Herpetofauna of the Phnom Kulen National Park, northern Cambodia—An annotated checklist

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មូលន័យសង្ខេប

យើងរាយការណ៍នូវលទ្ធផលនៃការសិក្សាថលជលិក និងល្មូនជាលើកដំបូងពីឧទ្យានជាតិភ្នំគូលេន ខេត្តសៀមរាប ភាគខាងជើងនៃប្រទេសកម្ពុជា។ ក្នុងរយៈពេលនៃការសិក្សានៅឆ្នាំ២០០៨, ២០០៩ និង២០១១ គេបានកំណត់អត្តសញ្ញាណថលជលិកចំនួន ២៥ប្រភេទ និងល្មូនចំនួន ៦១ប្រភេទ សរុបទាំងអស់ចំនួន ៨៦ប្រភេទ និងប្រមូលបានទិន្នន័យស្តីពីអេកូឡូស៊ីរបស់សត្វទាំងនោះ។ ក្នុងចំណោមប្រភេទសត្វដែលបានកំណត់អត្តសញ្ញាណ មានហ៊ីងឆ្នូតខ្នងមួយប្រភេទ *Kaloula mediolineata* Smith, 1817 ជាប្រភេទដែលទើបបានធ្វើកំណត់ត្រាជាលើកដំបូងសំរាប់ប្រទេសកម្ពុជា។ ការវិភាគរកចំណីអាហារនៅក្នុងពោះនៃសត្វទាំងនោះមួយចំនួនបានឱ្យគេយល់ដឹងជាលើកដំបូងស្តីពីអេកូឡូស៊ីនៃការស៊ីចំណីរបស់ពួកវា។ នេះគឺជាការសិក្សានៅក្នុងឧទ្យានជាតិនៃប្រទេសកម្ពុជាដ៏យូរមួយ ក្រៅពីការសិក្សានៅតំបន់ជួរភ្នំក្រវាញ។ សិក្សានេះបង្ហាញនូវចំនួនប្រភេទសត្វដ៏ច្រើនលើសគេ បើប្រៀបធៀបទៅនឹងទិន្នន័យដែលមានពីឧទ្យានជាតិផ្សេងៗទៀតនៅក្នុងប្រទេសកម្ពុជា។

Abstract

We report the findings of the first herpetofaunal surveys conducted in Phnom Kulen National Park, Siem Reap Province, northern Cambodia. During three intensive survey periods in 2008, 2009 and 2011, 86 species (25 amphibians and 61 reptiles) were recorded and data on their natural history were collected. One of the species, *Kaloula mediolineata* Smith, 1917, represents a new country record for Cambodia. Our analyses of stomach contents provide the first insight into the feeding ecology of several species. Our study is the first long term survey of amphibians and reptiles in a Cambodian protected area outside of the Cardamom Mountains. It shows the second highest number of species recorded nationally when compared with available data for other protected areas in Cambodia.

Keywords

Amphibians, distribution, feeding ecology, Indochina, natural history, reptiles.

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Introduction

Being part of tropical Indochina, Cambodia is known to host an extremely species rich herpetofauna (Bain & Hurley, 2011). In addition to surveys dating back to the colonial and postcolonial period of the 20th century (Smith, 1935; Bourret, 1941, 1942; Smith, 1943; Saint Girons, 1972), recent research has furthered our knowledge on the taxonomy and distribution of amphibians and reptiles in Cambodia within the last 20 years. However, survey efforts are still unequally distributed over the country, mainly focusing on the Cardamom Mountains range in the southwest (Daltry & Chheang, 2000; Daltry & Wüster, 2002; Long *et al*., 2002; Ohler *et al*., 2002; Swan & Daltry, 2002; Daltry & Traeholt, 2003; Stuart & Platt, 2004; Stuart & Emmett, 2006; Grismer *et al*., 2007a,b, 2008a,b, 2010; Wood *et al*., 2010; Neang *et al*., 2010, 2011a,b; Murdoch *et al*., 2019) and the foothills of the southern Annamite range in the northeast (Long *et al*., 2000; Stuart *et al*., 2006, 2010; Rowley *et al*., 2010; Neang *et al*., 2011a; Geissler *et al*., 2012). Knowledge on the herpetofauna of northern central Cambodia remains scarce and is based on only few field studies or singular sightings (Bezuijen *et al*., 2009; Hartmann *et al*., 2009, 2010, 2011, 2013b, 2014; Ihlow *et al*., 2012). However northern Cambodia represents an interesting biogeographic transition zone between the Khorat Plateau in eastern Thailand, the Mekong River along the border to Laos and the foothills of the Annamite Mountain Range in the east (Bain & Hurley, 2011; Geissler *et al*., 2015).

Methods

Study area

Phnom Kulen National Park (PKNP) is situated in the north of Siem Reap Province in north-central Cambodia, approximately 50 km north of Siem Reap town and the UNESCO World Heritage Site of Angkor. Covering 37,373 ha, the PKNP is a rather small protected area (Fig. 1). The national park was established in 1993 by a Royal Degree and is under the management jurisdiction of the Cambodian Ministry of Environment, although areas of archaeological value are managed by the Apsara Authority (Gaughan *et al*., 2009; Furey *et al*., 2012). PKNP is an exclusive geographical, predominantly sandstone feature in the largely flat central plains of northern Cambodia. Its highest peak is the Phnom (=Mount) Kulen with an elevation of 496 m above sea level (a.s.l.). The park is divided into two separate plateaus (Phnom Kbal Spean in the northwest and Phnom Kulen in the southeast) and is the source of the Siem Reap River.

Vegetation in PKNP comprises two main forest types (Fig. 2), the most abundant type being semi-evergreen forest on the hillside plateaus, whereas the small lowland areas were originally dominated by dry deciduous

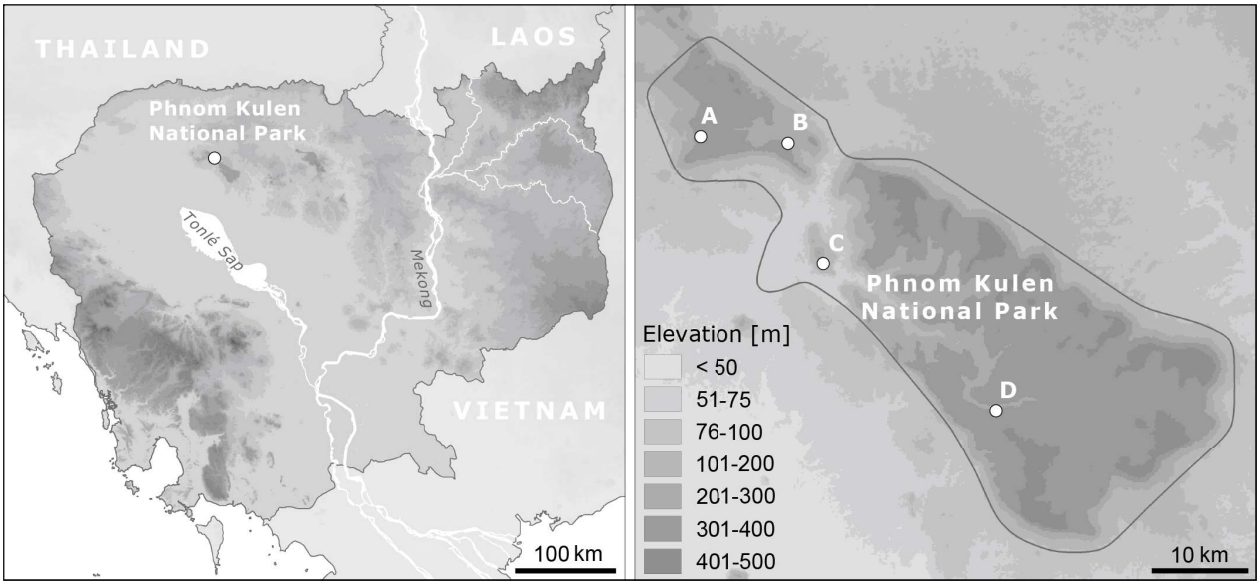

Fig. 1 (left) Location of Phnom Kulen National Park in Siem Reap Province, Cambodia. (right) Two distinct plateau areas and four survey sites (A—Banteay Srei District, Phnom Chor; B—Banteay Srei District, Phnom Kbal Spean; C—Banteay Srei District, Phnom Hop; D—Svay Leu District, Phnom Kulen Plateau) in Phnom Kulen National Park.

Fig. 2 Two major forest types in Phnom Kulen National Park: semi-evergreen forest on hillside plateaus (left) and dry deciduous dipterocarp forest (right) (© P. Geissler).

dipterocarp forest, of which only small and degraded areas remain (Neou *et al*., 2008).

