Recent literature from Cambodia

This section summarizes recent scientific publications concerning Cambodian biodiversity and natural resources. The complete abstracts of most articles are freely available online (and can be found using Google Scholar or other internet search engines), but not necessarily the whole article. Corresponding authors may be willing to provide free reprints or electronic copies on request and their email addresses, where known, are included in the summaries below.

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New species & taxonomic reviews

Csorba, G. & Furey, N.M. (2022) From greener times: a new species of thick-thumbed Myotis from Phnom Penh, Cambodia. *Acta Zoologica Academiae Scientiarum Hungaricae*, **68**, 85–97.

The authors describe a new species of mouse-eared bat to science (*Myotis hayesi* sp. nov) based on a single specimen collected in Phnom Penh in 2000. The new species is characterized by its fleshy, bicoloured thumb, large foot sole, full dentition, relatively short rostrum, and high frontal part of the skull. Author: neil.m.furey@gmail.com

Gupta, S.K., Kumar, A., van Berkel, T., Emsens, W.-J., Singh, B., Puls, S., Rin N. & Jocque, M. (2022) Genetic analysis reveals a distinct lineage of hog deer (*Axis porcinus*) in Kratie province, Cambodia. *Journal of Heredity*. DOI 10.1093/jhered/esac017

Two subspecies of hog deer are currently recognised: *A. p. porcinus*, ranging from Punjab Province in Pakistan, Nepal and the northern part of India to Myanmar, and *A. p. annamiticus*, occurring in Indochina, Thailand, Laos, Cambodia and Vietnam. The authors analysed variation in the mitochondrial DNA control region of samples of the latter subspecies from Kratie Province and found that these differ from mainland Indian and Thai populations. They conclude that the population in Kratie appears to be a distinct lineage which should be treated as an evolutionarily significant unit. Author: skg@wii.gov.in

Kosterin, O. (2021) *Burmagomphus williamsoni eddiei* subsp. nov. (Odonata, Gomphidae) from northern Cambodia. *International Dragonfly Fund-Report*, **161**, 1–15.

The author describes a new subspecies of dragonfly to science based on specimens collected in Phnom Kulen (Siem Reap Province) in 2018. The new subspecies also occurs in Preah Vihear Province. Author: kosterin@bionet.nsc. ru

Nekaris, K.A.-I. & Nijman, V. (2022) A new genus name for pygmy lorises, *Xanthonycticebus* gen. nov. (Mammalia, Primates). *Zoosystematics and Evolution*, **98**, 87–92.

Several studies have suggested that marked differences between the pygmy slow loris *Nycticebus pygmaeus* and other *Nycticebus* species may warrant recognition at the generic level. Based on morphological, behavioural, karyotypical and genetic data, the authors show that these differences are significant and consistent and propose *Xanthonycticebus* gen. nov. as a new genus name for pygmy slow lorises. They also indicate that their nomenclatural changes should not affect the legal status of species presently recognised. Author: vnijman@brookes.ac.uk

Souladeth, P., Newman, M.F. & Prajaksood, A. (2022) Two new species of *Eriocaulon* (Eriocaulaceae) from Cambodia. *Kew Bulletin*, **77**, 127–137.

The authors describe two new species of *Eriocaulon* from Bokor National Park in Kampot Province: *E. bokorense* and *E. cambodianum*. A conservation assessment based on IUCN guidelines is also provided for each species. Author: amopra@kku.ac.th

Stuart, B.L. & Rowley, J.J.L. (2020) A new *Leptobrachella* (Anura: Megophryidae) from the Cardamom Mountains of Cambodia. *Zootaxa*, **4834**, 556–572.

