

Herpetofauna, Parc National des Volcans, North Province, Republic of Rwanda

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ABSTRACT: Herein is presented a list of the reptiles and anurans from the Parc National des Volcans (PNV) (01°43' S, 29°52' W), an area in the west and north provinces of the Republic of Rwanda in the Albertine Rift region of Africa. Fieldwork was conducted between two and six days per week from June through August 2007 and 2008. We also conducted literature searches of all historical expeditions within the park for species records. Seventeen species of reptiles and anurans are recorded from the PNV. Nine of the species were anurans, distributed in five families: Arthroleptidae (3), Bufonidae (1), Hyperoliidae (3), Phrynobatrachidae (1), and Pipidae (1). Eight species of reptiles were recorded from five families: Chamaeleonidae (1), Lacertidae (2), Scincidae (2), Colubridae (2), and Viperidae (1). Eight of the seventeen species found in the PNV are endemic to the Albertine Rift.

INTRODUCTION

The Parc National des Volcans (PNV) in the Republic of Rwanda is situated in the northwest corner of the country along the border with the Democratic Republic of Congo (DRC) and the Republic of Uganda. The park encompasses an area of approximately 120 km² at an elevation of approximately 2,600 – 4,500 m (Sleeman *et al.* 2000). Within the boundaries of the PNV are portions of the Virunga Mountain range, a volcanic massif that is part of the Albertine Rift, which itself makes up the Central African highlands region (Saundry 2009). The PNV contains the sixth highest mountain in Africa (Mt. Karisimbi) and is one of two remaining areas with a population of mountain gorillas (*Gorilla beringei beringei*) (Plumptre *et al.* 2007). The Albertine Rift has more endemic vertebrate diversity than any other region in Africa and contains approximately 20% of the known amphibian species, 40 % of known bird species, and 20 % of the known mammal species on the continent of Africa (Plumptre *et al.* 2007). One species of endangered treefrog, *Leptopelis karissimbensis*, is known to exist within the borders of the PNV (IUCN 2009).

The PNV is part of a wider protected area that makes up most of the central Albertine Rift. This area was once a single national park called Albert National Park, although only a very small percentage of this original park now lies within the borders of Rwanda (< 5 %). In addition, the government of Rwanda annexed much of the lower elevations in the park during the 1970's and 80's in order to provide more land for human settlement, which almost completely eliminated all the true montane forest within the park. While de Witte (1941) wrote an excellent opus on the reptiles and amphibians of Albert National Park and Laurent (1972) published another book length review of the amphibians of the greater Virunga region, no comprehensive list exists for the herpetofauna of the PNV in its current form as a national park of Rwanda. Accurate data concerning species distribution is a necessary

component of biodiversity conservation. In this paper, we report on surveys we carried out in the PNV and provide a historical literature review in order to make a list of all the reptiles and amphibians currently found in the PNV, as well as any species that may occur within the borders of the park or have been extirpated. Many of the other protected areas formerly in Albert National Park such as Virunga National Park in DRC and Queen Elizabeth National Park in Uganda have lower elevation habitats (< 2,000 m), which often have a high number of amphibian and reptile species (Channing and Howell 2006). In contrast, the lowest elevations in the PNV are around 2,600 m.

MATERIALS AND METHODS

Study Site

The study site is the Parc National des Volcans and its neighboring areas, situated in the North Province of Rwanda in the northwestern corner of the country (Figures 1 and 2). The PNV has an area of approximately 15,000 ha and elevations above 2,600 m. Since the park is topographically diverse, there are several distinct vegetation zones: a bamboo zone dominated by *Arundinaria alpina*, which occurs between the park boundary and approximately 3,200 m; an upper forest zone dominated by large trees in the genera *Hypericum* and *Hagenia* between 3,200 m and 3,800 m; montane meadow communities dominated by *Senecio*, *Lobelia*, and various grasses occur interspersed throughout the forest at elevations between 3,000 m and 3,800 m; above 3,800 m, grasses, mosses, and lichens dominate the alpine zone, which exists all the way to the top of the highest mountains in the chain. The Virungas are one of only two areas in central Africa to have true Afromontane vegetative communities (Owiunji *et al.* 2005).

