THE STATE OF PHILIPPINE HERPETOLOGY AND THE CHALLENGES FOR THE NEXT DECADE

Rafe M. Brown, Arvin C. Diesmos, and Angel C. Alcala

First, there is a great need for more new basic research focused on biodiversity conservation, including systematics, ecology, behavior, and current patterns of distribution and abundance. Without such fundamental information, conservation planning will be incomplete at best.

Heaney et al., 1999: 315.

The information needed to make sense of Asian herpetology is not lurking in the literature; it is still out there in the rice paddies and in the vanishing patches of montane forest.

Crombie, 1992: 593

ABSTRACT

The herpetological fauna (amphibians and reptiles) of the Philippines is extremely rich in total species numbers, taxonomic diversity, and percent endemism—especially when considered as a function of available land area. The last 10 years of herpetological research in the Philippines have seen a dramatic increase in interest in taxonomy, biogeography, phylogenetic systematics, conservation, and biodiversity of Philippine species, especially amphibians. In the last decade, over 50 previously unrecognized species have been identified. Despite the publication of a recent field guide to the amphibians of the Philippines, available species summaries and diagnostic keys are currently out of date because progress has been so rapid. Revisions of these works are needed but must await the completion of several comprehensive taxonomic investigations currently in progress. In general, amphibians (especially ranid frogs) have received more attention than reptiles.

During the same period, there has been less activity in ecological research and conservation, and little or no activity in disciplines such as behavior, microevolution, reproductive biology, or population biology. In this paper we review a few model studies and point out where others are badly needed.

Available biogeographic analyses, combined with new, unpublished data, demonstrate that the distributions of amphibians and reptiles in the Philippines have been strongly influenced by the mid- to late-Pleistocene formation of several aggregate island complexes as well as by climatic gradients associated with elevation and anthropogenic disturbances (primarily deforestation). Each Pleistocene aggregate island complex is a major center of biological diversity, and within these major (and several other minor) land mass amalgamations, there exist numerous sub-centers of endemism and diversity centered on isolated mountains or mountain ranges. Amphibians and reptiles may represent particularly appropriate model organisms for the study of these lesser centers of biological organization due to their tendency towards finer-scale differentiation and isolation on single montane "islands" and mountain ranges. Several recent studies have begun the process of integrating phylogenetic data, species distribution data, and studies of the process of speciation on unique montane habitats, but many more are needed. In particular, the field of molecular systematics stands out as an immensely powerful set of tools that has yet to be tapped by conservation biologists in the Philippines.

The last decade has seen several attempts to assess the conservation status of many of the Philippines' unique and presumably threatened amphibians and reptiles. These efforts have been hampered by a general lack of knowledge, a paucity of basic baseline survey data, a lack of integration, public disinterest, bureaucratic obstacles to research, and by limitations in resources. The number one cause of amphibian and reptile population declines clearly is catastrophic habitat destruction due to the activities of humans.

Introduction

Situated at the interface between the Oriental and Australian faunal zones is the largely oceanic island nation of the Philippines. The Philippine islands are home to a spectacular and diverse set of amphibian and reptile radiations that have captured the attention and imagination of diversity specialists and biogeographers since the first accounts of Philippine herpetological diversity appeared in the scientific literature (e.g., Boulenger, 1882, 1894, 1920; Peters, 1863; Boettger, 1893; Taylor, 1915, 1918a, 1919, 1920a, 1920b, 1921, 1922a, 1922b; Taylor and Noble, 1924; Noble, 1931; Schmidt, 1935). The career of Edward H. Taylor in the 1920's (Taylor, 1975) brought the Philippines to the forefront of global appreciation of amphibian and reptile diversity as one of the world's major centers of herpetological diversity and endemism. Later taxonomic and biogeographic summaries (Inger, 1954, 1999; Leviton, 1963; Alcala, 1986; Brown and Alcala, 1970a, 1978, 1980, 1994; Allison, 1996; Brown, 1997; Alcala and Brown, 1998) further promoted the recognition of the importance of Philippine herpetological diversity and stressed the unique nature, evolutionary history, and remarkable diversity of Philippine amphibians and reptiles (see also Noble, 1931; Duellman and Trueb, 1994).

The last 10 years in Philippine herpetological research have seen an increase in interest in a diverse range of studies set against the backdrop of an emerging period of unprecedented taxonomic rediscovery, concern for conservation, and an increase in appreciation for biodiversity. The purpose of this paper is to review and analyze the past decade's progress, to consider its significance within the context of the history of Philippine herpetology, and to identify prospects and goals for future research and conservation.

Composition of the last 10 years' published literature

For this review we considered only published papers (or ones that were, at the time of writing, accepted or in press) and unpublished undergraduate honors, M.S. and/or Ph.D. theses. We mention unpublished data (theses and a few papers in review or preparation) in some cases but we can include contracted reports, private papers, or other pseudopublications that have not been or will not be peer reviewed. We have compiled 109 (see Literature Cited section) scientific publications on Philippine herpetology from between the years 1990 and 2001 (Fig. 1). The annual publication rate has remained relatively stable, with notable exceptions (i.e., in 1995 numerous articles were published on reptiles while many articles were published on amphibians in 1999 and 2000). The composition of the last decade's published record was markedly skewed towards research in systematics, taxonomy, biogeography, and species diversity (Fig. 2). The vast majority of the remaining studies consisted of ecological (includes population biology and community studies) and conservation studies and only a very small fraction addressed other subjects (e.g., information on Quaternary herpetofaunal communities; Reis, 1999; Reis and Garong, 2001) or were popular articles that, in part, addressed herpetological topics or biodiversity of amphibians and reptiles (Heaney et al., 2000; Diesmos, 2000, 2001; Brown and Alcala, 2000; Brown et al., 2002).

History of herpetological studies and species diversity in the Philippines

The first published papers on Philippine herpetology included the works of Boettger, Boulenger, Günther, Mertens, Peters, Weigmann, and Stejneger, among others (see Inger, 1954; Bayless and Adragna, 1997; Brown and Diesmos, this volume). This "age of discovery" in Philippine herpetology marked the first exposure of the outside world to Philippine herpetological diversity, and the papers that resulted were almost entirely descriptive in nature. The first worker to concentrate efforts on a comprehensive review of Philippine herpetofauna was Edward Harrison Taylor (1915-1975, see Literature Cited). In his numerous taxonomic works, Taylor recognized a total of 89 amphibians and approximately 253 reptiles. Later, Inger (1954, 1960a, 1960b; see also Hoogstral, 1951) recognized 55 species of Philippine Amphibia, reducing the species level diversity of Philippine Amphibia by application of the Polytypic Species Concept (see Brown, 1997; Brown et al., 2000; Brown and Diesmos, this volume). In the mid-1950s Angel Alcala and Walter Brown began a collaborative review of most major groups of lizards (see also Inger, 1958, 1983; Musters, 1983; Inger and Brown, 1980) in the Philippines and during the course of their field work, published numerous additional species descriptions (see Literature Cited: Alcala, 1955-1986; Alcala and Brown, 1955-1999; Brown and Alcala, 1955-1994; Brown et al., 1997-1999).

During the same period, Alan Leviton systematically reviewed the contents of most Philippine snake genera in his *Contributions to a review of Philippine snakes* series (Leviton, 1955-1983; see also Leviton and Brown, 1958; Inger and Marx, 1965; Inger and Leviton, 1966; Gyi, 1970; McDowel, 1974; Malnate and Underwood, 1988). Alcala (1986; see also Rabor, 1981) summarized some of this taxonomic work, recognizing 66 amphibian and 205 reptile species (see also Afuang, 1995; Gonzales, 1995; DENR and UNEP, 1997). Progress was made towards a synthesis of species diversity by the unpublished works of R. I. Crombie (*pers. comm.*). Crombie's bibliography and annotated checklist have served as the backbone of many working species lists used by researchers in the Philippines in the past decade.

The work of A. Alcala and W. Brown later set the stage for present studies that continue in collaboration with A. Diesmos and R. Brown. Currently, we recognize a total of 101 species (78, or 77%, endemic) of Philippine amphibians (Fig. 3) and an approximate total of 258 (169 or 65% endemic) species of Philippine reptiles (Fig. 4). That estimate will surely increase by 10-20% in the coming years as numerous undescribed species are named in ongoing taxonomic reviews (R. Crombie, *pers. comm*; Diesmos, Brown, and Alcala, unpublished data). Summaries of taxa described in the last decade are presented in Tables 1 and 2.

The vast majority of papers during the last 10 years of progress in classification and recognition of Philippine herpetological diversity have been species descriptions (e.g., Ota and Crombie, 1989; Lazell, 1992; Wynn and Leviton, 1993; Alcala et al., 1998; Brown et al., 1995a, 1999a, 1999b; Brown et al, 1997c, 1999a, 1999b; Lanza, 1999; Gaulke, 2002; Diemos et al., in review), redescriptions of poorly understood taxa (Ota et al., 1993; Brown et al., 1997; Brown et al., 1998), or clarifications of species boundaries (Ota et al., 1989; Brown et al., 1998; Brown et al, 2000a, 2000b, 2000c, 2001; Gumprecht, 2001). Additionally, several important papers have taken the form of more comprehensive reviews of genera or species groups (Gaulke 1992a; Dubois, 1992; Ota and Ross, 1994; Inger, 1996; Bayless and Adragna, 1997; Fritz et al., 1997; Brown et al., 1997a, 1997b, 1999b; Brown et al., 2000a, 2000c; Brown and Diesmos, this volume; Brown and Guttman, in press; McGuire and Alcala, 2000; Dubois and Ohler, 2000; Veith et al., 2000; Helfenberger, 2001). All of these studies have greatly increased recognized species diversity in the Philippines.

In amphibians, the greatest areas of activity have been in ranid frogs. For example, in the *Rana signata* and *Rana everetti* species groups, diversity has increased from two to twelve species (Brown et al, 2000a; Brown and Diesmos, this volume; Brown and Guttman, in press) and platymantine ranid frog diversity has increased from seven (Inger 1954) to more than 25 species (Alcala and Brown, 1998, 1999). We now know that the species diversity of Philippine flying lizards (genus *Draco,* 10-12 species; McGuire and Alcala, 2000) is closer to original estimates of Taylor (1922a, who recognized 11 species) than it is to later estimates of Inger (1983), who recognized three species (see also Musters, 1983). In total, over 50 previously unrecognized species have been identified in the past decade. Thirty-two of these have been formally named or resurrected from the synonymies of widespread polytypic species complexes (14 reptiles and 18 frogs). At present, more than 15 endemic Philippine frog species await description (Diesmos, Brown, and Alcala, unpublished data), and we suspect that many more await discovery.

Some recent discoveries have been truly spectacular. A new, very distinctive, endemic Philippine genus (*Parvoscincus*) of scincid lizards was discovered in the last decade (Ferner et al., 1997), and further generic subdivision of one group of ranid frogs currently is underway (Brown et al., unpublished data). Recognition of Philippine herpetological diversity has not simply been a process of splitting closely-related species; in fact, higher levels of taxonomic diversity are poorly understood in several key areas. The phylogenetic affinities of *Heosemys* (= "*Geomyda*") *leytensis* and *H. spinosa* are unclear; generic revision of these taxa may be required with on-going systematic studies (see Taylor, 1920b; Alcala, 1986; Timmerman and Auth, 1988; Buskirk, 1989; Iverson, 1992; Das, 1996a; Shaffer et al., 1997; Gonzales et al., 1997; McCord et al., 2000). A separate genus, *Coelognathus*, has been resurrected to accommodate Indo-Malayan ratsnakes (previously of the genus *Elaphe*; [Leviton, 1979]), including four Philippine taxa (Helfenberger, 2001). Finally, the discovery of a spectacular new species of frugivorous monitor lizard (Gaulke and Curio, 2001), presumably closely related to the Philippine endemic *Varanus olivaceus*, has captured the attention of herpetologists around the world. These studies indicate that an enormous amount of descriptive taxonomic work has yet to be conducted in the Philippines before we can adequately assert that the country's amphibian and reptilian species diversity is reasonably well known.

The types of data utilized by amphibian and reptilian taxonomists working in the Philippines have changed in some cases but have remained the same in many others. Although taxonomists are now distinguishing between species with DNA sequence divergence data (McGuire and Kiew, 2001; Brown et al., unpublished data), phylogenetic evidence such as a species' position in evolutionary trees (McGuire and Alcala, 2000; Brown and Guttman, in press), fixed allozyme differences (Brown, 1997; Brown and Guttman, in press), ecological differences (Brown et al., 2000a, 2000c) and behavioral differences (especially variation in acoustical advertisement signals of male frogs; Brown et al., 1997c, 1999a, 1999b; Brown and Guttman, in press), the majority of recent taxonomic papers have used morphological data in the form of character differences and comparisons of morphometric measurements or ratios of body proportions (Brown et al., 1997a, 1997b, 1997c, 1999a; Brown et al., 1995a, 1995b, 1999a, 1999b, 2000a, 2001).

Review of biogeographic studies of Philippine amphibians and reptiles

The first attempt at a biogeographic summarization of Philippine herpetofauna was Taylor's (1928) chapter in Dickerson's *Distribution of Life in the Philippines*. Taylor (1928) summarized the known species diversity at the time, plotted the distribution of the genera throughout the archipelago, and commented on possible dispersal routes. He also recognized the distinction between land-bridge (e.g., Palawan Aggregate Island Complex) and oceanic portions (the remainder) of the Philippines, although his distinction was inferred from distributional data from the fauna and not explicitly from a knowledge of channel depths or geological reconstructions. Taylor also noted the presence of several Sunda Shelf taxa in Palawan herpetofauna and the distribution of the more spectacular Philippine radiations (lizards of the genus *Brachymeles,* frogs of the genus *Platymantis,* and snakes of the genera *Oxyrhabdium*, *Cyclocorus,* and *Hologerrhum*) confined to the oceanic portions of the Philippines.

Later biogeographic summaries included papers by Inger (1954, 1999) on amphibians, Leviton's (1963) paper on snakes, Brown and Alcala's (1978) comments on gekkonids and their summary of the biogeography of the archipelago's herpetofauna (Brown and Alcala, 1970a). Brown (1997), Allison (1996), and Inger (1999) have summarized these data in the larger context of SE Asia and the SW Pacific. Most of these studies take similar approaches, namely the discussion of the zoogeographic relationships of the islands as indicated by calculation of faunal similarities (see also Brown and Alcala, 1986 and Ferner et al., 2001). All of these traditional summaries recognized most of the faunal subprovinces (five to seven distinct Pleistocene Aggregate Island Complexes) of Heaney (1985, 1986) as unique centers of biological endemism. Thus, Inger (1954), Leviton (1963) and Brown and Alcala (1970) all taxonomically recognized suites of endemic taxa on Luzon as separate from those of Mindanao or the Visayas (as embodied by the known herpetofauna of Negros; see Ferner et al, 2001) but fell short of acknowledging the importance of the lesser studied deep water islands of Mindoro, Sibuyan, Siquijor, Tablas + Romblon, Burias, islands of Batanes and the Babuyans, Camiguin, and Lubang. So, although endemic species were described from some of these islands (e.g., frogs and gecko endemics of Babuyans,

Camiguin or Tablas; Brown and Alcala 1967, 1974, 1978) the explicit geological basis for the processes that may have led to these patterns of species endemism had not been emphasized. However, although Inger (1954), Leviton (1963), and Brown and Alcala (1967, 1970a, 1986) acknowledged channel depths as potential barriers to dispersal (deeper channels indicative of a reduced chance of landbridges having existed in the past), the underlying framework for recognition of all deep water islands as unique centers of biological endemism was not widely recognized until Heaney (1985, 1986) traced the underwater 120 m bathymetric contours throughout the Philippines (Fig. 5). This exercise explicitly illustrated Pleistocene sea shores at the end of last glacial episode (22-12,000 years before present) and the formation of enlarged aggregate island complexes by exposure of land positive connections between Philippine islands separated by less than 120 m (Fig. 5). The recognition of Pleistocene aggregate island complexes is the appropriate framework for appreciation of Philippine biodiversity on all levels (Heaney and Regalado, 1998), for it is the unique geological history of the islands that unites the evolutionary histories of all these islands' residents (review: Brown and Diesmos, this volume). Understanding of mid- to late-Pleistocene geology is the key to appreciating the distribution of life in the Philippines (Taylor, 1928; Inger, 1954; Leviton, 1963; Brown and Alcala, 1970; Heaney, 1985, 1986; see also Hall, 1996, 1998), and it is the key to formulating effective conservation strategies (Utzurrum, 1991; Oliver and Heaney, 1997; Heaney and Regalado, 1998). Additionally, interpretation of Philippine biodiversity in the context of Pleistocene geology is the best approach for formulating taxonomic and zoogeographic hypotheses (see below) for testing in a phylogenetic context (Brown, 1997; Brown et al., 2000c; McGuire and Alcala, 2000; McGuire and Kiew, 2001; Brown and Guttman, in press).

Finally, one last class of papers warrants consideration when reviewing Philippine biogeographical studies. These are faunal inventories, focused on singular sites or regions (i.e., Leviton, 1955; Alcala, 1956, 1958; Rabor and Alcala, 1959; Alviola et al., 1998; Smith, 1993a, 1993b; Ubaldo, 1999; Reis and Garong, 2001), particular mountains or mountain ranges (Alcala and Brown, 1955; Custodio, 1986; Alcala et al., 1995; Brown et al., 1996; 2000b; Diesmos, 1998), small islands (Brown and Alcala, 1963b, 1967, 1974; Ross and Lazell, 1991; Ross and Gonzales, 1992; Gaulke, 1993, 1999; Gaulke and Altenbach, 1994; Gaulke, 1994a, 1995a, 1996,1999), and large islands (Gaulke, 1994b, 2001a, 2001b, 2001c; Sison et al., 1995; Denzer et al. 1999; Ferner et al, 2001; Gaulke , 2001a, 2001b, 2001c). One important new study (a first of its kind in Philippine herpetology) addressed biogeographical relationships of Palawan using new data on late Quaternary vertebrate communities, including amphibians and reptiles (Reis and Garong, 2001). Further faunal inventories are badly needed to fill in gaps in distribution data left by earlier biogeographic summaries that conspicuously missed certain mountains or islands (Inger, 1954, 1999; Leviton, 1963; Brown and Alcala, 1970a). Published faunal papers are extremely important because of their role in educating the international community about Philippine biodiversity, and because they are an important source of baseline data for biogeographers, conservation biologists, ecologists, and systematists. Unfortunately, many important data that have been collected are unavailable in their unpublished form (government and non-government organization or private organization reports).

