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 precurser 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 km^2 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 – 30April 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 (*Alophoixus 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, $n_{Siamese\text{-}Fireback}$=58, $n_{Silver\text{-}Pheasant}$=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 leonine*) 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. hallophyllus* 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. hallophyllus.* Khao Samo Khon is also a significant habitat for plant species. At least 6 species of plants are rare and endemic to Thailand, namely *Marcania 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. BIOM-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/ m^2.

Acetylcholinesterase inhibitors from the Thai sponge *Corticium* sp.

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Bioassay-guided fractionation of the Thai sponge *Corticium* sp. led to the isolation of a new steroidal alkaloid, 4-acetoxy-plakinamine B, along with an unidentified trihydroxy sterol. The structure was elucidated by means of spectroscopic analyses, including UV, IR, NMR and mass spectra. 4-Acetoxy-plakinamine B showed potent acetylcholinesterase-inhibition activity (IC_{50} 3.75±1.69 μM), with no significant cytotoxicity observed. The enzyme inhibition activity of 4-acetoxy-plakinamine B against acetylcholinesterase was reversible. In order to determine the kinetics of enzyme inhibition, V_{max} and K_m were measured. It was determined that the compound inhibited the targeted enzyme in a mixed-competitive manner.

The impact of the tsunami on coral recruitment at Mu Koh Surin National Park, Phang Nga Province

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Mu Koh Surin is a group of offshore islands in the Andaman Sea, located about 60 km from the mainland of Phang Nga Province, southern Thailand. It is recognized as one of the best diving spots. The 2004 tsunami caused severe damage to certain reef sites, especially those located in channels between islands which lie in an east-west direction, such as the channel between South Surin Island and Torinla Island. The present study concentrates on impacts of the tsunami on coral recruitment at Mu Koh Surin by using settlement plate experiments and field observation of juvenile coral colonies. Densities of juvenile coral colonies at Koh Torinla, Ao Pakkaad, Koh Pachumba, Ao Tao, Ao Jaak, Ao Mae Yai, Koh Stock, Ao Mai Ngam and Ao Suthep decreased to 0.10, 0.44, 0.89, 0.33, 0.29, 0.90, 0.05, 0.41 and 0.09 colonies/m^2, respectively. This is because juvenile colonies on substrates were washed away by strong waves and currents. The main groups of juvenile coral that decreased were *Galaxea*, *Fungia*, *Pocillopora*, *Acropora* and *Porites*. Coral recruitment on settlement plates varied by location and season. The peak of coral recruitment was in the January-March interval with an average of 56.36 ± 12.59 colonies/m^2. Coral recruitment rates at Ao Jaak, Ao Mae Yai, Ao Suthep, Ao Pakkaad and Koh Torinla were 45.56 ± 17.78, 36.05 ± 12.01, 25.43 ± 6.31, 34.57 ± 13.58 and 35.39 ± 10.56 colonies/m^2/year, respectively. The density of coral recruits on settlement plates at Mu Koh Surin was relatively high. Certain high tsunami-impacted reefs, such as Ao Pagkard, showed clear, natural recovery trends. The present study provides basic essential data for planning coral reef management at Mu Koh Surin.

Survival and growth of juvenile staghorn corals, *Acropora* spp., in a culture system

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At present, anthropogenic degradation of corals in Thailand is a major issue. Thus, a new method of coral restoration using coral cultivation is being introduced as an additional way to increase coral diversity. In this study, the gametes of 4 species of *Acropora* were collected from Ao Sattahip, Chonburi Province, and brought back to a land-based hatchery for fertilization and rearing for 9 months before being transplanted to natural reefs. Results from field surveys between 2006–2008 showed that the spawning period of *Acropora* species in this area occurred during January to March each year. The spawning date and time of all species was related to the neap tide of water and the lunar cycle, which were 5–12 nights after the full moon or the new moon. In the rearing system, the rates of fertilization of each species were more than 90%. After fertilization, the survival rates of planulae were higher than 87%, and the settlement rates of planulae were between 49–75% on the 4th day after fertilization. After settling, the highest mortality rates of juvenile corals occurred during the first 3 months, the period that corals needed zooxanthellae from surrounding seawater. After 9 months, the survival rate of juvenile corals was approximately 33.0 $\pm$ 3.55%, and the size reached 11.9 $\pm$ 9.85 mm in length.

Species diversity of terrestrial earthworms in Lower Northern Thailand

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A total of 21 species of terrestrial earthworms were collected from the Lower Northern part of Thailand from July – November 2007. There were 9 species of Megascolecidae, 3 species of Moniligastridae, and 1 species each of Glossoscolecidae and Octochaetidae. The genera *Amynthas* and *Metaphire* of the Megascolecidae were dominant and included 15 species, of which 11 species are thought to be new species. They differed from other *Amynthas* and *Metaphire* in their patterns of genital markings and in the appearance of the male pore region. They occurred in disturbed areas or where natural environments (forests) still remain, or in the areas relatively less disturbed by human activities. *Amynthas alexandri*, *Metaphire peguana* and *M. posthruma* are now the dominant earthworms of this area. Future studies at this site might include a seasonal study on the ecology and reproduction of these earthworm species.

Population genetic study of the *Anopheles barbirostris* species complex (Diptera: Culicidae) in Thailand

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A total of 113 isolines of *Anopheles barbirostris*, derived from human- and animal-biting females, showed branch summation in 2 groups of seta 2-VI pupal skins: 42 isolines were *An. barbirostris* (9-16 branches), and 71 were *An. campestris* (20-30 branches). Four karyotypic forms [Forms A (X_1, X_2, Y_1), B (X_1, X_2, X_3, Y_2), C (X_2, Y_3) and D (X_2, Y_4)] were obtained in *An. barbirostris*, and 3 karyotypic forms [Forms B (X_2, Y_2), E (X_1, X_2, X_3, Y_5) and F (X_2, X_3, Y_6)] were recovered in *An. campestris*. Based on the similarity of X_2-chromosomes, the latter species was designated as *An. campestris*-like Forms B, E and F. Results of non post-mating reproductive isolation among the crosses of *An. campestris*-like Forms B, E and F indicated intraspecific karyotype variation. The low sequence divergences of ITS2 of rDNA and COI and COII of mtDNA among the forms supported their intraspecific karyotype variation. Results of post-mating reproductive isolation among crosses of *An. campestris*-like Form E and *An. barbirostris* Form A strains from Chiang Mai, Phetchaburi and Kanchanaburi supported the existence of 5 species within the taxon *An. barbirostris*, designated as an *An. campestris*-like species, *An. barbirostris* species A1, A2, A3, and A4. The large sequence divergences of ITS2, COI, and COII supported the existence of these species. Results of non-post mating reproductive isolation from the crosses of different karotypic forms of species A1 (A, B, C, D) and A2 (A, B) suggested that different karyotypic forms occurred in natural populations of species A1 and A2.

Cytogenetic and molecular evidence for five new species within the taxon *Anopheles barbirostris* (Diptera: Culicidae) in Thailand

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A total of 113 isolines of *Anopheles barbirostris*, derived from human- and animal-biting females, showed branch summation in 2 groups of seta 2-VI pupal skins: 42 isolines were *An. barbirostris* (9-16 branches), and 71 were *An. campestris* (20-30 branches). Four karyotypic forms [Form A (X_1, X_2, Y_1), B (X_1, X_2, X_3, Y_2), C (X_2, Y_3) and D (X_2, Y_4)] were obtained in *An. barbirostris*, and 3 karyotypic forms [Form B (X_2, Y_2), E (X_1, X_2, X_3, Y_5) and F (X_2, X_3, Y_6)] were recovered in *An. campestris*. Based on the similarity of X_2-chromosomes, the latter species was designated as *An. campestris*-like Forms B, E and F. Results of non post-mating reproductive isolation among the crosses of *An. campestris*-like Forms B, E and F indicated intraspecific karyotype variation. Low sequence divergences of the ITS2 of rDNA, and COI and COII of mtDNA among the forms, supported their intraspecific karyotypic variation. Results of post-mating reproductive isolation among the crosses of *An. campestris*-like Form E and *An. barbirostris* Form A strains from Chiang Mai, Phetchaburi and Kanchanaburi supported the existence of 5 species within the taxon *An. barbirostris*, designated as *An. campestris*-like species and *An. barbirostris* species A1, A2, A3, and A4. The large sequence divergences of ITS2, COI, and COII supported this evidence. Results of non-post mating reproductive isolation from crosses of different karotypic forms of species A1 (A, B, C, D) and A2 (A, B), suggested that different karyotypic forms occurred in natural populations of species A1 and A2.

Diversity of mosquitoes susceptible to filarial parasites in an endemic area of *Wuchereria bancrofti* at the Thai-Myanmar border of Thong Pha Phum district, Kanchanaburi Province, Thailand

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This research aimed to survey the diversity of mosquitoes that are vectors of filarial parasites of both humans and animals in suburban and forest areas in the sub unit of Ban Mea Num Noi in rubber forest plantations, Huy Kayieng sub district, Thong Pha Phum district, Kanchanaburi province. Between November 2007 and July 2008, 23 species of mosquitoes were found, of which 7 species were diurnal feeding mosquitoes (06.05-19.00 h exposure time), 12 species were nocturnal feeding mosquitoes (19.05-06.00 h exposure time) and 4 species were diurnal-nocturnal feeding mosquitoes. Among the total number of 7,485 wild mosquitoes that were caught, 17 species have yet to be identified, and 57 mosquitoes of 5 species (0.76%) were positive for filarial parasites; these will be further identified to species level using a PCR technique.

Systematics and population genetics of black flies (Diptera: Simuliidae) in Thailand

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A total of 34 known *Simulium* species collected from 40 locations in northern, central and southern Thailand were identified based on morphological characters of larvae and pupae. One new species, namely *S.* (*G.*) *adleri*, was collected from Bang Thao Mae waterfall, Krabi Province, in southern Thailand. All species are placed into 4 subgenera of the genus *Simulium* Latreille s.l. Sixteen *Simulium* species were restricted to the north whereas 5 species were found only in the south. Ecological studies of the southern breeding sites indicated that species distribution and species composition were related to some physical factors of the breeding sites, such as stream size and depth, and water velocity. Larval polytene chromosomes of 1,330 individuals of *Simulium striatum* consisting of *S. quinquestriatum* (255), *S. chiangmaiense* (451) and *S. nakhonense* (624) were examined. These species showed homosequential sequences of polytene chromosome banding patterns. All larvae of *S. quinquestriatum* were monomorphic. Although most larvae of *S. chiangmaiense* and *S. nakhonense* were monomorphic, some larvae had different floating inversions with low frequencies. *S. chiangmaiense* had 6 floating inversions (IS-2, IL-1, IIS-3, IIL-1, IIL-2 and IIIL-9) with frequencies of 0.004-0.03 whereas *S. nakhonense* had 12 floating inversions (IS-1, IIS–1, IIS–2, IIIS-1, IIIL-1, IIIL–2, IIIL–3, IIIL–4, IIIL–5, IIIL–6, III– 7 and IIIL–8) with frequencies of 0.01 – 0.04 (except IIIL – 2 and IIIL – 4). It is possible that *S. quinquestriatum* is the ancestor of *S. chiangmaiense* and *S. nakhonense* with separation of the two lines occurrng by different floating inversions. However, these three species may be conspecific species by having the same polytene chromosome banding sequences. Differences in larval and pupal morphologies of these species may be due to adaptation to different ecological microhabitats. Further study of the molecular genetics of these species should provide knowledge of the taxonomic status of this species-group.

Biodiversity and ecology of black flies (Diptera: Simuliidae) in northern and southern Thailand

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The ecology of black flies in northern and southern Thailand was investigated. Larvae and pupae were collected from 65 stream sites in 10 northern provinces during the rainy, cool and hot seasons. An additional 18 sites in 9 southern provinces were studied. A total of 27 black fly species were identified from northern Thailand. Twenty-six species were found in the cool season, when the species richness and abundance were highest. A total of 18 species were found in 9 provinces in southern Thailand. *Simulium tani* was the most widely distributed species, occurring at 66.7% of sites in the South. Distributions of larval black flies in northern and southern Thailand were not random. Ecological analyses of stream sites revealed that air and water temperature, altitude, conductivity and salinity, dissolved oxygen, humidity, and stream size were important factors associated with the distributions of black flies in both regions. The polytene chromosomes of three described morphospecies in the *Simulium ceylonicum* group were examined from 52 sites in Thailand. Ten cytoforms were revealed on the basis of unique suites of fixed and floating inversions. All cytoforms appear to be good species, supported by chromosomal and morphological evidence. Three reproductively isolated cytoforms, for which sufficient specimens were available, were formally described as new species. The existence of chromosomally distinct entities in established morphospecies of the *S. ceylonicum* group supports a common trend of hidden biodiversity in Southeast Asian black flies. A preliminary study of symbionts showed that five groups of symbionts were found in larval black flies from northern Thailand: nematodes, microsporidia, chytrid fungi, trichomycete fungi and ichthyosporean protozoa.

Searching and ovipositional behaviors of the fruit fly parasitoid, *Diachasmimorpha longicaudata*

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Successful parasitism of parasitoids requires the processes of host habitat location, host location, host acceptance and larval development in the host. Parasitoids often respond to stimuli associated with both hosts and their habitats. They may use visual, acoustic or olfactory receptors to locate hosts. Questions concerning which stimuli can attract the solitary endoparasitoid, *Diachasmimorpha longicaudata*, to its tephritid fruit fly host were investigated. Results from laboratory studies of the stimuli affecting "searching and ovipositional behavior" showed that female parasitoids begin ovipositor-probing behavior when responding to sound and/or vibration produced by movement of host larvae within their microhabitat, and/or chemical stimuli derived from host larvae and/or host substrates. In nature, stimuli would be expected to be more complex. After parasitoids locate hosts, they may be faced with a sequence of decisions concerned with oviposition. The parasitoids may decide to use the hosts for oviposition or ignore them. If the hosts are accepted, parasitoids must decide to lay their eggs. A further question is what sex of egg should be laid? There is some evidence indicating that most solitary parasitoids lay male eggs in small hosts, and female eggs in large hosts. Thus, progeny sexes are under the decision of the female parasitoid. Another decision faced by female parasitic wasps results from their haplodiploid system, i.e., males develop from unfertilized eggs and females from fertilized eggs. This raises the question of how can female-biased sex ratios be achieved? This is because if a high proportion of female parasitoids is produced, their success at controlling host populations will increase. Thus, it is conceivable that the processes of searching and oviposition in parasitoids play an important role in a biological control program.

Ecological genetics and reproductive isolation of fruit fly parasitoids in the *Diachasmimorpha longicaudata* complex in Thailand

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The parasitoid *Diachasmimorpha longicaudata* is a beneficial wasp that is useful in biological control. Although *D. longicaudata* has been well studied, several researchers have documented and suggested that *D. longicaudata* is probably a species complex. Thus it is necessary to undertake genetic investigation of *D. longicaudata* populations in the field in order to understand their genetic diversity and to elucidate their taxonomic status. In this study, *D. longicaudata* samples were collected from several localities in Thailand. They were grouped into three forms (DLA, DLB and DLBB) based on host species. The PCR-linked single-strand conformation (PCR-SSCP) technique for nuclear DNA (28s and ITS2 regions) was used for investigating the molecular systematics of these *D. longicaudata* forms. Based on the 28s region, three different SSCP banding patterns were detected thus indicating that these three forms could be distinguished. The internal transcribed spacer (ITS2) region was amplified and PCR products were investigated. Three different products were found. Both SSCP patterns and PCR products of the 28s and ITS2 regions, respectively, suggested that genetic divergence exists within the *D. longicaudata* complex (DLA, DLB and DLBB). Moreover, results of cross-mating experiments among the three different forms of *D. longicaudata* provided evidence that these forms were reproductively isolated due to reproductive incompatibility. These results suggest that the three forms of *D. longicaudata* in Thailand are closely related species.

From captivity to conservation: the adaptive characteristics of the Thai aquatic firefly, *Luciola aquatilis*

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Luciola aquatilis sp. nov. Thancharoen (Coleoptera: Lampyridae) is a new species of aquatic firefly from Thailand. It is a common firefly species associated with freshwater area and possesses a wide distribution across Thailand. At present, this species is subjected to many negative impacts associated with human activity and urbanization, resulting in decreasing numbers and populations disappearing from many habitats. The successfully developed rearing technique of this species was not only useful for maintaining a complete life cycle for many generations, but also offers an opportunity for observing the duration and development of each instar, feeding habits, mating behavior and other biological data useful for consideration of developing conservation management practices of this species. There are several adaptive characteristics of *L. aquatilis* observed from laboratory culturing. Thus, the successful conservation of the fireflies is possibly done in the field.

Species survey and taxonomy of the infraorder Aculeata (Hymenoptera; Apocrita) in the North of Thailand

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Species surveys and sample collections of insects in the infraorder Aculeata in the north of Thailand were carried out from January 2006 to October 2008. The techniques of line transects and random sampling were used for sample collections. We found that in northern Thailand, the aculeates collected could be classified into 3 superfamilies, namely Apoidea Chrysidoidea and Vespoidea. A total of 120 species was recorded visiting flowers, from host plants and/or from colonies. The 86 specimens were identified to the species level and 34 specimens were identified to the genus level. These species belonged to 64 genera, 24 subfamilies and 9 families, namely Anthophoridae, Apidae, Chrysididae, Formicidae, Halictidae, Megachilidae, Scoliidae, Sphecidae and Vespidae. Family Formicidae (ants) had the highest species composition (50.83% or 61 species). Species diversity indices using Pielou's index in habitats were high, except in grassland, while dominance indices using Simpson's index indicated a simple structure. Sorensen's similarity coefficient showed that deciduous forest with bamboo and hill evergreen forest (0.6386), and primary forests combined and cultivated areas (0.6207) had similar aculeate species community structures.

Distribution, nest dispersion, nesting sites and nest structures of the stingless bee, *Trigona collina* Smith, 1857 (Apidae, Meliponinae) in Thailand

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The stingless bee species, *Trigona collina* Smith, 1857, is distributed throughout Thailand. From 640 collected colonies, nesting sites were only found in the altitude range from 18 to 830 meters above sea level. Most nests located in mixed deciduous forests were found at an altitude lower than 400 meters above sea level. Nesting sites could be divided into 4 main groups: 1) cavities in tree trunks (15.63%), 2) cavities in termite mounds (42.60%), 3) underground cavities (33.75%), and 4) cavities in buildings (7.96%). A total of 47 colonies were studied and the results of a standardized Morisita index of dispersion within the study area showed that nest dispersion was strongly clumped ($p<0.05$). The pattern of nest dispersion in this species probably ensures an adequate number of mates in their mating range. The nest structure of *T. collina* is comprised of 5 main components: 1) the external entrance tube, 2) batumen barrier, 3) honey pots, 4) pollen pots and 5) brood cells. The batumen is a multilayered cover of the brood chambers. We suggest that the variation in the number of batumen layers in the nest of *T. collina* is associated with temperature regulation of the nests. Nest dispersion was investigated in a mixed deciduous forest at the Phitsanulok Wildlife Conservation Development and Extension Station.

The development time of the red dwarf honey bee *Apis florea* in Huai Kayeng Sub-District, Thong Pha Phum District, Kanchanaburi Province

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The development times of *A. florea* workers, queens, and drones were studied in Huai Kayeng Sub-District, Thong Pha Phum District, Kanchanaburi Province, from March 2008 to July 2008. Five colonies of *A. florea* were used to study development times of eggs, larvae and pupae of workers, queens and drones. The development times of egg, larval and pupal stages of workers were 3.02 ± 0.57, 4.07 ± 0.64 and 9.57 ± 0.5 days (n=100), respectively. The development times of egg, larval and pupal stages of queens were 3.06 ± 0.76, 5 ± 0.67 and 7.19 ± 0.59 days (n=32), respectively. The drone's developmental times for eggs, larvae and pupae were 2.99 ± 0.39, 6.72 ± 0.45 and 12.73 ± 1.03 days (n=100), respectively. The total developmental periods from egg to adult of workers, queens and drones were 16.66 ± 1.08 (n=100), 15.25 ± 0.59 (n=32) and 22.44 ± 1.17 (n=100) days, respectively. Development times of workers and queens of *A. florea* from this study were shorter than those determined in previous research especially in the larval and pupal stages. Basic information from this research could be used to help community villagers understand important aspects of bee biology in order to preserve bees and make decisions for conservation of natural resources in the future, and to encourage sustainable resource utilization.

A taxonomic study of water striders (Hemiptera: Gerridae) in the Mae Klong River Basin, Thailand

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Water striders play a major role as biological control agents. They live in various types of habitats, such as freshwater**,** brackish water and seashores, including the open sea. This study aimed to ascertain the taxonomy and distribution of water striders in the Mae Klong River Basin. Specimens were collected from stream and stagnant water in Kanchanaburi, Ratchaburi, Samut Songkhram Tak and Uthai Thani Provinces. From this study, a total of 5,550 water strider individuals were collected and identified into 20 genera, 36 species and 4 morphospecies. They are *Amemboa armata, Amemboa cristata, Amemboa dentata, Amemboa javanica, Amemboa riparia, Amemboa schwendingeri, Aquarius adelaidis, Cylindrostethus costalis, Cylindrostethus scrutator, Eotrechus hygropetricus, Gnomobates* sp., *Lathriobates johorensis, Limnometra ciliata, Limnometra matsudai, Limnometra* sp., *Limnogonus fossarum, Limnogonus nitidus, Metrocoris acutus, Metrocoris bilobatus, Metrocoris ciliatus, Metrocoris nigrofascioides, Metrocoris squamifer, Metrocoris tenuicornis, Naboandelus* sp., *Neogerris parvulus, Onychotrechus esakii, Pleciobates tuberculatus, Pleciogonus wongsirii, Ptilomerag jariyae, Ptilomera hemmingseni, Ptilomera tennaserim, Ptilomera tigrina, Rhagadotarsus kraepelini, Rheumatogonus intermedius, Rheumatogonus vietnamensis, Rheumatometroides insularis, Tennagogonus* sp., *Ventidius hungerfordi, Ventidius malayensis* and *Ventidius pulai*. *Rheumatometroides insularis* collected from Samut Songkhram Province was the first record for Thailand.

Development of a biotic index for rapid bioassessment in the Mekong II Sub-Basin, Thailand

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The aim of this study is to develop a multimetric biotic index by using benthic macroinvertebrate community structures for wadeable streams in the Mekong II sub-basin in Thailand. The sampling method followed the rapid bioassessment protocol of the US EPA. Habitat assessment, water physicochemical measures and multihabitat instream sampling using D-frame dip nets for benthic macroinvertebrates were conducted in 15 streams. Three-hundred fixed-count subsamplings of benthic macroinvertebrates were performed in the laboratory. Samples were collected seasonally in a 2 year period from November 2005 through November 2007. Reference sites were established from positions in the headwaters (*a priori* method) with most located in preserved areas, whereas the test sites were situated in places with human activity. Spatial and temporal structure and composition of benthic macroinvertebrate communities were considered in reference and test sites. The *a priori* method for establishing reference status was not the best for stream classification due to there being intermittent stream types. Therefore *a posteriori* methods were used to classify 74 references sites into 46 types based on statistical analysis of physicochemical parameters, benthic macroinvertebrate data, and habitat assessment scores. Twenty orders, 108 families, 172 taxa, and 35,053 individuals of benthic macroinvertebrates were found. Of 72 metrics tested, 7 core metrics, including Beck's biotic index, EPT taxa, Hilsenhoff biotic index (HBI), intolerant taxa, % clinger organisms, % non-insect organisms, and scraper taxa, were calculated to determine a final biotic index score.

