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Wetland plant and aquatic macroinvertebrate communities of The Lower Central Plain: A case study at Salaya Campus, Mahidol University, Nakhon Pathom, Thailand

C. Sukhontapatipak, J. Milne and S. Srikosamatara
Mahidol University, Bangkok, *e-mail: tae_chu@yahoo.com*

A case study at Salaya Campus, Mahidol University, Nakhon Pathom Province, illustrates the problems of wetland degradation in the Lower Central Plain of Thailand. To fill the gap in knowledge on wetland ecology, a preliminary study of wetland plant and aquatic macroinvertebrate communities was conducted during November to December 2006. Twenty-eight sampling stations were set to cover an area of 8 ha of the campus wetlands. Dipnetting was used for sampling aquatic macroinvertebrates; then sorting and identification to Family level were done in the laboratory. At the same sampling stations, 1x1 m quadrat sampling was applied to estimate percent coverage of plants. Water depth was also measured. Based on the results the campus wetlands were classified as freshwater marshes where 36 species of plants were found with a Shannon's diversity index of 2.6. Among these, 22 species are facultative upland, 6 species are facultative wetland, and 8 species are obligate wetland plants. A transitional zone occurred between upland and wetland plants in this area at approximately depths of 0-25 cm covering 1.17 m of transects. Dynamic water levels caused zonation to occur in the wetland. The number of plant species tended to decrease as water level increased. For aquatic macroinvertebrates, at least 56 Families were identified. Shannon's diversity index was 2.5 for this community. Lymnaeidae, Chironomidae, and Planorbidae were the three most abundant taxa. The number of macroinvertebrate taxa was not related to water level. However, it tended to have a positive correlation with the number of plant species. On the basis of wetland plant and aquatic macroinvertebrate communities, biological metrics for wetland assessment will be developed.

Avian abundance and diversity: an assessment of monitoring methods for forest birds at the Mo-singto Long-term Biodiversity Research Plot, Khao Yai National Park

*P. D. Round¹, G. A. Gale², A. J. Pierce², K. Pobprasert²,
W. Sankamethawe², D. Khamcha², S. Nimnuan², N. Sukumal²,
K. Tokue², A. Pattanavibool³ and W. Y. Brockelman⁴*

¹*Mahidol University, Bangkok, e-mail: pdround@ksc.th.com,*

²*King Mongkut's University of Technology Thonburi, Bangkok,*

³*Wildlife Conservation Society-Thailand Program, Bangkok,*

⁴*Center for Conservation Biology, Mahidol University, Nakhon Pathom*

Little is known about the basic population ecology of Thai birds, particularly abundance, fecundity, and survival. Our objective was to conduct an intensive study of an evergreen forest bird community to estimate abundance of all species and assess the accuracy of different survey methods, and determine details of species ecology. Line-transects, point-counts, and spot mapping on the 30-hectare Mo-singto Plot, Khao Yai yielded >23,000 observations of 154 species of birds (2003-2006). The density was 2930 birds/km², similar to communities in Panama. The Puff-throated Bulbul had the highest density (300 individuals/ km²), while >85% of species had densities < 100 individuals/ km². Spot-mapping of colour-ringed birds provided the most accurate estimates of abundance, but did not work for all species. Distance sampling provided relatively accurate estimates of abundance more efficiently than spot-mapping, but was also unsuitable for some species. The estimates from line transects were somewhat better than from points. Birds were easiest to detect in March before the peak in nesting in April-May. November was the month where birds were the quietest. Most species completed breeding between January and August. We monitored 688 nests, one of the world's largest samples from a forested site in the tropics. Nesting success in most species was <25%, similar to other studies in the tropics. The chief cause of nest-loss was predation, especially by Pig-tailed Macaques. We colour ringed 1,207 birds which has enabled estimation of territories, movement patterns, and fecundity. Studies of survival are on-going. Other outputs include training of more than 12 Thai students and the publication of 12 international/regional papers.

