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Cover: Asian elephant in Royal Manas National Park, Bhutan (by Sonam Wangdi)

REVIEW PAPER

The status of Herpetofauna of Bhutan

JIGME TSHELTHRIM WANGYAL[1*]

Nanorana sp. from Rigsoom Gonpa, Trashiyangtse

Abstract

This paper presents the state-of-the-knowledge on Herpetofauna (reptiles and amphibians) of Bhutan. Through a comprehensive review of literature, the paper identifies 84 snakes, 23 lizards, 20 tortoises and turtles, 56 anurans, one caecilian and a Himalayan Salamander known to occur in Bhutan. Based on the author's field work, six previously unreported species of Herpetofauna viz. Russel's Kukri *(Oligodon taeniolatus),* Yunnan Bamboo Pit Viper *(Trimeresurus* cf. *stejnegeri yunnanensis),* Tibetan Pit Viper *(Trimeresurus* cf. *tibetanus),* Blue Fan Throated Lizard *(Ptyctolaemus gularis),* Annandali's Paa *(Nanorana annandali1),* and Pygmy Leaf Frog *(Chiromantis vittatus)* bring the total number of species known in Bhutan to 191. Two previously reported species, Gharial *(Gavialis gangeticus)* and the American Bull Frog *(Lithobates catesbeianus)* are removed from the list. The paper highlights which species need further confirmation, and which warrant further research or special conservation protection status.

Keywords: Herpetofauna, snakes, lizards, tortoises and turtles, amphibians, amurans, Bhutan.

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Introduction

Wilson (1998) states that "To the extent that we depend on prosthetic devices to keep ourselves and the biosphere alive, we will render everything fragile. To the extent that we banish the rest of life, we will impoverish our own species for all time." He offers a tremendously grave cautionary to *Homo sapiens*, a caution that on trying to use all the natural forces for ourselves we risk our very survival. Therefore, it is time that we understand our environment and its biodiversity so that we do not lose the meaning of our existence. Further, global loss of biodiversity according to Raven & Berg (2001) and many others is primarily due to habitat degradation and destruction. Bhutan is not immune to such degradation and destruction, which is manifested as deforestation for road construction, logging due to increased demand for timber, shifting agriculture practices, forest fires, expansions of towns, and other activities. It is important to examine the increasing development impacts on the country's biodiversity, including taxa such as Herpetofauna, which receive little attention in Bhutan.

Compiling and interpreting the available data on Herpetofauna is an important first step for creating awareness of and interest in this ecologically important, but often overlooked, taxon. The presence or the absence of Herpetofauna, particularly the amphibians, indicates transformation in habitat (Pechmann et al. 1991; Blaustein et al. 1994; Fontenot et al. 1996) because they depend on wet weather conditions where they live, so are responsive to changes in precipitation and moisture in their habitats. Amphibian populations may decline or explode depending upon such changes in the habitat they are in (Blaustein et al. 1994; Phelps & Lancia 1995; Gibbons et al. 1997). Many species of amphibians are also known to indicate climate change through which necessary action can be taken for the safety of the earth. Amphibians depend on short-lived water sources, so a wet year can lead to successful breeding and ultimate increment of new recruits while during dry conditions, few or no additional individuals may be added to the population. As such, they indicate short-term changes in their environment. Therefore, study of the taxa is very important.

This paper presents a comprehensive update on the Herpetofauna of Bhutan, to promote attention for research priorities in the foreseeable future, for the welfare of the taxa and the world as a whole.

Methods

All data in this report are based on a literature search beginning from the first ever report on the reptiles found in Bhutan by Biswas (1976) until the latest published report (Wangyal 2013) on the new records of amphibians and reptiles. This paper reviewed the reports of Bustard (1979, 1980a, 1980b) on crocodiles, of Bauer and Gunther (1992) on the preliminary list of reptiles for Bhutan, and Das and Palden (2000) for a collection of Herpetofauna. The paper also analyzed the work of Mitra (2009), and the recent works of Wangyal and Tenzin (2009) for the snakes and lizards from Bumdeling Wildlife Sanctuary region, Wangyal and Gurung (2010) on the snakes of the College of Natural Resources (CNR) compound, and Wangyal (2011) on the reptiles of Bhutan. Further reports of the taxa including Wangyal (2012) and Wangyal et al. (2012) and work on amphibians (Wangyal & Gurung 2012 a, b) have been also reviewed. A report on tortoises and turtles by Wangyal et al. (2012) and some new record reports (Wangyal 2013) have been reviewed. Finally, some information reported here are from personal field observations of the author. Species from all the papers have been listed and checked, and a comprehensive list has been prepared as a list of species known so far from Bhutan.

Lists of expected species were developed based on the recommendations of Whitaker and Captain (2004) for snakes, and Bauer and Gunther (1992) and Wangyal et al. (2012) for turtles and tortoises. The species distribution maps of the northeast Indian species have been taken as one basis to list the expected species for Bhutan. In addition, various other

literatures were consulted to determine the global conservation significance of species.

Results and discussion

Like many neighbouring countries, Bhutan has quite a number of reptiles and amphibians for which no comprehensive list has been properly prepared. This discussion shall start with reptiles (including snakes, lizards, testudines, crocodiles and amphibians (including anurans, a lone salamander species and a caecilian).