Field surveys

Field surveys were conducted by T. Hartmann in September 2008, June 2009 and (together with P. Geissler) June 2011 (comprising 82 days in total). Survey sites were chosen to cover both of the main forest types on the eastern and western parts of the Phnom Kulen plateau. Localities are shown in Fig. 1. Surveys were conducted during all hours of the day and night. Specimens were caught by hand or by using snares in the case of lizards. Leaf litter fauna were encountered visually while gently turning leaf litter and rotten logs. Drift fences and pitfall-traps were installed in each study site.

A total of 517 voucher specimens were collected over the three periods, including a maximum of four specimens of one species per month and site. Additional specimens encountered were photographed and released. All specimens collected were photographed prior to euthanasia using ethyl acetate. These were subsequently fixed and preserved in 70% ethanol. Measurements were taken with digital vernier callipers. Stomach contents were removed by dissecting the preserved specimens and examined using a stereo microscope. Upon dissection, individuals were sexed by examination of gonads. Prey items were sorted, counted, identified to the lowest practical taxonomic level (order or family level), and measured using a calibrated ocular micrometre (length and width 0.01 mm) fitted to the stereo microscope. The volume of prey items was calculated using the formulae for a cylinder ($V = \pi \times r^2 \times h$) and the volume percentage (%V) of each prey item category was subsequently calculated. Photographic vouchers were labelled as ZFMK-PA and these and all physical specimens were deposited at the Zoologisches Forschungsmuseum Alexander Koenig (ZFMK), Bonn, Germany.

Results

A total of 86 species (25 amphibians and 61 reptiles) are currently known to occur within PKNP. Voucher information as well as the species' current status on the *IUCN Red List for Threatened Species* (IUCN, 2018) are shown in Appendix 1. Fifty-seven of the species recorded are characteristic of anthropogenically modified environments and are widely distributed in Indochina and beyond. The remaining 29 species are dealt with in detail in the following accounts.

Amphibia

Bufonidae

***Ingerophrynus macrotis* (Boulenger, 1877) (Fig. 3)**

IUCN status: Least Concern.

Material examined: Siem Reap Province, Banteay Srei District, Phnom Kbal Spean: ZFMK 89259–265, 90157–166.

Remarks: Voucher specimens from PKNP agree with the diagnosis of Taylor (1962): head crests absent; parotoid glands low, little larger than eyelid; tympanum large, equal to or little less than eye diameter; skin tubercles on head being the smallest; tarsal fold absent, but a row of larger tubercles on tarsus present; distinct inner and a smaller outer metatarsal tubercle present; palmar

Fig. 3 Anurans recorded in Phnom Kulen National Park. Left, top to bottom: *Ingerophrynus macrotis* (ZFMK 90166), *Glyphoglossus molossus* (ZFMK 89311), *Kaloula mediolineata* (ZFMK 92546) and *Micryletta* cf. *inornata* (ZFMK 90234). Right, top to bottom: *Glyphoglossus guttulata* (ZFMK 90175), *Kalophrynus interlineatus* (ZFMK 90181), *Microhyla berdmorei* (ZFMK 90204) and *Limnonectes gyldenstolpei* (ZFMK 89290) (© T. Hartmann & P. Geissler).

tubercle large and rounded; the first finger longer than the second; subarticular tubercles on hand.

In September 2008, six individuals (ZFMK 89259–265) were encountered foraging in degraded secondary forest on rainy evenings (19:00–23:00 hrs). In early June 2009, after the first heavy rain of the year, eight mating adult toads (males in yellowish breeding colouration) and two juveniles (ZFMK 90157–166) were found in a temporary breeding pond in disturbed secondary forest in daytime (11:00–17:00 hrs). The stomachs contents of 14 specimens (four adult males, six adult females, four juveniles of unknown gender) contained the following items (in % volume): Blattodea (23.1), Coleoptera (31.7) and Hymenoptera (Formicidae) (42.5), while the remaining 2.5% comprised undefined plant matter, soil and chitinous fragments.

Microhylidae

***Glyphoglossus guttulatus* (Blyth, 1856) (Fig. 3)**

IUCN status: Least Concern.

Material examined: Siem Reap Province, Banteay Srei District, Phnom Kbal Spean: ZFMK 89309–310, 90168–172 and 90174–175. Siem Reap Province, Banteay Srei District, Phnom Hop: ZFMK 90173.

Remarks: Voucher specimens from PKNP accord with Stuart & Emmett's (2006) description of specimens from the Cardamom Mountains: snout obtusely rounded, longer than eye diameter; fourth finger shorter than the second; webbing on the fourth toe nearly reaching proximal subarticular tubercle, with a continuing fringe to tip; dorsum light brown with distinct cream-edged dark brown irregular markings. They also resemble Taylor's (1962) colour description: transverse black stripes on back of thighs and a distinct diagonal dark brown mark following the supratympanic fold.

In September 2008, two froglets (ZFMK 89309–310) were found close to a potential breeding pond in degraded forest. In early June 2009, seven adult individuals (ZFMK 90168–172 and 90174–175) were encountered at a breeding pond in disturbed secondary forest after the first heavy rain of the year. ZFMK 90173 was found in mid-June at 18:30 hrs in a little rivulet in disturbed secondary forest.

***Glyphoglossus molossus* Günther, 1869 (Fig. 3)**

IUCN status: Near Threatened.

Material examined: Siem Reap Province, Banteay Srei District, Phnom Kbal Spean: ZFMK 89311–314, 90176.

Remarks: Voucher specimens from PKNP accord with the description of Vassilieva *et al.* (2016) for specimens from southern Vietnam: sharply truncate snout; smooth round flat lip on lower jaw; body robust and inflatable; hind limbs short; toes webbed, fingers unwebbed, with lateral skin fringes; prominent metatarsal tubercles present; large spade shaped metatarsal tubercles on feet; colouration dark grey with an irregular yellow speckling.

In September 2008, three adult individuals (ZFMK 89311–313) were encountered between 19:00 and 23:00 hrs during heavy rain in disturbed lowland forest. One froglet (ZFMK 89314) was found at the end of September 2008. In June 2009, a sole individual (ZFMK 90176) was found hibernating 10 cm deep in sandy soil during construction works in our field camp.

***Kalophrynus interlineatus* (Blyth, 1855) (Fig. 3)**

IUCN status: Least Concern.

Material examined: Siem Reap Province, Banteay Srei District, Phnom Kbal Spean: ZFMK 89307–308, 90177–181. Siem Reap Province, Svay Leu District, Phnom Kulen: ZFMK 92545.

Remarks: Our specimens match the diagnosis provided by Parker (1934), Matsui *et al.* (1996) and Vassilieva *et al.* (2014): toes less than one-third webbed, with the third toe webbing not extending beyond the distal subarticular tubercle and the free portion of the fifth toe longer than the distance from snout to nostril; several pairs of wart-like glands on breast; dorsum pattern-less or with an indistinct camouflage pattern.

In September 2008, two individuals (ZFMK 89307–308) were found in degraded secondary forest in a heap of dead wood during daytime (10:30 hrs). In June 2009, five individuals (ZFMK 90177–181, were encountered at a small breeding pond in degraded lowland forest. At the end of June 2011, a single individual (ZFMK 92545) was collected within semi-evergreen forest.

***Kaloula mediolineata* Smith, 1917 (Fig. 3)**

IUCN status: Near Threatened.

Material examined: Siem Reap Province, Banteay Srei District, Phnom Kbal Spean: ZFMK 90187–199, 92546–547.

Remarks: Our voucher specimens agree with the descriptions provided by Bourret (1942), Taylor (1962) and Chan-ard *et al.* (2011) in the following characteristic features: dorsum dark brown, two broad light bands from upper eyelid to groin; median light stripe from middle of back to a point above vent; two large metatarsal tubercles, outer smaller; toes pointed, half webbed. Selected measurements are given in Table 1.

Table 1 Selected measurements of voucher specimens of *Kaloula mediolineata* Smith, 1917 from Phnom Kulen National Park.