Data Collection

Fieldwork was conducted between two and six days per

week depending on weather and logistical concerns from June through August 2007 and 2008. All searches were conducted during daylight hours in the PNV. Fieldwork at night was not possible due to security and wildlife concerns. The lack of ability to work at night probably impaired collection of some species and it is likely that if we had conducted extensive nighttime surveys, additional species could have been found. Amphibians and reptiles were collected using the active search method (Franco *et al.* 2002). Some animals were captured with the aid of nets, snake hooks or snake tongs. Tadpoles were collected with nets. All voucher specimens were preserved according to techniques outlined by McDiarmid (1994) and deposited in the University of Texas at Arlington's Amphibian and Reptile Diversity Research Center collection (UTA A or UTA R series) or at the Karisoke Research Center in Ruhengeri, Rwanda. Collecting permits were provided by the Rwandan National Office of Tourism, Parks, and Recreation (ORTPN permit number: 62-06-1007). All research was conducted under the supervision of the University of Texas at Arlington's Institutional Animal Care and Use Committee (IACUC protocol number: A07.021). In addition to the fieldwork mentioned above, we have made an effort to canvas existing literature to find records of reptiles and amphibians recorded from within the current

boundaries of the park. In the case of species that we did not personally observe, but are mentioned credibly in the literature, we have noted this disparity in the individual species accounts and Table 1.

The Amphibia and Reptilia taxonomy we use follows Frost (2010) and Spawls *et al.* (2002), respectively.

RESULTS AND DISCUSSION

Class Amphibia, Order Anura (Frogs and Toads)

Arthroleptis adolfifriederici (Arthroleptidae) (Montane Squeaker)

De Witte (1941) recorded this species from the South versant of Mt. Visoke. This locality probably occurs within the current boundaries of the PNV in Rwanda. We did not encounter this species, but based on its montane distribution in other high elevation areas such as the Bwindi Impenetrable Forest (Drewes and Vindum 1994), we feel that the species is likely to occur within the PNV.

Leptopelis karissimbensis (Arthroleptidae) (Karisimbi Treefrog)

Leptopelis karissimbensis was originally described by Ahl (1929) from the Virunga Mountains. The type locality is the slope of Mt. Karissimbi, likely within the borders of the PNV from Rwanda. This species is extremely morphologically similar to *L. kivuensis*, although diagnostic morphological features exist to diagnose the two species (Laurent 1973; Schiøtz 1999), which include a blue vocal sac in *L. karissimbensis* and a white vocal sac in *L. kivuensis*. Within the PNV, *L. karissimbensis* is common throughout the entire park near aquatic habitats in the bamboo zone, up to about 3200 m in elevation. We observed that this species was particularly abundant in seasonally flooded depression marshes (Figure 3). In these habitats, adults (Figure 4), metamorphs, and putatively identified larvae were common. Without the use of molecular techniques (DNA sequence analysis), the tadpoles of this species and those of *L. kivuensis* are indistinguishable.

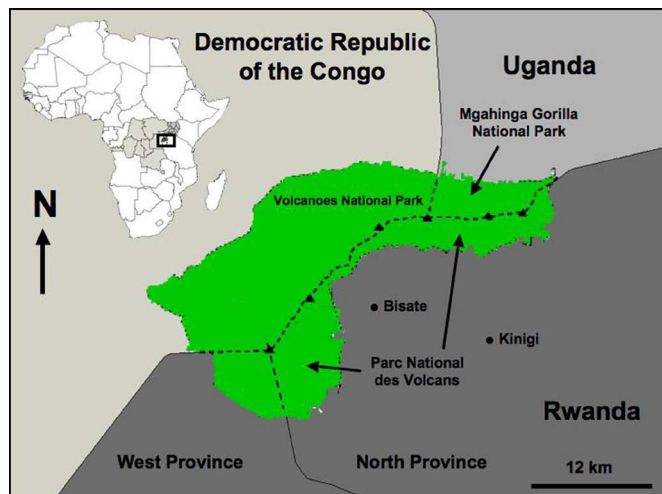


FIGURE 1. Map of all three national parks encompassing the Virunga Mountains on the border of Rwanda, Uganda, and Democratic Republic of the Congo.