Reptiles

Other than opportunistic species lists, there has been no serious study on reptiles of Bhutan. As a first preliminary list of reptiles of Bhutan, Bauer and Gunther (1992) reported 18 snakes and four lizards. They based their list on specimens collected by a 1972 expedition of the Basel Natural History Museum (Switzerland) in Bhutan. Wangyal and Tenzin (2009) tried to compile a list of the reptiles of Bumdeling Wildlife Sanctuary (Trashiyangtse, Bhutan) but could not come up with a comprehensive list due to lack of information on the Bhutanese reptiles. Some sporadic works on reptiles include Das and Palden (2000), Wangyal (2011, 2012 and 2013) and Wangyal and Gurung (2010). The synopses of the records of various reptiles of Bhutan are given below.

Snakes

The first ever report exclusively on reptiles of Bhutan (Das 1976) records two snake species, King Cobra *(Ophiphagus hannah)* and Himalayan Keelback *(Amphiesma platyceps)*. Bauer and Gunther (1992) added 11 new species of snakes based the on specimens collected by the 1972 expedition of the Basel Natural History Museum. However, their record on Indian Rock Python *(Python morulus)* may need further confirmation since they based their record report on Harris et al. (1964), who mentioned that this species is very common in the Duar plains of Bhutan. There are no confirmed sightings of the Indian Rock Python in Bhutan, after Bauer and Gunther (1992). In an interesting twist, a review conducted by Tillack (2006) on the same collection revealed that the Common Tawny Cat Snake *(Boiga ochracea)* reported by Bauer and Gunther turned out to be a Green Cat Snake *(Boiga cyanea)*. Hence, the record has been updated accordingly.

Das and Palden (2000) reported on a herpetofaunal collection the authors assembled while conducting Bhutan's first workshop on herpetological techniques for staff of the protected areas of Bhutan, at Royal Manas National Park (Sarpang, Bhutan). They added three new species of snakes to the list of snakes of Bhutan (Table 1): Mock Viper *(Psammodynastes pulverulentus)*, Cantor's Black-headed Snake *(Sibynophis sagittarius)*, and Banded Krait *(Bungarus fasciatus)*. They also confirmed the record of Spectacled Cobra *(Naja naja)*, formerly reported by Mahendra (1984) without any locality data.

Mitra (2009), based on his collection from Trashigang District, reported 16 snake species as new records for Bhutan. He made a list of 32 snakes from Bhutan with at least two species being misidentified and repeated: Green Rat Snake was reported twice, once as *Ptyas nigromarginatus* and another time as *Zaocys nigromarginatus;* Eastern Trinket was also reported as both *Orthriophis cantoris* and *Gyonosoma cantoris*. Therefore, his list needs to be reviewed thoroughly before validating his 2009 reports.

Later Wangyal (2011) reported 30 new species of snakes from Bumdeling Wildlife Sanctuary region, which covers the whole or parts of three districts in Bhutan (Mongar, Trashiyangtse and Lhuentse). But he did not consult the list provided by Mitra (2009). Therefore, species such as Eastern Trinket *(Orthriophis cantoris)*, White Barred Kukri Snake *(Oligodon albocinctus)*, Collared Black-headed Snake *(Sibynophis collaris)*, Banded Trinket Snake *(Oreocryptophis porphyracea porphyracea)*, Gunther's False Wolf Snake *(Dinodon septentrionalis)*, and Indo-Chinese Rat Snake *(Ptyas korros)* were mistakenly considered new reports by Wangyal (2011).

TABLE 1 List of snakes.

Sl.No.	Family	Species	Remarks
1	Colubridae	*Ahaetulla nasuta* (Lacepede 1789)	
2		*Ahaetulla prasina* (Boie 1827)	
3		*Amphiesma parallelum* (David et al. 1998)	
4		*Amphiesma platyceps* (Blyth 1854)	
5		*Amphiesma sieboldii* (Gunther 1860)	
6		*Amphiesma* sp.	BWS,Trashiyangtse
7		*Amphiesma stolatum* (Linnaeus 1758)	
8		*Boiga cyanea* (Dumeril, Bibron & Dumeril 1854)	
9		*Boiga gokool* (Gray 1835)	
10		*Boiga multifasciata* (Blyth 1861)	
11		*Boiga ochracea* (Gunther 1868)	
12		*Boiga ochracea stoliczkae* (Wall 1909)	
13		*Chrysopelea ornata* (Shaw 1902)	
14		*Coelognathus radiates* (Boie 1827)	
15		*Dendrelaphis cyanochloris* (Wall 1921)	
16		*Dendrelephis pictus* (Gmelin 1789)	
17		*Dendrelophis tristis* (Daudin 1803)	
18		*Dinodon gammiei* (Blandford 1878)	
19		*Dinodon septentrionalis* (Gunther 1858)	
20		*Dryacalomus* cf.*davisonii* (Nutphand 1986)	BWS,Bumdeling
21		*Enhydris enhydris* (Schneider 1799)	
22		*Lycodon aulicus* (Linnaeus 1758)	
23		*Lycodon fasciatus* (Anderson 1879)	
24		*Lycodon jara* (Shaw 1802)	
25		*Oligodon albocinctus* (Cantor 1839)	
26		*Oligodon cinereus* (Gunther 1864)	
27		*Oligodon cyclurus* (Cantor 1839)	
28		*Oligodon dorsalis* (Gray & Hardwake 1835)	
29		*Oligodon juglandifer* (Wall1909)	
30		*Oligodon* sp.	BWS,Bumdeling
31		*Oreocryptophis porphyracea porphyrocea* (Cantor 1839)	
32		*Orthriophis cantoris* (Cantor 1839)	
33		*Orthriophis taeniurus* (Anderson 1879)	
34		*Psommodynostes pulverulentus* (Boie 1827)	
35		*Psedoxenodon macrops* (Blyth 1855)	
36		*Ptyas korros* (Schlegel 1837)	
37		*Ptyas nigromorginotus* (Blyth 1854)	
38		*Ptyos mucosa* (Linnaeus 1758)	
39		*Rhabdophis himolayanus* (Gunther 1864)	
40		*Rhabdophis subminiotus* (Schlegel 1837)	
41		*Sibynophis colloris* (Gray 1853)	
42		*Sibynophis sagittarius* (Cantor 1839)	

