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Lists of Species

Amphibians and Reptiles, Luzon Island, Aurora Province and Aurora Memorial National Park, Northern Philippines: New island distribution records

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Abstract: We report 35 new amphibian and reptile distribution records for two regions within the southern Sierra Madre Mountain Range, Aurora Province, central Luzon Island, Philippines. Together with results of our previous survey work in Aurora, our new data result in a total of 82 amphibian and reptile species for the area. These results highlight the degree to which the island's biodiversity continues to be underestimated and poorly understood. We report on observations of rarely encountered species including the skink *Sphenomorphus leucospilos*, the forest gecko *Luperosaurus* cf. *cumingii*, and a sensational new species of monitor lizard, V*aranus bitatawa*. Our recent collections clarify the conservation status of the "critically endangered" Polillo Island forest frog *Platymantis polillensis*, now known to be widespread, abundant, and common throughout Camarines Norte, Quezon, and Aurora Provinces on the adjacent mainland of Luzon Island. These results add to our growing understanding of many species' distributions in the region.

Introduction

The Philippine island of Luzon was formed by the accretion of separate paleoislands in the recent geological past (Adams and Pratt 1911; Rutland 1968; Hashimoto 1981a, b; Auffenberg 1988; Hall 1996; 1998; Yumul *et al.* 2009). The approximate positions of suture zones are known (Defant *et al.* 1989; Yumul *et al.* 2003), and in some cases correspond to the limits of the geographical ranges of endemic faunal elements. Thus, we assume that the isolation of Luzon's precursor paleoislands and their eventual accretion contributed to, if not fueled, the evolutionary diversity we find today (Brown and Diesmos 2009). Although the complex intra-island geography of Luzon may have contributed to the evolutionary process of diversification (Brown *et al.* 1996; Brown and Diesmos 2009), our ability to interpret processes related to the generation of this diversity has been limited due to an incomplete knowledge of the distribution patterns of the fauna of Luzon. This shortcoming results from the limited biodiversity surveys that have been conducted since the work of Taylor in the 1920s (Brown *et al.* 1996). A renewed interest in the island's diversity has resulted in numerous studies highlighting the degree to which Luzon's biodiversity has been underestimated (*e.g.* Ross and Gonzales 1992; Brown *et al.* 1995a, b; 1996; 1997a, b, c; 1999a, b; 2000a, b; 2007; Alcala *et al.* 1998; Brown and Gonzales 2007; Wallach *et al.* 2007; Siler *et al.* 2009c; 2010a, b; Linkem *et al.* 2010).

The Sierra Madre Mountain range, on the eastern coast of north and central Luzon Island, corresponds approximately to one of Luzon's hypothesized paleoislands (Auffenberg 1988; Yumul *et al.* 2009). In the south-central end of the mountain range lie Aurora Province and Aurora Memorial National Park (Figure 1), the site of a recent biodiversity survey (Brown *et al.* 2000b). Results of that study provided a preliminary understanding of the herpetological diversity of the region (Table 1). In this paper, we report on additional species records for Aurora Province and highlight the degree to which Luzon's biodiversity continues to be underestimated.

Materials and Methods

The collections summarized in this inventory consist of new distribution records for Aurora Province, and in several instances, new information for rare species (*Sphenomorphus leucospilos*) collected by Brown *et al.* (2000b), or corrections to the accounts provided in that study (*Gonocephalus sophiae*, *Platymantis sierramadrensis*). Voucher specimens are deposited in the collections of the Cincinnati Museum of Natural History (CMNH), University of Kansas Biodiversity Institute (KU) and the Philippine National Museum (PNM). Field survey protocols followed guidelines outlined in an existing Memorandum of Agreement (MOA) between the University of Kansas and the Philippine Protected Areas and Wildlife Bureau (PAWB), and those outlined in an active Gratuitous Permit to Collect (GP) No. 185 (Renewal), also provided by PAWB. From May-June, 2009, a large team of biologists visited Aurora Province, Luzon Island, Philippines, and conducted biodiversity surveys in the following sites: Location 1- 915 m elevation, Mt. Dayap, Sitio Siete, Barangay Villa Aurora, Municipality of Maria Aurora (15°40'48" N, 121°20'10" E; on 29 May-1 June, 2009; Figures 1-3); Location 2- 507 m elevation, Sitio Dimani, Barangay Villa Aurora, Municipality of Maria Aurora (15°41'06" N, 121°20'28" E; on 19-29 May, 2009; Figures 1, 4, 5); Location 3- 18 m elevation, Aurora State College of Technology, Barangay Zabali, Municipality of Baler (15°44'31" N, 121°34'34" E; on 3-9 June, 2009;

Figures 1, 6-9); Location 4- 515 m elevation, Sitio Minoli, Barangay Real, Municipality of San Luis (15°40'48" N, 121°31'44" E; on 11-16 June, 2009; Figures 1, 10); Location 5- 543 m elevation, Barangay Lipimiental, Municipality of San Luis (15°39'13" N, 121°30'26" E; on 18-23 June, 2009; Figures 1, 11-13); Location 6- 1 m elevation, Barangay Casapsipan, IDC Forestry Lands, Municipality of Casiguran (16°17'12" N, 122°11'09" E; on 27 June-1 July, 2009; Figures 1, 14). Catalog numbers corresponding to voucher specimens (deposited at the University of Kansas Natural History Museum and Biodiversity Institute [KU] and National Museum of the Philippines [PNM]) are included below.