Voucher No.	ZFMK 90196	ZFMK 92547	ZFMK 92546	ZFMK 90198	ZFMK 90187	ZFMK 90192	ZFMK 90195	ZFMK 90197	ZFMK 90199	ZFMK 90193
Sex	female	male	female	male	male	female	female	female	female	female
SVL	70.85	53.1	56.9	51.3	49.0	48.4	53.3	45.9	55.0	43.9
HL	16.4	13.9	14.4	12.9	12.3	11.8	13.6	11.8	13.9	11.5
HW	18.1	15.1	16.7	14.0	13.6	13.5	14.9	13.7	16.8	13.4
SL	7.5	5.4	6.4	6.1	5.5	5.5	6.0	5.4	5.4	4.3
ED	5.6	5.1	5.8	4.9	3.7	4.5	5.3	4.4	4.8	3.9
IOD	6.2	4.3	5.1	4.6	4.2	4.0	4.6	4.4	5.1	4.0
IND	4.4	3.5	3.9	2.7	3.0	2.6	3.2	3.0	2.8	2.8
TBL	20.4	18.6	19.3	16.8	16.1	16.3	16.4	16.1	17.5	14.3
Fin3DW	0.8	0.6	0.8	0.5	0.6	0.7	0.6	0.5	0.5	0.5

Measurements follow Chan *et al.* (2013): snout–vent length (SVL), from tip of snout to vent; head length (HL), from posterior margin of mandible to tip of snout; head width (HW), measured at the level of the jaw articulation; snout length (SL), from anterior corner of eye to tip of snout; eye diameter (ED), length between anterior and posterior corners of eye; interorbital diameter (IOD), istance between medial margins of palpebrae at its closest point; internarial distance (IND), measured from medial, inner margins of nostrils; tibia length (TBL), measured from from knee inflection to tarsal inflection; third finger disc width (Fin3DW), widest horizontal diameter of third finger disc.

Our report from the PKNP is the first record of this species in Cambodia. Until now the species was only documented to occur in eastern Thailand (Taylor, 1962; Heyer, 1973; Nutphund, 2001; Chan-ard, 2003; Chan-ard *et al.*, 2011), southern Laos (Stuart, 1999), and southern Vietnam (Orlov *et al.*, 2002; Phung *et al.*, 2013). Due to this disjunct distribution pattern, a more widely occurrence, including Cambodia, was predicted (van Dijk & Chan-ard, 2004; Stuart *et al.*, 2008; Frost, 2019).

All individuals (ZFMK 90187–199, 92546–547) were encountered at a small breeding pond in degraded lowland forest at the very beginning of the rainy season in early June 2009 and 2011. In total, far more than 100 individuals of *K. mediolineata* were observed in early June 2009. The stomach contents of 14 specimens contained the following prey items (in % volume): Arachnida (1.5), Blattodea (14.0), Coleoptera (8.0) and Hymenoptera (Formicidae) (76.2).

***Microhyla berdmorei* (Blyth, 1856) (Fig. 3)**

IUCN status: Least Concern.

Material examined: Siem Reap Province, Banteay Srei District, Phnom Chor: ZFMK 90202–203. Siem Reap Province, Banteay Srei District, Phnom Kbal Spean: ZFMK 90200–201, 90204.

Remarks: The specimens from PKNP match the combination of traits described by Bain & Nguyen (2004) and Vassilieva *et al.* (2016) for specimens from Indochina: first finger shorter than one-half of the second; tibiotarsal joint beyond snout tip, when legs are adpressed; toes elongated, fully webbed; toe discs well developed; belly and thighs lemon yellow.

In June 2009, five individuals (ZFMK 90200–90204) were encountered actively foraging on leaf-litter in semi-evergreen forest (15:30–19:30 hrs).

***Micryletta* cf. *inornata* (Boulenger, 1890) (Fig. 3)**

IUCN status: Near Threatened.

Material examined: Siem Reap Province, Banteay Srei District, Phnom Kbal Spean: ZFMK 89337–340, 90234–246.

Remarks: The specimens from PKNP accord with Bain & Nguyen's (2004) characterization: snout blunt; dorsal skin smooth; first finger longer than one-half of the second; no discs and median grooves at finger and toe tips; toes not completely webbed, only one metatarsal tubercle present; arms and limbs bearing an orange marbled pattern.

Further molecular studies are needed to clarify the taxonomy of Cambodian populations currently assigned to this species. Populations in southern Vietnam and Thailand were recently assigned to the morphologically similar species *Micryletta erythropoda* (Tarkhnishvili, 1994) by Vassilieva *et al.* (2016) and Poyarkov *et al.* (2018) based on morphological and molecular traits. Though the specimens from PKNP resemble *M. erythropoda* in colouration, they lack an outer metatarsal tubercle, one

of the diagnostic traits mentioned by Tarkhnishvili (1994) for the type specimens from southern Vietnam. Hence, additional sampling is necessary to show whether Cambodian populations east or also west of the Mekong River should be assigned to this species.

In September 2008 and June 2009, all individuals (ZFMK 89337–340, ZFMK 90234–246) were found (16:30–23:30 hrs) relatively close to a small permanent pond in disturbed lowland forest.

Dicroglossidae

***Limnonectes gyldenstolpei* (Anderson, 1916) (Fig. 3)**

IUCN status: Least Concern.

Material examined: Svay Leu District, Phnom Kulen Plateau: ZFMK 89286–293. Banteay Srei District, Phnom Kbal Spean: ZFMK 89294–295, 90252–260. Banteay Srei District, Phnom Hop: ZFMK 90261–265.

Remarks: The voucher specimens from the PKNP correspond with the descriptions of Bourret (1942), Taylor (1962), Neang & Holden (2008) and Aowphol *et al*. (2015): males larger than females; male heads enlarged, bearing a dermal flap reaching beyond the interorbital region and swollen occipital regions; males bearing a pair of fangs on the lower jaw; tympanum and supratympanic fold distinct; dorsum and flanks bearing prominent tubercles.

All individuals were encountered actively foraging in semi-evergreen forest, always in very close proximity of rivers and rivulets (19:00–23:30 hrs, September 2008 and June 2009). The stomach contents of 24 specimens (8 males, 13 females, 2 juveniles) revealed the following items (in % volume): Arachnida (3.9), Blattodea (4.7), Coleoptera (9.4), Hymenoptera (Formicidae) (8.6), Insecta (4.5), Isopoda (2.7), Orthoptera (50.7) and Polydesmida (3.2), while the remaining 9% comprised undefined plant matter, soil and chitinous fragments. One individual was found to have swallowed a juvenile skink (*Scinella* sp.).

Ranidae

***Hylarana lateralis* (Boulenger, 1877) (Fig. 4)**

IUCN status: Least Concern.

Material examined: Banteay Srei District, Phnom Kbal Spean: ZFMK 92555.

Remarks: Our female specimen accords with the diagnosis provided by Bourret (1942), Taylor (1962) and Vassilieva *et al.* (2016): dorsolateral fold thick and distinct, laterally contrasted by a thin dark line; tympanum large, slightly less than eye; upper jaw thickened, bearing a white stripe, forming a triangular mark behind tympanum; males possessing well-developed humeral glands and small posterior vocal slits; dorsum bearing an irregular series of diagonal lines.

In June 2011, the female specimen was encountered at 20:00 hrs in a disturbed secondary lowland forest.

***Sylvirana mortenseni* (Boulenger, 1903) (Fig. 4)**

IUCN status: Near Threatened.

Material examined: Banteay Srei District, Phnom Hop: ZFMK 89341. Banteay Srei District, Phnom Kbal Spean: ZFMK 89342–347, 90287–294, 92553–554.

Remarks: Our series of specimens agrees with the expanded diagnosis published by Sheridan & Stuart (2018): all digit tips expanded, bearing a circummarginal groove; dorsal skin finely granular; ventral skin smooth; males and females equal in size; males bearing round black humeral glands and a thin nuptial pad on the first finger; pineal gland visible; vocal sac opening located near corner of mouth; no distinct gular pouch; flank with dark stripe below dorsolateral fold extending to groin; no strong demarcation between dark upper parts of flank and its light lower parts.

Sheridan & Stuart (2018) were the first to discover this species in Siem Reap Province. Formerly the species was only known to occur in the Cardamom Mountains in southwestern Cambodia, where it was recorded from 220 to 1,000 m a.s.l. (Ohler *et al*., 2002; Stuart & Emmet, 2006).

All individuals were encountered in semi-evergreen forest very close to rivers and rivulets from 17:00–21:00 hrs in September 2008 and June 2009 and 2011. The ZFMK 92553 male was observed calling, while sitting in a shallow pool between rocks and roots close to Kbal Spean River at 18:00 hrs on 5 June 2011. The stomach contents of 16 specimens (13 males, 3 females) contained the following items (in % volume): Arachnida (0.8), Blattodea (0.2), Coleoptera (72.9), Hymenoptera (Formicidae) (0.3), Gastropoda (12.7), and Insecta (6.3), while the remaining 6.5% comprised undefined plant matter, soil and chitinous fragments.

Rhacophoridae

***Theloderma* cf. *stellatum* Taylor, 1962 (Fig. 4)**

IUCN status: Near Threatened.

