
What is ecology research?

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There are two parts to this question which has been assigned to me: what is ecology, and what is research. There are many ways to define “ecology”. Ecology also has many related disciplines such as limnology, oceanography, conservation biology, landscape ecology, and in the broad sense all of these fields are branches of ecology. Interdisciplinary areas also make the boundaries hard to define, and much exciting research always sprouts in interdisciplinary areas. Ecology has always enjoyed a close symbiosis with systematics (including taxonomy) and evolutionary biology. Ecology (with a capital E) as a classical discipline has been defined as the study of the relations of organisms to their environment, but this definition fails to capture the substance and complexity of the modern field. The study of the structure and function of ecosystems is a better definition. This includes the study of populations and communities, as well as ecosystem dynamics. The precursor of ecology was “natural history”, a largely descriptive field which is still important, but ecological research now deals largely with quantitative problems that require statistical analysis and mathematical modeling. Unravelling cause-and-effect relations in ecological systems involves detecting correlations, carrying our simulation and modeling exercises (and testing the results), and doing experiments. Without imaginative field experiments, determining causes in natural systems is very difficult. Finally, doing research involves increasing the body of scientific knowledge through communication of results. This involves publishing papers and books in English, as science is a global activity and its communication medium is primarily English.

Careers in ecology--opportunities for the present & the future

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There are some excellent resources available for students interested in careers in ecology; the Ecological Society of America (www.ESA.org) offers a particularly useful set of information about how to get started in this dynamic field. In this talk I will summarize concepts and suggestions from the ESA as well as my 10 years of experience conducting ecological research in Thailand. There are a wide variety of branches of ecology available today for a Thai student, such as marine, vegetation, and statistical ecology; each field can provide us with information to better understand the world around us. Ecologists around the world are currently working hard to improve our environment, manage our natural resources, and protect human health. Problems that require ecologists include water pollution, non-native species invasions, endangered species protection, low agricultural yields, unsustainable fishing to name just a few. In addition, ecologists study oceans, deserts, forests, cities, grasslands, rivers, and other ecosystems in every corner of the world. Increasingly, ecologists collaborate with physical scientists, social scientists, policy makers, and computer programmers to understand better how organisms interact with each other and with the environment in which they live. Ecologists can be teachers, technicians, field scientists, administrators, consultants, and writers. Therefore, students interested in becoming ecologists should make sure that their training is both broad and deep. The main traits all ecologists should have are curiosity, creativity, a passion for observation and scientific inquiry, and enthusiasm for asking and answering hard questions.

Wetlands of Salaya Campus, Mahidol University, and their potential for developing undergraduate ecological exercises

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Massive degradation of wetlands in the Lower Central Plain of Thailand causes wetland fragmentation and accelerates changes in wetlands to become wastelands. Though values of remaining wetlands perceived by most urban people are low, some wetlands still maintain ecological functions and values to local communities. Thus, ecological studies of the wetlands of Salaya Campus, Mahidol University, Nakhon Pathom Province, have indicated a diversity of plants and animals. However, campus-based integrated management based on ecological knowledge is still required. To explore practical approaches for conserving the wetlands on campus, ecological education integrating place-based education and experiential learning was initiated. Wetland exercises were developed in an Ecology course for undergraduate biology students in 2007. Three wetland exercises comprising 60% of total exercises of the course were designed. The first exercise was four-weeks of a 6-hr field experiment on competition that resulted in niche separation between cattail (*Typha angustifolia* L.) and exotic paragrass (*Brachiaria mutica* (Forssk.) Stapf). The second 6-hr exercise was a rapid biological survey that integrated perspectives of the human landscape. While, the last 6-hr exercise was an empowerment process encouraging students to convert observations in the real environment to hypothesis testing. Field notes, evaluation and attitude assessment indicated students' knowledge on wetland ecology and values. In addition to recreation value, the roles of the campus' wetlands in education and research are suggested as other main reasons to conserve these wetlands.

