Annotated checklist of the reptiles and amphibians of Leyte, Philippines with notes on their ecology and conservation

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ABSTRACT

An annotated checklist of the amphibians and reptiles of Leyte, Philippines is presented. Currently, 24 frog species, 6 turtles, 1 crocodile, 39 lizards, and 28 snakes are known from Leyte. *Bufo marinus, Pelophryne lighti, Platymantis ingeri, P. spelaeus, Nyctixalus spinosus, Kaloula baleata, Gekko mindorensis, Bronchocela cristatella, Draco ornatus, Gonocephalus interruptus, G. sophiae, Mabuya multifasciata, Rhamphotyphlops braminus, Python reticulatus, Oligodon modestum, Boiga dendrophila, Dendrelaphis pictus,* and *Tropidolaemus wagleri* are reported for the first time from Leyte. *Platymantis corrugatus* is synonymized with *P. dorsalis. Calamaria joloensis* as is regarded as an unusual juvenile *C. gervaisi*. Taxonomic problems within the genus *Draco*. are pointed out Zoogeographically, the new record of *G. mindorensis* for the offshore island of Leyte and of the very rare *Platymantis spelaeus* is remarkable. In comparison to other Philippine islands of similar size, Leyte has the largest number of species but has no endemic species. The herpetofaunal similarity of Leyte and Dinagat which were connected during the Pleistocene is higher for reptiles but not for amphibians compared to Leyte and Negros which were not connected.

In the Mt. Pangasugan region, one of the last areas with extant native rainforest; 63% of the species known from Leyte have been found. Potential indicator species for ecological changes caused by forest clearing for kaingin farming and for the restoration success of agroforestry are discussed. Some of these species are only useful on Leyte whereas others show a wider potential application. Forty-eight percent of the species (observed more than five times) are restricted to primary or secondary forest and are very prone to extinction. Two species, *Crocodylus* sp. and *Heosemys leytensis*, are extinct in Leyte, the latter possibly elsewhere as well. In addition, 7 - 9 species (for two of them, Leyte may be an erroneous locality) have not been observed for more than 50 years. Five of them are restricted to primary forest. Finally, three species of sea turtles are rare in the waters around Leyte, and the lizards *Gekko mindorensis* and *Emoia atrocostata* are restricted to single offshore islands.

Keywords: Philippines, Leyte, Reptilia, Amphibia, checklist, new records, taxonomy, habitat requirements, indicator species, biogeography, conservation.

INTRODUCTION

The Philippine Islands were one of the first tropical islands for which extensive herpetological monographic treatises were available due to the pioneering and seminal work of Taylor (1919-1923). The Philippine Islands remained popular for herpetologists thereafter (e.g., Brown et al., 1978-1994; Inger, 1954, 1958; Leviton, 1955-1979; Gaulke, 1989-1994). Even a few detailed ecological studies have been undertaken on selected species (Alcala and Brown, 1967; Auffenberg, 1988; Klemmer and Gaulke, 1993; Gaulke, 1989). Nevertheless, large gaps still exist in our knowledge and even new species are regularly described (Brown and Alcala, 1994; Ota and Ross, 1994).

Early explorers like Jagor (1873) visited Leyte when the natural vegetation was still widespread. However, reports on natural habitats were vague, and the island remained poorly surveyed herpetologically. Only few records are available in the literature. Most of them are old and lack exact localities. So far, neither a checklist for the whole island or parts of it nor any detailed study of the ecology of any of its amphibians or reptiles exist.

An essential prerequisite for the development of effective conservation strategies are baseline data on the species present on the island and their dependence on more or less intact habitats. With the serious environmental changes still taking place in Leyte, many species may become extinct even before their identity can be estabiished (*Crocodylus* below).

Leyte belongs to the Mindanao zoogeographical region which also includes Samar, Bohol, Dinagat, and some smaller islands (Heaney 1985). During the Pleistocene when the sea level was lower, these islands were connected by land bridges so that an exchange of their faunas could occur.

Leyte covers an area of approximately 8,000 km^2 and lies in the Eastern Visayan Region of the Philippines (~10°N, 125°E). The eastern and western parts are separated by a mountain ridge running north-south with the highest peak in central Leyte (Mt. Lobi, 1350 m a.s.l.). The northern part is composed of basaltic rocks whereas the southern part is formed of lime stone. As a consequence, the northern mountains are often very steep whereas the southern ones are gently rolling. Limestone areas do not hold water as long as basaltic areas. Therefore, the soil tends to dry out quicker (see Asio, 1995 for a detailed geological description of Leyte). In addition, the southern part of Leyte receives less precipitation. The 15-year average rainfall at the Visayas State College of Agriculture (ViSCA), Baybay, Leyte station is about 2500 mm with a short dry period in April (Balzer, 1995).

Originally, Leyte was covered by primary forest. Lowland parts have already been cleared400 years ago, and the coastal zone is densely populated with utmost miniscule patches of primary vegetation left. Today, practically all accessible parts up to 600 m a.s.l. are cultivated, with rice fields and coconut groves dominating in the lowland areas. Even steep ridges at lower altitudes are used for intensive agriculture or kaingin farming. Thus, primary forests can only be found in the more remote areas of the island, e.g. the central mountains and in protected areas of Lake Danao, Ormoc.

One of the few areas which are still partially intact is the Mt. Pangasugan region. It provides a starting point for an environmental rehabilitation program run by the ViSCA-GTZ Ecology Program (Margraf and Milan, 1996). Under this program, the Mt. Pangasugan region was surveyed and data in some other areas of Leyte, mainly in the mountains east of Ormoc were collected.

The purpose of this paper is to present an annotated checklist of the reptiles and amphibians as a base line for ecological assessments of future ecological changes. Preliminary ecological data for the herpetofauna of the Mt.

Pangasugan region is presented and the suitability of amphibians and reptiles as indicator species for the degree of disturbance of natural forests and the ecological deterioration of intensive agricultures for the study region were presented. Moreover, the herpetofauna of Leyte were compared with that of neighbouring islands.

MATERIALS AND METHODS

The following checklist is based on our own collecting efforts mainly in the Mt. Pangasugan region near ViSCA and on the western half of Leyte. Intensive diurnal and nocturnal surveys of 1-3 weeks durations were made by two of us in February, 1992 (K.H.), March, 1993 (K.H.), April, 1994 (W.D.), April, 1995 (K.H.), and September, 1993 (W.D.). Since 1990, cursorial observations and collections were made by P.M. and J.M. and various PhD students working on other taxonomic groups. Occasional daytime surveys were also undertaken in the Alto Pic and Lake Danao area near Ormoc. In April, 1995, one of us (K.H.) surveyed the offshore islands of Apid and Digio for 2 days.

Our own data are supplemented by literature records. Major sources are Taylor (1919-1923) and Alcala (1986) for the Philippine herpetofauna, Inger (1954) and Brown and Alcala (1994) for amphibians, Leviton (1963-1979) for snakes, and Brown et al. (1956-1986) for lizards. Only these species are included in the checklist for which a definite record for Leyte is available. In case of marine reptiles, all species recorded from the Visayan Sea are listed.

Alcala's book (1986), the most recent reference to the Philippine herpetofauna, is the most widely available literature source in the Philippines. Unfortunately, it was published without the author's permission and contains several errors. Records for Leyte given in this book are commented unless supported by other sources. Whereever possible, the correct identification of older literature records was checked but this was not feasible for all material within the scope of this paper. In spite of this shortcoming, it is believed that this checklist can provide a sound basis for future studies of the herpetofauna of Leyte.

Identifications of collected specimens are based on comparisons with the herpetological material in the Zoologisches Forschungsinstitut und Museum Alexander Koenig (ZFMK, Bonn, Germany), the Zoologisches Museum Berlin (ZMB, Berlin, Germany), the Senckenberg Museum (SMF, Frankfurt a.M., Germany), and the Staatliches Museum für Naturkunde (SMNS, Stuttgart, Germany). A small collection of reptiles and amphibians from Leyte is also available in the museum of ViSCA. Species occuring in the Mt. Pangasugan area are preceded by an asterisk (*).

Except for specifically stated cases, our nomenclature follows Dowling and Duellman (1978). For amphibians, the more recent publications of Frost (1985) and Duellman (1993) were used as reference. Turtles are classified according to Ernst and Barbour (1989); the gekkonid and scincid nomenclature follows Brown and Alcala (1978, 1980).

The families and subfamilies are arranged in phylogenetic order and within these categories, the genera and species are arranged alphabetically. The literature citations under each species refer either to the major herpetological works mentioned above or to publications with detailed diagnoses or ecological data for the species.

Faunal similarities (FS) are compared with the Sörensen formula: $FS = 2*N_s/(N_i + N_j)$ with N_s signifying the number of shared species, and N_i and N_j the number of species of island i and j, respectively (Mühlenberg 1993).

FAUNAL LIST

Amphibia: ANURA

PELOBATIDAE

**Megophrys montana stejnegeri* TAYLOR, 1920

TAYLOR 1921: 148; INGER 1954: 224; ALCALA 1986: 7.

The horned frog inhabits primary and secondary forests. It lives on the forest floor and along streams and is predominantly nocturnal. Breeding takes place in the rainy season. The tadpoles live in running waters and in rock pools connected to slow flowing creeks. One tadpole was found in brackish water near the sea after a heavy rainstorm. Most probably, flood waters translocated it downwards to the estuary. The conspicuous tadpoles can attach themselves to steep rocks, which are slowly overflown by water. In a field experiment, 11 tadpoles were exposed to such conditions; only one drifted approximately 15 cm down the rock, the remaining tadpoles kept their positions within ± 5 cm. More developed tadpoles (stage 25 and older) were most often seen in pools with slow current adjacent to the main creeks. Dipterans and small plant particles are filtered from the surface and eaten; large particles are ejected again. We observed tadpoles from January to April. Calling males were heard at night during the same season.

We found tadpoles of *M. montana stejnegeri* in the Mt. Pangasugan area in the Lagolago and the Calbiga'a catchments in altitudes up to approximately 400 m. Tadpoles were observed in a creek at Mt. Alto Peak at approximately 850 m. The surroundings was mainly secondary forest, occasionally primary forest or patches of banana plantation. Toads were only rarely observed: most of them during the day in parts of creek beds with a broader gravel bed and some leaf litter.

BUFONIDAE

**Bufo marinus* (LINNAEUS, 1758)

Inger 1954: 231; Alcala 1986: 9.

The introduced cane toad is one of the most frequently encountered amphibians around houses at night. It is also abundant in all agricultural lowland sites e.g. rice fields and plantations along the coast from Baybay to Ormoc. Occasionally; it even enters mangroves, tidal gravel beaches, and tidal water bodies. At night, it often hunts on roads and gets killed by cars. *B. marinus* lives syntopically with *Kaloula picta* and can also be considered a commensual of man. Breeding aggregations can be found nearly every night during rainy periods. Clutches and tadpoles of this toad can be observed even in heavily polluted water. It seems that this species is highly adaptable to disturbed and destroyed areas. Since it penetrates primary or dense secondary forests, it is an indicator for heavily disturbed habitats. Although this species is widespread and already known from several Philippine islands, to our knowledge, this is the first record for Leyte.