Determining nest predators of understory forest birds using digital video surveillance at Khao Yai National Park

A. J. Pierce* and K. Popbrasert

King Mongkut's University of Technology Thonburi, Bangkok,

*e-mail: andrew@pdti.kmutt.ac.th

Nest predation is the primary cause of nest failure for many bird species. However, predation events are rarely seen and the predators are generally unknown. We developed a system using digital video recorders (DVR) to monitor nests in the understory of seasonally wet forest at Khao Yai National Park. Up to four DVR-camera systems were deployed during January - August 2006 & 2007 to monitor open cup, cavity and ground nests. A total of 710 days of active nesting was recorded at 72 nests of 11 species. 50 nests (74 %) lost at least one egg or nestling of which 44 (88 %) were due to predation. Non-predation failures included structural damage and starvation of nestlings. We recorded 5 different types of predators: the Pig-tailed Macaque, *Macaca nemestrina*, (18) rodents (7), birds (9), snakes (9) and the Common Palm Civet, *Paradoxurus hermaphroditus* (1). The civet and snake predation events were nocturnal. Two attacks by rats occurred at night while the remaining rodent events (tree shrews and squirrels) were diurnal. The Green magpie, *Cissa chinensis* (4) and the Crested Goshawk, *Accipiter trivirgatus* (3), were the most frequent bird predators. Cavity nests were depredated by snakes, macaques and a Crested Goshawk. Ground nests were depredated by a civet, macaques and a Crested Serpent Eagle, *Spilornis cheela*. Open-cup nests were depredated by snakes, macaques and birds. The high number of predation events caused by macaques deserves further attention to determine whether their populations have been increased by their habituation to humans in areas close to the study area.

An investigation of group composition of the cooperative-breeding Puff-throated Bulbul (*Alophoixus pallidus*) in Khao Yai National Park

P. Wonkson^{1,*}, *W. Sangkamethawee*¹, *D. Chamcha*¹,
*S. Tanasarnpaiboon*², *A. J. Pierce*¹, *G. A. Gale*¹ and *K. Tokue*¹

¹King Mongkut's University of Technology Thonburi, Bangkok,

*e-mail: phetpat@hotmail.com, ²Mahidol University, Bangkok

The Puff-throated Bulbul (*Alophoixus pallidus*) is one of the most common birds in evergreen forest in central Thailand and current evidence suggests that it is a very important seed disperser. It also has a complex social structure, including cooperative breeding which is poorly understood. Furthermore, recent evidence suggests that cooperative breeders may be particularly sensitive to habitat degradation, and fragmentation, and thus the reduction of such species could have significant effects on normal forest regeneration processes. The project objectives were: a) to investigate group size and the proportion of the Puff-throated Bulbul population engaging in cooperative breeding, b) investigate the relationship between group size and nesting success, and c) investigate the contribution to reproduction as well as to parental care provided by each flock member during different stages of nesting. The study is being undertaken on the Mo-Singto Long-term Biodiversity Plot, Khao Yai National Park. Preliminary results of this study indicate that Puff-throated Bulbuls live in groups of 2–7 individuals (average of 3.6 individuals per group). From observations at nests, feeding rates were 2.51 visits/hr. The primary female adult provided most of the parental care and insects were the main type of food fed to the nestlings (57.25%). We found that a larger group size and more helpers increased daily survival rates of nests from the egg stage until the nestling stage although the difference was not significant. Further work will help determine how group size affects nest and nestling survival.

Post-fledging survival and juvenile dispersal of the Puff-throated Bulbul (*Alophoixus pallidus*)

W. Sankamethawee* and G. A. Gale

King Mongkut's University of Technology Thonburi, Bangkok,

*e-mail swangworn@yahoo.com

Juvenile survival has a significant impact on population dynamics. The Puff-throated bulbul (*Alophoixus pallidus*) is the most abundant bird species in evergreen forest at Khao Yai National Park. These birds live in groups. This study focuses on a population in the Mo-Singto Long-Term Biodiversity Research Plot. Mist-netting and individual marking have been initiated to collect a variety of data including survival, group organization, territoriality, dispersal, and breeding behaviour. Preliminary results suggest that the survival of juvenile birds is relatively high (76%) if they survive the early post-fledging stage. In the majority of cases the cause of death was unknown, but presumably caused by predation, particularly by raptors as young fledglings are susceptible due to their weak flying ability. Juvenile birds started to feed independently when they are about 4 weeks old, but still got fed by adults in this weaning period. All juveniles stay in their natal territory for at least 28 weeks after fledging. Moulting started soon after the juveniles appeared full grown (4 weeks post fledging). The majority of juveniles (60%) seemed to disperse immediately before the subsequent breeding season while 16% stayed with parents in their natal territories. Sexual maturity occurred quicker than expected; both males and females can breed in the following year post-fledging, although only three individuals have been observed as breeders after dispersal. Female juveniles seem to disperse farther than males (400-700 m, <100 m respectively). Further data collection is ongoing to assess dispersal and recruitment in more detail.