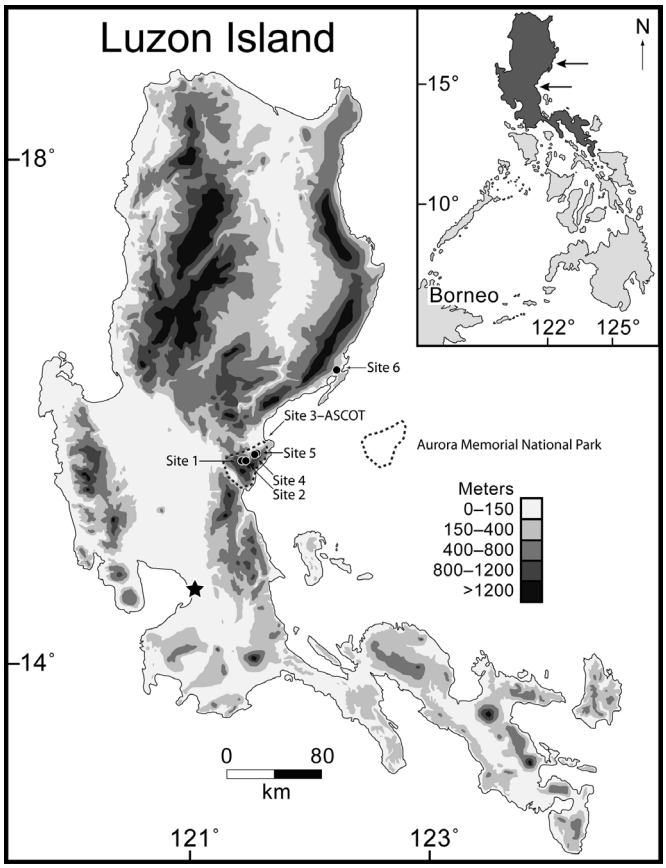

Figure 1. Map of Luzon Island, Philippines. The inset shows the location of Luzon Island (darkly shaded) within the Philippines. Elevation contours are indicated with incremental shading, and sampling localities are indicated by black circles. Site 3 shows the location of Aurora State College of Technology (ASCOT). The capital city, Manila, is shown for reference by a black star.

Figure 2. Cloud forest at Location 1. Photo by LJW.

Figure 3. Mountain view on hike to Location 1. Photo by LJW.

Figure 4. Mountain view at Location 2. Photo by LJW.

Figure 5. Mountain view at Location 2. Photo by RMB

Figure 6. View of lowlands from Location 3. Photo by RMB.

Figure 7. Mangrove forest at Location 3. Photo by LJW.

Figure 8. Lowland habitat at Location 3. Photo by LJW.

Figure 9. View of lowlands from Location 3. Photo by LJW.

Figure 10. Forest habitat at Location 4. Photo by LJW.

Figure 11. Forest habitat at Location 5. Photo by LJW.

Figure 12. River system at Location 5. Photo by LJW.

Figure 13. Rocky, river habitat at Location 5. Photo by CDS.

Figure 14. Coastal forest habitat at Location 6. Photo by LJW.

Results and Discussion

Species Accounts

AMPHIBIA

Bufonidae

Rhinella marina (Linnaeus, 1758)

We observed individuals of this introduced and invasive species around the Aurora State College of Technology campus and in the town of Baler. This species is common in highly disturbed habitats and can often be heard calling in loud breeding choruses in flooded agricultural fields. Figure 15. Location 3: KU 321853-62.

Figure 12. *Rhinella marina* in life (KU 321853; Location 3). Photo by LJW.

Ceratobatrachidae

Platymantis cf. *cornutus* (Taylor, 1922)

We collected individuals of this species on low hanging tree branches, leaves, and shrubs, in similar habitat to *Platymantis* cf. *luzonensis* (see below). Males were frequently heard at Locations 2 and 4, calling from forest canopy, with advertisement calls identified by their rapid note repetition rate and relatively high numbers of notes per call. Figure 16. Location 1: KU 321985-93, 322051-64, 323412; Location 2: KU 321953; Location 4: KU 322463-5, 323415; Location 5: KU 322469.

Figure 16. *Platymantis* cf. *cornutus* in life (KU 322471; Location 5). Photo by CDS.