Diversity of Protura in Doi Inthanon National Park

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In this study of the diversity of Protura in Doi Inthanon National Park, Chiang Mai province, soil samples were collected six times from five different forest types chosen at 500 meter intervals. The forest types were dry deciduous dipterocarp forest, mixed deciduous forest, lower evergreen forest, upper evergreen forest, and cloud forest, respectively. At each site, 10 soil samples were collected using a 15 × 15 centimeters quadrant to a depth of 5 centimeters. The soil samples were then transferred to Berlese funnels for 72 hours for the extraction of soil arthropods. The proturan specimens were separated and permanent slides were made for each sample.

Identification of proturans in Doi Inthanon National Park, Chiang Mai province, resulted in records of 11 species and 2 subspecies. They include 3 described species (*Condeellum regale* (Condé), *C. ishiianum ishiianum* Imadaté, and *Silvestridia keijiana* (Imadaté)), and a newly recorded subspecies for Thailand (*C. ishiianum setosum* Imadaté). In addition, one new species was found (*Baculentulus inthanonensis* Likhitrakarn, Nakamura and Tayutivutikul, *in preparation*). Seven undescribed species (*Australentulus* sp., *Kenyentulus* sp. 1, *Kenyentulus* sp. 2, *Eosentomon* sp. 1, *Eosentomon* sp. 2, *Eosentomon* sp. 3, and *Eosentomon* sp. 4) also have a high probability of being new species. It was found that we could not use Berlese funnels for collecting proturans when soil samples are wet. This research demonstrates the potential richness of proturan fauna in Thailand, and additional studies should be continued and expanded.

Taxonomy of Gasteracanthine spiders (Araneae: Araneidae) in Thailand

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The taxonomy of Gasteracanthine Spiders in Thailand was investigated from 2005-2007. All specimens were identified to tribe, genus, and species. Based on external morphology and genitalia, specimens identified up to the present time include 2 tribes, 4 genera and 12 species. All species recorded were as follows: *Macracantha arcuata* (Fabricius, 1793), *Thelacantha brevispina* (Doleschall, 1857), *Gasteracantha diadesmia* Thorell, 1887, *Gasteracantha geminate* (Fabricius, 1798), *Gasteracantha kuhli* C.L. Koch, 1938, *Gasteracantha hasselti* C. L. Koch, 1837, *Gasteracantha doriae* Simon, 1877, *Gasteracantha clavigera* Giebel, 1863, *Gasteracantha diardi* (Lucas, 1835), *Gasteracantha frontata* Blackwall, 1864 *Gasteracantha irradiata* (Walckenaer, 1842) and *Caerostris sumatrana* Strand, 1915. Among these, two morphospecies in the genus *Gasteracantha* were described as new species for Thailand.

Species diversity of stored product and house dust mites in Central Thailand

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A survey of stored product and stored food mites as well as house dust mites was conducted in the central part of Thailand in the eight provinces, Singburi, Chainat, Angthong, Supanburi, Kanchanaburi, Petchaburi, Prachuabkirikhan and Lopburi. The study was conducted from January-June 2008. Four families of mite pests as well as four families of predatory mites were found. The mite pests were classified as Acaridae, Eriophyidae, Histiostomidae and Glycyphagidae. The predatory mites were classified as Aschidae, Bdellidae, Cheyletidae and Smarididae.

House dust mites were classified into three Families. The highest number occurred in the family Pyroglyphidae, followed by Glycyphagidae and Cheyletidae. The most abundant species was *Dermatophagoides pteronyssinus* (Trouessart), comprising 57.7% of mites, followed by *Blomia tropicalis* (Bronswijk), *Cheyletus* sp., *Dermatophagoides farinae* (Hughes) and *Euroglyphus maynei* Cooreman, with 33.3, 6.5, 0.5 and 0.5 % of mites, respectively.

Acaricidal activity of essential oils of medicinal plants against the house dust mite, *Dermatophagoides pteronyssinus* (Trouessart)

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Fumigation by essential oils obtained from 9 selected medicinal plants was applied to house dust mite, *Dermatophagoides pteronyssinus* (Trouessart). Essential oils at various concentrations of 0 (95% ethanol as control), 0.01, 0.05, 0.10, 0.50, 1.00 and 1.50% (0, 0.012, 0.060, 0.120, 0.600, 1.200 and 1.800 μg/cm^3) at a volume of 3 cm^3 were applied within a 2.5x10^4 cm^3 knockdown chamber. The fumigation period was 1 hour, and mortality of house dust mites was observed at 24 hours after fumigation. It was found that essential oils of clove, *Syzygium aromaticum*, and cinnamon, *Cinnamomum cassia*, were successful in killing mites with 100% mortality at a concentration of 1.00% (1.200 μg/cm^3) and resulted in LC_{50} valves of 0.092 and 0.232 μg/cm^3, respectively. Next were turmeric, cassumunar ginger, lemon grass and citronella grass which had LC_{50} valves of 0.561, 0.704, 0.811 and 0.935 μg/cm^3, respectively. Essential oil formulations with the main components being clove or cinnamon essential oils at 1% concentration were also tested. Essential oils of cassumunar ginger or citronella grass at 1% concentration were used as minor components together with various perfumes, lavender, jasmine blue gum and coffee at 2.5%. All formulations could completely kill mites, and coffee and jasmine perfumes were strong smelling.

Cercarial infections of freshwater snails in the family Thiaridae in the Northeast of Thailand

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Cercarial infections of freshwater snails in the Family Thiaridae in the Northeast of Thailand were studied at twenty-eight sampling sites. The snails were collected every two months for one year for each sampling site which started and ended at varying times between February 2006 and October 2007. A counts per unit of time method and a scoop method were used in this study. Samples were collected every 10 minutes by five collectors. A total of 12,474 collected snails were classified into nine species. *Melanoides tuberculata* was the most common species comprising 60.88% (7,594:12,474) of collected snails. Cercarial infections were investigated using shedding and crushing methods. Eleven species of cercariae were categorized; they were *Cystophorous cercaria*, *Stictodora tridactyla*, *Apatemon gracilis*, *Centrocestus formosanus*, *Loxogenoides bicolor*, *Haematoloechus similis*, *Haplorchis taichui***,** *Acanthatrium hitaense*, *Mesostephanus appendicalatus*, *Cardicola alseae* and *Alaria mustelae*. Four species of snails were trematode hosts (1st intermediate hosts). They were *M. tuberculata*, *Melanoides jugicostis*, *Adamietta housei* and *Tarebia granifera* with infection rates of 22.80%, 6.80%, 0.66% and 0.15%, respectively. The number of cercarial-infected snails was 1,761, giving an infection rate of 14.12% (1,761/12,474). The infection rate of *L. bicolor* was 45.85% (801/1747); it was the most frequently infected snail species in this study. Double infections were found and consisted of three types. The first type was *S. tridactyla* and *C. alseae*, the second type was *L. bicolor* and *S. tridactyla*, and the third type was *A. hitaense* and *H. taichui*.

Variability in recruitment of non-native mussels *Mytilopsis adamsi* Morrison, 1946, in Haad-kaew Lagoon, Songkhla Province

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Mytilopsis adamsi Morrison, 1946 (Bivalvia: Dreissenidae) has been found for the first time in Thailand as an introduced species in Haad-kaew Lagoon in 2002. It is native to tropical West America; however, it has been reported to have invaded a number of ports in Indo-Pacific countries. According to many studies, *M. adamsi* is an eurythermic and euryhaline species, and also has high, rapid growth and a fast maturity rate. This mussel forms dense monocultures that exclude most other native species and subsequently there is an alteration in the biodiversity and community of infected areas. It can attach to all submerged structures, which causes economic problems. From background information, we suggest that *M. adamsi* has a high potential to invade and colonize the whole part of Thale Sap Songkhla's system. In order to control and manage this invasive species, an understanding of the basic biology and life history of *M. adamsi* is urgently needed.

The objective of this study is to investigate the spatial and temporal variability of recruitment and determine environmental parameters that may have effects on the success of recruitment. Investigated recruitment parmeters include larval supply and adult abundance and environmental parameters include salinity, water temperature, pH, dissolved oxygen and abundance of plankton. Recruitment data is essential for understanding the population dynamics of the mussel population. This is important for further study of *M. adamsi* and management of this species. This present study is possibly the first research regarding invasive mussels in Thailand.

Diversity of non-cropped vegetation, insects, and soil arthropods in relation to land management in Thong Pha Phum, Kanchanaburi

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The non-cropped vegetation, insects on non-cropped vegetation, and soil arthropods were compared between an organic farm, a chemically-intensive orchard, and a forest edge in Thong Pha Phum, Kanchanaburi. Nine samplings were conducted every two months from August 2006 - December 2007. Non-cropped vegetation found in all three areas was predominantly pioneer and invasive plants, considered weeds in agricultural practice, such as Cogon grass (*Imperata cylindrical*), Siam weed (*Chromolaena odorata*), and Sensitive plant (*Mimosa pudica*), particularly after habitat disturbance either by herbicide spraying, weed mowing, and burning. The forest edge and the organic farm had higher Shannon-Weiner diversity indices of above ground insects and soil mites than the chemically-intensive farm. The diversity index and the complexity of trophic levels were also higher in plots dominated by Siam weed than any by other plants. This suggests that Siam weed may be a potential reservoir of beneficial insects, especially parasitoids. High Shannon-Weiner diversity indices were observed in the late rainy season (October) of both years implying that there was an influence of water and vegetation availability on diversity and complexity of the trophic level in a habitat. Management practices, particularly habitat disturbance such as herbicide spraying, weed mowing, and burning, in each habitat influenced the diversity of non-cropped vegetation and associated arthropods.

Sentinel system for pesticide contamination in agricultural areas of the Thong Pha Phum region

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Agriculture is an important activity in Thong Pha Phum region. Cultivation of crops requires extensive use of pesticides that may contaminate the environment and affect the health of organisms in the area including humans. The current research aims to develop a sentinel system for pesticide contamination, which includes, 1) a database of pesticide use and 2) animal species potentially useful as sentinels of contamination. Questionnaire surveys of farmers from Tambon Lintin and Tambon Huay Khayeng of Thong Pha Phum District, Kanchanaburi Province, showed that during 2006-2007 84% of farmers used pesticides in their agricultural activities. The most commonly used herbicides were glyphosate and paraquatdichloride and the most commonly used insecticides were methomyl, chlorpyrifos and parathion methyl. The heaviest use of herbicides occurred in May or at the beginning of the rainy season when farmers prepared their fields for new crops, and the heaviest use of insecticides occurred in April to control the outbreak of aphids. The results suggest the possibility of large quantities of one or more pesticides being used at the same time, leading to contamination of the environment. Preliminary surveys of animal species potentially useful as sentinels of pesticide contamination were conducted in natural habitats overlapping with agricultural areas. Several species of freshwater snails were selected as potential sentinel species. Further investigation of the biologic responses of these sentinel species together with information on pesticide use and types of pesticides to be monitored could be of importance for risk assessment of pesticide contamination in natural ecosystems as well as human settlements.

Species diversity of acetic acid bacteria at Khanom-Mu Ko Thale Tai National Park, Nakhon Si Thammarat Province

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During the course of study of the species diversity of acetic acid bacteria at Khanom-Mu Ko Thale Tai National Park, Nakhon Si Thammarat Province, one hundred and eighty-three strains were isolated from one hundred and seventy-nine collected samples. Seventy-nine strains were selected to analyze the 5' ends of 16S rDNA sequences for identification. In phylogenetic trees based on these sequences, seventy-one strains had their identification confirmed as acetic acid bacteria. A phylogenetic tree based on the sequences showed that nineteen strains should be classified into two new genera in the family *Acetobacteraceae*. The other fifty-two strains were assigned to six known species of three genera, *Acetobacter*, *Asaia* and *Gluconobacter*, based on 16S rRNA gene sequences, namely *A. tropicalis*, *As. bogorensis, As. lannensis, G. cerinus*, *G. frateurii* and *G. oxydans*. However, additional phenotypic and genetic characteristics have to be further characterized before proposing the new taxa, especially DNA-DNA hybridization compared with the type strains of closely related taxa.

Species diversity and collection of yeasts at Khanom-Mu Ko Thale Tai National Park

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The diversity of yeast in Khanom-Mu Ko Thale Tai National Park, Nakhon Si Thammarat Province, was investigated. One hundred and fifty-six yeast strains were isolated from sea water (63), plant materials in sea water (61), seaweeds (50), and water and soils of mangrove forest (15). The membrane filtration technique and the direct streaking and enrichment technique were used for isolation. Fifty-three strains were identified by using morphological characteristics and molecular techniques; 42 strains were ascomycetous yeasts and 8 strains were basidiomycetous yeasts. Based on D1/D2 domain of 26S rDNA sequence similarity and phylogeny, 35 strains were identified as 22 known species (13 genera), 17 strains were found to represent 13 new species (5 genera) and the remaining strain could not be identified by D1/D2 sequences. The ITS gene is required for identification of the latter strain. Morphological, physiological characteristics, chemotaxonomy and molecular taxonomy are required for describing the new species.

Endophytic fungi isolated from seagrasses and seaweeds from Had Khanom-Mu Ko Thale Tai National Park and their antimicrobial activity

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Endophytic fungi were isolated from seagrasses (*Enhalus acoroides*) and seaweeds (*Sargassum* sp.) from two sites in Had Khanom-Mu Ko Thale Tai National Park. Sixty-four isolates from four collections were obtained. Molecular identification of these endophytes will be carried out at a later stage of the project. The overall colonization and isolation rates were relatively low, and this is in concordance with other studies. Fermentation broths from selected fungal isolates (endophytes and fungi obtained from Year 1 of the project) were tested for antimicrobial activity by agar well diffusion. Twenty five out of 132 isolates (18.9%) showed antimicrobial activity against at least one pathogen. The results obtained from this study indicated that endophytic fungi can be isolated from seagrasses and seaweeds and that they are a good source of natural antimicrobial compounds.

Plankton diversity at Mu Ko Thale Tai, Nakhon Si Thammarat Province

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The present study aimed to examine plankton species diversity along Khanom Canal, Had Khanom, Mu Ko Thale Tai, Nakhon Si Thammarat Province. Sampling was carried out covering 15 stations starting from Cho Waterfall to Khanom Canal and around five islands of Mu Ko Thale Tai (Wang Nok, Wang Nai, Rap, Tan and Mudsum) during October 2006 and September 2007. A total of 184 phytoplankton taxa in three Divisions was recorded. The most diverse Division was Chromophyta, comprising of Class Bacillariophyceae with 41 genera (104 taxa), Class Dinophyceae 17 genera (51 taxa), and Class Dictyochophyceae 1 genus (2 taxa). Moreover, *Bacteriastrum* sp1, *Chaetoceros diversus* and *Chaetoceros lorenzianus* were the most frequently found taxa throughout the sampling periods. Based on density, *Bacteriastrum* sp1 dominated the phytoplankton of all stations sampled throughout the sampling periods ($7.27x10^7$ cells/l). This species had the highest density in March 2007 ($1.17x10^6 \pm 2.21x10^6$ cells/l) followed by October 2006 ($8.80x10^5 \pm 1.28x10^6$ cells/l) and September 2007 ($8.68x10^5 \pm 6.24x10^5$ cells/l). Moreover, 61 taxa in 11 phyla of zooplankton were recorded. Arthropoda was the most diverse phylum, comprising 24 taxa, of which nineteen were the members of the Copepoda. Based on density, nauplii of crustaceans dominated the zooplankton at all stations over the sampling period (1316.67-5293.02 ind./l). They showed the highest density in January (5,297±8387 ind./l), March (4,662±6,315 ind./l) and September 2007 (3,437±4,279 ind./l). Besides the nauplii of crustaceans, *Tintinnopsis orientalis* and *Codonellopsis ostenfeldi* also showed high densities at all times during the sampling periods.

The present status of marine sponges in Had Khanom-Mu Ko Thale Tai National Park, Nakhon Si Thammarat Province, southern Thailand

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The species diversity and distribution of demosponges dwelling in the coral reefs of Had Khanom–Mu Ko Thale Tai National Park, the southern Gulf of Thailand was investigated with field surveys undertaken at 14 sites in November 2006 and May 2007 using SCUBA and random observations. 47 species of demosponges from 10 orders, 24 families and 34 genera were recorded. The order Haplosclerida had the most species, with 15, followed by Poecilosclerida with 9 species and Dictyoceratida with 6 species. The massive sponge was the most dominant growth form of the study area. The most abundant and common sponges in this area were *Oceanapia sagittaria*, *Neopetrosia* sp. "blue", *Xestospongia testudinaria* and *Haliclona (Gellius) cymaeformis*. Most species were common representatives of the Indo-Pacific fauna found throughout the Gulf of Thailand.

Species diversity of marine Ascidians dwelling in the coral reefs of the Khanom-South Islands, Nakhon Si Thammarat Province

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The species diversity and distribution of ascidians dwelling in the coral reefs of Had Khanom – Mu Ko Thale Tai National Park, Nakhon Si Thammarat Provice, the southern Gulf of Thailand were investigated. The investigations were conducted at 12 sites in the Mu Ko Thale Tai area and were carried out by SCUBA diving during the daytime and random observation throughout the reefs. The results yielded 10 species of ascidians from 3 orders, 3 families and 5 genera. The genera were *Didemnum* (6), *Diplosoma* (1), *Eudistoma* (1), *Polycarpa* (1) and *Ascidia* (1).

Diversity study on Echinoderms in Khanom Beach – South Sea Islands National Park, Nakhon Si Thammarat Province

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Echinoderms of Had Khanom – Mu Ko Thale Tai National Park, Nakhon Si Thammarat Province, locating in the southern part of the Gulf of Thailand were studied at 12 sties namely, Ko Tan (4 sties), Ko Mudsum (2 sites), Ko Wang Nai (2 sites), Ko Wang Nok (2 sites) and Ko Rab (2 sites) in November, 2006 and May 2008. The investigations were carried out by SCUBA diving in the daytime and random searches throughout the reefs. The results yielded 24 species of Echinoderms from 5 class, 10 orders, 14 families and 20 genera. The most abundant Echinoderms in this area are : *Lamprometra palmate, Ophiothrix exigua, Holothuria (Metensiothuria) leucospilota*, and *Diadema setosum*. All observed species were commonly found in the Gulf of Thailand and the Indo-Pacific.

Species diversity of nudibranches at Had Khanom – Mu Ko Thale Tai National Park, Thailand

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The purpose of this study was to investigate the diversity and habitat ecology of nudibranches at Had Khanom-Mu Ko Thale Tai National Park. Nudibranches belong to the mollusk group (subclass Opisthobranchia), but have no shells protecting their soft bodies. Specimens were collected using the SCUBA diving technique. Then, the specimens were photographed and recorded by using a VDO camera before they were preserved in alcohol. Shapes, body colors, and color patterns of the nudibranches were used to identify to species level. The results showed that nudibranches could be found on coral colonies, coral reefs, and sand substrates between 1-15 m depth of water. At least 18 species of nudibranches were found at Had Khanom - Mu Ko Thale Tai National Park. The species included *Phyllidia elegans, Phyllidiella nigra*, *Phyllidia coelestis*, *Phyllidiella pustulosa, Fryeria picta, Chromodoris preciosa*, *Flabellina rubrolineata*, *Glossodoris atromarginata*, *Jorunna funebris*, *Glossodoris cincta, Dendrodoris denisoni*, *Platydoris dierythos, Armina* cf. *japonica, Bornella stellifer*, *Phyllodesmium magnum, Mexichromis multituberculata, Thecacera* sp., and *Facelina* sp. The dominant nudibranch species were in the Family Phyllidiidae. Five species were first records for Thailand: *Chromodoris preciosa*, *Glossodoris cincta, Dendrodoris denisoni*, *Platydoris dierythos,* and *Bornella stellifer*.

Relationships and associations of nudibranches with other organisms at Had Khanom – Mu Ko Thale Tai National Park, Thailand

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Nudibranches belong to the mollusk group but have no shell protecting the soft body. Due to the lack of a shell, nudibranches are prone to predators. However, they protect themselves by producing secondary metabolic compounds, which are used as a chemical defense. Some secondary metabolic compounds exhibit potent cytotoxic activities against cancer cells, such as secondary metabolic compounds in *Jorunna funebris* found at Had Khanom. However, little is known about the biology and ecology of these particular nudibranches in Thailand. At present, in Thailand, approximately 110 species of nudibranches have been found including those from a previous study at Had Khanom - Mu Ko Thale Tai National Park. The purpose of this study was to investigate the relationships and associations of nudibranches with other organisms including determining their food and habitats. Surveys were done by scuba diving. During the surveys, size, habitat, food, and behavior of nudibranches in each species were recorded. The results from the field surveys showed that most nudibranches found at Had Khanom - Mu Ko Thale Tai National Park were associated with either hydroids, sponges, sea pens, soft corals, or bryozoans depending on which were their food sources. However some which had conspicuous and contrasting color patterns tended to be found on sand and bare rocks, and were active during the day. These included nudibranches in the Family Phyllidiidae. The results from the surveys also showed that the dominant species was *Flabellina rubrolineata* followed by *Jorunna funebris.* This may be due to the high abundances of their food sources. *F. rubrolineata* fed on hydroids while *J. funebris* fed on blue sponges.

Species diversity and distribution of gorgonians at Had Khanom – Mu Ko Thale Tai National Park, Thailand

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The purpose of this study was to investigate the diversity and distribution of gorgonians at Had Khanom-Mu Ko Thale Tai National Park using the SCUBA diving technique. Samples were photographed and some were collected and preserved in 70% alcohol for further identification and for being reference specimens. Shapes and characteristics of colonies and sclerites of gorgonians were used to identify to genus level. Fifteen genera from 7 families of gorgonians were found. These included: Family Anthothelidae, *Solenocaulon*; Family Subergorgiidae, *Subergorgia*; Family Melithaeidae, *Melithaea*; Family Acanthogorgiidae, *Anthogorgia*; Family Plexauridae, *Euplexaura*, *Echinomuricea*, *Echinogorgia*, *Menella*, *Astrogorgia*; Family Gorgoniidae, *Rumphella*, *Pseudopterogorgia*; and Family Ellisellidae, *Ctenocella*, *Junceella*, *Dichotella* and *Verrucella*. The highest number of gorgonians, 15 genera, was found at Ko Rab, followed by 12 genera at Ko Tan and Ko Mut Sum. The genus *Subergorgia* showed the highest density (0.05 colony/m^2), followed by *Ctenocella* and *Menella*. All gorgonians were usually found in 5 m depth of water or deeper, and were normally attached to rocks, dead corals, or rubble that lay beneath sand or silt substrates. Their distribution was clumped. Moreover, in this study, 3 genera, *Anthogorgia*, *Pseudopterogorgia*, and *Verrucella*, were found to be first records for Thai waters, and another 3 genera, *Solenocaulon*, *Astrogorgia*, and *Euplexaura*, were also first records for the Gulf of Thailand.

Organisms associated with the seagrass bed at Ko Tharai, Nakhon Si Thammarat Province

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Organisms associated with the seagrass bed at Ko Tharai, Nakhon Si Thammarat Province, were investigated. These included the groups that live in the sediment, on the bottom floor, in the water column, and on the seagrass. Three stations, *i.e.*, eastern, central, and western parts of the seagrass bed were sampled. The results showed that organisms found in the sediment of the seagrass bed were amphipods, polychaetes, and juveniles crabs, which used the seagrass bed for habitat and shelter. On the bottom of the seagrass bed, crabs (Diogenidae and Portunidae) were found. They used seagrass leaves to protect themselves from sunlight during low tide. Most organisms found in the water column were fishes. The most abundant fish groups were Leiognathidae and Siganidae while the economic fish groups were Lutjanidae, Lethrinidae, Serranidae and Sphyraenidae. Scatophagidae, Gobiidae, Syngnathidae, Sepiidae and Penaeidae were also recorded. The organisms associated with seagrass leaves were amphipods and copepods. These organisms also used seagrass leaves as habitat, shelter, and food sources.