Radio-telemetry study of home range size and activities of the black Asian giant tortoise *Manouria emys phayrei* (Blyth, 1853)

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Home range sizes and activities of *Manouria emys phayrei* were studied at Kaeng Krachan National Park, Phetchaburi Province, Thailand, from November 2005 - June 2007. A total of fourteen *M. e. phayrei* individuals consisting of eleven adults (seven males and four females) and three juveniles were radio-tracked. The median annual home ranges (95% minimum convex polygon) were 0.60 ± 0.33 , 0.56 ± 0.07 and 0.08 ± 0.06 km² for adult males, adult females and juveniles, respectively. The median home range sizes of males and females were not significantly different but were significantly larger than the home range sizes of juveniles (Mann-Whitney U-test). The median home range sizes in the wet season (May – October) were larger than in the dry season (November – April) for most individuals. In the rainy season (May - October), most adult tortoises were found foraging in bamboo forests whereas juvenile tortoises were generally located in mud-swamps. In the cold-dry season (November-February), few tortoises were active and they were often found beneath fallen branches or leaf litter whereas in the hot-dry season (March - April) they were frequently found soaking in shallow streams.

Effects of landscape characteristics on migratory shorebird communities in the Inner Gulf of Thailand

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Shorebirds are long-distant migrants which link continents and hemispheres with their annual movements. The Inner Gulf of Thailand is an important stopover and wintering habitat for shorebirds in the East Asian-Australasian Flyway. However, we lack basic ecological information about shorebirds in the Inner Gulf. Moreover, most of the area has little legal protection. This broad scale study investigated the relationship between migratory shorebird communities and landscape characteristics along the Inner Gulf of Thailand, and identified priority sites for conservation. Shorebirds were counted from October 2006 - April 2007 at 20 sites spanning the Inner Gulf. There were 35 species found. Those with the highest abundance were Sand Plover (35,334 birds), Black-tailed Godwit (20,922 birds) and Red-necked Stint (4,867 birds). Samut Sakorn Mangrove Research Station (SSMRS) contained both the highest numbers of species (27) and individuals (23,122 birds). However, Fisher's alpha index suggested that Laem Pak Bia had the highest diversity (26 species, 3,249 birds, Fisher's alpha = 3.85) while SSMRS was second highest (Fisher's alpha = 3.02). Shorebird communities in each site are being analyzed relative to the surrounding landscape using GIS tools to determine landscape keystone structures. Preliminary analysis of the landscape suggests that traditional salt-pans and large, extensive mudflats are necessary habitats. Distance between these two habitats may also potentially be important.

Effects of food supply on foraging patterns and weights of wintering shorebirds on a managed wetland in the Inner Gulf of Thailand

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The Inner Gulf of Thailand is particularly important as a wintering and staging area for migrant shorebirds of the East Asian-Australian Flyway. Studies of the feeding ecology of shorebirds will provide useful information regarding the fate of shorebirds that use the Inner Gulf as a wintering ground and provide information for future management plans. The study was conducted at the Laem Phak Bia Environmental Research and Development Project, Phetchaburi during 29 July 2006 – 30 April 2008 to examine the effect of seasonal food availability on foraging pattern and body weight of adult and juvenile shorebirds. Prey capture rates, chasing rates, and pace rates were used to represent foraging pattern. Seasonal differences in food availability, prey capture rates, pace rates, chasing rates, and weights were compared among three periods: April, July–September, and November–February. A total of 55 Long-toed Stints (49 new birds, 6 retraps) were caught. The most abundant invertebrates in the study plot were chironomids. July–September had a higher invertebrate density than April and November–February ($p < 0.001$). Long-toed Stint peck rates in treatment ponds and salt ponds did not differ significantly between September–January and February–April. Weights of juvenile and adult Long-toed Stints did not differ significantly among the three periods. Both juvenile and adult Long-toed Stints had higher weights during April and July–September than during November–February. Invertebrate variation seemed to be related with Long-toed Stint weight.

