlap between the faunas of coastal Central Africa

and southwestern Africa, as well as that of the Congo Basin. Importantly, the region of these surveys lies just to the north of the Congo River, which may serve as a major biogeographic barrier (e.g., in fish; Melanie Stiassny, pers. comm.). Because of this barrier, we might predict *a priori* that the fauna has greater similarities to coastal Central Africa than that of southwestern Africa.

MATERIALS AND METHODS

Study sites.—Located just outside Pointe Noire, the area studied by GENIVAR personnel (Fig. 1) is a patchwork of fragmented habitat types, heavily disturbed by the local human population (Table 1). Planned infrastructure associated with the potash project includes a natural gas pipeline that will run northeast from the Djeno Gas Plant to the Mengo Plateau, a solution-mining well-field to the north of the Mengo Plateau, and a brine effluent pipeline that will run along an existing railway track to an outfall located approximately 1 km offshore near the port of Pointe-Noire.

Sampling methods.—GENIVAR personnel carried out sampling between 22 October and 20 November 2005. These sampling stations were in four general areas of the study zone: Atlantic corridor, along the coast; Mengo plateau, the largest part of the study zone including most of the proposed and existing infrastructure; Mbondi corridor, between the Mengo plateau and the area surrounding the village of Mbondi; and the area surrounding the oil field and village of Mbondi, the part of the study zone furthest from Pointe-Noire. Personnel established 27 sampling stations, chosen to represent different habitat types and the different zones of the area studied (Fig. 1). The habitat types (Fig. 2) and human activity (Table 1) varied across the study area.

Survey personnel used three methods to document the presence of amphibian and reptile species: (1) traps; (2) active searching; and (3) visual observations. Roadkills and animals captured by villagers also provided opportunistic records of some species. GENIVAR personnel constructed drift fences at 20 sampling stations and checked daily. These consisted of plastic sheeting, 60 cm in height and 55 m in length. The purpose of these drift fences was to channel animals into traps set up along their length. Traps fall into three distinct types: (1) pitfall traps, consisting of 20 L buckets sunk into the ground with the rim level with the ground, approximately every 5 m along a drift fence; (2) wire-mesh funnel traps, cylinders (20 cm in height, 43 cm in length) with funnel-shaped entrances at both ends, to allow easy entry, but to make escape difficult; and (3)

TABLE 1. Habitat type and human activities at each sampling station in Kouilou Region of the Republic of Congo.

Station	Lat.	Long.	Elev. (m)	Habitat Type	Human Activity
AC1	-4.888	11.908	15	savanna	clearing land by burning to divide into plots for housing
AC2	-4.883	11.900	-2	wetland (small pond)	none
ME1	-4.726	11.958	64	savanna	burning, pasture for cattle
ME2	-4.678	11.952	118	savanna	burning
ME3	-4.711	11.967	121	eucalyptus plantation	logging, burning, planting
ME4	-4.675	11.963	162	eucalyptus plantation	logging, planting, burning, charcoal
ME5	-4.675	12.001	163	eucalyptus plantation	logging, planting, burning, charcoal
ME6	-4.688	11.972	164	secondary forest	logging, cultivation
ME7	-4.657	11.947	191	secondary forest	logging, collecting of kindling
ME8	-4.657	11.982	103	secondary forest	logging, planting, burning, bushmeat hunting, clearing trails
ME9	-4.650	11.929	116	secondary forest	logging, cultivation, charcoal
ME10	-4.649	11.966	92	secondary forest	logging, cultivation, charcoal
ME11	-4.647	12.003	129	secondary forest	logging, gathering kindling, cultivation, charcoal
ME12	-4.636	11.932	109	secondary forest	logging, burning, cultivation, harvesting of leaves, hunting
ME13	-4.720	12.005	69	fallow land (recently cultivated)	heavily logged, bushmeat hunting
ME14	-4.639	11.966	95	fallow land (old, regenerated)	logging, burning, cultivation, harvesting of leaves, charcoal
ME15	-4.721	11.961	38	wetland (small river)	fishing, dumping garbage
ME16	-4.707	11.978	62	wetland	harvesting of bark, leaves, &c
ME17	-4.695	11.953	58	wetland	logging, planting
ME18	-4.680	11.984	53	wetland	harvesting of forest products, logging, fishing
ME19	-4.654	11.966	50	wetland (stream in flooded land)	harvesting of leaves, bushmeat hunting, firewood
ME20	-4.636	11.973	48	wetland (stream and swamp)	logging, cultivation
ME21	-4.634	11.978	79	wetland (lake)	logging, harvesting of forest products, fishing, hunting
MC1	-4.533	12.021	45	fallow land (recently cultivated)	logging, cultivation of land cleared by burning, charcoal
MB1	-4.514	12.035	30	savanna	burning, cultivation, charcoal
MB2	-4.499	12.087	7	wetland (small river, swamp)	logging
MB3	-4.499	12.092	28	wetland (stream, swamp)	logging, silting up, harvesting of leaves, gathering of kindling