Organisms associated with gorgonians at Mu Ko Thale Tai, Surat Thani and Nakhon Si Thammarat

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From a previous study of diversity and distribution of gorgonians at Had Khanom – Mu Ko Thale Tai National Park, it was found that the azooxanthallae gorgonians group, which do not require sunlight for survival, were the most abundant gorgonians, particularly in deeper areas where strong currents and greater turbidity occurred. In this study, the organisms associated with gorgonians were investigated. Three different genera were chosen as representatives of each colony shape, *i.e.* fan shape (genus *Verrucella*), bushy form (genus *Dichotella*), and sparse form (genus *Subergorgia*). The surveys were conducted at 3 water depths, *i.e.*, shallow water (< 5 m depth), mid-depth (5 – 10 m), and deep water (> 10 m depth), in 3 areas, Ko Tan, Ko Mat Sum, and Ko Rab, using the SCUBA diving technique. The results showed that more than 10 groups of animals were associated with gorgonians. Brittle stars (or snake stars), allied cowries, wing oysters, and delicate-looking shrimps were found on all colony shapes. In addition, hydroids, barnacles, algae, sponges, and bryozoa were found settled on gorgonian colonies. Moreover, flat worms, nudibranches, synatid sea cucumbers, and small fishes were recorded. However, in shallow water (< 5 m depth), *Subergorgia* was the only genus found, and brittle stars were the most abundant organisms on *Subergorgia*.

Diversity of reef fish in Had Khanom-Mu Ko Thale Tai National Park, Nakhon Si Thammarat

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Data collection for a reef fish study was conducted 3 times in February, May and July, 2007, around Had Khanom - Mu Ko Thale Tai National Park at 5 stations: Ko Wang Nai, Ko Wang Nok, Ko Rab, Ko Mud Sum and Ko Tan. Coral reefs of each island were located on reef flats on the leeward and windward sides and on reef slopes on the leeward and windward sides. 97 species of reef fish were recorded during the study period. The dominant fish families were Pomacentridae (23 species) and Labridae (14 species). Fish community diversity did not differ significantly ($p>0.05$) between island or between windward and leeward sides of each island while species abundances and numbers on reef slopes and reef flats showed significant differences among all stations ($p<0.05$). The number of species in the reef slope fish communities was higher than in the community of reef flat areas. On the other hand, the diversity index and evenness index of the reef flat were higher than for the reef slope. From this study it was obvious that there were two types of fish community: the fish community of reef flats and the fish community of reef slopes. However, data on fish populations in different seasons should be collected in order to get more information on fish community patterns.

Estimating population size and distribution of Indo-Pacific humpback dolphins at Khanom

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The population of Indo-Pacific humpback dolphins (*Sousa chinensis*) that inhabits the Khanom sea shore are in critical condition due to a high death rate. This project aimed to estimate the number of Indo-Pacific humpback dolphins by using a Photo-Identification technique. Digital Analysis and Recognition of Whale Images on Network (DARWIN) software was used to identify individual dolphins. All selected pictures were represented by 1 (present) and 0 (absent) in the MARK software. We collected dolphin dorsal fin pictures by boat survey. We went to Pra-Tub Cape pier and took a long tail boat from 7.00 a.m. to 1.00 p.m. We found that dolphins tended to be present in clear water (visibility > 1 m) with no waves (< 20 cm). All survey routes were recorded using a GPS Garmin 76 CSX. Dolphins were found most frequently from Racha Ferry to Kwaeng Pao Bay. We took more than 400 dorsal fin pictures during each survey by SLR digital camera with lenses 18-135 mm and 70-300 mm. We selected the best dorsal fin pictures, and cropped only dorsal fins in order to decrease the picture size of the database in the DARWIN software. Within the two months survey, we could identify 20 individual Indo-Pacific Humpback dolphins in the Khanom area.

Bryophyte, pteridophyte and orchid diversity in the cloud forest of Khao Nan, Nakhon Si Thammarat Province

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The diversities of bryophytes, pteridophytes and orchids were explored from July 2007 to June 2008 from elevations above 600 m to the summit of Khao Nan Yai, Khao Nom and Sunyen in the Khao Nan area. A total of 1,279 specimens were collected from these focal sites. They were determined and classified into: 50 families, 131 genera, 264 species of bryophytes; 25 families, 66 genera, and 163 species of ferns and fern allies; and 41 genera, and 91 species of orchids. Among these, about 20 species may be new bryophyte records, two species, namely *Cyathea glabra* (Blume) Copel. and *C. hymenodes* Mett., are new records of ferns and 1 species, namely *Calanthe angustifolia* (Blume) Lindl. var. *flava* Ridl., is an orchid new record. It was seen that the cloud forest of Khao Nan houses up to 518 species of these nonvascular and vascular plants. Some of them are rare. It is noted that epiphytes are richer in number of species than terrestrials, probably due to the more suitable environment for plant growth in the cloud forest. These epiphytes seem to be good indicators for undisturbed hill evergreen forest. Implications for understanding global warming in tropical areas are discussed.

Diversity of pteridophytes in the cloud forest of the Khao Nan area, Nakhon Si Thammarat Province

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The diversity of pteridophytes was investigated from July 2007 to April 2008 at elevations above 600 m at Khao Nan Yai, Khao Nom and Sunyen in the Khao Nan area. Four hundred and forty-six specimens were collected and were determined into 25 families, 66 genera, and 163 species. Among these, 3 families, 5 genera and 12 species were fern allies, while 22 families, 61 genera, and 151 species were ferns. It is noted that epiphytes were richer in number of species than terrestrials, probably due to the more suitable environment for pteridophyte growth in the cloud forest. It was found that the fern family Grammitidaceae was observed only at altitudes above 900 m. Some members of the Hymenophyllaceae and Polypodiaceae also occurred near the mountain summit at about 1,300 m altitude. These ferns tend to be good indicators of undisturbed hill evergreen forest. The cloud forest of Khao Nan also housed rare plants that are on the Thailand Red Data list, i.e. *Xiphopteris khaoluangensis*, *Crypsinus laciniatus*, *Dipteris conjugata* and *Tapeinidium luzonicum*. In addition, a species of *Lycopodiella* new to science was found and will be published in the near future. It is expected that new data of pteridophyte diversity gained from this study will be useful for future management of the Khao Nan area.

Diversity of bryophytes in Khao Nan National Park, Nakhon Si Thammarat Province

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Exploration for bryophytes at Khao Nan National Park, Nakhon Si Thammarat Province, was conducted at 600 - 1438 m above mean sea level, from July 2007 to June 2008. A total number of 671 specimens of bryophytes were collected from this focal site. All specimens were identified and kept in the Kasin Suvatabhandhu Herbarium (BCU), Department of Botany, Faculty of Science, Chulalongkorn University. They were classified into 3 classes: Musci (mosses) with 24 Families, 66 Genera, 151 species; Hepaticae (liverworts) with 25 families, 64 genera, 112 species; and Anthocerotae (hornwort) with 1 species, namely *Dendroceros subplanus* Steph. Among these bryophytes, more than 20 species are reported as new records for Thailand. Furthermore, more than 50 species were undetermined. They apparently require further observations and investigation to determine their correct status. The distribution and abundance of bryophytes along each study trail suggests that Khao Nan National Park harbors a high diversity of bryophytes.

Diversity of orchids at high altitude in Khao Nan National Park, Nakhon Si Thammarat Province

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Field exploration and data collection for natural orchids were conducted at 600-1,438 m above sea level at Khao Nan National Park from July 2007 to June 2008. A total of 132 specimens of orchids were collected from this focal site. All specimens were identified and kept at the Kasin Suvatabhandhu Herbarium, Department of Botany, Faculty of Science, Chulalongkorn University. They were classified into 41 genera and 91 species. The most common genus, *Bulbophyllum*, had the highest number of species among orchids, i.e. 8. The other common genera found in the area were *Dendrobium*, *Calanthe* and *Coelogyne* (7, 6 and 6 species, respectively). According to habitat types, the specimens can be classified into 3 groups: terrestrial plants (29 species including 6 saprophytes), epiphytes (61 species), and lithophytes (1 species). One orchid was a newly recorded species for Thailand, i.e. *Calanthe angustifolia* (Bl.) Lindl. var. *flava*. Three endemic species of Thailand were found in the area, *Ceratostylis thailandica* Seidenf., *Bulbophyllum smitinandii* Seidenf. & Thorat and *Bulbophyllum* cf. *ovatum* Seidenf. The common species in Khao Nan National Park included *Coelogyne massangeana* Rchb.f., *Pholidota carnea* (Bl.) Lindl., and *Calanthe triplicata* (Willemet) Ames. There were 8 undetermined species apparently requiring further observations and investigation to determine their correct status. They were classified into the genera *Appendicula*, *Coelogyne*, *Dendrobium*, *Liparis*, *Oberonia*, *Pomatocalpa*, and *Taeniophyllum.* Moreover, 11 species are listed as threatened and 17 species are listed in the CITES database. These species were of endangered status and must be protected and conserved.

Species diversity and phenology of fig trees (*Ficus* ssp.) and their relationships to frugivore species diversity in Khao Nan National Park

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This research focuses on two main issues concerning the species diversity of fig trees, species richness and species abundance, and whether they can fulfill their ecological roles to serve local wildlife for successful survival. Habitat suitability for fig trees was also studied in detail. The results revealed 50 fig species, which was equivalent to 50% of species of the whole country. Species abundance varied from moderately common to very common. The majority of species were distributed throughout the study area, except for *Ficus ischnopoda* Miq. and *Ficus obpyramidata* King which kept to the waterways only. A phenological study concentrated on the fruiting of 7 representative species. It was found that all species tend to bear fruits all year round. 25 species of frugivores were recorded; among them the mammals seemed to prefer terrestrial figs to banyans, while the birds were opposite in their preferences.

Effect of habitat type on ground-dwelling ant diversity at Khao Nan National Park, Nakhon Si Thammarat

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Khao Nan National Park (KNNP) is located in Nakhon Si Thammarat Province. The national park consists of many different forest types. As a consequence, floral and fauna are very diverse. Ants play an important role in the ecosystem. However, there is little information about ants in the national park. The aim of this study was to determine the effect of habitat type on diversity of ground-dwelling ants in KNNP. Three study sites (Baucheak, Pra Forest, and the Sunantha trail) were chosen, each with three permanent plots of 30x30 m at least 500 m apart. Five different methods were used for ant sampling: honey bait (HB), leaf litter sampling (LL), hand collection (HC), pitfall trap (PT), and Winkler Bag (WB). Samples were taken every two months from January 2006-January 2007. 245 species from 50 genera of ants were detected. These were further classified into 10 subfamilies: Myrmicinae (109), Formicinae (55), Ponerinae (46), Dolichoderinae (15), Cerapachyinae (4), Pseudomyrmecinae (6), Aenicitinae (4), Dorylinae (3), Ectatomminae (2) and Amblyoponinae (1). The dominant genus of ants was *Pheidole* (31) followed by *Camponotus* (20). Each sampling method produced a different dominant species. Detrended Correspondence Analysis (DCA) showed that there was a distinct difference between the ants present at the Baucheak and Pra Forest sites.

Species composition of canopy ants (Hymenoptera: Formicidae) in tropical rainforest at Khao Nan National Park, Nakhon Si Thammarat Province

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This study is a year-round investigation of the species composition of ants present in the canopy of the tropical rainforest at Khao Nan National Park (KNNP), Nakhon Si Thammarat Province, Southern Thailand, from May 2006-March 2007. Two habitat types were chosen, one located at the headquarters of KNNP represented by evergreen trees and the other at Hui Lek station where there is a stand of the briefly-deciduous tree, *E. tapos*. Each habitat contained three permanent plots of 50 X 50 m^2 established 500 m apart from each other. A chemical knockdown by fogging technique was applied to collect ant samples. In each plot, a single tree was arbitrarily selected for fogging at bimonthly intervals. Overall, 16,884 individual ants were identified, belonging to 7 subfamilies, 34 genera and 210 morphospecies. Ants in the subfamily Myrmicinae and Formicinae were the dominant species followed by Dolichoderinae, Pseudomyrmicinae and Ponerinae, Anictinae, and Cerapachyinae. In terms of abundance of species, the top five genera were *Crematogaster*, *Camponotus*, *Polyrhachis*, *Pheidole*, and *Technomyrmex* whereas *Dolichoderus thoracicus*, *Oecophylla smaragdina*, *Dolichoderus* sp.4, *Dolichoderus* sp.5, and *Crematogaster (Paracrema)* sp.2 were dominant in terms of numbers of individuals.

Diversity of Olethreutine moths (Lepidoptera: Tortricidae) in Khao Nan National Park, Nakhon Si Thammarat Province

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Surveys and collections of Olethreutine moths in Khao Nan National Park were carried out from November 2007 to October 2008 at various sites in evergreen forest. A total of 380 specimens were collected using blacklight and mercury vapor lights on 60 nights. They were determined into 167 morphotypes within 7 tribes, namely Microcorsini, Gatesclarkeanini, Bactrini, Olethreutini, Enarmoniini, Eucosmini and Grapholitini. Of these, 16 species in 13 genera were identified. The survey also included 54 morphotypes that could be identified to 25 genera, but not to species level. Furthermore, ninety-seven morphotypes could not be placed into any known genus or species. The genera *Anthozela* and *Irianassa* are recognized as new genus records for Thailand.

Species diversity of butterflies in Khao Nan National Park, Nakhon Si Thammarat Province

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The species diversity of butterflies was investigated at Khao Nan National Park, Nakhon Si Thammarat province, by employing 2 conventional data collecting techniques, i.e., a 1-km line-transect and live trapping. The study was done every alternate month for 1 year, starting from late 2006 to late 2007. A total of 307 species of butterflies occurred in the area. They were classified into 5 families and 158 genera, of which 31 species were in the family Papilionidae, 25 in the family Pieridae, 121 in the family Nymphalidae, 78 in the family Lycaenidae, and 52 in the family Hesperiidae. Among these, 71 species were endemic to the south, and 1 was an alien species, the Julia. One, the Sumatran Gem (*Poritia sumatrae*), was found to be distinctive enough to be a new subspecies. Regarding species abundance, it was found that 154 species were very common, 120 were moderately common and 33 were rare. The preferred habitat as expressed by the decreasing value of diversity was lowland moist evergreen forest with H=4.456, secondary forest with streams with H=4.339; moist evergreen forest without streams with H=3.964. Regarding habitat similarity, the highest value was found between the lowland moist evergreen forest with streams and the secondary forest with streams, while the lowest value was between the secondary forest with streams and the moist evergreen forest without streams. This study also confirmed the existence of 3 legally protected butterflies, i.e., the Malayan Birdwing, Common Birdwing and Banded Peacock, all classified in the family Papilionidae; the first two are also declared insect species in the CITES Appendix II list.

Biodiversity and ecology of amphibians in the cloud forest of Khao Nan National Park

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An amphibian survey was carried out in Khao Nan National Park, Nakhon Si Thammarat Province, Thailand, between April 2006 and May 2007, and documented 31 species. Almost all amphibians inhabited stream ecosystems of the moist evergreen forest, hill evergreen forest and limestone caves. Various niches were recorded, such as aquatic, terrestrial. fossorial and aboreal. Records of species for this area comprised 2 orders (Anura and Gymnophiona) and 7 families, namely Ichthyophiidae, Megophryidae, Bufonidae, Microhylidae, Dicroglossidae, Rhacophoridae and Ranidae. Interesting species included *Brachytarsophrys carinensis, Xenophrys* spp., *Ansonia* sp., *Ingerana* sp. and *Limnonectes* sp. which need further studies.

Effect of climate change on cloud forest at Khao Nan, Nakhon Si Thammarat

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Cloud forest has a high incidence of low level cloud cover resulting in high relative humidity and low solar radiation. This research investigated climatic characteristics of the Khao Nan cloud forest ecosystem by developing a cloud forest habitat characterization model and simulating how climate change affects this cloud forest by varying climatic parameters. The process utilized real biological and geographical data from Khao Nan cloud forest from automatic weather stations and temperature/relative humidity data loggers. Programs for analyzing data were developed for this study. The programs included a statistics program, interpolation module, area-based interpolation module, data visualization, and area-based data visualization. We installed three automatic weather stations and eight data loggers around Khao Nan National Park. Data correction for sensors' battery problem and data visualization programming were done. More sensor installation and data analysis programming were done. A better understanding of how climatic factors affect cloud forest characteristics and boundaries helps in management and conservation of this forest ecosystem, which is considered a unique ecological community and an important source of endemic species.

Ecological characteristics of the tropical montane cloud forests of Khao Nan

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Cloud forest characteristics in the tropical montane cloud forest of Khao Nan, Nakhon Si Thammarat, were studied from 18-21 April 2007 with regard to climate, vegetation, soil and hydrology. An automatic weather station was installed on Doen Hok peak at 1053 m a.s.l. in March 2007 for collecting climate data. The results showed that as air temperature of the Sanyen cloud forest increased, the percent relative humidity decreased. The mean, minimum and maximum temperatures were 20.1, 17.4 and 24.1 °C, respectively. The amount of solar radiation at Sanyen cloud forest was very low with a range of 0-19 W/m^2. There were no differences among leaf widths, leaf lengths, leaf thicknesses and leaf areas of some plants with increasing elevation. As the elevation increased, bush height and tree height decreased. There were no associations of bush width and bush ratio with elevation. As elevation increased, the percent epiphyte cover and the percent soil moisture increased but water temperature, conductivity, and dissolved oxygen decreased. Percent soil moistures and organic contents were higher at elevations above 900 m than at elevations below. The mean, minimum and maximum temperatures of Doen Hok cloud forest automatic weather station from March 2007 to March 2008 were 19.5, 15.2 and 27.9 °C, respectively, with an average relative humidity of 96.1%.

A great cultural diversity in the Khao Nan Area

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Khao Nan is a mountain located in Nobphitum sub-district in Nakhon Si Thammarat Province. This area is surrounded by rich natural resources, of soil, rivers, forest, and various wildlife, which provide a high quality of life for people and contributes to the sustainable living of the people who utilize these resources.

The community of people in the Khao Nan area comprises various races and nations. Native people settled in this area for 800 years before Nakhon Si Thammarat was named. Some people came from other parts of Thailand, and some are of mixed racial parentages or descendants of other ethnic groups. These people inherited their own historical culture. However, until now, some cultures have become less important, some cultures have changed from their original cultures because of the influence of other cultures, and some cultures have been created from the local intelligence of community members.

The traditional characteristics of the Khao Nan people are related to human living. Most traditions are involved in the moral goodness of many religions especially Buddhism which support the happiness of both the individual and society. Regarding health care culture, patient treatment is still by using herbs together with psychotherapy through traditional rites. In terms of occupation, many types of work are found in this area, such as fishing, hunting and, exceptionally, driving bees out of nests, because of the fertility of the Khao Nan area. Presently, beliefs regarding supernatural things and superstition still remain.

The cultural diversity of Khao Nan's people results from natural conditions that affect their feelings and from combinations of experiences among individuals and groups. The majority of cultures are similar to Nakhon Si Thammarat Culture because of common descendants and mixing with neighbors. The existence of great cultural diversity in the Khao Nan area provides the high quality of their lives.

Evaluation of the use of *Eltaeriospermum tapos* forest: A case study of Nopphitam District, Nakhon Si Thammarat Province

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The objectives of this study were to evaluate the use of *Eltaeriospermum tapos* forest using the market valuation method and to assess the willingness to pay an entrance fee to use the forest using the Contingent Valuation Method (CVM). 252 respondents were randomly selected and interviewed from 4 villages in Tumbon Krumgching (Khao Nan National Park, Nopphitam District, Nakhon Si Thammarat Province). In the market valuation method, the use value of the forest could be estimated by the product of the price and quantity of non-timber forest products utilized by households. The results showed that in 2007 the use value of the forest, both for household consumption and trade, was 1,593,783.62 baht (or 6,324.56 baht per household). The closed-ended, single-bounded Contingent Valuation Method was used to estimate the community's willingness to pay an entrance fee to the *Eltaeriospermum tapos* forest. The results found that the mean willingness to pay for an entrance fee was 18.30 baht per person per day.

A preliminary study on socio-economics and relationships between communities and biodiversity for strategy development in collaborative biodiversity management: A case study of Khao Nan National Park, Nakhon Si Thammarat

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There are 27 communities surrounding Khao Nan National Park, ranging from 30 to 100 years of settlement. Communities were mostly established during the mine and forest concession periods. The main livelihoods now are Para rubber plantations, and fruit orchards. The religion is Buddhism, while people also maintain Nakhon Si Thammarat traditional culture. Forest dependence of the communities consists of water for orchards and for household consumption, as well as catching fresh water animals. Khao Nan National Park is the main watershed area providing ecosystem services through more than a hundred stream flows. Furthermore, communities derive non-timber products, e.g., wild plants and vegetables for food. The forest also provides important sources of income, especially 'Prah' or *Eltaeriospermum tapos* fruits. Khao Nan National Park has the biggest site for 'Prah' in Thailand covering 4,000-5,000 rai near Huai Lek Park Protection Unit and near Huai Tong and Tup Nam Tao villages. A quantitative study of the two villages showed that 97,036 kg of 'Prah' were collected during 20 August - 20 September 2007, with an average of 3.2 tons per day, and a total economic value of 1,259,550 Baht. This indicates that average financial flow within these two villages is 41,238 Baht per day and the average number of collectors per day is 117 people. Furthermore, the forest has important roles in local tradition, culture, nature tourism and maintaining local biodiversity, watershed ecosystem and wildlife habitats.

History of a Saiyok Community: A case study of Thasao Community

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This research entitled "History of a Saiyok Community: A Case Study of Thasao Community" was historical research which aimed at studying the origin and development of Thasao Community, Amphoe Saiyok, Kanchanaburi Province, in particular how the community formed and developed it's characteristics, culture, and economics, and it's political development. The techniques employed for data collecting consisted of searching all relevant documents from various sources, traveling and surveying throughout the area, and interviewing local informants. All collected data were analyzed and rechecked before writing for descriptive presentation. The tentative findings from the data indicated that Thasao Community had apparently been formed after the end of W.W. II (B.E. 2488). Prior to this, the area of Saiyok appeared to be a large, rich jungle full of natural resources, such as various kinds of woods and wild animals like tigers, elephants, bears, hogs and deers. There were a few Karen, Khamhu, and Mon who impermanently earned their living by taking profits from natural wild products. After the end of W.W. II, "The Death Railway" was in use so that many Thai people from nearby areas started to come for cutting bamboo, working in sawmills, and also doing some trading and planting, and finally settling permanently into an agricultural occupation. The numbers of immigrants kept on rising continuously so that the numbers of Karen, Khamhu, and Mon decreased.

Management of local wisdom concerning bamboo utilization in Tambon Thasao, Amphoe Saiyok, Kanchanaburi Province

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Preliminary results showed that the local community mainly utilized wild bamboo more than planted bamboo, which is rare. However, the proper harvesting of wild bamboo, in terms of season, age and stem length, would prolong the wild bamboos available in this area for years. Consequently, it would also affect conservation and propagation of bamboo. There were two main uses of bamboo: the shoots were used in numerous dishes, and the stems were used for different purposes in daily life. Bamboo was also used in local culture in a few cases. This local wisdom has been transferred from generation to generation orally and by practice but not recorded in any literature. As a result some of this local wisdom no longer exists while some has adjusted to the present conditions.