Cooperative breeding in a tropical forest bird: The Puff-throated Bulbul (*Alophoixus pallidus*) in Khao Yai National Park

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Puff-throated bulbuls are omnivorous but highly frugivorous. They are strongly social, live in groups of 2-7 individuals, and defend territories year round. During recent research we found them to be cooperative breeders. Cooperative breeding in birds is known from about 3.2% of all species and these species tend to share several life history characteristics: low breeding rates, high adult survival, limited dispersal, and deferred maturity. We measured several parameters including nest success, post-fledging survival, dispersal, territory turnover rate, and adult survival. The results showed they have low nest success of 7.7–8.6 %, but high post-fledging survival (0.94 ± 0.02 SE), and high annual adult survival (0.82 ± 0.02). There was no complete turnover of territory owners in one season but 10–20 % male replacement and 10–13 % female replacement. Only one pair successfully established a new territory. Some sexually mature offspring delay dispersal, forgo breeding independently, and help their parents to raise nestlings and fledglings. However, it is difficult to find any common ecological correlates for this breeding system and particular ecological constraints cannot be easily separated. Long-term monitoring of this population is particularly important to understand how ecological and social constraints are related. Molecular techniques are also required for measuring individual relatedness and will provide a better understanding of the evolution of cooperative breeding. Furthermore, while cooperative breeding is not randomly distributed, it would be interesting to compare life history characteristics of other sympatric bulbul species.

Post-fledging survival of the Puff-throated Bulbul (*Alophoxus pallidus*) at Khao Yai National Park

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Juvenile survival is of major importance to ensure reproductive success of a population. The post-fledging period is widely reported to have the greatest mortality risk, and is perhaps the least-studied stage of the avian life cycle.

Nests of all breeding groups within and adjacent to the Mo Singto permanent plot were searched for intensively during the breeding season (February-July). Known or marked fledglings were monitored once a week until week 8 for survival history. Survival and re-sighting probabilities were estimated using Program MARK to fit a capture-recapture model. Estimated survival from the best fit model with lowest *AICc*, which was a time-dependent model, varied from 0.75-1.0, which was relatively high. The probability of re-sighting was also time-dependent and varied from 0.64-0.96. Overall survival estimated for 2006 and 2007 was 0.94 ± 0.01 SE. Both years showed the same survival rate of 0.94 ± 0.02 SE. The highest risk of mortality was during the first week after fledging with a survival estimate of 0.75 ± 0.07 SE. If a fledgling survived after the first week, the probability of survival was almost 100 % in the 2 month period of post-fledging. This survival rate was similar to those of other tropical passerines and relatively higher than for those in the temperate zone. This demographic parameter might play a significant role in determining the evolution of cooperative breeding in the Puff-throated bulbul. Other parameters such as adult survival, local recruitment, dispersal, and habitat availability are important to determine the whole demographic component and life history traits of this cooperative breeding bird.

Influence of food availability on Puff-throated bulbul (*Alophoxius pallidus*) movement patterns

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The movement patterns of the forest-dwelling Puff-throated bulbul were examined in relation to fruit abundance and fruit dispersion in a long-term research plot in evergreen forest in northeastern Thailand. The objective of this study was to investigate the influence of fruit resources on Puff-throated bulbul movement patterns. We predicted that the: (a) total feeding range would decrease with increasing availability and aggregation of fruit resources, (b) average distance moved between fruit foraging locations would decrease with increasing availability and increasing aggregation of fruit resources, and (c) time spent foraging on individual trees would decrease with increasing availability and increasing aggregation of fruit resources. Ten family groups were followed for nine months to record feeding locations, distances moved, and time spent feeding. Correlations were used to analyze the relationships between movement data, monthly fruit availability and fruit tree dispersion. Puff-throated bulbuls made on average significantly shorter distance movements between fruit sources when fruit was in higher abundance. Distance moved was significantly negatively correlated with the index of fruit dispersion, whereas, in contrast to other studies, there was no significant relationship between fruit availability and total feeding range. There was also a significant negative correlation between fruit abundance, fruit dispersion and the average time spent feeding in a particular tree. Overall, fluctuation in fruit availability and dispersion seem to explain a significant proportion of the monthly variation in Puff-throated bulbul movement patterns. Future work will focus on gut retention time in relation to potential seed shadows generated by this bulbul.