The authors describe a new species of frog to science (*Leptobrachella neangi* sp. nov) based on morphological and genetic analyses of two specimens collected in the Cardamom Mountains. The new species is readily distinguished from its congeners by morphological features and is the third species of *Leptobrachella* confirmed in Cambodia. Author: bryan.stuart@naturalsciences.org

Vuong T.T., Görföl, T., Csorba, G., Arai S., Kikuchi F., Fukui D., Koyabu D., Furey, N.M., Saw Bawm, Kyaw San Lin, Alviola, P., Chu T.H., Nguyen T.S., Tran A.T. & Hassanin, A. (2021) Integrative taxonomy and biogeography of Asian yellow house bats (Vespertilionidae: *Scotophilus*) in the Indomalayan Region. *Journal of Zoological Systematics and Evolutionary Research*. DOI 10.1111/jzs.12448

The authors integrate morphological and molecular analyses to clarify the taxonomic status and phylogeo-

graphical patterns of yellow house bats (*Scotophilus*), a widespread genus of vespertilionid bats in the Indomalayan Region. Their results show these can be classified into just two widespread species, namely the smaller *S. kuhlii* and the larger *S. heathii*, which occur in sympatry in different parts of Southeast Asia, including Cambodia. Author: vttu@iebr.ac.vn

Yooprasert, S., Culham, A., Tagane S., Yahara T., Nguyen V.D., Nguyen K.S. & Utteridge, T.M.A. (2022) New species and new status of *Urophyllum* Wall. (Rubiaceae) from Cambodia and Viêtnam. *Adansonia*, **44**, 91–114.

The authors describe five new species of *Urophyllum* which are endemic to Cambodia and Vietnam. An identification key is provided for *Urophyllum* species in Cambodia, Laos and Vietnam and point occurrence maps are also presented for each species, as well as conservation assessments based on IUCN guidelines. Author: saveta.yo@gmail.com

Biodiversity inventories

Capelle, J., Furey, N., Hoem T., Ou T.P., Lim T., Hul V., Heng O., Chevalier, V., Dussart, P. & Duong V. (2021) Longitudinal monitoring in Cambodia suggests higher circulation of alpha and betacoronaviruses in juvenile and immature bats of three species. *Scientific Reports*, **11**, 24145.

Recent studies suggest that the progenitors of the SARS-CoV-2 virus could have originated in rhinolophid bats within the region. The authors sampled bats in Cambodia to test the association between their age and CoV infection status and reviewed the literature to determine the reproductive phenology of bat genera in southeast China, Vietnam, Laos and Cambodia. Their results suggest an association between positive coronavirus detections and juvenile and immature bats in Cambodia. As literature review indicates reproduction is largely synchronised among rhinolophid and hipposiderid bats, they suggest surveillance of CoV in insectivorous bat species in Southeast Asia could target certain months of year to maximise detection probabilities. Author: julien.cappelle@cirad.fr

Furey, N.M., Vuong T.T., Hitch, A., Pimsai, A., Chor K., Buor V., Yim R., Chheang S., Borthwick, S.A., Ch'ng L., Say S., Csorba, G., Ith S., Smith, G.J.D., Chheang D. & Mendenhall, I. (2021) First records of seemingly rare bats (Mammalia: Chiroptera) in Cambodia, with a revised checklist of species for the country. *Acta Chiropterologica*, **23**, 345–369.

Based on field surveys undertaken throughout Cambodia in 2014–2020, the authors use morphological, genetic and acoustic data to document the first records of six bat species nationally (*Rhinolophus marshalli*, *R. siamensis*, *Hipposideros halophyllus*, *H. lekaguli*, *Cassistrellus yokdonensis* and *Eptesicus pachyomus*) and the second in-country record for one additional species (*Saccolaimus saccolaimus*). They also provide a revised checklist of the 80 bat species now confirmed in Cambodia and remark on the potential for additional discoveries. Author: neil.m.furey@gmail.com

Kosterin, O. (2020) First data on Odonata of Prey Long Forest in Cambodian lowland. *International Dragonfly Fund-Report*, **154**, 1–27.

Kosterin, O. (2020) Odonata of the great Lake Tonle Sap of Cambodia, as examined in 2017–2019. *International Dragonfly Fund-Report*, **154**, 29–98.

Kosterin, O. & Smith, E. (2020) Odonata of Phnom Kulen Mts, Cambodia: a preliminary checklist. *International Dragonfly Fund-Report*, **154**, 99–183.

Kosterin, O. (2020) Miscellaneous faunal data on Odonata of Cambodia. *International Dragonfly Fund-Report*, **154**, 185–223.