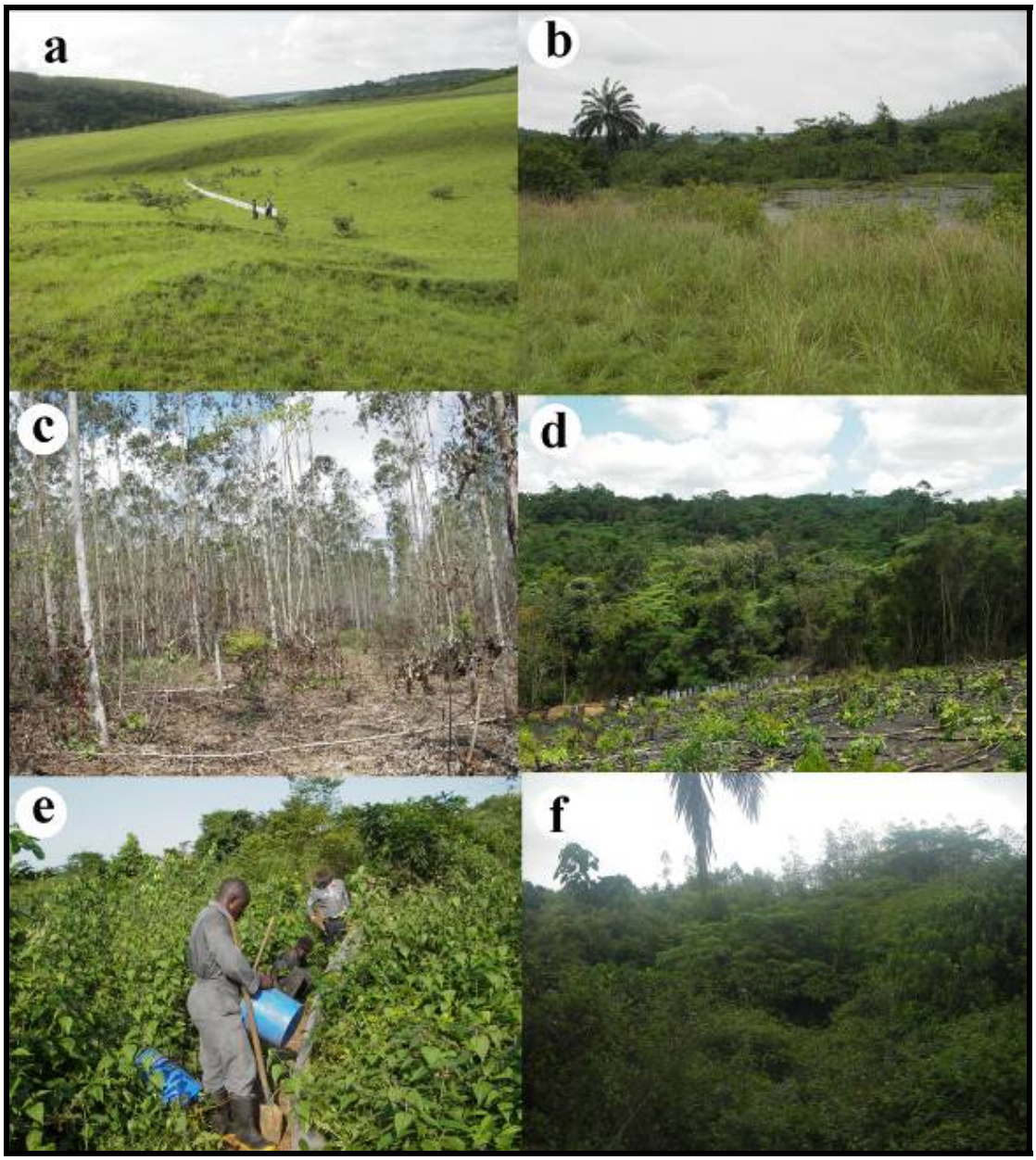

FIGURE 2. Habitat types sampled in Kouilou Region of the Republic of Congo: (a) grassy savanna with drift fence, (b) wetland (this is just one example of a highly varied habitat type), (c) eucalyptus plantation, (d) secondary forest (showing damage from logging), (e) recently cultivated fallow land, starting to regrow, (f) fallow land cultivated in the more distant past, regrown to the point that it is often a fine line between this habitat type and secondary forest. (Photographed by GENIVAR personnel)

simple wooden boards (40 x 40 cm) placed along the fence to serve as refugia for lizards and small snakes.

Active searching in wetlands and on land involved turning over logs, rocks, and other potential refugia. GENIVAR personnel also carried out visual encounter surveys at night using headlamps at 18 stations. Though not distributed evenly among stations, the total sampling effort was 48 cumulative hours of active searching.

Visual observations, documented when possible by photographs, were made of some captured specimens that were not collected. These included protected species and also species for which large series had already been collected.

Voucher specimens.—Throughout the survey, GENIVAR personnel collected and froze representative voucher specimens. These 187 frozen specimens are

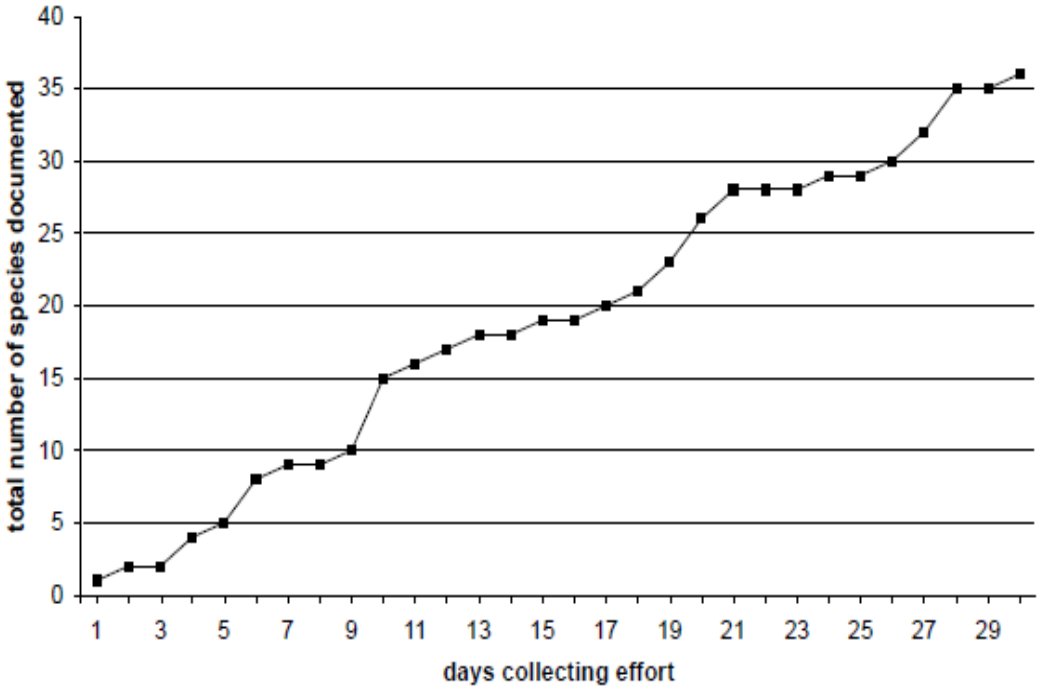

FIGURE 3. Total number of species documented over the course of the 30 day sampling period in Kouilou Region of the Republic of Congo.

deposited in the collection of the Redpath Museum at McGill University, Montreal. Tissue samples from each species were fixed in 90% ethanol and the vouchers were then fixed in 10% formalin. Family-level classification is consistent with that proposed by Frost et al. (2006), with the exception of that for the Ranidae, which follows Bossuyt et al. (2006) and Wiens et al. (2009).

RESULTS AND DISCUSSION

The total number of traps at all stations combined was 578, representing 37,886 cumulative hours of trapping (including all hours during which traps were set). We documented 37 species, including 12 amphibians and 25 reptiles over the course of 30 days of sampling (Table 2), although the species accumulation curve did not level-off (Fig. 3). Of the 12 amphibians documented, three were caught or observed in relatively high abundance and nine others were uncommon (Fig. 4). Of the 25 reptiles caught or seen, only one, *Trachylepis albilabris*, was found frequently (Fig. 5).

