

**DIVERSITY AND CONSERVATION OF PHILIPPINE LAND VERTEBRATES:
AN ANNOTATED BIBLIOGRAPHY**

**Danilo S. Balete¹, Hector C. Miranda Jr.², Lawrence R. Heaney³
and James F. Rieger³**

¹The Haribon Foundation, Rm 901 Richbelt Tower, No. 17 Annapolis Street
Greenhills, San Juan, Metro Manila

²Wildlife Biology Laboratory, Institute of Biological Sciences
University of the Philippines at Los Baños, 4031 College, Laguna

³Field Museum of Natural History, Roosevelt Road at Lake Shore Drive
Chicago, Illinois 60605, USA

ABSTRACT. Summaries of 111 important publications on the diversity and conservation of Philippine land vertebrates are presented as an aid to research and management.

INTRODUCTION

As we enter the final decade of the second millennium A.D., scientists, the lay public, and government leaders have clearly recognized that the Philippine environment is approaching a critical juncture. The action that we take in the next few years will make a huge difference not just in the number of species and habitats that can be saved, but in the prosperity of the human population of the archipelago.

Once a heavily forested country where freshwater, wildlife, and fertile land were abundant, the Philippines now suffers from widespread erosion, increasing frequency of floods and droughts, and permanent (and growing) loss of biological diversity. All of these problems are associated with the loss of forests and the consequent loss of watershed protection (Myers, 1988; Porter and Ganapin, 1988). A "now-or-never" situation is rapidly approaching: either the last remnants of the native environments of the Philippines will disappear, leaving behind a nation blighted by massive, irreversible damage, or thoughtful, rapid action will avert the worst of the environmental degradation, preserving an environment that simultaneously supports humankind and protects a portion of the natural heritage of the Philippines.

Recent events in the Philippines provide good reason to hope this latter, nurturing course will be followed. Conservation organizations are flourishing in the Philippines; the national government has initiated programs that meaningfully address watershed protection while promoting rural development, and a review and

rejuvenation of the national park system has begun. International conservation and development organizations have become actively involved in all these activities. Immediate work on many fronts, including management and research, will make crucial, long-lasting differences to the Philippine environment. However, both management and further research must be carefully planned and executed; to do so requires the best information available.

The precarious state of the wildlife of the Philippines, especially the more conspicuous, aesthetically attractive land vertebrates, has attracted special attention. The number of studies that have dealt broadly with conservation of these species--documenting patterns of diversity and endemism, determining ecology and habitat needs free-living of populations, determining the conservation status of species and habitats, and developing captive breeding programs for critically endangered species--is gradually increasing. Although much remains to be learned, and large gaps exist in our knowledge of conservation in the Philippines, a great deal of useful information is already in print.

Ready access to this information is often inhibited because it is scattered in hard-to-obtain literature, making it inaccessible to many researchers and decision-makers. As a means of facilitating access to literature pertinent to conservation in the Philippines, a compilation list of 111 publications on the diversity and conservation of Philippine land vertebrates considered to be critically important references are included, and brief summaries of each paper prepared. These will not substitute for the publications themselves, but is hoped that this compilation will substantially ease the job of identifying useful references and tracking them down.

Choosing which publications to include has been difficult, but space limitations have made it essential to exclude some references. Recent papers and those of broad importance are emphasized, but some early studies that have been particularly important in the historical development of Philippine vertebrate biology are deliberately pointed out. Similarly, it has been difficult to determine what aspects of each publication to emphasize, and in the end as much information as could be provided in the fewest words possible is given. Undoubtedly some critical references are missed, and the compilers beg the forgiveness of the authors and the readers for these oversights. Suggestions of references to include in updates of the bibliography will be welcomed.

Alcala, A. C. 1962. Breeding behavior and early development of frogs of Negros, Philippine Islands. Copeia, 4:679-726. Life histories of 11 Philippine frogs were studied in relation to their ecology, evolution, and phylogeny. Delineated the genus *Platymantis* from the other genera of the family Ranidae based on the former's direct mode of development, without passing through the aquatic larval stage, thus demonstrating the taxonomic importance of the modes of reproduction among the Philippine anurans.

Alcala, A. C. 1976. Philippine Land Vertebrates. New Day Publishers, Quezon City. 167 pp. Summarizes the habitats, zoogeography, life history, population structure and dynamics, and behavior of terrestrial Philippine mammals, birds, lizards, snakes, turtles, and amphibians. Reviews the conservation status and discusses the threats to the survival of Philippine land vertebrates. Suggests research areas that would provide basis for the conservation of Philippine land vertebrates.

Alcala, A. C. 1986. Guide to Philippine Flora and Fauna. Vol. X. Amphibians and Reptiles. Natural Resources Management Center and University of the Philippines, Quezon City. 213 pp. An illustrated guide to 66 species of amphibians (including 42 endemic species) and 205 species of turtles, lizards, and snakes (127 endemic). Includes notes on habitats, distribution, and ecological status.

Alcala, A. C. and W. C. Brown. 1982. Reproductive biology of some species of *Philautus* (Rhacophoridae) and other anurans. Kalikasan, Philippine Journal of Biology, 11:203-226. Discusses the life histories of ranid and rhacophorid anurans in the Philippines. Presents complete data on the life history of *Philautus lissobrachiatus* which confirms Inger's prediction of direct development among the species of this genus.