A series of papers documenting Odonata (dragonflies and damselflies) present in the vicinity of Prey Long, Tonle Sap Lake, Phnom Kulen, Siem Reap Province, Phnom Tbeng, Mondulkiri Province and Pursat Province. These include checklists of species for the studied localities and the first records for multiple taxa in Cambodia. Author: kosterin@bionet.nsc.ru

MacGowan, I. & Barták, M. (2022) An annotated list of Lonchaeidae (Diptera) from China, Cambodia and Vietnam with description of a new species. *Far Eastern Entomologist*, **447**, 10–16.

The authors provide a preliminary checklist of 14 species within the Lonchaeidae occurring in Cambodia, China and Vietnam. These include two species in Cambodia: *Silba ischnopoda* and *S. setifera*. Author: imacgowan9@gmail.com

Pin C., Kamler, J.F., Toem Y., Lay D., Vorn K., Kim N. & Macdonald, D.W. (2022) First record of a giant muntjac *Muntiacus vuquangensis* (Cervidae) from Cambodia. *Mammalia*. DOI 10.1515/mammalia-2021-0132

The giant muntjac *Muntiacus vuquangensis* is a Critically Endangered ungulate whose distribution extends along the Annamite Mountains in Laos and Vietnam. Based on a camera trap image taken in Virachey National Park, the authors report the first confirmed record of the species in Cambodia and suggest this likely represents an isolated population near the western edge of the species' distribution. Author: chanratana.pin@gmail.com

Si N., Ader, D. & Srean P. (2021) A checklist of wild orchids in Battambang, Cambodia. *Asian Journal of Agricultural and Environmental Safety*, **2021**, 66–68.

The authors report the occurrence of 79 species of wild orchids belonging to 38 genera in Battambang Province. Author: pao.srean@gmail.com

Zhang C., Luo C., Yang R., Yang Y., Guo X., Deng Y., Zhou H. & Zhang Y. (2022) Morphological and molecular identification reveals a high diversity of *Anopheles* species in the forest region of the Cambodia–Laos border. *Parasites & Vectors*, **15**, 94.

The authors employed morphological and molecular techniques to identify 2,394 mosquitoes collected in Siem Pang (Cambodia) and Pathoomphone (Laos). They identified 13 species of *Anopheles* in this region, with dominant species including *A. dirus*, *A. maculatus*, *A. philippinensis*, *A. kochi* and *A. sinensis*. Author: jamesyilong1010@aliyun.com

Species ecology & status

Freund, D., Signs, M. & Yoganand, K. (2021) *Primates of the Greater Mekong: Status, Threats and Conservation Efforts*. World Wide Fund for Nature, Gland, Switzerland. Https://wwfasia.awsassets.panda.org/downloads/primate_report_final_optimized.pdf [Accessed 3 June 2022].

Forty-four non-human primate species are currently recognised in the Greater Mekong region, some of which only occur in a single country or a small part of a country. This report summarizes the status of and threats to primates in the region and efforts by government and non-government agencies to conserve these. Despite the latter efforts, the authors conclude that many species are seriously threatened due to loss and fragmentation of habitats, coupled with poaching and trade of primates for meat, traditional medicine and pets.

Gray, T.N.E., Belecky, M., O'Kelly, H.J., Rao, M., Roberts, O. Tilker, A., Signs, M. & Yoganand, K. (2021) Understanding and solving the South-East Asian snaring crisis. *The Ecological Citizen*, **4**, 129–141.

The increasing use of snares for wildlife hunting is a major cause of population declines in terrestrial species in Southeast Asia. The authors document the removal of 371,056 snares from 11 protected areas in the region between 2005 and 2019. Due to the low detectability of snares and large size of many of the protected areas, this is believed to be a small fraction of total snares present. To address the threats posed by snares, anti-poaching patrols need urgent improvement and legislative changes are required to allow law enforcement officers to deter snaring in protected areas. Evidence-based campaigns to reduce the commercial demand for wildlife meat are also required. Author: tgray@wwf-tigers.org

Kamler, J.F., Minge, C., Rostro-García, S., Gharajehdaghipour, T., Crouthers, R., In, V., Pay C., Pin C., Sovanna P. & Macdonald, D.W. (2021) Home range, habitat selection, density, and diet of golden jackals in the Eastern Plains Landscape, Cambodia. *Journal of Mammalogy*, **102**, 636–650.