Phylogenetic and phylogeographic studies of Philippine amphibians and reptiles

The last several years have seen the advent of a new group of studies in Philippine herpetology. Brown (1997; Brown and Guttman, in press) conducted the first phylogenetic analysis of an endemic radiation of Philippine amphibians, and Brown et al. (2000c) and McGuire and Kiew (2001) published the first phylogenetic analyses of SE Asian reptiles with a significant proportion of their diversity represented in the Philippines. These three studies are significant in that they represent the first of their kind in Philippine herpetology and also because they strongly support interpretations of biogeographic patterns and routes of island colonization not previously suggested by data from birds and mammals. For example, Brown (1997) found that the Philippine *Rana signata* complex was composed of two major clades of frogs (Fig. 6a), one centered on the eastern Philippine island arc (Sulu-Mindanao-Leyte-Samar-Luzon) and one centered on the western island arc (Palawan-Buswanga-Mindoro; Brown, 1997; Brown and Guttman, in press), and that the stream frogs from Mindoro island were more closely related to those from Palawan and the Sunda Shelf than they were to the entire remainder of the oceanic portion of the Philippines (*contra* Inger, 1954, and Brown and Alcala, 1955, 1970a). In an additional phylogenetic study, Brown et al. (2000c; see Brown and Diesmos, in press, for review) conducted a phylogenetic analysis of the flap-legged geckos, genus *Luperosaurus* (half of which are Philippine endemics). This study showed evidence of two monophyletic clades, one with three non-Philippine species and the other containing the four Philippine species plus one species from northern Borneo. The position of the Bornean species, nested well within this second clade, suggested a re-invasion of Borneo from a Philippine source (probably the Sulu archipelago) following the initial radiation in the Philippine (Fig. 6b; Brown et al., 2000c; Brown and Diesmos, 2000).

McGuire and Kiew (2001; see also McGuire and Alcala, 2000) have demonstrated that flying lizards possess a much greater (10-12 lineages) species diversity in the Philippines than previously thought and that the endemic Palawan species is much more closely related to the true oceanic Philippine radiation than it is to Sunda Shelf species as suggested by earlier taxonomy (Fig. 7; *contra* Musters, 1983; Inger, 1983; Ross and Lazell, 1991). It is clear from McGuire and Kiew's (2000) analysis that Philippine *Draco* are derived from three separate invasions of the Philippines from the Sunda Shelf (Fig. 7).

Recent phylogenetic analyses of Old-world ratsnakes (Helfenberger, 2001) do not satisfactorily resolve the question of the monophyly of the Philippine supspecies of *Elaphe* (=*Coelognathus*) *erythrura* (*philippina, erythrura, manillensis*, and *psephenoura*; Leviton, 1979), but suggest that some Philippine lineages (designated as subspecies by Leviton, 1979) may, in fact, be valid species that are not each other's closest relatives. This study suggests that the relationships of the Philippine ratsnakes may be more interesting than previously thought, but that further studies, focussing specifically on the Philippine radiations, are needed. Recent phylogenetic analyses of crotaline snakes (Kraus et al., 1996; Malhotra and Thorpe, 1997, 2000) have included one or two species known from the Philippines. These analyses suggest the placement of Philippine radiations within larger groups of species but, as of yet, no exhaustive studies of Philippine radiations of snakes have been forthcoming.

One additional line of study (Emerson and Berrigan, 1993; Emerson, 1996; Emerson et al., 2000) contained several Philippine species of fanged frogs, genus *Limnonectes*. These studies indicate that the Philippine members of this genus are not a monophyletic group, but instead, most belong to a clade that also contains species from Sulawesi, suggesting a novel Philippines-Sulawesi connection (Evans et al., unpublished data) that have not been previously suggested by biogeographic studies of birds or mammals.

Phylogenetic analyses of several other groups of Philippine frogs are underway (Brown et al., unpublished data; Evans et al., unpublished data) and similar studies of selected Philippine lizard genera are also currently in progress (McGuire, Brown, and Diesmos, unpublished data). Results of these studies are preliminary but continue to suggest that the unique dispersal abilities of amphibians and reptiles, coupled with their finer scale patterns of differentiation on montane centers of endemism, have resulted in biogeographic patterns that are very different from those postulated traditionally for birds and mammals.

We believe that amphibians and reptiles represent excellent model systems for elucidating phylogenetic and interspecific phylogeographic patterns characteristic of lower relative dispersal abilities. As such, they should provide a powerful set of tools for distinguishing between hypotheses of vicariance from those of dispersal (characteristic of birds and volant mammals). Furthermore, future studies of Philippine amphibians and reptiles should provide a wealth of information to biogeographers on differing evolutionary processes that lead to their unique biogeographical patterns.

Ecological studies of Philippine amphibians and reptiles

Although there have been important ecological contributions to the literature in the last decade, a review of studies conducted in the past is necessary because so much of what we know is based on earlier work. It has become clear that amphibian and reptile community structure is strongly influenced by elevational gradients. The general results of workers utilizing elevational transect sampling regimes (Brown and Alcala, 1961; Brown et al., 1995b; 1996, 2000b; Diesmos, 1998; Ferner et al., 2001) suggest that species diversity decreases and endemicity increases with elevation (with a possible mid-elevation species bulge in diversity; Brown and Alcala, 1961; Diesmos, 1998). At present we lack the kind of fine scale information on elevational gradients that has been provided for mammals (e.g., Heaney and Rickart, 1990; Heaney et al., 1991; Rickart et al., 1991; but see Diesmos, 1998), and we have no detailed information (other than percent endemism) for community structure variation along elevational gradients on land-bridge versus oceanic islands. Such studies are greatly needed.

Habitats. The first sources of habitat preferences of Philippine amphibians and reptiles have been the descriptions of the habitats in which species were collected by taxonomists. Most of the taxonomic works of various workers (see Literature Cited; papers by Taylor, Brown, Alcala, Rabor, Inger, Leviton, Diesmos, Brown, McGuire, Gaulke, Ferner, and collaborators) mention specific microhabitats from which specimens were collected. From these works we can discern that important microhabitats for amphibians and reptiles collected in original forests include streamside microhabitats (on and under rocks, overhanging vegetation, debris on the banks, etc.), trees (on trunks, in branches, under bark, in canopies), epiphytes (aerial ferns, pandans, orchids, moss mats, suspended debris), litter and humus layers, upland moss accumulations, etc. A comprehensive synthesis of all that is known about habitat preferences would be very useful, but to date such a reference is still lacking. Fortunately, data on the microhabitat preferences of many species are available in the publications listed in this section.

Several important papers of the past 15 years have expanded our knowledge of specific habitat preferences. Alcala and Brown (1987) discussed the habitat preferences of the unusual Philippine endemic frog, *Barbourula busuangensis*. Gonzales and Dans (1994) expounded on arboreal habitat preferences of certain lizards and amphibians on Mt. Makiling (see also Das and Charles, 1994; see also Torres, 1955), and Gaulke (1995b) reported on the unusual utilization of arboreal habitats by typhlopids (see also Taylor 1922e). Diesmos (1998) gave detailed descriptions of frog microhabitat preferences on Mt. Makiling and Mt. Banahao, S. Luzon, and Brown et al. (1996, 2000b) have presented habitat information on populations in the Zambales and Sierra Madre mountains. Recent survey work by Ferner et al. (2001) and Gaulke (2001a, 2001b, 2001c) includes significant new information on the habitat preferences of several poorly known species from Panay Island. A recent investigation into cave habitats (C. Dolino, unpublished data) should provide interesting new information on subterranean species' habitat preferences (see also Brown and Alcala, 2000). Brown and Diesmos (2000) discuss the paucity of information on canopy habitats in the Philippines (see also Lowman, and Nadkarni, 1995) and the lack of knowledge regarding the microhabitat preferences of geckos of the genera *Luperosaurus, Pseudogekko,* and *Ptychozoon* (see also Brown et al., 1997, 2000c). Auffenberg and Auffenberg (1988) have provided detailed habitat descriptions for 11 sympatric species of southern Luzon scincids, and Auffenberg (1988), Gaulke (1989a, 1992b), and Bennett (1999a, 1999b) provided some information on varanid lizard habitat preferences.

More detailed descriptions of species partitioning in heterogeneous habitats and elevational gradients are available in Alcala (1967, 1980), Custodio (1986), Auffenberg and

Auffenberg (1988), Brown et al. (1995b, 1996), Diesmos, 1998; Hampson (1999b), and Ledesma (1999). Additionally, Smith (1993a, 1993b), Alcala and Brown (1998), Bennett (1999a, 1999b), Hampson (1999a, 1999b, 2001), Ledesma (1999), and Gaulke (1992b; 1994a, 1995b, 1996, 1999), all contain other incidental habitat preference details for species involved. Brown et al. (2000a) utilized microhabitat preference differences to facilitate the recognition of a new species of frog from the Sierra Madre mountain range (*Rana tipanan*).

Reproduction and development. There has virtually been no progress in the study of developmental biology of Philippine species in the past 10 years and nearly all of what we know comes from the studies of earlier workers, most notably A. Alcala, in collaboration with Brown (Alcala and Rabor, 1957; Alcala, 1962; Alcala and Brown, 1955, 1956, 1982; Brown and Alcala 1982b; see also Brown and Reyes, 1956). Given the absence of recent studies directed at development and reproduction, we are left with an attempt to piece together what is known from these earlier studies, combined with an effort to summarize incidental observations from recent works. With the exception of limited developmental data on a few newly-described direct developing frogs of the genus *Platymantis* (Brown et al., 1997a, 1997b), there has been almost no new information published on developmental timing, reproductive effort, clutch size, or other basic life history characteristics since the time of Brown and Alcala's (1982b) review. For information on particular species, readers are referred to this work. In general, however, we can state that a high degree of life history variation is exhibited by Philippine Amphibia. For example, ranid frogs of the genus *Platymantis* all exhibit reliance on direct development (Alcala and Brown, 1955b, 1982; Alcala, 1962), while some groups (e.g., rhacophorids) possess a variety of reproductive tactics, from direct development (all *Philautus*) to the construction of arboreal foam nests coupled with aquatic development at later larval stages (*Rhacophorus* and *Polypedates*; Alcala, 1962; Alcala and Brown, 1982, 1994; Brown et al., 1997a). Most non-platymantine ranids, bufonids, microhylids, megophryids, and caecilians rely entirely on indirect aquatic development (Taylor, 1920a; Inger, 1954; Alcala and Brown, 1956; Alcala and Alcala, 1980; Brown and Alcala, 1982b) while some ranids undergo terrestrial development in nests near or away from water (Inger, 1954; Alcala, 1962; Brown and Alcala, 1982b; Inger et al., 1986; see also Brown and Iskandar, 2000). Finally, some life histories in the Philippines still completely unknown (i.e., *Barbourula busuangensis*; family Bombinatoridae; Taylor and Noble, 1924; Myers, 1943; Brown and Alcala, 1982b; Alcala and Brown, 1987; Ubaldo, 1999; Diesmos, Infante, Gee, and Brown, unpublished observations) provide opportunities for exciting future studies.

Auffenberg and Auffenberg (1989) provided a detailed descriptive study of reproductive patterns in 11 sympatric skink species from the Caramoan peninsula of southern Luzon. Their study described a striking level of diversity in clutch composition (egg number and size), parity mode (viviparous vs. oviparous), and seasonality (month of egg laying) of the reproductive effort in the species studied. It is clear from this study that we have barely scratched the surface of describing and understanding patterns in reproductive biology of Philippine scincid lizards. It is also quite clear that the spectacular diversity of reproductive patterns in Philippine scincids provides unparalleled opportunities for future research.

There is no comprehensive review of Philippine reptile reproductive modes available, but some information on seasonality and reproductive effort can be found in the papers of Alcala (1962; 1967), Alcala and Brown (1967), Brown and Alcala (1970c, 1982b), Auffenberg (1988), Auffenberg and Auffenberg (1988, 1989), and Gaulke (1989a, 1992a, 1992b). Additionally, it would be very useful to compile a reference for reproductive timing, clutch size, and incubation period for Philippine snakes and lizards. These areas are fertile grounds for future research.

Population biology. Population studies involving Philippine amphibians and reptiles have been traditionally limited (Alcala, 1955, 1967, 1970; Alcala and Brown, 1967; Brown and Alcala, 1961, 1963c, 1970c). The most in-depth focal study of a single Philippine species of reptiles is the work of Auffenberg (1988) on gray's monitor lizard, *Varanus olivaceus*, published just over a decade ago. Auffenberg (1988) provided information on reproduction, life history trait variation, behavior, population size and densities, age structure, natural longevity, and diet of *V. olivaceus*. Since that time, Gaulke (1989a, 1991a, 1992a, 1992b) has provided some of the same data for selected other subspecies of *Varanus salvator*, and Bennett, (1999a, 1999b) has supplemented our knowledge of diet, movement patterns, and parasite loads on Polillo island populations of *V. s. marmoratus* and *V. olivaceus*. There are no recent studies on the population biology of Philippine amphibians save for Afuang's (1994) study on the introduced species *Bufo marinus*.

Community ecology. There have been only a few studies of amphibian and reptile communities in the past (Brown and Alcala, 1961, 1963c; Custodio, 1986; Diesmos, 1998; Brown et al., 1996, 2000b; Ferner et al., 2001). Auffenberg and Auffenberg (1988) provided a detailed description of a community of 11 species of sympatric scincids on the Caramoan Peninsula of S. Luzon. Their analysis showed that scincid species diversity is positively associated with density of vegetation and structural complexity and that, among habitats, intact original forest was the habitat that supported the highest species diversity. In natural habitat gradients, such as the study area utilized by Auffenberg and Auffenberg (1988; from

intact virgin forest to beach side habitats), there exists a wide range of habitats, none of which was utilized by all species considered. In fact, physically similar and dissimilar species pairs (*Brachymeles samarensis-B. boulengeri, Mabuya multicarinata-M. multifasciata, Dasia grisia-Lipinia pulchella*) occupying similar habitats showed evidence of ecological replacement. Finally, Auffenberg and Auffenberg (1988) showed no evidence of prey selection or food as a limiting resource. They did show strong evidence of niche variation based on habitat preferences (variation in diet composition as a function of the available prey in different habitats), prey item shifts on populations inhabiting both forested and open habitats, and temporal variation in diet brought about by natural seasonality.

Recent studies include the investigation into lizard communities on Polillo Island by Ledesma (1999) and studies of frog communities by Hampson (1999b, 2001). These studies demonstrated that diversity is highest in forested habitats, or in boundary areas where forest and perianthropic/agricultural commensuals coexist. One of these studies demonstrated clearly that frog species density and richness increases with increasing distance into the forest away from agriculture (Hampson, 1999b, 2001).

Behavior. There have been virtually no behavioral studies in the history of Philippine herpetology, despite the enormous potential for research offered by Philippine populations of amphibians and reptiles. There have been significant behavioral observations of selected species, mostly having to do with antipredatory behavior and habitat preferences (Brown and Alcala, 1961, 1978; Brown et al., 2000a, 2000b), reproductive behavior (Alcala et al., 1987; Auffenberg, 1988; Gaulke, 1991a, 1992b; Auffenberg, 1988), diets (Reyes, 1957, 1968), or even spacing patterns and patterns of movement (Auffenberg, 1988; Auffenberg and Auffenberg, 1988; Bennett, 1999a, 1999b).

Recently, there have been an increasing number of papers containing information on communication in Philippine frogs (e.g., Alcala et al., 1986; Brzoska et al., 1986; Brown et al., 1997b, 1997c, 1999a, 1999b; Hampson, 1999b), and one in-depth study of the evolution of diversity of behavioral mate-recognition signals in the genus *Platymantis* currently is underway (Brown et al., unpublished data).

Conservation: a review of what we know and suspect

It is abundantly clear that amphibian and reptile populations in the Philippines are imperiled due to massive loss of their forested habitats (Brown and Alcala, 1986, 1994; Auffenberg, 1988; Diesmos, 1998; Gaulke, 1989b, 1992b, 1998; Hampson, 1999b; Brown et al., 2000b; Ferner et al., 2001; Heaney and Regalado, 1998; Heaney et al., 1999). Other anthropogenic factors include the indirect effects of industry and population growth, subsistence farming and habitat modification, and the direct causes of population declines due to over-hunting, and exploitation of populations for food and trade (Seale, 1917; Taylor, 1920b; Domantay, 1953; Punay, 1975; Ross, 1982; Bacolod, 1984, 1990; de Celis, 1995; Gaulke, 1998). Still, despite all other known causes of declines, we must accept that the removal of original forests or other forms of habitat loss remains the most pervasive cause of population decline in all forms of terrestrial Philippine wildlife (Brown and Alcala, 1986; Whitmore, 1984; Whitmore and Sayer, 1992; Primack and Lovejoy, 1995; Heaney and Mittermeier, 1997; Heaney and Regalado, 1998; Heaney et al., 1999). There can be no doubt that a significant percentage of habitat loss is related to government-sanctioned commercial industries (Heaney and Mittermeier, 1997; Heaney and Regalado, 1998; Heaney et al., 1999). Philippine forests continue to be felled at an alarming rate (Bawa et al., 1990; Whitmore 1990; Collins et al., 1991; Whitmore and Sayer,

1992; Primak and Lovejoy, 1995). Although logging in the Philippines has significantly slowed, it is clear that this trend is due primarily to the absence of significant stands of Philippine timber left to cut (Heaney et al., 1999) rather than as a result of government grassroots wildlife protection initiatives or government efforts to sustainably manage resources (Kummer, 1992; Sajise et al., 1996).