Effects of landscape characteristics on diversity and abundance of migratory shorebirds in the Inner Gulf of Thailand

S. Sripanomyom

*King Mongkut's University of Technology Thonburi, Bangkok,
e-mail: ziriyaaz@yahoo.com*

The Inner Gulf of Thailand is known as an important stopover and wintering site for migratory shorebirds in the East Asian-Australasian flyway, but we lack basic ecological information about it and it currently has little legal protection. This study aims to investigate relationships between abundance of migratory shorebirds and surrounding landscapes and to define priority sites for conservation. Birds were counted during October 2006 – April 2007 at 20 sites along the Inner Gulf. Counts were performed four times at each site and the dependent double-observer approach was applied to calculate detection probability of each species in order to obtain more accurate estimates of abundance. There were 33 species recorded; the most abundant species were the Sand Plover, the Black-tailed Godwit and the Red-necked Stint, respectively. Two globally threatened species were found including the Spoon-billed Sandpiper and the Asian Dowitcher. The site with the highest abundance was Samut Sakorn Mangrove Research Station (23,122 birds) which also had the highest number of species (27 species). However, the Fisher alpha index indicated that Laem Pak Bia had the highest diversity (Fisher alpha = 3.85), which was assumed to be due to the greater evenness of species abundances. Cluster analysis was used to investigate community dissimilarities among the 20 sites by using the Bray-Curtis dissimilarity index as input. Sites clustered into four groups: poor, fair, good and high abundance sites. The detection probabilities have yet to be calculated for all species because larger samples of double-observer counts are needed. GIS analysis of bird communities in each site relative to landscape characteristics is on-going.

Pheasant habitat use and reproductive ecology in the Mo-Singto Long-term Biodiversity Research Plot, Khao Yai National Park

N. Sukumal and T. Savini*

*King Mongkut's University of Technology Thonburi, Bangkok,
e-mail: niti_230@hotmail.com

In the last decade the population of the Siamese Fireback (*Lophura diardi*) has increased in our study site (about 850m elevation) whereas in the past only the Silver Pheasant (*L. nycthemera*) was known to be present. We started a long-term project to investigate the effect of this increasing sympatry, suggested to be the consequence of general forest structural changes in the region; changes that have triggered the movement to higher elevations of a typically lowland species. By working on color-banded and radio-collared birds of both species we first investigated the ranging pattern, habitat use, range overlaps and micro-habitat structural differences. We defined habitat by tree density (DBH \geq 1 cm), soil moisture, canopy cover, elevation and slope exposure. Animal positions were recorded daily at two hour intervals. Locations were analyzed by ArcView GIS software using minimum convex polygons and kernel methods, and correlated with habitat variables. Home range size appeared to be 68 ha for the Siamese Fireback, which used primarily flat, wet areas, and 76 ha for the Silver Pheasant, which used more dry slopes. Second, we investigated their mating and nesting behaviour in order to define similarities that might, under extreme conditions, lead to inbreeding. Behavioural data were collected with 15-minute focal samplings in order to define bonding status between individual males and females and between males. Preliminary analyses suggest a difference between the two species' male mating strategies, with the Siamese Fireback showing a strong skew with a dominant male nearly monopolizing proximity with all females in the group. In the Silver Pheasant a lower skew was observed, with all males in the group sharing almost equal proximity with females. Mixed groups, with animals of both species, were sporadically observed.

Nightly activity patterns of understorey insectivorous bats in lowland tropical forest, Southern Thailand