The authors used radio and GPS collars to evaluate movements and habitat selection of golden jackals *Canis aureus* in dry deciduous forest in Srepok Wildlife Sanctuary. They also analysed 147 scats to determine seasonal variation in diets and prey selection. The mean annual size of home ranges was considerably larger than previously reported and resulted in an extremely low density. Jackals avoided dense forests and streams and had a strong selection for dirt roads, possibly to avoid larger predators. The diet was diverse in including at least 16 prey items, with no significant differences between seasons. The authors suggest jackals are an extremely adaptable and opportunistic species that exhibit unique behaviours to survive near the edge of their distribution. Author: jan.f.kamler@gmail.com

Ladd, R., Crouthers, R., Brook, S. & Eames, J.C. (2022) Reviewing the status and demise of the Endangered Eld's deer and identifying priority sites and conservation actions in Cambodia. *Mammalia*. DOI 10.1515/mammalia-2021-0151

Eld's deer *Rucervus eldii* once occurred widely across Southeast Asia, but is now listed as Endangered, having suffered severe population declines and range contractions. The authors assess its status in Cambodia based on records between 2000 and 2020 and conclude that very small, isolated populations of the species are now mostly restricted to nine areas in the eastern and northern parts of the country. They also suggest that urgent conservation actions including effective law enforcement and anti-hunting strategies are required to ensure survival of the species in Cambodia. Author: r.ladd@uq.net.au.

McGrath, S.J. & Behie, A.M. (2021) Hunting pressure on primates in Veun Sai-Siem Pang National Park, Cambodia. *International Journal of Primatology*. DOI 10.1007/s10764-021-00219-1

Six primate species are known to inhabit Veun Sai-Siem Pang National Park in northeast Cambodia. The authors investigated hunting pressure on these by interviewing 96 people in five villages adjacent to the park. Their results suggest that pygmy slow loris *Nycticebus pygmaeus* is the most frequently hunted, sold and sought-after primate species within the national park and is used in traditional medicine. Additionally, the northern yellow-cheeked crested gibbon *Nomascus annamensis* is most sought after for use as a pet, although this species is reportedly only rarely caught within the park. Author: sarah.mcgrath@anu.edu.au

Nuttall, M.N., Griffin, O., Fewster, R.M., McGowan, P.J.K., Abernethy, K., O'Kelly, H., Nut M., Sot V. & Bunnefeld, N. (2021) Long-term monitoring of wildlife populations for protected area management in Southeast Asia. *Conservation Science and Practice*. DOI 10.1111/csp2.614

Although rare, long-term monitoring of biodiversity in protected areas is critical to assess threats, link conserva-

tion actions to species outcomes and improve management. Based on line transect distance sampling surveys in Keo Seima Wildlife Sanctuary between 2010 and 2020, the authors report abundance estimates and population trends for 11 species and spatial distributions for seven species. Their results indicate arboreal primates and green peafowl *Pavo muticus* generally had either stable or increasing population trends, whereas ungulates and semi-arboreal primates generally had declining trends. This suggests that ground-based threats, such as snares and domestic dogs, are having serious negative effects on terrestrial species. Author: mattnuttall00@gmail.com

Pin C., Phan C., Kamler, J.F., Rostro-García, S., Penjor, U., In, V., Crouthers, R., Macdonald, E.A., Chou S. & Macdonald, D.W. (2022) Density and occupancy of leopard cats across different forest types in Cambodia. *Mammal Research*. DOI 10.1007/s13364-022-00634-6

The leopard cat *Prionailurus bengalensis* is the most common wild felid in Southeast Asia, yet little is known about the factors that affect their population density and occupancy of natural habitats. The authors used camera trap surveys to determine densities of leopard cats in three forest types in Cambodia and conducted occupancy analyses to evaluate their interactions with leopards *Panthera pardus*, dholes *Cuon alpinus* and domestic dogs *Canis familiaris*. Estimated densities were highest in continuous evergreen forest, followed by mosaics dominated by evergreen forest and mosaics dominated by dry deciduous forests. The probability of occupancy for leopard cats was not affected by the presence or absence of any large carnivore. The authors suggest their findings support the notion that leopard cats are habitat generalists, although evergreen forest appears to be the optimum natural habitat for the species in Southeast Asia. Author: chanratana.pin@gmail.com

Phun T., Platt, S.G., Som S. & Rainwater, T.R. (2021) *Crocodylus siamensis* (Siamese crocodile). Attempted predation. *Herpetological Review*, **52**, 400–401.