Pelophryne lighti (TAYLOR, 1920)

Taylor 1921: 139; Alcala 1986: 12.

Two specimens were collected on the forest floor on Mt. Balacaue. This record is the first for a native bufonid species in Leyte. So far, this rare toad was known only from a few individuals from Mindanao, Samar, and Bohol (Gaulke 1994). Its occurrence in Leyte shows that it has a wider distribution in the southern and eastern Philippines and might be found also in other islands. Our two specimens are deposited in the Senckenberg-Museum (SMF 74615-16).

RANIDAE

Taxonomy and nomenclature on the subfamilial, generic, and subgeneric levels follow Dubois (1992). The genus *Limnonectes* was considered congeneric with *Rana* by most authors (e.g. Alcala 1986) until very recently.

DICROGLOSSINAE

**Limnonectes (Fejervarya) cancrivorus cancrivorus* (GRAVENHORST, 1829)

Taylor 1921: 35 (as *R. moodei*); Inger 1954: 260; Alcala 1986: 21.

The crab-eating frog is found along the coast line and it even frequents brackish water this species is very common in rice fields. In January, hundreds of males were heard but only few during March and April. It was also encountered in mangrove forests and in herbs on a gravel beach close to the tide mark. It was never observed in primary or secondary forest. One individual contained the chelicerae of a crab in its feces. Recently metamorphosed juveniles and tadpoles with forelegs were observed in April 1995 in a small spring in a seriously degraded grazed coconut grove.

Based on allozyme frequencies (n = 2), Leyte populations are very distinct from Indonesian populations (Nei's distance of 0.31 - 0.47) probably on a subspecific level (Kosuch, pers. comm.).

?Limnonectes (Feyervarya) vittiger (INGER, 1954)

Leviton 1955: 258 (as *R. limnocharis*).

Leviton (1955) recorded several specimens from Leyte. They are now in the collection of the

Stanford University (SU 14695-704; "probably Leyte Island, August 1940").

**Limnonectes (Limnonectes) leytensis* (BOETTGER, 1893)

Taylor 1921: 47; Inger 1954: 299 (as *R. microdisca leytensis*); Alcala 1986: 23; Inger, 1966: 214.

The Leyte frog inhabits streams of secondary and primary forests and lives in rice fields close to secondary forest. In the Calbiga-a catchment, it seems to be concentrated on the ecotone between cultivated fields and secondary forest and generally does not occur further upstream. During daytime, it is often found hidden underneath rocks and leaves. Breeding takes place after heavy rain. The tadpoles can be found in running water and in small rock pools of side creeks. Tadpoles and metamorphosing frogs were observed in April and September. Probably, breeding takes place throughout the year.

**Limnonectes (Limnonectes) visayanus* (WIEGMANN, 1835)

Taylor 1921: 44; Inger 1954: 289 (as *R. macrodon visayanus*); Alcala 1986: 24; Ross & Lazell 1990; 261; Inger 1958; 254.

L. visayanus is more common than *L. leytensis* in the Mt. Pangasugan region. It is limited to secondary and primary forest and never found in rice fields. Occasionally, it is also observed in stretches of the Calbiga-a or Lago-lago rivers partly bordered by banana plantations. At night, they can be found sitting on rocks in or next to streams. After heavy rain, calling males can be heard at daytime. In March, one clutch containing 190 eggs and one additional recently hatched clutch were found. The clutches were attached to the rock surfaces approximately 20 cm above the water and sheltered by a huge stone. Tadpoles of different developmental stages, recently metamorphosed juveniles, and subadults plus calling males were all found from January to April and in September, indicating a prolonged breeding season. In April 1995, which was very dry, several hundred males and females were observed along those sectors of the Calbiga-a river still containing water but neither clutches nor very young tadpoles could be found. However, activity was very variable, and the species did not call in all nights of observation. In nights without calling activity, males and females are observed in equal numbers (12:15). *L. visayanus* was also observed in creeks within primary forest at Mt. Alto Peak in an altitude of 850 - 920 m.

**Phyrnoglossus l. laevis* (GÜNTHER, 1858)

Taylor 1921: 30; Inger 1954: 249; Alcala 1986: 13.

P. laevis is a common frog along streams in secondary and primary forests. During the day it is often found sitting in or close to small, shallow rock pools (surface ~ 10 x 20 cm, depth ~ 5 cm) of side creeks but rarely observed in the main creek. When disturbed, they escape to the rock pools and hide underneath debris. Breeding takes place throughout the year. Eggs are deposited in small clutches (3 - 13; $x = 7.8 \pm 3.4$, $n = 8$) on decaying leaves in rock pools. Tadpoles of all stages and frogs of all ages from January to April were observed.

**Platymantis corrugatus* (DUMÉRIL, 1853)

Taylor 1921: 115; Inger 1954: 351; Alcala 1986: 14.

This frog inhabits of secondary and primary forests where it stays on the forest floor and hides under bark and fallen leaves. Alcala (l.c.) reports specimens from wooded, cultivated areas.

**Platymantis dorsalis* (DUMÉRIL, 1853)

Taylor 1921: 112 (as *Cornufer meyeri*); Inger 1954: 354 (as *Cornufer meyeri*); Alcala 1986: 15; Ross & Lazell 1990: 260.

This species was collected from banana leaves in a plantation area at Mt. Pangasugan. However, it is more common on the floor of secondary and primary forest and in parts of gravel creek beds which are broader and contain significant leaf litter. In such shady moist areas, juveniles are sometimes active in large numbers during the day. In contrast, subadults and adults are active almost exclusively at night. Juveniles were observed from February to April. This species was found in altitudes up to approximately 400 m in the Calbiga-a catchment area. A single adult was found in 730 m altitude in a gravelly creek bed through primary forest on the southwestern side of Lake Danao, and a juvenile individual in a mossy forest in the Mt. Alto Peak area at 920 m a.s.l.

Taxonomic remarks:

Only a single character separates the two taxons *P. corrugatus* and *P. dorsalis*: the length of the longitudinal ridges on the back (Inger 1954, Alcala 1986): at least two of them exceed 1/3 body length in *P. corrugatus* whereas none in *P. dorsalis*. According to this character, ZFMK 57334 and ZFMK xx belong to *P. corrugatus*, whereas ZFMK 58828-9 belongs to *P. dorsalis*. All individuals originate from the same population in which a continuous variation was observed from individuals with only few very short ridges to individuals with all but 1 - 2 ridges clearly shorter than 1/3 body length (as in ZFMK 58828), individuals in which several ridges approach but none exceeds 1/3 body length, and individuals

having several ridges clearly extending more than 1/3 body length. Therefore, this character is unsuitable as a diagnostic one for the distinction of the two taxa, they are regarded as conspecific.

Platymantis guentheri (BOULENGER, 1882)

Taylor 1921: 109; Inger 1954: 362; Alcala 1986: 16.

According to Alcala (l.c.), this species lives in the primary rain forest on tree trunks and in epiphytes. We observed large numbers of young juveniles diurnally active in leaf litter in mossy cloud forest in the Mt. Alto Peak area (800 - 900 m a.s.l.) and in a dry gravel creek bed through primary forest on the southwest side of Lake Danao (720 - 750 m a.s.l.). Collected individuals measured 19.7 - 27.8 mm (x = 22.6 ± 3.4 mm; n = 5) snout-vent-length (SVL). Juveniles were fairly abundant in leaf litter in primary cloud forest at 920 m a.s.l. Whereas the first finger was considerably longer than twice the length of the metatarsal tubercle in the three largest individuals, it was exactly twice that length in the three smaller juveniles which also differed by their more pronounced light brown dorsal ground coloration (pink in alcohol). Nevertheless, they are regarded as conspecific.

Platymantis ingeri (BROWN & ALCALA, 1963)

Alcala 1986: 17.

Two adult individual with 18.3 and 24.2 mm SVL, respectively, (ZFMK xx) were collected syntopically with *P. guentheri* in primary cloud forest at Mt. Alto Peak close to the geothermal station at 920 m a.s.l. They were active during the day in leaf litter. Several juveniles were observed in the same locality. This species is recorded for the first time from Leyte.

**Platymantis spelaeus* BROWN & ALCALA, 1982

Brown & Alcala 1982: 386.

One individual (ZFMK xx) with 26.5 mm SVL was collected in the gravel bed of the Calbiga-a river. It was active during the day. So far, this species was known only from two caves in Negros (Brown & Alcala 1982).

RANIDAE

RANINAE

**Rana (Chalcorana) albotuberculata* INGER, 1954

Taylor 1921: 63; Inger 1954: 311; Alcala 1986: 23.

Breeding aggregations of this species were found on rocks of small streams around the year. Even during prolonged dry spells, hundreds of males and females still gather around the remaining pools of larger creeks, and occasionally even clutches are deposited. The clutches are attached to rocks at or below the water surface in deep rock pools. Clutches contained 80 - 500 eggs (x = 335 ± 148, n = 13). Most clutches (16/18) were deposited in deep (> 50 cm) permanent rock pools within the main creek. Five clutches were lying on the ground, one was attached to a large drifting leaf, and the remaining ones were attached to the walls. The oviposition side seems to be an adaptation to quickly changing water levels in the creek. Two clutches not deposited in deep rock pools fell dry. Additional clutches were found in small pools in September. In three clutches, we observed flatworms (Planaria) preying upon the eggs. Turbellarians have been shown to be significant predators on eggs of the European hybrid water frog *Rana esculenta* (Kwet 1995). In one clutch, we sampled 75 eggs were sampled; 18 of these contained dead embryos.

**Rana (Hylarana) erythraea* (SCHLEGEL, 1837)

Taylor 1921: 50; Inger 1954: 324; Alcala 1986: 22.

R. erythraea is a typical frog of rice fields. Breeding aggregations of hundreds of males can be heard at night. This species is not known from primary and secondary forest but it regularly enters garden ponds. Whereas males far outnumber females at breeding ponds (e.g., 10:1 in a garden pond), females are more frequently observed hunting on lawns and grassy vegetation (5:1 during the same April night). Most males call from the water edge, only few call while floating on the water (4%, n = 50). Disturbed males skip across the water before diving to hide away. Breeding takes place in short bursts in the rainy season. Males continue calling in dry periods at the edge of garden ponds but only at a low intensity. Outside these bursts, the species is observed only infrequently. Eggs are deposited as a surface film in shallow water. Allozyme patterns of specimens from Leyte are almost identical to those from Indonesian populations (Kosuch, pers. comm.).

**Rana (Pulchrana) grandocula* TAYLOR, 1920

Taylor 1921: 72; Inger 1954: 322; Alcala 1986: 26.

The systematic status of our record is still doubtful. We have a photograph which shows a frog of the former *Rana signata* complex. Comparisons with the drawings in Inger (1954) made us conclude that our specimen is *R. grandocula* although Inger (l.c.) recorded the subspecies *similis* for Leyte. As already doubted by Leviton (1963a), this form is not indigenous to Leyte. For further discussion see Gaulke (1994). This frog inhabits streams of the primary forest. It lives on rocks in or next to running water. Eggs are laid at the edges of rivers and small ponds of mountain streams (s. Alcala 1986).

**Staurois natator* (GÜNTHER, 1859)

Taylor 1921: 78; Inger 1954: 335; Alcala 1986: 29; Inger 1966: 245.