Material examined: Banteay Srei District, Phnom Chor: ZFMK 92565–566.

Remarks: Our one adult and one froglet agree with Taylor's (1962) original description: skin warty; dorsal surface brownish grey, covered with silvery and whitish asperities; shoulder area bearing a dark trifoliate spot; a large black spot on groin; fingers about one-third webbed, the third finger disc nearly equal to the diam-

Fig. 4 Anurans and chelonians from Phnom Kulen National Park. Left, top to bottom: *Hylarana lateralis* (ZFMK 92555), *Sylvirana mortenseni* (ZFMK 89346), *Cyclemys* cf. *oldhamii* (ZFMK-PA TH02) and *Malayemys subtrijuga* (ZFMK-PA TH03). Right, top to bottom: *Sylvirana mortenseni* (ZFMK 89347), *Theloderma* cf. *stellatus* (ZFMK 92565, 92566), *Cyclemys* cf. *oldhamii*, juvenile in lateral view (ZFMK-PA PG01) and head of *Indotestudo elongata* (ZFMK-PA TH04) (© T. Hartmann & P. Geissler).

eter of tympanum; whitish, velvety nuptial pads on the dorsal and medial surface of the first finger; interorbital distance almost equal to the width of upper eyelid; ventral surface bearing light reticulations. As stated by Poyarkov *et al.* (2015), the colour pattern is highly variable within populations and even within one individual, depending on the daytime of observation. As depicted in Fig. 4D, the colouration may also depend on the age of the specimen. Nevertheless, Poyarkov *et al.* (2015) identified the colour of the toe and finger pads as constant colouration traits. In this character, the two specimens from PKNP resemble *Theloderma vietnamense* Poyarkov *et al*. (2015) in bearing rusty red pads, instead of the pinkish ones of *Theloderma stellatum* specimens from Thailand (Poyarkov *et al*. 2015). The latter authors also summarize current knowledge on the distribution on the two sister species across Indochina, although the populations from PKNP and the recent record from Kulen Promtep Wildlife Sanctuary in northern Cambodia (Hartmann *et al*., 2013b) were not evaluated. Further studies should show whether the populations in central and northern Cambodia belong to *T. stellatum sensu stricto* or to *T. vietnamense* which is known from eastern Cambodia and southern Vietnam.

Both individuals were found on 3 June 2011 in a water-filled tree hollow at night after moderate rain.

Reptilia

Geoemydidae

***Cyclemys* cf. *oldhamii* Gray, 1863 (Fig. 4)**

IUCN status: Endangered (Rhodin *et al.*, 2018).

Material examined: Banteay Srei District, Phnom Chor: ZFMK-PA TH 02. Banteay Srei District, Phnom Kbal Spean: ZFMK 92567, ZFMK-PA PG 01.

Remarks: The morphology and colouration pattern of *Cyclemys* specimens from PKNP were characterized by Vamberger *et al.* (2017): head crown bearing a speckled pattern; neck dark with salmon striping; throat salmon showing a mottled dark pattern; carapace dark brownish; plastron spotted in juveniles, plastron with dense radiating dark streaks in subadults and adult specimens; in old specimens the plastron becomes uniformly dark coloured. This pattern fits the conditions of the eastern colouration morph of *C. oldhamii* described by Fritz *et al*. (2008).

The population in PKNP was first recorded by Durkin *et al.* (2010) as *Cyclemys* aff. *atripons*. Due to the morphological traits described above, Kim (2011) and Durkin (2012) assigned the population to *C. oldhamii*. The PKNP population seems to be geographically isolated and located between the ranges of *C. atripons* and *C. oldhamii*. The genetic work of Vamberger *et al.* (2017) revealed the presence of mitrochondrial haplotypes of *C. atripons*. The latter authors argued the PKNP population either represents a natural hybrid swarm or a distinct and as yet undescribed species. Alternatively, an anthropogenic translocation of confiscated specimens may have occurred within PKNP.

Our single collected individual (ZFMK 92567) and the photo-vouchered subadult (ZFMK-PA PG 01) were encountered in the evening in shallow, rather fast flowing areas within the Kbal Spean River in June 2011. The adult photo-vouchered individual (ZFMK-PA TH 02) was encountered at midday in a shallow and slow flowing area of Kbal Spean River in June 2011.

***Malayemys subtrijuga* (Schlegel & Mueller, 1845) (Fig. 4)**

IUCN status: Near Threatened (Rhodin *et al*., 2018).

Material examined: Banteay Srei District, Phnom Kbal Spean: ZFMK-PA TH 03.

Remarks: Characters visible in the voucher photo match the diagnostic traits mentioned by Taylor (1970) and Ihlow *et al.* (2016a): lower marginal scutes 8–12 bearing only very narrow blackish bars along the posterior margin; infraorbital stripe extending across loreal seam, joining the supraorbital stripe; infraorbital stripes distinctly angled below the anterior edge of eye; two yellowish orbital rings present.

Our photo-vouchered subadult individual was encountered foraging in a pond in heavily disturbed lowland forest habitat close to the foothills of Phnom Kbal Spean on 22 June 2009.

Testudinidae

***Indotestudo elongata* (Blyth, 1854) (Fig. 4)**

IUCN status: Critically Endangered (Rhodin *et al*., 2018).

Material examined: Svay Leu District, Phnom Kulen Plateau: ZFMK-PA TH 04.

Remarks: In September 2008, a photo voucher was taken of the shrunken head of a single tortoise that was mounted on a stick. This was encountered at the entrance of a home located within the national park. The residents reported that the tortoise had been collected behind the house in a heavily disturbed forest area for human consumption. The shrunken head fits Taylor's (1970) diagnosis: very well-defined pair of prefrontal shields; horny edge of upper jaw slightly denticulated. The length of the horny sheath of the upper jaw exceeds the head hight of the specimen. This condition differs clearly

from the head morphology of the other two Indochinese tortoise species: *Manouria impressa* and *M. emys*. For comparison, see photographs in Emmett (2009), Ihlow *et al*. (2016b) and Stanford *et al*. (2015).

Agamidae

***Leiolepis rubritaeniata* Mertens, 1961 (Fig. 5)**

IUCN status: Not Evaluated.

Material examined: Banteay Srei District, Phnom Kbal Spean: ZFMK 90305–07, ZFMK 92599–605.

Remarks: The colouration of our males agrees with the description of Peters (1971) and Hartmann *et al*. (2012): dorsum bearing a polygonal net-like pattern formed by the margins of faded ocelli; post-axillary region barred in red and black; posterior part of flanks plain reddish-orange.

All specimens were encountered and caught in snares at the entrance of their burrows at the end of the dry season in early June 2009 and 2011. Hartmann *et al*. (2012) provided further information on the ecology of the population in PKNP.

***Physignathus cocincinus* Cuvier, 1829**

IUCN status: Not Evaluated.

Material examined: Banteay Srei District, Phnom Kbal Spean: ZFMK 90305–307, ZFMK 92599–605.

Remarks: One subadult and one juvenile specimen were recorded. These fully accord with Taylor's (1963) expanded description: two diverging series of enlarged scales on lower jaw, larger than infralabials; tail laterally compressed, heavily keeled below; toes with extended fringes; the adult also agrees with Taylor's (1963) description in having a well-developed continuous nuchal and dorsal crest, while the caudal crest is well separated by a hiatus.

The juvenile specimen was found resting on a small tree close to a relatively big river at 19:00 hrs in early June 2011. The subadult specimen was found resting on a branch (approximately three meters above ground) close to a waterfall at 20:00 hrs on 3 June 2011.

Gekkonidae

***Cyrtodactylus* cf. *intermedius* (Smith, 1917) (Fig. 5)**

IUCN status: Not Evaluated.

Material examined: Banteay Srei District, Phnom Kbal Spean: ZFMK 88356–359, 90309–311, 92572–75.

Remarks: Specimens encountered within PKNP were assigned to the *C. intermedius* complex by the following trait combination (see Smith, 1917; Ngo *et al*., 2010; Murdoch *et al*., 2019): infralabials 8–11; lateral fold present, bearing slightly enlarged scales; midventrals 38–43; precloacal pores in males 9–10; dorsum greyish brown bearing four to five dark brown, yellow-edged cross-bars, the first forming a nuchal loop. However, a molecular phylogeny published by Grismer *et al*. (2015) showed that *C. intermedius* actually forms a species complex comprising at least five undescribed species in Cambodia. Murdoch *et al*. (2019) described six new species in the *C. intermedius* complex from the Cardamom Mountains of western Cambodia, restricting the known distribution of *C. intermedius sensu stricto* to eastern Thailand. Our specimens bear characters listed as diagnostic for *C. intermedius* by Murdoch *et al.* (2019): 24 enlarged femoral scales, proximal femoral scales one-half the size of the distal ones; three rows of enlarged post-precloacal scales; two or three postcloacal tubercles; no dark blotches on top of head; no pocketing between toes and fingers. But specimens from the PKNP also differ in some diagnostic traits (opposing diagnostic characters from Murdoch *et al*. 2019 are given in brackets): posterior border of nuchal loop chevron shaped (vs. rounded); supralabials 9–11 (vs. 8); ventral scales 34–42 (vs. 42–44). Further molecular and morphological studies are needed to clarify the taxonomic status of the population in the PKNP.