The last ten years have seen an increase in designation of protected areas and in public awareness of the need to preserve the habitats of endangered Philippine amphibians and reptiles (Brown and Alcala, 1986; de Celis, 1995; Sajise et al., 1996; DENR and UNEP, 1997; DENR and PALF, 1998; Heaney and Regalado, 1998; ECPF, 1998; Gaulke, 1998; Hicks, 2000; Tan, 2000). These advances in the potential for habitat protection are most encouraging (reviews: Heaney and Regalado; Heaney and Mittermeier, 1997; Heaney et al., 1999).

Conservation status of species. In recent years there has been a first genuine attempt to arrive at a consensus concerning the conservation status of amphibians and reptiles in the Philippines (Magbanua, 1991; Alcala and Custodio, 1995; Afuang and Gonzales, 1997; Gonzales et al., 1997; CI, FFI, and IUCN-SSC, 1999; Gaulke, 1998; Banks, 1999). In the past, international attention, concern, and attempts at regulation in the form of CITES or IUCN listings were limited to marine turtles (genera *Eretmochelys, Lepidochelys, Chelonia, Caretta*, and *Dermochelys*; see also de Celis, 1995), sailfin lizards (genus *Hydrosaurus*), a few freshwater turtles (genera *Heosemys, Pelochelys*), crocodiles (*Crocodylus porosus* and *C. mindorensis*; Ross, 1982; Trono, 1992; Ross and Alcala, 1993; Palma, 1993; Ortega et al., 1993; Regioniel, 1995), pythons (*Python reticulatus*), large water snakes (e.g., genera *Cerberus, Acrochordus, Laticauda, Hydrophis* and *Lapemis*), a few terrestrial snakes (e.g., genera *Naja*, *Elaphe*, *Stegonotus*, *Zoacys*; Alcala, 1986; Ross et al., 1987), and monitor lizards (*Varanus*; Gaulke, 1998)—those species presumably at risk due to an aggressive SE Asian leather trade (reviews: unpublished Sagip Wildlife Program list; Alcala, 1986; Gonzales et al., 1997; Erdelen, 1998; Gaulke, 1998; van Dijk et al., 2000). More recently, Alcala and Custodio (1995) and Afuang and Gonzales (1997; see also Banks, 1995, 1999) have begun an effort to address the conservation status of other, less noticeable species such as frogs (Afuang and Gonzales, 1997; CI, FFI, and IUCN-SSC, 1998; Banks, 1999; review: Hilton-Taylor, 2000). In contrast to many species status initiatives of the past that have argued for increased protection due to over-exploitation by humans, more recent projects (Alcala and Custodio, 1995; Gonzales et al., 1997; Banks, 1999) show that the majority of the newly listed species are considered threatened primarily by habitat loss, or are vulnerable as a consequence of limited geographical distributions.

The 1997 Wildlife Conservation Society of the Philippines *Philippine Red Data Book* (WCSP, 1997) represented the first attempt to arrive at a consensus as to the conservation status of Philippine amphibians and reptiles. Two amphibians and 10 reptiles considered globally threatened in the Philippines were included. Later, following the launching of the "Global Amphibian Campaign" (CI, FFI, and IUCN-SSC, 1999), Banks (1999) included an additional 32 species of Philippine amphibians in the 2000 *Red List of Threatened Species*. A new, comprehensive re-assessment of amphibian species' conservation status will soon be forthcoming (Diesmos et al., unpublished). We hope these efforts will result in increased protection of vulnerable populations, increased public awareness (Afuang et al., 2002), the designation of conservation priorities based on data (not politics), and increased use of conservation resources towards the study and protection of potentially threatened species.

Exploitation and consumption of amphibians and reptiles. There exists only a handful of studies documenting the exploitation of amphibian and reptile populations (as food sources, and for the leather and pet trades) in the Philippines. In general there are a few published reports that mention the use of amphibians and reptiles as food sources by indigenous groups (Villamor, 1990; Luxmoore and Groombridge, 1989; see also Gaulke, 1992b, 1998). We know that amphibians (rice field frogs of the genus *Rana* and fanged river frogs of the genus *Limnonectes*), reptiles (lizards of the genera *Hydrosaurus* and *Varanus*), and snakes, (i.e., genus *Python*) form an important part of the diet of many indigenous cultures in the Philippines (Lopez, 1976; Kikuchi, 1984; Griffin and Estioko-Griffin, 1985; Schult, 1991; review: Gaulke, 1989b). Road-side hawkers offering pythons and monitor lizards for sale are a common sight throughout the country (except in predominantly Muslim areas; *pers. obs.*).

However, many of the desired data (species identities, numbers of individuals harvested, seasonality of harvest, locations of primary harvests, percentage of the harvests that are subadults, sex of specimens harvested) are still lacking. We are in drastic need of these types of data in order to implement informed management decisions. Although leather and pet trade harvest and export were completely banned in 1994, the industry continues to thrive (Bacolod, 1984; 1990; Gaulke, 1989b, 1998) and is possibly growing (F. Yuwono, *pers. comm.*). Hides of Philippine reptiles continue to appear in overseas markets at the same time that rare and protected Philippine species are now increasingly advertised for sale at exorbitant prices on the internet (Brown, *pers. obs.*) as curiosities and "captive biological specimens" (= pets), reportedly, but doubtfully, bred in captivity in an attempt to "legalize" the selling of protected wildlife. We do know that unregulated exploitative harvests of sea snakes for skins have devastated rookeries in the Visayan sea (Bacolod, 1984; 1990), and that at present there are no specific laws in place to protect sea snakes from leather trade overexploitation (Gaulke, 1989b). The next decade will be a critical period in which the challenges of gaining information on these uses of amphibians and reptiles must be addressed in a meaningful fashion.

Some of the countries surrounding the Philippines have made efforts to monitor, regulate, and sustainably manage reptile harvests (Erdelen, 1998; van Dijk et al., 2000), and it is now time to begin a dialogue on the Philippines' own response to these growing industries. Gaulke (1998) recommended the implementation of regionally-oriented wildlife management plans which include protection of certain areas, but with legal trapping based on quotas and the principles of sustainable yield in others. This proposal is worthy of consideration because of the manner in which it may benefit both the animals and the local communities. In general, regulated, sustainable harvest of protected species is more desirable than unfettered, unregulated, unmonitored rampant illegal exploitation (Webb and Vardon, 1998; Shine et al., 1998; Erdelen, 1998; Webb and Vardon, 1998). We expect that some *Varanus, Acrochordus, Hydrophis, Laticauda, Naja* and *Python* populations can be harvested at sustainable levels once data are available to indicate the appropriate levels and harvest times. Data needed include the number of individuals that can be sustainably harvested from a population, when the appropriate (non-breeding) harvest season should occur, and which populations may be sustainably culled versus which must be allowed to recover unmolested.

Illegal collectors view black market trade as a nonrenewable resource that is best exploited as quickly as possible in order to accrue as much income as possible before their illegal activities are exposed. In contrast, legally-registered traders and leather merchants who invest in the monitoring of their resources tend to protect and guard their sources (see papers in Erdelen, 1998, e.g., Yuwono, 1998) and prevent

over-harvesting in order to insure future yields and their own livelihood. Finally, legal monitoring of reptile harvests would provide a great many badly-needed data for policy makers and wildlife biologists. With information on yields, size of harvests, percentages of each sex, and harvest locations (e.g., Shine et al., 1998), informed, biologically sound recommendations, and management decisions could be made to insure the continued survival of economically important species (Yuwono, 1998; Melisch, 1998; Gaulke, 1998). In the absence of such data, we are left with ignorance and forced to proceed from guesswork, while an unregulated black market in Philippines amphibians and reptiles continues to thrive.

Introduction of exotic species and the threat they pose. Recent survey work by Diesmos (1998; unpublished data; see also Diesmos, 2000, 2001) has augmented data on Asian and American species introduced into the Philippines. We now know that in addition to the Sunda Shelf species *Rana erythraea* (Brown and Alcala, 1970c; Alcala, 1986), middle American cane toads (*Bufo marinus*; Alcala, 1986; Afuang, 1994), Taiwanese bullfrogs (*Hoplobatrachus rugulosus*; Diesmos, 1998; Alcala and Brown, 1998), and American bullfrogs (*Rana catesbiana*; Inovejas and Vergara, 1985), have established breeding populations in the Philippines. All of these species have rapidly spread (Diesmos and Brown, *pers. obs.*) from the points of their original introductions. The rapid generation time, voracious dietary habits, and invasive abilities of the latter three species suggest that they represent serious threats to the communities and habitats they currently inhabit and that syntopic populations of Philippine endemics may soon be seriously threatened by these introductions. Basic documentary studies (Heyer et al., 1994) on the spread of these non-native species and their behavioral interactions with Philippine species are badly needed to document and, hopefully, stem the spread of potentially catastrophic invasions.

Legal issues, restrictions, and research permits

Gaulke (1998) reviewed the laws (or absence thereof) governing the exploitation and harvest of monitor lizards, pythons, sea snakes, and file snakes in the Philippines. The passage of Executive Order 247 of the Ramos administration (la Viña et al., 1997) and the recent Wildlife Bill under the Macapagal-Arroyo administration are both new attempts to protect Philippine wildlife and natural resources, including reptiles and amphibians. These efforts are generally encouraging in that they demonstrate an increased concern for the welfare of Philippine wildlife. Unfortunately, the co-occurring legal restrictions on the activities of research scientists and wildlife biologists have seriously crippled biodiversity research.

At present we see the absence of a clear cut distinction between academic/research and commercially-oriented activities (La Viña et al., 1997) as a policy in need of revision. Without such a distinction, EO 247 will continue to cripple biodiversity studies, despite its good intentions. One negative impact of the passage of EO 247 has been the manner in which it has contributed to an incorrect public perception of biologists as somehow akin to commercial exploiters of the environment ("bioprospectors"). Executive Order 247 was designed to protect wildlife and the Philippine environment from commercially exploitative enterprises such as large scale commercial harvesting of wildlife (i.e., butterfly and orchid collecting for lucrative overseas markets, unregulated pet trade harvests, or large-scale collecting of snakes, lizards, and turtles for shell and leather trades), commercial pharmaceutical extraction of potentially valuable plant extracts, commercial logging, or any other activity on the part of persons or groups who would profit from the sale or copyright of Philippine biological resources (La Viña et al., 1997). Unfortunately, the same restrictions that were developed to monitor and regulate commercial exploitation of biological resources now also apply to biodiversity researchers and field biologists.

Although biologists must also collect and preserve biological specimens as part of biodiversity studies, they do not use these preserved animals and plants for personal or commercial gain but, instead, deposit them in internationally accredited institutions such as the National Museum of the Philippines (Simmons, 1987; Reynolds et al., 1994; Resetar and Voris, 1997) where they become part of the public record and natural heritage of the nation rather than contribute to money-making enterprises. The philosophical, ethical, and practical differences between the activities of non-profit, scientific biologists and for-profit, commercial bioprospectors are beyond the scope of this paper, but numerous obvious distinctions are immediately apparent. The need for regulatory legislation that also distinguishes between the activities of commercial bioprospectors and research biologists should be equally apparent. Finally, although we are aware that it was not intended as such, the current implementation of EO 247 amounts to a policy of economic discrimination against university students and junior scientists. This is because the seemingly endless lists of legal requirements make it prohibitively expensive and nearly impossible for university students and biologists working with modest budgets to obtain legitimate research permits.

We suspect that most of the present bureaucratic restrictions on biologists stem from the understandable yet uninformed opinion of policymakers that the best way to preserve Philippine wildlife is to prevent any killing of animals, even in the name of identifying and cataloging the country's biodiversity. It is difficult to find fault with these sentiments because we too disdain the needless killing of animals. However, the total prevention of responsible faunal collecting efforts as part of legitimate biodiversity studies is misdirected. First, there is simply no substitute for vouchered locality data for mapping distributions of species (Reynolds et al., 1994). Second, there is no evidence to support the notion that responsible scientific collecting has negative impacts on natural populations (Hedges and Thomas, 1991; Goodman and Lanyon, 1994; Stuebing, 1998). Finally, the absolute need for the data generated by biologists' efforts is undeniable. Truly effective conservation programs rely heavily on quality museum collections (Hawksworth and Mound, 1991; Hedges and Thomas, 1991) and the importance of systematic collections for conservation efforts is immense (Hoagland, 1989; Foster, 1982; Nielsen and West, 1994; Savage, 1995; David, 1996; Leh, 1996; Resetar and Voris, 1997; Shaffer et al., 1998; Ponder et al., 2001). This is because the baseline data contained in museum collections form a disproportionately large percentage of material in databasing efforts, conservation priority-setting activities, and overall conservation of biological resources (e.g., Conservation International's recent Philippine Priority-Setting Workshops—based almost entirely on museum collection data).

At present, some informal discussions have been initiated regarding the establishment of a new Philippine government permitting system that would distinguish between commercial efforts and academic or university-based research, and we are very hopeful that relief will be forthcoming. However, we must stress that current government policies need to be revised so that they *promote, facilitate,* and *encourage* responsible research on biodiversity rather than strongly inhibit, restrict, or prevent it. Without such changes, current laws will probably continue to promote local paranoia, eventually causing unproductive rifts between the government and non-government, university, local, and scientific communities. The result of such rifts can only be that Philippine environment, Filipino biologists, and the biodiversity of this country will continue to suffer.

Comparisons with neighboring countries

A superficial look at the herpetological literature from surrounding SE Asian and SW Pacific countries reveals that trends in Philippine herpetology fit into the context of a great regional increase of knowledge during the past half century. Due to the inequality of progress in all regions, wide-scale comparisons are impossible at the present time. Nevertheless, some valuable comparisons can be made (and hopefully, are heuristic). For example, while estimates of numbers of amphibian species in the Philippines have increased (from 55 to 105 species; Inger, 1954; Alcala, 1986; Alcala and Brown, 1998; Brown and Diesmos, in press), so too have species estimates increased significantly on the island of Borneo (from 92 to 138 recognized species; Inger, 1966; Frost, 1985, 2000; Duellman, 1993; Inger and Tan, 1996a, 1996b; Inger, 1999). In fact similar trends can be seen on the islands of Java, Sumatra, and Bali (Iskandar, 1998; Frost, 1985; Duellman, 1993; Inger, 1999; Iskandar and Colijn, 2000), Sulawesi (Frost, 1985; Duellman, 1993; Iskandar and Tjan, 1996), New Guinea, and the Solomon-Bismark archipelagos (Frost, 1985, 2000; Duellman, 1993; Allison, 1996; Brown, 1997; Inger, 1999; Allison and Kraus, 2001). Similarly, though several comprehensive biodiversity projects are still in progress, we are aware that estimates of snake, turtle, and lizard diversity have substantially increased (Welch, 1988; Welch et al., 1990; Zhao et al., 1988, 2000; Keng and Tat-Mong, 1989; Matsui et al., 1989; Cox, 1991; Iverson, 1992; Lim and Lim, 1992; Zhao and Adler, 1993; Das, 1995, 1996b, 1998; David and Vogel, 1996; Dutta and Manamendra-Arachichi, 1996; Inger and Tan, 1996a, 1996b; Inger and Stuebing, 1989, 1997 Chou and Lin, 1997; Manthey and Grossman, 1997; Cox et al., 1998; da Silva, 1998; Chan-ard et al., 1999; Inger, 1999; Liat and Das, 1999; McDiarmid et al., 1999; Ota, 1999; Stuebing and Inger, 1999; Iskandar, 2000). Although a comprehensive review of all types of studies involving amphibians and reptiles throughout Asia and the Pacific is beyond the scope of this paper, our general impression is that the same trends that we have witnessed in the Philippines, specifically an explosion in the types of studies and dramatic increase in biodiversity and conservation, have occurred throughout SE Asia. As such, progress in Philippine herpetology fits into a broader context of the overall trends seen in SE Asia: dramatic increases in estimated numbers of species, increased understanding of natural history, systematics, biogeography, and ecology coupled with a drastic need for more information and conservation initiatives.

Future directions: the decade to come

Targets: species, sites, and kinds of studies. In this section we attempt to identify substantive gaps or research topics in need of study in Philippine herpetology.

In general, there has been more recent taxonomic work in amphibians than in reptiles. Accordingly, while we know of numerous undescribed Philippine amphibians, we suspect that far more numerous species of reptiles await discovery. There is a great need for comprehensive reviews of Philippine lizards and snakes within the context of modern species concepts.

Additionally, numerous regions of the Philippines cry out for faunal surveys. In a recent faunal survey in Aurora Memorial Natural Park, Brown et al. (2000b) stressed the need for exhaustive herpetological surveys throughout the Sierra Madre range. Similarly, while Brown et al. (1996) have provided a preliminary account of herpetological communities in the Zambales, their survey was conducted immediately following the eruption of Mt. Pinatubo, and so we suggest that further surveys are needed, especially if we are to gain an adequate

knowledge of amphibian diversity in this isolated mountain range (see comments by Diesmos, 1998). Recent work in the Central Cordillera (Heaney et al., 2000; Diesmos, Brown, Gee, unpublished data) should provide an important preliminary update towards the assessment of this mountain range's herpetological fauna, but other localities, specifically in the southern portions of the Cordillera, are in equally critical need of similar studies.

Likewise, the mountains of the Bicol Peninsula each deserve intensive survey efforts (see Brown et al., 2002). Outside of Luzon, numerous other areas require basic survey efforts. These include southeastern Mindoro, all of Samar and Leyte (but see Gaulke, 1994b; Deuzer et al., 1999), high elevation habitats of Mindanao (but see Rabor and Alcala, 1959; Smith, 1993a, 1993b), and numerous smaller islands including (but not limited to) Masbate (but see Gaulke, and Altenbach, 1994c), Sibuyan, Lubang, Burias, Siquijor, Camiguin, Maestro de Campo, Semirara, the Batanes and Babuyans, all of Palawan, Busuanga, Coron (But see Gaulke, 1999), and the Sulu archipelago (but see Gaulke, 1993, 1994a, 1995a, 1996).

Finally, basic population biology, behavioral, and reproductive biology studies are needed for numerous species believed to be threatened by activities of humans. It is only through the careful collection of basic population and demographic data that we will be able to make sound management recommendations. And it is only through the collection of basic data on the use of amphibians and reptiles by commercial and indigenous harvesters that we will be able to assess which populations are being most heavily exploited.