TABLE 1(cont'd)

Sl. No.	Family	Species	Remarks
43	Colubridae	*Trochischium* cf. *leave* (Peraca 1904)	
44		*Trochischium guentheri* (Boulenger 1890)	
45		*Trachischium* sp.	BWS, Bumdeling
46		*Trochischium tenuiceps* (Blyth 1854)	
47		*Xenochrophis piscotor* (Schneider 1799)	
48	Elapidae	*Bungorus bungoroides* (cantor 1839)	
49		*Bungorus fasciotus* (Schneider 1801)	
50		*Bungorus niger* (Wall 1908)	
51		*Nojo kaouthio* (Lesson 1831)	
52		*Nojo* (Linnaeus 1758)	
53		*Ophiophagus honnah* (Cantor 1836)	
54		*Sinomicrurus macclellandii* (Reinhradt 1844)	
55	Pythonidae	*Python molurus* (Linnaeus 1758)	
56		*Python bivittatus* (Kuhl 1820)	
57	Typhlopidae	*Romphotyphlops braminus* (Daudin 1803)	
58		*Typhlops jerdonii* (Bourret 1936)	
59		*Typhlops diardii* (Schlegel 1839)	
60	Viperidae	*Daboia russelii* (Shaw & Nodder 1797)	
61		*Gloydius himalayanus* (Gunther 1864)	
62		*Ovophis monticola* (Gunther 1864)	
63		*Protobothrops jerdonii* (Gunther 1875)	
64		*Trimeresurus jerdonii* (Guenther 1857)	
65		*Trimeresurus albolabris* (Gray 1842)	
66		*Trimeresurus erythrurus* (Cantor 1839)	
67		*Protobothrops himalayanus* (Pan et al. 2013)	Latest Viper

Another deficiency in his report is the lack of locality data for two records, the Himalayan Viper *(Gloydius himalayanus)* and Spot-tailed Pit Viper *(Trimeresurus erythrurus).*

Prior to the report of Wangyal (2011), Wangyal and Gurung (2010) reported the Common Wolf Snake *(Lycodon aulicus)* as a new record from the College of Natural Resources compound (Punakha, Bhutan). Further, Wangyal (2012) reported ten species of snakes as new records. But a proper literature review revealed that Brahminy Worm Snake *(Ramphotyphlops braminus),* Common Wolf Snake and Spectacled Cobra had been previously reported by others.

Wangyal (2013) reported another species of colubrid, Sikkim False Wolf Snake *(Dinodon gammiel),* a subject of interest currently considered a rare species by many herpetologists in the region. Pan et al. 2013) reported the presence of a new viper species, Himalayan Pit Viper *(Protobothrops himalayanus),* from Haa and Paro area with pictorial proof. The species was seen and collected by an American tourist and deposited at the College of Natural Resources in 2009. Bhutanese authors, however, could not describe the species at the time, so it was described by authors outside the country, using specimens from outside Bhutan.

Ahmed et al. (2009) mentioned many species of snakes from Bhutan in their pictorial guide. Some of these records require locality data, providing a scope for further study by Bhutanese researchers.

Snake species reported without proper identification

Many snake species have been reported with identification only up to the genus level. At least four colubrid snakes (Table 1) were reported without proper identification from Bumdeling Wildlife Sanctuary area. Therefore, further exploration on these species is very much necessary.

Conservation status of snakes

According to the Forest and Nature Conservation Act of Bhutan 1995 (FNCA 1995), section 22 (b), all animals in general are protected and they can only be used or taken after obtaining necessary permits from the relevant authorities. Even by way of Buddhist religion, snakes receive protection as they are considered deities and protectors of the earth with a network of knots on which the earth rests.

Therefore, in Bhutan the safety of snakes from harvest or wanton killing is assured. But unlike some species of importance from other taxa that receive special attention, snakes are not included in the protected list of any schedules under FNCA 1995.

Some snake species found in Bhutan are classified as vulnerable in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. Bhutan should consider protecting such species, which include King Cobra and Burmese Rock Python *(Python bivittatus)*. More research should be conducted to obtain baseline information on the abundance and distribution of these species in Bhutan. The Monocellate Cobra *(Naja kaouthia)*, which is very common in most parts of Bhutan but not adequately reported, may also require protection in the long run due to its medicinal value (Das et al. 2013), which may foster illegal harvest. More generally, further study on the taxon should focus on com pili ng a robust list of species with information on rarty, endemism and distribution.

Lizards

There are 23 species of lizards in Bhutan (Table 2). A report describing a new species of *Calates* species by S. Biswas from Zoological Survey of India (ZSI) in 1976 was the first ever document exclusively on the reptiles of Bhutan. The new species was part of a larger collection of reptile species reported by Dr. B. Biswas and his team while they were on birding trips in Bhutan between 1966 and 1967. Dr. Biswas and his team recorded five species of reptiles (two snakes and three lizards), one of which has been named after Bhutan as the Bhutan Agama *(Calates bhutanensis)*. However, Bauer and Gunther (1992) question this identification since it is very similar to Common Garden Lizard *(Calotes versicalor)*, the only differences being delineated by the author based on mi nor differences inscalation and colours. Further confirmation of the species identification is required by matching with the type specimen maintained at the ZSI in Kolkata, India.