All specimens were found after sunset (17:30–23:00 hrs) in rock crevices or foraging on sandstone rocks in semi-evergreen forest.

***Dixonius siamensis* (Boulenger, 1894) (Fig. 5)**

IUCN status: Not Evaluated.

Material examined: Banteay Srei District, Phnom Chor: ZFMK 90317. Banteay Srei District, Phnom Kbal Spean: ZFMK 88365, 90312–315, 92568. Banteay Srei District, Phnom Hop: ZFMK 90316.

Remarks: Five adult voucher specimens (SVL 45.2–51.9 mm) from PKNP show an array of diagnostic traits compiled by Taylor (1963) and Das (2010): terminal parts of digits bearing widened lamellae; 5 dorsolateral rows of enlarged, keeled scales on each side, ventrally blend into larger imbricate scales; ventral scales bearing minute posterior serrations; up to 6 precloacal pores in a curving angular series; supranasals separated by two granular scales; absence of a distinct canthal stripe. The genetic work of Ziegler *et al.* (2016) showed that the taxonomic status of Indochinese populations assigned to the genus *Dixonius* require further integrated study.

All specimens but one were caught after sunset (17:30–23:00 hrs in June 2009 and 2011) actively foraging on the forest floor in semi-evergreen forest. In September

Fig. 5 Lizards from Phnom Kulen National Park. Left, top to bottom: *Leiolepis rubritaeniata* (ZFMK 92602), *Scincella rupicola* (ZFMK 92587), *Tropidophorus cocincinensis* (ZFMK 92592) and *Dixonius siamensis* (ZFMK 92568). Right, top to bottom: *Lipinia vittigera microcercum* (ZFMK 92577), *Sphenomorphus lineopunctulatus* (ZFMK 92615), *Cyrtodactylus* cf. *intermedius* (ZFMK 88357) and *Hemiphyllodactylus* sp. (ZFMK 92571) (© T. Hartmann & P. Geissler).

2008, a single juvenile specimen was found in daytime (10:00 hrs) hidden in a pile of dead wood in a heavily disturbed area of semi-evergreen forest.

***Hemiphyllodactylus* sp. (Fig. 5)**

IUCN status: Not Evaluated.

Material examined: Banteay Srei District, Phnom Kbal Spean: ZFMK 92571.

Remarks: Our single female voucher specimen may be assigned to a currently undescribed taxon which Zug (2010) referred to as *Hemiphyllodactlus* "*yunnanensis*". Zug (2010) morphologically distinguishes the southern mainland Southeast Asian populations (named *H.* "*yunnanensis*") from southern Chinese and northern Vietnamese populations close to the type locality of *H. yunnanensis*. We assign our single female specimen to this taxon based on the following combination of morphological characters: snout-vent length 38.4 mm, tail length 33.8 mm, trunk length 20.6 mm, eye diameter 2.1 mm, head length 9.8 mm, head width 6.9 mm, nare-eye length 3.2 mm, snout-eye length 4.3 mm, internarial distance 1.2 mm, ear opening diameter 0.5 mm, 14–15 dorsal scale rows, 11 ventral scale rows, two feeble developed cloacal spurs, two scales between supranasals, four scales surrounding the nasal scale, 11/10 supralabials, 10/10 infralabials, 10/12 enlarged chin scales, distinct ear openings not bordered by enlarged scales, 3–3–3–3 lamella formula on forelimbs (lamella pairs only), 3–4–4–4 on hindlimbs, no precloacal pores, but six enlarged precloacal scales, no femoral pores or enlarged scales. The combination of bearing four circumnasal scales, only three lamellae on first finger and first toe and 10/12 enlarged chin shields also clearly differs from the conditions of newly described species from adjacent Thailand: *H. chiangmaiensis*, *H. khlonglanensis* and *H. flaviventris* (Grismer *et al*., 2014; Sukprasert *et al*., 2018), Laos: *H. indosobrinus*, *H. kizirani* and *H. serpispecus* (Nguyen *et al*., 2014; Eliades *et al*., 2019) and Vietnam: *H. banaensis* and *H. zugi* (Nguyen *et al*., 2013; Ngo *et al*., 2014). Further molecular and morphological studies are needed to clarify the taxonomic status of the population in PKNP.

Our single female specimen was found in June 2011 at 19:30 hrs on a leaf in semi-evergreen forest relatively near to a river.

Scincidae

***Lipinia vittigera microcercum* (Boettger, 1901) (Fig. 5)**

IUCN status: Not Evaluated.

Material examined: Svay Leu District, Phnom Kulen Plateau: ZFMK 90339, 92577–582.

Remarks: Our seven voucher specimens from PKNP agree with the description of this Indochinese subspecies by Vassilieva *et al.* (2016): 28–32 scales around midbody; head elongated; lower eyelid bearing a transparent window; frontonasal scales in broad median contact; narrow light vertebral stripe from snout tip to tail base; two paravertebral dark stripes from snout tip to tail base, two light dorsolateral stripes being less distinct; tail orange or bright red.

All seven individuals were found between 09:00 and 14:00 hrs in June 2009 and 2011 running down and around tree trunks in heavily disturbed semi-evergreen forest.

***Scincella rupicola* (Smith, 1916) (Fig. 5)**

IUCN status: Not Evaluated.

Material examined: Banteay Srei District, Phnom Chor: ZFMK 90355. Banteay Srei District, Phnom Kbal Spean: ZFMK 88372–374, 90346–354, 92586–588. Svay Leu District, Phnom Kulen Plateau: ZFMK 88375–377, 90356–359.

Remarks: The traits of our voucher specimens from the PKNP accord with the diagnostic traits reported by Smith (1916), Taylor (1963) and Neang *et al.* (2018): hind limb reaching the elbow when adpressed; lower eyelid bearing an undivided transparent disc; supranasals absent; prefrontals in broad contact; two preoculars; two presuboculars; nuchals feebly enlarged; seven supralabials, fifth and sixth largest, situated below the eye; ear opening large, nearly as large as eye; 17 to 18 lamellae beneath fourth toe; two pairs of enlarged preanals; colouration in females: dorsum light brown, outer scale rows a little lighter; a series of large irregular black spots along a vertebral line, smaller spots paired on neck; dark brown band from eye to tail base, interrupted by large light patches; tail pinkish-olive; colouration in males: dorsum without dark spots; dorsolateral stipes faint. However, the specimens from PKNP differ slightly in the following characters: midbody scale rows 34–37 (vs. 33–36 reported by Neang *et al.,* 2018); ventrals in transverse rows 71–74 (vs. 63–69 reported by Neang *et al.*, 2018); paravertebral scale rows 63–68 (vs. 68–73 reported by Neang *et al.*, 2018).

We follow Shea & Greer (2002), Teynié & David (2010) and Neang *et al.* (2018) in recognising this species as valid. The species was recently recorded from Laos (Teynié & David, 2010) and Vietnam (Nguyen *et al*., 2010a). Formerly it was only known from central and eastern Thailand (Taylor, 1963). However, the species was not listed in recent checklists for Thailand (Chanard *et al*., 2015). PKNP is the fourth known locality of

the taxon in Cambodia, it being previously only known from the Kampong Thom, Stung Treng and Preah Vihear Provinces (Hayes *et al*., 2015; Neang *et al.*, 2018).

All specimens were found actively foraging in leaf litter in disturbed semi-evergreen rainforest (09:00–17:00 hrs in June 2009 and 2011). Except for one juvenile (ZFMK 88372) found in September 2008, all specimens were encountered in June 2009 and 2011. Males bear a reddish breeding colouration in early June (Fig. 5).

***Sphenomorphus lineopunctulatus* Taylor, 1962 (Fig. 5)**

IUCN status: Not Evaluated.

Material examined: Svay Leu District, Phnom Kulen Plateau: ZFMK 88379, 88382, 92614–619.