AMPHIBIA: ANURA: ARTHROLEPTIDAE

***Arthroleptis "poecilonotus"* Peters, 1863.**—Fifty-eight specimens documented (35 collected). Localities: ME1, ME13, ME14, ME16, ME17, ME18, ME25, ME27 (not collected but observed at ME9, ME10, ME11). Voucher specimens: Redpath 4674–5, 4677–80, 4683–5, 4688, 4692, 4699, 4703, 4706–7, 4709, 4711, 4716, 4718, 4720, 4722, 4724, 4726–30, 4734–36, 4738, 4740–1, 4764–5. Nine specimens collected in funnel traps, one beneath a hide-board, 47 in pitfall traps, and one from active searching. *Arthroleptis poecilonotus* is a widespread species complex consisting of morphologically similar yet genetically divergent lineages (e.g., Rödel 2000; Rödel and Bangoura 2004; Blackburn 2008, 2010). Phylogenetic analysis of sequence from the mitochondrial 16S ribosomal RNA gene indicates that specimens from this survey form a clade with those from Cameroon, eastern Nigeria, and Gabon, and thus divergent from morphologically similar populations occurring in the Upper Guinean Forest Zone of western Africa (David Blackburn, unpubl. data). Of all amphibians and reptiles collected during this survey, *A. poecilonotus* was the only one to be found in all habitats, with the highest proportions of specimens coming from sites in wetlands, secondary forest, or recently cultivated but fallow land.

***Leptopelis* cf. *millsoni* Boulenger, 1895.—**Two specimens documented. Localities: ME1 and near Marcel-Rigny Camp. Voucher specimens: Redpath 4712, 4769. One specimen (Fig. 6e) collected in a pitfall

TABLE 2. Number of individuals of each species documented at each habitat type from 30 survey days in Kouilou Region of the Republic of Congo: GS = grassy savanna; WE = wetland; EP = eucalyptus plantation; SF = secondary forest; RC = recently cultivated fallow land; FC = formerly cultivated fallow land, regenerating; HH = human habitation.

Species	GS	WE	EP	SF	RC	FC	HH
Arthroleptis "*poecilonotus*"	5	11	4	15	17	6	
Leptopelis cf. *millsoni*	2						
Amietophrynus cf. *camerunensis*	4	1	2			1	
Hemisus perreti	1	2	1		1		
Hyperolius cinnamomeoventris		1	1				
Xenopus (*Silurana*) *epitropicalis*	1						
Xenopus (*Silurana*) sp. ("new tetraploid 1")	6						
Xenopus (*Silurana*) sp.		24	1				
Phrynobatrachus hylaios	6			2			
Ptychadena achietae							
Ptychadena cf. *perreti*		1					
Hylarana albolabris		6		13	3	2	
Agama agama	3		2				
Gerrhosaurus nigrolineatus	1	2			1		
Afroblepharus tancredi	2	1	1	1			
Feylinia currori		1					
Mochlus fernandi				5			
Trachylepis albilabris		1	3	27	7		
Chamaeleo dilepis	4			2			
Varanus niloticus	4						
Typhlops lineolatus			3	2	3	1	
Python sebae		1					
Boiga blandingii							1
Crotaphopeltis hotmaboeia		1					1
Dasypeltis fasciata							1
Hormonotus modestus		1					
Lamprophis fuliginosus							1
Lycophidion laterale				1			
Natriciteres olivacea		1					
Philothamnus angolensis		1					
Philothamnus heterodermus				1			
Psammophis sibilans	1						
Thrasops flavigularis							1
Dendroaspis jamesoni	1						
Naja melanoleuca	1						
Causus maculatus			1				1
Kinixys homeana	1				1		

trap and one from active searching. Both specimens were collected in grasslands. Following Amiet (2001), these specimens are best identified as *L. millsoni* because they exhibit a subrectangular and straight interocular bar as well as anastomosing markings on the dorsum. These records, if corresponding to *L. millsoni*, would extend the geographic range of this species into southern Republic of Congo.

BUFONIDAE

***Amietophrynus* cf. *camerunensis* (Parker, 1936).—** Seven specimens documented. Localities: MC1, ME3, ME13–ME15, and near Marcel-Rigny Camp. Voucher specimens: Redpath 4689–91, 4697, 4719, 4773, 4780. One specimen collected in a funnel trap, three in pitfall traps, and three from active searching. These specimens are morphologically heterogenous and might represent two or more distinct taxa. However, without genetic or acoustic data, at this time we tentatively assign all of these specimens to the same taxon, which may represent *A. camerunensis*. The morphology of several of these specimens (e.g., Redpath 4697, 4780) is essentially in agreement with the description provided for *A. camerunsensis* by Perret and Amiet (1971), while others (e.g., Redpath 4690) seem more similar to *A. maculatus* or even *A. regularis*.

HEMISOTIDAE

***Hemisus perreti* Laurent, 1972.—**Five specimens documented (three collected). Localities: ME13, ME15 (not collected but observed at ME2 and ME5). Voucher specimens: Redpath 4687, 4708, 4710. All specimens

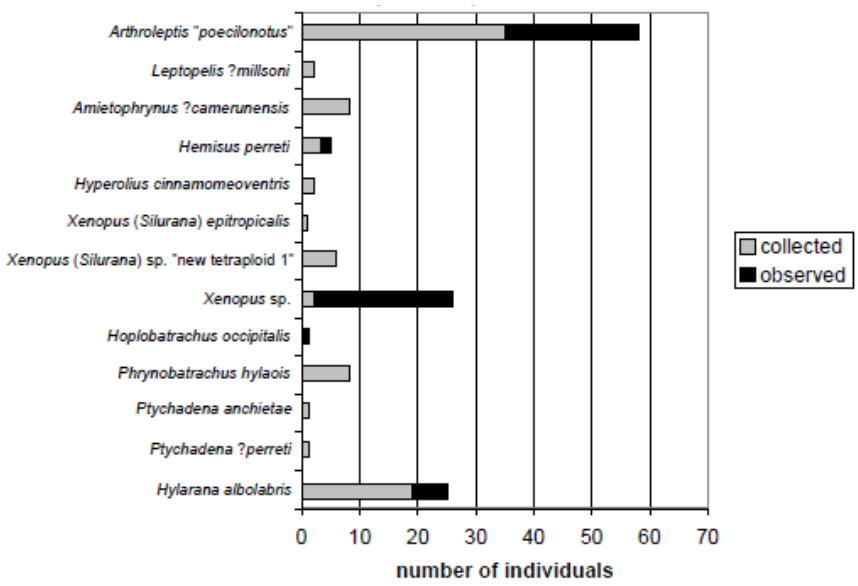

FIGURE 4. Total numbers of individuals of each amphibian species collected (grey) and observed but not collected (black).

collected in pitfall traps. This is a poorly known species (Fig. 6a) documented in few other faunal surveys of this region in Central Africa (Laurent 1972; Burger et al. 2006). *Hemisus perreti* was first described from a locality in the extreme southwestern and nearly coastal part of what is now the Democratic Republic of Congo, but is now also known from Gabon. Previous surveys documented this species in rainforest (Burger et al. 2006). The present surveys found it to also occur in grasslands, wetlands, and an eucalyptus plantation, which suggests a broad ecological tolerance. This species is one of few frogs that are endemic to this region of coastal Central Africa. To our knowledge, this is the first record from the Republic of Congo.