Alcala, A. C., C. A. Ross and E. L. Alcala. 1988. Observations on reproduction and behavior of captive Philippine crocodiles (*Crocodylus mindorensis* Schmid). Silliman Journal, 34:18-28. A report on captive breeding of the endangered Philippine freshwater crocodile at Silliman University from 1982-1984. Describes the courtship, mating, and nesting behavior of captive crocodiles. Reproductive activity occurs from January to August; incubation requires 77-85 days.

Alcasid, G. L. 1970. Checklist of Philippine Mammals. Philippine National Museum, Manila. 51 pp. A detailed synopsis of the taxonomy and distribution of 221 species and subspecies of mammals then known from the Philippines.

Auffenberg, W. 1988. Gray's Monitor Lizard. University of Florida Press, Gainesville. 419 pp. A detailed study of the ecology and biology of *Varanus olivaceus* (= *V. grayi*) in the Bicol Peninsula, Philippines. The species occurs mostly in lowland dipterocarp forests below 650 meters, on top or along forested ridges of karst or limestone hills. Courtship occurs from June to September and eggs are laid from middle of June to early November. Most females lay one clutch of 5 to 8 eggs and incubation may take months to one year. Gray's monitor is partially herbivorous: 46 food types were recorded (27 animals and 19 plants), with mollusks (11 species) most commonly eaten. Pili nut (*Canarium* sp.) is the most common plant eaten. The species is threatened by the loss of forest habitat.

Auffenberg, W. and T. Auffenberg. 1988. Resource partitioning in a community of Philippine skinks (Sauria: Scincidae). Bulletin of the Florida State Museum, Biological Sciences 32:151-219. Suggests that species diversity of Philippine skinks is positively correlated with vegetation density. Stomach analysis of 11 species of sympatric skinks yielded no evidence of food niche partitioning except for those that live in specialized habitats. Seasonal prey switching and presence of abdominal fat were linked to seasonal insect prey abundance.

Auffenberg, W. and T. Auffenberg. 1989. Reproductive patterns in sympatric Philippine skinks (Sauria: Scincidae). Bulletin of the Florida State Museum, Biological Sciences 34:202-247. Reproductive activity in 11 sympatric species was generally lowest during the dry months preceding each of the monsoon periods and highest after the first (June and July) and second (September through December) monsoons. The number of eggs laid by oviparous species typically exceeds the number of offspring born by viviparous species.

Barbehenn, K., J. P. Sumangil and J. L. Libay. 1973. Rodents of the Philippine croplands. Philippine Agriculturalist 56:217- 242. Reviews the taxonomy, geographical distribution, habitat preferences, and economic importance of commensal murid rodents in the Philippines. Four species—*Rattus rattus mindanensis*, *R. argentiventer*, *R. exulans*, and *R. norvegicus*—are considered major pest species. Concludes that forest destruction threatens some rare forest-dwelling species and increases colonization by pest species.

Brown, W. C. and A. C. Alcala. 1961. Populations of amphibians in the submontane and montane forests of Cuernos de Negros, Philippine Islands. Ecology 42: 628-636. Records 14 species of amphibians, 27 species of lizards, and 26 species of snakes associated with different forest zones. Fifty-one species were primarily forest-dwelling forms, of which 20 were associated with submontane and montane zones and 20 species were found below the submontane zone. Most of the submontane and montane forest species were considered rare.

Brown, W. C. and A. C. Alcala. 1964. Relationship of the herpetofaunas of the non-dipterocarp communities to that of the dipterocarp forest on southern Negros Island, Philippines. *Senckenbergiana Biologica* 45:591-611. Compares herpetofaunal communities in mangrove forest, littoral forest, fresh-water swamp forest, cogon grassland, wooded grassland, abaca groves, coconut groves, and ricefields with those of dipterocarp forest. Of the 67 species of amphibians and reptiles found in dipterocarp forest, 47 can be found in other vegetation types as well, and only five are restricted to dipterocarp forest. The highest degree of similarity with dipterocarp communities is seen in abaca and coconut groves. Suggests that species richness in non-dipterocarp communities can be affected by proximity to dipterocarp forests and other vegetation types, and by the amount of undergrowth, maturity of trees, and elevation.

Brown, W. C. and A. C. Alcala. 1970. The zoogeography of the herpetofauna of the Philippine Islands, a fringing archipelago. *Proceedings of the California Academy of Sciences*, 38(4):105-130. Concludes that species richness is influenced by island area; that colonization over salt-water channels is more frequent in reptiles than amphibians; that few if any species entered the Philippines by way of the Palawan chain; and that indigenous speciation has played an important role in creating current patterns of diversity.

Brown, W. C. and A. C. Alcala. 1978. Philippine Lizards of The Family Gekkonidae. Monograph Series 1. Silliman University, Dumaguete City. 146 pp. A revision of 10 genera and 33 species of Philippine gekkonid lizards of which two genera and 23 species are endemic, including three species which are new to science. Includes descriptions of species, diagnostic keys, and notes on ecology, distribution, and reproduction. Suggests that the Philippine species are primarily Oriental or Oriental-Australian in origin.

Brown, W. C. and A. C. Alcala. 1980. Philippine Lizards of the Family Scincidae. Monograph Series, Silliman University, Dumaguete City. No. 2, 264 pp. First revision of Philippine skinks since 1922. Recognizes 10 genera and 64 species of Philippine scincid lizards, of which 53 are endemic species and seven species are new to science. Includes descriptions of species, keys to genera and species, and notes on ecology, distribution, and reproduction. Documents similar biogeographical patterns as in gekkonid lizards.