The rock frog is found only in primary forests next to fast flowing streams and waterfalls. Preferred activity during daytime when the frogs can be observed sitting on rocks in the spray zone of water run-offs. The tadpoles live in fast flowing waters and can be sometimes found in the vertical walls of waterfalls (Denzer, unpubl. results from Borneo). Tadpoles of this species from Leyte are not yet known.

RHACOPHORIDAE

Contrary to the opinion of Dubois (1992), we prefer to accept family rank for rhacophorid frogs as indicated by Duellman (1993).

**Philautus leitensis* (BOULENGER, 1897)

Taylor 1921: 102; Inger 1954: 401; Alcala 1986: 35; Brown & Alcala 1994: 192.

Several specimens were observed in primary forest of Mt. Pangasugan. One of them was sitting on a large Araceae leaf approximately 1 m above the ground, several in abundant moist leaf litter on a steep slope at approximately 400 m a.s.l., and one jumped off the densely vegetated bank into the dry bed of a creek. The eggs are laid on leaves and undergo direct development (without free swimming tadpoles). We possess a photographic record of a metamorphosing frog in the gallert mass, which most probably is *P. leitensis*, the only *Philautus* species we found in the Mt. Pangasugan area. See Brown & Alcala (1994) for the difficulty to separate *P. leitensis* from *P. acutirostris* with whom it may be conspecific.

**Nyctixalus spinosus* (TAYLOR, 1920)

Taylor 1921: 93 (as *Hazelia spinosa*); Inger 1954: 407 (as *Philautus spinosus*); Alcala 1986: 31 (as *Edwardtayloria spinosa*); Brown & Alcala 1994: 188.

In April, tadpoles of this rare tree frog was collected from a water containing hole in a fallen tree (~ 1m above ground). Tadpoles of different developmental stages were found in the tree hole. The size of the biggest tadpole was approximately 1.3 cm body length plus 2 cm tail length. The first frog metamorphosed mid-June. This species was known only from Mindanao, Bohol, and Basilan (Brown & Alcala 1994).

**Polypedates leucomystax leucomystax* (GRAVENHORST, 1829)

Taylor 1921: 89; Inger 1954: 376; Alcala 1986: 37; Brown & Alcala 1994: 203.

This frog is a commensal of man. It can be found in small temporary pools at night, in large swamps, rice fields, plantations, and in gardens. Occasionally, they spawn in garden ponds attaching their foam nests to reed grasses. Breeding takes place around the year. Choruses of calling males can be heard after rain showers. We observed tadpoles in association with those of *Kaloula picta*, *Rana erythraea*, and *Limnonectes cancrivorus* in rice field puddles.

Rhacophorus appendiculatus appendiculatus (GÜNTHER, 1858)

Taylor 1921: 81; Inger 1954: 347; Leviton 1955: 258; Brown & Alcala 1994: 203.

This record is based on specimens in the Stanford University collection (SU 14750 - 4; "probably Leyte City, Leyte Island, June 1940", s. Leviton 1955).

MICROHYLIDAE: MICROHYLINAE

Chaperina fusca MOCQUARD, 1892

Taylor 1921: 134 (as *C. beyeri*); Inger 1954: 414; Leviton 1955: 258; Alcala 1986: 41.

Leviton (1955) recorded two specimens from Leyte now in the collection of the Stanford University (SU 14314-5; "probably Leyte City, June 1940"). The specific status of these specimens seemed to be uncertain to Leviton (l.c.) as his record is given as *Chaperina* cf. *fusca*. Although not seen, the specimens are referred to this species because there is no other similar microhylid known to occur in the Philippines, and because *Chaperina* is currently regarded as monotypic.

**Kalophrynus p. pleurostigma* TSCHUDI, 1838

Taylor 1921: 130 (als *K. stellatus*); Inger 1954: 416; Alcala 1986: 42.

The sticky frog is a common terrestrial species. It can be found in secondary and primary forest, especially when turning stones or logs. Its activity seems to vary seasonally. It is observed only very rarely from January to March but more often later in the year. Tadpoles were found in a large tree hole in April.

Kaloula baleata kalingensis TAYLOR, 1922

Inger 1954: 427; Alcala 1986: 43.

A single specimen (SMF 4184) was sent to the Senckenberg Museum by O.v. Moellendorf from Leyte in 1893. In the literature (Taylor 1921; Inger 1954; Alcala 1986), *K. baleata* is reported only from certain provinces of Luzon, whereas from Leyte, *K. conjuncta* and *K. picta* are known. Unfortunately, SMF 4184 is poorly preserved, and patterns have completely faded. However, the broadly truncated form of the finger tips, typical for *K. b. kalingensis* (see Inger, 1954, Fig. 76, p. 426), is still discernible, and there is no evidence

for supernumerary tubercles (typical for *K. conjuncta*). Therefore, the identity of SMF 4184 is confirmed, and this species has to be added to the herpetofaunal list of Leyte, as we have currently no reason to suspect an erroneous locality.

Kaloula conjuncta stickeli INGER, 1954

Taylor 1921: 124; Inger 1954: 428; Alcala 1986: 44.

K. conjuncta is a semifossorial species of the primary forest. Any specimen was never found and it is believed that it is absent or extremely rare in the Mt. Pangasugan area.

**Kaloula picta* (DUMERIL & BIBRON, 1841)

Taylor 1921: 124; Inger 1954: 428; Alcala 1986: 44.

As the preceding species, *K. picta* is a semifossorial burrower but is most often found after rainfalls and at night next to houses and in rice fields. It is a real commensual of man and therefore, very common throughout the campus of ViSCA after rain showers when choruses of thousands of individuals can be heard. These choruses last shorter than those of the syntopic *R. erythraea* but are considerably louder. Eggs are deposited in shallow water bodies which may dry out before metamorphosis. Breeding continues throughout the year.

Reptilia: TESTUDINES

EMYDIDAE

* *Cyclemys dentata* (GRAY, 1831)

Taylor 1921: 173 (as *C. dhor*); Alcala 1986: 47; Ernst & Barbour, 1989: 153.

A specimen is preserved in the Museum of ViSCA without exact locality record but most probably from the Mt. Pangasugan area.

Heosemys leytensis TAYLOR, 1920

Taylor 1921: 178; Alcala 1986: 48; Ernst & Barbour, 1989: 158.

The two types are from southern Leyte but nothing is known about the ecology of this rare turtle. A third specimen was recorded from Palawan. This specimen was purchased from a local resident. It has been caught "in a pool of a creek of an interior drainage" (Timmerman and Auth, 1988). No detailed survey has been undertaken in southern Leyte. However, considering the intensive ecological changes which have taken place in southern Leyte and the fact that it has never been observed again since its discovery, it is most likely that the species has become extinct in Leyte.

* *Cuora amboinensis amboinensis* (DAUDIN, 1802)

Taylor 1921: 169 (as *Cyclemys amboinensis*); Alcala 1986: 46; Ernst & Barbour, 1989: 147.

Two subadults have been found in a small mountain brook tributary of the Calbiga-a river within a disturbed patch of primary forest. Sometimes, specimens can be observed on the forest floor away from streams. Some people in the Visayas breed these turtles in small ponds. Nothing is known about its current status in Leyte. For discussion of the subspecific status, see Rummler and Fritz (1991).

DERMOCHELYIDAE

Dermochelys coriacea (LINNAEUS, 1766)

Alcala 1986: 49; Ernst & Barbour, 1989: 177.

This rare sea turtle is occasionally found in marine waters around the Visayas.

CHELONIIDAE

Eretmochelys imbricata (LINNAEUS, 1766)

Taylor 1921: 180; Alcala 1986: 50; Ernst & Barbour, 1989: 122.

A common sea turtle in the Philippine marine waters. Local fisherman of the offshore island Apid reported that sea turtles (species identification ambiguous from their descriptions) have been nesting on Apid. Supposedly, they still are occasionally nesting on the coral sand beach of the adjacent small island of Digio. The nesting period is said to be in August.

Chelonia mydas (LINNAEUS, 1758)

Alcala 1986: 51; Ernst & Barbour, 1989: 120.

The green turtle is found around the Philippine marine waters but has become quite rare due to overexploitation for food (i.e., turtle soup). See the preceding species for the only data on sea turtle breeding available for Leyte.

Reptilia: CROCODYLIA

CROCODYLIDAE

Crocodylus sp.

Jagor (1873) reported a large population of crocodiles from Lake Bito (Leyte). Groombridge (1987) did not list any crocodile species for Leyte. It is not clear, whether the species was *C. mindorensis* or *C. porosus*. *C. mindorensis* is known to have occurred at least on Samar (Ross and Alcala 1983). Lake Bito is a lowland lake approximately 3 km inland. Whereas lakes are a more typical habitat for *C. mindorensis*, *C. porosus* considerably penetrates inlands and is not restricted to coasts (e.g., Webb et al. 1987).

According to Ross and Alcala (1983), there are still suitable habitats for *C. mindorensis* in Leyte. This opinion is regarded as optimistic. Although some areas like Lake Danao may have been suitable until fairly recently, all potential (former) habitats familiar to su have been increasingly disturbed by man, e.g. in the area of Lake Danao; much of the formerly reasonably

extensive swampy areas have been destroyed or significantly altered, and humans are steadily encroaching on the lake.

The preferred habitat of *C. porosus* is the brackish zone along coasts, mangrove forests, and estuaries of larger rivers (e.g. Webb et al. 1987) which originally have been existing on Leyte. Due to the dense human population along the whole coast, certainly no suitable habitat exists anymore for *C. porosus*. The species known to Jagor (1983) (or both Philippine crocodiles) definitely have become extinct in Leyte even before their proper identity could be established.

Reptilia: SQUAMATA: SAURIA
GEKKONIDAE

**Cosymbotes platyurus* (SCHNEIDER, 1792)

Taylor 1922b: 59; Brown & Alcala 1978: 28; Alcala 1986: 54; Ross & Lazell 1990: 265.

A common species most often seen in and around houses at night; sometimes an occasional individual is also active during daytime. *C. platyurus* was observed in ViSCA and Baybay. A small population lives in houses and huts in the small village on the offshore island Apid.

At ViSCA, up to 25 individuals were observed on a house wall approximately 15 m long. The same habitat was shared with *Hemidactylus frenatus* (never more than four specimens observed), and *Gekko gecko*. In Leyte, it is clearly the most abundant species on most buildings, whereas *H. frenatus* dominates in banana groves, gardens, and in coconut trees. (A few suspected *C. platyurus* were observed on coconut trees but they could not be identified with certainty.) However, in some buildings in the ViSCA campus, both species are equally frequent, and rarely, *H. frenatus* is more abundant. In places where they share the same house walls, no direct direct interspecific interactions were observed.

In a sample of 19 individuals, six had regenerated tails. Adults frequently fight by biting the head of their opponents. Copulation is also initiated with a bite to the neck region of the female. After several bites, the male takes a firm grip, aligns his body parallel to the female, and pushes his body underneath that of the female. One fully observed copulation lasted approximately 3 min.

**Cyrtodactylus agusanensis* (TAYLOR, 1915)

Taylor 1922b: 49; Brown & Alcala 1978: 16; Alcala 1986: 57.