HYPEROLIIDAE

***Hyperolius cinnamomeoventris* Bocage, 1866.—**Two specimens documented. Localities: MB2, ME3. Voucher specimens: 4739, 4775. Both specimens found through active searching. This is a widespread species apparently tolerant of a variety of habitat types (International Union for the Conservation of Nature. 2009. IUCN Red List of Threatened Species. Version 2009.2. Available from http://www.iucnredlist .org), though this survey only found specimens associated with either wetlands or eucalyptus plantations.

PIPIDAE

***Xenopus* (*Silurana*) *epitropicalis* (Gray, 1864).—**One specimen collected. Localities: ME1. Voucher specimens: Redpath 4702. Single specimens collected through active searching. Unsurprising for an aquatic frog, personnel collected this species in a wetland area. Preliminary genetic analyses indicate that this specimen represents *Xenopus epitropicalis* (Ben Evans, unpubl. data), which agrees with both the geographic boundaries between *X. tropicalis* and *X. epitropicalis* proposed by Loumont (1983) and morphological comparisons to specimens of *X. epitropicalis* (KU 195664–5).

***Xenopus* (*Silurana*) sp. "new tetraploid 1" (*sensu* Evans et al., 2004).—**Six specimens collected. Locality: ME1. Voucher specimens: Redpath 4686, 4713, 4763, 4766–7, 4771. Four specimens collected in pitfall traps and two through active searching. These frogs occurred syntopically with *X. epitropicalis* in a wetland with more than 20 other morphologically similar specimens that personnel did not collect, thus making it impossible to refer these specimens with confidence to any of the *Xenopus* species listed here. Although morphologically similar to *X. epitropicalis*, genetic analyses (Ben Evans, unpubl. data) indicate that these represent *X.* (*Silurana*) "new tetraploid 1" of Evans et al. (2004).

***Xenopus* sp.—**Two specimens collected. Localities: ME4, ME15. Voucher specimens: Redpath 4704, 4714. Both specimens were collected in pitfall traps. As with the above *Xenopus* specimens, these two occurred in a wetland. However, because we lack genetic data for these and they are morphologically similar to those identified above as *X. epitropicalis* and *X.* sp. "new tetraploid 1", we refrain from identifying them to species.

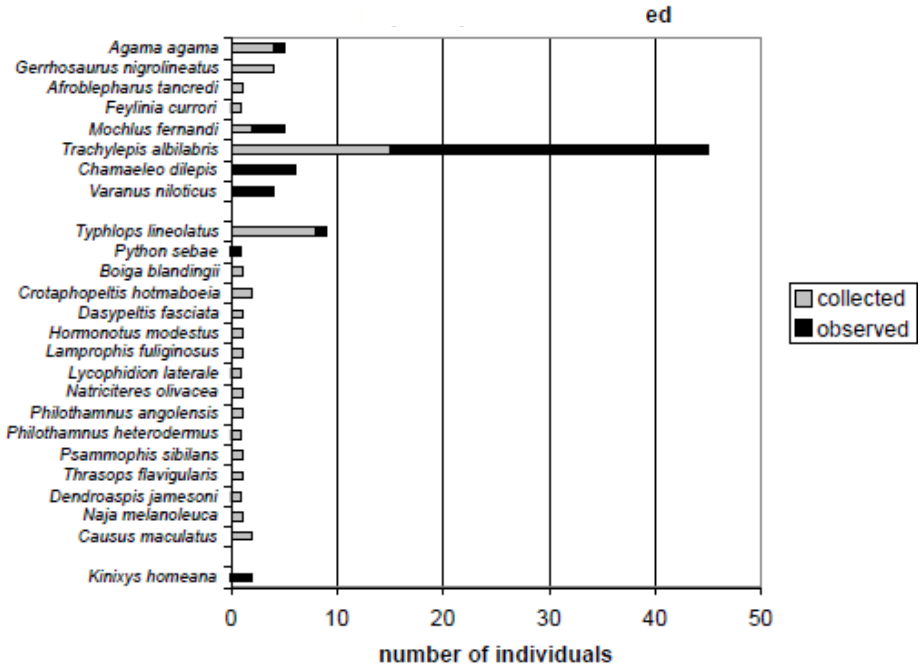

FIGURE 5. Total numbers of individuals of each reptile species collected (grey) and observed but not collected (black).

RANIDAE: DICROGLOSSINAE

***Hoplobatrachus occipitalis* (Günther, 1858).—**One specimen documented, but not collected. Locality: Unknown. This species is relatively widespread occurring in wetlands throughout much of Central, eastern, and western Africa, though it is apparently absent from much of the Congo Basin (IUCN 2009; for exception, see Jackson and Blackburn 2007; Jackson et al. 2007).

RANIDAE: PHRYNOBATRACHINAE

***Phrynobatrachus hylaios* Perret, 1959.—**Eight specimens documented. Localities: ME1, ME6, ME12. Voucher specimens: Redpath 4682, 4705, 4715, 4731, 4761, 4768, 4770, 4774. Three specimens collected in pitfall traps, four beneath hide boards, and one through active searching. *Phrynobatrachus hylaios* (Fig. 6b) is widespread throughout the coastal region of Central Africa extending in-land to parts of the Congo Basin (Jackson and Blackburn 2007; Jackson et al. 2007). All specimens occurred in association with swampy habitat in the wetlands. These specimens agree with the morphological diagnosis provided for the poorly known *P. hylaios* by Perret (1959) and are similar to those reported from elsewhere in the Republic of Congo (e.g., Jackson and Blackburn 2007).

RANIDAE: PTYCHADENINAE

***Ptychadena anchietae* (Bocage, 1868).—**One specimen documented. Localities: near Marcel-Rigny Camp. Voucher specimen: Redpath 4777. Specimen collected through active searching. The single specimen (Fig. 6d) occurred in an area with short grasses and low vegetation. This is one of few amphibian species documented in these surveys that is widespread throughout southern, and even eastern, Africa (Channing 2001).