Platymantis cf. *luzonensis* Brown, Alcala, Diesmos, and Alcala, 1997

This arboreal species in the genus *Platymantis* is known from mid-elevation, secondary-growth forests of Mt. Makiling, Mt. Banahao, and the volcanoes of the Bicol Peninsula in southern Luzon Island. Individuals were observed on low hanging tree branches, leaves, and shrubs, in similar habitat to *Platymantis* cf. *cornutus*, but the species is distinguished from *P.* cf. *cornutus* by its call which consists of fewer notes, delivered at a slow rate over several seconds. Location 1: KU 322074-5; Location 2: KU 322071-3; Location 4: KU 322418-9.

Platymantis polillensis (Taylor, 1922)

This species was previously considered to be a "Critically Endangered" taxon, endemic to Polillo Island. Now known from Mt. Labo (northern Bicol Peninsula), and numerous sites in Quezon and Aurora Province, it is quite clear that this species is abundant and common on SE Luzon and that its conservation status needs to be downgraded, possibly to Least Concern or Vulnerable. On Polillo Island and throughout Quezon, Camarines Norte and Aurora Province, *Platymantis polillensis* occurs in shrubby vegetation of secondary-growth forest and is common on exposed ferns and saplings in forest gaps and along forest edges. This species was the most abundant frog encountered at most sites in Aurora Province. *Platymantis polillensis* calls with a slow train of single notes, each consisting of rapidly stridulated pulses, and sounding to the human ear like high frequency chirps. Figure 17, 18. Location 1: KU 322123-9; Location 2: KU 322076-122; Location 3: KU 322130-3; Location 4: KU 322425-32; Location 5: KU 322420-4.

Platymantis sierramadrensis Brown, Alcala, Ong, and Diesmos, 1999

Exploration of Aurora Province at multiple elevations has allowed us to clarify the status of the species referred to in the past as *P. sierramadrensis* (Brown *et al.* 1999b; 2000b). We strongly suspect that all low elevation (300-600 m) populations referred to as *P. sierramadrensis* or *P.* cf. *sierramadrensis* (Brown *et al.* 1999b; 2000b) have been, in fact, members of the species *P. polillensis.* Higher elevation populations (>850 m) have a slightly larger body size, call with constant-frequency tonal, non-pulsed calls and vocalize from sapling leaves and *Pandanus* axils in primary forest. Unlike *P. polillensis*, they are not found in and around forest gaps and appear to avoid herbaceous layer vegetation, preferring perches 2-3 m above the ground (RMB, *pers. obs*). Location 1: KU 322157-78, 323414.

Platymantis sp. 1 "green"

A third small-bodied *P. hazelae* group species (Brown *et al.* 1997a) has been identified in Aurora Province. This small, tuberculate form calls from saplings and understory leaves above 900 m and 2-3 m above the ground; its call sounds to the human ear like a loud, intense "Psssst!" This undescribed species has also been encountered on Mt. Mingan, Aurora Province (specimens in FMNH). Figure 19. Location 1: KU 322134-56.

Figure 17. *Platymantis polillensis* in life (KU 322423; Location 5). Photo by LJW.

Figure 18. *Platymantis polillensis* in life (KU 322125; Location 1). Photo by RMB.

Figure 19. *Platymantis* sp. 1 "green" in life (KU 322144; Location 1). Photo by RMB.

Platymantis sp. 2 "enok"

This scansorial species was collected in shrubby vegetation of secondary-growth forest and called from low perches such as tree stumps, shrubs, and ferns. Presently defying identification, we designate this species with an onomatopoeic nickname derived from its distinct advertisement call. Location 1: KU 322018, 322026, 322040, 322185; Location 2: KU 321994-017, 322019-25, 322069, 322179-84.

Platymantis sp. 3 "meeyak"

This species was observed solely in limestone outcrops in disturbed and secondary-growth forest. Within the genus, the preference for karst forest habitat has also been observed for *P. bayani* (Siler *et al.* 2009a), *P. paengi* (Siler *et al.* 2007), *P. spelaeus* (Brown and Alcala 1982a),

P. biak (Siler *et al.* 2010c), and *P. insulatus* (Brown and Alcala 1970). The calls of male individuals were quiet when compared with the calls of other sympatric species in the genus; males were observed calling solely from cascading stream banks, within the spray zone of high gradient and rapidly flowing water. Several were collected midstream on rocky and gravel banks. Figure 20. Location 1: KU 322042-50; Location 2: KU 322041; Location 4: KU 322437-42; Location 5: KU 322433-6.

Figure 20. *Platymantis* sp. 2 "meeyak" in life (KU 322435; Location 5). Photo by CDS.