Publications and survey data. One final lesson from our experiences over the past decade that cannot be stressed too often or too fervently is the need to encourage students, government, non-government, and even contracted workers to publish the results of their studies. The amount of critically important unpublished data that we are aware of is staggering. If the information contained in non-government organizations' and university students' unpublished reports was now available to wildlife managers, conservation biologists, biodiversity specialists, and biogeographers, the state of Philippine herpetology would be markedly different than it is at present. In truth, unpublished survey data may do more harm than good because the tendency is for permitting authorities to discourage reinvestigations of previously-surveyed areas. Thus, unpublished data not only are unjustified (why collect data if they will not be put to use as part of the public record?), but they actually have a negative impact by barring later workers access to the same regions (Crombie, 1992).

Similarly, rushed or non-exhaustive, or even the burgeoningly popular "rapid assessment" surveys can often do more harm than good. In this instance, "a little" is not "better than nothing at all" if the results are that permitting authorities deny permission to conduct follow up surveys because the perception is that the work has already been completed. No amount of reanalysis of insufficient data will have positive or even illustrative results. We agree with Crombie's recent comment that "...considerable money and effort are being expended on analyzing [herpetological species] distribution information when the data base is so paltry that it scarcely warrants the exercise" (Crombie, 1992:594).

Field work. As suggested by Crombie's quote at the beginning of this paper, we believe the degree to which basic reliable distribution data are lacking and badly needed cannot be stressed too often. Unfortunately, the public disinterest, financial difficulties, and bureaucratic obstacles faced by any budding field research program in herpetology at the present day in the Philippines can be overwhelming. To students finding themselves in these or similar situations we wish to offer our encouragement and assistance wherever possible. This is because a comprehensive, careful, and well-orchestrated (and published in a timely fashion) field survey of even a single forested site makes a major contribution to our collective knowledge of Philippine herpetology. Simple "rice and beans" (Crombie, 1992) or "bean-counting" (A. Malliari, *pers. comm.*) field exercises can drastically change the way we view complex topics such as the influence of geological processes and marine barriers to gene flow on speciation and the composition of faunal communities, the effects of elevation on species abundance and distribution patterns, and overall zoogeographical relationships of particular islands (Brown et al., 1996; 2000b; Diesmos, 1998; Ferner et al., 2001). For all of these data, and the paradigm-altering conclusions that have been, and continue to be drawn from them, there is no substitute for reliable distribution data based on specimens deposited in accredited natural history museums.

Integration. We anticipate that the next decade will see a genuine effort to integrate recent efforts of taxonomists, systematists, biogeographers, and conservationists. Our review of the literature suggests that current herpetology in the Philippines is in a final stage of discovery. This descriptive, piece-meal process will no doubt culminate in the availability of an enormous amount of data available for reviews, syntheses of taxonomy and distribution, large scale biogeographic studies, and meta-analyses of ecological studies. Ecological, behavioral, and population studies will no doubt contribute to conservation if they can be integrated into larger synthetic analyses within the context of known history. Recent comprehensive studies of taxonomy, systematics, and the numerous factors affecting species distributions will no doubt have broad implications for conservation and management decisions. Integrating these studies and formulating and implementing policies on the basis of sound biology (instead of politics) will be a major challenge for the next decade's biologists, students, and policy makers.

Collaboration. It is instructive to note that Philippine herpetology has a rich recent history of international collaborative efforts. In particular, the development of Philippine herpetology since the 1950s has relied, at least in part, on foreign support. It has been this cooperation and partnership of scientists from several different countries that has produced the most remarkable discoveries and advances in Philippine herpetology. This tradition has taken the form of financial support for field research, advice, guidance, encouragement, and facilitation of academic studies abroad. We feel this history provides us with an important lesson. Biodiversity studies by both Filipinos and foreigners should be conducted in collaboration with Filipinos at all levels—government, university, municipality and the barangay. Our experience has shown that it is in the best interest of everyone for researchers coming to the Philippines to collaborate closely with Philippine scientists and local community representatives. There is a great deal to be shared and

learned through partnerships with local communities. In one sense, local communities are the most important guardians of the remaining forests; as such, it is in everyone's best interest that scientists, government officials, regional resource managers, and local indigenous peoples' organizations work together. The most productive research programs of recent history have all been collaborative efforts. By combining efforts, Filipinos and non-Filipinos have been able to achieve much more in collaboration than could have been possible as part of separate research programs. We are greatly encouraged by the fact that recent collaborative research efforts and conservation programs are now being led by Filipino biologists.

The last decade and the next generation of Philippine herpetologists. This last decade has left us with a growing sense of urgency and the ever-increasing need to involve and encourage Filipino students to participate in the study of their country's amphibians and reptiles. In particular, we are encouraged by the recent emergence of numerous women in Philippine herpetology and we support their interest and involvement in a field of science traditionally dominated by a few male personalities. We are intrigued to imagine who will constitute the next generation of Philippine herpetologists and we wish to encourage all interested students to pursue herpetology as a field of study, especially in the field, even (and perhaps especially) as represented by the populations in their backyards. It is our hope that the next generation of Philippine herpetologists can learn from our trials, our accomplishments, and our mistakes, and continue to work towards new, ever-enlightening conclusions. We hope students will find inspiration from past achievements in the field to realize their own power to make significant contributions, change the future's understanding, and increase the next generations' appreciation of the spectacular diversity, remarkable uniqueness, and intriguing natural history of amphibians and reptiles in the Philippines.

Acknowledgments

We are unable to express our gratitude towards all of the individuals, too numerous to list here, who have supported our efforts over the past decade. To these individuals, we offer our thanks and compliments. In particular, we thank our families for their patience and support and W. Brown, L. Heaney, R. Inger, J. McGuire, R. Crombie, A. Ross, A. Leviton, J. Ferner, N. Malliari, R. Fernandez, and R. Sison for helpful discussions regarding Philippine amphibian and reptile diversity. Constructive reviews of the manuscript were provided by M. Leonida, L. Heaney, J. Weghorst and an anonymous reviewer.

We dedicate this paper to Walter C. Brown in thanks for the inspiration, encouragement, and support he has provided to each of us.

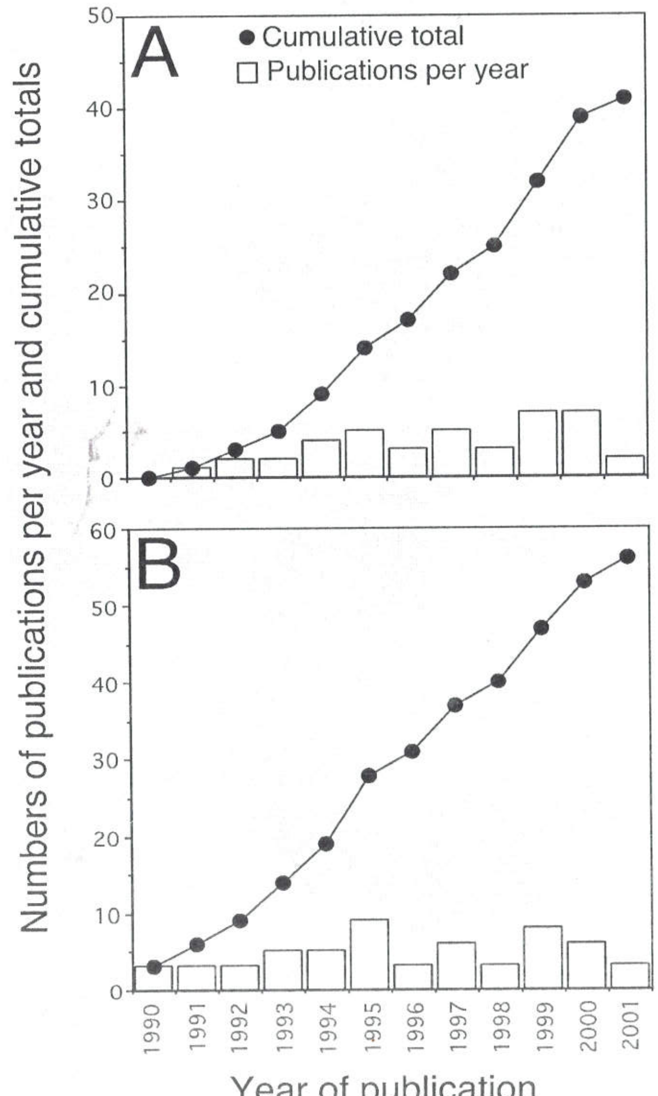
Table 1. List of amphibian species described since 1990.

Species	Family	Authority	Distribution
Kaloula kokacii	Microhylidae	Ross and Gonzales, 1992	Catanduanes Isl.
Philautus poecilus	Rhacophoridae	Brown and Alcala, 1994	Mt. Hilong-hilong, Mindanao Isl.
Philautus surrufus	Rhacophoridae	Brown and Alcala, 1994	Dapitan Peak, Mindanao Isl.
Platymantis panayensis	Ranidae	Brown, Brown, and Alcala, 1997	Mt. Madja-as, Panay Isl.
Platymantis isarog	Ranidae	Brown, Brown, Alcala, and Frost, 1997	Mt. Isarog, Luzon Isl.
Platymantis mimulus	Ranidae	Brown, Alcala, and Diesmos, 1997	Mt. Maquiling, Luzon Isl.
Platymantis rabori	Ranidae	Brown, Alcala, Diesmos, and Alcala, 1997	Cantaub, Bohol Isl.
Platymantis negrosensis	Ranidae	Brown, Alcala, Diesmos, and Alcala, 1997	Cuernos de Negros, Negros Isl.
Platymantis luzonensis	Ranidae	Brown, Alcala, Diesmos, and Alcala, 1997	Mt. Maquiling, Luzon Isl.
Platymantis banahao	Ranidae	Brown, Alcala, Diesmos, and Alcala, 1997	Mt. Banahao, Luzon Isl.
Platymantis pygmaeus	Ranidae	Alcala, Brown, and Diesmos, 1998	Sierra Madre mountains, Luzon Isl.
Platymantis naomiae	Ranidae	Alcala, Brown, and Diesmos, 1998	Mt. Banahao, Luzon Is.
Platymantis sierramadrensis	Ranidae	Brown, Alcala, Ong, and Diesmos, 1999	Sierra Madre mountains, Luzon Isl.
Platymantis cagayanensis	Ranidae	Brown, Alcala, and Diesmos, 1999	Central Cordillera mountains, Luzon Isl.
Platymantis taylori	Ranidae	Brown, Alcala, and Diesmos, 1999	Sierra Madre mountains, Luzon Isl.
Platymantis pseudodorsalis	Ranidae	Brown, Alcala, and Diesmos, 1999	Mt. Banahao, Luzon Isl.
Platymantis indeprensus	Ranidae	Brown, Alcala, and Diesmos, 1999	Mts. Banahao and San Cristobal, Luzon Isl.
Rana tipanan	Ranidae	Brown, McGuire, and Diesmos, 2000	Sierra Madre mountains, Luzon Isl.
Rana new species	Ranidae	Brown and Guttman, in press	Mindoro Isl.
Kaloula new species	Microhylidae	Diesmos, Brown, and Alcala, in review	Southern Luzon Isl.

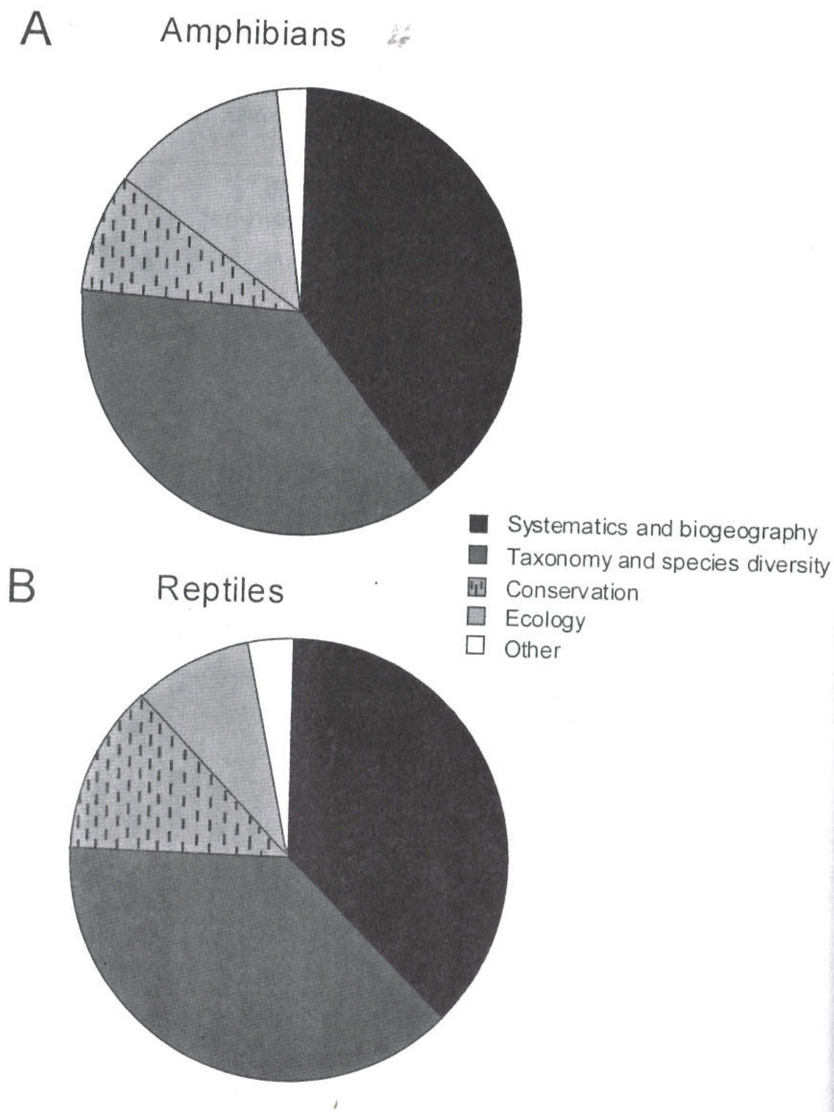
Table 2. List of reptilian taxa described since 1989.

Species	Family	Authority	Distribution
Lepidodactylus balioburius	Gekkonidae	Ota and Crombie, 1989	Batan Isl.
Draco jareckii	Agamidae	Lazell, 1992	Batan Isl.
Typhlops castanotus	Typhlopidae	Wynn and Leviton, 1993	Inampulugan Isl.
Typhlops collaris	Typhlopidae	Wynn and Leviton, 1993	Mt. Anuling, Luzon Isl.
Lycodon alcalai	Colubridae	Ota and Ross, 1994	Batan Isl.
Lycodon bibonius	Colubridae	Ota and Ross, 1994	Camiguin Isl.
Lycodon chrysoprateros	Colubridae	Ota and Ross, 1994	Dalupiri Isl.
Lycodon solivagus	Colubridae	Ota and Ross, 1994	Central Cordillera mountains, Luzon Isl.
Ahaetulla prasina suluensis	Colubridae	Gaulke, 1994	Tawitawi island group, Sulu archipelago
Sphenomorphus kitangladensis	Scincidae	Brown, 1995	Mt. Kitanglad, Mindanao Isl.
Sphenomorphus knollmanae	Scincidae	Brown, Ferner, and Ruedas, 1995	Mt. Isarog, Luzon Isl.
Brachymeles minimus	Scincidae	Brown and E. Alcala, 1995	Catanduanes Isl.
Parvoscincus sisoni	Scincidae	Ferner, Brown, and Greer, 1997	Mt. Madja-as, Panay Isl.
Sphenomorphus tagapayo	Scincidae	Brown, McGuire, Ferner, and Alcala, 1999	Mt. Maaling-aling, Luzon Isl.
Pseudorabdion talonuran	Colubridae	Brown, Leviton, and Sison, 1999	Mt. Madja-as, Panay Isl.
Draco palawanensis	Agamidae	McGuire and Alcala, 2000	Palawan Isl.
Hologerrhum dermali	Colubridae	Brown, Leviton, Ferner, and Sison, 2001	Mt. Madja-as, Panay Isl.
Lycodon fausti	Colubridae	Gaulke, 2002	NW Panay Isl.
Varanus mabitang	Varanidae	Gaulke and Curio, 2001	NW Panay Isl.

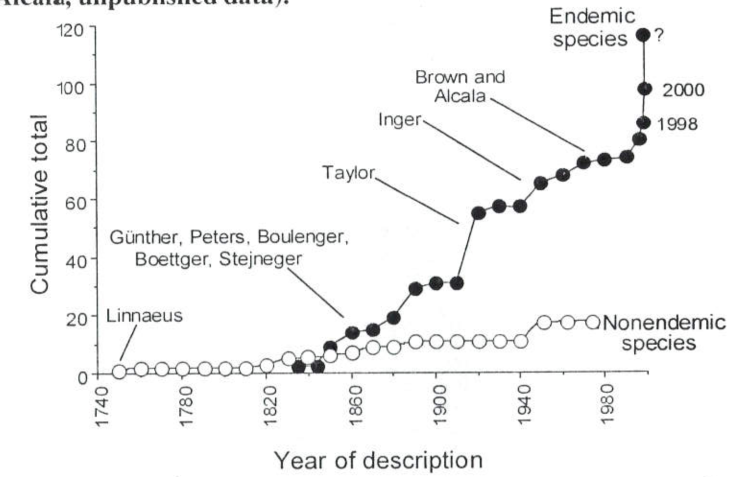
(Fig. 1) The relationship between the number of articles published per year (unshaded bars), the cummulative total of published articles for the past decade (shaded circles) and the year of publication for amphibian (A) and reptiles (B). Note: some articles were counted twice, as in the case where a publication addressed both amphibians and reptiles (e.g., Brown et al., 1996, Ferner et al., 2001; Gaulke, 1996, 1999) or taxonomy and systematics (Brown, 1997).