***Ptychadena* cf. *perreti* Guibé and Lamotte, 1958.—**One specimen documented. Localities: ME16. Voucher specimen: Redpath 4696. Specimen collected in funnel trap. The single specimen (Fig. 6c) occurred in swampy habitat in the wetlands. *Ptychadena perreti* is widespread throughout the lowland regions of coastal Central Africa and the western portion of the Congo Basin (e.g., Largen and Dowsett-Lemaire 1991; Burger et al. 2006; Jackson and Blackburn 2007).

RANIDAE: RANINAE

***Hylarana albolabris* (Hallowell, 1856).—**Twenty-five specimens documented (18 collected). Localities: ME9, ME10, ME12, ME13, ME22 (not collected but observed at ME15, ME20, ME21). Voucher specimens: Redpath 4673, 4676, 4681, 4693–5, 4698, 4700–1, 4717, 4721,

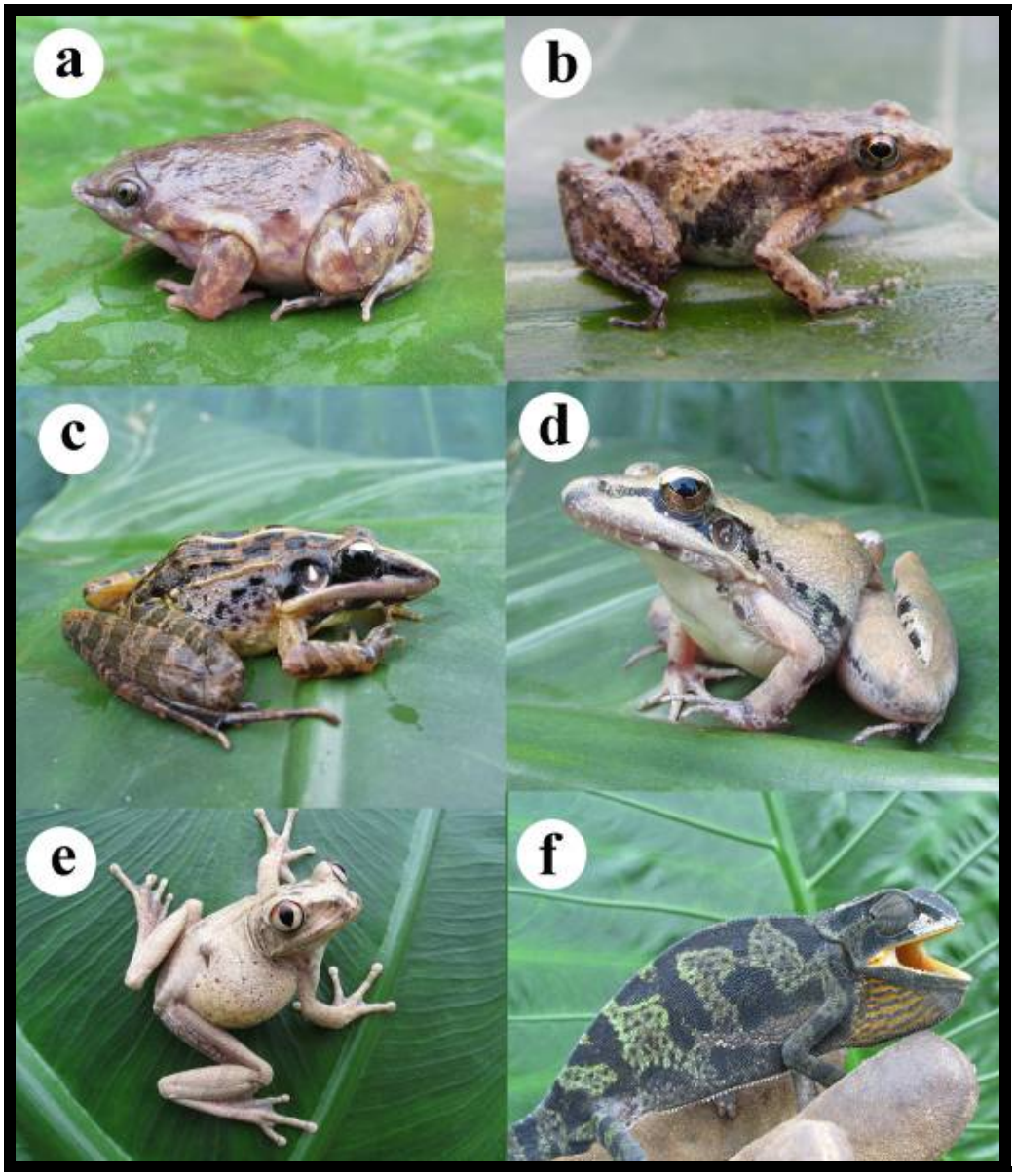

FIGURE 6. Some of the species collected from the degraded habitats in the Republic of Congo. (a) *Hemisus perreti* (Redpath 4710), SVL = 28.5 mm; ; (b) *Phrynobatrachus hylaios* (Redpath 4682), snout–vent length (SVL) = 21 mm; (c) *Ptychadena* cf. *perreti* (Redpath 4696), SVL = 44 mm; (d) *Ptychadena anchietae* (Redpath 4777), SVL = 50mm; (e) *Leptopelis* cf. *millsoni* (Redpath 4712), SVL = 44 mm; (f) *Chamaeleo dilepis* (not collected), SVL = 55 mm. Lengths as reported by GENIVAR personnel.

4723, 4725, 4732–3, 4762, 4776, 4788. Six specimens collected in funnel traps, two beneath hide boards, nine in pitfall traps, and eight through active searching. Nearly all specimens occurred in association with water (e.g., swamp, stream, lake) with the greatest proportions of specimens in either wetlands or secondary forest. *Hylarana albolabris* is widespread throughout western and Central Africa, including the Congo Basin, and is frequently associated with secondary habitats and degraded forests (IUCN 2009).

REPTILIA: SQUAMATA: "LACERTILIA": AGAMIDAE

***Agama agama* (Linnaeus, 1758).—**Five specimens documented (four collected). Localities: ME4, Boutoto village, eucalyptus plantation. Voucher specimens: Redpath 4665–7, 4779. Three specimens occurred in a village, one under charred wood in moderate overgrowth near a village, one on a tree trunk in a eucalyptus plantation. *Agama agama* has a vast distribution in Africa and is generally abundant, inhabiting a variety of

habitat types and being conspicuous on both the ground or climbing trees and buildings (Spawls et al. 2002; Chirio and LeBreton 2007). Largen (1991) documented this species in the Kouilou Province.