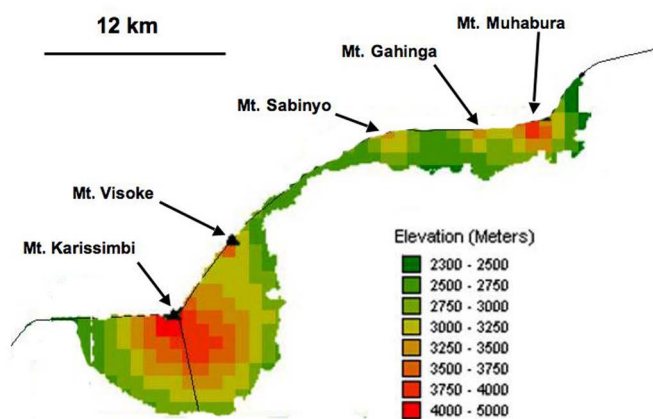


FIGURE 2. Map of the Parc National des Volcans, showing elevation.



FIGURE 3. Flooded depression marsh at approximately 2,800 m in elevation. *Hyperolius castaneus*, *Hyperolius cinnamomeoventris* and *Leptopelis karissimbensis* were common at this site. *Atheris nitschei*, *Philothamnus ruandae* and *Leptosiphos graueri* were also found at this site.



FIGURE 4. Adult *Leptopelis karissimbensis*.

Leptopelis kivuensis (Arthroleptidae) (Kivu Treefrog)

Leptopelis kivuensis was also described by Ahl (1929) from the immediate highlands surrounding the Virunga Mountains. Though the exact type locality is not known, the most accurate description by Ahl puts it near the town of Gisenyi on the Rwanda-DRC border, within 20 km of the nearest border of the PNV. Within the PNV, we collected this species in sympatry with *L. karissimbensis* at several localities, although *L. kivuensis* shows a distinct habitat preference for more wooded forest pools and may be more of a forest, rather than a meadow species as *L. karissimbensis* is thought to be (Schjötz 1975; Schjötz 1999). We found this species at slightly higher elevations than *L. karissimbensis*, all the way into the *Hypericum-Hagenia* vegetation zone up to about 3400 m. Adults, metamorphs, and putatively identified larvae were most common in and around shallow, water filled depressions in the forest.

Amietophrynus kisoensis (Bufonidae) (Kisolo Toad)

We did not encounter any individuals of this species in the PNV. De Witte (1941) encountered this species in Uganda on the slopes of Mt. Sabinyo, very close to the border with Rwanda. Laurent (1972) lists one male specimen that was collected on the south slope of Mt. Karissimbi in Rwanda. This species is extremely common in disturbed habitats near the park boundary and probably would be easily located during breeding aggregations, but our inability to work at night at the beginning of the rainy season probably influenced lack of ability to locate any individuals of this species within the boundaries of the PNV.

Hyperolius castaneus (Hyperoliidae) (Ahl's Reed Frog)

This species is an Albertine Rift endemic and is found only at high elevations. It was described by Ahl (1931) from the volcanic area northeast of Lake Kivu. This can only refer to the Virungas, although the exact type locality is not known. Adults of this species were uncommonly collected, but newly metamorphosed and juvenile frogs were among the most commonly encountered anurans in the PNV (Figure 5). This species was found in all lentic habitats and tadpoles were extremely common and easily identifiable because of their brown coloration and dark

lateral stripes. We encountered this species in the PNV from the lower park borders up to approximately 3400 m.