W. Bumrungsri¹, T. Chongsiri² and S. Bumrungsri²

¹6th Protected Area Administration, Songkla, e-mail: katereelee@hotmail.com,

²Prince of Songkla University, Songkla

Activity patterns of understorey insectivorous bats in Ton Nga Chang Wildlife Sanctuary were investigated by setting overnight a time expansion bat detector. A total of 2,377 bat passes (series of calls) were recorded on 29 dark sample nights, with most of them being characterized by bats emitting constant frequency calls (1,851 bat passes, 78%) whereas the rest were characterized by bats emitting frequency modulated calls. Bat activity as revealed by echolocation calls were highest in the first two hours after sunset (14-15 bat passes/hour), and gradually declined throughout the night, and were lowest at dawn (1.3 bat passes/hour). Similarly, from 1,111 bat passes recorded on 15 light nights, the peak of activity was in the first three hours after sunset. On light nights, the second smaller peak of activity appeared to be at midnight. Fourteen species of bats emitting CF calls were recognised, 8 of which were tentatively identified to species. They are *Rhinolophus lepidus*, *R. steno*, *R. affinis*, *R. robinsoni*, *R. macrotis*, *R. trifoliatus*, *R. coelophyllus*, and *Hipposideros larvatus*. Among these, *R. trifoliatus* had the highest number of bat passes (1,004), followed by *R. affinis*, *R. macrotis*, and *R. lepidus* (74-289 bat passes).

Population census and cave re-location investigation of the Thailand roundleaf bat (*Hipposideros halophyllus*), a Thai endemic mammal

S. Waengsothorn^{1,*}, J. Nabhitabhata², K. Muangkhum¹,
S. Charavuthanukul¹ and T. Moonchan¹

¹Thailand Institute of Scientific and Technological Research, Bangkok,
*e-mail: swaengso@gmail.com, ²National Science Museum, Pathum Thani

Hipposideros halophyllus was categorized by the IUCN in 1994 as being in the LOWER RISK, Near Threatened subcategory (LR/nt). The current global status is likely underestimated and unsupported by sufficient information because biological and ecological data on the bat has never been documented since its first discovery from 33 years ago until 2006. The most recent numbers estimated for the bat population were approximately 1,400 individuals across the country, which is possibly classified in the ENDANGERED (EN) category (criteria C) of the 2001 IUCN Red List Categories and Criteria version 3.1. However, current estimates of population size were likely biased because of geographic limitations in searching for their roosting sites, and poor visual observation in caves. Our objectives are to efficiently examine roosting caves, and to accurately estimate the population size. We determined roosting caves using a bat detector, and evaluated the number of populations using capture-recapture techniques. The first field work was conducted during 10-16 June 2007 at Khao Samo Khon, Lop Buri province. The ultrasonic calls of the bats ranged between 173 – 191 kHz. We discovered six roosting caves and were successful in capturing and marking 40 adult males and 39 post lactating females from three caves. We also captured a bat, with the circular-cut hole on the wing membrane made during marking, from a new roosting site, Fachi cave, the next day. There was no evidence to indicate its original cave because the bat cleaned the hair-dye marks from its back and color marks from its forearm.

Population, distribution and participatory conservation of the White-handed gibbon (*Hylobates lar* L.) in Mae Hong Son province, northern Thailand

P. Yimkao*, J. Naksamrit and S. Srikosamatara

*Mahidol University, Bangkok, *e-mail: tu_wild@yahoo.com*

White-handed gibbons (*Hylobates lar*) in Mae Hong Son are critically endangered. There are about 293 individuals in 66 groups within 33 isolated locations based on interview, survey and direct observation in 53 villages. Population sizes within a locality are 1-30 individuals. They are all facing extinction in the area. Local wisdom of 2 ethnic groups (Karen and Lahu Na) is very important for gibbon conservation. Socialization using traditional knowledge within ethnic groups has been eroding and has not been connected with the education system. The traditions and beliefs of Sgaw Karen communities and some impassioned individuals have helped the remaining gibbon populations. Major threats are hunting for food, and field crop expansion performed by various ethnic groups especially Lisu, Hmong and Lahu. Uncontrolled forest exploitation and growing urbanization cause habitat destruction and isolation. Community empowerment, impassioned individuals and place-based education are needed to promote gibbon conservation in these areas.