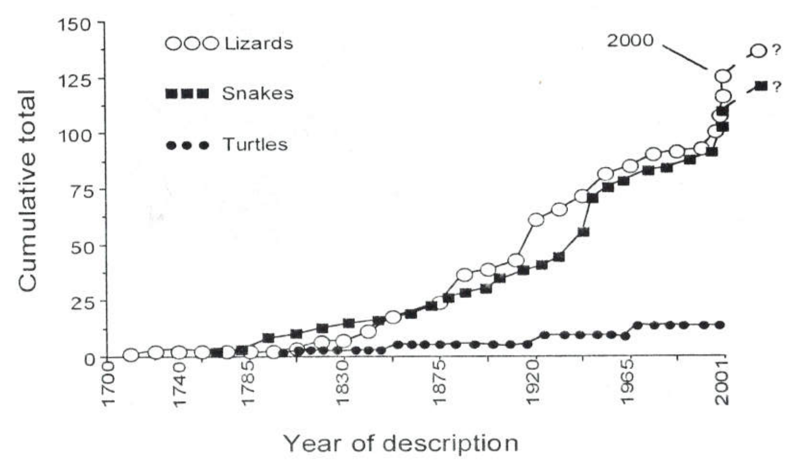
(Fig. 2) Composition of the last decade's literature on Philippine amphibians (A) and reptiles (B).



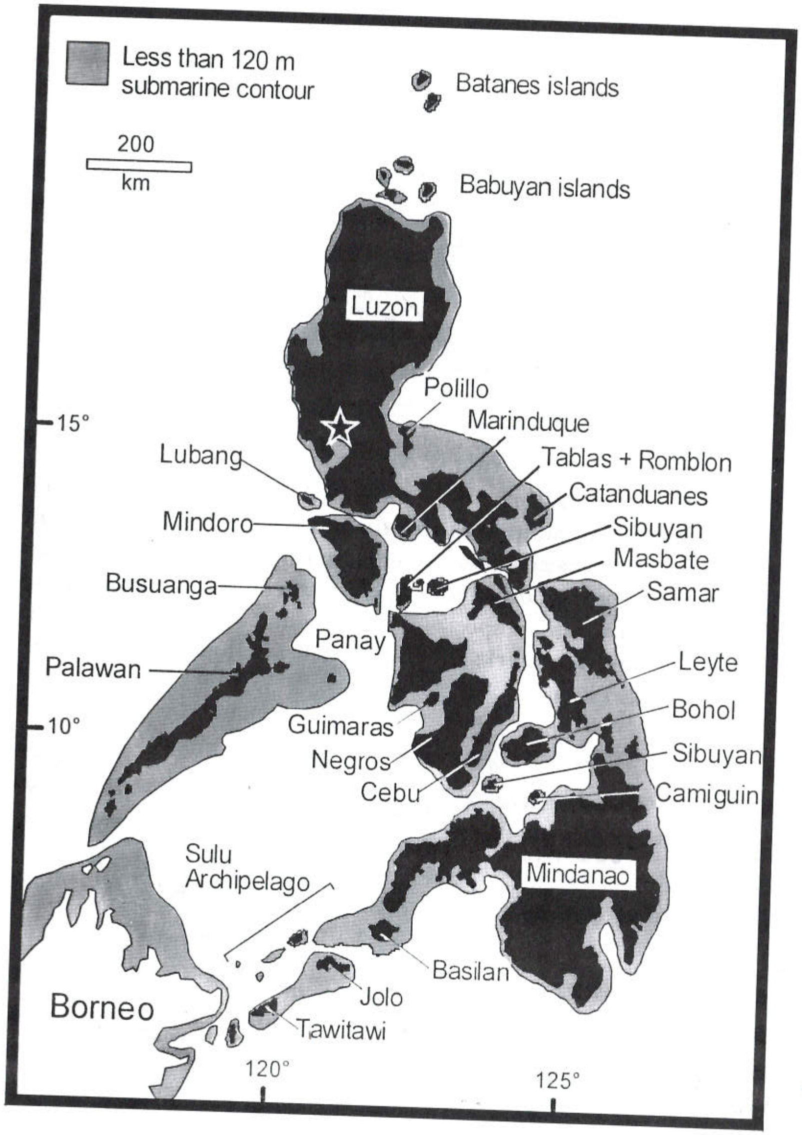
(Fig. 3) The relationship between the cumulative total number of amphibian species in the Philippines and the year of description. Note the dramatic increase in rate of descriptions in the past decade. The final point on this line (indicated with question mark) is the estimated number of new species awaiting description (Diesmos, Brown, and Alcala, unpublished data).



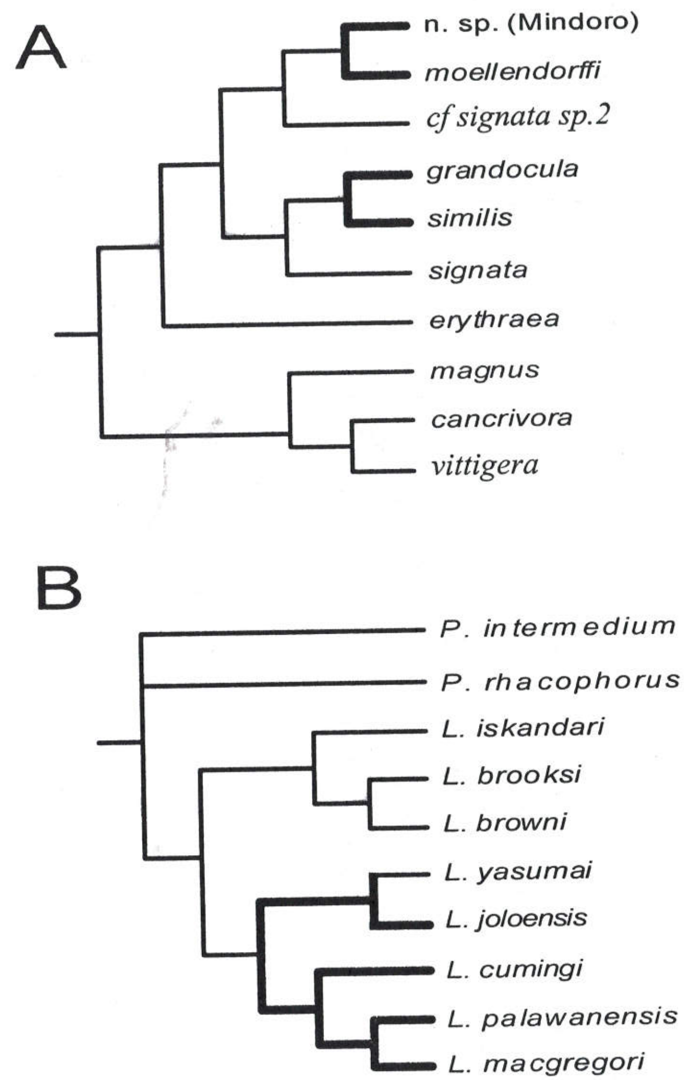
(Fig. 4) The relationship between the cumulative total number of reptile species in the Philippines and the year of description. For simplicity, only total species counts (endemic + non-endemic) are shown, and these are broken down into snakes, lizards, and turtles. Species diversity in crocodilian species is n = 2. Final species counts (indicated with question marks) are estimated numbers of new species awaiting description.



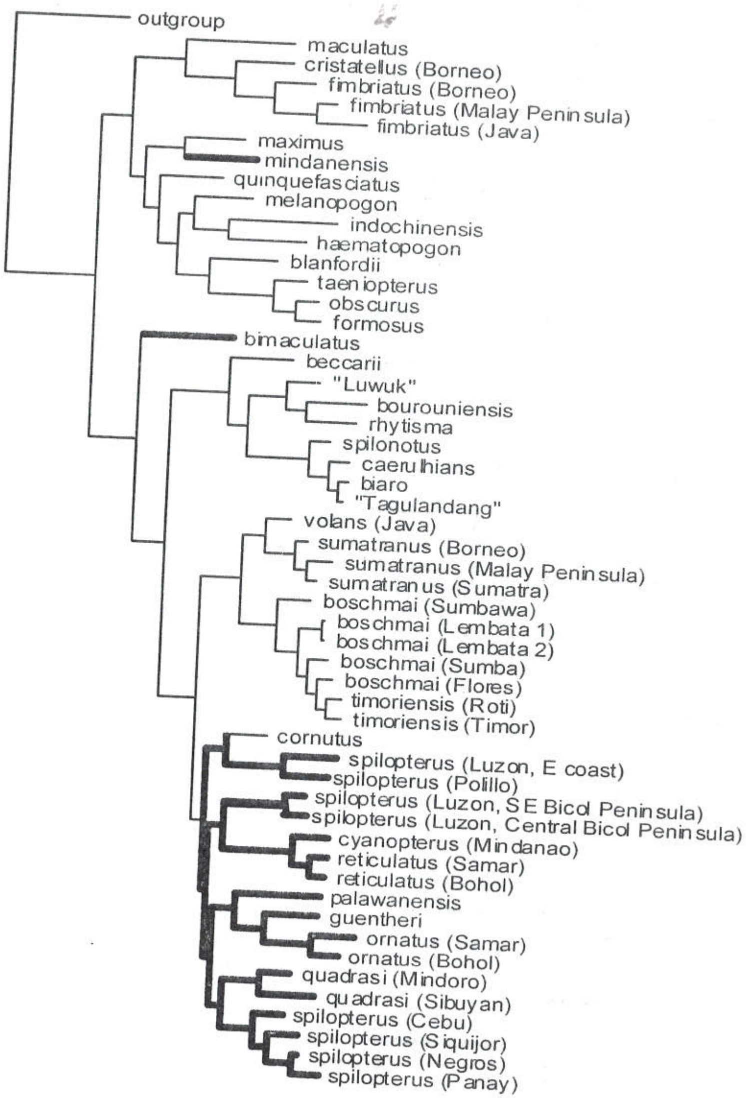
(Fig. 5) Formation of geological componentry of the Philippines: the major Pleistocene aggregate island complexes as delineated by the 120 underwater bathymetric contour and known mid- to late-Pleistocene sea level reductions (following Heaney, 1985, 1986).



(Fig. 6) The preferred phylogenetic hypotheses for the *Rana signata* complex of Philippine and Bornean stream frogs (A: Brown, 1997; Brown and Guttman, in press; bold terminal branches indicate Philippine *R. signata* complex species) and the preferred phylogenetic tree for the genus *Luperosaurus* (B: Brown et al., 2000c; bold terminal branches indicate Philippine species).



(Fig. 7) The preferred phylogenetic hypothesis for flying lizards of the genus *Draco* (McGuire and Kiew, 2001). Bold terminal branches indicate Philippine species.



Literature Cited

Afuang, L. E. 1994. Population ecology and distribution of *Bufo marinus* in the province of Isabela, Philippines. Unpublished Masters thesis, University of the Philippines at Los Baños, Laguna.

Afuang, L. E. 1995. State of the art report on Philippine amphibians. Sylvatrop: the Technical Journal of Philippine Ecosystems and Natural Resources 5: 114.

Afuang, L. E. and J. C. T. Gonzales. 1997. Amphibians. Pp. 45-95 In: Wildlife Conservation Society of the Philippines (Eds.) Philippine Red Data Book. Bookmark Publishing, Makati City, Philippines.

Afuang, L.E., R.L. Redor, and C.B. Banks. 2002. Increasing community awarenes of frogs in the Philippines. Oryx 36: 14-15.

Alcala, A. C. 1955. Observations on the life history and ecology of *Rana erythraea* Schlegel, on Negros Island, Philippines. Silliman Journal 2:175-192.

Alcala, A. C. 1956. *Kaloula picta* on Negros Island. Silliman Journal 31:44-146.

Alcala, A. C. 1957. Philippine notes on the ecology of the giant marine toad. Silliman Journal 4:90-96.

Alcala, A. C. 1958. Amphibians on Negros Island, including two new records. Silliman Journal 5:171-174.

Alcala, A. C. 1962. Breeding behavior and early development of frogs of Negros, Philippines Islands. Copeia 1962:679-726.

Alcala, A. C. 1967. Population biology of the "flying" lizards, *Draco volans*, on Negros Island, Philippines. University of the Philippines Natural and Applied Sciences Bulletin 20:335-372.

Alcala, A. C. 1970. Notes on the population biology of the lizard *Mabuya multicarinata*. The Philippine Biota 3:591-611.

Alcala, A. C.. 1980. Observations on the ecology of the Pacific Hawksbill turtle in the central Visayas, Philippines. Fisheries Research Journal of the Philippines 5:42-52.

Alcala, A. C. 1986. Guide to Philippine Flora and Fauna. Vol X, Amphibians and Reptiles. Natural Resource Management Center, Ministry of Natural Resource Management Center, Ministry of Natural Resources and the University of the Philippines, Manila, Philippines. 195 pp.

Alcala, A. C. and W. C. Brown. 1955a. Observations on amphibians of the Mount Halcon and Canlaon areas, Philippine Islands. Silliman Journal 2:93-102.

Alcala, A. C. and W. C. Brown. 1955b. Discovery of the frog *Cornufer guentheri* on Negros Island, Philippines, with observations on its life history. Herpetologica 13:182-184.

Alcala, A. C. and W. C. Brown. 1956. Early life history of two Philippine frogs with notes on egg deposition. Herpetologica 12:241-246.

Alcala, A. C. and W. C. Brown. 1966. Thermal relations of two tropical island lizards on Negros Island, Philippine Islands. Copeia 1966:593-594.

Alcala, A. C. and W. C. Brown. 1967. Population ecology of the tropical scincoid lizard. *Emoia atrocostata*, in the Philippines. Copeia 1967:596-604.

Alcala, A. C. and W. C. Brown. 1982. Reproductive biology of some species of *Philautus* (Rhacophoridae) and other Philippine anurans. Kalikasan, Philippine Journal of Biology 11:203-226.

Alcala, A. C. and W. C. Brown. 1987. Notes on the microhabitat of the Philippine discoglossid frog *Barbourula busuangensis*. Silliman Journal 34:12-17.

Alcala, A. C. and W. C. Brown. 1998. Philippine Amphibians: an Illustrated Field Guide. Bookmark Press, Makati City, Philippines. 113 pp.

Alcala, A. C. and W. C. Brown. 1999. Philippine frogs of the genus *Platymantis* (Amphibia: Ranidae). Philippine Journal of Science 128:281-287.

Alcala, A. C., W. C. Brown, and A. C. Diesmos. 1998. Two new species of the genus *Platymantis* (Amphibia: Ranidae) from Luzon Island, Philippines. Proceedings of the California Academy of Sciences 50:381-388.

Alcala, A. C. and C. C. Custodio. 1995. Status of endemic Philippine amphibian populations. Sylvatrop: the Technical Journal of Philippine Ecosystems and Natural Resources 5:72-86.

Alcala, A. C., C. C. Custodio, A. C. Diesmos, and J. C. T. Gonzales. 1995. List of amphibians of Mt. Makiling, Laguna, Philippines, with notes on their population status. Sylvatrop: the Technical Journal of Philippine Ecosystems and Natural Resources 5:65-71.

Alcala, A. C., G. Joermann, and J. Brzoska. 1986. Mating calls of certain Philippine anurans (Microhylidae, Ranidae). Silliman Journal 33:31-44.

Alcala, A. C. and D. S. Rabor. 1957. Breeding habit and variation of *Kaloula conjuncta negrosensis* Taylor on Negros Island, Philippines. Silliman Journal 4:14-16.

Alcala, A. C., C. A. Ross, and E. L. Alcala. 1987. Observations on reproduction and behavior of captive Philippine crocodiles (*Crocodylus mindorensis* Schmidt). Silliman Journal 34:18-28.

Alcala, N. and A. C. Alcala. 1980. Growth and annual reproductive pattern of *Rana c. cancrivora* on Negros Island, Philippines. The Philippine Biota 15:57-68.

Allison, A. 1996. Zoogeography of amphibians and reptiles of New Guinea and the Pacific region. Pp. 407-436. In: Keast, A. and S. E. Miller (Eds.). The Origin and Evolution of Pacific Island Biotas, New Guinea to Eastern Polynesia: Patterns and Processes. SPB Academic Publishing, Amsterdam, The Netherlands.

Allison, A. and F. Kraus. 2001. New species of *Platymantis* (Anura: Ranidae) from New Ireland. Copeia 2001:194-202.

Alviola, P. A., J. C. T. Gonzales, A. T. L. Dans, L. E. Afuang, and A. B. Dimapilis. 1998. Herpetofauna of Puerto Galera, Mindoro Island, Philippines. Sylvatrop: The Technical Journal of Philippine Ecosystems and Natural Resources 8: 86-93.

Auffenberg, W. 1988. Gray's monitor lizard. University of Florida Press, Gainesville, Florida. 419 pp.

Auffenberg, W. and T. Auffenberg. 1988. Resource partitioning in a community of Philippine skinks (Sauria: Scincidae). Bulletin of the Florida State Museum of Biological Sciences 32:151-219.

Auffenberg, W. and T. Auffenberg. 1989. Reproductive patterns in sympatric Philippine skinks (Sauria: Scincidae). Bulletin of the Florida State Museum of Biological Sciences 34:201-247.

Bacolod, P. T. 1984. Notes on a snake fishery on Gato Islet, Cebu City, Philippines, and a proposal for a conservation and management program. The Philippine Scientist 21:155-163.

Bacolod, P. T. 1990. The biology of some commercially important species of sea snakes (Hydrophiidae) in the Visayas Sea. The Philippine Scientist 27:61-88.

Banks, C. B. 1995. Melbourne Zoo's partnership role in the conservation of threatened endemic Philippine fauna. Sylvatrop: the Technical Journal of Philippine Ecosystems and Natural Resources 5:105-112.

Banks, C. B. 1999. Philippine frogs assessed. Froglog 33:1.

Bawa, K. S., R. Primack, and D. Woddruff. 1990. Conservation of biodiversity: a southeast Asian perspective. Trends in Ecology and Evolution 5:394-396.

Bayless, M. K., and J. A. Adragna. 1997. Monitor lizards in the Philippine Islands: a historical perspective (Sauria: Varanidae). Asia Life Sciences 6:39-50.