Microhylidae

Kaloula pulchra Gray, 1831

We collected this species under loose soil and leaf litter in a residential yard in the town of Baler. Until recently, this species was known to have a widespread distribution throughout much of southeast Asia except for the Philippines; however, it has now been introduced to the country, has recently been documented on Luzon (Diesmos *et al.* 2005), and likely occurs on other Philippine islands. Figure 21. Location 3: KU 322393.

Figure 21. *Kaloula pulchra* in life (KU 322393; Location 3). Photo by LJW.

Ranidae

Sanguirana aurantipunctata Fuiten, Welton, Diesmos, Barley, Oberheide, Duya, Rico, and Brown, 2011

This recently described species of wide-disked cascade stream frog was encountered at Location 1 and 4. This species has also been encountered on Mt. Mingan, southern Aurora Province (specimens in FMNH), and on Mt. Palali, Nueva Viscaya Province. This species is characterized by yellow-green dorsal coloration, bright orange flora-form spots on the dorsum, and the absence of transverse limb bars and dark coloration of the tympanum and canthal region. Location 1 (not collected); Location 4: KU 322548-9.

Rhacophoridae

Rhacophorus appendiculatus (Günther, 1858)

This infrequently encountered species is thought to have a widespread distribution throughout the Philippines, occurring in disturbed, secondary- and primary-growth forest. We encountered a large chorus of many dozens of individuals, situated on vegetation surrounding a stagnant, swampy pool in selectively logged forest. This is one of several Philippine anuran species known to build foam nests on vegetation overhanging pools of water (Brown and Alcala 1982b). Individuals were collected on the branches and leaves of shrubs surrounding small pools of water and swampy habitat. Figure 22. Location 2: KU 322209-53, 323413, 323418.

Figure 22. *Rhacophorus appendiculatus* in life (KU 322251; Location 2). Photo by RMB.

Rhacophorus bimaculatus (Peters, 1867)

Specimens of this species were collected on the branches and leaves of shrubs near swampy habitat and pools of water in disturbed and secondary-growth forest. This species is known to have a widespread distribution throughout much of the Philippines, and is known to build foam nests on vegetation above stagnant pools of water. Figure 23. Location 2: KU 322207-8, 323006.

Figure 23. *Rhacophorus bimaculatus* in life (KU 323006; Location 2). Photo by LJW.

REPTILIA (Lizards)

AGAMIDAE

Bronchocela marmorata Gray 1845

We found this species asleep at night on branches of trees and shrubs in disturbed forest. Several specimens ostensibly match the definition of *B. marmorata* while others can be keyed out (Hallermann 2005) to *B. cristatella* (Kuhl, 1820). However, we hesitate to definitively identify two sympatric taxa given the slight character differences that putatively distinguish the two forms and the absence of genetic data suggesting the existence of two species on Luzon (Brown, Siler, Welton, and Diesmos, unpublished data). Individuals were often found 2-4 m above the ground. This species is widely distributed in the Philippines. Figure 24. Location 2: KU 323044-5; Location 3: KU 323046-9; Location 4: KU 323051; Location 6: KU 323050.

FIGURE 24. *Bronchocela marmorata* (KU 323045; Location 2). Photo by RMB.

Gonocephalus sophiae (Gray, 1845)

We collected individuals of this species at night asleep on the trunks of small trees and saplings in secondary-growth forest. It was often found perched on sapling trunks in an upright position 1-2 m above the ground. We believe this is the same species as the unidentified species of *Gonocephalus* collected during the Brown *et al.* (2000b) expedition. Figure 25. Location 2: KU 323153-6; Location 5: KU 323157-8; Location 6: KU 323159.

Hydrosaurus pustulatus (Eschscholtz, 1829)

We collected individuals of this species at night on branches suspended over a river. It is known to occur on all major, and many small and isolated, Philippine islands except for Palawan. Figure 26. Location 1: KU 232161; Location 2: KU 323160; Location 3: 323162-3; Location 6: KU 325294.

GEKKONIDAE

Gehyra mutilata (Wiegmann, 1834)

This species, together with *Hemidactylus frenatus* and *H. platyurus*, make up the three common, widespread species of house geckos in the Philippines. We collected individuals at night on the walls and ceilings of Aurora State College of Technology campus buildings. Location 2: KU 322255-6; Location 3: KU 322254, 322257-61.

FIGURE 25. *Gonocephalus sophiae* in life (KU 323153; Location 2). Photo by LJW.

FIGURE 26. *Hydrosaurus pustulatus* in life (KU 325294; Location 6). Photo by JB.

Gekko mindorensis Taylor, 1919

This species has a wide distribution throughout the Philippine islands. The diversity within Philippine species in the genus *Gekko* has steadily increased over the years (Roesler *et al.* 2006; Brown *et al.* 2008; 2009), and *G. mindorensis* may eventually prove to be a complex of cryptic species. Location 3: KU 322295.