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

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Nesting success of birds is very low in tropical forests and predation is the primary cause of nest failure. However, predation events are rarely seen and the predators generally unknown. We developed a system using digital video recorders (DVR) to monitor nests at Khao Yai National Park. Cameras, with infrared diodes to allow 24 hour surveillance, were placed 3-5 m from the nests and connected to a DVR concealed 20–30m from the nest. Up to four DVR-camera systems were deployed during January 2006 - August 2008 to monitor understory nests. A total of 113 nests of 14 species were monitored for a total of 1215 days. There were 86 predation events including 4 nests at which there were two separate predation events by different predators. No differences in failure rates were recorded between nests with or without cameras. We recorded five different types of predators: Pig-tailed Macaque (38 events, 44.2%) small mammals (rat, squirrel, common palm civet and tree shrew (12 events, 14%), raptors (6 events, 7.0%) non-raptor birds (12 events, 14%) and snakes (18 events, 20.9%). Snake, rat and civet predation events were nocturnal while all other incidents occurred during the day. Green magpie *Cissa chinensis* (4) and Crested Goshawk *Accipiter trivirgatus* (3) were the most frequent bird predators. The high number of predation events caused by macaques deserves further attention to determine whether their behaviour has been affected by their habituation to humans in areas close to the study area. Non-predation failures included structural damage and death of nestlings, possibly due to starvation.

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

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This study was carried out to examine the effects of planted framework trees and the bird community on natural-seedling recruitment in a forest restoration area using the framework species method established by the Forest Restoration Research Unit (FORRU), Biology Department, Faculty of Science, Chiang Mai University. Natural tree seedlings were surveyed beneath 5 species of framework trees: *Erythrina subumbrans*, *Hovenia dulcis*, *Melia toosendan*, *Prunus cerasoides* and *Spondias axillaris*. Five individual trees of each species were selected (25 trees) in 3 replicated plots of the same age. Bird observations were carried out on each framework tree to determine visiting birds, which were assumed to affect natural-seedling recruitment. A total of 36 tree seedling species were found beneath the selected trees, of which 11 species were wind-dispersed and 25 species animal-dispersed. The population density of animal-dispersed tree seedlings was higher than wind-dispersed seedlings beneath all the selected framework trees. The sample plots beneath *Prunus cerasoides* supported the highest population density of tree seedlings. A total of 49 bird species was recorded between July 2006 and June 2007. Non-frugivorous birds were recorded to use the selected framework tree species more than the frugivorous birds. The effects of bird communities on seedling recruitment were different for each of the selected framework trees. Bigger trees, which attract a high number of birds by providing food resources, roosting and nesting sites, may increase seed deposition in the sampling plots more than smaller trees, which are less attractive to birds.

Nesting behavior and food habits of the collared scops owl (*Otus bakkamoena* Pennant) in Chanthaburi Province

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This study aimed to investigate ecological aspects in terms of basic nesting behavior, such as nest site selection, chick development and food habits. Chanthaburi Province was selected as the study area. During August 2006 to June 2007, public relations posters led to the discovery of twenty - three nests. The characterization of plant structure and composition was done by establishing a circular plot of 10 m radius around each nesting site. Egg size, owl parents, chicks and food habits were also recorded and data were analyzed.

The Collared Scops Owl started breeding in early February and continued until the middle of May, 2007. Agriculture is the major use of land in the area around nest sites. Two types of nests were observed: tree-nests and ground-nests. The average weight of adult owls was 141.3±17.8 g. Three eggs were found in most nests and the average number of eggs laid per nest was 1-4. However, this study found that only one bird (probably female) incubated eggs. The incubation period is around 22-29 days and hatching rate was 60%. Moreover, it was found that the average weight of hatched chicks was 12.8±1.6 g and the average weight of fledglings was 88.4±7.6 g. Hatched chicks had a 65% survival rate and dead chicks were found mostly between 0-10 days. The majority of foods consumed by vertebrate group were rodents (50%) while the majority of foods by invertebrate group were Coleoptera (45.3 %), Orthoptera (25.6%) and Hymenoptera (7.0%).