Bennett, D. 1999a. Preliminary survey and status report for *Varanus olivaceus* on Polillo Island. Pp. 9-28. In: Bennett, D. (Ed.). Wildlife of Polillo Island, Philippines: Oxford University-University of the Philippines at Los Baños Polillo Final Report. Viper Press, Glossup, Great Britain.

Bennett, D. 1999b. Notes on *Varanus salvator marmoratus* on Polillo Island, Philippines. Pp. 29-32. In: Bennett, D. (Ed.). Wildlife of Polillo Island, Philippines: Oxford University-University of the Philippines at Los Baños Polillo Final Report. Viper Press, Glossup, Great Britain.

Boettger, O. 1893. Neue reptilien und batrachier aus West-Java. *Zool. Anz.* 16:334-340.

Boulenger, G. A. 1882. Catalogue of the Batrachia Saliente s Ecaudata in the collection of the British Museum. London: Taylor and Francis. 126 pp.

Boulenger G. A. 1894. On the herpetological fauna of Palawan and Balabac. Annals and Magazine of Natural History 80:6-90.

Boulenger G. A. 1920. A monograph of the South Asian, Papuan, Melanesian and Australian frogs of the genus *Rana*. Records of the Indian Museum 20:1-126.

Brown, R. M. 1997. Systematic Evolution in the *Rana signata* Complex of Philippine and Bornean Stream Frogs: Huxley's Modification of Wallace's Line Reconsidered at the Oriental-Australian Faunal Zone Interface. Unpublished M.S. thesis, Miami University, Oxford, Ohio. ii + 74 pp.

Brown, R. M. and A. C. Alcala. 2000. Geckos, cave frogs, and small land-bridge islands in the Visayan sea. Haring Ibon 2:19-22.

Brown, R. M. and A. C. Diesmos. 2001. Application of lineage-based species concepts to oceanic island frog populations: the effects of differing taxonomic philosophies on the estimation of Philippine biodiversity. This volume.

Brown, R. M., and A. C. Diesmos. 2000. The lizard genus *Luperosaurus*: taxonomy, history, and conservation prospects for some of the world's rarest lizards. Sylvatrop, The Technical Journal of Philippine Ecosystems and Natural Resources 10: 107-124.

Brown, R. M., J. W. Ferner, and L. A. Ruedas. 1995a. A new species of lygosomine lizard (Reptilia; Lacertilia; Scincidae; *Sphenomorphus*) from Mt. Isarog, Luzon Island, Philippines. Proceedings of the Biological Society of Washington 108:18-28.

Brown, R. M., J. W. Ferner, & R. V. Sison. 1995b. Rediscovery and redescription of *Sphenomorphus beyeri* (Reptilia: Lacertilia: Scincidae) from the Zambales Mountains, Luzon Island, Philippines. Proceedings of the Biological Society of Washington 108:6-17.

Brown, R. M., J. W. Ferner, R. V. Sison, P. C. Gonzales, & R. S. Kennedy. 1996. Amphibians and reptiles of the Zambales Mountains of Luzon Island, Republic of the Philippines. Herpetological Natural History 4:1-22.

Brown, R. M., J. W. Ferner, and A. C. Diesmos. 1997. Definition of the Philippine parachute gecko, *Ptychozoon intermedium* Taylor 1915 (Reptilia; Lacertilia, Gekkonidae): redescription, designation of a neotype, and comparisons with related species. Herpetologica 53:357-373.

Brown, R. M., and S. I. Guttman. In press. Systematic evolution in the *Rana signata* complex of Philippine and Bornean stream frogs: reconsideration of Huxley's modification of Wallace's Line at the Oriental-Australian faunal zone interface. Biological Journal of the Linnean Society.

Brown, R. M. and D. T. Iskandar. 2000. Nest site selection, larval hatching, and advertisement calls, of *Rana arathooni* (Amphibia; Anura; Ranidae) from southwestern Sulawesi (Celebes) Island, Indonesia. Journal of Herpetology 34:404-413.

Brown, R. M., J. A. McGuire, J. W. Ferner, & A. C. Diesmos. 1999a. A new species of diminutive scincid lizard (Squamata; Lygosominae; *Sphenomorphus*) from Luzon Island, Republic of the Philippines. Copeia 1999:362-370.

Brown, R. M., A. E. Leviton, & R. V. Sison. 1999b. Description of a new species of *Pseudorabdion* (Serpentes: Colubridae) from Panay Island, Philippines with a revised key to the genus. Asiatic Herpetological Research 8:7-12.

Brown, R. M., J. A. McGuire, and A. C. Diesmos. 2000a. Status of some Philippines frogs referred to *Rana everetti* (Anura: Ranidae), description of a new species, and resurrection of *R. igorota* Taylor 1922. *Herpetologica* 56:81-104.

Brown, R. M., J. A. McGuire, J. W. Ferner, N. Icarangal, and R. S. Kennedy. 2000b. Amphibians and reptiles of Luzon Island, II: preliminary report on the herpetofauna of Aurora Memorial National Park, Philippines. Hamadryad 25:175-195.

Brown, R. M., J. Supriatna, and H. Ota. 2000c. Discovery of a new species of *Luperosaurus* (Squamata; Gekkonidae) from Sulawesi, with a phylogenetic analysis of the genus, and comments on the status of *L. serraticaudus*. Copeia 2000:191-209.

Brown, R. M., A. E. Leviton, J. W. Ferner, and R. V. Sison. 2001. A new species of snake in the genus *Hologerrhum* (Reptilia; Squamata; Serpentes) from Panay Island, Philippines. Asiatic Herpetological Research 9:9-22.

Brown, R. M., R. Fernandez, C. Rivero, R. Buenviaje, and A. Diesmos. 2002. Mt. Isarog's herpetological wonders. Haring Ibon 3:12-16.

Brown, W. C. 1997. Biogeography of amphibians in the islands of the southwest Pacific. Proceedings of the California Academy of Sci-

ences 50: 21-38.
Brown, W. C. and A. C. Alcala. 1955. Observations on amphibians of Mount Halcon and Mount Canlaon areas, Philippine Islands. Silliman Journal 2: 93-105.
Brown, W. C. and A. C. Alcala. 1956. A review of the Philippine lizards of the genus *Lygosoma* (*Leiolopisma*). Occasional Papers of the Natural History Museum of Standfor University 3:1-10.
Brown, W. C. and A. C. Alcala. 1961. Populations of amphibians and reptiles in submontane and montane forests of Cuernos de Negros, Philippine Islands. Ecology 42:628-636.
Brown, W. C. and A. C. Alcala. 1963a. Additions to the Leiolopismid lizards known from the Philippines, with descriptions of new species and subspecies. Proceedings of the Biological Society of Washington 76:69-80.
Brown, W. C. and A. C. Alcala. 1963b. A new frog of the genus *Cornufer* (Ranidae) with notes on other amphibians known from Bohol Island, Philippines. Copeia 1963:672-675.
Brown, W. C. and A. C. Alcala. 1963c. Relationships of the herpetofauna of the non-dipterocarp communities to that of the dipterocarp forest of southern Negros Island, Philippines. Senckenbergiana Biologica 45:591-611
Brown W. C. and Alcala A. C. 1967. A new frog of the genus *Oreophryne* and a list of the amphibians from Camiguin Island, Philippines. Proceedings of the Biological Society of Washington 80: 65-68.
Brown, W. C. and A. C. Alcala. 1970a. The zoogeography of the Philippine Islands, a fringing archipelago. Proceedings of the California Academy of Science 38:105-130.
Brown, W. C. and A. C. Alcala. 1970b. A new species of the genus *Platymantis* (Ranidae) with a list of the amphibians known from South Gigante Island, Philippines. Occasional Papers of the California Academy of Science 84:1-7.
Brown, W. C. and A. C. Alcala. 1970c. Population ecology of the frog *Rana erythraea* in southern Negros, Philippines. Copeia 1970:611-622.
Brown, W. C. and A. C. Alcala. 1974. A new frog of the genus *Platymantis* (Ranisae) from the Philippines. Occasional Papers of the California Academy of Sciences 113:1-12.
Brown, W. C. and A. C. Alcala. 1977. A new frog of the genus *Rana* from the Philippines. Proceedings of the Biological Society of Washington 90:669-675.
Brown, W. C. and A. C. Alcala. 1978. Philippine Lizards of the Family Gekkonidae. Silliman University Press, Dumaguete City, Philippines. 146 pp.

Brown, W. C. and A. C. Alcala. 1980. Philippine Lizards of the Family Scincidae. Silliman University Press, Dumaguete City, Philippines. 264 pp.
Brown, W. C. and A. C. Alcala. 1982a. A new cave *Platymantis* (Amphibia: Ranidae) from the Philippine Islands. Proceedings of the Biological Society of Washington 95:386-391.
Brown, W. C. and A. C. Alcala. 1982b. Modes of reproduction of Philippine anurans. Pp. 416-428. In: A. G. J. Rodin and K. Miyata (Eds.). Advances in Herpetology and Evolutionary Biology. Museum of Comparative Biology, Cambridge, MA, USA.
Brown, W. C. and A. C. Alcala. 1986. Comparison of the herpetofaunal species richness on Negros and Cebu Islands, Philippines. Silliman Journal 33:74-86.
Brown W. C. and A. C. Alcala. 1994. Philippine frogs of the family Rhacophoridae. Proceedings of the California Academy of Sciences 48:185-220.
Brown W. C., R. M. Brown, and A. C. Alcala. 1997a. Species of the *hazelae* group of *Platymantis* (Amphibia: Ranidae) from the Philippines, with descriptions of two new species. Proceedings of the California Academy of Sciences 49:405-421.
Brown W. C., A. C. Alcala, and A. C. Diesmos. 1997c. A new species of the genus *Platymantis* (Amphibia: Ranidae) from Luzon Island, Philippines. Proceedings of the Biological Society of Washington 110:18-23.
Brown W. C., A. C. Alcala, A. C. Diesmos, and E. Alcala. 1997b. Species of the *güntheri* group of *Platymantis* with descriptions of four new species. Proceedings of the California Academy of Sciences 50:1-20.
Brown, W. C., A. C. Alcala, and R. M. Brown. 1998. Taxonomic status of *Cornufer worcesteri*. Journal of Herpetology 33:131-133.
Brown W. C., A. C. Alcala, P. S. Ong, and A. C. Diesmos. 1999a. A new species of *Platymantis* (Amphibia: Ranidae) from the Sierra Madre Mountains of Luzon Island, Philippines. Proceedings of the Biological Society of Washington 112:510-514.
Brown W. C., A. C. Alcala, and A. C. Diesmos. 1999b. Four new species of the genus *Platymantis* (Amphibia: Ranidae) from Luzon Island, Philippines. Proceedings of the California Academy of Sciences 51:449-460.
Brown, W. C., R. M. Brown, A. C. Alcala, and D. Frost. 1997d. Replacement name for *Platymantis reticulatus* Brown, Brown, and Alcala, 1997 (Ranidae: Raninae). *Herpetological Review* 28:131.

Brown, W. C. and R. F. Inger. 1964. The taxonomic status of the frog *Cornufer dorsalis* A. Dumeril. Copeia 1964:450-451.
Brown, W. C. and A. E. Leviton. 1961. Discovery of the snake genus *Opisthotropis* in the Philippine Islands, with description of a new species. Occasional Papers of the Natural History Museum of Stanford University 8:1-5.
Brown, W. C. and D. S. Rabor. 1967a. A new sphenomorphid lizard from Palawan Island, Philippines. Occasional Papers of the California Academy of Sciences 32:1-4.
Brown, W. C. and D. S. Rabor. 1967b. Review of the genus *Brachymeles* (Scincidae), with descriptions of new species and subspecies. Proceedings of the California Academy of Sciences 34:525-548.
Brown, W. C. and A. Y. Reyes. 1956. Observations on the incubation period and on hatchlings of several oviparious species. Silliman Journal 3:139-143.
Brzoska, J., G. Joermann, and A. C. Alcala. 1986. Structure and variability of the calls of *Polypedates leucomystax* (Amphibia: Rhacophoridae) from Negros, Philippines. Silliman Journal 33:87-103.
Buskirk, J. R. 1989. A third specimen and neotype of *Heosemys leytensis* (Chelonia: Emydidae). Copeia 1989:224-227.
Chan-ard, T., W. Grossman, A. Gumprecht, and K.-D. Schultz. 1999. Amphibians and Reptiles of Peninsular Malaysia: an Illustrated Checklist. Bushmaster Publications, Wuerselen, Germany. 239 pp.
Chou, W.-H. and J.-Y. Lin. 1997. Tadpoles of Taiwan. Special Publication No. 7, National Museum of Natural Science. Ching-I Peng, Taichung, Taiwan. 98 pp.
Collins, N. M., J. A. Sayer, and T. C. Whitmore. 1991. The Conservation Atlas of Tropical Forests: Asia and the Pacific. Simon and Schuster, New York, NY, USA. 379 pp
Conservation International, Fauna and Flora International, and the IUCN Species Survival Commission. 1999. The global amphibian campaign. Sylvatrop: The Technical Journal of Philippine Ecosystems and Natural Resources 8:126-139.
Cox, M. J., P. P von Dijk, J. Nabhitabhata, and K. Thirakhupt. 1998. A Photographic Guide to Snakes and Other Reptiles of Peninsular Malaysia, Singapore, and Thailand. Ralph Curtis Books, Sanibel Island, Florida, USA. 144 pp.
Cox, M. J. 1991. The Snakes of Thailand and Their Husbandry. Krieger Publishing Co., Malabar, Florida, USA. 526 pp.
Crombie, R. I. 1992. A review of "Lizards of the Orient: a Checklist" by Welch, K. R. G., P. S. Cooke, and A. S. Wright. Copeia 1992:590-594.

Custodio, C. C. 1986. Altitudinal distribution of lizards of the Scincidae in Mt. Makiling, Laguna. Sylvatrop: the Technical Journal of Philippine Ecosystems and Natural Resources. 1:181-202.
Das, I. 1995. Turtles and Tortoises of India. Oxford University Press, Bombay, India. 179 pp.
Das, I. 1996a. First record of *Heosemys spinosa* from the Philippines, with biogeographic notes. Chelonian Conservation and Biology 2:80-82.
Das, I. 1996b. Bibliography of the Reptiles of South Asia. Krieger Publishing Co., Malabar, FL, USA 87 pp.
Das, I. 1998. Herpetological Bibliography of Indonesia. Krieger Publishing Co., Malabar, FL, USA. 92 pp.
Das, I. and J. K. Charles. 1994. Observations on the diet and microhabitat use by *Platymantis dorsalis* A Dueril 1853 (Aura: Ranidae) at Mount Makiling, Los Baños, Philippines. Hamadryad 19:76-78.
David, P. 1996. Museums and the Natural Environment: the Role of Natural History Museums in Biological Conservation. Leicester University Press, London, UK.
David, P. and G. Vogel. 1996. The Snakes of Sumatra. Edition Chimaira, Frankfurt am Main, Germany. 260 pp.
De Celis, N C. 1995. The status of research, exploitation, and conservation of marine turtles in the Philippines. Pp. 323-326 In: Bjorndal, K. A. (ed.) Biology and conservation of sea turtles, revised edition. Smithsonian Institution Press, Washington, DC, USA.
Denzer, W., K. Henle, M. Gaulke, J. Margraf, and P.P. Milan. 1999. An annotated checklist of the reptiles and amphibians of Leyte, Philippines, with notes on their ecology and conservation. Annals of Tropical Research 16: 44-70.
Department of the Environment and Natural Resources (DENR) and Philippine Airlines Foundation, Inc (PALF). 1998. Our Heritage: the Protected Areas of the Philippines. Department of the Environment and Natural Resources and Philippine Airlines Foundation, Manila, Philippines. 202 pp.
Department of the Environment and Natural Resources (DENR) and United Nations Environmental Programme (UNEP). 1997. Philippine Piodiversity: an Assessment and Action Plan. Bookmark, Inc., Makati City, Philippines. 298 pp.
Diesmos, A. C. 1998. The Amphibian Faunas of Mt. Banahao, Mt. San Cristobal, and Mt. Maquiling, Luzon Island, Philippines. Unpublished MS thesis, University of the Philippines at Los Baños, College, Laguna, Philippines. 115 pp.
Diesmos, A. C. 2000. Where the frogs are. Haring Ibon 2:6-10.

Diesmos, A. C. 2001. Amazing herps. Haring Ibon 3:15-17.
Diesmos, A. C., R. M. Brown, and A. C. Alcala. In review. A new species of narrow-mouthed frog (Amphibia: Anura: Microhylidae; genus *Kaloula*) from the mountains of southern Luzon and Polillo Islands, Philippines. Copeia.
van Dijk, P. P., B. L. Stuart, and A. G. J. Rhodin. 2000. Asian turtle trade: proceedings of a workshop on conservation and trade of freshwater turtles and tortoises in Asia. Chelonian Research Monographs 2:1-164.
Domantay, J. A. 1953. The turtle fisheries of the turtle islands. Bulletin of the Fisheries Society of the Philippines 3 & 4:3-27.
Dubois, A. 1992. Notes sur la classification des Ranidae (Amphibiens, Anoures). Bulletin Mensual Societé Linnéenne de Lyons 61:305-352.
Dubois, A. and A. Ohler. 2000. Systematics of *Fejervarya limnocharis* (Gravenhorst, 1829) (Amphibia, Anura, Ranidae) and related species. 1. Nomenclatural status of the nominal species *Rana limnocharis* Gravenhorst, 1829. Alytes 2000:15-50.
Duellman, W. E. 1993. Amphibian Species of the World: Additions and Corrections. The University of Kansas Museum of Natural History, Lawrence, Kansas. 372 pp.
Duellman, W. E. and L. S. Trueb. 1994. Biology of Amphibians. The Johns Hopkins University Press, Baltimore, MD. 670 pp.
Dutta, S. K. and M. Manamendra-Arachichi. 1996. The amphibian fauna of Sri Lanka. Wildlife Heritage Trust, Colombo, Sri Lanka. 230 pp.
Emerson, S. B. 1996. Phylogenies and physiological processes-the evolution of sexual dimorphism in southeast Asian fanged frogs. Systematic Biology 45:278-289.
Emerson, S. E. and D. Berrigan. 1993. Systematics of Southeast Asian ranids: multiple origins of voicelessness in the subgenus *Limnonectes* (Fitzinger). Herpetologica 49:22-31.
Emerson S. E., R. F. Inger, and D. Iskandar. 2000. Molecular systematics and biogeography of the fanged frogs of southeast Asia. Molecular Phylogenetics and Evolution 16: 131-142.
Environmental Center of the Philippines Foundation. 1998. Environment and Natural Resources Atlas of the Philippines. Environmental Center of the Philippines Foundation, Manila. 394 pp.
Erdelem, W. 1998. Trade in lizards and snakes in Indonesia -Biogeography, ignorance, and sustainability. Pp. 69-84 In: Erdelen, W. (Ed.) Conservation, Trade and Sustainable Use of Lizards and Snakes in Indonesia. Mertensiella, suppliment zu Salmandra 9.