Brown, W. C. and A. C. Alcala. 1982. A new cave *Platymantis* (Amphibia: Ranidae) from the Philippine Islands. *Proceedings of the Biological Society of Washington* 95:386-391. Describes a new frog, *Platymantis spelaeus*, that is endemic to caves in forested regions of southern Negros Island, and summarizes the distribution of the genus in the Philippines.

Brown, W. C. and A. C. Alcala. 1982. Modes of reproduction of Philippine anurans. pp. 416-428. In: A. G. J. Rhodin, and K. Miyata (eds.), *Advances in Herpetology and Evolutionary Biology, Essays in Honor of Ernest E. Williams*. Museum of Comparative Zoology, Cambridge, Massachusetts. 725 pp. Discusses the diversity of reproductive modes of Philippine anurans and proposes 18 specific modes within two primary categories: with aquatic larval stage and without aquatic larval stage (direct development). Documents modes of reproduction of 28 anuran species in the Philippines and concludes that there is no or little intrageneric diversity of reproductive modes among these species. Also concludes that families with greater numbers of species exhibit greater diversity in modes of reproduction.

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. Concludes that the herpetofauna of Cebu, in comparison to that of Negros and Bohol, is depauperate because of the effects of forest habitat destruction.

Brown, W. H. 1919. *The Vegetation of Philippine Mountains*. Monographs of the Bureau of Science, Manila, 13:1-434. An early but extensive account of the Philippine flora with a detailed descriptions of the original vegetation of Mount Makiling.

Catibog-Sinha, C. 1987. The wild vertebrate fauna of Mount Makiling, Laguna. *Philippine Journal of Science* 116:19-29. A report on an inventory of the vertebrates of the mountain, including external measurements and data on relative abundance of birds and mammals.

Cox, R. 1987. The Philippine spotted deer and the Visayan warty pig. *Oryx* 21:37-42. Basic information on the ecology, distribution, habitat, and conservation status of two endangered Philippine mammals: the Visayan spotted deer, *Cervus alfredi*, and the Visayan warty pig, *Sus barbatus cebifrons*.

Delacour, J. and E. Mayr. 1946. *Birds of the Philippines*. The Macmillan Company, New York. 309 pp. A detailed account of the ecology, distribution, and zoogeography of 450 species of Philippine birds, with keys to most groups. Includes illustrations in 68 black and white.

Diamond, J. and M. E. Gilpin. 1983. Biogeographic umbilici and the origin of the Philippine avifauna. *Oikos* 41:307-321. Concludes that the avifauna of the Philippines has features intermediate between oceanic and land-bridge avifaunas; that the presence of many non-water-crossing taxa within the Philippines reflects the 'umbilical' connections to the island of Borneo.

Dickerson, R. E. 1928. Distribution of life in the Philippines. Monographs of the Bureau of Science, Manila 2:1-322. The only available comprehensive synopsis of the biogeography of Philippine vertebrates, invertebrates, and plants, with an extensive discussion of geography, geology, climate, and hydrography.

Dickinson, E. C., R. S. Kennedy and K. C. Parkes. 1991. The birds of the Philippines. British Ornithologists' Union Checklist 12:1-507. A detailed listing of the taxonomy and distribution of 556 species of birds, with synopses of Philippine geography, climate, and vegetation. Analyzes biogeographic patterns and geographic variation and speciation; and breeding seasonality, migration patterns, and conservation needs.

duPont, J. E. 1971. Philippine Birds. Delaware Museum of Natural History, Delaware. 480 pp. Identification guide to some 940 species and subspecies of birds recorded in the Philippines with color illustrations of more than 500 species of resident and migratory birds.

duPont, J. E. 1976. Notes on Philippine birds (4): Additions and corrections to Philippine Birds. Nemouria 17:1-13. Corrects the errors and omissions in Philippine birds, and summarizes taxonomic changes published from 1971 to 1976.

duPont, J. E. and D. S. Rabor. 1973. Birds of Dinagat and Siargao, Philippines. Nemouria 10:1-111. Records 115 species of birds from Dinagat and Siargao islands, of which 69 and 65 species are new records for Dinagat and Siargao, respectively. Major vegetation types are described, and notes on the ecology and behavior of each species are provided.

Everett, A. H. 1889. Remarks on the zoo-geographical relationships of the island of Palawan and some adjacent islands. Proceedings of the Zoological Society of London 1889:220-228. An excellent account of the zoogeographic affinity of Palawan to Borneo rather than to the Philippine mainland, including the first consideration of the effects of sea level change on animal distributions in the Philippines.

Fooden, J. 1990. Eastern limit of distribution of the slow loris, *Nycticebus coucang*. International Journal of Primatology 12:287- 290. Documents the easternmost known record of the slow loris on Tawi-tawi Island, Philippines. An earlier report of the species on Mindanao was based on a mislabelled specimen.

Fooden, J. 1991. Systematic review of Philippine macaques (Primates, Cercopithecidae: *Macaca fascicularis* subsp.). *Fieldiana: Zoology* 64:1-44. Recognizes two subspecies of macaques in the Philippines, *Macaca fascicularis fascicularis* and *M. f. philippinensis*, based on comparative morphology, blood proteins, and natural history. Suggests two waves of dispersal into the Philippines by ancestral macaques from Borneo: dispersal by the ancestor of *M. f. philippinensis* during the penultimate glacial maximum via Balabac-Palawan route and dispersal by the ancestor of *M. f. fascicularis* during the most recent glacial maximum via Sulu route.