Diet analyses of the Red-headed Trogon and the Orange-breasted Trogon in relation to seasonal arthropod abundance and avian phenology

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A large amount of data has already been collected on the ecology of bird species at the Mo-Singto plot, Khao Yai, 30 ha, long term biodiversity plot, including data on breeding and moult observations. Round et al (2005) found little correlation of the seasonality of breeding and moult at the Mo-Singto plot with either rainfall or fruit abundance. They suggested, as have other studies (e.g., Poulin et al 1992), that arthropod abundance is a crucial factor governing the timing of breeding. To investigate this hypothesis two similar insectivorous species will be focused on, namely the Red-headed Trogon, *Harpactes erythrocephalus*, and the Orange-breasted Trogon, *Harpactes oreskios*. Information will be collected on the composition of arthropods in the two species' diets and relevant arthropods will be sampled to allow comparisons of prey abundances to be made between the two bird species.

Project objectives

i) Assess the composition of arthropods in the diets of the Red-headed Trogon and Orange-breasted Trogon.

ii) Collect data on seasonal changes in arthropod abundance relevant to the study species

iii) Examine the relationships between seasonal arthropod abundance and timing of breeding and moult.

iv) Investigate reasons for the difference in timing of breeding between the two species.

v) Investigate detailed differences in the feeding ecology between the two species so as to better understand ecological interactions between them.

Home range size and habitat use of sympatric Siamese Firebacks, *Lophura diardi*, and Silver Pheasants *L. nycthemera*, in Khao Yai National Park, Thailand

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During the past twenty years, a range expansion in the Siamese Fireback (*Lophura diardi*) population to higher elevations has been observed in Khao Yai National Park, Thailand, where previously only the Silver Pheasant (*Lophura nycthemera*) was observed. Increased evapotranspiration associated with general global warming was suggested to cause the migration of the Siamese Fireback to submontane habitats. This study investigates ranging patterns and habitat use of the two *Lophura* species co-occurring in the study area. Animals were fitted with colour bands and radio-collars. We collected data on tree density, topography, soil type and elevation at each point where marked pheasants were first located. Minimum Convex Polygons were used to estimate home ranges sizes on a two-month basis. Home range size for the Siamese Fireback averaged 59 ha, while the Silver Pheasant ranged over 60 ha. Preliminary analysis of habitat use revealed a difference between the two species, with the Siamese Fireback, a lowland species, significantly preferring flatter areas while the Silver Pheasant, a montane species, used mainly slopes (Mann-Whitney *U*-test, $z=-7.059$, $n_{\text{Siamese-Fireback}}=58$, $n_{\text{Silver-Pheasant}}=49$, $p<0.0001$). However, all nests of the Siamese Fireback were found on slopes > 15 degrees. Tree density did not differ between areas used by pheasants and areas randomly selected at the site (Siamese Fireback: Mann-Whitney *U*-test, $z=-0.763$, $n=114$, $p=0.448$; Silver Pheasant: Mann-Whitney *U*-test, $z=-1.388$, $n=24$, $p=0.173$). However, the areas where nests were located had a higher understory coverage compared to random plots (Mann-Whitney *U*-test, $z=-2.323$, $n=8$, $p=0.014$).

The effects of forest structure and food availability on the small carnivore community of Thung Yai Naresuan Wildlife Sanctuary, western Thailand