CHAMAELEONIDAE

***Chamaeleo dilepis* Leach, 1819.—**Six specimens documented (none collected). Localities: ME9, secondary forest, grassy savanna around and in Boutoto village. This species (Fig. 6f) has a broad distribution in Africa and is often locally abundant (Chirio and LeBreton 2007). Largen (1991) documented this species in the Kouilou Province. An arboreal but primarily savanna species, *C. dilepis* can be found perched on the branches of widely dispersed bushes and trees, as well as on the ground between them. A diurnal species, *C. dilepis* is reported as spending nights perched on tree branches at forest edges (Pauwels and Vande Weghe 2008). These observations are consistent with those made during this survey as individuals were found in secondary forest and, more commonly, in savanna and even in a village. Like all chameleons, *C. dilepis* is listed as CITES II.

GERRHOSAURIDAE

***Gerrhosaurus nigrolineatus* Hallowell, 1857.—**Four specimens documented. Localities: AC1, ME16, MC1. Vouchers: Redpath 4668–70, 4760. Three individuals captured by hand, and one in a funnel trap in savanna. Largen (1991) reported this species as ubiquitous in grassy clearings and at forest margins.

SCINCIDAE

***Afroablepharus tancredi* (Boulenger, 1909).—**Five specimens documented. Localities: ME2, ME5, ME10, MB3. Vouchers: Redpath 4655–7, 4663, 4772. Three specimens collected in pitfall traps, one beneath a hide board, and one by hand. This is the first record from the Republic of Congo. It is otherwise known from a handful of reports from regions as distant as Ethiopia and southern Democratic Republic of Congo (Fuhn 1970). A small and poorly studied species little is known of the natural history of *A. tancredi*, except that it is diurnal, terrestrial, and feeds primarily on insects and their larvae (Fuhn 1970; Perret 1975). Notably, the five specimens reported here occurred in a variety of habitat types (savanna, eucalyptus plantation, secondary forest, and a wetland).

***Feylinia currori* Gray, 1845.—**One specimen documented. Locality: ME16. Voucher: Redpath 4753. The single specimen collected in a pitfall trap. Largen (1991) also reported this species from Kouilou Province.

***Mochlus fernandi* (Burton, 1836).—**Five specimens documented (two collected). Locality: ME6 Vouchers: Repath 4672, 4671. All specimens collected in pitfall traps in secondary forest.

***Trachylepis albilabris* (Hallowell, 1857).—**Fort-five specimens documented (15 collected). Localities: ME8, ME5, ME6, ME4, ME9, ME10, ME11, ME12, ME13, ME14, ME15, ME16, ME18, MC1. Vouchers: Redpath 4658–62, 4664, 4746, 4754–8, 4783–4, 4786. Twenty-six specimens collected in funnel traps, 18 in pitfall traps, and one by hand. Our results are consistent with those of Largen (1991) who reported this species as present in coastal regions of West Africa from Guinea to Cameroon, Gabon and Congo, and by far the most common reptile at his study site in the Kouilou Province.

VARANIDAE

***Varanus niloticus* (Linnaeus, 1758).—**Four specimens documented (none collected). Localities: savanna near villages of Boutoto and Mengo. Documentation by visual survey or capture by hand. *Varanus niloticus* is listed as CITES II.

REPTILIA: SQUAMATA: SERPENTES: TYPHLOPHIDAE

***Typhlops lineolatus* Jan, 1864.**—Nine specimens documented (eight collected). Localities: ME5, ME13, ME14, ME16, ME18, ME19. Vouchers: Redpath 4746, 4752, 4754–58, 4786. All specimens captured in pitfall traps. *Typhlops lineolatus* is reported to be a savanna species (Trape and Roux-Estève 1995). However, the specimens reported here occurred in four different habitat types (Table 2), none of which is savanna.

PYTHONIDAE

***Python sebae* (Gmelin, 1789).**—One individual documented (not collected). Locality: ME18. *Python sebae* is reported to be primarily a savanna species that is often found around water even in forested habitats (Trape and Roux-Estève 1995; Chippaux 2006). The specimen found in this survey occurred in a wetland. The species is classified as CITES II and is often killed for its meat and skin (Chippaux 2006).

"COLUBRIDAE"

***Boiga blandingii* (Hallowell, 1844).**—One individal documented. Locality: away from any sampling station. Voucher: Redpath 4742. *Boiga blandingii* is an

arboreal forest species (Chippaux 2006). Our specimen, however, was captured inside a house in a village.

Crotaphopeltis hotamboeia **Laurenti, 1768.—**Two specimens documented. Locality: ME21 and away from any sampling station. Vouchers: Redpath 4747, 4787. This species is universally reported as a savanna species and is common around human habitations (Trape and Roux-Estève 1995; Chippaux 2006). Of our two specimens, one was captured in a house in a village, but the other, more surprisingly, occurred in a wetland.

Dasypeltis fasciata **Smith, 1849.—**One specimen documented. Locality: near Boutoto village. Voucher: Redpath 4782. Reported as a forest species, where it is often abundant (Trape and Roux-Estève 1995; Chippaux 2006), local people found and killed this specimen of *D. fasciata*.

Hormonotus modestus **(Duméril & Bibron, 1854).—**One specimen documented. Locality: ME16. Voucher: Redpath 4749. Known exclusively as an arboreal forest species (Trape and Roux-Estève 1995; Chippaux 2006), the single specimen reported here occurred in a funnel trap (and thus on the ground) in a wetland area.

Lamprophis fuliginosus **(Boie, 1827).—**One specimen documented. Locality: Marcel-Rigny Camp. Voucher: Redpath 4751. *Lamprophis fuliginosus* is a savanna species (Trape and Roux-Estève 1995) and often found near human habitations (Chippaux 2006; Kate Jackson, pers. obs.). The single specimen found during this study occurred at the Marcel-Rigny Camp, which is essentially a human habitation.

Lycophidion laterale **Hallowell, 1857.—**One specimen documented. Locality: ME9. Voucher: Redpath 4750. Collected in a pitfall trap. Little information is available for the habitat preferences of *L. laterale*. The specimen collected during this study is among the minority of snakes not captured opportunistically in areas heavily disturbed by human activity (e.g., villages and roads) or areas easily accessible to humans actively searching for snakes (e.g., savanna as opposed to forest). Thus the capture of this specimen in a pitfall trap in secondary forest may more accurately represent the true habitat of the species.

Natriciteres olivacea **(Peters, 1854).—**One specimen documented. Locality: ME21. Voucher: Redpath 4748. Within the genus *Natriciteres*, *N. olivacea* is said to be more typically associated with water (Trape and Roux-Estève 1995), indeed even semi-aquatic (Chippaux 2006), than its congener *N. fuliginoides*, a forest specialist species that is less aquatic. Predictably, this single specimen of *N. olivavea* occurred in a wetland.