Gonzales, P. C. 1983. *Birds of Catanduanes*. Zoological Papers, National Museum, Manila, No. 2, pp. 1-125. Describes 138 species of birds collected on Catanduanes Island with notes on distribution and ecology of each species. The composition of the avifauna supports the view that Catanduanes was connected to Luzon during the late Pleistocene.

Gonzales, P. C. and C. P. Rees. 1988. *Birds of the Philippines*. Haribon Foundation for the Conservation of Natural Resources, Inc., Manila. 184 pp. A guide featuring 133 species of Philippine birds grouped according to associated ecosystems. Includes notes on distribution and habits, a list of selected places accessible for birdwatching in the Philippines, and an updated checklist of Philippine birds.

Gonzales, R. B. 1968. A study of the breeding biology and ecology of the monkey-eating eagle. *Silliman Journal* 15:461-491. The first published documentation of the nesting biology of the Philippine Eagle. Reports that eagles feed mainly on monkeys and flying lemurs and a single egg is incubated for 60 days. Estimated the total population of eagles as 36 individuals.

Goodman, S. M. and P. G. Gonzales. 1990. The birds of Mt. Isarog National Park, southern Luzon, with particular reference to altitudinal distribution. *Fieldiana: Zoology* 60:1-39. Species accounts of 116 resident and 19 migratory species of birds recorded on Mt. Isarog with notes on taxonomy and ecology of many species. Comparison of the avifauna of Mt. Isarog with that of three other mountains in the Philippines shows that species richness decreases with elevation on all the mountains. Results of the 1988 survey indicate that at least 42% of the birds in lowland forest recorded by Rabor in 1961 are now locally extirpated. Recommends measures for protecting the remaining undisturbed forest on Mt. Isarog.

Groves, C. P. 1969. Systematics of the anoa (Mammalia, Bovidae). *Beaufortia* 17:1-12. A discussion of systematics of the genus *Anoa*, with reference to nomenclature and taxonomic history. Assigns the tamarao (*Bubalus mindorensis*) to the genus and subgenus *Bubalus*, rather than to *Anoa*.

Grubb, P. and C. P. Groves. 1983. Notes on the taxonomy of the deer (Mammalia, Cervidae) of the Philippines. *Zoologischer Anzeiger* 210:119-144. Recognizes *Cervus alfredi* (Visayan spotted deer) and *C. mariannus* (Philippine brown deer) as valid species, and the Calamian deer as a subspecies of the hog deer (*C. porcinus calamianensis*).

Hatchisuka, M. 1931-35. *The Birds of the Philippine Islands*. H. F. Witherby, London. 908 pp. A two-volume monograph on Philippine birds with an early description of the country and its people. Notes on the mammal fauna are also included.

Hauge, P., J. Terborgh, B. Winter and J. Parkinson. 1986. Conservation priorities in the Philippine archipelago. *Forktail* 2:83-91. Analyzes the distributions of terrestrial mammals, birds, reptiles, and amphibians in the Philippines. They conclude that all groups show strongly similar distribution patterns, and that a wildlife reserve system designed for one group will protect the others as well. Mindanao, Luzon, and Palawan together support 86% of the vertebrate fauna and 72% of the single-island endemics, and therefore deserve conservation priority, although some smaller islands deserve attention because they hold significant numbers of endemic species which may be especially vulnerable to extinction.

Heaney, L. R. 1985. Zoogeographic evidence for Middle and Late Pleistocene land bridges to the Philippine Islands. *Modern Quaternary Research in Southeast Asia* 9:127-144. Geologic evidence and mammal zoogeographic data show that, during the Pleistocene, Palawan was connected to Borneo but not to the rest of the Philippines, that the other islands remained isolated from the Asian continent, and that the present islands of the Philippines were united into larger islands.

Heaney, L. R. 1986. Biogeography of the mammals of Southeast Asia: estimates of colonization, extinction, and speciation. *Biological Journal of the Linnean Society* 28:127-165. Identifies four major island categories in Southeast Asia based on Pleistocene land-bridge connections. Characterizes six faunal regions in the Philippines by their mammalian faunas and concludes that majority of the non-volant mammals of the Philippines originated from the Sunda Shelf. Suggests that speciation within the Philippines has contributed between 50% and 70% of its non-volant mammal species. Also suggests that murid rodents are the most successful colonizers and the carnivores are the least successful.

Heaney, L. R. 1991. An analysis of patterns of distribution and species richness among Philippine fruit bats (Pteropodidae). *Bulletin of the American Museum of Natural History* 206:145-167. Indicates four patterns of distribution for 23 species of Philippine fruit bats including 14 endemics: Southeast Asian, Sundaic, Philippine endemic, and single-island endemic. Shows that species richness is positively correlated

with island area; several of the endemic species are members of a single phylogenetic clade that has undergone substantial diversification within the Philippines. Concludes that fruit bats in the Philippines exhibit similar biogeographic patterns observed among non-volant mammals but notes that fruit bats have higher rates of colonization and lower rates of extinction and local speciation than non-volant mammals.

Heaney, L. R., P. C. Gonzales and A. C. Alcala. 1987. An annotated checklist of the taxonomic and conservation status of land mammals in the Philippines. Silliman Journal 34:32-66. A summary of the distribution, taxonomy, and conservation status of each of the 165 species of terrestrial mammals found in the Philippines.