Economic and capital analysis of planted bamboo in Thasao Sub-district, Saiyok District, Kanchanaburi

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It is well-known that Kanchanaburi is one of the Provinces of Thailand with many bamboo forests. Bamboo is a natural resource that has been used for a long time. The Thasao community is a community of Kanchanaburi that is rich of bamboo. Villagers use bamboo to produce goods for sale as well as for home use. However, use of bamboo is increasing while planting bamboo for replacement is not done, so that the amount of bamboo in the forest is being reduced. That is why this research is about planted bamboo. By studying agriculturalists' general information, production factors, capital for planting, and monetary factors of families that plant bamboo have been determined.

From a six-month study at Thasao sub-district, Saiyok District, Kanchanaburi, it was found that, there are nine agriculturalists who plant bamboo. Eight of these agriculturists plant bamboo on their own properties. Of these eight, there are 5 persons, who plant one kind of bamboo, two persons, who plant two kinds of bamboo, and one person who plant three kinds of bamboo. After using bamboo for their own families, agriculturalists who plant bamboo will sell both bamboo and bamboo shoots to earn added income for their families.

Capital management and production value assessment of bamboo products for sustainable development: A case study at Thasao Sub-district, Saiyok District, Kanchanaburi

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A study of capital management and assessment of production value of bamboo products for sustainable development at Thasao sub-district, Saiyok district, Kanchanaburi, was conducted in order to get data for planning, controlling, and decision making. Such information can help people know how to use bamboo in worthwhile and efficient ways as well as use it sustainably.

To collect data, the researcher did a field-work study by observation, questionnaires, and in–depth interviews. Data were then analyzed using descriptive and quantitative methods. From a six-month study, it was found that people in 4 villages produced bamboo baskets. Capital production is as follows: bamboo, plastic strips, other materials, equipment and machines, wages, electricity, maintenance, and transportation. Problems in production are weather, agreement between communities and the Forestry Department, and leftovers from production that are useless.

Biotic community of the bamboo ecosystem at Pu-teuy community forest, Tambon Thasao, Saiyok District, Kanchanaburi

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This research aims to compare the diversity of biotic communities found in different types of bamboo. The experiment comprised 4 treatments; *Gigantochloa albociliata* (Munro) Kurz, *Thyrsostachys siamensis* Gamble, *Gigantochloa densa*, and a mixture of *G. albociliata* (Munro) Kurz, and *G. densa*. Each treatment was replicated 3 times. Animal species were collected from 20x20 m permanent sample plots. Animals were separated into groups: macroscopic soil animals, insects, vertebrates especially amphibians and reptiles, birds and mammals. The data is being collected from December 2007-November 2008 and covers all seasons.

Preliminary results indicate that there are more than 18 species of ants, 15 species of birds, and some species of reptiles such as *Chameleo* sp. and *Sphenomorphus* sp. Most organisms were distributed in all permanent sample plots.

Screening of phosphate-solubilizing bacteria from bamboo root soil in Pu-Teuy community forest, Saiyok District, Kanchanaburi Province

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Pu-teuy community forest comprises various plant and animal species as well as soil microorganisms. Soil samples from the bamboo rhizophere in the zone of swamp forest were taken for study of physical and biological parameters. The pH of soil samples ranged from 6.68-8.98 showing weak acidity. The moisture content of soils were in the range of 10.12-17.76%. Total P was 628.9-2558.8 ppm as P_2O_3, whereas soluble P was only 95.3-343.1 ppm as P_2O_3. These results indicate that there is plenty of P in the soil but it is in an insoluble form that cannot be utilized by plants.

Based on the idea that phosphate-solubilizing microorganisms are a key factor for plant growth, such functional rhizospherous microorganisms were screened using Pikovskaya's media. Twelve isolates showed remarkable growth performance with clear zones on these solid media. The most effective solubilizing bacteria were selected; these were 5 strains, A14, A2, A5, A6 and A7, that gave halo:colony ratios of 3.5, 3.1, 2.49, 2.16 and 2.00 mm respectively. Then, the specificity between species of bamboo and p solubilizing bacteria were analyzed. The results showed that A14 was specific to 'Kaow-Lam' bamboo while A2 and A3 were found in 'Roag' bamboo. In addition, A3 could be found in 'Noul' and 'Pag' bamboo. Of the strain A5 was found in both 'Ta-Dum' and 'Plong-Yaw' bamboo. The last strain, A6, was found only in the rhyzophere of 'Nam' bamboo.

Steamed bamboo shoot production in Thasao community, Saiyok District, Kanchanaburi Province

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Thasao Sub-district, Saiyok District, Kanchanaburi, is located in an abundant forest area where the community obtains many advantages. Bamboo shoots (*Thyrsostachys siamensis* Gamble) are one of the valued plant products that can be gathered in large amounts during the rainy season. Thasao villagers gather bamboo shoots for domestic consumption and pack the surplus in plastic for a steaming process. They steam bamboo shoots to gain some extra income. But this process in which villagers steam bamboo shoots in plastic bags can result in chemical contamination from the plastic bags. This problem made the researchers aware of its danger and resulted in this study of the production of steamed bamboo shoots by the Thasao community. After analyzing physical characters, contaminants and duration to expiry, the researcher determined 3 ways of production as follows:

1) Boil unpeeled bamboo shoots, then peel them before steaming the bamboo shoots that are packed in plastic bags.

2) Peel the bamboo shoots before packing them in plastic bags and steaming.

3) Peel the bamboo shoots and cook them in steam and pack them in plastic bags.

The factors used for physical analysis of the processes were the general characters, color, odor, texture, and diluted substances. The quality control standard for steamed bamboo shoot products for local products are *pH* between 5.07-5.48 and lead level in range of 0.038-0.185 milligram per kilogram. From the study, raw bamboo shoots that were steamed before being packed in plastic bags could be kept for more than 60 days. But raw bamboo shoots that were steamed in plastic bags could be kept for 30-60 days and bamboo shoots well-cooked before being packed and steamed could be kept for not more than 30 days.

A study of local people's knowledge on non timber product utilization and the transformation to local production

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The aim of this study was to investigate the diversity of species used for non–timber forest products (NTFPs) in a Thong Pha Phum plantation, Kanchanaburi. The methodology consisted of 3 parts: 1) to investigate the relationship between socioeconomic factors and NTFP utilization level by using 137 questionaires, 2) to investigate utilization by using 42 questionaires, 3) to explore species diversity of plants used as NTFPs by collecting plant samples for identification. From the results, we found that plants used for NTFPs were very diverse and could be classified into 3 groups according to regular utilization:

1) herbs species with 49 species, different parts of each herb were used with the leaf component having the highest utilization,

2) Edible wild plants with 41 species, as well as animal groups in the study area, which were classified into 22 species. The main method of transforming edible wild plants into local food product was by fermentation. Some animals were transformed into local food products by fermentation and by drying,

3) Handicraft plant species; 13 species were found. Utilization patterns were different depending on the handicraft plant species. Thus grass was transformed into various local handicraft products such as roofs of huts, hats and brooms. Bamboo was transformed and used as many handicraft utensils, while hardwood was transformed into charcoal.

Changing ecosystems and its impact on biodiversity and local knowledge in the Greater Mekong Sub-region

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This project aims at a better understanding of transnational mega projects and their impact on changing ecosystems and the lives and livelihoods of marginal communities in the Mekong region. The focus is on marginal fishing communities along the Mekong and its tributaries and to understand how changing ecosystems have impacted upon fish ecology, and the impact of changing ecosystems on local economies, life-styles, and cultural practices.

For the studied communities presented in this research, the ongoing economic and social transformations are resulting in increased vulnerability and environmental degradation. While depicting a stark future for less advantaged Mekong communities, the research still gives reason for hope by pointing out that these communities have the capacity to react. Their local knowledge is continuously transformed into adaptive responses that allow them to cope with evolving historical realities. For instance, in response to erratic fluctuation of water levels, many local communities have devised conservation measures to regulate the timing and extent of fishing. In this sense, the research contends that if the value of this knowledge is recognized, and local communities are included in regional and national planning, a sounder natural resource management system can be fostered. Consequently, the research advocates the incorporation of bottom-up planning processes in the development of the GMS. Communities, however, may not be able to spur a more inclusive approach on their own, considering the unequal power structure within and across countries. Here is where the project emphasizes that the formation of 'transnational civil society' alliances between local groups and regional and international organizations is crucial to more balanced development in the GMS.

The relationship between agro-biodiversity and community livelihood in Thung Kula Ronghai

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The objectives of this research are to study ecosystems, plant and animal diversity and their relationships with community livelihoods in Mek dam and Nong Bua Kaeo sub-districts, Phayakkhaphum Phisai district, Maha Sarakham, and to evaluate biodiversity used by the local community. During the primary study, we determined 117 plant species, 160 animal species and 69 topics of local knowledge. Within our study area, 5 terrestrial ecosystems and 4 aquatic ecosystems occurred. We also found a close relationship between livelihood and biodiversity for food and other uses for daily life. Once completed, this research will provide us with an improved understanding of the value of biodiversity used by the local community and baseline information for use and conservation of important biodiversity in the area.

Seasonally flooded forest and household subsistence livelihoods: A case study of the lower Songkhram river basin

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The study aimed at determining the contribution of seasonally flooded forest to the subsistence of local households and exploring the factors affecting household subsistence livelihoods. Structured questionnaires and in-depth interviews were used as key tools for data collection. The sampled population consisted of 269 household heads in 12 villages located on both sides of the lower Songkhram River in Nakhon Phanom Province. Data were collected from October 2005 – January 2006.

Two indices were used to indicate household subsistence livelihood. The first index was the proportion of the total amounts of products that households actually harvested from seasonally flooded forest per year over the actual amounts of products consumed by households per year. The second index was the proportion of the actual amounts of products consumed by households over the standard amounts of products which Thai people should consume.

The results revealed that most sampled households had subsistence livelihoods; 61.3 %, 69.5 % and 69.1 % of the households had sufficient rice, vegetable and fish consumption, respectively. Amounts of rice, vegetables and fish products that households could harvest from seasonally flooded forest areas per year exceeded the actual amounts consumed by households per year. 82.5 % of households consumed more rice than the standard (Department of Health: 1997). However, 85.1% and 97 % of households consumed less vegetables and fish, respectively, than the standard (Department of Health: 1997).

It was concluded that seasonally flooded forest had contributed significantly to household subsistence and livelihoods. Any change or damage to the natural characteristics of seasonally flooded forest needs careful thought.

Risk assessments of damage by tourism to resources and of dangers to tourists in Huai Yang Waterfall National Park, Prachuap Khirikhan Province

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The three main objectives of this study were to study the characteristics of the water, forest and wildlife resources in Huai Yang Waterfall National Park, to study tourist behavior and tourist dangers and to assess the risk of resources damage by tourism and dangers to tourists. Data was gathered by various methods. 160 tourists were interviewed and the resulting data were analyzed using the Statistical Package for Social Sciences (SPSS). In-depth interviews with park officers and risk assessments of each tourism site were conducted by 5 specialists plus the researcher.

The study found that water quality of Huai Yang waterfall in the dry season and rainy season was under the standard quality for every parameter of surface water type 2 according to the Department of Pollution Control. The Panda crab, the only endemic wildlife species, and the Malayan Tapir, Serow and Banteng, which are rare wildlife species, were found. Rare or endangered plant species were not found on nature trails near the waterfall. Investigation of tourist behavior found that more than 50 percent of tourists followed the national park's suggestions. The most important tourism activity was viewing scenery. The main danger to tourists was insect bites and the most dangerous area was Pa Ta Kae. The tourism sites most at risk were the Hub Ta Khien area, followed by Yot Khao Luang and then Huai Yang Waterfall. The most dangerous area in terms of tourist accidents was Huai Yang Waterfall, especially the 2nd, 3rd and 5th stages. As for risk assessment of dangers to tourists, the study found poisonous animals were the most dangerous, followed by flash floods, and then slippery areas.

A new species, *Gluconobacter kanchanaburiensis* sp. nov., proposed for strains isolated from Thong Pha Phum, Kanchanaburi, Thailand

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Two isolates, AD92^T and AD93, were isolated from fermented fruits of *Artocarpus heterophyllus* (common name: Jackfruit) collected at Thong Pha Phum, Kanchanaburi, Thailand. In phylogenetic trees based on 16S rRNA gene sequences, the two isolates were included within a lineage comprising *Gluconobacter oxydans, Gluconobacter albidus, Gluconobacter kondonii*, *Gluconobacter roseus* and *Gluconobacter sphaericus* and formed an independent cluster along with the type strains of *Gluconobacter cerinus, Gluconobacter frateurii* and *Gluconobacter thailandicus*. Pair-wise sequence similarities of isolate AD92^T with the type strains of the eight *Gluconobacter* species were calculated to be 97.4-99.5%. DNA base composition was 59.4-59.5 mol% G+C with a range of 0.1 mol%. Labeled DNA of isolate AD92^T presented levels of DNA-DNA hybridization of 100, 32, 10, 16, 27, 20, 39, 47, 44 and 7% to DNA respectively from isolate AD93 and the type strains of *G. oxydans, G. cerinus, G. frateurii, G. albidus, G. thailandicus, G. kondonii, G. roseus*, *G. sphaericus* and *Acetobacter aceti.* The two isolates were phenotypically discriminated from *G. oxydans, G. albidus, G. kondonii*, *G. roseus* and *G. sphaericus* by growth without nicotinic acid. The two isolates had Q-10. The unique phylogenetic, genetic and phenotypic characteristics obtained indicate that the two isolates were sufficiently different to be classified into a separate species, and *Gluconobacter kanchanaburiensis* sp. nov. is proposed. The type strain is isolate AD92^T (= BCC 15889^T, = NBRC 103587^T), which has a DNA G+C content of 59.5 mol%.

Biodiversity of waste lubricating oil-degrading bacteria in soil

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Consortia of waste lubricating oil-degrading microorganisms were isolated from oil contaminated soil collected from garages and petrol stations in Nakhon Si Thammarat, Songkhla and Suraj Thani Provinces. An enrichment culture technique was used for the isolation of microorganisms responsible for the biodegradation of waste lubricating oil. One gram of soil sample was added into mineral salt medium containing 1% waste lubricating oil as the sole carbon source. Waste lubricating oil degradation activity was measured by a weight loss method. The most active consortium in the assimilation of waste lubricating oil was SC-9. The SC-9 consortium showed 40.46% oil degrading activity within 5 days. Oil concentration affected degradation by the SC-9 consortia. Degrading activity was decreased from 40.46% to 15.05% when waste lubricating oil concentration was increased from 1% to 10%. The SC-9 consortia contained four bacterial isolates, two isolates were Gram-positive with rod-shapes and the others were Gram-negative, with cocci and rod shapes. Analysis of nucleotide sequences of the gene encoding 16S rDNA resulted in the identification of the four bacterial strains as *Chryseobacterium* sp., *Bacillus cereus*, *Sphingobacterium multivorum* and *Agrobacterium tumefaciens*.

Diversity of marine gliding bacteria in Thailand

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Eighty-four marine gliding bacteria were isolated from specimens collected in the Gulf of Thailand and the Andaman Sea. All exhibited gliding motility and swarm colonies on cultivation plates. Phylogenetic analysis indicated that the represented isolates could be separated into six different clades (gr. 1 - gr. 6) within the *Cytophaga-Flavobacterium-Bacteriodes* (CFB) group. Group 1 formed a remote line with only 90% sequence similarity with *Flavobacteriaceae bacterium,* which indicated a potentially novel taxonomic group. Groups 2 and 3 were identified as the recently proposed *Tenacibaculum mesophilum* and *Fulvivirga kasyanovii,* respectively. Groups 4, 5 and 6, consisting of the largest number of members, were identified as *Rapidithrix thailandica*, *Aureispira marina* and *Aureispira maritima,* respectively.

Numerical analysis and Random Amplified Polymorphic DNA (RAPD) analysis of root-nodule bacteria isolated from the Thai medicinal plants, *Pueraria mirifica, Derris elliptica* Benth., and *Indigofera tinctoria* Linn.

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Two hundred and twenty-one isolates from the Thai medicinal plants, *Pueraria mirifica*, *Derris elliptica* Benth., and *Indigofera tinctoria* Linn., grown in 16 Provinces in Thailand were analyzed for DNA polymorphisms using a randomly amplified polymorphic DNA (RAPD) method. The results indicated that there was significant genetic diversity among strains from distinct geographic areas. The total of 54 representative strains was characterized using a numerical analysis of 113 phenotypic features including utilization of 52 carbon sources, utilization of 30 nitrogen sources, requirements for 10 vitamins, tolerances to 10 antibiotics, growth at pH's 5.0, 6.5 and 8.0, growth on media supplemented with NaCl at concentrations of 0.2 and 1.0 M, growth at 20, 30, and 40°C, acid or alkaline production, colony morphology, doubling time, indole-3-acetic acid (IAA) production and melanin production. The strains could be differentiated and the phenotypic diversity among these strains was revealed. Partial sequences (approx. 500 bp) of the 16S rRNA gene of the strains DASA57009, DASA57020 and DASA57038 from *I. tinctoria* showed 69%-72% homology with strains in the *Ralstonia*/*Cupriavidus* group.

Molecular phylogeny of selected coelomycetes with fusiform conidia, *Robillarda, Pseudorobillarda* and *Xepiculopsis,* based on nuclear ribosomal DNA sequences

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Conidial appendages and conidiogenesis are key characters in the identification of coelomycete genera and species. The genera *Robillarda, Pseudorobillarda* and *Xepiculopsis* possess ellipsoidal conidia with appendages but differ in conidial appendage ontogeny. No teleomorphs are known for *Pseduorobillarda* and *Xepiculopsis*, while the putative teleomorph of *Robillarda* is a member of the Amphisphaeriaceae. *Robillarda* and *Pseudorobillarda* are often confused as they both possess septate conidia with polar and or basal appendages. Because of the lack of clarity in identifying *Robillarda*, *Pseudorobillarda* and *Xepiculopsis*, a taxonomic study was undertaken to resolve their familial and ordinal statuses using nuclear SSU and LSU rDNA sequences. The phylogenetic analysis demonstrated that these three coelomycetes fall into two distinct lineages. Firstly, *Robillarda* and *Xepiculopsis* are well placed within the Sordariomycetes, and the ordinal position of these two genera fall within the Hypocreales and Xylariales, respectively. Secondly, *Pseudorobillarda* species have a phylogenetic affinity with the Dothideomycetes, although their ordinal and familial levels remain unresolved. Although these three genera morphologically have similar fusiform conidia, they show no consistency in their phylogenetic relationships. This study has enabled the identification of the putative teleomorphs for these three coelomycete genera.

A multigene phylogeny of the marine ascomycetes: *Biatriospora marina, Decaisnella formosa* and *Platystomum scabridisporum*

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A multigene phylogeny of the marine ascomycetes, *Biatriospora marina*, *Decaisnella formosa* and *Platystomum scabridisporum,* was investigated using the combined nucleotide sequences of SSU, LSU rDNA, RPB2 (RNA polymerase II second largest subunit) and Elongation factor 1-alpha (EF-1-alpha). 234 sequences of these gene regions from 71 species from GenBank were aligned with *Hypocrea lutea*, *Xylaria acuta* and *Neurospora crassa* as outgroups. The combined data set was analysed phylogenetically using maximum parsimony and Bayesian analyses.

The results showed that *Biatriospora marina, Decaisnella formosa* and *Platystomum scabridisporum* grouped within the Pleosporales in all analyses supported by 100% bootstrap values and 1.00 posterior probabilities. Sequence analyses indicated that *Decaisnella formosa* and *Platystomum scabridisporum* clustered within the Lophiostomataceae subclade 4 (59% bootstrap values and 0.99 posterior probabilities) with *Lophiostoma arundinis*, *L. crenatum*, *M. bipolaris* and *Trematosphaeria heterospora* as sister taxa. *Biatriospora marina* has an affinity with the Testudinaceae, but its taxonomic position within the family remains unresolved and it does not appear to have any close evolutionary relationship with any known testudinaceaeous genera. Our molecular data also support the previous phylogenetic hypotheses that the Lophiostomataceae is polyphyletic.

Comparative fungal diversity studies of palms in Thailand

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The biodiversity of fungi on selected palms, *Calamus* sp. and *Elaeis guineensis*, was studied. Endophytic fungi were collected following 2 field surveys in November 2006 and May 2007. Ten field collections were made for saprophytic fungi in September, October, November, December 2006 and March 2007 and one for endophytic isolation experiments (November 2006). Saprophytic fungi from *Elaeis guineensis* comprised 65 taxa: 28 Ascomycota, 28 anamorphic fungi and 9 Basidiomycota. *Annulatascus velatispora*, *Stilbohypoxylon* sp., *Falciformispora* sp., *Vanakripa* sp., *Grammothele fuligo*, *Schizophyllum commune* and *Marasmius* sp. were common on this palm. On *Calamus* sp. a total of 98 saprophytic taxa (224 records), consisting of 40 Ascomycota, 12 Basidiomycota and 46 anamorphic fungi, were recorded. Samples were collected from 4 parts of the palm with 61% of the fungi recorded from petioles, 38% from rachises and 1% from trunks. Palm material collected from different habitats was also sampled; dry aerial material yielded 68.5% of the fungi and damp/moist material 31.5% of fungi were collected from the leaves. On this palm, a number of species, namely AOM 318, *Morenoina palmicola* and *Circinoconis paradoxa*, were common.

Diversity and distribution of freshwater fungi in natural habitats at different temperatures in Thailand

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One-hundred and eighty-two species of freshwater fungi were collected from submerged wood at 27 subsites in Thailand, which ranged in water temperatures between 21 and 95°C. Two-hundred and fifty-eight strains were isolated and are preserved in the BIOTEC Culture Collection (BCC). These include 48 Ascomycetes (36.3%) and 45 Mitosporic fungi (56.6%) of the total taxa. They belong to 2 classes, 10 orders, 13 families and 47 genera. Tat Ta Phu Waterfall (25°C) at Khao Yai National Park and Sirindhorn Waterfall (25°C) at Hala-Bala Wildlife Sanctuary possessed the highest fungal diversity (10% and 9.2%) while Malika Hot-spring (68°C) had the highest number of fungal species of all hot-springs (3.8%). This study showed that the number of fungal species is not correlated to the temperature of the habitat in which they were found. The reason may be due to the thermo-tolerance characteristics of freshwater fungi. Moreover, water from a marine hot-spring (68°C) (0% fungal diversity), which is based on powdery sand rock with accumulated salt and $CaCO_3$ crystals, may have influenced the efficiency of fungal growth and colonization on this substratum. The most common species in streams with normal temperature profiles (e.g. <35°C) were *Ellisembia opaca* and *Phaeoisaria clematidis*. However, our study requires more information in order to completely understand the relationship between temperature and freshwater fungal biodiversity.

Relationship of the genus *Savoryella* (teleomorph ascomycete) and its anamorph *Canalisporium* as inferred by multiple gene phylogenies

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The taxonomic placement of selected freshwater *Savoryella* species and some marine *Savoryella* species as well as putative *Canalisporium* species that originated from submerged woods in aquatic habitats have not been classified into any family or order with certainty. Results based on individual molecular data analyses of the partial small sequence (SSU data), indicate that *Savoryella* form a monophyletic clade and group within the subclass Hypocreomycetidae, Sordariomycetes. The genus *Savoryella* shows no affinities with the Hypocreales despite earlier assignment to that order. In addition, we can confirm using the large subunit rRNA gene (28S rDNA) the taxonomic position within Hypocreomycetidae, which is in good agreement with the 18S rDNA gene. Further analyses will be conducted including more strains of these taxa, and combining molecular analyses, such as ITS, RPB1, RPB2 and EF1-α, for determining the precise taxonomic placement of these genera.