Bauer and Gunther (1992) reported ten species of lizards, three of which had already been reported by Biswas (1975). Their report included a description of a new species of scincid lizard, Bhutan Skink *(Eutropis quadratilabus)* from the 1972 collection of reptiles by the Natural History Museum of Basel, Switzerland. Except for the "who will do it" worry, further study on this species that was collected from western Samtse would be very interesting as the species is endemic to Bhutan.

Das and Palden (2000) reported the presence of Khasi Hills Bent-toed Gecko *(Cyrtadactylus khasiensis)* in Sershong, Sarpang, and of Bronze Mabuya (also known as Bronze Grass Skink, *Eutropis macularia)* from Gelephu. They also reported a sighting of the Inda-Pacific Gecko *(Hemidactylus garnoti1)*.

Wangyal (2011) reported Jerdon's Forest Lizard *(Calotesjerdonii)*, Keeled Indian Mabuya *(Eutropiscarinata)*, Dotted Garden Skink *(Riopa punctata)* and Yellow Monitor Lizard *(Varanus flavescens)* as new records. Further, Wangyal (2012) affirmed the presence of Spotted Litter Skink *(Sphenamar phusmaculatus)* and

TABLE 2 List of lizards.

Sl. No.	Family	Species	Remarks
1	Agamidae	*Calates bhutanensis* (Biswas 1975}	
2		*Catotes jerdonii* (Guenther 1870)	
3		*Calotes versicolor* {Daudin 1802)	
4		*Japatura variegata* (Gray 1853)	
5	Anguidae	*Ophisaurus gracilis* (Gray 1845)	
6	Gekkonidae	*Cyrtodactylus khasiensis* (Jerdon 1870)	
7		*Gekko gecko* (Linnaeus 1758)	
8		*Hemidactylus brookii* (Gray 1845)	
9		*Hemidactylus frenatus* (Dumeril & Bibron 1836)	
10		*Hemidactylus garnotii* (Dumeril & Bibron 1836)	
11		*Hemidactylus platyurus* (Schneider 1792)	
12	Scincidae	*Asymblepharus* sp.	BWS,Khoma
13		*Asymblepharus sikimmensis* (Blyth 1854)	
14		*Eutropis carinata* (Schneider 1801)	
15		*Eutropis mocularia* (Blyth 1853)	
16		*Eutropis quadratilobus* (Bauer & Gunther 1992)	
17		*Riopa punctata* (Linnaeus 1766; Gray 1845)	
18		*Sphenomorphus indicus* (Gray 1853)	
19		*Sphenomarphus maculatus* (Blyth 1853)	
20		*Sphenomorphus* sp.	Serzhong,BWS
21	Varanidae	*Varanus bengalensis* (Daudin 1802}	
22		*Varanus flavescens (Hardwicke* & Gray 1827)	

formally reported the presence of Tokay Gekko *(Gekko gecko)* in Bhutan.

An amazing aspect of Bhutanese conservation is the protection given to Tokay Gekko. Today, if a person is caught poaching the species, a penalty of Nu. 1,000,000 (Ngultrum one million) equivalent to US$ 16,667 is imposed by the relevant authorities. This might need a serious review because the species is not at all categorized in any of the country's protected lists, and the IUCN has yet to assess the status of the species although hunting of the species is discouraged. The penalty for poaching of Tokay Gekko may be justifiably increased or decreased after thorough review of the status of the species.

Lizard species reported without proper identification

By way of lizards, there are at least two species from *Asymblepharus* and *Sphenomorphus* genera (Table 2) from Bumdeling Wildlife Sanctuary that need further confirmation. Therefore, studies on these two species may be conducted thoroughly for authentication of their presence.

Conservation status of lizards

As with snakes, lizards in Bhutan are protected only through a blanket law that states that all animals in Bhutan are protected (FNCA 1995, Section 22 (b)). But the beauty of the Bhutanese conservation system is that

a species can be taken up for strict protection (not just normal protection with nominal penalty but severe penalties) if that particular species is found to be under threat for any reason. An example is the complete protection of the Tokay Gekko, which is rumoured to have medicinal value though these benefits have not been confirmed scientifically.

Another species that may warrant protection is the Bhutan Agama, which occurs in Pang Zor Mani, Trongsa, and was initially reported by Biswas (1975). If proven beyond doubt that the species is a separate entity, it would constitute one of Bhutan's few endemic lizards, and could be considered for special protection. Yet another species of interest is the presence of Burmese Glass Lizard *(Ophisaurus gracilis)* from Zhemgang reported by Wangyal (2013) through data from his field colleagues. Probably, a detailed study of the species is warranted, being the only legless lizard the country has reported so far.

Crocodiles

Bustard (1979) wrote a paper on Crocodile Conservation Commercial Farming, which was later followed by a 1980 status report on the Gharial *(Gavialis gangeticus)*. Around the same time Bustard (1980b) also reported on the extinction of the Gharial in Bhutan. Ross (1989) listed Bhutan as part of the Gharial range, contrary to Bustard's (1979, 1908a, 1980b) earlier claims that the species had been extirpated from its primary habitat in the country, the Manas River. Bustard (1980a & 1980b) and Groombridge (1987) suggested reintroducing the species to suitable habitats in Bhutan. Whitaker (1987) recorded a small population of Gharial in the Indian portion of Manas River. But the latest report by Das et al. (2011), on assessment of assisted recovery of Gharial in the river systems of northeast India, established that northeast India and Bhutan do not have any viable population of Gharial. The report mentions that even the best natural habitat of the species-the Bhutan stretch of Manas, as suggested by Bustard (1980) can no longer support the Gharial because of the damming of the rivers upstream. However, if Bhutan considers reintroducing the species in the long run, it is possible if done with utmost care and prudence, since the habitat is under the protected area system of the country. But for now, this paper considers that there are no wild Gharial in Bhutan except for a few individuals at the crocodile rearing centre in Phuntsholing.