Remarks: Currently only one species assigned to the genus *Sphenomorphus* Fitzinger, 1843 is known to occur within PKNP. Hartmann *et al.* (2010) provided a detailed morphological description of our voucher specimens (see Table 1 in Hartmann *et al*., 2010) and identified them as *S. lineopunctulatus*. Until now, this remained the only known population of the species in Cambodia and one of only three documented occurrences in the world.

All specimens were found on a rocky, sandy and scarcely vegetated plateau during the day (09:00–16:30 hrs). Four juvenile specimens (ZFMK 92616–92619) were encountered at the end of the rainy season in June 2011.

***Tropidophorus cocincinensis* Duméril & Bibron, 1839 (Fig. 5)**

IUCN status: Not Evaluated.

Material examined: Banteay Srei District, Phnom Chor: ZFMK 90364. Banteay Srei District, Phnom Kbal Spean: ZFMK 88378, 90360–363, 92589–598.

Remarks: The species was first recorded in PKNP and Cambodia by Hartmann *et al*. (2009) who provided a detailed morphological description of the specimens from PKNP. Because its core distribution area is situated in central Vietnam (Quang Binh to Kon Tum Provinces: Nguyen *et al*., 2010b), southern Laos (Champasak and Xe Kong Provinces: Chuaynkern *et al*., 2005) and north-eastern Cambodia (Virachey National Park: Stuart *et al*., 2010), the population inhabiting PKNP forms the westernmost point known of the species' putative range. It is only known from one other locality in Cambodia and records from eastern Thailand may have been based on a misidentification of *Tropidophorus microlepis* Günther, 1861 specimens (Hartmann *et al*., 2009; Chan-ard *et al*., 2015).

The following ecological data were recorded during the transition of the dry and monsoon season in early June 2011: individuals were mainly active in early morning and one hour before sunset; 44% of recorded specimens (n=36) were found on rocks near a stream; 31% were found on leaf litter or logs; 22% were active within flowing water; mean body temperature was 28.9°C (±1.1 SD; n=26) at a mean air temperature of 27.1°C (±0.9 SD; n=26). The stomach contents of 28 specimens contained the following items (in % volume): Ephemeroptera (0.2), Plecoptera (0.3), Anisoptera (larvae) (3.3), Zygoptera (larvae) (0.2), Blattodea (0.2), Isoptera (0.3), Coleoptera (3.9), Diplopoda (0.8), Decapoda (85.3), Aranae (1.2), Oligochaeta (0.4) and Gastropoda (4.1). Besides using the water body as a retreat when approached by predators, our data show that the population in the PKNP also seems to highly depend on aquatic prey items (Odonata larvae and Decapoda). This is the first indication of aquatic foraging behaviour within the genus *Tropidophorus* (Nguyen *et al*., 2010b).

Colubridae

***Boiga siamensis* (Nutaphand, 1971) (Fig. 6)**

IUCN status: Not Evaluated.

Material examined: Banteay Srei District, Phnom Kbal Spean: ZFMK 88337, 92624.

Remarks: Our two voucher specimens from PKNP correspond with the diagnostic traits published by Vassilieva *et al*. (2016) and Das (2010): body compressed laterally; midbody scale rows 23; ventrals 247–270; subcaudals paired, 116–129; anal entire; vertebral scales enlarged; head very distinct from neck; pupils vertical; light brown on back with dark brown, chevron shaped blotches; dark stripe from eye to jaw angle.

Both specimens were found resting in trees in daytime in disturbed semi-evergreen forest.

***Dendrelaphis subocularis* (Boulenger, 1888) (Fig. 6)**

IUCN status: Least Concern.

Material examined: Banteay Srei District, Phnom Hop: ZFMK 88324.

Remarks: The voucher specimen from PKNP fits the description of Vietnamese specimens provided by Vassilieva *et al.* (2016): midbody scale rows 15; ventrals 173; subcaudals paired, 103; anal divided; dorsal scales smooth; head elongated; loreal present; 8 supralabials, only fifth in contact with orbit; dorsum brown, with bronze tint; paravertebral yellow dots form an vertebral stripe on anterior parts of dorsum; cream ventrolateral stripe from labial scales to tail base.

Our single specimen was found actively hunting a subadult *Fejervarya limnocharis* on a sunny morning

Fig. 6 Snakes from Phnom Kulen National Park. Left, top to bottom: *Boiga siamensis* (ZFMK 92624), *Lycodon davisonii* (ZFMK 92628), adult *Lycodon subcinctus* (ZFMK 92631) and adult *Oligodon fasciolatus* (ZFMK 92633). Right, top to bottom: *Dendrelaphis subocularis* (ZFMK 88324), juvenile *Lycodon subcinctus* (ZFMK 90372), juvenile *Oligodon fasciolatus* (ZFMK 92634) and *Amphiesma stolatum* (ZFMK-PA RW01) (© T. Hartmann, P. Geissler & R. Weckauf).

(09:00 hrs) on 1 September in 2008 in disturbed lowland habitat.

***Lycodon davisonii* (Blanford, 1878) (Fig. 6)**

IUCN status: Least Concern.

Material examined: Svay Leu District, Phnom Kulen Plateau: ZFMK 92628.

Remarks: Voucher specimens from PKNP match the descriptions of other Indochinese populations published by Saint-Girons (1972), Geissler *et al.* (2011) and Vassilieva *et al.* (2016): midbody scale rows 13; ventrals 226; subcaudals paired, 97; anal entire; dorsal scales smooth; head flattened; loreal present; preocular absent; nasals separated by two internasals; whitish cross-bars alternate with broad semicircles in dark brown; on posterior parts of body and tail the pattern appears dissolved into a reticulate pattern.

The species was formerly assigned to the genus *Dryocalamus*, which was put into the synonomy of *Lycodon* by Figueroa *et al.* (2016). Our single specimen was found resting on the twigs of a bush in disturbed semi-evergreen forest at 20:30 hrs on 7 June 2011.

***Lycodon subcinctus* Boie, 1827 (Fig. 6)**

IUCN status: Least Concern.

Material examined: Banteay Srei District, Phnom Kbal Spean: ZFMK 90371–372, 92631.

Remarks: The three voucher specimens from the PKNP match the descriptions of other Indochinese populations published by Saint-Girons (1972), Geissler *et al.* (2011) and Vassilieva *et al.* (2016): midbody scale rows 17; ventrals 192–230; subcaudals paired, 60–91; anal divided; scales feebly keeled; snout broad; nasals separated by two internasals; dorsal colouration dark grey to black, with broad distinct white cross-bars on anterior part of body; cross-bars on anterior part of body and tail almost invisible.

All individuals were found actively foraging after dawn (17:30–21:00 hrs) in leaf litter in disturbed semi-evergreen forest.

***Oligodon fasciolatus* (Günther, 1864) (Fig. 6)**

IUCN status: Least Concern.

Material examined: Banteay Srei District, Phnom Hop: ZFMK 88380. Banteay Srei District, Phnom Kbal Spean: ZFMK 92633–634.

Remarks: Our three specimens agree with the descriptions of other Indochinese populations published by Saint-Girons (1972), Grismer *et al.* (2008b) and Vassilieva *et al.* (2016): midbody scale rows 21–23; ventrals 147–210; tail short, tapering; subcaudals paired, 33–61; one preocular; one presubocular; two postoculars; supralabials 7–8; dorsum grey to yellowish brown; 11–22 brownish, dark edged rhomboid blotches on back, each separated by three reticulated cross-bars.

All three specimens were encountered being active during the daytime (11:00–16:30 hrs) in leaf litter within disturbed semi-evergreen forest.

***Amphiesma stolatum* (Linnaeus, 1758) (Fig. 6)**

IUCN status: Not Evaluated.

Material examined: Banteay Srei District, Phnom Kbal Spean: ZFMK-PA RW 01.

Remarks: A photo voucher taken by Regine Weckauf shows the characteristic colouration pattern of this species as described by Saint-Girons (1972) and Vassilieva *et al*. (2016): dorsum grey; dark cross-bars on back and flanks, more distinct on anterior part of body; two cream to brownish dorsolateral stripes, interrupted by brownish blotches on the anterior part of body and edged by a thin dark line on the posterior part of body and tail; neck rusty orange.

The photo-vouchered specimen was encountered in heavily disturbed open dipterocarp forest at 15:30 hrs on 24 August.

Discussion

Though one of the smaller national parks (covering 37,373 ha: Hayes *et al*., 2013) in Cambodia, PKNP is important for conserving the herpetofauna of lowland habitats in mainland Southeast Asia. Three species confirmed in our study (*Sphenomorphus lineopunctulatus*, *Hemiphyllodactylus* sp. and *Kaloula mediolineata*) are currently unknown from any other locality in Cambodia and only two additional localities in Laos and Thailand are known for *S. lineopunctulatus,* neither of which are in a protected area. Semi-evergreen and evergreen lowland forests and their species-rich herpetofauna are under severe threat, having faced extensive clearance in recent years (Souter *et al*., 2016).