Biodiversity of *Xylaria* species associated with termite nests or that emerge from soil in Thailand

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Thailand supports a rich diversity of fungi. The Xylariaceous fungi are very interesting to study especially the termite-associated *Xylaria* species. In the past, *Xylaria* species associated with termite nests were too poorly known to be described. Only 25 *Xylaria* species associated with termite nests have been described. This study aimed to survey and collect *Xylaria* species associated with termite nests or that emerge from soil in Thailand. More than 10 species were found and a further 5 species await identification and description. The following species were recognized: *Xylaria acuminatilongissima*, *X. atrodivaricata*, *X. brunneovinosa*, *X. cirrata*, *X. escharoidea*, *X. intraflava*, *X. kedahae*, *X. nigripes*, *X. ochraceostroma*, *X. piperiformis* and *X. reinkingii*.

Fungal diversity on decaying seeds of the Dipterocarpaceae

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Fungi on naturally decaying seeds play an important role in recycling nutrients in the forest ecosystem. They have also been shown to produce bioactive compounds with pharmaceutical potential. The objectives of this study are to record fungi colonizing seeds of the family Dipterocarpaceae, which is the dominant plant family of tropical forests in Asia, and to isolate them into pure culture for further utilization. Methods used in the study included: collection of seeds on the forest floor, incubation of seeds in moist chambers, seed examination using dissection and compound microscopes, and fungal isolation with a single spore technique. Collection sites included: Khao Yai National Park, Khao Soi Dao Wildlife Sanctuary, and Phu Phan National Park. This study has yielded over 40 fungal species from 300 seed samples. Seeds of each collection site supported 8-16 fungal species with 3-5 species overlapping with the other sites. The similarity of fungi on different seed species ranged between 20-25%, thus indicating that different seed species support different fungal communities.

Comparitive study between blastospore and conidia preservation of insect pathogenic fungi using the L-Drying technique

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Insect pathogenic fungi are important regulators of insect populations in nature. In addition, many of the species known to date have been reported as a group of potential candidates for novel secondary metabolites useful for medical and agricultural applications. However, insect pathogenic fungi are a group of fungi which are difficult to grow and maintain under laboratory conditions. Long term storage of most cultures using standard procedures such as freeze-drying of spores often results in the loss of valuable properties, genetic stability and, finally, viability of the strains. Moreover, induction of spore formation of insect pathogenic fungi is one of the obstacles. Therefore, an efficient and inexpensive method for long-term preservation of insect pathogenic fungal isolates especially those that cannot produce asexual spores under laboratory conditions will be investigated in this study. Approximately 50 isolates of important insect pathogenic fungi will be investigated for their ability to produce different types of spores such as blastospores and conidia. Optimization of induction conditions will be studied for all isolates in order to maximize yield. Then, preservation protocols using the liquid-drying (L-drying) technique for each isolate will be determined and the viability obtained will be compared with a commonly used preservation method. By the end of the study, the most effective and economical means for long-term preservation of valuable species of insect pathogenic fungi will be established which could be used as a standard protocol for culture collections dealing with insect pathogenic fungi.

Diversity of fungi in water, plants and fish in the Chi River

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The fungi from water, plants and fishes in the Chi River in Chaiyaphum, Khon kaen and Maha Sarakham Provinces, were bimonthly isolated during April 2007 to February 2008. Two hundred and ninety-four fungal isolates were found. The most dominant fungi were imperfecti (206 isolates), especially the genus *Fusarium* (79 isolates). Eighty-four isolates of Oomycetes were also investigated, mostly belonging to the Order Saprolegniales, Family Saprolegniaceae. Within this family, the genus *Achlya* obtained from the studied sites was dominant (33 isolates). Other genera such as *Aphanomyces* (27 isolates), *Saprolegnia (*21 isolates) and *Leptolegnia* (3 isolates) were found as well as 4 isolates of *Pythium*. Only few isolates were identified through to species because sexual reproductive organs were not produced. In addition, the results revealed that only *Aphanomyces*, *Saprolegnia*, *Achlya*, *Fusarium* and some imperfect fungi could be isolated from fishes, whereas other fungi were isolated from water, sand and plants (leaves, twigs and roots) in the Chi river. These would need to fulfill Koch's postulates by artificial infection of normal fish. However, the results suggested that temperature and geographical differences rather than infected fish species has played an important role in the species diversity of water moulds.

Biological characteristics of 4 genera including effects of temperature, salinity (sodium chloride, NaCl) and pH on hyphal growth showed that the fungi grew at 10-30°C, 1-2.5% NaCl, and pH 5-10. Artificial infections of 6 fungal genera to Nile tilapia *Oreochromis niloticus* and Silver barb *Puntius gonionotus* showed only *Aphanomyces* sp. was pathogenic to the fish but others were secondary infections.

Yeast diversity in water of mangrove forest at Laem Son National Park, Ranong Province

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The diversity of yeast in water of a mangrove forest in Laem Son National Park, King Amphoe Suksamran, Ranong Province, was investigated by isolation of yeasts using a membrane filtration technique and identification based on the analysis of the D1/D2 domain of 26S rDNA sequences by similarity and phylogeny. Among seventy-five strains belonging to the Phylum Ascomycota, 44 strains were identified as 17 described species, namely *Candida butyri*, *Candida parapsilosis*, *Candida picinguabensis*, *Candida rugosa*, *Candida silvae*, *Candida thaimueangensis*, *Candida tropicalis*, *Debaryomyces nepalensis*, *Galactomyces geotrichum*, *Issatchenkia occidentalis*, *Issatchenkia orientalis*, *Issatchenkia siamensis*, *Issatchenkia terricola*, *Kodamaea ohmeri*, *Pichia burtonii, Pichia galeiformis* and *Pichia kluyveri*, and 12 strains were found to be five undescribed yeast species, similar to *Candida* sp. NRRL Y-27127, *Candida* sp. NRRL Y-27665, *Hanseniaspora* sp. CS-2008b, *Hanseniaspora* sp. ST-250 and *Hanseniaspora* sp. YS DN19. The remaining 19 strains were found to represent four novel species. On the basis of polyphasic taxonomy including molecular taxonomy, phylogenetic analysis, conventional taxonomy and chemotaxonomy, *Kluyveromyces siamensis* sp. nov. was described.

Diversity of yeast in water and sediments of mangrove forests along the upper coast of the Gulf of Thailand

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Mangrove forest is a unique ecosystem which possesses much biodiversity. In Thailand, mangrove forests are distributed over both saline coasts of the Gulf of Thailand and the Andaman Sea. Due to the lack of investigation of yeast diversity in Gulf of Thailand coastal mangrove forests, this study was proposed to determine the diversity of culturable yeasts in water and sediments in mangrove forests on the east and west coasts of the Gulf of Thailand. A total of 100 strains of yeast were isolated from water and sediment samples collected from mangrove forests in the upper coast of the Gulf of Thailand and were subjected to identification procedures. Molecular taxonomy, based on the analysis of the D1/D2 domain of 26S rDNA sequences using similarity and phylogenetic analyses revealed that 105 strains were known species and four strains were undescribed species. Among the strains of known species, 87 strains belonged to 31 species of 13 genera of ascomycetous yeast, namely *Brettanomyces, Candida* (39% of all known species), *Debaryomyces, Hanseniaspora, Issatchenkia, Kloeckera, Kluyveromyces* (15% of all known species), *Kodamaea, Metschnikowia, Pichia*, *Saccharomyces, Torulaspora* and *Williopsis,* and 19 strains belonged to *Rhodotorula mucilaginosa* (17% of all known species), a basidiomycetous yeast. Three were found to represent novel species in three genera of ascomycetous yeast, namely *Candida, Issatchenkia* and *Saturnispora*.

Development of microbial diversity as biological indicators for soil quality in sustainable organic rice farming

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This study is aimed at developing and using microbial diversity in rice soil as indicators of soil quality for sustainable organic rice farms. An experiment was carried out using an existing rice field (Kao Dok Mali 105 variety) in Surin Rice Research Center, Thailand. Four plots of rice receiving different management practices were investigated in this study. They include: (1) conventional farming (CF) with a normal rate of chemical fertilizer applied; (2,3) two organics, one with green manure (GM) and the other with rice straw (RS); and (4) a control plot (CT) without an external source of plant nutrients. Soil quality in the four treatments was assessed using selected physical, chemical and biological parameters. Relevant findings were that a typical low pH (4.2-5.2) was observed in soil at harvest from all treatments, likewise inadequate phosphorus was detected (Bray II P with a range 2-5 ppm) except in the CF treated soil, and available P was enough for growing rice with values ≥ 10 ppm. In addition, soil respiration (1.75-7.76 mg/kg/day) as well as microbial biomass carbon and nitrogen (0.041-2.169 and 0.027-0.571 g/kg, respectively) were quite low for all treatments. Because of mineralized N and because other plant nutrients were small, there was not enough to meet the demand of rice plants. Low yields of rice (≥500 kg/rai) and perhaps low quality too are expected from organic rice (GM and RS) soils. Nitrogen seemed to be a limiting factor and should be provided to all plots including the CF plot. Determination of microbial community diversity in paddy soil is still on-going with denaturing gradient gel electrophoresis of polymerase chain reaction-amplified 16S rDNA partial sequences (PCR-DGGE). Fluorescence *in situ* hybridization analysis (FISH) and the BIOLOG Ecoplate method are included in this study.

Impact of land management on soil bacterial diversity at Thong Pha Phum District, Kanchanaburi Province

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Variations in soil properties and bacterial diversity in soil samples were observed for different types of land management, namely a chemically-intensive farm, an organic farm, and a forest at Thong Pha Phum District, Kanchanaburi Province. Significant differences in soil physical factors and nutrients were found at sampling sites. Analysis of soil bacterial community structure showed that the bacterial communities obtained from soils in the 3 different sites were dominated by *r*-strategist bacteria. No significant differences were found in bacterial numbers both between sites and seasons. However, colony forming unit (CFU) values were positively correlated with soil pH and soil nutrients. Ecophysiological index (EPI) values were not significantly different between sites and seasons. Finally, impacts of land management on bacterial diversity were analyzed. Total soil DNA samples were isolated from soil collected from 3 sites. The 16S rDNA was amplified and cloned into plasmid vectors. Among 70 clones obtained, the majority belonged to unidentified, uncultured bacteria (57.14%). Moreover, *Alpha-* (8.57%), *Beta-* (2.86%), and *Gamma-* (7.14%) *Proteobacteria*, *Firmicutes* (12.86%), *Actinobacteria* (8.57%), *Bacteriodes* (1.43%), and *Planctomycetes* (1.43%) were also found in this study. From the results of bacterial diversity study, different land management could affect bacterial diversity because there were large numbers of unique phylotypes in each site. Furthermore, impacts of land management were related to other factors, such as chemical residues remaining in the area. Long-term studies should be implemented to examine absolute changes caused by land management.

Genetic diversity and phylogenetic relationships of hot spring cyanobacteria

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A study of the genetic diversity and phylogenetic relationships of 16S ribosomal RNA (16S rDNA), 16S-23S internal transcribed spacer (16S-23S ITS), intergenic spacer of phycocyanin operon (PC-IGS) and DNA fingerprints of short and long tandem repeat repetitive sequences (STRR and LTRR) from 11 hot spring cyanobacterial isolates was conducted. It was found that the genetics of Thai hot spring cyanobacteria differ from cyanobacteria from other sources. Comparisons of 16S rDNA sequences with Genbank showed only *Synechococcus* spp. to have high similarities of 95-99 % to those in the database, whereas other genera showed similarities ranging between 83-95 %. For 16S-23S ITS, only 7 sequences were obtained with similarities ranging from 88 – 100 % to Genbank sequences. Five sequences were obtained from PC-IGS. Only two sequences, *Synechococcus* sp. SK 50 and *Synechococcus* sp. SK70, showed similarity with Genbank sequences. The phylogenetic relationship study showed that the phylogenetic trees of 16S rDNA and PC-IGS were related with the morphological classification. On the other hand, the tree from 16S-23S ITS showed an unclear grouping because this region has a high degree of variation. This marker may be suitable to classify cyanobacteria within the same genus. Cluster analysis of DNA fingerprints obtained from two primers specific to the short tandem repeats, STRR 1A and STRR 1B, distinguished hot spring cyanobacteria at the genus level. On the other hand, two primers specific to the long tandem repeat repetitive sequences, LTRR1 and LTRR2, were not suitable for generating DNA fingerprints in this group of cyanobacteria.

Diversity of benthic diatoms in major rivers in Thailand and establishment of water quality indices

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A study on the diversity of benthic diatoms and water quality in major rivers of Thailand was carried out in March 2008 (dried season). It was found that the dominant species of benthic diatoms in the Ping River were *Gomphonema parvulum* (Kützing) Grunow, *Luticola mutica* (Kützing) D.G. Mann and *Nitzschia palea* (Kützing) W. Smith. *Gomphonema* sp 1, *Luticola* sp. 1 and *Nitzschia palea* (Kützing) W. Smith were dominant species in the Tha Chin River, *Encyonema mesianum* (Cholnoky) D.G. Mann, *Eunotia* sp. 1 and *Navicula radiosa* Kützing in the Chantaburi River, *Synedra ulna* (Nitzsch) Ehrenberg, *Cocconeis placentula* Ehrenberg and *Sellaphora pupula* (Kützing) Mereschkowsky in the Kwai River, *Rhopalodia gibba* (Ehrenberg) O. Müller, *Nitzschia clausii* Hantzsch and *Navicula symmetrica* Patrick in the Chi River and *Gomphonema clevei* Fricke. *Cymbella turgidula* Grunow and *Gomphonema* sp 2 were found to be dominant species in the Tapee River. Some physical and chemical factors were investigated for evaluating general water quality. The results indicated that the water quality based on trophic status and the water quality of most sampling sites were not clearly different and could be classified as clean-moderate water quality (oligotrophic-mesotrophic status). However, the water quality in some sampling sites was different, especially site 1 in the Tapee River which could be classified as clean water quality (oligotrophic status) and sites 4 and 5 in the Tha Chin River which could be classified as polluted water quality (eutrophic status).

Research and development of algal products for restoration of soil and sustainable agricultural production

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The four algal strains, *Nostoc* sp. TISTR 8290, *Nostoc muscorum* TISTR 9054, *Nostoc muscorum* TISTR 8871, and *Nostoc* sp. TISTR 8873, were selected as potential strains based on their rapid growth and high total polysaccharide production. The efficiency as soil conditioners of these algae was studied by comparison between the addition of algal biomass (AB) and extracellular polysaccharide (EPS). The findings indicated that addition of EPS produced faster and higher increases in microbial activities, total porosity, and water-stable aggregates and decreased bulk density than did addition of AB. *Nostoc muscorum* TISTR 9054 delivered the best results either with the addition of AB or EPS. These results showed statistical significant differences ($p \leq 0.05$) with the control group in terms of organic matter, microbial activity, bulk density and total porosity of Lam Takhong soil, and organic matter and microbial activity of Thung Gula Ronghai soil. The survival of algae in developed soil conditioner products (granular, powder, sun-dried cells, hot oven-dried cells, including fresh cells in aluminium foil bags) could be detected up to the level of 10^6-10^7 cells per gram or per millilitre after storage for 9 months.

Algae: alternative feedstocks for new renewable energy (NRE)

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While the global and domestic communities are concerned about the shortage of fossil fuel, biofuel has emerged among the options to solve this crisis. A number of crop plants such as cassava and palm have increasingly been used for biofuel production. But this alternative is not without obstacles. Competition between food crops and energy crops raises the global issue of food security. To avoid this problem, algae (including cyanobacteria) are considered as promising feedstocks for new renewable energy (NRE). The advantages of using algae as NRE are:

1) their much smaller foot-print (than plants) for biomass production owing to their higher growth rates and the ability to cultivate and harvest algae all year round,

2) the incorporation into NRE production of the energy-waste system for biomass production, e.g., flue gas and waste water. Therefore NRE production could be considered to be a green production system which reduces global warming,

3) obtaining valuable co-products (e.g. pigments) increases the cost effectiveness of using algae, and

4) various types of energy could be produced, e.g., hydrogen and bioethanol from high starch accumulating strains (*Nostoc* and *Oscillatoria*), biodiesel from high oil producing strains (*Botryococcus braunii* and many species of marine diatom) and gas/oil from high cellulose containing strains (*Lyngbya*).

Many developed countries are actively doing research on algae as NRE. Nevertheless, commercialization of biofuel from algae has not yet occurred. As for Thailand, abundant algal biodiversity and a geographical advantage results in a greater possibility to obtain potent algal strains that can be cultivated under optimal growth conditions. It is believed, therefore, that R&D on NRE from algae will bring great benefits to the country.

Algal response to herbivore exclusion and nutrient enrichment: insights into growth, reproduction and chemical defense

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Resource allocation is known to be important to algal fitnesss and it is adaptive to the environment. Here, we pose questions on how algae will respond and allocate their resources when they encounter herbivory and nutrient variation. The effects of herbivore exclusion and nutrient enrichment on algal resource allocation patterns (growth, reproduction and chemical defense) were experimentally tested in the subtidal zone. The experimental design comprised plots (50 x 50 cm^2) of 2 dense macroalgae (*Turbinaria conoides* and *Halimeda macroloba*), 2 densities of herbivory and 2 nutrient levels. Cages (50 x 50 x 30 cm^3) were used to exclude herbivores: uncaged plots and fully caged plots. Cages were covered with wire mesh (mesh size was 2 x 2 cm) and fixed on the dead coral substrate. To determine the effect of nutrients, 2 nutrients levels were manipulated: enriched and ambient levels. In the enriched plots, 60 g of Osmocote® slow-release fertilizer was placed in each plot. Reproductive output, biomass, and tissue nutrients (using C:N:P ratio) of algae in each plot were examined. To quantify chemical defense concentrations, tissues were analyzed using high performance liquid chromatograph (HPLC). This research will be completed in November 2008. We should be able to explain and get a better understanding of the effects of herbivores, nutrients and their interactions on resource allocation patterns of tropical algae in tropical coral reefs, where they are greatly disturbed.

Species diversity and distribution of seaweed along the coastal shore of Chumporn Province, Thailand

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Seaweeds are important primary producers in marine ecosystems. Their rich diversity, abundance and wide distribution are due to their ability to adapt to changing environments. Seaweeds also are also a food source for human beings and aquaculture animals, a source of agar and other gels, and in aquarium tanks. The purpose of this project was to investigate the seaweed diversity in Chumporn Province along the coastal shores of the Remar and Phra Til Districts. Samples were collected in May 2007 along the beach during low tide; snorkeling was used when needed. The species distribution was investigated at the seaside site of King Mongkut's Institule of Technology Ladkrabang in July and October 2007. Three six hundred meter line transects were set up to assess the vertical distribution of seaweed from the shore. Thirty-two species of marine macroalgae were found. There were 2 species of cyanobacteria, 8 species of green algae, 13 species of brown algae and 9 species of red algae, reflecting that the full range of seaweed are well represented and distributed along the coastal shore out to 600 meters where the coral reef begins. The brown seaweeds, *Turbinaria* sp., *Sargasssum* sp., *Padina* sp., *Lobophora* sp. and *Dictyota* sp, are more common in the deeper zone than the others. As indicated by the presence of many small young thalli, the seaweeds started growing up in July 2007 and reached their peak growth in October 2007. Therefore the percentage cover of seaweed was higher in October than in July 2007.

Morphological variation in an adelphoparasite and in the agarophyte, *Gracilaria salicornia* (C. Agardh) Dawson

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Gracilaria salicornia and adelphoparasite specimens were collected from 11 sites in Chonburi (Ko Sichang, Ang Sila, Samaesan, Sri Racha harbor), Rayong (Ban Phe), Trat (Laem Sok, Laem Tien, Ao Cho), Prachuap Khiri Khan (Ta Mong Lai, Had Wanakorn), and Chumporn (Had Thung Wua Laen) Provinces. The sites could be grouped according to exposure, based on semi-exposed and sheltered conditions. Specimens of the adelphoparasite and *G. salicornia* were analyzed based on seven and eight morphological characters, respectively. The multivariate data sets were analyzed by canonical discriminant analysis in combination with a clustering procedure. For *G. salicornia*, sites clustered into two groups: 1) Laem Sok, Laem Tien, Ta Mong Lai, Had Thung Wua Laen, Ao Cho, Ang Sila, and Sri Racha harbor, (2) Ko Sichang, Had Wanakorn, Samaesan and Ban Phe. For the adelphoparasite specimens, sites could also be divided into two groups: (1) Samaesan, Laem Sok and Ao Cho, and (2) Had Thung Wua Laen, Ta Mong Lai and Had Wanakorn.

RAPD analysis was used to investigate molecular characteristics of the two plants. By screening twenty primers, twelve primers gave detectable polymorphisms. The UPGMA test gave identity values close to one for specimens of all sites. The results corresponded to those of discriminant analysis. This study showed close relationships occurred among specimens of *G. salicornia* as well as of the adelphoparasite growing in different habitats. On the other hand, their variation is thought to be caused by the changing external environments of the study sites.

Yield, components and antimicrobial effects of polysaccharides extracted from some Thai species of brown seaweed

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Several brown seaweed species were collected from Chonburi, Rayong and Chumporn Provinces. Crude polysaccharides were extracted from dry material of *Colpomenia sinuosa, Hydroclathrus clathratus, Sargassum polycystum, Turbinaria conoides, Dictyota dichotoma, Padina australis* and *Padina minor*. The dry materials were extracted in distilled water at 100°C (E1) and in 2 mol/l of HCl solution at 75°C (E2). E1 gave the highest yields of 1.97 ± 1.15 % w/w for *S. polycystum* from Rayong and of 1.81 ± 0.48 % w/w for *C. sinuosa* from Chonburi. Total carbohydrate was high in the E1 of *P. minor* from Chumporn (55.95 ± 0.72 %) and of *P. australis* from Chonburi (51.94 ± 0.08 %). The highest sulfate content was 18.10 ± 0.25 % obtained from the E1 of *H. clathratus* from Chonburi. However, higher yields were obtained from the E2. A maximum yield of 19.69 ± 0.23 % (w/w) was obtained from *H. clathratus* from Chonburi. The highest carbohydrate yield of 44.41 ± 0.94 % was obtained from the E2 of *P. minor* whereas the highest sulfate contents were from *C. sinuosa* (14.22 ± 0.69 %) and *H. clathratus* (13.82 ± 0.18 %).

The techniques, TLC and HPLC, were used for analysis of sugar composition of the E1 and E2 crude extracts using glucose, galactose, xylose, fucose and fructose as standards. The results showed fucose as the main component in all extracts. Both the E1 and E2 crude extracts were assayed for antimicrobial activity as well. At a concentration of 2 mg/ml crude extracts of *S. polycystum* from Chonburi showed activity against *Candida albicans* (E1 = 0.122 ± 0.004 mm, E2 = 0.123 ± 0.003 mm). E2 of *C. sinuosa* also showed activity (0.156 ± 0.035 mm).

Seasonal variation in distribution, density, and life stages of *Halimeda macroloba* decaisne at Tangkhen Bay, Phuket Province, Thailand

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The genus *Halimeda*, a green alga (Chlorophyta), is widely distributed in tropical and sub-tropical marine environments. *Halimeda macroloba* Decaisne has several calcified segments, an erect and flat thallus, and a massive bulbous holdfast attached to the sandy bottom. The purposes of this project are to study the seasonal variation in distribution, density, and life stages of *H. macroloba* at Tangkhen Bay, Phuket Province, Thailand, and to investigate the relationships between sediment composition in the holdfast and in the study area, blade surface area and holdfast volume, and wave motion and blade and holdfast size. The results showed that there was seasonal variation in distribution, density, and life stages of *H. macroloba* resulting from wave action which contributes to asexual reproduction by vegetative fragmentation, rainfall which increases sedimentation, sediment composition of the substrate, and invasion of seagrasses. The life span of *H. macroloba* at Tangkhen Bay was 8-12 months. The sediment study showed that sediment accumulation in the holdfast of *H. macroloba* might be a process of sediment selection for the advantages of increasing holdfast strength (holdfast tenacity), nutrient uptake and decreasing desiccation. There was a positive relationship between holdfast volume and blade surface area in *H. macroloba*. However, there was no relationship between water velocity and both holdfast volume and blade surface area of *H. macroloba* at Thangkhen Bay. This might result from its flexible morphology which can reduce the drag force imposed on the algae by reconforming with flow.