Preliminary results on distribution, ecology and behaviour of the pigtail macaque (*Macaca nemestrina*) in Khao Yai National Park

T. Savini^{1,2}, M. C. Huynen², G. Bottin² and A. Latinne²

¹King Mongkut's University of Technology Thonburi, Bangkok, e-mail: tommaso.sav@kmutt.ac.th, ²University of Liege, Belgium

Pigtail macaque (*Macaca nemestrina*) ecology and behavior is still largely unknown. We started a long term project in 2006 to investigate the socio-ecology of two semi-habituated troops in Khao Yai National Park, Thailand. We observed activity budgets, feeding ecology, home ranges and seed dispersal capacity of two semi-habituated troops (HQ and CAM). Data were collected with 30-min scan sampling alternated with 10-min focal sampling of mature males. Scan sampling included records on habitat type, individual identification, age/sex class, canopy height used, attention status, behavior (activity and social interactions, specifying donors/receivers). Eaten items (species, part consumed, and maturity) were also recorded. During contacts with the macaques, we recorded GPS coordinates every 30 minutes. A home range size of about 1 km² was estimated for the HQ troop with a daily distance traveled of 2600 meters (SD+/- 250m). For the CAM troop the home range size was estimated at 3.2 km², with daily distance traveled being about 4500 meters (SD+/- 250m). Preliminary analysis of habitat use shows that macaques tend to spend most of the early morning and late afternoon in close proximity to human settlements while the middle of the day is spent in the pristine forest. Data collected on fruit species consumed by macaques and germination enhancement of dispersed seeds showed an overall consumption of 50 plant species of which 15 were dispersed.

Effects of planted trees and the bird community on natural seedling recruitment in a forest restoration area using the framework tree species method

C. Wydhayagarn*, P. Wangpakattanawong and S. Elliott

Chiang Mai University, Chiang Mai, *e-mail: schwarzir@hotmail.com

Forest restoration by planted trees can attract birds and mammals, which can accelerate recovery of biodiversity by dispersing seeds from natural forest into planted sites. This research is examining the attractiveness of different “framework tree species” in a forest restoration site established by the Forest Restoration Research Unit (FORRU), at Ban Mae Sa-Mai, Mae Rim District, Chiang Mai. Natural tree seedlings have been surveyed beneath 5 species of framework trees: *Erythrina subumbrans*, *Hovenia dulcis*, *Melia toosenden*, *Prunus cerasoides* and *Spondias axillaris*. Five individual trees of each species were selected (25 trees) in 3 replicated plots of the same age (9 years since planting). Bird observations were carried out on each tree to determine bird communities, which are assumed to affect natural seedling recruitment. A total of 37 tree seedling species were found beneath the trees, of which 11 species were wind-dispersed and 26 species animal-dispersed. *Prunus cerasoides* supported the highest density of tree seedlings, whilst *Hovenia dulcis* supported the lowest. Forty-eight bird species were recorded using the trees, of which 23 species were frugivores and 22 species non-frugivores. *Prunus cerasoides* supported the highest density and species richness of birds, whilst *Hovenia dulcis* supported the lowest. Different tree species characteristic such as tree size (GBH), height and crown width affect seedling recruitment. The effects of bird communities on seedling recruitment are different among the trees. Bigger trees, which attract high numbers of birds by providing food resources and perching sites may increase seed dispersal into the plots more than smaller trees.

Natural establishment of tree seedlings in forest restoration trials at Ban Mae Sa Mai, Chiang Mai Province

*K. Sinhaseni**, *S. Elliott*, *P. Wangpakattanawong* and *S. Chairuang Sri*
*Chiang Mai University, Chiang Mai, *e-mail: k_sinhaseni@hotmail.com*

Chiang Mai University's Forest Restoration Research Unit has successfully adapted the framework species method of forest restoration to accelerate natural regeneration of upland evergreen forest on deforested sites in northern Thailand. The method involves planting 20-30 indigenous forest tree species selected for fast growth, resilience to weeds and fire, and attractiveness to seed-dispersing animals. Trial plots to test the technique have been established annually in Doi Suthep-Pui National Park, northern Thailand, since 1998. The objectives of the research presented here were i) to determine to what extent the framework species method encourages recruitment of non-planted tree species into planted plots, resulting in increased tree species richness and a return to the tree species composition of natural forest, and ii) to determine the effects of the planted tree species, planting plot-age and fire on natural tree seedling establishment. Circular sample units of 10 m in diameter were laid out across plots planted in 1998 (9 years old) and 2002 (5 years old) and non-planted control plots. The results showed that seeds of most tree species were dispersed into the planted plots by animals (rather than by wind). Seedling numbers increased with the plot-ages. The mortality of seedlings in the control sites was mostly 3 times higher than in the planted plots. Moreover, 73 percent of the total number of tree seedlings established in the planted plots were recruited species (non-planted species). Therefore, the framework species method is effective at accelerating forest regeneration.