To infom effective conservation efforts in future, better understanding of species assemblages in protected areas in Cambodia is needed. Of the 41 protected areas in the country, PKNP and Phnom Samkos Wildlife Sanctuary are the only sites where long-term surveys of herpetofauna have been undertaken over several

years. Grismer *et al.* (2008a,b) documented the highest diversity of amphibians (29) and reptiles (65) known for Cambodia in Phnom Samkos Wildlife Sanctuary. This is followed by PKNP with 25 amphibians and 61 reptiles. All other protected areas of Cambodia have so far only received short term assessments resulting in much lower species numbers e.g., 22 amphibians and 33 reptiles in Kulen Promtep National Park (Hartmann *et al*., 2013b), 20 amphibians and 22 reptiles in Keo Seima Wildlife Sanctuary (Stuart *et al*., 2010), 21 amphibians and 17 reptiles in Phnom Nam Lyr Wildlife Sanctuary (Stuart *et al*., 2010) and 12 amphibians and 16 reptiles in Virachey National Park (Stuart *et al*., 2010). These figures probably reflect different levels of survey effort rather than an actual gradient in herpeto-diversity. More extensive long-term surveys are therefore urgently needed. This need is underlined by the fact that in the case of the PKNP, 42.5 % of the species have yet to be classified on the *IUCN Red List of Threatened Species*, in most cases due to a lack of information on their distribution and status.

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Appendix 1 Amphibian and reptile species recorded in Phnom Kulen National Park, with voucher specimen numbers and capture localities

Locality abbreviations correspond with Fig. 1 and refer to A) Banteay Srei District, Phnom Chor (13°41′13′′N, 103°58′45′′E), B) Banteay Srei District, Phnom Kbal Spean (13°41′21′′N, 104°00′55′′E), C) Banteay Srei District, Phnom Hop (13°37′87′′N, 104°01′91′′E) and D) Svay Leu District, Phnom Kulen Plateau (13°32′49′′N 104°06′76′′E).

Photographic vouchers are indicated by ZFMK-PA with following initials referring to the photographer: AM=Alistair Mould, JBC=Jean-Baptiste Chevance, LA=Lukas Ackermann, PG=Peter Geissler, RW=Regine Weckauf, TH=Timo Hartmann and PW=Philipp Wagner.

Distribution in Indochina: Species characteristic of anthropogenically modified environments and widespread in Indochina (*sensu* Stuart & Emmett, 2006; Bezuijen *et al*., 2009; Bain & Hurley, 2011; Hartmann *et al*., 2013b) are marked with an asterisk (*). Species records based on literature alone (Hayes *et al*., 2013; Herr & Lee, 2016) are marked with a "L". Distribution abbreviations for the remainder follow Bain & Hurley (2011): NWU=Northwest Uplands, NEU=Northeast Uplands, NAN=Northern Annamites, NEL=Northeast Lowlands, UML=Upper Mekong Lowlands, CAN=Central Annamites, SAN=Southern Annamites, CSL=Central-south Vietnam Lowlands, SLU=Southern Lao Uplands, SLL=Southern Lao Lowlands, MEK=Mekong Delta, CMB=interior Cambodian Lowlands, CDU=Cardamom Uplands, CDL=Cardamom Lowlands; NC=Northern Coast, CC=Central Coast, SC=Southern Coast, NIS=Northern Islands and SIS=Southern Islands.

IUCN Status: CR=Critically Endangered, EN=Endangered, LC=Least Concern, NE=Not evaluated, NT=Near Threatened, VU=Vulnerable (IUCN, 2018).

Taxon	Locality: Voucher Number /Record	Distribution in Indochina	IUCN Status
Bufonidae			
Duttaphrynus melanostictus (Schneider, 1799)	A: 90167, B: ZFMK 89255–258, 90154–156	*	LC
Ingerophrynus macrotis (Boulenger, 1877)	B: ZFMK 89259–265, 90157–166	UML, CAN, CSL, SLL, CMB, CDU, CDL	LC

Appendix 1 Cont'd

Taxon	Locality: Voucher Number /Record	Distribution in Indochina	IUCN Status
Microhylidae			
Glyphoglossus guttulatus (Blyth, 1856)	B: ZFMK 89309–310, 90168–172, 90174–175, C: ZFMK 90173	NWU, NEL, CAN, CSL, SLL, CMB, CDL	LC
Glyphoglossus molossus Günther, 1869	B: ZFMK 89311–314, 90176	CSL, SLL, MEK, CMB	NT
Kalophrynus interlineatus (Blyth, 1855)	B: ZFMK 89307–308, 90177–181, D: ZFMK 92545	NWU, NEU, NAN, NEL, UML, SAN, CSL, SLL, MEK, CMB, CDU, CDL	LC
Kaloula mediolineata Smith, 1917	B: ZFMK 90187–199, 92546–547	CSL SLL SIS	NT
Kaloula pulchra Gray, 1831	A: ZFMK 89325–326, B: ZFMK 89317–322, 89324, 90182–186, D: ZFMK 89323	*	LC
Microhyla berdmorei (Blyth, 1856)	A: ZFMK 90202–203, B: ZFMK 90200–201, 90204	*	LC
Microhyla butleri Boulenger, 1900	B: ZFMK 89315–316, 90205–210, 92548	*	LC
Microhyla mukhlesuri Hasan, Islam, Kuramoto, Kurabayashi & Sumida, 2016	A: ZFMK 90220, B: ZFMK 89327–331, 90211–219	*	LC
Microhyla heymonsi Vogt, 1911	B: ZFMK 89332, 90221–229, 92549	*	LC
Microhyla pulchra (Hallowell, 1861)	A: ZFMK 89333, B: ZFMK 89334–336, 90230–233, D: ZFMK 92550	*	LC
Micryletta cf. *inornata* (Boulenger, 1890)	B: ZFMK 89337–340, 90234–246	NAN, NEL, UML, CSL, SLL, MEK, CMB, CDU, CDL	LC
Dicroglossidae			
Fejervarya limnocharis (Gravenhorst, 1829)	A: ZFMK 89274, B: ZFMK 89266–268, 276–278, 90247–249, C: ZFMK 89269–272, D: ZFMK 89275	*	LC
Hoplobatrachus rugulosus (Wiegmann, 1834)	A: ZFMK 89281, B: ZFMK 89279–280, 90250–251 D: ZFMK 89282–284	*	LC
Limnonectes gyldenstolpei (Anderson, 1916)	B: ZFMK 89294–295, 90252–260, C: ZFMK 90261–265, D: ZFMK 89286–293	NWU, UML, SLL, CDU, CDL	LC
Occidozyga lima (Gravenhorst, 1829)	B: ZFMK 89297–303, 90266–90270, C: ZFMK 89296, 92556	*	LC
Occidozyga martensii (Peters, 1867)	B: ZFMK 89304, 90271-281, D: ZFMK 89305–306, , 92557	*	LC
Ranidae			
Hylarana erythraea (Schlegel, 1837)	B: ZFMK 90282–286, 92551–52	*	LC
Pelophylax lateralis (Boulenger, 1877)	B: ZFMK 92555	CAN, SAN, CSL, SLL	LC
Sylvirana mortenseni (Boulenger, 1903)	B: ZFMK 89342–347, 90287–294, 92553–554, C: ZFMK 89341	CDU, CDL	NT
Rhacophoridae			
Feihyla vittata (Boulenger, 1877)	B: ZFMK 89349–353, 92560–562	*	LC
Chiromantis nongkhorensis (Boulenger, 1877)	B: 92558–559, C: ZFMK 89348	*	LC
Theloderma cf. *stellatum* (Taylor, 1962)	A: ZFMK 92565–566	CAN, SAN, CSL, CDL, SIS	NT
Polypedates megacephalus (Hallowell, 1861)	A: ZFMK 89354–360, 89366, B: 90295–297, 92563–564, C: ZFMK 89361–362, D: ZFMK 89363–365	*	LC