This nocturnal gekkonid lizard was found in secondary and primary forest patches along rivers (Calbiga-a and Lago-lago) where they hunt for insects on almost vertical wet cliffs, in tree buttresses, and between large blocks of rocks in the creek bed. During daytime, the geckos hide in tree holes, underneath the bark, and in rock crevices. Up to four individuals were found in the same hiding place. Juveniles were present in January.

One specimen with a pattern typical for *C. annulatus* was observed in the same fallen tree in the Calbiga-a river as the two specimens definitely identified as *C. agusanensis*. As pattern is not a reliable discriminating character for the *Cyrtodactylus* species of Leyte, and the female could not be identified with certainty, it was regarded that it also belonged to *C. agusanensis*. Another specimen of *Cyrtodactylus* from the same locality showed a conspicuous middorsal band. Its pattern differed considerably from other specimens observed in the same region or from known descriptions of Philippine individuals of *C. agusanensis*. However, some individuals in the ZFMK collection from other regions within the distribution of this gecko show indications towards such a pattern. Unfortunately, the specimen got lost before a definite identification was possible.

Cyrtodactylus annulatus (TAYLOR, 1915)

Taylor 1922b: 44; Brown and Alcala 1978: 20; Alcala 1986: 55.

This species is found in the same habitats as the preceding one but seems to be less common. It has been recorded for Leyte by Brown and Alcala (l.c.).

**Gehyra mutilata* (WIEGMANN, 1834)

Taylor 1922b: 62; Brown & Alcala 1978: 39; Alcala 1986: 58.

Only few specimens were found in the garden of a house near the beach at ViSCA but elsewhere, this nocturnal gecko lives also in forests and plantations where it inhabits trees (Alcala 1986).

**Gekko gecko gecko* (LINNAEUS, 1758)

Taylor 1922b: 94; Brown & Alcala 1978: 61; Alcala 1986: 59.

Aside from the surrounding of ViSCA, *G. gecko* were observed in Punta and in the island of Apid where it is very common on coconut trees. According to local people, it also lives on the neighboring coral reef of Digio.

G. gecko is commonly found in and around houses at night where it hunts for insects attracted by light. Calls are also heard in the daytime. It is also very frequent in coconut plantations even in extremely degraded grassland like in Punta (south of Baybay) in which only a low grassy vegetation survives between the coconut trees. It occurs also in tree canopies of plantations and at the edge of

forests but at a much lower density. It was never heard in primary forest or far inside secondary forest. Six eggs have been found under roof tiles in an abandoned hut. A clutch of two eggs was deposited in a hole in a palm tree. They developed within approximately 60 days. Juveniles were observed in January. *G. gecko* was observed preying upon large beetles (Lamellicornia), on spiders, and moths.

Gekko mindorensis TAYLOR, 1919.

Brown & Alcala 1978: xx; Alcala 1986: 60.

One male and three females were collected from the offshore island of Apid. Three individuals were observed on thin stems of *Ficus* sp. One individual was foraging on a coconut tree. Three of the individuals were lower than 50 cm above ground, one at 2 m height. All individuals tried to escape to the ground. All observations were made close to the edge of the island or close to limited remains of natural vegetation.

Our record is the first for Leyte (including its offshore islands). *G. mindorensis* differs only slightly from *G. monarchus* by its higher number of praeanofemoral pores and the dorsal markings forming an indistinct cross band. With 54 pores, our collected individual (ZFMK xx) is clearly attributable to *G. mindorensis*. However, the dark dorsal markings are very distinct and consist of separate dark brown spots close to the tail and in the neck region. Distinct dark brown spots instead of weak cross bands are a diagnostic feature of *G. monarchus* (Brown & Alcala 1978). In the three live specimens, the dark dorsal cross bands are even more distinct. Furthermore, they are broken into two distinct blotches in the neck and tail region. For implications of this pattern, see discussion.

The geckos jump up to 20 cm from branch to branch while hunting for insects. In captivity, the species is occasionally active during the day and licks condensing water from leaves after spraying. The species is noticeably vocal during aggressive encounters.

Gekko monarchus (DUMÉRIL & BIBRON, 1836)

Taylor 1922b: 91; Brown & Alcala 1978: 70; Alcala 1986: 61.

Usually, it is a conspicuous species reaching high densities (Grossmann, 1993 for Malaysia; Denzer unpubl. for Borneo) and sometimes found in the neighborhood of man. In the Philippines, it inhabits mostly the tropical rainforests occupying the nocturnal, semiarboreal niche, and partly the same habitats as *Cyrtodactylus* species (see Alcala l.c.). The specimen depicted in Alcala (l.c., fig. 54) is a *Cyrtodactylus*.

**Hemidactylus frenatus* DUMÉRIL & BIBRON, 1836

Taylor 1922b: 52; Brown & Alcala 1978: 34; Alcala 1986: 64.

H. frenatus is a commensual of man and very common in coconut and banana plantations. It also lives under drift wood on the beach. In the offshore island of Apid, it hunts on coral blocks and on the ground at night. In this island, the species is extremely abundant. Occasionally, an individual can be observed active during the day but only under cover.

It was also found in houses in ViSCA but here it is usually rarer than *Cosymbotes platyurus* (but see under *C. platyurus*). During the day, *H. frenatus* often hides in the axils of banana leaves. An egg was found on the ground underneath pieces of bark at the base of a palm tree (possibly the second egg displaced), one (probably of this species) in a tree stump, and two adhering eggs sticking in the axil of a banana leaf. Gravid females and juveniles were present in all months. One observed copulation lasted 25 minutes. The male grasped the female on the flanks behind the forearms before intromission. In initiating copulation, the pair form a rotating circle for approximately 2 minutes.

**Lepidodactylus herrei medianus* BROWN & ALCALA, 1978

Brown & Alcala 1978: 91; Alcala 1986: 67.

Two specimens were found in a house and in a banana plant next to the beach. Normally, this diurnal species occurs in secondary and primary forest. It inhabits leaf axills of *Pandanus* and aerial plants like nest ferns (*Asplenium nidus*).

Ptychozoon intermedium TAYLOR, 1915

Taylor 1922b: 101; Brown & Alcala 1978: 129; Alcala 1986: 76; Ross & Lazell 1990: 265.

The "flying" gecko is a nocturnal, arboreal species of the primary forest. It is rarely seen as it inhabits high trees. During daytime, it hides underneath the bark.

Most probably, the gekkonid species *Pseudogecko brevipes* known from Bohol, Cebu, Negros, and Samar, *P. compressicorpus* (Bohol, Masbate, southern Luzon, and others), *Lepidodactylus planicaudis* (among others Bohol, Cebu, Masbate, Samar), and *Hemiphyllodactylus typus* (Bohol, Cebu, Samar, and others) (Brown & Alcala 1978, Alcala 1986) occur on Leyte but have not yet been recorded.

AGAMIDAE

The "flying dragons" of the genus *Draco* were determined according to Musters (1983) with some modifications mentioned in the text. However, different opinions regarding

the status and distribution of various taxa still exist (compare Inger, 1983, Ross and Lazell, 1990), and future revisions of the genus may lead to different specific allocations of some *Draco* species of Leyte.

Musters (1983) reported *D. volans* from Leyte but as already discussed by Taylor (1922b), this species probably occurs only in Palawan. The more widespread and similar species *D. spilopterus* is still unknown from Leyte. Several specimens were observed but unfortunately none of a *volans* or *spilopterus* like species was collected. The morphological difference (tympanum scaly or not; superciliary scaly or not) is not discernible in the field. Until more preserved material from Leyte is available, it is preferred not to list one of these species. According to C. Ross (pers. comm.), there may be still some undescribed *Draco* species in the Philippines.

About the genus *Gonocephalus*, all three known species were listed, although morphological differences between these species are minor. More material will perhaps yield a new classification within the Philippine anglehead lizards.

**Bronchocela cristatella* (KUHL, 1820)

Taylor 1922b: 139; Alcala 1986: 77.

A specimen send by O.v. Moellendorf to the Senckenberg Museum (SMF 9874) is listed in Boettger (1893) but wrongly identified as *Calotes marmoratus* due to its high nuchal crest. Neither Taylor (1922b) nor Welch et al. (1990) included Leyte in the range of this species. It probably has a wider distribution in the East Visayan region but its density seems to be very low as only one specimen of this usually abundant and common species was found in a plantation area in Mt. Pangasugan. The specimen caught a caterpillar.

*Cf *Draco* (*lineatus*) *bimaculatus* GÜNTHER, 1864

Taylor 1922b: 126; Alcala 1986: 78; Ross & Lazell 1990: 262; Gaulke 1993: 251.

Our specimen (ZFMK 57811) is tentatively referred to this species inspite of several morphological differences. In life, the wing membranes show yellowish-orange cross bands dorsally (only the posterior two distinct) instead of bluish lines. The dew laps are variable in their pattern. In most individuals, it is whitish with at most a small black stripe along the anterior edge. In some individuals of the same population, the dew lap is light bluish with two conspicuous black bars along the anterior and posterior edge. The two bars join and form a triangle. In contrast, the gular sac of *D. bimaculatus* is usually darkly marbled greenish or greenish-gray, bluish white or yellowish. In spite of the differences, coining a name for our specimen until more material becomes available, or until a complete revision of Philippine *Draco* species has resolved still existing problems with several taxa (see above).

D. bimaculatus is fairly abundant in a secondary forest close to the Forestry Department of ViSCA. We observed one individual on a ridge top in 380 m altitude displaying on an exposed tree trunk. This was the only specimen observed in secondary or primary forest. Occasionally, an individual in was observed gardens on the campus of ViSCA. When disturbed, *D. bimaculatus* runs to the side of the tree opposite to the observer. If two males meet, they show an impressing display behavior with extensions of the patagia and dew laps. In most cases, they run up the tree in spirals with the non-dominant male jumping to the next tree.

Draco species prefer tall trees with sun-exposed trunks. Sometimes they are feeding on ants on the ground. Pregnant females lay their eggs in self-dug holes in the soil. One clutch contained four eggs which all hatched.

Draco everetti BOULENGER, 1885

Alcala 1986: 82; Ross & Lazell 1990: 262.

Until very recently, this species has been considered a synonym of *D. volans* (Hennig 1936, Musters 1983). Based on new material and comparisons with the types, Ross and Lazell (l.c.) removed *D. everetti* from that synonymy and revalidated it. Our record for Leyte is based on museum material held in the Californian Academy of Science. This species is also listed in Alcala (1986) for Bohol and Camiguin.

Draco ornatus (GRAY, 1845)

Alcala 1986: 82; Ross and Lazell 1990: 264.

Our record is based on a single specimen in the Senckenberg Museum (SMF 74610: Mt. Balocaue). According to Ross and Lazell (1990), this is a valid species easily recognized by a large black patch at the outer margin of the extended patagia which includes several light spots. For further discussion, see Ross and Lazell (1990) and Gaulke (1994). Alcala (1986) reports *D. ornatus* from Mindanao and Luzon.

Gonocephalus interruptus BOULENGER, 1885

Boettger 1893: 44; Taylor 1922b: 134; Alcala: 86.