This note reports observations of attempted predation of a small juvenile Siamese crocodile by a snakehead fish (*Channa* sp.) in the Sre Ambel River System of Koh Kong Province in 2020. Author: pthorn@wcs.org

Rostro-García, S., Kamler, J.F., Minge, C., Caragiulo, A., Crouthers, R., Groenenberg, M., Gray, T.N.E., In, V., Pin C., Sovanna P., Kery, M. & Macdonald, D.W. (2021) Small cats in big trouble? Diet, activity, and habitat use of jungle cats and leopard cats in threatened dry deciduous forests, Cambodia. *Ecology and Evolution*. DOI 10.1002/ece3.7316

The jungle cat *Felis chaus* is a little known dry deciduous dipterocarp forest (DDF) specialist that only occurs in small isolated populations in Southeast Asia. The authors used camera trap data and DNA-confirmed scats collected in Srepok Wildlife Sanctuary from 2009 to 2019 to determine temporal, dietary and spatial overlap between jungle cats and the more common leopard cats *Prionailurus bengalensis*. The diet of jungle cats was more diverse than leopard cats, although both species mostly consumed small rodents. Both species were primarily nocturnal and had high temporal overlap, although modelling suggested jungle cats were restricted to DDF and had low occupancy, whereas leopard cats had higher occupancy and were habitat generalists. The former suggests protection of large areas of DDF will be required to conserve jungle cats in Southeast Asia. Author: rostro.susana@gmail.com

Schloesing, E., Chambon, R., Tran A., Choden, K., Ravon, S., Epstein, J.H., Hoem T., Furey, N., Labadie, M., Bourgarel, M., De Nys, H.M., Caron, A. & Cappelle, J. (2020) Patterns of foraging activity & fidelity in a Southeast Asian flying fox. *Movement Ecology*, **8**, 46.

The authors analysed GPS data obtained from eight *Pteropus lylei* to evaluate the influence of environmental and behavioral variables on their foraging patterns in a heterogeneous landscape in Cambodia. The bats performed few foraging bouts (area-restricted searches) on a given night, mainly in residential areas, and the duration of these decreased during the night. The probability of a bat revisiting a foraging area within 48 hrs varied according to the time previously spent there, its distance from the roost site, and the corresponding habitat type. The study provides evidence that human-made environments may promote complex patterns of foraging-behaviour and short-term re-visitation in fruit bat species within these landscapes. Author: elodie.schloesing@gmail.com

Som S., Platt, S.G., Haislip, N.A. & Rainwater, T.R. (2021) *Cyclemys atripons* (black-bridged leaf turtle). Reproduction. *Herpetological Review*, **52**, 389–390.

The authors describe the eggs and reproductive phenology of *C. atripons* in Cambodia, based on observations of a female obtained near Peam Krasaop Wildlife Sanctuary and temporarily held at the Koh Kong Reptile Conservation Center. Author: ssom@wcs.org

Tak C., Crouthers, R., Sukumal, N., Chhin S. & Savini, T. (2022) Importance of Srepok Wildlife Sanctuary, Cambodia, for the endangered green peafowl: implications of co-occurrence near human use areas. *Raffles Bulletin of Zoology*, **70**, 249–256