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Small mammalian carnivores are diverse both in terms of species and ecological traits. Thung Yai Naresuan Wildlife Sanctuary, western Thailand, is believed to support up to 23 species of small carnivores (≤ 15 kg) within a mosaic of habitats. The patterns of species diversity and occupancy between 2 major forest types, semi-evergreen forest (SEF) and mixed deciduous forest (MDF)/Savannah are being examined using camera traps. I hypothesized that small carnivores were highest in species richness, relative abundance and occupancy in SEF where forest structure is more complex and more food available (small mammals and fruit). Small carnivores accounted for 16% of photographs taken, consisting of 10 species from 5 families with an average of 1 photograph taken per day. Camera traps failed to detect half of the species thought to occur in the study area. These unseen species are probably rare while others are restricted to an arboreal habitat. The small carnivore communities differed greatly between the two forests (Sorensen index = 0.27). More species were observed in MDF/Savannah with higher relative abundance and rates of occupancy. This may be explained by the higher abundance of small mammals and the lack of connectivity of the canopy forcing semi-arboreal species to travel more on the ground. However, species occupancy levels and predicted habitat associations currently have low levels of precision possibly due to small numbers of detections and coarsely defined sampling units. This study suggests possible limitations of camera trapping and recommends a spot-lighting survey to account for nocturnal small carnivore species with more arboreal habits.

Habitat use and feeding behavior of the Bengal slow loris, *Nycticebus bengalensis*, in Khao Ang Rue Nai Wildlife Sanctuary: Preliminary results

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The ecological role of nocturnal primates in the tropics is less well understood than that of diurnal primates. Hence, nocturnal study is required to generate the missing information. The conservation status of the Bengal slow loris (*Nycticebus bengalensis*), *CITES Appendix I* and *Data Deficient* (IUCN 2000), underlines the crucial need of knowledge to preserve the species. Our ongoing study was initiated in November 2007 in Khao Ang Rue Nai Wildlife Sanctuary. We aim to investigate habitat use and feeding behavior of this species in relation to habitat characteristics. A 3.6 km-dirt road which cuts through various vegetation types (i.e. exotic plantation, plantation with succession, pristine forest, and open habitat) was surveyed monthly by a 1 km/hr pace walk. We took notes on position, substrate, vegetation, and food at each first detection. Behaviors were noted via continuous focal animal sampling. During 43 night-walks, we detected lorises at 62 locations. Detection in each vegetation was disproportionate to vegetation cover. They were most frequently detected in succession habitat at 5-10 m height. The diet consisted of plant exudates (*Terminalia catappa* and *Bauhinia* sp.), floral parts (*Parkia* sp.), fruits (*Lepisanthes rubiginosa* and possibly *Canarium subulatum*), and insects. Activity budgets of adult males and females at one *Terminalia* tree, the commonest feeding tree, were similar. Progress during the study revealed biases in habitat used by these animals which hint towards selection. We described some behaviors of this cryptic species, although observations were limited. Future work will involve study of micro-habitat selection and increased observation number to improve results.

Distribution, ecology and behaviour of the pigtail macaque (*Macaca nemestrina leonina*) in Thailand

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The role of pigtail macaques (*Macaca nemestrina leonina*) as seed dispersers has always been assumed but never tested in wild populations. While working on a major project investigating the influence of human proximity on the ecology of pigtail macaques living in the surroundings of Khao Yai National Park headquarters, we investigated their seed-dispersal potential. Our preliminary results, presented here, suggest they have an important role as seed dispersers, a role which has not been considered yet when analysing the importance of the frugivore community in forest regeneration.

The troop studied was composed of 40 individuals (3 adult males, 9 adult females, and 28 juveniles and infants) inhabiting a 100 ha home range. Sleeping sites were close to the park headquarters. About 30% of their daily activity was in primary forest, and the rest (more than 60%) in secondary forest and open areas. They consumed 6.4% of human food and 76% wild collected fruits, for which faeces analysis revealed the presence of a high number of seeds, up to 20mm in size. High viability of these seeds was determined using the cut-test and Tetrazolium immersion. Three series of seeds (defecated, spat, and control seeds) placed in germination boxes germinated at high rates with no uniform significant differences between the categories. Seeds without pulp, which were frequently found after macaque transport and processing, appeared more likely to germinate than seeds rejected with their pulp directly under parent trees. These results suggest that pigtail macaques are potential seed dispersers, an important attribute in regard to their regular use of degraded habitat.