There is a male specimen of an anglehead lizard in the Senckenberg Museum (SMF 9761: Ormoc), which most probably belongs to this species. Our comparisons showed that the specimen fits the original description of Boulenger (1885) and has to be added to the faunal list of Leyte.

**Gonocephalus semperi* (PETERS, 1867)

Taylor 1922b: 131; Alcala 1986: 85.

We do not possess a voucher specimen of this anglehead lizard but one of us (J.M.) took a

photograph of a specimen. This specimen certainly belongs to the *G. semperi* - group as defined by Manthey and Denzer (1991). In spite of specific searches, the species was never observed again in the area. Alcala (l.c.) recorded *G. semperi* from Leyte.

Gonocephalus sophiae (GRAY, 1845)

Taylor 1922b: 133; Alcala 1986: 86.

Our record for Leyte is based on a single specimen in the collection of the Californian Academy of Science.

***Hydrosaurus pustulatus* (ESCHSCHOLTZ, 1829)**

Taylor 1922b: 141; Alcala 1986: 87.

The first record of this species from Leyte is listed in Boettger (1893b) based on a specimen sent to the Senckenberg Museum by O.v. Moellendorf (SMF 10384) and identified as *Lophura amboinensis*. In following publications, this record was overlooked, and Leyte was not included in its range since then.

The sailfin water lizard always lives next to streams. In Mt. Pangasugan, it is found in the open grassy areas along the Calbiga-a River. These areas are situated in secondary forests as well as in plantations. The individuals can be observed on sun-exposed rocks in the stream or on overhanging trees but are very shy. When disturbed, they run away and hide in shrubs for at least half an hour.

VARANIDAE

***Varanus salvator cumingi* MARTIN, 1838**

Taylor 1922b: 151; Alcala 1986: 123; Gaulke 1991: 159.

The Malay monitor lizard can be found in forests and in open plains. It is often associated with human habitations especially next to rice fields. A foraging adult specimen was observed along the Calbiga-a River. When disturbed, it take refuge in a huge hollow broken down tree. A subadult individual foraged close to the Forest Department on ViSCA campus in a savanna like area.

Recent tracks of the species was surprisingly observed at the beach of Apid island approx. 5 km off the coast of Leyte. The small and densely populated island with a circumference of approx. 2.4 km is heavily modified (almost exclusively coconut trees and *Pandanus* sp. in the center, huts on the beach). Local residents reported that they observe monitor lizards on the island on rare occasions suggesting that an albeit small population survives in it.

SCINCIDAE

***Brachymeles gracilis hilong* BROWN and RABOR, 1967**

Taylor 1922b: 247; Brown and Rabor 1967: 543; Brown and Alcala 1980: 39; Alcala 1986: 89; Ross and Lazell 1990: 270.

This burrowing skink inhabits the dipterocarp forest where it lives on the ground under rotting wood and leaves. In Leyte, it was found also in coconut plantations and secondary forests. A dead specimen was found on a broad track through primary forest but close to plantations along the southwestern side of Lake Danao. A second individual was caught by a snake, possibly *Ololygodon modestum*, in leaf litter adjacent to a small tributary to Lake Danao in primary forest. The skink was gripped at the posterior part of the body. Three different bite marks were visible. In its struggle, the skink lost its tail. The snake could not suffocate the skink within 2 min. The collected skink (ZFMK) recovered from the attack.

Brachymeles samarensis BROWN, 1956

Brown 1956: 6; Brown and Alcala 1980: 26; Alcala 1986: 93.

B. samarensis prefers the same habitats as the preceding species.

***Brachymeles schadenbergi orientalis* BROWN and RABOR, 1967**

Taylor 1922b: 249; Brown and Alcala 1980: 52; Alcala 1986: 90; Ross & Lazell 1990: 270; Klemmer and Gaulke 1993: 57.

Like the other species of *Brachymeles*, this skink lives in the soil of the forest floor. Klemmer and Gaulke (l.c.) reported a single specimen from St. Bernard (Leyte). P. Becker found a specimen in leaf litter in his forested garden close to the ViSCA campus.

Emoia atrocostata (LESSON, 1826)

Taylor 1922b: 226; Brown and Alcala 1980: 69; Alcala 1986: 97.

Brown and Alcala (1980) list this species in their account for Leyte but did not mention any museum material or literature record. Coastal habitats in Leyte are particularly heavily modified, and at most very few suitable areas remain so that the species may not exist on Leyte itself anymore. In April 1994, one of us (M.G.) observed one specimen of *E. atrocostata* on a small offshore mangrove island (Tres Marias) near Palompon (Leyte). See Brygoo (1986) for the correct dating of the species description.

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**Lamprolepis smaragdina philippinica* (MERTENS, 1928)
Taylor 1922b: 205; Brown and Alcala 1980: 76; Alcala 1986: 98.

L. smaragdina lives in the coconut palms near the coast and in secondary growth on sun-exposed trees. Rarely, it was observed in dense secondary forest. In addition, individuals were found on the garden walls at the hospital in Baybay, in gardens and in mangrove trees in ViSCA. Specimens observed in February and April were predominantly green and only slightly brownish on the posterior part of the body. Those observed in September are predominantly brownish with a brilliant green coloration on the anterior part of the body. This difference in colouration may be due to mating seasons. Juveniles were observed in September. After a heavy storm in April, two round, hard-shelled eggs were found under a fallen tree trunk. They probably belong to this species. One adult was preyed-upon by a snake (*Dendrelaphis caudolineatus terrificus*).

**Lipinia pulchella pulchella* GRAY, 1845
Taylor 1922b: 212; Brown and Alcala 1980: 93; Alcala 1986: 99.

This little skink was found in primary as well as in secondary forests of Mt. Pangasugan. It lives on trees where it is sometimes found together with *L. smaragdina*. Occasionally a specimen was observed in the dry gravel bed of the Calbiga-a River and its small tributaries. Large numbers of this skink were observed in January and September but only few specimens in February. Juveniles were found in March and April.

Lipinia quadrivittata quadrivittata (PETERS, 1867)
Taylor 1922b: 223 (as *Siaphos quadrivittatum*); Brown and Alcala 1980: 85; Welch et al. 1990: 81.

According to Brown and Alcala (l.c.), this species inhabits mostly aerial ferns. In Negros, it was observed in swampy areas as well as in dipterocarp forest (Brown and Alcala l.c.).

Mabuya indeprensa BROWN and ALCALA, 1980
Brown & Alcala 1980: 122; Welch et al. 1990: 86.

Previously, this species has been confused with *M. multicarinata*. Populations of *M. indeprensa* are known from secondary and primary forests.

**Mabuya multicarinata multicarinata* (GRAY, 1845)
Taylor 1922b: 159; Brown and Alcala 1980: 126; Alcala 1986: 105.

It is one of the most common terrestrial skinks in logged and cleared areas in plantations, and on sunny patches in secondary and primary forests. It is occasionally on the walls of abandoned buildings. Extremely high densities were observed in grassy edges of secondary forests, where up to 25 individuals were seen at the same time on an area of 3 x 20 m. They were fairly abundant on the naturally disturbed very steep and narrow ridge tops between Pangasugan and Lago-lago rivers which are partially open and partially densely covered by ferns and grasses. A few individuals were observed in pioneer vegetation on a landslide area along a small mountain creek on Mt. Alto Peak, along the edge of a newly constructed gravel road, and at the edge of vegetation around an area of sulphuric fumaroles. *M. multicarinata* is very abundant along the grassy forest road and tracks along the southwestern side of Lake Danao (approx. 700 - 725 m a.s.l.). It occurs in Leyte from sea level to at least 987 m. However, it is apparently absent from the heavily degraded coconut plantations in Punta. A small population lives on the small offshore coral island of Digio. Some specimens could be observed climbing small bushes or low vegetation hunting for insects. Juveniles were seen in April, August, and September but breeding season is probably throughout the year.

In the experimental closed canopy reforestation area, *M. multicarinata* decreased in abundance between 1993 and 1995. In 1993, K.H. observed 9 individuals within 1 hour of survey. In contrast, in 1995, K.H. detected only three individuals within 90 min of search. In 1993, the area was still very open and mainly sun-exposed. In 1995, the canopy already started to close, and shady areas dominated.

**Mabuya multifasciata* (KUHL, 1820)
Taylor 1922b: 158; Brown and Alcala 1980: 131; Alcala 1986: 102.

Although *M. multifasciata* is usually an abundant and common skink throughout the Philippines (Brown and Alcala 1980), only very few specimens were found in the campus of ViSCA. There was no other published record of this species from Leyte.

**Sphenomorphus (Otosaurus) cumingi* (GRAY, 1845)
Taylor 1922b: 163; Brown and Alcala 1980: 193; Alcala 1986: 108.

This terrestrial species prefers dipterocarp forests and secondary growth from 500 - 1000 m a.s.l. (Brown and Alcala l.c.). It is rarely observed along the Calbiga-a creek either on rocks or on tree trunks approximately 1 m above ground at altitudes between 200 - 300 m. When disturbed, they escape to the ground hiding in the soil and underneath pieces of bark.

**Sphenomorphus acutus* (PETERS, 1864)

Taylor 1922b: 168; Brown and Alcala 1980: 179; Alcala 1986: 109; Ross and Lazell 1990: 266.

S. acutus is an arboreal skink which is often observed in low vegetation. According to Brown and Alcala (l.c.), they also live in aerial plants. It is occasionally observed on the ground in the Calbiga-a river area. A copulating pair was seen in September.

**Sphenomorphus coxi coxi* TAYLOR, 1915.

Taylor 1922b: 173; Brown & Alcala 1980: 204; Alcala 1986: 111.

Only one subadult specimen was found along the Calbiga-a river in January (ZFMK 57835). In contrast, it was the most abundant *Sphenomorphus* species in a gravel creek bed with ample leaf litter on the southwestern side of Lake Danao. The creek runs through primary forest at an altitude of 720 - 750 m. When disturbed, most individuals flew to the banks of the creek hiding in leaf litter or in the ground. Occasionally, they also hide within the gravel of the creek. A voucher specimen accidentally killed is held in the collection of the ZFMK.

Sphenomorphus fasciatus (GRAY, 1845)

Taylor 1922b: 188; Brown and Alcala 1980: 218; Alcala 1986: 111.

Brown & Alcala (l.c.) reported that this species is terrestrial, sometimes found between tree buttresses in the dipterocarp forest.

**Sphenomorphus jagori jagori* (PETERS, 1864)

Taylor 1922b: 192; Brown and Alcala 1980: 209; Alcala 1986: 112; Ross and Lazell 1990: 267; Klemmer and Gaulke 1993: 60.

S. jagori is the most common and abundant lizard of the secondary and primary forests of the Mt. Pangasugan area. On sunny days, one can find hundreds of them along the Calbiga-a river. The density of this terrestrial species is highest near streams but some specimens can also be seen far away from water. They live on all steep slopes and ridge tops provided that they are heavily shaded, the ground is moist, and some leaf litter is available. It is observed up to an altitude of 510 m in the Mt. Pangasugan area and up to 750 m at a small tributary to Lake Danao. Here, the species was much less common than in the Mt. Pangasugan area but still the second most frequently observed species after *S. coxi*.

Occasionally, an individual was observed active at dusk or in heavy rain. This species is common throughout the year. In March, juveniles clearly dominated (66 in a sample of 75).