Tortoises and turtles

There are six species of tortoises and turtles (Table 3) known in Bhutan. The presence of Yellow Tortoises *(Indotestudo elongata)* was first formally reported from Manas, Sarpang, by Wangyal (2011). Wangyal et al. (2012) also was the first to report the occurrence of four turtle species, Malayan Box Turtle *(Cuora amboinensis)*, Keeled Box Turtle *(Cuora mouhotii)*, Indian Leaf Turtle *(Cyclemys gemeli)*, and Tricarinate Turtle *(Melanochelys tricarinata)* in Bhutan, in addition to reconfirming the presence of Yellow Tortoises. The record of Keeled Box Turtle represented a significant range extension to the west while Malayan Box Turtle represented a range extension across a political border from the same landscape in adjacent

TABLE 3 List of tortoises and turtles.

Sl.No.	Family	Species	Remarks
1	Geoemydidae	*Cuora amboinensis* (Daudin 1801)	
2		*Cuora mauhatii* (Gray 1842)	
3		*Cyclemys gemeli* (Fritz et al. 2008)	
4		*Melonachelys tricarinata* (Blyth 1856)	
5		*Melanachelys trijuga* (Annandale 1930)	
6	Testudinidae	*Indotestuda elongate* (Blyth 1853)	Reported widely

northeast India. The other three species, Indian Leaf Turtle, Tricarinate Turtle, and Yellow Tortoises, filled geographic gaps in their known distributions. The sixth species, Black Pond Turtle *(Melanochelys trijuga),* was reported by Wangyal (2013) from the Royal Manas National Park (RMNP) area with information from field officials of the RMNP.

Conservation status of tortoises and turtles

As in the case of other Herpetofauna, none of the tortoises and turtles is listed in any schedule of the Forest and Nature Conservation Act of Bhutan (1995), but the safety of all species is covered under the same FNCA 1995. Yellow Tortoise and Tricarinate Turtle are considered endangered and vulnerable respectively by IUCN, so the species may warrant special listing after thorough study. The Malayan Box Turtle may also be considered for additional conservation protection as it is under the vulnerable category of IUCN.

Amphibians

There were no studies on amphibians of Bhutan until Das and Palden's (2000) herpetofaunal collection during the Royal Manas National Park workshop. They reported seven amphibians from three families (one megophryid, one bufonid, and five ranids), which were all new records for Bhutan. The country thus far has recorded 58 species of amphibians, but some of these species are identified only to the genus level (Table 4 for anurans). Therefore, further work to confirm the species whose species specific epithets are missing must continue as an urgent work by the relevant research institutions of the country. Wangyal (2011) reported eight species (Table 4) including an American Bull Frog *(Lithobates catesbeianus),* which is almost certainly a blunder for the amphibians list of Bhutan. With this paper, the species remains deleted because it was later verified that that the species in question was indeed an Indian Bull Frog and not the American Bull Frog. Further, Wangyal's (2011) record of *Hyla* cf. *annectans* must also be verified.

Wangyal (2012) studied the amphibians of Punakha-Wangdiphodrang valley and reconfirmed the presence of Himalayan Newts *(Tylototriton verrucosus)* reported by Frost (1985) and Palden (2003). However, his study could not confirm presence of an endemic Bhutan Cat-eyed Toad *(Scutiger bhutanensis)* and Point-nosed Frog *(Clinotarsus alticola)* reported by Ahmed, Das and Dutta (2009). Works of Das and Palden (2000) on presence of the Common Asiatic Toad *(Duttaphrynus melanostictus),* Marbled Sucker Frog *(Amolops marmoratus),* Indian Skipping Frog *(Euphlyctis cyanophlyctis*),Indian Bull Frog *(Hoplobatrachus tigerinus),* and Indian Cricket Frog *(Fejervarya* cf. *limnocharis)* with an exception of a ranid *(Rana (Sylvirana)* sp.) from southern Bhutan are all well verified. Deuti (2010), based on the 1969 collection of Zoological Survey of India, reported the presence in Haa District of Liebig's Hill Frog *(Nanorana liebigii),* which is also well verified. Reports of new species-Stuart's Toad *(Duttaphrynus* cf. *stuarti),* Mountain Cascade Frog *(Amolops* cf. *monticola),* Nangkiang Toad *(Xenophrys* cf. *nankiangensis),* Himalayan Tree Frog *(Polypedates* cf. *himalayensis)* and an undescribed species of *Nanorana* genus-by Wangyal and Gurung (2012) may need further verification and closer study.

In 2013, Wangyal published a paper on new species records of Herpetofauna. He reported thirteen new species of anurans that included six dicroglossids, three megophryids and four ranids for the first time from Bhutan. However, since the collections are based on sporadic information from field foresters, further confirmation is necessary.

This report considers Chunam Tree Frog *(Polypedates maculatus)* (Fig. 1) and Large Tree Frog *(Rhacophorus maximus;* Fig. 2) as new mentions (Table 4) because the species are very much available in Zhemgang and Sarpang areas although there are no formal reports on the species in journals or other documents.

Research on endemic species such as the Bhutan Cat-eyed Toad must be carried out and their presence in the country confirmed. And if at all they are part of the country's endemic

TABLE 4 List of anurans (but note that *Lithobates catesbeianus* was wrongly reported).