Hyperolius cinnamomeoventris (Hyperoliidae) (Cinnamon-Bellied Reed Frog)

This widely distributed species was another species of which we collected numerous individuals within the PNV. Adults were commonly collected in depression marshes and swamps. Juveniles and metamorphs were most common on sedge hummocks a few meters or more from standing water. This species is dimorphic as adults with the males being brown or green above with a light dorsolateral line and the females being green above and yellow on the venter with a dark line separating the two colors (Channing and Howell 2006) (Figure 6). Males can easily be confused in the PNV with adults of *Hyperolius castaneus*, but the dorsolateral line on a male *H. castaneus* is dark, while the line on a male *H. cinnamomeoventris* is light. We collected this species at localities up to 3200 m in the PNV.



FIGURE 5. Juvenile *Hyperolius castaneus*.



FIGURE 6. Adult male and female *Hyperolius cinnamomeoventris*; showing sexual dimorphism.

Hyperolius viridiflavus (Hyperoliidae) (Variable Reed Frog)

This extremely variable species is extremely wide ranging across East and parts of Central Africa and is found within the borders of the PNV in wet meadows and swamps from the lower park boundaries up to 3,000

m. Only adults were located, sometimes by the calling of males during the day. This is a forest species (Drewes and Vindum 1994) and it is likely that we could not locate individuals in thick forest because of their cryptic behavior and color pattern. While this species exhibits an amazing array of brilliant color patterns in other areas, individuals from the Virungas are dull grayish brown with yellow flecks on the dorsum and dark eyes (Figure 7).



FIGURE 7. Adult *Hyperolius viridiflavus*.

Phrynobatrachus graueri (Phrynobatrachidae) (Grauer's Puddle Frog)

De Witte (1941) recorded this species from the slopes of Mt. Sabinyo in Uganda. We found this species to be common in leaf litter habitats below the boundaries of the PNV. We did not encounter it within the park borders. It is possible that this species occurs at low elevations within the PNV.

Xenopus wittei (Pipidae) (de Witte's Clawed Frog)

We did not encounter this species in the PNV, but this was likely because of limited collecting effort directed towards this species. While we used small nets in many permanent bodies of water within the PNV (the preferred habitat of this frog), *X. wittei* are fast and agile underwater and may have evaded capture. It is also possible we never searched water deep enough to find either tadpoles or adults of *X. wittei*. This species is not mentioned as being found in the PNV by any previous publication (e.g., de Witte, 1941; Laurent, 1972), but *X. wittei* is common in many permanent bodies of water within 10 km of the park boundary and may exist in some lakes within the PNV.

Class Reptilia, Order Squamata (Lizards and Snakes)

Chamaeleo rudis (Chamaeleonidae) (Ruwenzori Side-striped Chameleon)

This species has two forms: the eastern form is found in northeastern Tanzania, while the western form is found along the Albertine Rift. This was the most commonly encountered reptile in the PNV and occurs all the way from the park boundary up to at least 4,000 m in elevation. This makes it the reptile that occurs at the highest elevation within the park. At the upper limits of its occurrence, temperatures are extremely cold. We found this species active at air temperatures as low as 4-5 C. Mt. Karisimbi

experiences what could be classified as "winter events" marked by snowfall and ice storms (Figure 8). Occasionally subfreezing temperatures extend far down the mountain's slopes at night. Since most species of chameleons sleep exposed on vegetation and this species exhibits this behavior, it is likely that *C. rudis* in the Virunga Mountains has the ability to supercool to avoid freezing to death. We found these chameleons in every vegetation zone and habitat within the park, although they exhibit a preference for sunlight openings and clearings in the forest, where they can bask cryptically in arboreal habitats to raise their body temperature (Figure 9). We encountered over 100 specimens in our surveys of the PNV.



FIGURE 8. Summit of Mt. Karisimbi showing the results of a periodic ice/snow storm.



FIGURE 9. Adult *Chamaeleo rudis*.