Hemidactylus platyurus (Schneider, 1792)

We collected individuals of this species of common house gecko at night on the walls and ceilings of Aurora State College of Technology campus buildings. This species is widespread throughout the Philippines. Location 3: KU 322262-79.

Lepidodactylus sp.

This species of house gecko is less commonly observed in the Philippines. An individual of this species was found at night on the walls and ceilings of Aurora State College of Technology campus buildings. The specimen appears to be morphologically similar to *Lepidodactylus lugubris* and *L. planicaudus*, but cannot reliably be identified to species. Location 3: KU 323919.

Luperosaurus n. sp.

This rare forest gecko (Gaulke *et al.* 2007) was encountered at Locations 3 and 6. One specimen was collected on an external wall of a building on Aurora State College of Technology campus and two others were collected in coastal forest scrub (on the trunks of second growth trees) in Casiguran. An impending taxonomic study will address the status of the northern Luzon populations

currently referred to *L. cumingii* (Brown *et al.* in press). Location 3: KU 322189; Location 6: KU 321815, 322190.

Scincidae

Brachymeles boulengeri Taylor, 1922

We collected individuals of this species under rotting logs, piles of coconuts, and loose soil and leaf litter surrounding the roots of trees in low elevation, disturbed and secondary-growth forest. This species was recently elevated to full species status (Siler and Brown 2010), and is known to have a wide geographic distribution, occurring on Luzon, Marinduque, Masbate, and Polillo Islands (Brown 1956; Brown and Rabor 1967; Brown and Alcala 1980; Siler and Brown 2010). Location 3: KU 232409, 322314-18, PNM 9702; Location 4: KU 322320.

Brachymeles kadwa Siler and Brown, 2010

We collected individuals of this newly described species under rotting logs, piles of coconuts, and loose soil and leaf litter surrounding the roots of trees in low elevation, disturbed and secondary-growth forest. The species was previously assigned to *Brachymeles talinis*, however, morphological and genetic data revealed the Luzon Island and Babuyan Island Group populations to be part of a unique northern Philippine lineage (Siler and Brown 2010). Several recent discoveries of new species of *Brachymeles* have quickly increased the known diversity in the Philippines (Siler *et al.* 2009c; 2010a; b; Siler and Brown 2010). Location 3: KU 323090-107, 323407; Location 6: KU 323108-48.

Emoia atrocostata (Lesson, 1830)

We collected two specimens of this species on sandy habitat near the coast at Casiguran. This species is widely distributed but seldom collected in recent years, most likely due to ubiquitous coastal development throughout the country. Figure 27. Location 6: KU 323195-6.

Figure 27. *Emoia atrocostata* in life (KU 323195; Location 6). Photo by CDS.

Eutropis multifasciata (Kuhl, 1820)

We collected individuals of this species on leaf litter material in disturbed habitats. Males of this species are known to have varying patches of brightly colored scales on the lateral surfaces of their body. This species is known to occur throughout the Philippines. Location 3: KU 322321-7.

Sphenomorphus leucospilos (Peters, 1872)

Prior to the collection of a single individual in 2000, this rare species was known from only two specimens collected on Luzon Island (Brown *et al.* 2000b). We observed this species active during the day on boulders on the banks of rapidly flowing river systems. When disturbed, individuals dove into the water or quickly crawled into crevices between rocks. Figure 28. Location 5: KU 323920-30.

Figure 28. *Sphenomorphus leucospilos* in life (KU 323925; Location 5). Photo by CDS.

Varanidae

Varanus bitatawa Welton, Siler, Bennett, Diesmos, Duya, Dugay, Rico, Van Weerd and Brown, 2010

A single individual of this newly described frugivorous species of monitor lizard was salvaged from a hunter (Welton *et al.* 2010b). This species is morphologically distinct from *Varanus olivaceus*, which is known to occur in the small remnant forest patches in southeastern Luzon, The Bicol Peninsula, Catanduanes, and Polillo Islands (Auffenberg 1988; Welton *et al.* 2010b). Frugivorous monitors in the Philippines have been documented to eat the fruits of several palm species (*Corphya elata*, *Livistonia rotundifolia*, *Caryota sp.*), fig species (*Ficus altissima, F. merritti, F. benjamina, F. balete*), and pandanus (*Pandanus tectorius*) fruits (Auffenberg 1988). According to the local community, the species is commonly collected by hunters and individuals in the area have been observed in coastal disturbed and secondary-growth forest. Figure 29. Location 6: PNM 9728 (formerly KU 320000).

Figure 29. *Varanus bitatawa* in life (PNM 9728 ; Location 6). Photo by LJW.

REPTILIA (Snakes)

COLUBRIDAE

Ahaetulla prasina preocularis (Taylor, 1922)

We collected this species of vine snake asleep on branches of shrubs in secondary-growth forest. This species is widely distributed in the Philippines (Leviton 1967). Location 1: KU 323364; Location 6: KU 323363.