Sl. No.	Family	Species	Remarks
1	Bufonidae	*Duttophrynus melonostictus* (Schneider 1799)	
2		*Duttophrynus* cf. *stuorti* (Smith 1929)	
3		*Duttophrynus himoloyonus* (Gunther 1864)	
4	Dicroglossidae	*Euphlyctis cyonophlyctis* (Schneider 1799)	
5		*Fejervoryo* cf. *limnochoris* (Gravenhorst 1829)	
6		*Fejervoryo nepolensis* (Dubois 1975)	
7		*Fejervoryo pierrei* (Dubois 1975)	
8		*Fejervoryo teroiensis* (Dubois 1984)	
9		*Hoplobotrachus tigerinus* (Daudin 1802)	
10		*Nonorona conoensis* (Fei & Huang 1981)	
11		*Nanorana liebigii* (Guenther 1860)	
12		*Nanorona blonfordii* (Boulenger 1882)	
13		*Nanorana pleskei* (Gunther 1896)	
14		*Nanorana* sp.	Thimphu,Dochula
15	Hylidae	*Hylo* cf.*onnectans* (Jerdon 1870)	Locality data
16	Megophrydae	*Xenophrys* cf. *nankiangensis* (Liu & Hu 1966)	Punakha,Menchuna
17		*Scutiger bhutanensis* (Delorme & Dubois 2001)	
18		*Scutiger sikimmensis* (Edward Blyth 1855)	
19		*Megophrys parvo* (Boulenger 1908)	
20		*Xenophrys glandulosa* (Fei,Ye & Huang 1991)	
21		*Xenophrys major* (Boulenger 1908)	
22		*Xenophrys minor* (Stejneger 1926)	
23	Microhylidae	*Microhylo ornoto* (Dumeril and Bibron 1841)	
24	Ranidae	*Amo/ops marmorotus* (Blyth 1855)	
25		*Amo/ops* cf. *monticola* (Anderson 1871)	Burichu, Wangdiphodrang
26		*Clinatorsus alticala* (Boulenger 1882)	
27		*Rana (Sylvirana)* sp.	
28		*Hylarana* sp.	
29		*Lithabates cates beianus* (Shaw 1802)	Wrongly reported
30		*Amolops mantzarum* (David 1872)	
31		*Hylarona taipehensis* (van Denburgh 1909)	
32		*Sylvirano leptoglassa* (Cope 1868)	
33		*Sylvirono* cf. *guentheri* (Boulenger 1882)	Lingmeythang, Mongar
34	Rhacophoridae	*Polypedotes* cf. *himaloyensis* (Annandale 1912)	
35		*Polypedotes moculotus* (Gray 1830)	New mention
36		*Rhocophorus moximus* (Gunther 1858)	New mention

species, they should be given protected species status since they are found only in Bhutan. Otherwise, chances are that the species might go locally extinct even before their presence is properly recorded.

Salamanders

Frost (1985), without any locality information, reported the presence of Himalayan Newt or Salamander *(Tylototriton verrucosus)* in Bhutan, which was later confirmed by Palden (2003). Wangyal (2012) reconfirmed the presence of the species in Punakha and Wangdi Phodrang valley including a small population in Dagana's Tshangkha Lake.

The conservation of Himalayan Salamander has not been considered important by the state since there are no obvious immediate threats. However, the species may warrant protection as it is the only salamander known in the country.

FIGURE 1 Chunam Tree Frog *(Polypedates maculatus)* from Zhemgang. (Photo Credit: Ugyen Oorji, Zhemgang)

FIGURE 2 Large Tree Frog *(Rhacophorus maximus)* from Zhemgang. (Photo Credit: Bep Tshering, Perna Gatshel)

Gymnophiona

Northeast India has three species of caecilians, namely Sikkim Caecilian *(Ichthyophis sikkimensis),* Hussain's Caecilian *(lchthyophis husaim),* and Garo Hills Caecilian *(Ichthyophis garoensis)* (Ahmed et al. 2009). Considering the proximity, Bhutan can safely assume the presence of Sikkim Caecilian in Bhutan. However, further work on the species is required to confirm the presence adequately.

Amphibian species reported without proper identification

There are at least five species of anurans that need further confirmation (Table 4) as they may have been misidentified. They are a *Nanorana* sp. from Dochula reported by Wangyal (2012), *Hyla* cf. *annectans,* which need locality data, *Xenophrys* cf. *nankiangensis, Amolops* cf. *monticola* and *Sylvirana* cf. *guentherii.* Therefore, studies on these species are expected to further confirm their presence in the near future.

Conservation of amphibians

No amphibians of Bhutan are recorded in the protected list, but all are afforded protection by the blanket law (FNCA 1995). It may be time to look into conservation issues for the amphibians, especially anurans, because there are instances and informal reports of frogs being eaten by people in various parts of Bhutan. In one such incident personally witnessed by this author in 2013, a household in Jomotshangkha, Samdrup Jongkhar District, was found facilitating the sale of frogs (supposedly Paa frogs) collected by an Indian. Many frogs were being dried in the household's makeshift kitchen (Fig. 3). Unless verified, there is no evidence to prove that the frogs were collected from India. Further, it was found that the species in question was not a Paa but rather Indian Bull Frog *(Hoplobatrachus tigerinus)*. The author bought the live specimens to verify the species. If such incidences go unchecked, chances are that the species might go locally extinct someday. However, if at all the frogs are to be eaten, farmers in the long run may be encouraged to breed the frogs and make some income after proper and relevant studies.

There are also confirmed cases of consumption of Annandali's Paa *(Nanorana annandalil)* and Blandford's Paa *(Nanoran blandfordil)* by the residents of Sakteng, Trashigang District. Perhaps a study should be conducted to assess the status of these species so that protection status can be given by the state if the research finds imminent threat to the species. At present, there are good numbers of both the species in the stream near Sakteng village (Fig. 4).