Adolfus jacksoni (Lacertidae) (Jackson's Forest Lizard)

The PNV is surrounded by an artificial volcanic rock wall intended to keep buffalo (*Syncerus caffer*) inside the park boundary. This wall is 1-2 m high across the entire boundary of the park within Rwanda. The habitat surrounding the park has been deforested and is almost exclusively agricultural fields. *Adolfus jacksoni* was extremely commonly sighted and captured along this wall and occurs within the PNV, but was never sighted anywhere past the wall in the park. This lizard is an animal of open canopy habitats that prefers to perch on elevated surfaces (Spawls *et al.* 2002). With the exception of the edges of

forest clearings, few habitats of this nature occur within the PNV, but the buffalo wall provides ample habitat for *A. jacksoni*.

Adolfus vauereselli (Lacertidae) (Sparse-scaled Forest Lizard)

We encountered this species only on the buffalo wall mentioned in the account for *A. jacksoni*. These two species are sympatric in this region and were found basking within 3 m of each other on the wall. *Adolfus jacksoni* appeared to be more common than *A. vauereselli*. Spawls *et al.* (2002) mentions that this species is a true forest lizard, but we never encountered it in true forest or any other closed canopy habitat.

Leptosiphos graueri (Scincidae) (Rwanda Five-toed Skink)

This species is an Albertine Rift endemic. Spawls *et al.* (2002) states that it is a fossorial animal that often lives among the buttresses of trees in leaf litter. We found several specimens along rocky ledges covered in moss including one aggregation of three individuals in the open in some kind of social interaction. Other specimens were located while crossing trails. One specimen was found in a sedge swamp exposed on a hummock. Upon being sighted, the animal quickly dove into the sedge hummock and was located after considerable search within the center of the plant. Another specimen was found crossing a trail in the bamboo zone. We found this species up to 3,100 m in elevation.

Mabuya striata (Scincidae) (Striped Skink)

Within the PNV, we only encountered this species on the margin of the park on the buffalo wall, along with *Adolfus jacksoni* and *A. vauereselli*. Of the three lizard species mentioned that we found basking on the buffalo wall, *M. striata* was the most common. This is not surprising, as this is the most commonly seen reptile in disturbed and urban habitats in Rwanda. We feel that the buffalo wall represents excellent habitat for the three species of lizards mentioned because of its ecological resemblance to a forest clearing with the added benefit of escape cover in the form of volcanic rock crevices, which make predation on any of the species by birds difficult.

Lamprophis olivaceus (Colubridae) (Olive House Snake)

We found no individuals of this species in the PNV, but Spawls *et al.* (2002) mentions that several individuals were collected from “mid-altitude” forest on Mt. Karissimbi. Since this book does not include records from the DRC, we assume these animals were collected in Rwanda. It is likely that the forest mentioned is either remnant montane forest or *Hypericum-Hagenia* forest, which could also be classified as high elevation cloud forest. It is likely that this species occurs within the PNV.

Philothamnus ruandae (Colubridae) (Rwanda Forest Green Snake)

We encountered two individuals of this species during our surveys in the PNV and a primatologist observing Mountain Gorillas likely observed another specimen based on a credible description. Of the two specimens

we observed, one specimen was an adult sitting on a horizontal bamboo stalk about 2 m above ground at the edge of a swamp. Another was found on the ground at the edge of the same swamp. This swamp is at approximately 2,900 m in elevation. This represents the highest elevation that this species has been found. Like many species of herpetofauna found in the PNV, this species is an Albertine Rift endemic (Figure 10).



FIGURE 10. Adult *Philothamnus ruandae*.

Atheris nitschei (Viperidae) (Great Lakes Bush Viper)

This species is another Albertine Rift endemic and is named for the large lakes along the length of the rift. We encountered two individuals of this species in the PNV and a primatologist encountered another, which could be easily identified from a photograph. All specimens were encountered in the bamboo zone at elevations between 2600-2800 m. One adult individual was encountered in thick, closed canopy bamboo forest draped across a horizontal stalk of bamboo about 2 m above the ground. Another adult was encountered along the margin of a swamp in the multiple small branches of new growth at the end of a horizontal bamboo stalk, about 1 m above the ground. The final specimen was a juvenile (Figure 11) that was encountered at the edge of a forest clearing on horizontal bamboo, about 1 m above the ground (Figure 12). The first individual, encountered by the primatologist, was not disturbed. The second two individuals, upon being disturbed, dropped backwards off their perches and attempted to burrow into vegetative cover on the ground in escape attempts. Before being preserved, the juvenile specimen was maintained for four days in a plastic shoebox and during this time, consumed an adult *Adolfus jacksoni* (Jackson's Forest Lizard) that was offered to it.