Boiga cynodon (Boie, 1827)

We collected this species in arboreal habitats in disturbed and secondary-growth forest. Individuals were encountered actively hunting at night on branches of trees and shrubs in the forest. This species is currently recognized to occur on Palawan, Mindanao, Luzon, and Panay Islands (Leviton 1963b; 1970; Alcala 1986; Ferner *et al.* 2000; Gaulke 2001). Figure 30. Location 2: KU 322355; Location 3: KU 322356-7, 323367; Location 6: KU 322354.

FIGURE 30. *Boiga cynodon* in life (KU 322354; Location 6). Photo by LJW.

Boiga dendrophila divergens Taylor, 1922

This species was observed near rivers in disturbed and secondary-growth forest and in mangrove forest habitats. Individuals were encountered on the ground while actively hunting at night. This polytypic species occurs throughout the Philippines, and consists of four subspecies (Leviton 1970): *B. dendrophila divergens* (Luzon and Polillo Islands), *B. dendrophila latifasciata* (Mindanao Island), *B. dendrophila levitoni* (Panay Island), and *B. dendrophila multicincta* (Balabac and Palawan Islands). Figure 31. Location 4: KU 323366; Location 6: KU 323365.

FIGURE 31. *Boiga dendrophila divergens* in life (KU 323366; Location 4). Photo by JB.

Cyclocorus lineatus lineatus (Reinhardt, 1843)

This species was collected under leaf litter and fallen logs in disturbed and secondary-growth forest. The species is known to occur throughout the Philippine islands (Leviton 1965b). Location 2: KU 323379-82; Location 4: KU 323375-8; Location 5: KU 323370-1, 323388; Location 6: KU 323372-4.

Gonyosoma oxycephalum (Boie, 1827)

A single individual of this species was collected inside the root system of a large, cut tree in disturbed forest. This species occurs throughout the Philippine islands. Location 3: KU 322353, 323410.

Lycodon capucinus (Boie, 1827)

We found individuals of this species under leaf litter and fallen logs in disturbed and secondary-growth forest. This species is one of five endemic Philippine species of snakes in the genus *Lycodon*, and is recognized to have a broad geographic distribution throughout the Philippines (Leviton 1965a). Location 2: KU 322340; Location 3: KU 322341-4.

Lycodon muelleri Duméril, Bibron and Duméril, 1854

We collected this species on leaf litter on the forest floor in secondary-growth forest. This species of wolf snake has been recorded on Batan, Luzon, Mindoro, and Polillo Islands (Leviton 1965a). Figure 32. Location 2: KU 323383; Location 5: KU 323384-5.

FIGURE 32. *Lycodon muelleri* in life (KU 323384; Location 5). Photo by CDS.

ELAPIDAE

Hemibungarus calligaster calligaster (Wiegmann, 1835)

We collected two individuals of this species in mid-elevation, secondary-growth forest under logs and rocks. The polytypic species is often encountered in semi-fossorial habitats and consists of three subspecies (Leviton 1963a; b; Alcala 1986; Ferner *et al.* 2000): *H. calligaster calligaster* (Luzon and Mindoro Islands), *H. calligaster mcclungi* (Polillo Island), and *H. calligaster gemianulis* (Cebu, Negros, and Panay Islands). Figure 33. Location 1: KU 323338; Location 5: KU 323337.

Ophiophagus hannah (Cantor, 1936)

King cobras occur throughout the Philippines (Leviton 1964b) but due to habitat destruction and intense human

extirpation efforts around the country, the species appears to have become rare on many islands. We collected a single individual of this species on the surface of the forest floor in secondary-growth forest. Location 2: KU 322351.

Figure 33. *Hemibungarus calligaster calligaster* in life (KU 323337; Location 5). Photo by CDS.

Viperidae

Parias flavomaculatus (Gray, 1842)

We collected individuals of this species of pit viper coiled and asleep at night on branches of trees in secondary-growth forest. This polytypic species occurs throughout the Philippines and consists of three subspecies (Leviton 1964a): *P. flavomaculatus flavomaculatus* (Bohol, Camiguin, Catanduanes, Dinagat, Jolo, Leyte, Luzon, Mindanao, Mindoro, Negros, and Panay Islands), *P. flavomaculatus halieus* (Polillo Island), and *P. flavomaculatus macgregori* (Batanes Island Group). Some of our specimens clearly key out to *P. f. halieus*, and others (from the same population) key out to *P. f. flavomaculatus*. This suggests to us that the single color character used to distinguish the two "subspecies" is a color polymorphism that occurs throughout the range of this single, widespread species and does not correspond to a valid taxonomic entity that is endemic to Polillo Island. Figure 34-36. Location 2: KU 323394-6; Location 5: KU 323399-401.

Figure 34. *Parias flavomaculatus* in life (KU 323399; Location 5). Photo by CDS.