FIGURE 3 Mass frog drying up for consumption at Jomotshangkha.

FIGURE 4 Sakteng valley, habitat for Annandali's Paa and Blandford's Paa.

Therefore, further studies on amphibians, especially of those that are under local and global threats and those that are considered by IUCN as vulnerable or endangered, may be conducted so that baseline data on species of conservation importance can be obtained to avert local extinction of species.

Expected species of Herpetofauna in Bhutan

There are at least 43 species of Herpetofauna expected to occur in Bhutan, but not yet reported. These include 17 species of snakes, one lizard, 21 anurans and 14 species of tortoises and turtles (Tables 5-7). The list of expected species is based on their geographic distribution and on recommendations by the authors of various papers on Herpetofauna of Bhutan and northeast India. As such, there is still much scope for further research on herpetology in Bhutan.

New species records

This report includes six new species records of Herpetofauna in Bhutan (Table 8, Figs. 5-10). The photographic data in this report were collected from various field offices and from personal friends of the author. All photos are reprinted here with permission.

Total Herpetofauna in Bhutan

Considering all the species that are confirmed as well as those that are expected plus the author's six new species records in this report, the total number of Herpetofauna known and expected in Bhutan is 191 species (84 snakes of which 67 are confirmed and 17 expected; 23 lizards of which one is expected while 22 are confirmed; 20 tortoises and turtles of which 14 are expected and 6 confirmed; 56 anurans of which 21 are expected while 35 are confirmed; one caecilian and one salamander; and six new records by the author in this report). American Bull Frog and Gharial are deleted from the list of Herpetofauna of Bhutan with this status report. Further study is necessary to confirm species reported only once, and those reported with identification only up to the genera level.

According to a news article posted on the Indian express website by Samudra Gupta Kashyap on 9th July 2014, a recent survey conducted at the border of Bhutan and Indian Manas as a transboundary conservation initiative discovered 20 amphibian species and 35 reptile species including the Bubble Nest Frog *(Roaorchestes chalazodes)*, Twin Spotted Tree Frog *(Rhacophorus bipunctatus)*, Blue Fan-throated Lizard *(Ptyctolaemus gularis)*, King Cobra *(Ophiphagus hannah)* and Pope's

TABLE 5 List of expected snakes and lizards.

Sl. No.	Family	Species	Remarks
1	Colubrida;e	*Pareas macularius* (Theobald 1868)	Based on Whitaker and Captain {2004)
2		*Elaphe prasina* (Blyth 1854)	
3		*Coelognothus heleno helena* {Daudin 1803)	
4		*Orthriophis hodgsonii* (Gunther 1860)	
5		*Argyrogena foscioloto* (Shaw 1802)	
6		*Uopeltis frenoto* (Gunther 1858)	
7		*Lycodon laoensis* (Gunther 1864)	
8		*Amphiesma khosiense* (Boulenger 1890)	
9		*Xenochrophis sanctijohannis* (Boulenger 1890)	
10		*Blythio reticulata* (Blyth 1854)	
11		*Boiga multomaculata* (Boie 1827)	
12		*Boiga trigonata* (Schneider 1802)	
13		*Boiga ocellato* (Kroon 1973)	
14		*Boigo forsteni* (Dumeril, Bibron & Dumeril 1854)	
15		*Enhydris seiboldii* (Schlegel 1837)	
16	Elapidae	*Bungorus caeruleus* (Schneider 1801)	
17		*Cal/iophis melanurus* (Shaw 1802)	
18	Varanidae	*Voronus solvotor* (Laurenti 1768)	

TABLE 6 List of expected anurans.

Sl. No.	Family	Species	Remarks
1	Dicroglossidae	*Nanorana vicina* (Stoliczka 1872)	Based on Amphibia web
2		*Nanorano polun ini* (Smith 1951)	
3		*Ingerana borealis* (Annandale 1912)	
4		*Ombrona sikimensis* (Jerdon 1870)	
5		*Allopao hazarensis* (Dubois & Khan 1979)	
6		*Scutiger boulengeri* (Bedriaga 1898)	
7	Ranidae	*Amolops farmosus* (Gunther 1876)	
8		*Amolops himalayanus* (Boulenger 1888)	
9		*Amolops gerbillus* (Annandale 1912)	
10		*Humerana humeralis* (Boulenger 1887)	
11		*Hylorana nigrovittata* (Blyth 1856)	
12		*Hylorana tytleri* (Theobald 1868)	
13	Rhacophoridae	*Rhacophorus tuberculatus* (Anderson 1871)	
14		*Theladerma andersoni* (Ahl 1927)	
15		*Theladerma asperum* (Boulenger 1886)	
16		*Polypedates taeniatus* (Boulenger 1906)	
17		*Polypedotes leucomystox* (Gravenhorst 1829)	
18		*Pseudophilautus annandali* (Annandale 1913).	
19		*Theloderma moloch* (Annandale 1912)	
20		*Sphaerotheca maskeyi* (Schleich and Anders 1998)	
21		*Rhacophorus bipunctatus* (Ahl 1927)	

TABLE 7 List of expected tortoises and turtles.