Survey of and preparation of a guide to natural resources in Khao Samo Khon, Amphoe Tha Wung, Changwat Lop Buri

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Khao Samo Khon, a limestone hill in Lop Buri Province, is a substantial habitat for the Thailand roundleaf bat, *Hipposideros halophyllus*, a nationally endangered mammal. This area is occupied by the largest colonies of *H. halophyllus* in the country. We report here an intensive species diversity survey in the area, including vertebrate and invertebrate animals, and plant species. Our results revealed that organism diversity consists of at least 14 families and 24 species of mammals, 38 families and 78 species of birds, 7 families and 25 species of reptiles, 3 families and 7 species of amphibians, 17 families and 65 species of insects, and 64 families and 175 species of plants. The majority of animal species are common, except for *H. halophyllus*. Khao Samo Khon is also a significant habitat for plant species. At least 6 species of plants are rare and endemic to Thailand, namely *Marcantia grandiflora* Imlay, *Spondias bipinnata* Airy Shaw & Forman, *Capparis echinocarpus* Pierre ex Gagnep., *Bauhinia winitii* Craib, *Jasminum siamense* Craib, and *Glycosmis parva* Craib. Moreover, we report at least 15 species of nationally rare plants, e.g., *Ehretia winitii* Craib, *Phyllanthus mirabilis* Müll. Arg., *Lagerstroemia noei* Craib var. *longifolia* Furtado & Montien, *Ficus glaberrima* Blume subsp. *siamensis* Corner, etc. Some plant species are under laboratory examination, and may possibly be reported as new records or new species.

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

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The Forest Restoration Research Unit has successfully adapted the framework species method of forest restoration. This method involves planting 20-30 indigenous forest tree species, selected for fast growth, weed and fire resilience, and attractiveness to seed-dispersing animals. Trial plots to test the technique have been established annually in Doi Suthep-Pui National Park, northern Thailand. The objectives of the research were i) to determine if forest restoration encourages diversity of non-planted tree species, and ii) to determine the effects of planting density, plot-age and fire on natural tree seedling establishment. The study was carried out using two survey techniques. To determine the effects of planting density, 10x30m rectangular sample units were established in 1999-planted plots at 3 different densities (2.3, 1.8 and 1.5 m between trees at planting time). To determine the effects of plot age, 10-m diameter circular sample units were laid out in 1998-, 2002- and non-planted plots. In all sample units, height, root collar diameter, canopy width, health, weed cover and shade of all natural seedlings were recorded. The natural seedling population density and proportion of climax species increased with age of planted plots. Spacing trees 1.8 m apart at planting time resulted in optimal natural seedling establishment. Most seedlings had been dispersed into the planted plots by animals. Mortality of seedlings in the control sites was higher than in planted plots. Seventy-two recorded tree seedling species in the planted plots were recruited species. Previous fires in the planted areas inhibited seedling establishment and increased mortality rate.

Comparison of SPOT S10-Data with Biome-BGC model parameters for teak plantation characterization

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During the period 2004-2007 in a Maemoh site (Thailand), SPOT s10-data was compared with Biome-BGC model parameters. SPOT 10-day composite imageries at 1 km resolution were one pixel cutoffs with center at fluxtower site. A Biome-BGC model estimated LAI and NPP by using general ecophysiological parameterization schemes according to White et al. (2000) and user vegetation onset and offset. Four-year climate records were generated by MT-CLIM. The vegetation type of the Maemoh site was artificial teak plantation (*T. grandis*), in a tropical zone. BIOME-BGC tended to underestimate LAI in comparison with SPOT results. The difference in vegetation growth was probably associated with spatial resolution of the SPOT image and discrepancies in classification of land cover due to the presence of a variety of local species in the teak plantation. SPOT LAI and modeled LAI had an acceptable correlation ($R^2=0.58$). In this study, the four years exhibited different precipitation regimes and thus different vegetation growth. The difference in precipitation quantity influenced LAI values. NPP which was estimated by using BIOME-BGC showed a NPP reduction called the “missing carbon sink” at the Maemoh site in these four years. The NPP values in these four years were 776.1, 740.4, 605.6 and 687.4 gC/ m².