One of the type specimens in the Berlin Museum (ZMB 4975) was collected from Leyte.

**Sphenomorphus llanosi* TAYLOR, 1919

Taylor 1922b: 182; Brown and Alcala 1980: 212; Alcala 1986: 117.

This skink is always in or next to running water. It is often seen in association with *S. jagori*. When disturbed, this species hides under rocks in streams and occasionally swims or dives. Similar observations have been made in Samar, where specimens could be observed catching small gastropods under water (Gaulke 1994). Our specimens were found in secondary and primary forests along the Calbiga-a river. Interestingly, this species was rarely observed in January and March but quite often in April 1994. It was not found again in the exceptionally dry April 1995.

Sphenomorphus mindanensis TAYLOR, 1915

Taylor 1922b: 198; Brown and Alcala 1980: 174; Alcala 1986: 118; Ross and Lazell 1990: 267.

Only few data are available on the ecology of this species. It is apparently a terrestrial species of the submontane zone (Brown & Alcala 1980). In March 1993, we collected a juvenile of 23 mm snout-vent-length (ZFMK 57839) on gravel in a creek bed through primary forest at Mt. Alto Peak at approximately 850 m altitude. The narrow creek bed was deeply cut. In life, the tail was red. In preservative (75% ethylene), it turned brownish. In April 1995, an active adult was observed between gravel in the southwestern tributary to Lake Danao within the primary forest on an altitude of 750 m. The tail was bright orange.

**Sphenomorphus steerei* STEJNEGER, 1908

Taylor 1922b: 180; Brown and Alcala 1980: 166; Alcala 1986: 113.

This small skink considerably increased in the closed canopy experimental plantation of the ViSCA-GTZ ecology program during the re-establishment of a closed canopy. At the beginning of the reforestation in 1993, the area was still very open and strongly exposed to the sun. In that period, we (J.M., K.H.) found only once two individuals hiding underneath rotting banana leaves. In April 1995, the canopy was already fairly closed, and shaded areas dominated. Within a 90 min survey by one of us (K.H.), ten individuals were observed, and seven of them were active in areas with extensive shade and accumulated leaf litter.

S. steerei was also occasionally observed on the edge of the gravel bed of the Calbiga-a river. It further lives in secondary and primary forests

along the steep slopes and ridges between the Pangasugan and Lago-lago rivers provided there is sufficient shade and leaf litter available. Except within leaf litter, specimens may be found hiding in or underneath rotting logs and woods. They may also burrow into the moist soil of humus forest floors. It was observed up to an altitude of 395 m. On the southwestern side of Lake Danao (altitude approx. 720 m) and on Luzon (Mt. Makiling), it is found in primary forest.

A pair was found together in a burrow. The female was distinctly larger than the male. Although specimens could not be sexed reliably in the field, it appeared that there are two distinct adult size classes, with females being significantly larger than males. All gravid females (n = 5) carried only a single egg. Two females deposited their eggs in January and March, respectively. One egg measured 6.6 x 2.9 mm. One female carried the egg in its mouth trying to find a suitable deposition place within the transport box.

**Sphenomorphus variegatus* (PETERS, 1867)

Brown and Alcala 1980: 190; Alcala 1986: 119; Welch et al. 1990: 109.

This species was found only rarely in association with *S. jagori* in secondary and primary forests. All specimens were observed next to small creeks and only in the more shaded parts of the stream bed.

**Tropidophorus grayi* GÜNTHER, 1861

Taylor 1922b: 236; Brown and Alcala 1980: 222; Alcala 1986: 120; Klemmer and Gaulke 1993: 60.

The spiny water skink is a semiaquatic species of the secondary and primary rain forests. It can be observed sitting on rocks in the streams basking in the sun. When disturbed, they hide under stones and logs or in shelters. At the Calbiga-a river, this species was only observed along a short section where it was abundant in 1989 (Klemmer and Gaulke 1993). The species seems to have disappeared from this area since no specimens can be found anymore since 1993, inspite of intensive searches. However, a single specimen was found at Lago-lago river in September 1993. See Klemmer and Gaulke (1993) for an ecological account of the species.

Reptilia: SQUAMATA: SERPENTES

TYPHLOPIDAE

**Ramphotyphlops braminus* (DAUDIN, 1803)

Taylor 1922a: 50; Alcala 1986: 124.

This common and widespread typhlopid species was only recently discovered for Leyte when P. Schütz found several specimens in the excrements of a cane toad (*Bufo marinus*) and a single specimen in a house near the beach at ViSCA (SMNS 7878).

BOIDAE

**Python reticulatus* (SCHNEIDER, 1801)

Taylor 1922a: 68; Alcala 1986: 130; Welch 1988: 24/

A specimen at approximately 3.5 m length was found in a reforestation area near ViSCA. It was hidden under barks and banana leaves. Two living juveniles of this snake are kept in the Museum at ViSCA. The reticulated python is quite common but the people fear this snake especially the large ones and kill them in most cases.

COLUBRIDAE

LYCODONTINAE

**Lycodon (aulicus) capucinus* BOIE, 1827

Taylor 1922a: 120 (als *Ophites aulicus*); Leviton 1965c: 131; Alcala 1986: 144.

The common wolf snake is often found in cultivated areas and next to houses where it feeds on small mammals and lizards. It is semiterrestrial and nocturnal. A road-killed adult specimen and a dead semiadult individual were collected next to a road in the ViSCA area. Two juvenile specimens were also collected in gardens on the campus of ViSCA (ZFMK).

Several authors refer to *L. capucinus* as a valid species restricting the occurrence of *L. aulicus* to the Indian subcontinent (Welch 1988).

Lycodon muelleri DUMÉRIL, BIBRON and DUMÉRIL, 1854

Leviton 1963b: 389; Alcala 1986: 158

Nothing is known about the habits and life history of this rare snake.

Cf. *Oligodon modestum* (Günther, xx)

Alcala 1986: 150.

One individual was observed on the bank of a dry creek bed on the southwest side of Lake Danao at 720 m a.s.l. The snake caught a *Brachymeles gracilis hilong* but could not suffocate it within a 2 min period and released it when disturbed by flash light. The skink had lost its tail. This is the first record of *O. modestum* for Leyte. The snake was tentatively identified in the field and from photographs by its reddish vertebral stripe, reddish-brown ground color, and yellowish venter with black spots.

**Psammodynastes pulverulentus* (BOIE, 1827)

Taylor 1922a: 209; Alcala 1986: 154; Welch 1988: 92.

The mock viper is a semiarboreal species of the primary forest. It feeds on small mammals,

amphibians, and lizards. A juvenile and several adult specimens were observed on the ground. One specimen was found in a tree hole. Juveniles are easy to recognize by their distinct yellowish ground coloration whereas adults are mainly brown.

COLUBRINAE

Ahaetulla prasina preocularis (TAYLOR, 1922)

Taylor 1922a: 219; Leviton 1968a: 85; Alcala 1986: 131.

The whip snake lives on bushes and in trees of all growth types. It feeds on lizards and small birds.

Boiga angulata (PETERS, 1861)

Taylor 1922a: 204; Leviton 1968b: 395; Alcala 1986: 134.

B. angulata is an arboreal and nocturnal snake of secondary and primary forests. There is a specimen from Leyte in the collection of the Berlin Museum (ZMB 4000; "Leyte", leg. Jagor).

Boiga cynodon (BOIE, 1827)

Taylor 1922a: 206; Leviton 1968b: 299; Alcala 1986: 133.

This species can be observed in trees where it hunts for birds and lizards. Sometimes, specimens are found on the ground. They are nocturnal and prefer forested regions.

**Boiga dendrophila* (Boie, 1827)

Leviton 1968b; Alcala 1986: 133.

One adult specimen was found dead close to the campus on ViSCA. It is the first record for Leyte. The collected specimen probably belongs to the subspecies *B. d. latifasciata*.

Calamaria gervaisi DUMÉRIL, BIBRON and DUMÉRIL, 1854

Inger and Marx 1965: 106; Alcala 1986: 135.

An adult specimen (ZFMK 57833) was found under rotten wood in a partly deforested edge of a swamp near Lake Danao. This individual has an eye diameter equal to 0.54 times eye-snout-distance. A juvenile *Calamaria* of 79 mm total length (SMNS 8260) was collected at a forest edge at Lake Danao. This individual has only 110 ventrals and a small eye with a diameter less than half the distance of the eye to the snout. According to these characters, it could be *C. joloensis* which presently has a unique type of 14.4 cm total length and 119 ventrals. *C. gervaisi* usually has 132 - 164 ventrals and a larger eye with a diameter of approximately eye-snout-distance. There are no other discriminating characters (Inger and Marx 1965). We possess a further juvenile *Calamaria* collected in Mt. Makiling, Luzon (ZFMK 57832) which has 145+ ventrals, but its eye diameter is only 0.42. Thus, the supposedly diagnostic characters are unsuitable, and *C. joloensis* is most likely a juvenile *C. gervaisi*.

Calamaria lumbricoidea H. BOIE in F. BOIE, 1827

Inger and Marx 1965: 75; Alcala 1986: 136; Ross and Lazell 1990: 268.

This semifossorial snake lives in the soil of the forest floor.

**Chrysopelea paradisi variabilis* MERTENS, 1968

Taylor 1922a: 216 (as *C. ornata*); Leviton 1964a: 133; Alcala 1986: 137.

A dead individual was collected on the road from ViSCA to Baybay within cultivated areas. Juveniles are brightly colored with yellowish spots and stripes on the head and distinctive red blotches on the back. See Mertens (1968) for a discussion of the subspecific status.

**Dendrelaphis caudolineatus terrificus* (PETERS, 1872)

Taylor 1922a: 174; Leviton 1968c: 389; Alcala 1986: 139.

One adult specimen was collected at 250 m altitude on the ground in a rocky creek bed of a tributary to the Calbiga-a river within a mixture of primary and secondary forests. The snake was about to devour a *Lamprolepis smaragdina* skink.

Dendrelaphis pictus pictus (GMELIN, 1788)

Taylor 1922a: 166; Alcala 1986: 140.

There is a single specimen in the collection of the Berlin Museum (ZMB 5417: Tacloban). To our knowledge, this is the first record of this usually common and widespread species for Leyte.

**Elaphe erythrura erythrura* (DUMÉRIL, BIBRON and DUMÉRIL, 1854)

Taylor 1922a: 156; Alcala 1986: 141; Welch 1988: 59.

One road killed specimen was found approximately 10 km north of ViSCA on the way to Ormoc. Individuals are regularly reported by residents of the ViSCA area. One killed specimen and a slough are in the collection of the ZFMK. The species has a distinctive red tail still visible in preservative. For discussion of the subspecific status, see Leviton (1979).

Cf. **Stegonotus muelleri* (DUMÉRIL and BIBRON, 1854)

Alcala 1986: 158.

One adult individual was found in the Calbiga-a river within plantations. The snake was killed by residents. Only the head was still in a satisfactory condition for preservation. Because the morphology of this rare snake can not be adequately described, the identity remains tentative.

Zaocys luzonensis GÜNTHER, 1873

Boetter 1890: 63; Taylor 1922a: 135; Alcala 1986: 158; Ross et al. 1987: 29.