Appendix 1 Cont'd

Taxon	Locality: Voucher Number /Record	Distribution in Indochina	IUCN Status
Bataguridae			
Cyclemys cf. *oldhamii*	A: ZFMK-PA TH 02, B: ZFMK 92567, ZFMK-PA PG 01	NWU, NAN, NEL, UML, CAN, SLL, CMB, CDU, NC	EN
Malayemys subtrijuga (Schweigger, 1812)	B: ZFMK-PA TH 03	UML, SLL, MEK, CMB	NT
Testudinidae			
Indotestudo elongata (Blyth, 1854)	D: ZFMK-PA TH 04	NEU, NEL, CSL, SLL, MEK, CMB, CDU, CDL	CR
Agamidae			
Calotes aff. *mystaceus* Duméril & Bibron, 1837	B: ZFMK 88340–341, 90298– 299, 92606–607	*	NE
Calotes versicolour (Daudin, 1802)	A: ZFMK 88350, B: ZFMK 88342, 88349, 90300–303, C: ZFMK 88343, D: ZFMK 88344–348	*	NE
Draco maculatus (Gray, 1845)	D: ZFMK 88351-352, 90304, 92608–611	*	LC
Leiolepis rubritaeniata Mertens, 1961	B: ZFMK 90305–307, 92599–605	UML, SLL, CSL, CMB	NE
Physignathus cocincinus Cuvier, 1829	B: ZFMK 92612–613	NWU, NEU, NAN, NEL, CAN, SAN, CSL, SLU, SLL, MEK, CMB, CDL, SC, SIS	NE
Gekkonidae			
Cyrtodactylus cf. *intermedius* (Smith, 1917)	B: ZFMK 88356–359, 90309–311, 92572–575	CSL, CMB	NE
Dixonius siamensis (Boulenger, 1894)	A: ZFMK 90317, B: ZFMK 88365, 90312–315, 92568, C: ZFMK 90316	NEL, CMB, SAN, SLL, MEK, CDU, CDL	NE
Gehyra mutilata (Wiegmann, 1834)	B: ZFMK 90320	*	NE
Gekko gecko (Linnaeus, 1758)	C: ZFMK 90308, D: ZFMK 88363–864	*	NE
Hemidactylus frenatus Schlegel, 1836	B: ZFMK 90318–319, 92569	*	NE
Hemidactylus platyurus (Schneider, 1792)	B: ZFMK 88360, 88362, 90321–322, D: ZFMK 88361, 92570	*	NE
Hemiphyllodactylus sp.	B: ZFMK 92571		NE
Ptychozoon lionotum Annandale, 1905	L, Herr & Lee (2016)	CSL, CDU, SIS	LC
Scincidae			
Eutropis longicaudata (Hallowell, 1857)	B: 90325–326, D: ZFMK 88366, 92576	*	NE
Eutropis macularia (Blyth, 1853)	B: ZFMK 90327–333	*	NE
Eutropis multifasciata (Kuhl, 1820)	A: ZFMK 88367, ZFMK 90342, B: ZFMK 88371, 90340–341, C: ZFMK 88368–369, D: ZFMK 88370, 90343–345	*	NE
Lipinia vittigera microcercum (Boulenger, 1894)	D: ZFMK 90339, 92577–582	NAN, CAN, SAN, CSL, SLL, CMB, CDU, CDL, SC, SIS	NE
Lygosoma bowringii (Günther, 1864)	A: ZFMK 90335, B: ZFMK 90334, 90336, 92583–584, D: ZFMK 90337–338	*	NE
Lygosoma siamensis Siler, Heitz, Davis, Freitas, Aowphol, Termprayoon and Grismer, 2018	B: ZFMK 92585	*	NE

Appendix 1 Cont'd

Taxon	Locality: Voucher Number /Record	Distribution in Indochina	IUCN Status
Scincella rupicola (Smith, 1916)	A: ZFMK 90355, B: ZFMK 88372–374, 90346–90354, 92586–588, D: ZFMK 88375–377, 90356-359	SAN	NE
Sphenomorphus lineopunctulatus Taylor, 1962	D: ZFMK 88379, 88382, 92614–619	SLL, CMB	NE
Tropidophorus cocincinensis Duméril and Bibron, 1839	A: ZFMK 90364, B: ZFMK 88378, 90360–363, 92589–598	NAN, CAN, CSL, CMB, MEK	NE
Lacertidae			
Takydromus sexlineatus Daudin, 1802	C: ZFMK 90323–324	*	LC
Varanidae			
Varanus nebulosus (Gray, 1831)	A: ZFMK–PA PW 01, L, Hayes *et al.* (2013)	*	NE
Varanus salvator (Laurenti, 1768)	B: ZFMK-PA AM 01	*	LC
Typhlopidae			
Indotyphlops braminus (Daudin, 1803)	B: ZFMK 88338–339, 90365–366, 92620	*	NE
Xenopeltidae			
Xenopeltis unicolour Boie, 1827	B: ZFMK 92621	*	LC
Pythonidae			
Python bivittatus Kuhl, 1820	L, Hayes *et al.* (2013)	*	VU
Malayopython reticulatus (Schneider, 1801)	L, Hayes *et al.* (2013)	*	LC
Pareatidae			
Pareas carinatus (Boie, 1828)	A: ZFMK 90376, B: ZFMK 90375, 90377, D: ZFMK 92635	*	LC
Pareas margaritophorus (Jan, 1866)	B: ZFMK 90378, 92636–637	*	LC
Colubridae			
Ahaetulla prasina (Boie, 1827)	B: ZFMK 90392	*	LC
Boiga cyanea (Duméril, Duméril & Bibron, 1854)	B: ZFMK 88335, ZFMK 92622–623, D: ZFMK 88336,	*	NE
Boiga multomaculata (Boie, 1827)	B: ZFMK 92625–627	*	NE
Boiga siamensis (Nutaphand, 1971)	B: ZFMK 88337, 92624	SAN, CSL, SLL, CMB, CDU, CDL	NE
Chrysopelea ornata (Shaw, 1802)	A: ZFMK 88322, B: ZFMK 90367–368, D: ZFMK 88323	*	NE
Coelognathus radiatus (Boie, 1827)	A: ZFMK-PA PW 02, B: Sight record by TH	*	LC
Dendrelaphis pictus (Gmelin, 1789)	B: ZFMK 90393	*	LC
Dendrelaphis subocularis (Boulenger, 1888)	C: ZFMK 88324	SAN, SLL, MEK, CMB, CDU, CC, SC	LC
Gonyosoma oxycephalum (Boie, 1827)	D: ZFMK 92629	*	LC
Lycodon capucinus (Boie, 1827)	B: ZFMK 90370, 92630	*	LC
Lycodon davisonii (Blanford, 1878)	D: ZFMK 92628	NAN, UML, CAN, CSL, SLL, MEK, CMB, CDU, CDL, SC, SIS	LC
Lycodon laoensis (Günther, 1864)	B: ZFMK-PA LA 01-03	*	LC

Appendix 1 Cont'd

Taxon	Locality: Voucher Number /Record	Distribution in Indochina	IUCN Status
Lycodon subcinctus Boie, 1827	B: ZFMK 90371–372, 92631	CAN, SAN, CSL, SLL, MEK, CMB	LC
Oligodon fasciolatus (Günther, 1864)	B: ZFMK 92633–634, C: ZFMK 88380	SAN, CSL, SLL; MEK, CMB, CDU, CDL, CC, SC	LC
Oligodon taeniatus (Günther, 1861)	B: ZFMK 90373–374, 92632	*	
Ptyas korros (Schlegel, 1837)	B: ZFMK 88319	*	NE
Natricidae			
Amphiesma stolatum (Linnaeus, 1758)	B: ZFMK-PA RW 01	UML; CAN, CSL, SLL; MEK, CMB, CDU, CC	NE
Rhabdophis subminiatus (Schlegel, 1837)	B: ZFMK 88330, 92640, D: ZFMK 88331	*	LC
Xenochrophis flavipunctatus (Hallowell, 1860)	B: ZFMK 90390–391, 92641, D: ZFMK 88321	*	LC
Homalopsidae			
Hypsiscopus plumbeus (Boie, 1827)	B: ZFMK 90369	*	NE
Lamprophiidae			
Psammodynastes pulverulentus (Boie, 1827)	A: ZFMK 88332, 88334, B: ZFMK 90379–382, 92639, D: ZFMK 88333, 92638	*	NE
Elapidae			
Bungarus candidus (Linnaeus, 1758)	B: ZFMK 88320	*	LC
Calliophis maculiceps (Günther, 1858)	B: ZFMK 90383, 92642	*	LC
Naja kaouthia Lesson, 1831	B: ZFMK-PA LA 04	*	LC
Ophiophagus hannah (Cantor, 1836)	B: ZFMK-PA PW 03	*	VU
Viperidae			
Trimeresurus cf. *macrops* Kramer, 1977	A: ZFMK 88326, B: ZFMK 88325, 88328–329, 90384–389, 92643-648, D: ZFMK 88327	*	NE
Calloselasma rhodostoma (Kuhl, 1824)	D: ZFMK-PA JBC 01	*	LC