Effects of light, sediment and salinity on growth, pigments, agar production and reproduction in *Gracilaria fisheri* (B.M. Xia & I.A. Abbott) I.A. Abbott, J. Zhang & B.M. Xia at Koh Yor, Songkhla lagoon, Songkhla Province, Thailand

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Gracilaria fisheri (B.M. Xia & I.A. Abbott) I.A. Abbott, J.Zhang & B.M. Xia is a red alga, distributed in the tropics. In Thailand, *G. fisheri* is known to be abundant in Pattani Bay and Songkhla Lagoon. At present, the population of *Gracilaria* spp. in Songkhla lagoon is declining because of development around the lake. This has changed the salinity and turbidity of the lake. The aim of this research is to study the effects of salinity and sediment on growth, pigment content, the amount of agar and reproduction of *Gracilaria fisheri*. The experiments will be set up to test the effects of salinity and sediment on *Gracilaria fisheri* under different conditions, derived from a preliminary survey of Songkhla lake during 2006 – 2007, in short-term (5 day) and long-term (30 day) responses. The algae will be cultivated at a temperature of 25ºC, 3 levels of salinity (33, 25, 0 ppt.), 4 levels of light intensity (1000, 700, 400 and 150 µmol photons m^{-2} s^{-1}) and 3 levels of sediment (2.28, 0.67, 0 mg). Photosynthesis will be measured during the first 5 day experiment. Photosynthesitic biomass, pigments and agar will be measured after the 30 day experiment.

Use of *Ceriodaphnia cornuta* Sars as food for hybrid catfish and angel fish larvae

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This study aims to evaluate the potential of *Ceriodaphnia cornuta* Sars as food for hybrid catfish and angel fish larvae. One hundred hybrid catfish larvae of age 1-15 days old and 50 angel fish larvae of age 1-15 days old were reared in 24×12×12 inches aquarium tanks, and 30 angel fish larvae of age 16-30 days old were reared in concrete ponds of 1.0×1.0×0.3 meters. *Moina macrocopa* (Straus), *C. cornuta* and a mixture of *M. macrocopa* and *C. cornuta* were fed to hybrid cat fish and two age groups of angel fish 2 times a day for 15 days. *M. macrocopa* and *C. cornuta* used in this experiment were reared and harvested from outdoor ponds every day. Survival and growth of hybrid catfish fed with *M. macrocopa* was higher than of those fed the mix of *M. macrocopa* and *C. cornuta* and of *C. cornuta* ($p<0.05$). For angel fish of age 1-15 days old fed with all three diets, survival was less than 20% and growth was highly variable, whereas for angel fish of age 16-30 days old, survival did not differ significantly ($p>0.05$) among the *M. macrocopa*, the mix of *M. macrocopa* and *C. cornuta* and the *C. cornuta* food treatments. However, the growth of fish fed with *M. macrocopa* was higher than for any other group ($p<0.05$). This study indicated that *C. cornuta* can be used as fish larval food when there is a shortage of *M. macrocopa*.

Cultures of *Diaphanosoma excisum* Sars and *Simocephalus heilongjiangensis* Shi & Shi in the laboratory

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This study aims to culture two cladoceran species collected from Huay Khayeng: *Diaphanosoma excisum* Sars and *Simocephalus heilongjiangensis* Shi & Li. Live cladocera were transported from Huay Khayeng to the laboratory of the Suphanburi College of Agriculture and Technology. Four food types, *Chlorella* sp., rice bran, ami-ami and molasses waste water from the alcohol industry, at 5 concentrations, i.e., 100, 75, 50, 25, 5 and 0%, were introduced to both cladoceran species. Neonates of the experimental cladocera were reared individually in each of 100 ml plastic vessels containing 50 ml of food to record fecundity, time to first reproduction, number of clutches, clutch size and longevity. The results from previous experiments were used to modify laboratory cultures. A *Chlorella* sp. concentration of 5% was suitable for growth and reproduction of *D. excisum* and *S. heilongjiangensis*. Average time to first reproduction and the number of clutches of *D. excisum* and *S. heilongjiangensis* were 3.75±0.5 days and 8.5±1.91 clutches, and 5.4±0.54 days and 6.0±0.70 clutches, respectively. One female *D. excisum* and one female *S. heilongjiangensis* lived on average 12.75±3.20 and 13.65±0.89 days, and produced 45.5±15.02 and 89±18.50 neonates per female, respectively. The highest densities of *D. excisum* and *S. heilongjiangensis* in 50 ml containers were 11.50 and 34.64 individuals in day 3 and day 5 of culture, respectively. This study indicated that these two cladoceran species collected from Huay Khayeng can be successfully reared in the laboratory.

Species diversity of ostracods in Srisaket Province

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A survey of species diversity of ostracods from Srisaket Province was conducted in winter (December 2006), summer (April 2007) and rainy (September 2007) seasons. Samples were collected from rice fields, ponds, swamps, reservoirs, canals, lakes and rivers using a 60 μm mesh plankton net. In each location some water quality parameters (pH, water temperature and conductivity) were measured. Nitrate and Phosphate concentrations were measured by a Hach model DR/2400 Portable Spectrophotometer. Latitude and longitude were measured by a Sportrak GPS Receiver. Specimens were preserved in 70% alcohol and identified under compound and stereo microscopes. Images of identified species were taken using a Leo 1450VP scanning electron microscope. Eleven genera and 40 species of ostracods were identified. Species diversity of ostracods was negatively related to water conductivity with high statistical significance in the rainy season ($p<0.01$) and in the summer season ($p<0.05$). In contrast, temperature, pH, phosphate and nitrate did not correlate with species diversity in all seasons.

The calanoid copepod family Pontellidae from Thai waters of the Andaman Sea

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The diversity of marine calanoid copepods (Family Pontellidae) in Thai waters of the Andaman Sea was investigated from November 2005 to May 2007. Zooplankton samples from 142 stations were collected horizontally, vertically and obliquely with a plankton net with 330 µm mesh size. A total of thirty one species and five genera of calanoid copepods were found and twenty species were first records for Thai waters of the Andaman Sea, such as *Calanopia elliptica* (Dana), *C. minor* A. Scott, *Labidocera acuta* (Dana), *L. bengalensis* Krishnaswamy, *L. laevidentata* (Brady), *L. pectinata* Thompson & Scott, *Pontella danae* Giesbrecht, *P. diagonalis* Wilson, *P. fera* Dana, *P. investigatoris* Sewell, *P. spinipes* (Giesbrecht), *P. valida* Dana, *Pontellina morii* Fleming & Hulsemann, *P. plumata* (Dana), *Pontellopsis armata* (Giesbrecht), *P. inflatodigitata* Chen & Shen, *P. krameri* (Giesbrecht), *P. macronyx* A. Scott, *P. perspicax* (Dana) and *P. scotti* Sewell. Among these species, *Labidocera bengalensis* Krishnaswamy, *L. pectinata* Thompson & Scott, *Pontella danae* Giesbrecht, *P. diagonalis* Wilson, *P. fera* Dana, *P. investigatoris* Sewell, *P. spinipes* (Giesbrecht), *P. valida* Dana, *Pontellina morii* Fleming & Hulsemann, *Pontellopsis armata* (Giesbrecht), *P. krameri* (Giesbrecht) and *P. scotti* Sewell, were also first records for the Gulf of Thailand. Furthermore, six other unidentified species in the genera *Labidocera* (3 species) *Pontella* (2 species) and *Pontellopsis* (1 species) are potential new records in Thai waters.

Species diversity and distribution of cladocerans in 5 Provinces in central, eastern and southern parts of Cambodia in comparison with Thailand

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The species diversity and distribution of cladocerans in 5 Provinces in central, eastern and southern parts of Cambodia were studied in June 2006. Qualitative samples (70 samples) were collected using a 60 micrometer mesh size net and preserved in 5% formaldehyde. Forty species from 25 genera were recorded, 38 species of which are new to Cambodia. According to the frequency of occurrence, the most common species were *Moina micrura* Kurz (60 % of sampled localities), followed by *Diaphanosoma excisum* Sars (57 % of sampled localities) and *Ceriodaphnia cornuta* Sars (47% of sampled localities), respectively. Rare species were *Bosmina meridionalis* (Sars), *Chydorus ventricosus* (Dadays), *Dunhevedia crassa* (King), *D. serrata* (Daday), *Kurzia brevilabris* Rajapaksa and Fernando, *Leydigia acanthoceriodes* (Fischer), *Nismirnovius eximius* (Kiser), *Pseudochydorus globosus* (Baird) and *Macrothrix sioli* (Smirnov). The majority of cladocerans recorded in this study were circumtropical species. The species diversity of cladocerans had a significant positive correlation with pH ($r = 0.26$, $p > 0.05$). To compare the species diversity of cladocerans between Thailand and Cambodia, the results of this study were compared with the early literature of Thailand. The species richness of the Cambodian cladocerans was less than that in Thailand because of fewer samples. The research will be continued in order to increase the knowledge of cladoceran fauna diversity of this country.

Morphological and anatomical variation in the genus *Halimeda* Lamouroux (Chlorophyta, Caulerpales) in Thailand

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The green calcified seaweed genus *Halimeda* (Chlorophyta, Caulerpales) is a common inhabitant of tropical and warm-temperate marine environments in reefs and lagoons. Morphological and anatomical variability within the Genus *Halimeda* could cause taxonomic problems. Specimens are often difficult to identify using identification keys and taxonomic descriptions. In Thailand, research on seaweed and especially *Halimeda* is very limited. Lewmanomont et al. (1995) reported that there were only five species of *Halimeda* found: *Halimeda macroloba* Decaisne, *H. discoidea* Decaisne, *H. incrassata* (J.Ellis) J.V. Lamouroux, *H. opuntia* (Linnaeus) J.V. Lamouroux and *H. velasquezii* Taylor. Although, *Halimeda* spp. are very common and are distributed throughout Thai waters, there have not been any studies on these algae. In addition, some *Halimeda* studies show different results. Thus, Verbruggen (2005) reported the known distribution of *H. incrassata* (J. Ellis) J.V. Lamouroux in the Atlantic. But this species has also been reported in the Indo-pacific. So, I will study the diversity, distribution and variation of the genus *Halimeda* in Thailand. Specimens will be collected from every site where the Genus *Halimeda* is found in Thailand. Part of the thallus will be preserved in ethanol (95%) or formaldehyde (5%), and 14 morphological characters and 28 anatomical characters will be examined using the morphometric method of Verbruggen (2005).

Systematic treatment of the Sematophyllaceae (Musci) in Thailand

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A taxonomic study of the Sematophyllaceae in Thailand was carried out based on more than 2000 specimens. These specimens were on loan from the main herbaria in Thailand, Europe and America together with additional collections by the authors. Gross morphological studies were conducted of all organs of each specimen under the microscope. An artificial key, description, distribution, ecology, illustrations and photos of each species are provided. Enumeration of this moss family revealed 24 genera, 97 species, 5 varieties and 1 form. Three genera, *Pseudotrismegistia, Heterophyllium,* and *Pylaisiadelpha*, are new additions to the Flora of Thailand. Eleven species and 2 varieties are endemic to Thailand, i.e. *Acroporium convolutifolium* Dixon, *A. hamulatum* (M. Fleisch.) M. Fleisch. var. *procumbens* (M. Fleisch.) Dixon, *A. secundum* (Reinw. & Hornsch.) M. Fleisch. var. *siamense* Dixon, *Mastopoma subfiliferum* Horikawa & Ando, *Rhaphidostichum leptocarpoides* (Broth.) Broth., *Sematophyllum subrevolutum* Broth., *Taxithelium clastobryoides* Dixon, *T. epapillosum* Dixon, *T. inerme* P. Tixier, *Trichosteleum trachycystis* Broth. and *Wijkia filipendula* (Dixon) H. A. Crum. Eleven species reported as new to Thailand are *Acroporium johannis-winkleri* Broth., *A. rufum* (Reinw. & Hornsch.) M. Fleisch., *A. sigmatodontium* (Müll & Hal.) M. Fleisch., *Aptychella speciosa* (Mitt.) P. Tixier, *Brotherella erythrocaulis* (Mitt.) M. Fleisch., *Chionostomum baolocense* Tixier, *C. inicola* Tixier, *Hageniella assamica* Dixon, *Rhaphidostichum piliferum* (Broth.) Broth., *Taxithelium parvulum* (Broth. & Paris) Broth. and *Wijkia hornschuchii* (M. Fleisch.) H. A. Crum. The phytogeography of this family confirm the previous hypothesis that Thailand is a traditional region forming a bridge between the Malayan-Philippine and Sino-Himalayan floras.

Taxonomic revision of the fern *Microsorum punctatum* (L.) Copel. complex (Polypodiaceae)

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Microsorum punctatum (L.) Copel., a widespread species with great variation in many characters, has been proposed as a species complex and so is worth investigating. In order to investigate this doubtful taxon, more than 1,500 specimens deposited at BCU, BKF, BM, K, B, L and P were studied. Based on morphological and anatomical characters, the *M. punctatum* complex can be divided into 8 taxa. This corresponded well with the results of cluster analysis and canonical discriminant analysis performed on 707 herbarium specimens. Twenty three quantitative and 35 qualitative characters were employed. Cluster analysis revealed the separation of the taxa in the species complex into eight groups. The eight-cluster grouping is discussed. From a canonical discriminant analysis using the eight-cluster grouping as a priori groups, it was concluded that *M. siamense*, *M. thailandicum*, *M. membranaceum*, *M. glossophyllum* and *M. musifolium* are obviously distinct taxa, while specimens of *M. steerei* and *M. whiteheadii* mixed together and should be proposed as the same species. Likewise, the specimens of species previously recognized as the other 10 synonyms of *M. punctatum* are not distinct from *M. punctatum* and are treated here as members of *M. punctatum.* The six most important characters that separated the eight species are stipe length, number of sori row between the adjacent secondary vein, sori diameter, sori density, primary-areole width, and spore width. These quantitative characters, together with some qualitative characters, were useful in constructing an identification key to these species. According to RAPD data, two cultivar varieties can still be recognized. The results of phylogenic study agreed with morphological and morphometric studies that separated *M. glossophyllum* and *M. musifolium* from *M. punctatum*. *M. membranaceum* and *M. musifolium* formed the most basally positioned monophyletic clade of the complex. The larger clade was divided into four recognizable subclades.

A taxonomic revision of *Fissidens* Hedw. (Bryophyta: Fissidentaceae) in Thailand

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Thirty-eight species and 4 varieties of *Fissidens* Hedw. are known in Thailand. These include 2 new species (*F. kanyanii* K. Wong. & B.C. Tan and *F. bentanii* K. Wong. & Santa.) and 6 new records (*F. crispulus* Brid. var. *robinsonii* (Broth.) Z. Iwats. & Z.-H. Li, *F. flaccidus* C. Muell., *F. incognitus* Gangulee, *F. involutus* Wils. *ex* Mitt., *F. jungermanniodes* Griff., and *F. serratus* C. Muell.). Eight hundred and sixty four specimens were collected from 10 National Parks (Doi Inthanon, Doi Suthep-Pui, Pha Daeng, Phu Hin Rong Kla, Phu Phan, Pu-Toei, Khao Yai, Nam Tok Ngao, Khao Nan, amd Phanom Pencha) and Chiang Dao Wildlife Sanctuary. This study revealed new species and new records and new taxonomic and ecological information on Thai *Fissidens* will be added. More collecting in other areas in Thailand is needed to determine if more species are in the country.

Taxonomy of the Lejeuneaceae subfamily Ptychanthoideae (Bryophyta, Hepaticae) from nine National Parks in Thailand

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One hundred and forty specimens of leafy liverworts of the family Lejeuneaceae, subfamily Ptychanthoideae, were collected from nine National Parks in Thailand (Doi Suthep-Pui, Doi Inthanon, Pha Daeng, Phu Phan, Pha Taem, Mu Koh Chang, Nam Tok Ngao, Khao Phanom Bencha, and Khao Nan). Nine genera and eighteen species were found. Fifteen species were epiphytes, two species were either epiphytes or epiliths, and one was an epiphyllous species. *Mastigolejeunea* (5 spp.) and *Lopholejeunea* (4 spp.) were the most common genera. *Acrolejeunea fertilis* (Reinw. *et al.*) Schiffn. grows under a wide range of habitats, *i.e.* dry to moist habitats. It is also the most common and abundant species of Ptychanthoideae found in deciduous dipterocarp forest (500-1000 m).

The effects of shoot density on growth, recruitment and reproduction of *Enhalus acoroides* (L.f.) Royle at Had Chao Mai National Park, Trang Province, Thailand

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Enhalus acoroides (L.f.) Royle is one of the largest species of seagrass and is common in the Indo-Pacific tropics. In Had Chao Mai National Park, Trang, *E. acoroides* grows in dense meadows, in which plants might undergo intraspecific competition and self-shading. The aim of this study is to investigate the effects of density on growth, recruitment and reproduction. Experiments were carried out from August 2006 to July 2007 in a monospecific meadow of *E. acoroides* by placing ten permanent quadrats (0.25 m^2) in each of 4 densities designated as follows: 100% density (35 shoots/ quadrat), 50% density (18 shoots/ quadrat), 25% density (9 shoots/ quadrat) and 10% density (4 shoots/ quadrat). The densities were manipulated by cutting the shoots at the leaf bundle meristem. Leaf elongation rate, leaf surface area, shoot weight, number of new shoots and numbers of flowers and fruits were estimated by statistical sampling methods. In addition, the light intensity under canopies was measured. The analysis of results showed that there was no intraspecific competition between plants in the dense meadow as indicated by the slope of log mean ramet weight versus log density which does not follow the -3/2 power self-thinning rule of Yoda *et al*. (1963). However, leaf surface area, recruitment rate and total flower and fruit production at low densities were higher than at high densities. The results suggest that self-shading occurred and that light availability is an important factor in the regulation of growth, recruitment and reproduction.

Effect of seasonal variation on growth and sexual reproduction of *Thalassia hemprichii* (Ehrenb.) Aschers in Haad Chao Mai National Park, Trang Province, Thailand

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Thalassia hemprichii (Ehrenb.) Aschers is one of the dominant seagrass species found in mixed seagrass beds throughout SE Asia. This species is also dominant in Haad Chao Mai National Park, where it forms the largest seagrass bed in Thailand. In this study, not only the physical parameters (such as light intensity, temperature) and chemical parameters (such as nutrients in water and nutrients in sediment) will be measured, but also the biomass, and growth rates of leaves, flowers and fruit of *T. hemprichii* will be investigated. The effects of physical and chemical parameters on growth and sexual reproduction of *T. hemprichii* will be investigated. Seasonal variation of growth and sexual reproduction of *T. hemprichii* will be studied throughout the year. Field collection will be carried out monthly, and has already started since January 2008. It will be completed in January 2009. The study will reveal the seasonal variations in *T. hemprichii* growth and reproduction in Haad Chao Mai National Park.

Fishery resource value of seagrass beds utilized by the community of Libong Island, Trang Province

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Libong Island located in Trang Province has the biggest seagrass bed in Thailand; this bed is rich in species diversity. Due to the characteristics of seagrass beds as open access resources, non-exclusive use is allowed and this causes seagrass deterioration. To prevent this problem, government and non-government organizations have provided information about the functions and benefits of seagrass to local people in order to change people's attitudes and behaviors regarding the use of seagrass resources. However, it takes time for the people of a community to change their behavior. This study will use the Market Value Approach to estimate the fishery resource value of seagrass beds utilized by a community, and will focus on economic aquatic animals of Libong Island's seagrass bed. This value quantifies the monetary benefits of the seagrass bed that are obtained and broadly shared among local people and gives the reasons for the importance of awareness and conservation of seagrass biodiversity. This research continues to study seagrass bed utilization by people in Libong Island and the factors affecting the fishery resource value of the seagrass bed at Libong Island. Local government and NGOs should benefit from using this information for preparing guidelines to manage the seagrass bed efficiently and assure environmental sustainability.

Classification of bamboos (Poaceae; Bambusoideae) in Thailand inferred from a multi-gene region phylogenetic analysis

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Over 60 taxa representing all the bamboo subtribes *sensu* Clayton and Renvoize (1986) and Orhnberger (1999) and related non bambusoid grasses were sampled. A combined analysis of five plastid DNA regions, *trnL* intron, *trnL-F* intergenic spacer, *atpB-rbcL* intergeneric spacer, *rps16* intron, and *matK*, was used to study the phylogenetic relationships among the bamboos in general and the woody bamboos in particular. The BEP (Bambusoideae, Ehrhartoideae, Pooideae) clade was resolved and Pooideae was supported as a sister group to Bambusoideae s.s.. Traditional Bambuseae, the woody bamboos, were not monophyletic. Olyreae, the herbaceous bamboos, was a sister group to tropical Bambuseae. Temperate Bambuseae was a sister group to the group consisting of tropical Bambuseae and Olyreae. Melocanninae was a sister group to the remaining tropical Bambuseae. The traditional Bambuseae were re-defined and the use of the tribal name Arundinarieae was recommended to accommodate the temperate woody bamboos. Classification of the bamboos will be discussed in relation to the commonly used classification systems, and patterns of diversification will be interpreted within a biogeograpic context.

Rice genomics for understanding the evolutionary story of rice: From Asian wild rice (*Oryza rufipogon* Griff.) to Asian cultivated rice (*O. sativa* L.)

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One of the most fundamental questions regarding the evolution of Asian cultivated rice, *Oryza sativa* L. (spp. *indica* or *japonica*), is the geographic origin and the number of times domestication has occurred for this rice species. The wild progenitor, *O. rufipogon* Griff.,, has been identified using a combination of morphological, biochemical, and genetic studies. Coupled with the geographic ranges of the ancestral species and phylogenetic data, the origin of Asian cultivated rice is now being uncovered. These data suggest that Asian cultivated rice was domesticated at least twice from different *O. rufipogon* populations and that the products of these two independent domestication events are the two major rice subspecies (i.e., *indica* and *japonica*). Sequencing of the whole genome of rice has predictably resulted in a rapid surge in research on rice genetics and evolution. Cloning rice genes has concentrated on the most important domestication-related genes. There are four major genes that have been reported, i.e., the *Waxy* gene, *Rc* gene, shattering gene, and fragrance gene. This presentation is aimed to help us understand the history and origins of genetic mutations that have changed wild rice into cultivated rice.

The fragrance (*fgr*) gene in natural populations of wild rice (*Oryza rufipogon* Griff.)

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The Asian cultivated rice, *Oryza sativa* L. (spp. *indica* or *japonica*), is assumed to have originated from one or both of the two wild Asian species, *O. rufipogon* Griff. and *O. nivara* Sharma and Shastry. They occur throughout monsoonal Asia and west Oceania. Fragrance is the most important trait among the domesticated characters of basmati and jasmine rice of Asia. The gene for fragrance in scented rice, *fgr*, shows the presence of a mutated portion (i.e., an eight base pair deletion in exon 7) that results in the loss of its function. In the present study, 229 wild rice *O. rufipogon* accessions were genotyped for this locus using a PCR assay. The wild rice species contained the mutated allele of the *fgr* gene at a low frequency of 0.23. The surveyed populations were in Hardy–Weinberg equilibrium. This observation supports the hypothesis that the allele for fragrance was already present in the wild rice, and that this trait appeared in scented rice cultivars because of selection by farmers of genotypes possessing this character during the process of domestication.