Figure 35. *Parias flavomaculatus* in life (KU 323395; Location 2). Photo by RMB.

Figure 36. *Parias flavomaculatus* in life (KU 323400; Location 5). Photo by CDS.

Boidae

Python reticulatus Schneider 1801

This species was captured on the ground at night in secondary-growth forest. Figure 37. Location 2: KU 322358, 325296.

Typhlopidae

Ramphotyphlops braminus (Daudin, 1803)

We collected this introduced species under fallen logs in disturbed and secondary-growth forest. Location 2: KU 322332; Location 4: KU 322331.

Figure 37. *Python reticulatus* in life (KU 325296; Location 2). Photo by LJW.

The results of our surveys provide additional baseline data on the diversity of amphibians and reptiles in the southern Sierra Madres mountain range, Aurora Province (Table 1, Figure 1). The species encountered during the surveys include many interesting discoveries, potentially new and endemic species, and additional information on rare species known previously from few observations and specimens. Although much of the habitat we explored in recent surveys was secondary-growth regenerating forest at best, high species diversity was encountered at all sites. Several species, previously believed to be rare, have turned out to be quite common, including the stream frog *Sanguirana tipanan,* the "Polillo" forest frog *P. polillensis*, and the skink *Sphenomorphus leucospilos*. Unfortunately, we suspect that habitat disturbance brought about by rapid development of Aurora Province is most likely having a negative impact on the local herpetofauna. At all sites visited by us, signs of low-level timber harvesting was apparent. The invasive and introduced species *Rhinella marina* and *Kaloula pulchra* were observed during this survey, in contrast to their absence during the Brown *et al.* (2000b) inventory. Additionally, the recent documentation of chytrid fungus in the Philippines (Brown *et al.* unpublished data) proves to be a potential threat to many Sierra Madre and Philippine endemic species of amphibians. Additional chytrid surveys should focus on documenting the geographic distribution of chytrid in Aurora Province, and possibly focus on comparisons along disturbance gradients in forested areas.

The results of this study bring the total number of known amphibian and reptile species in Aurora Province to 82 (Table 1). While this study added greatly to our knowledge of this unique herpetofauna, the resulting 35 additional species records for Aurora Province highlight the fact that we are just beginning to understand the diversity of Luzon Island and its geographically diverse landscape. Together with the Brown *et al.* (2000b) survey, this study still provides just a preliminary understanding of the region's herpetofaunal diversity. We suspect that future studies in the area will not only result in additional species' distribution records, but will also result in the discovery of new, endemic species. Many groups of amphibians and reptiles in Aurora warrant additional taxonomic study. These include species of the genera *Platymantis, Brachymeles, Cyrtodactylus, Gekko, Limnonectes, Sphenomorphus*, *Philautus,* and *Rhacophorus*, all of which contain widespread and polytypic species. In the last ten years alone, studies involving just a few of these groups have resulted in the discovery of numerous new species in the Philippines (*e.g.* Brown *et al.* 1999a; 2000a; 2008; Brown and Guttman 2002; Rösler *et al.* 2006; Brown and Gonzalez 2007; Siler *et al.* 2007; 2009a, b, c; 2010a, b; Linkem *et al.* 2010; Welton *et al.* 2009; 2010a, b). Our ultimate goal is a near-complete understanding of the amphibian and reptile diversity of Luzon and a contribution to the understanding of the evolutionary history of Philippine biodiversity. Reaching that goal will require a combination of high quality and painstaking survey work, coupled with detailed taxonomic reviews.

Table 1. Families and species of amphibians (anurans) and reptiles (lizards, snakes and turtles) from Aurora Province, Luzon Island, Philippines. N = new species distribution record for Aurora Province observed during this study; B-2000 = species observed only during the Brown et al. (2000b) survey; B = species observed during both studies.

TAXA	STUDY
AMPHIBIA	
Bufonidae	
Rhinella marina (Linnaeus, 1758)	N
Ceratobatrachidae	
Platymantis corrugatus (Duméril, 1853)	B
Platymantis cf. *cornutus* (Taylor, 1922)	N
Platymantis cf. *mimulus* Brown, Alcala, and Diesmos, 1997	B
Platymantis sierramadrensis Brown, Alcala, Ong, and Diesmos, 1999	B
Platymantis dorsalis (Duméril, 1853)	B
Platymantis cf. *luzonensis* Brown, Alcala, Diesmos, and Alcala, 1997	N
Platymantis polillensis (Taylor, 1922)	N
Platymantis pygmaeus Brown, Alcala, and Diesmos, 1998	B
Platymantis sp. 1 "green"	N
Platymantis sp. 2 "enok"	N
Platymantis sp. 3 "meeyak"	N
Platymantis sp. 3 "Brown *et al.* (2000b)"	B-2000
Dicroglossidae	
Limnonectes macrocephalus (Inger, 1954)	B
Limnonectes woodworthi (Taylor, 1923)	B