Ferner, J. W., R. M. Brown, and A. E. Greer. 1997. A new genus and species of moist closed canopy forest skinks from the Philippines. Jour. Herpetol. 31:187-192.
Ferner, J. W., R. M. Brown, R. V. Sison, and R. S. Kennedy. 2001. The amphibians and reptiles of Panay Island. Asiatic Herpetological Re search 9:34-70.
Foster, M. S. 1982. The research natural history museum: pertinent or passe? Biologist 54:1-12.
Fritz, U., M. Gaulke, and E. Lehr. 1997. Revision der südostaiatischen Dornschildkroten-Gattung *Cyclemys* Bell, 1834, mit Beschreibung einer neuen Art. Salamandra 33:183-212.
Frost, D. R. 1985. Amphibian Species of the World. Allen Press and the Association of Systematic Collections, Lawrence, KS, USA. 732 pp.
_____. 2000. Amphibian species of the world: an online reference. Version 2.20. electronic database available at http://research.amnh.org/herpetology/amphibia/index.html. American Museum of Natural History, New York.
Gaulke, M. 1989a. Zur Biologie des Bindenwaranes, unter Berücksichtigung der palaoggeographischen Verbreitung und der phylogenetischen Entwicklung der Varanidae. Courier Forschungsinstitut Senckenberg 112:1-242.
Gaulke, M. 1989b. Distribution, population status and exploitation of *Varanus salvator* in the Philippines. Pp. 27-36 In: Luxmoore, R., and B. Groombridge (Eds.), Asian Monitor Lizards, a Review of Distribution, Status, Exploitation, and Trade in Four Selected Species. CITES Reports, Cambridge, UK.
Gaulke, M. 1991a. On the diet of the water monitor, *Varanus salvator*, in the Philippines. Mertensiella 15:143-153.
Gaulke, M. 1991b. Systematic relationships of the Philippine water monitors as compared with *Varanus salvator salvator*, with a discussion of possible dispersal routes. Mertensiella 15:154-167.
Gaulke, M. 1992a. Taxonomy and biology of the Philippine monitors (*Varanus salvator*). Philippine Journal of Science 121:345-381.
Gaulke, M. 1992b. Distribution, population density, and exploitation of the water monitor in the Philippines. Hamadryad 17:21-27.
Gaulke, M. 1993. Beobachtungen an Flugdrachen auf dem Sulu-Archipel. Salamaandra 28:251-257.
Gaulke, M. 1994a. Contribution to the snake fauna of the Sulu archipelago with the description of a new subspecies of *Dendrelaphis caudolineatus* (Gray, 1834). Herpetological Journal 4:136-144.
Gaulke, M. 1994b. Notes on the herpetofauna of Panaon and Samar, east

Visayas, Philippines. Hamadryad 19:1-10.
Gaulke, M. 1995a. Der Sulu-Arphipel-Besiedlungsgsgeschichte, geologie und herpetofauna. Natur und Museum 125:217-226.
Gaulke, M. 1995b. Observations on arboreality in a Philippine blind snake. Asiatic Herpetological Research 6:45-48.
Gaulke, M. 1996. Die herpetofauna von Sibutu Island (Philippinen), unter Berücksichtigung zoogeographischer und okologischer aspekte. Senckenbergiana biologica 75:45-56.
Gaulke, M. 1998. Utilization and conservation of lizards and snakes in the Philippines. Pp. 137-142 In: Erdelen, W. (Ed.) Conservation, Trade and Sustainable Use of Lizards and Snakes in Indonesia. Mertensiella, suppliment zu Salmandra 9.
Gaulke, M. 1999. Die herpetofauna von Calauit Island (Calaamiaanes-Inseln, Provinz Palawan, Philippinen) (Amphibia et Reptilia). Faunistische Abhandlungen 21:273-282.
Gaulke, M. 2001a. Die Herpetofauna von Sibaliw (Panay), einem der letzten Tieflandregenwaldgebiete der West-Visayas, Philippinen - Teil I: amphibien und anmerkungen zu einer schildkrotenart. Herpetofauna 23(1):1-14.
Gaulke, M. 2001b. Die Herpetofauna von Sibaliw (Panay), einem der letzten Tieflandregenwaldgebiete der West-Visayas, Philippinen - Teil II: schlangen. Herpetofauna 23(1):15-34.
Gaulke, M. 2001c. Die Herpetofauna von Sibaliw (Panay), einem der letzten Tieflandregenwaldgebiete der West-Visayas, Philippinen - Teil III: echsen und discussion. Herpetofauna 23(2):5-18.
Gaulke, M. 2002. A new species of *Lycodon* from Panay Island, Philippines (Reptilia, Serpentes, Colubridae). Spixiana 25:85-92.
Gaulke, M. and A. V. Altenbach. 1994. Contribution to the knowledge of the snake fauna of Masbate (Philippines). Herpetozoa 7:63-66.
Gaulke, M., and E. Curio. 2001. A new monitor lizard from Panay Island, Philippines (Reptilia, Sauria, Varanidae). Spixiana 24:275-286
Gaulke, M. and U. Fritz. 1998. Distribution patterns of batagurid turtles in the Philippines. Herpetozoa 11:3-12.
Gonzales, J. C. T. 1995. State of the art report on Philippine reptiles. Sylvatrop, the Technical Journal of Philippine Ecosystems and Natural Resources 5: 115.
Gonzales, J. C. T., L. E. Afuang, and R. R. de Veyra. 1997. Reptiles. Pp. 47-95 In: Wildlife Conservation Society of the Philippines (Eds.) Philippine Red Data Book. Bookmark Publishing, Makati City, Philippines.
Gonzales, J. C. T. and A. T. L. Dans. 1994. Microhabitats of endemic

dimunitive frogs and skinks in Mount Makiling Forest Reserve, Luzon, Philippines. Asia Life Sciences 3:227-243.
Goodman, S. M. and S. M. Lanyon. 1994. Scientific collecting. Conservation Biology 8:314-315.
Griffin, P. B. and A. Estioko-Griffin. 1985. The Agta of Northeastern Luzon: Recent Studies. San Carlos Publications, Cebu City. 189 pp.
Gumprecht, A. 2001. Die Bambusottern der Gattung Trimeresurus Lacepede Teil V: Die philippinischen Bambusottern I: Die Philippinen oder Gelbflecken-Bambusotter Trimeresurus flavomaculatus (Gray, 1842). Sauria 23:3-14.
Gyi, K. 1970. A revision of the colubrid snakes of the subfamily Homolopsinae. Miscellaneous Publications of the University of Kansas Museum of Natural History 29:47-223.
Hall, R. 1996. Reconstructing Cenozoic SE Asia. Pp 153-184 In: Tectonic evolution of Southeast Asia. Hall, R., and D. Blundell (Eds.). Geological Society, London.
Hall, R. 1998. The plate tectonics of Cenozoic SE Asia and the distribution of land and sea. Pp: 99-132 In: Biogeography and geological evolution of Southeast Asia Hall, R., and J. D. Holloway (Eds). Brackhuys, Leiden.
Hampson, K. 1999a. An account of the amphibian species found on Polillo island, Philippines. Pp. 33-40. In: Bennett. D (Ed.). Wildlife of Polillo Island, Philippines: Oxford University-University of the Philippines at Los Baños Polillo Final Report.Viper Press, Glossup, Great Britain.
Hampson, K. 1999b. An investigation into the amphibian assemblages of Polillo Island, Philippines. Pp. 41-86. In: Bennett. D (Ed.). Wildlife of Polillo Island, Philippines: Oxford University-University of the Philippines at Los Baños Polillo Final Report.Viper Press, Glossup, Great Britain.
Hampson, K. 2001. An investigation of habitat type and forest edge effects on a Philippine amphibian assemblage. Unpublished undergraduate honors thesis, Oxford University. Pp 56.
Hawksworth, D. L., and L. A. Mound. 1991. Biodiversity databases: the crucial significance of collections. Pp. 17-29. In: Hawksworth, D. L. (Ed.). The Biodiversity of Microorganisms and Invertebrates: its Role in Sustainable Agriculture. Proceedinsg of the first workshop on the ecological foundations of sustainable agriculture. Commonwealth Agricultural Bureaux International, Oxon, UK.
Heaney, L. R. 1985. Zoogeographic evidence for middle and late Pleistocene land bridges to the Philippines. Modern Quaternary

Research of SE Asia 9:127-143.
Heaney, L. R. 1986. Biogeography of small mammals in SE Asia: estimates of rates of colonization, extinction and speciation. Biological Journal of the Linnean Society 28:127-165.
Heaney, L. R., A. Diesmos, B. Tabaranza, A. Mallari, R. Brown, and G. Gee. 2000. Beacon of hope; a first report from Kalinga Province in the northern Central Cordillera. Haring Ibon 2:14-18.
Heaney, L. R., P. C. Gonzales, R. C. B. Utzurrum, and E. R. Rickart. 1991. The mammals of Catanduanes Island: implications for biogeography of small land-bridge islands in the Philippines. Proceedings of the Biological Society of Washington 104:399-415.
Heaney, L. H., and R. A. Mittermeier. 1997. The Philippines. Pp 236-255 In: Mittermeier, R. A., P. Robles Gil, and G. G. Mittermeier (Eds.) Megadiversity: earth's biologically wealthiest nations. CEMEX, Monterrey, Mexico.
Heaney, L. H., P. Ong, R. A. Mittermeier, and C. G. Mittermeier. 1999. The Philippines. Pp. 308-317 In: Mittermeier, R. A., N. Myers, P. R. Gil, and C. G. Mittermeier (Eds), Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecosystems. CEMEX, Monterrey, Mexico.
Heaney, L. H., & J. C. Regalado. 1998. Vanishing treasures of the Philippine rain forest. The Field Museum, Chicago. IL, USA. 88 pp.
Heaney, L. R., and E. R. Rickart. 1990. Correlation of clades and clines: geographic, elevational, and phylogenetic distribution patterns among Philippine mammals. Pp. 321-332. In: Peters, G. and R. Huterer (Eds). Vertebrates in the Tropics. Zoologisches Forschungsinstitut und Museum 2Alexander Koenig, Leiden, The Netherlands.
Hedges, B. S. and R. Thomas. 1991. The importance of systematic research in the conservation of amphibians and reptile populations Pp 56-61. In: Moreno, J. A. (Ed.) Status y Distribucion de los Reptiles y Amfibios de la Region de Puerto Rico. Departmento de Recursos Naturales de Puerto Rico, Publicacion Cientifica Miscelanea 1.
Helfenberger, N. 2001. Phylogenetic relationships of the old world ratsnakes based on visceral organ topography, osteology, and allozyme variation. Supplement to Russian Journal of Herpetology 2001:1-62.
Heyer, W. R., M. A. Donnelly, R. W. McDiarmid, L.-A. C. Hayek, & M. S. Foster. 1994. Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians. Smithsonian Institution Press, Washington DC, USA. 364 pp.

Hicks, N. 2000. The National Parks and Other Wild Places of the Philippines. New Holland Publishers, London, UK. 175 pp.
Hilton-Taylor, C. 2000. 2000 IUCN Red List of Threatened Species. IUCN, Gland, Switzerland and Cambridge. 61 pp.
Hoagland, K. E. 1989. Socially-responsible: in the 1990s natural history museums will focuss their efforts on maintaining the diverse life of a healthy planet. Museum News, Sept./Oct.: 5052.
Hoogstral, H. 1951. Philippine Zoological Expedition 1946-1947: narrative and itinerary. Fieldiana: Zoology 33:1-86.
Inger, R. F. 1954. Systematics and zoogeography of Philippine Amphibia. Fieldiana 33:181-531.
Inger, R. F. 1958. A new gecko of the genus *Cyrtodactylus* with a key to the species from Borneo and the Philippines. Sarawak Museum Journal 8:261-264.
Inger, R. F. 1960a. Notes on the toads of the genus *Pelophryne*. Fieldiana 39:415-418.
Inger, R. F. 1960b. A review of the Oriental toads of the genus *Ansonia* Stoliczka. Fieldiana: Zoology 39:473-503.
Inger, R. F. 1966. The systematics and zoogeography of the Amphibia of Borneo. Fieldiana: Zoology 52:1-402.
Inger, R. F. 1983. Morphological and ecological variation in the flying lizards (genus *Draco*) Fieldiana: Zoology 18:1-35.
Inger, R. F. 1996. Commentary on a proposed classification of the family Ranidae. Herpetologica 52:241-246.
Inger, R. F. 1999. Distributions of amphibians in southern Asia and adjacent islands. Pp. 445-482. In: Duellman, W.E. (Ed.). Patterns of Distribution of Amphibians, a Global Perspective. John Hopkins University Press, Baltimore, MD, USA..
Inger, R. F. and W. C. Brown. 1980. Species of the scincid genus *Dasia* Gray. Fieldiana: Zoology 3:1-11.
Inger, R. F. and A. E. Leviton. 1966. The taxonomic status of Bornean snakes of the genus *Pseudorabdion* Jan and of the nominal genus *Idiopholis* Mocquard. Proceedings of the California Academy of Science 34:307-314, 3 figs.
Inger, R. F. and H. Marx. 1965. The systematics and evolution of the Oriental snake genus *Calamaria*. Fieldiana 49:1-304.
Inger, R. F. and R. B. Stuebing. 1989. Frogs of Sabah. Sabah Parks Trustees, Kota Kinabalu, Sabah, Malaysia. 132 pp.
Inger, R. F. and R. B. Stuebing. 1997. A Field Guide to the Frogs of Borneo. Science and Technology Unit, Sabah, Malayisa. 205 pp.
Inger, R. F. and F. L. Tan. 1996a. The Natural History of Amphibians and Reptiles in Sabah. Natural History Publications, Kota Kinabalu,

Sabah, Malaysia. 100 pp.
Inger, R. I. and F. L. Tan. 1996b. Checklist of the frogs of Borneo. Raffles Bulletin of Zoology 44:551-574.
Inger, R. F., H. K. Voris, and P. Walker. 1986. Larval transport in a Bornean ranid frog. Copeia 1986:523-525.
Inovejas, W. P. and M. E. Vergbara. 1985. The American bullfrog: tapped for lucrative farming in the Philippines. Habitat Philippines 5:30-44.
Iskandar, D. 1998. The Amphibians of Java and Bali. Research and Development Centre for Biology-LIPI, Bandung, Indonesia. 117 pp.
Iskandar, D. 2000. Turtles and Crocodiles of Insular Southeast Asia and New Guinea. PALmedia Citra, Bandung, Indonesia. 191 pp.
Iskandar, D. and E. Colijn. 2000. Preliminary checklist of the Southeast Asian and New Guinean herpetofuna. Treubi 31:1-134.
Iskandar, D. T. and K. N. Tjan. 1996. The amphibians and reptiles of Sulawesi, with notes on the distribution and chromosomal number of frogs. Pp. 39-46. In: Kitchener, D. J. and A. Suyanto (Eds.). Proceedings of the First International Conference on Eastern-Australian Vertebrate Fauna. Western Australian Museum for Lembaga Ilmu Pengetahuan Indonesia, Perth, Australia.
Iverson, J. B. 1992. A Revised Checklist with Distribution Maps of the Turtles of the World. Richmond, Indiana: privately printed, 363 pp.
Keng, F. L. L. and M. L. Tat-Mong. 1989. Fascinating Snakes of Southeast Asia. Tropical Press Sdn. Bhd., Kuala Lumpur, Malaysia. 124 pp.
Kikuchi Y. 1984. Mindoro Highlanders: the Life of Swidden Agriculturalists. New Day Publishers, Quezon City, Philippines. 211 pp.
Kraus, F., D. G. Mink, and W. M. Brown. 1996. Crotaline intergeneric relationships based on mitochondrial DNA sequence data. Copeia 1996:763-773.
Kummer, D. M. 1992. Deforestation in the Postwar Philippines. Ateneo De Manila University Press, Manila, Philippines. 178 pp.
Lanza, B. 1999. A new species of *Lycodon* from the Philippines, with a key to the genus (Reptilia Serpentes Colubridae). Tropical Zoology 12:89-104.
Lazell, J. 1992. New flying lizards and predictive biogeography of two Asian archipelagos. Bulletin of the Museum of Comparative Zoology 152:475-505.
Ledesma, M. M. 1999. Lizard diversity patterns along disturbance gradients in Polillo Island: implications for effective conservation.