Rice landrace diversity and community conservation in Northeastern Thailand

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Rice is one of the most important food grains in the world. Almost 3,000 million people particularly Asian people consume rice as the main staple food. Today, the diversity of rice varieties has declined and disappeared significantly because of the main system of monocultural and commercial agricultural production, which is supported mainly by government policy. This research aims to study local knowledge and local farmers in Northeastern Thailand in order to understand how they conserve their traditional rice varieties. This study uses agro-morphological traits, genetic diversity, and the geographical information system (GIS) to analyze substantial data collected from rice fields. This is to examine how the diversity of rice varieties could be possibly promoted in localities, in a type of *in-situ* conservation.

Molecular systematics of *Kaempferia* (Zingiberaceae) in Thailand

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Plants in the genus *Kaempferia* (Zingiberaceae), especially *K. parviflora* (Krachai Dum), are well-known as medicinal herbs. Some species are also useful as vegetables, ornamentals or incense. About 20 species are enumerated for Thailand. However, the morphological similarity among plants in the Zingiberaceae and morphological variations within species makes it difficult to distinguish plants. To date, 40 accessions of *Kaempferia*, representing 14 recognized, 5 new and 1 unidentified *Kaempferia* species in Thailand, have been examined by sequencing of *psbA-trnH* and *petA-psbJ* spacer regions. Six species of closely related taxa (*Gagnepainia godefroyi*, *Gagnepainia thoreliana*, *Smithatris supraneanae*, *Scaphochlamys biloba*, *Scaphochlamys minutiflora*, and *Stahlianthus* sp.) were also included. After multiple sequence alignments, sequences of 957 and 835 bp in length were obtained from *psbA-trnH* and partial *petA-psbJ*, respectively. Pairwise divergence of *psbA-trnH* ranged from 0.00-3.04% (*K. filifolia* and *K. rotunda*) while pairwise divergence of *petA-psbJ* ranged from 0.00-3.40% (*Kaempferia*.sp.2 and *S. biloba*). Based on both data sets, intraspecific sequence variation was not observed in 4 species, namely *K. candida*, *Kaempferia* sp.1 (Phor Suatam), *Kaempferia* sp.3 (Phor Saraburi), and *G. thoreliana* for which more than 1 specimen was available. In contrast, intraspecific sequence variations were observed among different populations of *K. elegans*, *K. pulchra*, *K. rotunda*, *K. marginata*, *K. larsenii*, *K. siamensis*, and *K. parviflora*.

Taxonomic revision of the family Stemonaceae in Thailand

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A taxonomic revision of the family Stemonaceae in Thailand was conducted by searching the literature, comparing herbarium specimens from several herbaria in Thailand and data gained from the Kew Herbarium. Additional field surveys and specimen collections were made thoughout the country. There are 10 species, which belong to 2 genera, *Stemona* Lour. comprised of 9 species,namely *Stemona aphylla* Craib, *S. burkillii* Prain, *S. cochinchinensis* Gagnep., *S. collinsiae* Craib, *S. curtisii* Hook.f., *S. kerrii* Craib, *S. phyllantha* Gagnep., *S. pierrei* Gagnep.and *S. tuberosa* Lour., and the genus *Stichoneuron* consisting of one species, *Stichoneuron caudatum* Ridl. Two species are endemic to Thailand, *i.e., Stemona aphylla* Craib and *S. collinsiae* Craib. *Stichoneuron caudatum* Ridl. is endemic to the Malay Peninsular. Two species, *i.e., Stemona cochinchinensis* Gagnep. and *S. pierrei* Gagnep., are new records for Thailand.

Taxonomy of *Goniothalamus* (Blume) Hook. f. & Thoms. (Annonaceae) in Thailand

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Twenty specimens of *Goniothalamus* in Thailand were collected, of which 16 species were identified and 4 were unidentified. Among these are 5 new records for Thailand, namely *G. elegans, G. cheliensis, G. repevensis, G. sawtehii* and *G. umbrosus.*

Many characters were taxonomically important, with variation evident in size, shape, colour and indumenta. The characters that were used taxonomically for Thai *Goniothalamus* taxa are the presence or absence of hairs on the surfaces of leaves, sepals, outer petals and inner petals. The whole dome shape needs to be considered as a unit for taxonomic analysis. Its morphology is diverse within the genus, with at least six distinct types. Another notable structure is the pistil, including stigma shape and indumentum. There were six types of stigmas. Moreover, ovule number is taxonomically important as well. The staminal connectives are very variable in shape, with truncate, convex, short apiculate, long apiculate and sharply apiculate forms. Elements of both Boerlage's and Bân's infrageneric classifications are reflected in Thai *Goniothalamus,* although many species could not be classified into the sectional level of Bân's classification. Thai *Goniothalamus* cannot be classified into sectional levels using Bân's classification because they have more diverse characters than those that Bân proposed.

However, if more samples from a wider distribution of the genus and tribe are available, it would be useful for further study. This preliminary study can be used for further research of *Goniothalamus*.

Distribution of *Uraria* Desv. (Leguminosae) in Thailand

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The genus *Uraria* Desv. (Leguminosae) in Thailand was preliminarily studied. Thirteen species are enumerated. *Uraria crinita* (L.) Desv. ex DC., *U. lagopodioides* (L.) Desv. ex DC., *U. picta* Desv., and *U. rufescens* (DC.) Schindl. are widespread; especially the first two species are the most common species. *U. acaulis* Schindl., *U. acuminata* Kurz, *U. campanulata* (Benth.) Gagnep., *U. cordifolia* Wall., *U. pierrei* Schindl. and *U. rotundata* Craib are found in many areas except in Southern Thailand. *U. lacei* Craib and *U. poilanei* Dy Phon are restricted to Northern Thailand and *U. cochinchinensis* Schindl. Is found only in Sakon Nakhon, Surin and Si Sa Ket provinces.

Taxonomy of Amaryllidaceae, Asparagaceae, Boraginaceae, Piperaceae, Polygonaceae and Eragrostideae (Poaceae) in Thailand and *Indigofera* L. (Leguminosae) and Myrtaceae in Laos PDR

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A taxonomic account of some plant groups in Thailand and Laos PDR is presented. Field collections have been conducted and herbarium specimens have been examined throughout the two countries. There were determined two genera and six species in Amaryllidaceae, one genus and six species in Asparagaceae, 10 genera and 35 species in Boraginaceae, three genera and 48 species in Piperaceae, seven genera and 33 species in Polygonaceae and 10 genera and 60 species in Eragrostideae (Poaceae) in Thailand. *Crinum thaianum* J. Schulze, *Ehretia winitii* Craib, *Tournefortia intonsa* Kerr and *Trichodesma calcareum* Craib are endemic to Thailand. Eight species of Piperaceae and one in Polygonaceae are expected to be new to science. Eighteen species of *Indigofera* and 10 genera and 33 species of Myrtaceae in Laos PDR are enumerated. *Indigofera aralensis* Gagnep. is newly recorded and five *Syzygium* are endemic species in Lao PDR.

Mussaenda species (Rubiaceae) in Thailand

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A taxonomic study of the genus *Mussaenda* in Thailand has been conducted. Herbarium specimens have been examined, accompanied by field work in Thailand. Twenty-three species have been recognized, three of which were introduced as ornamentals. Seven species are known to be endemic to Thailand. The enlarged creamy-white petaloid calyx lobes, bifid interpetiolar stipules and distyly are common characters for the genus. In the native species, only one calyx lobe was developed into a petaloid, while all five in the ornamentals were enlarged.

A preliminary study of phylogenetic relationships in Thai Vernonieae (Asteraceae)

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The large and widespread tribe Vernonieae (Compositae) is well represented in Thailand with numerous endemic species in several genera (i.e. *Iododcephalus*, *Camchaya*, *Koyamasia*, *Vernonia*). *Vernonia* is the largest of these genera with >30 species in Thailand. Relationships among these taxa are poorly understood, in large part due to the highly variable and overlapping nature of most morphological characters on which all past taxonomic treatments have been based. In this study we explore the phylogenetic relationships among a selection of Thai Vernonieae using sequences from chloroplast (*trn*LC-F, *ndh*F) and nuclear DNA (ITS). Preliminary data identified several strongly supported clades within *Vernonia*. Although no taxonomic recommendations have yet been made, the data provide additional evidence for the removal of a number of species from that genus, as suggested by Robinson (1999). Pollen morphology and growth habit changed over the phylogenetic tree suggesting that the annual habit and triporate pollen were derived characters.

The genus *Ficus* L. in the northeast of Thailand

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The taxonomy of the genus *Ficus* in the northeast of Thailand was studied between August 2005 and March 2008. Six subgenera and 47 species were enumerated. Keys to subgenera and species were constructed. Ecological and distributional data, vernacular names, photographs and line drawings are provided. The habits, leaves and syconia present a number of taxonomic characters useful for classifying the genus into subgenera and species. Leaf anatomy of 10 species was investigated. Some anatomical characters could be useful for the identification of *Ficus* species, *i.e.*, the position and number of cell layers of palisade, presence of an hypodermis, cuticle pattern, intercellular spaces of spongy cells and dermal tissue system of petioles. Pollen morphology of 12 species was examined by light microscopy. The pollen is generally very small to small (7.00–13.50 µm), isopolar, bilaterally symmetric with 2(–3) pores. The shape is mainly elliptic or oblong rarely globose or triangular in polar view. Pollen features do not provide good taxonomic evidence.

Genetic diversity and biology of *Sirindhornia* (Orchidaceae)

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Sirindhornia is a beautiful rare terrestrial orchid genus. It comprises three species: *S. pulchella* endemic to Doi Chiang Dao, Chiang Mai province; *S. mirabilis* endemic to Doi Hua Mot, Tak province; and *S. monophylla* distributed longitudinally from southern China (Yunnan) through eastern Myanmar and western Thailand. Doi Chiang Dao and Doi Hua Mot are, nowadays, becoming more well-known by tourists. The number of visitors has been increasing every year. Affected by tourism and some local impacts, e.g., deforestation, cattle feeding, and forest burning (for hunting, mushroom collecting etc.), all *Sirindhornia* are extremely disturbed and at risk of extinction. The only way to protect these rare orchids is to understand their natural histories in the wild.

The project proposed here aims to study mainly the biology and ecology of this small orchid genus from many different angles, e.g., distribution, flowering, fruiting, reproductive system, pollination, propagation, and relationships between the orchid and mycorrhizal fungi, which is important for seed germination. The project also includes studies of genetic diversity within each population using molecular methods. All results and information from this research will be analyzed and then used to propose a sustainable conservation strategy in the future.

A taxonomic study of Orchidaceae at Doi Phahom Pok, Doi Phahom Pok National Park, Chiang Mai Province

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A taxonomic study of Orchidaceae at Doi Phahom Pok, Doi Phahom Pok National Park, Chiang Mai Province, was carried out by surveying and collecting specimens from March 2006 to December 2007. The specimens were identified using taxonomic literature and described, supported by line drawing illustrations, photographs, vernacular names, and ecological data. Keys to the genera and species were constructed. There were 33 genera and 85 species of orchids recorded in this study of which *Dendrobium* Sw., *Bulbophyllum* Thouars and *Eria* Lindl. are among the most common orchid species represented by 12, 11 and 8 species, respectively. *Ornithochilus yingjiangensis* Z.H.Tsi is a newly recorded species for Thailand. *Bulbophyllum propinquum* Kraenzl., *B. shweliense* W. W. Sm., *Dendrobium dantaniense* Guill., *Porpax lanii* Seidenf., and *Platanthera angustilabris* Seidenf. are endemic species. In addition, 13 species, namely *Bulbophyllum forrestii* Seidenf., *B. khasyanum* Griff., *Cymbidium lowianum* Rchb.f., *C. mastersii* Griff. ex Lindl., *Dendrobium chrysanthum* Lindl., *D. devonianum* Paxton, *D. falconeri* Hook., *D. strongylanthum* Rchb.f., *Liparis regnieri* Finet, *L. resupinata* Ridl., *Monomeria barbata* Lindl., *Platanthera angustilabris* Seidenf. and *Robiquetia pachyphylla* (Rchb.f.) Garay, are threatened orchids.

In Vitro propagation and protocorm cryopreservation of *Phalaenopsis cornu- cervi* (Breda) Blume & Rchb. f.

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The effect of thidiazuron (TDZ) and benzyladenine (BA) on PLBs induction from leaf explants was investigated. It was found that TDZ was superior to BA. The highest number of PLBs per leaf explant was found to be the optimum on ½ MS medium supplemented with 9 µM TDZ with significant differences from other media. The regenerated plantlets were potted in sphagnum moss or brick and acclimatized in the greenhouse. These plants grew well and developed into normal plants after 1 month of transplantation. A 100% survival rate of plantlets was achieved when they were planted on brick. Two-month-old protocorms at the GI 4 stage were cryopreserved in liquid nitrogen by a vitrification method. The protocorms were precultured in MS liquid medium containing 0.5M sucrose for 2 days then loaded in 2M glycerol plus 0.4M sucrose for 20 min. Protocorms were then exposed to PVS2 solution at 25 ± 1°C for 60 min and stored in a liquid nitrogen tank for 1 day. After being recovered from the liquid nitrogen tank and rapidly plunged into a water bath at 45°C for 1 min, the PVS2 solution was replaced by MS liquid medium containing 0.5 ml of 1.2M sucrose for 20 min. The percentage of protocorm survival was 31 ± 1% as measured by Evan's blue. No protocorms survived without vitrification treatments. In addition, protocorm viability showed no differences when stored in liquid nitrogen for 1 hour, 1 day, 1 week, 1 month, 3 months or 5 months.

Diversity of vascular plants on cliffs and rocky ridges of Sankalakhiri range in Betong district, Yala province

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A study on the diversity of vascular plants on the cliffs and rocky ridges of Sankalakhiri range in Betong district, Yala province, was conducted from October 2005 to June 2008. A total of 128 plants species were collected. Of these, 37 species were pteridophytes, three species were gymnosperms and 88 species were flowering plants. The family Orchidaceae was the largest group of plants in the study area and included 28 species. Most plants were facultative epiphytes and had typical xeromorphic features. In addition, there were 13 newly recorded plant species for Thailand, i.e., *Syngramma minima* Holttum, *Willughbeia tenuiflora* Dyer ex. Hook.f., *Hoya imperialis* Lindl., *Elaeocarpus pedunculatus* Wall. ex Mast., *Didymocarpus citrinus* Ridl., *D. cordatus* A. DC. var. *cordatus*, *Henckelia bombycina* (Ridl.) A. Weber, *Paraboea elegans* (Ridl.) B.L. Burtt, *Pachycentria glauca* Triana subsp. *maingayi* (C.B. Clarke) Clausing, *P. hanseniana* Clausing, *Coelogyne prasina* Ridl., *C. testacea* Lindl. and *Geostachys penangensis* Ridl. Plant community types are also briefly discussed. Descriptions and status of each plant species (common, uncommon, rare or endemic) in the study area together with ecological data, localities and distribution ranges of each species are presented as well as photographs and keys to genera and species. Voucher specimens are deposited at the Prince of Songkla University Herbarium (PSU), Department of Biology, Faculty of Science, Prince of Songkla University and the Forest Herbarium (BKF), National Park, Wildlife and Plant Conservation Department, Ministry of Natural Resources and Environment.

The diversity of vascular plants along Bangwan and Tamnang streams in Kuraburi district, Phang-nga province

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A study of the vascular plant diversity along Bangwan and Tamnang streams at Kuraburi, Phangnga province, was undertaken from January 2006 to December 2007. A total of 61 families, 120 genera, and 156 species were collected. The numbers of species of monocotyledons, dicotyledons, and pteridophytes were 51, 92, and 13, respectively. The most common family was the Cyperaceae with 15 species being recorded, followed by the Rubiaceae and Zingiberaceae with 14 and 11 species, respectively. Plant community types along streams are discussed and descriptions, the status of each plant species (common, uncommon, rare or endemic) in the study area together with ecological data, localities and distribution ranges of each species are given. Voucher specimens are deposited at the Prince of Songkla University Herbarium (PSU), Department of Biology, Faculty of Science, Prince of Songkla University and the Forest Herbarium (BKF), National Park, Wildlife and Plant Conservation Department, Ministry of Natural Resources and Environment.

Field surveys of natural populations of *Begonia* in Thailand

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Field surveys of natural populations of the genus *Begonia* (Begoniaceae) were conducted in all parts of Thailand from June 2007 - May 2008. The 30 species recognized so far were collected from various habitats on various substrata, i.e., terrestrial, epiphytic and lithophytic. In all cases, natural populations of *Begonia* occurred only near streams or waterfalls or in humid places such as on moist bark or rocks, from low elevations at about sea level in the eastern part and the peninsula to the summits of mountains over 2,000 m in northern Thailand. All species found were either annual or perennial herbs that appeared in the rainy season. Concerning taxon abundance and distribution, three groups of *Begonia* could be determined, i.e., northern taxa, central taxa and peninsular taxa. Only one species was found all over the country, i.e., *Begonia integrifolia* Dalzell, and another two taxa occurred in two floristic regions (south-eastern and peninsular), i.e., *Begonia sinuata* Wall. ex Meisn. var. *sinuata* and *B. variabilis* Ridl. Otherwise, each taxon was recorded from only one floristic region of Thailand.

Meliaceae of Thailand

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A revision of the family Meliaceae of Thailand, with financial support from the Biodiversity Research and Training Program (BRT), has been conducted for 2 years (2007-2008) of this 3-year project. Our main work is based on botanical collection in the field and study of specimens in herbaria (both Thai and foreign) in order to verify each plant species. So far, 15 genera have been revised primarily from a total of 18 genera. They are *Aglaia*, *Aphanamixis*, *Azadirachta*, *Chisocheton*, *Chukrasia*, *Cipadessa*, *Heynea*, *Lansium*, *Melia*, *Munronia*, *Pseudoclausena*, *Toona*, *Turraea*, *Walsura* and *Xylocarpus*. One important genus from the north, *Pseudoclausena* is considered to be a new genus record for Thailand. The revision of the Meliaceae of Thailand will be completed within 2009 as planned.

Species diversity of vascular plants on limestone in Southeastern Thailand

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A study of vascular plant diversity on limestone in southeastern Thailand was undertaken for 2 years from May 2006 to April 2008. The study sites were located at Khao Chakan, Khao Lueam, Khao Ta Ngok, Khao Wong, Khao Cha-ang Ngonngaen, Khao Cha-ang On and Khao Yai. So far, 1,162 species, 652 genera and 153 families have been determined. The most common families were Euphorbiaceae, Leguminosae and Orchidaceae. Among them, 93 species are restricted to limestone. Two hundred and fifteen species were classified as threatened. At least 6 species may be new to science.

Plant species first discovered in Thailand

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Thailand is situated in the tropical monsoon zone and plant genetic diversity is one of the highest in the world. Many new species have been discovered in Thailand, and this book presents details and photos of some of these new species. There are 7 species named after Thai royalty, namely *Afgekia mahidoliae, Bauhinia sirindhorniae, Magnolia sirindhorniae, Mitrephora sirikitiae, Sirindhornia mirabilis, Sirindhornia pulchella* and *Wrightia sirikitiae*. There are 75 species named in honour of Thailand, such as *Acalypha siamensis, Alyxia thailandica, Artabotrys siamensis, Boesenbergia siamensis, Calamus siamensis, Crinum thaianum, Cycas siamensis, Dasoclema siamensis, Gardenia thailandica, Jasminum siamense, Magnolia siamensis, Magnolia thailandica, Mammea siamensis, Sindora siamensis* and *Vanilla siamensis*. Another 28 species take their name from the localities where they were discovered (provinces, districts, villages, mountains, rivers), such as *Amorphophallus saraburiensis, Gardenia sootepensis, Hydrocotyl chiangdaoensis, Iguanura thalangensis, Impatiens phuluangensis* and *Xyris kradungensis.* There are 57 plants named after their discoverer or someone the author wanted to acknowledge, such as *Adiantum thongthamii, Aglaonema chermsiriwattaniae, Argostemma thaithongiae, Artabotrys vanprukii, Bauhinia winitii, Begonia puttii, Boesenbergia baimaii, Bulbophyllum smithinandii, Gardenia collinsiae, Hoya kerrii, Magnolia garrettii* and *Magnolia rajaniana.* Finally, 37 plants take their name from characters they have, such as *Aristolochia grandis, Artabotrys spinosus, Bauhinia aureifolia, Cyathostemma longipes, Eriocaulon minimum, Jasminum calcicola, Magnolia citrata, Polyalthia viridis* and *Trachycarpus oreophilus.* Many of these new species are endemic or rare and endangered, and steps need to be taken to ensure their conservation for future Thai generations.

Conservation, development and utilization of *Gluta* (Anacardiaceae) in Thailand

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This 2-year project on the conservation, development and utilization of *Gluta* plants began in October 2007, and is studying 11 native species in Thailand. *Gluta* is found in every region in Thailand, in dry dipterocarp forest, dry evergreen forest and in scrub. The fertility of sandy soils and sandstone bed rock areas was very low, relative humidity was very low to medium and the altitude of habitats was 50-400 m. The dominant characters for identifying *Gluta* species are from flowers and fruits. *Gluta ustitata* (Wall.) Ding Hou is the most economically valuable species because of the value of its latex. At full bloom with creamy white flowers in November, it stands out in dry dipterocarp forest in Tak, Lampang, Lamphun, Chiang Mai, Udon Thani, Nakhon Ratchasima and Kanchanaburi provinces. Fruits ripen in February, with 5 large reddish wings that produce a twisting fall similar to that of the fruits of *Dipterocarpus alatus* Roxb.ex G.Don. Seed germination in natural habitats is very low because of the lack of rain, low humidity and fire in summer. Seed germination experiments with various treatments produced more than 50% germination. Seedling cultivation will be done and appropriate techniques developed for farmers.

Development of fragrant flower plants for decoration and essential oil production

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This is the third year of study of the use of fragrant flower species for aromatherapy purposes. The methodology is based on simple techniques and self sufficiency for rural areas. A proposed prototype aims to cultivate fragrant flower plants for massage rooms, herbal incubator rooms, rest areas, fitness parks and toilet zones in petrol stations. The main considerations were flowering period, time of anthesis, number of flowers and aromatic concentration. A poll of 100 people found *Jasminum sabac* to be the most popular mild fragrant flower species, followed by *Tarenna stellulata, Magnolia X alba, Magnolia champaca, Friesodielsis desmoides, Artabotrys hexapetalus, Ixora finlaysoniana, Rosa damascena, Parameria barbata, Oxyceros horridus, Alyxia reinwardtii, Marsdenia floribunda* and *Vallaris glabra*. Of the strong fragrant flower species very suitable for toilet zones in petrol stations, *Wrightia religiosa* was the most favoured, followed by *Murraya paniculata, Polianthes tuberosa, Cestrum diurnum, Gardenia augusta, Crinum asiaticum, Buddleja paniculata,* and *Plumeria obtusa*. Cultivation techniques and maintenance are very important for management over a long period. Cutting, pruning and re-planting at suitable times made them more attractive.

Taxonomy of spiny eels (Synbranchiformes: Mastacembelidae) in Thailand

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The present taxonomic study is an updated revision of spiny eels (Synbranchiformes: Mastacembelidae) found in Thailand. It is based on specimens deposited in local reference collections and new specimens collected throughout Thailand from June 2006 to September 2007. It represents an attempt to alleviate difficulties with species identification of individual specimens by providing a treatment of the nomenclature and taxonomy of all available local members. Two genera and twelve species, *Macrognathus aculeatus*, *M. circumcinctus*, *M. maculatus*, *M. meklongensis*, *M. semiocellatus*, *M. siamensis*, *M. zebrinus*, *Mastacembelus alboguttatus*, *M. armatus*, *M. erythrotaenia*, *M. favus* and *M. tinwini*, were recognized. All of them are freshwater fish. However, *M. erythrotaenia* can be found in both fresh and brackish waters. From this study, *M. tinwini* is a newly recorded species.