Philothamnus angolensis **Bocage, 1882.—**One specimen documented. Locality: swamp away from a sampling station. Voucher: Redpath: 4745. *Philothamnus* is a genus of diurnal arboreal snakes, with the natural history of this particular species poorly known.

Philothamnus heterodermus **(Hallowell, 1957).—**One specimen documented. Locality: ME9. Voucher: Redpath 4785. *Philothamnus heterodermus*, a savanna species (Trape and Roux-Estève 1995), can be found in degraded secondary forest and around human habitations (Chippaux 2006). Our specimen occurred in degraded secondary forest. Although an arboreal species, the specimen collected in this study was found on the ground and may reflect the fact that snakes on the ground are more easily noticed and captured than those in trees.

Psammophis sibilans **(Linnaeus, 1758).—**One specimen documented. Locality: grassy savanna away from sampling station. Voucher: Redpath 4781. *Psammophis sibilans* is distinctive for its unusual distribution (Trape and Roux-Estève 1995; Chippaux 2006). Although primarily a West African species, it is locally abundant in the coastal region of the Congo in the vicinity of Pointe Noire. Consistent with its reputation as a savanna species, this specimen occurred on the ground in savanna.

Thrasops flavigularis **(Hallowell, 1852).**—One specimen documented. Locality: near Mengo village, away from a sampling station. Voucher: Redpath 4743. A villager found and killed the single specimen recorded. *Thrasops flavigularis* has been previously reported as an arboreal species (Chippaux 2006).

ELAPIDAE

Dendroaspis jamesoni **(Traill, 1843).—**One specimen documented. Locality: savanna away from a sampling station. Voucher: Redpath 4759. A semi-arboreal species (Chippaux 2006) that is said to be abundant in forests (Trape and Roux-Estève 1995), a vehicle ran over this single specimen on a road passing through savanna habitat.

Naja melanoleuca **Hallowell, 1857.**—One specimen documented. Locality: savanna away from a sampling station. Voucher: Redpath 4744. *Naja melanoleuca* is abundant in forests and often found in and around bodies of water (Trape and Roux-Estève 1995; Kate Jackson, pers. obs.). In contrast, personnel captured this specimen on the ground in savanna.

VIPERIDAE

***Causus maculatus* (Hallowell, 1842).—**Two specimens documented. Locality: away from sampling stations; one on a road between secondary forest and a eucalyptus plantation, and the other in a village. Vouchers: Redpath 4783, 4784. Known as a versatile savanna species that is also found in other degraded habitats types (Trape and Roux-Estève 1995), *C. maculatus* adapts so well to human habitations that it is even found in large cities such as Brazzaville (Jackson, pers. obs.)

REPTILIA: TESTUDINES: TESTUDINIDAE

***Kinixys homeana* Bell 1827.—**Two specimens documented (none collected). Localities: ME13, savanna near Boutoto village. This is the first report of this species from the Republic of Congo, though it is known to occur in neighboring countries: Cameroon, Equatorial Guinea, Democratic Republic of Congo, and Gabon (Chirio and LeBreton 2007). Pauwels and Vande Weghe (2008), however, do not record *K. homeana* in Gabon. Chirio and LeBreton (2007) describe *K. homeana* as a forest species with a preference for conditions damper than those preferred by *K. erosa*. However, all of the specimens reported here occurred in open habitats. *Kinixys homeana* is listed as CITES II and is primarily threatened by local people collecting individuals for food.

FAUNAL COMPARISONS

There are few thorough studies of the amphibian and reptile fauna of the Republic of Congo. This country encompasses a diversity of Central African habitats, ranging from swamp forests of the Congo Basin to savannas near the coast. Forested regions in the northern reaches of the country are among the most poorly studied (Guibé 1946; Blackburn and Jackson 2006; Jackson and Beier 2006; Jackson and Blackburn 2007; Jackson et al. 2007). Previous studies focusing on amphibians (Laurent 1961; Largen and Dowsett-Lemaire 1991), reptiles in general (Mocquard 1889; de Witte 1967; Largen 1991), or even snakes in specific (Ravisse 1960; Trape 1985; Trape and Roux-Estève 1990, 1995; Rasmussen 1991), from regions nearer to the coast have revealed varying relationships between faunas. The latter are particularly important for evaluating the biogeographic relationship between the coastal regions of Central African and that to the south of the Congo River. Collecting methods for several previous studies bordered on haphazard (Trape 1985; Rasmussen 1991) though other recent studies are more methodical (e.g., Largen and Dowsett-Lemaire 1991). Previous work by Largen and Dowsett-Lemaire (1991) on the amphibian fauna of this region of Republic of Congo documented a much greater number of species, though a number of these localities were relatively intact forested sites that would be expected to harbor greater diversity than the anthropogenically degraded habitats surveyed here. Instead of only generating a list of species present at studied localities, GENIVAR staff designed and implemented this survey as an attempt to estimate relative abundances of species. Although possibly effective for terrestrial anurans and lizards, this proved ineffective for documenting snakes and arboreal anurans. It is notable that the number of species documented did not level off over the course of the 30-day sampling period (Fig. 3), suggesting that this survey under-represents the number of species actually present in the study area. Thus, while these surveys provide valuable documentation of a poorly studied fauna, we cannot consider this to be a thorough inventory of the amphibian and reptile species in this region.

Throughout our study of the snakes collected during this survey, we frequently found discordance between the habitat type recorded for a given species during this survey and that reported to be typical for it in the literature. Unfortunately, in many cases, it is difficult to evaluate this discordance in habitat types. For instance, we record the Forest Cobra (*Naja melanoleuca*) in savanna. This may reflect fragmentation or destruction of the former forest habitat of the species or, alternatively, simply may reflect the ease of finding and capturing a snake in open savanna relative to forest. Because of these discordances, we believe that this survey of snakes is undermined by several factors: (1) the difficulty of finding snakes in African tropical forest and the lack of effective methods for capturing them; (2) the extreme fragmentation and anthropogenic disturbance of the study zone, such that "typical" habitats represented only small areas; and, related to both of the above factors, (3) the heavy reliance on either opportunistic captures by villagers or chance encounters with snakes outside of time dedicated to "active searching" and away from sampling stations. This last point is particularly important for assessing habitat preferences. Opportunistic encounters may bias sampling towards species, or even specific individuals, that tend to enter human habitations or locations where snakes are more easily encountered. As such, in either case, it is difficult to interpret the habitat types recorded here as representing the "real" habitat for many species.

Even though the list of snake species found during this survey is certainly incomplete, comparisons are still valuable to two other surveys of snakes in the Kouilou River drainage basin. These studies by Trape (1985) and Rasmussen (1991) were limited to snakes and carried out on a much larger scale than in the survey conducted by GENIVAR near Pointe Noire. Comparisons are revealing despite the different sampling methodologies.