Sl. No.	Family	Species	Remarks
1	Geoemydidae	*Geaclemys hamiltonii* (Gray 1830)	
2		*Hardella thurjii* (Gray 1831)	
3		*Kachuga dhongoka* (Gray 1832)	Suggested by Bauer & Giinther (1992) and Wangyal *et al.* (2012)
4		*Kachuga* (Gray 1831)	
5		*Marenia petersi* (Anderson 1879)	
6		*Pangshura smithii* (Gray 1863)	
7		*Pangshura sylhetensis* (Jerdon 1870)	
8		*Pangshura tectum* (Gray 1831)	
9		*Pangshura tentaria* (Gray 1834)	
10	Trionychidae	*Chitra indica* (Gray 1831)	
11		*Lissemys punctata* (Lacepede 1788)	
12		*Nilssania gangeticus* (Cuvier 1825)	
13		*Nilssania hurum* (Gray 1830)	
14		*Nilssonia nigricans* (Anderson 1875)	

TABLE 8 List of new species recorded.

Sl. No.	Family	Species	Remarks
1	Colubridae	Russel's Kukri *(Oligodon toeniolotus,* Jerdon 1853)	Trashigang
2	Viperidae	Yunnan Bamboo Pit Viper *(Trimeresurus* cf. *stejnegeri yunnanensis,* Schmidt 1925}	Nangla Geog, Panbang, Zhemgang
3		Tibetan Bamboo Pit Viper *(Trimeresurus* cf. *tibetanus,* Huang 1982)	Trongsa proper, Trongsa
4	Agamidae	Blue Fan-throated Lizard *(Ptyctoloemus guloris,* Peters 1864)	Samdrup Jongkhar
S	Dicroglossiade	Annandali's Spiny Frog *(Nanorono onnondolii,* Boulenger 1920)	Jakar, Bumthang
6	Rhacophorldae	Striped Pygmy Tree Frog *(Chiromantis vittatus,* Boulenger 1887)	Pelingtsho, Nganglam, Pema Gatshel

FIGURE 5 Russel's Kukri, *Oligodon taeniolatus* (Jerdon, 1853) from Trashigang (Photo Credit: Sonam Lhendup).

FIGURE 6 Yunnan Bamboo Pit Viper, *Trimeresurus* cf. *stejnegeri yunnanensis* (Schmidt, 1925) from Zhemgang (Photo Credit: Reta Bahadur).

FIGURE 7 Tibetan Bamboo Pit Viper, *Trimeresurus* cf. *tibetanus* (Huang, 1982) from Trongsa (Photo Credit: Jigme Tshering, Trongsa).

FIGURE 8 Blue Fan-throated Lizard, *Ptyctolaemus gularis* (Peters, 1864) from Samdrup Jongkhar (Photo Credit: Ugyen Chophel, Samdrup Jongkhar).

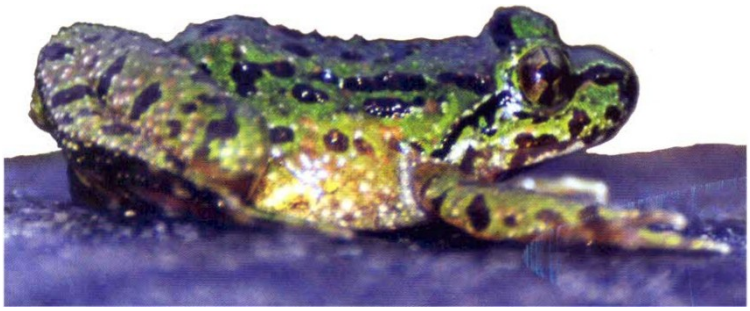

FIGURE 9 Annandali's Spiny Frog, *Nanorana annandalii* (Boulenger, 1920) from Sakteng, Trashigang.

FIGURE 10 Striped Pygmy Tree Frog, *Chiromantis vittatus* (Boulenger, 1887) from Peling Tsho, Perna Gatshel (Photo Credit: Watershed Management Division, DoFPS, Thimphu)

Pit Viper *(Trimeresurus popeiorum)*, which are supposed to be of significant conservation value. A technical report on this survey is pending. While some species are new to Bhutan, most of the species are supposed to have been already known to occur on the Indian side of the survey area.

Whatever the case, Bhutan at the moment might focus study on the occurrence and ecology of Sikkim Caecilian, a *Nanorana* sp. from Dochula, *Hyla* cf. *annectans*, *Xenophrys* cf. *nankiangensis* from Menchuna, Wangdiphodrang, *Amolops* cf. *monticola* from Burichu, Wangdhiphodrang and *Sylvirana cf .guentherii* from Lingmeythang, Mongar, reported by Wangyal (2012). These species have been reported only once and further confirmation is very much necessary.

Some other important species of Herpetofauna that need further studies are Bhutan Agama, Bhutan Skink, and Bhutan Cat-eyed Toad. These species are endemic to Bhutan and further study to confirm their abundance, habitat and other ecological characteristics are important as the studies could help save them from imminent threats if any. They may also be considered for special protection status by listing them in the schedule of protected species in the relevant acts and rules of the country if it is found necessary.

Further, Yellow Tortoises and Keeled Box Turtle must be thoroughly studied because they belong to the endangered category of species in the IUCN Red List. Even Malayan Box Turtle must be studied as it is also listed in the vulnerable category of the IUCN Red List. This paper also would like to recommend Bhutan to consider thorough study of King Cobra and Burmese Rock Python, for they are considered vulnerable species by IUCN.

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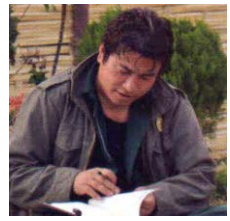

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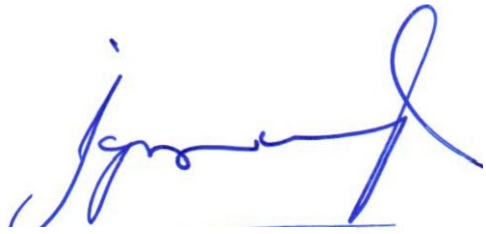

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