The Leyte record of this species is based on a single specimen reported by Boettger (l.c.). Ross

et al. (l.c.) consider the Leyte record as doubtful. Here, it is preferred to list *Z. luzonensis* as a questionable species. According to Alcala (l.c.), this is a tropical forest form. It seems to be rare because it generally is unknown to the people. Some authors consider the genus *Zaocys* as congeneric with *Ptyas* (Welch 1988).

NATRICINAE

**Amphiesma auriculata auriculata* (GÜNTHER, 1858)

Taylor 1922a: 89; Alcala 1986: 147; Welch 1988: 98.

The white-lined water snake lives along streams in forested areas. This snake is semiaquatic and feeds on amphibians and fishes. Our record is based on a preserved specimen in the ViSCA Museum.

**Cerberus rynchops rynchops* (SCHNEIDER, 1799)

Taylor 1922a: 111; Taylor 1923: 546; Alcala 1986: 143.

This aquatic snake can be found in brackish waters and in mangrove swamps. Sometimes, specimens can be observed climbing on trees or lying on branches overhanging water. They feed on fishes and frogs. Our record is based on a preserved specimen in the ViSCA Museum and a voucher specimen in the ZFMK, both collected in the vicinity of ViSCA.

Cyclocorus nuchalis taylori LEVITON, 1965

Taylor 1922a: 106 (als *C. lineatus*); Leviton 1965d: 532; Alcala 1986: 139.

C. nuchalis is a ground snake of secondary forest and plantations.

**Oxyrhabdium modestum* (DUMÉRIL, BIBRON and DUMÉRIL, 1854)

Taylor 1922a: 100; Leviton 1965a: 410; Alcala 1986: 154.

According to Alcala (1986), this snake is a burrower which can be found under rotting logs and in the soil on the forest floor. One specimen was observed on a ridge top at 395 m altitude. The surrounding was a naturally disturbed semi-open area with ferns bordering a 50 m high vertical cliff. The snake disappeared into a large hole between rocks on top of the cliff.

ELAPIDAE

ELAPINAE

**Naja samarensis* PETERS, 1861

Taylor 1922a: 259; Leviton 1965b: 542; Alcala 1986: 161; Wüster and Thorpe 1990: 333.

The common cobra can be found around houses and in forests. As it feeds preferably on small mammals like mice and rats, this species became a commensal of man especially in plantation areas.

HYDROPHIINAE

Hydrophis cyanocinctus DAUDIN, 1803

Alcala 1986: 163.

A common sea snake in the Visayan Sea.

Hydrophis fasciatus atriceps GÜNTHER, 1864

Alcala 1986: 164.

This species has been recorded from the Visayan Sea. One specimen probably belonging to this species was observed at low tide in 0.8 m water depth on the gravel shore at ViSCA.

Hydrophis ornatus ornatus (GRAY, 1842)

Alcala 1986: 165.

Alcala (l.c.) recorded a specimen from the Visayan Sea.

Lapemis hardwickii GRAY, 1835

Alcala 1986: 170

Alcala (l.c.) recorded a specimen from the Visayan Sea.

Pelamis platurus (Linnaeus, 1766)

Alcala 1986: 170.

We possess one juvenile specimen (ZFMK 57343) from the coast near Bayhay.

LATICAUDIDAE

Laticauda colubrina (Schneider, 1799)

Alcala 1986:264

One adult individual was collected on the coral island of Mahaba off Inopacan in February 1995.

Most probably, the species *Laticauda laticauda* and *L. semifasciata* can be encountered in Leyte Island but there is no material supporting this opinion.

VIPERIDAE: CROTALINAE

Trimeresurus flavomaculatus flavomaculatus (GRAY, 1842)

Taylor 1922a: 288; Leviton 1964b: 257; Alcala 1986: 171.

The Philippine pit viper inhabits primary forest. It lives on bushes and small trees along streams but is occasionally found on the ground.

**Tropidolaemus wagleri* (SCHLEGEL, 1837)

Taylor 1922a: 2965: Leviton 1964b: 265; Alcala 1986: 172.

Wagler's pit viper inhabits the same habitats as the preceding species. Both species are predominantly arboreal and nocturnal. It can also be found in mangrove areas. Although the species is widespread in the Philippines, any earlier record for Leyte could not be located. Until very recently, the genera *Trimeresurus* and *Tropidolaemus* were considered congeneric (Welch 1988).

DISCUSSION

Biogeography

A total of 65 terrestrial reptiles and 24 amphibians as well as nine marine reptiles (three sea turtles plus six sea snakes) are documented for Leyte (Tables 1 and 2), i.e., 31 and 30 %, respectively, of the 244 reptile and 81 amphibian species currently known from the Philippines (Gonzalez 1995; Crombie 1994). Eighteen of the 98 species are recorded for the first time for Leyte.

The marine reptiles are excluded from further biogeographic discussions because it is not known whether any of them have stable breeding populations on the shores of Leyte and its offshore islands. Also worldwide, only very few sea snake species are restricted to certain islands. Thus, they are of limited relevance for inter-island comparisons within the same zoogeographical region.

Amphibian genera are well represented but the families Caeciliidae and Discoglossidae are lacking (Table 1). It is remarkable that only one native bufonid was found despite a wide range of suitable habitats in the more remote areas of the island (which however have hardly been surveyed). One species of the small riverine toads of the genus *Ansonia* may have been overlooked in Leyte because species are recorded from most neighboring islands. Half of the 24 recorded amphibian species belong to five genera of the family Ranidae. Rhacophorids and microhylids are represented with four and five species, respectively.

All three species of turtles known from the Philippines are recorded in Leyte. Two of them are widely distributed within and outside the Philippines. One (*Heosemys leytensis*) was thought to be endemic in Leyte until it was very recently reported in Palawan (s. above).

Among the lizards, most genera and many species known from the Philippines occur in Leyte. Among the agamid lizards, only *Draco* species are frequently observed but the usually common *Bronchocela cristatella* was encountered only once. In total, 10 gekkonid species (7 genera), 8 agamid species (4 genera), 1 varanid, and 20 scincid species (7 genera) are known from Leyte and its offshore islands. Within the scincid lizards, half of the species (10 out of 20) belong to the genus *Sphenomorphus*.

Table 1. Number of species in higher taxonomic levels (familial and subfamilial) recorded from Leyte and the Mt. Pangasugan area, respectively. Only terrestrial species are considered. The last column refers to the percentage of the herpetofauna of Leyte occurring on Mt. Pangasugan.

Taxon	Leyte N	Mt. Pangasugan N	Mt. Pangasugan %
AMPHIBIA : ANURA			
Pelobatidae	1	1	100
Bufonidae	2	1	50
Ranidae			
Dicroglossinae	8 + 1?	6	75
Raninae	4	4	100
Rhacophoridae	4	3	75
Microhylidae	5	2	40
REPTILIA			
Testudines			
Emydidae	3	2	67
Crocodylia	≥1	—	0
Sauria			
Gekkonidae	10	6	60
Agamidae	8	4	50
Varanidae	1	1	100
Scincidae	20	13	65
Serpentes			
Typhlopidae	1	1	100
Boidae	1	1	100
Colubridae			
Lycodontinae	3	2	67
Colubrinae	10 + 1?	4	40
Natricinae	4	3	75
Elapidae	1	1	100
Viperidae	2	1	50
Total	**89 + 2?**	**56**	**63**

Twenty-two species of terrestrial snakes are recorded, but they are generally uncommon or seldom encountered (except of *Elaphe erythrura*). Most of the snake species are colubrids (17 out of 22) and belong to 12 different genera. In general, snakes were underrepresented in our survey. It is likely that additional species will be added at least to the list of species occurring in the Mt. Pangasugan area (Table 1).

Endemic species typical of the the faunal province to which Leyte belongs (Eastern Visayas, Mindanao, and Basilan) are for example *Pelophryne lighti, Cyrtodactylus agusanensis, Varanus salvator cumingi, Sphenomorphus variegatus,* and *Dendrelaphis caudolineatus terrificus* - all occurring in Leyte. However, no reptile or amphibian species is endemic to Leyte. Of the 18 species recorded for the first time from Leyte, all but *Platymantis spelaeus, Gekko mindorensis*, and *Gonocephalus interruptus* were already known from islands belonging to the Greater Mindanao Pleistocene Island of which Leyte was a part (Brown and Alcala, 1994). *P. spelaeus* was known only from two localities in Negros, *G. interruptus* only from Mindoro (according to Alcala, 1986, but also in Mindanao (Ross and Lazell, 1990) though without supporting references or material), and *G. mindorensis* has been observed in many islands of the Mindoro and the Greater Negros-Panay Pleistocene Islands. The former was considerably but the latter only narrowly separated from the Greater Mindanao Pleistocene Island (Brown and Alcala, 1994).

The new record of *G. mindorensis* is of particular interest, because in Leyte itself, the morphologically very similar and closely related *G. monarchus* occurs. The latter is also widely distributed in other islands of the Greater Mindanao Pleistocene Island, in Luzon, Sulu, and Palawan. The island Apid lies between Leyte and Cebu (from where *G. mindorensis* was recorded) and was not connected to either during the Pleistocene. As *G. mindorensis* is intermediate in dorsal coloration in Apid between typical *G. mindorensis* and *G. monarchus*, the two taxa may only be subspecifically distinct. The population of Apid possibly represents a third undescribed one, a hypothesis which can be tested only in the future using morphological, genetic, and breeding techniques.

Compared to other Philippine islands with available checklists, Leyte has the highest species number, although it is not the largest one (Table 2). It is remarkable that from Bohol with an area half that of Leyte, nearly as many species are known. This is probably due to the fact that Bohol has been surveyed particularly well historically (e.g. Taylor, 1921-1923; Brown and Alcala, 1986). However, considering the tiny remaining forested area of Bohol (64 km^2, i.e. 1.6% of the total island size, Brown and Alcala, 1986), it is highly probable that not all of the recorded species are still extant in Bohol as definitely as the case in Leyte. The low number of species in Cebu probably results mainly from low survey efforts but extinctions due to deforestation may now contribute to it. The species richness of Negros and Leyte is almost identical, and species similarity is high (FS = 0,68 for amphibians and FS = 0,58 for reptiles).

Leyte and Dinagat (east-southeast of the southern end of Leyte) share a larger fraction of their reptile but a lower fraction of their amphibian species (FS = 0,7 and 0,51, respectively) compared to Leyte and Negros. The former is expected because Leyte and Dinagat but not Leyte and Negros have been connected by a land bridge during the late Pleistocene (Leviton, 1963b; Heaney, 1985; Ross and Lazell, 1990). As only nine of the 11 amphibian species recorded from Dinagat are shared with Leyte, the low similarity may be an artefact of low sampling intensity in Dinagat. In spite of the high reptile species similarity of Leyte and Dinagat, two interesting exceptions occur: the scincid genus *Tropidophorus* is represented in Leyte by

Table 2. Comparison of the herpetofaunal species richness of some Philippine islands. Species accounts for Bohol, Cebu, and Negros are from Brown & Alcala (1986), for Dinagat from Ross & Lazell (1991), and for Samar from Gaulke (1994). Only terrestrial species are considered.