During our surveys of the PNV, we collected twelve out of seventeen species of reptiles and amphibians historically recorded from the park. Of these seventeen species, eight are considered to be endemic to the Albertine Rift (Table 1). Nine of the species recorded from the PNV were anurans, distributed in five families (the number of species in each family is in parenthesis): Arthroleptidae (3), Bufonidae (1), Hyperoliidae (3), Phrynobatrachidae (1), and Pipidae (1). Eight species of reptiles were recorded from five families: Chamaeleonidae (1), Lacertidae (2), Scincidae

(2), Colubridae (2), and Viperidae (1).

According to the IUCN (2009), the eight reptile species that occur in the PNV are not listed. Of the nine amphibian species that occur or likely occur within the boundaries of the PNV, six are listed in the “Least Concern” (LC) category because they have relatively large distributional ranges and do not appear to be in any danger of widespread population decline. *Leptopelis kivuensis* is listed “Near Threatened” (NT) because it occupies an area of occurrence not much greater than 20,000 km² and its montane habitat is declining. They cite this species as being close to qualifying for the more imperiled “Vulnerable” category. *Hyperolius castaneus* is listed as “Vulnerable” (V) because its area of occurrence is less than 20,000 km², and its habitat has become very fragmented. The IUCN states that the montane swamp habitat of *H. castaneus* is declining in both quality and extent. *Leptopelis karissimbensis* is listed as “Endangered” (EN), because its known range is less than 5000 km², all known individuals are known from less than five locations, and its montane habitat is declining in both quality and extent.

The Virungas are some of the highest mountains in Africa. The protected area that lies within the country of Rwanda is small in comparison with neighboring DRC and

the lower park boundary is much higher. The lowest park boundary in Rwanda is approximately 2600 m in elevation, while the lowest park boundary in DRC is approximately 1900 m in elevation. This is important, because true montane forest communities do not usually exist in this region above about 2500 m. There is virtually no true montane forest left within the park boundaries of the PNV, and consequently, reptile and amphibian diversity is much lower in the PNV than other forested Albertine Rift areas in close proximity. Two of these areas in Uganda, Bwindi Impenetrable National Park and Kibale National Park, have had excellent surveys conducted for the presence of herpetofaunal diversity (Drewes and Vindum 1994; Vonesh 2001). Drewes and Vindum (1994) reported thirty-six reptile and twenty-nine amphibian species from Bwindi Impenetrable National Park (BINP), whose closest border to the PNV in Rwanda is only about 35 kilometers straight line distance to the North. Approximately 140 km North of the PNV, Vonesh (2001) reported fifty-three species of reptiles and thirty species of amphibians from Kibale Forest in Kibale National Park. Both of these parks are significantly lower in elevation than the PNV. The highest elevations in BINP are approximately 2600 m in elevation and are approximately 1600 m in elevation in Kibale National Park, but most of the area of both parks



FIGURE 11. Juvenile *Atheris nitschei*.



FIGURE 12. Horizontal bamboo stalks on edge of forest clearing in bamboo vegetative zone where *Atheris nitschei* illustrated in Figure 11 was found.