Species identification within the family Mastacembelidae is based largely on configurations and the presence or absence of colour markings on the body and the different numbers of spines, fin rays and vertebrae. Dichotomous keys to genera and to species are provided. Information about scientific names, synonyms and citations, common names, local names, examined materials, diagnoses, descriptions, distributions, habitats, frequency distributions of spines, fins and vertebrae and photographs are available. Morphometric and meristic dendograms using Hierarchical cluster analysis were constructed.

Demography of an invasive alien sailfin molly, *Poecilia velifera* (Regan, 1914) (Cyprinodontiformes: Poeciliidae), in Thale Sap Songkhla and Haad-kaew Lagoon, south Thailand

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Established populations of the sailfin molly, *Poecilia velifera* (Regan, 1914), have been recorded for the first time in Thale Sap Songkhla sub-basin (the outermost part of Thale Sap Songkhla) and Haad-kaew Lagoon, south Thailand. From a coast survey along the coast, we know that they are currently established along the entire coastline of Thale Sap Songkhla sub-basin and Haad-kaew Lagoon (adjacent to the mouth of Thale Sap Songkhla). Biological data shows that their male : female ratio is 1.0:1.8. First maturation occurs at 16.8 mm SL in males, and 17.1 mm SL in females, whereas their maximum standard length is 69.8 mm. They can reproduce several times a year with 3-252 offspring each female. Their preferred habitat is vegetated coastal areas and they tend to spread rapidly throughout the region and probably have an adverse impact on many indigenous species as a result of predation and competition for food and space. On the other hand, populations of *P. velifera* may provide a food source for predatory fishes in their environment.

The ecology of fish communities in rivers in eastern Thailand: Co-existence strategies

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Diversity of freshwater fishes in Thailand is among the highest in the world but information on their abundances and co-existence strategies in rivers is almost non-existent. Concern for conservation of biological diversity requires the development of practical tools for quantitatively sampling small and medium-sized rivers to determine numbers of species and their spatial distribution which is a project currently under study in south eastern and central Thailand using multipass electrofishing techniques. Research has also been initiated to examine strategies employed among species for co-existence including feeding dynamics, morphology and reproduction. Our studies on reproduction strategies include fecundity, oocyte growth rate and gonadosomatic indices. Studies on feeding dynamics are currently focusing on feeding periodicity among fishes as well as precise descriptions of diets and potential food resources including macrobenthos, periphyton and stream drift. Feeding periodicity is important as we have clearly demonstrated distinct species-specific patterns. For example, *Shistura* sp. and *Amblyceps foratum* feed most actively in early morning while *Balitora* sp. and *Channa guacha* are nocturnal feeders. Finally we are investigating ways employed by fishes that allow them to live where they are found. Information has been collected on specific gravity or density, body and fin shapes, sizes and locations to understand how their morphologies define specific hydrodynamic characteristics. This information, along with other morphological adaptations and selected physical and biological characteristics of their habitat will be synthesized to provide some understanding of why they live where they are found.

2008 year of the frog

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At present, global amphibian decline is regarded as one of the critical threats to biodiversity around the world. Several potential causes have been linked to this problem including deforestation, acid precipitation, fungal infestation, and pollution. To understand this problem, Amphibian Ark, a branch of the IUCN Amphibian Specialist Group, has created a campaign "2008 Year of the Frog" to generate public awareness and understanding of the amphibian extinction crisis. Some of the specific aims of this project include: 1) to create partnerships among Zoos, Aquaria, Botanical Gardens, and private and public institutions (universities, etc) around the world to ensure the global survival of amphibians; 2) to highlight ways in which the public can make positive contributions to conservation through activities in their daily lives; 3) to stimulate a sustained and long-term interest in amphibian conservation and related interactions within the wider environment; and 4) to raise increased awareness of the protection of biodiversity through the conservation of amphibians.

Cloning antimicrobial peptide genes from *Rana nigrovittata*

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Frog genes encoding for antimicrobial peptides were cloned and their sequences were analyzed. Mucous from the skin of *Rana nigrovittata* was obtained using mild electrical shock. The secretion contains mRNA which was used as template for reverse transcription reactions (RT-PCR). To analyze the sequence of cDNA, the cDNA was cloned into either pCR4 or pCR8 plasmids using a TOPO cloning method. Next, the ligated products were transformed into TOP10 *E. coli* cells. The bacteria were then grown overnight and plasmids were extracted. Sequencing reactions were done using universal primers. After that the sequences were analyzed, conceptually translated into amino acid sequences and classified into groups based on sequence similarity. According to the classification, they were divided into eight groups. Six groups of peptides have the typical properties of antimicrobial peptides found in other *Rana* frogs, that is, positive net charge, and two Cysteines which were separated from each other by about seven amino acids. The peptides in the other two groups have negative net charge and their sizes were too small. Therefore, these two groups may not be antimicrobial peptides. Finally, the peptide sequences were used for alignment against known peptide sequences in a public database using BLAST. All of the BLAST results showed % similarities between 30-70%.

The genetic diversity of rice field frogs *Hoplobatrachus rugulosus* (Wiegmann, 1835) inferred from cytochrome *b* gene sequences

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The Rice Field Frog (*Hoplobatrachus rugulosus*) is an economically important species in Thailand. It belongs to the family Ranidae, genus *Hoplobatrachus*, and can be found from East Asia and throughout the Thai-Malay peninsula. Recently, populations of this frog in its natural habitat have been decreasing. The main reasons are habitat destruction, pollution, pesticide use, climate change and hunting. In a study of genetic diversity, we sampled rice field frogs from 4 regions (10 populations) in Thailand and extracted DNA from the liver or toe clips of each species. A segment of the mitochondrial cytochrome *b* (Cyt-*b*) gene was amplified and the nucleotide sequences of this gene were analyzed. Comparisons of sequence divergence of the Cyt-*b* gene among populations suggested that the populations form two major clades within this species, divergent from each other by high values of 12.94-14.54%. The first clade included populations from the Northeastern montane region, Southeastern Asian lowlands and the Tenasserim-Malay peninsula in Thailand, and the other clade included a population from the Thai-Lao dry plateau and some populations from the Southeast Asian lowlands in Thailand. The highest value of sequence divergence occurred between Chonburi and Nakhon Ratchasima populations (14.54%).

Effects of atrazine on the early development and gonad development of the rice field frog, *Hoplobatrachus rugulosus* (Wiegmann, 1835)

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Amphibians have declined dramatically around the world. Agrochemical contamination is considered one of the disastrous causes of amphibian declines. A triazine-herbicide, "atrazine", is the most commonly used herbicide in Thailand and probably in the world. Atrazine has been found to be an endocrine disruptor pollutant capable of feminizing male amphibians. However, there is no report on the effects of atrazine at environmentally relevant concentrations on amphibians in Thailand. The aim of this study is to determine the effects of atrazine on the development of the rice field frog, *Hoplobatrachus rugulosus* (Weigman, 1835), a common frog species in Thailand. To study the effects of atrazine on embryonic and early larval development, a modified FETAX procedure (ASTM E 1439-98, 2004) was used. Nominal concentrations of atrazine used were: 0.01, 0.1, 1, 10, 100 and 1000 ppb. The aim of the other experiment was to study the effect of atrazine on gonad development. The embryos of *H. rugulosus* were treated with the nominal concentration of atrazine until the end of metamorphosis. The gonads of froglets will be investigated morphologically and histologically. The expected results can be used to explain the effects of atrazine on embryonic and gonadal development of the rice field frog, from which its role in the amphibian decline situation can be inferred.

Vertical distribution and diets of median-striped bullfrogs *Kaloula mediolineata* (SMITH, 1917) in Sam Ngao District, Tak Province

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The vertical distribution and diet composition of the median-striped bullfrog, *Kaloula mediolineata* (Smith, 1917), were studied in Sam Ngao District, Tak Province, Thailand, from July 2006 to June 2007. The results showed that the average depth of frog burrows in dry months (December 2006 to March 2007, average rainfall = 56.60 mm, N = 75) was significantly deeper than in wet months (July to November, 2005, April to June, 2006, average rainfall = 31.59 mm, N = 140). Significant negative correlations were observed when vertical distribution was compared with the following physical factors: soil surface moisture (R = -0.298; p = 0.000), relative humidity (R = -0.249; p = 0.000) and air temperature (R = -0213; p = 0.002).

Moreover, diet composition was analyzed. The results showed that only empty stomachs were observed during the dry months, whereas during the wet months, empty stomachs were observed in 42.9% of specimens. The main food items were ants (Order Hymenoptera, Family Formicidae), termites (Order Isoptera) and beetles (Order Coleoptera). The stomach contents were similar in both female and male frogs (Simple Similarity Index between 0.91-0.99). Furthermore, a relationship between diet and prey availability was observed (tau = 0.469, p = 0.046). In conclusion, the results suggest that the median-striped bullfrog is a generalist predator which is active in wet months, and ants, termites and beetles are the main food-sources of this frog.

Phylogenetic relationships among Thai newts assessed using mitochondrial DNA sequences

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The genetic variation of the Himalayan newt (*Tylototriton verrucosus*) in Thailand was examined through field surveys, which were carried out at 14 locations in 7 provinces of Thailand, from December 2001 to September 2006. It was observed that, in Thailand, this species could be divided into two morphotypes based upon body coloration (orange to yellow and dull colorations), and female size (the orange to yellow type was noticeably bigger than the dull type). The two morphotypes, as described, also coincided with their current distribution ranges (northern and northeastern mountain ranges). The current local distributions within Thailand of both of the two types of *T. verrucosus* were determined, with new localities discovered, and are reported.

Among 7 populations, the genetic variation among 21 individuals was examined using DNA sequence analysis of two mitochondrial DNA gene fragments: 16S ribosomal RNA (498-500 base pairs) and D-loop (729-730 base pairs). Phylogenetic relationships were established using distance and maximum likelihood methods. The clear findings revealed the existence of two distinct genetic lineages, which are related to their geographic distributions and color patterns. These data showed that there are two morphotypes of *T. verrucosus* in Thailand based on distribution patterns and molecular characters.

Recent occurrence of the endangered big-headed turtle *Platysternon megacephalum* Gray, 1831 in Thailand

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The big–headed turtle, *Platysternon megacephalum,* is a species of concern to conservationists. It is listed as endangered in the IUCN Red List of Threatened Species, 2007, and is given in Appendix II of CITES. In addition, it is a protected species under the Preservation and Protection of Wild Animals Act (No. 2), B.E. 2546. Areas where this species has been reported are in Chiang Mai, Mae Hong Son, Phrae, Tak, Kanchanaburi, Loei, Phetchabun and Chaiyaphum Provinces (Nabhitabhata and Chan-ard, 2005). The purpose of this study is to explore the present distribution of this turtle in Thailand, and to provide data required for its conservation. The data were collected by mailing questionnaires to authorities and field surveys were conducted in the areas that had positive information. In addition, literature and museum records of this species in Thailand were compiled.

Preliminary results suggest that these turtles are widely distributed in northern, northeastern, central and western Thailand. Protected areas in Chiang Rai, Nan, Prayao, Uttaradit, Phitsanulok and Sukhothai Provinces are new localities for the big-headed turtle found in this study.

Appraisal of the evolution of testudinoid turtle diversity from the Late Palaeogene and Neogene of Thailand

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The evolution of testudinoid turtles of Thailand was assessed using both fossil records and recent turtle data. Two localities were selected for studying fossil turtles, Nong Ya Plong (Oligocene), Petchaburi Province, and Tha Chang Sandpits (Neogene), Nakhon Ratchasima Province. The turtles from the first locality were described and the specimens are considered to be a new species of *Mauremys* and a new genus closely related to *Malayemys*. The turtle from the second locality is reminiscent of a giant testudinid turtle. Turtles living before the late Neogene have not been found in this study.

The geographical distribution of the superfamily Testudinoidea was studied using clustering methods for separating five biogeographical provinces (Sino-Indian Province, Taiwanese/Eastern Chinese Province, Philippines Province, Indochinese Province, and Indonesian Province) based on the similarity of taxa. These provinces were then integrated with a published phylogeny in order to study endemic and migration patterns. The results showed that the *Heosemys* group is an endemic taxon to the Indochinese Province. In addition, the turtles in Thailand are more related to the Indonesian Province than to turtles in India and China. However, evidence of fossil *Heosemys* has not been found before the Pliocene or Pleistocene. It means that the biogeographical identity of living turtles in Southeast Asia began recently.

Species diversity of amphibians at different elevations in Num San Noi Stream at Phuluang Wildlife Sanctuary

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Species composition and abundance of frogs at Nam San Noi stream, Phu Luang Wildlife Sanctuary, northeastern Thailand were determined at three elevations, 800, 950, and 1250 m, by visual encounter surveys during May 2006 to May 2007. Three 100 m-stream transects at each elevation were surveyed each month during 19:00-21:00 hrs. A total of 22 species was found. The species diversity of frogs at 800 m (n=17, Shannon-Wiener's index=1.54) was highest, followed by 950 m (n=15, Shannon-Wiener's index=1.38), and 1250 m (n=10, Shannon-Wiener's index=0.71). The average abundances of all stream-dwelling frogs, except for *Limnonectes gyldenstolpei*, showed significant differences across elevations. Compared with other species, *Limnonectes kuhlii* had the highest abundance at 1250 m, whereas *Sylvirana nigrovittata* was the most common at both 950 m and 800 m. *Xenophrys major* was found only at one elevation, 950 m. It was concluded that the diversity and abundances of frogs in Nam San Noi stream are largely determined by elevation.

Reproductive cycle of the rainbow water snake, *Enhydris enhydris*, in Prachinburi Province, Thailand

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From March 2006 to April 2007, two hundred and thirteen *Enhydris enhydris* females at Ban Borthong, Kabinburi District, Prachinburi Province were collected for reproductive cycle examination. Thirty-nine gravid females, at carrying stages 30-37, were found during the nine month period from February to October, of which the number of gravid females was highest in August. Mean snout to vent length of gravid females was 560.65 ± 6.53 mm. Mean clutch size was 13.12 ± 5.41 embryos, ranging from 1 to 27. The full-term stage of embryos, stage 37, was found in May, June and October. The complete reproductive cycle of the rainbow water snake is demonstrated.

Genetic diversity of the Thai roundleaf bat (*Hipposideros halophyllus*)

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The Thai roundleaf bat (*Hipposideros halophyllus*), a mammal endemic to Thailand, has been categorized in the low risk subcategory: Near Threatened (LR/nt) on the IUCN Red List. There are currently three free living populations of the roundleaf bat in Thailand which are at least 130 km apart from each other and this may prevent gene flow between these populations. This study aimed to evaluate the genetic diversity of the Thai roundleaf bat using microsatellite markers that were developed from different bat species. A total of 41 microsatellite primer pairs were developed and 8 primer pairs showed polymorphic patterns within the samples. The results showed that the bats from Ta-Pa and Fa-Tho Caves had the closest genetic relationship. This may be due to the two caves being located in close proximity and as such the bats are likely to have an opportunity to exchange individuals between populations. In contrast, the bat population of Tai-Din Cave was genetically divergent from the bat populations of the other caves, and this may be due to the geographical distance. Interestingly, the bats from Tai-Din Cave had lower heterozygosity than that found in the other populations suggesting that the smaller size of the bat population at Tai-Din Cave results in inbreeding of the species. Due to the crisis of a sharp decline in the numbers of the Thai Roundleaf bat, our data will be useful for establishing an effective conservation plan for this species.

A review of bat research in Thailand with eight new species records for the country

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A review of the literature relating to the history of bat research in Thailand (1821–2006) is included together with lists of the 119 bat species currently recorded from the country and the 16 that are omitted for lack of supporting data. The geographical distribution within Thailand of some of the more significant bat field studies (1896–2004) is mapped and briefly discussed. Based on field work conducted in peninsular Thailand in 1993 and 2003–2004, eight bat species (*Hipposideros ridleyi*, *Myotis hermani*, *Pipistrellus stenopterus*, *Hesperoptenus tomesi*, *Murina suilla*, *Murina aenea*, *Kerivoula pellucida*, and *Mops mops*) were recorded from the country for the first time; information is provided on their taxonomy, distribution, and ecology. Recommendations are made for further bat studies in Thailand, with emphasis placed on selecting less well known species groups, such as forest bats, in under-researched habitats in neglected geographical areas (for example, the deciduous dipterocarp forests of eastern Thailand and the semi-evergreen forests of peninsular Thailand). A need to develop in-country skills in bat acoustics and taxonomy is also highlighted.

A taxonomic review of *Rhinolophus pusillus* and *Rhinolophus lepidus* (Chiroptera: Rhinolophidae) in Thailand

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Rhinolophus pusillus and *R. lepidus* are horseshoe bats which have essentially similar external morphology and cranio-dental measurements. Previous taxonomic studies suggest that their taxonomy is confused as there are number of synonyms and a smaller number of subspecies. In the past taxonomic studies of the two species have been of the classical kind with a qualitative and quantitative review of external and cranio-dental morphology. Today, morphometric analysis techniques are more sophisticated and better able to discriminate between taxa. Species identification can also be supported with recordings and analysis of echolocation calls and it has been shown elsewhere that the calls of many bat species are a useful aid to identification at genus and species levels. Current information suggests that the constant frequency of the echolocation call for *Rhinolophus lepidus* is 95-105 kHz in Thailand and 100 kHz in Malaysia. The frequency for *Rhinolophus pusillus* is 105-110 kHz. From recent studies, there is a third taxon that is morphologically similar to *R. lepidus* and *R. pusillus* but larger and with a lower frequency of about 85.2-91.6 kHz. It is known from Pho Soun Sai National Park, Loei province, in Northeast Thailand. There is also another taxon which is smaller than *R. pusillus* with a higher frequency of about 126.3 kHz, known from Khao Samohkhon, Lopburi province, in Central Thailand. From the current study, it is shown that the *R. pusillus* taxon comprises a species complex and that there are more than two taxa of this group in Thailand.

Asian origin of anthropoid primates and the evolution of Miocene apes

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New paleontological results have firmly established Asia as the ancestral homeland for the anthropoids. Asian anthropoids are not only the oldest recorded but also the most primitive known. During the Early to Middle Eocene, the Eosimidae, *Eosimias* from China (45 Ma) and *Bahinia* from Myanmar (37 Ma), are recognized as the earliest undoubted Anthropoidea. During the late Eocene, the Amphipithecidae, *Myanmarpithecus* and *Pondaungia* from Myanmar (37 Ma) and *Siamopithecus* from Thailand (35 Ma) radiated. This group which is widely distributed from Pakistan to Thailand, has developed the same characters as those of crown anthropoids, such as a short face, massive jaw, low crowned molar with flat occlusal surface, orbit frontation, a.s.o. This morphological evolution is interpreted as the result of an adaptation to a strongly seasonal climate and to a hard-food dominated diet. The evolutionary scenarios relative to early anthropoid evolution imply therefore one or several dispersal events between Southeast Asia and Africa.

Thai Miocene hominoids, *Khoratpithecus chiangmuanensis* from northern (13.5-10 Ma) and *Khoratpithecus piriyai* from northeastern Thailand (9-7 Ma), share one unique derived character with orang-utans and are therefore considered as their closest fossil relatives. Both Thai fossils evolved in a humid tropical forest. Climatic fluctuations recorded from the marine realm suggest that these hominoids did not migrate “Out of Africa” around 12.5 Ma, as commonly stated, but were already present in Southeast Asia and extended their distribution area further north during the warm climatic events. In conclusion, an “Out of Asia” scenario for early anthropoids and for African late Miocene hominid primates is more strongly established than the classical “Out of Africa” scenario. This emphasizes the importance of climatic changes and of paleogeographic constraints on their evolution.

Conflict and commensalisms between long-tailed macaques and humans

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Long-tailed macaques (*Macaca fascicularis*) are the most frequently encountered primate in Thailand. They are currently considered at low risk of extinction on the IUCN Red List 2007, However, they are threatened by genetic pollution (hybrids and translocation), and by habitat fragmentation, loss and transformation. Their habitats have been greatly changed from natural forests to recreation parks or Buddhist temples. Living in temples, besides provisioning by monks and pilgrims, monkeys are safe without fear of hunters or predators. Thus, the populations of long-tailed macaques are currently in a state of over-population in many locations. There are always pros and cons regarding the maintenance of macaque populations in Thailand, and people fall into one of two groups. The group with a positive attitude, such as banana venders, hotel owners and shop keepers, mostly benefit from monkeys. They have established a foundation for monkey food and they feed the macaques. The group with a negative attitude, such as people living near the sites, are disturbed by the monkeys. The monkeys raid their houses for food or damage their crops during the dry season when natural foods are scarce. Up to now, there have been no concrete management plans to overcome the problems of over-population of Thai long-tailed macaques and of conflict with humans. This is a delicate matter. To solve the problem, we need mutual understanding among people and require cooperation from various groups, including primatologists, conservationists, governmental agencies, and NGO's.

Morphological and genetic characters of stump-tailed macaques in the Indochinese and Sundaic sub-regions of Thailand

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The stump-tailed macaque (*Macaca arctoides*) is one of five species of macaque monkeys in Thailand. They are categorized as a vulnerable species by IUCN 2007. Although they were reported to be distributed throughout Thailand, information on this macaque presently is scarce. Based on geological and palaeontological evidence, marine transgressions occurred over the Thai-Malay Peninsula and caused the separation of land, especially at the Isthmus of Kra, into the Indochinese and Sundaic sub-regions. There have been reports that show that fauna and flora have restricted distributions in different areas of the Indochinese and Sundaic sub-regions. Thus, this project aims to 1) research the distribution of stump-tailed macaques in Thailand, and 2) investigate differences in morphological and genetic characters of stump-tailed macaques inhabiting the Indochinese and Sundaic sub-regions of Thailand. Methods used will include a census of stump-tailed macaques based on previous reports, replies to questionnaires which were sent to heads of subdistricts throughout Thailand (7,410 questionnaires), assessment of demography, taking photos and measuring body size and determining pelage color from these photographs, and analyzing genetic characters and phylogenetic relationships.

Managing human-elephant conflict based on elephant and human behavior: a case study at Thong Pha Phum National Park, Kanchanaburi Province, Thailand

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Most mitigating methods for Human-Elephant Conflict (HEC) tend to solve immediate problems without considering long-term and accumulated changes in elephant and human behaviors. Adaptive management based on elephant and human behavior principles have been explored. Field experiments on elephant responses to different repellent methods were conducted on 3 farms. Farm I used a single sound repellent (firecracker), farm II used a single light repellent (spotlight) and farm III used double and simultaneous repellents (firecracker and spotlight). Lone male and family herd elephants showed hiding patterns and stayed longer on the farm in response to a single sound or a single light repellent method compared with a shorter stay for the double and simultaneous repellents method. The light repellent could elicit a flee response more than the sound repellent in family herds. This information was used on other farms to select the most effective repellent technique. For elephant welfare, human behavior was assessed by direct observation and categorized as verbal aggression (insult elephant) and physical aggression (intend to harm elephant with a gun) during elephant raiding. Farm III selected a win-win solution by applying ecotourism in addition to the existing repellent technique for a long-term solution. However, Farms I and II decided not to include ecotourism. Results showed that villagers in Farm III expressed verbal aggression and physical aggression less than Farms I and II after ecotourism implementation, and physical aggression disappeared after Farm III set rules not to harm elephants. Adaptive management based on elephant and human behavior may help to provide the long-term solution for HEC.