	Leyte	Samar	Dinagat	Bohol	Cebu	Negros
Island area (km^2)	8000	13300	800	4000	4500	13000
Amphibian species	24 + 1?	15	11	22	9	17
Reptile species	65 + 1?	56 + 1?	47	59	48	67
Turtles	3	1	1	1	1	1
Crocodiles	≥1	1?	—	—	—	1
Lizards	39	29	27	35	27	35
Snakes	22 + 1?	26	19	23	20	30
Total No. of Species	89 + 2?	71 + 1?	58	81	57	84

T. grayi and on Dinagat by *T. partelloi*; and *Brachymeles* species is missing from Dinagat, whereas three species are known from Leyte.

Ecology and conservation

The number of species recorded by us from Leyte shows that this island still provides suitable habitats for many species of primary forests. The number of different biotops, i.e. mangroves, secondary and primary lowland forests, submontane and mountain forests as well as mossy cloud forests contributes to the biotic diversity of Leyte. This fact is surely one of the reasons for the high herpetofaunal species diversity. However, primary forest is rapidly decreasing with lowland forests almost gone.

Primary and secondary forests provide habitat to more and a different set of species than *kaingins* and the intensive lowland agricultures (Table 3). Of the 40 species, i.e. 45% of the herpetofauna of Leyte, which were observed at least five times either in the Mt. Pangasugan or the Lake Danao/ Alto Peak area, 48 % have been found only or almost exclusively in primary and secondary forests, and 52% have adapted to man-made habitats. Five (13%) euryoecious species are found both in primary forest and intensively used agricultural landscapes. However, extreme forms of agriculture like monocultural coconut groves in the calcareous southern part of Leyte (e.g. in Punta) hardly provide habitat for any species (only *Limnonectes cancrivorus* and *Gekko gecko* were found). Small plantations within primary or secondary forests occasionally may still harbor species of primary or secondary forests, euryoecious species like *Mabuya multicarinata*, *Hemidactylus frenatus*, and *Gekko gecko* clearly dominate, and the former group probably occurs mainly (exclusively?) as dispersing specimens. Therefore no indications that any of these species reproduces in such areas.

The percentage of reptile and amphibian species adapted to man-made habitats in Cebu is very similar (51%) to Leyte but much lower in Negros (37%) (Brown and Alcala, 1986). Notwithstanding, the set of species adapted to man-made habitats is very similar for Leyte and Negros (compare Table 3 with Brown and Alcala, 1986). Negros has the largest percentage of rain forest cover left (see Brown and Alcala, 1986). These data indicate that some species of primary forests have already become extinct in Leyte and Cebu before they could be discovered (or for Leyte, have become so rare that their habitat requirements could not sufficiently determined).

Due to the large number of species in tropical ecosystems, ecological assessments will always be limited to a few species, and the same will hold true for conservation programs. Thus, it is important to develop a system of target and indicator species (Reck et al., 1991). Suitable indicator species should be sensitive to habitat changes and sufficiently common for monitoring or measuring their relative abundance (Hovestadt et al., 1991). The species listed in Table 3 are potential candidates. Whereas snakes, turtles, and *Gonocephalus* species are unsuitable because of their rarity (difficulty to observe), several lizard and frog species of the Mt. Pangasugan region show potential as indicator species.

Among the lizards, *Mabuya multicarinata* seems to be a particularly good indicator for natural and anthropogenic disturbances in forests. This species requires open sunny patches where it can be encountered in high numbers. It seems to be most common in extensively used plantations with a mixture of ample decaying leaf litter and grass. Its abundance considerably declined in the reforestation area when the canopy started to close. Detailed quantitative comparisons are required before it can be assessed if the species can also be used to discriminate between low and high intensity plantations or between various stages of secondary growth. However, it should be mentioned that Brown and Alcala (1986) did not list this species among those adapted to man-made habitats. They listed instead the ecologically very similar *M. multifasciata* which is very rare to absent in our main study area - and found only in man-made habitats. The possible suitability of species as indicators for forest disturbances may depend on the presence or absence of ecologically similar species.

Gekko gecko is another species which indicates anthropogenic disturbances. Whereas it is common in man-made habitats and tree plantations (native and exotic trees), it was never found

Table 3. Habitats of amphibians and reptiles on Leyte. Only species observed at least five times are considered. PF: primary forest; SF: secondary forest; AH: man-made habitats.

Species	PF	SF	AH
Megophrys montana stejnegeri	+	+	(+)
Bufo marinus	-	-	+
Limnonectes cancrivorus	-	-	+
Limnonectes leytensis	+	+	+
Limnonectes visayanus	+	(+)	-
Phrynoglossus laevis	+	+	-
Platymantis dorsalis	+	+	(+)
Platymantis guentheri	+	-	-
Platymantis ingeri	+	-	-
Rana albotuberculata	+	+	(+)
Rana erythraea	-	-	+
Polypedates leucomystax	-	-	+
Philautus leitensis	+	-	-
Kalophrynus pleurostigma	+	+	-
Kaloula picta	-	-	+
Cuora amboinensis	+	+	+
Cosymbotes platyurus	-	-	+
Cyrtodactylus agusanensis	+	+	-
Gekko gecko	-	(+)	+
Hemidactylus frenatus	-	-	+
Draco bimaculatus	+	+	+
Hydrosaurus pustulatus	-	+	+
Varanus salvator	+	+	+
Lamprolepis smaragdina	-	+	+
Lipinia pulchella	+	+	-
Mabuya multicarinata	+	+	+
Mabuya multifasciata	-	-	+
Sphenomorphus cumingi	+	+	-
Sphenomorphus acutus	+	+	-
Spenomorphus coxi	+	-	-
Sphenomorphus jagori	+	+	-
Sphenomorphus llanosi	+	(+)	-
Sphenomorphus steerei	+	+	(+)
Sphenomorphus variegatus	+	+	-
Tropidophorus grayi	(+)	+	-
Rhamphotyphlops braminus	-	-	+
Lycodon (aulicus) capucinus	-	-	+
Psammodynastes pulverulentus	+	+	-
Elaphe erythrura	-	-	+
Cerberus rhynchops	-	-	+
Total number	**24**	**21**	**20**

Table 4. Change in relative abundance of reptiles on the ViSCA-GTZ reforestation site before and after closure of the canopy.

Species	Open	Closed
Mabuya multicarinata	9	2
Sphenomorphus steerei	2	10
Other species	3	2

in dense secondary or primary forest. The species is easily observed at night, very vocal during day and night, and common enough to be a suitable indicator species.

Lipinia pulchella, Sphenomorphus llanosi, Cyrtodactylus agusanensis, and *S. jagori* are restricted to primary or secondary forest with a dense canopy. All of them are very sensitive to water loss (pers. observations) and thus cannot survive in open, intensively used plantations or logged areas. *S. jagori* is very abundant and can easily be monitored. *C. agusanensis* and *L. pulchella* have been sufficiently common only during some parts of the year, and *S. llanosi* was found too infrequently. Our observations regarding these four species are in accordance with those of Brown and Alcala (1986).

The small *Sphenomorphus steerei* invades plantation areas next to forests as a successor species if enough leaf litter is available on the ground and humidity is relatively high. It significantly increased in abundance in the ViSCA-GTZ reforestation site after canopy closure (Table 4; $\chi^2 = 9.9$; $\alpha < 0{,}01$). Consequently, it seems to be an indicator for "good" plantations with a high plant diversity.

Among the agamid lizards, the usually common and abundant *Bronchocela cristatella* is expected to be a suitable indicator for intensively used plantations. Strangely enough, only a single individual was encountered during our surveys. Brown and Alcala (1986) did not list it as a species adapted to man-made habitats in Negros. Elsewhere in Southeast Asia, the related *Calotes versicolor* is a suitable indicator species of disturbed habitats (Denzer, in press).

Several species of frogs are breeding only in creek beds in primary and secondary forests or in abandoned plantations in the transition areas to secondary forest. Of these, *Limnonectes visayanus, Phrynoglossus laevis,* and *Rana albotuberculata* as well as the tadpoles of *Megophrys montana stejnegeri* were frequently encountered, thus making them useful monitoring species. *Platymantis dorsalis* may be added to this list but is less common. In contrast, *Bufo marinus, Rana erythraea,* and *Kaloula picta* are absent from forested areas but are very common in agricultural fields. The same applies to *Limnonectes cancrivorus.* However, this species also enters mangroves without major anthropogenic disturbances. Interestingly, contrary to the case in Leyte; Brown and Alcala (1964) reported *R. erythraea* from primary forest at 900 m a.s.l. in Negros but later (1986) stated that the species has adapted to man-made habitats. The observation of *Phyrnoglossus laevis* having adapted and of *Limnonectes leytensis* of not having adapted to man-made habitats on Negros (Brown and Alcala, 1986) is also contrary to the case in Leyte.

Other studies (e.g. Crump, 1971; Duellman 1978; Brown and Alcala, 1964) also show that generally in tropical regions, a set of amphibian species exists which is restricted to primary forests or late successional stages of secondary forests whereas others have adapted to intensively modified ecosystems and may be found mainly in man-made habitats (see Wilcox 1986 for animal in general). Probably the latter are mainly species originally adapted to natural disturbances as is the case of *Mabuya multicariata.*

Usually, some of these species (mainly frogs and lizards) are abundant enough and sufficiently easily surveyed that they are useful potential indicator species. However, the idea of amphibian and reptile indicator species in tropi-

cal ecosystems has not yet been rigorously pursued. Nevertheless, above comparisons demonstrate that lizards and frogs provide potential suitable positive and negative indicator species for disturbances of forests and for restoration successes. Some of them are suitable only within small areas whereas others can be used for larger regions.

At least 19 species additional to those discussed as positive indicator species are confined to primary and late secondary forests (compare Table 3). Therefore, they must be regarded as bound for extinction unless continued clearing of the few remains of rain forest can be completely banned. The same generally holds true for Philippine rhacophorids except of the genus *Polypedates* (Brown and Alcala, 1994). Significantly, out of the nine species based only on museum records collected more than 50 years ago, five are restricted to primary forests. For two, the locality records may be erroneous and for two rare species, habitat requirements are insufficiently known. Also, most additional species not observed by ourselves (and not listed in Table 3) are inhabitants of primary forests.

It needs to be pointed out that two species, the coastal skink *Emoia atrocostata* and the gecko *Gekko mindorensis*, which are generally regarded as common in the Philippines are very rare in Leyte (currently known only from offshore islands). For *G. mindorensis*, this may be due to the fact that only one offshore island was colonized (see above). The range of *E. atrocostata* well covers Leyte but its habitat has almost completely disappeared in this island. Due to the preferential development of human habitations along the coast, the remaining habitats of this species (if some can still be located) should be given high conservation priority. Moreover, monitoring programs on other Philippine islands should be carried out. Otherwise, its situation may generally approach that in Leyte without it even being realized. Crocodiles which also show preferences for coastal mangroves already have become almost extinct, and the same is likely true for many neglected invertebrates of the same habitat.

Finally, the reports of continued albeit rare sea turtle nesting on the offshore island of Digio should be checked. If they turn out to be correct, the nesting would deserve very high conservation ranking and would require immediate conservation action (legal protection of the island but in consensus with the inhabitants) and cancellation of all plans to convert it into a holiday resort.

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