Table 1. ***Continued.***

TAXA	STUDY
Microhylidae	
Kaloula kalingensis Taylor, 1922	B
Kaloula picta (Duméril and Bibron, 1841)	B-2000
Kaloula pulchra Gray, 1831	N
Ranidae	
Fejervarya vittigera (Wiegmann, 1834)	B
Occidozyga laevis (Günther, 1859)	B
Hylarana similis (Günther, 1873)	B
Sanguirana aurantipunctata Fuiten, Welton, Diesmos, Barley, Oberheide, Duya, Rico, and Brown, 2011	N
Sanguirana luzonensis (Boulenger, 1896)	B
Sanguirana tipanan (Brown, McGuire, and Diesmos, 2000)	B
Rhacophoridae	
Philautus surdus Peters, 1863	B
Polypedates leucomystax Gravenhorst, 1829	B
Rhacophorus appendiculatus (Günther, 1858)	N
Rhacophorus bimaculatus (Peters, 1867)	N
Rhacophorus pardalis Günther, 1859	B
REPTILIA (Lizards)	
Agamidae	
Bronchocela marmorata Gray 1845	N
Draco spilopterus (Wiegmann, 1834)	B
Gonocephalus sophiae (Gray, 1845)	B
Hydrosaurus pustulatus (Exchscholtz, 1829)	N
Gekkonidae	
Cyrtodactylus philippinicus (Steindachner, 1867)	B
Gekko mindorensis Taylor, 1919	N
Gehyra mutilata (Wiegmann, 1834)	N
Hemidactylus frenatus Duméril and Bibron, 1836	B
Hemidactylus platyurus (Schneider, 1792)	N
Lepidodactylus sp.	N
Luperosaurus n. sp.	N
Scincidae	
Brachymeles bicolor (Gray, 1845)	B
Brachymeles bonitae Duméril and Bibron, 1839	B
Brachymeles boulengeri Taylor, 1922	N
Brachymeles kadwa Siler and Brown, 2010	N
Dasia grisea (Gray, 1845)	B-2000
Emoia atrocostata (Lesson, 1830)	N
Eutropis cumingi (Brown and Alcala, 1980)	B
Eutropis multicarinata borealis (Brown and Alcala, 1980)	B
Eutropis multifasciata (Kuhl, 1820)	N
Lamprolepis smaragdina philippinica Mertens, 1829	B
Lipinia pulchella Gray, 1845	B
Sphenomorphus abdictus aquilonius Brown and Alcala, 1980	B
Sphenomorphus decipiens (Boulenger, 1895)	B
Sphenomorphus leucospilos (Peters, 1872)	B
Sphenomorphus sp. "Brown *et al.* (2000b)"	B-2000
Sphenomorphus steerei Stejneger, 1908	B
Sphenomorphus tagapayo Brown, McGuire, Ferner, and Alcala, 1999	B-2000
Varanidae	
Varanus marmoratus (Wiegmann, 1834)	B
Varanus bitatawa Welton, Siler, Bennett, Diesmos, Ruya, Dugay, Rico, Van Weerd and Brown, 2010	N
REPTILIA (Snakes)	
Colubridae	
Ahaetulla prasina preocularis (Taylor, 1922)	N

Table 1. ***Continued.***

TAXA	STUDY
Boiga cynodon (Boie, 1827)	N
Boiga dendrophila divergens Taylor, 1922	N
Calamaria bitorques Peters, 1872	B
Calamaria gervaisi Duméril and Bibron, 1854	B
Cyclocorus lineatus lineatus (Reinhardt, 1843)	N
Dendrelaphis caudolineatus luzonensis Leviton, 1961	B
Dendrelaphis pictus pictus (Gmelin, 1789)	B
Coelognathus erythrura manillensis Jan, 1863	B
Gonyosoma oxycephalum (Boie, 1827)	N
Lycodon capucinus (Boie, 1827)	N
Lycodon muelleri Duméril, Bibron and Duméril, 1854	N
Oxyrhabdium leporinum leporinum (Günther, 1858)	B
Psammodynastes pulverulentus (Boie, 1827)	B
Pseudorabdion oxycephalum (Günther, 1858)	B
Rhabdophis spilogaster (Boie, 1827)	B
Elapidae	
Hemibungarus calligaster calligaster (Wiegmann, 1835)	N
Ophiophagus hannah (Cantor, 1936)	N
Viperidae	
Parias flavomaculatus (Gray, 1842)	N
Boidae	
Python reticulatus Schneider 1801	N
Typhlopidae	
Rhamphotyphlops braminus (Daudin, 1803)	N
Typhlops luzonensis Taylor, 1919	B
REPTILIA (Turtles)	
Bataguridae	
Cuora amboinensis (Daudin, 1801)	B-2000

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