Heaney, L. R. P. C. Gonzales, R. C. B. Uzzurum and E. A. Rickart. 1991. The mammals of Catanduanes Island: implications for the biogeography of small land-bridge islands in the Philippines. Proceedings of the Biological Society of Washington 104:399-415. Lists 35 species of mammals. No endemic species are present, all but one are known from Luzon, and the fauna is smaller than that of Luzon; all of these are general patterns among mammal faunas on small islands once connected to larger islands. Birds on Catanduanes show similar patterns.

Heaney, L. R. and P. D. Heideman. 1987. Philippine fruit bats, endangered and extinct. Bats 5:3-5. Concludes that Chapman's bare-backed fruit bat (*Dobsonia chapmani*) is extinct, *Acerodon lucifer* may be extinct, *Acerodon jubatus* and *Pteropus vampyrus* are declining, and the Negros tube-nosed bat (*Nyctimene rabori*) is seriously threatened.

Heaney, L. R., P. D. Heideman, E. A. Rickart, R. B. Uzzurum and J. S. H. Klompen. 1989. Elevational zonation of mammals in the central Philippines. Journal of Tropical Ecology 5:259-280. On both Leyte and Negros, diversity of small non-volant mammals increases with increasing elevation, but fruit bat diversity declines with elevation. Murid rodents found at higher elevations on Leyte are members of old endemic Philippine clades, while those found at lower elevations are members of recently arrived groups. Recommends preserving large tracts of primary forest along complete elevational gradients for conservation of wildlife.

Heaney, L. R. and E. A. Rickart. 1990. Correlations of clades and clines: geographic, elevational, and phylogenetic distribution patterns among Philippine mammals, pp. 321-332. In: G. Peters and R. Hutterer (eds.), Vertebrates in the Tropics. Museum Alexander Koenig, Bonn. 424 pp. A summary of ongoing research on mammalian biogeography and evolution in the Philippines with a discussion of patterns of distribution and endemism, elevational changes in species richness, and phylogeny of pteropodid bats and murid rodents.

Heaney, L. R. and R. C. B. Uzzurum. 1991. A review of the conservation status of Philippine land mammals. Association of Philippine Systematic Biologists Communications. In press. Thirty-two species of endangered Philippines mammals are listed in categories according to conservation status with a brief, current summary of their biology and ecology.

Heideman, P. D. and L. R. Heaney. 1989. Population biology and estimates of abundance of fruit bats (Pteropodidae) in Philippine submontane rainforest. *Journal of Zoology (London)* 218:565-586. Discusses community composition, local heterogeneity, movement distances, longevity, population size, and density of pteropodid bats on Negros Island based on mark and recapture studies. Suggests that small pteropodids may live for up to ten years and may occur at densities of up to ten bats per hectare. Estimated densities from mark-and-recapture studies are highly correlated with rank-order abundances in netted samples of 100 bats, which means that samples of 100 captures may be used to accurately estimate fruit bat communities.

Heideman, P. D., L. R. Heaney, R. L. Thomas and K. R. Erickson. 1987. Patterns of faunal diversity and species abundance of non-volant mammals on Negros Island, Philippines. *Journal of Mammalogy* 68:884-888. Documents habitat associations of small mammals on Negros Island, and shows that assessment of relative abundance of small mammals based on bones in the scats of predators is very similar to that based on trapping.

Hoogstraal, H. 1951. *Philippine Zoological Expedition, 1946-1947. Narrative and itinerary.* *Fieldiana: Zoology* 33:1-86. A detailed itinerary of the single largest vertebrate inventory project in the Philippines; collecting took place on Luzon, Mindanao, and Palawan. Includes valuable descriptions of the vegetation and habitats of many current national park sites, including Mt. Data, Mt. Apo, and southern Palawan.

Inger, R. F. 1954. *Systematics and zoogeography of Philippine Amphibia.* *Fieldiana, Zoology* 33:181-531. A comprehensive systematic and zoogeographic treatment of Philippine amphibians. Traces dispersal to the Philippines from Borneo via Palawan and Sulu-Mindanao, and from New Guinea via Papua-Moluccas-Talau. Sets a tentative order of amphibian invasions in the Philippines with the relict species *Barbourula busuangensis* as the oldest invader, followed by non-relict endemics in early but subsequent invasions, and finally by the non-endemics as the most recent arrivals. Concludes that Palawan has an amphibian fauna distinct from the rest of the Philippines, but similar to that of Borneo.

Jones, G. S. and D. B. Jones. 1976. **A Bibliography of the Land Mammals of Southeast Asia, 1699-1969.** Bishop Museum Special Publications. 238 pp. A compilation of 5213 individual titles on anatomy, behavior, ecology, paleontology, parasitology, physiology, systematics, and zoonoses of mammals in Southeast Asia published between 1699 and 1969.

Kennedy, R. S. 1977. **Notes on the biology and population status of the monkey-eating eagle of the Philippines.** *Wilson Bulletin* 89:1-20. Describes the hunting behavior of Philippine Eagles and their dipterocarp forest habitat. Estimates the home range of a pair to be 12 to 100 km². Estimates the population size of Philippine Eagles in 1970 - 1973 at 200 - 400 birds.