The Endangered green peafowl *Pavo muticus* has dramatically declined in recent decades, with northern and eastern Cambodia representing one of the few remaining strongholds for the species. The authors conducted distance-based point counts of vocalisations to estimate densities of male green peafowls in Srepok Wildlife Sanctuary during the 2016 breeding season. This resulted in an estimated population of 1,165 calling males. Compared

to the core survey area, densities of males were higher in the outer survey area, and closer to human settlements and agricultural farms. The authors recommend that future conservation initiatives incorporate holistic approaches to integrate the needs of people and wildlife in areas of shared resources. Author: rachel.crouthers1@gmail.com

van Berkel, T., Emsens, W.-J., Eam S.U., Simoes, S., Puls S., Rin N., Kimsan L. & Jocque, M. (2022) Population density, habitat use and activity patterns of endangered hog deer in Cambodia. *Mammal Research*. DOI 10.1007/s13364-022-00619-5

Hog deer *Axis porcinus* were once widespread throughout much of lowland Southern Asia, but have rapidly declined in the last two decades. The authors conducted two camera trap surveys of a recently discovered population along the western bank of the Mekong River, near Kratie. They found that hog deer were confined to a ca. 2 km^2 relict patch of tall moist grassland during the dry season and estimated a density of 41.8 individuals/km^{-2}. Activity was mainly crepuscular and nocturnal. They conclude that the population (with an estimated 84 individuals) is extremely vulnerable to extinction due to its small size and dependency on a tiny remnant patch of core habitat. Author: info@binco.eu

Coasts, wetlands & aquatic resources

Sor R., Ngor P.B., Soum S., Chandra S., Hogan, Z.S. & Null, S.E. (2021) Water quality degradation in the Lower Mekong Basin. *Water*, **13**, 1555.

As one of the largest rivers in the world, the Mekong River supports significant biodiversity and ecosystem services. Based on biological and physical-chemical data collected over the last two decades, the authors employed biotic and abiotic metrics to evaluate water quality within the Lower Mekong Basin (LMB). Their results suggest water quality declined in the LMB in the 2010s, particularly near Vientiane City, the Sekong, Sesan, and Srepok Rivers, Tonle Sap Lake and Mekong Delta. This decline is likely associated with flow alteration, erosion, sediment trapping and point and non-point wastewater, which have resulted from rapid hydropower development, deforestation, intensive agriculture, plastic pollution and urbanization in the region. Author: sorsim.ratha@gmail.com

Strong, J.A., Wardell, C., Haïssoune, A., Jones, A.L. & Coals, L. (2022) Marine habitat mapping to support the use of conservation and anti-trawl structures in Kep Province, Cambodia. *ICES Journal of Marine Science*. DOI 10.1093/icesjms/fsac001

Despite designation as a Marine Fisheries Management Area (a local form of marine protected area), illegal trawling has continued to damage vulnerable marine habitats within the Kep Archipelago. The authors deployed 40 conservation and anti-trawling structures within the archipelago which can snare nets used by illegal trawlers and provide substrates for coral colonization. They present the results of a side-scan sonar survey and ground truthing campaign used to precisely locate these structures and produce maps of the important benthic habitats in the area. Author: james.strong@noc.ac.uk

Forests & forest resources

Crouthers, R. (2021) *Human Wildlife Interactions and People's Perceptions Towards Wildlife, Conservation and Protected Area Management Systems Across Communities Living Within or Adjacent to Srepok and Phnom Prich Wildlife Sanctuaries*. World Wide Fund for Nature, Phnom Penh, Cambodia.

This technical report presents the results of 1,369 household interviews undertaken in 49 villages located within and adjacent to the Srepok and Phnom Prich wildlife sanctuaries in eastern Cambodia. The overall purpose of the surveys was to generate baseline information to facilitate the future development of interdisciplinary conservation strategies within the area. Author: rachel.crouthers1@gmail.com

Ehara M., Saito H., Michinaka T., Hirata Y., Leng C., Matsumoto M. & Riano, C. (2021) Allocating the REDD+ national baseline to local projects: a case study of Cambodia. *Forest Policy and Economics*, **129**, 102474.

The authors evaluate forest cover, forest carbon stocks and historical deforestation trends using 77 hypothetical REDD+ (Reducing Emissions from Deforestation and forest Degradation) projects and five actual REDD+ projects in Cambodia. These analyses are employed to propose tools for deciding Cambodia's national REDD+ baseline or initial forest reference level for local REDD+ projects. Author: makotoehara1@gmail.com

The Recent Literature section was compiled by Neil Furey, with contributions from Oleg Kosterin.