Trape (1985) collected 351 snakes representing 45 species in four villages in the Mayombe Region in fragmented primary forest approximately 100 km northeast of Pointe Noire. Snakes were sampled over a period of two years by placing carboys of formalin in several villages and compensating villagers for capturing snakes and storing them in the carboys, which were collected periodically. In a later study, Rasmussen (1991) assembled a list of snake species present in the Kouilou River by combining information from several small collections made by other researchers. These specimens came from several localities within the Kouilou region, with none from more than 80 km from Pointe Noire. Rasmussen (1991) documented 48 snake captures representing 25 species. In the present study, we documented only 26 snake specimens representing 16 species. Yet, there are considerable differences in species composition, including several of the species reported here not occurring in the inventories of either Trape (1985) or Rasmussen (1991). Given the differences in habitat type between this study and that of Trape (1985), such differences are not surprising. However, Trape (1985) did not observe six species that are occasionally associated with forest and observed in the survey presented here: *Typhlops lineolatus*, *Crotaphopeltis hotamboiea*, *Natriciteres olivacea*, *Philothamnus angolensis*, *Psammophis sibilans*, and *Causus maculatus*. Similarly, Rasmussen (1991) did not find six species found in our survey, though this can be attributed to the small sample sizes of both surveys. Interestingly, the six species differing between this survey and that of Rasmussen (1991) are also ones tending to favor forested habitats, but still largely differ from those differing between this survey and that of Trape (1985): *Natriciteres olivacea*, *Hormonotus modestus*, *Philothamnus angolensis*, *P. heterodermus*, *Dasypeltis fasciata*, and *Thrasops flavigularis.*

Similar to the records for snakes, there is discordance for the Hingeback Tortoise (*Kinixys homeana*) between the observed and previously reported habitat types. Previously, Chirio and LeBreton (2007) reported that *K. homeana* prefers damp forest, but this survey found specimens in open habitats. Similar to the situation with some snakes, these observations might be biased by sampling strategy as tortoises may be more easily found in savanna than in forest.

While several records are significant range extensions for species of frogs (i.e., *Hemisus perreti*, *Leptopelis millsoni*), perhaps the most notable record is that of *Afroablepharus tancredi* in the Republic of Congo. This record represents a remarkable range extension for a species previously known from widely separated Ethiopia and southern Democratic Republic of Congo. Its presence in the Congo likely reflects a general pattern for many African species that are widespread but either not generally abundant or only infrequently encountered.

In general, the degraded sites surveyed during this work held few surprises in terms of species occurrences. Most of the recorded amphibian species are already known to tolerate a variety of habitat types, including anthropogenically degraded sites such as secondary forests, palm plantations, and “farmbush” (IUCN 2009). Perhaps most surprising are records of species at sites sampled during these surveys that were previously believed to be associated with primary forests or less disturbed forest; this includes *Hemisus perreti*, which occurred in a variety of disturbed habitats. Recent research on African amphibian community ecology demonstrates that faunal composition can differ substantially between natural and artificial habitats (Vignoli et al. 2010), with the typically greater species diversity at “natural” sites attributed to the greater number of ecological niches. Vignoli et al. (2010) also attribute the apparently random species assemblages at artificial sites to be a function of chance recent colonizations. In the present study, the composition of the fauna at disturbed sites is also likely determined by a combination of chance and the efficacy of colonization for a given species. Yet, given the history of human-driven habitat change in Central Africa (e.g., Delègue et al. 2001; Brncic et al. 2007), as well as the potential for such changes even in the deep past (e.g., Oslisly and Peyrot 1992; Tutin and Oslisly 1995), it is not possible to evaluate the time-frame of faunal assembly at sites surveyed in this work. It is conceivable that the fauna of these disturbed sites is hundreds, or perhaps even thousands, of years old.

Most species of amphibians and reptiles encountered during this survey occur throughout Central Africa or even more broadly with ranges extending into West or even East Africa (e.g., Chirio and LeBreton 2007; IUCN 2009). Even though many of the species recorded are widely distributed and known to tolerate moderate to high levels of habitat disturbance, components of this fauna are still interesting biogeographically. Some species, such as *Hemisus perreti*, *Phrynobatrachus hylaios*, and *Thrasops flavigularis*, are restricted to the region of Central Africa extending from Cameroon to southern Republic of Congo. Others also extend into the Congo Basin (e.g., *Amietophrynus camerunensis*, *Hyperolius cinnamomeoventris*, *Ptychadena perreti*). Among reptiles, several species encountered are distributed in forested regions of both West and Central Africa (e.g., *Dendroaspis jamesoni*, *Kinixys homeana*, *Lycophidion laterale*, *Trachylepis albilabris*; Chippaux 2006; Chirio and LeBreton 2007). Recent taxonomic revisions of amphibians and other vertebrates tend to recognize species endemic to each of these regions, thus eroding examples of forest taxa with disjunct distributions in West and Central Africa (e.g., Rödel and Ernst 2000; Tandy and Perret 2000; Ernst and Rödel 2002; Fahr et al. 2002; Blackburn et al. 2008). Such will

likely also be the case for one of the frog species encountered in this study; evidence suggests that *A. poecilonotus* is a species complex with component taxa being restricted to either Central or West Africa (Rödel and Bangoura 2004; Blackburn 2008, 2010). For both amphibians and reptiles, future refining of species boundaries may reveal that particular cryptic taxa are more tolerant of habitat disturbance than others. An interesting pattern shared among a few species (e.g., *Hoplobatrachus occipitalis*, *Ptychadena anchietae*, *Varanus niloticus*) is a broad distribution throughout savannas in Central as well as West and/or East Africa, yet absence from the generally forested region of southern Cameroon, Gabon, and Equatorial Guinea. Future phylogeographic analyses of such species will be important for shedding light on the history of the relevant populations documented here in southern Republic of Congo. Did these species colonize this region from the south or, instead, did they have previously larger ranges that have fragmented by expansion of forests (e.g., Delègue et al. 2001) along the coasts of Cameroon, Gabon, and Equatorial Guinea? If the latter, and if the Congo River is indeed a major barrier to gene flow, then one might expect populations from the Republic of Congo to be more closely related to those from the savannas of Cameroon than those to the south of the Congo River. While we cannot address these questions here, the voucher specimens and related tissue samples collected during this survey and deposited at the Redpath Museum will provide an important resource for future biogeographic studies focused on these and other questions.

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Errata 20-Jan-2011. Corrected misplaced parentheses in the author designation of several scientific names. MLM.

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