Kennedy, R. S. 1981. **Saving the Philippine Eagle.** *National Geographic* 159:846-856. An account of the efforts to study and document the life history of the Philippine Eagle. Reports that eagles feed mainly on flying lemurs, breed once every two years, and fledge the young after five months.

Kennedy, R. S., E. C. Dickinson and M. D. Bruce. 1985. **Bibliography of Philippine ornithology.** *Nemouria* 29:1-86. A listing of 1152 references dealing with the biology, distribution, and taxonomy of Philippine birds, particularly endemic species.

Koopman, K. F. 1989. **Distributional patterns of Indo-Malayan bats (Mammalia: Chiroptera).** *American Museum Novitates* 2942:1-19. An enumeration of the bat faunas of the Indochinese and Malayan subregions and their outliers, including the Philippines. Analysis of the distributional patterns shows that oceanic islands such as the Philippines and Sulawesi are depauperate in bat faunas but have much higher degrees of endemism than continental islands.

Kornfield, I. and K. E. Carpenter. 1984. **Cyprinids of Lake Lanao, Philippines: taxonomic validity, evolutionary rates and speciation scenarios.** pp. 69-84. In: A. A. Echelle and I. Kornfield (eds.), *Evolution of fish species flocks.* Orono Press: University of Maine. A discussion of the systematics and zoogeography of the endemic fresh-water cyprinids of Lake Lanao based on comparative electrophoresis. Concludes that the endemic Lake Lanao cyprinid complex descended from an extant common ancestor, *Puntius binotatus*, and is therefore monophyletic. Suggests that the ancestral cyprinid colonized Mindanao via the Sulu land-bridge before the Pleistocene.

Kuehn, D. W. 1986. Population and social characteristics of the Tamarao (*Bubalus mindorensis*). *Biotropica* 18:263-266. Gives an estimate of at least 51 tamaraos in a 20 km² study area in Mt. Iglit Game Refuge and Wildlife Sanctuary, Mindoro. Comparisons of social behavior of tamaraos and water buffalos suggests that adult tamaraos are less sociable than water buffalos and that this could be an adaptation of the tamaraos to forest habitat.

Leviton, A. E. 1963. Remarks on the zoogeography of Philippine terrestrial snakes. *Proceedings of the California Academy of Sciences* 31:369-416. Records 87 species and subspecies of terrestrial snakes in the Philippines, including 34 endemic and 32 non-endemic species. Considers the Philippine terrestrial snakes to be of Indo-Malayan affinities and excluded Celebes, the Papuan region, and Taiwan as sources of Philippine snakes. Suggests that the Philippines can be divided faunistically into five districts based on the zoogeography of its terrestrial snakes.

Lewis, R. E. 1986. A rain-forest raptor in danger. *Oryx* 20:170-175. Presents an overview of the current status of the endangered Philippine Eagle and its habitat. Concludes that the eagle's population in Mindanao has been severely reduced due to forest habitat fragmentation and that the Sierra Madre mountains in Luzon could be the last stronghold for the species.

Lewis, R. E. 1988. Mt. Apo and other national parks in the Philippines. *Oryx* 20:170-175. A description of the present conservation status of Mount Apo and the persistent threats to its ecological integrity.

McGregor, R.C. 1907. Notes on birds collected in Cebu. *Philippine Journal of Science* 2:298-309. Provides a taxonomic listing with behavioral notes on 114 bird species collected out of 149 species that were known to occur on Cebu. Provides notes on extirpated forms such as the Red-vent Cockatoo (*Cacatua haematuropygia*), Cebu Hanging Parakeet (*Loriculus*) sp. and the now extinct flowerpecker, *Dicaeum quadricolor* (= *Prionichilus*).

McGregor, R. C. 1920. Some features of the Philippine *Ornis* with notes on the vegetation in relation to the avifauna. *Philippine Journal of Science* 16:361-438. An extensive analysis of the distribution of 469 species of endemic birds in the Philippines based on Worcester's grouping of islands. Discusses the distribution of birds relative to forest type and concludes that large islands with large areas of intact lowland forests and high elevations tend to have more species of birds than smaller islands, low-lying islands, or islands with little remaining forest.

Mendoza, M. M. 1987. Updated list of Mt. Makiling avifauna. Philippine Journal of Science 116:31-46. Species accounts of 132 species of birds recorded on Mt. Makiling and vicinity.

Morioka, H. and R. V. Sison. 1987. Birds of the highlands of Mt. Halcon, Mindoro, Philippines. Japanese Journal of Ornithology 35:109-124. Species accounts of the highland avifauna collected and observed on Mt. Halcon, Mindoro. Suggests that the highland avifauna of Mt. Halcon is poor in species, that it is more similar to that of northern Luzon than to that of Palawan, and that the absence of endemics in the highlands is caused by a higher rate of extinction than in the lowlands, where many endemics are found.

Musser, G. G. 1977. *Epimys benguetensis*, a composite, and one zoogeographic view of the rat and mouse faunas in the Philippines and Celebes. American Museum Novitates 2636:1-14. Lists the many taxonomic synonyms of the commensal murid rodents of the genera *Mus* and *Rattus*. In the Philippines and Indonesian Archipelago east of Wallace's Line, endemic murid rodents are restricted to primary forest habitats, and in both places a common assemblage of commensal murid rodents is associated with man-made habitats.