TABLE 1. Anuran and reptile species found in the Parc National des Volcans, Republic of Rwanda based on published literature records and collecting trips from June – August 2007 and 2008. 1 = Observation of adult specimen(s); 2 = observation of juvenile specimen(s); 3 = observation of tadpoles; 4 = recorded from published literature; 5 = Albertine Rift endemic. NA = not applicable

FAMILY / SPECIES	1	2	3	4	5
Arthroleptidae Mivart, 1869					
<i>Arthroleptis adolfi-friederici</i> Nieden, 1911	-	-	-	X	X
<i>Leptopelis karissimbensis</i> Ahl, 1929	X	X	X	X	X
<i>Leptopelis kivuensis</i> Ahl, 1929	X	X	X	X	X
Bufonidae Gray, 1825					
<i>Amietophrynus kisoensis</i> Loveridge, 1932	-	-	-	X	-
Hyperoliidae Laurent, 1943					
<i>Hyperolius castaneus</i> Ahl, 1931	X	X	X	X	X
<i>Hyperolius cinnamomeiventris</i> Bocage, 1866	X	X	X	X	-
<i>Hyperolius viridiflavus</i> Duméril and Bibron, 1841	X	X	X	X	-
Phrynobatrachidae Laurent, 1941					
<i>Phrynobatrachus graueri</i> Nieden, 1911	-	-	-	X	-
Pipidae Gray, 1825					
<i>Xenopus wittei</i> Tinsley, Kobel, and Fischburg, 1979	-	-	-	X	X
Chamaeleonidae Rafinesque, 1815					
<i>Chamaeleo rudis</i> Boulenger, 1906	X	X	NA	X	-
Lacertidae Gray, 1825					
<i>Adolfus jacksoni</i> Boulenger, 1899	X	X	NA	X	-
<i>Adolfus vauereselli</i> Tornier, 1902	X	-	NA	X	-
Scincidae Gray, 1825					
<i>Leptosiaphos graueri</i> Sternfeld, 1912	X	-	NA	X	X
<i>Mabuya striata</i> Peters, 1844	X	X	NA	X	-
Colubridae Oppel, 1811					
<i>Lamprophis olivaceus</i> Duméril, 1856	-	-	NA	X	-
<i>Philothamnus ruandae</i> Broadley, 1998	X	-	NA	X	X
Viperidae Oppel, 1811					
<i>Atheris nitschei</i> Tornier, 1902	X	X	NA	X	X

is considerably lower and consequently warmer. As mentioned earlier, the lowest elevations in the PNV are approximately 2600 m in elevation.

The high elevations found in the PNV have a profound affect on herpetofaunal diversity. Ectotherm diversity at an ecosystem level is affected greatly by temperature (Vitt and Caldwell 2009) and the Virunga Mountains are no exception. With only seventeen species of reptiles and amphibians reported from the park, herpetofaunal diversity at this site is considerably lower than at geographically proximate surveyed sites in the same region. Eight of the seventeen species mentioned are Albertine Rift endemics. While this appears to be a high proportion of endemic species for a taxonomic group at a specific site, it must be remembered that the Albertine Rift has large areas of protected habitat when compared with other areas of Africa (Plumptre *et al.* 2007) and that all the species found in the Virungas have been reported or are likely to occur in other protected sites in the Albertine Rift such as Bwindi Impenetrable National Park in southern Uganda and Nyungwe National Park in southern Rwanda. *Leptopelis karissimbensis* is the only amphibian or reptile species thought to be endemic to the Virungas (IUCN 2009), although historical and recent research suggests that this species is more widely distributed throughout the Albertine Rift (de Witte 1941; Hölting *et al.* 2009) than some literature (Schlötter 1975, 1999) and the IUCN report on the species would indicate. Based on these considerations, we feel that the herpetofauna of the PNV is adequately protected as it is likely that no reptile or amphibian species are endemic to the park itself and the PNV is one of the most highly controlled and protected areas in Africa because of the presence of mountain gorillas. The park exists largely for the protection of these mammals and their presence acts as a “conservation umbrella” for all other species found in the PNV, because as gorilla habitat remains protected, that habitat is thus protected for other species. Despite low herpetofaunal diversity for an equatorial area, the Virunga Mountains ecosystem in Rwanda is amazing for its unique combination of geologic, historical, and biological wealth and stands as a model for conservation biology.

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