Pp 87-103. In: Bennett. D. (Ed). Wildlife of Polillo Island, Philippines: Oxford University - University of the Philippines at Los Baños Polillo Island Final Report. Viper Press, Glossup, Great Britain.
Leh, M. U. 1996. The role of museums in biodiversity research and conservation. Pp 36-49. In: Turner, I. M., C. H. Diong, S. M. Lim, and P. K. L. Ng (Eds.). Biodiversity and the Dynamics of Ecosystems. The International Network for DIVERSITAS in the Western Pacific and Asia (DIWPA), Singapore.
Leviton A. E. 1955. New distributional records for Philippine amphibians. Copeia 1955:258.
Leviton, A. E. 1961. Description of a new subspecies of the Philippine snake *Dendrelaphis caudolineatus*. Occasional Papers of the Natural History Museum of Stanford University 9:1-6.
Leviton, A. E. 1962. Contributions to a review of Philippine snakes, I. The snakes of the genus *Oligodon*. Philippine Journal of Science 91:365-381.
Leviton A. E. 1963a. Remarks on the zoogeography of Philippine terrestrial snakes. Proceedings of the California Academy of Sciences 42:112-145.
Leviton, A. E. 1963b. Contributions to a review of Philippine Snakes, III. The genera *Maticora* and *Calliophis*. Philippine Journal of Science 92:523-550.
Leviton, A. E. 1964a. Contributions to a review of Philippine snakes, IV. The genera *Chrysopelea* and *Dryophiops*. Philippine Journal of Science 93:131-145.
Leviton, A. E. 1964b. Contributions to a review of Philippine snakes, V. The snakes of the genus *Trimeresurus*. Philippine Journal of Science 93:250-2760.
Leviton, A. E. 1964c. Contributions to a review of Philippine snakes, VI. The snakes of the genus *Oxyrhabdium*. Philippine Journal of Science 93:407-422.
Leviton, A. E. 1964d. Contributions to a review of Philippine snakes, VII. The snakes of the genera *Naja* and *Ophiophagus*. Philippine Journal of Science 93:530-550.
Leviton, A. E. 1965a. Contributions to a review of Philippine Snakes, VIII. The snakes of the genus *Lycodon* H. Boie. Philippine Journal of Science 94:117-140.
Leviton, A. E. 1965b. Contributions to a review of Philippine Snakes, IX. The snakes of the genus *Cyclocorus*. Philippine Journal of Science 94:519-533.
Leviton, A. E. 1967. Contributions to a review of Philippine Snakes, X.

The snakes of the genus *Ahaetulla*. Philippine Journal of Science 96:73-90.
Leviton, A. E. 1968. Contributions to a review of Philippine snakes, XII. The Philippine snakes of the genus *Dendrelaphis* (Serpentes: Colubridae). Philippine Journal of Science 97:371-396.
Leviton, A. E. 1979. Contributions to a review of Philippine snakes, XIII. The snakes of the Genus *Elaphe*. Philippine Journal of Science 106:99-128.
Leviton, A. E. 1983. Contributions to a review of Philippine snakes, XIV. The Snakes of the Genus *Xenopeltis, Zaocys, Psammodynastes*, and *Myersophis*. Philippine Journal of Science 112:195-223.
Leviton, A. E. and W. C. Brown. 1958. A review of the snakes of the genus *Pseudorabdion* with remarks on the status of the genera *Agrophis* and *Typhlogeophis* (Serpentes: Colubridae). Proceedings of the California Academy of Sciences 14:475-508.
Leviton, A. E. and W. C. Brown. 1959. A review of the genus *Pseudorabdion* with remarks on the status of the genera *Agrophis* and *Typhlogeophis* (Serpentes: Colubridae). Proceedings of the California Academy of Sciences 29:475-508.
Liat, L. B., and I. Das. 1999. Turtles of Borneo and Peninsular Malaysia. Natural History Publications, Kota Kinabalu, Sabah, Malaysia. 151 pp.
Lim, K. K. P. and F. L. K. Lim. 1992. A guide to the Amphibians and Reptiles of Singapore. Singapore Science Center, Singapore. 160 pp.
Liu, D. S., L. R. Iverson, and S. Brown. 1993. Rates and patterns of deforestation in the Philippines: application of geographic information system analysis. Forest Ecology and Management 57:1-16.
Lowman, M. D. and N. M. Nadkarni (Eds.). 1995. Forest Canopies. Academic Press, San Diego, CA. 202 pp.
Lopez, V. B. 1976. The Mangyans of Mindoro: an ethnohistory. University of the Philippines Press, Quezon City, Philippines. 178 pp.
Luxmoore, R. and B. Groombridge. 1989. Asian Monitor Lizards, a Review of Distribution, Status, Exploitation, and Trade in Four Selected Species. CITES Reports, Cambridge, UK.
Magbanua, C. S. A. 1991. Crocodile farm produces 272 crocodiles. Canopy International 16:12.
Malnate, E. V. and G. Underwood. 1988. Australasian natricine snakes of the genus *Tropidorophis*. Proceedings of the Academy of Natural Science of Philadelphia 140:59-201.
Malhotra, A., and R. S. Thorpe. 1997. New perspective on the evolution of South-East Asian pitvipers (genus *Trimeresurus*) from mo-

lecular studies. Pp. 115-118 In: R. S. Thorpe, W. Wüster, and A. Malhotra (Eds.) Venomous Snakes: Ecology, Evolution, and Snakebite. Symposium of the Zoological Society of London 70.
Malhotra, A., and R. S. Thorpe. 2000. A phylogeny of the *Trimeresurus* group of pit vipers: new evidence from a mitochondrial gene tree. Molecular Phylogenetics and Evolution 16:199-211.
Manthey, U., and W. Grossman. 1997. Amphibien und Reptilien Südostasiens. Natur und Tier, Verlag, Germany. 512 pp.
Matsui, M., T. Hikida, and R. C. Goris. 1989. Current Herpetology in East Asia. Herpetological Society of Japan, Kyoto, Japan. 520 pp.
McCord, W. P., J. B. Iverson, P. Q. Spinks, and H. B. Shaffer. 2000. A new genus of geomydid turtle from Asia. Hamadryad 25:86-90.
McDiarmid, R. W., J. A. Cambell, and T. A. Touré. 1999. Snake Species of the World: A Taxonomic and Geographic Reference. The Herpetologists' League, Washington DC, USA. 511 pp.
McDowell, S. B. 1974. A catalog of the snakes of New Guinea and the Solomons, with special reference to those in the Bernice P. Bishop Museum, Part I. Scolecophidia. Journal of Herpetology 8:1-57.
McGuire, J. A. and A. C. Alcala. 2000. A taxonomic revision of the flying lizards of the Philippine Islands (Iguania: Agamidae: *Draco*), with adescription of a new species. Herpetological Monograpgs 14:92-145.
McGuire, J. A. and B.H. Kiew. 2001. Phylogenetic systematics of Southeast Asian flying lizards (Iguania: Agamidae: *Draco*) as inferred from mitochondrial DNA sequence data. Biological Journal of the Linnean Society 72:203-229.
Melisch, R. 1998. Wildlife trade, sustainible use, and conservation implications from a WWF and TRAFFIC perspective. Pp. 1-8. In: Erdelen, W. (Ed.). Conservation, Trade and Sustainable Use of Lizards and Snakes in Indonesia. Mertensiella, suppliment zu Salmandra 9.
Musters, C. J. M. 1983. Taxonomy of the genus *Draco* L. (Agamidae. Lecertilia, Reptilia). Zool. Verhandel., Leiden. 199:1-20.
Myers, G. S. 1943. Rediscovery of the Philippine discoglossid frog, *Barbourula busuangensis*. Copeia 1943:148-150.
Nielsen, E. S. and J. G. West. 1994. Biodiversity research and biological collections: transfer of information. Pp. 101-121. In: Pforey, P. L., C. J. Humphries, and R. I. Vane-Wright (Eds.). Systematics and Conservation Evaluation. Systematics Association special volume 50. Clarendon Press, Oxford, UK.
Noble, G. K. 1931. The Biology of the Amphibia. McGraw-Hill, New

York, NY. 577 pp.

Oliver, W. L. R. and L. R. Heaney. 1997. Biodiversity and conservation in the Philippines: an introduction to a global priority. Pp. 1-12. In: Wildlife Conservation Society of the Philippines (Eds.). Philippine Red Data Book. Bookmark Inc., Makati City, Philippines.

Ortega, G. V., P. A. Regoniel, and M. L. M. Jamerlan. 1993. Philippine crocodiles: their conservation, management, and future sustainable use. Asia Life Sciences 2:121-140.

Ota, H. (Ed.). 1999. Tropical Island Herpetofauna: Origin, Current Diversity, and Conservation. Alsevier, Amsterdam. 353 pp.

Ota, H., and R. I. Crombie. 1989. A new lizard of the genus *Lepidodactylus* (Reptilia: Gekkonidae) from Batan island, Philippines. Proceedings of the Biological Society of Washington 102:559-567.

Ota, H., I. S. Darevsky, L. A. Kupriyanova, T. Hikida, K.-Y. Lue, S.-H. Chen, and T. Hayashi. 1993. Geographic variation in the parthenogenic lizard *Hemidactylus stejnegeri* Ota and Hikida 1989 (Gekkonidae: Reptilia), with comments on recently discovered male phenotypes. Tropical Zoology 6:125-142.

Ota, H. and T. Hikida. 1989. A record of a triploid gecko, *Hemidactylus stejnegeri*, from the northern Philippines. Japanese Journal of Herpetology 13:35-39.

Ota, H., K. Y. Lue, S. H. Chen, and W. C. Brown. 1989. Taxonomic status of the Taiwanese *Gekko* with comments on the synonymy of *Luperosaurus amissus*. J. Herpetol. 23:76-78.

Ota, H. and C, A. Ross. 1994. Four new species of *Lycodon* (Serpentes: Colubridae) from the northern Philippines. Copeia 1994:159-174.

Palma, J. A. M. 1993. Marine turtle conservation in the Philippines. Pp. 74-96. In: Nacu. N., R. Trono, J. A. Palma, D. Torres, and F. Agas (Eds.) Proceedings of the First ASEAN Symposium Workshop on Marine Turtle Conservation.

Peters, W. H. C. 1863. Fernere mitteilungen über neue batrachier. Mber. Konigl. Akad. Wiss. Berlin 1863:445-470.

Primak, R. B. and T. E. Lovejoy. 1995. Ecology, Conservation, and Management of Southeast Asian Rainforests. Yale University Press, New Haven, CT, USA. 304 pp.

Ponder, W. F., G. A. Carter, P. Flemons, and R. R. Chapman. 2001. Evaluation of museum collection data for use in biodiversity assessment. Conservation Biology 15:648-657.

Punay, E. M. 1975. Commercial sea snake fisheries in the Philippines. Pp. 489-502. In: Dunson, W. (Ed.). Biology of Sea Snakes. University Park Press, Baltimore, MD, USA.

Rabor, D. S. 1981. Philippine Reptiles and Amphibians. Pundasyon sa

Pagpapaunlad ng Kaalaman sa Pagtuturo ng Agham, Ink.Diliman, Quezon City, Philippines. 79 pp.

Rabor, D. S. and A. C. Alcala. 1959. Notes on a collection of amphibians from Mindanao Island, Philippines. Silliman Journal 2:93-102.

Regoniel, P. A. 1995. Sexual dimorphism in the Philippine freshwater crocodile (*Crocodylus mindorensis* Schmidt). Sylvatrop: the Technical Journal of Philippine Ecosystems and Natural Resources 5:35-43.

Reis, K. R. 1999. Late Quaternary Terrestrial Vertebrates from Palawan Island, Philippines. Unpublished Masters thesis, University of Florida, Gainsville. 117 pp.

Reis, K. R., and A. M. Garong. 2001. Late Quaternary terrestrial vertebrates from Palawan Island, Philippines. Palaeogeography, palaeoclimatology, and palaeoecology 171:409-421.

Resetar, A., and H. K. Voris. 1997. Herpetology at the Field Museum of Natural History, Chicago: the first one hundred years. Pp. 495-506 In: Pietsch, T. W., W. D. Anderson Jr. (Eds.) Collection building in ichthyology and herpetology. American Society of Ichthyologists and Herpetologists (special publication 3), Lawrence, KS, USA.

Reyes, A. T. 1957. Notes on the food habits of a Philippine skink, *Dasia smaragdina philippinica* Mertens. Silliman Journal 4:180-191.

Reyes, A. T. 1968. Food habits of *Draco volans* Linnaeus. Silliman Journal 5:353-356.

Reynolds, R. P., R. I. Crombie, and R. W. McDiarmid. 1994. Voucher specimens. Pp. 66-71. In: W. R. Heyer, M. A. Donnelly, R. W. McDiarmid, L. C. Hayek, and M. S. Foster (Eds). Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians. Smithsonian Institution Press, Washington, DC, USA.

Rickart, E. R., L. R. Heaney, and R. C. Utzurrum. 1991. Distribution and ecology of small mammals along elevational transect in southeastern Luzon, Philippines. Journal of Mammalogy 72:458-469.

Ross, C. A. 1982. The crocodile must stay. Habitat (Philippines) 3:13-19.

Ross, C. A. and A. C. Alcala. 1983. Distribution and status of the Philippine crocodile (*Crocodylus mindorensis*). Kalikasan, Philippine Journal of Biology 12:169-173.

Ross, C. A., A. C. Alcala, and R. V. Sison. 1987. Distribution of *Zaocys luzonensis* (Serpentes: Colubridae) in the Visayan Islands, Philippines. Silliman Journal 34:29-31.

Ross, C. A. and P. C. Gonzales. 1992. Amphibians and reptiles of Catanduanes Island, Philippines. National Museum Papers (Manila) 2:50-76.

Ross, C. A. and J. Lazell. 1991. Amphibians and reptiles of Dinagat and

Siargao islands, Philippines. Philippine Journal of Science 119:257-286.

Sajise, P. E., N. E. Tapay, E. P. Pacardo, N. D. Briones, R. D. Jimenez, E. E. Gomez, P. M. Zamora, M. D. Fortes, M. T. Zafaralla, and I. Zosa-Feranil. 1996. Baseline Assessments: the State of the Philippine Environment. UP Center for Integrative and Developmenta Studies and the University of the Philippines Press, Quezon City, Philippines. 338 pp.

Savage, J. M. 1995. Systematics and the biodiversity crisis. Bioscience 45:673-679.

Schmidt, K. P. 1935. A new crocodile from the Philippine islands. Zoological Series of the Field Museum of Natural History 20:67-70.

Schult, V. 1991. Mindoro: A Social History of a Philippine Island in the 20th Century. Divine World Publications, Manila, Philippines. 172 pp.

Seale, A. 1917. Sea products of Mindanao and Sulu III: sponges, tortoiseshell, corals, and trepang. Philippine Journal of Science 12:191-213.

Shaffer, H. B., R. N. Fisher, and C. Davidson. 1998. The role of natural history collections in documenting species declines. Trends in Ecology and Evolution 13:27-30.

Shaffer, H. B., P. Meylan, and M. L. McKnight. 1997. Test of turtle phylogeny: molecular, morphological, and paleontological approaches. Systematic Biology 46:235-268.

Shine, R., P. Harlow, Ambariyanto, Boeadi, Mumpuni, and J. S. Keogh. 1998. Monitoring monitors: a biological persective on the commercial harvesting of Indonesian reptiles. Pp. 61-28. In: Erdelen, W. (Ed.). Conservation, Trade, and Sustainable Use of Lizards and Snakes in Indonesia. Mertensiella, suppliment zu Salmandra 9.

da Silva, A. (Ed.). 1998. Biology and Conservation of the Amphibians and Reptiles and Their Habitats in South Asia. Amphibia and Reptilia Research Organization of Sri Lanka (ARROS) Nandana Enterprises, Peradeniya, Sri Lanka. 365 pp.

Simmons, J. E. 1987. Herpetological collecting and collections management. Society for the Study of Amphibians and Repiles Herpetological Circular 16:1-70.

Sison, R., P. C. Gonzales, and J. W. Ferner. 1995. New records from Panay, Philippines. Herpetological Review 26:48-49.

Smith, B. E. 1993a. Notes on a collection of squamate reptiles from eastern Mindanao, Philippines Islands, Part 1: Lacertilia. Asiatic Herpetological Research 5:85-95.

Smith, B. E. 1993b. Notes on a collection of squamate reptiles from eastern Mindanao, Philippines Islands, Part 2: Serpentes. Asiatic

Herpetological Research 5:95-102.

Stuebing, R. E. 1998. Faunal collecting in Southeast Asia: fundamental need or bloodsport? Raffles Bulletin of Zoology 46:1-10.

Stuebing, R. B. and Inger, R. F. 1999. A Field Guide to the Snakes of Borneo. Natural History Publications (Borneo) Sdn. Bhd., Kota Kinabalu, Sabah, Malaysia. 254 pp.

Tan, J. M. L. 2000. The Last Great Forest: Luzon's Northern Sierra Madre Natural Park. Bookmark Inc., Makati City.153 pp.

Taylor, E. H. 1915. New species of Philippine lizards. Philippine Journal of Science 10:89-108.

Taylor, E. H. 1917a. *Brachymeles*, a genus of Philippine lizards. Philippine Journal of Science 12:267-279.

Taylor, E. H. 1917b. Snakes and lizards known from Negros with descriptions of new species and new subspecies. Philippine Journal of Science 12:353-381.

Taylor, E. H. 1918a. Reptiles of the Sulu archipelago. Philippine Journal of Science 13:233-267.

Taylor, E. H. 1918b. Two new snakes of the genus *Holarchus* with descriptions of other new species. Philippine Journal of Science 13:359-369.

Taylor, E. H. 1919. New or rare Philippine reptiles. Philippine Journal of Science 14:105-125.

Taylor, E. H. 1920a. Philippine Amphibia. Philippine Journal of Science 16: 213-359.

Taylor, E. H. 1920b. Philippine turtles. Philippine Journal of Science 16: 111-144.

Taylor, E. H. 1921. Amphibians and Turtles of the Philippine Islands. Department of Agriculture and Natural Resources, Bureau of Science, Manila Publication 15:1-193.

Taylor, E. H. 1922a. The Lizards of the Philippine Islands. Philippine Bureau of Science, Monogr. 17, Manila, Philippines.

Taylor, E. H. 1922b. Additions to the herpetological fauna of the Philippine Islands, I. Philippine Journal of Science 21:161-206.

Taylor, E. H. 1922c. Additions to the herpetological fauna of the Philippine Islands, II. Philippine Journal of Science 21: 257-303.

Taylor, E. H. 1922d. Herpetological fauna of Mount Makiling. The Philippine Agriculturist 5:127-139.

Taylor, E. H. 1922e. The snakes of the Philippine Islands. Department of Agriculture and Natural Resources, Bureaau of Science, Manila, Philippines. 312 pp.

Taylor, E. H. 1923. Additions to the herpetological fauna of the Philippine Islands, III. Philippine Journal of Science 22:515-557.