Musser, G. G. 1979. Results of the Archbold Expeditions. No. 105. Notes on the systematics of Indo-Malayan murid rodents, and descriptions of new genera and species from Ceylon, Sulawesi, and the Philippines. Bulletin of the American Museum of Natural History 168:225-334. Separates murid rodent groups previously referred to *Rattus* into four genera. Diagnoses, descriptions, and comparisons are provided. A new genus and species of murid rodent, *Anonymomys mindorensis*, is described from Mindoro.

Musser, G. G. 1982. Results of the Archbold Expeditions. No. 108. The definition of *Apomys*, a native rat of the Philippine Islands. American Museum Novitates 2746:1-43. Provides diagnosis of forest mice of the genus *Apomys*, the most speciose murid in the Philippines, and differentiates it from *Rattus* based on comparative morphology. Separates eight species of *Apomys* into two groups: *Apomys datae* and *Apomys abraehylocetes* groups.

Musser, G. G. 1982. Results of the Archbold Expeditions. No. 110. *Crunomys* and the small-bodied shrew-rats native to the Philippine Islands and Sulawesi (Celebes). Bulletin of the American Museum of Natural History 174:1-95. Describes two new species of murid rodents from the Philippines, *Crunomys rabori* from Leyte Island and *Archboldomys luzonensis* from Mt. Isarog, southeastern Luzon. Compares Philippine and Celebes murid rodents and finds no close phylogenetic relationships.

Musser, G. G. and L. K. Gordon. 1981. A new species of *Crateromys* (Muridae) from the Philippines. *Journal of Mammalogy* 62:513-525. Describes a new species of cloud rat, *Crateromys paulus*, from Ilin Island, Mindoro, and suggests that *C. paulus* is closely related to *C. schadenbergi*; several of the diagnostic characters of *C. paulus* appear primitive relative to *C. schadenbergi*.

Musser, G. G. and P. W. Freeman. 1981. A new species of *Rhynchomys* (Muridae) from the Philippines. *Journal of Mammalogy* 62:154-159. Describes *Rhynchomys isarogensis*, from Mt. Isarog, southeastern Luzon, with a discussion of its distribution and origins. Suggests that during the Pleistocene, the montane forest *Rhynchomys* habitat might have been more extensive or even continuous between the Central Cordillera and Mt. Isarog.

Musser, G. G. and L. R. Heaney. 1985. Philippine *Rattus*: a new species from the Sulu Archipelago. *American Museum Novitates* 2818:1-32. Describes *Rattus tawitawiensis* from Tawi-tawi Island. Morphological characteristics of *R. tawitawiensis* indicate that it is most similar to *Rattus tiomanicus* in the Maratua Archipelago on the Sunda Shelf. However, analysis of the zoogeography of mammals in the Sulu Archipelago suggests that Sulu had no recent land bridge connections with either Borneo or Mindanao.

Musser, G. G. L. R. Heaney and D. S. Rabor. 1985. Philippine rats: description of a new species of *Crateromys* from Dinagat Island. *American Museum Novitates* 2821:1-25. Describes *Crateromys australis* from Dinagat Island. Concludes that *C. australis* is more primitive than *C. schadenbergi* and *C. paulus* based on morphological characteristics.

Myers, N. 1988. Environmental degradation and some economic consequences in the Philippines. *Environmental Conservation* 15:205-213. Discusses the implications on the Philippine economy of deforestation, soil erosion, disruption of hydrological systems, over-exploitation of fisheries, destruction of coral reefs, extinction of species, and high human population density. Points out that national development is largely dependent upon the natural resources of the Philippines and that environmental degradation could lead to major adverse economic consequences.

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. Describes a new gekko, *Lepidodactylus balioburius*, that is endemic to Batan Island; its closest relative occurs on a small island adjacent to Taiwan. Summarizes the distribution of the genus in the Philippines.

Parkes, K. C. 1973. Annotated list of the birds of Leyte Island, Philippines. *Nemouria* 11:1-73. A list of the 180 species of birds known from Leyte with notes on behavior, breeding habitat, and taxonomy. Traces the history of ornithology of Leyte and briefly discusses the zoogeographic affinity of Leyte with Samar and Bohol.

Peters, J. L. 1939. Collections from the Philippine Islands: Birds. *Bulletin of the Museum of Comparative Zoology* 86:74-128. Species accounts of 179 species of birds collected on Basilan, Cebu, Luzon, Mactan Island, Marinduque, Mindanao, Mindoro, and Palawan.

Porter, G., and D. J. Ganapin, Jr. 1988. Resources, population, and the Philippines' future: a case study. World Resources Institute, Washington, D.C., Paper No. 4, pp. 1-68. An excellent treatise on the complex inter-connections among the many environmental problems and the economic prospects of an ever-increasing human population in the Philippines.

Quinnel, R. and A. Balmford. 1988. A future for Palawan's forest? *Oryx* 22:30-35. Discusses the present environmental status of Palawan and the impact of commercial logging, kaingin, mining, and hunting on wildlife and its habitat.

Rabor, D. S. 1955. Notes on mammals and birds of the central northern Luzon highlands, Philippines. Pt. 1. Notes on mammals. *Silliman Journal* 2:193-218. Discusses behavior, geographic variation, and habitats of mammals and birds on Mt. Data, Mt. Kapilingan, and Abra highlands in northern Luzon observed during the 1946-1947 Philippine Zoological Expedition.

Rabor, D. S. 1959. The impact of deforestation on birds of Cebu, Philippines, with new records for that island. *Auk* 76: 37-43. Documents the disappearance of nine of 10 endemic birds of Cebu, the first record of avian extinction in the Philippines due to extensive logging. Records six resident and four migrant species of birds new to Cebu.

Rabor, D. S. 1966. Conservation in the Philippines. *Silliman Journal* 13:594-604. An expression of concern over the destruction of natural resources in the Philippines. Traces the causes of conservation problems to poor implementation of laws, rampant logging, misguided policies of government, and others. Proposes effective implementation of existing laws and extensive conservation education as the primary solutions.

Rabor, D. S. 1966. A report on the zoological expeditions in the Philippines for the period 1961-1966. Silliman Journal 13:604- 616. Summarizes ten expeditions to various islands, including dates, membership of the research teams, objectives, sponsors, data gathered, museums where specimens were deposited, and publications that resulted.

Rabor, D. S. 1977. Notes on the ecology of the Sulu Archipelago. Pterocarpus 3:33-41. Notes on the geographical, floral, and faunal features of the Sulu Archipelago and some recommendation for the conservation of its natural resources.

Rabor, D. S. 1977. Philippine birds and mammals. University of the Philippines Press, Quezon City. 284 pp. A non-technical guide featuring description and illustrations of 102 bird species and 33 terrestrial mammals. Measurements and notes on habits, food, and distribution of these species are included.

Rabor, D. S. 1986. Guide to Philippine Flora and Fauna. Vol. XI. Birds and Mammals. Natural Resources Management Center and University of the Philippines, Quezon City. 213 pp. A illustrated guide to 70 species of passerine birds and 75 species of mammals. Sixty-one of the bird species and 58 of the mammals featured are Philippine endemics. Notes on biology, distribution, economic importance, and ecological status are given.

Rabor, D. S., A. C. Alcala and R. B. Gonzales. 1970. A list of the land vertebrates of Negros Island, Philippines. Silliman Journal 17:297-316. An update of the 1958 land vertebrate faunal list of Negros Island; brings species totals to 16 amphibians, 1 turtle, 1 crocodile, 33 lizards, 30 snakes, 268 birds, and 39 mammals.

Rand, A. L. 1951. Birds of Negros Island. Fieldiana: Zoology 31:571-596. Discusses 29 species of birds from Negros Island. Includes a thoughtful discussion of geographic variation and a strong argument against the indiscriminant naming of subspecies.

Rand, A. L. and D. S. Rabor. 1960. Birds of the Philippine Islands: Siquijor, Mt. Malindang, Bohol, and Samar. Fieldiana, Zoology 35:222-411. Species lists, with notes on habits, of birds recorded on Siquijor, Bohol, Samar, and Mt. Malindang. Suggests that the depauperate fauna of Siquijor is due to its small size and that the avian colonization of Siquijor is affected more by prevailing winds than by its distance from neighboring islands. Shows that Bohol and Samar have very similar avifaunas.

Rickart, E. A. and L. R. Heaney. 1991. A new species of *Chrotomys* (Muridae) from Luzon Island, Philippines. *Proceedings of the Biological Society of Washington* 104:387-398. Describes *Chrotomys gonzalesi* from Mt. Isarog, southeastern Luzon and distinguishes it from *C. mindorensis*, *C. whiteheadi*, and *Celaenomys*; stomach contents, morphological features, and trapping data indicate that *C. gonzalesi* feeds primarily on annelid worms, is active both day and night, and is semifossorial. Concludes that the distribution of *Chrotomys* supports vicariant speciation patterns observed between murid rodent faunas of northern and southern Luzon, and comments on Mt. Isarog as a center of endemism.

Rickart, E. A., L. R. Heaney and R. B. Utzurrum. 1991. Distribution and ecology of small mammals along an elevational transect in southeastern Luzon, Philippines. *Journal of Mammalogy* 72:458-469. A discussion of the ecology, distribution, and feeding habits of one species of shrew and seven species of murid rodents on Mt. Isarog. Results indicate four trophic patterns: omnivory in three species, insectivory in two species, vermivory in two species and granivory-frugivory in one species. Observed pattern of increased species richness, abundance, and endemism with increasing elevation support previous predictions for small mammals in the Philippines.

Ripley, S. D. and D. S. Rabor. 1961. The avifauna of Mount Katanglad. *Postilla* 50:1-20. A summary of the 1960 expedition, which obtained 41 species, bringing the total for the mountain to 97. Two species (*Serinus mindanensis* and *Erythrura coloria*) and two subspecies are described as new.

Ross, C. A. and A. C. Alcala. 1983. Distribution and status of Philippine crocodile (*Crocodylus mindorensis*). *Kalikasan, Philippine Journal of Biology* 12: 169-173. Describes the former range of *Crocodylus mindorensis*: Camarines, Manila Bay, Laguna de Bay of Luzon, Mindoro, Masbate, Samar, Negros, Mindanao including Zamboanga, and Jolo. Suggests that the Philippine endemic is one of the world's most threatened crocodiles.

Sanborn, C. C. *Philippine Zoological Expedition, 1946-1947. Mammals. Fieldiana: Zoology*, 33:89-158. A report on 95 species of mammals obtained by the expedition, including nine species and six subspecies described as new.

Sanguila, W. M. and B. R. Tabaranza, Jr. 1979. A list of land mammals of Mindanao. *Mindanao Journal* 5:130-140. An enumeration of 97 species and subspecies of terrestrial mammals recorded from Mindanao.